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

MAOA FIRST PLENARY SESSION
April 7, 2011

1. Peripheral Nerve Blocks and Incidence of Postoperative Neurogenic Complaints and Pain Scores

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Peripheral nerve blocks (PNBs) are a common adjuvant for anesthesia. In our experience PNBs cause a significant incidence of severe pain and neurologic complaints.

We instituted a previously validated questionnaire completed by patients at their first postoperative visit. We asked patients to indicate if they received a PNB and to rate their pain on a standardized pain scale at several points in the postoperative period. Patients indicated if they experienced severe pain, had to return to the ER, and if they experienced lasting neurologic complaints. Comparative data was collected on patients who received a PNB and those who did not receive a PNB (control).

307 patients completed the survey, 244 patients with PNBs and 63 control patients. There was a 39.8% incidence of neurologic complaints in patients who received PNBs as compared to 9.5% incidence in patients who did not receive a PNB, $P < 0.001$. There was 27.9% (PNB) versus 14.3% (control) incidence of severe pain, P 0.027. Twenty-four patients that received PNBs versus five control patients visited the ER, P 0.65. Patients who received PNBs had significantly better pain control immediately after surgery (P 0.02) and trended towards improved pain control the same night (P 0.055), but there was no difference in pain control the morning after surgery, 24 hours after surgery, and at the one week postoperative period (P 0.99, 0.19, and 0.88).

Patients who receive PNBs are at an increased risk for developing postoperative neurologic complaints as compared to control groups. Patients who receive PNBs have improved initial pain control, but the pain control profile shows no difference after less than 24 hours. Patients who receive PNBs experience more severe pain. This data demonstrates a significant incidence of unexpected neurologic complaints. Surgeons should counsel their patients about the potential risk of PNBs.

2. Prospective Randomized Evaluation of the Need for Blood Transfusion During Primary Total Hip Arthroplasty with Use of a Bipolar Sealer

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INTRODUCTION: The purpose of this study was to test for differences in transfusion requirements, clinical, functional, and health related quality of life patient outcomes in patients managed with total hip arthroplasty (THA) with and without the use of the bipolar sealer. Our research question addresses whether this device warrants routine use in the healthy, relatively uncomplicated population of THA patients.

METHODS: This prospective, single-center, randomized, double-blinded study was designed to enroll 140 patients, randomized to either the treatment arm (radiofrequency using Aquamantys 6.0™) or control arm (standard 'bovie' electrocautery). Patients with low preoperative hemoglobin (i.e., under 11.5 g/dL) or bleeding abnormalities were excluded. The primary outcome measure was transfusion requirement, while secondary outcome measures were operative estimated blood loss, postoperative hemoglobin levels, perioperative narcotics usage, and postoperative function (Harris hip score and Short Form-12 quality of life scores).

RESULTS: Seventy-one patients were assigned to the treatment arm and 69 were assigned to the control arm. Mean units transfused for all patients in the study arm and control arm were 0.38 and 0.44 units, respectively ($p = 0.72$). Transfusion requirements were similar between the two groups with the treatment arm having 15/71 patients transfused and the control arm with 14/69 transfused ($p = 0.9$). No significant differences were detected between groups in terms of secondary outcome measures.

CONCLUSIONS: In this patient population, no significant reductions in the need for blood transfusions overall blood loss were observed. Given these findings, we have discontinued the use of this bipolar sealing device in uncomplicated primary THA patients.

3. Stress Examination of Supination External Rotation Ankle Fractures: Prospective Randomized Trial of Emergency Department Lateral Gravity Stress versus Manual Stress

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INTRODUCTION: Supination External Rotation (SER) ankle fractures are common injuries presenting with varying amounts of fracture displacement and mortise congruency. Manual stress (MS) has been the gold standard of determining deltoid ligament injury and associated ankle instability. The goal of this study was to determine the effectiveness and satisfaction of MS versus lateral gravity stress (LGS) in a prospective randomized trial.

METHODS: With IRB approval, 73 consecutive isolated SER ankle fractures over a two-year period (2007-2009), at a Level-1 Trauma Center, were randomized to LGS versus MS. No patients were given sedation during the procedure.

RESULTS: Of the 73 total SER ankle fractures, 38 (52.1%) and 35 (47.9%) were randomized to LGS and MS, respectively. Males and females comprised 50.7% (37) and 49.3% (36), respectively. The average age was 46 (range 18-87). No statistically significant differences were noted in relation to age, sex, or BMI. Average time from ED admission to stress was 175 minutes (range 26-666) with LGS and MS averaging 181 minutes and 171 minutes, respectively. Time did not vary based upon day of week. Pain averaged 5.5/10 and 5.3/10 for pre and post stress, respectively. Pain was significantly less for LGS as compared to MS after stress at 4.3/10 versus 6.4/10, respectively ($p = 0.005$). The amount of pain, length of time in ED, and overall satisfaction were 1.9/4, 1.8/4, and 1.5/4, respectively. Patients with more pain after stress were less satisfied with amount of pain during stress procedure ($r = 0.537$, $p < 0.001$). The ED experience and satisfaction was inversely related to length of time spent in ED ($r = 0.684$, $p < 0.001$).

DISCUSSION: LGS is as effective as MS in determining deltoid ligament injury and instability of SER ankle fractures, but is less painful and can be performed without orthopedic resident assistance or time delays. Timely and effective deployment of the LGS could improve diagnosis of deltoid ligament injury, ED throughput, patient satisfaction, and lessen orthopedic resident services in busy Level-1 trauma centers.

4. Incidence of Symptomatic Venous Thromboembolism After Knee Arthroscopy

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INTRODUCTION: Venous thromboembolic events (VTE) are a rare but potentially serious complication following knee arthroscopy. The purpose of this study was to determine the incidence of VTE after knee arthroscopy at a single institution, and to determine associated risk factors for VTE in these patients.

METHODS: The records of all patients who underwent arthroscopy at a single institution between 1985 and 2005 were reviewed. Confirmed VTE events occurring within four weeks following the index arthroscopy procedure were noted. A 2:1 matched control group was generated to include patients for whom knee arthroscopy was performed by the same surgeon either on the same day or immediately prior to each case resulting in VTE. Pre- and perioperative data were collected with respect to demographics, past medical history, medications, and surgical and anesthesia data. Chemoprophylaxis was not routinely used.

RESULTS: 12,595 patients underwent knee arthroscopy during the study period. 43 cases of VTE (35 deep vein thromboses [DVT], 5 pulmonary embolisms [PE], and 3 DVTs that progressed to PE) occurred in 12,595 knee arthroscopy procedures, resulting in an incidence of 0.30% (95% CI 0.22-0.41%) for DVT, and 0.06% (95% CI 0.03-0.12%) for PE. Factors associated with an elevated risk of postoperative VTE included history of malignancy ($p = 0.01$), history of prior VTE ($p = 0.02$; OR = 8.9), and the presence of ≥ 2 classic risk factors for VTE ($p = 0.04$;OR = 2.66).

CONCLUSIONS: VTEs occur in 0.34% of knee arthroscopy cases in the absence of routine chemoprophylaxis. Patients with a history of VTE, malignancy, or 2 or more classic risk factors are at increased risk for VTE after knee arthroscopy.

5. Reverse Shoulder Arthroplasty for Instability After Anatomic Arthroplasty

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INTRODUCTION: Instability after shoulder arthroplasty is difficult to correct. Reverse shoulder arthroplasty represents an attractive option. However, the results of such procedures are largely unknown. The purpose of this study was to determine the results of revision of the unstable anatomic shoulder arthroplasty to a reverse prosthesis.

METHODS: Between 2004 and 2007, 33 unstable anatomic shoulder arthroplasties were revised to a reverse design. Outcomes evaluated included visual analog scores (VAS) for pain, range of motion, Neer rating, and shoulder stability. The mean age was 71 years, with 58% of the patients being female. The average follow-up was 26 months.

RESULTS: The average time from the index arthroplasty to revision was 26 months (range, 4-164 months). Pain scores improved significantly (preoperative VAS 7.2 ± 1.6; most recent VAS 2.2 ± 1.9; $p = 0.001$). There was a statistically significant increase in active forward elevation from 40.2° ± 27.3° to 97.0° ± 36.2° ($p = 0.001$). There was no difference in internal ($p = 0.93$) or external ($p = 0.40$) rotation. At last follow-up, 31 shoulders (94%) were deemed stable. The remaining two patients experienced dislocations, one at 2.5 weeks postoperatively and the other at 3 months postoperatively. According to the Neer rating system, there were 13 excellent, 10 satisfactory, and 10 unsatisfactory results.

CONCLUSIONS: Revision of an unstable shoulder arthroplasty to reverse prosthesis is associated with a high rate of postoperative stability, improved pain relief, and gains in active elevation. Overall results are excellent or satisfactory in approximately 70% of the patients.

6. Bacterial Contamination of Surgical Scrubs: A Nosocomial Infection Risk?

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BACKGROUND: The bacterial load within an operating room can contribute to perioperative infections. The goal of this prospective, controlled trial was to determine the bacterial burden and milieu of post-call scrubs.

METHODS: Thirty pairs of scrubs were swabbed in ten defined locations (right and left axilla, inside and outside break pocket, crotch, pant line, inside and outside pants pocket, and left and right thigh) on a per call basis. Samples were obtained prior to scrub wear and after approximately 24 hours of continuous wear during call. All swabs were screened for aerobic gram-positive and gram-negative bacteria using standard microbiologic technique. Bacteria underwent antimicrobial resistance testing and genetic relatedness by pulsed-field gel electrophoresis.

RESULTS: 123 (41%) of pre-call and 268 (89%) of post-call scrub samples were positive for bacteria. There was a statistically significant difference ($p < 0.001$) in burden of bacteria on residents' scrubs pre- and post-call. On pre-call scrubs, coagulase negative Staphylococcus (CNS) was the most common pathogen identified (94), followed by gram positive rods (34), and Streptococcus viridians (8). On post-call scrubs, 271 CNS isolates, 51 micrococcus, 33 Staphylococcus aureus, and 28 gram positive rods were found. Of note, all S. aureus were methicillin susceptible (MSSA). The area most frequently contaminated pre-call was the crotch (21). The areas least often contaminated post-call were the right (22) and left (23) axilla. There were 4 different pulsed-field types (PFTs) of S. aureus, all methicillin susceptible. Among CNS contamination of individual scrubs, different antibiotic resistance, species and PFTs were present with some post-call scrub areas having different species and PFTs. No scrubs were found to harbor multidrug-resistant organisms or gram-negative bacteria.

CONCLUSIONS: This prospective controlled trial showed that scrubs worn for at least 24 hours harbor significantly more bacteria than fresh scrubs. It appears prudent to require post-call personnel to don fresh scrubs prior to arthroplasty cases to decrease possible nosocomial transmission.

7. Is Smoking a Risk Factor for Complications After Elective Primary Total Knee or Total Hip Arthroplasty?

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BACKGROUND: Smoking has been linked to complications following many surgical procedures. The effect of smoking on veterans' outcomes after elective Primary Total Hip and Total Knee Replacement (THR/TKR) has not been studied.

METHODS: All elective primary THR/TKR surgeries performed from 2002 to 2008 in the VA and assessed in the National Surgical Quality Improvement Program,(n = 33,294) were studied. Patients were stratified by preoperative smoking status into current, prior, and never smoker. Multivariable logistic regression was used to assess adjusted risk of complications and death. Analyses were adjusted for age, race/ethnicity, ASA class, work RVU, and year. Surgical site infection (SSI) was additionally adjusted for wound classification.

RESULTS: Current smokers (n = 7,984) were younger (58 versus 66 years) while prior smokers (n = 6,297) had higher ASA class (ASA class 3/4, 72% versus 63%) compared to never-smokers (n = 19,013) ($p < 0.0001$). Work RVU was similar across smoking categories for the THR/TKR: current smoker, 21.3; never smoker, 21.5; and prior smoker, 21.4.

After adjusting, current smokers were significantly more likely than never smokers to have SSI (OR = 1.44; 95% CI, 1.18 to 1.74), pulmonary complication (pneumonia, failure to wean, re-intubation) (OR = 1.54; 95% CI, 1.16 to 2.02) and a worse composite outcome (SSI, vascular [myocardial infarction or stroke] or pulmonary complication) (OR = 1.47; 95% CI, 1.26 to 1.72). Prior smokers were significantly more likely than never smokers to have pulmonary complication (OR = 1.33; 95% CI, 1.04 to 1.69).

CONCLUSION: Current smoking is independently associated with an approximate 50% increase in SSI and pulmonary complications following elective THR or TKR. Preoperative smoking cessation interventions should target patients undergoing THR/TKR to reduce complications.

MAOA BREAKOUT SESSION #1
ADULT KNEE #1
April 7, 2011

8. Hybrid Total Knee Arthroplasty: A 10-16 Year Follow-Up Study

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INTRODUCTION: Cementless femoral components are technically less difficult to implant than cemented components when small incisions are utilized during primary total knee arthroplasty. The purpose of this study was to evaluate the outcome, at a mean follow-up of 14 years (range 10-16 years), of a hybrid total knee replacement.

METHODS: A cohort of 250 consecutive hybrid total knee arthroplasties in 218 patients were performed between 1993 and 1995. A porous coated femoral component articulating with a cemented tibial and patellar component was used in all cases. The outcome of all 250 total knee arthroplasties was determined in both living and deceased patients. Radiographic follow-up was obtained on 128 patients (148 knees) who survived 10 years (range 10-16 years).

RESULTS: Six (2%) of the 250 total knee arthroplasties required revision of all components. Three of these were revised for sepsis; two for polyethylene wear and instability, and one was revised for fracture. Ten additional re-operations were performed (4%). In three, a loose patellar component was revised, and seven knees required tibial bearing exchange for wear. Radiographically, three patellar components were loose, two tibial components were possibly loose, and no femoral components were loose.

CONCLUSION: In this series of 250 hybrid total knee arthroplasties, 98% of the uncemented femoral components, 97% of the cemented tibial components, and 95% of the patellar components remained in place and well fixed at 14 years. These results support the use of a hybrid total knee in patients requiring total knee arthroplasty.

9. Early Failure of Cementless Porous Tantalum Monoblock Tibial Components is Likely Related to Patient Height, Weight, and Gender

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INTRODUCTION: Recently, there is a renewed interest in cementless total knee arthroplasty (TKA) with improved biomaterials such as highly porous tantalum. However, proper patient selection for this technology remains elusive and challenging. We report a high early failure rate and a characteristic failure mode of a porous tantalum monoblock tibial component in a series of cementless TKA.

METHODS: A series of 106 consecutive TKAs (93 patients) performed with a porous tantalum monoblock tibial component was reviewed. All TKAs were performed without cement and with a PCL-substituting design. The mean age was 65 years, the mean BMI was 33, and the cohort consisted of 36 males and 57 females. Patient demographics and radiographic parameters were compared between the early failure group and the well-functioning TKA group at final follow-up.

RESULTS: Eight failures occurred at a mean 18 months (range, 3-41 months). Six of the eight failures have undergone revision TKA. All failures occurred in male patients and demonstrated a characteristic failure mode of medial tibial collapse. The mean height of 72.5” in the failure group was greater than the 65.8” in the well-functioning group ($p = 0.000001$). The mean weight of 260.4 lbs in the failure group was greater than the 204.1 lbs in the well-functioning group ($p = 0.0004$). There was no difference in the mean BMI between groups ($p > 0.54$) with numbers available.

CONCLUSIONS: An early failure rate of 7.5% is reported in this series of PCL-substituting cementless porous tantalum tibial components with predominance in tall, heavy, male patients. This may be related to medial tibial overload resulting from increased flexibility of the implant in this patient type. This information is helpful to optimize patient selection and functional outcomes with emerging cementless TKA designs. Further investigation and close clinical follow-up is warranted.

10. Is Mid-Term Follow-Up Surveillance of Total Knee Arthroplasty Patients Necessary?

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INTRODUCTION: Routine implant surveillance for TKA patients has been recommended to facilitate early diagnosis of implant failure. Nevertheless, the efficacy and cost-effectiveness of patient screening protocols have not been determined. The purpose of this study was to assess the number and nature of interventions that result from routine mid-term follow-up visits for TKA patients.

METHODS: We retrospectively reviewed 286 total knee arthroplasty patients that were seen for routine mid-term (4-8 years) follow-up evaluations. The clinic notes from these visits were reviewed and the reason(s) for the visit, patient's pain rating, resulting interventions, and recommended interval for the next visit were recorded.

RESULTS: 286 identified patients generated 639 clinic visits. Patients were asymptomatic during 232 routinely scheduled appointments. No interventions were recommended during 195 (84.1%) of these appointments. When patients reported symptoms (407 appointments), physical therapy was the most common intervention recommended for either the surgical knee (17.4%) or the contralateral lower extremity (29.5%). Revision surgery was only recommended for 9 symptomatic patients (3.1%). No surgical intervention was recommended for any asymptomatic patient.

CONCLUSION: Interventions resulting from routine mid-term follow-up visits for TKA surveillance are extremely uncommon in asymptomatic patients. The results of this study question the efficacy and cost-effectiveness of the current methods of total knee arthroplasty surveillance at mid-term follow-up.

11. Changes in Capsule Gene Expression Over Time in a Rabbit Knee Model of Joint Contracture

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INTRODUCTION: The pathophysiology of arthrofibrosis remains poorly understood. Understanding which genes are up- or down-regulated in arthrofibrosis might clarify this condition. The aim of our study was to determine changes in gene expression over time in capsule samples obtained from contracted rabbit knees.

MATERIALS: Eighteen rabbits were operated on to create a knee contracture and divided into 3 groups of six: Group 1 underwent 2 weeks of immobilization, Group 2 underwent 8 weeks of immobilization, and Group 3 underwent 8 weeks of immobilization plus 16 weeks of remobilization. The right limb was operated on, while the left served as the control. At the endpoint, rabbits were sacrificed and the joint capsules were harvested. After mRNA extraction, a custom microarray was utilized to evaluate fold changes of approximately 300 genes at various time points.

RESULTS: The most significant changes from 2 to 8 weeks included increases in the calmodulin-dependent protein kinase II (CDPK-II), dystroglycan, and VEGF genes. From 8 to 24 weeks, the most significant changes included a decrease in the CDPK-II, caveolin, and a 3 type IV collagen genes. When comparing 2 to 24 weeks, the most significant changes included an increase in the tenascin-X gene and decreases in the neutrophil attractant/activation protein-1 (IL-8) and endothelial leukocyte adhesion molecule I genes.

CONCLUSIONS: Several genes showed marked and significant changes in their expression over time in a rabbit model of joint contracture. Bioinformatics is currently under way to identify possible inhibitors to aid in the development of pharmacologic interventions.

12. Comparison of Coronal Alignment Using Conventional versus Patient Specific Instrumentation

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Coronal alignment has been previously shown to impact clinical outcomes and survivorship of total knee arthroplasty (TKA). The objective of our study was to evaluate the coronal alignment for primary TKA patients using conventional instrumentation and two different customized cutting guides based on preoperative MRI.

128 total knee arthroplasties were performed through the same operative approach (mid-vastus) with the same CR knee. Conventional instrumentation was used in group 1 (n = 48), customized cutting guides based on traditional mechanical axis in group 2 (n = 36), and customized "shape matching" cutting guides in group 3 (n = 44). Scout CT images were obtained for all patients postoperatively and the femorotibial angle (FTA), Hip-Knee-Ankle Angle (HKA), mechanical axis deviation (MAD), and the zone of mechanical axis were measured.

The FTA was within 2-8° valgus for 68.8%, 63.9% and 81.8% of groups 1, 2 and 3, respectively ($p = 0.07$; 0.25; 0.005). The HKA was between 3° varus and 3° valgus for 85.4%, 80.6%, and 65.9% of groups 1, 2 and 3, respectively ($p = 0.008$; 0.002; 0.0003). The mechanical axis was within 5 mm of the center of the knee for 51.1%, 52.8%, and 27.3% of groups 1, 2, and 3, respectively ($p = 0.001$; 0.002; 0.0007).

Standard instrumentation achieved equivalent coronal plane alignment to custom guides that utilized a mechanical axis target. The flexion-extension axis based cutting guides resulted in a significantly different mechanical axis than the standard or mechanical axis custom guide cases.

13. Knee Arthroplasty Rehabilitation: Comparing Conventional Therapy to a Music Rehabilitation Video

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INTRODUCTION: Rising costs and limited access to services has led to the search for equally effective alternative treatments, including postoperative knee rehabilitation. We conducted a prospective, randomized controlled trial to see if patients who used a music exercise video following their knee surgery would demonstrate equivalent outcomes, satisfaction, and decreased costs compared to conventional physical therapy.

METHODS: We randomized 100 patients undergoing total knee (58) and unicompartmental arthroplasty (42) into a Video Group or Control Group. The video group used a music exercise video following their surgery. The control group followed conventional in-home or out-patient physical therapy. Knee Society scores were determined preoperatively and 6-week and 6-month intervals, along with patient satisfaction ratings. The scorekeepers were blinded as to treatment group. Physical therapy costs were extrapolated.

RESULTS: Six-month Knee scores were 90.9 (+/-8.7) and 92.1 (+/-9.1) for the Control and Video groups respectively ($p = .5841$). Improvement from preoperative knee scores were +38.7 (+/-13.6) and +38.1 (+/-15.1) ($p = .2442$) respectively, and were statistically equivalent within 0.5 standard deviation ($p = .0459$). Function score was 82.1(+/-16.7) and 77.4(+/-19.3) at 6 months ($p = .3778$) respectively. Overall patient satisfaction was 4.7 (+/-0.5) and 4.7(+/-0.5) and were statistically equivalent within 0.5 points ($p < .0001$) and 0.25 points ($p = .0130$) (1 to 5 scale). Therapy charges for the control group were estimated at $1,700 more per patient than the video group.

CONCLUSION: Knee arthroplasty patients who use a music rehabilitation video may achieve equivalent outcomes, satisfaction, and decreased costs compared to conventional physical therapy.

14. Template-Directed Instrumentation in Total Knee Arthroplasty: A Cost Savings Analysis

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INTRODUCTION: Digital radiography and templating software are becoming more prevalent in contemporary total knee arthroplasty (TKA). Template-directed instrumentation (TDI) is a novel concept combining digital templating with the instruments utilized during surgery. We hypothesize using TDI will decrease costs without compromising results in TKA.

METHODS: Fifty consecutive cases were reviewed using TDI over a six-month period. Patient demographics and preoperative templated sizes of anticipated components were recorded. Digital templating software was used to determine the two most likely femoral and tibial component sizes for each patient. This information was utilized to direct vendors to provide three lightweight instrument trays based upon the sizes directed by the digital templating. The sizes of the implanted components and the number of additional trays required were documented. A detailed cost analysis was performed to compare pre-TDI and TDI surgical expenses.

RESULTS: In 49 of the 50 cases (98%), the prepared sizes and three trays were all that was needed. In one case, we converted from a cruciate retaining implant to a posterior-stabilized implant of the same size. The average number of trays utilized with TDI was 3.04 (range 3-5), compared to the 50 preceding cases, 7.5 (range 6-9). Based on a standard charge to sterilize and package an implant tray, this represents approximately $19,000 savings during this 6-month review period.

CONCLUSION: Utilizing TDI can be a cost-effective adjunct in performing TKA. The implications for this novel technique include lower operative costs, shorter turnover times, and improved handling of inventory for hospitals and vendors.

15. Which Primary Total Knee Replacement Patients Experience the Greatest Increase in Quality of Life?

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INTRODUCTION: Providers are increasingly being pressured to identify the benefit of medical and surgical interventions. This study aimed to identify which patients experience the greatest improvement in their self-reported quality of life following a primary total knee replacement (TKR).

METHODS: A prospective cohort study of young employed patients undergoing a primary TKR was conducted. The patients' health-related quality of life was assessed using the standardized Knee injury and Osteoarthritis Outcome Score (KOOS) instrument. Patients completed questionnaires preoperatively and at six months postoperatively which contained items assessing the patient's characteristics, the complete KOOS measuring knee health, a measure of global health, a patient's motivation to return to work postoperatively, and other factors potentially affecting the patient's recovery. Multivariable linear regression models assessed which factors significantly affected the magnitude of change in a patient's quality of life.

RESULTS: Of 162 patients enrolled in the study, 120 (74.1%) completed both the preoperative and postoperative quality of life measurement. The patients were predominantly female (70.8%) with a median age of 57 years and a mean change in their quality of life of 42.8 (on a 100-point scale). Individuals with less preoperative pain ($p = 0.0002$) and worker's compensation recipients ($p = 0.049$) had less improvement in their quality of life. Patients who urgently wanted to return to work ($p = 0.032$), had physically demanding jobs ($p = 0.027$), or had employer-based health insurance ($p = 0.044$) reported greater improvement in their quality of life postoperatively.

CONCLUSION: Not all patients experience equal improvement in their quality of life following surgical interventions such as a primary TKR.

16. Prospective, Randomized Evaluation of Multimodal Pain Management in Less Invasive TKA

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We believe pain management is a critical factor affecting early outcomes after less invasive TKA. We hypothesize patients receiving multimodal pain management after minimally invasive TKA will have improved postoperative pain scores, improved satisfaction, and reach early recovery milestones sooner than patients receiving patient controlled intravenous narcotic analgesia (PCA).

Thirty-eight patients undergoing minimally invasive TKA were prospectively randomized to receive one of two different pain management strategies:
Group 1: Periarticular injection prior to wound closure:
(30 cc 0.5% Bupivacaine, 10mg MSO4, 15mg Ketorolac),
Postoperative multimodal pain management:
(scheduled Oxycodone, Tramadol, Ketorolac, prn narcotic)
Prophylactic antiemetics.
Group 2: No periarticular injection, Dilaudid PCA, and prn antiemetics,

Pre-surgical and postoperative data were collected regarding VAS pain scores, narcotic consumption, and medication related side effects on postoperative days 0, 1, 2, 3, and weeks 3, 6, and 12. A reference analgesic dose of Morphine 10 mg was used to calculate conversion factors and equianalgesic dosages for each narcotic**.** Statistical analysis was performed with two tailed t-test and 95% confidence intervals. Time to therapeutic milestones, LOS, and satisfaction scores were recorded.

Patients in Group 1 had lower VAS scores ($p < 0.003$) on each postoperative hospital day, fewer medication related side effects, and lower daily ($p < 0.004$) and total ($p < 0.004$) narcotic usage at each time point up to three weeks postoperatively. Eighty-nine percent of Group 1 patients scored 5 out of 5 for satisfaction at all time points versus only 26% of patients in Group 2. A faster time to early recovery milestones (straight-leg-raise postoperative day zero: 89% versus 16%) and shorter hospitalization (1.9 versus 2.5 days) were also noted in Group 1.

Multimodal pain management decreases narcotic use, improves pain scores, increases satisfaction, and enhances early recovery after less invasive TKA.

17. Medial Unicompartmental Knee Arthroplasty in Patients Younger than 55

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INTRODUCTION: The indications for unicompartmental knee arthroplasty have begun to include a younger patient population in recent years. The purpose of this investigation was to evaluate the results in patients under 55 years of age with minimum two-year follow-up that underwent medial unicompartmental knee arthroplasty.

METHODS: 127 consecutive patients with a medial unicompartmental knee arthroplasty were retrospectively identified. 105 patients were available for follow-up at a minimum of 2 years (average 2.8 years). Knee Society scores were determined on all patients postoperatively and a subset of patients preoperatively. Radiographs were reviewed in all zones for any signs of loosening or osteolysis, as well as for lateral compartment degeneration. Complications and revisions were subjectively noted.

RESULTS: The average age of patients was 51.1 ± 3.4 years of age (41-55, 16 female, 19 male); average postoperative follow-up was 2.8 years. The mean Knee Society score preoperatively 50.1 ± 10.1 improved postoperatively to 95.0 ± 6.5 in the 65 patients with preoperative KSS scores; paired t-test analysis indicated a significant improvement ($p < 0.0001$). Four knees underwent revision to a total knee arthroplasty secondary to persistent postoperative pain. At the time of final follow-up, there was no radiographic evidence of component loosening or osteolysis and no evidence of progressive arthritic changes in the lateral or patellofemoral compartments in any patient in this cohort.

CONCLUSION: The results of this study indicate that unicompartmental knee arthroplasty is associated with exceptional clinical and radiographic results in patients younger than 55 at a minimum of two years.

MAOA BREAKOUT SESSION #2
HAND
April 7, 2011

18. Acute Boutonniere Deformity – Recreating a Fresh Cadaveric Model

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INTRODUCTION: Acute boutonniere deformity results when a characteristic proximal interphalangeal joint (PIPJ) flexion occurs in conjunction with hyperextension at the distal interphalangeal joint (DIPJ), often as a result of an acute traumatic injury to the dorsal finger. Several reports attempted identifying all the structures involved, with little agreement. The purpose of this study is to evaluate the necessary and sufficient injured structures required to recreate this deformity in a fresh cadaveric model.

METHODS: We dissected and identified the extensor hood, central slip, lateral bands, and triangular ligament on ten, fresh cadaveric fingers. On all fingers, we lacerated the central slip within 3 mm to its insertion on the base of the middle phalanx. In Group A (5 fingers total), we sequentially lacerated the triangular ligament, then the connections between the extensor hood and the lateral bands, testing for the recreation of a Boutonniere deformity. In Group B (5 fingers total), we reversed the sequence.

RESULTS: In Group A, we were unable to recreate a Boutonniere deformity after incising the triangular ligament. We were, however, successful after the connections between the extensor hood and the lateral bands were incised. Similarly in Group B, we recreated a Boutonniere deformity only after both structures were disrupted.

CONCLUSIONS: In a fresh cadaveric model, recreation of an acute Boutonniere requires disruption of the extensor hood, triangular ligament, and the dorsal connections of the lateral bands. This does not depend on the sequence of disruption. This information can prove useful in devising cadaveric models to reproduce an acute Boutonniere. Further investigation is required to determine the appropriate treatment of the deformity.

19. Effects of Supplemental Oxygen and Hyperbaric Oxygen in Tendon Healing in a Rat Model

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INTRODUCTION: Systemic supplemental oxygen therapy (SOT) and systemic hyperbaric oxygen therapy (HBOT) have both been shown to positively impact wound healing. No prior studies have examined the effect of SOT on tendon healing, however. The purpose of this study was to evaluate the effects of SOT and HBOT on tendon healing in a rat patella tendon model.

METHODS: We utilized an established rat patella tendon repair model to evaluate the effects of SOT and HBOT on tendon healing. The right patellar tendon of 90 male Sprague-Dawley rats was completely sectioned. Animals were randomized to one of three groups to receive HBOT, normobaric SOT, or normobaric room air therapy (RA - control group). The HBOT group involved intermittent daily sessions of 100% FiO2 oxygen at 2 atmospheres for 60 minutes. The SOT group involved similar sessions at approximately 1 atmosphere and the control group received room air only. Fifteen animals from the three groups were sacrificed at 3 and 6 weeks postoperatively and their patellar tendons harvested. The ultimate tensile strength in axial extension was then determined and compared within, and between, groups at 3 and 6 weeks. Statistical significance was calculated using the student's t-test.

RESULTS: An increase in ultimate tensile strength was appreciated in all three groups from the 3- to 6-week time-points. The SOT group exhibited the highest tensile strength at both time-points, although HBOT was the only treatment that exhibited a statistically significant increase in tensile strength between time-periods ($p = 0.006$). There was no statistical difference in ultimate tensile strength when the three groups (HBOT, SOT, RA) were compared at the 3- or 6-week time-points.

CONCLUSION: Results presented here cannot support the premise that intermittent systemic hyperbaric oxygen therapy, or supplemental oxygen therapy, significantly increase the healing of tendon repairs.

20. Skeletal Muscle and Bone Marrow Derived Stromal Cells: A Comparison of Tenocyte Differentiation Capabilities

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INTRODUCTION: Flexor tendon injuries of the hand represent an area within orthopedic surgery that stands to benefit greatly from the use of mesenchymal stromal cells. This study addresses three aims: (1) to identify whether a difference exists between bone marrow derived stromal cells and skeletal muscle derived stromal cells with respect to their ability to be isolated from their tissues of origin and undergo expansion in culture, (2) to evaluate if a discrepancy exists between these two stromal cell populations in their ability to differentiate into tenocytes, (3) to determine if tenogenesis in these cell types can be augmented by addition of growth and differentiation factor-5 (GDF-5).

MATERIALS AND METHODS: Skeletal muscle harvest and bone marrow aspiration were performed on the hind limbs of seven female, mongrel hounds in accordance with the Institutional Animal Care and Use Committee guidelines. Following four passages in culture, samples were induced toward tenogenesis utilizing two culture conditions employing either ascorbic acid alone or in conjunction GDF-5. RNA was extracted from each sample prior to induction, and following 7 and 14 days of induction. cDNA libraries were constructed and RT-PCR was performed to measure and compare expression of tenomodulin (TNMD), collagen type 1 (COL1), and collagen type 3 (COL3).

RESULTS: Mesenchymal stromal cells were extracted from skeletal muscle tissue and, following three passages in culture, showed an expression profile of myosin and CD44 that was not significantly different than bone marrow derived stromal cells. Following induction of tenogenesis, both stromal cell types showed an increase in expression of TNMD, COL1, and COL3 at 14 days, indicating tenocytic differentiation. While there was no significant difference in TNMD expression between the two stromal cell types, muscle derived stromal cells did have a higher expression that trended toward significance ($p = 0.0611$). Bone marrow stromal cells had a significantly higher relative expression of both matrix protein genes. Growth factor augmentation with GDF-5 did not have a statistically significant effect on gene expression.

21. Three-Dimensional Analysis of the Proximal Articulating Surfaces of the Lunate and Capitate

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HYPOTHESIS: The surfaces proximal articular surfaces of the capitate and lunate can be described by an ellipsoid geometry.

METHODS: We examined 24 sets of human carpal bone specimens and 41 CT scans of the wrist. The specimens were scanned using a three-dimensional digitizer (Surface Scans). The CT scans were traced both manually (2D CT scans) and digitally (3D CT scans). In both groups, the proximal articulating surfaces of the lunate and capitate were sampled, and the surface data were processed using a non-linear regression model (Simplex Optimization). The 2D scans were processed using a graphic editing program (Adobe® Photoshop®) to manually obtain fit ellipsoids.

RESULTS: Best fit ellipsoids were successfully obtained using the surface scans with a small margin statistical error (error of 0.07-0.45 mm compared to a diameter of 6-15 mm). The perpendicular distance from the data point to the surface of the ellipsoid averaged 0.01- 0.06 mm (range 0.00-0.18). The volume of the lunate ellipsoids was larger than the capitate counter-part (8 cc versus 2 cc). The manual fitting of the 2D scans was satisfactory, but it produces relatively smaller ellipsoids compared with the surface data. We could not verify the results. The 3D CT scan data successfully produced fitting ellipsoids, but the results lacked consistency.

SUMMARY POINTS: The proximal articulating surfaces of the lunate and capitate can be successfully described by an ellipsoidal surface. The lunate ellipsoids are significantly larger than those of the capitates. Those findings explain how proximal row carpectomies fail when they do so, and support the arguments toward preserving the lunocapitate joint when possible, and that capitate implant arthroplasty should match the surface of the lunate.

22. Biomechanical Comparison of Proximal Radius Locking Plates

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Locked plating systems are utilized with increasing frequency in the management of complex and highly comminuted fractures. Historically, proximal radius fractures have been treated with excision or prosthetic replacement; however, recent literature advocates radial head preservation whenever possible. The purpose of this study is to compare the biomechanical properties of four contemporary proximal radius locking plate devices under loading mimicking immediate postoperative and rehabilitative phases of the fracture healing process.

METHODS: Eight plates of each design were fixed to corticocancellous composite sawbones. An 8 mm gap was created with the use of a standardized cutting fixture in order to simulate radial neck comminution. Each construct was loaded for 2000 cycles at 100N, 200N, and 300N, respectively at 2Hz and then to failure at 2N/s. Locking screws were visually inspected for loosening and load-deformation curves determined.

RESULTS: The stiffness, load-displacement curves, and ultimate yield strength were similar for each of the plate designs tested. No screw loosening was observed. All plates failed at loads above 800N which is considered physiologic for the postoperative fracture healing and rehabilitative phases.

DISCUSSION AND CONCLUSION: No significant differences ($p > 0.05$) were found between the four proximal radius locking plate designs studied. All failed within a tight range at loads higher than would be expected during the postoperative fracture healing phase. Proximal radius locking plates assist head preservation while promoting fracture healing by minimizing the prospect for mal- or nonunion.

23. Radial Nerve Palsy Following Humeral Revision in Total Elbow Arthroplasty

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INTRODUCTION: Revision for failed total elbow arthroplasty is increasingly common. The radial nerve is at risk during humeral component revision. The purpose of this study was to define the incidence, treatment, and outcome of radial nerve palsy following humeral implant revision.

METHODS AND MATERIALS: The Total Joint Database at our institution was searched for all humeral component revisions between 1988 and 2007. The search was then refined to identify patients with radial nerve palsies discovered following this procedure. Several variables, including the use of power and/or ultrasound instruments, formal radial nerve exposure, and the use of electrodiagnostic testing were analyzed.

RESULTS: Seven out of 258 (2.7%) humeral component revisions, with an average follow-up of 84 months (range 24-233), were complicated by radial nerve palsy. Only three out of seven (43%) patients ultimately regained function. No nerve recovery occurred in three out of four patients where power instruments were used for cement removal, and in the one patient where ultrasound technology was employed. However, two of the three patients who underwent formal operative exposure of the radial nerve at the time of revision had return of function. Six patients had electrodiagnostic studies data obtained at least six weeks after the revision procedure, which was predictive of ultimate nerve status in five (83%) patients.

CONCLUSION: Radial nerve palsy is an uncommon complication following humeral revision in total elbow arthroplasty, but is not necessarily associated with full recovery. In patients who develop this complication, and where power instruments or ultrasound technology were used for cement removal, return of function is less likely. Electrodiagnostic testing is predictive of ultimate neurological outcome. If injury occurs after formal exposure and protection of the radial nerve, recovery is possible. We, therefore, conclude that palpation and presumption of radial nerve security is inadequate in this setting. We recommend formal exposure, visualization, and protection of the radial nerve during humeral component revision.

24. The Effect of Early versus Delayed Range of Motion in the Outcome of Patients with Distal Radius Fractures Treated with Volar Locking Plates: A Prospective Randomized Trial

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Distal radius fractures are very common and the trend in fixation has included the use of locked volar plating. The amount of splinting that is required after surgery and the effect that splinting has upon the outcome of the wrist is not clear. Our aim was to compare the outcome (strength, motion, and outcome scores) of patients treated with an early versus late motion protocol after volar plating.

METHODS: Thirty-three adult patients with distal radius fractures were prospectively and randomly enrolled into an early versus late motion study which included volar plating of a distal radius fracture. Early motion was defined as initiation of an active and passive motion protocol by 14 days after surgery and delayed motion was initiated at 5 weeks. Fractures were defined as intra-articular and extra-articular, and those with, and without, ulnar styloid fracture. Volar plating was completed through a FCR approach in all cases. Outcome measures (DASH/PRWE), motion (flexion-extension, radial-ulnar deviation, pronation-supination), and strength (appositional and oppositional pinch and grip) were measured through one year.

RESULTS: Wrist motion and DASH and PRWE scores were all significantly different at 6 weeks ($p < 0.05$). There were no significant differences at any later time points up to one year.

CONCLUSION: Following volar plating of distal radius fractures, early motion favored earlier return of wrist motion along with lower DASH and PRWE scores, but only at the 6-week point. All subsequent measurements revealed no significant difference in strength, motion, or outcome score.

25. Functional Outcomes of Ulnar Head Endoprosthesis Implantation After Degenerative Joint Disease or Resection Arthroplasty of the Distal Radioulnar Joint

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HYPOTHESIS: Ulnar head endoprostheses restore stability and functionality to the upper limb after degenerative joint disease or resection arthroplasty of the distal radioulnar joint (DRUJ).

METHODS: A retrospective review was conducted analyzing the outcome of all ulnar head prostheses implanted within our institution over a ten-year period. All patients presented complaining of pain and functional disability due to instability or arthrosis of the DRUJ. Standardized preoperative and postoperative assessments included a patient rated pain score, forearm range of motion, grip strength, and Mayo Wrist Score. Preoperative and postoperative radiographs were examined to determine whether outcome could be based upon the type of sigmoid notch and the implant used. Statistical analyses used included survival curve, parametric, and nonparametric t tests.

RESULTS: Ninety-five patients were followed for an average of 53 months (range: 24-126 months). Eighty-two percent of prostheses were uncemented and 18% cemented. Pain scores decreased by 57% with an associated improvement in Mayo Wrist scores after surgery. Average grip strength improved by 17% from preoperative measurements. There were no differences with respect to pre- and postoperative pronation and supination (average 69° and 56° respectively). Eighty Avanta, 8 Ascension, 5 Aptis, and 2 custom made implants were placed. Survival curve analysis demonstrated a 50% survival at 9 years and 78% at 5 years.

26. Biomechanical Comparison of Three Fixation Techniques Used for Four-Corner Arthrodesis

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INTRODUCTION: Four-corner arthrodesis is a common salvage procedure for the arthritic wrist. Clinical results vary in the literature and suggest that the fixation technique may be related to nonunion while no biomechanical comparisons have been reported that evaluate the differences between Kirschner wire, dorsal circular plate (DCP), and locked dorsal circular plate (LDCP) fixation. We examined the displacement between the lunate and capitate with the hypothesis that these three different types of fixation would have significantly different amounts of displacement within a cadaveric four-corner arthrodesis model.

METHODS: Eighteen fresh-frozen wrists (9 pairs) were randomly allocated to the three groups of fixation techniques. Following simulated arthrodesis, a magnet and transducer were secured to the radial side of the lunate and capitate to measure displacement. The wrists were then cyclically loaded to either implant failure or displacement > 1 mm with a maximum range of 60º of flexion and 60º of extension and a torque limit of 100N-cm to demonstrate fatigability.

RESULTS: There was significantly less lunocapitate displacement in the LDCP group compared to the DCP and K-wire groups ($p = 0.018$ and 0.006). There were no failures in the LDCP. One wrist in the K-wire group and 2 wrists in the DCP group also were without failure.

CONCLUSION: In our four-corner arthrodesis model, wrists with the locked dorsal circular plate were significantly more stable than those with K-wires or the dorsal circular plate. Our results are limited only to the biomechanical behavior of these fixation techniques.

27. Concomitant Spinal Cord Injuries in Adult Patients with Traumatic Brachial Plexus Injuries

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BACKGROUND: Combined injuries to the spinal cord and brachial plexus present challenging aspects in the detection of both injuries as well as subsequent treatment. The purpose of this study is to describe the epidemiology and clinical factors of concomitant SCI in patients with a known BPI.

METHODS: A retrospective review was performed on all patients evaluated for a BPI in a tertiary, multi-disciplinary brachial plexus clinic from January 2000 to December 2008. Patients with clinical and/or radiographic findings for a coexistent SCI were identified and further analyzed. Various epidemiologic and clinical variables were reviewed and compared between patients with combined SCI/BPI and patients with isolated BPI.

RESULTS: A total of 255 adult patients were evaluated for a traumatic, traction injury to the brachial plexus during our study period. We identified 31 patients with a concomitant SCI for an incidence of 12.1% (31/255), a preganglionic BPI had been sustained in all cases. The mean age at the time of injury was 33.6 years (range 18-63 years). The most common associated injury in the combined SCI/BPI patients was to the head or face (77.4%, 24/31). The combined SCI/BPI group had significantly more preoperative pain on the visual analogue scale (p-value = 0.022), a statistically greater likelihood for a supraclavicular vascular injury (p-value = 0.015), and a statistically significant association with cervical spine fracture (p-value = 0.001). Lastly, the combined SCI/BPI group was more likely to exhibit a Horner's sign (p-value = 0.011), phrenic nerve dysfunction (p-value = 0.037), and a higher number of pseudomeningoceles on imaging studies (p-value = 0.043) when compared to the BPI only group.

CONCLUSION: Careful neurologic evaluation and the presence of various associated clinical findings and epidemiologic factors may aid in the recognition of these combined injuries. Accurate detection of an associated upper motor neuron injury is imperative in determining the appropriate surgical options for brachial plexus reconstruction.

MAOA BREAKOUT SESSION #3
SPORTS
April 7, 2011

28. The Efficacy of Combined Cryotherapy and Compression Compared to Cryotherapy Alone Following Anterior Cruciate Ligament Reconstruction

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INTRODUCTION: The utility of cold therapy for acute musculoskeletal injuries has been previously established. Cryotherapy results in significant reductions in cellular metabolism, tissue hypoxia, edema formation, nerve conduction, and secondary pain. In addition to cryotherapy, concomitant pneumatic compression may also contribute to better short-term clinical outcomes. However, few studies have adequately investigated and demonstrated the benefits of compressive cryotherapy when compared to conventional ice treatment alone.

METHODS: This was a prospective randomized control trial of patients undergoing ACL reconstruction at a single institution. Group 1 patients were provided with a cryotherapy/compression device (Game Ready®, Alameda, CA), while group 2 patients were provided a standardized ice pack. Both groups were instructed to use the ice or cryotherapy/compression device three times per day and return to the clinic at 1, 2, and 6 weeks postoperatively. Patient-derived outcome measurements used in this study consisted of the Visual Analog Scale (VAS), the Lysholm knee score, SF-36, and Single Assessment Numerical Evaluation (SANE). Circumferential measurements of the knee at three locations (1 cm proximal to patella, mid-patella, and 1 cm distal to patella) were also obtained as a measure of postoperative edema. Narcotic medication use was recorded by questionnaire.

RESULTS: The primary outcome measure (VAS) was significantly different among groups in the preoperative measurement, despite similarities in group demographics. Baseline VAS for group 1 was 54.9 compared with group 2 at 35.6 ($p = 0.01$). By six weeks, this had lowered to 28.1 and 40.3, respectively, resulting in a significant 27-point decrease in mean VAS for group 1 ($p < 0.0001$). However, the small increase in VAS for group 2 was not significant ($p = 0.34$). No significant differences were noted for the Lysholm, SF-36, or SANE scores either between groups or time points. Furthermore, no significant differences were noted for any of the circumferential measurements either between groups or time points. Of all patients, 83% of group 1 discontinued narcotic use by six weeks, compared with only 28% of group 2 ($p = 0.0008$).

CONCLUSIONS: The use of combined cryotherapy and compression in the postoperative period after ACL reconstruction results in improved, short-term pain relief, and a greater likelihood of independence from narcotic use compared with cryotherapy alone.

29. Surgical Management of Femoral Tunnel Malposition in ACL Revision Reconstruction: Results from the MARS Group

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INTRODUCTION: Most ACL reconstruction failures are due to technical errors and, in particular, femoral tunnel malposition. The purpose of this subset analysis study of the MARS database is to describe the specific details of femoral tunnel malposition and the subsequent management strategies that surgeons chose in the revision setting.

METHODS: Of the 460 revision ACL reconstructions catalogued in the MARS database, failure of the initial surgery was attributed to femoral tunnel malposition alone in 117 cases. For this group, primary ACL reconstruction data was examined regarding surgical technique, graft selection, and tunnel position. Revision ACL reconstruction data was analyzed regarding surgical technique, tunnel preparation, graft selection, and bone grafting.

RESULTS: Primary reconstruction technique for this cohort involved a one-incision arthroscopic single-tunnel in 102 cases (87.2%), a two-incision arthroscopic single-tunnel in 14 cases (12.0%), and a traditional arthrotomy in one case (0.9%). With respect to tunnel malposition, the revision surgeon judged the femoral tunnel too vertical in 42 cases (35.9%), too anterior in 35 cases (29.9%), too vertical and anterior in 31 cases (26.5%), and compromised due to position and size in 9 cases (7.7%). Revision reconstruction technique involved the drilling of an entirely new femoral tunnel in 91 cases (82.1%), a blended femoral tunnel in 16 cases (13.7%), an added second femoral tunnel in 5 cases (4.3%), and the same compromised femoral tunnel aperture in 2 cases (1.7%).

CONCLUSIONS: Femoral tunnel malposition is the most common technical error resulting in primary ACL reconstruction failure. Surgeons prefer to drill an entirely new femoral tunnel in the vast majority of revision procedures. These observations underscore the importance of understanding the ACL femoral footprint anatomy and the technique of femoral tunnel placement at the time of primary ACL reconstruction.

30. Anteromedial Femoral Notch Ridging in a Normal Population

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OBJECTIVES: (1) To determine the prevalence and degree of anteromedial femoral notch outlet ridging, a recently identified risk factor for non-contact ACL injury, in a normal population, (2) to identify any relationship between notch ridging and demographic measures or condylar curvature, and (3) to characterize ridge symmetry between knees.

METHODS: The femoral intercondylar notches of 170 non-arthritic skeletal specimens (79 women, 90 men, mean age 34.3 years, range 5-88) were measured for anterior outlet width, anteromedial outlet ridge thickness, and percent anterior outlet stenosis due to the ridge. Curvature radii of the femoral condyles were also measured. Percent stenosis was evaluated by age, height, weight, sex, race, and condylar curvature. Percent stenosis was also compared between knees.

RESULTS: A positive association was found between percent stenosis and age ($p < 0.0001$, $r = 0.40$). Women were found to have a greater percent stenosis than men ($p = 0.0004$; women 19.8% ± 9.7, range 0-48.9%; men 14.6% ± 8.6, range 0-35.1%), with no difference noted by race ($p = 0.55$). Among women, a positive association was observed between percent stenosis and height or weight ($p < 0.0001$; $r = 0.41$ and 0.37, respectively); no association was observed among men ($p = 0.36$ and 0.32, respectively). Percent stenosis was associated with curvature of the medial condyle only ($p < 0.0001$; $r = 0.35$). Finally, total notch width and anteromedial ridge thickness is highly correlated between knees ($r = 0.98$ and 0.95, respectively).

CONCLUSION: Anteromedial femoral notch ridge thickness increases with age, with wide individual variation, suggesting the ridge is the result of a lifelong remodeling process. A small subset of individuals has highly stenotic knees (> 30%) even at young ages (15-25 years). Women tend to exhibit a greater percent notch stenosis than men. These results coincide with increased ACL injury rates among women and warrant investigation of screening for young individuals with > 30% stenosis as an ACL injury risk stratification tool. Finally, notch dimensions can be collected on either knee of a given individual for screening.

31. Effects of Serial Sectioning and Repair of Radial Tears in the Lateral Meniscus

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Radial meniscal tears are a difficult condition to treat with both long- and short-term implications. We hypothesize that sequential radial sectioning of the lateral meniscus will increase contact pressures, and repair with both an all inside as well as an inside out technique will restore meniscal function.

Eight paired cadaver knees were dissected down to the capsule. Each tibia was placed in a Taylor Spatial Frame. Tekscan sensors were placed submeniscal in both compartments. For each condition, the knees were loaded at 800N in both extension and 60° of flexion. Sequential radial sections were made in the lateral meniscus just posterior to the popliteal hiatus. Complete sectioning was followed by a pair matched repair using either an all-inside or an inside-out technique. Conditions tested: intact lateral meniscus, 50%, 75%, and 100% radial width incision, repaired meniscus, and complete lateral meniscectomy.

See table for results. ANOVA testing was completed for all data.

Biomechanical data regarding radial meniscal tears in the literature is limited. The current study provides essential fundamental information regarding repair constructs and contact pressure changes. Overall, there were no significant differences in contact area or pressure with radial sectioning up to 75%. However, there was a significant change from 75% to 100%. The two repair constructs showed improved pressure profiles when compared to the sectioned state, but no differences between each other. Essentially, radial meniscal tears that violate the periphery do benefit from repair.

		Intact vs 50%	Intact vs 75%	Intact vs 100%	Intact vs Repair	100% vs Meniscec-tomy	100% vs Repair	75% vs 100%
Extension	Contact Area	-0.03 p>0.05	-0.02 p>0.05	-0.48 p<0.001	-0.27 p<0.01	-0.01 p<0.05	0.21 p<0.05	-0.46 p<0.001
	Contact Pressure	-0.18 p>0.05	-0.53 p>0.05	3.91 p<0.001	0.85 p>0.05	1.93 p>0.05	-3.06 p<0.01	4.44 p>0.001
Flexion	Contact Area	-0.04 p>0.05	-0.04 p>0.05	-0.41 p<0.001	-0.32 p<0.001	-0.08 p>0.05	0.18 p<0.05	-0.37 p<0.001
	Contact Pressure	-0.18 p>0.05	-0.31 p>0.05	1.81 p<0.05	0.32 p>0.05	2.4 p<0.01	-1.49 p<0.05	2.13 p<0.01

32. Biomechanical Evaluation of Meniscal Repairs in a Shear Force Scenario

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PURPOSE: The purpose of this study was to evaluate the stiffness and ultimate load of meniscal repair in shear using all-inside meniscal repair devices and the standard inside-out vertical suture technique.

DESCRIPTION OF METHODS: Forty fresh-frozen porcine menisci (medial and lateral) were used for this study. A 30 mm full thickness lesion was created and repaired using one of four fixation techniques:
Group 1 (n = 9)- 2-0 MaxBraid meniscus needles (Biomet, Warsaw, IN)
Group 2 (n = 9) - Ultra Fast-Fix (Smith and Nephew, Andover, MA)
Group 3 (n = 10) - Meniscal Cinch (Arthrex, Naples, FL)
Group 4 (n = 9) – Biomet Marxmen Maxfire
Each repair was subjected to a single load to failure in shear at 12.5 mm/s using a materials testing machine. Statistical analysis was performed on load to failure and stiffness for each group using a Student's t-test. Significance was reported at $p < 0.05$.

SUMMARY OF RESULTS: The average load to failure was 57.4 N (MaxBraid), 57.5 N (Ultra Fast-Fix), 64.1 N (Meniscal Cinch), and 34.4 N (Maxfire). The Ultra Fast-Fix failed at a significantly higher load than Maxfire ($p = 0.017$). There was a trend indicating MaxBraid and Meniscal Cinch failed at higher loads than Maxfire ($p = 0.059$). Stiffness was calculated using the linear portion of the load/displacement curve on each specimen. The stiffness was 4.8 N/mm, 5.1 N/mm, 3.2 N/mm, 5.8 N/mm for MaxBraid, Ultra Fast-Fix, Meniscal Cinch, and Maxfire, respectively. MaxBraid, Ultra Fast-Fix, and Maxfire were significantly stiffer than the Meniscal Cinch ($p < 0.05$). There was no significant difference between any of the other devices.

CONCLUSION: The Ultra Fast-Fix provided a stiff construct with a high load to failure. Clinically, a stiffer repair with a higher load to failure would be preferred in order to minimize tissue gapping during the rehabilitation period. The Meniscal Cinch was not as stiff as the other constructs which could lead to gapping at the injury site. This should be examined further by subjecting the repairs to cyclic loading.

33. Isolated Medial Patellofemoral Ligament Repair for Recurrent Patellar Dislocation

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INTRODUCTION: The medial patellofemoral ligament (MPFL) is the primary restraint to extreme lateral displacement and is typically disrupted with an acute lateral patellar dislocation. Patients who fail a comprehensive non-operative program and experience recurrent lateral patellar instability episodes are candidates for surgical treatment. The purpose of this study was to review the clinical, functional, and radiographic outcomes of isolated MPFL repair for recurrent lateral patellar dislocation.

METHODS: The records of all patients undergoing MPFL repair for recurrent patellar dislocation at our institution from 2001 – 2006 were retrospectively reviewed. Twenty-seven patients (29 knees) with an average age of 19 years (range, 11-32) were included in this study. Clinical, functional, and radiographic outcomes were assessed at an average of 4 years after surgery (range, 2-7), using recurrent instability as the primary endpoint.

RESULTS: The success rate of MPFL repair for preventing recurrent dislocations was 72% (21 of 29 knees). Eight patients (28%) experienced a recurrent lateral patellar dislocation. Five of these patients required a reoperation, including two MPFL reconstructions, one tibial tubercle osteotomy (TTO) with MPFL reconstruction, one TTO with revision MPFL repair, and one revision MPFL repair. At final follow-up, the mean Lysholm and Kujala scores were 86 (range 42-100) and 92 (range, 57-105), respectively. Postoperative radiographs revealed a mean patellofemoral congruence angle improvement of 27° (range, 5-44°). The only statistically significant risk factor for failure was non-anatomic MPFL repair at the medial femoral condyle ($p = 0.004$).

CONCLUSIONS: Isolated repair of the MPFL for recurrent patellar instability is associated with a relatively high failure rate, but remains a viable surgical option if surgical technique principles are followed. The clinical success of this operation depends on restoration of the anatomic origin of the MPFL and careful patient selection.

34. Youth Baseball Pitchers: How Well Do Coaches Follow the USA Baseball Medical and Safety Advisory Committee Pitching Guidelines?

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INTRODUCTION: Baseball is a sport that is enjoyed by an estimated 2.2 million young athletes worldwide. A growing concern of players, parents, and coaches are injuries suffered by young pitchers. Epidemiologic studies have shown an incidence of elbow pain in 26% of youth pitchers and 58% in high school players.

METHODS: A total of 95 coaches of the local Youth Baseball League voluntarily took an Internet-based survey. These coaches instruct players between the ages of 9 to 15 years old. The survey consisted of 18 items asking questions concerning the USA Baseball Medical and Safety Advisory Committee pitching guidelines, the practices of the other coaches in the league, as well as, any symptoms or injuries experienced by the athletes. Their responses were then graded and reported as a percentage of correct answers based on the pitching guidelines.

RESULTS: Coaches of the 9-10 year age group answered an average of 62% of pitching guideline questions correctly. The 11-12 year age group coaches scored an average of 35% and the 13-14 year age group coaches scored an average of 42%. The coaches of the 9-10 year age group had the highest average score compared to the other coaches ($p < 0.01$). The number of pitchers who played with reported pain in the elbow or shoulder increased as age increased ($p < 0.01$). Overall, 19% of coaches report that they had players that pitched with arm pain. A total of 75% of coaches in the 9-10 year age group, 65% in the 11-12 year age group, and 84% in the 13-14 year age group state that they follow the guidelines.

CONCLUSIONS: All coaches scored poorly when tested on their knowledge of the pitching guidelines. Coaches of the younger aged players scored significantly higher than the other coaches. The baseball community needs to better educate their coaches on the pitching guidelines.

35. Fatty Infiltration of the Semitendinosus Muscle Following Tendon Resection: An Experimental Study in Rabbits

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BACKGROUND: The hamstring tendon autograft is one of the most commonly used graft choices in ACL reconstruction. Several studies have shown postoperative hamstring strength deficit in those patients who have had a hamstring graft; however, other studies have shown near normal return of strength. The semitendinosus tendon has been shown to regenerate after harvesting for ACL autograft, suggesting that the muscle has the potential to regain normal function. However, no studies to our knowledge have been performed to define the microstructural changes that occur in the semitendinosus muscle after tendon resection.

HYPOTHESIS: Fatty infiltration of the semitendinosus muscle after tendon harvest increases postoperatively and remains constant or increases as time progresses.

METHODS: The semitendinosus tendon was unilaterally detached and harvested from 15 New Zealand White rabbits. Five rabbits were sacrificed at 3, 6, and 12-month intervals, and the semitendinosus muscle-tendon units were reharvested. The tendon and muscle dimensions were measured and histopathology was used to assess the percentage of fatty infiltration in the semitendinosus muscle.

RESULTS: Fatty infiltration was significantly greater in the experimental muscle (7.8%) compared to the control muscle (2.7%) at the musculotendinous junction for all 15 specimen ($p = 0.05$). However, the fat to muscle ratio did not increase over time and in fact normalized in comparison to control muscle. There was no difference between the control and experimental muscle at the midsubstance or origin at any time point. Histologic examination displayed fatty infiltration which appeared grossly different from that seen in rotator cuff models.

CONCLUSIONS: Harvesting the semitendinosus tendon in rabbits does alter the microstructure of the muscle by increasing fatty infiltration at the musculotendinous junction. However, the injury pattern and microstructure is different from previous injury models seen in rotator cuff models.

36. Complications, Reoperations, and Failures After Autologous Chondrocyte Implantation♦

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Autologous chondrocyte implantation (ACI) is a treatment for chondral defects in the knee. Complications such as graft hypertrophy and knee stiffness occur more frequently in open, first generation ACI. Avoidance of periosteal cover has reduced the frequency of hypertrophy. Arthroscopic ACI has reduced the frequency of stiffness. With newer ACI generations, the complication and reoperation profile has been reduced. The study purpose was to determine complication, reoperation, and failure rates of all generations and techniques of ACI. A systematic review of multiple medical databases was performed. Level I-IV evidence was included. Generations of ACI and complications after ACI were explicitly defined. All subject and defect demographic data were analyzed. Ninety-five studies were identified for inclusion. 5,869 subjects were analyzed (6,691 defects) (3,771 first-generation periosteal-cover ACI subjects; 906 first-generation collagen-membrane cover ACI subjects; 1,184 second-generation ACI subjects [794 open; 390 arthroscopic]; and 8 third-generation ACI subjects). There were 343 failures overall (5.8% subjects; mean time to failure 18 months) with failure rates after PACI, CACI, and second-generation ACI of 7.5%, 1.5%, and 3.9%, respectively. Among workers' compensation subjects, failure rate was 23%. Reoperation rate after PACI, CACI, and second-generation ACI was 37%, 41%, and 18%, respectively. Second-look arthroscopy, however, was planned in 30%, 89%, and 70% of these reoperations, respectively. Hypertrophy was most common after PACI. Arthrofibrosis was most common after PACI or CACI. There were very few cases of infection, deep-vein thrombosis, or pulmonary embolus. In conclusion, the entire volume of ACI cases reported in the orthopedic literature was evaluated with this review. Failure rate after all generations is low (~5%). Unplanned reoperations are highest with PACI, then CACI, then second-generation ACI. Hypertrophy is most common after PACI. Arthrofibrosis is most common after arthrotomy-based ACI. Newer generations of ACI with avoidance of a periosteal cover and all-arthroscopic approaches have reduced the complication and reoperation rate after ACI.

37. Outcomes Following Conventional and 3D Navigational Open-Wedge High Tibial Osteotomies

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INTRODUCTION: Surgical correction during high tibial osteotomies (HTO) currently relies on preoperative templates from long leg radiographs or subjective intraoperative fluoroscopic guidance with the cable method. Techniques for preserving the posterior tibial slope are described in the literature, but there is little the surgeon can do intraoperatively to assess the sagittal plane. This study evaluates the radiographic accuracy of a computer navigation system with rigid-body tracking of the proximal tibia as well as barriers to its clinical adoption.

METHODS: The control group was collected historically from HTOs performed from 2005 to 2010 by a single surgeon with both pre- and postoperative long leg radiographs and no concurrent procedure. The control group was assessed intraoperatively with cable fluoroscopy. In the navigation group, optoelectric markers fixed to the femur, tibia, ankle, and proximal tibia were registered with the OrthoPilot (3D HTO version 1.5, B.Braun Aesculap). The system tracked the hip, knee, ankle, and osteotomy "joints," while monitoring knee flexion, mechanical axis, weight-bearing line, and posterior tibial slope in real time. Long leg and lateral radiographs were collected.

RESULTS: Nineteen patients met inclusion criteria and comprised the control group. Ten patients have undergone HTOs with navigational assessment. Undercorrection (< 50%) and overcorrection (> 75%) were determined by weight-bearing lines. The control group (M = 58%, SD = 14%) had 6 undercorrected and 3 overcorrected patients. The navigational group (M = 68%, SD = 6%) had 1 overcorrected patient. Posterior tibial slope increased both in the control (M = 2.2°, SD = 3.2) and the navigational (M = 1.5°, SD = 6.5°) groups. Procedures averaged 120 minutes and 160 minutes in the control and navigational groups respectively.

CONCLUSION: While this study is ongoing, preliminary data is consistent with results in the literature. Navigational guidance minimizes undercorrection in the coronal plane. It is too early to assess the benefits of tracking the posterior tibial slope. This is a technically demanding addition to the surgical protocol with a substantial learning curve. Anecdotal evidence suggests navigation improves with familiarity and experience, and continued use is expected to reduce operative duration.

MAOA BREAKOUT SESSION #4
ADULT HIP
April 7, 2011

38. Early Discharge Protocol After Joint Replacement Does Not Increase Readmission Rates

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INTRODUCTION: There has been a push in recent years towards early discharge after total joint replacement, but there is still some concern whether this practice could lead to unforeseen medical complications or higher readmission rates. The objective of this study was to assess in a consecutive group of patients whether early discharge from the hospital resulted in higher complication rates and readmissions to the hospital.

MATERIALS AND METHODS: The charts of 2,026 patients undergoing 910 unilateral total hip (THA) and 1,016 total knee arthroplasties (TKA) were reviewed for 90-day readmission and postoperative complications. 537 patients underwent TKA and 447 underwent THA between January 1, 2008, and June 30, 2008, prior to implementation of early discharge protocol (Group 1). These were compared with 579 patients undergoing TKA and 463 undergoing THA between July 2009 and December 31, 2009, after the protocol was up and running for six months (Group 2). Patients' charts were reviewed for 90-day readmissions as well as complications. Patient age, gender, BMI, and the ASA score were used as independent variables.

RESULTS: The average LOS decreased from an average of 3.8 days in 2008 to 2.9 days in 2009 for both THA and TKA. There was no significant difference in readmission rates between Group 1 and 2 at 90 days ($p = 0.88$ for THA and 0.83 for TKA) after adjusting for meaningful co-variates (odds ratio 1.05 and 0.964, respectively).

DISCUSSION: A rapid discharge protocol after THA and TKA does not increase the risk 90-day readmission to the hospital and can be cost saving for the institution.

39. Serum and Synovial Fluid Tests for Periprosthetic Infection in Patients with Inflammatory Arthritis

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INTRODUCTION: Serum erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), synovial fluid white blood cell (WBC) count, and differential are effective in diagnosing periprosthetic joint infection (PPJI); however, their utility in patients with inflammatory arthritis is unknown. The purpose of this study is to determine the utility of these tests in patients with inflammatory arthritis.

METHODS: 934 consecutive revision hip and knee arthroplasties were prospectively evaluated for PPJI. 202 cases were excluded due to acute postoperative or hematogenous infection. 690 patients had non-inflammatory and 42 had inflammatory arthritis. Receiver operating characteristic (ROC) curves were used to establish optimal ESR, CRP, WBC, and % neutrophil values for diagnosis of PPJI, and the area under the curve (AUC) was calculated to determine overall accuracy.

RESULTS: The optimal thresholds for predicting PPJI were ESR 30mm/hr, CRP 17mg/L, WBC 2667, and differential 75% neutrophils in inflammatory arthritis, and ESR 32mm/hr, CRP 15mg/L, WBC 4000, and 78% neutrophils in non-inflammatory arthritis. The efficacy of these tests was similar in both populations; AUC for inflammatory ESR = 85.0%, CRP = 85.1%, WBC = 93.8%, differential = 93.6% and for non-inflammatory ESR = 84.9%, CRP = 88.5%, WBC = 94.5%, differential = 95%. There was no significant difference between groups (ESR p = 0.861, CRP p = 0.549, WBC p = 0.8315, differential p = 0.7021). The rate of PPJI was significantly higher in patients with inflammatory arthritis (33.3% versus 18.8%) (p-value=0.013).

CONCLUSIONS: These results suggest that the ESR, CRP, synovial fluid WBC count, and differential are useful in diagnosing PPJI in patients with inflammatory as well as non-inflammatory arthritis with similar optimal cut-off values.

40. Anemia in Arthroplasty Patients: Correlation with Transfusion Risk, Cost, and Readmission

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INTRODUCTION: Patients facing hip and knee arthroplasty may present with preoperative anemia that can increase the risk of requiring postoperative blood transfusion. The prevalence of anemia in this patient population is not well defined. This study was undertaken to assess the prevalence of anemia in this patient population and the impact on the relative risk of postoperative transfusion.

SUMMARY: Anemia is a prevalent co-morbid condition in elective hip and knee arthroplasty patients and is correlated with increased risk of prolonged hospitalization, allogeneic blood transfusion, and hospital readmission.

METHODS: This study was a retrospective chart review of 704 primary knee and 514 primary hip arthroplasty patients at a single institution in 2009. Preoperative labs were analyzed and patients were categorized as being anemic or normocytic based on World Health Organization definitions (Hgb < 12 in females and < 13 in males). The patient charts were reviewed for postoperative blood transfusions, hospital length of stay, and incidence of readmission. There were no differences in transfusion indications or care pathways between the two groups. The impact of anemia on the relative risk of each outcome was determined while statistically controlling for other co-morbidities.

RESULTS: Anemia was present in 24% of patients undergoing elective TJA, with a similar incidence among hip and knee patients. Anemic patients, whether undergoing hip or knee replacement, had a higher incidence of transfusion (22% versus 7%), a longer average length of stay (3.8 versus 3.2 days), and a higher rate of readmission within 30 days (10% versus 5%).

CONCLUSION: Anemia is common among elective joint replacement patients and significantly increases a patient's risk of receiving an allogeneic blood transfusion. As postoperative allogeneic blood transfusion may be associated with increased morbidity and cost, early identification and appropriate treatment of preoperative anemia may improve outcomes in these patients.

41. Effects of Surface Area and Volume on Mechanical Properties and Elution Characteristics of Hydroxyapatite Cement Impregnated with Tobramycin and Vancomycin Constructs

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INTRODUCTION: Hydroxyapatite (HA) cement has been utilized in human reconstructive surgery for a number of years, and as a potential antibiotic delivery system for the treatment of musculoskeletal infections. The objective of this study is to investigate the antibiotic elution characteristics and mechanical properties of HA cement combined with Tobramycin and Vancomycin. This study also examines the effect that surface area and volume of the HA cement specimens has on these factors.

METHODS: HA cement mixed with Tobramycin (2.5 weight %) and Vancomycin (2.5 weight %) was used, and seven groups of specimens were made using several uniquely sized molds, thus allowing for different surface areas and volumes. Minimum inhibitory concentration (MIC) testing with methicillin-sensitive Staphylococcus aureus (MSSA) was used to determine the elution characteristics of the different specimens at six different time intervals. The specimens' ultimate compressive strength (UCS) was also determined at three different time intervals. Statistical analysis was performed using the one-way analysis of variance (ANOVA) with $p < 0.05$ denoting significance. Post hoc tests were also conducted using the least significant difference multiple comparisons test method.

RESULTS: Surface area and volume did have a significant effect on the total antibiotic released and elution rate of the antibiotics. Between 29% and 80% of the total amount of antibiotics present was eluted in 14 days; and on Day 1, the antibiotic released was only 8% to 29% dependent upon the surface area and the volume of the specimens. The elution rate ranged from 4 mg/day to 39 mg/day dependent upon the specimen's size. The mean UCS at Day 0 was much lower than at Day 10 ($p < 0.05$), and the mean UCS at Day 10 was lower than the mean UCS at Day 14 except for sample groups B and D.

CONCLUSION: The experimental results revealed an effect on the cumulative elution mass and elution rate of the antibiotics due to the distance from the core to the surface of the loaded cement. The shorter the distance from the core to the surface of the loaded cement, the more antibiotic released.

42. Primary Cementless Acetabular Fixation at Minimum 20-Year Follow-Up: Are We Improving Compared to Cement Fixation?

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INTRODUCTION: Long-term loosening is a major issue associated with cemented acetabular components in total hip arthroplasty (THA). This study evaluates cementless acetabular fixation at a minimum 20-year follow-up and compares them to cemented acetabular fixation performed by the same surgeon at the same length of follow-up.

METHODS: 120 consecutive non-selected total hip arthroplasties were performed in 108 patients using a fiber mesh cementless acetabular component with screws and a cemented femoral component. This series was evaluated at minimum 20-year follow-up. It was compared to 330 hips performed by the same surgeon with cemented acetabular components and followed for a comparable period of time. Both groups were evaluated clinically for need of revision and using the Harris hip ratings. Final follow-up radiographs were evaluated for loosening, osteolysis, and wear in both studies.

RESULTS: Fifty patients with 54 hips were living at 20 years in the cementless group. In this cementless group, there were 22 revisions performed during the follow-up period, but only one was required for loosening of the acetabular component (0.8%). One other case demonstrated radiographic loosening. In the cemented group with comparable follow-up, 6% were revised for loosening and 8% were radiographically loose ($p < 0.05$ for both endpoints).

CONCLUSION: Primary cementless acetabular fixation using a fiber mesh surface provided durable results at minimum 20-year follow-up (0.8% revision for loosening and 0.8% radiographic loosening). These results provided superior fixation and durability when compared to cemented components with comparable follow-up.

43. Cementless THA for the Treatment of Osteonecrosis at Ten-Year Follow-Up: Have We Improved?

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INTRODUCTION: We evaluated the results of cementless THA in patients with osteonecrosis at a minimum ten-year follow-up and compared them to the results of cemented THA in patients with osteonecrosis at comparable follow-up.

METHODS: We evaluated 80 primary THAs performed by a single surgeon in 66 patients for the diagnosis of osteonecrosis using extensively coated stems and cementless acetabular shells. Hips were followed for a minimum of ten years and the results were compared to 46 primary cemented THAs performed for osteonecrosis with similar follow-up length and evaluation included need for revision and radiographic evidence of loosening, wear, and osteolysis.

RESULTS: At follow-up, 53 patients (62 hips) were living. None of the 13 deceased patients (17 hips) required revision. Nine hips (11.3%) in living patients required a revision for any reason at an average of 7.6 years postoperatively. None of the revisions were for aseptic loosening and most cases (6 hips) required reoperation for problems related to the bearing surface. Additionally, none of the 80 hips had evidence of radiographic loosening of the acetabular or femoral components. This compares favorably to the cemented group which had revision rates for aseptic loosening of the femoral and acetabular components of 6.5% and 13%, respectively. Additionally, radiographic loosening of the femoral and acetabular components in the cemented group was 13% and 15.2%, respectively.

CONCLUSIONS: The durability of cementless THA in patients with osteonecrosis is excellent at minimum ten-year follow-up and compares favorably to that of the results of cemented THA for the same diagnosis at the same interval of follow-up ($p = 0.001$). Cementless fixation has not been the issue, but problems with the bearing surface have been a concern.

44. Total Hip Arthroplasty in Young Patients: Do We Improve Activity Profiles?

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INTRODUCTION: Traditional hip outcome measures fail to precisely measure activity levels in younger, active patients. Methods to objectively assess activity are needed to optimize treatment and distinguish the relative efficacy of different procedures. The purpose of this study was to use a step activity monitor (SAM) to determine alterations in step counts and step rate after primary THA in young patients.

METHODS: We prospectively analyzed 39 THA patients with an average age of 41.6 years (range, 17.8-50.3). Patients were monitored for seven days both preoperatively and one year postoperatively. Total steps and percent of time at various activity levels (step rates) were analyzed.

RESULTS: Total step counts increased 23.8% from an average 4,375 (range 1,094-8,857) to 5,418 (range 2,248-9,181) ($p < 0.001$). Analysis of step rate demonstrated increases in time spent at high ($p < 0.001$) and moderate ($p = 0.0017$) activity. Time at inactivity decreased ($p < 0.001$). These results correlate with the change in Harris hip score from 53 (range, 23.1-67.6) to 90 (range, 62.6-100) (p value < 0.001) and the change in UCLA activity score from 5.9 (range, 3-10) to 7 (range, 4-10) (p value = 0.00018).

CONCLUSION: These data demonstrate that young patients undergoing THA markedly increase their daily strides and improve their step rate activity profile. Time spent at high and moderate activity increases, while time at inactivity decreases. This activity measurement tool may provide more detailed, objective activity data than traditional outcome tools.

45. Postoperative Activity Level in the Less than 22-Year-Old Total Hip Arthroplasty Patient

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INTRODUCTION: Total hip arthroplasty (THA) for the very young patient is often met with opposition because of the perceived activity demands of this age group. However, the current literature does not define the postoperative function of young adults and adolescents who receive a hip replacement. We hypothesize that very young patients who undergo THA expect to reach an activity level similar to their peers who have not had hip surgery but are not able to realize this level of activity.

METHODS: Twenty-two patients (group 1) under the age of 22 years at the time of THA, with a minimum of two years of follow-up were identified and asked to complete the UCLA Activity Scale questionnaire in terms of expected and actual activity levels. These results were compared to a randomly selected, age-matched cohort of individuals (group 2) who had no known hip pathology and completed a similar questionnaire. As secondary analyses, we compared Short Form-12 and visual analog pain scale scores for both groups.

RESULTS: Group 1 included 16/22 subjects (72.7% enrollment) with an average follow-up of 52 months (range, 29-89 months). Group 2 included 56 control subjects. The groups were well-matched for age and gender, with a notable significant difference in the average BMI ($p = 0.003$) between group 1 (29.6 kg/m^2) and group 2 (22.4 kg/m^2). SF-12 comparison showed similar mental composite scores, however, significantly different physical composite scores ($p < 0.0001$) between the groups (group 1 = 40.3; group 2 = 55.4). VAS pain score was 2.8 for group 1 and 1.8 for group 2 ($p = 0.08$). Group 1 had an average UCLA score of 5.8 and an expected score of 6.9, which was not significant. Group 2 had an average UCLA score of 8.6. Differences between the actual score from group 2 and both the actual and expected scores from group 1 were statistically significant ($p < 0.0001$; $p = 0.003$, respectively).

CONCLUSION: Less than 22-year-old hip THA patients are not as active as their peers nor do they expect to be this active following surgery. Their activity level is actually quite similar to historical data from a more typical hip arthroplasty population.

46. Alumina Ceramic Bearings for Total Hip Arthroplasty: Minimum Ten-Year Follow-Up

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INTRODUCTION: Alumina ceramic bearings are scratch resistant and have superior lubrication and wear resistance compared to other bearings.

METHODS: In 1996, a prospective, randomized, controlled, multicenter trial comparing alumina ceramic bearings to metal-on-conventional polyethylene was initiated. Five surgeons from five centers now continue to follow 278 patients (289 cases) at and beyond ten years. Three patients cohorts were randomized: group I had ceramic bearings with a porous titanium cup; group II with a roughened HA cup; group III, a control metal-on-polyethylene with a porous titanium cup. There is no difference in the demographics between the patients who received alumina ceramic bearings and those who received the metal-on polyethylene controls. Follow-up includes Kaplan-Meyer survivorship, revisions for any reason, radiographic analysis, and complications including squeaking.

RESULTS: The clinical performance with Harris Hip Score was no different for the study groups. Survivorship revision for any reason at 12 years is 96.8% for the alumina ceramic cases compared to 91.3% for the control metal-on-polyethylene cases ($p = 0.0046$). There have been no revisions for aseptic loosening in any patient cohort. The only ceramic bearing surface failure occurred at nine years when a peripheral rim fracture fragment led to a liner revision. Osteolysis was noted in 17.6% of the control group and in none of those patients receiving the ceramic bearing. Occasional squeaking has occurred in two ceramic patients (0.9%).

CONCLUSIONS: Alumina ceramic bearings for THA in a young and active patient population have performed well out to 12 years with a high survivorship and low rate of complications.

47. Precision THA Using Modular Neck and Cost Effective CR Imaging

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INTRODUCTION: Critical features of a successful total hip arthroplasty include component alignment and fit, leg length, and offset. Historically, the surgeon has relied on certain instruments, implants, and the "feel" tempered by experience to achieve the desired result. The success rate, however, can certainly be improved upon. This paper describes the use of modular neck femoral components and computed radiography in THA.

METHODS: A consecutive retrospective radiographic review of 467 total hips employing a modular neck femoral component and intraoperative computed radiography was carried out. This femoral component is used to permit incremental adjustments of leg length and offset. The use of affordable, computed intraoperative radiography permits timely (within 45 seconds), precise feedback at a time when further adjustments can be made. Corrections to stem size, cup position, screw length and position, leg length, and offset were made based on an intraoperative A-P pelvis x-ray.

RESULTS: Acetabular abduction angle ranged from 35°-48° (mean 43). Adjustment was performed 25% of the time based on x-ray. Apposition was within 3 mm 100% of the time. Re-seating of the cup was carried out in three hips. Femoral component was neutral in 87% and 3°-5° of varus in 13%. Femoral component was upsized 55% of the time. Leg length discrepancy was less than 5 mm in 100% of hips. Offset was within 3 mm of the normal side in 264 patients in whom this was measurable. There have been no neck fractures or dissociations. Operative time averaged 1 hour and 5 minutes.

DISCUSSION: The use of modular neck femoral components and intraoperative computed radiography permit improved precision of component placement in total hip arthroplasty. The technique should be affordable with regard to actual dollars and time spent.

48. Reliability of a Radiographic Total Hip Arthroplasty Classification System

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INTRODUCTION: Routine clinical and radiographic surveillance has been common practice following total hip arthroplasty (THA). Defining the hip at risk for failure is important to establish targeted THA surveillance protocols. In this study, we validate a radiographic THA classification system.

METHODS: Three fellowship-trained arthroplasty surgeons used objective criteria to assess 120 pre-selected radiographs that were preformed on patients returning for mid- or late-term follow-up. Reviewers were blinded to patient history and treatment or intervention recommendations. X-rays were graded for osteolysis, polyethylene wear, and component fixation variables using a four point scale that represented no concern (1), minor concern (2), major concern (3), or failure (4). Individual variable scores were combined by the reviewers to create a composite score for recommended follow-up or surgical intervention. Statistical analysis was performed to determine consistency in measurement for individual variables and for interobserver agreement.

RESULTS: Significant agreement was noted between reviewers in determination of composite score ($k = 0.68$) and assessment of linear polyethylene wear ($k = 0.70$), with less uniform agreement on osteolysis ($k = 0.57$) and fixation ($k = 0.51$). All three reviewers perfectly agreed on final assessment score in 62 cases (60.2%) and were within one level of agreement for 109 cases (90.8%). Of the 11 outlying radiographs, consensus for surveillance or revision was present in 10 (90.9%). Only one case (0.8%) had a significant divergence by a single reviewer.

CONCLUSIONS: Radiographic features for the hip at risk can be effectively determined using radiographic criteria for wear, osteolysis, and component loosening with strong interobserver reliability.

MAOA BREAKOUT SESSION #5
SPINE/TUMOR
April 7, 2011

49. Outpatient Microscopic Lumbar Discectomy Using a Fixed Tubular Retractor: 12-Month Results

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The literature supports the theory that less muscle damage occurs using a tubular retractor than with a blade retractor, but a recent study has suggested that the results for traditional MLD may be better than those for tubular MLD. To confirm or refute this, we reviewed our results with outpatient tubular MLD.

Between January 2007 and September 2008, 35 outpatient primary microscopic lumbar discectomies with a 16- or 18-mm fixed tubular retractor were performed by a single surgeon. Demographic information, operative time, estimated blood loss, time to discharge and use of narcotics were recorded, as were VAS, Oswestry Disability Index, and SF-36 scores (preoperative and postoperative).

Most patients were discharged less than two hours postoperatively; all went home the day of surgery. No patient suffered a dural tear or spinal fluid leak. No patient needed admission to a hospital. Final follow-up averaged just over 12 months. VAS decreased from 3.8 to 1.63, ODI from 46.9 to 13. SF-36 scores also had improved at six months. There were four recurrent herniations during the follow-up period, an 11.4% incidence.

In 35 patients, tubular MLD produced results comparable to traditional MLD, with a similar rate of recurrent herniation. Patients had outpatient surgery, were mobilized immediately, and typically had complete resolution of leg pain (median leg VAS = 0 at final follow-up).

50. Documentation of Outcomes for Sacroiliac Joint Fusion: Does Prior Spinal Fusion Influence the Outcome?

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INTRODUCTION: The reported prevalence of low back pain (LBP) thought to originate from the sacroiliac joint (SIJ) has ranged from 13–35% in the published literature. Patients are generally initially treated nonoperatively with pain control, mobilization of the joint, physical therapy, and/or joint injections. The purpose of this study was to determine the outcomes from anterior SIJ fusion.

MATERIALS AND METHODS: Our prospective study included 35 patients who underwent SIJ fusion with anterior plate fixation. All patients had failed nonoperative treatment, had a positive Patrick test, and had positive response to intra-articular SIJ injections with greater than 50% pain relief. Patients had regular follow-up at 6, 12, and 52 weeks where they completed Oswestry Disability Index (ODI) and Short Musculoskeletal Functional Assessment (SMFA) surveys for subjective outcome scores. The ODI and SMFA scores were compared between the patients with prior spinal fusion and those without prior spinal fusion.

RESULTS: Complete data is available for 24 patients. Significant improvement in ODI and SMFA scores were observed with average improvements of 18.8 ($p < 0.001$) and 10.4 ($p = 0.02$), respectively. There was a significant difference in the change in ODI scores between patients that had previous spinal fusion surgery and those that did not (10.6 and 28.5 $p < 0.05$). A difference was not seen in the SMFA scores when comparing patients with and without spinal fusions. There were no significant differences in age, gender, BMI, or multiple versus single level spinal fusion patients. We noted five postoperative complications. These patients had less improvement, according to ODI and SMFA, when compared to the patients that did not have postoperative complications; however, they were not found to be statistically significant (5.6 versus 22.3, $p = 0.13$ and -1.6 versus 13.5, $p = 0.14$, respectively).

CONCLUSIONS: Patients who have not undergone prior spinal fusion surgeries, regardless of age, gender, and BMI have better outcomes following SIJ fusion.

51. Lateral Lumbar Fusion (LLIF) versus Standard Fusion Approaches: Analysis of Segmental Lordosis Change

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SUMMARY: 167 patients underwent fusion of 245 lumbar levels via LLIF, ALIF, TLIF, or PSF. LLIF provided lordosis change similar to other interbody fusion approaches (ALIF and TLIF) and greater than posterior fusion alone.

INTRODUCTION: Potential advantages of minimally-invasive lateral lumbar interbody fusion (LLIF) include reduced morbidity and blood loss, decreased postoperative pain, and faster recovery. Improvement in sagittal alignment is considered an important goal in lumbar fusion. There are no studies comparing restoration of sagittal parameters utilizing the LLIF approach versus standard approaches.

METHODS: This is a comparative x-ray analysis of four lumbar fusion approaches. In a two-year period, 245 levels in 167 patients were fused: LLIF (43 patients, 63 levels), ALIF (41 patients, 67 levels), TLIF (56 patients, 74 levels), and PSF (30 patients, 41 levels). The following parameters were measured on pre- and postoperative standing radiographs: segmental lordosis, overall lumbar lordosis (L1-S1), and anterior and posterior disk heights. Comparison of measurement changes between groups were performed using student's t-test.

RESULTS: All interbody procedures produced significantly greater lordosis change compared to posterior fusion alone (ALIF $p = 0.007$, TLIF $p = 0.019$, LLIF $p = 0.03$). The three interbody approaches were not significantly different (ALIF versus TLIF $p = 0.15$, ALIF versus LLIF $p = 0.28$, and TLIF versus LLIF $p = 0.80$). Only ALIF showed significant improvement in overall lumbar lordosis ($p = 0.0017$). LLIF anterior disk height increase is intermediate between ALIF and TLIF. LLIF posterior disk height increase is similar to ALIF and superior to TLIF and PSF.

CONCLUSION: LLIF provides similar segmental sagittal contour change compared to other interbody fusion approaches (ALIF and TLIF), and significantly greater compared to posterior fusion alone. Overall lumbar lordosis remains unchanged after LLIF. Posterior disk height increase is significant and may provide basis for indirect decompression.

52. Optimizing Iliac Screws: An Image Guided Biomechanical Study on Trajectory and Size

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INTRODUCTION: Iliac fixation is a major component of instrumentation for long spinal fusion constructs across the spinopelvic junction. An unstable base may lead to pseudoarthrosis. Great variability exists in iliac screw diameter, length, and trajectory in clinical use. Optimal iliac screw characteristics are unknown. The study's goal was to determine the effect of iliac screw size, length, and trajectory on peak insertional torques using 3D navigation. We hypothesized that larger and longer screws aimed from the posterior superior iliac spine (PSIS) at the anterior inferior iliac spine (AIIS) rather than supra-acetabular bone will produce greater insertional torque.

METHODS: Ten fresh frozen cadavers were used and 7.5 and 9.5 x 140 mm iliac screws were placed under 3D image guidance in randomized fashion in one of two trajectories (from PSIS to [1] supra-acetabular bone or [2] AIIS) per side. Peak insertional torque for each full screw revolution and screw depth for each torque measurement were recorded. Insertional torque was correlated with local bony anatomy.

RESULTS: There was no difference in mean peak insertional torque between trajectories (supra-acetabular: 25.6+/-16.4 in-lbs; AIIS: 26.3+/-18.2 in-lbs; $p = 0.8$). However, there was a difference between the two screw diameters (7.5 mm: 21.1+/-10.9 in-lbs; 9.5 mm: 33.7+/-19.4 in-lbs; $p < 0.001$). The greatest mean peak insertional torques were observed at depths > 80 mm (< 80 mm: 12.7+/-9.6 in-lbs; > 80 mm: 23.7+/-15.7 in-lbs; $p < 0.001$). Insertional torque peaks correlated with engagement of cortical bony anatomy at the lateral iliac cortex and the superior iliac fossa. Screws could be placed accurately in the intended trajectory using image guidance.

CONCLUSION: Iliac screw trajectory had no effect on insertional torque. Placing larger diameter and longer screws in close proximity to bony landmarks at distances > 80 mm from the PSIS led to greater insertional torque. Longer screws than commonly used in clinical practice can be safely and accurately placed using image guidance, and reproducible screw paths can be achieved.

53. Indirect Decompression of Lumbar Nerve Roots with Percutaneous Pedicle Screws

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BACKGROUND: Percutaneous pedicle screws are being placed with increasing frequency during lumbar interbody fusions. Few studies exist concerning the assessment of postoperative disc height and indirect decompression following varied techniques in vertebral column fusion. There is little data concerning the degree of indirect decompression achievable with pedicle screws during single or multilevel lumbar fusion and no data with percutaneously placed pedicle screws.

METHODS: We retrospectively reviewed 38 patients (76 spinal segments) undergoing a 360° two-level lumbar interbody fusion at L4-5 and L5-S1 for degenerative disc disease and spondylolisthesis utilizing the AxiaLIF with posterior segmental percutaneous pedicle screws (Alphatec Illico). The pedicle screws were placed and distraction performed prior to placing the AxiaLIF. Standing lateral preoperative radiographs were compared to standing lateral postoperative radiographs. Pre- and postoperative disc and foramen heights were evaluated at the L4-L5 and L5-S1 level and recorded in both millimeters and percentage of height in relation to the L5 vertebral body for two-level AxiaLIF procedures.

RESULTS: Ten patients did not have complete preoperative or postoperative x-rays and were excluded from analysis leaving 28 patients for our sample size. In 3 patients, radiographs were not adequate to measure heights at L5-S1. The disc height increased 2.7 mm (± 1.5 mm)/7.0% (± 3.2%) at L4-5 and 1.7 mm (± 0.9 mm)/4.5% (± 2.0%) at L5-S1. The foraminal height increased 3.5 mm (± 2.5 mm)/8.8% (± 5.0%) at L4-5 and 2.3 mm (± 1.9 mm)/5.3% (± 4.6%) at L5-S1. All changes were statistically significant ($p < 0.015$). The increase in foraminal height was greater than the increase in disc height and this trended toward statistical significance (L4-L5 $p = 0.07$ for mm/$p = 0.07$ for %; L5-S1 $p = 0.07$ for mm/$p = 0.20$ for %).

CONCLUSION: Distraction with percutaneous pedicle screws allows for indirect decompression of lumbar nerve roots by increasing both posterior disc height and foraminal height. Foraminal height was increased more than disc height which could alter sagittal alignment.

54. Characterization of Risk Factors for Complications Following Spinal Surgery: A Comprehensive Analysis Using the NSQIP Cohort

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INTRODUCTION: Complications following spinal surgery can result in significant morbidity and mortality, increased healthcare costs, and impaired outcomes. While some studies have speculated on the influence of certain risk factors on the rate of complications, no large prognostic investigation has been conducted to date.

METHODS: The database of the National Surgical Quality Improvement Program (NSQIP) was queried to identify patients undergoing spinal surgery between 2005-2008. Demographic data, medical comorbidities, past medical history, BMI, and type of procedure performed were obtained for all identified patients. All complications, including mortality, within 30 days of the spinal procedure were also documented. Complications were grouped into major and minor categories using accepted protocols. Logistic regression analysis was used to identify the effect of individual factors on mortality, as well as the risk of developing major complications, minor complications, or any complication.

RESULTS: Between 2005-2008, 3,475 patients receiving spinal surgery were included in the NSQIP database. The average age of patients was 55 (range 16-90), and 54% of the cohort was male. Ten patients (0.3%) died following surgery and there were 260 (7.5%) patients with at least one complication. BMI ($p = 0.03$) and wound contamination ($p = 0.03$) were found to significantly influence the risk of mortality. Males ($p = 0.04$) had an increased risk of post-operative complications, as did those with a history of cardiac issues ($p = 0.03$), neurologic compromise ($p = 0.02$), steroid use ($p < 0.001$), ASA class > 2 ($p < 0.001$), and greater operative times ($p < 0.001$). With the exception of gender, these factors were also found to contribute to the risk of major and minor complications.

CONCLUSIONS: This research represents the first such study to characterize risk factors for postoperative spine surgical complications in a large cohort representative of the general U.S. population. BMI, wound contamination, gender, medical comorbidities, and longer operative times all appear to influence the risk of complications to some degree.

55. Complication Rates Utilizing rhBMP-2 for Instrumented Lumbar Posterolateral Fusions♦

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INTRODUCTION: rhBMP-2 (INFUSE) has been utilized off label for instrumented lumbar posterolateral fusions for many years. The goal of this study was to evaluate the number of complications requiring reoperation for symptomatic failed fusion, infection, and hyper responsive neural compressions.

MATERIALS AND METHODS: During a seven-year period (2002-2009), all patients undergoing lumbar posterolateral fusion consenting to utilizing of rhBMP-2 (INFUSE) were retrospectively evaluated as a quality analysis within a large orthopedic surgery private practice. Patient demographics, BMI, comorbidities, number of levels, and types of bone void filler (BVF) were analyzed.

RESULTS: 1,158 consecutive patients were evaluated with 40.4% males and 59.6% females. Average age was 59 years and BMI was 30.7. Number of levels fused was: 1 (414, 36%), 2 (469, 41%), 3 (162, 14%), 4 (70, 6%), 5 (19, 2%), 6 (11, 1%), 7 (7, 0.6%), 8 (4, 0.3%), and 9 (2, 0.2%). Complications requiring reoperation were 117/1,158 (10%): seroma with acute neural compression 32 (2.8%), excess bone formation with delayed neural compression 4 (0.3%), infection requiring debridement 26 (2.2%), and symptomatic nonunion requiring redo fusion and instrumentation 41 (3.5%). Seroma formation was not associated with interbody fusion, BMI, or comorbidities. The incidence of seroma formation was significantly higher in patients with higher doses of rhBMP-2 ($p=0.050$) and especially in patients with more than 12 mg rhBMP-2 ($x^2=0.025$). Bone reformation at the laminectomy and foraminotomy sites occurred in a delayed fashion associated with a solid union, progressive worsening of radicular pain, and were successfully treated with repeat neural decompression only. Infection rate was related to fusions of more than three levels, total BMP dose, as well as dose per level.

CONCLUSION: Neural compression acutely with fluid or delayed with osseous formations and nonunions associated with rhBMP2 require further evaluation.

56. Reliability of Recist, Choi, and Pet-CT for Assessing Soft Tissue Sarcoma Treatment Response

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Treatment response in soft tissue sarcomas (STS) was initially performed using RECIST criteria based upon tumor size. However, STS are a heterogeneous population of tumors that respond differently to treatment with some tumors enlarging after tumor necrosis. The Choi criteria and PET-CT SUV response attempt to address this issue yet the reliability of these techniques has never been proven. This study's goal was to determine the reliability of RECIST, Choi criteria, and PET-CT SUV-max for assessing treatment response in STS. Twenty-seven patients with high grade STS were independently examined by three observers from two different medical specialties with different experience in image interpretation. Each observer measured the largest 1-dimensional (D) and 2D size, average Hounsfield units, and 3D SUV-max of all tumors. Treatment response, based on RECIST, Choi criteria, and PET-CT SUV-max was calculated. The inter-observer and intra-observer agreement was determined using kappa or intra-class correlation coefficient statistics. There was good to excellent agreement for all three CT methods of measurement. There was near perfect inter-observer agreement for PET-CT. No statistically significant differences were found when comparing the inter-observer agreement ($p > 0.22$) and intra-observer agreement ($p = 0.53$) of the different CT response methods. These results indicate that RECIST (1D, 2D), Choi criteria, and PET-CT SUV-max assessing STS treatment response are reproducible across/within examiners with varying experience levels, despite the subjective aspects of imaging measurements.

57. Prevalence of MSSA and MRSA Colonization in Orthopedic Oncology Patients

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INTRODUCTION: The consequences of infection in orthopedic oncology patients are well known. Methicillin sensitive- and resistant S*taphylococcus aureus* (MSSA and MRSA, respectively) are common infecting organisms which may colonize patients preoperatively. The prevalence of colonization in orthopedic oncology patients is unknown. We sought to prospectively establish the prevalence of MSSA and MRSA colonization in an orthopedic oncology patient population.

METHODS: Beginning in September 2009, all oncology patients of a single surgical service were screened preoperatively for MSSA and/or MRSA colonization using PCR nasal swabs as part of an infection control protocol. Patients identified as carriers underwent decolonization treatment perioperatively.

RESULTS: 117 oncology patients were treated from September 2009 – April 2010. Thirty-seven patients were not screened for colonization (other surgeon primary n = 25, opportunity missed n = 5, known *Staph*. infection already n = 3, miscellaneous n = 4), leaving 80 patients in the study group. 54/80 patients were treated for malignant conditions; 35/80 had received recent chemotherapy and 30/80 recent radiotherapy.

Prevalence of MSSA colonization was 16% and MRSA colonization was 2.5%. MSSA colonization was not associated with malignant diagnosis ($p = 0.49$), or recent chemo- or radiotherapy treatment ($p > 0.50$ for both).

Postoperative infection developed in 5 patients (2 sacrectomies with excision of the rectum/anus, 2 radiated groin/thigh sarcomas, and 1 combined chest wall/lung/spine resection).

CONCLUSIONS: MSSA colonization rates in orthopedic oncology patients are similar to reported population values. MRSA colonization rates are low. Patient diagnosis or adjuvant treatments do not appear to influence colonization rates.

58. Shortening and Plating of Critical Bone Defects of the Humerus Results in Better Torsional Strength in Pathological Humeral Fractures

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INTRODUCTION: The hypothesis tested in this study was that excision of a distal pathological defect and shortening of the humerus maximizes its torsional strength following compression plating.

METHODS AND MATERIALS: Eighteen pairs of embalmed humeri were randomly assigned to three paired-test groups based on defect size, measured as a percent of the bone circumference (33% and 66%) or shortening by defect excision. The U-shaped defects were made transversely on the distal, anteromedial cortex, and a saw cut was made at the apex of the defect posterolaterally. A compression plate was installed posterolaterally, and the specimens were tested in torsion.

RESULTS: The torque-rotation curves were initially linear before arcing into a region of minimal slope. There were no statistically significant differences in initial torsional stiffness or in peak torque among the three test groups. The overall average initial torsional stiffness was 0.67 Nm/° ± 0.14 Nm/°, and the average peak torque was 12.8 Nm ± 1.7 Nm.

DISCUSSION/CONCLUSION: Compression plating bent the plate-bone construct concave to the plate. Contact across the fracture site was maintained only over a small region adjacent to the plate. Neither the initial torsional stiffness nor the peak torque was affected by the defect sizes used in this study. If plate fixation of this type is used, excision of the defect is recommended to place the greatest possible fracture surface in close apposition to enhance fracture healing.

59. Combined Arthroscopy and Periacetabular Osteotomy: Intra-Articular Disease and Impact on Treatment

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INTRODUCTION: Periacetabular osteotomy (PAO) is an effective treatment for acetabular dysplasia, but failure over time is associated with labral tears and articular cartilage disease encountered at the time of acetabular reorientation. Concurrent treatment of intra-articular disease could improve results. The purpose of this study was to describe intra-articular findings and determine treatment impact of hip arthroscopy when combined with a PAO for treatment of symptomatic acetabular dysplasia.

METHODS: We retrospectively reviewed 177 PAOs performed by two surgeons. A subset of 58 patients (60 hips) underwent PAO and combined hip arthroscopy for the management of acetabular dysplasia and associated mechanical symptoms and/or MRI findings indicative of intra-articular disease. Intra-articular findings and arthroscopic procedure impact on treatment were assessed.

RESULTS: There were 53 females and 5 males. Mean age was 28.5 years and mean BMI was 24.2. Labrochondral disruption and acetabular chondromalacia/flap of the anterior and/or superolateral acetabular rim was noted in 85% and 60% of hips, respectively. Ligamentum teres rupture was present in three hips. Arthroscopic interventions included labral repairs/partial resections in 25 hips, chondroplasty or microfracture in 17, and ligamentum debridement in 3. 86.7% of hips had some type of arthroscopic intervention for intra-articular disease, and 13.3% had no intervention. One PAO was aborted due to advanced disease.

CONCLUSION: Arthroscopy performed in conjunction with a PAO demonstrates a high incidence of intra-articular abnormalities and provides additional joint preserving treatments not addressed by PAO alone. Longer-term results are needed to determine the impact of arthroscopy on clinical outcomes.

60. Update on the Prevalence of Magnetic Resonance Imaging Changes in the Hip Among Asymptomatic Adolescent Athletes

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The prevalence of femoroacetabular impingement (FAI) in the general population is not known. Screening exams for young patients, similar to those used for scoliosis, are not currently available. The purpose of this study was to determine the prevalence of abnormal hip examinations indicative of FAI in a population of young, asymptomatic athletes and to correlate physical exam findings with radiographic signs of FAI.

We examined 226 high school athletes age 12 to 18 presenting for state-mandated pre-participation athletic physicals. Nineteen patients (37 hips, 8%) had internal rotation of less than 10° with the hip in 90° of flexion (Group 1). Six of these patients (10 hips, 2%) had a positive anterior impingement sign. A repeat examination was scheduled with a surgeon and patients underwent standard radiographs and MRI of both hips. MRI findings were compared to age-matched asymptomatic controls with normal range of motion, also recruited from the screening (Group 2). A blinded musculoskeletal radiologist reviewed all MRIs.

Twenty-one patients (11 in Group 1, 10 in Group 2) have returned for clinical and radiographic examination. In Group 1, 4 patients (7 hips, 32%) had positive radiographic crossover sign and 7 patients (14 hips, 64%) had cam lesions on plain radiographs. The mean alpha angle measured from radial MRI sequences was 58.1° versus 45.1° in Group 2 (p-value = 0.0003). Signal changes were also noted within the labrum on MRI in 13 hips from Group 1 (59%) and 10 hips from Group 2 (50%).

Eight percent of normal teens had abnormal hip exams, and 64% had radiographic abnormalities consistent with FAI. Labral pathology was evident on MRI in both groups; however, analysis is ongoing to determine the clinical relevance of these findings. Screening for FAI may help detect patients at risk for early hip damage and provide recommendations regarding activity modification or sports participation.

61. A Randomized Clinical Trial of 240 Rotating Platform and Fixed-Bearing TKA Shows No Difference in Range of Motion, Function, or Durability at Five-Follow-Up

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

INTRODUCTION: Rotating-platform knee designs are intellectually appealing because of the contention that they can self-align and, thus, accommodate small mismatches in the rotational position of the tibial and femoral components after TKA. Others have suggested a durability advantage with these designs over time. We carried out a randomized clinical trial to determine if there was a clinically important difference in function, motion, or durability between rotating platform and fixed bearing TKA.

METHODS: This prospective randomized study of 240 primary TKA used a single posterior-stabilized femoral component and included three groups of 80 patients: all-polyethylene fixed bearing, a modular metal-backed fixed bearing, and rotating platform. The three groups were dynamically balanced with a computerized randomization process that accounted for age, gender, BMI, surgeon and implant and, thus, there were no significant differences in the demographic characteristics between the groups. Patients returned for examination and radiographs at 3 months, 1 year, 2 years, and 5 years.

RESULTS: Function, as measured by Knee Society scores, at both 2 years (90, 91, and 91) and 5 years (88, 89, and 88) was not significantly different among the all-polyethylene, modular metal-backed, and rotating platform groups, respectively. Stair climbing scores at 2 years and 5 years (39, 40, and 39) were not significantly different among the three groups. Range of motion at both 2 years (111°, 111°, and 109°) and 5 years (110°, 109°, and 109°) was not significantly different among the three groups. There were 5 revisions: 1 in the all-polyethylene group (patella fracture), 2 in the modular metal-backed group (aseptic loosening), and 2 in the rotating platform group (infection).

CONCLUSION: In this randomized clinical trial, the rotating platform design did not result in better knee flexion, function, or durability at 5 years compared with a posterior-stabilized, fixed-bearing knee.

62. Prospective Randomized Evaluation of a Collagen/Thrombin and Autologous Platelet Hemostatic Agent During Total Knee Arthroplasty

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Dr. Bloomfield is the recipient of the E. W. Johnson, Jr., M.D. Physician in Training Award.

INTRODUCTION: Considerable attention is being paid to blood conservation following elective arthroplasty surgery. The purpose of this study was to evaluate the effectiveness of an FDA-approved collagen/thrombin and autologous platelet hemostatic agent in preventing blood loss during primary unilateral total knee arthroplasty (TKA).

METHODS: This prospective, double-blinded, randomized study was designed to enroll a total of 100 patients. The average age was 64.4 (± 8.7) years; 57 were female. Patients were randomized 1:1 to either the treatment arm (standard intraoperative hemostasis plus study product) or the control arm (standard hemostasis alone). The primary outcome measure was blood transfusion requirement, as determined by a blinded investigator using standardized criteria. Secondary outcome measures included daily postoperative hemoglobin levels, pain scores, and narcotic requirements. Preoperative and four-week postoperative function was measured by range of motion, as well as with Short Form-12 and Knee Injury and Osteoarthritis Outcome Scores.

RESULTS: Fifty patients were randomized to each arm. There was one cross-over in each group, and the results were analyzed according to the intention-to-treat principle. Transfusion requirements were significantly lower in the treatment group (no blood transfusions) compared to the control group (5 transfusions; $p = 0.007$). There was a trend toward higher hemoglobin levels in the treatment arm starting on the second postoperative day which became significant by the fourth day (10.0 ± 1.0 versus 8.8 ± 1.1; $p = 0.01$). No other significant differences were detected between the two groups in any of the secondary outcomes.

CONCLUSIONS: The addition of a collagen/thrombin and autologous platelet product to standard surgical hemostasis appears efficacious in preventing blood loss following primary TKA.

63. Efficacy of Preoperative Home Use of 2% Chlorhexidine Cloth Prior to Shoulder Surgery

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Dr. Murray is the recipient of the Carl L. Nelson, M.D. Physician in Training Award.

Deep infection following shoulder surgery is a rare but devastating problem. The purpose of this study was to evaluate the efficacy of a preoperative home application of a 2% chlorhexidine gluconate cloth prior to shoulder surgery.

This randomized, prospective study evaluated 100 consecutive patients undergoing shoulder surgery at one institution. Patients were assigned to either perform their usual bathing routine prior to surgery (control group) or to apply 2% chlorhexidine gluconate impregnated cloths the night prior to and morning of surgery (treatment group). Upon arrival in the preoperative holding area, cutaneous bacterial cultures were taken from their shoulder. Postoperatively, patients were followed for clinical signs of infection for one month.

The overall positive culture rate was 66% in the chlorhexidine group versus 94% in the control group ($p < 0.001$). The positive culture rate for coagulase negative Staphylococcus was 30% in the chlorhexidine group versus 80% in the control group ($p < 0.001$). The positive culture rate for *Propionibacterium acnes* was 46% in the chlorhexidine group versus 58% in the control group ($p = 0.23$). Quantitative cultures for coagulase negative Staphylococcus (the most populous pathogenic organism) yielded an average of 0.121 colonies per cm^2 in the chlorhexidine group versus 1.08 colonies per cm^2 in the control group ($p < 0.001$).

The home use of the 2% chlorhexidine impregnated cloth was effective at decreasing the overall bacterial culture rates prior to shoulder surgery. Use of this product may be helpful in the prevention of postoperative infections in shoulder surgery.

64. Comparison of Ultrasound Fusion and Computed Tomography Guided Biopsy in Musculoskeletal Neoplasia

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

OBJECTIVES: Percutaneous biopsy for musculoskeletal tumors commonly relies on imaging adjuncts including ultrasound (US), computed tomography (CT), or Magnetic Resonance Imaging (MRI). US fusion is a novel technique. Our objective is to determine whether, compared to CT guidance, biopsies obtained via US fusion provide equivalent diagnostic yield and accuracy, allow quicker biopsy scheduling and procedure time, and achieve better patient satisfaction scores.

METHODS: From January to December 2010, 47 patients were randomized into undergoing US fusion or CT guided biopsies. Results were examined for adequacy of the histologic specimen (diagnostic yield) and correlation with surgical pathology (diagnostic accuracy). We also examined variables relating to scheduling time and length of biopsy procedure. Patient outcomes including level of comfort during the procedure, pain, and complication rates were measured.

RESULTS: US fusion (US/MRI and US/CT) and CT scan guided biopsy groups had a comparable diagnostic yield (US/MRI = 94%; US/CT = 93%; CT = 94%) and accuracy was (US/MRI = 90%; US/CT = 100%; CT = 83%). US fusion biopsies were faster to schedule and perform. Patient feedback showed no demonstrable difference in procedural comfort and pain. All procedures were safe with minimal complication rate.

CONCLUSION: US fusion is a safe and effective technique to obtain musculoskeletal biopsies for a wide range of conditions. It provides a high diagnostic yield and accuracy that are comparable to CT guided biopsy while being performed in the convenience of an US suite. This might have resulted in the observed faster scheduling and biopsy times. Further studies might show superiority in patient comfort measures.

MAOA BREAKOUT SESSION #6
PEDIATRICS
April 8, 2011

65. Risk Factors for Infections Following Pediatric Spine Fusion Surgery

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INTRODUCTION: In pediatric scoliosis patients, multi-level spinal fusions are among the most invasive surgeries with high potential for complications. Complications vary widely depending on both extra-operative factors and intra-operative factors. This retrospective analysis of 234 spinal fusions performed over a five-year period seeks to quantify risk factors for infections.

METHODS: 234 patients who underwent multi-level spinal fusions over a five-year period at a major academic pediatric orthopedic hospital were analyzed. Postoperative infection developing within one year after surgery was the dependent variable. Independent variables included age, gender, diagnosis, procedure, type of instrumentation, levels fused, BMI, operative time, blood loss, transfusions, and pre/postoperative lab values. A multivariate logistic regression was performed to develop a model to predict the probability of developing infection.

RESULTS: Nineteen infections were identified. Patients with neuromuscular scoliosis had an increased odds ratio of developing infection of 5.2 ($p = .001$). Each one unit drop in preoperative hemoglobin had an increased odds ratio of infection of 1.6 ($p = .02$). Increasing intraoperative blood loss was associated with increased odds of infection ($p = .004$). Increased numbers of levels fused and type of instrumentation did not have a statistically significant association with infection rates.

CONCLUSION: In pediatric spinal deformity surgery, there is a wide variation in infection rates. The great proportion of this variation is due to factors that are outside of the surgeon's control. The most important predictor of infection risk is the preoperative diagnosis. Patients with neuromuscular scoliosis have the highest infection risk and those with idiopathic scoliosis have the lowest, irrespective of type of instrumentation or extent of surgery.

66. Scoliosis in Patients Undergoing Operative Repair of Pectus Excavatum Deformity

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INTRODUCTION: Recent evidence supports the existence of a genetic link between scoliosis and pectus excavatum (PE). This study examined the prevalence of scoliosis in patients undergoing operative repair of their PE deformity.

METHODS: Preoperative chest CT scans and postoperative chest x-rays were examined for the presence of scoliosis. Cobb angles were measured on each of the radiographs as well as on follow-up examinations if the Cobb angle was greater than 10° initially.

RESULTS: 251 patients underwent operative repair of their deformity; of these, 27.1% had a Cobb angle of greater than 10°, 4% had a curve of greater than 20°, and 1.6% had a curve of greater than 30°. The degree of scoliosis correlated with patient Haller index, the number of bars used, and with postoperative infection rate.

CONCLUSION: There is a significant correlation between PE and scoliosis with over one in four patients with PE having scoliosis. Screening in this population should be highly considered.

Curve Characteristics	Number	Percentage of Patients with Scoliosis
10-20°	54	79.4
21-30°	10	14.7
> 30°	4	5.9
Thoracic	58	85.3
Thoracolumbar	10	14.7
Single	57	83.9
Double	11	16.2
Right Major	38	55.9
Left Major	30	44.1

67. Scoliosis in Patients Undergoing Operative Repair of Pectus Carinatum Deformity

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INTRODUCTION: Recent evidence supports the existence of a genetic link between scoliosis and pectus excavatum. Because of this linkage between chest wall deformity and spinal deformity, this study examined the rate of scoliosis in patients undergoing operative repair of their Pectus Carinatum (PC) deformity.

METHODS: Preoperative chest CT scans and postoperative chest x-rays were examined for the presence of scoliosis. Cobb angles were measured on each of the radiographs as well as on follow-up exams if the Cobb angle was greater than 10° initially.

RESULTS: Seventy-six patients underwent operative repair of their deformity; of these 14 were found to have scoliosis, two patients had a curve of greater than 20°, and none had a curve of greater than 30°. The average Cobb angle for all patients was 5.2°.

CONCLUSION: There is a significant correlation between PC and scoliosis with nearly one in six patients with PC having scoliosis. Screening should be considered in this population.

Curve Characteristics	Number	Percentage of Patients with Scoliosis
10-20°	12	85.7
21-30°	2	14.3
> 30°	0	0
Thoracic	14	100
Thoracolumbar	0	0
Single	14	100
Double	0	0
Left Major	6	42.9
Right Major	8	57.1

68. The Value of a Screening Hip Ultrasound in Children Presenting with Clubfoot

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BACKGROUND: The aim of this study is to define the incidence of developmental dysplasia of the hip (DDH) in children presenting with idiopathic talipes equinovarus to the pediatric orthopedic surgeon. The current literature has a wide range of estimates for this incidence and has been largely based on studies using pelvic radiographs as the radiology screening tool. Ultrasound has emerged as the study of choice to assess the neonatal hip given the limited ossification present and the absence of radiation. With a better understanding of how commonly these two conditions present together, we hope to be able to guide future clinical decision making for these patients.

METHODS: A retrospective chart review was conducted of patients presenting to the senior author (S.S.) with the diagnosis of talipes equinovarus from 1998 to 2008. Only children identified as having idiopathic clubfoot were included in the study. Over the 20-year period, 180 children qualified for further chart review. Clinic notes, birth history, physical examination findings, radiology studies, and operative notes were reviewed and documented.

RESULTS: Of the 180 patients, 122 (67.8%) were male and 58 (32.3%) were female. Average age of presentation was 0.8 years and patients were followed for an average of 6.0 years. Screening radiographic study was performed as an ultrasound in 108 patients at 6.7 weeks and as a radiograph in 72 patients at 2.6 years. Seventeen patients (15.7%) were identified as having developmental dysplasia of the hip as a result of the screening hip ultrasound, and 5 of these required treatment.

DISCUSSION: Conflicting reports in the literature have estimated the incidence of DDH in the idiopathic clubfoot population as high as 16% and as low as 1% when using radiographs to screen for dysplasia. The incidence of DDH requiring treatment has been estimated to be 1.3/1000 live births and in our study population, DDH requiring treatment was 28 times higher. The association between these two disease processes seems to exist and future studies with increased power are needed.

69. Fibrous Tissue of Idiopathic Clubfeet: Analyses by Gene Expression, Histology, and Immunohistochemistry

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BACKGROUND: Congenital idiopathic talipes equinovarus is a relatively common disorder of uncertain etiology. Many hypotheses have been suggested without complete agreement as to the cause of the disorder. Thickened fibrous tissue is routinely seen at the level of the talonavicular articulation in clubfoot patients. The purpose of this study is to characterize idiopathic talipes equinovarus at a molecular and cellular level compared to control specimens.

METHODS: Excess human fibrous tissue was obtained at the talonavicular articulation in surgeries to correct idiopathic clubfeet. Age-matched control specimens of excess fibrous tissue were also taken from a cadaveric talonavicular articulation and from surgeries to correct polydactyly and a myelodysplastic clubfoot. Harvested tissues were divided into portions for histological, immunohistochemical, and quantitative reverse transcription-polymerase chain reaction (QRT-PCR) analyses.

RESULTS: Compared to controls, idiopathic clubfoot tissue demonstrated no apparent morphological differences on histological examination, but significant increases in both ALK-1 (a myofibroblast marker) and α-actin immunohistochemical staining. On QRT-PCR study, idiopathic clubfoot (n = 5) normalized gene expression ratios for type I to type III collagen increased compared to controls (n = 5). Gene expression analyses of α-actin, vimentin, and desmin yielded variable and inconclusive data.

CONCLUSION: Myofibroblasts normally secrete types I and III collagen. The present work found an increased number of myofibroblasts indicated by greater ALK-1 immunohistochemical staining of idiopathic clubfoot compared to control specimens. This result would seem consistent with increased gene expression of types I/III collagen on comparison of the same samples. Interpretation of α-actin, vimentin, and desmin expression data is uncertain at this point. This investigation provides a foundation by which to determine the molecular and cellular nature of fibrous tissue at the talonavicular articulation, results leading to greater insight and understanding of the idiopathic clubfoot pathology.

70. Short-Leg Casting for Pediatric Tibia Fractures with Equivalent Outcomes as Long-Leg Casting

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INTRODUCTION: The standard treatment of middle and distal third tibia fractures without significant shortening or comminution is long-leg casting. However, we found that reduction and rotation can be maintained with short-leg casting focusing on proper molding of the proximal tibia in a triangular pattern. This allows for knee mobility, provides tolerance of immobilization of the fracture, and permits better perineal hygiene.

METHODS: We performed a comprehensive chart review of 65 children that sustained a middle or distal third tibia fracture and included 55 children with 56 tibia fractures. We recorded radiographic findings including initial fracture characteristics, displacement, angulation, and shortening and compared them to final radiographic and clinical outcomes. During the first clinic visit, patients were placed in short leg casts for three weeks. The proximal aspect of the cast was well molded in a triangular shape to aid in rotational control of the tibia.

RESULTS: The average age was 7.74 years, and 57% were male. Twelve were middle third fractures, 37 were distal third fractures, and 6 were distal physeal fractures. Of the injuries, 46 were closed and 10 were type I open injuries according to the Gustilo Anderson classification. The open injuries were treated with intraoperative irrigation and debridement. All 56 were treated with short-leg casting. Eight fractures from the closed injury group underwent a closed reduction and one underwent an open reduction. Eight of the 10 open fractures also underwent reduction. The overall union rate was 100%, reduction was maintained in 98.2% of patients, and 91.1% did not have any clinical or radiographic signs of shortening, rotational deformity, or angulation > 5°.

DISCUSSION AND CONCLUSION: Short-leg casting for middle and distal third tibia fractures provided adequate immobilization and maintained alignment. The freedom of knee motion was tolerated well, and the short-leg cast provided better perineal hygiene.

71. The Effects of Hypothyroidism on the Proximal Femoral Physis in Miniature Swine

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BACKGROUND: Hypothyroidism has been associated with slipped capital femoral epiphysis (SCFE). Studies of hypothyroidism at a cellular level are limited, but the condition and its potential tissue effects in miniature swine could serve as a model for human comparison. This study is intended to obtain a defined hypothyroid state in immature miniature swine and determine the effect on their growth plates. The authors hypothesize that hypothyroid miniature swine physes exhibit structural changes in cells and extracellular matrices of the tissues and gene expression changes in major components that lead to growth plate resilience and strength (aggrecan and type II collagen), chondrocyte hypertrophy and maturation (type X collagen), and cartilage degradation (matrix metalloprotease-13 [MMP-13]).

METHODS: Two male, ten-week-old Sinclair miniature swine were given 6-propyl-2-thiouracil (PTU) in their water and two other like animals (controls) were provided water without PTU. Animal blood levels of thyroid stimulating hormone (TSH), triiodothyronine (T3), and thyroxin (T4) were monitored weekly. After 15 weeks, proximal femoral physes were harvested for histology, laser capture microdissection, and quantitative reverse transcription-polymerase chain reaction analysis.

RESULTS: Compared to controls, swine provided PTU had increased TSH and decreased T3 and T4 levels, features consistent with a hypothyroid state. Compared to controls, hypothyroid swine exhibited structurally altered physes and had statistically significant decreased gene expression levels of aggrecan ($p < 0.05$) and type X collagen ($p < 0.1$), a trend toward decreased expression of type II collagen, and no change in MMP-13 expression.

CONCLUSION: This is the first model establishing hypothyroidism in miniature swine. On control comparison, hypothyroid swine physes changed in the molecular and biochemical character of their proteoglycans and collagens in addition to their cellular and extracellular matrix architecture. These differences may provide insight into human growth plate disorders such as SCFE.

72. Meniscus Tears in the Young Athlete: Results of Arthroscopic Repair

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INTRODUCTION: With the increasing incidence of knee injuries in adolescents, no clear guidelines exist regarding partial meniscectomy versus repair, and few studies have evaluated the results of arthroscopic repair in this population. This study presents our arthroscopic repair results for young athletes.

METHODS: After IRB approval, the records of patients under 18 who underwent meniscus repair between 2003 and 2007 at the University of Michigan were retrospectively reviewed. IKDC and Tegner scores were collected postoperatively.

RESULTS: Forty-five patients (31 males) with 49 knees and mean age 13 years (range 9-17) underwent 17 medial meniscus, 28 lateral meniscus, and 4 both meniscus repairs using inside-out technique. Delay from injury to surgery averaged 88 days (range 15-300). There were 15 bucket handle tears, 18 complex tears, and 16 simple tears involving the posterior horn in 30 and the mid-body in 19. Tears were red-red in 7 knees, red-white in 33, and white-white in 9 knees. Concomitant ACL reconstruction occurred in 31 patients, and the physes were open at the time of surgery in 33 patients. Mean follow-up was 23 months (range 4-39). Four patients were casted, and 41 were braced postoperatively. Forty patients returned to pre-injury activity at average of 6.5 months, with 27 in IKDC level 1 and 13 in level 2 activities. Average Tegner score was 8 (range 5-9). Two patients required revision lateral meniscus repair.

CONCLUSIONS: Despite delays from injury to surgery and repairs in red-white and white-white zones, the clinical success rate of arthroscopic meniscus repair in pediatric patients was excellent.

73. All-Epiphyseal ACL Reconstruction Improves Knee Stability: An In Vitro Study

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BACKGROUND: An all-epiphyseal approach to ACL reconstruction in pediatric patients is performed to restore knee stability without disturbing the physis. The current study was performed to evaluate the influence of all-epiphyseal ACL reconstruction on knee stability in vitro by analyzing tibiofemoral kinematics and point of contact on the tibia.

METHODS: Ten cadaver knees were tested with the ACL cut and with an all-epiphyseal ACL reconstruction. The knees were placed on a testing frame and physiologically realistic loading levels were applied at multiple flexion angles (0°, 15°, 30°, and 45°) with the quadriceps (600 N) loaded in isolation, loaded in combination with an anterior force (100 N), and with the quadriceps and hamstrings (200 N) loaded in combination. An anatomical coordinate system was set on the fixed femur, and a magnetic sensor was fixed to the tibia to characterize tibiofemoral kinematics. Pressure sensors were inserted under the menisci to characterize the center of force on the tibia for all testing conditions. Paired t-tests were used to compare all data between the reconstructed and cut conditions at all flexion angles.

RESULTS: Reconstruction significantly translated the tibia posteriorly at all angles, significantly reoriented the tibia into varus at 30° and 45°, and significantly shifted the tibia laterally and rotated the tibia externally for some conditions. Reconstruction also shifted the center of force anteriorly on the tibia. On the medial plateau, the anterior shift was approximately 3 mm, which was significant at all angles. On the lateral plateau, the anterior shift was approximately 2 mm from 15° to 45°, with the changes being significant for these flexion angles.

CONCLUSION: The data indicates that the all-epiphyseal ACL reconstruction improves knee stability. Reconstructing the ACL primarily pulled the tibia posteriorly, and reversed some other kinematic changes associated with ACL injury. The all-epiphyseal ACL reconstruction seems to be an effective method to treat ACL injury while decreasing the risk of iatrogenic physeal injury and subsequent growth disturbances.

BREAKOUT SESSION #7
TRAUMA I
April 8, 2011

74. Distal Locking in Femoral Nailing of 52 Patients without X-ray Guidance – A Multicenter Study

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INTRODUCTION: Distal locking of femoral nail continues to be a challenge, because of problems in accuracy and radiation exposure. This study was conducted to determine the effectiveness of a new technique in distal locking without x-ray guidance.

METHODS: Study population consisted of 52 patients from six institutions with femoral shaft fracture indicated for static intramedullary nailing. The new distal locking technique was performed using a flexible drilling cable. The device is inserted into the nail, where a cable exits through the distal lateral screw hole and drills a pilot hole to the lateral femoral cortex. Using the pilot hole as reference, drilling back through the nail and medial cortex is made possible without the guidance of x-ray. Drill-back technique evolved as attempts to optimize drilling time was sought for. Confirmation of screw insertion was by sounding test and by an institutionally required x-ray. Effectiveness was assessed by the percentage and average time of successful locking, and by the adverse events that may arise.

RESULTS: Out of the 52 patients, 50 were successfully locked using the device. Of the 50 patients, successful distal locking was 96% on first attempt and 100% for the second. No pilot holes were created on the two other cases because of mechanical problems, which were rectified for succeeding cases.

DISCUSSION AND CONCLUSION: The use of this device made distal locking easy, accurate, and fast because of its automation and unique technique. Additionally, use of this device has the potential to minimize or eliminate radiation exposure to the surgeon and other OR personnel.

75. Evaluation of Skeletal versus Cutaneous Femoral Traction for Diaphyseal Femur Fractures

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INTRODUCTION: Indications for preoperative skeletal traction for diaphyseal femur fractures in adults are not well defined, and there are no clinical studies showing that skeletal traction provides better outcomes in time of reduction in the operating theater or better pain control than cutaneous traction.

METHODS: After IRB informed consent was obtained, we randomized the application of skeletal and cutaneous traction. If the patient enrolled in the study, they completed a visual analog scale (VAS) in reference to their pain upon admission and their pain post traction application. We also evaluated multiple data points with concern to the on-call resident's time of application of the traction modality assigned, operative time of reduction, and other demographic data points from the patient's chart.

RESULTS: Twenty-four patients received cutaneous femoral traction while 16 patients received skeletal traction. There was a significant reduction in time of application for the cutaneous traction (25.50 ± 23.63 min) compared to skeletal traction (57.38 ± 25.45 min) ($p = < 0.05$). There was not a statistically significant difference in VAS scores when compared to pre-traction application pain assessment and post-traction pain assessment between the cutaneous and skeletal traction groups with a VAS of (0.71 ± 3.14 and 0.85 ± 2.96) respectively ($p = 0.92$). There was not a significant difference in reduction time of the fracture (skin incision to guide wire passage) in the operating room between cutaneous traction (28.0 ± 11.04 minutes) versus skeletal traction (31.05 ± 12.39 minutes) ($p = 0.35$).

CONCLUSION: Use of cutaneous traction for diaphyseal femur fractures when compared to skeletal traction results in a statistically significant reduction in time of application to the on-call resident with no complications or detrimental change in operative time and no difference in VAS pain scores.

76. Assessment of Periprosthetic Fracture Risk with Short and Long Cephalomedullary Nails – A Biomechanical Study

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INTRODUCTION: The cephalomedullary (CM) nail is standard treatment for surgical stabilization of unstable intertrochanteric and subtrochanteric proximal femur fractures. The purpose of this study was to evaluate the risk of periprosthetic fracture at the distal end of the nail for long versus short nails and titanium versus stainless steel nails.

METHODS: Twenty-eight cadaveric femurs (right and left) were harvested, radiographed, and scanned for bone density (DEXA). Each femur was randomized to receive fixation with either a short stainless nail (7 femurs), long stainless nail (7), short titanium nail (7), or long titanium nail (7). Each specimen was then tested in axial compression (700N) and cyclic torsion ($\pm$ 5Nm) for 30,000 cycles then loaded to failure in torsion. Stiffness, energy change, and load to failure were analyzed to identify any difference between groups.

RESULTS : There were no differences between groups in age and bone density. The long titanium group (76 Nm) had significantly higher load to failure than the short stainless (51 Nm, $p = .042$) and short titanium (41 Nm, $p = .006$) groups. Load to failure was also significantly higher for long (65 Nm) versus short nails (46 Nm, $p = .031$)

CONCLUSION: Long titanium CM nails are most protective against subsequent fracture in torsion. Distal femoral fracture risk was less likely for long (titanium and stainless) versus short CM nails, regardless of the metal make-up of the implant.

77. The Fate of Patients with a "Surprise" Positive Culture After Nonunion Surgery

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INTRODUCTION: The purpose of this study is to review a series of patients who had a "surprise" positive culture result (unexpected at the time of nonunion surgery) from definitive surgery for nonunion with regards to postoperative treatment and ultimate result.

MATERIALS: All patients treated for nonunion at three level 1 trauma centers who were considered at risk for indolent infection and had cultures taken at the time of definitive nonunion surgery were evaluated for organism, antibiotic regimen, and result.

RESULTS: Of 666 consecutive nonunions, 456 (68%) had cultures sent at the time of definitive surgical management for a history of prior surgery or open fracture. Ninety-four (21%) had a "surprise" positive culture. The definitive procedures were IM nail (45), ORIF (42), ex fix (1), and bone graft alone (6). Forty-five (52%) of the patients who had internal stabilization also had local augmentation with graft and/or bmp. Coag Neg Staph (45), MRSA (12), and MSSA (7) were the most common bacteria isolated. Seven had multiple organisms. Infectious disease consultants were involved in all cases. Eight cultures were considered probable contaminants and no additional antibiotics were given. The other 86 patients were treated with six to eight weeks of culture specific antibiotics (77) or with a slightly shorter duration (9). Five of the 8 patients with presumed contaminants healed, 3 have a persistent nonunion, of which 2 were infected and 1 was amputated. Of the 86 treated with antibiotics, 79 (92%) healed, 5 (6%) developed a recurrent nonunion, and 2 (2%) became grossly infected. Ultimately, 12 (15%) of the 79 who healed had their hardware removed after union.

DISCUSSION: In patients with a history of prior surgery or open fracture, we found that 21% had positive intraoperative cultures from the definitive nonunion surgery. All but those felt to be contaminants were treated with antibiotics, leading to a post-reconstruction infection rate of 2.2%, all with the same organisms cultured at the definitive procedure. The use of culture specific antibiotics seems justified based on the overall low rate of infection in this complex patient population.

78. Atrophic Nonunion After Open Fracture: Are Bone Morphogenetic Proteins the Answer to the Problem?♦

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PURPOSE: Nonunions following open fractures present a difficult clinical challenge, often complicated by compromised soft tissues, lack of adequate bone stock, and an increased risk of infection compared to nonunions after closed fractures. The purpose of this study was to evaluate the efficacy of bone morphogenetic proteins (BMPs) versus autograft for the treatment of atrophic nonunion resulting from open long bone fracture.

METHODS: A retrospective review was completed at our Level I Trauma Center for all fracture nonunions from January 2003 to June 2009. Patients were included in the study if they were diagnosed with an atrophic nonunion following treatment for an open fracture. In addition, patients had to have undergone nonunion treatment with revision surgery and insertion of autograft, composite marrow aspirate/injection, or bone morphogenetic protein. Medical records were reviewed for demographic data, surgery details, and radiographic follow-up.

RESULTS: From January 2003 to June 2009, 178 patients were treated for a fracture non-union at our institution. Of these, 37 had a prior open long bone fracture and a diagnosed atrophic nonunion. Fourteen were smokers and nine patients had culture positive infected nonunions. Twelve patients received autograft, 2 composite marrow aspirate/injection, 11 rhBMP-2, and 12 rhBMP-7. Thirty-three out of 37 patients underwent deformity correction with hardware revision prior to insertion of bone graft. The average follow-up after bone grafting procedure was 25.6 months (range 2-68). Seventy-four percent of patients treated with BMPs and 67% treated with autograft healed with a single bone grafting procedure. Rate of union ($p = 0.164$) and time to healing ($p = 0.488$) were not significant. Of the 12 who did not heal with the initial graft procedure (2 rhBMP-7, 2 marrow asp/inj, 4 rhBMP-2, 4 autograft), 9 underwent additional procedures and 3 were lost to follow-up. The secondary procedures involved hardware revision alone in four patients, and four patients had a second bone grafting procedure with hardware revision. Two patients are still not healed, with one having recently undergone a third revision procedure. Sixty-seven percent of those patients that did not heal were smokers ($p < 0.05$), 42% had an infection ($p = 0.099$), and all were Type III open fractures ($p < 0.05$).

CONCLUSIONS: No significant difference was found between BMP and autograft with rate of union, time to union, and need for additional procedures. Smoking had a significant association with failure of initial grafting procedure. Type III fractures were more likely than Type II fractures to not heal after a bone grafting procedure. Composite iliac crest bone marrow aspirate and injection was not effective as an isolated bone grafting procedure. Atrophic nonunions after open fractures are a challenging problem, requiring hardware revision and bone graft augmentation. When treating an atrophic nonunion after an open fracture, there is no significant clinical advantage to the use of BMPs over autograft.

79. Mesenchymal Stem Cells (MSCs) Facilitate Fracture Repair in an Alcohol-Induced Impaired Healing Model

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SUMMARY: Repeated pre-injury alcohol exposure impairs fracture healing in the mouse; intravenously administered autologous mesenchymal stem cells are capable of augmenting fracture repair.

INTRODUCTION: Alcohol has shown to be a risk factor in delayed fracture healing and nonunion. In this study, we sought to develop an impaired fracture healing model based on repeated alcohol exposure and to examine the regenerative effects of an intravenously administered pure population of MSCs.

METHODS: Adult mice were exposed to a two-week alcohol binge via intraperitoneal alcohol injection and subjected to a stabilized tibia fracture. Autologous MSCs were isolated by bone marrow immunodepletion from transgenic green fluorescent protein (GFP)-expressing adolescent mice and administered intravenously to injured animals on postoperative day one. In vivo assessment of MSC localization was performed with a Xenogen imaging system. Animals were sacrificed at two weeks following injury, and fractured tibiae were collected and formalin-fixed prior to immunohistochemical, micro-computed tomography (microCT), and biomechanical analysis. Biomechanical analysis was performed via four-point bending with an Instron materials testing machine.

RESULTS: Pre-injury alcohol exposure resulted in a significant impairment in biomechanical strength ($p < 0.001$) and callus volume by microCT ($p = 0.044$) of fractured tibiae compared with control animals. MSC transplants restored both fracture callus volume ($p \leq 0.05$) and biomechanical strength ($p \leq 0.05$) in animals with alcohol-impaired healing. Saline-exposed animals treated with MSC transplant showed trends towards improved callus volume and strength. In vivo imaging demonstrated a time-dependent MSC migration to the fracture site. Immunohistochemical analysis showed transplanted MSCs specifically localize to the site of fracture at an endosteal location.

CONCLUSION: Intravenously-administered autologous MSCs are capable of homing to the site of injury and of augmenting fracture repair in animals with impaired fracture healing secondary to alcohol exposure.

80. Immediate Full Weightbearing After Stabilization of Anterior Column Acetabulum Fractures

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PURPOSE: To present clinical, radiographic, and functional outcomes of patients allowed immediate full weightbearing after closed reduction and percutaneous fixation of anterior column (AC) acetabulum fractures. We hypothesize that certain AC fracture variants may be successfully managed with an immediate full weightbearing protocol.

METHODS: We retrospectively reviewed a prospective treatment protocol of percutaneous lag screw stabilization of anterior column fractures followed by immediate full weightbearing. From September 2001 to December 2008, we enrolled 28/439 (6.3%) consecutive patients. Adequacy of reduction, final radiographs, and functional outcomes were assessed by an independent orthopedic surgeon.

RESULTS: Mean patient age was 49 years (19-83). Fractures included 14 anterior column and 14 anterior column posterior hemitransverse types. Twelve patients had associated orthopedic injuries; however, none that prohibited immediate full weightbearing. Eighteen patients had an anatomic reduction, 8 had an imperfect reduction, and 2 had a poor reduction on plain radiographs. On postoperative CT scan, 18 had an anatomic reduction and 10 had an imperfect reduction. Six patients were lost to follow-up (< 1 year), and the remaining 22 (79%) had a mean follow-up of 39 months (12-74). One patient suffered a partial peroneal nerve palsy post-operatively. At final follow-up, radiographic grades were excellent in 19, good in 2, and fair in 1 patient. The mean modified Merle d'Aubigné Score was 17.4 (11-18). The mean SMFA function and bothersome index were 20.2 (0-72.8) and 20.1 (0-72.9), respectively.

CONCLUSIONS: This protocol which permitted immediate full weightbearing and early return to work after percutaneous stabilization of anterior column fractures produced clinical, radiographic, and functional outcomes comparable to outcomes after ORIF and nonoperative treatment.

81. Open Reduction and Internal Fixation of Clavicle Nonunions with Demineralized Bone Matrix

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BACKGROUND: Clavicle nonunion rates after nonoperative treatment range from < 1% to 4.5% of clavicle fractures. When nonunions do occur, open reduction and internal fixation (ORIF) with iliac crest bone graft (ICBG) is currently the gold standard of treatment with excellent rates of healing. However, a well-documented complication rate exists with ICBG. Biologic augmentation with demineralized bone matrix (DBM) has shown equal efficacy healing humeral and tibial shaft nonunions, as well as enhancing fusion rates in the spine without the complications associated with graft harvest. However, corresponding literature does not exist for the usage of DBM in clavicle nonunions.

PURPOSE: The purpose of this study was to evaluate the outcomes, healing, and complications of clavicle nonunions treated with ORIF and DBM.

MATERIALS AND METHODS: Twenty clavicle nonunions treated with ORIF and DBM were evaluated retrospectively to assess outcomes and healing rates based on clinical symptoms and radiographic findings.

RESULTS: Twenty-four adults with clavicle nonunions were identified, 20 of whom were treated with ORIF and DBM. Follow-up was available on 19 of the 20 patients. Eight of the 20 patients were smokers. Clinical follow-up averaged 8.3 months. Seventeen of the 20 patients showed evidence of union at this time. These 17 patients achieved full shoulder motion and strength. Three patients showed a persistent nonunion, each of whom were smokers ($p = 0.08$). Two had persistent pain and no radiographic evidence of healing and one presented with hardware failure; all were re-plated. Two of three went on to union, one was lost to follow-up. One patient who healed required hardware removal due to pain.

CONCLUSION: Open reduction and internal fixation with demineralized bone matrix is an acceptable treatment alternative to ICBG for clavicle nonunions. Smokers may have a higher risk for failure with DBM, although this was not found to be statistically significant. Given this trend, ORIF and iliac crest bone graft may better serve patients who smoke.

82. The Value of Washers in Internal Fixation of Femoral Neck Fractures with Cancellous Screws: A Biomechanical Evaluation

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INTRODUCTION: A lack of washers has been shown clinically to be the single largest predictor of fixation failure in the treatment of femoral neck fractures with cancellous screws. This finding was somewhat surprising as washers do not prevent the screws from backing out and do not provide any increase resistance to varus collapse. The purpose of this study was to evaluate the maximal insertional torque of screws in osteoporotic bone with and without washers. We hypothesized that a higher maximal screw insertion torque could be achieved with washers.

METHODS: We used eight matched pairs of osteoporotic fresh-frozen human cadaveric femurs (age > 70 years, all female). Two screws each were inserted in each femur either with or without a washer and maximal insertional torque was measured using a 50 Nm torque transducer. The testing was performed using a customized device which allowed the torque transducer to apply a constant axial force and torque speed to the screws. A paired student's t-test was used to compare the maximal screw insertional torque of screws with washers versus screws without washers in matched pairs.

RESULTS: Fifteen out of 16 times the maximal screw insertional torque was higher when a washer was used. The average maximal torque with a washer was 5.1 Newtonmeter (Nm) compared to 3.1 Nm without a washer ($p < 0.001$).

CONCLUSION: We conclude that the addition of washers increases the maximal insertion torque of cancellous screws in the treatment of osteoporotic femoral neck fractures by providing counter resistance to the screw heads at an otherwise weak lateral cortex. As a clinical reference value for interpretation of this data, the limit of torque limiting screw drivers used with locking plates is set between 4 and 6 Nm. Therefore, the difference in insertion torques likely represents clinically relevant values. Since there is no apparent disadvantage in the use of washers and they are inexpensive and readily available, we advocate for their routine use until larger clinical studies disprove their efficacy.

83. Does Pain Correlate with Patient Based Functional Outcomes Scores After Pelvic and Acetabular Fractures?

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INTRODUCTION: The purpose of this study was to evaluate the correlation of a validated visual analog scale (VAS) for pain with the SMFA scores and subscores in patients treated operatively for pelvic and acetabular fractures.

METHODS: A cohort of 24 patients with pelvic fractures and 25 patients with acetabular fractures treated operatively and followed for > 6 months comprise the study group. SMFA and VAS pain scores (10 points) were prospectively collected. We evaluated the correlation of the SMFA dysfunction (and subscales) and bother indices with the VAS for pain using Pearson's correlation matrix.

RESULTS: For pelvic fractures, the dysfunction index was 38.67 $\pm$ 17.25 and the bother index was 31.97 $\pm$ 21.64. The pain VAS was 5.02 $\pm$ 3.23. Pain VAS had a significant correlation with the dysfunction index, daily function, emotional status, and arm and hand function ($p < 0.05$). No significant correlation was found between pain VAS and the bother index or mobility, $p = 0.06$ and 0.13, respectively. Pain VAS did not correlate with SMFA Question 46, "How much are you bothered by problems with stiffness and pain?" $r = 0.298$, $p = 0.14$. For acetabular fractures, the dysfunction index was 26.45 $\pm$ 19.51 and bother index was 27.30 $\pm$ 23.70. The pain VAS was 4.74 $\pm$ 3.05. Pain correlated with the dysfunction index, the bother index, and all subscores, including SMFA Question 46 ($p < 0.05$). Table 1: Correlation of SMFA with VAS (Pearson's r * $p < 0.05$)

	Dysfunction	Bother	Daily	Emotional	Arm/Hand	Mobility	SMFA Question 46
Pelvic	*0.617	0.366	*0.615	*0.682	*0.582	0.302	0.298
Acetabular	*0.757	*0.822	*0.668	*0.797	*0.426	*0.699	*0.848

CONCLUSIONS: Our findings suggest that pain is an important factor in the explanation of the patient based SMFA for patients with operatively treated pelvic or acetabular fractures.

MAOA BREAKOUT SESSION #8
SHOULDER
April 8, 2011

84. Position and Duration of Immobilization After Primary Anterior Shoulder Dislocation. A Systematic Review and Meta-Analysis of the Literature

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BACKGROUND: Immobilization after closed reduction has long been the standard treatment for primary anterior dislocation of the shoulder. To determine the optimal duration and position of immobilization to prevent recurrent dislocation, a systematic review of the relevant literature was conducted.

METHODS: Of over 400 published studies identified by literature review, ten Level-I and Level-II studies were systematically reviewed. The outcome of interest was recurrent dislocation. Additional calculations were performed by pooling data to identify the ideal length and position (external or internal rotation) of immobilization.

RESULTS: Six studies (five Level I, one Level II) evaluated the use of immobilization in internal rotation for varying lengths of time. Pooled data analysis found a 19% (54 of 284) recurrence risk in patients immobilized for one week or less and a 45% (218 of 486) rate of recurrent instability in patients immobilized for three weeks or longer ($p < 0.0001$). Age of less than 30 years at the time of index dislocation was significantly predictive of recurrence in all studies. Four studies (one Level I, three Level II) compared recurrence rates with immobilization in external and internal rotation. Analysis of the pooled data found recurrence risks of 36% (27 of 76) in patients treated with conventional sling immobilization in internal rotation and 25% (26 of 105) when external rotation bracing was used ($p = 0.14$).

CONCLUSIONS: Analysis of the best available evidence indicates there is no benefit for conventional sling immobilization longer than one week for primary anterior shoulder dislocation. Age of less than 30 years at the time of injury is significantly predictive of recurrence. External rotation bracing may provide a clinically significant benefit over traditional sling immobilization, but the difference in recurrence rates did not achieve statistical significance with the numbers available.

85. Acromioplasty in the State of Wisconsin from 2003-2009

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Anterior acromioplasty is a very common surgical procedure originally described by Charles Neer for impingement of the rotator cuff beneath the coracoacromial arch. It has become one of the more commonly performed operations. It is unclear if it is being performed for indications other than those originally described. The purpose of this study is to gain an understanding of the indications currently used for the application of this procedure.

We searched a public statewide database in Wisconsin from 2003-2009 for the procedure codes for open and arthroscopic acromioplasty. The data retrieved included number of procedures, patient age, sex, and corresponding primary diagnosis codes. We stratified the data according to age and sex and determined the primary diagnosis codes associated with this procedure for each group.

A total of 21,689 acromioplasties were performed (12,814 male: 8,875 female). The age of patients ranged from 1-91 years with a mean age of 48.9 years (male: 47.96 and female: 50.29). Approximately 23% of the patients were under the age of 40; 12.5% were 19 years old or younger. The majority of patients had expected diagnoses of Shoulder Region Disorder, Rotator Cuff Syndrome, Rotator Cuff Sprain, and Rotator Cuff Rupture. There were, however, a large percentage of diagnoses inconsistent with the original indications for the procedure including SLAP tear (6.59%), dislocation (1.27%), and adhesive capsulitis (2.03%).

These data are concerning. The benefit of acromioplasty is unclear for SLAP tears unless there is concomitant subacromial impingement. It has no clear role in the treatment of instability and can potentially lead to more adhesions in adhesive capsulitis. If performed in the presence of an irreparable rotator cuff tear, it can lead to anterior superior escape. There are also unclear indications in younger patients who likely have not developed bony acromial changes. Acromioplasty is a beneficial operation in appropriate patients. Further study needs to be directed at clarifying the indications for this procedure.

86. Relationship Between Rotator Cuff Tear Type and Acromial Impingement

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INTRODUCTION: The precise role of acromioplasty remains controversial in the operative treatment of rotator cuff disease. Studies note that changes to the acromial undersurface exist, but there are no reports that describe the frequency of these abnormalities or their association with different types of tears (articular surface, bursal surface, and full thickness). The purpose of this study is to identify, in a consecutive cohort of patients undergoing arthroscopic shoulder surgery for rotator cuff disease, the frequency of acromial abnormalities characteristic of impingement.

METHODS: We obtained IRB approval and during a two-year period enrolled all patients from a single institution undergoing arthroscopic shoulder surgery for partial or full thickness rotator cuff tears. We used preoperative radiographs, MRI, and intraoperative arthroscopic observation to evaluate the acromial type (I-III) and acromial index. We recorded the presence or absence of undersurface enthesophytes subacromial bursal fluid, subacromial adhesions, and coracoacromial ligament changes. We compared these characteristics of impingement to the type of rotator cuff tear. Fisher's Exact Test was used to obtain p-values.

RESULTS: Twelve articular and 13 bursal-sided partial thickness tears were compared individually and as a group to 78 full thickness tears. No significant correlations between acromial morphology, degree of bursal fluid, subacromial adhesions, coracoacromial ligament changes, AC joint arthrosis, or presence of enthesophytes were identified.

CONCLUSION: While undersurface acromial changes may be present in rotator cuff tears, there is no correlation between these changes and tear type. Based on these findings, we are unable to support the routine use of acromioplasty in rotator cuff repairs.

87. Humeral Head Abrasion: An Association with Failed SLAP Repairs

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BACKGROUND: An abrasion on the humeral head under the articulating portion of the biceps tendon has been observed in patients with pain and stiffness following SLAP repair. To our knowledge, a humeral head chondral defect associated with SLAP lesions and failed SLAP repairs has not been previously described. The purpose of this study was to examine this humeral head abrasion (HHA) and its association with various diagnoses involving pathology of the biceps-labral complex. We hypothesized that it would be more common in failed SLAP repairs than other diagnoses.

METHODS: A retrospective chart review was performed of 253 patients who underwent shoulder arthroscopy over a five-year period by a single surgeon. Postoperative diagnoses were used to confirm one of the following diagnoses: failed SLAP repair, biceps tendonitis, SLAP lesion with biceps tendonitis, and isolated SLAP lesion. Operative reports and surgical images were analyzed to identify the presence or absence of HHA. Demographic data including age, sex, handedness, and onset of injury were also collected. Chi-square analysis was performed to compare the frequency of this lesion among the different diagnoses and patient characteristics.

RESULTS: HHA was observed in 13/18 (72.2%) cases with failed SLAP repairs, 8/18 (44.4%) with biceps tendonitis, 11/20 (55%) with SLAP lesion and biceps tendonitis, and 1/71 (1.4%) with isolated SLAP lesions, significantly differing in frequency by diagnosis ($p < 0.001$). Patients with HHA had a higher median age (48) than those without (40, $p = 0.004$). There was no relationship between sex, handedness, or timing of injury onset and the presence of HHA.

DISCUSSION: HHA is common in patients with a pathologic biceps-labral complex, especially those with failed SLAP repair. We speculate that this lesion is due to increased biceps-humeral head contact pressure. The presence of HHA may provide objective evidence of an overly tensioned biceps tendon after SLAP repair, a possible culprit in postoperative pain, stiffness, and failure.

88. Suture Capsulorrhaphy versus Capsulolabral Advancement for Shoulder Instability

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PURPOSE: Many failures of arthroscopic repair often result from inadequate treatment of capsular laxity or injury. Patients with shoulder instability secondary to capsular injury or laxity and without a concomitant labral tear are not uncommon. Also, patients with labral tears may have a more global laxity issue. The relative strength and durability of a capsulorrhaphy suture versus using suture anchors in the shoulder is not clear. Our goal was to test the mechanical performance of a suture capsulorrhaphy repair versus a repair with suture anchors in a cadaver model with anterior-inferior shoulder instability.

MATERIALS AND METHODS: In a controlled laboratory study, 14 cadaveric shoulders (7 matched pairs) were tested with either a suture capsulorrhaphy to the intact labrum or a capsulolabral advance using a suture anchor into the glenoid. Specimens were translated with the shoulder in an abducted, externally rotated position to failure on a MTS machine. Axial force, displacement, and time to failure were measured, load and stiffness were calculated, and a statistical analysis was done.

RESULTS: The capsulolabral advance showed a significantly higher load to failure, 210.24 N +/- 64.5 N, when compared to suture capsulorrhaphy, 118.58 N +/- 60.30 N, $p = 0.018$. Stiffness (N/m) was higher for the anchor group as well, 23.92 N +/- 10.69 N, versus 19.51 N +/- 12.72 N, but not statistically significant. When examining the failure modes, in the suture capsulorrhaphy, 2 specimens had failure of the sutures, while 5 actually cut through the labrum itself. In the anchor group, 3 had failure of the anchors, while the others pulled through the capsule—the failure of the anchors did occur at higher mean load than the sutures.

CONCLUSIONS: Capsulolabral advance with suture anchors tends to offer greater initial strength and stiffness as compared to a suture capsulorrhaphy. Clinical experience supports better results with anchor capsulolabral advance, but this is the first biomechanical study to show statistical significance. Rigid examination of failure modes reveal that capsulorrhaphy stitches can case major damage to the labrum in failure, which could lead to problems in patients with a traumatic re-dislocation. Further testing is necessary to draw definitive conclusions regarding the stiffness of these two stabilization constructs.

89. Comparison of Various Imaging Techniques to Quantify Glenoid Bone Loss in Shoulder Instability

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SUMMARY: Three-dimensional computed tomography (3D CT) is the most accurate and reliable imaging modality to quantify the percent of glenoid bone loss in the setting of recurrent anterior shoulder instability.

INTRODUCTION: The purpose of this study was to determine the most accurate imaging modality to quantify glenoid bone loss in recurrent anterior shoulder instability. This will allow the best preoperative prediction of the patients needing a bone grafting procedure.

METHODS: Six fresh-frozen shoulder cadavers were imaged with radiographs (x-ray), magnetic resonance imaging (MRI), CT, and 3-D CT. Three sequential glenoid defects were created, measured, and re-imaged. The defect sizes were: 0, < 12.5%, 12.5% - 27%, and > 27%. Four independent blinded evaluators (2 radiologists, 2 surgeons) reviewed the 96 image sets and estimated the percent glenoid bone loss.

RESULTS: The Pearson correlation coefficients between the predicted bone loss versus the true loss across all four raters are: 0.904 (3-DCT), 0.822 (CT), 0.649 (MRI), and 0.477 (x-ray). The prediction errors (PE) (mean+/- Standard Deviation [StD], in %) are: 3-D CT (-2.3+/-5.9), CT (-2.9+/-8.3), MRI (-1.7+/-10.9), and x-ray (-5.9+/-12.8). The means of the PE are not significantly different among 3-D CT, CT, and MRI, but the StD of the PE are similar among all four evaluators for 3-D CT and are lower than all other imaging techniques. The prediction based on x-ray has the largest error and StD. Covariance parameters revealed large variances for shoulders on MRI and x-ray.

DISCUSSION AND CONCLUSION: 3-D CT was the most accurate imaging modality in predicting glenoid bone loss among four blinded independent evaluators. It was the most consistent among evaluators with the smallest degree of error. The authors would recommend 3-D CT to evaluate the need for a bone grafting procedure when glenoid bone loss is a concern.

90. Rabbit Supraspinatus Motor Endplates are Unaffected by a Rotator Cuff Tear

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INTRODUCTION: Rotator cuff tears are a major cause of morbidity with an incidence of up to 35%. Fatty infiltration is a degenerative process that begins after a tear and limits the potential for successful repair. Recently a process of suprascapular neuropathy has been described which results from excessive traction on the suprascapular nerve in massive retracted tears. This injury to the nerve has been hypothesized to cause fatty infiltration of the muscle.

METHODS: Five skeletally mature New Zealand white rabbits were randomized to receive an index procedure on either their right or left shoulder with the opposite shoulder serving as a control. The supraspinatus tendon was transected at its insertion and allowed to retract. At three months, the rabbits were sacrificed and both supraspinatus muscles were harvested. The specimens were then examined with confocal microscopy and histology.

RESULTS: Atrophy was grossly visible and fatty infiltration was confirmed with osmium tetroxide staining in 4 of the 5 test muscles. An average of 294 motor endplates were analyzed per specimen with an average of < 2% denervation. Less than 1% of the test muscles were partially denervated. There was no significant difference between control and surgically transected muscles.

CONCLUSION: Rotator cuff tears do not lead to loss of the motor endplate or innervation status of the supraspinatus at three months. Fatty infiltration is not caused by denervation of the supraspinatus.

91. Dynamic, In Vivo Glenohumeral Joint Mechanics After Rotator Cuff Repair: Long-Term Follow-Up of Repaired and Contralateral Shoulders

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INTRODUCTION: Rotator cuff tears are common, and treatment protocols are based on the belief that it is necessary to restore normal glenohumeral joint (GHJ) mechanics to obtain a satisfactory result. However, the extent to which cuff repair restores GHJ mechanics is unknown. The purpose of this study was to quantify GHJ mechanics in the repaired and asymptomatic contralateral shoulders of rotator cuff repair patients.

METHODS: Twenty-two rotator cuff patients (age: 64 ± 10) enrolled in this study. Bilateral, 3D, in-vivo GHJ motion was accurately (± 0.4 mm, ± 0.5°) measured from biplane x-ray images at two years post-surgery. Shoulder strength, clinical outcomes, and bilateral ultrasound images were acquired from each patient. Repaired and contralateral GHJ motion was assessed with a paired t-test. As a secondary analysis, GHJ motion and strength were compared between the contralateral shoulders with an intact cuff (n = 12) and those with a partial- or full-thickness tear (n = 10).

RESULTS: Repaired shoulder strength was greater in internal rotation ($p < 0.01$), but no difference between shoulders was detected for abduction, elevation, or external rotation ($p > 0.08$). The humerus in the repaired shoulder was located 10% ± 11% more superiorly on the glenoid than the contralateral shoulder ($p < 0.01$). No significant difference was detected between intact and torn contralateral shoulders in GHJ motion ($p = 0.12$) or measures of shoulder strength ($p > 0.33$).

DISCUSSION: It is unclear if the position of the humerus on the glenoid in the repaired shoulder is an etiologic factor or a consequence of surgery. However, the finding that the contralateral shoulders with a partial/full-thickness tear have similar strength and GHJ motion as contralateral shoulders with an intact cuff suggests that the surgical repair may be contributing to the altered joint mechanics in the repaired shoulder. Further research hopes to establish a relationship between GHJ mechanics and development of symptoms requiring clinical intervention.

92. Predictors of Pain and Function in Symptomatic, Atraumatic Full-Thickness Rotator Cuff Tears

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INTRODUCTION: The prevalence of full-thickness rotator cuff tears increases with age. Many patients are asymptomatic. Thus, not all of these patients require surgical repair. It is unclear which factors definitively contribute to patients' pain and function. The purpose of this study was to determine what non-modifiable and non-surgically modifiable factors contribute to pain and function with symptomatic, atraumatic full-thickness rotator cuff tears.

METHODS: A prospective, non-randomized cohort study reporting time-zero data of patients enrolled in a non-operative treatment program for symptomatic, atraumatic rotator cuff tears by the Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Group. Based on ASES (American Shoulder and Elbow Surgeons) scores and WORC (Western Ontario Rotator Cuff) indices, several variables were analyzed.

RESULTS: 389 subjects were enrolled. The following variables significantly affected the WORC and ASES scores: sex (females had higher score; $p = .001$), education level (higher education, higher score; $p < .001$), active abduction (degrees; $p = .021$), strength in forward elevation ($p = .002$) and abduction ($p = .007$), scapulothoracic dyskinesia ($p < .001$), and atrophy of the supraspinatus ($p = .04$) and of the infraspinatus ($p = .003$). Tear size was not a significant predictor, unless comparing isolated supraspinatus tears to supraspinatus, infraspinatus, and subscapularis tears (WORC) ($p = .004$). Age, tear retraction, and humeral head migration were not statistically significant.

CONCLUSIONS: Non-surgically modifiable factors such as scapulothoracic dyskinesia, active abduction, and strength in forward elevation and abduction were identified that could be addressed non-operatively with therapy. This could turn a symptomatic patient into a less symptomatic or asymptomatic patient. A larger tear size with retraction may not be a contraindication to initial non-operative management with therapy.

MAOA BREAKOUT SESSION #9
ADULT KNEE II
April 8, 2011

93. Postoperative Morbidity and Mortality Associated with Primary Total Knee and Unicompartmental Knee Arthroplasty

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INTRODUCTION: This study compares the incidence of postoperative complications (within 90 days) following primary total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA).

METHODS: 944 consecutive patients were retrospectively reviewed over five years at a single institution; 756 underwent primary TKA and 188 underwent UKA. Bilateral procedures and diagnoses other than osteoarthritis were excluded. Both groups were matched for age; there were more females in the TKA group (70% versus 59%; $p = .005$). BMI and Charlson Co-morbidity index scores were significantly higher in the TKA group (33.3 versus 29.2; $p < 0.001$ and 0.59 versus 0.41; $p < 0.01$, respectively).

RESULTS: Ninety-three (12.3%) TKA patients had a major postoperative complication compared to three (1.6%) UKA patients ($p < .001$). Manipulation under anesthesia (5.6% versus 0.5%; $p = 0.001$) and blood transfusions (2.8% versus 0%; $p = 0.012$) were more common following TKA. Eighteen (2.4%) TKA patients required a re-operation compared to zero (0.0%) UKA patients ($p = .033$), and 65 (8.6%) TKA patients were re-admitted for a secondary diagnosis/intervention compared to one (.05%) UKA patient ($p < 0.001$). Length of stay was longer following TKA (3.5 days versus 1.8 days; $p < 0.001$). The prevalence of deep vein thrombosis, pulmonary embolus, deep infection, admission to ICU, and death were similar in both groups.

CONCLUSION: The morbidity of TKA is significantly higher than UKA although UKA patients had lower BMI and Charlson co-morbidity scores which may be related to UKA selection criteria.

94. Total Knee Arthroplasty in Patients with Preoperative Genu Recurvatum

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Preoperative genu recurvatum deformity in patients undergoing total knee arthroplasty (TKA) is concerning because of the potential for ligamentous instability and early failure.

Little information is available about this deformity and results following TKA. Our study was done to determine the postoperative outcomes, resultant knee function, and failure rates in patients with preoperative recurvatum deformity undergoing TKA.

We identified 24 patients (26 knees) with preoperative genu recurvatum (average 7.6°) who underwent primary TKA between 1995 and 2005. Evaluation included Knee Society clinical and functional scores, radiographic evaluation, and outcome analysis. The average follow-up was 4.7 years.

Patients with genu recurvatum demonstrated median preoperative Knee Society knee score and function score of 43.2 and 36.3 points, respectively. In 18 knees (69.23%), gonarthrosis was a diagnosis, 4 (15.4%) post-traumatic arthritis, 3 (7.7%) polio, and 1 (7.7%) JRA. Most knees in our study (18, 69.23%) were posterior stabilized implants (PS), 3 (11.5%) were cruciate retaining (CR) knees, 3 (11.5%) constrained implants, and 2 hinge-type implants (both in patients with polio). There were no revisions; one implant was removed for chronic infection at 2.61 years and not reimplanted. In two knees, hyperextension recurred after TKA, one of those had pain complaints thought to represent post impingement. Other complications included patellar clunk syndrome in one patient and flexion instability in one knee, neither had reoperation. Overall Postoperative Knee Society knee scores and functional scores improved to 96.1 and 68.8, respectively.

Total knee arthroplasty in a patient with preoperative genu recurvatum is a successful operation and in our experience does not lead to significant level of complication related to instability or early failure.

95. Comparison of Perioperative Cost-Utility for Conventional and Customized Total Knee Arthroplasty

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Increased focus has been directed towards optimizing the efficiency and cost-utility associated with total knee arthroplasty (TKA). The purpose of this study was to compare perioperative time, material resource allocation, and sterile processing required for conventional instrumentation versus customized cutting guides for TKA.

The full cycle of sterile processing for TKA instrumentation was analyzed and divided into the following phases: instrument collection, transportation, decontamination (manual and mechanical washing), instrument tray assembly, and sterilization. Each phase was timed for five conventional and five customized TKA cases by an independent observer, not involved with the surgical procedure, using standard industrial efficiency methodology.

On average, four fewer trays of instruments were needed to perform a customized TKA compared with conventional TKA. Timed measurements were averaged for the following phases of processing for conventional and customized TKA, respectively: instrument collection (11.0 versus 7.4 min; $p = 0.031$), transportation (8.8 versus 6.4 min; $p = 0.06$), manual washing (40.0 versus 29.8 min; $p = 0.007$), mechanical washing (41.0 versus 41.0), tray assembly (86.4 versus 17.6 min; $p = 0.0002$), and sterilization (60.0 versus 60.0 min). Total processing times for conventional and customized TKA were 4.2 and 2.8 hours ($p = 0.0004$), which only resulted in an actual hospital cost savings of $24.59 per case.

Customized TKA cutting guides reduced perioperative processing time significantly compared with conventional TKA instrumentation; however, custom cutting blocks did not achieve substantial hospital savings in instrument processing.

96. Inflammatory and Immunological Responses to Bolas versus Multiple Injections of Synvisc in a Murine Biocompatibility Model

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OBJECTIVE: Although local reactivity to Synvisc has been studied, no study has been done which compares the reactivity of Synvisc in single versus multiple injections using both systemic and local parameters. Thus, the objective of our study was to use the murine biocompatibility model to study the inflammatory response to Synvisc after various treatment protocols.

STUDY DESIGN: Air pouches were established subcutaneously in the dorsum of 50 BALB/c mice. Ten mice were randomly placed into each group, and the pouches were injected with: (PBS, negative control), 5 mg (positive control), 0.5 ml Synvisc (one injection/week for three weeks, harvested 14 days after last injection), and 1.5 ml Synvisc bolus (harvested either 14 or 28 days after last injection). At the time of sacrifice, sera and air pouch tissues were collected. Serum antibody titers to Synvisc were determined by enzyme-linked immunosorbent assay. Inflammatory gene expression of air pouch tissue was quantified by polymerase chain reaction. Inflammation was also evaluated by histological analysis of wall thickness and cellularity in several locations on the H&E-stained pouch.

RESULTS: Inflammation was observed with all Synvisc treatments, as pouch wall thickness and cellular density were increased, relative to PBS ($P < 0.01$). However, three injections of Synvisc resulted in significantly ($P < 0.05$) greater tumor necrosis factor-alpha gene expression compared to both PBS and bolus Synvisc harvested after 14 or 28 days. While all Synvisc treatments resulted in serum antibody titers to Synvisc ($P < 0.01$), mice that received three injections of Synvisc had higher titers than mice receiving a single injection ($P < 0.02$).

CONCLUSION: A single injection of Synvisc led to less inflammation when compared to multiple injections. This result supports the current change in treatment from multiple injections to a single injection of Synvisc.

97. Myofibroblast Numbers are Increased Early in a Rabbit Knee Contracture Model

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INTRODUCTION: Some studies have demonstrated increased myofibroblasts in established contractures. However, the timeline of myofibroblast proliferation in joint contractures is largely unknown. The aim of this study was to determine the relative number of myofibroblasts present in contracting joint capsules at different time points.

METHODS: Eighteen rabbits were divided into three groups of six: Group 1 underwent 2 weeks of immobilization, Group 2 underwent 8 weeks of immobilization, and Group 3 underwent 8 weeks of immobilization plus 16 weeks of remobilization. The right limb was operated on, while the left served as the control. Rabbits were sacrificed at each time point and myofibroblasts in the joint capsules were quantified using immunohistochemistry.

RESULTS: The percent of myofibroblasts was significantly elevated in the operated limbs compared to the control limbs at two weeks (20% versus 7%, respectively; $p = 0.014$). There was no difference in the percent of myofibroblasts between the operated and control limbs at 8 or 24 weeks ($p = 0.96$ and 0.19, respectively). The percent of myofibroblasts dropped from 20% at 2 weeks to 3.0% at 8 weeks ($p < 0.001$). The decrease from 8 to 24 weeks was not significant ($p = 0.19$).

CONCLUSIONS: There was a statistically greater percentage of myofibroblasts in the contracted limb at 2 weeks. Such significance was lost at 8 and 24 weeks. Furthermore, the percent of myofibroblasts in the operative limb peaked at 2 weeks and decreased over time. Such data indicates that the pathology in fibrosis occurs early. Pharmacologic interventions should take such into account.

98. Validating Patient-Specific Total Knee Arthroplasty

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INTRODUCTION: Patient-specific total knee arthroplasty (PS-TKA) is an innovative technology that utilizes preoperative imaging to create a customized guide for cutting block placement. Patient Specific Instrumentation Systems generate a custom “guide” based on preoperative magnetic resonance imaging (MRI) of the affected knee and ipsilateral hip and ankle. Variables such as limb and implant alignment and rotation, implant size, and amount of resection can be customized for each case. Very little clinical data exists regarding the accuracy of this technology. The purpose of this study was validate, intraoperatively, limb and implant alignment using CAS navigation and establish the accuracy of implant sizing, rotation, and amount of resection using intraoperative manual measurements.

METHODS: Fifteen primary TKAs were performed using patient specific guides to determine the placement of the femoral and tibial cutting blocks. A navigation system was used to record alignment measurements. All intraoperative cuts and recuts were recorded and the amount of bone resected was measured with a caliper and compared to the PS-TKA preoperative plan. Whiteside’s line was marked and comparisons were made with the PS-TKA based rotation profile.

RESULTS: The patients’ mechanical axes with the PSI cuts was within 1° of neutral in 13 of 15 cases. The average difference in posterior bone resected to the templated cuts was 1.01 mm on the posterior condyle medially and 1.02 mm on the posterior condyle laterally. The femoral component size was accurate in 14 of 15 cases. The tibial component size was accurate in 10 of 16 cases and within one size for the remaining cases. The anterior cut was flush in all cases except one, in which it was too anterior. No notching was noted. The rotation profile was in accordance with Whiteside’s line in 13 of 15 cases. Recuts were made on the distal femur in 9 of 15 cases. The tibia was recut in one case to correct the slope and in 10 of 15 cases to resect more bone.

DISCUSSION: PS-TKA offers surgeons the prospect of performing the arthroplasty accurately, reproducibly, and efficiently. The results of this study indicate that, when positioned correctly, the cutting guides produce accurate limb and implant alignment, correct implant size, and consistent implant positioning relative to bone landmarks. Correct femoral guide positioning was achieved consistently. Accurate tibial guide placement was more difficult to achieve. Malpositioning of guides can be associated with significant malalignment of implants.

99. Total Knee Arthroplasty in Morbidly Obese Patients Treated with Bariatric Surgery: A Comparative Study

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BACKGROUND: Obesity is one of the most serious public health problems and a leading cause of preventable deaths worldwide. It has been reported that excessive weight predisposes obese patients to develop accelerated DJD. For patients with morbid obesity as well as accompanying medical comorbidities, bariatric surgery has been used with excellent results. We report the results of 125 TKAs in patients who have also undergone bariatric, weight loss surgery. It is our hypothesis that patients undergoing weight loss surgery prior to TKA will have fewer perioperative complications when compared to undergoing TKA prior to weight loss surgery.

METHODS: In an attempt to identify the timing of when bariatric surgery and TKA is optimized in relation to each other, the authors divided the subjects into three groups. Group 1 had TKA prior to bariatric surgery; Group 2 $\leq$ 2 years after bariatric surgery; and Group 3 > 2 years after bariatric surgery. Total operative time, perioperative complications, need for transfusion, hospital length of stay, and rate of revision were retrieved and analyzed for statistical significance.

RESULTS: There were a total of 125 TKAs with follow-up ranging from 22 months to 14 years. Group 1 had 39 TKAs; group 2, 25 TKAs; and group 3, 61 TKAs. Total operative time for group 3 was significantly less than for group 1 ($p = < 0.001$) as well as group 2 ($p = 0.022$). Overall complication rate was 15.2% (19/125). Although there was a trend toward a higher complication rate seen in group 1, it did not meet statistical significance ($p = 0.08$). There were no transfusions required in group 1 compared to 3/25 in group 2 ($p = 0.06$) and 6/61 in group 3 ($p = 0.08$). Mean hospital stay was similar at 6.1, 5.7, and 6.0 days, respectively. Revision rate was 5.6% (7/125), with no significance attributed to groups.

CONCLUSIONS: TKA in the morbidly obese represents challenges to the surgeon as well as an increased risk for the patient. Findings suggest that although operative time is less and transfusion rates are lower, patients experience similar rates of perioperative complications regardless of the temporal relationship between weight loss surgery and TKA.

100. Repair of Medial Patellofemoral Ligament Improves Patellar Tracking in Total Knee Replacement

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INTRODUCTION: The medial patellofemoral ligament (MPFL) is recognized as an important static stabilizer of the patella that has not been addressed in total knee replacement (TKR). The purpose of this study was to determine whether patella stability is improved by repairing the MPFL prior to arthrotomy closure in TKR.

METHODS: A review of 46 TKRs in 40 patients was performed. TKR was performed through a median parapatellar approach without lateral release. The patella was resurfaced in all cases. Standard closure was performed in 29 procedures. In 17 procedures, the MPFL was isolated and anatomically reapproximated at 30° of flexion. Blinded radiographic evaluation was performed preoperatively and four months postoperatively.

RESULTS: The MPFL repair group demonstrated a mean correction in patellar tilt of 4.8° after surgery, compared to only 0.1° average improvement in the standard closure group ($p = 0.019$). Despite essentially equal preoperative mean subluxation in both groups (14.1 mm and 14.6 mm; $p = 0.93$), postoperative patellar subluxation corrected to a mean of 1.3 mm medially in the MPFL repair group compared to a mean residual 6.4 mm lateral subluxation in the standard group ($p = 0.008$).

CONCLUSION: Despite a trend for greater preoperative tilt, patients undergoing TKR with reconstitution of the MPFL prior to arthrotomy closure demonstrated a greater correction of tilt postoperatively as well as more optimal tracking centrally in the femoral trochlea. This simple step at arthrotomy closure appears to optimize patella tracking and may improve long-term outcomes through minimization of patellar complications and wear.

101. Single Radius versus Multi-Radius of Curvature Design in Total Knee Arthroplasty

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INTRODUCTION: Total knee arthroplasty (TKA) design continually evolves to better recreate the kinematics and geometry of a healthy joint. One relatively recent development has been a change from a multi-radius (MR) design to a single radius (SR) design, in which a fixed axis with a posterior center of flexion results in a longer extensor moment arm. Potential advantages of SR TKAs may include improved extensor mechanism function, improved stability in mid-flexion, and decreased pain. The purpose of this study was to test for differences between SR and MR TKAs in function, stability, and pain.

METHODS: A query of our operating room information system identified 796 primary TKA patients treated by two orthopedic surgeons, who had received either a MR knee (n = 186 Duracon; Stryker Orthopaedics, Mahwah NJ) or a SR knee system (n = 610 Triathlon; Stryker Orthopaedics, Mahwah NJ) between 2003 and 2008. Patients were contacted via telephone, and asked a series of questions using a modification of the Knee Society Score (KSS) instrument.

RESULTS: Of the 796 patients identified, 15 were deceased, 1 refused to participate, and 123 were lost to follow-up, leaving 657 patients (82.5%; SR = 525, MR = 132) with a minimum two year follow-up. The SR TKA design showed statistically significant improvements in pain ($p = 0.03$), stability ($p = 0.002$), stair climbing ($p = 0.002$), ability to walk ($p = 0.0007$), use of assistive devices ($p = 0.0006$), function ($p < 0.0001$), and overall KSS ($p = 0.0012$).

CONCLUSIONS: These data support the SR design, and provide evidence of improved mid-term patient outcomes in terms of function, stability, and pain relative to patients receiving the MR design.

102. Cruciate-Retaining Mobile-Bearing Total Knee Arthroplasty: Minimum Four-Year Follow-Up

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BACKGROUND: Most mobile bearing knee replacements require posterior cruciate ligament excision. We evaluated a cruciate-retaining mobile-bearing total knee arthroplasty (TKA) at a minimum of four years.

METHODS: 152 consecutive cruciate-retaining rotating platform TKAs were performed in 123 patients by a single surgeon and evaluated at a minimum four-year follow-up. Average patient age at surgery was 62 years. At a minimum of four years, 118 patients (146 knees) were living and evaluated clinically and radiographically at an average of five years from the primary procedure. One patient (one knee) was lost to follow-up, and one patient (one knee) declined to be part of the study. Clinical analysis consisted of the need for revision or reoperation, WOMAC scores, SF-36 scores, Knee Society scores, and UCLA Activity scores. Radiographic analysis consisted of component alignment, loosening, and osteolysis.

RESULTS: No femoral or tibial components have been revised. Two knees underwent liner exchange due to infection. Liner exchange is indicated for one knee because of instability and wear. Average motion was 118° (range: 75°-135°). Minimum four-year radiographs were obtained on 85% of patients. Incomplete radiolucencies in one or two zones were noted around 55% of knees at follow-up, but no component was considered loose. Evidence of osteolysis was demonstrated on 3% of the radiographs.

CONCLUSION: In a single-surgeon series, cruciate-retaining mobile-bearing TKA has good clinical and radiographic results at minimum four-year follow-up. In addition, range of motion was comparable to the reports of PS mobile bearing designs.

BREAKOUT SESSION #10
HIP PRESERVATION
April 8, 2011

103. Hip Pain Referral Patterns in Patients with Labral Tears: Analysis Based on Intra-Articular Injections, Hip Arthroscopy, and a New Pain "Circle" Diagram

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INTRODUCTION: Fluoroscopically guided intra-articular anesthetic (FGIA) injections have been used in hip arthroscopy patients to determine if the hip joint is the source of their "hip" pain. To our knowledge, there have been no studies that have used FGIA hip joint injections to determine the pain referral patterns (PRP) of patients with labral tears. The objective of this study was to define the PRPs of patients with labral tears and evaluate a new pain "circle" diagram (PCD) developed for this analysis.

METHODS: Fifty-two patients that were evaluated at our institution and had: (1) a preoperative FGIA anesthetic (ropivicaine) hip joint injection, (2) completed our pain "circle" diagram (PCD) and a visual analog pain scale pre- and post-injection, (3) had significant (≥ 80%) pain reduction 30 minutes after their FGIA injection in one or more "circle" areas, and (4) hip arthroscopy performed by the senior author that documented a labral tear and minimal (≤ grade II) articular cartilage changes, are the basis of this study. The PCD had line-drawings of the lower back, abdomen, pelvis, and proximal thighs, and circles that the patients put an "X" in to indicate pain in the following areas: anterior superior spine (A), greater trochanter (B), central groin (C), symphysis pubis (D), proximal inner thigh (E), anterior thigh (F), posterior iliac crest (G), sacro-iliac joint (H), sciatic notch (I), and ischial tuberosity (J).

RESULTS: Based on the percentage of patients with significant (≥ 80%) pain reduction after the FGIAs, the pain referral frequency by "circle" area was the: central groin (73%), greater trochanter (44%), anterior superior iliac spine (39%) and posterior iliac crest (37%), proximal inner thigh (33%), sciatic notch and sacroiliac joint (25%), ischial tuberosity (12%), and anterior thigh (8%).

CONCLUSIONS: The most common areas of referred pain associated with labral tears were the groin and the greater trochanter. The least common areas were two areas typically associated with osteoarthritis of the hip, the ischial tuberosity and the anterior thigh. The results of this study may help physicians reconcile the often unreasonable expectations of patients with labral tears who believe that hip arthroscopy will treat their multiple areas of "hip" pain.

104. Incidence of Bone Abnormalities in Patients with and without Acetabular Labral Tears

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(Presented by Douglas R. Arnold, M.D., Madison, WI)

INTRODUCTION: Prior studies have found that 79-85% of people with labral tears have bony abnormalities of the hip joint. However, there have been no studies that have compared the incidence of bony abnormalities in a matched group of patients without labral tears.

MATERIALS AND METHODS: Conventional radiographs of 50 patients who did not have acetabular labral tears (NLT patients) on magnetic resonance arthrograms performed at our institution were compared with those of a matched-group of 50 patients who had labral tears (LT patients) documented at hip arthroscopy by the senior author. The anteroposterior and lateral radiographs of these 100 patients were examined for abnormal findings defined as: Tonnis angle ≥ 15°, center-edge angle (CEA) < 15°, retroversion of the acetabulum, cross-over sign, neck-shaft angle < 120° or > 140°, a head-neck offset of < 7.2 mm, or an alpha angle > 55°.

RESULTS: Bony abnormalities were found in 73% of the NLT and 78% of the LT patients ($p > 0.05$). The incidence of each abnormality in the NLT and LT patients was: Tonnis angle 6.7% versus 6.0%, CEA 3% versus 8%, retroversion 12% versus 14.6%, cross-over sign 13% versus 14%, neck-shaft angle 10% versus 18%, head-neck offset 7% versus 42%, and alpha angle 13.4% versus 34%, respectively. The only significant differences between the groups ($p < 0.05$) were the higher incidence of abnormal anterior head-neck offsets (7% versus 42%) and alpha angles (13.4 versus 34%) in the LT patients.

CONCLUSIONS: Although the overall incidence of bony abnormalities in patients with labral tears was similar to patients without tears (73% versus 78%), patients with labral tears had a significantly higher incidence of abnormal anterior head-neck offsets and alpha angles. These findings support the concept that femoroacetabular impingement predisposes patients to labral tears.

105. Do Alpha Angles on Plain Radiographs Correlate with Three-Dimensional Imaging?

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INTRODUCTION: Identification and localization of femoral head-neck offset deformities is critical in diagnosing and treating femoroacetabular impingement (FAI), yet the optimal radiographic and three-dimensional imaging modalities remains controversial. The purpose of this study was to compare plain radiographic views with CT scans for detection and quantification of femoral head-neck deformities.

METHODS: We reviewed 41 consecutive surgical patients with a complete radiographic series (AP pelvis, 45° Dunn, frog lateral, and cross-table lateral) and a CT scan. Twenty-eight were female, 13 male, and the average age was 31.7 years. Diagnoses included cam FAI (56.1%), combined cam-pincer FAI (36.6%), DDH (4.9%), and normal structural anatomy (2.4%). Radial CT reformations were constructed at 12, 1, 2, and 3 o'clock positions spanning the superior to anterior neck. We investigated the correlation between alpha angles on plain radiographs and the predicted CT cut (AP/12 or 1, Dunn/1 or 2, Frog/3, cross table/3).

RESULTS: Maximum alpha angles were most commonly located at 1 o'clock (36.6%) and 2 o'clock (34.1%) on CT, and on the Dunn view (61.0%) for radiographs. The maximum alpha angle on plain radiographs was greater than that of CT reformats in 61.0% of cases. The location of maximal deformity on CT and radiographs correlated in 68.3% of hips. Maximum alpha angles on CT and radiographs were within 10° in 82.9%. ICCs showed substantial agreement (0.64-0.75) between alpha angles on radiographs and corresponding CT cuts for all comparisons. The Dunn view was most sensitive (71.4-80.0%) to the detection of deformity.

CONCLUSIONS: Plain radiographs detect deformity seen on CT scan, and in some cases may overestimate the alpha angle. The combination of an AP pelvis, 45° Dunn, and frog lateral has excellent sensitivity in detecting head-neck malformations. Alpha angles on plain radiographs showed substantial agreement with those from CT reformats.

106. Evaluation of the Acetabular Labrum in Impingement Free Range of Motion and Dislocation Using a Novel Cadaveric Robotics Model

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The mechanism of acetabular labral pathology and its subsequent influence on biomechanics of the hip has become an area of intense speculation. Previous biomechanical evaluation of the labrum has focused on the acetabular labral seal, which is thought to enhance joint stability. No study has directly evaluated and quantified the acetabular labrum and its role in hip stability under representative in vivo conditions. We developed a cadaveric robotics model that functions under load-control parameters to recreate in vivo hip mechanics. This study identifies the impingent-free ROM and direction of force vectors required for dislocation in the native hip with and without the labrum. Five cadaveric hip specimens consisting of a hemipelvis and femur were rigidly secured to a custom testing apparatus and mounted onto a robotic manipulator (Rotopod R2000) that is capable of manipulating in 6° of freedom (6 DOF). A 6 DOF force-torque sensor (SI-2500-400, ATI Industrial Automation) was used to evaluate force vectors required for dislocation in two provocative positions. Impingement was detected as a sudden increase in the reaction moment with respect to the center of the hip. At this point of impingement, 3D force vectors were applied medially and swept laterally at increasing angles (magnitude held constant) until dislocation. A statistical analysis utilizing ANOVA was completed with significance set at a p-value of < 0.05 and paired t-test for magnitude. Each specimen was evaluated both with and without its labrum and was tested in two positions. Position 1 data demonstrated a significance of 7° between the means of the native hip and absent labrum ($p < 0.0015$). On average, excision of the labrum reduced the stability envelope by 8% to 9% in each position. Using the first known application of a 6 DOF Robot, we have developed a reproducible, dynamic, quantifiable testing system for impingement. Based on our results, the labrum contributes to hip stability significantly. Moreover, removing the labrum decreased the stability envelope by 8% and 9% in positions 1 and 2, respectively. This suggests there may be potential benefit to repairing rather than debriding labral pathology.

107. Markerless Tracking of Hip Motion and Femoroacetabular Impingement

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Femoroacetabular impingement due to CAM and pincer morphology has been described as contact between the anterior femoral head/neck junction and superolateral acetabulum. Methods for studying the hip joint kinematics and impingement included computer models and static imaging. Radiostereometric analysis (RSA) is considered the gold standard for motion analysis but involves an invasive surgical procedure to implant the tantalum beads used to track motions. The aim of this study was to assess the accuracy of a new model-based tracking technique for measuring three-dimensional (3D), in vivo, hip kinematics, and to demonstrate the application of this technique to assess clinical femoroacetabular impingement. We have developed a model-based tracking technique for measuring in vivo joint motion from biplane x-ray images that tracks the position and orientation of bones based on their 3D shape and texture. To assess the accuracy of this technique, we implanted tantalum beads bilaterally into the femur and pelvis of a cadaver and then recorded biplane x-ray images of the hip joint while manually moving the limb in prescribed, clinically relevant exam motions. Technique accuracy was assessed in terms of the bias, precision, and RMS error between the two techniques. A computer model simulating Pincer and CAM impingement were created and studied in terms of contact pattern and percentage change in range of motion. Accuracy assessment results include translational bias of 1.32 ± 0.53 mm and a rotational bias of 3.09° ± 1.57°. The translational and rotational precision was 0.74 mm and 1.31°, respectively. The dynamic RMS error was 1.46 mm and 3.54° for translation and rotation, respectively. Contact areas of interest during CAM impingement include the anterosuperior femoral neck in abduction and internal rotation. The superior femoral head-neck junction was implicated in impingement during abduction. Validating the model based tracking system may provide valuable insight into the pathomechanics of FAI while improving diagnosis and management of this condition.

108. Increased Alpha Angle in Young Hip Arthroplasty Patients

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Femoroacetabular impingement represents a cause of progressive degenerative change that may lead to osteoarthritis in younger patients. The identification of predisposing pathoanatomy could potentially aid in the overall treatment paradigm. The purpose of this study is to evaluate the presence of aberrant anatomy in young patients undergoing total hip arthroplasty.

A single surgeon's database was queried for patients that underwent total hip arthroplasty. From this population, 50 patients above and below 50 years of age were randomly selected. Initial screening was completed in order to ensure that there were no differences in pre-operative Tönnis score. Two independent observers then reviewed 25 preoperative radiographs from each group. Measuresments taken include: the α angle, the neck-shaft angle, the Tönnis angle, the centre-edge angle of Wiberg, and the anatomical medial proximal femoral angle. The radiographs were also assessed for the presence of localized over-coverage, cross-over sign, and posterior wall anatomy.

Statistical analysis revealed no significant differences between all measured variables with the exception of the alpha angle as measured on the anteroposterior radiograph. For the group over 50 years of age, the alpha angle was $57° \pm 14$, whereas for the group under 50 years of age it was $80° \pm 22$. This did reach statistical significance of $p < 0.002$.

The natural history of impingement and associated pathology is poorly understood. A variety of theories have been proposed, but with limited scientific evidence. The current study states that in our arthroplasty population, patients under the age of 50 have significantly larger alpha angles. This suggests that these patients may have an anatomic cause for their early osteoarticular degeneration.

109. Combined PAO and Surgical Dislocation for Correction of Perthes-Like Hip Deformities

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BACKGROUND: “Perthes-like” hip deformities can encompass a combination of structural abnormalities including acetabular dysplasia, a large aspheric femoral head, short femoral neck, and high greater trochanter. In complex cases, the hip is compromised by concurrent structural instability (acetabular dysplasia) and femoroacetabular impingement (proximal femoral deformities). The purpose of this study was to investigate the radiographic correction and early clinical outcomes achieved with a combined periacetabular osteotomy (PAO) and surgical hip dislocation for the treatment of severe Perthes-like hip disorders.

METHODS: Fourteen consecutive patients (14 hips) with severe Perthes-like hip deformities treated with a combined PAO and surgical hip dislocation were analyzed retrospectively. Radiographic correction was evaluated with established methods and clinical outcomes/hip function measured with the Harris hip score (HHS). All hips had a PAO, femoral head-neck osteochondroplasty and trochanteric advancement, 8 had relative neck lengthening, and 11 had labral resection/repair and/or chondroplasty. Five hips had previous surgery.

RESULTS: Radiographic correction was profound with average improvements of Tönnis angle 12.2°, LCEA 24.2, ACEA 24.8, and acetabular inclination, 12.2°. The trochanter was transferred distally an average 12 mm. HHS increased from 58 preoperative to 87 at a mean 14 months of follow-up indicating an average of 29 points of improvement. Complications included one deep infection.

CONCLUSION: Combined PAO and surgical dislocation provides major deformity correction in severe, Perthes-like hip deformities. Early clinical results are encouraging and the complication rate is acceptable. Longer-term follow-up is needed to determine the efficacy of this surgical strategy.

110. The Reliability of Computer-Assisted Analysis of Pelvic Radiographs

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INTRODUCTION: Precise characterization of acetabular and pelvic morphology is fundamental to the diagnosis and treatment of pre-arthritic hip disorders. With the increased recognition of femoroacetabular impingement, radiographic analysis of the pre-arthritic hip has become more complex and time-consuming. We developed a novel computer software system for pelvic radiograph interpretation, attempting to improve the reliability of radiographic interpretation. The purpose of this study was to determine the reliability of hip surgeons in determining radiographic indicators of acetabular and pelvic morphology with this novel computer-assisted protocol.

METHODS: AP pelvic radiographs from 70 consecutive patients undergoing hip preservation surgery were analyzed by four experienced surgeons with a novel computer-assisted software. A comprehensive group of parameters of acetabular and pelvic morphology were investigated. Intraobserver and interobserver reliability was calculated using kappa statistics and intraclass correlation coefficients.

RESULTS: Parameters for pincer FAI demonstrated moderate-substantial interobserver reliability (Kappa 0.44-0.75), and substantial-excellent intraobserver reliability (Kappa 0.71-0.84). Parameters for acetabular dysplasia all had excellent interobserver (ICC 0.80-0.88) and intraobserver reliability (ICC 0.94-0.95). Among markers of pelvic tilt, the inferior sacroiliac points resulted in significantly higher interobserver reliability (ICC 0.98) than the sacrococcygeal joint and coccyx (both 0.80).

CONCLUSIONS: Computer-assisted analysis of radiographic parameters of acetabular and pelvic morphology may improve the reliability of radiographic measurements, compared to manual measurements.

111. Arthroscopic Management of Intra-Articular Hip Pathology: A Prospective Cohort Study

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BACKGROUND: Recent advances in diagnostic imaging and clinical evaluation tools have expanded our understanding of intra-articular hip pain and pathologies. Nonoperative and open treatment strategies have known limitations. As an alternative, hip arthroscopy has emerged as a useful tool for evaluating and treating intra-articular hip pathology.

PURPOSE: To report the initial results of hip arthroscopy in a prospective cohort.

METHODS: All patients undergoing hip arthroscopy at our institution have been prospectively assessed with the visual analogue pain scale, Harris Hip score, and SF-12 quality of life assessment preoperatively and, then, postoperatively at 6 weeks, 3 months, 6 months, and 12 months. A database was created to record variables including: age, sex, diagnosis, and surgical procedures performed. Trends regarding patient demographics and subjective outcomes were determined.

RESULTS: Between February 2008 and February 2010, 55 patients (58 hips) underwent hip arthroscopy at an academic medical center by one surgeon. Follow-up data was available for 37 patients. The predominant diagnosis was FAI with associated labral pathology. Other diagnoses included psoas tendonitis, internal snapping hip, and ligamentum teres tears. Procedures performed included labral debridement (17/37), labral repair with acetabular rim trimming (19/37), femoral neck osteoplasty (36/37), psoas tenotomy (9/37), and ligamentum teres debridement (8/37). Average visual analogue pain scores improved from 8.1 preoperative, to 2.1 and 2.5 at six weeks and six months postoperative, respectively. Average Harris Hip scores improved from 58 preoperative to 81 and 82 at six weeks and six months postoperative, respectively. Harris hip data demonstrated superior functional outcomes for labral repair (75) versus debridement (62) at final follow-up. Subjectively, SF-12 data improved at each follow-up visit.

CONCLUSIONS: Hip arthroscopy for the treatment of intra-articular hip pathology, particularly FAI, can produce substantial clinical improvements. Superior functional outcomes have been observed in those who undergo labral repair versus debridement.

MAOA THIRD PLENARY SESSION
April 9, 2011

112. What is the Value of Metal-on-Metal THA: Analysis of Survival in a Community Registry

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INTRODUCTION: Metal-on-metal (MOM) total hip arthroplasty (THA) has been performed in increasing numbers in the U.S., but it is unclear that this more costly implant adds value in terms of function or longevity. The purpose of this study was to evaluate survival of MOM THA compared to metal-on-cross-linked polyethylene (MOXP) THA in a community joint registry.

METHODS: All MOM THAs (resurfacings excluded) performed between January 2002 and December 2009 were included (n = 1066) and compared to a control group of MOXP THAs (n = 984) done in the same time frame. Analysis was performed to compare age, gender, cost of implant, length of stay, year of index procedure, diagnosis, head size (< 32 mm versus ≥ 32 mm), revision, and revision reason for both groups. Analysis was done using Wilcoxon rank sum tests, Pearson's chi-square tests, Kaplan Meier methods, and Cox regression.

RESULTS: MOM THA was performed on average in a younger age group (m 62.2 years) than MOXP THA (m 68.2; $p < .001$) and had a shorter length of stay (3.3 versus 3.7d; $p < .001$). MOM THA was on average approximately $700 more expensive than MOXP THA ($p < .001$). There was no difference in gender or diagnosis between the two groups. Although there was no difference in the cumulative revision rate between the groups (MOM CRR = 4.1%; MOXP CRR = 3.1%; $p = 0.06$), a higher percentage (15/24, 63%) of MOXP THAs than MOM THAs (6/32; 19%) were revised for dislocation ($p < .001$). However, after adjusting for age, head size, and year of index procedure, MOM implants were found to be 2.18 times as likely to be revised compared to MOXP ($p = .05$).

CONCLUSIONS: In this time frame, MOM THA demonstrated inferior survival to MOXP THA after adjusting for age, head size, and year of procedure. The present capability to use larger head sizes (≥ 32 mm) with MOXP THA may offset the perceived advantage of MOM THA in that area, while limiting revisions for other reasons. Longer follow-up is necessary to demonstrate whether MOM THA adds value in younger patient groups.

113. Serum Cobalt and Chromium Levels in Patients with a Metal-on-Metal Resurfacing Hip Prosthesis: Minimum Five-Year Analysis—An Update

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INTRODUCTION: Metal-on-metal (MOM) bearing surfaces release metal ions locally and systemically. Concerns about long-term elevation and its potential side effects exist.

METHODS: Whole blood samples were collected on patients a minimum of five years post MOM hip resurfacing arthroplasty. Trace metal analysis of whole blood Co and Cr levels using high-resolution inductively coupled plasma mass spectrometry were collected and analyzed according to a standardized protocol. These were analyzed in relation to component position as determined by radiographs.

RESULTS: 173 patients (192 hips) have been studied. There were 123 males and 50 females, mean age 54 years (range: 26-76) with an average weight of 191 lbs. Femoral head sizes implanted ranged from 40-56 mm. For unilateral subjects (n = 154), mean whole blood Co concentrations were 2.16 microg/L (range, 0.3-14.8) and mean Cr concentrations were 2.07 microg/L (0.51-9.16). When analyzed by femoral head size, Co and Cr concentrations were significantly different ($p = 0.0025$ and $p < 0.0001$ respectively) with mean concentrations higher for smaller head sizes. Co and Cr concentrations in bilateral subjects were significantly higher when compared to unilateral subjects ($p = 0.0002$ and $p < 0.0001$ respectively). We could not identify a relationship between ion concentration and component position in this study population.

CONCLUSIONS: Studies of patients without metal implants (control) suggest whole blood Co and Cr concentrations will be less than 0.5 microg/L. Our findings document elevations above control concentrations at minimum five years following resurfacing arthroplasty. Elevated ion levels will prove a useful measure to identify and follow patients at greater risk for failure following MOM resurfacing arthroplasty.

114. Metal-on-Metal Revisions: A Review of Causes and a High Incidence of Early Failure

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INTRODUCTION: Metal-on-metal (MOM) total hip arthroplasty (THA) has become an increasingly popular option for contemporary alternative bearing surfaces. However, early failures due to aseptic loosening, metal hypersensitivity reactions, pseudotumor formation, and component seizing are being realized. The purpose of this study is to investigate the timing, common modes of failure, and incidence of MOM THA revisions.

METHODS: A retrospective review of 77 consecutive patients who underwent revision of a failed MOM THA for any reason was performed. The average age of the patients was 57.61 ± 10.8 years (range 31-84 years), with 40 being male and 37 being female. Clinical and radiographic data points were gathered to include: causes of failure, patient factors, time to revision, and original implants used.

RESULTS: The most common reason for metal-on-metal failure was acetabular loosening with a rate of 57.1% (44/77 patients). Other reasons in descending order were infection (13.0%), metal hypersensitivity (6.5%), failed resurfacing (6.5%), fracture (5.2%), loose stem (3.9%), dislodged liner (3.9%), seizing (1.3%), cup malposition (1.3%), and femoral stem fracture (1.3%). Early failure of MOM THAs was noted, with 62.9% of these revisions being performed within two years of the index operation and 81.5% within three years. Further, 90.9% (70/77) of these revisions had been performed over the short time-span of two years. Two pseudotumors were observed among these patients with an additional 25% of the patients experiencing significant soft tissue metallosis.

CONCLUSIONS: Our study demonstrates a relatively high incidence of MOM THA revisions at early follow-up. Component loosening is a common mode of failure. Phenomena relatively unique to MOM bearing such as pseudotumor, metal sensitivity, and metallosis are being observed in a significant percentage of MOM failures. It is imperative for the surgeon to be cognizant of the fact that the proposed advantages of MOM THA are not without their potential detrimental sequelae.

115. Social Networking Profiles of Orthopedic Surgery Applicants: Are There Concerns for Professionalism?

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INTRODUCTION: To examine the public Facebook accounts of residency applicants for breaches of professionalism.

METHODS: Facebook profiles of all 2010 orthopedic surgery residency applicants to our institution were reviewed, as well as the Facebook pages of current residents, faculty, program directors, and chairs. Four observers gave a professionalism score (3 - no issues, 2 - questionable content, 1 - clear professionalism violation) based upon the ACGME guidelines of professionalism. An unprofessional profile was defined as a combined score of 10 or lower. Age, gender, marital status, USMLE, and a program derived applicant score were analyzed. Odds ratios and 95% confidence interval were analyzed.

RESULTS: 46.4% (200/431) applicants, 53.3% (16/30) residents, 4.5% (1/22) faculty, and 8.6% (20/232) chairs and residency directors had visible public Facebook pages. Professionalism violation scores of 10 or less were identified in 14% (24/171) of applicants, 16.6% (2/16) of current residents, and 0% of faculty, chairs, and residency directors. Interobserver reliability for professionalism scores was moderate overall (Kappa = 0.43) and strongest for a score of 1 (Kappa = 0.57). Unprofessional scores were more common in males, singles, individuals with increased number of Facebook profile pages, and applicants who did not match into orthopedic surgery. No relationship was seen with USMLE score ($p = 0.64$) and program composite scores ($p = 0.13$).

CONCLUSIONS: A notable difference in social networking and professionalism concerns exists between orthopedic surgery residency applicants and residents compared to teaching staff. Residency programs are encouraged to review residency applicant's social networking profiles as part of their selection process.

116. Design, Implementation, and Evaluation of Methods for Collecting Implant Registry Data

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INTRODUCTION: Regardless of the well-documented benefits of a National Arthroplasty Registry, practical issues surrounding its establishment in the United States remain. The purpose of this study was to test and compare completion rate and accuracy for three methods of collecting joint registry data at a large tertiary care academic center (AC) and a community hospital (CH) within a single healthcare system.

METHODS: Data were simultaneously collected at the AC and CH on patients for which total hip or total knee devices were implanted and/or removed. Three methods were examined separately, dividing the study into three phases. Phase I utilized scannable paper forms which were read by an optical mark reader. Phase II used an intranet-based interface, which relied on keypunching and scroll-down menus. Phase III used the same Internet interface, but included the use of a barcode scanner. Completeness was evaluated by comparing data collected with information from the operating room information system. Accuracy was assessed by comparing the data collected with the information in the patients' medical records.

RESULTS: Completion rate was 45% overall, and was poorer for the AC compared to the CH (35% versus 60%). Accuracy was 62% overall, was significantly higher for Phase III (68%, barcode scanner method) compared with the other methods, and was lower for the AC (50%) than the CH (73%).

CONCLUSIONS: Even with uncomplicated reporting systems, the completeness and accuracy of the data collected was very poor. This study emphasizes the need for strict oversight and/or a process that is tied into billing to ensure its use and reliability.

MAOA BREAKOUT SESSION #11
SHOULDER/ELBOW
April 9, 2011

117. The Use of 3D Surgical Simulation Software to Assess Glenoid Bone Loss and Retroversion as Critical Factors in Preoperative Planning for Total Shoulder Arthroplasty

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BACKGROUND: There is no evidence-based consensus regarding the magnitude of glenoid bone loss (GBL) that can be surgically corrected and still accommodate an anchor peg glenoid component implanted within the range of physiologic version. We hypothesized glenoid size, degree of GBL, and glenoid retroversion are parameters that can accurately predict peg perforation when asymmetric reaming is used to correct version and posterior GBL.

METHODS: We utilized 3-dimensional CT simulation software to evaluate 24 patients with varying degrees of glenohumeral osteoarthritis. We simulated glenoid resurfacing using an anchor peg glenoid and correcting version with asymmetric reaming. We quantified pre-morbid glenoid vault dimensions, magnitude of preoperative retroversion and GBL and compared these parameters to peg perforation for each simulation.

RESULTS: Ten patients could not be implanted without peg penetration at neutral version. Their average preoperative retroversion was 21.0° ± 7.3° compared to 14.5° ± 6.8° ($p < 0.02$) for the 14 patients who could successfully accommodate the implant at neutral version. There was a significant difference in average amount of posterior bone loss for the peg perforation group (3.69 mm ± 2.8) compared to the successful implantation group (1.70 mm ± 1.7) ($p < 0.04$). Correcting to 6° of retroversion or the patient's native version, yielded 7 implant failures with an average preoperative retroversion of 22.7° ± 3.2° (range 18.4°-27.7°) compared to 15.0° ± 7.6° (range 2.8-26.2) which was statistically significant ($p < 0.001$).

CONCLUSIONS: 3D surgical simulation software demonstrated that both increased glenoid retroversion and posterior glenoid bone loss are critical components in determining successful glenoid component implantation. It is, however, to understand the amount of correction needed for optimal component placement which may not be standardized for all patients.

118. Heat Generated with Pegged or Keeled Glenoid Components Fixed with Defined Amounts of Cement

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The most common complication of total shoulder arthroplasty is failure of the glenoid component. Radiolucent lines around the glenoid component are frequently seen immediately postoperatively. Generation of heat during the exothermic reaction of cement curing has been suggested as a possible cause of these lines. The purpose of this study was to measure the heat generated with a defined amount of cement used for fixation of either a keeled or pegged glenoid component and then analyze the fixation using computed tomography.

Ten fresh-frozen cadaver scapulas were randomized to receive either a keeled or pegged component with 1, 2, 3, 5, or 7 grams of cement used for fixation. The components were placed using standard techniques while maintaining the scapulas at a steady state temperature. A FLIR Thermovision A20M infrared camera was used to record the surface temperature generated during the cement curing process to an accuracy of +/- 2.0°C. After the cementing process was complete, CT scans were obtained to analyze the percent of the pegs or keel surrounded by cement and the cement mantle thickness.

The maximum temperatures recorded were: 32.6˚C for 1g keeled and 29.0˚C for 1g pegged; 38.1˚C for 2g keeled and 33.4˚C for 2g pegged; 34.2˚C for 3g keeled and 31.0˚C for 3g pegged; 38.9˚C for 5g keeled and 44.8˚C for 5g pegged; and 48.3˚C for 7g keeled and 37.6˚C for 7g pegged. The three specimens without a complete mantle were those utilizing a smaller quantity of cement (1, 2, or 3 g), and the largest cement mantle thicknesses were observed with the 7g specimens.

None of the temperatures recorded for either the keeled or pegged components reached published thresholds for thermal necrosis of bone. There was a trend towards higher temperatures with increasing amounts of cement. Based on our results, up to 7g of cement can be used without significant concern of thermal necrosis to glenoid bone. However, smaller amounts of cement can be used without compromising fixation.

119. Assessment of Scapular Morphology as a Predictor of Notching in Reverse Shoulder Replacement

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BACKGROUND: Reverse shoulder arthroplasty provides a treatment option that relieves pain and restores function in patients with cuff tear arthropathy. The most frequent reported radiographic complication is inferior scapular notching. The purpose of our study was to evaluate the effect of glenoid and scapular morphology on the occurrence of scapular notching.

METHODS: Twenty-four patients with rotator cuff arthropathy were treated with a reverse shoulder arthroplasty and were followed clinically and radiographically for a minimum of 24 months. Radiographic assessment of cranial-caudal glenoid component positioning, scapular neck angle, screw trajectory, and scapular notching were reviewed.

RESULTS: Twenty-one patients developed scapular notching, 21 had inferior scapular notching, 11 had posterior scapular notching, and 2 had anterior scapular notching. Of the 21 patients with inferior scapular notching, 10 patients had minimal notching (Grade 1 or Grade 1 Nerot), and 13 patients had moderate notching (Grade 2 or Grade 3 Nerot). The scapular neck angle in patients with minimal notching (103° ± 11°) was significantly less ($p = 0.039$) compared to patients with moderate notching (113° ± 9°). The cranial-caudal base plate position did not significantly correlate with inferior notching (21.1 ± 2.7 mm versus 23.6 ± 4.1 mm). The prosthetic scapular neck angle was significantly less ($p = 0.011$) in patients with minimal notching (116° ± 7°) compared to patients with moderate notching (130° ± 13°).

CONCLUSIONS: Previous described anatomic and radiographic parameters consistently predicted the occurrence of scapular notching in our series. With better understanding of scapular morphology and predictive measurement tools, scapular notching can be more accurately prevented.

120. Early Subjective and Objective Outcomes of Patients Undergoing Reverse Bilateral Total Shoulder Arthroplasty

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Controversy exists regarding use of bilateral reverse total shoulder arthroplasty (BRTSA). While significant pain relief has been well documented, concern exists over the possible loss of active external rotation postoperatively. We hypothesized that subjective and functional scores following BRTSA are significantly improved and are comparable to a unilateral RTSA case control group.

Since 2003, 21 patients underwent BRTSA by a single surgeon. Average follow-up was 33.4 months (range 12-58 months), and average age at operation was 70 years (range 58-82). We selected 1:2 case control groups matched by age, preoperative diagnosis, gender, follow-up length, and prosthesis.

BRTSA patients had significant improvement in visual analog pain scale, shoulder subjective value, forward elevation, and American Shoulder and Elbow Surgeon scores. Average change in active external rotation (aER) was loss of 3°. Three patients lost aER in both shoulders. All other patients had no clinical change or showed increase in aER in one or both shoulders postoperatively. Our case control study showed BRTSA patients had a significant improvement in external rotation strength and postoperative pain compared to the unilateral RTSA group. Patients expressed satisfaction in 85% of shoulders. Eighty percent of patients stated they would have BRTSA again.

To our knowledge, this is the first reported series of BRTSA. Despite mild loss of aER, patient satisfaction, pain scores, and function significantly improved. We feel BRTSA is an option for patients with severe bilateral shoulder disease. Surgical candidates should be counseled pre-operatively on possible loss of active external rotation after surgery. Further studies are needed to determine whether long-term satisfaction and function persist.

121. Comparison of Suture Patterns in Labral Repairs of the Glenohumeral Joint

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INTRODUCTION: The purpose of this study was to examine the effect of different suture patterns on the biomechanical properties of the glenohumeral joint during abduction and external rotation.

METHODS: Ten fresh, frozen cadaveric specimens were randomly assigned to one of three groups: simple suture pattern, vertical mattress, or horizontal mattress. After creating a simulated labral tear, the designated repair was performed using three 4.5 titanium anchors placed at the 3, 4, and 5 o'clock positions of the glenoid. Specimens were mounted into a custom fixture at 90˚ external rotation and 90˚ glenohumeral abduction with respect to the plane of the scapula. A 20 N preload was applied, and the specimens were loaded until failure using a servohydraulic testing machine at a rate of 25 mm/min. Peak load, displacement, and method of failure were recorded and stiffness was calculated for each specimen. Data were compared using a student's paired-t test.

RESULTS: There was no statistically significant difference in peak load, stiffness, or displacement between any of the repair types. Average peak load was 461 N for the simple suture pattern, 656 N for the vertical mattress, and 531 N for the horizontal mattress.

DISCUSSION: The repair stiffness may be clinically similar though other factors may make one technique more suitable to clinical use. The data from the current study indicates that additional clinical evidence should be considered when determining which suture pattern should be used.

122. Biomechanical Testing of Implants for Segmental Defects of the Humeral Diaphysis: OsteoBridge® versus Intramedullary Nails

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INTRODUCTION: Segmental diaphyseal defects of the humerus can be seen in patients with disseminated malignancies. Previous studies have shown that intercalary spacers may be biomechanically superior to an interlocked intramedullary (IM) nail supplemented with methylmethacrylate. The newest intercalary spacer available is the OsteoBridge® IDSF. This study directly compares the biomechanical properties of the OsteoBridge® IDSF with those of a locked IM nail combined with methylmethacrylate for fixation of segmental diaphyseal defects of the humerus.

MATERIALS AND METHODS: Ten matched pairs of fresh frozen humeri were randomly divided into two groups of specimens: Group 1, OsteoBridge® IDSF implant; Group 2, IM nail with methylmethacrylate. A 4 cm mid-diaphyseal defect was created. Each specimen was tested in torsion, compression, tension, and four-point bend on a materials testing machine. These tests were used to determine the stability of fixation for each individual implant. The zone of laxity was chosen as the most appropriate measure of the overall fixation stability. Wilcoxon Signed-Rank Test was used to compare the mean and median values of the zone of laxity. Statistical significance was set at $p = 0.05$.

RESULTS: The OsteoBridge® was found to be significantly ($p < 0.05$) more stable in all modes of testing under the low loads applied except in tension ($p = 0.65$) and compression ($p = 0.09$). The IM nail specimens were found to have failed at the bone-cement interface.

CONCLUSION: We conclude that for segmental diaphyseal defects of the humerus, reconstruction with the OsteoBridge® IDSF provides greater overall stability and stiffness than an interlocked intramedullary nail supplemented with methylmethacrylate.

123. Arthroscopic Knotless Rotator Cuff Repair and Accelerated Rehabilitation Outcomes

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INTRODUCTION: Variable loss of rotator cuff integrity, whether insidious or traumatic, has been effectively managed via arthroscopic repair with a recent movement to maximize “biology”. Yet, our incomplete understanding of this biologic process has resulted in increasing implant use and extended rehabilitation protection, resulting in greater cost and acceptance of stiffer shoulders. This study explores the outcomes of a single row of fixation via a knotless arthroscopic system with an accelerated rehabilitation program.

METHODS: One hundred thirty (130) consecutive patients undergoing arthroscopic rotator cuff repair of 2 centimeters or greater with a subacromial decompression and acromioplasty, by a single surgeon, using a knotless single row system, and an accelerated rehabilitation program were studied with an average follow-up of greater than two years. Preoperative motion and “functional deficit” as defined by pain and/or resisted abduction “drop arm” sign/weakness were documented. Insidious versus traumatic etiology and tear size were also noted. All patients were scheduled for postoperative rehabilitation within the first week. Immediate passive motion progressing to full motion was followed by progressive active and muscle strengthening. All patients progressed to tolerance without regard to time constraints. Discharge was defined as full, pain-free, symmetric, passive range of motion together with symmetric strength with manual muscle testing, as compared to preoperative “function” in all planes. Patients were allowed to return to activity on a gradual basis to tolerance.

RESULTS: Of the 130 patients studied, the average age was 59 years (range 41-81), with 63% males, and an etiology of 75% traumatic (45% massive). Postoperatively, 98% were pain-free with revision surgery performed in 5% with an average time to discharge at 11 weeks.

CONCLUSION: A knotless, single row, arthroscopic system employing an accelerated rehabilitation program can result in a pain-free resumption to pre-morbid “function”.

124. Medial Elbow Exposure: FCU-Split versus Over-the-Top

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INTRODUCTION: The optimal interval for exposure of the medial elbow is unknown. The purpose of this study was to quantitatively compare the osseous and ligamentous exposure of the anteromedial coronoid and proximal ulna utilizing the flexor-carpi-ulnaris (FCU)-Splitting and Hotchkiss Over-the-Top approaches.

METHODS: Forty surgical approaches were performed on 20 fresh-frozen cadaveric elbows using a randomized crossover design. After each approach, a calibrated digital image was taken from the surgeon's perspective. Access to key anatomic landmarks (anteromedial facet, coronoid tip, sublime tubercle/anterior bundle of the medial collateral ligament [MCL], posterior bundle of the MCL, and radial head) was assessed. At the conclusion of data collection for the first 20 approaches, the alternate approach was performed and data collected. Digital images were analyzed using a software program, ImageJ (NIH, Bethesda, MD), to calculate the surface area of coronoid and proximal ulna exposed.

RESULTS: The average surface area exposed was three times greater with the FCU-Splitting approach (13.3cm^2) compared to the Hotchkiss Over-the-Top approach (4.4 cm^2) ($p < 0.0001$). All key anatomic landmarks were directly visualized with the FCU-Splitting approach in each specimen. Visualization of the sublime tubercle/anterior bundle of the MCL and posterior bundle of the MCL was unobtainable with the Hotchkiss approach in 17 (85%) and 20 (100%) specimens, respectively. There were no statistically significant correlations between exposure and sequence of dissection, specimen age, gender, or laterality.

CONCLUSIONS: The FCU-Splitting approach provides more extensive exposure of the anteromedial coronoid and proximal ulna as well as the medial ligamentous structures than the Hotchkiss Over-the-Top approach. Other advantages may include ease of dissection using the natural split between the two muscle heads, maintaining the native origin of the flexor-pronator mass, and avoidance of the anterior neurovascular structures.

125. Olecranon Plating – How to Minimize Symptomatic Hardware

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INTRODUCTION: Plate fixation of olecranon fractures offers superior biomechanical fixation compared to tension band constructs. Recently, several pre-contoured low profile implant systems have gained popularity for fixation of olecranon fractures. However, plating may have reoperation rates as high as 30% for symptomatic hardware removal. We hypothesize that a modification of the surgical technique potentially minimizes the incidence of symptomatic hardware.

METHODS: A retrospective evaluation of 38 patients underwent ORIF of an olecranon fracture by a single surgeon. The incision is lateral to the subcutaneous border of the ulna. The plate is placed submuscularly after undermining the skin to the subcutaneous border. Locking screws are used, with the head flush with the plate. Postoperatively, unrestricted range of motion is allowed. We performed a retrospective review to evaluate for union, need for reoperation, hardware related symptoms, range of motion, and union at final follow-up.

RESULTS: Two patients complained of hardware related symptoms; only one required removal of hardware, for persistent symptoms. Another patient required removal of the plate for infection. One patient had a fracture distal to the plate in an unrelated trauma. At final follow-up, all patients had flexion > 120°. Average extension deficit was 8.1° (95% CI 2.6-13.5); 1 patient had extension deficit > 30°. All patients had complete union; however, two patients required bone stimulators for delayed union. These patients had open fractures from blunt trauma. There was no failure of fixation or malunion.

CONCLUSIONS: A non-subcutaneous incision, meticulous detail to plate placement, adequate soft-tissue coverage, and the use of low profile locking screws may minimize the possibility of hardware-related symptoms while improving fixation quality in olecranon fractures. Immediate range of motion is possible with plate fixation.

126. Osteochondritis Dissecans Involving the Trochlea of the Elbow: Can it be Treated like the Capitellum?

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INTRODUCTION: Osteochondritis dissecans (OCD) involving the trochlea of the elbow is a condition with limited recognition in the literature. The purpose of this study was to determine results and complications of this clinical entity in a recent patient cohort.

METHODS: Eight patients between 1998-2008 developed the lesion after insidious onset of progressive elbow pain. Decreased range of motion, most notable in terminal extension, was found in all cases. All patients developed mechanical symptoms. The cohort consisted of five throwing athletes, two gymnasts, and a competitive weightlifter. Treatment guidelines were extrapolated from well-established principles for those involving the capitellum.

RESULTS: With a minimum 12-month follow-up, seven patients underwent arthroscopic debridement/microfracture with loose body excision. Postoperatively, all returned to sport, with five of seven returning to full preinjury function. Range of motion significantly improved with an average postoperative flexion contracture of 5°. No complications were noted with surgical management.

CONCLUSIONS: Trochlear OCD of the elbow is a less-known clinical entity compared to similar lesions found in the humeral capitellum. Treatment principles appear transferable with excellent short-term results.

127. Long-Term Outcomes of Distal Bicep Tendon Ruptures

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INTRODUCTION: Distal biceps tendon ruptures typically occur in males who are middle aged with eccentric bicep contraction. Surgical repair accepted due to concern for loss of supination and flexion strength with conservative treatment; however, there is little evidence to support this claim with long-term follow-up.

MATERIALS AND METHODS: Thirteen patients with distal biceps tendon ruptures were followed for an average of 7 years, 5 months (range 1.5-16 years). Three patients were treated conservatively with physical therapy only. The conservative follow-up group ranged from 7¾-8¾ years. Nine patients underwent the two incision anatomic repair, and one patient was treated with an exploration of the biceps tendon and followed for 11 years, 4 months.

All patients were male with an average age of 50 years (range 34-57 years) at the time of injury. The injured side was the dominant extremity in nine patients. Strength and endurance outcomes of the conservative and operative patients were evaluated based on the Biodex isokinetic dynamometer, physical examination, and DASH scores performed.

RESULTS: The results evidence no difference with strength and endurance outcomes between operative and conservative groups.

The DASH score from each patient was reviewed and the maximum score was achieved in 70% of patients. Three operative patients complained of mild discomfort, and one complained of mild difficulty with sporting activities. The maximum score was achieved with all nonoperative patients.

CONCLUSIONS: The long-term follow-up patients treated with a two incision anatomic repair versus conservative management suggest no difference in outcome. In fact, the nonoperative group was able to maintain excellent strength and comparable endurance in comparison to the non-injured extremity.

MAOA BREAKOUT SESSION #12
TRAUMA II
April 9, 2011

128. Role of Acute Negative Pressure Wound Therapy Over Primarily Closed Surgical Incisions in Hip, Pelvis, and Acetabular Fracture Surgery – A Prospective Randomized Trial

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PURPOSE: To determine the effectiveness of using Negative Pressure Wound Therapy (NPWT) over primarily closed surgical incisions used for hip, pelvis, and acetabular fracture surgery in decreasing postoperative surgical wound drainage, infections, and hospital stay in a cost-effective manner when compared to standard gauze dressings.

METHODS: After IRB approval and initial power analysis, 63 patients that underwent a surgical exposure for hip, pelvis, or acetabular fracture surgery were prospectively randomized to either receiving standard gauze or negative pressure dressing applied over the primarily closed incision sterilely in the operating room. NPWT was left on for two days or longer if drainage continued. Prospective data points collected include patient demographics, mechanism of injury, fracture type, surgical approach, type of surgical closure, associated injuries and procedures, Injury Severity Score, BMI, depth of subcutaneous adipose tissue, condition of soft tissue associated with surgical approach, DVT prophylaxis, ICU stay, antibiotic use, hospital stay, dressing changes, length of wound VAC use, superficial and deep infection, skin maceration/wound breakdown, and drainage.

RESULTS: Thirty patients randomized to the NPWT and 33 patients randomized to standard dressings. Rate of deep infection in the NPWT group was 1/30 (3%) in a patient with a BMI of 37.5. One NPWT patient (3%) with a BMI of 54.8 had cellulitis. Three NPWT patients (10%) had superficial wound infections that resolved with local wound care and oral antibiotics. Two patients (6.1%) in the standard gauze group had deep infections requiring operative debridement and had BMIs of 21.55 and 27.6.

CONCLUSIONS: Although no significant differences were found between the two groups, the NPWT group had fewer deep infections and higher BMIs. The standard gauze group typically had lower BMIs, but had deep infections. Patients with high-energy hip and pelvic injuries, large surgical exposures, and postoperative anticoagulation therapy may benefit from the use of NPWT over primarily closed incisions.

129. A Prospective Study Assessing the Influence of Insurance Status on Initial Treatment and Referral of Operative Ankle Fractures to a Level I Trauma Center

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PURPOSE: Ankle fractures are common injuries, and their management should be within the skill set of most board certified orthopedic surgeons. The purpose of this study is to evaluate the association between patient insurance status on the initial treatment and referral of operative ankle fractures at a level I trauma center. Our null hypothesis states: "No difference in (1) initial treatment [adequate reduction], and (2) insurance status will be observed between operative ankle fracture patients who are referred to a Level I center versus those who present primarily."

METHODS: We prospectively enrolled 200 consecutive ankle fracture patients who were surgically treated at our level I trauma center into this IRB approved study. Power analysis demonstrated a power of 0.8 to detect a difference of 20-25% between those uninsured in the referred versus primary groups with 200 total patients. Demographic, injury, and definitive treatment data were abstracted from the medical record. Information regarding initial treatment, insurance status, and referral recommendations were obtained by direct patient interview. Adequacy of reduction was assessed radiographically by an independent orthopedic surgeon not involved in the definitive care or surgery.

RESULTS: Forty-five patients were referred and 155 presented primarily. Demographic data including age, gender, race, and tobacco use were statistically similar between the groups. However, there was a trend toward a higher percentage of unemployed patients in the referred group (Referred: 71.1%; Primary: 59.4%; $p = 0.15$). No significant differences were observed between the groups for mechanism of injury, fracture classification, and percentage of open fractures. In terms of treatment, 70% of primary patients had an attempted closed reduction compared to 33% of those referred ($p < .0001$), and an acceptable reduction was obtained in 65.2% of the primary compared to 42.5 % of the referred patients ($p = 0.009$). The interval from injury to surgery was 1.74 days in the primary group compared to 5.13 days in the referred group ($p < .0001$). When considering insurance status, a trend was noted toward a higher percentage of uninsured patients in the referred group compared to the primary group (Referred: 51%; Primary: 37%; $p = 0.099$).

CONCLUSIONS: This prospective study assessing the influence of insurance status on initial treatment and referral for operative ankle fractures demonstrates that initial appropriate orthopedic treatment appears to be substantially influenced by insurance status as this null hypothesis was rejected ($p = 0.009$). Referral to a level I center for definitive treatment may be influenced by insurance status as this null hypothesis was not rejected, but a trend was noted ($p = 0.099$).

130. Inter- and Intraobserver Reliability in Determining Hip Stability After Posterior Wall Acetabulum Fractures Using Plain Radiographs and Computed Tomography

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INTRODUCTION: Hip stability status after posterior wall acetabular fracture involving 20% to 50% of the posterior wall is difficult to determine. However, noted experts have professed that hip stability can be accurately determined by careful review of good quality AP and oblique plain radiographs and a CT scan. The purpose of this study was to evaluate the interobserver and intraobserver reliability and accuracy of fellowship-trained orthopedic traumatologists in determining hip stability in these fractures.

METHODS: Plain radiographs and axial CT images of 15 fractures involving 20% to 50% of the posterior wall were reviewed by four expert, fellowship-trained orthopedic traumatologists specializing in acetabular fractures. A determination of hip stability status was made for each fracture at two time points based on these images along with any history of dislocation of the hip at the time of injury. These determinations were compared to the findings of examination under anesthesia (EUA), which served as the gold standard.

RESULTS: Although intraobserver reliability was good (0.65), interobserver reliability was poor (0.12). In addition, percent correct was only 53.3% for the initial reading and only 51.7% for the second. For the initial reading, sensitivity and specificity were 100% and 12.5%, respectively. For the second reading, the sensitivity and specificity were 57.1% and 46.9%, respectively.

DISCUSSION AND CONCLUSION: Orthopedic traumatologists expert in acetabular fracture care cannot adequately determine hip stability status for fractures involving 20% to 50% of the posterior wall using plain radiographs and CT. EUA is vital in determining hip stability status for these fractures.

131. Risk Factors for Syndesmotic and Medial Ankle Sprain: Role of Sex, Sport, and Level of Competition

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BACKGROUND: Syndesmotic and medial ankle sprains constitute up to 15% of all ankle sprains in athletic populations and can result in significant time lost to injury and long-term disability.

METHODS: The Cadet Illness and Injury Tracking System (CIITS) database at USMA was queried for all ankle injuries between 2005 and 2009. Sex, level of competition, and exposure to sport were among risk factors analyzed.

RESULTS: Among 20,336 person-years, 1,206 cadets sustained ankle sprain. Syndesmotic (6.7%) and medial (5.1%) ankle sprains had an incidence rate (IR) of 4.8 and 3.5 per 1,000 person-years, respectively. Compared with females, males were three times more likely to experience medial ankle sprain (incidence rate ratio [IRR] 3.37; 95% CI 1.05, 10.74), but there was no difference in rate of syndesmotic sprains by sex (IRR 1.06; 95% CI 0.58, 1.95). Athletics accounted for 81% of syndesmotic sprains and 64% of medial sprains. Sprint football (52.3), team handball (men's, 34.7), soccer (men's, 30.5; women's, 6.5), and basketball (men's, 24.8; women's, 6.7) had the highest syndesmotic IR per 100,000 athlete-exposures. Medial sprain IR was highest in men's rugby (16.6) and gymnastics (14.0). When analyzed by athletic exposure, male intercollegiate athletes had a greater risk of syndesmotic sprain than their female counterparts (3.53; 95% CI 1.26, 9.83). Furthermore, Intercollegiate level of competition had an increased risk of syndesmotic sprain when compared with intramural level (IRR 2.41; 95% CI 1.03, 5.65).

CONCLUSION: Males have over three-fold greater risk of medial ankle sprain in the general cadet population. Male sex and higher level of competition are risk factors for syndesmotic ankle sprain during athletics.

132. Comparison of Lateral Locked Plating with Additional Distal Fixation and Antiglide Plating for Fixation of Distal Fibular Fractures in Osteoporotic Bone

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The accepted form of treatment for unstable osteoporotic ankle fractures is surgical intervention. Unfortunately, fixation of osteoporotic bone in distal fibula fractures is a surgical challenge. Traditionally, antiglide plating has been described as the biomechanically strongest construct. The purpose of this study was to compare a newly designed lateral locking plate to antiglide plating in the setting of osteoporotic unstable distal fibula fractures.

Unstable distal fibula fractures at the level of the syndesmosis were created in 16 paired cadaveric ankles. All specimens were Caucasian females over 70 years old. The bone mineral density (BMD) was determined and the fractures were fixed with a lateral locking plate and an independent lag screw or an antiglide plate with a lag screw through the plate. Under 600N of axial load and freedom in the mediolateral and anteroposterior axis, the specimens went through stiffness, cyclical loading, and load to failure testing. The energy absorbed until failure, torque to failure, construct stiffness, angle at failure, and energy at failure testing were recorded.

The BMD was not different between the two treatment groups ($p = 0.50$). Two of the lateral locking plate constructs and four of the antiglide plate constructs failed during cyclical loading. The energy absorbed to failure of the lateral locking plate construct (29515 ± 11958 Nm-deg) was greater than the antiglide plating construct (24968 ± 13190 Nm-deg) ($p = 0.03$). The lateral locking plate construct had a higher torque to failure ($p = 0.02$) and construct stiffness ($p = 0.04$). The angle at failure trended to be greater for the lateral locking plate construct ($p = 0.07$).

The newly designed lateral locking plate with an increased number of distal locking screws is biomechanically stronger than antiglide plating in the setting of unstable, osteoporotic distal fibula fractures.

133. Monolateral External Fixation Frames with Divergent Half Pins: A Biomechanical Study

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BACKGROUND: The use of contemporary monolateral external fixation is currently advocated for the treatment of acute traumatic conditions as well as for reconstruction of chronic malunions, nonunions, and osteomyelitis. These frames have traditionally utilized half pins directed orthogonal (90°) to the bone. Clinically, this is difficult to achieve consistently, especially when treating complex pathology with soft tissue concerns. Additionally, these orthogonal half pin frames demonstrate mechanical instability compared to similar circular fixator constructs that are applied with non-orthogonal pin angles.

PURPOSE: To determine if non-orthogonal pin orientation in a half pin monolateral ex-fix mounting demonstrates superior mechanical stability compared to the traditional 90° half pin monolateral frames.

MATERIALS AND METHODS: A 2 cm tibia diaphyseal fracture gap was fashioned in a biomechanical Sawbones® testing model. Monolateral fixators were mounted placing two half pins per limb segment in three distinct orientations for each testing group. Pin insertion groups were (1) Biplanar 60° divergent angle, (2) Biplanar 60° convergent angle, and (3) Standard 90 degree orthogonal angle. Mechanical testing consisted of cyclic axial loading of 500N for 3600 cycles, followed by axial loading to failure. Axial strain, angulation, stiffness, and load to failure were calculated. Statistical analysis was performed for group comparison.

RESULTS: Both 60° angle insertion groups demonstrated significantly greater stiffness, greater load to failure, and less strain than the 90° model ($p = 0.002, 0.001, 0.009$, respectively). The 60° convergent group was similar to the 60° divergent group with respect to stiffness and strain, but did demonstrate significantly greater load to failure compared to the divergent group ($p = 0.008$). The 60° divergent group had a 50% (4/8) iatrogenic distal pin site tibia fracture rate as a mode of failure, while all other samples failed by pin bending and gap closure.

CONCLUSION: Based on the biomechanical performance of the 60° convergent frames, we feel that this configuration of improved stability can be utilized clinically without detrimental consequences. By simply angling the pin insertion angle, monolateral frame stability can be significantly improved while avoiding the tedious routine of applying pins in a perfect 90º orientation.

134. Polyaxial Locked Implants for Treatment of Periprosthetic Fractures of the Femur

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The treatment of periprosthetic fracture implants with multidirectional locked screws has theoretical advantages. Locked plate systems with multidirectional applicable screws give a high stability in the osteoporotic bone. Implants with the ability of locking screws in various angles make the screw application easier in the presence of periprosthetic fractures and provide rigid fixation. We performed a retrospective study of a consecutive series of patients with femoral fractures Vancouver types B1 and C using two specific locked implants (straight and wave plate).

From June 1996 to December 2004, we treated 58 patients with periprosthetic fractures of the femur with poliaxial locked plates. The mean age at the procedure was 72.4 years. Forty patients were female (69%). Thirty-two patients had a total hip replacement (55.2%), 21 had a total knee replacement (36.2%), and 5 cases both (8.6%). The outcome measurements were intra- and postoperative complications, bone union, degree of mobility, and social status. The Barthel Mobility Index and “stand up and go” test were used. Union occurred in 56 cases after the procedure (96.5%). In this series, we had two cases of implant failure and four cases of general complications. The mean time to full weight bear in these patients was 8.6 weeks. At follow-up, 46 patients (78%) had maintained the same social status as before the fracture. Regarding the mobility status, 52 patients had regained their previous level (89%). From four patients walking without aid before surgery, two of them required a walking stick and two a walking frame. The mean Barthel Index was 85 points of possible 100. This improved from 35 points at the beginning of the rehabilitation. The mean stand up and go test time was measured at 22 seconds.

CONCLUSION: The overall failure rate of osteosynthesis after periprosthetic fractures has been reported as up to 35% (20). This study had a 3.5% implant failure and 7% general complications. The implants and methods used achieve bone union and good mobility in a high percentage of cases.

135. Results and Functional Outcome of Femoral Neck Nonunions in Young Adults

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PURPOSE: The purpose of this study was to evaluate long-term functional outcome, results, and complications in young adults with femoral neck (FN) fractures complicated by nonunions (NU).

METHODS: Over a five-year period, 2002-2007, 22 skeletally mature patients were retrospectively identified with a FNNU at a Level I teaching trauma center.

RESULTS: There were 14 (63.6%) males and 8 (36.4%) females with a mean age of 44.1 (19-65) and BMI of 26.2 (18-41). Five (22.7%) patients had an associated femoral shaft fracture. Mechanism of injury was low-energy falls (12, 54.5%) and high-energy injuries (10, 45.5%). AO/OTA fracture classification included 9 (40.9%) B2 and 13 (59.1%) B3 fracture pattern. Primary fracture treatment consisted of 17 (77.3%) ORIF and 5 (22.7%) CRIF and secondary surgery for FNNU was 10 intertrochanteric osteotomies and 8 arthroplasties. Complications included leg length shortening (17, 77.3%), secondary OA (9, 40.9%), heterotopic ossification (8 Brooker I, 3 Brooker II), AVN (7, 31.8%), and infection (1, 4.5%). Functional status was Daily 32.5, Emotional 32.0, Arm-Hand 11.3, Mobility 36.6, Dysfunction 28.5, Bother 25.6, Physical Component Summary (PCS) 31.0, and Mental Component Summary 56.8. Pain requiring medication was present in 14 (63.4%). Mobility assistive devices were utilized in 4, and 14 were limping. Specialized shoe wear was needed by 5 (22.7%). Return to work status was 14 (63.6%) full return, 6 (27.3%) with restrictions, and 2 (9.1%) did not return to previous level of activity. FNNU functional status was significantly reduced compared to normative values but similar to hip arthroplasty. BMI independently contributed to inferior functional status, and an associated shaft fracture contributed to a worse mobility score.

CONCLUSION: Femoral neck nonunions in the younger adults are debilitating injuries. Long-term functional status remains impaired with similar results compared to arthroplasty. BMI and ipsilateral shaft fracture contribute to inferior functional status.

136. Effects of Computerized Physician Order Entry (CPOE) on Postoperative Antibiotic Administration Errors in Patients with Open and Closed Fractures

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PURPOSE: To determine if implementation of computerized physician order entry (CPOE) affects postoperative antibiotic administration in orthopedic trauma patients when compared to standard paper-based charting.

METHODS: We retrospectively evaluated electronic medical records of patients with open fractures that were managed during the one-year period prior to and one year after implementation of CPOE at our regional trauma center. A comparable cohort of consecutive closed fractures was also evaluated before and after CPOE initiation. Demographics and injury characteristics were collected. Orders for pre- and postoperative antibiotic orders were assessed, along with documentation as to whether they were appropriately administered. Our protocol is for 24 hours of prophylactic antibiotic coverage after fixation of closed fractures and a minimum of 48 hours after fixation of open fractures or ongoing in patients with acute open wounds. We defined an antibiotic administration error as any missed dose of antibiotics during the period requested by the surgeon, or failure by the surgical team to initiate postoperative antibiotic orders.

RESULTS: In the year prior to CPOE implementation 74 acute open fracture surgeries were performed on 47 patients and 7 medication errors occurred (9.5%). Since CPOE, there were 50 operative procedures in 26 patients with open fractures and 3 errors occurred (6%) ($P = 0.38$). During the same period, 7 medication errors occurred in a cohort of 60 patients with closed fractures (11.7%). After CPOE, there were 5 errors in 60 closed fractures managed operatively (8.3%) ($P = 0.40$). All deviations in antibiotic dosing involved the failed administration of a single antibiotic dose and no patients went completely without antibiotics after surgery.

CONCLUSION: Implementation of computerized physician order entry (CPOE) does not significantly alter the number or severity of postoperative antibiotic administration errors compared to pre-printed order sheets in orthopedic trauma patients.

137. Orthopedic Surgical Procedures Required by Soldiers in a U.S. Army Brigade Combat Team Upon Return from Operation Iraqi Freedom

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BACKGROUND: No prior research has been conducted regarding the orthopedic surgical needs of soldiers returning from deployment in a theater of combat operations.

METHODS: A centralized casualty database and an electronic medical record system were used to perform an epidemiological review of the orthopedic surgery consultations and surgical procedures required by soldiers returning from a combat deployment. Demographic information was collected for each soldier including age, sex, mechanism or injury, reason for orthopedic consultation, and procedure(s) performed. The overall incidence of the orthopedic burden of disease was calculated and multivariate Poisson regression analysis was utilized to determine the effect of age and sex on the type of orthopedic injury.

RESULTS: Among the 4,122 soldiers deployed, there were 390 combat casualties and 1,324 Disease and Non-Battle Injuries. 3,787 soldiers returned from theater at the end of deployment without having been killed or medically evacuated. There were 711 orthopedic surgical consultations for evaluation of a musculoskeletal complaint in this cohort and 140 surgical procedures were performed as a result. Significant main effects were noted for the demographic age variable ($p < .0001$); and age was found to be an important risk factor for requiring an orthopedic consultation. The most common procedures performed were shoulder stabilization, superior labrum anterior to posterior lesion (SLAP) repair, upper extremity nerve decompressions, anterior cruciate ligament reconstruction, and knee arthroscopy with meniscal debridement.

CONCLUSIONS: Nearly 20% of all soldiers deployed to a theater of combat required an orthopedic surgical consultation upon return from deployment. The vast majority of these issues concerned pathology of the knee or shoulder. This represents a large burden of care for returning soldiers on orthopedic surgical services and has important implications for future resource utilization.

138. Cell Viability and Osteogenic Potential of Bone Graft Obtained via Iliac Crest versus Reamer Irrigator Aspirator (RIA)

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PURPOSE: To compare cell viability and osteogenic potential between bone graft obtained from the iliac crest and Reamer Irrigator Aspirator (RIA).

MATERIALS AND METHODS: Osseous samples were obtained from patients undergoing fracture nonunion repair that incorporated autogenous bone graft harvested using either RIA (n = 5) or ICBG (n = 2). Cell viability was assessed after harvest using trypan blue. Cell surface markers CD 45, 34, 90, and 105 were used to identify the degree of differentiation of the cellular aspirate before and after culture. The tissue was cultured in basic growth media for 14 days and then introduced to inductive media for 14 days. Supernatants were taken at three-day intervals until day 28 when the cultured cells reached confluency. Ultimately osteocalcin concentrations in the supernatant were measured using enzyme linked immunoassay (ELISA). Alzarin red staining for alkaline phosphatase was also done after culture to further verify evidence of osteogenesis.

RESULTS: Both RIA and iliac crest tissue yielded cellular viabilities of at least 95% after harvest. Cell surface markers demonstrated growth of bone marrow derived mesenchymal stem cells (MSCs) during tissue culture by staining positive to CD 90 and CD 105. Differentiation towards osteogenic lineage was shown by production of osteocalcin, which significantly increased after induction in ICBG group by 439% and in the RIA group by 673%. All samples stained positive for Alizarin Red to signify alkaline phosphatase production and the osteogenic lineage.

CONCLUSIONS: These results suggest that both methods of harvesting bone graft yielded a high concentration of viable cells that were able to successfully differentiate into the osteogenic lineage. Further clinical outcomes studies are required to adequately compare the effectiveness of these techniques.

139. Off-Label Treatment of Nonunions with BMP-2♦

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BACKGROUND: More than 500,000 bone grafting procedures are performed annually in the United States for nonunions. Outcomes for off-label use of BMP-2 for nonunions compared to traditional methods are not clearly delineated. This is a retrospective "audit type" study comparing off-label use of BMP-2 with autologous bone grafting.

METHODS: At our institution, 2006 brought a shift in practice management from using autograft to using BMP-2 for nonunion surgery. We compared patients treated for nonunions with autograft prior to this shift in management with patients treated thereafter with BMP-2 for nonunions. Our inclusion criteria included all nonunions diagnosed and treated by two orthopedic traumatologists at a single institution, and date ranges from January 2004 to July 2008. Fractures included the tibia/fibula, humerus, ulna, femur, 5^{th} metatarsal, clavicle, talus, elbow, and ankle. This produced a cohort of 144 patients, of which we had follow-up on 127. The outcome measured was the treating surgeons' impression based upon clinical and radiographic criteria.

RESULTS: There were 79 cases of nonunion treated with autograft prior to 2006, of which 10 failed to heal, 10 were lost to follow-up, and 59 healed. The healing rate was 85.5% if those lost to follow-up are excluded. There were 65 cases of nonunion after 2006, 38 of which were treated with BMP-2, and 27 were treated with autograft without BMP-2. All cases after 2006 had a healing rate of 94.8% if those lost to follow-up were excluded (7 were lost to follow-up). The two larger groups, prior to 2006 and after 2006, were compared using a Chi square test with a p value of 0.0843.

CONCLUSIONS: The group which included some patients receiving BMP-2 showed a higher rate of healing which is trending towards significance compared with the group that did not have BMP-2 as an option.

MAOA BREAKOUT SESSION #13
SPORTS/RESURFACING
April 9, 2011

140. The Effect of Platelet-Rich Plasma in Allograft ACL Reconstruction

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INTRODUCTION: When the ACL is injured, it does not heal spontaneously. Reconstruction with autograft or allograft tissue is needed to restore stability to the knee joint in active patients. The high concentration of platelets found in platelet-rich plasma (PRP) provides an endogenous source of growth factors including Platelet-Derived Growth Factor (PDGF) and Transforming Growth Factor-Beta (TGF-β). PRP's proposed effects on revascularization and healing might positively impact allograft incorporation and lead to a better clinical outcome.

METHODS: Patients who underwent ACL reconstruction with allograft and PRP augmentation were identified and placed in the study group. These patients were matched to controls based on age, gender, and previous ACL revision status. Data was then collected from patient charts for both groups. Parameters evaluated included additional surgical procedures, failure of ACL graft, postoperative effusion, postoperative pain, and other complications. Data was analyzed using Fisher's exact test.

RESULTS: There were 51 PRP patients and 51 matched controls. The average age was 35.12 years ± 11.55 for the PRP group and 35.25 ± 11.53 for the control group. There were 22 females and 29 males in each group. There were no differences between groups in terms of mechanism of injury, additional surgeries, types of complications, postoperative subacute or chronic effusions, or postoperative acute or subacute pain ($p > 0.05$). There was significantly more trace effusions in the postoperative acute phase ($p = 0.021$) and mild pain in the postoperative chronic phase ($p = 0.03$) in the control group compared to the PRP group.

CONCLUSIONS: PRP is safe to use and provides benefits to patients both in the acute and chronic phases of recovery post-ACL reconstruction. Acute effusion and chronic pain were significantly decreased in the group receiving PRP when compared to matched controls. Further studies utilizing more subjects and longer follow-up times are warranted and may reveal additional benefits of PRP use in allograft ACL reconstruction.

141. The Effect of the Iliotibial Band on Knee Laxity in ACL Injuries

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INTRODUCTION: Residual laxity following anterior cruciate ligament (ACL) reconstruction can occur when tissues are damaged concurrently with the ACL. Studies have shown a higher incidence of concurrent iliotibial (IT) band injury than commonly assumed. The purpose of this study is to confirm that there is increased laxity within the knee when the iliotibial band is damaged along with the ACL, and that this laxity persists after ACL reconstruction.

METHODS: Seventeen cadaveric knees were tested with anterior displacement and rotating loads at 30° and 90° of flexion. The knees were tested with conditions of ACL intact/IT intact, ACL deficient/IT intact, and ACL deficient/IT deficient. All kinematic data was collected using the Aesculap Orthopilot.

RESULTS: Anterior tibial translation (ATT) significantly increased under anterior drawer loads with the loss of the ACL in both 30° ($p < .0001$) and 90° ($p < .0001$) of flexion. Additional loss of the IT band did not show further significant increase in ATT (30° [$p = .42$], 90° [$p = .11$]). Significant changes in internal rotation were seen under all loading conditions with the loss of the ACL and with the subsequent loss of the IT band. When comparing ACL reconstruction/IT intact and ACL reconstruction/IT deficient, significant differences were seen in internal rotation values, but not in ATT.

CONCLUSION: ATT does not significantly change when the IT band is deficient in an ACL reconstructed knee, showing that ATT is mainly controlled by the ACL. However, internal rotation shows significant changes with the additional loss of the IT band. When the ACL was reconstructed and held constant, there were significant differences in internal rotation between the IT intact and deficient states. These results suggest that IT band damage should be considered when a reconstructed ACL shows residual laxity.

142. Soft Tissue Healing in an In Vivo ACL Allograft Model: Comparison to Autograft and Effects of Gamma Irradiation

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INTRODUCTION: The effect of low-dose gamma irradiation on healing of soft tissue allografts remains largely unknown.

METHODS: *Surgery:* Forty-eight New Zealand white rabbits underwent bilateral ACL reconstructions with semitendinosus tendon graft using an established rabbit model. Sixteen rabbits were reconstructed with autografts, the remainder with allografts. The 32 allograft rabbits each received one irradiated allograft (1.2 Mrad), with the contralateral leg receiving a non-irradiated allograft. Animals were euthanized at two weeks or eight weeks postoperatively. *Biomechanics:* Using custom designed grips, each specimen was mounted on an electro-mechanical materials testing system (MTS Insight 5). Tensile stiffness, maximum load, and displacement at maximum load were measured. Statistical analysis with ANOVA was performed, with significance set at $p < 0.05$. *Histology:* After staining, the following histomorphometric parameters were computed: quantity of new tendon formation between graft and bone, tendon-bone interface width, and anterior-posterior and medial-lateral diameters of the bone tunnel.

RESULTS: There were no significant differences between the maximum load or stiffness values among the autograft and allograft rabbits in the eight-week groups. A significantly higher elongation at maximum load ($p = 0.035$) was observed in the two-week irradiated group compared to the eight-week autograft and eight-week non-irradiated allograft group. None of the eight-week tendons failed in the graft tunnel.

DISCUSSION: The maximum load and stiffness of a healing tendon graft in ACL reconstruction appears to be independent of low-dose (1.2 Mrad) irradiation. At eight weeks, there was no difference with regard to biomechanic or histologic analysis of bone-tendon healing in allografts versus autograft controls.

143. Using Evidence-Based Medicine in the Management of Chondral Defects of the Knee in Athletes

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Chondral defects of the knee are common in the general population (34-62% arthroscopic prevalence). Within athletes, the prevalence is unknown. Within athletes, the ideal treatment, factors that influence treatment, and surgical indications are unclear. The purposes of this study were: (1) to determine the prevalence of chondral defects in athletes, (2) to determine which surgical technique(s) improve(s) outcomes in athletes, (3) to determine the rate of return-to-sports (RTS), and (4) to determine which factors influence outcomes after cartilage repair or restoration. Two systematic reviews were conducted, evaluating studies reporting the prevalence of chondral defects in athletes (via magnetic resonance imaging or arthroscopy) and reporting the clinical outcomes, including rate of RTS, after cartilage repair in athletes. Twenty-two studies (1,589 subjects) were identified for inclusion (11 within each review). The overall prevalence of full-thickness, focal chondral defects in athletes was 36% (2.4-75% between all studies). Fourteen percent of athletes were asymptomatic at the time of diagnosis. Patellofemoral defects (37%) were more common than femoral condyle (35%) and tibial plateau (25%) defects. Patellar defects were more common than trochlear (64% versus 36%). Medial condyle was more common than lateral (68% versus 32%). Defect prevalence in asymptomatic NBA athletes was 49% (74% patellofemoral). Better clinical outcomes seen after ACI and osteochondral autograft (OATS) versus microfracture. Overall rate of RTS was 66%. Clinical outcomes, rate of RTS, and performance upon RTS after microfracture deteriorated with time, and were worse with larger defects. RTS was quickest after OATS and slowest after ACI. Factors positively influencing outcome after cartilage repair included: defect size < 2 cm^2, preoperative duration of symptoms less than 18 months, no prior surgery, younger patient age (< 30-40 years of age), and higher pre-injury and post-surgical level of sport. Full-thickness chondral defects in the knee are more common in athletes than the general population, and many athletes are asymptomatic. Treatment choice is multifactorial.

144. When to Release Patients to High Impact Activities Following Hip Resurfacing

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The purpose of this study was to measure the effect of surface replacement arthroplasty (SRA) on bone mineral density (BMD) of the proximal femur to determine when patients may return to high impact activities.

We prospectively enrolled 86 young, active patients (49 SRA and 37 THA) to receive dual energy x-ray absorptiometry (DEXA) scans. Inclusion criteria: age < 60, UCLA score ≥ 6, BMI ≤ 35, and a desire to return to high impact activities. The THA group consisted of patients meeting the inclusion criteria but with a contraindication precluding SRA (e.g., large cyst; AVN > 50%). DEXA scans were performed postoperatively at 6 weeks, 6 months, and 1 year for both cohorts.

There was a significant difference between the SRA and THA cohorts in Gruen zones 1, 6, and 7 at 6 months ($p < 0.0001$) and 1 year ($p < 0.004$). SRA patients had a significant increase in BMD between 6 weeks and 6 months ($p = 0.033$) on the tension side of the femoral neck and no significant difference between 6 months and 1 year ($p = 0.28$).

BMD was significantly higher in SRA patients compared to THA patients at all time periods ($p < 0.001$), and there was minimal change in BMD in the SRA group between 6 months and 1 year.

145. Step Activity Levels After Hip Resurfacing and THA in a Young Active Population

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There has been recent interest in surface replacement arthroplasty (SRA) as an alternative to total hip arthroplasty (THA), although there is limited objective data to support claims that SRA allows patients to be more active postoperatively. The purpose of this study was to objectively determine the functional outcomes following SRA compared to THA using a step activity monitoring device.

We prospectively enrolled 51 young, active patients (26 SRA and 25 THA) to wear a StepWatch™ Activity Monitor (SAM), which measures duration and level of activity, total number of steps taken per day, and distinguishes between patterns of activity and inactivity. Inclusion criteria: age < 60, UCLA score ≥ 6, BMI ≤ 35, and a desire to return to high impact activities. THA group consisted of patients meeting the inclusion criteria but with a contraindication precluding SRA (e.g., large cyst; AVN > 50%). Patients wore the SAM on their ankle for one week preoperatively and at one year postoperatively.

Both groups increased their activity after surgery: average number of steps per day (SRA $p = 0.0277$; THA $p < 0.0001$), percentage of time at medium (THA $p = 0.0096$) and high levels of activity (SRA $p = 0.0289$; THA $p = 0.0005$), and a decrease in the percentage of inactivity (THA $p < 0.0001$). The only significant difference between the two groups was change in inactivity after surgery ($p = 0.0473$).

Step activity monitoring data indicates that both SRA and THA patients increase activity levels following surgery, although there was no evidence to support the claim that SRA patients are more active than THA patients.

146. Current Generation Hip Resurfacing versus a New Uncemented Total Hip Arthroplasty: Clinical Outcomes and the Learning Curve

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INTRODUCTION: We sought to evaluate the learning curve by comparing the initial clinical and radiographic results of hip resurfacing to a new uncemented total hip arthroplasty (THA).

MATERIALS AND METHODS: We compared the first 55 consecutive metal-on-metal hip resurfacing arthroplasties to the first 100 uncemented total hip arthroplasties utilizing a new tapered femoral stem. All procedures were performed by an experienced surgeon at a single institution.

RESULTS: The overall complication rates between the THA and resurfacing groups were not significantly different ($p = 0.398$). The reoperation rate for the resurfacing group was significantly higher ($p = 0.019$). There were four (4%) reoperations in the THA group and eight (14.5%) conversions from resurfacing to THA. The last reoperation among the resurfacing group was the 55^{th} case. There were no reoperations in the subsequent 37 hip resurfacings.

Six (6%) THA patients sustained incomplete Vancouver A fractures during surgery that were treated with cerclage cable fixation; four occurred during the first 50 procedures.

Preoperative Harris Hip Scores (HHS), postoperative HHS, and SF-12 scores were not significantly different respectively between the two groups ($p = 0.2$, $p < 0.65$, and 0.32). Kaplan-Meier survival analysis with an endpoint of time to reoperation suggests complications occurred earlier in the resurfacing group versus THA (Log-rank test $p = 0.007$).

CONCLUSIONS: In comparison to THA, operative complications occur earlier and more often after hip resurfacing during the learning period. With either technique, there is a learning curve of approximately 50 cases. Final clinical outcomes in both groups are similar.

147. Computer Models for Testing Impingement – Free Range of Motion in Hip Resurfacing

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INTRODUCTION: Increased patient demand and surgeon interest in hip resurfacing have been based on several theoretical advantages, including increased range of motion (ROM). A careful evaluation of this procedure's effect on ROM in different hip types (i.e., normal, dysplastic, varus, and valgus) is missing from the literature. The purpose of this study was to create computer models for testing impingement-free ROM achieved with varied acetabular positions used in hip resurfacing, allowing for the comparison of ROM profiles for different hip types.

METHODS: Patient CT scans of normal, dysplastic, varus, and valgus hips were used to create 3D computer models of the entire femur and hemipelvis (Cleveland Clinic proprietary software, Cleveland, OH). Hip resurfacing components were virtually implanted and tested for impingement-free ROM using 25 combinations of acetabular positioning.

RESULTS: The normal patients tended to have greater flexion and greater internal rotation than the dysplastic, valgus, and varus patients at every combination of acetabular positioning. The dysplastic patients tended to have the least amount of flexion but the greatest amount of external rotation at nearly every acetabular position.

CONCLUSIONS: The decreased femoral neck anteversion and center-edge angle in the dysplastic patients likely explains the differences seen between their ROM profiles. These data provide a foundation for better understanding the hip resurfacing ROM profile for different hip types.

148. Functional Outcome of Total Hip Resurfacing versus Total Hip Arthroplasty: A Blinded, Randomized Trial♦

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INTRODUCTION: The objective of this study was to compare the early recovery and functional outcome of total hip resurfacing versus total hip replacement.

MATERIALS AND METHODS: Twenty-three patients were randomized blindly to either receive a total hip resurfacing (n = 11) or a total hip replacement (with a large metal-on-metal femoral head) (n = 12). The average age at surgery was 49.3 for the group. Fifteen patients were male and eight were female. Objective functional outcome was assessed in the gait lab preoperatively, at 8 weeks, and at 1 year. Activity was assessed with a step-watch gait analysis tool at the same time intervals.

RESULTS: There were no differences between the two groups preoperatively. There were no differences between the groups for kinematic and kinetic data for level walking and up and down stairs, temporal distance, active range of motion, step watch count, and strength at the two different postoperative data collections.

DISCUSSION: Our study did not show any statistically significant difference in functional outcome between total hip resurfacing and total hip arthroplasty using large metal-on-metal femoral heads.

MAOA BREAKOUT SESSION #14
REVISION HIP/KNEE
April 9, 2011

149. Revision of a Cemented Acetabular Component to a Cementless Acetabular Component at Minimum 20-Year Follow-Up

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INTRODUCTION: Long-term component durability is a problem associated with total hip arthroplasty (THA) and revision hip surgeries, with aseptic loosening being reduced when using cementless rather than cemented acetabular components. We evaluated a cohort of revision THAs using cementless acetabular components at a minimum 20-year follow-up and compared them to a cohort of revision THAs using cemented acetabular components performed by the same surgeon at the same interval of follow-up.

METHODS: Between January 1986 and November 1988, 61 consecutive hybrid revision THAs were performed in 55 patients by one surgeon for mechanical failure of a cemented total hip prosthesis. In all patients, the acetabular and femoral components were revised to a porous-coated acetabular component inserted without cement and a cemented femoral component. Ten patients (12 hips) were alive at a mean of 22.9 years following the operation. These results were compared to 83 consecutive cemented THA revisions performed by the same surgeon at the same interval of follow-up.

RESULTS: At minimum 20-year follow-up, no cementless acetabular revisions required further re-revisions for aseptic loosening. Of the index acetabular components, 3% demonstrated evidence of radiographic loosening. In the cemented revision THA cohort, 20% required re-revision of the acetabular component for aseptic loosening and an additional 19% demonstrated radiographic evidence of loosening at minimum 20-year follow-up.

CONCLUSIONS: Cementless acetabular revision demonstrated durable results at minimum 20-year follow-up with no components requiring re-revision for aseptic loosening. This compares favorably to cemented acetabular revision at the same interval of follow-up. The authors are encouraged by these results and continue to use cementless acetabular fixation in their revision THA procedures.

150. Effectiveness of False Profile Radiographs in Detection of Pelvic Discontinuity in a Cadaver Model

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BACKGROUND: Pelvic dissociation is a serious complication of total hip arthroplasty. Traditional screening includes antero-posterior, labral, and Judet view radiographs, but these views do not always detect dissociation when it is present. The Lequense or “False profile” radiograph is a 65° oblique view which may show the posterior column of the acetabulum more effectively in the setting of total hip arthroplasty. The purpose of this study is to show that the false profile view is more effective than antero-posterior, lateral, and Judet views for detection of pelvic dissociation in patients with a total hip arthroplasty.

METHODS: Ten cadaver pelvises were skeletonized and non-cemented acetabular hip arthroplasty components were implanted. Antero-posterior, lateral, Judet, and false profile radiographs were obtained. Dissociations were created bilaterally in the pelvises and identical radiographs were obtained. All radiographs were analyzed in a blinded fashion by three experienced hip surgeons and two senior level orthopedic residents. The data was analyzed to determine agreement between surgeons and for the sensitivity and specificity of identifying a pelvic dissociation.

RESULTS: Sensitivity and specificity of the false profile view for detecting a pelvic dissociation were 79% (CI 70-86) and 91% (CI 84-96), respectively. There was statistically significant difference in the sensitivity between the false profile and both the antero-posterior (Sensitivity 42% (CI 32-52) and lateral view (Sensitivity 28% (CI 20-38). The false profile had a higher sensitivity than the Judet view (Sensitivity 77% (CI 68-84), but this difference was not significant. In the analysis of inter-observer agreement, false profile and Judet views showed substantial agreement while the antero-posterior and lateral views showed only moderate agreement.

CONCLUSION: The false profile view was significantly better than antero-posterior and lateral views in detecting pelvic dissociation. There was a trend towards superiority of the false profile view over a Judet view, but this was not statistically significant. We would recommend a false profile view as a standard screening radiograph for pelvic discontinuity.

151. Acute and Delayed Total Hip Arthroplasty with Antiprotrusio Cage for Treatment of Acetabular Fractures

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Unstable acetabular fractures with marginal impaction and segmental defects in older patients and in patients with significant osteopenia have a relatively poor prognosis. Open reduction and internal fixation may not always be feasible. In these patients, primary total hip arthroplasty (THA) may lead to satisfactory results. This study compares complications and functional outcomes of patients treated with primary THA using an antiprotrusio cage for reconstruction of the acetabular deficiency.

Between 2000-2006, 17 patients were treated with primary THA using an antiprotrusio cage. All patients had segmental and/or cavitary bone defects secondary to an acetabular fracture. None were considered to be candidates for open reduction and internal fixation and stabilization using hemispherical cups with or without plate fixation was not considered feasible. Thirteen patients were treated acutely and four patients were managed with delayed primary THA. Patients were assessed clinically, radiographically, and using the Harris Hip Score.

The average age was 63 years (22-85 years). Average follow-up was 65 months (24-101 months). Three patients died 2, 5, and 13 months following surgery from unrelated causes, but were included in the statistical analysis due to postoperative complications. All fractures united. There were 4 (36%) early dislocations in the group treated acutely and 3 (75%) in the delayed group ($p = 0.06$). Three patients (27%) had wound infections in the acute group, while there were none in the delayed group ($p = 0.02$). All cage and cup constructs remained stable at follow-up. The average Harris Hip Score was 81 in the group treated acutely and 75 in the delayed group ($p = 0.28$).

Total hip arthroplasty in the face of acute unstable acetabular fractures is extremely challenging. Primary THA with an antiprotrusio cage is an option in selected patients. While many of these fracture patterns are now treated with trabecular metal acetabular components and augments, cages still have a role in managing some unstable transverse or both column fracture patterns. Both acute and delayed treatment in these patients is associated with high complication rates compared to elective primary total hip arthroplasty.

152. Modular Tapered Implants for Severe Femoral Bone Loss in Revision Total Hip Arthroplasty

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INTRODUCTION: Modular tapered femoral components have been suggested as the optimal implants for patients with severe femoral bone loss undergoing revision total hip arthroplasty (THA); however, there is little data available to support this recommendation. The purpose of this study is to report minimum two-year follow-up of patients treated with modular tapered prostheses for Paprosky type IIIB and IV femoral bone loss.

METHODS: Forty-four consecutive patients with Paprosky type IIIB (23) or IV (21) femurs undergoing revision THA using cementless modular tapered prostheses were studied. Ten patients were deceased within 2 years of surgery; the remaining 34 were followed for an average of 42 months (range 25-69 months). Clinical outcomes were measured using the Harris Hip Score, and radiographs were assessed for signs of stem loosening or subsidence > 4 mm.

RESULTS: Four additional revisions were required: (1) for infection, (2) for instability, and (1) for periprosthetic fracture. In patients with surviving implants, the mean Harris Hip Score improved from 33 (range 11-49) preoperatively to 77 (range 55-100). There was no radiographic evidence of loosening. Kaplan-Meier analysis showed 94.6% survivorship at 2 years (0.805-0.991) and 90.1% at 4 years (0.747-0.970).

CONCLUSIONS: These outcomes support the use of modular tapered implants as a reasonable option for the most complex femoral revisions (type IIIB and IV femurs).

153. Varus Remodeling of the Femur in Revision Total Hip Arthroplasty

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INTRODUCTION: Femora that require revision sometimes undergo varus remodeling, which can complicate insertion of a revision component and lead to periprosthetic fracture or undersizing. Although the concept of varus remodeling is well accepted, we are unaware of any published literature on the topic. The purpose of this study was to determine the prevalence of and risk factors for varus femoral remodeling (VFR).

METHODS: 205 consecutive femoral revisions were reviewed; revisions associated with periprosthetic fracture and infection without loosening were excluded. VFR was considered to be present if a properly sized extensively coated acrylic template had appropriate distal canal fill but lied within 2 mm of the proximal lateral endosteal cortex or completely outside of the femoral canal. A stepwise logistic regression was utilized to evaluate possible risk factors for VFR.

RESULTS: The overall prevalence of VFR was 41% (84 of 205 hips). An extended trochanteric osteotomy (ETO) was required in 44 of the cases with VFR (52%) to correct the deformity and appropriately size the revision component. The stepwise logistic regression identified two variables that predicted VFR: increasing Paprosky class ($P = 0.0011$) and patient age ($p = 0.0469$). Using Paprosky class II as a reference, patients with type IIIa femurs had a three-fold probability of VFR (OR: 3.16, 95% CI: 1.30, 7.65) and patients with type IIIb had six times the probability of VFR (OR: 5.94, 95% CI: 1.35, 26.01).

CONCLUSION: VFR was present in over one third of hips requiring femoral revision and an ETO was required in 21% to address the deformity. Patients with extensive femoral bone loss (Paprosky IIIA or greater) and advanced age are at high risk for VFR. Orthopedic surgeons performing revision arthroplasty should be prepared to encounter VFR in the setting of these risk factors.

154. Revision THR in Geriatric Patients: Is it Similar to Younger Patients?

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INTRODUCTION: Revision THRs are increasing particularly in older patients. Revisions are associated with a higher rate of complications: infections, dislocations, mortality, etc. The purpose of this study is to determine if there were greater complications and poorer short-term outcome in geriatric (> 75 years) patients than in younger patients following revision THRs.

METHODS: All patients undergoing revision or conversion THRs under a single surgeon were entered prospectively into a database since 2004 (total of 434 cases). Fifty patients were over age 75 years (mean 80 years). These patients were matched to a similar size cohort of younger patients (mean age 58 years) based upon: type of surgery, year of surgery, and perioperative management. Outcome was assessed using: Harris hip score, blood loss, length of surgery, hospital stay, and complications.

RESULTS: There were no deaths in the 12-month follow-up period in either group. The difference in age was significant (80 years versus 58 years, $p < 0.05$). There was no difference in BMI (29 versus 30). There was no difference in operative time (173 minutes versus 190 minutes), blood loss (915 ml versus 930 ml), nor complications ($p > 0.05$). However, there was a significant difference in length of hospital stay (6.2 days versus 5.5 days, $p = 0.03$). The geriatric group also had a higher incidence of intraoperative fractures of either the greater trochanter or inadvertent perforations, but the difference was not significant (9 versus 4 cases, $p > 0.05$). There was no difference in the Harris hip score at one-year follow-up (91.3 versus 90.2, $p > 0.05$).

CONCLUSION: We found no difference in outcome between the geriatric and younger groups except for length of stay. The possible reasons for longer length of stay include slower physiotherapy progress, longer monitoring in the acute hospital setting, and the need to finalize disposition. We are currently extracting financial data to determine if greater resource utilization and costs were incurred in the geriatric patients.

155. Porous Tantalum Cones for Large Bone Defects in Total Knee Arthroplasty

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INTRODUCTION: Major cavitary, segmental, or combined defects often pose a significant problem in revision total knee arthroplasty (TKA). Various surgical techniques, such as bulk allograft and tumor prosthesis have potential complications such as graft resorption and early failure. The purpose of this study is to evaluate the results of using porous tantalum cones in the reconstruction of severe bone defects in complex primary and revision TKA.

MATERIALS AND METHODS: Thirty-eight porous Tantalum cones in 33 revision TKAs (two bilateral) and two primary TKAs for a total of 33 patients have been used. We retrospectively reviewed the clinical results and radiographs of all patients who underwent TKA surgery using a porous tantalum tibial and/or femoral cone at our institution. Trabecular Metal™ (Zimmer, Warsaw, IN) tibial cones were used in 30 cases, femoral cones in 8 cases, and both in 4 cases.

RESULTS: The average patient age at time of revision was 67 years old (range, 56-84). Mean Knee Society scores significantly improved from 40 preoperatively to 87 postoperatively. After a mean follow-up time of 28 months (range 9-62 months), 4 patients (4 knees) required revision surgery for recurrent infection. Three of the four patients subsequently went to arthrodesis and one a second two-stage exchange procedure. There were no intraoperative complications associated with use of these porous cones. Osseointegration of the porous cones was evident in the 29 patients that did not undergo revision at latest follow-up.

DISCUSSION: Porous Tantalum cones appear to be a viable alternative in revision and complex primary TKA to deal with severe bone defects at early follow-up. Tibial and femoral cones afford the possibility of assembling a “custom-implant” off of the shelf making it a good alternative to formal custom-made devices or bulk allograft.

156. Results of Total Knee Revision for Malrotation

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INTRODUCTION: Rotational malalignment of total knee arthroplasty (TKA) has been correlated with patellofemoral maltracking, instability, subluxation, and stiffness. Previous studies have evaluated results of revision TKR surgery for malrotated components with plain radiographs. Our hypothesis is that revision TKA for malrotation, as defined by CT scan, will improve ROM, Knee Society Scores, and SF-36 scores.

METHODS: Preoperative CTs of 22 consecutive knees from 22 subjects that underwent revision surgery for malrotation were evaluated in conjunction with pre- and postoperative range-of-motion and pre- and postoperative Knee Society (KS) and SF-36 scores. Measurements of internal and external rotation of components were assigned quantitative negative and positive values respectively. The effect of tibial and femoral component rotation on knee ROM, KS, and SF-36 scores was analyzed pre- and postoperatively by Spearman Correlation and Wilcoxon rank-sum test.

RESULTS: Of the 22 revisions, average preoperative femoral and tibial rotation was -3° and -18°, respectively. Postoperative ROM arcs were significantly improved when compared to pre-operative arcs ($p < 0.0001$). Postoperative KS and SF-36 scores were significantly improved ($p = 0.001$ and $p = 0.003$, respectively) when compared to preoperative scores. The average improvement in postoperative KS and SF-36 scores were 29.73 and 61.25 respectively. Pre-operative SF-36 scores were significantly correlated with preoperative ROM arc.

DISCUSSION AND CONCLUSION: For 22 revisions, postoperative ROM arcs, KS and SF-36 scores were significantly improved when compared to preoperative values. By revising TKAs for malrotation based on CT scan, we did improve ROM, KS, and SF-36 scores.

157. Articulating Antibiotic Spacers for Infected Knee Arthroplasty: Is There a "Best Method"?

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INTRODUCTION: Periprosthetic infection (PPI) in total knee arthroplasty (TKA) is a challenging problem. Two-stage exchange arthroplasty with an interval antibiotic spacer is the most successful treatment. Numerous articulating spacer techniques have been reported. We sought to determine whether a particular articulating spacer technique had superior outcomes.

METHODS: Fifty-three patients with infected TKAs who had undergone two-stage exchange arthroplasty with articulating spacers were reviewed. Fifteen patients underwent an autoclaved original component (AOC) technique, 22 a silicone mold component (SMC) technique, and 16 a new femoral component (NFC) technique. We compared outcomes based on infection eradication and ROM. Success was judged to be an infection-free joint at minimum one year follow-up without (1) further surgery for infection or (2) chronic antibiotic suppression following reimplantation.

RESULTS: The three cohorts were comparable in terms of age, indication for primary TKA, prior surgeries, antibiotic protocols, and Charlson co-morbidity index ($p = 0.43$). There was no significant difference ($p = 0.17$) in infection eradication between the three techniques. Ten of 15 (66.7%) AOC spacers were infection-free at mean 73 months (r = 37-105 months), 14/16 (87.5%) NFC spacers were infection-free at mean 19 months (r = 12-32 months) and 16/24 (66.7 %) SMC spacers were infection-free at mean 32 months (r = 4-56 months) follow-up. Multivariate Cox regression analysis showed that SMC spacer technique ($p = 0.03$), antibiotic resistant microorganisms ($p = 0.03$), and COPD ($p = 0.005$) were variables associated with a higher risk of failure. Mean flexion achieved prior to reimplantation did not vary significantly ($p = 0.92$) between the groups. Direct costs for all spacer materials averaged $3,945 for the SMC technique, $3,589 for the NFC technique, and $932 for the AOC technique.

CONCLUSIONS: Our study shows comparable efficacy in infection eradication and range of motion for the three techniques. The SMC technique has the disadvantage of added direct and indirect costs. Concerns of persistent infection with the AOC technique are not justified. Larger multicenter prospective studies are needed in this area.

158. Lateral Patellar Facet Resection for Symptomatic Lateral Facet Impingement After Primary TKA

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INTRODUCTION: During patellar resurfacing in TKA, if the lateral facet is not resected and the button is placed medial, then a select group of patients may develop pain over the lateral aspect of the patella as it rides over the lateral femoral condyle in flexion, causing so-called lateral facet impingement. This complication is sparsely reported in the literature and the results of surgical management are unknown.

METHODS: We reviewed retrospectively a selected group of patients who underwent revision for lateral patellar facet impingement at our institution from 1996-2008. These patients were assessed with a Knee Society rating before and after their revisions and the sunrise view on plain x-rays were used to measure the thickness of the medial and lateral facets before and after revision and were matched 3-to-1 to controls who did not undergo revision.

RESULTS: We identified 14 patients that fit the criteria with a mean follow-up of 4.5 years. The average pain score prior to revision was 75.43 (range of 50-95). The average pain score improved to 78.86 (range of 47-99) following revision, but this did not reach statistical significance, $p = 0.44$. Similarly, the knee function score improved from 54.2 (range 35-80) to 60.0 (range 20-90), but this increase was also not statistically significant, $p = 0.36$. Seventy-one percent of patients were satisfied with the revision while 14% felt somewhat better and 14% felt that they were not helped by the revision. The average pain score for the 43 control patients after TKA was 87.1 (range of 57-100). Forty-five percent of these controls had some degree of lateral patellar facet contact on sunrise view, but only 4.7% reported any degree of pain at follow-up in the anterior/subpatellar region.

DISCUSSION AND CONCLUSION: Approximately 2/3 of patients undergoing revision surgery for so-called lateral facet impingement were satisfied with the operation despite not significantly having an improvement in the pain scores. This should be taken into account when counseling patients who develop this complication post TKA.

159. Revision Surgery for Patellofemoral Problems: Prevalence in TKA with and without Patellar Resurfacing

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INTRODUCTION: Controversy persists regarding routine patellar resurfacing in total knee arthroplasty (TKA), with both resurfacing and bicompartmental arthroplasty supported by the literature. This study examined a community-based joint registry for failures related to the patellofemoral articulation in TKA. We hypothesized that routine patellar resurfacing would result in better TKA survival than bicompartmental arthroplasty.

METHODS: All TKAs with a cemented all-polyethylene patella performed between September 1991 and December of 2009 (n = 8713) were included and compared to 656 bicompartmental arthroplasties (BKA) without patellar resurfacing done in the same time frame. Analysis was done to compare age, gender, implant cost, length of stay, year of index procedure, diagnosis, cruciate status, revision, and revision reason. The analysis was done using Wilcoxon rank sum tests, Pearsons chi-square tests, Kaplan Meier methods, and Cox regression.

RESULTS: Resurfacing was performed in a younger age group (m 66.6 versus 69.6 years), had a slightly higher cost (m ≈ $150), and a shorter length of stay (m 3.9 versus 4.8 days) than the BKA group (all $p < .001$). There was a higher percentage (3% versus 1%; $p < .001$) of BKAs with a diagnosis of rheumatoid arthritis. Resurfaced TKAs had a significantly lower cumulative revision risk than unresurfaced BKAs (0.8% versus 4.5%; $p < .001$). After adjusting for age, unresurfaced BKAs were found to be 6.76 times more likely to be revised than resurfaced TKAs. Cruciate status (CR TKA versus PS TKA) did not influence revision risk for either group. The percentage of all TKAs not resurfaced in our registry dropped from 16.4% in 1991 to 1.9% in 2009.

CONCLUSIONS: In a registry with over 40 surgeons and multiple TKA designs, BKAs performed without patellar resurfacing had a significantly higher revision rate than resurfaced TKAs. To reduce the probability of reoperation for patellofemoral problems, the patella should be resurfaced at the time of index surgery.

BREAKOUT SESSION #15
FOOT AND ANKLE
April 9, 2011

160. Long-Term Outcome of Total Ankle Arthroplasty

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INTRODUCTION: Total ankle arthroplasty (TAA) and ankle arthrodesis are common surgical treatments for end-stage ankle arthritis, but the choice between the two is controversial.

METHODS: A single surgeon performed 67 total ankle arthroplasties between June 1999 and May 2001 which were identified by searching Current Procedural Terminology codes. Information on these patients was gathered through mailed questionnaires, telephone interviews, and retrospective chart reviews.

RESULTS: Data was gathered at an average of nine years following TAA. At that point, 9 of 67 patients had died. Follow-up data was available for 39 of the remaining 58 patients. The etiology of arthritis in these 39 patients was post-traumatic arthritis in 22, rheumatoid arthritis in 6, and other causes in 11. The rate of revision surgery in this group was 41% (16 of 39). These revisions consisted of 10 ankle arthrodeses, 3 revision TAAs, and 3 below-knee amputations. Of the 16 patients who required revision, 11 (69%) had post-traumatic arthritis, 2 (12.5%) had rheumatoid arthritis, and 3 (19%) had other etiologic causes. The average time to revision surgery was 4.3 years, with 6 of the revisions (38%) occurring within one year of TAA. The reasons for revision surgery were infection (2 patients) and implant failure (14 patients). Of the patients who retained their implant, 10 of 23 required a secondary surgery, yielding an overall secondary surgery rate of 67% (26 of 39). Among the 23 patients who retained their prosthesis, the average Visual Analog Pain Score using a scale of 1-10 was 4.5, the average Foot and Ankle Ability Measure (FAAM) sports subscale score was 36.8, and the average FAAM activities of daily living subscale score was 56.5.

CONCLUSION: Total ankle arthroplasty has a high long-term revision and re-operation rate. Patients who are able to retain their implant still have only moderate pain relief and function. Therefore, we believe total ankle arthroplasty must be approached with caution. More research is needed to elucidate the role of total ankle arthroplasty in the treatment of ankle arthritis.

161. Ankle Fusion versus Salto Talaris Anatomic Ankle Replacement: A Two-Year Experience

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BACKGROUND: Arthritis of the ankle joint can be as debilitating as coronary artery disease, renal failure, hip arthrosis, or cervical spine conditions. After conservative measures are exhausted, the two most common surgical treatments are ankle arthrodesis and ankle replacement. Each procedure has unique risks and benefits. While ankle fusion remains the gold standard, newer generation ankle replacements such as the Salto Talaris Anatomic Ankle (FDA approved in November 2006) have been developed to maintain motion in an effort to improve overall patient function.

MATERIALS AND METHODS: A non-randomized retrospective review from December 2006 to August 2009 was performed comparing patients with isolated ankle fusions versus patients with replacements using the Salto Talaris Anatomic Ankle. Demographics were recorded along with preoperative and follow-up SF-12 and Musculoskeletal Quality of Life (MSQOL) scores. Postoperative range of motion (ROM) was also recorded on ankle replacement patients.

RESULTS: The 50 ankle arthrodesis patients were significantly younger (mean 54 years) than the 19 ankle replacement patients (mean 63 years). Other demographics were not significantly different. Preoperative physical component summary of SF-12 was not significantly different between the two groups ($p < 0.001$). Ankle replacement patients had a mean postoperative dorsiflexion of 11° and mean plantar flexion of 34°. Postoperative MSQOL and physical component summary of SF-12 were significantly better in ankle replacement patients ($p < 0.001$). Complications were noted in 7/19 (37%) of ankle replacement patients and 18/50 (36%) of arthrodesis patients. Patient follow-up ranged from 6-24 months.

CONCLUSION: In intermediate-term follow-up, ankle replacement appears to be a safe alternative to ankle fusion and may lead to improved patient function. However, further analysis and longer-term follow-up is required before any definitive recommendations or conclusions may be made.

162. Treatment of Jones' Fractures Without Weight-Bearing Restrictions

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INTRODUCTION: Fractures at the proximal meta-diaphyseal junction of the fifth metatarsal are a unique entity. Strict non-weight-bearing has been standard for nonoperative management of this injury. Our experience has been that patient compliance with these restrictions is variable, seemingly with little clinical consequence.

METHODS: We identified 167 patients with fractures at the base of the fifth metatarsal treated by the senior author between January 1, 2000, and December 31, 2009. We reviewed each patient's radiographs to identify those with Jones' fractures, i.e., a fracture extending into the 4^{th}-5^{th} metatarsal inter-articulation, and found 51 such fractures in 50 patients. We reviewed the records of these patients.

RESULTS: Thirteen patients had inadequate records or were lost to follow-up leaving 37 patients (38 fractures) for evaluation. The average age of the patients was 42 and their average BMI was 27.5. Eleven of these fractures were treated with non-weight-bearing (NWB, 4), partial weight bearing (PWB, 5), or unrecorded (2). The remaining 27 fractures (71.1%) were allowed to weight-bear as tolerated (WBAT). No patients elected for primary operative treatment. Of the 34 patients with available medical history, 2 patients (5.9%) were smokers and none had diabetes mellitus. Twenty-six of 27 fractures treated with WBAT (96.3%) achieved clinical union at a mean of 8.2 weeks of follow-up. There was 1 (3.7%) failure of primary treatment in a patient who was allowed WBAT. He had a cavovarus foot deformity prior to injury and was also a smoker. All 11 treated with protected WB achieved clinical union at a mean of 9.9 weeks

DISCUSSION: We believe that WBAT is a safe alternative to strict weight-bearing precautions in patients with Jones' fractures. Strict weight-bearing restrictions are cumbersome to patients. Furthermore, longer periods of non-weight-bearing may be associated with worse functional outcomes. Treatment without weight-bearing restrictions minimizes morbidity and makes surgical risk negligible. Further investigations should compare patients treated with various weight-bearing restrictions.

163. Stress Fractures in Patients with Metatarsus Adductus

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PURPOSE: Metatarsus adductus in adults has been treated as a cosmetic deformity and is not generally considered to cause future problems. While other foot deformities such as cavus have been associated with an increase in stress fractures, the same association has not been considered to be true for metatarsus adductus. The purpose of this study is to document a pattern of stress fractures seen in patients with metatarsus adductus foot deformities.

METHODS: A retrospective review of available medical records and conventional radiographs was performed on 19 patients (12 men and 7 women; ages 24-57 years old) with stress fractures and metatarsus adductus. Factors evaluated were location, type of fracture, and metatarsus adductus angle. AP radiographs were evaluated and Metatarsus Adductus Angle (MAA) was measured for using Kilmartin's Method.

SUMMARY OF RESULTS: A total of 38 stress fractures in 19 patients and 25 feet (16 left and 9 right) were demonstrated. Of these, 0 were in the 1st metatarsal, 1 was in the 2nd metatarsal, 3 were 3rd metatarsals, 15 were in the 4th metatarsals, and 19 were seen in the 5th metatarsals. The fracture level in the metatarsals was proximal in 34 metatarsal fractures, middle in 3 metatarsal shaft fractures, and distal in 1 metatarsal shaft fracture. All fractures were considered to be stress fractures, with no history of trauma noted in any of the cases. The average Metatarsus Adductus Angle of the involved feet was 35.8° (range 24°-48°).

CONCLUSION: Patients with metatarsus adductus may be at increased risk of stress fractures specifically in the lateral metatarsals as compared to patients with normal foot posture. This may likely be due to higher biomechanical stresses on the lateral metatarsals. These cases illustrate that lateral stresses placed on a foot with metatarsus adductus may lead to problems during adulthood. Nonoperative treatment has been utilized in most patients; however, occasionally operative repair may be necessary.

164. Complications of Percutaneous Posterior to Anteriorly Inserted Screw Fixation in Patients with Talar Neck Fractures

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PURPOSE: Although screw fixation inserted from posterior to anterior for talar neck fractures have biomechanical and anatomical advantages, most surgeons apply screws only from the opposite direction. The goal of this clinical study is to evaluate the safety and efficacy of percutaneously inserted posterior to anterior screws in patients with talus fractures.

METHODS: A retrospective analysis was performed to evaluate patients with a talar neck fracture repaired with posterior to anteriorly applied screw fixation by a single orthopedic trauma surgeon. Data was collected from medical records, radiographs, and clinical examination at > 3 months or until the fracture was healed. Patients were evaluated for surgical complications including failed fixation, sural nerve, and flexor hallucis longus (FHL) injury.

RESULTS: Twenty-seven of 34 patients with a talar neck fracture were managed using this technique during the study period, including 1 Canale and Kelly type I fracture, 20 type II fractures, 4 type III fractures, and 2 type IV fractures. Twenty-two patients were available at an average of 22 months (range, 3-78). None experienced a loss of fixation or deep infection. One patient's screw was too long impinging on the talonavicular joint (required revision). One patient had pain, weakness, or stiffness with FHL function and 3 (13%) experienced minor dysfunction of the sural nerve.

CONCLUSIONS: Insertion of percutaneous posterior to anteriorly directed screws appear to be a safe and effective alternative to traditional screw trajectories in the treatment of talar neck fractures. Relatively minor sural nerve dysfunction was commonly seen early in this series, but appears well controlled using enhanced soft-tissue protection.

165. Outcomes of Type 2 and 3 Open Calcaneus Fractures Managed with Open Reduction and Internal Fixation Using the Medial Open Fracture Wound

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PURPOSE: To determine the clinical and functional outcomes of high-grade open calcaneus fractures managed with a protocol of soft tissue debridement, open reduction via the medial open fracture wound, and internal fixation.

METHODS: A retrospective analysis was performed after IRB approval. Inclusion criteria included patients with a Type 2 and 3 open calcaneus fracture managed surgically by the senior author using an aggressive wound debridement/care with open reduction and internal fixation (ORIF) using the open medial fracture wound that was available for a minimum of 12 month follow-up. Demographics, injury characteristics, and clinical results were assessed through chart review of medical records and radiographs. Hindfoot function was assessed using the AOFAS and Maryland Foot Scores (MFS) and whole body health was assessed using the SF-36.

RESULTS: Seventeen consecutive patients with a type 3 open calcaneus fracture met criteria for inclusion, and 11 of these had outcomes scores at an average of 56 months. The average patient was 38 years old and 12 were men. Ten patients were injured in motor vehicle collisions, 3 in falls, and 2 sustained crush injuries. There were 3 type 2 fractures, 9 type 3A fractures, and 3 type 3B fractures according to the system of Gustilo and Anderson and all wounds were located medially. Patients averaged 2.2 surgical debridements prior to definitive ORIF of the calcaneus (range, 2-4). No patients required amputation, although additional procedures were necessary in 67% of patients. The average AOFAS score was 76 (range, 35-95), the average MFS was 70 (range, 26-90), and the average SF-36 scores were 43.2 ± 12.2 for the physical component score and 50.5 ± 13.8 for the mental component score.

CONCLUSION: Limb-threatening complications are uncommon for high-grade open calcaneus fractures treated with aggressive soft tissue debridement/care with open reduction and internal fixation using the medial open fracture wound. Limb and whole body functional outcomes remain only fair at mid-term follow-up.

166. A Biomechanical Comparison of Periarticular versus One-Third Tubular Plates for Fixation of Osteoporotic Distal Fibula Fractures

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INTRODUCTION: The incidence of osteoporotic ankle fractures will increase as the population continues to age. Recent advancements in plate technology include pre-contoured periarticular plates and the locking plate. Locking plates have been indicated for fractures in osteoporotic bone. The purpose of this study was to test the biomechanical properties of locking and non-locking plates, in both one-third tubular and periarticular plate designs, used in the treatment of osteoporotic distal fibula fractures.

MATERIALS AND METHODS: Biomechanical testing of four constructs, which included locking and non-locking one-third tubular plates and locking and non-locking periarticular plates, were tested in an osteoporotic cadaveric fracture model that simulated the Lauge-Hansen supination-external rotation stage IV injury. The biomechanical properties measured were axial displacement and stiffness, torque to failure, and rotational stiffness. Mode of failure was also recorded.

RESULTS: Overall, the periarticular plates outperformed the one-third tubular plates for both the non-locking and locking constructs. In testing of the one-third tubular plate, the non-locking plate model was superior to the locking plates.

DISCUSSION AND CONCLUSION: Periarticular plates provided superior fixation to one-third tubular plates for SER IV ankle fractures, even in osteoporotic bone. Both the non-locking periarticular plate and non-locking one-third tubular plate performed better in biomechanical testing than their locking counterparts in osteoporotic bone for these injuries. More extensive biomechanical testing and subsequent clinical trials are needed to support these results and confirm the benefit of using locking plates in the osteoporotic fibula and periarticular plates in distal fibula fractures.

167. Biomechanical Comparison of Distal Tibiofibular Syndesmotic Joint Fixation: Novel Suture Construct versus Metallic Screw Construct in Syndesmotic Injury Model

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BACKGROUND: Syndesmotic injuries of the ankle commonly occur via an external rotation force applied to the ankle joint. The effects of rigid or non-rigid of the syndesmotic injury can be assessed by evaluating the three-dimensional kinematics behavior of a tibiofibular diastasis.

METHODS: Ten fresh-frozen lower extremity cadavers were used. A specially designed apparatus was used to stabilize the specimen and rotate the ankle joint from abduction 35° to adduction 25° at a rate of 5°/sec for 10 cycles. Group I fixed with a novel suture construct across the distal syndesmosis, and Group II fixed with a metallic screw. Torque, rotational angle, and three dimensional syndesmotic diastasis readings were recorded.

RESULTS: Three-dimensional tibiofibular diastasis was identified. No significant difference was detected between these two groups in term of overall syndesmotic diastasis. The severance of the syndesmosis ligaments and the deltoid ligament resulted in a significant decreased in foot torsional strength (abducted: 59%; adducted: 26%; $p < 0.05$) compared to intact specimen. No significant difference of foot torsional strength loss for either group for foot abducted 35°; however, for foot adducted 25°, Group II lost 40% torsional strength and Group I only lost 17% torsional strength.

CONCLUSIONS: Group I and Group II were found to produce similar biomechanical stability in a cadaveric model of a syndesmosis fixation. The relationship between human foot abduction-adduction and torque force was explored in an effort to understand the foot biomechanics, and also explored the physiological motion in three-dimensional of the distal tibiofibular syndesmosis.

168. Functional Outcome After Bridle Procedure for Foot Drop

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Bridle procedure is a posterior tibial tendon transfer procedure performed for patients with foot drop in attempt to ambulate without a brace. The published results are favorable, but activity levels have not been reported.

This is a retrospective consecutive series of 20 patients with greater than one year follow-up. The etiology of the foot drop was knee dislocation with peroneal nerve injury (10), sciatic nerve injury (7), and peroneal nerve resection during tumor resection (3). Average age of patient at time of surgery was 36 years with a range 21 to 72 years.

Eighteen of 20 patients were completely brace-free. One patient required a brace for heavy lifting only. Over 50% of the patients had returned to high-level activities such as basketball, softball, running, and hiking without a brace; however, they did feel they were limited at these activities.

This procedure allows patients to return to activities without a brace.

169. The Incidence of DVT After Hindfoot Arthrodesis – Is Prophylactic Anticoagulation Justified?

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INTRODUCTION: Due to the low incidence of lower extremity DVT, prophylactic anticoagulation for patients undergoing lower extremity surgery has been a debated topic of conversation. Recent surveys among foot and ankle surgeons have demonstrated a low rate of use of anticoagulation (19%) for elective and traumatic foot and ankle surgeries. Specifically, the issue of anticoagulation for patients undergoing hindfoot arthrodesis has recently emerged as a controversial topic and as of yet is unresolved. Early studies have indicated that anticoagulation is not necessary but recent criticism of these earlier studies has led to mixed opinions on the standard for orthopedic surgeons performing hindfoot fusions. The purpose of this study is to determine the incidence of DVT and the efficacy of postoperative prophylaxis against thromboembolism with use of low-molecular weight heparin (LMWH) or Warfarin in patients undergoing hindfoot fusion.

MATERIALS AND METHODS: A retrospective review of all patients undergoing hindfoot fusions (tibiotalar, ankle, and triple) by the four senior authors from 2001-2010 was performed. During this period, a total of 315 hindfoot fusions were performed in 300 patients. Of those, we were able to determine the postoperative anticoagulation status after 256 hindfoot fusions. Ages ranged from 15-95 with a mean of 58.3 at the time of surgery. All patients with clinical symptoms of DVT underwent bilateral compression ultrasonography during the postoperative period.

RESULTS: Following 92 out of 315 procedures where patients received DVT prophylaxis, 3 (3.3%) were found to have evidence of acute DVT via ultrasound. Of the 193 patients who did not receive anticoagulation, 3 (1.6%) were found to have an acute DVT.

CONCLUSION: In patients undergoing hindfoot fusion, postoperative prophylaxis with low-molecular weight heparin (LMWH) or Warfarin does not significantly reduce the incidence of clinically symptomatic DVT.

MISCELLANEOUS

1. The Use of Implantable Bone Stimulators in Nonunion Treatment

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PURPOSE: Delayed or failure of bone healing in fracture, osteotomy, and arthrodesis patients continues to be a clinical dilemma. Electromagnetic stimulation is one modality demonstrated in many studies to aid bone healing; however, relatively few studies depict the use and complications associated with direct current implantable bone stimulators (IBS).

METHODS: Over a nine-year period, we studied a consecutive series of 120 adult patients who underwent implantation of a direct current bone stimulator. The goals of this study were to determine the time until healing, the presence of infection, and the need for additional nonunion surgery or salvage procedure following internal bone stimulator placement for nonunion treatment.

RESULTS: Of the factors affecting the time until healing, tobacco smoking was a significant factor associated with increased time until healing. Tobacco smoking and duration of nonunion prior to implantable bone stimulator placement were both significant factors in the need for revision nonunion surgery or salvage procedure after IBS placement. Deep soft tissue infection or osteomyelitis was a significant factor predicting prolonged time to healing, subsequent infection following IBS placement, and the need for revision or salvage surgery.

CONCLUSIONS: There are several studies detailing the beneficial effects of electromagnetic stimulation in the peer-reviewed literature. With the relative lack of complications directly attributable to electromagnetic implantable bone stimulators, their use may be an effective adjuvant to stable internal fixation and autogenous bone grafting in healing nonunions. However, the use of IBS in nonunion patients with prior deep soft tissue infection or osteomyelitis exhibited an increased rate of postoperative infection in this series.

2. Differentiation of Adult Human Adipose-Derived Stem Cells into Articular Chondrocytes is Achieved by Overexpression of the BMP Receptor 1A

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INTRODUCTION: The minimal donor site morbidity associated with removing subcutaneous fat makes Adipose-Derived Stem Cells (ADSC) ideal for clinical applications of tissue engineering. Previous work has demonstrated that bone morphogenetic protein receptor 1A (BMP receptor 1A) signaling is required for postnatal maintenance of articular cartilage. Based on this evidence, we used a lentiviral vector to amplify expression of BMP receptor 1A by our stem cells in order to direct their differentiation into the chondrocyte lineage.

METHODS: We harvested subcutaneous adipose tissue intraoperatively from consenting patients undergoing elective panniculectomy procedures and established a homogeneous stem cell population. In addition, we subcloned an expression plasmid containing the BMP receptor 1A locus. This plasmid was packaged into a lentiviral vector to provide both reliable genomic integration and long-term expression of the BMP receptor 1A gene. Hence, transduction of ADSC using this vector resulted in robust overexpression of BMP receptor 1A.

RESULTS: The ADSC that overexpressed BMP receptor 1A achieved chondrogenic differentiation after 13 to 16 days of in vitro culture on polycaprolactone polymer scaffolds, as revealed by immunohistochemistry assays for two biomarkers of articular cartilage (type II collagen and the proteoglycan aggrecan).

CONCLUSION: Our results demonstrate that stem cells derived from the adipose tissue of a patient represent a viable means of culturing autologous chondrocytes for future implantation at the site of osteochondral defects. By transducing the ADSC with a lentiviral vector, we have also confirmed the critical importance of signaling mediated by the BMP receptor 1A during chondrogenesis.

3. Bioengineered Hyaline Cartilage from Human and Bovine Chondrocytes Embedded in Polyethylene Glycol and Electrospun Polycaprolactone Polymer Scaffolds

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INTRODUCTION: Articular cartilage has a limited capacity to heal, and surgical treatments often fail to reproduce the normal structure and function of hyaline articular cartilage. While the ex vivo production of bovine hyaline cartilage tissue has been achieved, human chondrocytes have been unable to produce 3-dimensional hyaline cartilage in the same environment. Embedding chondrycytes in electrospun polycaprolactone (PCL) polymer scaffold may provide the correct mechanical milieu to enhance the capacity of chondrocytes to form 3-dimensional cartilage tissue.

METHODS: Chondroctyes were isolated from bovine calf knees through dissection and enzymatic digestion. The cells were then suspended in a collagen I hydrogel and embedded in an electrospun PCL mat. The polymer/cell constructs were then cultured for 7 days and then divided for histological analysis.

RESULTS: Viable bovine chondrocytes were found embedded throughout the PCL mat. They generated metachromatic territorial and interstitial matrix consistent with extracellular proteoglycan production by chondrocytes found in articular cartilage.

DISCUSSION/CONCLUSION: The bovine chondrocytes effectively integrated into the PCL mats and retained the ability to produce 3-dimensional of hyaline cartilage. Further investigation is needed to determine if a PCL polymer scaffold will enhance the ability of human chondrocytes to form 3-dimensional cartilage.

4. Orthopedic Surgery in Rural America: A Survey of Rural Orthopedic Surgeons

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INTRODUCTION: There is little information on exactly why rural orthopedic surgeons choose a rural practice. In addition, there is a lack of information on practice patterns, lifestyle, income, competition, and isolation and training issues faced by rural orthopedic surgeons.

METHODS: All orthopedic surgeons in five geographically unique states listed in the AAOS online directory with an address that met the criteria for rural town according to the Rural Urban Commuting Area codes were included in the study and were mailed a survey. This survey included questions that addressed training background, length of time in practice and at their current practice, perceptions of rural practice, professional isolation, breadth of practice, standard of living, and benefits of living in a smaller community.

RESULTS: 72/164 eligible rural orthopedic surgeons completed the survey. The median number of full-time orthopedic surgeons at their hospitals was three. Twenty-five percent were employed by the hospital, 58% were part of a private orthopedic group, and 17% were solo. Forty-five percent completed a fellowship. The median number of nights on call/month was seven. Thirty percent received additional compensation for taking ER call with a median of $700/night. Thirty-nine percent felt there was a need for additional orthopedic surgeons in their community and 62% felt there was a need for additional orthopedic services in other rural areas of their state. The median time at their current practice was 9 years and the median time in practice total was 16 years. Seventy-two percent felt that they have a broader scope of practice when compared to their urban peers. Seventy-nine percent felt that they have the same or a higher standard of living when compared to their urban peers. Thirty-six percent felt professionally isolated. Many cited family reasons and lifestyle for choosing to practice in a rural community.

CONCLUSIONS: Most rural orthopedic surgeons are part of a private orthopedic group. Relatively few receive additional compensation for ER call. Many feel there is a need for additional orthopedic services in other rural areas of their states. Family reasons and lifestyle are the primary factors that bring orthopedic surgeons to rural communities.

FOOT AND ANKLE

5. Partial Tibial Nerve Transfer to the Tibialis Anterior Motor Branch for the Treatment of Peroneal Nerve Injury

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INTRODUCTION: Traumatic peroneal nerve ruptures preclude nerve grafting secondary to the length of nerve injury. The resultant foot drop is often treated with tendon transfers or AFO. Partial nerve transfers of an uninjured nerve to the motor branch of a denervated muscle are successful in the upper extremity.

The purpose is to evaluate patient outcomes following traumatic peroneal nerve ruptures treated with a partial nerve transfer from the tibial nerve to the motor branch of tibialis anterior.

METHODS: All patients treated with nerve transfers for foot drop at Mayo Clinic, Rochester, Minnesota, were reviewed. Patient demographics, mechanism of injury, and time to surgery were recorded. Perioperative motor grading by the British Medical Research Council was obtained. Patients completed questionnaires regarding disability and satisfaction.

RESULTS: Eleven male patients underwent tibial nerve to deep peroneal nerve transfers an average 5.8 months post-injury. Four patients (36%) had successful restoration of grade 3+ ankle-dorsiflexion, two patients (18%) regained grade 1, one patient (9%) regained grade 2, and four patients (36%) did not regain muscle activity. Clinically, apparent motor recovery occurred 7.6 months postoperatively. Reinnervation was demonstrated electromyographically 9.1 months postoperatively.

Most patients (71%) could ambulate and participate in activities. Although 71% of patients did not wear an AFO, only 29% of patients did not limp. The donor deficits included weak toe flexion (29%) and reduced calf circumference (57%).

Generally, 57% of patients were satisfied and 71% would recommend surgery.

CONCLUSIONS: Nerve transfers for foot drop give inconsistent results. Although 36% of patients achieved M3+ recovery, the remaining patients regained minimal muscle strength and risked the morbidity of the procedure.

6. Doubled Allograft Reconstruction for Chronic Syndesmotic Injuries

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INTRODUCTION: Chronic syndesmotic injuries are challenging to treat, with options including debridement, screw stabilization, bone-block ligament advancement, or fusion providing modest results. Anatomic reconstruction with doubled allograft provides promise for these challenging patients.

METHODS: Symptomatic young laborers with chronic syndesmotic injuries were offered allograft reconstruction. Syndesmotic and medial and lateral gutter debridement was followed by reduction and proximal suture-button fixation of the syndesmosis. Parallel tunnels 1 and 2.5 cm proximal to the tibiotalar joint accommodate graft passage. Graft was fixed, tensioned, and fixed again with medial tibial tenodesis screws. Deltoid ligaments were repaired primarily. Weight bearing was protected for 3 months, followed by physical therapy, radiographs at 2 weeks, 6 weeks, then 3-month intervals, and a 6-month CT scan.

SUMMARY OF RESULTS: Six patients (3 females) with 6 ankles (4 left) and mean age 34 years (range 24-50) underwent doubled allograft reconstruction with mean follow-up 11 months (range 4-16). Three patients failed previous treatment, while three had a missed diagnosis, and all had a minimum one prior surgical procedure. BMI averaged 36.6 (range 24-46), and four patients were smokers. Radiographic results at 2 weeks, 6 weeks, and 3-month intervals demonstrate continued syndesmotic reduction with no failures compared to preoperative opposite ankle radiographs. Mean plantar flexion is 35° (range 30°-40°), and dorsiflexion 5° (range 0°-10°). Overall clinical results show 4 “excellent” and 1 “good” result with AOFAS and SF-36 scores in collection.

CONCLUSION: Doubled allograft reconstruction of the syndesmosis provides a promising option for chronic, symptomatic syndesmotic injuries in young laborers.

HIP AND KNEE

7. Uncemented Total Hip Arthroplasty in Obese versus Non-Obese Patients: An 18-27 Year Follow-Up Study Using a Tapered Stem

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INTRODUCTION: The purpose of this study was to evaluate the incidence of aseptic loosening with use of an uncemented tapered femoral component in obese versus non-obese patients at 18 to 27 years (mean 23.5 years).

METHODS: Two hundred eighty-five consecutive uncemented total hip arthroplasties were performed between 1983 and 1987 with use of a tapered stem. The patients were divided into two groups, obese and non-obese, as determined by their body mass index (BMI). There were 105 obese patients (119 hips) (BMI ≥ 30) and 156 non-obese patients (166 hips) (BMI < 30). The outcome of every femoral component with regards to stem fixation, revision, or retention was determined for all 285 hips. Complete follow-up was obtained on the 97 patients (111 hips) surviving a minimum of 18 years (range 18-27 years).

RESULTS: Obese: Of the 119 hips in living and deceased patients, one stem (1%) had been revised for aseptic loosening and one was loose by radiographic criteria. In the 55 surviving hips, none had been revised for aseptic loosening and one was loose.
Non-Obese: Of the 166 hips in living and deceased patients, none had been revised for aseptic loosening and one was loose by radiographic criteria. In the 56 surviving hips, none had been revised for aseptic loosening and one was loose. No significant difference between the two groups with regard to clinical outcome, or perioperative complications was found.

CONCLUSION: Uncemented tapered stems provide excellent fixation in obese and non-obese patients out to 27 years.

8. Impingement Free Range of Motion and Dislocation Potential in Total Hip Arthroplasty versus Femoral Head Resurfacing Using a Novel Cadaveric Robotics Model

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Hip impingement is a known cause of instability and accelerated wear, and it is difficult to identify from static, plain radiographs or clinical evaluation. We have developed a dynamic cadaveric robotics model that functions in real time under load-control parameters to recreate in vivo hip mechanics. This study specifically identifies and compares the impingent-free ROM and direction of force vectors required for dislocation in the native hip, femoral head resurfacing, and total hip replacement (size 28, 36 mm femoral heads).

Five cadaveric hip specimens were secured to a custom potting fixture and mounted to a robotic manipulator (Rotopod R2000, Parallel Robotics Systems) which is capable of manipulating in 6 degrees of freedom (6 DOF). A 6 DOF force-torque sensor (SI-2500-400, ATI Industrial Automation) was used to evaluate force vectors required for dislocation. Impingement was detected and recorded for each condition (i.e., native hip, FHR, THA) as a sudden increase in the reaction moment with respect to the center of the hip. Once impingement occurred, 3D force vectors were applied medially and swept laterally at increasing angles (magnitude held constant) until dislocation was achieved. A statistical analysis evaluating impingement was done utilizing ANOVA with significance set at a p-value of < 0.05. The effect on impingement-free ROM was significant statistically in position (2) ($p = 0.0024$) and post hoc tests revealed that differences existed between FHR and 36 mm THA ($P = .0064$) as well as native hip and 36 mm THA ($P = .0083$). Impingement of the FHR occurred at an average of $5° \pm 10°$ of internal rotation in position (2) while THA impingement occurred at an average $33° \pm 15°$ and $28° \pm 24°$ for 36 mm and 28 mm heads.

This study is the first known application of a 6 DOF Robot in the evaluation of hip stability in a cadaveric model. Our findings underscore the importance of the head-neck ratio. The impingement free ROM for the THA 36 mm head was significantly larger than the FHR. Also, the stability envelopes for both the 36 mm head and 28 mm THA were significantly found to be 5% larger than the FHR.

9. The Effects of Material Selection on the Endurance Strength of Modular Necks

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INTRODUCTION: Both CoCrMo alloy and Ti6Al4V alloy are being used in the manufacturing of hip stems. Recent in vitro hip simulator wear studies have shown wrought CoCrMo alloy femoral heads to perform exceptionally well reducing wear when articulated against softer material due to high hardness and fine grain microstructure. The objective of the current study is to evaluate the endurance strength of both alloys.

METHODS: Two groups were tested in the current study including: Group (1) 28 mm (+10.5 mm neck) extra-extra long CoCrMo modular femoral heads, 8° varus/valgus long Ti6Al4V alloy modular necks, and Ti6Al4V alloy stems, and Group (2) 28 mm (+10.5 mm neck) extra-extra long CoCrMo femoral heads, 8° varus/valgus long CoCrMo alloy necks, and Ti6Al4V alloy stems. Compressive loads were applied to the neck assembly through the femoral head center in a sinusoidal waveform (R = 0.1, where R = Pmin/Pmax) until failure of any component of the assembly construct or 10 Million cycles (Mc) was reached to establish the force-number of cycles (F-N) curve.

RESULTS: In this study, Ti6al4V modular necks did not exhibit a consistent failure location. During low cycle fatigue load, they fractured at the head neck interface region, while at high cycle fatigue load they fractured inside the stem pocket. However, all the CoCrMo alloy modular necks exhibited consistent failure location and they occurred inside the stem taper pocket. CoCrMo alloy modular necks exhibited 128.5% higher fatigue strength when compared to the Ti6Al4V modular neck. CoCrMo alloy modular necks exhibited endurance load higher than those recommended by ISO or ASTM.

DISCUSSION AND CONCLUSION: From the current study, the modular necks that were manufactured from wrought CoCrMo alloy demonstrated a substantial improvement in endurance strength over the Ti6Al4V alloy modular necks.

10. High Speed Recreational Riding Activities After Total Hip Arthroplasty: Are They Safe?

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INTRODUCTION: Total hip arthroplasty (THA) provides patients the ability to return to higher activity level, including high speed riding activities. At this time, there is limited information or objective data providing recommendations on activities such as motorcycle, four-wheeler, and horseback riding. We hypothesized that these are safe activities post THA.

METHODS: We queried 897 consecutive THA patients with a minimum of two-year follow-up to determine how many were participating in these high-speed recreational activities. We analyzed Harris Hip, SF36, and Womac scores, and sent a detailed questionnaire to these patients to determine if motorcycle, four-wheeler, or horseback riding had deleterious effects including pain, loss of function, revision, or other complications.

RESULTS: Twenty-one of the 23 motorcycle and four-wheeler patients and 11 of the 13 horseback rider patients noted improvement in riding comfort after THA. Seven patients experienced at least one fall while riding, but none of these patients sustained a complication, dislocation, or required revision. Harris Hip Scores were increased by more than 50 points in each of the groups at most recent follow-up (average = 4.0 and 4.4 years). Similarly, postoperative Womac and SF36 scores were significantly improved and the improvement was maintained over the follow-up interval.

DISCUSSION: Despite the inherent risks of these high-speed recreational activities, our follow-up has not demonstrated an increased risk of complications or revisions after THA; however, patients should be counseled about these risks and riding safety.

11. Modified Superior Approach for THA with Percutaneous Assistance: Technique and Early Results

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INTRODUCTION: The supercapsular and percutaneously-assisted approaches to total hip arthroplasty (THA) each have had over six years of clinical success with published results rivaling those of other minimally-invasive hip approaches. This paper describes a superiorly-based minimally-invasive approach in which the interval between the piriformis and minimus is exploited. A longitudinal incision in the superior capsule is used to prepare the femur in-situ. Acetabular preparation is done through this incision and an additional percutaneous portal.

METHODS: 110 (57 female, 53 male) consecutive THAs (108 primaries and 2 revisions) done by the same surgeon were entered into this study. Follow-up was two years, with data continuing to be collected. Average age was 63.82 (SD = 12.56); average BMI was 29.23 (SD = 5.94). Harris Hip Scores (HHS) and UCLA data were obtained at preop, 6 month-, 12 month-, and 24-month intervals. Radiographic data was recorded and analyzed by a third party for 66 consecutive THAs.

RESULTS: Mean operative duration was 80 minutes (range 40-141), mean blood loss was 328 mLs (range 100-900), and mean incision length was 7.4 cm (range 5-12). Mean hospital stay was 1.7 days. No instability, neurovascular injuries, infections, or perioperative mortalities occurred. Mean HHS were 45.44 (SD = 15.49) at preop, 89.93 (SD = 10.91) at 6 months, and 87.26 (SD = 14.97) at 12 months. Mean UCLA was 3.98 (SD = 1.17) at preop, 5.52 (SD = 1.37) at 6 months, and 5.67 (SD = 0.58) at 12 months. Radiographically, mean acetabular component inclination was 40.13° (SD = 6.30) with all femoral and acetabular components well-seated. One post-traumatic posterior dislocation occurred, requiring re-operation to a hooded liner and primary repair of capsule and external rotator musculature.

DISCUSSION: Early results of this modified minimally invasive approach demonstrate safety and reliability in the short-term, with results better or comparable to those reported by studies regarding other hip approaches. Clinical and radiographic results are comparable to those published for both original techniques from which this technique was derived.

12. Femoral Head Decompression and Autologous Bone Marrow Concentrate in Early Stage Osteonecrosis

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INTRODUCTION: Treatment of early stage osteonecrosis (ON) is controversial. Previous reports on the use of autologous bone marrow concentrate in patients with early stage ON have been promising. The author reports the early results of decompression of the femoral head with the adjuvant use of bone marrow concentrate.

METHODS: Twenty-five patients with 35 hips undergoing hip decompression for early stage ON (Steinberg 1 or 2) were treated between June 2007 and May 2009. Bilateral hip decompression was performed in 15 patients. Ten other patients underwent unilateral hip decompression with eight of these undergoing a contralateral total hip arthroplasty (THA) for ON. Sixteen patients were male and nine were female with an average age of 47.08 years (range 21-68). Patients were assessed clinically and radiographically at 2 months, 6 months, 1 year, and yearly thereafter. Two patients were lost to follow-up before the two-year mark.

RESULTS: The average follow-up was 2 years (range 12-36 months). At least 12 ccs of bone marrow concentrate were injected into each femoral head. There were no immediate complications related to the procedure itself. Six hips progressed to THA with five of these progressing to post-collapse stage. Four of the six hips that progressed had a contralateral THA performed. One hip had radiographic progression of ON (2 to 3), but the patient was asymptomatic. All other hips had no progression in symptoms or ON grade.

DISCUSSION AND CONCLUSION: At short-term follow-up, simple hip decompression without removal of a core and re-injection of bone marrow concentrate into the necrotic lesion appears to provide satisfactory results in patients with early stage ON. The procedure is simple, relatively reproducible and has a very low complication rate, and the patients are allowed to weight bear as tolerated if both hips are done in a bilateral simultaneous fashion.

13. Complications Following Operative Treatment of Acute Periprosthetic Femur Fractures

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INTRODUCTION: The purpose of this study was to determine the rate of complications and re-operations after operative treatment of periprosthetic femur fractures sustained within 90 days following primary total hip arthroplasty (THA).

METHODS: 4,433 patients (5,196 consecutive primary THAs) over 10 years were retrospectively reviewed. Thirty-five (0.67%) periprosthetic fractures treated operatively in 32 patients and classified using the Vancouver Classification. There were 9 type Ag fractures, 2 type B1 fractures, 17 B2 fractures, 1 type B3 fracture, and 3 concomitant type Ag and B2 fractures. Eleven (34%) patients were treated with isolated ORIF: greater trochanter (9) or femoral shaft (2). Twenty-one (66%) were treated with femoral revision combined with (14) or without (7) attempted fracture fragment reduction; a diaphyseal engaging stem was utilized in all revisions. One patient was lost to follow-up leaving 31 patients for evaluation.

RESULTS: Nineteen (61%) patients sustained 22 major complications including nonunion of the greater trochanter in 10 of the 12 Ag fractures, three nonunions of the femoral shaft (10%), three Brooker grade 3 heterotopic ossification (10%), two deep infections (6%), one stem subsidence (3%), one greater trochanteric fracture with instability (3%), one hematoma (3%) and one peroneal nerve palsy (3%). Seven patients (23%) required a second operative procedure for management of a complication and one patient required a third operation.

CONCLUSION: Operative treatment of acute postoperative periprosthetic fractures is associated with a high rate of major complications (61%) and re-operation (23%).

14. Demographic and Comorbid Disparities Based on a Payer Type in a Total Joint Arthroplasty Cohort

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INTRODUCTION: The purpose of this study was to define demographic and comorbid disparities based on insurance payer stratification at an academic institution.

METHODS: A retrospective review of 875 primary TKAs and THAs by a single surgeon at an academic institution between January 2004 and June 2008 was performed. Data on the primary insurance payer was used to stratify the cohort into two groups, Medicaid/State Aid insured and Medicare/Commercial insured. Demographic, functional, access to care, and comorbidity data obtained from a standard preoperative survey were compared.

RESULTS: Of 875 primary TKAs and THAs, 17.7% of patients were Medicaid/State Aid, while 83.3% were Medicare/Commercial Payer. Average age was 53.7 and 62.3, while average BMI was 35.2 and 32.9, respectively. The Medicaid/State Aid group was found to be three times more likely to use tobacco (25.2% versus 8.3%). Preoperative WOMAC Function scores were 33.9 and 46.8, respectively. Self reported diabetes was used as a general surrogate for health comorbidities and were 12.3% and 11.5%, respectively. Distance traveled was used as a general surrogate for access to care with averages of 92.5 miles and 62.8 miles, respectively.

CONCLUSION: The Medicaid/State Aid group had significantly higher rates of smoking, were significantly younger, and had significantly lower WOMAC scores ($p < 0.05$). BMI and diabetes rates were comparable between the two cohorts. Medicaid/State Aid patients traveled 29.7 miles farther, suggesting they had less access to local orthopedic care. There are major differences in comorbidities and patient demographics between payer types.

15. Reliability of Preoperative Patient Reported Comorbidities in Total Joint Arthroplasty

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BACKGROUND: With the increasing complexity of patients and lack of communication among competing health care systems, patient-reported histories have gained interest and popularity in determining preoperative risk for patients undergoing a total knee or total hip arthroplasty. Patient-reported histories are a cost-effective and efficient means for obtaining patient information, but the accuracy of the patient information can come into question. The purpose of this study was to compare patient reported comorbidities with those recorded in the medical record by a physician.

METHODS: A preoperative morbidity assessment form detailing 26 potential conditions was given to 501 patients undergoing total knee or total hip arthroplasty, and was completed by 246. A thorough review of these 246 patients' electronic medical records was conducted by an orthopedic surgery resident, who was blinded to the patient-completed forms. Results for dichotomous responses were compared using a kappa coefficient and validated using stratified chi-square analysis.

RESULTS: Of the 26 items assessed, only tobacco use ($K = 0.80$; $p < 0.01$) and diabetes ($K = 0.76$; $p < 0.0001$) were significant for substantial correlation between patient and physician reports. Ten items ranged from slight to moderate correlation (K, 0.13 to 0.56; $p < 0.05$). One item (liver disease) was significant for no correlation ($K = -0.05$; $p = 0.002$). The remaining 13 items were not statistically significant.

CONCLUSIONS: These results highlight the incongruence between patient and physician reported comorbidities. This study emphasizes the need for detailed histories completed by healthcare professionals, particularly for medically complicated patients, in order to minimize complications of total knee and total hip arthroplasty.

16. Mid-Term Follow-Up of the C-Stem: Results Using Three Different Distal Cementing Techniques

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INTRODUCTION: In total hip arthroplasty, vertical subsidence > 2 mm is a risk factor for osteolysis; however, some subsidence helps to stabilize cemented stems. The triple-tapered polished C-stem (DePuy) was designed to allow controlled subsidence. This study assessed the subsidence of the C-stem using three different distal cementing techniques.

METHODS: One hundred thirty-seven hips replaced with the C-stem were included in the study (one surgeon, January 1999 – January 2003, DePuy Endurance HV cement). One of three end cementing techniques was used: a bone plug (16), a gelatin end cap (76), or direct placement (5). Radiographic evaluations were at 3 weeks, 1 year, and 1-2 year intervals. Subsidence was measured, and cement mantle was graded. Two one-way ANOVAs were used to analyze vertical subsidence against distal cementing technique and cement grade.

RESULTS: Before being seen at least five years postoperatively, 28 patients died, 8 were lost to follow-up, and 2 had full revisions (implant fracture and posterior instability), leaving 97 hips. At a mean of 7.1 years (range 5-9), mean vertical and rotational subsidence were 1.00 and .39 mm, respectively. No patient had > 1.91 mm subsidence. ANOVA showed no significant differences related to end cementing technique ($p = .74$). Cement grade was related to vertical subsidence ($p = .03$). No stem was at risk for aseptic loosening.

CONCLUSION: The greatest amount of subsidence was 1.91 mm. There were no differences in subsidence between distal cementing techniques, although it was greater in patients with lower cement grade. Ninety-eight percent of patients had the C-stem at final follow-up, and there were no hips at risk for aseptic loosening.

17. Is There Any Benefit of Hip Resurfacing Over Mini-Incision Total Hip Replacement?

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Hip replacement options in young, active patients remain controversial, especially with regards to the ideal bearing surface and implant selection. The purpose of this study was to determine if surface replacement arthroplasty (SRA) has any immediate benefits over mini-posterior approach total hip replacement (THA) in young, active patients.

We retrospectively reviewed the medical records for 100 consecutive SRA patients and a case matched cohort of 100 patients with THA performed through a posterior mini-incision (less than 10 cm). Patients were case matched for gender, age at surgery, and UCLA activity score. Data included for review: patient demographics, duration of surgery, estimated blood loss, transfusion requirements, drain output, pain scores, narcotic requirements, distance ambulated, assistive device used, and time to discharge.

Duration of surgery was 72.7 ± 17.4 minutes in the THA group and 109.9 ± 20.0 minutes in the SRA group ($p < 0.0001$). Estimated blood loss was 577.4 ± 305.8 mL in the THA group and 732.2 ± 319.8 in the SRA group ($p = 0.0004$). All narcotics were converted to equianalgesic milligrams of oral morphine for comparison, but were not found to be statistically different. Average hospital stay was 54.3 ± 13.3 hours for THA patients and 63.4 ± 18.4 hours for SRA patients ($p < 0.0001$). Thirty-six percent of THA patients were discharged the day after surgery compared to 17% of SRA patients ($p = 0.0011$). There were no differences between groups for pain score at discharge.

Compared to SRA, THA performed through a posterior mini-incision resulted in shorter surgery, less blood loss, and earlier hospital discharge.

18. Metal Ion Levels After Hip Resurfacing in a Young Active Population

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Modern metal on metal hip surface replacement arthroplasty (SRA) is an alternative to total hip arthroplasty in young, active patients. Recent concerns about metal ion levels and early failure have limited data to support the notion that activity levels are related to metal ion levels and risk for early failure. The purpose of this study is to determine the metal ion levels in young, active patients following SRA.

We prospectively enrolled 36 young, active patients (average age 49.3; 86.1% males) scheduled to receive unilateral SRA. Inclusion criteria: age < 60, UCLA score ≥ 6, BMI ≤ 35, and a desire to return to high impact activities. Cobalt (Co) and chromium (Cr) levels were tested from whole blood samples collected preoperatively, one year postoperatively for all patients, and two years postoperatively for 16 patients. Blood samples were analyzed by the same independent laboratory using a high-resolution inductively-coupled plasma mass spectrometer**.**

Co and Cr levels increased significantly from preoperative to one year postoperative (Co, $p = 0.002$; Cr, $p = 0.015$). At one year postoperative, the average Co level was 1.81 parts per billion (ppb) and average Cr level was 1.82 ppb. Only two patients had Co or Cr levels greater than 5 ppb postoperatively. There was no significant change in Co and Cr levels between one and two years postoperative (Co, $p = 0.320$; Cr, $p = 0.141$).

Young, active patients with SRA have an increase in whole blood Co and Cr levels after surgery that remains elevated at two years postoperatively, but very few crossed the 5 ppb threshold for concern.

19. Minimum Two-Year Outcome and Survivorship of the Birmingham Hip Resurfacing System in the United States

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Previous data on survivorship of the Birmingham Hip Resurfacing (BHR) system come from the design surgeons and large national databases outside the United States. The purpose of this study was to determine the survivorship of this implant at 2-4 year follow-up in the United States.

A multicenter, retrospective review of all patients treated with a BHR implant at five high volume total joint centers with established joint registries from June 2006 until April 2008 was undertaken. Charts were reviewed and patient demographics, Harris Hip Scores (HHS) and radiographic findings were recorded. Patients without a two-year follow-up clinic visit were contacted by phone. All patients were asked about complications, re-operations, or failure of their implants.

There were 669 patients with minimum two-year follow-up. Average age was 52.3 years and 72.2% were males. Average HHS improved from 58.5 preoperatively to 97.1 ($p < 0.0001$) at follow-up. There were 12 (1.8%) re-operations, and all but one were converted to THA: 3 femoral neck fractures, 2 femoral loosening, 2 malpositioned acetabular components with pain, 1 deep infection, 1 acetabular loosening, 1 pseudotumor, 1 chronic dislocator, and 1 heterotopic ossification excision without changing implants. Additional complications included 2 single dislocations treated closed (0.3%), 2 nerve injuries (0.3%), and one radiographic impending failure due to femoral loosening.

At 2-4 year follow-up, the revision rate and major complication rate of the BHR was similar to primary THA as reported by total joint centers. Only a single pseudotumor was seen at this short-term follow-up.

20. Systematic Literature Review of THA in the Very Young Patient

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INTRODUCTION: Total hip arthroplasty (THA) in patients less than 30 years of age is controversial and there is limited information to guide clinical decision-making. The purpose of this study was to analyze the orthopedic literature regarding THA in patients less than 30 years of age, including level of evidence, clinical outcomes, and implant survivorship.

METHODS: Pubmed, EMBASE, CINAHL, and Cochrane Library search engines identified 4,499 THA studies that included young patients. Nineteen studies met our inclusion criteria and focused on the very young THA patient. Detailed analysis of these 19 studies was performed.

RESULTS: These studies included 729 THAs (508 patients) with a mean follow-up of 11.2 years (range, 1.6-30). Harris Hip scores improved from a mean of 46.6 to 86.5 in ten studies that reported clinical scores. There were 172 acetabular component failures (23.6%) and 74 femoral failures (10.2%). A transition from cemented to cementless implants in the 1980s was associated with a significant reduction in femoral failures (1.8%, $p < 0.002$), yet acetabular failures remained problematic (20.8%). Cemented implants were followed for a mean of 12.5 years, cementless implants 9.5 years ($p = 0.07$).

CONCLUSIONS: The level of evidence for THA in very young patients is level IV. Pain relief and improved hip function are achieved yet implant failure increases during the second decade. Revision surgery appears to be lower with the use of cementless implants but longer-term follow-up is needed. Alternative bearing materials may improve survivorship, but these have not been assessed to date.

21. Patterns of Hospital Readmissions Following Total Hip Arthroplasty

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INTRODUCTION: Data obtained from national registries have identified a rate of hospital readmission as high as 5% in the initial 90 days following total joint arthroplasty. The reasons for readmission have not been well delineated.

METHODS: We reviewed five years of hospital readmission data to our institution to assess for patterns of readmission following total hip and total knee arthroplasty.

RESULTS: 1,515 patient readmissions were noted. 857 admissions (56.6%) occurred within the first four weeks of hospital discharge. Medical complications were noted for 403 admissions (26.6%). Arthroplasty related readmissions were noted for 288 admissions (19.0%). Treatment of infection related complications were noted for 119 patients (7.9%). Bleeding and other complications potentially attributable to anticoagulation occurred for 110 patients (7.3%). Readmissions for documented venous thromboembolic events were noted for 56 patients (3.7%).

CONCLUSIONS: The most common reasons for hospital readmission include the management of medical conditions and mechanical issues related to the arthroplasty procedure. Readmission for complications of bleeding, potentially associated with chemical thromboprophylaxis, are almost twice as common as readmissions for venous thromboembolism.

22. Bleeding and Postoperative Wound Infection in Total Hip and Knee Arthroplasty with Thromboprophylaxis: A Comprehensive Literature Review

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BACKGROUND: Orthopedic surgeons' concerns regarding a possible association between surgical site bleeding and increased risk for wound infections after total hip and knee arthroplasty (THA/TKA) may, in part, account for reluctance to employ effective postoperative thromboprophylaxis. We conducted a comprehensive literature review to assess the most recent evidence relating anticoagulant prophylaxis to postoperative bleeding and prosthetic wound infections after THA/TKA.

METHODS: A key word search was conducted using the MEDLINE® database. Articles published in English between January 2004 and May 2009 on risk factors for postoperative wound infections were reviewed.

RESULTS: Of 2,172 citations identified, 624 articles contained information relevant to the search criteria. Few articles specified the definition used for determining wound infection; infection timing post-surgery was presented in only one third of the studies. The incidence of both superficial and deep wound infections was greater following revision as compared with primary arthroplasty (median = 3.7% and 1.7%, respectively). Wound complications, including prolonged drainage and hematoma, were identified as significant predictors of infection. Contradictory results were found as to other risk factors: patient demographics, co-morbidities (diabetes, obesity, rheumatoid arthritis), wound issues (blood transfusion, drain output), longer surgery, and longer hospital stay. Little evidence supported an association between bleeding and wound infection. Most of the bleeding related to thromboprophylaxis was minor; major bleeding complications were infrequent (median < 1%).

CONCLUSION: Little evidence exists to implicate bleeding as a mediating factor in the hypothesized association between thromboprophylaxis and wound infection, although the validity of this assertion is weakened by inconsistency of reported findings and limitations of the reviewed publications. Studies designed to examine the causality of the inter-relationship between anticoagulant prophylaxis, increased bleeding, and risk for wound infection following THA/TKA are warranted.

23. Association of Allogeneic Blood Transfusion with Prosthetic Joint Replacement Infection

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SUMMARY: Allogeneic transfusion is associated with a significant increase in the risk of developing a postoperative surgical site infection following total joint arthroplasty.

INTRODUCTION: Prosthetic Joint infection (PJI) is a devastating complication which may be associated with a number of co-morbid events or processes. Blood transfusion has been suggested to have a depressive effect on the immune system, reducing resistance to infection. This study attempts to assess the impact of allogeneic blood transfusion on the subsequent development of PJI.

METHODS: This study was a retrospective chart review of a prospectively collected surgical site infection surveillance registry that consisted of all postoperative infections occurring following primary and revision total hip and knee replacements over a 36-month period. Cases were reviewed for the presence or absence of allogeneic transfusion associated with the index procedure, the magnitude of the transfusion, and other associated co-morbid conditions from the Charleson co-morbidity index. The incidence of transfusion was then compared with the incidence across the cohort of non-infected cases. Eighty-one cases of deep or superficial infection comprised this analysis.

RESULTS: A previous transfusion was present in 48 of 81 (59%) infected cases versus 32% for non-infected cases. There was a significant association for all procedures with transfusion present in 15 of 35 (42%) primary knees, 11 of 14 (78%) primary hips, 10 of 17 (59%) revision knees, and 12 of 15 (80%) revision hips. The association was most striking for both primary and revision hip replacement.

CONCLUSION: Allogeneic transfusion is associated with a significant increase in the incidence of postoperative surgical site infection following both primary and revision hip and knee replacement. While the association is strongest for hip patients, this data suggests that care pathways engineered to minimize the risk of transfusion may lead to corresponding reductions in infection rates.

24. The Basic Science of Continuous Passive Motion in Promoting Knee Health: A Systematic Review

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PURPOSE: To evaluate the basic science evidence surrounding the use of continuous passive motion (CPM) for improving anatomic and functional outcomes related to knee health.

METHODS: We conducted a search of multiple databases, identifying and evaluating animal studies that focused on the basic science of CPM of the knee. The databases included in this review were Medline, PubMed, Biosis Previews, SPORTDiscus, and EMBASE. The terms “continuous passive motion” and “knee” were used to search these databases. This search yielded 475 articles.

RESULTS: Of 475 articles identified, 18 animal studies that were published from 1980 to present met inclusion criteria. All 18 studies were conducted in a rabbit experimental model. Primary outcomes that were observed under the influence of CPM included histological changes in articular cartilage (12 studies), biomechanical changes and nutrition of intra-articular tissue (3 studies), and anti-inflammatory biochemical changes (3 studies). There were 8 studies that specifically examined osteochondral defects, 6 of which utilized autogenous periosteal grafts. Other pathologies included in this review are antigen-induced arthritis (AIA), septic arthritis, medial collateral ligament (MCL) reconstruction, hemarthrosis, and chymopapain-induced proteoglycan destruction. Overall, knees undergoing CPM were associated with regenerated articular cartilage that appeared more similar to normal articular cartilage, both grossly and microscopically, and contained more collagen type II compared to immobilized control knees. The use of CPM is also shown to create a strong anti-inflammatory environment for knee rehabilitation.

CONCLUSION: There is good evidence that through its stimulating effects on chondrocytes and anti-inflammatory properties, CPM is superior to immobilization for recovery of normal articular tissue in the knee. Through multiple mechanisms, CPM may contribute to knee health and prevent the development of post-traumatic arthritic conditions.

25. Race and Sex Specific Correlates of Tibiofemoral Joint Morphology in a Normal Population

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OBJECTIVE: To identify race or sex specific correlates between tibial and femoral articular surface shape in a healthy, skeletally mature population. Knowledge of the manner and degree to which femoral articular surface shape correlates with tibial articular surface shape is essential for the sex and race-specific characterization of knee biomechanics, implant sizing for TKA, and degenerative knee diseases.

METHODS: Surface models of 165 non-arthritic knees (age 28.8 ± 7.6 years, range 8-40; 85 black, 80 white, 86 M, 79 F) of skeletons from a repository were obtained with a laser scanner (0.127 mm resolution). Femoral and tibial articular SA (surface area), femoral condylar and tibial widths, AP curvatures of the tibial plateaus, tibial plateau slope, and AP curvatures of the femoral condyles were measured. Associations between the tibial and femoral joint surfaces were characterized for the entire sample and by sex and race.

RESULTS: Women have smaller and narrower tibiofemoral joint surfaces, regardless of race ($p < 0.001$). Femoral SA correlated with tibial SA, height, and femoral width among white individuals only ($p < 0.0001$, $r > 0.58$ white; $p > 0.05$, $r < 0.19$ black), though all groups had a mean femoral: tibial SA ratio of 2.5:1. Tibial SA was correlated with tibial width and posterior femoral condylar curvature among white individuals only ($p < 0.0001$, $r > 0.55$ white, $p > 0.05$, $r < 0.22$ black). The axial curvature of the trochlea was correlated with tibiofemoral size and shape among white women only ($p < 0.001$, $r > 0.42$ white women, $p > 0.05$ all others).

CONCLUSIONS: Several race and sex specific correlates exist between tibial and femoral articular surface shape, with important implications in the fields of knee arthroplasty, knee biomechanics, and the study of knee diseases such as OA. Black individuals may require a unique set of measures for estimating joint size for TKA, as joint width adequately predicts joint surface area for white individuals only, and tibial and femoral surfaces areas are strongly correlated among white individuals only. Finally, investigation of a femoral:tibial SA ratio that deviates greatly from 2.5:1 as a risk factor for OA may be warranted.

26. Arthroscopic ACL Femoral Tunnel Length Variations Using Three Dimensional Computed Tomography

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INTRODUCTION: With a renewed focus on anatomic relationships of the anterior cruciate ligament (ACL), technical adjustments to reconstructions have been introduced. From double-bundle to lower femoral tunnel placement single-bundle interventions, these newer techniques have introduced questions on the ideal method of reconstruction. The medial portal femoral tunnel approach has allowed surgeons to place grafts closer to the anatomic origin of the ACL. As previous investigators have shown, lower femoral tunnel placement leads to improved rotational stability without sacrificing anterior tibial translation. With this improvement comes the question of tunnel length impacting biologic healing and pullout strength. The focus of this study is to identify the variation in arthroscopic ACL femoral tunnel length using 3D-Computed Tomography (CT).

METHODS: Five individuals (ten match-paired knees), who underwent previous ACL reconstruction on one knee, were accepted for the study. CT of both lower extremities was performed with three-dimensional reconstructions. Two separate investigators identified entry and exit points along the lateral femoral condyle of 3D-CT knee models that corresponded with different approaches to femoral tunnel placement in arthroscopic ACL reconstruction (transtibial, low transtibial, medial portal techniques). Custom software was utilized to calculate mean femoral tunnel lengths with standard deviation observed for the three approaches.

RESULTS: The mean femoral tunnel lengths based on three approaches were as follows: transtibial, 48.2 mm (SD 2.2 mm); low transtibial, 41.3 mm (SD 2.6 mm); and medial portal, 33.6 mm (SD 2.2 mm). Repeated measures ANOVA confirmed statistically significant difference in mean femoral tunnel length (p-value 0.001).

CONCLUSIONS: Femoral tunnel length is greatest using the transtibial technique, followed by low transtibial and medial portal techniques. Lateralization of femoral tunnel position results in decreased femoral tunnel length.

27. Utilization of an Intramedullary Tibial Guide During UKA

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Unicompartmental arthroplasty (UKA) is most commonly performed with extramedullary (EM) tibial alignment. In contrast, there is limited literature discussing intramedullary (IM) alignment for the proximal tibial cut. The purpose of this study was to assess utilization of an IM tibial cutting guide during UKA. One hundred consecutive, prospective UKA procedures were performed by a single surgeon. IM alignment with an 8 mm diameter rod was performed in each case. Pre- and postoperative knee alignment was assessed by independent radiographic review of varus/valgus and tibial slope angle. Mean preoperative alignment was 4.1° ± 2.7° of varus, with a tibial slope of 5.3° ± 3.9°. Postoperatively, mean alignment was 1.4° ± 3.1° valgus, with a tibial slope of 2.0° ± 2.1°. Neutral knee alignment, defined as mechanical axis passing over the tibial midline, was restored in 96% of subjects. There was no observed intraoperative ACL violation or postoperative knee laxity. Intraoperative blood loss was minimal, with only one subject requiring blood transfusion. As compared to EM, the utilization of IM alignment offers improved instrument stability and relative procedure ease during UKA.

28. Clinical Progression of Patients Following an Isolated Meniscectomy

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Poor clinical outcomes are often reported following a meniscectomy. We believe that the presence of advanced chondromalacia on the side of the meniscectomy is a strong predictor of poor results after an arthroscope. When the other compartment remains healthy, an unloader brace can shift the weight-bearing axis of the knee through the unaffected compartment of the knee. Most patients appear to tolerate this situation well; however, some require more drastic realignment of the weight-bearing axis through surgical osteotomy. It is the short-term goal of this paper to examine the relationship to chondromalacia, the need for further treatments such as injections, unloader braces, and if the patients progressed to high tibial osteotomy (HTO).

Medical charts of patients were accessed of patients who were at least two years postoperative meniscectomy. These records were examined to determine how many patients started off with significant chondromalacia ended up receiving a Generation II Unloader Brace or a HTO. Demographic information, WOMAC scores, and orthopedic medical history were simultaneously collected.

Data has been collected on 237 meniscectomies preformed from 2003 to 2008. Four percent of the patients received Synvisc injections to relieve pain after the meniscectomy. Sixteen percent of the patients have received an unloader brace approximately nine months after the meniscectomy. Eighty-eight percent of the patients that received a brace also received a prior Synvisc injection. Only 3% of patients of the original group underwent a proximal tibial osteotomy.

29. Gene Expression Profiles of Fibrosis in a Rabbit Knee Model of Joint Contracture

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Dr. Abdel is the recipient of a 2011 Poster Award.

INTRODUCTION: The pathophysiology of arthrofibrosis remains poorly understood. Currently, there is limited information about gene expression during contracture development. The goal of this study was to determine which genes are up- or down-regulated in a rabbit model of joint contracture when compared to the non-contracted limb.

MATERIALS: Eighteen rabbits were operated on to develop a knee contracture and divided into 3 groups of six: Group 1 underwent 2 weeks of immobilization, Group 2 underwent 8 weeks of immobilization, and Group 3 underwent 8 weeks of immobilization plus 16 weeks of remobilization. The right limb was operated on, while the left served as the control. At the endpoint, rabbits were sacrificed and the joint capsules were harvested. After mRNA extraction, a custom microarray was utilized to evaluate fold changes of approximately 300 genes at various time points. At each time point, gene expression of the operated and non-operated limbs were compared.

RESULTS: At two weeks, caspase-10 and urokinase plasminogen activator were the most significantly increased genes, while the tenascin-X gene was most significantly decreased. The genes for IL-1, LOX-1, and macrophage scavenger receptor type II were most significantly decreased at 8 weeks. At 24 weeks, neutrophil attractant/activation protein-1 (IL-8), α 3 type IV collagen, and aggrecanase-2 genes were most significantly decreased.

CONCLUSIONS: In this animal model of arthrofibrosis, significant changes in gene expression were identified during the development of contractures. Bioinformatics is currently underway to determine novel inhibitors in the fibrotic pathway. It is our expectation that this will aid with developing pharmacologic interventions.

30. Comparison of Intramedullary Nail versus Locked Plate for Periprosthetic Distal Femur Fractures

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INTRODUCTION: By 2030, the demand for primary total knee arthroplasties in the United States is expected to grow by 700% to 3.5 million procedures. Fractures of the distal femur in such patients are often difficult to treat and may result in significant pain and functional impairment. The purpose of this study is to directly compare the outcomes of intramedullary fixation versus locked plates for supracondylar periprosthetic fractures.

METHODS: Between 2000 and 2005, 33 patients with distal femur periprosthetic fractures were treated with locked plates, while 7 were treated with intramedullary fixation. All were Lewis and Rorabeck type 2 periprosthetic fractures. Outcomes evaluated included postoperative range of motion (ROM), time to union, and reoperation rates. The mean age was 78 years, with 75% of the patients being female. There were no demographical differences between the two groups. The average follow-up was 24 months.

RESULTS: There was no clinical or statistical difference in the average ROM between the intramedullary fixation and locked plate groups (1-100° versus 2-99°). The average time to union in the intramedullary fixation group was 8.4 months, while the average time to union in the locked plate group was 8.6 months. Again, there was no statistical difference. In regards to nonunions, 1/7 patients (14%) in the intramedullary fixation group had a nonunion, while 7/32 patients (22%) in the locked plate had a nonunion ($p = 0.55$). There was no statistical difference in reoperation rate between the intramedullary fixation and locked plate groups (22% versus 28%, respectively; $p = 0.54$).

CONCLUSIONS: In this direct comparison of intramedullary fixation and locked plates for the treatment of supracondylar periprosthetic femur fractures, there is no difference in postoperative ROM, time to union, or reoperation rates, supporting the continued use of both implants. Further prospective studies with extended follow-up are required.

31. Patellar Dislocation in the United States: Role of Sex, Age, Race, and Athletic Participation

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INTRODUCTION: Patellar instability has been extensively studied in selected, high-risk cohorts, but the epidemiology in the general population remains unclear.

METHODS: The National Electronic Injury Surveillance System (NEISS) was queried for all patellar dislocations presenting to emergency departments between 2003 and 2008. Incidence rate ratios were then calculated with respect to sex, age, and race.

RESULTS: An estimated 40,544 patellar dislocations occurred among an at-risk population of 1,774,210,081 person-years for an incidence rate of 2.29 per 100,000 person-years in the United States. When compared with males, females showed no significant differences in the rates of patellar dislocation (incidence rate ratio [IRR] 0.85, 95% CI 0.71, 1.00). Similarly, no differences were detected by sex and five-year age group. Peak incidence of patellar dislocation occurred between 15 to 19 years of age (11.19/100,000 person-years). When compared with Hispanic race, black and white race were associated with significantly higher rates of patellar dislocation (IRR 4.30 [95% CI 1.63, 6.97], IRR 4.02 [95% CI 1.06, 6.98], respectively). Nearly half of all patellar dislocation (51.9%) occurred during athletic activity, with basketball (18.2%), soccer (6.9%), and football (6.3%) associated with the highest percentage of patellar dislocation during athletics.

CONCLUSION: Age between 15 and 19-years-old is associated with higher rates of patellar dislocation. Sex is not a significant risk factor for patellar dislocation. Black and white race are a significant risk factors for patellar dislocation when compared to Hispanic race. Half of all patellar dislocation occurs during athletic activity.

32. Development of the Cleveland Occupational Knee (CLOCK) Index to Predict Returning to Work

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INTRODUCTION: The aim of this study was to design and validate a patient-completed questionnaire capable of accurately predicting whether a primary total knee arthroplasty (TKA) patient will or will not have returned to work by a given postoperative time point.

METHODS: A prospective cohort study was conducted in which primary TKA patients completed a questionnaire preoperatively that assessed patient characteristics, motivation to work, physical demands of their job, workplace characteristics, knee functionality, and global health. The participants were assessed at 4-6 weeks, 3 months, and 6 months postoperatively to identify when they returned to work. Survival analysis identified significant predictors of the patient's return to work. A composite score was calculated based on the results of the survival analysis to predict whether a patient would return to work by the three time points: 6 weeks, 3 months, and 6 months postoperatively.

RESULTS: The Cleveland Occupational Knee (CLOCK) Index is completely patient-derived and can be completed within five to ten minutes. Based on the 162 patients enrolled, the CLOCK Index has a negative predictive value of 84.7% in predicting if the patient will not have returned to work within 6 weeks postoperatively. At the 3 and 6 month endpoints, the index can accurately predict if the patient will have returned to work with positive predictive values of 75.4% and 92.4% respectively.

CONCLUSION: The CLOCK Index can aid in the preoperative counseling of patients considering a primary TKA by accurately predicting if and when the patient might anticipate returning to work postoperatively.

33. Five-Year Follow-Up of Patients Whose Primary TKAs were Navigated

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INTRODUCTION: From a technical standpoint, achieving proper alignment and stability have proven to be among the most important determinants of long-term success of total knee arthroplasty (TKA). There have been many reports in the literature showing that surgical navigation provides a more predictable implantation. Proper alignment and stability has been reported at higher rates than conventional instrumentation when compared directly, but clinical significance has yet to be proven. The intent of this study is to provide five-year follow-up data on patients who have had TKA performed with the guidance of surgical navigation.

METHODS: The records of all patients who had a primary TKA performed with surgical navigation at least five years prior to database close were reviewed for this study. The Knee Society Clinical Rating System was used for clinical evaluation and radiographic analysis was performed to assess limb alignment. Data from the intraoperative navigation reports were also reviewed.

RESULTS: One hundred forty-six TKAs met the criteria. Of those, 2 patients (3 knees) are deceased and 17 others are lost to follow-up leaving 126 knees for review (92 female, 34 male). At an average follow-up of 3 years (range: 0.08 - 6.71 years), the mean Pain Score was 41.9 and the mean Knee Score was 85.2. The average limb alignment on short films was 4.6° ± 1.4 and the average range of motion (ROM) was 114.9° ± 11.1. Neither Pain nor Knee Scores were correlated with limb alignment but did show a statistically significant correlation with ROM ($p = 0.0001$ and $p < 0.0001$ respectively). Initial and final ROM from the navigation reports were also correlated ($p < 0.0001$).

CONCLUSION: This group of patients is performing well clinically at their most recent follow-up.

34. Is the Pie-Crusting Technique Safe for MCL Release in Varus Deformity Correction in TKR?

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INTRODUCTION: Recently, some have advocated a pie-crusting technique to release the medial collateral ligament (MCL) for correction of varus deformity during total knee replacement (TKR). This study evaluated the biomechanical characteristics of the MCL released with pie-crusting compared to a traditional technique.

METHODS: A median parapatellar arthrotomy and tibial and femoral bone cuts were performed on fresh frozen cadaver specimens. In five knees, the superficial MCL was released at the joint line with the pie-crusting technique. In the contralateral knee, a traditional MCL release was performed as popularized by Insall by elevating the anterior MCL fibers from the tibia. Along with a control group of unreleased ligaments, each MCL was isolated and subjected to cyclic mechanical loading to failure. Force-displacement data was collected, compared, and statistically analyzed between the three groups.

RESULTS: The mean ligament stiffness and the mean force required to cause ligament elongation were all less in MCL pie-crusting technique group compared to the control group ($p < 0.04$) and demonstrated a characteristic “stair-step” failure mode. Statistical significance was not reached between the traditional MCL release and control groups ($p > 0.08$) or between the pie-crusting and traditional MCL release technique groups ($p > 0.2$) with the numbers available. The pie-crusting specimens characteristically failed at the joint line, whereas the traditional MCL release and the control specimens failed at the tibial attachment.

CONCLUSIONS: Although no statistical difference in the mechanical strength was observed between the MCL release technique groups, their characteristic failure modes are different. Unlike the traditional MCL release method, pie-crusting is likely technique dependent since failure occurs within the ligament itself. Due to the critical importance of the MCL in knee stability, further research is warranted and caution should be utilized before employing a pie-crusting technique for MCL release in TKR.

35. Mid-Term Survivorship of Hinged Total Knee Arthroplasty in Non-Tumor Patients

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INTRODUCTION: Hinge total knee arthroplasty (TKA) has suffered for decades under the perception of poor longevity and complications. However, it remains widely used for cases involving resection or bone loss that preclude use of standard TKA prostheses. The purpose of this retrospective study was to examine mid- to long-term survivorship in non-tumor primary and revision hinge TKAs.

METHODS: A query of the operating room information system at our institution was used to identify a cohort of non-tumor hinge TKA recipients. A retrospective review of patients' electronic medical records and a telephone survey were completed. Data collected included age, gender, the need for further intervention(s), and subjective self-assessment of pain and functionality.

RESULTS: A total of 273 hinge TKAs performed between December 3, 1985, and June 9, 2008, were identified. We excluded 78 knees with tumor as surgical indication and 96 knees that belonged to deceased patients, resulting in a final cohort of 99 knees. Of these, 7 were lost to follow-up, leaving 92 knees for analysis with an average follow-up of 78.1 months (range, 2.4-227.7 months). Sixty-five knees survived without surgical intervention. Average time to intervention was 31.9 months (range, 0-152.6 months). Kaplan-Meier survival analysis showed hinge TKA survival of 66.4% at 8 years (95% CI 55.7 to 75.7). Patients had an average age of 71 years (range, 46-92) and were 69.6% female.

CONCLUSIONS: As a final salvage for the knee before arthrodesis or amputation, the rate of patients who required no additional surgery supports the use of hinge TKA.

SPINE

36. Chronic Axial Skeletal Pain: Evaluation of a Single Institution's Referral Patterns

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INTRODUCTION: Lower back pain (LBP) is the most common reason for an outpatient visit with a primary care physician (PCP). The AAFP and ACP have specific guidelines for treatment and imaging of patients with LBP. The ACP recommends that "clinicians should not routinely obtain imaging or other diagnostic test in patients with non specific lower back pain", and the AAFP guidelines are similar. The purpose of this study is to examine our local referral population and assess whether the AAFP and ACP guidelines are being followed by local and regional PCPs.

METHODS: This study is a retrospective chart review of all new SIU orthopedic spine patients presenting from April 2009 through December 2009 with LBP who were referred to our clinic. Seventy-two patients with chronic low back pain were identified and 11 were excluded from analysis due to prior back surgery leaving 61 patients for analysis. Demographics, Oswestry score, duration of pain, ER visits, imaging performed, time from PCP visit to imaging, and data relating to nonoperative treatment of back pain was recorded and analyzed.

RESULTS: Our LBP patients had an average age of 51 years with a mean duration of LBP of 3.3 years. Eighty percent of the LBP patients had imaging studies prior to consultation with most studies occurring within the first two weeks of seeing their PCP. MRI was performed in 79%, compared to 54% receiving plain radiographs and 21% having a CT scan. Forty-six percent had multiple imaging studies ordered. Average time from initial evaluation by their PCP to orthopedic specialist referral was 6.8 weeks. Prior visits to physical therapists and chiropractors occurred in 55.2% and 34.5% of the patients, respectively. Chronic opioid use occurred in 58.6% of the patients and 34% had at least one epidural steroid injection.

CONCLUSION: The majority of the referred patients to our institution did not receive the recommended nonoperative management for their LBP. Imaging studies were ordered excessively and did not follow the AAFP and ACP recommendations and guidelines. We recommend avoidance of narcotic analgesics, physical therapy, and selective imaging in chronic LBP to avoid overcost and burden on the health system.

37. Biomechanical Evaluation of a Low Profile, Anchored Cervical Interbody Spacer Device in the Setting of Cervical Flexion Distraction Injury♦

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INTRODUCTION: Consistent with published clinical results, recent biomechanical studies have shown that anterior cervical plating can stabilize severe Flexion-Distraction (F-D) injury in vitro. In order to address inherent problems with anterior plating, a low profile anchored spacer device (ASD) has been recently developed (Synthes, West Chester, PA); however, it has not been evaluated in the setting of F-D injury. We assessed the ability of the ASD to stabilize the subaxial cervical spine in the presence of F-D injury of increasing severity.

METHODS: Range of motion of six human cadaveric cervical spines (C3-C7; age: 42.3 ± 12.5) was measured under ± 1.5 Nm moments. The testing sequence included intact spines, followed by ASD implantation at C5-C6. Next, a progressive posterior destabilization was performed in three stages at C5-C6 to account for increasing grades of injury: Grade-1: posterior ligament complex resection, Grade-2: unilateral facet capsule and inter-transverse ligament resection, and Grade-3: bilateral facet capsule and PLL resection.

RESULTS: The anchored spacer device significantly reduced C5-C6 flexion-extension (FE) motion from 14.8 ± 4.2 to 3.9 ± 1.8 degrees, lateral bending (LB) from 10.3 ± 2.0 to 1.6 ± 0.8, and axial rotation (AR) from 11.0 ± 2.4 to 2.5 ± 0.8 compared to intact ($p < 0.01$). Grade 1 injury significantly increased motion in only FE compared to fusion with intact posterior structures ($p < 0.01$). Grade-3 injury significantly increased motions in FE ($p = 0.002$) and AR ($p < 0.01$) compared to Grade 1 injury. The ROM of the C5-C6 segment with the ASD construct and Grade-3 F-D injury was 4.9 ± 1.9 in FE, 1.9 ± 0.9 in LB, and 3.1 ± 1.1 in AR.

DISCUSSION/CONCLUSION: Biomechanical testing of anchored cervical interbody spacer device showed that motions at the C5-6 level were significantly reduced compared to the intact spine even in the setting of progressive flexion-distraction injury. The resulting motions were slightly higher than previous studies where a plate construct was used. Therefore, a cervical collar may be recommended when this device is used alone to stabilize severe F-D injuries.

38. Characterization of Combat Related Spinal Injuries Sustained by a U.S. Army Brigade Combat Team During Operation Iraqi Freedom

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Andrew J. Schoenfeld, M.D. El Paso, TX
Philip J. Belmont, Jr., M.D. El Paso, TX
(Jason Dutton, D.O., El Paso, TX to present)

BACKGROUND CONTEXT**:** The United States is presently engaged in the largest scale armed conflict since Vietnam. Despite recent investigations into the scope of injuries sustained by soldiers in Iraq and Afghanistan, little information is available regarding the incidence and epidemiology of spine trauma in this population.

PURPOSE: To perform a descriptive epidemiologic study characterizing the incidence and epidemiology of spinal injuries sustained during combat by soldiers of a United States Army Brigade Combat Team (BCT) that participated in Operation Iraqi Freedom.

METHODS: A total of 4,122 soldiers served in Iraq with an Army BCT during "The Surge" operation. Unit rosters were obtained and a comprehensive database identifying all combat related spine injuries was created by querying each soldiers' electronic medical record and the unit's casualty rosters. Demographic information was recorded including: age, sex, rank, injury mechanism, presence of polytrauma, and injury outcome. Injury outcomes were classified as killed in action, died of wounds, medically evacuated (MEDEVAC), or returned to duty. The incidence of spine injuries was determined and epidemiology was characterized using calculations of the spine combat casualty rate, and percent MEDEVAC.

RESULTS: A total of 29 soldiers sustained 31 combat related spine injuries. These accounted for 7.4% (29/390) of all casualties sustained during combat. Blunt trauma to the spine, often resulting from an explosive mechanism, was encountered in 65% of cases. Closed fractures of the spine occurred in 21% of casualties and open injuries occurred in 7%. The spine combat casualty rate was 5.6/1,000 soldier combat-years and the percent MEDEVAC was 19%.

CONCLUSIONS: This investigation is the first of its kind, documenting the nature of spine trauma in a major American conflict. The incidence of spine injuries in this study is the highest ever documented and is indicative of the tactics employed by the enemy in the current war.

TRAUMA

39. Staged Reverse Sural Fasciocutaneous Flap for Exposed Medial Malleolar Hardware in High Risk Patients – A Case Series

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INTRODUCTION: Most series on flap coverage describe a wide variety of wounds and various medical co-morbidities of the patients. We describe the use of a staged reverse sural fasciocutaneous flap for a distinct group of patients with advanced age, diabetes, and other medical co-morbidities who have exposed hardware of the medial malleolus.

RESULTS: Three patients, age 55, 64, and 69, had surgical wound breakdown over plated distal tibia fractures. Medical co-morbidities included diabetes, hypertension, COPD, obesity, and an extensive smoking history. By the AO/OTA fracture classification system, one fracture was a 43-A3, while two were 43-C3. All were closed injuries and the C3 fractures were treated initially with external fixators. Surgical wounds were closed appropriately without undue tension. Wound breakdown was noted at 2 weeks, 3 weeks, and 6 months postoperatively. All patients were treated by appropriate irrigation and debridement of the soft tissue overlying the plate, retention of the hardware, and staged sural fasciocutaneous flap. The wounds requiring flap coverage averaged 3 cm x 4 cm. The sural flaps were staged by a range of 5 to 7 days. All flaps survived with no partial necrosis.

One patient retained the hardware until fracture healing, and two patients have been able to retain the hardware with no further surgery. Two patients were able to return to normal shoe wear while one has been non-ambulatory due to polytrauma.

CONCLUSION: A sural fasciocutaneous flap is an effective option for soft tissue coverage of wound dehiscence over the medial malleolus. In this region, a small, thin flap with sufficient blood supply is needed. Staged sural flap procedures can be advantageous for patients with high risk of poor vascularity to the skin and fascia due to medical co-morbidities. This series presents the success of a staged sural flap for a subset of older patients with significant medical co-morbidities and exposed medial malleolar hardware.

40. Outcomes of Open Distal Femur Fractures Using Locking Plates

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PURPOSE: To determine the rate of complications, secondary procedures, and risk factors associated with nonunion when angle-stable plates are used to manage high-energy open distal femur fractures.

METHODS: A 3.5 year retrospective review with a minimum of 12 month follow-up was performed for open distal femur fractures treated with anatomically precontoured distal femoral locking plates. Thirty-one patients with 32 open distal femur fractures were identified. Retrospective medical record and radiograph review was performed to record patient demographics and evaluate the incidence of nonunion, infection, location, and dimensions of open fracture wound, bone loss, hardware failure, type of implant and bone graft, screw configuration, and secondary surgical procedures.

RESULTS: 29/31 patients underwent initial irrigation and debridement and knee spanning external fixation with delayed definitive open reduction and internal fixation. Of the 32 open fractures there were: 4 type I, 4 type II, 13 type IIIA, 9 type IIIB, and 2 type IIIC fractures. Bone loss ranged from 0-18 cm. Twenty-nine of the 32 fractures were AO/OTA type C fractures. All patients underwent definitive management with either titanium or stainless steel precontoured locking distal femur plates with either unidirectional or multidirectional locking mechanisms. Hybrid fixation techniques were used. Thirteen patients (39.4%) underwent nonunion repair. Deep infection occurred in seven patients (21.9%). 123 procedures were performed. 38 procedures (30.9%) were secondary. Five patients (15.2%) had mechanical failure of the plate.

CONCLUSIONS: This large series of open distal femur fractures treated with locking plates reveals that these patients have a remarkably higher rate of nonunion, infection, hardware failure, and secondary surgical procedures when compared to closed fractures.

41. The Anterolateral Approach to Pilon Fractures Compromises Blood Supply to the Skin

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PURPOSE: Anterolateral plating of the pilon fracture with concurrent fibular plating is associated with a risk of skin necrosis and wound breakdown. The purpose of this study was to examine the blood supply to the adjacent skin and its vulnerability to anterolateral tibial plating with concurrent fibular plating through one surgical incision.

METHODS: This IRB exempt study was performed using ten lightly embalmed cadaver legs without a history of lower extremity trauma or surgery that were obtained from a bequeathal program at a university-based level one trauma center. The average age was 71 years old (range, 57 to 87). Each specimen was injected with a commercially available silicone compound through the popliteal artery. The left leg was plated through a modified, extensile Böhler approach, and the right leg served as the control. Each leg was anatomically dissected in order to locate and quantify the number and location of the perforating arteries. All measurements were taken using a digital caliper and were analyzed using Microsoft Excel.

RESULTS: The mean foot length was 233.84 ± 16.48 mm. A mean of 9.30 (range, 4.00-17.00) perforating arteries were present and in the proximity of the fibula plate.

DISCUSSION: This investigation suggests there is the risk of soft tissue damage in the region of the superficial peroneal nerve as a result of concurrent fibular plating along with anterolateral tibial plating. Better outcomes with respect to wound complications after anterolateral tibial plating and concurrent fibular plating may come from improved understanding of the local blood supply to the adjacent skin.

42. Cadaver Pelvic Biomechanical Study: Locked versus Standard Unlocked Plating of the Symphysis Pubis in a Type-C Pelvic Injury Model

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INTRODUCTION: This is a biomechanical study comparing locked plating of the pubic symphysis with standard unlocked bicortical fixation using a Synthes 3.5 mm six hole combination locked/non-locked symphyseal plate in an osteopenic type-C pelvic injury model. The hypothesis is that there will be no difference in failure rates of the symphyseal fixation between the locking and non-locking constructs.

MATERIALS/METHODS: After a DEXA scan was performed on each of eight cadaver pelvis specimens, sectioning of the pubic symphysis was performed in conjunction with unilateral release of the sacroiliac, sacrospinous and sacrotuberous ligaments, and pelvic floor to simulate a type-C pelvic injury. The disrupted SI joint was then reduced and fixed using two Synthes 6.5 mm cannulated screws. Fluoroscopy was used to confirm appropriate reduction and screw placement. Next, a Synthes six-hole 3.5 mm symphysis plate was applied. Four pelvises were fixed with six 3.5 mm locking screws and four pelvises were fixed with six standard 3.5 mm unlocked bicortical screws. Both groups were similar, as based on the DEXA scan results ($p = .686$). Each pelvis was then mounted on a servohydraulic materials-testing machine in a fashion similar to the "dancing pelvis" model used by Tile et al and were cycled up to 1 million cycles or failure, whichever occurred first.

RESULTS: Five specimens experienced failure at the interface between the mounting jig and the S1 vertebral body at between 400,000 and 1 million cycles. Frank failure of the anterior or posterior instrumentation did not occur. There were no differences between the groups with respect to average cycles (.886) or symphyseal minor widening (.686).

DISCUSSION: Locked plating has various theoretical advantages when compared to standard plating techniques. However, there appears to be no difference in failure rates between these two constructs in an osteopenic type-C pelvic injury model. The results from this study indicate that, in the setting of an acute pelvic ring injury, a traditional and potentially more cost-effective strategy can be employed with similar expectation for success.

UPPER EXTREMITY

43. Incidence, Complications, and Results of Long Stem Humeral Components in Primary Shoulder Arthroplasty

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

MATERIALS AND METHODS: From 1976 to 2006, 3,623 shoulder arthroplasties were performed at our institution. Our study group included 38 shoulders with intermediate or long stem humeral components that were followed clinically for at least two years or until revision surgery. The diagnoses were osteoarthritis in 17 shoulders, nonunion in 10, acute traumatic fracture in 6, rheumatoid arthritis in 4, and malunion in 1. Indications for use were a large humeral canal in 18 shoulders, severe preoperative metaphyseal or diaphyseal bone loss in 17, and intraoperative diaphyseal fracture in three. Ten of the components were cemented and bone graft was used in 15 cases.

RESULTS: Intraoperative complications included diaphyseal extension of a proximal fracture in one case and an unrecognized nondisplaced diaphyseal fracture that later displaced in one case. Late complications included fracture nonunion in one and deep infection in one. Reoperations were performed in three shoulders. Pain ratings (on a scale of 1 to 5) decreased from a mean of 4.5 preoperatively to 2.4 postoperatively. Excellent or satisfactory results were achieved in 22 of 38 shoulders according to the modified Neer rating system. Radiolucent lines were identified in six cases, but no components met criteria to be considered radiographically “at risk” for clinical loosening.

DISCUSSION: Intermediate or long stem humeral components are useful in obtaining a secure distal fit in cases involving diaphyseal fracture, significant bone loss, or in patients with a large humeral canal. Caution should be taken to avoid intraoperative fractures distally. Outcomes are often determined by proximal soft tissue integrity and not affected by long stem placement. Neither clinical nor radiographic follow-up show these components to be at high risk for loosening.

44. Two Stage Reimplantation for the Treatment of Prosthetic Shoulder Infections

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Jason Ho, M.D. Cleveland, OH
Joseph P. Iannotti, M.D. Cleveland, OH

BACKGROUND: Infection after shoulder replacement is a devastating complication. The purpose of our study was to evaluate the efficacy and clinical outcomes in infected joints using a uniform two stage re-implantation technique performed by a single surgeon. We hypothesized that patients with rotator cuff deficiency after infection would have better clinical outcomes when reconstructed with a reverse shoulder replacement than those patients treated with an anatomic prosthesis.

METHODS: We identified 27 patients who were treated with a two stage re-implantation for prosthetic shoulder infection from 2001-2009 by the senior author. All patients were treated with a uniform protocol and the mean clinical follow-up was 25.9 months (range 24-80).

RESULTS: There was one case of recurrence of infection in this series 1/27 (3.7%). The mean PENN scores in patients treated with reverse shoulder arthroplasty group (n = 17) was 61.6 ± 19.3 was not significantly different than patients with rotator cuff deficiency at the time of revision surgery treated with a hemiarthroplasty (n = 9) with a total shoulder score of 54.8 ± 29.1 points (p = 0.5821). The average postoperative motion for all patients was 117.5° ± 31.5° of forward flexion and 24.4° ± 11.1° of external rotation. Average final follow-up postoperative motion was comparable for the two groups equaling 122.3° ± 32.1° of forward flexion and external rotation 25.0° ± 5.3° in patients treated with a reverse shoulder arthroplasty and 110.0° ± 34.3° and 22.2° ± 19.2° in patients with an anatomic prosthetic and a deficient rotator cuff.

CONCLUSIONS: In patients treated with a second stage reimplantation after prosthetic shoulder infections, important consideration must be given toward soft tissue and bone deficits. Consideration should be made for a reverse shoulder arthroplasty; however, given the higher complication rates and comparable outcomes to anatomic reconstructions (TSA and hemiarthroplasty), reverse shoulder arthroplasty may not be the ideal revision arthroplasty option.

45. A Biomechanical Comparison of Biceps Tenodesis with Suture Anchor versus Thermal Tenodesis

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INTRODUCTION: Thermal tenodesis of the proximal biceps tendon may provide an alternative to traditional tenotomy while reducing the risk of development of a popeye deformity. The purpose of this study is to compare the biomechanical properties of the suture anchor to the thermal tenodesis.

METHODS: Eleven fresh-frozen, human cadaveric shoulders were randomized into two groups. For group 1 (n = 6), the proximal biceps tendon was heated using the coagulation setting of a radiofrequency wand until the tendon was approximately three times its original width and then severed. In group 2 (n = 5), a tenodesis was performed using a 4.5 PEEK suture anchor. The distal portion of the tendon was secured to a materials testing machine and the tendon was pulled in line with the bicipital groove at a rate of 10 mm/second. Peak load, displacement, and method of failure were recorded and stiffness was calculated for each specimen. Data were compared by a student's t-test for significance ($p < 0.05$).

RESULTS: The average peak load was 44.6 N for the thermal tenodesis and 161 N for the suture anchor tenodesis and this difference was significant ($p = 0.0015$). The suture anchor was also significantly stiffer than the thermal tenodesis (8.1 N/mm versus 2.2 N/mm, $p = 0.006$).

CONCLUSION: Previous studies have shown that the pullout strength of the traditional biceps tenotomy is 25 N. Our study showed that the initial biomechanical properties of the thermal tenodesis are superior to the initial biomechanical properties of previously published data on traditional tenotomy and inferior to the suture anchor tenodesis.

46. Total Distal Radioulnar Joint Arthroplasty with a Semi-Constrained Prosthesis: A Preliminary Report

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PURPOSE: We are reporting the short-term outcomes of patients undergoing placement of a new semi-constrained complete distal radioulnar joint (DRUJ) arthroplasty.

METHODS: This is a retrospective review of four patients (three female) who underwent placement of the STABILITY Sigmoid Notch Total DRUJ System (STABILITY) from 2003-2008. The four patients underwent this procedure for the following reasons: two patients had painful erosions following U-head arthroplasty, one patient had severe trauma, and one patient had a failed Sauve Kapandji procedure. Mean age at time of surgery was 43.5 years (range 35-51) and mean follow-up was 30 months (range 9-64 months). Preoperative and postoperative assessments included range of motion (ROM), grip strength, visual analog pain scale, patient satisfaction, and radiographs.

RESULTS: Final ROM showed mean pronation of 88° (range 80°-90°) and mean supination of 65° (range 45°-70°). Final grip strength on the operated extremity was 25.5 kg (73% of contralateral side). Visual analog pain scale decreased from 8 to 2.5. Patient satisfaction was 100%. One patient returned to manual labor, one returned to office work, and two patients remain off work. Postoperative radiographs depict appropriate alignment of the DRUJ.

CONCLUSIONS: Total DRUJ reconstruction is an alternative to resection in cases of severe DRUJ injury. Unipolar ulnar head replacement and bipolar total DRUJ arthroplasty have been described, with varying levels of success and length of outcome data. The STABILITY Sigmoid Notch Total DRUJ System may provide a means of decreasing pain and restoring DRUJ stability and motion following severe trauma, failed arthroplasty, or failed Sauve-Kapandji procedure.

* = presenter

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Cabanela, Miguel E.	1, 2, 3b – Stryker; 8 – Clinical Orthopaedics and Related Research; 9 – International Hip Society
Cabrera-Palacios, Hector	n
Callaci, John	n
Callaghan, John J.	1 – DePuy, a Johnson & Johnson Company; 7 – Wolters Kuwer Health – Lippincott Williams & Wilkins
Cameron, Kenneth L.	3b – Musculoskeletal Transplant Foundation
Camp, Christopher L.	n
Campagna, Elizabeth	n
Canete, Arturo C.	9 – Philippine Orthopaedic Association Foundation, Inc., Philippine Orthopaedic Trauma Society
Cannada, Lisa K.	2 – Smith & Nephew; 5 – Department of Defense, Synthes, Zimmer; 8 – Clinical Orthopaedics & Related Research, Journal of Bone and Joint Surgery-American, Journal of Orthopaedics and Traumatology, Orthopedics Today; 9 – AAOS, Ruth Jackson Orthopaedic Society, Orthopaedic Trauma Association
Capello, William N.	1 – Stryker; 3b – Stryker; 4 – Stryker
Carandang, Gerard	n
Carlson, Michael J.	n
Carolin, Chelsea	n

Caskey, Paul M.	n
Cass, Joseph R.	4 – K2M; 9 – Orthopaedic Trauma Association
Chadha, Harbinder S.	2, 3b – Wright Medical Technology, Inc.
Chaudhari, Ajit W.	n
Cheng, Edward Y.	1 – Innomed; 4 – Fulfillium, Inc., Sensurtec, Inc.; 5 – Aastrom Biosciences; 6 – Musculoskeletal Transplant Foundation; 8 – Journal of Bone and Joint Surgery-American; 9 – Musculoskeletal Tumor Society
Childs, Dylan	n
Choate, Walter S.	n
Chong, Alexander C. M.	n
Chow, James C.	2 – Wright Medical Technology, Inc.; 3b – Smith & Nephew, Wright Medical Technology, Inc.; 5 – Wright Medical Technology, Inc.
Chubinskaya, Susanna	5 – Joint Restoration Foundation, Regentis, LLC, Zimmer; 9 – International Cartilage Repair Society, Orthopaedic Research Society, OsteoArthritis Research Society
Ciarelli, Kristin	n
Cipriano, Cara A.	n
Clark, Randy R.	n
Classie, Justin	n
Clohisy, John C.	3b - Biomet; 5 – Wright Medical Technology, Inc., Zimmer, Inc. (Clinical Research Grant); 8 – Journal of Bone and Joint Surgery-American (Associate Editor); 9 – Mid-America Orthopaedic Association
Coale, Robert M.	n
Cofield, Robert H.	1 – DJ Orthopaedics, Smith & Nephew; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins
Colbrunn, Robb W.	n
Cole, Brian J.	1 – Arthrex, Inc., DJ Orthopaedics, Elsevier, Lippincott; 2 – Genzyme; 3b – Allosource, Arthrex, Inc., Biomimmetic, Carticept, DePuy, Zimmer; 5 – Arthrex, DJ Orthopaedics, Regentis, Smith & Nephew; 7 – Elsevier, Lippincott, WB Saunders; 8 – AJO, AJSM, Cartilage, Elsevier, JBJS, JSES
Cole, Peter A.	3b – Synthes; 5 – Acumed, DePuy, Smith & Nephew, Stryker, Synthes, Zimmer
Collinge, Cory A.	1 – Advanced Orthopedic Systems, Biomet, Smith & Nephew; 3b – Biomet; 8 – Journal of Orthopaedics & Traumatology; 9 – Foundation for Orthopedic Trauma
Cook, Laurence	n
Cooper, Ross J.	n
Cordill, Ronda	n
Coulibaly, Marlon O.	n
Creevy, William R.	n
Crist, Brett D.	5 – KCI, Medtronic, Novalign, Smith & Nephew, Stryker, Synthes, Wound Care Technologies; 8 – Journal of Orthopaedic Trauma, Your Orthopaedic Connection; 9 – Orthopaedic Trauma Association
Crosby, Colin G.	n
Dahm, Diane L.	n
Daluga, Andrew T.	n
D'Antonio, James A.	1, 2, 3b, 5 – Stryker
Davis, Adrian T.	5 – Synthes, Zimmer
de Beaubien, Brian C.	2, 3b – Stryker

DeFor, Todd E.	n
Della Rocca, Gregory J.	4 – Amedica; 5 – Smith & Nephew, Stryker, Synthes, Wound Care Technologies; 8 – Journal of Bone and Joint Surgery-American, Journal of Orthopaedic Trauma, Journal of the AAOS; 9 – AAOS, Orthopaedic Trauma Association
Della Valle, Craig J.	3b – Angiotech, Biomet, Kinamed, Smith & Nephew; 5 – Pacira, Zimmer; 8 – Orthopedics Today; 9 – American Association of Hip and Knee Surgeons, Arthritis Foundation
Dennison, David G.	5 – DePuy, a Johnson & Johnson Company
DeSilva, Gregory L.	4 – Pfizer
DeSilva, Stephen P.	n
DeSmet, Arthur A.	n
Determann, Jason R.	n
Dhurairaj, Thiruvenkatasam	n
Dilisio, Matthew F.	n
Dobrasevic, Nikola	n
Donaldson, Christopher	n
Douglas, Keith C.	n
Downing, Devin	n
Drake, Gregory N.	n
Duey, Richard E.	n
Duncan, Douglas D.	5 – Biomet
Dunn, Warren R.	6 – Arthrex, Inc.
Dutton, Jason R.	n
Earhart, Jeffrey S.	n
Edwards, Sara L.	n
Eggers, Jonathan	n
Elhassan, Bassem T.	n
Elias, John	6 – Arthrex, Inc.
Ellison, Bradley S.	n
Elwood, Justin	n
Endres, Terrence J.	n
Engh, C. Anderson, Jr.	1, 2, 3b – DePuy, a Johnson & Johnson Company; 4 – DePuy, a Johnson & Johnson Company, Stryker; 5 – DePuy, a Johnson & Johnson Company, Inova Health Care Services, Smith & Nephew; 9 – American Association of Hip and Knee Surgeons
Erez, Orry	n
Esquivel, Amanda	n
Evans, Peter J.	n
Even, Jesse L.	n
Everhart, Joshua S.	n
Ewald, Timothy J.	n
Fabi, David W.	n
Fabing, Meredith H.	n
Faschinbauer, Maximilian	n
Fazalare, Joseph J.	n
Fisher, Brent E.	n
Fisher, David A.	1, 2, 3b – DePuy, a Johnson & Johnson Company; 3c – Orthopediatrics; 4 – Eli Lilly, Incisive Surgical, Pfizer, Tornier, Visible Assets; 5 – DePuy, a Johnson & Johnson Company, Incisive Surgical
Fitzgibbons, Timothy C.	n
Flanigan, David C.	2 – Genzyme; 6 – Arthrex, Inc., Biomet, Mitek, Smith &

	Nephew
Fleck, Erin E.	n
Flynn, Jeffrey C.	9 – American Board of Medical Laboratory, Association of Medical Laboratory Immunology
Foran, Jared R.	n
Ford, Adrienne	n
Foreman, Keith A.	n
Fournie, Anne	n
Frampton, Caroline	n
Frank, Rachel	n
Freeman, Andrew L.	5 – K Spine, Medtronic, Smith & Nephew, Stryker, Trans 1
Freitag, Per	2 – Alphatec Spine
Froelich, Jerry W.	n
Froimson, Mark I.	1 – DePuy Orthopaedics; 4 – Medical Compression Systems; 6 – Centocor
Gad, Bishoy V.	4 – Advanced Cell Technology, Inc.
Gallo, Theresa J.	n
Galvin, Joseph W.	n
Garcia, E'Stephan J.	n
Gardner, Michael J.	3b – Amgen Co, DGIMed, Synthes; 5 – Amgen Co., Synthes; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 9 – Orthopaedic Trauma Association
Gardocki, Raymond J.	n
Gartsman, Gary M.	1 – Ferring Pharmaceuticals, Smith & Nephew; 2, 3b, 5, 6 – Smith & Nephew, Tornier; 4 – Tornier; 7 – Elsevier; 8 – Techniques in Shoulder and Elbow Surgery
Garvin, Kevin L.	1 – Biomet; 2 – ConvaTec; 3a – Biomet; 7, 8 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 9 – AAOS, American Orthopaedic Association
Gayton, J. Christopher	n
Geissler, Jacqueline A.	n
George, Alyssa	n
Gerlinger, Tad L.	9 – Society of Military Orthopaedic Surgeons
Ghanayem, Alexander J.	8 – Journal of Spinal Disorders and Techniques; 9 – AAOS, American Orthopaedic Association, Cervical Spine Research Society, Lumbar Spine Research Society, North American Spine Society
Gioe, Terence J.	4 – Eli Lilly, Johnson & Johnson ; 5 – DePuy, a Johnson & Johnson Company; 9 – American Board of Orthopaedic Surgery, Inc., American Joint Replacement Registry
Giuffre, Jennifer	n
Goetz, Devon D.	8 – Clinical Orthopaedics and Related Research; 9 – Society for Arthritic Joint Surgery
Goitz, Henry T.	n
Goldberg, Benjamin A.	2, 3b – Acumed, LLC, Allen Medical, Aston, Stryker
Goldberg, Victor M.	2, 3b – Astrazenica, Osteotech; 4 – TissueLink; 5 – NIH, Sultzer/Zimmer; 7 – Elsevier; 8 – Clinical Orthopaedics and Related Research, Journal of Bone and Joint Surgery-American, Journal of Orthopaedic Research, Osteoarthritis and Cartilage; 9 – Bioinnovations Institute, OASRI
Gonzalez, Mark H.	1 – Johnson & Johnson; 3b – Smith & Nephew; 4 – Ortho Sensing Technology
Goodman, Gens P.	n
Gough, Brandon E.	n

Gourineni, Prasad V.	n
Gradisar, Ian	n
Grau, Luis C.	n
Greeson, Clay B.	n
Greenwald, A. Seth	n
Grier, Kathleen M.	n
Grimshaw, Charles S.	n
Gryzlo, Stephen M.	n
Guo, Xin	n
Gustilo, Ramon B.	1 – Smith & Nephew; 3c, 4, 6, 8, 9 – Orthopaedic International, Inc. (Philippines)
Guymon, Charles H.	n
Hanssen, Arlen D.	1 – Ortho Development Corp., Stryker; 5 – Biomet, a Johnson & Johnson Company, Stryker, Zimmer; 9 – Knee Society, President
Harris, Joshua D.	n
Harris-Hayes, Marcie	n
Hartzband, Mark A.	1, 2, 3b, 5 – Zimmer
Hattrup, Steven J.	3b – Zimmer
Havey, Robert M.	n
Hawn, Mary	n
Hebert-Blouin, Marie-Noelle	n
Heinlein, Kate	n
Hellman, Edward J.	2, 3b – NovoNordisk, Stryker
Helming, Jarrett	n
Helmy, Hany F.	5 – Corin U.S.A.
Henderson, William	n
Henely, Joan	n
Higuera, Carlos A.	n
Himes, Ryan	n
Ho, Jason	n
Hoffmann, Martin F.	n
Horazdovsky, Ryan D.	n
Horne, Walter	n
Horton, Walter	n
Hosalkar, Harish S.	2, 3b – Synthes; 4 – GlaxoSmithKline, Johnson & Johnson, Pfizer; 5 – Zimmer; 7 – Journal of Bone and Joint Surgery-American, Turner White
Houston, Thomas	n
Howell, Stephen M.	1 – Biomet; 2, 3b – Biomet, Stryker; 7 – Saunders/Mosby-Elsevier; 8 – American Journal of Sports Medicine, Knee
Howell, Steven J.	n
Hoyen, Harry A.	n
Hsu, Joseph R.	5 – The Geneva Foundation; 9 – Society of Military Orthopaedic Surgeons
Huang, Der-Chen Tim	n
Hughes, Michael S.	n
Huh, Jeannie	n
Huo, Michael H.	2 – Genzyme, King Pharmaceutical, Sanofi-Aventis; 3b – Cadence, King Pharmaceutical, Salient Surgical, Sanofi-Aventis, Stryker; 9 – American Association of Hip and Knee Surgeons
Iannotti, Joseph P.	1 – DePuy, a Johnson & Johnson Company; 3b – DePuy, a Johnson & Johnson Company, Tornier, Wyeth; 7 – Wolters

	Kluwer Health – Lippincott Williams & Wilkins; 8 – Journal of Shoulder and Elbow Surgery
Inda, David J.	n
Iorio, Timothy E.	n
Israel, Heidi	n
Jackson, Nancy M.	n
Jacobs, Michael A.	1, 2 – Biomet, Smith & Nephew; 3b – Biomet, Corin U.S.A.; 6 – Brainlab; 8 – Journal of Arthroplasty
Jacques, Lina	n
Jacquet, Robin	n
Jain, Neel P.	n
Jen, Jin	n
Johnson, Todd C.	n
Johnston, Richard C.	n
Jones, Clifford B.	2 – AONA; 8 – Clinical Orthopaedics and Related Research, ORR, JBJS, Journal of Orthopaedic Trauma, Journal of Trauma, OCNA
Jones, Grant L.	3c – Arthrotek; 5 – Biomet, Genzyme; 9 – American Orthopaedic Society for Sports Medicine
Jones, Kerwyn C.	3c – Orthopediatrics; 7 – Cambridge Publishing
Jorgensen, Anton Y.	n
Joyce, Timothy	n
Jung, Edward	n
Jürgens, Christian	n
Kadakia, Anish R.	3b – Synthes
Kaeding, Christopher C.	n
Kakar, Sanjeev	n
Kalisvaart, Michael	n
Kalore, Niraj V.	n
Kamien, Przemyslaw M.	n
Kang, Richard W.	n
Kaufman, Kenton R.	1 – Otto Bock HealthCare; 8 – Gait and Posture
Kazemi, Namdar	n
Keene, James S.	9 – American Orthopaedic Society for Sports Medicine
Keeney James A.	9 – Society of Military Orthopaedic Surgeons
Keiser, Seth	n
Kempton, Laurence B.	n
Kennedy, William R.	5, 6 – Corin U.S.A.
Kercher, Jim	n
Kersten, Andrew D.	n
Kesto, William K.	n
Khalil, Jad G.	n
Khazzam, Michael S.	n
Kim, Young-Jo	n
Kirby, Jess M.	n
Kirkpatrick, Marcus	n
Kistler, Kristin D.	n
Klaskala, Winslow	n
Klein, Gregg R.	2 – Zimmer; 3b – Biomet, Zimmer; 8 – American Journal of Orthopedics
Klika, Alison K.	n
Klonk, Christopher	n
Knavel, Erica M.	n
Kolowich, Patricia A.	9 – American Orthopaedic Society for Sports Medicine,

	Arthroscopy Association of North America
Konigsberg, Beau S.	n
Kovacevic, David	n
Kovachevich, Rudy	n
Kraisarin, Jirachart	n
Krebs, Viktor E.	1 – Shukla Medical (Extract-All); 2 – Shukla Medical (Extract-All), Salient Surgical, Stryker; 3b – Shukla Medical (Extract-All), Stryker
Kregor, Philip J.	3c – AO Technical Commission, Synthes
Kreofsky, Cole R.	n
Krueger, Chad A.	9 – AAOS (Communications Cabinet Member)
Krych, Aaron J.	n
Kuhn, John E.	1 – Pfizer; 5 – Arthrex, Inc.; 8 – Journal of Shoulder and Elbow Surgery
Kuhn, Margaret G.	n
Kukkar, Nittin	n
Kumar, Ajay	n
Kunkel, Sanford S.	n
Kurtz, William	n
Kwong, Louis M.	3b – Zimmer; 5 – Astellas Bayer Takeda; 8 – Journal of Surgical Orthopaedic Advances
Lake, Jason E.	n
Landis, William	n
Larkin, Brian J.	n
Lauing, Kristen	n
Lawless, Matthew W.	n
Lawton, Jeffrey N.	3b – Innomed, SBI
Lee, Ho H.	n
Lee, Kyla R.	n
Lemos, David	n
Lemos, Stephen E.	8 – American Journal of Sports Medicine, Arthroscopy; 9 – CORD – AOA, Michigan Orthopaedic Society
Lerner, Benjamin A.	n
Les, Clifford M.	n
Levine, Brett R.	2 – Angiotech, Ethicon; 3b – Zimmer; 5 – Biomet, Zimmer; 8 – Hospital for Joint Disease Bulletin Rush Year in Review; 9 – AAOS
Levine, Harlan B.	2 – Zimmer; 3b - Biomet; 8 – Journal of Arthroplasty
Levy, Bruce A.	1 – VOT Solutions; 3b – Arthrex, Inc.; 8 – Journal of Knee Surgery, Knee Surgery, Sports Traumatology, Arthroscopy
Lewallen, David G.	1, 2 – Zimmer; 3b – Orthosonics, Osteotech, Zimmer; 8 – Clinical Orthopaedics and Related Research; 9 – American Association of Hip and Knee Surgeons, Hip Society, Mid-America Orthopaedic Association, OREF
Lewis, T. R.	n
Lieberman, Jay R.	3b – DePuy, a Johnson & Johnson Company; 5 – Amgen Co., Arthrex, Inc.; 8 – Journal of Arthroplasty, Journal of the AAOS; 9 – AAOS, American Association of Hip and Knee Surgeons
Lindgren, Kevin E.	n
Liu, Steve S.	n
Lock, Terrence R.	n
LoGrasso, Mary	n
Lowder, Elizabeth	n

Mabry, Tad M.	4 – Pfizer, Merck
Machen, M. Shaun	n
Maddox, Grady E.	n
Maheshware, Aditya V.	n
Mai, Matthew C.	n
Mainers, Jan	n
Malawer, Martin M.	n
Manning, David W.	2 – Biomet, Smith & Nephew; 3b – Biomet, Smith & Nephew
Manoli, Arthur, II	1 – DJ Orthopaedics; 2 – Stryker, Synthes; 6 – Synthes; 8 – Foot and Ankle International; 9 – Michigan Orthopaedic Society
Manza, Stephanie G.	n
Markel, David C.	2, 3b – Stryker; 4 – Biogen, Novi Bone and Joint Center, Pfizer, Stryker; 5 – Stryker; 8 – Clinical Orthopaedics and Related Research, Journal of Arthroplasty, Journal of Bone and Joint Surgery-American, Osteoarthritis and Cartilage; 9 – AAOS, American Association of Hip and Knee Surgeons, Michigan Orthopaedic Society
Markert, Ronald J.	n
Marsh, J. Lawrence	1 – Biomet; 7 – Oxford Press; 9 – ABOS, American Orthopaedic Association, Orthopaedic Trauma Association
Marshall, Emily	n
Marshall, Kathleen	n
Martell, John M.	3b – Biomet, Harris Foundation, Smith & Nephew, Stryker, Zimmer
Martens, Kelly A.	6 – Stryker, Tornier
Mayer, Theodore	n
McArthur, Samuel	n
McBurney, Denise	n
McCoy, Brett W.	n
McGwin, Gerald	n
McIff, Terence E.	9 – Orthopaedic Research Society
McKinley, Todd O.	n
McLaughlin, Jeffrey R.	n
McMullen, Scott T.	4 – Orthologic
McQueen, David A.	n
Medvecky, Michael J.	2 – Smith & Nephew; 5 – Wyeth
Mehle, Susan	n
Mellecker, Chloe	n
Mende, Katrin	n
Meneghini, R. Michael	3b, 5, 6 – Stryker
Merk, Bradley R.	2 – Stryker, Synthes; 3b – Stryker; 5 – Stryker, Synthes; 8 – American Journal of Orthopedics
Michael, Andrew W.	n
Milbrandt, Joseph C.	5 – Corin U.S.A.
Millis, Michael B.	n
Mills, Roger	n
Misfeldt, Michael	n
Mitchell, Erika J.	n
Moed, Berton R.	1 – DePuy, a Johnson & Johnson Company; 5 – Stryker; 7 – Clinical Orthopaedics and Related Research; 8 – Clinical Orthopaedics and Related Research, Journal of Orthopaedic Trauma, Injury
Molloy, Robert M.	5 – Stryker

Moodie, Patrick G.	n
Moore, Christopher A.	n
Moran, Steven L.	1, 2 – Ascension; 8 – Journal of Hand Surgery-American
Moravek, James E.	n
Morgan, Joseph A.	n
Moric, Mario A.	n
Morrey, Bernard F.	1 – SBI DonJoy; 3b – Zimmer; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins, Elsevier
Morrey, Mark E.	n
Morris, William Z.	n
Morscher, Melanie	n
Mott, Michael P.	4 – Johnson & Johnson; 5 – GE Healthcare; 9 – Mid-America Orthopaedic Association
Moutzouros, Vasilios	n
Mueller, Benjamin	n
Muh, Stephanie J.	n
Mumoh, Enesi	n
Murphy, Steven	n
Murray, Clinton D.	n
Murray, Michael R.	n
Murray, Trevor G.	n
Murtha, Yvonne M.	n
Myer, Daniel M.	n
Naik, Rishi	n
Nathan, Senthil T.	n
Naughton, Marybeth	3a, 4 – Stryker
Neary, Kaitlin C.	n
Neely, Gregory M.	n
Nelson, Christopher D.	n
Nepple, Jeffrey J.	n
Nho, Shane J.	3b – Stryker ; 5 – Arthrex, Inc., Athletico, DJ Orthopaedics, Linvatec, Miomed, Smith & Nephew
Nikolaus, O. Brant	n
Noe, Donald A.	n
Nuber, Gordon W.	4 – Johnson & Johnson, Stryker; 5 – Sage Pharmaceuticals
Nunley, Ryan M.	3b – Salient Surgical, Smith & Nephew, Wright Medical Technology, Inc.; 5 – Biomet, Biospace, Mobile Compression Systems, Smith & Nephew, Stryker, Wright Medical Technology Inc.
Obermeyer, Thomas S.	n
O'Boynick, Christopher P.	n
Obremskey, William	8 – Clinical Orthopaedics and Related Research, Journal of the AAOS, Journal of Bone and Joint Surgery-American, Journal of Orthopaedics and Traumatology
Ochoa, Leah M.	n
Ode, Gabrielle	n
O'Donnell, Patrick W.	n
O'Driscoll, Shawn W.	1 – Acumed, LLC, Aircast (DJ), Tornier; 2 – Acumed, LLC;
Olomu, Eghosa A.	n
Olszewski, Dana	n
Omar, Imran	n
Otto, Robert J.	n
Otto, Thomas J.	n
Owens, Brett D.	8 – American Journal of Sports Medicine, Journal of Surgical

	Orthopaedic Advances, Orthopedics; 9 – AAOS, American Orthopaedic Society for Sports Medicine, Society of Military Orthopaedic Surgeons
Owens, Christopher J.	n
Pagnano, Mark W.	1 – DePuy, a Johnson & Johnson Company, MAKO; 5 – Zimmer; 7, 8 – Clinical Orthopaedics and Related Research; 9 – Knee Society
Pangrazzi, Garett J.	n
Paprosky, Wayne G.	1 – Wright Medical Technology, Inc., Zimmer; 2 – Zimmer; 3b – Biomet, Zimmer; 7, 8 – Journal of Arthroplasty; 9 – Hip Society
Parsons, Theodore W.	5 – GE Healthcare; 9 – American Orthopaedic Association, Michigan Orthopaedic Society, Musculoskeletal Tumor Society, Society of Military Orthopaedic Surgeons
Pascual-Garrido, Cecilia	n
Pashos, Gail	4 – GlaxoSmithKline
Passanise, Angela M.	n
Patel, Preetesh D.	n
Paterson, William H.	n
Patwardhan, Avinash G.	n
Pedroza, Angela	n
Penello, Daniel	n
Penenberg, Brad L.	1, 2, 3b, 5 – Wright Medical Technology, Inc.; 4 – Radlink Corp.
Perry, Kevin I.	n
Peterson, Blake	n
Peterson, Ed	n
Petty, Carter	n
Pichkofsky, Howard	n
Pierce, Lori L. A.	n
Pirola, Elena	n
Plantikow, Carla J.	n
Podeszwa, David A.	n
Polavarapu, Mahesh	n
Polly, David W., Jr.	9 – Scoliosis Research Society
Ponce, Brent A.	2 – Arthrex, Inc., Tornier
Postak, Paul	5 – Amedica, ConforMIS, Encore Medical, Integra LifeSciences, Kapp Surgical, Maxx Health, Nuvasive, OmniLife Sciences, OrthoHelix, SBI, Synvasive, TJO, Wright Medical Technology, Inc.
Potluri, Tejaswy	n
Prayson, Michael J.	2 – AO faculty, Smith & Nephew; 3b – Smith & Nephew; 5 – Smith & Nephew, Synthes; 8 – Acta Orthopaedica, Journal of Orthopaedic Trauma, Journal of Trauma; 9 – Wright State Physicians, Inc.
Price, Nigel J.	n
Prifti, Dritan	n
Raaii, Farhang	n
Randolph, Joseph C.	5 – Cool Systems, Inc.; 9 – Indiana Orthopaedic Society
Ren, Weiping	n
Ren, Yupeng	n
Rerko, Michael A.	n
Rhee, Peter C.	n
Ricci, William M.	1, 2, 3b, 3c – Smith & Nephew, Wright Medical Technology,

	Inc.; 5 – AONA, Smith & Nephew, Synthes, Wright Medical Technology; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 8 – Journal of Orthopaedic Trauma, Wolters Kluwer Health – Lippincott Williams & Wilkins; 9 – Orthopaedic Trauma Association
Rich, Mark M.	n
Richards, Justin E.	n
Richman, Joshua	n
Riester, Scott M.	n
Riggenbach, Michael D.	n
Riley, Michelle	n
Ringler, James R.	n
Ritzman, Todd	n
Rivkin, Gurion	n
Roberts, Craig S.	5 – Synthes; 7 – Skeletal Trauma; 8 – Injury (Deputy Editor), Journal of Orthopaedic Trauma (Editorial Board), 9 – American Academy of Orthopaedic Surgeons (Evaluation Committee), Mid-America Orthopaedic Association, Orthopaedic Trauma Association (Public Relations Committee), Kentucky Orthopaedic Society (Vice-President)
Robinson, Deborah E.	n
Rogerson, John S.	n
Rolston, Lindsey	1, 3b, 5 – Smith & Nephew
Rose, Peter S.	9 – AAOS, Minnesota Orthopaedic Society, Scoliosis Research Society
Rosenberg, Keith	n
Rubino, L. Joseph	n
Rudert, M. James	n
Ruh, Erin L.	n
Sabesan, Vani J.	n
Sadr, Kamran N.	n
Saltzman, Matthew D.	2 – CareFusion, DJ Orthopaedics; 5 – Arthrex, Inc.
Sami, Syed A.	n
Sanchez-Sotelo, Joaquin	1 – Stryker; 5 – DePuy, Stryker, Zimmer; 8 – Journal of Shoulder and Elbow Surgery
Santos, Edward R. G.	5 – Medtronic; 6 – Synthes
Sarr, Michael G.	n
Sassoon, Adam A.	n
Scallon, Greg L.	n
Schneider, Erika	n
Schoenecker, Perry L.	8 – Journal of Orthopaedic Research
Schoenfeld, Andrew J.	9 – AAOS
Schrickel, Tyson T.	n
Schroeppel, J. Paul	n
Schulz, A. Peter	n
Sekiya, Jon K.	1 – Arthrex, Inc., OrthoDynamix, LLC; 3b – Arthrex, Inc.; 3c, 4 – OrthoDynamix, LLC; 7 – Elsevier; 8 – Sports Medicine and Arthroscopy Review; 9 – American Orthopaedic Society for Sports Medicine Council of Delegates and Education Committee
Sembler Soles, Gillian L.	n
Sembrano, Jonathan N.	5 – Nuvasive
Severson, Erik P.	n
Sferra, James J.	n

Shah, Kushal	n
Shah, Nirav	n
Shah, Smiresh S.	n
Sharma, Amit K.	n
Sherman, Courtney E.	n
Sheth, Neil P.	n
Shin, Alexander Y.	5 – Integra Life Sciences, Musculoskeletal Transplant Foundation
Shortt, Michael	n
Sieg, Ryan N.	n
Sierra, Rafael J.	3b – Biomet; 5 – DePuy, a Johnson & Johnson Company, Stryker, Zimmer; 9 – Maurice Mueller Foundation, Mid-America Orthopaedic Association
Sietsema, Debra L.	2, 3b – Eli Lilly
Singer, Mendel E.	n
Singh, Jasvinder	3b – EuroRSG, Novartis, Savient, URL Pharma; 5 – Takeda, Savient; 8 – Journal of Clinical Rheumatology Biomedical central MSK disease
Sink, Ernest L.	3b – Biomet; 9 – Pediatric Orthopaedic Society of North America
Siston, Robert A.	n
Slinkard, Nathaniel J.	n
Smith, Travis	n
Smits, Shelly A.	n
Smyth, Kathleen	n
Sneddon, Nathan E.	n
Song, Zheng	n
Speering, Leann M.	n
Sperling, John W.	1 – Biomet, DJ Orthopaedics; 3b – Tornier; 4 – Emerge Surgical, Tornier; 8 – Journal of Shoulder and Elbow Surgery
Spinner, Robert J.	3b – Mayo Medical Ventures; 8 – Clinical Anatomy, Journal of Surgical Orthopaedic Advances, Mayo Clinic Proceedings, Neurosurgery, World Neurosurgery; 9 – Joint Sections Spine/Peripheral Nerve, American Society for Peripheral Nerve
Sporer, Scott M.	3b – Smith & Nephew, Zimmer; 5 – Coolsystems; 7 – SLACK Incorporated
Sraj, Shafic A.	n
St. John, Lauren	n
St. Peter, Shawn	n
Stannard, James P.	2 – KCI, Medtronic Sofamor Danek; 3b – KCI, Medtronic Sofamor Danek, Novalign; 5 – Synthes; 7 – Theime; 8 – Journal of Knee Surgery; 9 – Orthopaedic Trauma Association
Stefl, Michael	n
Steger-May, Karen	7 – Pfizer Lilly
Steinmann, Scott P.	1 – DePuy, a Johnson & Johnson Company; 3b – Arthrex, Inc., DePuy, a Johnson & Johnson Company, Wright Medical Technology, Inc.; 5 – Wright Medical Technology, Inc.; 7 – Journal of Hand Surgery-American, Journal of Shoulder and Elbow Surgery, Yearbook of Hand Surgery
Stock, Stuart	n
Stonestreet, Matthew	n
Stouffer, Mark H.	5 – Smith & Nephew

Stover, Michael D.	5 – Synthes
Streubel, Phillipp	n
Strnad, Gregory	n
Strong, Clayton E.	n
Stuart, Chris	n
Stuart, Michael J.	3b – Arthrex, Inc., Fios; 5 – Stryker; 8 – American Journal of Sports Medicine; 9 – AAOS, American Orthopaedic Society for Sports Medicine
Stucken, Charlton	n
Stulberg, Bernard N.	1 – Exactech, Inc.; 2 – Sanofi-Aventis; 3b – Exactech, Inc., Stryker; 5 – Corin U.S.A.; 8 – Journal of Arthroplasty; 9 – Mid-America Orthopaedic Association
Stulberg, S. David	1 – Aesculap/B. Braun, Biomet, Innomed, Omniscience; 2 – Aesculap/ B. Braun, Genzyme, Stryker, Zimmer; 3b – Aesculap/B. Braun, OmniScience, Stryker, Zimmer; 4 – Johnson & Johnson, Stryker; 7 – Peachtree Publishers
Sturgis, Lindsey A.	n
Styron, Joseph F.	n
Su, Edwin P.	3b – Smith & Nephew; 5 – Cool Systems, Inc., Smith & Nephew; 8 – American Journal of Orthopedics
Sucato, Daniel J.	2 – Medtronic; 7 – Saunders/Mosby-Elsevier; 9 – AAOS, Pediatric Orthopaedic Society of North America, Scoliosis Research Society
Sullivan, Jaron P.	n
Sullivan, Jason P.	n
Sun, Yu Long	n
Sundberg, Stephen B.	n
Suri, Misty	n
Svoboda, Steven J.	9 – AAOS, American Orthopaedic Society for Sports Medicine
Swaims, Chad	n
Swann, Russell P.	n
Swiontkowski, Marc F.	3b – Baxter Healthcare, Eli Lilly, Wyeth; 7 – Saunders/Mosby-Elsevier, Wolters Kluwer Health, Lippincott Williams & Wilkins; 8 – Journal of Bone and Joint Surgery-American; 9 – American Board of Medical Specialties, American Orthopaedic Association, Mid-America Orthopaedic Association
Tank, Jason C.	n
Tatman Penny	n
Tellez, Alejandra	n
Templeton, Kimberly J.	3c – Zimmer; 9 – Bone and Joint Decade, U.S.A.
Terry, Michael A.	1 – Smith & Nephew; 2 – Victory Pharmacy Magellan; 3b – DePuy, a Johnson & Johnson Company, Linvatec, Smith & Nephew; 6 – Smith & Nephew; 7 – Saunders/Mosby-Elsevier
Thedens, Daniel R.	n
Theiss, Steven M.	2, 3b – Biomet, Synthes; 5 – Synthes; 9 – American Spinal Injury Association
Thompson, Kevin	n
Thomson, A. Brian	5 – Biomimetic; 9 – American Orthopaedic Foot and Ankle Society
Throckmorton, Thomas W.	2, 5 – Biomet
Todd, Michael S.	n
Tompkins, Bryan J.	9 – Pediatric Orthopaedic Society of North America

Toor, Aneet	n
Tornetta, Paul, III	1, 3b – Smith & Nephew; 7 – Wolters Kluwer Health – Lippincott Williams & Wilkins; 8 – Journal of Bone and Joint Surgery-American; 9 – American Orthopaedic Association
Trappey, George J., IV	n
Tressler, Marc	9- American Osteopathic Academy of Orthopedics
Trinh, Thai Q.	n
Trousdale, Robert T.	1 – DePuy, a Johnson & Johnson Company, Wright Medical Technology, Inc., ortho development; 3b – DePuy, a Johnson & Johnson Company, Wright Medical Technology, Inc.
Truchan, Lisa M.	n
Trumm, Bryan	n
Tsitsopoulos, Parmenion P.	n
Tubb, Creighton C.	4 – Pfizer; 5 – Stryker
Turner, Norman S.	n
Uppal, Harmeeth	n
Utz, Christopher J.	n
Vade BonCoeur, Daniel	n
Van Demark, Robert E., III	n
Van de Bogert, Antonie J.	n
Van Holsbeeck, Marnix T.	4 – Bristol-Myers Squibb, GE Healthcare, Johnson & Johnson, Norvartis; 5 – GE Healthcare; 7 – Saunders/Mosby-Elsevier; 8 – Journal of Clinical Ultrasound
Van Thiel, Geoffrey S.	n
Vanderhave, Kelly L.	n
Vaughn, Joshua	n
Venkatarayappa, Indresh	n
Verma, Nikhil N.	n
Villarama Dungca, III, Godofredo	n
Voigt, Christine	n
Voll, Anthony E.	n
Voronov, Leonard I.	n
Vourazeris, Jason D.	n
Wagner, Eric	n
Walker, John J.	n
Wang, Vincent M.	8 – Journal of Knee Surgery
Warlick, Bradley Q.	n
Warth, Lucian C.	n
Waterman, Brian R.	n
Watson, J. Tracy	1 – DePuy, a Johnson & Johnson Company, Smith & Nephew; 3b – Digimed; 3c – Accelalox; 8 – Ortho Knowledge Online; 9 – Foundation for Orthopedic Trauma, National Trauma Institute, Orthopaedic Trauma Association
Weichel, Derek W.	n
Weiner, Dennis S.	n
Weiner, Scott D.	n
Weisburger, Michael C.	n
Wells, Christopher W.	n
Wendt, Matthew C.	n
Wera, Glenn D.	n
Wiater, J. Michael	2 – Zimmer; 3b – Synthes, Zimmer; 8 – Journal of the AAOS, Journal of Bone and Joint Surgery-American, Journal of Shoulder and Elbow Surgery, Saunders/Mosby-Elsevier; 9

	– AAOS, American Shoulder and Elbow Surgeons
Wijdicks, Coen A.	n
Wildgoose, Peter	n
Wilson, Trent J.	n
Wojewnik, Bartosz	5 – Synthes
Wojtys, Edward M.	n
Wolf, Brian R.	8 – Arthroscopy; 9 – American Orthopaedic Society for Sports Medicine, Arthroscopy Association of North America
Wolfe, Caroline	n
Womack, James L.	n
Wong, Shing-Chung	n
Woodward, Chase	n
Wooley, Paul H.	n
Woolridge, Caitlin	n
Yaffe, Mark A.	n
Yang, Carolyn B.	n
Yonick, David	n
Yuan, Brandon J.	n
Zadzilka, Jayson D.	n
Zaltz, Ira	5 – DePuy, a Johnson & Johnson Company
Zarkadas, Peter C.	n
Zelenakova, Julia	n
Zhang, Li-Qun	n
Zhang, Zachary	n
Zhao, Chunfeng	n
Zhu, Jinjun	n
Ziemba-Davis, Mary	n
Zlowodzki, Michael P.	n