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

MAOA FIRST PLENARY SESSION
April 22, 2010

1. Patient Perceptions of Surgeon-Industry Relations

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INTRODUCTION: Little information is available on patients' perceptions of physician-industry relationships identifying any differing views between surgical and nonsurgical patients.

METHODS: Two groups of surgical patients representing primary total joint arthroplasty and instrumented spinal surgery were randomly selected from all primary THAs and TKAs or instrumented spinal fusions performed between 2003 and 2007. These were matched with cohorts of nonsurgical patients with correlating diagnoses. A comprehensive survey was sent; mailing response rate was 45%. We obtained 404 usable survey responses for matched cohorts.

RESULTS: Survey responders were a mean age of 66 years and 51% were males. 93% agree or strongly agree that it is beneficial for doctors to advise the manufacturers of medical devices. 92% trust their doctor to do what is best for the patient. 82% agree that doctors should receive payment for designing implants, but 40% believe doctors should receive financial reimbursement for an advisory role. 71% agree that doctors should disclose a financial or advisory relationship. Only 27% agree that surgeon choice of implant is influenced by financial reimbursement. Nonsurgical groups respond more strongly that surgeon industry relationships increase the cost of medical care. Surgical patients were more inclined to allow doctors to make the sole choice of implants and were significantly less in favor of the patient choosing the implant. 7% believe that hospitals or insurers should have sole choice of implant. 89% believe the outcome of surgery is affected by the choice of implant.

CONCLUSIONS: The vast majority of patients surveyed believe that surgeon-industry relations are beneficial and appropriate. A large majority of patients believe that implant choice is not influenced by financial reimbursement, but surgeons should disclose any financial or advisory relationship. Most believe that implant choice affects the outcome of their surgery, and that neither hospitals nor insurers should have sole choice of implants. Age, gender, education, employment in healthcare, and prior surgery did not significantly alter these perceptions.

2. Minimum 20-Year Follow-Up of Rotating Platform Mobile Bearing TKR

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INTRODUCTION: The purpose of this study was to evaluate the minimum 20-year follow-up of a single surgeon consecutive series study of total knee replacements performed with a rotating platform design.

METHODS: 119 consecutive total knee arthroplasties were performed in 86 patients and were followed for a minimum of 20 years. Average age of the patients was 70 years (range 37-88). 34 patients were males and 52 were females. At minimum 20-year follow-up, 20 patients (26 knees) were known to be living, 64 patients (91 knees) were deceased, 1 patient (1 knee) was lost to follow-up, and 1 patient (1 knee) refused to participate. The living patients were evaluated clinically for the need of revision and with the Knee Society Score, the Hospital for Special Surgery Score, and the WOMAC Score. Radiographs were evaluated for loosening and osteolysis.

RESULTS: No knee had a revision of an implant. Two knees required reoperation for periprosthetic fracture without revision of the components. One additional knee required a liner exchange for hematogenous infection. One knee has demonstrated radiographic loosening of the femoral component. Over the 20-year follow-up, six knees have demonstrated osteolysis, two of which were extensive. Clinically, the average KSS were 89 (clinical) and 67 (functional), the average HSS score was 80, and the average scaled WOMAC score was 19.

CONCLUSIONS: Considering that gamma irradiated in air polyethylene was utilized in these cases, the durability of this cohort of TKRs has been excellent. These results have encouraged us to continue the use of mobile bearing knee replacements.

3. Return to Sports Following Total Hip Arthroplasty in Young Active Patients

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THA is being performed in younger, more active patients. The purpose of this study was to determine the participation of patients in their preferred sport(s) prior to surgery and return to that sport following primary THA.

A retrospective review of patients aged 18-60 who underwent primary THA due to non-inflammatory arthritis over a four-year period at five investigational sites was completed. Data was collected via administration of a telephone questionnaire by an independent third party survey center.

Data was collected on 710 consecutive primary THA patients with preoperative UCLA activity score of $\geq$ 6 and minimum 1 year follow-up. 63.1% were males; 36.9% were females with an average age of 49.4 years; average length of follow-up was 2.4 years. Patients were asked to list their top two most important sporting activities they had to limit prior to undergoing THA surgery. Walking and running/jogging were the activities most commonly engaged in by patients pre- and postoperatively, followed by golf, biking, basketball, and racquet sports. 557 patients (78.45%) participated in some form of recreational activity preoperatively and 374 (67.15%) of those patients have participated in at least one of their two preferred activities in the last 30 days. 504 patients (70.98%) have tried to run at least some distance since surgery while 92 patients (12.95%) are routinely running for exercise, and run an average of 5.6 miles per week.

Most young, active patients who participated in some type of sporting activity prior to primary THA returned to their preferred sport after surgery.

4. Revision Total Shoulder Arthroplasty for Painful Glenoid Arthrosis Following Humeral Head Replacement

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BACKGROUND: Primary humeral head replacement (HHR) is an option in the treatment of traumatic and non-traumatic glenohumeral arthritis. An unfortunate subset of patients, treated with HHR, will require revision to total shoulder arthroplasty (TSA) following the development of progressive glenoid arthrosis. This study seeks to characterize the outcomes of revision TSA for glenoid arthrosis in patients with an existing HHR.

METHODS: One hundred and two HHRs in 101 patients that were revised to a TSA in the treatment of glenoid arthrosis were retrospectively reviewed. All patients in this study had their revision TSA performed by the senior author, RHC, between 1981 and 2005 and had a minimum of two years clinical follow-up. Revision procedures were separated into a traumatic and a non-traumatic group for analysis, depending on whether their index HHR was performed secondary to a fracture of the humerus.

RESULTS: Fifty-six women and 46 men, with a mean age of 57 (ranging from 23 to 82), underwent a revision TSA for glenoid arthrosis following a HHR. The average time that elapsed between the index HHR and the revision TSA was 4 years (range 0.5 to 17 years). The mean follow-up for these patients was 7 years (ranging from 3 months to 20 years). Pain scores for all patients decreased from 4.3 to 2.6 ($p<0.001$). Mean abduction was increased from 79.7° to 104.9°, mean external rotation was increased from 31.7° to 47.9° ($p<0.001$), and mean internal rotation was unchanged. Modified Neer score results for all patients yielded 23 (22%) excellent, 19 (19%) satisfactory, and 60 (59%) poor outcomes. The overall, re-revision free, survivorship rate following revision TSA in all patients was 97%, 88%, and 80% at 1, 5, and 10 years, respectively. Patients who underwent their index HHR procedure without a history of humeral fracture had significantly better pain relief, active abduction, and external rotation compared to those with a history of fracture.

CONCLUSIONS: Revision TSA following HHR results in significant decreases in pain scores and increases in range of motion. Patient satisfaction rates following these revision procedures, however, are not indicative of the improvements in these parameters. Revision TSA for non-fracture related HHR results in superior outcomes when compared to revision TSA following HHR performed initially for humeral fracture.

5. Correlation of Radiographic (MRI) Appearance and Clinical Outcome in Arthroscopic Rotator Cuff Repair

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PURPOSE: Many studies have focused on clinical outcomes of arthroscopic rotator cuff repair. Other reports have focused on radiographic evidence of rotator cuff healing following repair. We wish to correlate the postoperative functional and clinical outcomes with radiographic appearance in patients undergoing arthroscopic rotator cuff repair.

METHODS: Objective measures were obtained preoperatively, and at 3, 6, 12, and 24 months postoperatively. These measures included dynamometric strength evaluation of the supraspinatus, infraspinatus, and subscapularis, goniometric range-of-motion measurements, and ASES, UCLA, and VAS scores. Fifty-seven consented to undergo MRI of the affected shoulder postoperatively. Radiographic healing was determined and graded according to the scale introduced by Sugaya. ANOVA tests and correlation scores were used to determine associations between MRI scores and outcomes.

RESULTS: At two-year follow-up, 53 (93%) patients were satisfied with their outcomes. Thirty-four (58%) of these patients demonstrated fully healed cuffs, 7 (11.5%) were intact but thin, 11 (20%) had small residual defects, and 5 (10.5%) had large residual defects. Functional (strength and range-of-motion) and clinical (ASES, UCLA, VAS) saw statistically significant improvements across the board. However, as determined by ANOVA and correlation tests, relative outcome improvement did not correlate with radiographic appearance of rotator cuff healing.

CONCLUSION: Despite radiographic evidence of differing rotator cuff repair healing, relative improvements in functional and clinical outcomes were relatively homogenous within the patient population. Save a few exceptions, all patients, regardless of MRI scores, saw significant reductions in pain and increases in shoulder functionality. These improvements were found to be completely independent of radiographic healing. This would potentially indicate that postoperative MRI potentially does not offer significant benefit in predicting the functional patient.

6. Analysis of Research Activity by Orthopedic Residency Applicants

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SUMMARY: 16% of applicants misrepresent publications in their applications; foreign medical graduate status confers increased risk. Less than 30% of publications listed as submitted resulted in publication.

BACKGROUND: Misrepresentation of publications in residency applicants has been documented previously. However, no prior studies have examined the ultimate outcome of publications listed as "submitted" or factors which correlate with misrepresentation of publications in orthopedic residency applicants.

METHODS: We reviewed all claimed English language peer reviewed publications of 413 applicants for orthopedic residency to our institution in 2007 based on the applicants Electronic Residency Application Service (ERAS). Pubmed, Internet, and library resources were used to verify publication accuracy.

RESULTS: 198 (47.9%) of the 413 applicants reported a total of 564 peer reviewed publications. Of these, 497 were in fact peer reviewed formats. 419 of these could be verified to exist (84.3% of claimed peer reviewed publications). 120 (29.1%) of the applicants reported 242 publications submitted for publication. 72 (29.7%) of these have resulted in publications a minimum 18 months after ERAS application finalization. Foreign medical graduate status was highly correlated with unverifiable publications ($p<0.001$). Sex and prior failed attempts at the USMLE were not.

CONCLUSIONS: A high percentage (15.7%) of applicants to orthopedic residency report peer reviewed publications that cannot be verified to exist. A minority of works described as submitted (29.7%) result in publication 18+ months after finalizing their application. Foreign medical graduate status correlates with a higher risk of non-verifiable publications.

7. Outcomes of Cemented THA for Post-Traumatic Arthritis Following an Acetabular Fracture

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BACKGROUND: Total hip replacement for treatment of traumatic arthritis after acetabular fracture poses a challenge to reconstructive surgeons. Most surgeons prefer hip replacement after the fracture has been stabilized and has united. This study utilized uncemented acetabular and femoral component placement, for the treatment of post-traumatic hip arthritis after acetabular fracture.

METHODS: Twenty-nine THAs were performed between 1991–2005, for post-traumatic arthritis, following acetabulum fracture treatment, at one institution. Twenty patients, 11 male, 9 female, at an average of 7.33 years (2-14) following THA, returned for follow-up. Information on five subjects, who were deceased at the time of follow-up, were included. Four patients were lost to follow-up. A physical assessment to include Harris Hip score and radiographs were obtained and subjects completed the SF-36.

RESULTS: At final follow-up, none of the hips were mechanically failed. Two patients suffered a hip dislocation with one revised. The mean Harris Hip was 80.25, (SD=16.54). The SF 36 mean was 44.09 (SD=9.12) for physical component and 50.67 (SD=10.55) for mental component. The physical component score of the SF 36 significantly and positively correlated to the Harris Hip, $r=0.61$ $p=<.01$, while the mental component had no correlation to the Harris Hip, $r=0.001$ $p=0.996$. Complications included six asymptomatic heterotopic ossification, but no infections.

DISCUSSION: THA, using uncemented acetabular components, for traumatic arthritis after acetabular fracture, shows satisfactory radiographic and clinical results.

8. MIS Pedicle Screw Fixation without Arthrodesis as Definitive Treatment for Unstable Spinal Fractures: Early Experience and Results

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INTRODUCTION: Operative treatment of thoracolumbar fractures has traditionally consisted of arthrodesis of involved motion segments, with the addition of internal fixation to provide initial stability and to improve fusion rates. While these techniques have been highly successful in treating unstable fracture, the loss of motion resulting from the fusion is often distressing to patients, and often mandates changes in occupation or activity levels.

The recent advent of MIS percutaneous pedicle screw fixation techniques and hardware have allowed the initial stabilization of thoracolumbar fractures in polytrauma patients, in an application similar to external fixation in so called “damage control orthopedics”. These early successes of MIS pedicle screw fixation without arthrodesis for polytrauma patient at our institution prompted its use as definitive treatment for isolated spinal trauma as well.

METHODS: We present a series of 14 patients with thoracolumbar or proximal thoracic fractures necessitating operative treatment that underwent definitive MIS pedicle screw fixation without arthrodesis. Patients were scheduled for elective outpatient removal of their hardware at 4-6 months. Eight patients were subsequently followed for at least one year, with repeat films at each visit and a functional assessment completed near their one-year follow-up. Six patients were followed at least six months. Films were evaluated for initial reduction, maintenance of reduction both before and after hardware removal. Operative records were also evaluated for operative time, blood loss, and fluoroscopy time.

RESULTS: With these early results, we have had no significant collapse of fractured vertebrae, no infections, excellent pain relief, and no intra-operative or postoperative complications. Our questionnaires have consistently shown high patient satisfaction rates, with a consistent sensation of significant gains in spinal motion after hardware removal. Minimal blood loss and short operating time serve to further validate these techniques as definitive treatment for unstable thoracolumbar fractures.

MAOA BREAKOUT SESSION #1
TOTAL KNEE REPLACEMENT
April 22, 2010

9. Maximizing Patient Understanding in Informed Consent for Total Knee Arthroplasty

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OBJECTIVES: Informed consent is a critical component of all surgical procedures, but patients' understanding and recall of potential risks/benefits is poor. How can surgeons maximize patient understanding and comprehension of the procedure? We hypothesized that utilization of multiple, standardized education modalities in the informed consent process would allow for better retention and a more informed patient.

METHODS: Following IRB approval and power analysis, 150 patients undergoing total knee arthroplasty (TKA) were randomized to three groups. Group I received a standardized informed consent and a handout detailing risks/benefits of TKA. Group 2 underwent the same process and also viewed video detailing risks/benefits of TKA. Group 3 underwent the same process as Group II but additionally had formal nurse education. All patients took a 15-item questionnaire at their preoperative appointment, morning of surgery, and six weeks postoperatively. Questions targeted risks, indications, and expectations of TKA addressed in the informed consent process. Data was analyzed using a t-test and ANOVA.

RESULTS: There was no difference ($p=.79$) in satisfaction with the consent process between the three groups; 92-97% of the patients rated the consent process good-excellent at all time points. Number of correct answers did not differ significantly between the groups at any time period ($p=0.31- 0.81$). Scores dropped significantly ($p=.004$) from preop to six weeks postop in all groups combined, but there was no difference ($p=.17$) between the groups. A higher level of satisfaction with the process was reflected in higher scores preoperatively in all groups ($p=0.028$).

DISCUSSION: Preoperatively, patients satisfied with the consent process may have better recall of risks/benefits and expectations of surgery. Neither retention nor satisfaction was influenced by the reinforcement methods; they may, therefore, be unnecessary. Additional studies may determine which adjuncts to the formal consent process are necessary for an informed, satisfied patient.

10. Psychosocial Profiles of Indigent Patients with Severe Osteoarthritis Requiring Arthroplasty

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INTRODUCTION: The disparity of clinical results of total joint arthroplasty (TJA) in indigent patients may be attributable to access, socioeconomic, and medical factors. This study investigates the prevalence of DSM Axis I diagnoses (i.e., Depression, Anxiety, Somatization) and their effect on initial pain, disability, function, and quality of life in an indigent population undergoing TJA.

METHODS: Consecutive indigent patients (n=226, income <$25,000) scheduled for a knee or hip arthroplasty were placed into either: a Psychologically Distressed Group (PD); or a Non-Psychologically Distressed Group (NPD). Group placement was based on the Patient Health Questionnaire (PHQ), which is a validated self-report measure used to diagnose Axis I psychopathology. Patients also completed the Short-Form (36) Health Survey, the Western Ontario McMaster (WOMAC), the Patient Disability Questionnaire (PDQ), and either the Harris Hip Score (HHS) or the Knee Society Score (KSS).

RESULTS: Thirty-eight percent (n=85) of subjects were PD, with depression being the most prevalent. The PD group had significantly lower measures on 7 of the 8 components of the SF-36, the HHS, and KSS (all $p<0.05$). The PD group scored significantly higher on the WOMAC ($p<0.001$) and the PDQ ($p<0.001$).

CONCLUSIONS: There is a high prevalence of psychopathology in the indigent population undergoing TJA and they are more likely to exhibit poorer scores in pain, disability, function, and quality of life prior to surgery. These findings may help explain the disparity in outcomes of indigent patients undergoing TJA.

11. National Trends in Primary Total Knee Arthroplasty: A Population-Based Study

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INTRODUCTION: Data on national trends for total knee arthroplasty is limited. The aim of this study was to describe these trends in the past 15 years in patients undergoing primary total knee replacement.

METHODS: The National Hospital Discharge Surveys (NHDS) from 1990 to 1994 and from 2002 to 2006 were used. The data was weighted to allow national estimates. Only patients 50 years or older who underwent primary total knee arthroplasty for osteoarthritis were selected. Changes in demographics, hospital stay, mortality, disposition, and payment were reported.

RESULTS: A total of 776,065 procedures were estimated in the period 1990-94 and 2,130,531 in 2002-06. Average age in the first group was 70 years vs. 68 years in the second group ($p<0.001$) with 8.0% of patients being non-white vs. 9.4% respectively ($p<0.001$). Mean length of stay was 8.4 days vs. 3.9 days ($p<0.001$) with a higher percentage of patients discharged to short/long-term facilities in the most recent period (21.2% vs. 40.8%; $p<0.001$). Hospitals with less than 300 beds were more common in the most recent group (63.1% vs. 72.2%; $p<0.001$) with Medicare paying less of this procedure (72.1% vs. 61.4%; $p<0.001$).

DISCUSSION: Total knee arthroplasty is being performed in younger patients with increase percentage in minorities. Length of stay has decreased with an increase in the number of patients going to short/long term facilities. Most surgeries are being performed in smaller hospitals and payment from Medicare has decreased in recent years.

12. Patient versus Provider Characteristics Impacting Hospital Length of Stay Following Total Knee or Hip Arthroplasty

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INTRODUCTION: The purpose of this study was to determine whether patient- or provider-level characteristics have a greater impact on a patient's length of stay (LOS) for lower extremity arthroplasty. Identifying sources of prolonged LOS in total joint arthroplasties (TJA) could inform the development of cost-saving strategies.

METHODS: A query was performed of the 2002 Health Care Utilization Project – Nationwide Inpatient Sample which includes inpatient discharge abstracts from a representative sample of hospitals in participating states. Multi-level linear regression models were used to evaluate the associations between baseline patient- and provider-level characteristics on patients' LOS in the hospital following primary lower extremity TJA.

RESULTS: The target population included 322,894 discharges with a primary procedure code for primary total knee arthroplasty and 193,553 discharges with a primary procedure code for primary total hip arthroplasty. Patient attributes associated with increased LOS included older age, female gender, increased comorbidities, African-American race, and having public insurance. Among provider-level characteristics, higher surgeon and hospital volume of joint replacements was associated with decreased LOS. Provider-level characteristics showed a greater magnitude of effect on LOS following a lower extremity TJA procedure.

CONCLUSIONS: Surgeon and hospital volumes had the greatest effect on LOS. A total hip arthroplasty patient treated by a low-volume surgeon in a low-volume center would stay 5.34 days compared to 4 days when treated by a high-volume surgeon in a high-volume center. The variations between individual patients are small, but could represent substantial unnecessary burden placed on the health care system.

13. The Impact of Platelet Rich Plasma on Hemoglobin Loss in Female Unilateral Total Knee Arthroplasty: A Retrospective Analysis

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INTRODUCTION: The use of platelet gel in primary unilateral cemented total knee arthroplasty (TKA) makes no clinical difference in postoperative hemoglobin loss or allogenic transfusion.

METHODS: 812 consecutive subjects undergoing a primary cemented unilateral TKA were divided into a control group (n=356) and experimental group (n=456). The experimental group received intraoperative platelet gel and the control group received no intervention. Hemoglobin levels and transfusion data was collected and compared between the two groups

RESULTS: Subject demographics were statistically similar. The average hemoglobin (Hgb) preoperatively (PreOp) and on postoperative Day 1 (POD1) for the control group was 13.2 grams per deciliter (g/dl) and 11.2 g/dl, respectively with a change in PreOp to POD1 Hgb (delta Hgb) of 2.0 g/dl. The platelet gel group average PreOp Hgb was 13.3 g/dl while the POD1 Hgb was 11.2 g/dl, with a delta Hgb of 2.1 g/dl. Transfusion rate for experimental and control groups were 6.97% and 5.62% respectively. All p-values were > 0.05. Analysis of PreOp Hgb for non transfused patients and transfused patients were 13.4 and 11.5, respectively, with a p-value of <0.0001.

DISCUSSION AND CONCLUSION: Platelet gel appears to have no significant effect on postoperative hemoglobin loss. Our analysis showed that a lower PreOp Hgb also appears to be the most predictive factor for receiving an allogenic transfusion.

14. Tourniquet Pressure in Total Knee Arthroplasty: A Randomized Clinical Trial

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INTRODUCTION: Tourniquet pressure during total knee arthroplasty is often set arbitrarily. This may result in tourniquet pressures that may be higher than necessary. The purpose of this study was to compare the effect of a standard tourniquet setting of 350 mm Hg to 100 mm Hg over the systolic blood pressure on the quality of the surgical field in terms of hemostasis.

METHODS: We randomized 100 consecutive knees in 96 patients undergoing TKA at one institution into two groups: Group I, 50 knees, control group with tourniquet pressure set at 350 mm Hg; and group II, 50 knees, the experimental group with tourniquet pressure set at 100 mm Hg above the patient's initial systolic pressure upon entering the operating room. Leg circumference, BMI, and other operative data were recorded for each patient. The surgeon (RG) was blinded to the pressure setting. Adequacy of the surgical field (hemostasis) was determined by this single surgeon.

RESULTS: There were seven failures in group II and none in group I ($P<0.05$). The two groups were similar in leg circumference, tourniquet size, mean BP, and BMI. There was a trend in the failures towards higher thigh circumferences, but this was not significant.

CONCLUSION: The literature reports that higher tourniquet pressures may lead to increased tissue micro-necrosis, decreased quadriceps strength, longer rehabilitation times, and other adverse outcomes. We discovered that patients with tourniquets set at 350 mm Hg had adequate hemostasis across the board. However, there is a trend of inadequate hemostasis in the experimental group associated with increasing leg circumference. This will lead to further studies to indicate what patient factors can help predict adequate tourniquet pressure.

15. The Role of the Popliteus Tendon in Providing Stability During Posterior Stabilized Total Knee

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OBJECTIVES: The purpose of this study was to assess the role of the popliteus tendon in providing stability to the lateral aspect of the knee using both an in vitro and in vivo study.

METHODS: Five cadaver knees were prepared for a posterior stabilized total knee arthroplasty utilizing a modified tibial tray with four transducers able to precisely measure the pressures in four places underneath the tibial tray (anterolateral, posterolateral, anteromedial, posteromedial). The pressures were measured with the popliteus tendon intact, and then again after complete popliteal resection. This was followed by a blinded, randomized trial in 20 patients undergoing total knee replacement. Twenty patients had their knee prepared for posterior stabilized TKA. The flexion and extension spaces were then assessed using standard techniques. The surgeon stepped away from the operating room table, and the first assistant then randomly resected or left the popliteus tendon intact. The “blinded” surgeon then reassessed any change in the flexion/extension balance.

RESULTS: In none of the 20 patients was the surgeon able to perceive whether the tendon was resected or left intact. There was no perceivable difference in the flexion-extension balancing of the knee when the tendon was resected. Preliminary in vitro study with this model further confirmed minimal contribution of the popliteal tendon to knee stability.

CONCLUSIONS: This is the first study that we are aware of that accurately documents the role of the popliteus tendon in providing stability during TKA utilizing a sophisticated in vitro measuring device and followed up with a blinded, randomized, clinical trial. The status of the popliteus tendon does not contribute any perceivable stability to the extension or flexion gaps during TKA.

16. Range of Motion and Patient Satisfaction of Traditional and High Flex Knee Rotating Platform Knees

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OBJECTIVES: To determine if a DePuy Sigma Rotating Platform High Flex (RP-F) knee provides greater flexion and overall patient satisfaction than a DePuy Sigma Rotating Platform (RP) knee.

METHODS: One hundred sixty-three total knee arthroplasties for osteoarthritis were performed by a single surgeon from December 2006 through January 2008. Seventy-nine consecutive knees were replaced with the RP-F implant and 84 knees with the RP implant. Seven subjects were lost to follow-up and 3 died, leaving 153. Active flexion and satisfaction scores were obtained from 9 to 33 months postoperatively (mean 16.7). Satisfaction was on a scale of 1–5, with 1 equaling "Completely Dissatisfied" and 5 equaling "Completely Satisfied." RP-F subjects were matched to controls primarily on preoperative flexion, then on months of follow-up, sex, age, and BMI. Subjects were also separated into two groups, those with <120° (N=106) and those with $\geq$120° (N=47) preoperative flexion. Student's t test and chi square were used for statistical analysis.

RESULTS: Sixty-four matched pairs were analyzed. There were no significant differences in any preoperative data. At follow-up, the mean flexion of the RP and RP-F groups was 116.2° and 114.6°, respectfully ($p>0.50$, one-tailed). In patients with <120° preoperative flexion, mean postoperative flexion was 115.9° for RP subjects and 111.9° for RP-F subjects ($p >0.50$, one-tailed). For the $\geq$120° group, RP and RP-F subjects had a mean flexion of 116.7° and 119.5°, respectfully ($p=0.09$, one-tailed). Implant costs were $1,100 greater in the RP-F group than the RP group. There were no significant differences in overall satisfaction between any of the groups.

CONCLUSION: Compared to the RP knee, the RP-F knee did not significantly increase flexion or satisfaction in any grouping, and it increased costs by $1,100.

18. Mid-Term Results of Primary Total Knee Arthroplasty with a Medial Pivot Implant Design

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BACKGROUND: The medial pivot total knee arthroplasty was designed to more closely simulate natural knee kinematics. The unique features of this design include a near constant radius of curvature of the femoral component, a highly congruent and asymmetric tibia, and a "medial pivot" motion during knee flexion. There is very limited information regarding the clinical performance and efficacy of medial pivot total knee arthroplasty beyond early follow-up. The purpose of this study was to analyze the mid-term clinical and radiographic results of primary total knee arthroplasty with a medial pivot implant design.

METHODS: Ninety-three medial pivot knee replacements (74 patients) were retrospectively reviewed at an average 6.4 years (range, 4-9.6). Average patient age was 59 years (range, 29-82). Twenty-eight were male and 46 were female. Surgeries were performed by one surgeon, and then reviewed independently. Patients were evaluated clinically and radiographically (81%) or alternatively, by questionnaire (19%). Standard radiographic evaluation and Knee Society scores were used.

RESULTS: The average Knee Society scores improved by 39.8 points when comparing preoperative to final follow-up values ($p<0.001$). The functional score improved by 21.2 points ($p<0.001$). The range of motion arc improved an average 13.7° ($p<0.05$). There were no revisions and all implants were well-fixed at the most recent follow-up visit. Complications included the need for 8 manipulations, 2 deep infections, and 2 DVTs.

CONCLUSION: Primary TKA with a medial pivot implant design is associated with major improvement in knee function, an improved range of motion arc, and excellent fixation at mid-term follow-up.

19. Do "Premium" Joint Implants Add Value? Analysis of High Cost Total Joint Implants in a Community Registry

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INTRODUCTION: Numerous joint implant options of varying cost are available to the surgeon, but it is unclear that more costly implants add value in terms of function or longevity. The purpose of this study was to evaluate outcomes of higher cost "premium" knee and hip components compared to lower-priced standard components used in a community registry.

METHODS: "Premium" TKA components were defined as either cemented or cementless mobile-bearing designs or those including oxinium femoral components. "Premium" THAs included ceramic-on-ceramic, metal-on-metal, and ceramic on highly cross-linked polyethylene designs. Because "premium" implants were introduced more recently, we included only TKAs from 2001-2008 and THAs from 2002-2008. Standard implants were age-matched to "premium" implants where possible. Analysis was done using Wilcoxon rank sum tests, Pearson's chi-square tests, Kaplan Meier survival, and Cox regression.

RESULTS: For the analysis, 1,913 standard TKAs were compared to 1,273 "premium" TKAs and 868 standard THAs were compared to 1,311 "premium" THAs. Cost of the "premium" implants was on average approximately $1,000 higher than the standard implants ($p<.001$). Standard implants had longer mean follow-up than the premium implants ($p< .001$). For the TKA group, there was no difference in sex, primary diagnosis, or revision reason between the groups. For the THA group, there were more patients with a primary diagnosis of avascular necrosis ($p< .001$), and fewer patients revised for dislocation ($p<.007$) in the "premium" group. There was no significant difference in the risk of revision between "premium" and standard TKA ($p=0.79$) or standard THA ($p=0.24$).

DISCUSSION: In the short time frame of evaluation here, "premium" implants did not demonstrate better survival than standard implants. The use of larger head sizes in "premium" metal-on-metal THA contributed to fewer revisions for dislocation in this group. Longer follow-up is necessary to demonstrate whether "premium" implants add value.

MAOA BREAKOUT SESSION #2
TRAUMA
April 22, 2010

20. Comparison of Open Reduction Internal Fixation versus Closed Reduction Internal Fixation for the Treatment of High Energy Adult Femoral Neck Fractures

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INTRODUCTION: The purpose of this study was to compare results of open reduction internal fixation (ORIF) and closed reduction internal fixation (CRIF) of high-energy adult femoral neck fractures (FNF).

METHODS: Over a five-year period, 2002-2007, 66 skeletally mature patients were retrospectively identified with FNF and treated with ORIF or CRIF at a Level I teaching trauma center.

RESULTS: There were 37 (56.1%) males and 29 (43.9%) females with a mean age of 46.9 (19-65) and a BMI of 27.1 (18-58). Treatment consisted of ORIF in 43 (65.2%) and CRIF in 23 (34.8%). Mechanism of injury was falls (36, 54.5%), high-energy injuries (25, 37.9%), and sports/recreational (5, 7.6%). AO/OTA fracture classification included: 13 B1, 27 B2, 26 B3. Significantly more B2 and B3 fractures occurred in the ORIF group (χ^2= 0.011) than B1 fractures. Complications included: infection (2, 3.0%, both ORIF), AVN (13, 19.7%), collapse (7, 10.6%), nonunion (24, 36.4%), and secondary OA (16, 24.2%). Similar distribution occurred for AVN, collapse, secondary OA, but a significant difference (χ^2=0.019) in nonunion between ORIF (20) and CRIF (4). At final follow-up, pain requiring medication was present in 50 cases (75.8%). Mobility assistive devices were utilized in 13 (19.7%) patients. Specialized shoe wear was needed by 17 (25.8%). Return to work status was 50 (75.7%) returned, 10 (15.2%) with restrictions, and 6 (9.1%) were unable. Pain and functional ability were not different between groups.

CONCLUSION: Adult high-energy FNF adults are debilitating injuries, and treatment is associated with a high rate of complications. ORIF and CRIF show similar results regarding functional ability and pain.

22. Can All Femoral Neck Fractures Be Exposed Through a Minimally Invasive Smith-Petersen Approach?

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OBJECTIVES: To quantify the area of osseous exposure and identify critical landmarks necessary to reduce a femoral neck fracture using a minimally invasive direct anterior approach to the hip. The authors hypothesize that this approach will provide adequate exposure to reduce all femoral neck fractures regardless of their anatomic location on the neck.

METHODS: Ten fresh-frozen hemi-pelves were dissected using a minimally invasive Smith-Petersen approach. Upon completion of the exposure, a calibrated digital image was taken from the surgeon's best perspective. Identification of six osseous landmarks (anterior-superior acetabulum, anterior-inferior acetabulum, greater trochanter, lesser trochanter, anterior inferior iliac spine, and vastus ridge) was attempted either by direct visualization and/or palpation with a tonsil clamp. These landmarks exceed the border for any intracapsular hip fracture. The digital images were then analyzed using a computer software program, *ImageJ* (National Institutes of Health, Bethesda, Maryland), to calculate the square area of proximal femur exposed.

RESULTS: The average square area of proximal femur exposed was 20.31 cm^2 (standard deviation: 3.09, range: 15.16-24.18). The area exposed correlated with the vertical height of the specimen ($r=0.69$, $p<0.05$). With the numbers available, there was no correlation between exposure and weight ($p=0.71$) or body mass index (BMI) ($p=0.87$). In all ten cadaver specimens, the six osseous landmarks were easily identified; five by direct visualization and one by palpation (lesser trochanter, deep portion) due to incomplete visualization.

CONCLUSIONS: The minimally invasive Smith-Petersen approach to the hip provides adequate exposure for all intracapsular proximal femur fractures. It is a simple, direct approach for open reduction of subcapital, mid-cervical, and basicervical femoral neck fractures.

23. A Biomechanical Comparison of Vertical Femoral Neck Fracture Fixation: Three versus Four Screws

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SUMMARY: There was no significant difference in biomechanical properties when three parallel cannulated screws are supplemented by a perpendicular lag screw for the fixation of vertical femoral neck fractures in this biomechanical study.

METHODS: Vertical femoral neck fractures were created in 18 matched fresh-frozen cadaveric femurs and fixed in one of two methods: three 6.5-mm parallel cannulated screws placed in an inverted triangle configuration (group 1) and three parallel screws supplemented with a 4.5-mm cortical screw placed perpendicular to the osteotomy in lag fashion (group 2). Each group was tested under incremental loading, cyclical loading, and loading to failure. The modes of failure were noted and biomechanical properties were calculated.

RESULTS: None of the specimens failed during incremental or cyclic loading. There was no statistically significant difference between the two groups regarding stiffness, failure load, or failure energy ($P > 0.05$). The majority of specimens failed with inferior displacement of the femoral head and backing out of the screws.

CONCLUSIONS: Supplementing three parallel cannulated screws with a perpendicular lag screw does not demonstrate any significant stability for fixation of a vertical femoral neck fracture.

24. A Comparison of Rigidity of Fracture Fixation of Unstable Intertrochanteric Hip Fractures Using Short Locked Cephalomedullary Nails versus Long Unlocked Cephalomedullary Nails: A Biomechanical Study

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BACKGROUND: With the development of cephalomedullary (CM) proximal femoral devices, surgeons have a more reliable treatment option for unstable intertrochanteric femur fractures. The null hypothesis of this study was that there was no significant difference in fracture construct rigidity between a long unlocked CM nail and a short locked CM nail of four-part intertrochanteric fractures when subjected to axial loading.

METHODS: Twelve composite femurs were used divided into two groups. One group was instrumented with long unlocked CM nails; the other group was instrumented with short locked CM nails. Each femur then had an identical four-part intertrochanteric fracture created by a thin blade oscillating saw. The specimens were placed in a Materials Testing System (MTS) and loaded with an axial force of 500N. Three measurements were made: (1) displacement at the fracture site, (2) tension distraction on the lateral cortex, and (3) absolute head deflection expressed in millimeters (mm).

RESULTS: (1) The mean fracture site displacement was 12.4% of head deflection in the short locked nail group and 14.6% in the long unlocked nail group ($p>0.05$). (2) The mean lateral cortex tension distraction was 1.3% of head displacement for the short locked nail group and 0.5% in the long locked nail group ($P=<0.02$). (3) The absolute head deflection was 2.4 mm for the short locked nail group and 4.7 mm in the long unlocked nail group ($P<0.05$).

CONCLUSION: Both short locked and long unlocked cephalomedullary nails showed the same fracture rigidity in four-part intertrochanteric femur fractures under axial compression. However, the femurs instrumented with the short locked nails had more force distributed to the lateral cortex and the femurs instrumented with the long unlocked nail had more force distributed to the femoral head.

25. Evaluation of a Simulator-Based Model for Placement of a Dynamic Hip Screw

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INTRODUCTION: Implementation of work hour restrictions has caused many residency programs to institute motor skills labs to augment resident skill development and exposure in a controlled and more efficient manner. We evaluated resident proficiency and efficiency using a model for simulated placement of a guidewire during fixation of a proximal femur fracture utilizing a dynamic hip screw.

METHODS: Each resident watched a short instructional video explaining the operation of the hardware (Simulations Trauma Vision VR). The residents then had two minutes to use the machine prior to testing to familiarize themselves with the simulator. Senior residents, PGY 3-5, placed a single reamed central guide pin into a femoral head utilizing the surgical simulator four times. Junior residents (PGY 1-2) completed the same task a total of six times. Residents were then evaluated and compared based upon final tip-apex distance (TAD), fluoroscopy exposure time, time to completion, number of distinct attempts at pin placement, as well as final three-dimensional location of the pin from the isometric center of the femoral head.

RESULTS: No significant difference was noted between the junior and senior residents in total time, fluoroscopy time, distinct attempts, tip-apex distance, AP long, AP superior/inferior, and lateral long. There was a significant difference in the anterior/posterior final position on the lateral view with senior residents more likely to place the wire anterior to the midline while junior residents were more likely to position the wire posterior to midline. No differences were noted when comparing each resident's first two trials versus their last two trials.

CONCLUSIONS: Using the current model and measurement protocols, there were no obvious differences in proficiency between junior and senior residents. Although our approach did not clearly differentiate residents based upon surgical proficiency, the use of this simulator model may be helpful early during residency to gain comfort with this procedure prior to entrance into the OR suite.

27. Sequential Ultrasound Screening for Deep Venous Thrombosis in Acetabular or Pelvic Fracture Patients

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INTRODUCTION: The timing of duplex Doppler ultrasound screening (DDUS) for the diagnosis of deep vein thrombosis (DVT) in asymptomatic trauma patients has been inconsistently described (i.e., within 3 days of hospital admission or in the 24 hours before discharge from the hospital, etc.). The purpose of this study was to examine the utility of sequential scans obtained preoperatively and before hospital discharge in asymptomatic patients with acetabular and/or pelvic fractures treated operatively.

METHODS: A lower extremity DDUS protocol for DVT was begun for asymptomatic patients with acetabular and pelvic fractures treated operatively. No attempt was made to assess the pelvic veins. DDUS was to be done either the evening before or the morning of surgery and then the day before planned discharge from the hospital. Preoperative patients with positive studies were to receive an inferior vena caval (IVC) filter. Postoperative patients with positive studies were to have anticoagulation. A protocol for DVT prophylaxis was also instituted. Of 388 patients enrolled, 159 were excluded due to breaches of protocol and occurrence of symptomatic preoperative DVT or pulmonary embolism (PE), leaving 229 for study**.**

RESULTS: There were 51 patients (22%) with DVT. Twenty-six (11%) were diagnosed preoperative and received inferior vena cava filters. Twenty-five (11%) were diagnosed postoperative and received therapeutic anticoagulation. In addition, two patients (1%) had a postoperative symptomatic PE diagnosed the day following surgery. In both patients, a postoperative ultrasound was obtained and was interpreted as negative for DVT. Fatal PE did not occur.

CONCLUSIONS: Sequential DDUS for DVT is a vast improvement over a single preoperative or predischarge scan. Preoperative DDUS decreases the risk of operating on a patient with an asymptomatic DVT; the predischarge scan decreases the risk of sending a patient home with an untreated DVT. However, patients remain at risk for PE propagating from an undiagnosed pelvic vein thrombosis.

28. Functional Outcomes of Operatively Treated Displaced Acetabular Fractures

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INTRODUCTION: The purpose of this study was to evaluate the functional outcome measures for operatively treated displaced acetabular fractures.

METHODS: Over a five-year period, 2002-2007, 264 operatively treated displaced acetabular fractures in skeletally mature patients had prospectively measured functional outcome data at 6, 12, and 24 months.

RESULTS: More males (189, 71.6%) than females (75, 28.4%) had fractures. Average age was 44 (16-91) and BMI was 28.7 (17.4-69.7). Mechanism of injury was primarily high energy (216, 81.8%) followed by low energy falls (26, 9.8%), and other (22, 8.3%). The SMFA daily activity (33.8, 27.6, 27.3), emotional (38.1, 35.2, 37.3), arm/hand (8.8, 8.8, 4.7), mobility (35.0, 31.5, 32.1), dysfunction (28.7, 25.8, 25.5) and bother (32.4, 28.2, 28.4) functional outcome measures did not have a significant improvement over the two-year period (6, 12, 24 months, $p > 0.05$). Those ≥ 60 significantly improved from 6 to 24 months as compared to those younger in daily activity, emotional, mobility, and dysfunction indices, and the age groups significantly differed in these functional outcomes and bother at 24 months ($p<0.05$). Daily activity significantly improved over time for the normal weight cases compared to those with BMI > 30, and there was a significant difference in daily activity and mobility at 24 months ($p<0.05$). Polytrauma versus isolated injuries only showed a significant difference at 24 months in the emotional index ($p=0.03$). Simple versus Associated patterns did not show significant SMFA differences.

CONCLUSIONS: Displaced acetabular fractures represent severe articular injuries of the lower extremity. SMFA indices remain high compared to the general population. Elderly and those with BMI < 30 show greater functional improvements.

29. Outcome of Dynamic Stress Examination Under Anesthesia (EUA) in Posterior Wall Acetabular Fractures

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INTRODUCTION: Dynamic stress fluoroscopy performed during an examination under general anesthesia (EUA) is a clinical assessment of hip stability and congruence currently used at our institution as an adjunct in determining the need for operative treatment for isolated posterior wall acetabular fractures.

METHODS: From July 2003 to June 2007 at our institution, 21 patients were shown to have stable hip joints after EUA for isolated posterior wall fractures of the acetabulum and were treated non-operatively. Three patients were lost to follow-up leaving 18 for the study. At follow-up, patients underwent clinical and/or radiographic evaluation. Patients were evaluated radiographically for hip joint congruence and post-traumatic arthritis as compared to the normal contralateral hip. Hip function was determined by the modified d'Aubigne score.

RESULTS: Clinical follow-up was obtained on all 18 patients at a minimum of two years (mean 39.8 months) with an average d'Aubigne score of 17.2/18 (95% Confidence Interval 16.7 to 17.6) with no one having a less than good clinical outcome. Fifteen of these 18 patients had radiographic evaluation at a minimum of two years (mean 41.2 months) demonstrating a congruent joint with a normal joint space and no evidence of post-traumatic arthritis. Radiographic evaluation at a mean of 2.7 months on the remaining 3 of these 18 patients similarly showed a congruent joint with a normal joint space and no evidence of post-traumatic arthritis. Two of these patients were incarcerated at the time of clinical evaluation preventing radiographic examination. The third patient was completely asymptomatic but refused follow-up radiographic examination.

CONCLUSION: Hip joint stability determined by EUA after isolated posterior wall acetabular fracture is predictive of maintenance of hip joint congruity and good to excellent clinical outcome with non-operative treatment at two-year follow-up.

30. Observer Reliability in Computed Tomography Assessment of Hip Stability for Posterior Wall Acetabular Fracture

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INTRODUCTION: Exam under anesthesia (EUA) is considered the gold standard for diagnosis of dynamic hip stability status. However, computed tomography (CT) assessment of fracture fragment size and position may be able to identify clinically unstable hips that require operative fixation. The purpose of this study is to determine if there is sufficient observer consistency in this CT assessment for prediction of hip stability status in posterior wall acetabular fractures.

METHODS: CT scans of ten patients with posterior wall acetabular fractures were evaluated for stability with a previously described subtraction method. CT scans were reviewed twice with a washout period greater than one month by three junior orthopedic residents (PGY2), three senior residents (PGY5), and three traumatologists who routinely perform acetabular fixation. Stability predictions were compared with EUA status and intraclass correlation coefficients were calculated to determine intra- and interobserver reliability.

RESULTS: Intraobserver reproducibility was >0.80 (0.82-1.0) and interobserver reliability was > 0.80 (0.82-0.95) regardless of level of experience. After comparison with EUA, sensitivity was calculated at 98% and specificity was 88%. One EUA stable hip was predicted to be unstable and one EUA unstable hip was predicted to be stable by four observers at both time points.

CONCLUSION: This subtraction method for CT hip stability status is both reliable and reproducible; however, the presence of a nondisplaced transverse fracture line or posterior wall fracture obliquity may lead to inaccurate prediction. This CT hip stability assessment method is clinically satisfactory only for large fracture fragments, as small unstable fractures may be predicted incorrectly as stable, resulting in a clinical disaster. EUA remains the gold standard in determining dynamic hip stability after posterior wall fractures.

31. Effect of Repetitive Screw Insertion on Pullout Strength of Metaphyseal Osteoporotic Bone

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INTRODUCTION: The effect of repetitive screw insertion in the metaphyseal bone has not been critically analyzed. Within surgery, screws are frequently inserted, removed, and replaced with different length screws, creating the potential for weakening of a screw's purchase and reduction of the repair construct's stability. This is especially true in osteoporotic bone. As the frequency, cost, and difficulty in treating geriatric fractures continues to increase, it is important to definitively investigate this issue.

METHODS: Twelve embalmed cadavers provided 24 femora for testing. The distal femurs were selected for the study. Maximum torque was measured at a location 2.0 cm anterior to the epicondyle using a torque screwdriver. Pullout tests were performed at two points: 1.8 cm posterior and 1.8 cm proximal to the max torque hole. Cortical screws (4.5 mm diameter) were inserted at 50% maximal torque and were either inserted once or twice between the two holes and alternating between the matched pairs (right/ left). Each distal femur was fixed in a custom fixture to align the screw axis with the actuator of the Material Testing System. The screws were pulled out at a rate of 1 mm/sec with the data sampled at a frequency of 100 Hz. Maximum pullout strength (Fmax) was determined and statistical analysis was performed with a significance level of $\alpha = 0.05$.

RESULTS: Results indicated that Fmax averaged 463.2 ± 268.9 N for single and 387.5 ± 251.8 N for double insertion. A paired t-test indicated that these differences were significant ($p=0.008$).

CONCLUSION: Repetitive screw insertion in the metaphyseal bone reduced the bone-screw interface strength by almost 17% in the present experiments. These results suggest that surgical techniques which limit the number of repeated insertions will increase fixation stability.

MAOA BREAKOUT SESSION #3
SPINE
April 22, 2010

33. Evaluating the Cost and Utility of Digital Angiography in Diagnosing Blunt Cerebrovascular Arterial Injury

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With recent advances in digital angiography (DA) with computed tomography (CTA) and/or magnetic resonance (MRA) angiography, use of these modalities has increased dramatically in the screening for BCVI. It is unclear whether the use of DA is advantageous, and if so, in which instances it can be employed effectively. We aimed to explore the utility of DA in screening for BCVI. Specifically, which injury patterns and risk factors are suggestive of BCVI? Does relying on DA affect patient outcomes or cost?

2,025 consecutive adult patients being evaluated for acute blunt cervical trauma and/or BCVI were reviewed. Screening for BCVI was determined based upon institutional guidelines. 203 patients received DA as a first-line study to evaluate for BCVI. 43 patients were diagnosed with BCVI, a screening yield of 21.3%. Screening yield in patients symptomatic at presentation was 48.8%. Typical signs and symptoms of large-vessel internal carotid, vertebral, anterior spinal, and basilar artery occlusion were associated with a positive screen ($p<0.01$).

Of patients with injuries found on DA, 50.0% of BCVI involved C1-3 fracture, 34.2% involved subluxation, and 65.8% involved foramina transversaria. Patients screened positively had higher odds of death (OR 1.33) and being diagnosed with ischemic neurological events (OR 5.45). There was no significant difference in mean total charge between patients positively screened ($453.41) and negatively screened ($468.57). 68.4% of patients with BCVI had changes made in their treatment based on findings noted on DA. There were 0 recognized incidences of missed injury on follow-up. All-cause mortality was 1.0%, with three deaths in patients with diagnosed BCVI.

In patients with blunt trauma to the cervical spine, DA is a safe and effective tool to screen for BCVI. In asymptomatic patients, certain injury patterns such as C1-C3 fracture, subluxation, or fracture involving foramina transversaria indicate a higher likelihood of BCVI. Importantly, patient outcomes did not suffer as a result of using DA as the primary screening modality for most instances of suspected BCVI.

34. Nonoperative Treatment of Occipital Condyle Fractures: An Outcomes Review of 32 Fractures

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INTRODUCTION: The majority of occipital condyle fractures are treated nonoperatively with the exception of unstable Anderson-Montesano Type 3 fractures. However, few studies have observed the functional outcomes of these patients in the years following injury. The purpose of this study is to evaluate the outcomes of patients with occipital condyle fractures treated non-operatively and to establish factors predictive of disability.

MATERIALS AND METHODS: A retrospective cohort study was carried out of 103 patients with occipital condyle fractures. All selected patients either had treatment for their fracture in a hard cervical orthosis or received no immobilization at all. Twenty-eight patients (with a total of 32 fractures) were successfully contacted and able to participate. Each of these patients was given the Neck Disability Index (NDI). These were scored to assess overall neck disability and further reviewed using a student's t-test for factors predictive of greater disability including age (<40; 40-60; >60), sex, Type (I,II,III), bilaterality, associated head injury, and fracture displacement.

RESULTS: The overall mean NDI was 14.04 (0-43), which correlates with mild disability. Only one patient's score revealed complete disability (NDI=43). Using the student's t-test, no statistically significant correlations were found between NDI and Type of fracture (p=.125), displacement of fracture (p=0.204), sex (p=.118), or presence of head injury (p=.290). Age did correlate with NDI, with 40-60 year olds showing the greatest disability (p=.01). Of the 8 patients in this age range, the mean disability was moderate (NDI=23.4). The pain intensity question did correlate with this age range as well (p=.003).

CONCLUSION: Anderson and Montessano Types I, II, and III fractures may be treated non-operatively in the absence of ligamentous instability with the expectation of mild disability. None of the three types of occipital condyle fractures are predictive of greater disability, nor is bilaterality or displacement. The greatest predictor of disability in this study was age (40-60), with a statistically significant correlation with pain intensity in these patients.

35. Biomechanical Evaluation of a Low Profile, Anchored Cervical Interbody Spacer Device at the Index Level or Adjacent to Plated Fusion

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Currently, most anterior cervical decompressions and fusions (ACDF) are performed using a spacer and plate stabilization. We present a biomechanical evaluation of a new anchored spacer device as an alternative to the plate-spacer construct at the index level and, in cases of revision, adjacent to a previous plate. To be appropriate for this indication, this device must perform similar to a standard plate and spacer construct at an index level and at a level adjacent to a simulated fusion.

METHODS: Eight fresh frozen human cervical spines (C2-T1) were used. Flexion-extension, lateral bending, and axial rotation were tested using a moment of 1.5 Nm under 0 and 150 N follower preload. Spines were tested first intact, then after ACDF at C4-5 and C6-7 with either a plate-spacer construct or anchored spacer device (randomized). The specimens were tested finally with an ACDF at the floating C5-6 segment using the anchored spacer device adjacent to the previous fusions.

RESULTS: Both the plate spacer and anchored spacer device significantly reduced motion from the intact spine in flexion-extension, lateral bending, and axial rotation ($p<.005$). There was no statistical difference between the plate spacer-construct and the anchored spacer device in the amount of motion at either the index level or the adjacent level to the plate.

DISCUSSION: The biomechanical comparison shows a similar reduction in motion at the randomized cervical spine levels. This would support the use of the anchored spacer device as an alternative to a plate-spacer construct for an ACDF. In addition, the anchored spacer device provided a significant decrease in motion when placed adjacent to a previously plated segment. The clinical benefit of this could be substantial in the face of adjacent level disease. The anchored spacer device could be inserted adjacent to a healed plated fusion and would avoid plate removal and transition to a multilevel plated construct.

36. Long-Term Outcome of a Modified Cervical Laminoplasty Technique Evaluated by Volumetric Analysis

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INTRODUCTION: A main complication of Hirabayashi's open-door cervical laminoplasty technique is postoperative closure of the hinge. In an effort to maintain canal expansion, a modification has been introduced which uses 2.0 mm suture anchors throughout the area of expansion from C3-7. The purpose of this study is to present a modified suture anchor technique, by minimizing structural change at the end levels and to quantify the sustained canal expansion by MRI volumetric analysis.

METHODS: Thirteen patients with multilevel cervical stenosis who were treated with a modified open-door laminoplasty with suture anchor fixation were reviewed. The modification involves a partial laminectomy at the end levels of the stenotic region and use of 2.0 mm suture anchors at the intermediate levels. Measurements of canal and cord volume were done on preoperative and postoperative MRIs to quantify the expansion in the space available for the spinal cord (SAC) from C2-3 to C7-T1 levels and at the end levels alone. Radiographic outcomes, neck and arm Visual Analog Scale (VAS) scores, and modified Japanese Orthopaedic Association (JOA) scores were also evaluated.

RESULTS: The mean follow-up period was 27 months. All patients showed no evidence of instability, suture anchor loosening, or kyphosis at final follow-up. Twelve patients had CT scans done at final follow-up which showed evidence of hinge fusion. The mean preoperative SAC from C2-3 to C7-T1 levels improved from 7,542 to 13,279 mm^3 ($p< 0.00001$), and the mean SAC at the undercut end levels improved from 2,135 to 3,467 mm^3 ($p< 0.02$). The mean preoperative VAS score for neck pain improved from 5.2 to 1.9 ($p< 0.02$), and the mean preoperative VAS score for arm pain improved from 6.2 to 1.5 ($p< 0.0006$). At final follow-up, the average JOA score was 12.

CONCLUSIONS: Significant and sustained expansion in the space available for the spinal cord along with improved clinical outcomes can be accomplished by performing a partial laminectomy at the end levels and an open-door laminoplasty at the intermediate levels.

37. Sagittal Alignment Following Multilevel Axial Lumbar Interbody Fusion

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BACKGROUND: A change in lumbar lordosis can affect the outcome following lumber fusion, and intraoperative positioning is a prime determinant of the postoperative lordosis. There is little data published with follow-up of multilevel lumbar fusion using a presacral approach. There is no data concerning the sagittal alignment of the lumbar spine utilizing this novel minimally invasive approach.

METHODS: We retrospectively reviewed 23 patients undergoing a 360° lumbar interbody fusion at L4-5 and L5-S1 for degenerative disc disease and spondylolisthesis utilizing the axial interbody fusion with posterior segmental percutaneous pedicle screws. Standing lateral preoperative radiographs were compared to standing lateral postoperative radiographs. Lumbar Cobb angles were measured at L1-S1, L4-S1, and individual lumbar levels.

RESULTS: Six patients did not have complete preoperative or postoperative x-rays and were excluded from analysis leaving 17 patients. The average preoperative lordosis was 50+/-13.4 (30-71) degrees and the average postoperative lordosis was 47.8+/-12.9 (18-67) degrees. The average change in lordosis was 2.2°. The individual lumbar levels showed change in lordosis of 7.6° at L4-S1 and 7° at L4-L5. Five patients had greater than a 10° decrease in their lordosis with one showing an increase in greater than 10°.

CONCLUSION: Twenty-nine percent of our patients had a change in lordosis of greater than 10° with the most change occurring at the L4-S1 and L4-L5 levels. Care must be taken to keep the hips extended during positioning to prevent a decrease in lordosis.

38. "Topping Off" a Fusion with Dynamic Stabilization in the Treatment of Transition Syndrome in the Lumbar Spine♦

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PURPOSE: To report our results with dynamic stabilization in the treatment of transition syndrome (adjacent segment degeneration).

INTRODUCTION: Transition syndrome about a spine fusion is a challenging clinical problem. The senior author's recent surgical approach to this problem in the lumbar spine has been to perform laminectomies for stenosis, extend the fusion using rigid pedicle screw fixation for the degenerative adjacent segment(s), and use dynamic stabilization at the new adjacent segment above the fusion. "Topping off" the fusion construct is done to stabilize (or protect) the new adjacent segment(s) to reduce the risk of future transition syndrome.

MATERIALS: From 5/2006 to 4/2009, dynamic stabilization was used in ten patients for the treatment of transition syndrome adjacent to a prior fusion. All ten patients underwent laminectomies for spinal stenosis. Nine of ten had lumbar fusion. Eight patients had their fusion "topped off' with one unfused, dynamically-stabilized segment, while two patients had three unfused segments. Mean age was 62 years, an average of 17 years after the first fusion (range: 2-40 years). Patients had an average of 2.4 prior lumbar spine operations (range: 1-6). Length of prior fusions ranged from 1 to 6 levels (mean: 2.6 levels).

RESULTS: Follow-up: average, 17 months (range: 6-37 months). Mean graphic pain scale (1=no pain, 4=moderate pain, 7=severe pain) score was 6.8 (range: 6-7) preoperative; mean postoperative pain score was 3.1 (range: 1-7). Two patients had subsequent surgery. One patient who fell 11 months postoperative sustained a fracture through his fusion at L5, at the inferior aspect of his rigid fixation. One patient had a percutaneous spinal neurostimulator placed. All fusions appear to be consolidating. No patient has had surgery at any of the dynamically-stabilized, unfused segments.

CONCLUSION**:** Satisfactory short-term and intermediate-term results are obtained in patients when dynamic stabilization is used as an adjunct to laminectomy and fusion for the treatment of transition syndrome adjacent to a lumbar fusion. Further study with long-term follow-up is necessary to determine whether dynamic stabilization can reduce the risk of developing recurrent transition syndrome.

39. The Effect of Sagittal Plane Position on Two-Level Lumbar Disc Arthroplasty♦

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In one-level lumbar total disc replacement (TDR), posterior position of TDR in the sagittal plane improves biomechanics and clinical outcomes compared to anterior position. It is unknown what effect sagittal positioning has in two-level lumbar TDR, specifically what effect it has on adjacent levels.

Ten human cadaveric specimens (L1-sacrum) were used. Each specimen was tested through four scenarios: intact spine, one-level TDR at L5-S1 (posterior position), two-level TDR at L5-S1 (posterior position) and at L4-L5 (anterior position), and two-level TDR at L5-S1 and L4-L5 (both posterior position). Each specimen was tested through flexion-extension (400N follower pre-load), lateral bending, and axial rotation. Range of motion and quality of motion were analyzed for all specimens. Pair-wise comparisons were performed using Bonferroni correction.

At the L4-L5 level, posterior position of TDR at L4-L5 increased the flexion-extension range of motion compared to anterior position (8.3^{o} vs 7.2^{o}, respectively, $p=0.006$). Sagittal positioning of L4-L5 TDR did not have an effect on range of motion at the L5-S1 level.

The sagittal position of L4-L5 TDR had an effect on the quality of motion at L4-S1. Anterior positioning of TDR at L4-L5 caused unnatural motion at L4-L5. Posterior positioning of TDR at L4-L5 closely replicated the motion of the intact spine. Motion at L5-S1 began earlier when TDR at L4-L5 was in the anterior position compared to the posterior position.

Posterior position of TDR in the sagittal plane had improved range of motion quantity and quality compared to anterior position in a two-level lumbar model.

40. A Study of the Static and Dynamic Biomechanical Properties of Oblique Lumbar Interbody Fixation in a Vertebrectomy Model

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INTRODUCTION: Oblique lumbar interbody fixation (OLIF) has been used for stabilization of degenerative spondylolisthesis at the lumbosacral junction. We hypothesize that the biomechanical properties of this technique will be comparable to the contemporary standard of pedicle screws and rod constructs.

METHODS: The vertebrectomy model sample was assembled using two UHMWPE blocks to simulate lumbar motion segment according to instructions given by 1717-04 ASTM protocol. The space (active length) between the blocks was set to 20 mm and the horizontal distance between the blocks was set to 40 mm. An axial compression rate of 0.2 mm/sec was used for the static test. Static torsion was also tested using 1^{o}/second. Dynamic compression testing was then carried out that corresponded with the yield load from the static test at a frequency of 5 Hz. End point of the dynamic test was reached when either failure of implant occurred or attainment of minimum of 5 million cycles. Six specimens were used for each arm of testing.

RESULTS: The mean and standard deviation of the yield load and stiffness of the static test were 599.21N (53.6N) and 96.12N/m (6.4Nm), respectively. The mean and standard deviation of the yield moment and torsional stiffness were 58.16Nm (2.8Nm) and 6.73Nm/^{o} (0.29Nm/^{o}), respectively. All specimens were plastically deformed after the static testing without gross failure. For dynamic compression testing, the established run-out load was determined as 350N up to 8 million cycles.

CONCLUSION: These results indicate that static load and stiffness of OLIF in a UHMWPE vertebrectomy model is comparable to pedicle screws and rod devices. In dynamic testing, OLIF can withstand at least 8 million cycles without failure.

41. A Thoracolumbar Vertebral Fracture Outcomes Study of a Trauma Registry Cohort

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BACKGROUND: Thoracolumbar vertebral body fractures of T10 to L2 juncture are severe spinal column injuries most often resulting from high-energy trauma. Many studies have focused on surgical treatment of these injuries, but few have evaluated subjective outcomes. The purpose of this study was to measure subjective outcomes of a trauma registry cohort with T10 to L2 vertebral body fractures and to identify factors that influence poor functional outcomes.

METHODS: A retrospective review of trauma registry records for spine fractures at two level 1 trauma centers over a six-year period identified 458 (40%) compression or burst vertebral body fractures. Of those with juncture fractures (T10 to L2), 38 were consented for follow-up evaluations at a mean of 2.41 years (17 with ≥ 25° kyphosis). Fourteen responded at 4.34 years (7 with ≥ 25° kyphosis). The Nottingham Health Profile (NHP), Oswestry Back Pain Questionnaire (OBP), and the Roland-Morris Disability Questionnaire (RMDQ) were administered at both evaluations.

RESULTS: Of those that sustained a thoracolumbar juncture fracture (T10 to L2 region) and responded to both evaluations, no significant difference was detected between the two periods based on NHP, OBP, and RMD results. Comparisons within each group stratified at 25 or greater degrees of kyphosis detected no significant differences.

CONCLUSIONS: Based on our results, it does not appear that subjective outcomes deteriorate over time nor does kyphosis of ≥ 25° lead to poorer outcomes. Using the criterion of ≥ 25° of kyphosis as an indication for surgery should be used with caution.

42. Universal Clamp in Treatment of Pediatric Spinal Deformity

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A retrospective review of 22 cases in which the Universal clamp was utilized in pediatric spinal deformity surgery was performed. A total of 196 Universal clamps were utilized with the following diagnostic categories: idiopathic scoliosis (8 cases/25 clamps); congenital scoliosis (3 cases/28 clamps); neuromuscular deformity including scoliosis, kyphosis, and lordosis (8 cases/114 clamps); and spondylolysis/spondylolisthesis (3 cases/6 clamps). Indications for the Universal clamp included dysplastic pedicles on the concave side of scoliotic curves, fractured pedicles, hypokyphosis in the thoracic spine, neuromuscular lumbar lordosis, osteoporotic bone, “back-up” of pedicle screws/hooks, and in fusionless surgery for congenital and early onset scoliosis. Follow-up range is 6 months to 15 months.

Complications included two intraoperative clamp failures, one feeding tube in a CP patient, one superior mesenteric artery syndrome in a congenital scoliosis that resolved in one week with hyperalementation, and two superficial wound dehiscences that healed with treatment by a vacuum-assisted closure in a patient that had spinal muscular atrophy and myotubular myopathy respectively. There were no neurologic complications (all patients had multi-modality intraoperative spinal cord monitoring) and no complications in the idiopathic scoliosis group. Coronal correction in the idiopathic scoliosis group was 71% and in the neuromuscular scoliosis group 69%. One hundred percent of patients achieved normal sagittal balance as determined by C-7 plumb line to the sacrum (+/- 20 mm). Lumbar lordosis in the neuromuscular group improved by 42%. Kyphosis in the congenital/neuromuscular group was treated by posterior multi-level Ponte type osteotomies and corrected on average 58%.

SUMMARY: The Universal clamp is a superior sublaminar implant and can be used as an adjunct to pedicle screws to aid in correction of idiopathic scoliosis. It provides superb fixation with low failure rate in osteoporotic bone found in neuromuscular scoliosis and lordosis. In addition, the Universal band and clamp can be used to reduce and stabilize spondylolysis and spondylolisthesis cases.

MAOA BREAKOUT SESSION #4
SPORTS
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43. Epidemiology of Major League Baseball Injuries

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SUMMARY SENTENCE: We analyzed injuries in Major League Baseball players, noting a higher occurrence of upper extremity injuries in pitchers, with hamstring and back injuries as the most common injuries in fielders.

OBJECTIVE: Little is known about the injury rates in Major League Baseball (MLB) players, as a formal injury surveillance system does not yet exist. The goal of this study was to characterize the epidemiology of MLB injuries over a seven-year period.

METHODS: We analyzed the Major League Baseball disabled list data from 2002 through 2008. The injuries were categorized by major anatomic zones and then further stratified based on injury type. Position-specific sub-analyses for pitcher and position players were also performed and comparisons between the proportion of injury by region was performed using chi-square analysis.

RESULTS: Overall, a mean of 439 injuries occurred per season resulting in a player being placed on the disabled list. Overall, upper extremity injuries accounted for 51.2% of all injuries compared with 27% in the lower extremity. For pitchers, there were 243 injuries on average per season with 66.6% being upper extremity and 12.8% being lower. For fielders, there were 196 injuries on average per season with 44.6% lower extremity injuries and 32.1% in the upper extremity. This difference in upper and lower extremity injuries was significant ($p<0.0001$). The breakdown of upper extremity injuries was also different in pitchers (50.3% shoulder, 42.8% elbow, 6.9% hand/wrist) and position players (30.7% shoulder, 13.6% elbow, 55.7% hand/wrist). These differences were also significant ($p<0.0001$).

DISCUSSION AND CONCLUSIONS: In the evaluation of Major League Baseball injuries resulting in time on the disabled list, upper extremity injuries are predominant in pitchers while lower extremity injuries are more common in position players. Potential preseason training and in-season conditioning may be employed for specific injury prevention based on these findings.

44. Glenohumeral Internal Rotational Deficits: Correlation with Shoulder Strength and Total Arc of Motion Deficits in Professional Baseball Pitchers

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OBJECTIVES: Shoulder injuries are common in professional baseball pitchers.[1] Many adaptive changes occur in the dominant shoulder of overhead athletes, including increased humeral retroversion and capsular fibrosis and laxity.[2] Clinically, these changes manifest as a glenohumeral internal rotation deficit, or GIRD.[3] Internal rotation deficits of greater than 20° are thought to be significant in the development of shoulder pathology.[4] Total arc of motion and internal rotation have been noted to decrease in pitchers with shoulder pain.[5] The goal of this study is to correlate strength deficits and total arc of motion (TAM) with GIRD in professional baseball pitchers.

METHODS: Shoulder ROM and strength data from pitchers from seven professional baseball teams were obtained by staff athletic trainers over a four-year period with goniometer and digital dynamometer.

RESULTS: Means and standard deviations for each measurement were calculated for the entire group and for pitchers with and without GIRD. A regression analysis was performed to evaluate whether deficiencies (compared with non-dominant arm) in TAM, and shoulder strength measured in scaption and abduction predicted GIRD. Deficiencies in TAM ($p<0.001$) and scaption strength ($p<0.043$) were significantly associated with GIRD.

CONCLUSION: Deficiencies in dominant shoulder TAM are associated with GIRD in professional baseball pitchers. This implies that throwers who maintain more normal TAM are better able to forestall the development of clinically significant GIRD (>20°). Deficits in shoulder strength demonstrated a partial correlation with GIRD. The group examined in this study was measured without regard to shoulder symptoms. More pronounced strength deficits in the setting of GIRD may be observed as a response to injury rather than as a cause of injury.

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45. The Abduction External Rotation Test for the Diagnosis of SLAP Tears

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The purpose of this study is to help identify SLAP tears utilizing a new clinical test. Many tests have been devised for differentiating labral pathology. These tests lack the specificity needed for correct diagnosis of labral pathology. The difficulty is finding a test with reproducible results while determining the correct shoulder abnormality. A total of 124 shoulders (69 right, 55 left) were prospectively identified in the clinic as having had undergone a physical examination conducted by the senior author (KDN) or a sports medicine fellow. The tests performed were the O'Brien's test, Speed's test, and Yergason's test in addition to our new test. From the 124 shoulders, 74 were males and 50 were females with an average age of 52 and an age range of 18-88. In this test, the patient's injured shoulder was abducted to 90° and then maximally externally rotated. The patient was then asked to internally rotate their arm with resistance from the physician. A positive test was an examination that reproduced the patient's shoulder pain. Sixty-one of the study population (124 patients) had a positive Nord test, 88 had a positive O'Brien's test, 12 had a positive Speed's test, and 11 had a positive Yergason's test. Arthroscopic exam revealed 40 patients with a SLAP tear. Those patients with a type I tear were not included in the study leaving 29 shoulders. There were 19 type II tears, 7 type VIII tears, 1 of type IX, and 2 of type X. We found the Nord test to have a sensitivity of 83% and a specificity of 62%. The idea to perform this test was based upon the peel back mechanism as described and evaluated arthroscopically by Burkhart and Morgan. This test has been shown to be effective in diagnosing SLAP and labral tears. We recommend using several of these tests together to improve the accuracy of diagnosis.

46. The Longitudinal Anatomy of the Long Head of the Biceps Tendon: An Anatomic Study in Human Cadavers

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Although past investigations have studied variations in the origin of the long head of the biceps and differences in the morphology of the bicipital groove, no reports have quantified the entirety of its course from its origin to the musculotendinous junction. We hypothesize that in respect to common relevant anatomic landmarks, measurements of the biceps tendon can be reliably predicted.

Forty-three grossly embalmed shoulder specimens were harvested, and their tendon measurements were recorded. Markers were placed at four points along its length: (1) the proximal border of the bicipital groove, (2) the distal border of the bicipital groove, (3) the proximal edge of the pectoralis major insertion, and (4) the musculotendinous junction. Using the tendon origin as the initial point of reference, measurements were made to the four subsequent sites. The entire humeral length was recorded by measuring the distance between the greater tuberosity and the lateral epicondyle.

In respect to measurements, differences between values from the proximal bicipital groove ($p=0.292$) and distal bicipital groove ($p=0.301$) were not statistically significant. After dividing the recorded values by the humeral length (HL), there were no statistical differences between measurements of the proximal bicipital groove/HL ($p=0.290$), distal bicipital groove/HL ($p=0.536$), and musculotendinous junction/HL ($p=0.141$).

When divided by the humeral length, measurements of the long head of the biceps involving the proximal and distal bicipital groove and the musculotendinous junction can be reproducibly quantified.

47. Disease and Non-Battle Injuries Sustained by a U.S. Army Brigade Combat Team During Operation Iraqi Freedom

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BACKGROUND: Historically, disease and non-battle injuries (DNBI) have resulted in significantly more hospitalizations and time lost than battle injuries sustained from hostile enemy action. Previous reports have primarily focused on combat casualties and underestimated the significance of DNBI; however, little is known about the epidemiology of musculoskeletal non-battle injuries in the current Iraq war.

METHODS: A longitudinal cohort analysis of DNBI sustained by a U.S. Army Brigade Combat Team (BCT) during a counterinsurgency campaign was undertaken.

RESULTS: Of the 4,122 soldiers deployed, there were 1,328 DNBI of which 5 died of their DNBI, 208 were medically evacuated (MEDEVAC), and 1,115 (83.9%) were returned to duty (RTD). Musculoskeletal injury (50.2%) was the most common body system involved with DNBI casualties and the musculoskeletal DNBI casualty rate for the BCT was 129.5/1,000 soldier combat-years. Males (16.3%), compared with females (15.1%), were not at a significantly increased risk for becoming a musculoskeletal DNBI casualty ($p=0.62$). The BCT cohort incidence rates for common musculoskeletal injuries per 1,000 combat-years were as follows: anterior cruciate ligament (ACL) rupture 3.3, first-time shoulder dislocation 1.2, and ankle sprain 15.3. When compared to sprains 0.7%, fracture 19.7% ($p<.0001$), and instability 19.4% ($p<0.0001$) musculoskeletal DNBI casualties were at a greater risk for being MEDEVAC. The five most common musculoskeletal DNBI locations were hand (17.5%), lumbar spine (13.5%), knee (13.5%), ankle (13.5%), and shoulder (11.8%). When comparing the DNBI casualty classification by musculoskeletal location and rank group, there was not a significant difference among the percentage of DNBI casualties that were MEDEVAC.

CONCLUSIONS: In the BCT cohort, DNBI accounted for 75% more casualties than battle-related injuries. Musculoskeletal injuries accounted for 50% of all DNBI casualties and 32.9% of non-pregnancy related DNBI casualties requiring subsequent MEDEVAC. The musculoskeletal injury incidence rates of ACL rupture and first-time shoulder dislocation were five-fold greater than the general population.

48. Shoulder Dislocations in the United States Population: Incidence and Demographic Risk Factors

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INTRODUCTION: The epidemiology of shoulder dislocations is poorly defined in recent literature. We aimed to determine its incidence and demographic risk factors in the United States population.

METHODS: The National Electronic Injury Surveillance System (NEISS), a probability sample of all injuries presenting to U.S. emergency rooms, was queried for shoulder dislocations over a five-year period from 2002-2006. Based on model design, weighted NEISS sample data yielded weighted estimates of U.S. cases. Patient and injury characteristics were analyzed using SAS statistical software. U.S. Census data were used to calculate incidence rates (IR) and incident rate ratios (IRR) for the U.S. population and age, gender, and race-delimited subgroups.

RESULTS: A total of 8,940 shoulder dislocations were identified, resulting in an overall IR in the U.S. of 23.9/100,000 person-years (95% CI 20.8-27.0). The male incidence rate was significantly higher 34.90 (30.08-39.73) with an IRR of 2.64 (2.34-2.88) relative to females. Males accounted for 71.8% of dislocations. Stratified by decade, maximum incidence occurred in the third decade (IRR= 3.70 [3.15-4.25], referent 50-59 years old), corresponding to the maximum male IR (79.2 [67.4-90.9]). Patients aged 15 to 29 years accounted for 46.8% of injuries. Referenced to white populations, dislocations showed a trend toward higher incidence in black populations (IRR 1.25 [0.66-1.86]), while incidence was significantly lower in other populations (0.42 [0.22-0.61]). Dislocations were most frequently anterior (94.4%), resulted from a fall (58.8%), and occurred at home (47.6%) or at sites of sports/recreation (33.6%). 48.3% of injuries occurred during sports/recreation.

DISCUSSION AND CONCLUSION: The estimated U.S. incidence rate of 23.9/100,000 person-years is approximately twice the previously reported value. Young age and male gender are independent risk factors for shoulder dislocation. Results are based on the largest published sample for shoulder dislocation epidemiology.

Keywords: shoulder, dislocation, epidemiology

49. Incidence and Functional Outcomes of Articular Cartilage Injuries in Patients with Glenohumeral Instability

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INTRODUCTION: The purpose of the study was to determine the incidence of articular cartilage injuries in patients with instability of the glenohumeral (GH) joint and correlate these injuries with postoperative functional outcome.

MATERIALS AND METHODS: A cohort of 87 consecutive patients who underwent diagnostic MRI and shoulder arthroscopy for instability from 1997-2006 was identified. Radiographic and arthroscopic findings were recorded. Functional outcome was assessed utilizing the American Shoulder and Elbow Surgeons (ASES) Elbow Evaluation Instrument.

RESULTS: The cohort of 87 patients included 60 males and 17 females with a mean age of 27.0 (range 18-64) years. Previously documented shoulder dislocation was present in 60 patients (69.0%). Anterior instability was present in 71 (81.6%), and posterior instability was present in 16 (18.4%) on clinical exam. Cartilage injuries were detected in 55 (63.2%). Seventy-one patients completed ASES surveys at a mean clinical follow-up of 36 (range 33-39) months. Mean ASES score was 89.5 ± 11 for the affected side and 97 ± 12 points for the unaffected side ($p=0.008$). Forty-six of the 71 patients had documented articular cartilage lesions by arthroscopy at the time of initial operation. Among those with an articular cartilage lesion, the mean ASES score was 89 ± 10 points on the affected side and 97 ± 2 on the unaffected side. Among those without cartilage lesions, the mean ASES score was 89 ± 14 on the affected side and 99 ± 2 on the unaffected side. No statistically significant difference between groups was observed when comparing the ASES scores for affected, unaffected, or both arms ($p=0.92$, 0.80, 0.33, respectively).

CONCLUSION: Cartilage lesions were detected in more than half of the patients with GH instability, with a measured incidence of 63.2% for this cohort. At a minimum 33-month follow-up, the presence of cartilage lesions at initial arthroscopy for treatment of instability does not appear to affect clinical outcome. Continued follow-up is recommended.

50. A Biomechanical Analysis of Anterior Bankart Repair Using Suture Anchors

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INTRODUCTION: Arthroscopic repair of anterior Bankart lesions are typically fixed with single loaded suture anchors tied with simple stitch configuration. Multiple different suturing techniques have been described in the arthroscopic treatment of anterior shoulder instability. The purpose of this study was to compare the biomechanical properties of single loaded suture anchor with simple stitch (SSA) and knotless suture anchors (KSA).

METHODS: Fresh-frozen shoulders were dissected down to the glenohumeral capsule and an anteroinferior Bankart lesion was created. For Part 1, specimens were randomized into either SSA or KSA. Each construct was preloaded to 5 N for 1 minute and then loaded to failure at 25 mm/minute. For Part 2, specimens were randomized into one of the following four repair techniques: (1) SSA, (2) suture anchor with horizontal mattress configuration (HSA), (3) double loaded suture anchor with simple stitch configuration (DSA), or (4) KSA. Each shoulder was preloaded to 5N for 2 minutes, cycled from 5N to 25N for 100 cycles (1 Hz), and then loaded to failure at 15 mm/minute. Optical tracking was to quantify capsular displacement from the fixed glenoid.

RESULTS: For Part 1, there was no statistical difference in ultimate load to failure between SSA and KSA. The load required for 2 mm displacement was significantly greater in SSA (66.5 ± 21.7 N) compared to KSA (35.0 ± 12.5 N, $p=0.02$). For Part 2, the single loaded suture anchor with simple stitch (184.0 ± 64.5 N), horizontal mattress stitch (189.0 ± 65.3 N), and double loaded suture anchor with simple stitch (216.7 ± 61.7 N) groups had significantly ($p<0.05$) higher loads than the knotless group (103.9 ± 52.8 N).

CONCLUSIONS: The optimal fixation construct for capsular plication of the anterior capsule has not yet been determined and several different techniques have been described. The findings of the present study demonstrate that the KSA required lower loads for 2 mm of displacement without cycling and a decreased ultimate load to failure with cycling at the time of implantation.

51. Biomechanical Evaluation of Three Self-Cinching Stitches for Shoulder Arthroscopy: The Lasso-Loop, Lasso-Mattress, and Double-Cinch Stitches

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INTRODUCTION: The tissue-suture interface remains the most common site of failure in tissue repair. Improving stitch strengths may lead to lower failure rates. Several stitch techniques utilize a self-cinching mechanism. Similar to a "Chinese finger-trap", increased tension on the suture leads to an increased grasp upon the tissue. The lasso-loop, lasso-mattress, and double-cinch stitches are technically simple stitches that utilize this self-cinching quality. We sought to compare biomechanical properties of three self-cinching stitches to the simple, mattress, Modified Mason-Allen (MMA), and massive cuff (MAC) stitches.

METHODS: 336 sheep infraspinatus grafts were randomized and divided among seven stitches. Each graft was cyclically loaded on a MTS from 5-30N for 20 cycles and then loaded to failure. A mixed-model, multivariate regression model was used to test significance of suture type on load-to-failure, peak-to-peak displacement, and cyclic elongation. Means and standard deviations are reported.

RESULTS: Load to failure for the simple suture (48.2 ± 23N), was significantly lower than the other stitches: lasso-loop (65.5 ± 26 N), mattress (67.3 ± 28N), double-cinch (94.2 ± 42N), MMA (129 ± 51N), lasso-mattress (145 ± 61N), and MAC (153 ± 40N) ($p \leq 0.01$ for all). Significant differences were found in cyclic elongation (1.44 mm for the simple to 1.81 mm for the lasso-mattress) ($p<0.01$). Peak-to-peak displacement was similar for all stitches, 1.16 mm – 1.21 mm ($p>0.2$ for all).

CONCLUSIONS: Self-cinching stitches lead to superior tissue holding strength at the tissue-suture interface in comparison to equivalent non-cinching stitches. However, the critical factor in stitch strength is the complexity of stitch chosen.

52. Correlation Between MRI Signs, Pain, and Function in Patients with Knee Osteoarthritis

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INTRODUCTION: The ability to detect early changes in osteoarthritis will make it possible to treat patients at an earlier stage and prevent pain and loss of function. The cause of knee pain in patients with osteoarthritis still remains unclear. Our objective was to evaluate the association between knee pain and function with structural abnormalities found with MRI in patients with knee OA. We hypothesized that early changes detected by the MRI will correlate with patient symptoms such as pain and loss of function.

METHODS: 266 patients were enrolled (421 knees). The mean age was 57 years (range 31-81 years) and 77% were females. Patient oriented outcomes included the WOMAC score and pain visual analog scale (VAS) for each knee. A Whole-Organ Magnetic Resonance Imaging Score (WORMS) of the knee was used to assess OA changes. All statistical tests were two-sided and the threshold of statistical significance was set at $\alpha=0.05$.

RESULTS: Severe synovitis as measured by the WORMS subscale was associated with a higher WOMAC pain score (73.4 vs. 68.45; $p=0.02$), WOMAC function score (78.11 vs. 73.04; $p=0.01$), ADL (77.85 vs. 73.13; $p=0.01$), and pain VAS (Δ 0.73; $p=0.004$). Medial compartment BME was also associated with changes in WOMAC pain (Δ-3.11; $p=0.001$), WOMAC Function (Δ -4.06; $p<0.001$), ADL (Δ -3.75; $p<0001$), and pain VAS (Δ 0.54; $p<0.001$).

DISCUSSION: The current study found that knee pain and function in patients with OA is associated with severe synovitis and bone marrow edema particularly in the knee medial compartment as revealed by MRI.

53. Effect of Partial Meniscectomy on Peak Contact Pressures of Displaced and Nondisplaced Meniscus Tears

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INTRODUCTION: We hypothesize that nondisplaced longitudinal meniscus tears, though symptomatic, may have a protective effect on the adjacent cartilage. The purpose was to evaluate contact pressures adjacent to nondisplaced and displaced longitudinal meniscus tears, and compare to contact pressures following partial meniscectomy.

METHODS: Twelve human cadaveric knees were randomized into two groups: vertical (#1) and bucket handle (#2). Tears were created through the red-white zone of the meniscus. Knees were loaded in extension with the meniscus intact, with a nondisplaced tear, displaced tear (bucket-handle group only), and after partial meniscectomy. The peak contact pressures were recorded (MPa).

RESULTS: #1: peak pressures (*pp*) increased on the medial side from an average of 6.00 with intact meniscus to 6.30 with a nondisplaced vertical tear. After partial meniscectomy, *pp* increased to an average of 7.17 (p=0.002). On the lateral side, *pp* increased from an average of 5.71 to 6.32 with a nondisplaced vertical tear (p=0.015). After partial meniscectomy, *pp* increased to an average of 6.92 (p=0.002).
#2: average *pp* medially for the intact meniscus increased from 3.76 to 4.02 with a nondisplaced tear, and to 4.53 (p=0.023) once the tear was bucketed; *pp* decreased to an average of 4.18 after partial meniscectomy (p=0.028). Average *pp* laterally for the intact meniscus was 3.67—increased to an average of 3.96 with a nondisplaced tear (p=0.014), and to 4.65 once the tear was bucketed (p=0.008). *PP* decreased to an average of 4.09 (p=0.034) after partial meniscectomy.

DISCUSSION: Significant differences in contact pressures were shown comparing intact to torn menisci, including significant increases once the torn meniscus piece was excised. Longitudinal meniscus tears that have not bucketed, though often symptomatic, may still absorb loads and protect adjacent cartilage.

54. Can Two Easily Administered Functional Tests Predict Short-Term Outcome Following Partial Meniscectomy?

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SUMMARY: Two commonly used and easily administered functional tests show good correlation with short-term outcome following meniscectomy. All but two subjects returned to baseline or surpassed baseline function.

BACKGROUND: Up to 95% of patients have good outcomes following partial meniscectomy; however, it is best to determine, preoperatively, if the patient is a good candidate for meniscectomy or whether the patient should seek treatment from other modalities. Two functional tests, the Timed Up-and-Go (TUG) test and the Stair Climb Test (SCT), are easily administered tests often used in research to assess varying levels of function.

OBJECTIVE: Determine if preoperative functional testing provides a clinically useful estimate of postoperative outcome and return to function which can then be used as part of a surgeon's screening protocol.

METHODS: Twenty-two adults scheduled to undergo meniscectomy were prospectively studied with two functional tests (TUG test and the SCT) prior to surgery and at each follow-up appointment through 12 weeks postoperative. Although only 15 subjects had preoperative IKDC scores, all subjects had 12-week postoperative IKDC scores.

RESULTS: Twenty subjects returned or surpassed their baseline time on both tests at 12 weeks postoperative. Both the TUG and SCT tests showed moderate correlation with the IKDC outcome score ($r=-0.5563$ and -0.6788 respectively). Three subjects had a decrease in their IKDC score from preoperative baseline while 12 displayed significant increases.

DISCUSSION: Preoperative function, estimated by results of the TUG test and SCT, correlates well with patient outcome following arthroscopic partial menisectomy. While certainly not definitive, results from these easily administered office tests can be combined with other preoperative clinical and radiographic findings to determine which patients would most benefit from arthroscopic partial menisectomy.

MAOA BREAKOUT SESSION #5
PEDIATRICS/EDUCATION
April 22, 2010

55. Effect of High Speed Burr and Argon Beam Coagulation on Local Recurrence Rates of Aneurysmal Bone Cysts

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Although benign, Aneurysmal Bone Cysts (ABCs) are locally aggressive with a high rate of recurrence after treatment. The standard approach is to curette the lesion, apply an adjuvant, and then eliminate the void with a filling material. Numerous adjuvant treatments are currently in use without any particular one consistently demonstrating a recurrence rate below 20%. Ten years ago, in a small, retrospective review we reported a 12% recurrence rate after treatment with curettage and a high-speed burr (HSB). We revisited our tumor registry to try and validate the effectiveness of the HSB and also to determine the effect of a new adjuvant, argon beam coagulation, on the local recurrence rates of surgically treated ABCs.

We retrospectively reviewed 84 patients with primary ABCs, treated at our institution from 1983 to 2008. Mean age was 18.45 years, mean follow-up was 31.9 months. Fifty-seven percent of the patients were female. One-third of lesions abutted the physis. Ten lesions were completely resected with no recurrence. Demographic and clinical parameters were similar in patients treated with and without argon beam coagulation. Thirty-four lesions were treated with HSB alone with a local recurrence rate of 20.6%. Forty lesions received treatment with HSB plus argon beam with a recurrence rate of 5%. We observed a higher recurrence in females and distal radius lesions, as well as no effect from proximity to the growth plate.

High-speed burr alone has a recurrence rate similar to other adjuvant treatments. However, in conjunction with argon beam treatment, the recurrence rate is significantly diminished. Argon beam coagulation is an effective adjuvant treatment for surgical treatment of Aneurysmal Bone Cysts and may be superior to other adjuvants.

56. A Two-Year Follow-Up of Patients Receiving a Southwick-Fulkerson Osteotomy with Operative Guidance of Alignment via Femoral Nerve Stimulation

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INTRODUCTION: Patients underwent a Southwick-Fulkerson Osteotomy and medial patellofemoral ligament (MPFL) repair or reconstruction. Femoral nerve stimulation of the quadriceps muscle allowed a dynamic evaluation of the procedure intraoperatively. Two-year minimum outcomes of these patients were determined to evaluate the effectiveness of Southwick-Fulkerson procedures under the guidance of intraoperative femoral nerve stimulation as treatment for patellofemoral instability. The effectiveness of MPFL repair versus reconstruction on the elimination of postoperative apprehension was also compared.

METHODS: Thirty-two patients for a total of 37 knees were contacted. This included all patients who received this procedure and were at least two years postoperative. 26/31 patients (31 knees) returned for follow-up. Patients were evaluated using KOOS and IKDC scores, and physical examination features of apprehension, dynamic tracking, and crepitus.

RESULTS: Twenty-nine knees reported they were happy with the procedure and 29 reported they would do it again. One knee (3%) reportedly redislocated, but did not return for examination for verification. 30/31 had relatively normal tracking. One knee displayed a residual J sign. 4/16 knees with MPFL repair and 0/15 with reconstruction exhibited apprehension. Increased age and apprehension were correlated with lower outcome scores. Demonstration of chondromalacia did not affect functional outcome scores.

DISCUSSION/CONCLUSION: Intraoperative femoral nerve stimulation is an effective way of evaluating patellar tracking intraoperatively that leads to 97% successful postoperative results. The Southwick modification of the Fulkerson Osteotomy decreased recovery times. MPFL reconstruction eliminates the persistence of the apprehension sign.

57. Periacetabular Osteotomy for Symptomatic, Residual Acetabular Dysplasia After Previous Hip Reconstruction

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INTRODUCTION: The periacetabular osteotomy (PAO) provides excellent deformity correction and good clinical results for symptomatic acetabular dysplasia. This procedure is more complex when a previous osteotomy or shelf procedure has been performed. The clinical results of the PAO in this setting are not well defined. We analyzed the clinical and radiographic results of a series of PAOs performed in patients with a previous hip osteotomy or shelf procedure.

MATERIALS AND METHODS: We retrospectively analyzed 65 patients (67 hips, 56 females and 9 males) who underwent a PAO for symptomatic, residual deformities after previous hip reconstruction (41 pelvic osteotomies, 11 femoral osteotomies, and 4 shelf procedures). The average age was 18.0 years (range, 10.4-53.6). Standard radiographic evaluation and Harris hip score for function were evaluated.

RESULTS: Radiographic analysis demonstrated an average improvement of 28.4° in the lateral center edge angle, 28.2° in the anterior center edge angle, 15.9° in acetabular inclination, and 3.6 mm of medial translation (all with $p<0.001$). The osteoarthritis grade remained unchanged or improved in 95.3% hips and worsened in 4.5%. Hip scores improved from an average 64.5 preoperatively to 79.8 postoperatively ($p<0.001$). Major complications included one transient sciatic nerve palsy, one wound hematoma, and one posterior column nonunion. One patient required THA three years after the PAO.

CONCLUSION: Periacetabular osteotomy after previous hip osteotomy or acetabular shelf procedure is associated with excellent deformity correction and good clinical results in most patients. The surgical procedure is technically demanding and hip function recovery is limited in some patients.

58. Examination of the "Second-Hit" Phenomenon in Pediatric Blunt Polytrauma Patients Undergoing Orthopedic Surgery

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BACKGROUND: Recent publications have identified several parameters in adults that indicate the extent of physiologic compromise after blunt polytrauma (BPT) that can be used to determine the timing of orthopedic surgery (OS). To our knowledge, no such parameters have been reported in the pediatric population. The purpose of this study is to report on the pediatric physiologic response the "second-hit" of OS after BPT and the factors that influenced surgical timing at a single regional hospital.

METHODS: A retrospective review was conducted of all patients in our pediatric trauma registry with an injury severity score (ISS) of 16 or greater due to BPT requiring OS between June 2004 and January 2007. Thirty patients were identified; 35 OS were performed. Traumatic brain injury (TBI) was defined as a heat CT finding of fracture or intracranial bleed. We analyzed 20 different vital signs and/or lab markers 24 hours pre- and 48 hours post-surgery to determine the pediatric pathophysiologic response to OS. Statistics used to analyze data included chi-square.

RESULTS: The 20 different parameters analyzed remained unchanged or improved after surgery in almost all patients. The only adverse outcome was the death of one patient due to severe TBI. There was one case of compartment syndrome requiring a second OS. There were 4 cases of infection, all successfully treated. The timing of OS was dependent on the Glasgow Coma Scale (GCS) ($p=0.01$), the presence of TBI ($p=0.03$), and the ISS ($p=0.01$).

CONCLUSION: The pediatric pathophysiologic response to OS after BPT appears minimal. Few postoperative complications were encountered. The GCS, TBI, and ISS were the most influential drivers of surgical timing. Further investigation is needed to determine the optimal timing of orthopedic surgical procedures after pediatric BPT.

59. Effect of IGF1 and BMP3 on Physeal Injury in a Rat Tibia Model

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It was hypothesized that bony bridge formation could be prevented across a healing physeal injury by injecting IGF1 (a chondrogenic factor) and/or BMP3 (an antagonist of osteogenic BMPs) in a rat tibia model.

After establishing the appropriate multiplicity of infection (MOI) for each of the two adenoviral vectors (AdBMP3 and AdIGF1) in the study, 24 skeletally-immature rats were divided into four groups of six. A central defect was created in the proximal growth plate of one rear tibia in each rat. Adenoviral vectors representing one of four experimental groups were then injected into the defect: (1) GFP/control, (2) AdIGF1, (3) AdBMP3, and (4) combination of AdIGF1 and AdBMP3. Half of the rats were sacrificed at two weeks and the other half at four weeks. The tibias were harvested, fixed, and examined histologically with a pathologist. No rats died prior to sacrifice.

Results were similar at both time points. The control group healed with formation of a physeal bar. The IGF1 group showed only chondral healing within the physis (no osteoid formation). The BMP3 and combination groups were similar to each other but qualitatively different than the controls, showing mature bone cells and matrix across the physeal injury site.

Use of IGF1 at the site of physeal injury prevented bony bridge formation across the growth plate. BMP3 alone and a combination of IGF1 and BMP3 did not prevent bony bridge formation.

60. Prospective Analysis of Computer Navigated In-Situ Fixation of Slipped Capital Femoral Epiphysis

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BACKGROUND: Slipped capital femoral epiphysis (SCFE) is usually treated with percutaneous in-situ screw fixation to prevent further progression of the deformity and reduce the risk of early degenerative changes to the hip. This study was designed to compare the use of computer navigation (CN) with the traditional use of fluoroscopic (fluoro) imaging during operative fixation. We hypothesize that the CN system leads to: better screw placement, fewer pin passes, less radiation exposure, and longer operating room (OR) time initially.

METHODS: This study was an IRB approved prospective study of 36 hip pinnings in 31 children from September 2006 to February 2009. Traditional fluoro techniques were used in 16 cases; CN in 20. Screw placement was evaluated using a postoperative reduced-dose CT. Statistics used to analyze data included chi-square and the median test.

RESULTS: When compared to the fluoro group, the CN group had improved screw placement ($p=0.039$). There was no statistical difference between the two groups in the number of pin passes ($p=0.236$) and radiation exposure ($p=0.387$). OR time in the CN group averaged 19 minutes longer than the fluoro group ($p<0.0001$); however, there was a trend decreasing OR time with increasing experience. Postoperative CT in the fluoro group revealed one case of joint penetration not appreciated on intraoperative fluoro examination, which required subsequent screw adjustment. There were no cases of avascular necrosis, chondrolysis, or reslipping.

CONCLUSION: Compared to traditional fluoro techniques, CN in-situ fixation of SCFE results in better screw placement, comparable number of pin passes and radiation exposure, but longer OR time at least initially. Postoperative limited cut reduced-dose CT scans may be beneficial after in-situ fixation of SCFE to rule out possible joint penetration.

61. A Prospective Study on the Effectiveness of Cotton versus Gortex Cast Padding in Maintaining the Reduction of 100% Displaced Distal Forearm Fractures in Children

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BACKGROUND: Distal Forearm Fractures (DFFx) are one of the most common fractures seen in the pediatric population. Patients who suffer DFFx often prefer to be casted with waterproof cast-liner for convenience. This study investigates whether gortex-lined casts are as effective as traditional casts in maintaining reduction of DFFx in children.

METHODS: Fifty-six consecutive patients treated for 100% displaced DFFx at our institution between February 2007 and April 2009 were prospectively enrolled in our study and divided into gortex-padded (N=36) and cotton-padded (N=20) cast groups. The mean maximum change in displacement and angulation comparing post-reduction radiographs and additional follow-up radiographs in the AP and lateral planes were analyzed between the two groups using two-sided independent t-tests. Power analysis was also performed.

RESULTS: The mean maximum change in AP angulation, AP displacement, lateral angulation, and lateral displacement of the radius fracture following initial reduction were 9.86^{o}, 7.36%, 13.86^{o}, and 15.53% respectively for the cotton-lined cast group and 5.70^{o}, 3.50%, 13.80^{o}, and 9.50% respectively for the gortex-lined cast group. There was no statistical difference between the means of the four measurements (p=0.08, 0.16, 0.87, and 0.10 respectively). In addition, 36.1% of cotton-padded casts and 25% of gortex-padded casts (p=0.38) required intervention due to severe redisplacement or reangulation. Subgroup analysis exclusively studying patients with only concurrent ulnar fractures, intact ulnas, Salter-Harris fractures, or metaphyseal fractures also showed no difference between cast groups.

CONCLUSION: Gortex-lined casts are as equally effective as cotton-lined casts at maintaining reduction of 100% displaced DFFx. Thus, gortex-lined casts can be offered to pediatric patients immediately following closed reduction of DFFx of any severity.

62. Are There Predictors of an Orthopedic Resident's Performance on Written Specialty Certification Examinations?

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BACKGROUND: A previous study has shown that USMLE step 1 scores are a predictor of future resident's ability to pass pediatric boards. Orthopedic residents and many residents in other specialties are subjected to in-service training examinations, which may also be predictive of board success. We evaluated data from a single residency program in an attempt to identify correlations between multiple performance measures including written boards, USMLE Step I, USMLE Step 2, and OITE scores.

METHODS: Retrospective review of data for the last 15 years, held by the residency coordinator, in search of USMLE step 1, USMLE step 2, in-service training exam (from second and fifth year of training), and written orthopedic specialty board scores. All personalized information was removed by the residency coordinator. Two groups were compared based upon those scoring above the 50th percentile on written boards and those scoring below the 50th percentile.

RESULTS: Twenty-four residents were identified. A significant difference was seen between the groups in regards to USMLE scores for both Step I and II; also significant difference between OITE scores for both the second and fifth years. Moderate correlations were found for USMLE Step 1, Step 2, OITE 2, and OITE 5 when compared to performance on written boards. One resident initially failed written boards with a subsequent pass on the second attempt. This resident consistently scored in the 20th and 30th percentiles on the in-training exams.

CONCLUSION: Significantly higher levels of performance were observed in USMLE Step 1, USMLE Step 2, OITE 2, and OITE 5 scores for those residents who performed above the 50th percentile on their written boards. USMLE Step 1 and 2 scores along with OITE scores are helpful in defining how well a resident may perform on written boards. A low USMLE score, along with consistently low OITE scores, may define a resident at risk of failing written boards.

63. Does a Trauma Course Improve Resident Performance on OITE?

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PURPOSE: The value of didactic lecture based interventions in improving medical knowledge and healthcare outcomes has been questioned. Lecture based courses are common in orthopedic surgery, but the extent to which participants acquire orthopedic knowledge has not been assessed. The OTA and the AO both offer a three-day predominantly didactic resident trauma course. The purpose of this study is to determine whether these courses improve resident performance on the trauma domain of the Orthopedic in Training Examination (OITE).

METHODS: The OITE scores of 40 PGY 2 residents were retrospectively analyzed. Twenty-five residents who took a trauma course within six weeks of the November OITE (Course Before, CB) were the subjects, and 15 residents who took the course after the OITE served as controls (Course After, CA). The percentile score on the trauma domain of the OITE was the main outcome. As a secondary analysis, the effect of a trauma rotation before (TB) and trauma rotation after (TA) the OITE was also assessed. The baseline orthopedic knowledge between the two groups was compared using their overall OITE percentile scores. Differences in the mean percentile scores were assessed for significance with a t-test.

RESULTS: The mean trauma domain scores were not significantly different ($p=0.17$) between the subject and control groups (CB - 63.6 [SD 9.3], CA - 59.8 [SD 6.6]). In addition, the CB group scored higher on the overall test than the CA group ($p=0.04$) indicating greater baseline orthopedic knowledge (overall score CB - 60.9 [SD 4.8] and CA - 57.6 [SD 4.5]). There were no significant differences for the average trauma domain scores between the TB (65.2 [SD 7.0]) and the TA groups (60.1 [SD 8.6]). The subgroup of residents that had both a course and a trauma rotation before the test scored significantly better ($p=0.028$) on the trauma domain than the subgroup that had neither of these before the test (66.4 [SD 8.18] and 57.4 [SD 7.0]).

CONCLUSION: A traditional didactic course does little to enhance orthopedic residents' trauma medical knowledge as assessed on a standardized test. The combination of both a course and a trauma rotation does improve trauma test scores; however, the differences in mean scores were still relatively small representing on average only 4-5 more correct responses on a 50-question test.

64. Can Pre-Residency Academic Productivity Predict Residency Performance?

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Perceived future academic productivity is frequently considered in selection of orthopedic residents. We examined whether pre-residency publications (any field or orthopedic only), advanced degrees, or gender predicted academic productivity in residency.

METHODS: The academic productivity (peer-reviewed publications originating in residency) of 117 graduating residents from 1998-2008 at an academic institution were reviewed. We examined whether advanced degrees (M.S./Ph.D.), pre-residency publications (total and orthopedic only), and gender were associated with academic productivity during residency using univariate ordinal logistic regression. Residents at our program are required to complete a senior project, but not required to publish.

RESULTS: Residents had 121 pre-residency publications (54 orthopedic) and 278 residency publications. There was a marginally significant association between pre-residency publications and the number of publications during residency ($p=0.054$). The odds ratio for residency publications was 1.32 times greater for those with 1 pre-residency publication and 3.36 for those with multiple pre-residency publications versus those with none. There was no significant association between residency publications and pre-residency orthopedic publications ($p=0.28$), advanced degree ($p=0.94$), or gender ($p=0.53$). There was a marginal association between year and number of publications during residency ($p=0.053$). Residents in later years were more likely to publish (odds ratio of having more residency publications was 1.11 for each additional year in the study period).

CONCLUSIONS: Pre-residency publications are marginally associated with academic productivity during orthopedic residency. However, pre-residency orthopedic publications, advanced degrees, and gender are not. This is the first study to analyze this topic and calls into question traditional criteria used to select candidates for residency.

66. Burden of VTE "Never Events" for Medicare Patients Undergoing Total Hip or Total Knee Replacement Surgery

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INTRODUCTION: Venous thromboembolism (VTE), which includes deep vein thrombosis (DVT) and pulmonary embolism (PE), is a leading cause of morbidity and mortality in patients undergoing total hip or total knee replacement (THR, TKR) surgery. Postoperative VTE is considered among preventable medical errors that result in serious consequences for the patient, one of the "never events" defined by the Centers for Medicare and Medicaid Services. The incidence and impact of VTE during initial hospitalization of older patients (65≥99 years) undergoing THR or TKR surgery was examined.

METHODS: Patients were identified from the 2004–2006 national Medicare claims database. Rates of mortality, re-hospitalization, and bleeding, as well as costs of inpatient care in a period up to 30 days post-surgery were compared between patients with and without symptomatic VTE.

RESULTS: Among all patients who had THR (n=93,748) and TKR (n=112,950) surgery, 1.8% experienced symptomatic VTE during the initial hospitalization. Of these, approximately 70% had DVT, 24% had PE, and 6% had both DVT and PE. More than 20% of these patients had >2 postoperative VTE events. Compared with patients without VTE, in THR, VTE was associated with significantly higher rates of mortality (9.88% vs. 3.54%), re-hospitalization (27.89% vs. 16.63%), and bleeding (10.11% vs. 3.16%), as well as higher inpatient care costs ($30,125 vs. $21,309). Similar results were seen for TKR: mortality (1.45% vs. 0.36%), re-hospitalization (16.90% vs. 8.27%), bleeding (9.66% vs. 2.23%), and inpatient care costs ($22,798 vs. $16,671) were higher when VTE occurred during initial hospitalization.

CONCLUSION: Symptomatic VTE occurred in 1.8% of all patients who had THR or TKR surgery identified over a three-year period from the Medicare claims database. This was associated with significantly greater incidences of mortality, re-hospitalization, and bleeding as well as higher costs of inpatient care, compared with patients who did not experience symptomatic VTE. Preventing VTE during initial hospitalization should be a priority in patients undergoing THR or TKR surgery.

67. Clinical Utility of Routine Lower Extremity Venous Ultrasonography After Periacetabular Osteotomy

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SUMMARY: The periacetabular osteotomy (PAO) has become a common procedure for treating acetabular dysplasia. Like other major hip procedures, there is concern regarding the risk of venous thromboembolic (VTE) disease. Nevertheless, the incidence, need for screening, and optimal prophylactic measures have not been established. We investigated the efficacy of an aspirin prophylaxis regime and the role of screening venous ultrasonography after PAO.

METHODS: We performed a retrospective review of 154 consecutive, adult patients (171 hips) treated with a PAO. Mean patient age was 30 years (range, 18-60). Follow-up averaged 27 months. The same thromboembolic prophylactic regimen was utilized for all patients. This consisted of lower extremity compression devices while hospitalized, and compression stockings and aspirin 325 mg BID for six weeks. Screening bilateral lower extremity ultrasonography was performed on all patients within one week (mean, 4 days) of the procedure.

RESULTS: For the 171 hips analyzed, no DVTs (0%) were identified with the screening venous ultrasonography exams. There were no pulmonary emboli. Two female patients (2 hips, 1.2%) with negative postoperative screening presented at 14 and 38 days with clinical symptoms of DVT. Ultrasound confirmed this diagnosis and both were treated successfully with three months of anticoagulation. The cost of screening ultrasonography in this cohort was $114,000.

CONCLUSION: These data indicate that in association with a PAO, the incidence of VTE disease is very low (1.2%). This suggests that routine postoperative screening and aggressive pharmacological DVT prophylaxis are unnecessary. Aspirin in combination with mechanical measures is effective DVT prophylaxis.

68. Use of Daycase Surgery Centers for Major Joint Arthroplasty

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Over the past few years, there has been an exponential rise in the cost of major joint arthroplasty, despite declining surgeons' fees. Most of these costs are incurred from inpatient hospital care. In the past, joint replacements were performed on the elderly; however, it is becoming a more common procedure in people under 60.

Since January 2009, we have been doing uni knee arthroplasties and PFJ replacements as a same day procedure in our surgery center. Any patient fit to undergo surgery as a daycase was selected. General anesthesia with or without nerve block was administered according to the patients' preference. All patients had infiltration of subcutaneous tissues around the incision and posterior capsule with a cocktail of Bupivocaine with adrenaline, Depomedrol, Ancef, and Torradol. Depomedrol was not used if the patient was diabetic or had immune deficiency.

A suction drain was used postoperatively and removed before the release. Patients who opted for a nerve block were given a hinged brace to assist with mobilization. All patients received intravenous antibiotics prior to tourniquet application. Enteric-coated Aspirin 325 mg was given for thromboprophylaxis for one month. Patients were seen by a visiting nurse at home on the evening of surgery and were helped with pain control if necessary.

Twenty-two patients underwent joint replacements (6 PFJ replacements and 16 uni knee replacements) in our surgery center. Mean age and weight were 56 years and 87.1 kg, respectfully. One subject had an ASA score of 3, while the rest were 2. Two patients were later admitted to the hospital (persistent high blood pressure in one case and shortness of breath in the other), but both were discharged without further surgery or complication. One patient had a washout and liner exchange for possible infection. The total cost of joint replacement was almost halved by using daycase surgery. Patient satisfaction was found to be very high.

In select patients, joint replacements can be performed as an outpatient procedure safely and this can dramatically reduce the cost incurred for these procedures.

69. An Algorithmic Approach to the Unstable Total Hip Arthroplasty

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INTRODUCTION: The purpose of this study was to classify the etiologies of instability after total hip arthroplasty (THA) and evaluate the outcomes of revision based on a surgical treatment algorithm.

METHODS: We performed 77 consecutive revision THAs for instability. Patients had a mean age of 68 (range, 26 to 94). There were 47 females (61%) and 30 males (39%). Patients had a mean of 2 (range, 0 to 6) prior revisions for hip instability. The subjects were divided into six types based on the primary etiology of instability: (I) malposition of the acetabular component, (II) malposition of the femoral component, (III) abductor deficiency, (IV) impingement, (V) late wear, or (VI) unclear etiology. Types I and II were treated with revision of the malpositioned component, Type III and VI with constrained liners, Type IV by removing sources of impingement plus a large femoral head, and Type V with a liner change and a larger femoral head.

RESULTS: The primary causes of instability were Type I: 25 (33%); Type II: 8 (10%); Type III: 28 (37%); Type IV: 7 (9%); Type V: 5 (7%); and Type VI: 3 (4%). At a mean of 32.5 months (Range, 24 to 79), 12 patients re-dislocated (15.6%). Among these 12 failures, 8 (75%) were in type III patients who were treated with a constrained liner, 5 of which had been cemented into a well-fixed shell. The remaining 4 failures were Type I (2), Type V (1), and Type VI (1).

CONCLUSIONS: The most common causes of instability were cup malposition and abductor insufficiency. Overall, our treatment protocol had an 84.4% success rate. The highest risk of failure was in patients with abductor insufficiency with a revision for other etiologies having a success rate of 92%.

70. Lack of Callus Predicts Nonunion After Locking Plate for Distal Femur Fractures: Are Locking Plates Too Stiff?

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PURPOSE: Locking plates for distal femur fractures are frequently applied with a bridge plating technique which requires interfragmentary callus formation. Locking plates may be too stiff to optimize callus. This study uses image analysis techniques to measure callus in distal femur fractures treated with locking plates comparing the amount of callus formed between fractures that healed and those that did not.

METHODS: Eighty-six distal femur fractures were treated with fixed-angle lateral locking plates. The medical records and radiographs of all patients were reviewed. Nonunion was defined clinically as an inability to bear weight and radiographically as lack of bridging callus at six months without progression of healing for three months as observed by the treating surgeon. Callus was measured on multiple postoperative radiographs using a novel, image analysis technique. Custom software objectively extracted the size of periosteal callus from digital radiographs by outlining the cortex and assigning a region as callus based on pixel intensity. The measured callus was compared between fractures that united and those that developed nonunions and between the two different plate materials.

RESULTS: There were 14 fractures that failed to unite (16.2%). The incidence of diabetes, smoking, or open fracture was similar in fractures that united compared to those that did not unite. Those fractures that failed to unite had less callus formation at 6 ($p=0.022$), 12 ($p=0.007$), and 24 weeks ($p=0.035$). Angular deviation greater than 5° occurred in 19 patients in the coronal plane and 10 patients in the sagittal. Only 2/14 (14.3%) nonunions changed alignment greater than 5° over their course of follow-up. The remaining 12 maintained alignment, but failed to form bridging callus.

CONCLUSION AND SIGNIFICANCE: The incidence of nonunion was higher than previously reported. Nonunion often presents relatively late without hardware failure or loss of alignment. Cases that fail to heal usually maintain alignment and form less callus after injury suggesting that callus inhibition rather than hardware failure is the primary problem.

71. Predictors of Early Adverse Outcomes in Geriatric Patients After Total Knee and Hip Arthroplasty

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INTRODUCTION: Geriatric patients experience more adverse outcomes due to early complications after total knee or hip arthroplasty (TKA or THA) related to pre-existing comorbidities and surgical variables.

METHODS: A cohort of consecutive geriatric patients (>65 years) undergoing TKA or THA were followed prospectively. Demographics, comorbidities, postoperative complications (systemic, local, minor, and major), surgical and hospitalization information, discharge disposition, readmission, and/or reoperation within 90 days were collected. Adjusted hierarchical stepwise multivariate regression models were used to analyze associations and relative risks with complications, length of stay, readmission, and reoperation rates.

RESULTS: Five hundred and two patients underwent 550 procedures (304 TKA, 48 bilateral [B/L], and 198 THA). Patients were twice as likely to have a major systemic complication per ten years of age ($p<0.0001$). Bilateral TKA procedures were 67% more likely to have any type of complication ($p=0.0001$), and epidural anesthesia was 2.4 times more likely to have a major systemic complication ($p=0.0044$). Patients with coronary artery disease (CAD) were 1.5 times more likely to have a transfusion ($p=0.005$), 4.4 times more likely to have major local complications ($p=0.016$) including joint infection ($p=0.048$), 3.6 times more likely to have a major systemic complication ($p<0.0001$), 2.6 times more likely to be readmitted ($p=0.017$), and 3 times more likely to require a reoperation ($p=0.035$).

CONCLUSION: Age, type of surgery, anesthesia, and CAD are associated with complications and adverse outcomes. Surgeons should be aware of these risk factors and utilize them in counseling patients and making surgical decisions.

72. Single Incision versus Double Incision Fasciotomy for Tibial Compartment Syndrome

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PURPOSE: Emergent fasciotomy through dual medial/lateral incisions or a single lateral incision is necessary to prevent ischemic myonecrosis in the setting of tibial compartment syndrome. Following decompression, successful wound closure can be problematic, often requiring multiple debridements and possible split thickness skin grafting (STSG). The purpose of this study was to evaluate a prospective protocol and review the results of two fasciotomy techniques to determine if fasciotomy through a single lateral incision increases the need for secondary procedures and/or STSG to achieve competent wound closure.

METHODS: Patients requiring fasciotomy were selected for each treatment group by surgeon randomization. Outcomes analyzed included number of debridement procedures prior to closure or grafting, time to wound closure, length of hospitalization, and the necessity of split thickness skin grafting.

RESULTS: Ninety-eight patients underwent 100 fasciotomies and were available for long-term follow-up. Forty-seven fasciotomies were performed through a dual medial/lateral approach, while 53 were performed through a single lateral incision. Seventeen wounds, 8 (17.0%) in the dual incision group and 9 (17.0%) in the single incision group required STSG. Mean time until wound closure was 8.0 (±4.8) days in the single incision group and 7.4 (±4.2) in the dual incision group (p=.526). There were no significant differences between the two groups with regard to number of I&D procedures, length of hospitalization, and the necessity for STSG. All wounds healed clinically following closure or STSG.

CONCLUSIONS: Fasciotomy by single or dual incision is an effective means of relieving elevated compartmental pressures as a result of lower extremity trauma. Both methods allow wound closure at similar time intervals and have a similar incidence of STSG. The perceived additional iatrogenic soft tissue trauma caused by release of the deep compartments from the lateral side does not appear to have a significant impact on wound closure or eventual outcome.

MAOA BREAKOUT SESSION #6
COMPLEX/REVISION TOTAL HIP ARTHROPLASTY
April 23, 2010

73. The Subset of $CD14^+CD16^+$ Blood Monocytes is Expended in Patients with Aseptic Loosening

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INTRODUCTION: Aseptic loosening (AL) is a main complication of total joint replacement surgery. It is unclear why some patients develop AL while others do not. Additional efforts are needed to characterize the risk factors that lead to the AL progression. Blood monocytes from AL patients share phenotypic characteristics with macrophages isolated from periprosthetic tissue of patients with AL. There are two distinct subpopulations of blood monocytes, $CD14^+CD16^-$ and $CD14^+CD16^+$. $CD14^+CD16^+$ monocytes are inflammatory and expended in various inflammatory conditions. The aim of this study was to investigate the relevance of blood $CD14^+CD16^+$ monocytes subset in AL patients.

MATERIALS AND METHODS: We recruited a total of 57 patients, including 40 patients with stable implants (SI) and 17 patients with AL. Blood samples were collected and the expression of monocyte cell marker CD14 and CD16 was analyzed by flow cytometry.

RESULTS AND DISCUSSION: We found that the subset of $CD14^+CD16^+$ monocytes were significantly increased in AL (14.9 ± 6.7%) compared with patients with SI (8.3 ± 4.1%) ($P< 0.05$). Re-evaluation of eight AL patients three months after revision surgery revealed a significant decrease of the $CD14^+CD16^+$ monocytes subset (8.1 ± 2.5%), compared with that of prior to revision surgery (20.1 ± 4.1%) ($P< 0.01$). This reduction corresponded with a marked improvement in pain and joint function following the revision surgery. These findings indicate that the subset of $CD14^+CD16^+$ monocytes is expanded in AL patients and correlated to the loosening periprosthetic tissue profiles. Additional efforts are needed to determine whether the measurement of $CD14^+CD16^+$ monocytes subset could be used as a reliable biomarker for monitoring TJR patients who are at a high risk of AL development.

74. Premature Failure at Short-Term Follow-Up in Primary Total Hip Arthroplasties Using the Alfa II Modular Stem System

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INTRODUCTION: Modular femoral trunions offer the surgeon increased intraoperative options in adjusting the offset, leg length, and anteversion. However, modularity may result in an increased risk of fretting and corrosion along with a higher risk of implant dissociation or fracture. The purpose of this study was to look at the short-term follow-up of primary total hip arthroplasties using a cementless prosthesis with a modular trunion and modular femoral head.

MATERIALS AND METHODS: 221 patients who underwent a total hip arthroplasty using the Alfa II modular stem (Encore Medical) between 2002 and 2004 were reviewed. 218 patients underwent a primary total hip arthroplasty, and 5 patients underwent a total hip conversion procedure. Patients were followed for five to seven years and were evaluated radiographically and using the Modified Harris Hip score.

RESULTS: Of the 221 original patients, 26 died from causes unrelated to the surgery, 9 were lost to follow-up, and 71 are pending follow-up. Eighty-seven patients have had a follow-up period of 5-7 years. Twenty-eight additional patients were contacted for a 5-7 year follow-up after surgery and evaluated through phone interview using a modified Harris Hip Score. Twenty-six of the 115 patients in the follow-up group required a revision surgery. Eleven patients had a dissociation of the modular components of the prosthesis. Seven patients had a fracture of the prosthesis, and four patients had other component failures. Four patients had other failure modalities not involving mechanical failure of the prosthesis. Eighty-nine patients had a well-fixed prosthesis with no dissociation or fracture of the components. The Harris Hip Score mean in the office follow-up patients is 90.4, and the modified Harris Hip Score mean in the phone interview group is 72.7 out of 93. Of the patients in the follow-up group, it was found that this prosthesis has a 22.6% failure rate requiring a revision operation. When those pending or lost to follow-up are included and assumed not to have hardware failure, the failure rate is 14.4%.

CONCLUSION: The Alfa II modular stem hip system demonstrates a high failure rate at short-term follow-up.

75. The Technique of Acetabular Distraction for the Treatment of Chronic Pelvic Discontinuities

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INTRODUCTION: Reconstruction of severe acetabular bone loss with an associated pelvic discontinuity remains challenging. The use of an elliptical trabecular metal acetabular component inserted into the acetabulum with subsequent distraction through the discontinuity is an alternative to bone allograft and rigid fixation. The purpose of this study was to evaluate the early results of this method of treatment in patients undergoing acetabular revision with an associated chronic pelvic discontinuity.

MATERIALS AND METHODS: Twenty-nine patients who underwent an acetabular revision for Paprosky type 2C, 3A, and 3B acetabular defects with chronic pelvic discontinuity between 2002 and 2006 were reviewed. A trabecular metal cup was inserted with or without augments using a distraction technique through the pelvic discontinuity. All patients were examined clinically and radiographically at 2 weeks, 6 weeks, 3 months, 6 months, and yearly thereafter for a minimum of 2 years.

RESULTS: Of the 29 original patients, 5 died from causes unrelated to the surgery and 6 have been lost to follow-up. All constructs were stable at the most recent follow-up in these patients. The remaining 18 patients have had greater than a year of follow-up (mean of 42 months). Of these 18 patients, one construct failed requiring revision surgery. Three of the remaining 17 constructs were identified as loose radiographically. In these remaining 17 patients, the mean modified Merle d'Aubigne pain and ambulation score improved from 3.3 to 10.0. The three patients with identified radiographic loosening were doing well with a mean score of 9.0. Eleven of the 18 patients had radiographs demonstrating healing of the discontinuity.

CONCLUSION: Use of a trabecular metal acetabular component using a distraction technique for the treatment of pelvic discontinuity in a revision total hip arthroplasty provides good short-term outcomes with healing of the discontinuity in a majority of cases and an improved functional outcome.

76. The Fate of Grafted Acetabular Defects in Revision Total Hip Arthroplasty

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INTRODUCTION: Acetabular defects are frequently grafted during revision THA. Previous studies report high rates of graft incorporation using plain radiographs. The purpose of this study was to quantify acetabular defect fill and graft incorporation following revision THA using CT analysis.

METHODS: We performed 755 revision THAs from August 1996 to May 2008, with 536 (71%) performed for osteolysis or aseptic loosening. 132 hips (25%) had head and liner exchange with bone grafting around a retained acetabular component, while 270 (50%) hips underwent full acetabular revision with bone grafting of defects. CT scans were offered to all patients that met inclusion criteria. Lesion size, percent fill, and graft healing were segmented and quantified.

RESULTS: Forty-one patients agreed to be scanned at an average of 4.8 years (range 1 to 11 years). Defect size averaged 11.1 cm^3, and the average graft volume was 3.8 cm^3 (range 0 to 19.5 cm^3). Overall, the average defect fill was 30% (range 0% to 81%). The average percent healing to host bone was 24%. Complete revisions had a significantly higher percent defect fill compared to head/liner changes (47% vs. 17%, $p<0.0001$). Complete revisions also had a significantly higher degree of graft healing to host bone compared to head/liner changes (36% vs. 14%, $p <0.0001$).

CONCLUSION: High resolution CT of grafted lesions demonstrated lower percentages of defect fill and graft healing than previous reports. Higher degrees of defect fill and healing were seen with complete revisions compared to head/liner exchanges. The impact of defect fill on implant survivorship is worthy of further investigation.

77. Cementation of Acetabular Liners into Secure Cementless Shells in Cases of Polyethylene Wear

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INTRODUCTION: Fixation of cementless acetabular components have demonstrated excellent long-term durability with loosening rates of less than 2% at 15 years. However, acetabular polyethylene liner wear has been a major long-term problem. The purpose of this study was to evaluate the results of cementing acetabular liners into fixed cementless shells where polyethylene wear through had occurred.

METHODS: Thirty consecutive hips in 29 patients with well fixed cementless acetabular shells and worn polyethylene liners were revised by cementing a new liner into the well-fixed shell. Patients were evaluated at 2-9 years for clinical results, Harris Hip Ratings, and the need for re-revision.

RESULTS: The average age of the patients at the time of index surgery was 52 years. The shells had been in place an average 9.9 years. The backs of all acetabular liners were scored in a spider web pattern to a depth of 1 to 2 mm. All patients were braced or casted for 6 weeks. There were no failures of the construct at 2-9 year follow-up. One hip had a one time dislocation. Two acetabular liners wore through again and required a re-revision. No liners dissociated. There were no other signs of radiographic failure at follow-up.

CONCLUSION: Cementation of a liner into a well-fixed cementless shell provides excellent fixation and no failures at average five year follow-up. Postoperative dislocation was a minimal problem; however, all patients were immobilized in a brace or cast.

78. The Results of Head and Liner Exchange with Bone Grafting for Osteolysis in Total Hip Arthroplasty

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INTRODUCTION: To prevent complete acetabular revision due to osteolysis, bone grafting around a well-fixed acetabular component has been advocated. This study examines the clinical results and CT measurements of bone grafting at the time of head and liner exchange for revision THA.

METHODS: We identified 199 patients who had revision THA for osteolysis in which the acetabular component was well fixed and only a head and liner exchange was performed. 132 of these patients also had bone grafting at the time of their revision and were invited to undergo high resolution CT imaging to evaluate defect fill and graft incorporation. The original acetabular defect size and percent fill were segmented and quantified.

RESULTS: Of these 132 hips, 11 patients (8%) required additional surgery with either an additional head/liner exchange (2) or full acetabular component revision (9). Twenty-three hips were analyzed using CT imaging at an average of 5 years (range 2-11 years) follow-up. Harris Hip Scores increased an average of 13.8 (from 69.9 to 83.7, p=0.009). The average defect size was 12.7 cm^3 and the average volume filled was 3.2 cm^3 (16.9%).

CONCLUSIONS: The clinical results of head and liner exchange were good despite the fact that relatively little graft material was present in acetabular defects at five years follow-up. The low rate of revisions may indicate that adequate debridement and converting to a highly crosslinked liner may stop the lytic process and prevent further hip destruction. Further study is needed regarding the fate of bone graft in revision THA.

79. Treatment of Early Postoperative Infection Following Cementless Total Hip Arthroplasty: A Decision Analysis

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INTRODUCTION: Periprosthetic infection of the hip in the early postoperative period is a devastating complication for which the best treatment is unknown. The purpose of this study was to model three different therapeutic options through decision analysis to determine the optimal treatment for an acute postoperative infection following total hip arthroplasty (THA).

METHODS: Three initial treatment options, open debridement, single stage exchange, and two-stage exchange, were modeled using decision analysis techniques to determine the procedure with the best outcome (quality of life) and optimal cost-effectiveness (Cost/QALY) for treating infection following cementless THA. Patients failing the initial treatment were presumed to undergo a two-stage exchange, with a maximum of (2) two-stage exchange procedures. Success rate, quality of life outcome measures, and cost were estimated from previously published data. Sensitivity analysis was used to estimate the impact of uncertainty in specific model variables on patient outcomes.

RESULTS: Single stage exchange appears to be the optimal choice of initial treatment for acute postoperative infections of cementless THA in terms of outcome, cost, and cost-effectiveness. Based upon previously published data and sensitivity analysis, the success rate of a single stage exchange must fall below 71% or the success rate of open debridement must be greater than 40% in order for open debridement to be the optimal treatment. Only when the success rate of open debridement falls below 29% and that of single stage exchange falls below 70% would the model recommend two-stage exchange.

CONCLUSIONS: Single stage exchange appears to be the optimal initial treatment for acute periprosthetic infections following cementless THA based on decision analysis modeling and data currently available in the orthopedic literature.

80. Perioperative Testing for Persistent Sepsis Following Resection Arthroplasty of the Hip for Periprosthetic Infection

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BACKGROUND: Two-stage exchange is commonly used for treatment of the infected total hip arthroplasty (THA). Although the erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are routinely used to determine treatment response, no prior studies characterize the utility of these tests. The purpose of this study was to evaluate the utility of the ESR, CRP, synovial fluid white blood cell (WBC) count, and differential for identifying persistent infection following resection arthroplasty for periprosthetic infection.

METHODS: Eighty-nine consecutive patients were treated by resection arthroplasty and insertion of an antibiotic spacer followed by six weeks of IV antibiotics. The ESR and CRP were repeated two weeks following cessation of antibiotics and an intraoperative synovial fluid WBC and differential were obtained at the time of proposed re-implantation. Patients were considered to be persistently infected if intraoperative cultures were positive for bacterial growth. The mean time between resection arthroplasty and attempted reimplantation was 73.6 days (range 56 to 317). Receiver operator curves (ROC) were generated to determine optimum cut-off values. Mean values were calculated and compared between stages and between persistently infected and cured cases.

RESULTS: Nine hips (10.1%) were persistently infected. The mean synovial fluid WBC count was significantly different between cured and persistently infected cases (1280 vs. 19,500; $p<0.001$), as were the ESR and WBC differential ($p=.031$, $.011$). The ESR and CRP were both persistently elevated, despite evidence of a cure, in 19 hips (23.8%). ROC showed the synovial fluid WBC was the best perioperative test (area under the curve of 0.912) with an optimum cutoff value of 3,528 (sensitivity 78%, specificity 96%).

DISCUSSION: The ESR and CRP both remained elevated in a high percentage (23.8%) of hips in whom infection has been eradicated. The synovial fluid WBC count was the most useful test for identifying persistent infection.

81. Comparison of Bacterial Adherence in Titanium and Tantalum Acetabular Implants

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INTRODUCTION: There exists a theoretical concern that the increased porosity of tantalum implants predisposes them to increased bacterial adherence, potentially limiting options in the face of infection. However, previous reports indicate that bacteria may be less adherent to newer tantalum implants when compared with other, more commonly used orthopedic implants. The purpose of this study is to compare bacteria adherence to tantalum and titanium acetabular implants following a standard irrigation.

METHODS: Twenty-three consecutive trials were performed on titanium and tantalum acetabular implants. Each implant was immersed in bioluminescent bacteria (P. aeruginosa [lux]). The bacteria were genetically engineered to emit photons, allowing for quantification with a photon-counting camera system. After a 24-hour incubation and agitation period, allowing adequate time for biofilm formation, baseline bacterial luminescent images were obtained of each implant. Implants were then irrigated with 3 liters of normal saline via gravity-flow irrigation. Imaging was then repeated for each implant and compared with pre-irrigation images to determine the reduction in bacterial luminescence resulting from irrigation.

RESULTS: Prior to irrigation, the total bacteria counts were similar between the titanium and tantalum implants. When compared to pre-irrigation levels, the total bacteria count for the titanium and tantalum implants were significantly reduced 93% and 95% respectively ($p<0.0001$). This reduction in total bacteria counts was similar for both groups ($p=0.43$).

CONCLUSION: This study suggests that there is no difference in bacterial adherence to titanium versus tantalum acetabular implants. Regardless of implant material, standard irrigation of acetabular implants results in a similar reduction in bacterial load.

82. Complications Associated with Antibiotic Hip Spacer Options Used in Two Stage Total Hip Arthroplasty

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INTRODUCTION: Two stage total hip arthroplasty (THA) revision utilizing an antibiotic impregnated cement spacer for patients with infected THAs is the gold standard treatment in the United States. The type of antibiotic cement spacer placed at the time of the first stage procedure is highly variable, and is often based on surgeon preference with no literature supporting one specific type over the other. Some spacers function like a hemi-arthroplasty (HA-like) while others function like a total hip arthroplasty (THA-like) due to the use of an acetabular component. The purpose of this study was to compare complication rates associated with the various antibiotic cement spacers (THA-like vs. HA-like).

METHODS: Forty-nine cases were reviewed in which 21 ready-made, 13 custom HA-like, and 15 custom THA-like antibiotic loaded cement spacers were used in two stage revision THA.

RESULTS: Fractures occurred in 4 ready-made, 1 custom HA-like, and 2 custom THA-like. Dislocations occurred in 1 ready-made, 2 custom HA-like, and none in the custom THA-like spacers. There were 7 cases with continued infection which required further surgery, 3 of which utilized ready-made spacers, 3 with custom HA-like spacers, and 1 with a custom THA-like spacer. With these complications combined, we found that the custom THA-like spacers had the lower overall complication rates when compared to both ready-made and custom HA-like spacers.

DISCUSSION: At our institution, the custom THA-like spacer was 53% less expensive than the cheapest ready-made spacer. These data support custom THA-like spacers as an excellent option with fewer complications and can be more cost effective.

83. National Trends in Revision Hip Arthroplasty: A Population-Based Study

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INTRODUCTION: Data on national trends for revision hip arthroplasty is limited. The aim of this study was to describe these trends in the past 15 years in patients undergoing revision hip replacement.

METHODS: The National Hospital Discharge Surveys (NHDS) from 1990 to 1994 and from 2002 to 2006 were used. The data was weighted to allow national estimates. Only patients 50 years or older who underwent revision hip arthroplasty were selected. Changes in demographics, hospital stay, disposition, and payment were reported.

RESULTS: A total of 96,715 procedures were estimated in the period 1990-94 and 133,137 in 2002-06. Average age in the first group was 70 years vs. 71 years in the second group ($p<0.001$) with 9.7% of patients being non-white vs. 7.0% respectively ($p<0.001$). Mean length of stay was 10.9 days vs. 5.6 days ($p<0.001$) with a higher percentage of patients discharged to short/long-term facilities in the most recent period (29.8% vs. 57.3%; $p<0.001$). Hospitals with less than 300 beds were more common in the most recent group (55.9% vs. 64.3%; $p<0.001$) with nonprofit hospitals paying most of this procedure (79.4% vs. 81.9%; $p<0.001$).

DISCUSSION: Revision hip arthroplasty is being performed in older patients with decrease percentage in minorities. Length of stay has decreased with an increase in the number of patients going to short/long-term facilities. Most surgeries are being performed in smaller hospitals, and payment from for-profit hospitals has decreased in recent years.

84. Total Femur Replacement of Severe Bone Loss from Periprosthetic Fractures

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Periprosthetic fractures often occur in patients with poor bone quality. Failed attempts at fixation and nonunion can lead to significant morbidity with extensive loss of femoral bone stock. This study evaluates six patients treated with a total femur replacement after multiple attempts at internal fixation and revision joint reconstruction. The goal of the study is to describe the surgical technique, complications, and evaluate the functional outcome in this small group of patients. The follow-up ranged from 6 months to 5 years (average: 1.8 years). The study group included five females and four males. Data was collected prospectively and included clinical and radiographic outcome, as well as a report of associated complications. All patients were nonambulatory prior to the total femoral replacement surgery. Their nonambulatory status ranged from 8 months to 3 years (average 12.2 months). The average number of surgeries prior to the total femur replacement was 5.3 (range 3-9 surgeries). At six months follow-up, 7 of 9 patients were ambulating without assistive devices and 2 of 6 were using walkers. All patients at one year were able to ambulate (2 of 9 using walkers) and all reported that they would have the surgery again. Postoperative complications included 1 postoperative hematoma, requiring surgical evacuation, 1 DVT, and 1 superficial infection, requiring debridement and antibiotics. Patients with a history of infection were treated with three months of oral antibiotics specific to cultures from prior infection. Hospitalization ranged from 4 to 8 days (5.2 days) and anticoagulation treatment was given for 6 weeks postoperative. At last follow-up, no patients required revision, and the satisfaction rating was high. Most common complaints were knee pain, and abductor weakness was the most common etiology of ambulatory difficulty. Total femur replacement is an acceptable option for patients with extensive femoral bone loss from periprosthetic fracture. It allows patients to return to early full weight-bearing status and satisfactory ambulatory status.

85. Total Femoral Arthroplasty: Retrospective Review

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INTRODUCTION: The total femoral arthroplasty is a salvage option for failure of total hip and total knee arthroplasty. The purpose of this study is to retrospectively review the outcomes of this population who received total femoral arthroplasty for non-oncologic conditions.

METHODS: The computerized databases of the authors' institutions were used to identify all total femoral arthroplasties. The operative reports, x-rays, and clinical notes were reviewed to correlate clinical factors.

RESULTS: There were a total of 21 total femoral arthroplasties performed at the authors' institution from 1994 to 2008. Average clinical follow-up from TFA was 35 months. Average radiographic follow-up from TFA was 25 months. The average age at TFA was 64 years. The average pre-TFA Harris Hip Score (HHS) was 28, the average post-TFA HHS was 60. Five patients had a reoperation of one or both components. Four of the five had instability leading to revision. Two subsequently became infected; one was treated with hip disarticulation, and one was treated with resection and an antibiotic spacer. One patient was revised for infection and was treated with a one stage exchange and antibiotic suppression.

DISCUSSION AND CONCLUSION: The revision rate after TFA was 24%. Hip instability and infection were the most common modes of failure. Clinical outcomes as measured by Harris Hip Scores were modest at 60, but encouraging in this complicated patient population. Total femoral arthroplasty is a viable limb salvage option for patients with massive femoral bone deficiency.

MAOA BREAKOUT SESSION #7
SHOULDER
April 23, 2010

86. Dynamic, In-Vivo Glenohumeral Joint Mechanics of the Normal, Healthy Shoulder: Dominant versus Non-Dominant Shoulders

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INTRODUCTION: Rotator cuff tears are a very common injury and a major source of pain, disability, and medical expense. Treatment protocols are implicitly based on the belief that it is necessary to restore normal glenohumeral joint (GHJ) mechanics to obtain a satisfactory result. However, relatively little is known about GHJ mechanics, particularly under in-vivo conditions. Thus, the purpose of this study was to characterize in-vivo GHJ mechanics in the dominant (DOM) and non-dominant (NDOM) shoulders of a normal, asymptomatic population.

METHODS: Dynamic, biplane x-ray images were acquired during coronal-plane elevation from the DOM and NDOM shoulders of seven subjects (age: 26.1±4.4) with no history of shoulder symptoms, injury, or surgery. The 3D positions of the humerus and scapula were accurately (±0.4 mm, ±0.5°) measured from the biplane x-ray images using a model-based tracking technique. The path of the GHJ contact center on the glenoid was determined throughout the elevation trial for each shoulder. GHJ contact patterns were quantified in terms of the average contact center position in ant/post (A/P) and sup/inf (S/I) directions. In addition, the contact center range was also quantified in the A/P and S/I directions.

RESULTS: The DOM shoulder's average contact center was located more posteriorly on the glenoid than the NDOM shoulder ($p=0.09$), but no difference between shoulders was detected in the S/I contact center ($p=0.75$). The NDOM shoulder's contact center range was greater than the DOM shoulder in both the A/P ($p=0.10$) and S/I ($p=0.12$) directions.

DISCUSSION: Differences in contact center range suggest that the DOM shoulder may be more precisely controlled than the NDOM shoulder. Alternatively, anatomical differences between shoulders may afford the DOM shoulder greater in-vivo stability than the NDOM shoulder. These differences in glenohumeral joint mechanics between DOM and NDOM shoulders may have implications for the development of cuff tears.

88. Continuous Interscalene Block for Adhesive Capsulitis Shoulder – A Formula for Painless Expediated Management

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PURPOSE: Management of resistant adhesive capsulitis (AC) shoulder can entail substantial morbidity because of painful postoperative course and requirement of high narcotic use. This study was undertaken to determine the efficacy and outcomes of ultrasound guided continuous interscalene block for patients with AC. Associated rotator cuff pathology and impingement are evaluated for impact on outcomes.

METHODS: Thirty consecutive patients, average 55 years (range 19-72) with AC who failed to improve with physical therapy were studied. Associated pathologies were noted and a suggestion of impact on outcomes determined. All patients underwent preoperative continuous interscalene block, subsequent manipulation under anesthesia, and arthroscopic treatment of associated pathology in an outpatient setting. All patients were interviewed on a daily basis, for visual analog pain scores (VAS) and narcotic requirements recorded for the duration of the indwelling catheter, which were kept in for 3-5 days. Postoperatively, aggressive rehabilitation program was started on postoperative day one with daily visits for one week then thrice a week thereafter.

RESULTS: All patients noted minimal to no pain (VAS 0-2) while catheter was in place. Narcotic requirements were minimal to none during the study time. All patients were followed until full motion achieved (4-6 weeks). At final follow-up, average gain was 42° of elevation (115°- 157°), 51° of abduction (106° - 157°), and 24° of external rotation (43°- 67°). All patients achieved functional, full range of motion within 6.9 weeks (range 4-13). Associated pathologies had no influence on the outcomes. There were no catheter related complications.

CONCLUSION: Ultrasound guided continuous interscalene block proved invaluable in the postoperative management of adhesive capsulitis. It allowed for immediate aggressive, passive range of motion in an uncomplicated manner, negating the need for narcotic use.

89. CT Evidence of Bone Incorporation Between Radial Fins of an Uncemented Glenoid Component Central Peg

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Cement interdigitation problems and/or bone necrosis contribute to glenoid component failures. This led to a component promoting biologic fixation between radial fins of its central peg and cement fixation of its peripheral pegs. We hypothesized better bone incorporation between the fins is associated with less peg lucencies. This study's purpose was to utilize thin cut CT and plain films to assess bone between the central peg's radial fins and to assess peg lucencies.

35/48 consecutively performed total shoulder replacements were in patients able to participate a minimum two years post surgery. All had humeral head reamings packed between radial fins of the central peg and placement of minimal peripheral peg cement. Simple Shoulder Test (SST), Constant Score, plain films, and CT (0.625 mm cuts in 3 planes) were obtained. A musculoskeletal radiologist calculated modified Lazarus scores, Yian scores, and bone incorporation.

At a mean of 43 months and by CT, better Yian scores correlated with better bone incorporation between fins ($p=0.0006$). Also by CT, bone incorporated with host bone in 6/6 compartments in 23/35 shoulders, averaging 4.5. Modified Lazarus scores (0-5 with 0=no radiolucency) averaged 0.45. Mean SST was 10.3 and mean Constant was 81.3. Neither better SST ($p=0.108$) nor Constant ($p=0.550$) scores correlated with better Yian scores, possibly due to low rates of loosening.

TSA utilizing minimal glenoid peripheral peg cement and autologous reamings placed between radial fins of the central peg allowed host bone incorporation for the central peg. Better bone incorporation imparted fewer overall peg lucencies.

SUMMARY: Bone packed between radial fins of a central glenoid component peg incorporated into surrounding bone. Better incorporation imparted better lucency scores by thin cut CT.

90. Persistence of Glenoid Lucency Across Generations: Outcomes of a Second Generation Shoulder Arthroplasty Design in the Treatment of Osteoarthritis

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BACKGROUND: Second generation modular total shoulder systems offer advantages over first generation nonmodular designs by facilitating precise placement of the humeral head with respect to the tuberosities and rotator cuff in order to achieve appropriate soft tissue tensioning and balance. The purpose of this study was to evaluate the outcome of 129 consecutive total shoulder arthroplasties with a modular design performed by a single surgeon in the treatment of osteoarthritis.

MATERIALS AND METHODS: Between 1995 and 1999, 129 consecutive total shoulder arthroplasties in 116 patients were performed at our institution by the senior surgeon for the treatment of osteoarthritis using the same modular prosthesis system. 122 shoulders were followed for a minimum of 2 years (mean, 7.8 years) or until the time of revision surgery. Both clinical examination and radiographs (presence of glenoid erosion, glenohumeral subluxation, periprosthetic lucency, and shift in component position) were evaluated at latest follow-up. The mean age of the 35 (30%) female and 81 (70%) male patients was 69 years at the time of surgery (range, 47 to 87 years).

RESULTS: Total shoulder arthroplasty for osteoarthritis using a modular design was significantly associated with pain relief ($p<0.001$), improvement in elevation from a mean of 96° to 149° ($p< 0.001$), and external rotation from a mean of 32° to 60° ($p<0.001$). At a mean follow-up of 7.8 years, 46% had an excellent result, 17% a satisfactory result, and 37% an unsatisfactory result according to the modified Neer rating system. Six patients underwent revision arthroplasty, a 10-year joint survival of 95.1% (95% CI: 91.0,99.4). Glenoid periprosthetic lucency was present in 89 of 117 shoulders (76.1%) at a mean radiographic follow-up of 5.7 years, and 14 shoulders (12.0%) had a glenoid component that was deemed “at risk”.

CONCLUSIONS: Using a modular prosthesis for osteoarthritis is associated with satisfactory long-term pain relief and improvement in motion. Although the rate and type of complications have changed compared to first generation prostheses, the rate of glenoid periprosthetic lucency has not improved significantly with second generation designs.

91. Five-Year Radiographic and Clinical Follow-Up of All-Cemented Total Shoulder Arthroplasty

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INTRODUCTION: Total shoulder arthroplasty (TSA) is an effective treatment for degenerative arthritis of the shoulder. The association between radiographic and clinical outcomes in TSA has not been adequately examined. The purpose of our study was to compare the radiographic and clinical outcomes of TSA for patients followed for a five-year period.

MATERIALS/METHODS: Records were reviewed for all-cemented TSA procedures performed from 2000-2004. Fifty-nine patients with a minimum five-year follow-up were identified. Eighteen patients were lost to follow-up or died, and seven other procedures failed. Thus, 34 TSA procedures were included, with the most frequent primary diagnosis being degenerative arthritis of the glenohumeral joint (n=24). Radiographs were graded at initial, two-year, and five-year postoperative follow-up appointments. Patient function was evaluated at the preoperative, two-year, and five-year follow-up visit using a visual analog scale for pain, active/passive forward flexion, active/passive abduction, active/passive external rotation, internal rotation, ability to perform belly press and lift off tests, as well as the ASES shoulder score, Constant shoulder score, SST-12, and UCLA shoulder score.

RESULTS: The mean radiographic grade for glenoid loosening was 0.75, 1.48, and 1.93 for initial follow-up, two-year follow-up, and five-year follow-up, respectively ($p<.001$). The change in grade from year two to year five was also significant ($p=0.001$). Significant clinical improvement was found following surgery in pain, active/passive forward flexion, active/passive external rotation, internal rotation, active/passive abduction, ASES, Constant shoulder score, UCLA shoulder score, and the SST-12 ($p<0.001$ for all outcomes). There was a small but statistically significant decrease in ASES and SST-12 at five-year follow-up compared to two-year follow-up ($p=0.029$ and 0.012, respectively).

CONCLUSION: In patients with glenohumeral arthritis, all-cemented total shoulder arthroplasty is an effective treatment, with improvement in function and pain relief. While clinical outcomes improve notably, a progressive decrease in radiographic outcomes was found over time.

92. Anteromedial Approach for Shoulder Arthroplasty: Current Indications, Complications, and Results

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INTRODUCTION: Anteromedial approach to the shoulder has been proposed as a method of enhancing shoulder arthroplasty surgical technique in difficult cases. The aim of this study was to describe the current frequency of use, indications, results, and complications of anteromedial shoulder approach.

MATERIAL AND METHODS: 723 consecutive shoulder arthroplasties were reviewed. 110 cases performed through an anteromedial approach were identified and studied. Previous surgeries, indication for surgery and anteromedial approach, pain mobility, and strength before and after the surgery, and clinical and radiologic complications were recorded.

RESULTS: Anteromedial approach was used in 10% of primary cases and 40% of revisions. 70% of cases in which an anteromedial approach was used had had previous surgeries. The most frequent underlying diagnosis was primary osteoarthritis (36%) and sequel after proximal humerus fracture among primary cases, and instability (24%) and glenoid loosening (20%) in revisions. The indication for anteromedial approach was severe scarring in the joint in 43% of cases, protection of a frail deltoid in 20%, improve cuff or glenoid exposure in 15%, frail bone in 8%, and tumor exposure and resection in 6%. The mean follow-up was four years. Pain, elevation, and external rotation improved after primary arthroplasty. Pain and strength in external rotation improved after revision arthroplasty. A tendency in loss of strength in abduction was noticed among primary cases. No proximal deltoid detachments occurred. No complications related to this specific surgical approach were identified. Twenty-five percent of cases had complications; of those, 70% needed additional surgery.

CONCLUSION: Anteromedial approach is a safe and reliable method to improve surgical exposure and safety in the most technically demanding shoulder arthroplasty cases.

93. Long-Term Functional and Radiographic Outcomes of Hemiarthroplasty for Proximal Humerus Fractures

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INTRODUCTION: Hemiarthroplasty has become the gold standard for comminuted proximal humerus fractures. Radiographic parameters have been identified that appear to correlate with poor functional outcomes. We present a retrospective study to ascertain the functional and radiographic outcomes in patients who received a hemiarthroplasty for three- and four-part proximal humerus fractures at two- and five-year follow-up.

MATERIALS AND METHODS: Seventy-six patients were managed with a cemented shoulder hemiarthroplasty at our institution between 2000 and 2006. Postoperative x-rays were compared to radiographs at two and five years along with active range of motion and functional outcomes scores.

RESULTS: Twenty-nine patients died or could not be contacted for two-year follow-up. Of the remaining 47 patients, 25 were examined at two years and 22 at both two and five years. The mean acromial-humeral distance (AHD) decreased from 10.31 mm postoperatively to 8.48 mm at two years and 6.71 mm at five years. Changes in AHD were statistically significant ($p<0.001$). Significant increases in stem osteolysis and tuberosity reabsorption were observed ($p=0.023$ and 0.01, respectively). The UCLA score decreased from 25.95 to 22.27 ($p=0.045$), Constant score decreased from 61.09 to 50.14 ($p=0.01$), SST –12 decreased from 7.68 to 6.23 ($p=0.018$), and ASES score decreased from 70.36 to 58.77 ($p=0.015$). Range of motion likewise deteriorated; however, only forward flexion and internal rotation were statistically significant ($p=0.033$ and 0.25, respectively).

CONCLUSIONS: Hemiarthroplasty is associated with a high rate of morbidity and subsequent revision surgery. Increases in AHD, stem osteolysis, and tuberosity reabsorption are observed between two- and five-year follow-up. Subjective pain scores and functional outcomes predictably worsen.

94. Total Shoulder Arthroplasty for Osteoarthritis in Patients 80 Years of Age and Older

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BACKGROUND: This study was done to review the safety and outcome of primary shoulder arthroplasty for patients 80 years of age and older. Because little data exist about the safety or efficacy of shoulder replacement in this elderly population, some physicians may be hesitant to recommend surgery to patients of this age.

METHODS: Between 1980 and 2000, 51 total shoulder replacements in 45 patients between the ages of 80 and 89 were performed at our institution. One patient died within two years after surgery. The remaining 44 patients were followed for a minimum of 2 years (mean, 5.5 years). Previous health status, surgical report, and postoperative course were analyzed. Both pre-surgical and last follow-up pain, satisfaction, and mobility were recorded as well as medical and surgical complications. Outcome was rated with Neer score. Preoperative, immediate postoperative, and the most recent radiographs were reviewed.

RESULTS: There were no perioperative deaths. The mean length hospital stay was seven days. A stay of more than 24 hours in the Intensive Care Unit occurred in 4% of patients. Elevation, external rotation, and internal rotation improved significantly a mean of 60°, 30°, and 4 spinal levels respectively. There was no or slight pain at last follow-up in 78% of the patients. According to modified Neer rating, 80% of the patients had a satisfactory/excellent result. There were medical or surgical complications in 34% of patients. Three patients required revision surgery.

CONCLUSION: Total shoulder arthroplasty is a safe and effective treatment option in elderly patients with primary osteoarthritis, with a high probability of being a definitive treatment for the rest of their lives.

95. A Prospective Evaluation of Reverse Total Shoulder Arthroplasty Clinical Outcomes with Minimum Two-Year Follow-Up

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PURPOSE: This prospective study presents the two-year outcomes of an initial series of RTSA by a single surgeon. We hypothesized that revision arthroplasties would have poorer clinical outcomes than primary arthroplasties.

METHODS: From 2004 to 2007, 112 shoulders in 107 patients underwent RTSA procedures. The inclusion criterion for this report was minimum two-year follow-up, leaving 67 procedures in 64 patients. Average age was 71 years (53-89 years). Average follow-up was 30.8 months (24-49 months). Postoperative clinical data were compared to preoperative values, and primary arthroplasties were compared to revisions.

RESULTS: Significant mean preoperative to postoperative improvements included the shoulder subjective value (SSV) increasing from 17% to 77%, visual-analog pain score decreasing from 7.8 to 2.0, American Shoulder and Elbow Surgeons (ASES) score increasing from 26 to 73, and active forward elevation increasing from 52° to 116° (all with $p<0.0001$). Mean active external rotation improved from 8° to 19° ($p=0.0044$). The overall satisfaction rate was 96%. Primary arthroplasties compared to revisions had significantly higher postoperative SSV ($p=0.0294$), higher ASES score ($p=0.0317$), higher likelihood of achieving internal rotation at or above the sacrum ($p=0.013$), and lower postoperative pain scores ($p=0.0027$). The scapular notching rate was 49%. The overall complication rate was 14.9% with no significant difference between primary and revision arthroplasties ($p=1.00$). Prosthesis survivorship was 100%.

CONCLUSIONS: RTSA provides predictable improvements with pain and function for appropriate candidates. The two-year clinical results of RTSA are promising with an acceptable complication rate. Longer follow-up is necessary to determine the prosthesis survivorship.

96. Correlation of Function with Patient Self-Assessment After Reversed Total Shoulder Arthroplasty

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INTRODUCTION: Reversed total shoulder arthroplasty (RTSA) has demonstrated a high rate of patient satisfaction in short to medium term follow-up. Poor active rotational movement following RTSA is a potential cause of lowered patient satisfaction. The purpose of this study was to examine whether objective shoulder function correlates with patient self-assessment following RTSA.

METHODS: Sixty-five consecutive RTSA patients met inclusion criteria and had adequate follow-up (minimum 12 months). Both revision (n=11) and primary (n=54) surgeries were included. Subjects completed both pre- and postoperative outcome measures (Short Form-12, American Shoulder and Elbow Surgeons Form, Western Ontario Rotator Cuff Index, and Western Ontario Osteoarthritis of the Shoulder Index). Postoperative assessment performed by an independent observer included goniometer measurement of active range of motion and determination of abdominal press and lift-off tests. Functional measurements were correlated to patient self-assessed outcome scores using Pearson correlations and multivariate multiple regression analysis.

RESULTS: Mean SF-12, ASES, WORC, and WOOS scores all improved significantly at latest follow-up ($p<0.01$). Active forward elevation (FE) improved from 54.2° to 133.7° following surgery ($p<0.01$), while external rotation (ER) failed to change ($p=0.37$). Higher active FE and ER were not independently predictive of increased patient satisfaction; however, there was a trend toward higher patient satisfaction in those with improved ER ($p=0.075$).

DISCUSSION AND CONCLUSION: RTSA results in predictable increases in objective shoulder function. However, the functional improvements do not correlate strongly with patient self-assessed outcome. A trend toward increased self-reported scores in those with better ER requires further study.

MAOA BREAKOUT SESSION #8
FOOT AND ANKLE
April 23, 2010

97. Radiographic Correction After Hindfoot Arthrodesis

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INTRODUCTION: Hindfoot deformity is associated with numerous debilitating and disabling conditions. We report the radiographic correction and AOFAS data at short-term follow-up after hindfoot arthrodesis.

MATERIALS AND METHODS: A retrospective study was performed on 273 patients (300 feet) who underwent talonavicular arthrodesis, either isolated or as a part of multiple joints fusion performed by the two senior authors from 1998 to 2006. Data collection included pre- and postoperative radiographic alignment including on AP x-ray peritalar subluxation, talocalcaneal angle, and talo-1st metatarsal angle, and on lateral x-rays Meary's line, talocalcaneal angle, and pitch. The charts were reviewed and AOFAS hindfoot score were evaluated.

RESULTS: A total of 174 feet met the inclusion criteria for the study. Preoperative AOFAS score was 38.9 and postoperative AOFAS score was 84.4. Preoperative radiographic alignment included average peritalar subluxation of 16° (+/- 18.0°), AP talocalcaneal angle 21.3° (+/- 10.1°), AP talo-1st metatarsal angle 14.8° (+/- 11.5°), and on lateral x-ray Meary's line 22.3° (+/- 16.4°), talocalcaneal angle 52.3° (+/- 12.9°), and calcaneal pitch 15.3° (+/- 8.2°). Postoperative radiographic alignment improved on AP x-ray talocalcaneal angle to 17.8° (+/- 7.6°), talo-1st metatarsal angle 5.2° (+/- 5.5°) , and on lateral x-rays Meary's line 0.7° (+/- 9.7°), talocalcaneal angle 44.6° (+/- 8.4°), and calcaneal pitch 21.6° (+/- 6.8°). All improvements were to $p<.001$.

DISCUSSION: Radiographic correction after hindfoot arthrodesis is a variably reported measure. Correction of malalignment to normal and near normal values has been shown to improve patients' levels of pain postoperatively. We show that significant malalignment can be corrected, and using a modified AOFAS score significant improvement can be expected in patients' function.

CONCLUSION: We report a retrospective review of 174 feet after hindfoot arthrodesis and show significant correction can be obtained with significant improvement in AOFAS scores.

98. Preliminary Clinical Experience with the Use of Adult Mesenchymal Stem Cell Augmentation in Hindfoot Arthrodesis

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INTRODUCTION: Recent literature on arthrodesis graft materials has focused on finding alternatives to autogenous bone graft that have similar efficacy but not the morbidity associated with donor sites. We have previously reported our results on the use of bone marrow aspirate with DBM at this meeting. There is increasing evidence that adult mesenchymal stem cells may show equivalence to autogenous bone graft in supporting arthrodesis. The purpose of this study was to investigate the outcomes based effects of co-administration of fresh harvested autologous bone marrow aspirate and allograft adult mesenchymal stem cells during a hindfoot arthrodesis procedure.

MATERIALS AND METHODS: Twenty-three adult patients underwent a hindfoot arthrodesis procedure using our standard technique for endstage hindfoot arthritis. Thirteen patients underwent a triple arthrodesis, six underwent isolated subtalar, three a tibiotalocalcaneal, and one an ankle arthrodesis. All had bone marrow aspirated from the iliac crest using a standard technique. Aspirate was combined with a human cellular and tissue-based, allograft adult mesenchymal stem cell product with osteoconductive, osteoinductive, and osteogenic properties. Average patient age was 57 years old. Twelve males and 11 females were available for evaluation. Outcomes were measured by subjective complaints, physical examination, plain radiographic evidence of fusion, and time to fusion.

RESULTS: Twenty-one of 23 (91%) patients demonstrated plain radiographic evidence of complete fusion and satisfaction with the procedure. Eleven of these patients were pain free while the other ten had minimal or occasional pain. Based on a review of postoperative radiographs, time to fusion was a mean of 4.3 months.

CONCLUSION: The use of adult mesenchymal stem cells in foot and ankle arthrodesis procedures has shown promise; however, further study is necessary to determine the precise independent efficacy and ideal indications. The cost of this material may prevent its use except in perhaps high-risk cases only.

99. Outcome After Hindfoot Arthrodesis

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BACKGROUND: Outcome after hindfoot arthrodesis is a variably reported measure. We reviewed modified AOFAS scores at an average of 23.9 months after hindfoot arthrodesis and stratified the improvements based on six specific locations fused.

MATERIALS AND METHODS: A retrospective study was performed on 273 patients (300 feet) who had talonavicular arthrodesis, either isolated or as a part of multiple hindfoot arthrodesis performed by the two senior authors from 1998 to 2006. Data collection included demographic data, indication for surgery, joints fused, combined procedures, operative details and grafts used, time to union, and a modified AOFAS ankle-hindfoot score.

RESULTS: A total of 248 feet on 231 patients met inclusion for the study. The subjects included 105 males and 143 females at an average age of 55.8 (range 15-86) at the time of surgery. The mean preoperative AOFAS score was 38.1 and postoperative was 83.7 at an average of 23.9 months. The preoperative modified AOFAS score for isolated talonavicular arthrodesis (N=24) was 46.0 and improved to 83.3 postoperative, isolated triple arthrodesis (N=168) improved from 36.4 to 84.3, talonavicular arthrodesis combined with ankle arthrodesis (N=16) improved from 36.0 to 76.3, talonavicular arthrodesis combined with subtalar arthrodesis (N=19) improved from 41.5 to 83.4, talonavicular combined with calcaneocuboid arthrodesis (N=16) improved from 41.3 to 85.8, and talonavicular arthrodesis combined with any other medial column arthrodesis (N=5) improved from 39.0 to 82.2. All improvements were significant to a p=.001. Time to union average was 4.2 months. A total of 52 patients had a procedure done after their index procedure. There were six nonunions, and three patients underwent a below knee amputation.

CONCLUSION: Significant improvement can be expected in pain and function in patients undergoing both isolated talonavicular arthrodesis and with multiple joint arthrodesis of the hindfoot.

100. A Surgical Approach for Type II Compensated Equinus: Retrospective Review of Outcomes and Review of the Literature

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INTRODUCTION: A gastrocnemius contracture is known to affect foot biomechanics leading to arch collapse. Forefoot deformities (i.e., hypermobile 1st ray, hallux valgus, lesser metatarsalgia, and hammer toe) may arise out of this collapse and need careful assessment and corrective procedures to achieve good results. Long-term outcome studies are needed to develop a structured approach for appropriate treatment.

METHODS: 374 patients (412 feet) were included in this retrospective study. Data was collected by chart reviews, telephone interviews, and questionnaires by mail. Foot function index, pain scores, and satisfaction scores were analyzed.

RESULTS: The minimum follow-up was two years (range 2-9 years). The majority of patients were female (83%). 86.9% had primary procedures. Ninety percent had first tarsometatarsal fusions for hypermobile first ray, 62% modified McBride procedures for hallux valgus, 56% metatarsal shortening for lesser metatarsalgia, and 57% hammer toe corrections. Union rate was 93.2% with a delayed union of 2.8% and nonunion of 4%. Twenty feet had delayed wound healing with a total of 3.7% major complications (nerve injury, deep infections, reflex sympathetic dystrophy, and amputation). Eight percent had subsequent forefoot procedures. Hardware removal occurred in 18.8% an average of 18.1 months after surgery. There was an improvement in pain and satisfaction scores.

CONCLUSION: A structured approach to the management of arch collapse and forefoot deformities yields excellent union rates and low reoperation and complication rates. Longer-term outcome studies are needed to determine appropriate treatment in arch collapse and the spectrum of related deformities.

101. Subtalar Arthroereisis Screw Placement as an Adjunct to Tarsal Coalition Resection with Associated Flatfoot Deformity

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INTRODUCTION: Flatfoot deformity as the result of tarsal coalition remains a challenging entity to treat. Symptomatic tarsal coalitions in pediatric patients have been traditionally treated with resection followed by muscular or fat interposition and placement of bone wax. While this procedure has historically provided favorable results, concern still exists for recurrence of the coalition. The podiatric community has long utilized arthroereisis devices as assistive techniques to stabilize the subtalar joint and realign the hindfoot, however, this type of adjunct has yet to be fully embraced by orthopedic foot and ankle surgeons. The purpose of this study is to evaluate the results of coalition resection and arthroereisis screw placement in a group of patients with tarsal coalition and associated flatfoot.

MATERIALS AND METHODS: Four patients underwent a standard approach tarsal coalition resection and placement of a ProStop (Arthrex) subtalar arthroereisis screw for symptomatic flexible flatfoot and tarsal coalition between November 2007 and June 2009. The surgeries were performed by the two senior authors (TCF, STM). The average age was 17 years old; there were two males and two females. Outcomes were measured by patient satisfaction and pain, physical examination, and plain radiographs. The average follow-up was eight months.

RESULTS: All patients were satisfied with their outcome. Three of the four were pain free at most recent follow-up. The one patient with pain had symptomatic spurring and beaking of the talonavicular joint and subsequently underwent a cheilectomy and removal of the arthroereisis screw during the same surgery. Radiographs at final follow-up demonstrated resection of the coalition, maintenance of hindfoot realignment in all cases, and no evidence of loosening or migration of the subtalar arthroereisis screw in the three patients with retained arthroereisis screws.

CONCLUSIONS: Subtalar arthroereisis screw placement as an adjunct to tarsal coalition resection in flatfoot deformity shows promise to prevent recurrence of the coalition and is a less invasive method of realigning the hindfoot. Although our cohort is small and our follow-up period is relatively short, our experience demonstrates durable surgical outcomes for this challenging problem.

102. Three-Dimensional Computer Image Analysis in Foot and Ankle Surgery: Computer Modeling in the Determination of At-Risk Structures for Calcaneal Osteotomies

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BACKGROUND: Improvements in radiographic computer imaging have provided means to obtain three-dimensional anatomical visualizations of bone and soft tissue anatomy, pathology, and of orthopedic injuries. The OsiriX software program is a free, open-source, Mac-based, DICOM viewer that provides such opportunities for patient-specific surgical planning and post-surgical evaluation. This software has been applied to many fields of medicine; however, to our knowledge, its use has not been studied in the field of orthopedics.

PURPOSE: The purpose of this study is to evaluate the accuracy of the OsiriX software for application to foot and ankle surgery, and, more generally, to orthopedic surgery. We present three-dimensional computer imaging of first, inanimate objects and second, the anatomy placed at-risk in common osteotomies performed in foot and ankle surgery.

METHODS: The accuracy of the OsiriX software was evaluated by two separate methods. First, a three-dimensional model was created with radiopaque objects of various sizes, shapes, and angles. Physical measurements were taken with calipers. A CT scan of the model was then imported into the OsiriX software, and the corresponding measurements were obtained. Second, to determine the applicability of the OsiriX software in the clinical setting, CT scans of two cadaver feet were obtained. These feet where then dissected medially to identify structures at-risk in the medial displacement and Evan's calcaneal osteotomies. Both osteotomies were performed and physical measurements were obtained between the medial structures and the medial calcaneal cortex at the osteotomy sites. The OsiriX software was then used to obtain corresponding measurements derived from the CT scans of the two feet.

RESULTS: The mean difference between the physical measurements vs. OsiriX measurements for the inanimate model was – 0.047 $\pm$ 0.68 mm. The mean difference between the physical and OsiriX measurements in the cadaver specimens was 0.124 $\pm$ 0.934 mm.

DISCUSSION: We have shown that the measurements obtained through the OsiriX program are reliable and can be used in the clinical or research setting. Virtual surgery and computer imaging opens new possibilities for developing novel surgical procedures, better understanding of the three-dimensional nature of the involved anatomy, evaluation of surgical corrections, and individualization of patient care. Ease of use and accessibility make the OsiriX software a valuable tool for orthopedic surgeons.

CONCLUSIONS: Our findings support the use of the Osirix software for use in orthopedic imaging. This open source software allows universal access to a tool which can be helpful in

surgical planning, outcomes measures in post-surgical situations, and virtual training and research.

103. Do Foot Angle Measurements Relate to Operatively Treated Lisfranc Functional Outcomes?

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INTRODUCTION: Unstable tarsometatarsal joint injuries (Lisfranc) injuries require operative reduction and stable fixation. Treatment methods consist of pin, screw, or plate fixation (ORIF) with or without primary arthrodesis (PA).

METHODS: During a seven-year time period (1998-2005), operatively treated Lisfranc injuries were retrospectively evaluated that had adequate radiographs and prospectively gathered outcome measurements (SMFA). Regularly measured foot angles were performed on digitized original postoperative radiographs. These same angles were repeated on radiographs that had Photoshop erasure of hardware and joint surfaces in order to "blind" the treatment method. The angle measurements were analyzed based on SMFA functional outcomes.

RESULTS: Of the 101 injuries, 62 were male and 39 were female. Average age was 37 (18-93). Surgical treatment was 77/101 ORIF (76%) and 24/101 PA (24%). Foot angle measurements were tibial-talus (115°), tibial-calcaneal (70°), tibial-plantar (25°), calcaneal-talus (47°), talo-MT (12°), 1st MT-phalanx (13°), and inter-MT (9°). No significant difference was noted between original and Photoshop angle measurements ($p>0.05$) and between two reviewers. Average SMFA measured outcomes were daily activity (11.0), emotional (17.4), arm/hand (5.6), mobility (27.4), dysfunction (19.1), and bother (15.2). No differences were noted between ORIF vs. PA ($p>0.05$). Angle measurements did not relate to differences in SMFA scores ($p>0.05$). Polytrauma had significantly greater tibial-calcaneal ($t=-2.386$, $sig=0.023$), calcaneal-talus ($t=2.255$, $sig=0.031$) angles. Work status was return to original work (93), work restrictions (1), unknown (4), or did not return to work (3). Patients returning to work had greater talus-plantar ($t=-9.587$, $sig=0.000$), inter-MT ($t=-2.007$, $sig=0.048$), and smaller talo-MT ($t=2.095$, $sig=0.05$) angle measurements.

CONCLUSION: Stable fixation with ORIF or PA produced similar outcome (SMFA) and foot angle measurements. Some foot angle measurements (talus-plantar, inter-MT, and talo-MT) related to return to work.

104. Midfoot Reconstruction for Atraumatic Degenerative Arthritis: Analysis of Outcomes

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SUMMARY: Arthrodesis is a safe and effective treatment for the management of midfoot arthritis and arch collapse.

INTRODUCTION: Primary midfoot arthritis and its potential causes are not well documented in the current literature. It is felt that arthrodesis of the involved midfoot articulations is a safe and effective management for primary midfoot arthritis and arch collapse.

METHODS: Ninety-five patients (104 feet) who had undergone arthrodesis for primary midfoot arthritis were included in this study. The indication for surgery was failed nonoperative management of midfoot arthritis and collapse.

The data was collected by chart review, telephone interview, questionnaires by mail, and patient examination. Pain scores, AOFAS/Foot function index scores, patient satisfaction scores, and radiographs were analyzed.

RESULTS: Minimum follow-up was 2 years (range 2-8 years). 47.4% were obese, 32.6% were smokers, and 8% were diabetic without signs of neuropathy. Autogenous bone graft was used in 91.4%, allograft in 3.9%. 77.9% required a gastrocnemius recession for associated equinus. 92.3% union was achieved.

CONCLUSION: Arthrodesis is a safe and reliable procedure with high union rates, low complication rates, and high patient satisfaction for the treatment of primary midfoot collapse.

105. Functional Outcomes of Operatively Treated Midfoot Fractures

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INTRODUCTION: Midfoot fractures (MF) are uncommon with an incidence of 0.45% of all fractures. The purpose of this study was to evaluate functional outcome in patients with an operatively treated MF.

METHODS: A prospective analysis was undertaken on a retrospective cohort of patients diagnosed with MF between March 2002 and June 2007 at a Level I teaching trauma center. Fifty-two patients with 54 operatively treated cuboid and navicular fractures or midfoot returned functional outcome surveys. Clinical outcomes consisted of complications and functional ability (foot function index [FFI] and SMFA).

RESULTS: The mean age was 40 years (range 17-72) and BMI 28.0 (17.5-48.9) with equal distribution of males and females. Five (9.3%) were open and 12 (22.2%) were isolated injuries. MF included 37 navicular fractures, 35 cuboid fractures, 18 Lisfranc injuries, and 17 cuneiform fractures. Associated foot injuries consisted of 25 metatarsal fractures, 13 calcaneal fractures, 12 talar fractures, 9 ankle fractures, and 3 pilon fractures. Medial column injury (MED) was present in 19 (35.2%), bicolumn injuries (BIC) in 18 (33.3%), and lateral column injuries (LAT) in 17 (31.5%). Complications were 13 HDW problems, development of secondary osteoarthritis in 35 (64.8%), 8 equinus contracture, 8 flatfoot and 10 cavus deformities, and 3 infections. Pain was present at final follow-up in 24 (44.4%) cases. 68.5% of patients returned to previous work, and 35.2% needed customized shoe wear. FFI was 30.2. SMFA indices included daily activity 24.4, emotion 32.9, arm/hand 8.1, mobility 29.1, dysfunction 23.5, and bother 24.9. BIC performed significantly worse than LAT or MED for all functional outcome measures except arm/hand ($p<0.05$).

CONCLUSIONS: Midfoot fractures are debilitating injuries that remain challenging for the orthopedic surgeon. Bicolumn injuries have the worst long-term outcome. Pain, post-traumatic arthrosis, and inability to wear normal shoes are related to inferior results.

106. Evidence Based Guidelines for Treatment of Multiple Metatarsal Fractures

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INTRODUCTION: Previous guidelines for the treatment of multiple metatarsal fractures have been formulated solely on anecdotal recommendations without any evidence-based input. The purpose of our study was to retrospectively review our experience of the natural history of multiple metatarsal fractures treated nonoperatively.

METHODS: A retrospective review of all patients with multiple metatarsal fractures from 1997 to 2007 at a Level 1 trauma center was conducted. Exclusion criteria included operatively treated fractures, Lisfranc injuries, neuropathic joints, stress fractures, and open physes. The displacement and angulation of the fractures were measured on injury and follow-up radiographs and reported as a Delta (or change in alignment) value.

RESULTS: Thirty-two patients met our inclusion criteria. Average age was 47 years (19-90). An increasing number of metatarsals fractured does not directly correlate with increasing displacement or angulation at final follow-up. Cross-referencing the nonoperative cohort with the current treatment recommendations (which suggest a surgical threshold of 10° of angulation or 3-4 mm of displacement), some fractures that met initial operative criteria demonstrated improved alignment at final follow-up. Fractures in the non-operative cohort also demonstrated general improvement. Metatarsal fractures in patients with ipsilateral lower extremity fractures trended toward poorer alignment at follow-up.

CONCLUSION: Our study provides the first evidence-based assessment of patients that have sustained multiple metatarsal fractures. Fractures that initially meet surgical indications based on alignment parameters may improve their alignment over time with nonoperative management. An exception to this may involve ipsilateral lower extremity injuries. Our non-operative cohort suggests that current treatment recommendations may lead to surgical intervention more often than needed.

107. Results of Operative Repair of Lateral Process Talar Fractures with Mini Plate Fixation

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INTRODUCTION: Talar lateral process fractures are uncommon. Most studies have primarily assessed outcomes in patients treated with nonoperative treatment or screw fixation. The purpose of this study was to evaluate the outcomes of patients treated with mini plate fixation.

METHODS: A retrospective cohort analysis was conducted of 46 lateral process talar fractures in 45 skeletally mature patients that were operatively treated with mini plate fixation at a level 1 teaching trauma center from 2002 through 2007.

RESULTS: Gender was 23 males (51.1%) and 22 females (48.9%) with more right talus injuries (29, 63%) than left (17, 37%). Average age was 35 years (19-63). Twenty (43.5%) had isolated lateral process injuries, and 21 (45.7%) had ipsilateral foot/ankle injuries. Talar fracture type included: process only (25, 54.3%); associated dome (7, 15.2%); associated neck (8, 17.4%); and associated neck and dome (6, 13.1%). Hardware complications included: broken (4), painful/irritating (6), and loosening (3). Radiographic analysis showed tibiotalar arthritis in 16 (34.8%) and subtalar arthritis in 19 (41.3%). Other complications were AVN (4), articular incongruity (2), nonunion (1), and infection (1). Eighteen fractures (39.1%) required secondary surgery. Thirty-eight (82.6%) had pain at final follow-up, but 26 had a pain rating between 1-3 on a 10-point scale. There was a near equal distribution of those who did not return to previous activities, returned to work, but had restrictions or different work, and those who returned to the same occupation. As pain increased, patients were less likely to return to work ($p<0.01$). A relationship between severity of pain and decreased dorsiflexion and subtalar motion was noted ($p<0.05$). Post-traumatic arthritis of the ankle related to decreased DF & PF ($p<0.01$). A significantly greater incidence of pain among polytrauma ($p=0.028$) was measured.

CONCLUSIONS: Lateral process talar fractures require anatomic restoration but still result in post-traumatic arthritis, chronic pain, and stiffness which have a devastating effect on function and ability to return to previous activities and employment.

108. Anterolateral Plating is Equivalent to Medial Plating of Pilon Fractures

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OBJECTIVE: To compare the relative axial and torsional stiffness between anterolateral and medial distal tibial locked plating in a tibia pilon fracture model.

METHODS: Six third-generation Sawbones composite tibia models with a simulated pilon fracture with associated varus or valgus comminution (OTA 43-A2.2) were reduced and plated with either a Synthes 3.5 mm contoured anterolateral plate or medial distal tibia plate. Transmitted load as a function of axial displacement and transmitted torque as a function of angular displacement was measured.

RESULTS: In the medial loading position, there was no significant difference between the anterolateral and medial plates in mean stiffness when the fracture wedge was in place. A significant difference was found between plates when the fracture wedge was removed. For the posterior loading position, there was no significant difference between plates in mean stiffness with the fracture wedge in place and then the fracture wedge was removed. With the fracture wedge in place, there was a significant difference ($p<0.05$) in mean torsional stiffness between the plate/tibia constructs under positive deflection (internal rotation). With the fracture wedge removed, there was no significant difference in mean torsional stiffness between the plate/tibia constructs in positive displacement or negative displacement.

CONCLUSION: The similarities in biomechanical stiffness between the medial and anterolateral plates support the clinical use of anterolateral locked plating of pilon fractures.

109. Isolated Gastrocnemius Recession: Retrospective Review of Outcomes

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INTRODUCTION: Gastrocnemius contracture alters foot biomechanics, causing painful foot pathologies. Gastrocnemius recession is a well-known procedure in management for spastic contractures, but literature on its role in neurologically normal limbs with chronic foot pain is still scant.

METHODS: 100 patients (118 feet), who had undergone isolated gastrocnemius recession, were included in this retrospective study. The indications were plantar fasciitis, metatarsalgia, or chronic Achilles tendinopathy (CAT) without any structural or radiological abnormality. All had failed conservative management for at least six months. The data was collected by chart reviews, telephonic interview, questionnaires by mail, and patient examination. Pain scores, AOFAS score, and satisfaction levels were analyzed.

RESULTS: Minimum follow-up was 2 years [range 2-7 years]. 56% were obese and 40% were smokers. 28.1% had metatarsalgia, 65% plantar fasciitis, and 9% CAT. Pain scores improved in 87%. Wound problems were seen in 5.1% and deep vein thrombosis in 5.9%. Sural neuropathy was seen in 3.4%. There was a 5.1% reoperation rate, which included any foot surgery at a later date. The gastrocnemius contracture recurred in only one patient and required a recession again.

CONCLUSION: Gastrocnemius recession is a safe procedure with low recurrence and complication rate. It provides symptomatic relief in a high percentage of patients with chronic foot pain and no structural abnormality.

MAOA BREAKOUT SESSION #9
TRAUMA
April 23, 2010

110. Locked Transsacral Screw Fixation of Bilateral Injuries of the Posterior Pelvic Ring: Initial Clinical Series♦

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INTRODUCTION: A few reports have described posterior pelvic fixation using transsacral screws (inserted through the body of the sacrum and out the contralateral ilium), mainly for the treatment of pelvic nonunion. In 2000, a cannulated extra-long 7.0 mm diameter cancellous screw capable of being percutaneously inserted and locked at its distal end with a self-locking nut became available on a limited basis. The purpose of this study was to evaluate the clinical safety and efficacy of this new device for fracture fixation in patients with acute bilateral posterior ring injuries.

METHODS: Beginning in 2001, ten patients with bilateral injury to the posterior pelvic ring were treated using a cannulated transsacral screw having a novel locking capability. Patients ranged in age from 21 to 64 years. Follow-up averaged 18 months. Preoperative and postoperative radiographic evaluation included anteroposterior, inlet and outlet pelvic x-rays, and two-dimensional computerized tomography (CT) with 3 mm slice thickness. Candidates for this fixation required adequate space estimated on CT across either the first or second sacral body.

RESULTS: Satisfactory screw position was documented on the postoperative CT in all cases. There were no iatrogenic nerve injuries. Fixation failure did not occur and satisfactory pelvic ring position was maintained until fracture healing in all ten patients. Removal of the transsacral screw and self-locking nut was performed in two patients because of local irritation from a prominent screw tip. This hardware removal was accomplished on an outpatient basis without difficulty.

CONCLUSION: Locked transsacral screw fixation is a safe and effective technique that should be added to our surgical armamentarium. Indications include bilateral posterior injury, as well as any situation in which routine transsacral screw fixation might otherwise be considered, such as the presence of pelvic osteopenia or insufficient space for a second point of posterior fixation.

111. Cadaver Pelvic Biomechanical Study: Locked versus Standard Unlocked Plating of the Symphysis Pubis

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INTRODUCTION: Although locked plating has advantages for diaphyseal and metaphyseal fracture fixation, its use for pubic symphyseal disruption has raised concerns, especially regarding the potential for catastrophic fixation failure.

METHODS: Ten unembalmed cadaver pelvic specimens were harvested and DEXA scans were obtained to ensure uniformity of the specimens' bone density. Sacrospinous, sacrotuberous, and anterior sacroiliac ligaments were released, and the symphysis pubis was transected to simulate a partially stable open-book (AO/OTA 61-B3.1) injury. Using a six-hole 3.5 mm plate designed for the symphysis pubis with the capability of fixation in locked or unlocked mode, five pelves were fixed with six 3.5 mm locking screws and five pelves were fixed with six standard 3.5 mm unlocked bicortical screws. A specially designed jig was used to ensure uniformity of screw placement. The pelves were then mounted on a materials testing apparatus using the "dancing pelvis" model, as described by Tile, and stressed at 440N for a total of 1 million cycles (equivalent to 6.5 months of daily walking) or until fixation failure.

RESULTS: There was no significant difference between the two groups of pelvic specimens with regard to bone density ($p=0.548$). All pelvic specimens in both fixation groups completed 1 million cycles without plate or screw failure. However, diastasis of the initial pubic symphysis reduction was found in all pelves (mean 2.45 mm; range 1.5-4.0 mm) regardless of fixation method. This loss of reduction was not significantly different between the two fixation groups ($p=0.914$).

CONCLUSION: Although no catastrophic failures were seen in either group, minor loss of the symphyseal reduction, recently described as relaxation of symphyseal hardware, was evident in all pelves regardless of fixation method. Therefore, locked plating of the pubic symphysis does not appear to offer any advantage over the standard unlocked technique for partially stable open-book injuries in osteopenic patients.

112. Mapping the Columns of the Acetabulum – Implications for Percutaneous Fixation

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PURPOSE: Knowledge of the bony thickness of the acetabular columns is one requisite for safe execution of percutaneous fixation of acetabular fractures. We performed a cadaveric study to determine the anatomical dimensions of the columns of acetabulum with reference to percutaneous screw fixation.

METHODS: Twenty-two hemipelvis (11 pairs) from 6 male and 5 female cadavers were measured and statistically analyzed.

RESULTS: In the anterior column, the psoas groove displayed the least vertical thickness of 15.1 mm (range, 12.1-18.2 mm), followed by the obturator canal with 15.9 mm (range, 12.2-20.6 mm). The mean thickness of the posterior column wall of the acetabulum along the screw path displayed 21.3 mm (range, 16.5-30.3 mm).

DISCUSSION: This study provides a clinical map for safe passage of both antegrade and retrograde percutaneous screws. Anatomic data suggests that 7.3 mm cannulated screws can be safely accommodated by the anterior and posterior columns of the acetabulum.

113. Cost Comparison of Cemented versus Uncemented Endoprostheses for Femoral Neck Fracture

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Femoral neck fractures are an increasingly common orthopedic entity as our population ages. This study was carried out to determine the added cost burden to our institution by using an uncemented prosthesis.

Thirty-four patients treated by the author, over a 30 day period of time, were stratified to either cemented or uncemented prostheses, solely based on the Dorr classification of bone quality. Factoring in the cost of the prosthesis, cement and cement supplies, operating room cost per 15 minutes, and anesthesia cost per 15 minutes, the uncemented device cost $1,091.77 more, per case, than the cemented device.

In conclusion, with documented increasing numbers of hip fractures annually, the use of uncemented prosthetics for femoral neck fracture proves to be an additional financial burden to the institution.

114. Successful Treatment of Recalcitrant Femoral Nonunions with Plate Osteosynthesis and Intramedullary Nail Retention

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PURPOSE/HYPOTHESIS: The most popular method for treatment of femoral nonunion after initial intramedullary fixation is exchange nailing. However, ongoing nonunion after exchange nailing represents a severe problem. In these rare cases, we used plate augmentation and bone grafting with nail retention. We report our experience with a case series from two centers.

MATERIALS/METHODS: We reviewed 11 patients with femoral nonunion (9 atrophic and 2 hypertrophic) treated initially with an interlocking intramedullary nail. Patient age ranged from 23 to 85 years old. Five subjects were male and six female. Each patient underwent compression plating of the lateral femur using AO technique with the nail left in situ. Either allograft or autograft was used in nine patients. BMP was used for nine subjects. Patients were allowed to be partial weight-bearing following plate augmentation.

RESULTS: This technique was utilized primarily for cases of recalcitrant femoral nonunion as the average number of surgeries prior to plate augmentation was two. All patients achieved radiographic and clinical union. The average time to resolution of pain and radiographic union was five months.

CONCLUSION/SIGNIFICANCE: This study is concordant with three previous investigations found in the international literature, all of which conclude that plate augmentation is a reliable method for nonunion treatment. All patients in our study went on to bony union using plate augmentation. We conclude that plate augmentation is a viable alternative to a second exchange nailing procedure to promote bony consolidation of a femoral nonunion in recurrent nonunions.

115. Incidence and Epidemiology of Combat Injuries Sustained During "The Surge" Portion of Operation Iraqi Freedom by a U.S. Army Brigade Combat Team

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BACKGROUND: A prospective, longitudinal analysis of injuries sustained by a large combat-deployed maneuver unit has not previously been performed.

METHODS: A detailed description of the combat casualty care statistics, distribution of wounds, and mechanisms of injury incurred by a U.S. Army Brigade Combat Team (BCT) during "The Surge" phase of Operation Iraqi Freedom (OIF) was performed utilizing a centralized casualty database and an electronic medical record system.

RESULTS: Among the 4,122 soldiers deployed, there were 500 combat wounds in 390 combat casualties. The combat casualty rate for the BCT was 75.7/1,000 soldier combat-years. The percent Killed in Action (KIA) was 22.1%, and the percent Died of Wounds (DOW) was 3.2%. The distribution of these wounds was as follows: head/neck 36.2%, thorax 7.5%, abdomen 6.9%, and extremities 49.4%. The percentage of combat wounds showed a significant increase in the head/neck region ($p<0.0001$) and a decrease in the extremities ($p<0.03$) compared to data from WWII, Korea, and Vietnam. The percentage of thoracic wounds ($p<0.03$) was significantly less than historical data from WWII and Vietnam. The percent KIA was significantly greater in those soldiers injured by an explosion (26.3%) compared to those soldiers injured by a GSW (4.6%) ($p=0.003$). Improvised explosive devices (IEDs) accounted for 77.7% of all combat wounds.

CONCLUSIONS: There was a significantly higher proportion of head/neck wounds compared to prior U.S. conflicts. The 22.1% KIA was comparable to prior U.S. conflicts despite improvements in individual/vehicular body armor and is largely attributable to the lethality of IEDs. The lethality of a GSW in OIF has decreased to 4.6% with the use of individual body armor.

Keywords*:* military, combat, casualty, wound, epidemiology, injury

116. Massive Pelvic Wounds Managed with the Vacuum-Assisted Closure (VAC) Device

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The management of massive pelvic wounds remains a surgical challenge. Perioperative complications may be due to blood loss, deep venous thrombosis, or infection. Soft tissue coverage options are often limited, and may result in additional functional loss. This study evaluates 21 patients treated with a vacuum-assisted closure device (VAC) to manage a massive pelvic wound between January 2003 and January 2008 at a single institution. The term “massive” has been defined as greater than 20 cm. The follow-up ranged from 6 months to 4 years (average: 17 months). The medical charts, home health records, imaging, and patient interviews were conducted to assess the safety and efficacy of the VAC. The study group included 15 female and 7 male patients, ranging in age from 21-61 years of age (average 41.4 years). The etiology of the wounds included 11 sarcomas, 6 traumatic, and 4 infections. Adaptec non-adherent dressing was placed between the VAC sponge and the host tissue to reduce the ingrowth of granulation tissue into the sponge. This technique allowed for a reduction in the number of VAC changes to weekly, rather than the usual three times per week. The periphery of the sponge was secured in place with staples, and stoma paste was used in the perineum when indicated. The length of treatment averaged 2.2 months (range 1-6.5 months). Two underwent rotational flap coverage following VAC treatment. In these two patients, the VAC was also used on the flap in order to reduce drainage and swelling. At last follow-up, all 21 patients were able to be compliant with the VAC management protocol with the assistance of home health nursing. The average number of surgical procedures was 4.8 per patient. The length of hospitalization averaged 28.1 days (range 9-61 days). The VAC device appears to be safe and effective in the management of these highly complex wounds. Although successful wound management can be achieved, it is recommended that this technique be performed by a highly trained surgical team and that the patient be prepared for a lengthy recovery period.

117. Negative Pressure Wound Therapy in a Contaminated Musculoskeletal Wound Model: Is NPWT Effective on *Staphylococcus aureus*?

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PURPOSE: Previous work demonstrated that negative pressure wound therapy (NPWT) resulted in less *Pseudomonas aeruginosa* than standard wet-to-dry (WTD) dressings in a complex orthopedic wound model. *S. aureus* is more clinically relevant in open fractures and is the most prevalent bacteria in osteomyelitis. The purpose of this study is to determine if *S. aureus* responds similarly to *P. aeruginosa* when treated with NPWT.

METHODS: A complex musculoskeletal wound was created on the hind limb of 20 goats and contaminated with *S. aureus* (lux) bacteria. The bacteria are genetically engineered to emit photons, allowing for quantification with a photon-counting camera system. The wounds were debrided and irrigated with 9 L of normal saline using gravity flow irrigation six hours after inoculation. Goats were assigned to two different treatment groups: a control group using WTD dressing changes and an experimental group using NPWT. The wounds were debrided and irrigated every other day for six days. Bacteria within the wounds were quantified both before and after each debridement.

RESULTS: There was no difference between treatment groups in amounts of bacteria in the wound at all time points ($p \geq 0.37$).

CONCLUSION: Previous work demonstrated that NPWT resulted in a significant and clinically relevant reduction of *P. aeruginosa* at all time points in a similar model. We presume that NPWT was effective because it created an environment that allowed the body to ward off this “opportunistic” gram negative. However, as shown in this study, *S. aureus* is less affected by NPWT and persists within the wound.

118. Circular External Fixator Frames Using Perpendicular versus Divergent Half-Pins: A Biomechanical Study

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INTRODUCTION: The use of Hexapod circular external fixators has vastly simplified the ability to correct complex limb deformities without cumbersome frame reconfigurations. In an effort to further minimize frame complexity, various half-pin mountings have been advocated. This study compares the biomechanical performance of several half-pin configurations currently in clinical use in an effort to determine the optimum pin insertion pattern.

METHODS: Four frame configurations were applied to a uniform 2 cm fracture gap model using biomechanical sawbones with the following pin formulas: (A) 6 mm half pins at 90° angles (90-6), (B) 5 mm half pins at 60° divergent angles (60-5), (C) 5 mm half pins at 45° angles (45-5), and (D) 6 mm half pins at 45° angles (45-6). Four pins per fracture segment were used in perpendicular frames, and three pins per segment were used in all divergent frames. Pin mountings were attached to a standardized four-ring construct. Axial loads were applied using a MTS machine, and vector analysis was performed to determine net strain for each frame. Statistical analysis compared results of each frame to those of a previous study comparing a traditional tensioned wire frame, 5 mm half pins at 90° angles, 8 pins total (90-5), and 6 mm half pins at 60° angles, 6 pins total (60-6).

RESULTS: The 90-6 frame was the most rigid frame. The 60-6 and 90-5 frames were more rigid than all but the 90-6 frame. There was no statistical difference between the 45-6, 60-5, and tensioned wire frames, which were less rigid than the 90-6, 90-5, and 60-6 frames. The 45-5 frame was the least rigid frame.

CONCLUSIONS: The mechanical performance demonstrates that 5 mm and 6 mm half-pin frames applied as described in divergent or perpendicular angles can be used without concern for mechanical instability. Four pins per segment should be used in perpendicular frames, while only three half pins are needed per segment for divergent frames. However, if 5 mm pins are used for divergent frames, they should be applied at 60° angles.

119. BMP-2 to Treat Large Bone Defects in the Tibia: An Evaluation of Different Carriers in a Non-Human Primate Model

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PURPOSE: Bone morphogenetic protein (BMP) has emerged as a useful adjunct to traditional bone graft. Questions still remain regarding the most effective use of this substance. This study was designed to evaluate various carriers of BMP in healing a defect in the tibial diaphysis of non-human primates.

METHODS: Fifteen non-human primates underwent excision of a segment of their tibia. The animals then received intramedullary fixation of their fracture and rhBMP-2 soaked material was placed in the gap. The animals were randomized and received one of five different BMP/graft combinations: (1) rhBMP-2 on a compression resistant matrix, (2) rhBMP-2/ACS wrapped around Master Graft granules, (3) rhBMP-2 applied to putty with small granules, (4) rhBMP-2 applied to putty with large granules, and (5) autograft. The animals had weekly radiographs, mechanical testing, and histomorphometry to assess healing. These parameters were compared to a normal non-human primate tibia.

RESULTS: The animals in Group 1 that received rhBMP-2 on compression resistant matrix in their tibia appeared to have healed more completely and attained higher marks in categories relating to mechanical strength. Group 2's animals received rhBMP-2 on an absorbable collagen sponge wrapped around MasterGraft Granules and also healed well, although not as completely as the animals in Group 1. The animals in Group 2 led all other groups in many of the categories associated with microscopic and histological evaluation.

CONCLUSION: The best applications appear to be either the BMP-2 collagen sponge wrapped around calcium granules (Group 2) or BMP-2 applied directly to a compression resistant matrix (CRM) carrier (Group 1). The data derived from this study reduces the number of variables for the clinician to consider by proving that other techniques, including traditional autologous bone graft, are not as effective.

120. The Effect of Mesenchymal Stem Cells Derived from Umbilical Cord Blood on Healing of Fracture Nonunions in a Rat Model

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INTRODUCTION: Previous studies have shown that mesenchymal stem cells transplanted at a fracture site in animal models improve fracture healing. These mesenchymal stem cells have traditionally been isolated from bone marrow. Due to the fact that bone marrow requires an invasive procedure to obtain, as well as its decreased ability to proliferate and differentiate with age, alternative sources have been explored including umbilical cord blood.

Our study looked at a new method of isolating mesenchymal stem cells from human umbilical cord blood and the osteogenic potential of these cells in a rat fracture nonunion model.

MATERIALS AND METHODS: Mesenchymal stem cells were isolated from human umbilical cord blood using CD 271 as a marker. Cells were cultured using either standard or osteogenic media. Cells were prepared in a collagen matrix gel and were injected into a 6 mm critical size femoral defect of 10 athymic nude rats (5 for each culture media type). The critical size defect was stabilized by a uniplanar external fixator. Ten nude rats with 6 mm critical size defects stabilized by uniplanar external fixators were used as controls (5 with collagen matrix gel injected and 5 with no implant). Radiographs were taken at regular intervals to evaluate bone growth up to eight postoperative weeks. At week eight, the animals were sacrificed; the femur from the operative side was dissected and prepared for histological analysis.

RESULTS: Analysis of radiographs over the eight-week time period showed no radiographic evidence of defect healing. Comparison of the bone growth at the defect bone ends over time showed no significant decrease in the defect size. Histologic examination of the nonunion showed no significant signs of preliminary or definitive healing of the defect.

CONCLUSION: In our rat fracture nonunion model, the implantation of CD 271+ mesenchymal stem cells into a nude rat 6 mm critical size defect did not lead to increased bone formation or healing. Further research needs to be performed to assess the use of these cells in animal models including using allograft based implants.

MAOA BREAKOUT SESSION #10
SPORTS
April 23, 2010

121. Screening for Femoroacetabular Impingement in Asymptomatic Adolescent Athletes

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Femoroacetabular impingement (FAI) is a cause of significant activity related hip pain in young, active individuals and is a common cause of early onset osteoarthritis. The prevalence of FAI in the general population is not known and in young patients screening exams, similar to those used for scoliosis, are not available.

We examined 150 local high school athletes age 12 to 18 presenting for state-mandated preparticipation athletic physicals. As part of the examination, hip range of motion was assessed for supine hip flexion, and internal and external rotation with the hip flexed to 90°. An anterior impingement test (groin pain with hip flexion, adduction, and internal rotation) was also performed. Patients were excluded for presence of pre-existing hip disease.

Of the 150 patients examined, 15 (10%) had hip internal rotation of less than 10° with the hip in 90° of flexion. One patient also had a positive anterior impingement sign. Hip radiographs and magnetic resonance imaging (MRI) will be obtained of these patients and compared to a control group of subjects with normal hip range of motion in whom MRI will be obtained.

Ten percent of normal teens that were examined had abnormal hip exams. Decreased internal rotation is common in patients with FAI. Activity modification, nonimpact activity sports, and continued vigilance in patients with abnormal exams is recommended as FAI has been demonstrated to be a mechanism that leads to early osteoarthritis.

122. Evaluation of Alpha Angle as a Predictor of Outcome in the Arthroscopic Management of Labral Disease

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INTRODUCTION: Debate exists as to whether it is necessary to resect impingement lesions while addressing labral pathology during arthroscopic treatment. Alpha angle (AA) is often used as a marker of CAM impingement lesions. The purpose of this study was to test the hypothesis that, independent of AA, favorable outcomes can be obtained with arthroscopic labral debridement alone.

METHODS: A retrospective review was conducted by two independent clinicians to measure the AA of patients who underwent arthroscopic debridement of a labral tear. Surgeries were performed by two surgeons between 2001-2005. Outcomes were considered successful if patients were pain-free and no further treatment was rendered one year postoperative.

RESULTS: 111 patients were identified with MRI/MRA documented labral tear(s). Seven were lost to follow-up, leaving a final cohort of 104 patients with an average age of 35.3 years (range, 15-61) and 52/104 males. Seventy-six of 104 (73.1%) patients had a successful outcome and average AA of 54.5 ± 15.0 (range, 34-85). An AA of 53.2 ± 14.9 (range, 40-90) was found for 28 (26.9%) patients who failed treatment, and the difference between the two groups was not significantly different (p=0.70). Eight of the 28 (28.6%) failures went on to total hip arthroplasty.

CONCLUSIONS: No statistically significant association was found between offset AA and one-year outcomes following arthroscopic debridement of labral tears, suggesting that resection of the impingement lesion (CAM) is not essential to a favorable outcome. The study appears to be appropriately powered based on the standard deviations for the two groups.

123. Femoroacetabular Impingement in Athletes Less Than 21 Years of Age

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INTRODUCTION: Activities that require extreme ranges of motion in patients with FAI, such as ballet, yoga, and martial artists can particularly aggravate the condition. The purpose of our study was to analyze young, active individuals to determine their preliminary clinical results from surgical dislocation and debridement and return to activities.

METHODS: A retrospective review of FAI cases that underwent open surgical correction from 2003-2008 were reviewed. An athlete was defined as anyone who played on a team or individual based sport requiring participation at least three times a week for an hour or more of continual activity. FAI was identified clinically and radiographically. Failure was determined by progression of OA or lack of improvement in acetabular version. Postoperatively, patients were evaluated for pain, return to activities, further treatments, and limitations with a minimal one-year follow-up.

RESULTS: Twenty-four patients were identified. The average age was 17 years (range, 17 to 20 years); four patients were female. One patient did not return to her regular activities because of constant discomfort in the hip. One patient with bilateral surgical procedure was able to return to dance with intermittent pain. Four had no further discomfort. Eighty-seven percent were able to return to their previous level of performance. There were no radiological failures.

CONCLUSIONS: Open surgical correction appears to effectively treat FAI discomfort in this population. Young athletes are able to resume high-level performance. Currently, open surgical correction is a reasonable treatment to treat the pathology associated with FAI.

124. Evaluation of Patella Instability Due to Disruption of the Medial Patellofemoral Ligament in Patients with Knee Dislocations

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BACKGROUND: The purpose of the following study was to evaluate if patients who suffered a traumatic knee dislocation and concomitant medial patellofemoral ligament (MPFL) injury develop patellar instability.

METHODS: Nine patients, six men and three women, who had a knee dislocation and associated MPFL disruption, were examined for the presence or absence of patellar instability. The patients had MRI findings consistent with a knee dislocation and injury to their MPFL. None of the patients underwent repair or reconstruction of their MPFL. The median follow-up time was 4.3 years. At time of follow-up, patients underwent a physical exam to evaluate for patella instability and completed a 2000 IKDC subjective knee form. In addition, radiographs of the knee were obtained.

RESULTS: At follow-up examination, none of the patients demonstrated physical examination findings of patella instability. Furthermore, none of the patients exhibited pain on patellar grind test. The average IKDC subjective knee score for the group was 71. Radiographs revealed the presence of excessive lateral deviation of the patella in one patient and patellofemoral arthritis in six patients.

CONCLUSIONS: No signs of patellar instability were found in a group of patients who had a knee dislocation and associated MPFL disruption. It is our recommendation that in this group of patients that the MPFL ligament does not need repair or reconstruction to prevent future patellar subluxations or dislocations.

125. Fatigue Mediated Alteration of Knee Proprioception in the Adolescent Athlete – An Implication for Sports Related Injury

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PURPOSE: Knee injuries generally occur late in the course of athletic play, suggesting that fatigue may contribute to altered neuromuscular control. The present study aims to investigate the effects of whole body fatigue on knee joint proprioception.

METHODS: Proprioceptive data was collected with an electro-goniometer on 36 healthy high school male athletes, average age 16 years (range, 15-18). Subjects were instructed to replicate specific target angles (randomly chosen), of knee flexion. The protocol included knee flexion angles between 10° to 60° at 5° intervals. Measurements were taken before and after a comprehensive, reproducible, fatigue protocol. "Proprioceptive error" (i.e., achieved angle, minus the target angle) was evaluated in a two-way repeated-measures ANOVA, examining the effect of fatigue state and target angle.

RESULTS: Proprioceptive error was significantly greater ($p<0.001$) in the fatigued state. There was a significant target angle/fatigue interaction ($p=0.071$); most significant was that post-fatigue errors were significantly greater than pre-fatigue errors at lower target angles of 10-30° of knee flexion.

CONCLUSIONS: Proprioception statistically declines with fatigue when measured in a closed chain, functionally relevant position. This suggests a fatigue-mediated alteration in proprioception results in loss of dynamic stabilization of the knee that may explain the associated increase in sports related injuries when fatigued. This is particularly evident at the knee flexion angles that generally correlate with the risk of non-contact ACL injury, i.e., less than 30° of knee flexion.

126. Nonoperative Treatment of Tibial Stress Fractures in Female Athletes with Anterior Cortical Defects

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Most stress fractures of the tibia involve the posteromedial aspect of the proximal and distal tibia and, because they are on the compression side of the tibia, respond well to nonoperative management. Stress fractures in the anterior aspect of the tibia are less common, accounting for approximately 2% of all stress fractures and 5% of all tibial stress fractures, and have proven more difficult to treat nonoperatively, especially when radiographic evidence of an anterior cortical defect is present; they have been associated with prolonged healing times and progression to nonunion that requires operative treatment. A retrospective review of medical records identified five women with anterior cortical defects on radiographs who were treated between November 1997 through June 2005. All five were basketball players, and they ranged in age from 17 to 21 years (average 18 years). The median duration of symptoms before evaluation was 8 weeks (range 2 to 12 weeks). The most common complaint was pain with running or jumping. On clinical examination, all patients had tenderness to palpation over the fracture site, and the “dreaded black line” was visible on radiographs of all five patients. All five patients were treated with modified exercise programs consisting primarily of decreasing their running and axial loading exercises. A cast boot was worn except when playing basketball, at which time they wore an AirCast, and PEMF was used daily.

Radiographic evidence of healing of the stress fracture was present in four patients at a median of 12 weeks (range 8 to 13 weeks). No patient went on to complete fracture. All patients returned to their previous levels of play. The median time of return to athletic activity was 12 weeks (range 8 to 13 weeks). All patients returned to competitive athletics without recurrence during the follow-up period (median 28 weeks, range 3 to 39 weeks). One patient had recurrence of moderate pain three years after radiographic evidence of healing. Radiographs at that time showed no evidence of recurrent stress fracture, and periostitis of the anterior tibia was diagnosed.

127. Surgically Treated Tibial Tuberosity Fractures in Adolescents

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Avulsion fractures of the tibial tuberosity are rarely reported injuries. We have observed substantially larger numbers of these injuries than identified in a previous study at our institution. A retrospective review identified 41 patients with 43 tibial tuberosity fractures treated surgically over a five-year period. Patient records and radiographs were analyzed, and outcomes of patients with $\geq$ 12 weeks of follow-up were reviewed. This included 26 patients with 28 fractures. All 41 patients were adolescent males, with an average age of 14 years 10 months. All but one injury were sports-related. Thirty-six fractures (84%) occurred while playing basketball, two (5%) during football, and one each (2%) during gymnastics, hurdles, skateboarding, and baseball. The most common mechanisms of injury included jumping (60%), falling (14%), and a collision (7%). Evidence of pre-existing Osgood-Schlatter was detected in 42% of patients.

Radiographs were available for 40 of the 43 fractures. Using the Ogden classification, we identified zero 1A fractures, two 1B fractures, four 2A fractures, eight 2B fractures, sixteen 3A fractures, and ten 3B fractures. Using the Watson-Jones classification we identified twelve type I fractures, two type 2 fractures, and twenty-six type 3 fractures. Nine of the 40 (23%) fractures met the criteria for Ryu's type IV classification. All 43 fractures were treated with open reduction and internal fixation. Twenty-five of the 28 patients available for follow-up (mean 20.3 weeks) obtained $\geq$ 120° of flexion. One major complication (2%), a compartment syndrome, occurred in one patient who was discharged from the Emergency Department, applied a topical analgesic cream, and returned the following day with elevated compartment pressures requiring fasciotomy. His fracture healed and his knee range of motion returned, but he had a residual partial deep peroneal nerve palsy. Eight minor complications (19%) were identified including hardware irritation in three knees, quadriceps atrophy in three, and painless effusions in two.

128. Incidence of Ankle Sprain in the United States

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INTRODUCTION: Ankle sprain is a common injury. While this has been studied in athletic cohorts, little is known of the epidemiology of this injury in the general population. A longitudinal, prospective epidemiological database was used to determine the incidence and demographic risk factors among the general population of the U.S.

METHODS: The National Electronic Injury Surveillance System (NEISS) was queried for all ankle sprain injuries presenting to emergency departments between 2002 and 2006. Sex, age, race, mechanism, and setting were analyzed.

RESULTS: During the study period, an estimated 3,140,132 ankle sprains occurred among an at-risk population of 1,461,379,599 person-years for an incidence rate (IR) of 2.15 per 1,000 person-years in the United States. Males, when compared with females, did not demonstrate an overall increased incidence rate ratio for ankle sprain (IRR 1.04, 95% CI 1.00, 1.09). However, males between 15 and 24 years old had significantly higher incidence of ankle sprain than their female cohorts (IRR 1.53, 95% CI 1.41, 1.66), whereas females over 30 years old had higher incidence rates when compared with male cohorts (IRR 2.03, 95% CI 1.65, 2.65). Peak incidence of ankle sprain occurred in the second decade of life (7.2/1,000 person-years), with peaks between the ages of 15 and 19 years old in males (8.9/1,000 person-years) and 10 to 14 years old in females (5.4/1,000 person-years). When compared with Hispanic race, black IRR 3.60 (95% CI 1.03, 6.16) and white race IRR 2.49 (95% CI 1.01, 3.97) were associated with significantly higher rates of ankle sprain. Nearly half of all ankle sprains (49.3%) occurred during athletic activity, with basketball (41.1%), football (9.3%), and soccer (7.9%) associated with the highest percentage of ankle sprain during athletics. The majority of injuries occurred in and around the home (47.9%), followed by athletic or recreation facilities (28.5%) and schools (14.5%).

CONCLUSION: In the largest incidence study to date, second decade of life and black race are associated with higher rates of ankle sprain. Males aged 15-24 had higher rates of ankle sprain than females, whereas females over 30 years old had higher rates than males. Half of all ankle sprains occur with athletic activity.

129. Modified Chrisman-Snook Repair for the Treatment of Chronic Ankle Ligamentous Instability in Children and Adolescents

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BACKGROUND: Chronic ankle ligamentous instability is not uncommonly encountered in children and adolescents. A number of operative procedures have been developed and described in the literature, including variations on the original Chrisman-Snook (CS) repair. The purpose of this study is to describe a modification of the CS repair and report the outcomes of this surgery for the treatment of chronic ankle ligamentous instability in children and adolescents.

METHODS: A retrospective review was conducted of 80 consecutive surgeries in 53 children performed by a single surgeon who modified the CS repair using a split peroneus brevis tendon to reinforce the anterior talofibular and calcaneofibular ligaments in chronic ligamentously lax patients. All charts were reviewed for complications. Forty cases had at least two years follow-up and were evaluated for the following outcomes: return to activity, ligamentous laxity, pain, and subsequent sprains.

RESULTS: Of the 80 surgeries performed, no patient required repeat ligamentous repair. There were no deep wound infections. There were ten cases of minor wound healing problems and one case of temporary nerve dysfunction, all of which resolved without consequence. There were two cases of sural nerve branch entrapment which required subsequent surgery. Of the 40 cases with at least two years follow-up, the following outcomes were obtained: all patients returned to full activities of their choice, all but one case maintained <45° of ankle inversion postoperatively, all patients were pain-free or had only occasional discomfort, and 85% of the ankles experienced no subsequent sprains. Six patients had subsequent minor sprains with physical activity, all resolving without incident.

CONCLUSION: A modification of the CS repair where the split peroneous brevis tendon is used to create ankle stability has been routinely successful in 80 consecutive cases for chronic ligamentous instability in children and adolescents with very few complications.

MAOA THIRD PLENARY SESSION
April 24, 2010

130. Hinged External Fixation in the Treatment of Knee Dislocations: A Prospective Randomized Study

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INTRODUCTION: The study hypothesis was that knee dislocation patients treated with hinged external fixators and reconstruction would have fewer failures than patients without external fixation.

METHODS: This was a prospective randomized study. Group A patients had ligament reconstruction plus a knee brace. Group B patients had the same reconstruction, plus a hinged external fixator (Compass Knee Hinge) for six weeks. Patients were evaluated with physical examination, Lysholm and IKDC knee scores, KT-2000 ligament arthrometer exams, analog pain scores, and return to work and activities.

RESULTS: One hundred patients with 103 knee dislocations were enrolled, with minimum 12 month follow-up in 79 dislocations (32 Group A, 47 Group B). Group A had a total of 9 (28%) failed reconstructions compared to 7 (15%) in Group B ($p=0.15$). Group A had 22 (21%) individual ligament failures compared to 11 (7%) in Group B ($p<0.001$, power >0.8). There were trends toward better motion, pain scores, return to work, and return to activity in Group A patients, with similar Lysholm and IKDC knee scores. Final IKDC scores were similar with 75% normal or near normal knees in Group A compared to 82% in Group B.

CONCLUSION: Hinged external fixation with reconstruction had fewer failed ligament reconstructions following dislocation compared with external bracing. However, there were slight trends toward improved pain, motion, and return to activity in patients treated with bracing. Hinged external fixation should be considered for highly unstable (Type IV) knee dislocations to supplement reconstruction.

131. Use of Knotless Suture for Closure of Total Hip and Knee Arthroplasty: A Prospective, Randomized Clinical Trial

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INTRODUCTION: The purpose of this study was to investigate the use of bidirectional, barbed suture for wound closure in primary total hip (THA) and knee arthroplasty (TKA) to determine whether its use is safe, cosmetic, and cost-effective when compared with traditional suture.

METHODS: We carried out a blinded, prospective-randomized controlled trial comparing bidirectional, barbed suture (Quill™ SRS; Angiotech Pharmaceuticals, Inc.) and a traditional absorbable-layered wound closure following primary THA and TKA. We included 25 THAs (14 Quill; 11 traditional) and 35 TKAs (17 Quill; 18 traditional). Closure times, operative data, Hollander wound scores, and patient satisfaction assessments were collected at a minimum of three-months follow-up. A detailed cost analysis was performed to determine differences in expenditures for both types of closure. Power analysis determined a minimum of 23 patients per arm of the study were necessary to report statistical significance.

RESULTS: Wound closure in the experimental group was significantly faster than traditional suture; mean closure time 9.2 minutes versus 13.4 minutes ($p=0.0005$). Traditional closure required a mean 5.4 sutures, compared to a mean 2.6 sutures ($p<0.0001$). In spite of the mean savings of 4.2 minutes and 2.8 sutures per closure when utilizing Quill, the unit cost of the barbed suture was 5-12 times that of conventional suture. One patient who had undergone Quill closure developed superficial wound drainage, postoperatively (1.7%). Delayed healing occurred in this case without surgical intervention.

DISCUSSION/CONCLUSION: Bidirectional, barbed suture appears to be an efficient and effective means of primary wound closure following THA and TKA, however, its cost may be a barrier to widespread acceptance.

132. Patient-Generated Outcome Measurements in Long-Term TKA Surveillance: Comparison of AKS, Oxford Knee Scores, and ROM Self-Report versus Surgeon Assessment

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INTRODUCTION: Although the necessity of long-term surveillance of total knee arthroplasty (TKA) patients is unquestioned, the task can become burdensome as greater numbers of TKAs are performed. We sought to determine whether patients could reliably assess their own outcomes using a combination of American Knee Society (AKS) and Oxford Knee Score (OKS) questionnaires and self-reported range of motion (ROM) compared to physician assessment. Based on an earlier study, we hypothesized that patients would self-report worse pain and function scores, and similar ROM measurements, to the clinicians.

METHODS: Following IRB approval and power analysis, 91 patients undergoing routine TKA follow-up at two centers were mailed AKS and OKS questionnaires, photographic images of knee ROM in 5° increments for comparison to the patient's knee, and a goniometer with instructions. Patients were then seen within a two-week period of time and their AKS, OKS, and ROM was measured by one of three clinicians unassociated with the surgery. Patient- and physician-reported measures were compared using independent sample t-test and correlated using Spearman's coefficient.

RESULTS: Pain scores as part of the AKS were, on average, 6 points worse and AKS function scores were 12 points worse ($p<.001$) when self-reported compared to clinician assessment. The OKS score did not vary significantly ($p>.10$) between patient self-assessment and clinician. ROM showed a clinically minor (2°) but significant ($p<.001$) difference between patient photo assessment of flexion versus clinician measurement and a <1° difference between patient's photo assessment of flexion and their own goniometer measurement.

DISCUSSION: Patient reports of pain and function in the AKS score are worse than clinician assessments, but OKS scores are similar. ROM may be reasonably self-assessed using photo comparisons. Long-term surveillance of TKA patients may be possible using self-report measures, but further evaluation with other validated instruments is warranted.

133. Pathologic Proximal Humerus Fractures Treated with a Proximal Humeral Locking Plate and Bone Cement

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Pathologic fractures of the proximal humerus are relatively common. Bone loss can be difficult to manage and surgical options for joint preservation are often limited. Oncologic prosthesis of the proximal humerus often leads to poor results secondary to motor loss of the rotator cuff and/or deltoid function and instability. Locking plate technology may extend the indications for curettage, cementation, and internal fixation which may reduce hospital stay, perioperative morbidity, and improve overall shoulder function. Thirty-six patients with pathologic fractures of the proximal humerus were included. Patients with primary bone and/or soft tissue sarcomas were excluded. The diagnoses included: 14 renal cell, 10 myeloma, 4 thyroid, 4 breast, 1 bladder, 1 uterine, 1 colon, and 1 lymphoma. The patients were followed at postoperative intervals: 6 weeks, 3 months, 6 months, 1 year, 18 months, and 2 years. The study was approved by the institutional IRB and patients received informed consent. Functional and radiograph assessments were prospectively collected. All procedures were performed through a deltopectoral approach using the proximal humeral locking plate and Simplex cement. A high-speed burr and pulse lavage were used. The plate and screws were placed prior to placement of cement. At six weeks follow-up, 21 patients did not have pain, 12 had moderate pain, and 3 had severe pain. Pain subsided significantly by three months postoperatively, with only three patients indicating persistent pain in the region of the shoulder. Two patients had local recurrence, which required repeat curettage and cementation with retention of the locking plate. Functional outcomes scores were significantly superior to those reported in the literature for proximal replacement and humeral allografts. Salvage of the proximal humerus with use of locking plates and cementation allows for early mobility, acceptable pain control, and long-term stability.

134. Anterior Plate Fixation of Humeral Shaft Fractures Yields Comparable Overall Upper Extremity Function but Poorer Shoulder Function Than Posterior Plate Fixation

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PURPOSE: The purpose of this study was to compare functional outcomes following either anterior or posterior plate fixation of humeral shaft fractures. The null hypothesis was that there would be no significant difference between these two groups in shoulder, elbow, and overall upper extremity function.

METHODS: Medical charts and radiographs were reviewed on 83 humeral shaft fracture subjects having undergone either anterior or posterior plate fixation. Twenty-nine subjects, (21 anterior/8 posterior), were available to return for functional testing which included the Constant-Murley Score (CMS), Simple Shoulder Test (SST), Mayo Elbow Performance Score, and the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. Statistical analyses were performed to compare results between the two groups.

RESULTS: All but one fracture healed. There was no significant difference ($p>0.05$) between anterior and posterior fixation groups in the overall CMS (74 [A] vs. 83.5 [P]), mean Dash score (1.93 [A] vs. 1.37 [P]), Mayo scores, nor in 10 of 12 individual responses on the SST. Differences in passive motion approached significance at $p=0.07$ as all patients in the posterior group had maximum elevation scores. Active elevation was significantly better ($p=0.03$) in the posterior group. The posterior group also had significantly better SST scores on 2 of the 12 individual functions scored with this test ($p=0.03$ and 0.04, respectively).

CONCLUSION: Anterior fixation of humeral shaft fractures yields satisfactory upper extremity functional outcomes that are comparable to those of extremities that have undergone posterior fixation. However, shoulder function tends to be better following posterior fixation.

135. Evaluation of the Clinical Outcome of the Work Injured versus Non-Work Injured Patient Undergoing Arthroscopic Rotator Cuff Repair

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PURPOSE: When caring for patients with rotator cuff injuries sustained during the course of their occupation, it can be challenging to ascertain whether acceptable outcomes are obtained due to the subjective nature of continued complaints. It has been established that patients' perceptions of clinical outcomes may be biased due to obvious compensatory gain in continued disability. This analysis evaluates clinical outcomes of arthroscopic rotator cuff repair in the work injured and non-work injured patient. Specifically evaluated is the comparison of objective versus subjective clinical outcome measures to determine if a difference exists in patients' subjective perception versus objective reality.

METHOD: A total of 196 patients who underwent arthroscopic rotator cuff repair returned at a minimum of 12 months for functional and clinical outcome score. These measures included digital dynamometer strength evaluation of the supraspinatus, infraspinatus, and subscapularis, goniometric range-of-motion measurements, and ASES, UCLA, VAS, and satisfaction scores.

RESULTS: At follow-ups between 12 and 24 months postoperative, our patient populations saw statistically significant improvements in all functional and clinical outcomes ($p<.05$). Within arthroscopically determined tear size groupings and as a whole population, patients with worker's compensation claims showed significantly poorer results in all subjective outcome measurements; these include patient satisfaction, ASES, UCLA, and VAS scores. Interestingly, the outcomes did not differ significantly for dynamometric force or goniometric range-of-motion between populations.

CONCLUSIONS: Patients that undergo treatment for rotator cuff injuries sustained in a work setting generally demonstrate worse outcomes when results incorporate subjective measures. When comparing objective measures between these patient populations, specifically measuring function in strength and range of motion, no difference in clinical outcome exists between these patient populations.

MAOA BREAKOUT SESSION #11
TOTAL KNEE ARTHROPLASTY
April 24, 2010

136. Implementation of a Low Cost, Low Burden Method for Collecting Implant Registry Data

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INTRODUCTION: National Arthroplasty Registries have proven to be valuable tools for evaluating implant performance and detecting failures. Other than a multiple payer system, primary barriers to such registries in the U.S. are a cost and burden to physicians. This study reports accuracy rates associated with a low-cost, low-burden system designed and implemented in our health system.

METHODS: Data was collected at two hospitals within a single health system, including a large academic center with over 2,000 annual total joint arthroplasties (AC) and a high volume community hospital (CH). A consecutive cohort of patients undergoing total hip or knee arthroplasty was included. Data collected included demographics, diagnosis, intervention, and device(s) implanted. Nurses were thoroughly trained prior to implementation and data collection. Forms were faxed and scanned to a centralized data warehouse, and analyzed for completeness and accuracy by comparison with electronic medical records.

RESULTS: Overall, data was collected on 171/208 (82%) of patients included in the cohort (76% AC; 97% CH), of which 123/208 (59%) were fully completed and accurate (42% AC; 78% CH). There were 45 errors made regarding demographic information (7 technical, 38 human error), 30 errors related to main implant components (4 technical, 20 human), 12 errors with respect to implant accessory data (i.e., augments, screws; 3 technical, 9 human), and 7 errors regarding intervention details (all human error).

CONCLUSIONS: Even with an initial training period, there were several inaccuracies in the data collection. This study highlights the factors important to manage and consider in designing a method to be used for wide scale implant data collection.

137. Clinical Results of Hybrid Total Knee Arthroplasty with Minimum 20-Year Follow-Up

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One hundred and two hybrid uncemented femurs and cemented tibias were implanted using the Pressfit Condylar System between January 1986 and December 1987. Fifty-nine subjects were deceased prior to 20-year follow-up, and their average follow-up was 92 months. Average follow-up for the remaining subjects was 164 months with a range of 28 to 243. There were 16 revisions; 8 for loosening, 2 for infection, and 6 for polyethylene wear. Specific attention to uncemented femoral survivorship in this group revealed that only two femurs were revised for loosening. The other two femurs were revised for infection and were not loose at the time of removal.

This study demonstrates a survivorship of 90.6% in these knees at 16.4 years. (Note: There were too few patients remaining after 16.4 years to produce a reportable Kaplan-Meier Survival Estimate).

In conclusion, not only does the uncemented femur provide excellent long-term fixation, it also seems to protect the patient from loosening in the presence of osteolysis.

138. Meta Analysis of Randomized Controlled Trials Comparing Cemented and Cementless Primary Total Knee Arthroplasty

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BACKGROUND: Optimal fixation techniques for primary TKA continue to be debated with advocates for both cemented and cementless implants. An analysis of the current literature on the relative effectiveness of these two distinct TKA designs will assist surgeons in decisions regarding implant fixation. We performed a systematic literature review to summarize current data regarding the relative effectiveness of cemented and cementless primary TKA.

METHODS: We performed a literature search for prospective, RCTs within Ovid, Embase, Pubmed, and CINHAL. Search terms included: cemented, cementless, TKA, prospective, and randomized. Thirteen studies met our inclusion criteria and were evaluated for patient demographics, inclusion/exclusion criteria, outcome measures, statistical assessments, significant findings, and potential biases. Postoperative scores were analyzed for difference in the two treatment groups (cemented vs. cementless) among knee society score, knee functioning score, range of motion, and knee pain score.

RESULTS: Nine Level I and four Level II studies described a total of 1,055 TKAs with a mean follow-up of 5 years (range, 0.5-10). Good or excellent results were noted for 73 to 88% of patients within the individual reports. The only significant difference between cemented versus cementless groups was observed for postoperative knee pain score, in which the cemented group experienced less pain on average of 5.374 points with a 95% CI of -10.4476 ($p=0.038$).

CONCLUSION: Level I and Level II studies comprise a minority of the reports assessing TKA fixation. When comparing cemented and cementless TKA, the cemented group reports a lower postoperative pain, on average of 5.374 points. Further studies are needed to assess the efficacy of new cementless designs, and to better elucidate patient subgroups that may benefit from a specific fixation strategy.

139. Using Surgical Navigation Intraoperatively to Assess Implant Design Goals: A Comparative Study

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Surgical navigation in total knee arthroplasty (TKA) provides more predictable outcomes in terms of component placement and overall alignment of the limb. Design features of TKA devices assume that components are placed in the optimum position to achieve the desired kinematic performance. It is assumed that optimal positioning can result in a better clinical performance. The purpose of this study was to evaluate intra- and postoperative kinematic behavior of two knee designs using intraoperative navigation.

Two posterior-stabilized (PS) TKA designs from the same manufacturer were investigated. Major design differences relate to differences in contact position during flexion. Intraoperative kinematic differences were assessed using surgical navigation, evaluating stability throughout the entire range of motion (ROM). This information was then compared to clinical, radiographic (including CT), and fluoroscopic evaluations made postoperatively.

Results suggest that both implants provide stability throughout the entire range of motion. The greatest amount of instability in the medial/lateral plane, 5° in all cases, was seen at 20° of flexion. The intraoperative results were similar for both knee designs and resulted in excellent clinical results. No knees have been revised to date. The average Knee Society scores are (87) at the most recent follow-up.

This study is an effort to determine whether navigation can be used to evaluate and differentiate specific device design criteria intraoperatively. In addition, we wished to assess whether documenting those kinematic qualities could allow us to relate these to clinical performance postoperatively. Parameters such as stability and ROM can be quantitatively assessed and documented and directly related to postoperative clinical performance. The combination of these techniques allows comparative, quantifiable intraoperative evaluation of design features to identify relationships to kinematic performance of the implant.

140. Anatomic Landmarks Do Not Accurately Predict the Kinematic Flexion Axis (KFA) of the Knee

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Placing the femoral component of a TKA so that the flexion axis (FA) of the replaced joint matches the normal should lead to ligament isometry and a balanced joint. The relationship of the FA to anatomic landmarks is not completely understood. The helical axis is a kinematic parameter that represents the flexion axis of the knee combined with internal and external rotation. We report results from this and previous studies to define the kinematic flexion axis with internal and external rotations eliminated (KFA). This study compares the correlation between the KFA and commonly used anatomic axes.

Six cadaver lower extremities were skeletonized except for the knee joint. Passive navigation markers were placed, and CT scans obtained. The limbs were placed in an open-chain lower extremity rig that allows full range of knee motion. 3-D data were recorded and the helical axis of motion was calculated. Anatomic landmarks on CT derived CAD models of the extremities defined spherical (SA) and cylindrical fits (CA) of the femoral condyles and a trans-epicondylar axis (TEA). Helical axis data for the normal knees were compared to the SA, CA, and TEA over varying ranges of flexion.

The least variation in the helical axis occurred at 40-50° of flexion (2.89 ± 0.722) confirming previous work that showed flexion motion with internal and external rotation minimized in this range. The helical axis in this range was defined as the KFA. The anatomic axes defined by the TEA, CA, and SA differed significantly from the KFA (3.127 ± 2.029° p=0.013, 5.111 ± 1.710° p=0.002, 5.115 ± 2.129° p=0.001).

The TEA, SA, and CA are not a consistently valid approximation of the KFA of the knee as defined in this study. The TEA represents the closest approximation of the three with a 95% CI between 0.998 and 5.256°. If a total knee joint prosthesis is to be placed so that the KFA of the replaced knee matches that of the normal, reliance cannot be placed on the commonly used anatomic landmarks evaluated in this study.

141. The Applicability of Utilizing an Intraoperative Navigation System to Help Select Ideal Femoral Component Size in TKA

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INTRODUCTION: An intraoperative navigation system can be used to help guide implant selection during a total knee arthroplasty (TKA). The purpose of the present study was to compare both predicted and actual femoral component selection in TKA, as well as examine the relationship between pre- and postoperative outcome measures and degree of deviation from navigation-generated predicted implant selection.

METHODS: Sixty-six consecutive computer-assisted TKAs were performed on 48 patients. Thirty patients underwent unilateral, and 18 patients underwent bilateral TKA. Each TKA was stratified based on the degree of deviation between navigation-generated predicted and actual intraoperative femoral component selection. The degree of deviation was examined in relation to clinical and functional outcome measures preoperatively and two to four years postoperatively. Statistical analysis was performed using a Kruskal Wallis H Test.

RESULTS: There was a weak correlation between the computer predicted femoral component size and the actual implant size used (Pearson Correlation = .392). There was no statistically significant association between Knee Society Knee score or Function score and degree of deviation between predicted and actual femoral implant selection (preoperative Knee score p value = 0.599, preoperative Function score p value = 0.584, two to four year Knee score p value = 0.901, two to four year Function score p value = 0.404).

CONCLUSION: There is no difference in clinical and functional outcomes at two to four years postoperative when actual femoral component selection differs from that predicted with a navigation system. The weak correlation between computer predicted femoral component and actual femoral component suggests that an intraoperative navigation system may be limited in its ability to accurately predict ideal femoral component selection in patients.

142. Image Guided Custom Cutting Blocks for the Triathalon Knee: Preliminary Results of 65 Consecutive Patients

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The surgical technique for knee arthroplasty (TKA) is not universally accepted. Variables include surgical approach, extent of incisions, computer navigation, component alignment, and patella resurfacing, along with variations in implant design. Component positioning along the biomechanical axis does not reliably translate to predictably good clinical outcomes. Sixty-five consecutive patients treated with the use of image-guided technology and the Triatholon total knee were included in this prospective study. The inclusion criterion was the presence of primary arthritis that were able to have an MRI study performed. No adverse events occurred with the custom-fit technique. None of the patients had evidence of a pulmonary embolus, and four patients required a knee manipulation under general anesthesia for stiffness. Three of four of these patients obtained full range of motion following the manipulation procedure. No femoral cuts had to be redone; however, 11 tibial cuts had to be redone to remove an additional 2 mm of the tibia, and an additional four tibias were recut because of excessive varus noted intraoperatively. Image guided component placement in conjunction with removal of osteophytes and preservation of ligaments appeared to result in rapidly return to function, restored motion, and stability. At six months postoperative, the combined Knee Society score was 168+/-22 (range 130-200), the active range of motion average was 119 (88-135), and the operative time averaged 42 minutes from skin incision to dressing application. Compared to a historical cohort using the Triatholon knee system without custom cutting blocks by the same surgeon, only operative time reached statistical significance. Earlier return to activities and superior knee society scores were noted at six weeks postoperative in the study group compared to historical control, but this statistical significance was lost by six months. Image guided cutting blocks appear to reduce surgical time, accurately guide component size, and potentially reduce embolic events, associated with intramedullary instrumentation. Long-term studies are needed to determine this technology's impact on implant survival.

143. Effects of Tibial Insert Slope on Polyethylene Wear

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INTRODUCTION: One proposal for achieving well-balanced posterior cruciate ligaments (PCL) is a tibial insert with choices in posterior slope in addition to size and thickness. However, slope variation, defined by the angle between the distal and proximal faces of the insert, redistributes ultra-high molecular weight polyethylene (UHMWPE) insert thickness in the sagittal plane, which may affect wear performance. This study evaluated effects of insert slope on UHMWPE wear using an in-vitro wear test to compare a standard cruciate-retaining (CR) tibial insert (STD) with a corresponding 6° sloped version (SLP). The hypothesis was slope variation has little effect on wear.

METHODS: Two specimens for each insert design were tested on an Instron-Stanmore knee simulator. The gait cycle, terms, and definitions given in ISO 14243-3 were simulated with the exception of the reference position, which was shifted posteriorly by 6 mm to simulate a worst-case scenario. The STD insert was posteriorly tilted by 6° more than the SLP insert to level the articular surfaces. The wear was measured gravimetrically at many intervals according to a strict protocol.

RESULTS: No statistical difference ($p=0.36$) was found between wear rates for the STD (9.5 ±1.8 mg/Mc) and SLP (11.4 ±0.5 mg/Mc) inserts.

DISCUSSION: The overall wear rate measured by the experimental wear test was much higher than previously published rates using implants similar to the STD inserts. One of the reasons was the test set-up. The posteriorly shifted reference position and presence of a 6° tibial slope increased shear loading on the specimens.

To the knowledge of the authors, this is the first time that the effect of tibial insert slope on wear was evaluated. When limited to 6°, wear test indicates tibial insert slope has a minor effect on wear and stress.

144. Improving Predictability in Cruciate Retaining Total Knee Arthroplasty

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INTRODUCTION: An intact posterior cruciate ligament (PCL) is required for optimal cruciate-retaining total knee arthroplasty. However, the PCL can be compromised during tibial resection or surgical interventions to optimize flexion. A method using posteriorly sloped tibial inserts to optimize ligament tension and range of motion without PCL compromise was developed, and this study assesses its effects on intraoperative passive flexion.

METHODS: An IRB-approved, prospective, non-randomized, multi-center clinical study beginning April 2008 consecutively enrolled 30 subjects at least 21 years old undergoing primary TKA with an intact PCL and modest joint deformities. Subjects were preoperatively and intraoperatively evaluated. Passive flexion was measured by goniometer using tibial insert trials with 0, 3°, and 6° posterior slopes and thicknesses ranging from 9 mm to 13 mm.

RESULTS: Average intraoperative flexions for the 0, 3°, and, 6° insert trials were 114°, 119°, and 123° respectively, producing an average 5° difference between the 0 and 3°, and 9° between the 0 and 6°, both statistically significant ($p=0.018$ and $p=0.001$). The 3° final insert was implanted in 21 subjects and the 6° in 9.

CONCLUSION: Tibial insert trials with varying slopes can be intraoperatively used to evaluate flexion and stability after initial conservative proximal tibia resection. Additional surgical intervention that could potentially compromise the PCL was avoided in this series, and final implant selection was based solely on optimum motion and stability. The results demonstrate sloped tibial inserts can facilitate PCL preservation and optimal flexion in cruciate-retaining total knee arthroplasty.

145. Factors Affecting Returning to Work Following Primary Total Knee Replacement

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INTRODUCTION: Nearly half of the nation's expenditures on arthritis come from indirect costs such as lost wages. This study aims to identify to what types of jobs patients are able to return following a total knee replacement (TKR), how long patients can anticipate being off work following a TKR, and what factors are important in speeding their return to work.

METHODS: A prospective cohort study was performed in which patients scheduled for a primary TKR (n=165) were given a questionnaire at their visits preoperatively and through six months postoperatively. The questionnaire assessed the physical demands of their job, their physical status, their motivation to return to work, and potential confounders that may facilitate or hinder their return to work. A Cox-proportional hazards model was constructed evaluating the effects of each independent variable on the outcome and time to return to work.

RESULTS: Self-motivation to return to work was the most significant predictor of returning to work. Self-employed patients returned to work at 186.2% the rate of others. Other factors associated with a faster return to work included: BMI, Mental Composite Summary Score, and a handicap-accessible workplace. Factors associated with a slower return to work included: receiving worker's compensation and the importance of working to the patient's family.

CONCLUSIONS: Patients can return to work at even the most physically demanding jobs post-TKR. The patient's motivation to return to work is the single strongest predictor of the amount of time a patient will have to take off prior to returning to work following a TKR.

146. Revision Total Knee Arthroplasty for Stiffness

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OBJECTIVE: Few studies have evaluated the results of revision of well-fixed components for stiffness. We hypothesize that tibial and femoral component revision will lead to significant improvements in range of motion (ROM) by optimizing component size, rotation, and ligament balance while facilitating a complete intra-articular synovectomy and posterior capsular release.

METHODS: We identified 35 consecutive patients who underwent revision of both femoral and tibial components for stiffness. Two patients died prior to the two-year minimum follow-up, and two patients were lost to follow-up leaving 31 TKA.

RESULTS: At a mean of 53.8 months (range 25 to 128), the mean arc of motion improved 44.6° (range, -10° to 105°) from a preoperative mean of 52.1° (range, 10° to 90°) to a postoperative mean of 96.4° (range, 50° to 130°) ($p<0.0001$). The arc of motion improved by >30° in 74% (23/31) of patients. The mean Knee Society knee score improved from 32.2 points to 60.6 points ($p<0.0001$). Fourteen patients required 26 reoperations including 11 manipulations. Complications included (3) deep infections, (3) extensor mechanism disruptions, (1) transient foot drop, and (1) periprosthetic fracture. Regression analysis found no relationship between age, gender, BMI, use of a tunneled epidural, time to revision, the Insall-Salvati ratio, change in joint line, or whether a previous revision had been attempted and improvement of >30°.

CONCLUSIONS: These results suggest that two-component revision for the stiff TKA can be performed with a reasonable expectation of improvement in ROM although the risk of complications and additional operative procedures is substantial.

147. Articulating Antibiotic Spacers in the Treatment of Total Knee Arthroplasty

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Chronic infections in total knee arthroplasty have been successfully managed with the use of a two-stage protocol incorporating a temporary antibiotic loaded cement spacer. The use of a static versus an articulating spacer is controversial. The goal of this report is to detail our experience with an articulating, all cement spacer fashioned intraoperatively using silicone molds.

Eighty-two patients from four institutions were retrospectively reviewed at a minimum of 24 months following re-implantation (range, 25 to 35 months). The same spacer was used in all cases; however, the amount of antibiotics added to the cement was variable based on surgeon preference. All patients were allowed range of motion during spacer treatment.

There were two complications related to the spacer: one dislocation and one spacer breakage. Six patients required a second debridement/spacer prior to re-implantation. There was no bone loss associated with the spacer. At the time of re-implantation, an extensile approach was not required in any patient. There were eight recurrent infections (9.8%). Mean pre-spacer range of motion improved from 78° (0-125°) to 96° (0 125°, $p < 0.05$). The mean Knee Society score improved from 53.2 (26-97) to 79.9 (51-100, $p < 0.01$).

The articulating antibiotic loaded cement spacer utilized in this study was associated with a reasonable rate of infection eradication. Bone loss from the spacer was not identified, and there were no complications related to the cement on cement articulation. Exposure at the time of re-implantation was straightforward without the need for extensile approaches.

148. The Use of Extended Extensor Mechanism Allograft in Revision TKA with Significant Tibial Bone Loss

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In patients with significant bone loss and a nonfunctioning extensor mechanism, the approach to revision is complicated. We describe a unique approach to solve this complex problem to help restore clinically satisfactory results. Our technique involves the use of a donor allograft that consists of proximal tibia along with the attached extensor mechanism (patellar tendon-patella-quadriceps tendon).

Five reconstructions utilizing bone allografts and extensor mechanisms were performed by two surgeons. Each has extensive surgical history on the affected knee and presented with gross instability, considerable bone loss, and significant extensor lag or total loss of extension. The implants used were press-fit stems with the tibial base plate cemented into the allograft prior to implantation. In this series, either hinged or total stabilized prostheses were used.

The follow-up ranged from one to five years. The only complication to date was reported in one patient who required irrigation and debridement with surgical wound closure after partial dehiscence. However, the patency of the allograft was not disrupted. All prostheses have been noted to be stable with no signs of loosening.

This procedure presented should be considered a salvage procedure for bone stock and extensor mechanism deficiency in revision total knee arthroplasty. The advantage to our allograft is the inherent stability of the proximal tibia with the tibial tubercle and associated extensor mechanism. For patients with this complex deficiency, there has been no effective method of treatment, and we advocate the use of this procedure to restore function and relieve pain to an otherwise grossly unstable and functionally limited joint.

149. Early TKR Revision for Tibial Component Debonding

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We retrospectively reviewed a series of 17 early TKR failures of a single design which required revision for aseptic loosening due to tibial debonding. This previously unreported failure mode was a consistent finding in all cases. Preoperative imaging was not uniformly diagnostic, and surgeons evaluating patients with this implant should have a heightened index of suspicion for loosening when patients present with persistent pain and effusion. While early mechanical failure is otherwise rare in TKR, design features of this particular implant may contribute to tibial debonding and predispose patients to early revision.

MAOA BREAKOUT SESSION #12
HIP
April 24, 2010

150. The Expected Value of Hip Resurfacing Arthroplasty versus Total Hip Arthroplasty for Patients 50 Years of Age with Osteoarthritis of the Hip

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BACKGROUND: Hip resurfacing is gaining in popularity among young patients with hip osteoarthritis. It is unknown whether hip resurfacing offers improved quality of life when compared to conventional total hip arthroplasty.

HYPOTHESIS: Hip resurfacing and total hip arthroplasty provide equivalent expected gains in quality of life for patients 50 years of age.

METHODS: A Markhov decision model was constructed to compare the quality of life of young patients considering hip resurfacing or total hip arthroplasty. Outcome probabilities were taken directly from the literature and large joint registries. Accumulated quality adjusted life years (QUALYs) were calculated for each treatment option.

RESULTS: The Markov model demonstrated that the average number of quality-adjusted life-years (QUALYs) obtained by a patient in the resurfacing arm is 14.86, compared with 13.31 for a patient in the total hip arthroplasty arm. Additionally, hip resurfacing results in the greatest QUALYS compared to total hip arthroplasty throughout a range of plausible utilities and rates of complications. The model favors hip resurfacing over total hip arthroplasty using the base cases analysis.

CONCLUSIONS: Hip resurfacing appears to result in improved quality of life for young patients considering surgical treatment of hip osteoarthritis when compared to total hip arthroplasty.

151. Femoral Head Resurfacing in Patients Under 30 Years of Age

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Isolated involvement of the femoral head remains a challenging problem in young patients with disabling hip pain. The etiology of femoral head abnormality is most commonly from avascular necrosis, dysplasia, or trauma. With extensive involvement of the articular surface, surgical options include total joint replacement, hip resurfacing and to a lesser extent, osteotomy.

Between October 2002 and October 2007, 14 femoral head resurfacing procedures in 13 patients were performed by a single orthopedic surgeon. Of the 13 patients, 10 had AVN, 2 femoral head fractures, and 2 dysplasia. The etiology of the AVN was chemotherapy (3), radiation (2), steroids (3), and idiopathic (2). The age of the patients ranged from 16-28 years (mean 24.2). The Conserve hip was used in all cases. The decision to resurface the acetabulum was assessed at the time of surgery. Only those patients with normal articular acetabular cartilage were left unresurfaced and included in the study group.

Data was collected retrospectively to assess patient satisfaction, functional outcome, and complications. Patients with a minimum of one-year follow-up (range 1-6 years; mean 3.4 years) were included. Three of 14 patients were converted to a total hip. One patient was converted to a total hip 12 months after surgery for a femoral neck fracture, one had recurrence of pain 14 months after surgery, and one had persistent pain after a motor vehicle accident. No radiographic loosening was noted in any of the 14 patients at last follow-up. Excellent functional outcome was reported in 13 of 14 hips. Femoral head resurfacing is a bone preserving approach that optimizes stability and range of motion with a large femoral head without the risk of metal or polyethylene wear. This surgical option appears to result in an excellent functional outcome in young adults with isolated femoral head compromise.

152. Femoral Head Viability After Total Hip Resurfacing: Comparison Using ^{18}F PET Scan

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INTRODUCTION: It is recognized that the blood supply to the femoral head can be damaged during a posterior surgical approach for hip resurfacing. It is, however, the most commonly used approach, and there has been no proven deleterious effect on femoral head viability and long-term outcome of the operation. The purpose of this study was to evaluate femoral head viability using ^{18}F-fluoride PET scanning in patients who had undergone total hip resurfacing through a modified posterolateral approach versus a transtrochanteric approach.

MATERIALS AND METHODS: Six patients who had undergone total hip resurfacing through either a transtrochanteric or modified posterolateral approach were included in the study. All patients were at least two years from the operation. These patients had no history of previous surgery or trauma to the opposite hip. Patients underwent PET scanning with ^{18}F-fluoride. Radiotracer production, scanning methodology, and data analysis was conducted per standard protocols.

RESULTS: The influx constant of fluoride derived from the 60-minute dynamic image (KI) and simple measure of uptake from a five-minute image from the operated hip (SUV) was comparable to the opposite normal hip in all patients independent of approach. The KI and SUV ratio for each patient, (difference between the KI or SUV from the hip with the implant divided by the KI or SUV for the contralateral hip) greater than 1.5 for all patients except one in which the ratios were close to unity.

CONCLUSIONS: All patients either performed through the transtrochanteric approach or modified posterolateral approach showed uniform uptake underneath the resurfacing cap which was higher than the opposite hip. There was no difference in radiotracer uptake between patients that had undergone hip resurfacing through a transtrochanteric or a modified posterolateral approach as all femoral heads showed viability below the resurfacing implant at two years from surgery.

153. Serum Cobalt and Chromium Levels in Patients with a Metal-on-Metal Resurfacing Hip Prosthesis

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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 have been collected as part of a specific subset study of the multicenter Cormet Hip Resurfacing IDE. Data on patients a minimum five years postoperative have been analyzed. Trace metal analysis (SGAB Analytica, Lulea, Sweden) of whole blood Co and Cr levels were determined using high-resolution inductively coupled plasma mass spectrometry.

RESULTS: Seventy-eight patients (84 hips) have been studied to date. Fifty-three (53) males/ 25 females, mean age 53 years (range: 33-72) at the time of surgery, had an average weight of 190 lbs. Femoral head sizes used ranged from 40-56 mm. For unilateral subjects (n=72), mean whole blood Co concentrations were 2.62 microg/L (range, 0.4-14.8) and mean Cr concentrations were 2.28 microg/L (0.51-8.98). When separated by femoral head size, Cr concentrations were significantly different ($p=0.039$) with mean concentrations higher for smaller head sizes. Co and Cr concentrations in bilateral subjects were higher when compared to unilateral subjects ($p<0.01$). In 22 male subjects with larger implants (52/56 mm), mean concentrations for Co were 1.93 microg/L and for Cr 1.384 microg/L.

CONCLUSION: Increased levels of cobalt and chromium have been observed in patients with MOM implants. 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 for at least five years.

154. The Prevalence of Groin Pain After Total Hip Arthroplasty and Total Hip Resurfacing

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BACKGROUND: Groin pain after total hip arthroplasty (THA) or total hip resurfacing arthroplasty can be troubling for patients and surgeons. Potential sources of pain include infection, loosening, metal hypersensitivity, or impingement of bony structures or the iliopsoas tendon.

QUESTIONS/PURPOSES: We compared the rate of groin pain after THA or hip resurfacing using metal on metal to those of other bearing surfaces.

METHODS: We identified 347 (334 patients) primary total hip (n=301) or resurfacing (n=46) arthroplasties. Complete preoperative, operative, and postoperative data were available for 282 hips. We retrospectively reviewed the charts for the presence or absence of groin pain at a minimum of one year after surgery with a specific focus on etiologic factors. The minimum follow-up was 12 months (mean, 14 months; range 12 to 24 months).

RESULTS: The rate of groin pain was 7% (15 of 217 patients) after THA with conventional bearing surfaces, 15% (4 of 26 patients) with metal on metal THA, and 18% (7of 39 patients) with total hip resurfacing. Younger patients were more likely to report groin pain postoperatively and more likely to have metal-on-metal bearing surfaces.

CONCLUSIONS: Our data at short-term follow-up suggest increased rates of groin pain after metal-on-metal THA or resurfacing arthroplasty versus THA using polyethylene or ceramic bearing surfaces. The reasons are not clear, but they appear to be associated with younger age. Potential factors include impingement, activity level, and possibly higher expectations for patients receiving metal on metal bearing surfaces which may make those patients more likely to report postoperative pain.

155. Aspirin Decreases the Incidence and Severity of Heterotopic Ossification After Hip Resurfacing

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The purpose of this study was to determine the incidence of HO following hip resurfacing (SRA), and to determine if aspirin effectively decreases the incidence and severity of heterotopic ossification (HO).

We retrospectively evaluated radiographs of three consecutive cohorts of patients: SRA with aspirin (176 hips), SRA with Coumadin (60 hips), and a control group of THA with Coumadin (240 hips). All patients satisfied the same selection criteria: male <65 and female <55 years old; diagnosis: osteoarthritis; BMI <35; no previous hip surgery; surgical approach: posterolateral.

SRA patients with aspirin had HO detected in 3 of 128 hips (2.3%; two Brooker grade I; one grade II; no patients had grade III/IV) at one-year follow-up. SRA patients with Coumadin had HO detected in 5 of 34 hips (14.7%; one Brooker grade I, and four grade III) at one-year follow-up. All eight HO patients in both SRA groups were male. HO incidence and severity was statistically different between SRA with aspirin and SRA with Coumadin ($p<0.01$). THA patients with Coumadin had HO detected in 5 of 134 hips (3.7%; three Brooker grade I; two grade II) at one-year follow-up (3 male and 2 female). HO incidence and severity was statistically different between SRA and THA with Coumadin ($p<0.05$).

Hip resurfacing has an increased incidence and severity of HO compared with THA, especially in male patients. Aspirin can effectively decrease the HO incidence and severity after hip resurfacing to a level comparable with THA.

156. In Vitro Analysis of Retrieved Ceramic Implants for Squeaking

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INTRODUCTION: "Squeaking noise" with alumina ceramic on ceramic (COC) bearing surface is a complication which sometimes leads to revision. The precise etiology of this phenomenon remains elusive. The aim of the study was to analyze retrieved implants, try to reproduce squeaking in vitro, and compare those implants with implants only used for biomechanical testing.

MATERIAL AND METHOD: Nine retrieved ceramic implants that were reviewed for squeaking were analyzed. Macroscopic damages were noticed and microscopic roughness was analyzed with a surface profiler. The retrieved implants were then tested on a hip simulator reproducing flexion/extension motions in several situations in lubricated and non-lubricated conditions in order to reproduce squeaking. Tests were performed up to 15,000 cycles.

RESULTS: Impingement damage was visible on seven implants. All the retrieved heads had metal transfer. Eight implants had visible stripe wear. Microscopic analysis showed roughness higher than 6 microns on the retrieved heads. Squeaking was reproduced in dry conditions. In lubricated conditions, squeaking didn't occur after more than 15,000 cycles for the retrieved hips.

DISCUSSION/CONCLUSION: All squeaking retrieved hips had evidence of metal transfer. Seven of nine had gross evidence of impingement. Eight of nine had stripe wear. This retrieval analysis suggests that metal transfer $\pm$ stripe wear is a common theme in COC bearings that squeak.

157. Reliability and Variation of Acetabular Component Measurements Using Cross-Table Lateral Radiographs

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The purpose of this study was to quantitatively evaluate the reliability and variation of acetabular component version measured on cross-table lateral (CTL) radiographs compared with pelvic CT.

We reviewed 98 THA patients (119 hips) with serial CTL radiographs and a postoperative CT scan. Average age at surgery was 49.8 ± 11.6 years and average BMI was 28.9 ± 6.6. Acetabular component version was measured on serial CTL radiographs using six-week and annual follow-up films. Acetabular version was measured on pelvic CT using standard 2D-CT measurement methods.

Anteversion measurements on CTL radiographs had a mean of 26.1 ± 9.5° (range: -2 to 48.3°) compared to anteversion measurements on CT with a mean of 28.8 ± 11.8° (range: -7 to 54°). These differences were statistically significant ($p<0.0001$). These deviations were not influenced by gender ($p=0.68$) or BMI ($p=0.78$). The variation of anteversion measurements on serial CTL radiographs for each patient had a mean of 6.1 ± 3.8°, including variation ≥5° in 75 of 119 hips (63%), and ≥10° in 24 of 119 hips (20.2%) (range: 0-18.3°). There were no statistical differences in variation of anteversion measurements related to BMI <25, BMI 25-35, and BMI >35 patients ($p=0.32$).

Acetabular component version measured on serial CTL radiographs has significant variation, which might be related to pelvic tilt and contralateral hip and knee flexion contractions, and should be considered in clinical practice and research.

158. Metaphyseal Engaging Short Stem Femoral Implants: A Minimum Two-Year Follow-Up

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INTRODUCTION: Despite the clinical success of uncemented femoral stems of various types, current issues continue to require repeated examination: (1) proximal-distal mismatch, (2) optimization of load transfer and preservation of femoral bone, and (3) facilitation of MIS (minimally-invasive surgery) exposures, particularly an anterior approach. A previous study demonstrated that a custom-made (based on CT scan) short metaphyseal engaging femoral stem design provided stable fixation and reliable bony ingrowth at four-year follow-up. The purpose of this study is to present the minimum two-year clinical and radiographic results obtained with an off-the-shelf metaphyseal filling short stem.

METHODS: A prospective clinical and radiographic evaluation of 134 hips in 123 consecutive patients treated with an uncemented metaphyseal engaging short (91-105 mm) stem was performed. Average age was 70 years (range 29-85), and the average BMI was 27 (range 19-42) in this cohort. The implant was made of titanium alloy with a hydroxyapatite coating on a titanium plasma-spray in the proximal third of the stem.

RESULTS: The average Harris hip score (HHS) was 52 (range 10-80) preoperatively and 92 (range 70-100) postoperatively, and no patients experienced thigh pain. Preoperative WOMAC scores averaged 50, compared to a postoperative average of 5. There were no postoperative fractures, no radiographic evidence of subsidence, and all stems were radiographically stable on most recent radiographs. The typical pattern of bony ingrowth was that of bone bridging and endosteal condensation at the proximal portion of the stem.

CONCLUSIONS: This study demonstrated that the use of an off-the-shelf short femoral stem designed to fit and fill the metaphysis provides reliable clinical and radiographic results at a minimum two-year (average 33 months) follow-up. Short stems may be particularly helpful to surgeons performing total hip arthroplasty using a MIS anterior approach.

159. The Use of Foam Metal Coated Acetabular Cups in the Management of Post-Traumatic Arthritis

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Post-traumatic arthropathy remains a complex problem following the acute treatment of acetabular fractures. Leg length discrepancy, significant bone periarticular bone loss, and substantial soft tissue injury are common associated problems. This study evaluates the use of foam metal backed components in the reconstruction of patients who had undergone previous open reduction and internal fixation of acetabular fractures. Between January 2004 and January 2007, 41 patients treated for post-traumatic osteoarthritis with a minimum of two years follow-up were included. The patients were reconstructed using a combination of trabecular metal augments and titanium foam acetabular cups. A review of medical records, patient interviews, and imaging studies were performed. Functional outcome, radiographic assessment, and complications were recorded. Functional results were excellent in 37 patients, good in 3 patients, and fair in 1 patient. One patient was treated for a deep infection. The components were retained in this patient, and he was successfully treated with IV antibiotics and surgical debridement. Two of 41 exhibited a Trendelenburg gait. Thirty-six of 41 patients were ambulating without assistive devices at two years follow-up. Two patients were using a walker and three were using canes. Leg lengths were corrected using a modular femoral component. The leg length correction ranged from 2-5 cm (average 3.1 cm). Radiographically, two patients showed evidence of acetabular cup loosening. Both of these patients were revised using an antiprotusio cage. Thirty-nine of 41 hips were radiographically stable at two-year follow-up, and 22 of 22 hips with four-year follow-up were radiographically stable. Post-traumatic arthropathy remains a challenging surgical problem. Leg length discrepancies, soft tissue contracture, and bone loss must be carefully considered. Foam metal backed acetabular implants appear to enhance initial stability and durable bone ingrowth. This technology has become the option of choice at our institution for acetabular bone compromise due to trauma, radiation, or tumor.

160. The Accuracy and Reliability of Shenton's Line in Diagnosing Development Dysplasia of the Hip in the Skeletally Mature Patient

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INTRODUCTION: Undetected developmental dysplasia of the hip (DDH) can progress to hip instability which can be an etiologic factor in the development of early osteoarthritis. The purpose of this study was to determine the inter- and intra-observer reliability of detecting a break in Shenton's line and the ability to accurately diagnose acetabular dysplasia in the skeletally mature patient.

METHODS: Standardized anteroposterior (AP) pelvic radiographs were obtained from pre-operative patients with a diagnosis of DDH prior to pelvic osteotomy (64 hips, 32 left, and 32 right) and from patients without radiographic indices of acetabular dysplasia (64 hips, 32 left, 32 right) for a total of 128 hips. The pelvic radiographs were cropped to only display the elements of Shenton's line (superior border of the obturator foramen and the inferior border of the femoral neck). Each reviewer was asked to determine if Shenton's line was broken (superior subluxation of the femoral head of any magnitude) or intact. Four orthopedic surgeons reviewed the films initially (inter-observer reliability), two of which reviewed the randomized films again after four weeks (intra-observer reliability).

RESULTS: The inter-observer reliability for all possible pairs was excellent (kappa = 0.9692, 0.9232, and 0.8925) in three pairs of reviewers and good (kappa = 0.6071, 0.6071, and 0.5798) in the remaining three pairs. The intra-observer reliability was excellent (kappa = 0.9234 and 0.8913). The use of Shenton's line produced a sensitivity of 84.38%, specificity of 98.44%, positive predictive value of 98.18%, and negative predictive value of 86.30% in the ability to diagnose acetabular dysplasia in the skeletally mature patient.

CONCLUSION: Shenton's line is a convenient radiographic sign which can accurately and reliably diagnose subluxation of the femoral head caused by developmental dysplasia of the hip on standard pelvic radiographs.

161. Does the Periacetabular Osteotomy Correct Hip Joint Pathomechanics?

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INTRODUCTION: The periacetabular osteotomy (PAO) is an effective technique for deformity correction and clinical improvement in patients with acetabular dysplasia. There is limited data regarding the specific biomechanical consequences of deformity correction and the optimal acetabular reduction position. The purpose of this study was to quantify postoperative structural changes and their impact on the biomechanical environment of the hip following PAO.

METHODS: We reviewed 58 consecutive patients (62 hips) treated with a PAO for symptomatic acetabular dysplasia. Digital AP pelvis radiographs were analyzed using custom software to quantify the lever-arm ratios (LAR), joint force multiplier (JFM), acetabular angle of Sharp (AAS), and joint reaction force (JRF – JFM * 5/6 body weight). A subgroup of 20 hips had magnification markers, and femoral head contact area was calculated based on head size and acetabular coverage. Mean stress was calculated as JRF/head contact area.

RESULTS: Average patient age was 30.1 years. Forty-three were female and 15 male. The mean preoperative body weight was 151.6 pounds. After PAO, the AAS improved from 46° to 31°, LAR from 2.41 to 2.13, JFM from 2.76 to 2.55, JRF from 419.9 to 387.5 lbs., and contact stress from 0.718 MPa to 0.591 MPa. All of these parameters were significantly improved ($p<0.0001$).

CONCLUSION: PAO deformity correction is associated with a markedly improved biomechanical environment of the hip. These data support the PAO as an effective technique to improve hip pathomechanics and potentially preserve the joint. Correlation with clinical results and survivorship may facilitate determination of optimal acetabular reduction characteristics.

162. Early Complications Associated with the Periacetabular Osteotomy: A Prospective Multicenter Study

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INTRODUCTION: The periacetabular osteotomy (PAO) is a common osteotomy for the treatment of acetabular dysplasia. Associated complications are known to be problematic during a surgeon's learning curve experience, yet the complication risk of experienced surgeons is not known. We performed a prospective, multicenter study with experienced surgeons to determine the "non-learning curve" risk of perioperative complications associated with the PAO.

METHODS: We analyzed perioperative complications in 118 consecutive PAOs treated at six institutions over 21 months. All procedures were performed by experienced osteotomy surgeons. All perioperative (1-12 months) complications were recorded in a standardized fashion. The mean age was 26.4 years. There were 80 females and 38 males.

RESULTS: Major complications occurred in 5 (4.2%) of the 118 cases and included three transient nerve palsies, one deep infection, and one arrhythmia. These patients all recovered without a persistent problem. Moderate complications occurred in three (2.5%) cases and included a symptomatic delayed union of the pubis, a wound hematoma, and a superficial infection. There were 5 (4.2%) minor complications. There were three reoperations: one peroneal nerve release, one hip arthroscopy, and one wound debridement. Fifty-one (43%) patients had some dysfunction of the lateral femoral cutaneous nerve which was not considered a notable complication.

CONCLUSION: The risk of complications associated with the PAO persists beyond the initial surgeon learning curve, yet is acceptable. These data are important in counseling patients regarding surgical risk and expectations. All major complications resolved without a permanent impact on the clinical result.

MAOA BREAKOUT SESSION #13
ELBOW/HAND
April 24, 2010

163. Comparison of Operative versus Nonoperative Treatment of Distal Humeral Diaphyseal Fractures

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INTRODUCTION: Distal humeral diaphyseal fractures are problematic to treat nonoperatively secondary to long immobilization and skin irritation while operative treatment involves the radial nerve and short segment fixation.

METHODS: A retrospective case-control analysis was undertaken on patients diagnosed with distal humeral diaphyseal fractures from 2002-2007 at a Level I teaching trauma center. Treatment was based upon surgeon determination. Nonoperative (NO) treatment consisted of biweekly long-arm cast changes until change to functional bracing. Operative treatment (ORIF) was posterior triceps splitting or posterior lateral intermuscular septum approaches with posterior plate fixation.

RESULTS: Of 76 fractures, 21 (28%) were treated NO while 40 (72%) were treated ORIF. The NO group was comprised of more females (16) than males (5) while the ORIF group had more even distribution (21 females, 19 males). The NO group was older (72 years) than the ORIF group (48 years). None of the NO fractures were open, while 12 of the ORIF fractures were open. In the NO group, two failed conservative treatment and were converted to ORIF, two developed adhesive capsulitis, and final elbow ROM was 15-119°. The ORIF group had one nonunion, one transient radial nerve palsy, and average final elbow ROM was 6-131°. None of the plates required removal for prominence. No infections were noted. None of the anatomically reduced fractures lost fixation or alignment.

CONCLUSION: Operative fixation of distal humeral diaphyseal fractures creates stable fixation, predictable alignment, improved ROM, and quicker return to function with minimal complications compared to operative treatment.

164. Outcomes Following Distal Humeral Fracture Fixation with an Extensor Mechanism-On Approach

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Despite potential for morbidity, distal humerus fractures have traditionally been managed via extensor mechanism-disrupting approaches with a 100° motion arc considered a reasonable outcome. We hypothesized that an extensor mechanism-on approach for distal humerus fractures with parallel or orthogonal plate constructs would allow predictable healing, an arc exceeding 100°, and maintenance of extension strength.

ORIF was performed with either orthogonal or parallel plate constructs in 35 elbows via an extensor mechanism-on approach. Twenty-four were in patients available for evaluation at a minimum of one year postoperative. Eight were type A, 1 was type B, and 15 were type C fractures; 5 were open. Radiographs as well as Mayo, DASH, and SF-36 scores were obtained. Extension strength was assessed with a dynamometer.

All fractures healed primarily. Three elbows underwent releases for stiffness; pre-release motion was used for analysis. Average total motion arc was 110°. Mean Mayo elbow score was 92 and mean Dash index was 13.0, indicating excellent scores with mild impairment. Mean triceps strength loss was 12% compared to respective contralateral elbows. Plate orientation (orthogonal vs. parallel) did not affect total motion arc.

Open treatment of distal humerus fractures with a triceps-on approach is challenging but imparted predictable healing, a mean 110° total arc of motion, and maintenance of elbow extension strength.

165. Retrospective Review of Incidence and Risk Factors for Heterotopic Ossification Following Elbow Trauma

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Fractures of the distal humerus comprise 2% of all fractures and 30% of humeral fractures in adults. It is generally accepted that open reduction internal fixation (ORIF) of these fractures results in the best possible clinical outcomes. However, heterotopic ossification (HO) is a postoperative complication with a reported incidence between 14-49% in distal humerus fractures. To date there have been few investigations into those factors which correlate with postoperative heterotopic ossification formation in the elbow region. We sought to determine the incidence of HO formation after surgical fixation of distal humerus fractures and identify the risk factors that predispose patients to HO formation. A retrospective review of the medical records of 37 adult patients who underwent ORIF of distal humerus fractures at our institution was conducted. Exclusion criteria included those patients less than 18 years of age, pathologic fracture, and less than 90 days of follow-up. Fifteen females (41%) and 22 males (59%) were included in the study. The most common mechanisms of injury were a fall from less than eight feet (15/41%), motor vehicle accident (13/34%), and gunshot wound (4/11%). Five patients (13%) had concurrent head trauma and 21 fractures (55%) were open. One of six fellowship trained orthopedic traumatologists at our institution performed ORIF through a posterior approach in all patients and olecranon osteotomies were utilized in 33 (87%) patients. At an average radiographic follow-up of 13 months, heterotopic ossification was identified in 18 (47%) patients. Subgroup analysis revealed significantly higher incidences of HO formation in both the open fracture group (P=.038) and the head injured group (P=.05). Our results demonstrate a high rate of HO formation in operatively treated distal humerus fractures, particularly among open fractures and in those patients with associated head injuries. There may be a role for routine HO prophylaxis after ORIF of distal humerus fractures in adults, though prospective studies have yet to be performed that adequately address whether prophylaxis is beneficial in reducing the rate of HO formation about the elbow.

166. Magnetic Resonance Imaging After Arthroscopic Microfracture of Capitellar Osteochondritis Dissecans

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INTRODUCTION: OCD of the capitellum affects young athletes involved in elbow bearing activities. Unstable lesions are best managed surgically, although debate remains regarding the optimal method. Arthroscopic treatment allows rapid recovery, but the effect on the articular surface is undetermined. The purpose of the present study is to evaluate the outcome of arthroscopic OCD fragment excision and capitellar microfracture using functional assessment scores and repeat imaging.

METHODS: We reviewed records of 11 consecutive patients with OCD lesions of the capitellum managed with arthroscopic microfracture. The mean age at the time of surgery was 17.1 years (10.9-26.8); 6 patients were skeletally immature and 5 were skeletally mature. Pre- and postoperative functional assessment included active range of motion, Mayo Elbow Performance Score (MEPS), and Timmerman/Andrews Elbow Score. All patients underwent plain radiographic and MRI evaluation at latest follow-up (minimum 12 months).

RESULTS: The mean range of motion improved in both flexion (133.3°→138.6°, p=0.067) and extension (19°→ 0.8°, p=<0.01). The mean MEPS (70.9 → 94.5, p=<0.01) and Timmerman/Andrews Elbow scores (116.4 →190, p=<0.01) improved significantly. Plain radiographs demonstrated degenerative changes in 1/11 (9%). MRI evaluation demonstrated an improvement in overall joint congruence and the formation of a reparative articular surface in 8/11 (73%). No reoperations or major complications were encountered.

DISCUSSION AND CONCLUSION: Arthroscopic OCD fragment excision and capitellar microfracture demonstrates good to excellent functional results in short term follow-up. Follow-up MRI suggests potential for a reparative fibrocartilaginous articular surface. Longer-term follow-up is necessary to determine durability of the technique.

167. Repair of Distal Biceps Tendon Rupture Using the Single Incision Sliding Column Stitch Technique

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PURPOSE: The purpose of this paper is to report a new technique in repairing distal biceps ruptures via a “sliding column stitch technique.” This innovative, yet simple technique allows for the single anterior incision approach to provide a strong, nonbinding advancement and secure attachment of the biceps tendon while avoiding many of the complications seen in existing methods.

METHODS: In our case series, we retrospectively identified 17 consecutive patients with a rupture of the distal insertion of the biceps tendon. All had an acute rupture within six weeks of presentation and underwent repair by an innovative “Single Incision Sliding Column Stitch” between 2000 and 2007. Patients returned after their course of physical therapy for a physical examination and DASH questionnaire completion. The optional work and sports/performing arts modules were included in the questionnaire.

RESULTS: Patients are able to undergo an early range of motion program which resulted in no loss of extension and favorable postoperative strength. We have also found excellent return of function. Patients were able to return to full work duties as well as leisure activities. The clinical and functional outcomes from our technique support its use. The mean reported DASH score was 2.77 ± 4.89. For the additional work module, the mean score was 1.17 ± 3.40. Five of the patients opted not to participate in the sports module. The mean score of the remaining individuals was 5.21 ± 12.45 with the distribution skewed to the right.

CONCLUSION: This new technique presented is an alternative to repair of distal biceps tendon ruptures. In our series, no complications have been found. Our suture technique itself is much simpler than the suture anchors previously reported. Our method of repair can be utilized even by surgeons who do not encounter many distal biceps ruptures in their career. The clinical and functional outcomes from our technique support its use.

168. Do Stainless Steel Screws and Titanium Plates Decrease Hardware Complications in Elbow Fractures?

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SUMMARY: Titanium screws in fracture surgery are associated with a high rate of breakage that complicates primary and revision operations. Substituting stainless steel screws will decrease hardware failure and yield equivalent outcomes.

METHODS: We reviewed 730 screws in 70 elbow fractures treated with precontoured titanium plates. Group I using 233 titanium (Ti-Ti) and Group II including 497 stainless steel (Ti-SS) screws were compared for screw breakage, stripping, fracture healing, nonunion, infection, or need for revision surgery.

RESULTS: Groups were statistically similar ($p>0.05$). In Group I, nine screws failed in 21 patients (3.8%), while zero screws failed in 49 patients of Group II ($p=0.00003$). Two patients required screw removal through the fracture site for head stripping. No infections or nonunions occurred in Group I. One infected nonunion occurred in Group II that eventually healed after revision. No instances of symptomatic hardware were found in either group. No clinical manifestations of metallosis were detected.

CONCLUSION: The use of stainless steel locking screws with precontoured titanium plates is more reliable and resistant to hardware failure than Ti-Ti constructs. Clinical results of Ti-SS and Ti-Ti were equivalent, and all fractures healed. There were no clinical implications of combining dissimilar metals.

169. Results of Ulnar Shaft Fracture Treatment in Adults

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BACKGROUND: Adult isolated ulnar shaft fractures (IUSF) are uncommon and treatment remains controversial. The purpose of this study was to compare the results of operative and nonoperative treatment in patients with IUSF.

METHODS: A retrospective case-control analysis was undertaken on patients diagnosed with IUSF between 2002 and 2008 at a Level I teaching trauma center. Surgeon discretion determined treatment of nonoperative (NO) casting or operative (ORIF) plating methods.

RESULTS: Seventy patients had similar characteristics by treatment group: near-equal distribution of males and females with a mean age of 44.6 (18-86) and BMI of 27.9 (17-47). Mechanism of injury included low energy fall (8, 11.4%), high-energy injury (60, 85.7%), and sports (2, 2.9%). Treatment consisted of NO (33, 47.1%) and ORIF (37, 52.9%). AO/OTA fracture classification was 48 A1, 20 B2, and 2 C1 with no significant difference between groups. Treatment resulted in significantly more anatomic reductions with ORIF (35, 94.6%) compared to NO (10, 30.3%) (χ^2=0.001). NO treatment was converted to ORIF in 8/33 (24.2%) cases. Secondary ORIF was required in 1 ORIF for fixation failure and hardware removal occurred in 10 (27%). Secondary displacement (<2 mm) occurred in more NO (10, 30.3%) than ORIF (1, 2.7%). Cast/brace related problems resulted in 2 (6.2%) of NO. No neural complications were noted. Malunion related to a shorter proximal fragment (r=-0.353, p=0.003) and increased proximal to distal fragment ratio (r=0.362, p=0.002). Nonunion related to a longer distal fragment (r=0.361, p=0.002) and increased proximal to distal fragment ratio (r=0.297, p=0.014). At final follow-up, only 2 had severely limited range of motion (both NO). Level of work/activity was 60 without restrictions, 6 with restrictions, and 3 did not return to work (no difference between groups). All cases had minimal or no pain at final follow-up.

CONCLUSIONS: IUSF treatment remains challenging in the adult population. Fracture characteristics influence reduction. NO treatment is prone to more complications.

170. Osteoporotic Risk Factors in Patients Surgically Treated for Distal Radius Fractures

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INTRODUCTION: The first osteoporotic fracture is often a distal radius fracture. The purpose of this study was to determine osteoporotic risk factors in patients with surgically treated distal radius fractures.

METHODS: During a five-year period, 2002-2007, 273 patients at a large private orthopedic practice were determined to have surgically treated distal radius fractures as a result of low energy falls. Risk assessment surveys were sent to these patients.

RESULTS: 103 (28%) surveys were returned. There were more females (82, 79.6%) than males (21, 20.4%) with an average age of 63 (31-91) and BMI of 28.3 (16-58). Forty-four (42.7%) had a DXA scan prior to the fracture of which 18 (17.5%) were diagnosed with osteoporosis and 10 (9.7%) were treated with bisphosphonates. Risk factors include: loss of height (40, 38.8%), parent had fracture due to a fall (43, 41.7%), weight-bearing exercise <3 times per week (81, 78.6%), inadequate calcium in diet/supplements (51, 49.5%), and fallen >1 times in previous year (47, 45.6%). Twenty (19.4%) had fractures from low-energy falls prior to the distal radius fracture. As a result of the distal radius fracture: 15 (14.6%) were referred for osteoporosis evaluation, 23 (22.3%) had DXA scans, 42 (40.8%) had calcium supplements recommended, 18 (17.5%) had vitamin D supplements recommended, 3 (2.9%) were referred for fall prevention or balance training, 15 (14.6%) were referred for an exercise program, and 17 (16.5%) were prescribed medication for osteoporosis.

CONCLUSIONS: Osteoporosis risks were high in those who had low energy falls resulting in distal radius fractures, but risk assessment, referral, and treatment was minimal. Osteoporosis screening following distal radius fractures is essential to promote positive lifestyle behaviors, maximize bone mass early, and decrease the risk of sustaining a secondary osteoporotic fracture. Since this study, a fragility fracture osteoporosis clinic was initiated.

171. Fixation of Distal Radius Fractures with a Radial Locking Plate

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In recent years, the use of volar plating for unstable distal radius fractures has become the mainstay of surgical intervention. On the other hand, radial plating for distal radius fractures is used infrequently and usually in association with other approaches to augment fixation for an unstable fracture pattern. This is a retrospective study of one surgeon's initial experience with open operative intervention of distal radius fractures using only a radial approach with a newly developed anatomic, locking, distal radius plate. Over a three-year period, 36 patients underwent open reduction and internal fixation (ORIF) using an anatomically designed radial locking plate. Outcome measures included radiographic parameters, grip strength, side pinch strength, Visual Analog Scores (VAS), Disabilities of the Arm, Shoulder, and Hand Score (DASH), and the Mayo wrist score. Twenty-two patients returned for evaluation at an average of 13 months follow-up. The mean age at the time of surgery was 54.2 years. Sixty-eight percent (15) of the 22 fractures were classified as AO type A and 32% (7) were classified as type B. Radiographic assessment showed that all fractures achieved union at final follow-up. At follow-up, the mean grip strength on the injured sides was significantly lower than that of the contralateral side (35.8 compared with 51.3 lbs; p=0.006), and the mean pinch strength on the injured side was equal to that of the contralateral side (9.6 compared with 10.8 lbs; p=0.27). The average palmar tilt for the operative wrist was 5.8 compared with 9.77 on the contralateral side (p=0.0136). The average VAS score was 1.4 (range 0.0-7.0), average DASH score was 15.8 (range 0.0-54.5), and 86% of the patients had an excellent or satisfactory score on the Mayo wrist score. Three patients experienced transient paresthesias in the distribution of the superficial branch of the radial nerve that were all resolved by six months. ORIF using a radial stabilization locking plate provides a simple alternative to traditional volar plating for A-O Type A and some Type B fractures. This approach reduces the surgical dissection on the volar side of the wrist, avoids the flexor tendon plane, and facilitates early range of motion and postoperative recovery.

172. The Effect of Screw Length on Fracture Stability in Volar Locked Plating of Distal Radius Fractures

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INTRODUCTION: In locked volar plating of the distal radius, screws engage the plate creating a fixed angle construct that supports subchondral bone. Dorsally prominent screws may cause injury to extensor tendons. Screws placed short of the dorsal cortex should avoid extensor tendon injury; however, the effect this construct has on fracture stability is unknown. The purpose of this study was to evaluate the effect of distal fragment screw length on fracture stability using locking volar distal radius plates in an extra-articular cadaveric fracture model.

METHODS: Nine fresh frozen cadaveric radii were osteotomized to simulate extra-articular fractures with metaphyseal comminution and stabilized using volar locking plates. The specimens were divided into three groups that differed only by the length of screws placed in the distal fragment. Screws were placed either 75% of the distance to the dorsal cortex (group 1), to the dorsal cortex (group 2), or bicortically (group 3). The plated specimens were axially loaded to failure in a materials testing machine.

RESULTS: The mean load to failure for group one was 947N, group two 780N, and group three 1062N. Peak loads ranged from 570N to 1400N. There was no significant difference ($p>0.266$) between groups. These loads exceed documented activity related loads on the distal radius.

CONCLUSION: When plating extra-articular distal radius fractures, screws can be placed 75% of the distance to the dorsal cortex without sacrificing support of the subchondral bone. A technique using screws that do not violate the dorsal cortex should eliminate extensor tendon related complications.

173. In Vivo Three-Dimensional Kinematics of the Normal Distal Radioulnar Joint with Loading

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INTRODUCTION: We aimed to define the 3-D kinematics of the normal distal radioulnar joint (DRUJ), which have yet to be described accurately. Our hypothesis was that the DRUJ would display greater laxity in the loaded (with grip) compared to the unloaded wrist.

METHODS: Ten healthy volunteers' wrists were scanned by CT using 0.6 mm cuts with 3-D reconstructions. The wrists were imaged utilizing a custom device in varying degrees of forearm rotation (neutral, full pronation, full supination, mid-pronation, and mid-supination) in both loaded and unloaded states. We analyzed a reproducible landmark, the DRUJ point (DRUJP) on the sigmoid notch of the radius, using custom software. A student t-test was used to evaluate for statistical differences.

RESULTS: The unloaded DRUJP rotated 45.9° in full pronation to –36° in full supination. The DRUJP displaced radially and proximally in all rotations as well as volarly in pronation and dorsally in supination. The differences in total DRUJ translation in the loaded compared to the unloaded states were statistically significant in all tested rotations: neutral (mean 0.05 mm difference, $p=0.03$), mid-pronation (0.06 mm, $p=0.01$), full pronation (0.07 mm, $p=0.006$), mid-supination (0.07 mm, $p<0.001$), and full supination (0.05 mm, $p=0.03$) with increased displacement in the loaded state.

DISCUSSION: Our results provide a detailed analysis of the kinematics of the normal DRUJ. The DRUJP on the sigmoid notch of the radius translated in the radial-volar-proximal direction with pronation and the radial-dorsal-proximal direction in supination. The normal DRUJ displayed statistically significant increased displacement with loading of the wrist. Increased displacement of the DRUJ during loading may have clinical relevance with operative management including the design of anatomic DRUJ arthroplasty implants.

174. Distal Radius Hemiarthroplasty and Hemiarthroplasty with Proximal Row Carpectomy in a Cadaver Model Using the Universal 2 Implant

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A distal radius hemiarthroplasty may obviate the need for the strict restrictions required of patients treated by total wrist arthroplasty, thus, providing another motion-preserving surgical option for active patients with severe wrist arthritis.

The purpose of this cadaver study was to evaluate the radiographic static alignment of the wrist following distal radius hemiarthroplasty and after hemiarthroplasty combined with proximal row carpectomy (PRC).

Results showed the capitate remained within 2.59 mm and 1.42 mm of its native longitudinal and radial-ulnar positions, respectively, following hemiarthroplasty. Radial-ulnar alignment remained within 4.69 mm despite the obligatory shortening after the combined hemiarthroplasty and PRC.

This study indicates that hemiarthroplasty and hemiarthroplasty with PRC results in good static alignment of the wrist and, thus, supports the concept of these procedures as a potential treatment alternative for advanced wrist arthritis.

175. Enchondroma of the Hand: Factors Affecting Recurrence, Healing, Motion, and Malignant Transformation

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BACKGROUND: Enchondromas represent the most common primary bone tumor arising in the hand. Despite their relative frequency, a standardized treatment protocol remains absent. This study seeks to characterize the outcomes of patients treated surgically for a diagnosis of enchondromas with regard to variables in treatment algorithms.

METHODS: One hundred two cases of enchondromas in 80 patients, identified between 1991 and 2008, were retrospectively reviewed with a mean clinical follow-up of 38 months. The effects of age, tumor location, and graft choice on outcomes were assessed for all lesions. Patients presenting with Ollier's disease, Maffucci's syndrome, pathologic fractures, or recurrent disease were separated for additional analysis.

RESULTS: Sixty-two lesions (61%) achieved complete radiographic healing. The median time to reach complete healing was six months. Complete range of motion was achieved following 68 procedures (67%). The median time to reach full range of motion was three months. Ninety-five lesions (93%) remained free of recurrence following surgery. There was only one case of malignant transformation in a patient with Maffucci's syndrome. Tumor location and graft choice did not show any significant difference in healing grade, time to healing, range of motion, or recurrence rate. An age at presentation older than 30 was associated with accelerated healing ($p=0.03$). Monocentric, non-expanding lesions were associated with improved postoperative range of motion ($p=0.01$). Patients with a diagnosis of multiple enchondromas had a higher rate of recurrence following surgery ($p=0.04$) and a lower rate of complications ($p=0.01$). Following a pathologic fracture, no differences in outcome measures were observed when enchondromas were treated primarily or following fracture healing.

CONCLUSIONS: Following surgical treatment of enchondromas, the majority of patients achieve complete healing and regain full range of motion regardless of the graft material used. Malignant transformation is extremely rare and aggressive follow-up measures should be reserved for patients with a diagnosis of multiple enchondromas.

MAOA BREAKOUT SESSION #14
SPORTS
April 24, 2010

176. Outcome of Operatively Treated High Energy Multiligament Knee Injuries

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INTRODUCTION: Multiligament knee injuries (MLKI) are uncommon injuries but usually associated with high-energy mechanisms and associated injuries. Timing and type of surgery and number of ligaments to be repaired are controversial.

METHODS: Over a three-year period (2005-2008), 48 MLKI in 46 patients were retrospectively reviewed based upon prospectively gathered data.

RESULTS: Gender was 26 males and 20 females with age of 36 (18-70). The mechanism was high-energy motor vehicle, pedestrian, or sports. The injuries were medial meniscus (MM, 15), lateral meniscus (LM, 12), posteromedial corner (PMC, 11), popliteus (25), lateral collateral (LCL, 29), patellofemoral ligament (PFL, 13), biceps (13), anterior cruciate (ACL, 30), and posterior cruciate (PCL, 28). Time to operative reconstruction was 31 acute (<3 weeks), 13 subacute (3 weeks-3 months), and 4 chronic (>3 months). ACL and PCL injuries were reconstructed in all cases. The MCL was repaired in 10 and reconstructed in 5. The LCL was repaired in 14 and reconstructed in 15. The PCL was repaired in 11, reconstructed in 7, and repaired with supplemental reconstruction in 11. Final average ROM results were extension of 2° (-5-20) and flexion 112° (40-135). Pre- and postoperative laxity for MCL was 1.0(0°)/1.2(30°) and 0.4(0°)/0.5(30°), respectively. Pre- and postoperative laxity for LCL was 1.6(0°)/1.8(30°) and 0.3(0°)/0.4(30°), respectively. Complications were 1 superficial infection, 1 deep wound infection, 4 peroneal nerve palsy, 0 amputation, 9 arthrofibrosis, 5 heterotopic ossification (HO), 1 compartment syndrome, 4 persistent pain, 8 persistent instability, and 3 revisions. Acute time to repair was related to arthrofibrosis and HO ($p<0.05$). Meniscal injuries did not relate to HO, pain, instability, ROM, or laxity. Increased number of MLKI relates to postoperative LCL laxity at 0° and 30° ($p<0.01$). HO relates to persistent pain, decreased extension, and decreased flexion ($p<0.01$).

CONCLUSION: MLKI varied injury patterns and associated injuries. Operative treatment of knee dislocations is best tailored to the nature of ligamentous injury, which produces satisfactory clinical results.

177. Posteromedial Corner Injuries in Knee Dislocations

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INTRODUCTION: The purpose of this study is to report on outcomes of knee dislocation patients who have sustained posteromedial corner (PMC) injuries.

METHODS: This is a prospective outcome study. PMC injuries were treated with three methods: repair, autograft reconstruction, or allograft reconstruction. All patients underwent identical early motion rehabilitation. Outcome data included: Lysholm knee score, IKDC score, SF-36, and success of reconstruction.

RESULTS: This study has 71 knee dislocation patients with 73 PMC tears. Mean follow-up was 43 months (24-86). Twenty-five repair patients had 5 failures (20%). Final (after revision of failures) IKDC results: normal 50%, near normal 27%, abnormal 9%, and severely abnormal 14%. Lysholm scores were a mean of 94, SF-36 PCS=36.6, and MCS=47.2. Twenty-seven autograft reconstructions had only one failure (3.7%). Final IKDC was: normal 32%, near normal 52%, abnormal 12%, and severely abnormal 4%. Lysholm scores were 83, SF-36 PCS 31.6, MCS=41.7. Twenty-one allograft reconstructions had only one (4.8%) failure. IKDC results: normal 36%, near normal 43%, abnormal 14%, and severely abnormal 7%. Lysholm score was 88, SF-36 PCS=34.3, and MCS=41.6. There was a significant difference in failures between PMC repairs (20%) and PMC reconstructions (4%) (p=.042).

CONCLUSION: Posteromedial corner reconstruction following knee dislocation using either allograft or autograft worked well with failure rates of 4%. Repair of the PMC tear was significantly less successful with a failure rate of 20%. Reconstruction yielded excellent functional outcomes with low failure rates in patients following knee dislocation.

178. Arthrofibrosis of the Knee Following Lower Extremity Trauma Treated with Arthroscopic Lysis of Adhesions and Manipulations

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PURPOSE: The objective of the study was to quantify the effect of arthroscopic lysis of adhesions and manipulation for the treatment of post-traumatic arthrofibrosis of the knee.

METHODS: Sixty-seven patients were treated for post-traumatic arthrofibrosis of the knee with arthroscopic lysis of adhesions and manipulation from 1999 to 2008. The postoperative range of motion of the knee was compared to the preoperative, post-traumatic range of motion of the knee. All patients were followed for at least four months following the lysis procedure. In 23 patients, the mean follow-up was 41 months (range: 10-79 months). These 23 patients completed a patient satisfaction survey.

RESULTS: For the 23 patients followed for 41 months, the average increase in the knee range of motion was 55° ($p<0.0001$). These 23 patients had a 6° increase in range of motion from 4 months to 41 months (95% CI 2.1,10.8, $p=0.0054$). The majority of the observed increase in range of motion occurred in the first four months. The average increase in knee range of motion at four months for all of the patients was 48° ($p<0.0001$). All 23 patients who completed the survey were satisfied with the outcome and would have had the procedure again. Two patients (2/67) had a repeat procedure. There were three complications: one patella fracture, one patellar tendon rupture, and one distal femur fracture. All were successfully treated without recurrence of arthrofibrosis. There were no infections.

CONCLUSION: Arthroscopic lysis of adhesions with manipulation for traumatic knee arthrofibrosis compares favorably to an open lysis or arthroscopic lysis of adhesions with quadricepsplasty. Significant improvements in knee range of motion can be obtained and maintained with this technique without the morbidity of a quadricepsplasty.

179. Evaluation of the Influence of Combined Growth Factors and Catabolic Inhibitors on ACL Healing

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SUMMARY: Rabbit ACLs with the cocktail of both anabolic growth factors and catabolic inhibitors have shown increased biomechanical strength when compared to groups with individual factors. Also, this group showed greater gross and histologic healing.

METHODS: Twenty New Zealand White Rabbits underwent ACL transection and addition of various combinations of growth factors. After six weeks of healing, the rabbits were sacrificed and underwent gross and histologic evaluation. In addition, uniaxial load to failure testing was done. The groups contained the following: Group 1 anabolic factors (plasma, TGF-B1, bFGF), Group 2 catabolic inhibitors (plasma, Alpha-2 macroglobulin), Group 3 combined (plasma, TGF-B1, bFGF, A-2 macroglobulin), Group 4 (plasma), and Group 5 (transection only.)

RESULTS: Uniaxial load to failure results are the following: Group 1- 9.10 N +/- 1.78 N (n=3), Group 2- 4.38 N +/- 2.27 N (n=2), Group 3- 61.97 N +/- 41.10 N (n=3), Group 4- 46.35 N +/- N/A (n=1), Group 5- 18.54 N +/- 30.49 N (n=4), Control (non-operative limbs): 180.85 N +/- 53.53 N (n=2). On gross examinations, ACL healing was most evident in Group 3 (combined factors). This was also confirmed on histologic examination which showed greater fibroblastic activity, increased number of fibroblasts, and more organized collagen arrangement in Group 3 compared to other groups.

CONCLUSION: A cocktail of anabolic growth factors and catabolic inhibitors has shown better healing of acutely ruptured ACL on gross, histologic, and biomechanical evaluation compared to controls and individual growth factors.

180. Factors Impacting Early Functional and Isokinetic Test Results Following ACL Reconstruction

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SUMMARY SENTENCE: Patients with excellent early functional and isokinetic test results following ACL reconstruction demonstrated younger age, lower BMI, higher preoperative Tegner scores, and allograft reconstruction.

INTRODUCTION: Surgeons often use objective measures such as functional and isokinetic testing to assist with clearance for return to sport following anterior cruciate ligament (ACL) reconstruction. The purpose of this study was to identify factors associated with excellent early functional and isokinetic testing results following ACL reconstruction.

METHODS: The charts of all patients who underwent primary ACL reconstruction by a single surgeon between 1998 and 2005 were reviewed. Patients with multiple ligaments reconstructed were excluded. Three hundred ninety patients were identified. Of those, 224 had agreed to undergo functional and isokinetic testing at six months postoperative. An “excellent” result was defined as having <10% deficit in functional testing and <20% deficit in isokinetic quadriceps and hamstring testing when compared to the opposite limb. Patient demographics, graft type, and associated pathology were recorded. Logistic regression was used to assess the association of these variables with excellent functional and isokinetic testing results. Results are presented with odds ratios (OR) and p-values.

RESULTS: Mean age was 26 (range 12 to 59). There were 93 (42%) males and 131 (58%) females. Graft type included 134 bone patellar tendon bone (BTB) autografts (59.8%), 62 BTB allografts (27.7%), 27 hamstring autografts (12.1%), and 1 hamstring allograft (0.4%). Fifty-four (24%) met the criteria for excellent functional and isokinetic results at six months. In a multivariate model, variables showing a significant association with the excellent outcome group were: younger age (OR=0.95 per one-year increase, p=0.01), lower BMI (OR=0.90 per 1-unit increase, p=0.02), higher preoperative Tegner score (OR=1.3 per 1-unit increase, p=0.05), and allograft reconstruction (OR=3.5, p=0.02). Male gender demonstrated a trend toward significance (OR=1.8, p=0.09).

CONCLUSION: Factors associated with excellent early functional and isokinetic test results following ACL reconstruction included: younger age, lower BMI, higher preoperative Tegner scores, and allograft reconstruction.

181. Failure of Anterior Cruciate Ligament Reconstruction Related to Age and Graft Type

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INTRODUCTION: Success after anterior cruciate ligament (ACL) surgery depends on age, gender, activity, associated pathology, and graft type. Recent studies have focused on activity and grafts. The purpose of this study is to determine if different graft types will have higher instability rates in young, active patients.

MATERIALS AND METHODS: Search from a single surgeon's relational database between 2000-2007 revealed 325 patients of all ages, and activity levels, with a minimum two years follow-up, who underwent primary, single-bundle ACL reconstruction using autograft patella (BTB), hamstring, or allograft tendons. Patients with inadequate follow-up, with quadriceps or double bundle hamstring tendons, or patients who underwent revisions were excluded. Patients were categorized by age, gender, and graft type, and were evaluated for instability defined as needing revision ACL reconstruction, any +pivot shift, or a combination of a +Lachman with no endpoint, and $\geq$5 mm difference KT-1000.

RESULTS: When stratified based on age at time of reconstruction, 199 (61.2%) patients were ≤25 years and 126 (38.8%) were >25 years. Twenty-nine (14.6%) ACL reconstructions were deemed unstable in the ≤25 group versus only 11 (8.7%) in the >25 group. When the ≤25 group was divided by graft type, 5/18 (27.8%) allografts and 10/45 (22.2%) hamstrings had instability, versus only 14/136 (10.3%) BTBs. In the >25 group, 6/48 (12.5%) allografts, 3/3 (87.9%) hamstrings, and 2/40 (5%) BTBs were found unstable.

CONCLUSION: In this review, all grafts types had increased failure in the younger age group. Autograft hamstring and allografts had a high failure rate in the <25 group, especially when compared to autograft BTBs. BTB autografts may be the better choice for ACL surgery in the young, active population.

IRB STATEMENT: This is a retrospective review of procedures performed without regard to specific research. All patients sign consent to have chart entered into a relational database. No patient names in the study.

182. Reasons for Lack of Return to Pre-Injury Level of Function After ACL Reconstruction

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Short-term outcomes of anterior cruciate ligament reconstructions (ACLR) are usually attributed to the success of returning the athlete back to previous level of activity. Unfortunately, many do not return to their previous level despite a "successful" surgery. To our knowledge, there have been no attempts to investigate why a reconstructed patient does not regain the previous level of activity postoperatively from the patients' perspective. We hypothesized that non-anatomic considerations are adversely affecting patients' ability to return to their pre-injury level of function. 171 patients with 171 ACL reconstructions at a single institution were retrospectively identified between 1-2 years postoperative. Patients were contacted by telephone for a brief interview. Patients were asked what their prior activities were, what their current activities were, and whether they had returned to their prior level of pre-injury function. Patient responses were catalogued into 15 categories. Of 171 eligible patients, 88 completed the survey. There were 44 men and 44 women. Of these 88 patients, 44 (50%) said that they had not returned to their prior level of function. Of the 44 patients that did not return to their prior level of function, 21/44 (48%) were women with a mean age of 29.3 years (range 15-51 years, SD+/-11.2 years), and 23/44 (52%) were men with a mean age of 31.7 years (range 16-46, SD+/- 9.4 years). Knee-related problems were reported by 30/44 (68%) patients. Life event related considerations were identified by 16 patients. Twenty-two patients responded that their inability to return to prior level of function was influenced by choices they made, with "fear of re-injury" (n=18) the most common, followed by "no time in schedule" (n=3), "not interested in playing at prior level" (n=2), and "was told not to return to prior level" (n=2). This study indicates that ACLR short-term outcomes based on return to prior level of activity are highly variable and influenced by many factors. An anatomically sound reconstruction does not guarantee a return to previous level of activity. Residual pain and fear of re-injury seem to be the most common reasons. Further research is needed to determine all the factors that prevent a patient to return to activity.

183. Defining Chronicity in ACL Deficient Knees Undergoing Reconstruction

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This investigation defines the differences in acute and chronic ACL-deficient knees undergoing reconstruction through statistical differences in meniscal tear rates and chondral integrity at time from ACL injury until reconstruction.

676 patients completed ACL reconstruction by two high-volume ACL surgeons. Patients (207/676) with multiple ligament-injured knees (medial collateral ligament [MCL] ≥ grade 3, posterior cruciate ligament [PCL] ≥ grade 2, or lateral collateral ligament [LCL] ≥ grade 3); previous meniscus, cartilage, or ligament-reconstruction knee surgeries were excluded from review. Chart review identified 469 patients (age ≥12 years old) meeting inclusion criteria undergoing primary, isolated-ligament ACL reconstruction surgery from 2005-2008. 311 patients with complete demographic, functional, and surgical data in the Multicenter Orthopaedic Outcomes Network or surgeons' databases were included for study. Meniscus tear incidence, giving way episodes, and chondral integrity were identified for groups at increasing weekly intervals at times from ACL injury until reconstruction.

Statistically significant differences in medial meniscus tears (week 11) and Outerbridge grade ≥2 medial compartment chondral lesions (week 4) identified by Fisher's exact test established the chronic ACL group from the baseline (acute) group. Statistically significant differences in Outerbridge grade ≥2 chondral lesions in the lateral (week 7) and patellofemoral compartments (week 11) were observed. No statistically significant differences in mean lateral meniscus tear rates or giving way episodes at any time interval were identified.

Utilization of statistically significant differences in medial meniscus integrity and chondral lesions from ACL injury until reconstruction is an improvement on previous methods used to define acute and chronic ACL-deficient knees undergoing reconstruction.

184. Relationship of ACL Graft Obliquity to Knee Stability in Athletes at the NFL Combine

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INTRODUCTION: There has been growing emphasis on the importance of anatomic ACL reconstruction in order to optimize knee stability and clinical outcome. The purpose of this study was to describe the obliquity of ACL reconstructions and its relation to knee stability in elite athletes.

METHODS: Forty-nine knees in athletes at the 2007 and 2008 NFL combines were identified as having had previous ACL reconstructions. The graft type, fixation, and physical exam findings were recorded for each athlete. Graft obliquity was measured using previously described methodologies based on radiograph[1] and MRI[2] images. The obliquity of stable knees based on Lachman, pivot shift, and KT1000 were compared to the obliquity of knees with greater laxity.

RESULTS: The average tibial tunnel placement was 44.5% from the medial plateau on the AP and 39.2% of the distance from the anterior tibia on the lateral. The average femoral tunnel was 31.3% from the posterior aspect of the femoral condyle. The average sagittal obliquity angle was 58.3° (range 44.5-79.5, SD 6.8), and the average coronal obliquity angle was 73.9° (range 61.5-89, SD 5.7). Knees with greater translation on Lachman exam had more vertical grafts based on the sagittal ACL angle (61° vs. 56°, p=0.03) and the ACL-Blumensaat's line angle (12° vs. 5.5°, p=0.002).

CONCLUSIONS: There was a wide range of ACL graft obliquity in this cohort of elite athletes who continued to perform at high levels. Less oblique grafts were associated with more anterior translation on Lachman exam. More investigation is needed in larger cohorts to better determine the relevance of ACL graft obliquity in this population.

185. Use of a Flexible Guide Pin for Drilling the Femoral Tunnel in Anterior Cruciate Ligament Reconstruction

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INTRODUCTION: Drilling of the femoral tunnel through a medial arthroscopic portal can result in shorter femoral tunnel lengths, damage to the articular cartilage of the medial femoral condyle, and is in close proximity to the common peroneal nerve compared to transtibial techniques. The purpose of this study is to compare the differences in femoral tunnel length and distance to the lateral anatomic structures when utilizing standard and flexible guide pins for anterior cruciate ligament (ACL) femoral tunnel drilling using a medial portal.

METHODS: Utilizing a medial arthroscopic portal in 10 cadaveric knees, we drilled straight and flexible 2.4 mm guide pins into the center of the ACL femoral footprint using the same starting point. We recorded the interosseous length and distances to the peroneal nerve and the femoral origin of the lateral collateral ligament (LCL) for each pin.

RESULTS: The mean interosseous length for the flexible pin was 43.5 mm and for the straight pin was 37.1 mm ($p=0.01$). The mean distance to the peroneal nerve was 42.3 mm for the flexible pin and 37.8 mm for the straight pin ($p=0.33$). The mean distance to the femoral origin of the LCL was 26.1 mm for the flexible pin and 13.4 mm for the straight pin ($p=0.003$).

CONCLUSION: Use of a flexible reamer using a medial portal technique allows longer femoral tunnels and may ease suspensory femoral fixation of anatomic soft-tissue ACL grafts.

186. Inter- and Intraobserver Reliability of the Clock Face Representation as Used to Describe the Femoral Intercondylar Notch

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PURPOSE: To validate the use of the clock face reference as a reliable means of communicating surgical femoral intercondylar notch position.

METHODS: A single red mark was made on ten identical left synthetic femurs in the intercondylar notch. The marks were placed around the circumference of the femoral notch, and were staggered between the distal and the proximal rims of the notch. A random four-digit number written on the femoral head identified each femur. Ten surgeons, who routinely perform knee arthroscopic ligament reconstructions, were presented the femurs and asked to state the position of the mark to the nearest 30-minute interval. Their responses were recorded once, and then repeated three weeks later. The results were then analyzed with an intra-class correlation coefficient (ICC), Cronbach's alpha test, and descriptive statistics.

RESULTS: The ICC for all ten femurs was 0.996 while individual physician's Cronbach's alpha test ranged from 0.954-0.999 indicating a very high interobserver and intraobserver reliability. Descriptive statistics showed a mean range of 1.55 hours across all specimens and that the actual range of responses were 2 hours or more in 4 specimens and 1.5 hours in 3 specimens.

CONCLUSIONS: The clock face reference is reproducible for describing position within the femoral notch for individual surgeons. Despite a high ICC, there is significant range between surgeons' responses.

CLINICAL RELEVANCE: The clock face reference is reproducible for an individual surgeon; however, we question its reliability for use between surgeons. Other methods involving anatomic landmarks may be more accurate for describing intercondylar notch anatomy.

187. The Effect of Grade IV Articular Cartilage Lesion Size, Shape, and Location on MRI Diagnostic Predictability in the Porcine Knee

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Articular cartilage lesions are common arthroscopic findings causing knee pain and dysfunction. Long-term consequences of the lesions include osteoarthritis. It is important to define the size and extent of the lesion as it may impact treatment plan. Magnetic Resonance Imaging (MR) is emerging as a modality used for this purpose, especially when focal cartilage lesions are suspected. But MR has not been as accurate as arthroscopic evaluation in previous studies. This study was created to evaluate the ability of MR to predict different shapes and sizes in a porcine model.

HYPOTHESIS: Lesions of different size, shape, and location in the knee produce statistically significant differences in MR sensitivity and PPV.

METHODS: Twelve porcine knees were acquired and an arthrotomy performed at the knee. Different sized and shaped grade 4 lesions created at various locations in each knee-72 lesions in all. The knees were closed and a viscous solution was injected in the joint and the knee placed in a bag of viscous solution that was airtight. The knees were imaged with a 3T MR using standard protocol, and the images read independently by two experienced, blinded readers.

RESULTS: They correctly identified 59/72 and 55/72 lesions, with 16 and 12 false positives respectively. Overall sensitivity was 0.792; overall PPV was 0.803. Sens: lateral trochlea 0.667; lateral femoral condyle 0.909; lateral patella 0.864; medial patella 0.583; medial femoral condyle 0.962; medial trochlea 0.769; circle 0.808; oval 0.886; triangle 0.688; large 0.771; and small 0.811. PPVs: lateral trochlea 0.941; lateral femoral condyle 0.870; lateral patella 0.905; medial trochlea 0.933; medial femoral condyle 0.781; and medial patella 0.800.

CONCLUSIONS: Focal lesion location was the more important determinant of MRI sensitivity than lesion size or shape. Furthermore, differences in MR sensitivity and PPV among lesion locations were statistically significant. The geometry and lesion size from MR is not as a reliable predictor preoperatively.

188. Contact Pressure of Proud Synthetic versus Osteochondral Plugs with Cyclical Loading in a Bovine Model♦

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Synthetic grafts have recently been developed that hold promise to the treatment of these lesions and may prove a good alternative to osteochondral autograft procedures. This project was designed to compare the ability of two proud synthetic plugs to conform to surrounding native cartilage versus that of a proud autograft plug. The hypothesis is that there will be a difference in the contact pressures of synthetic grafts versus osteochondral grafts with cyclical loading. Twenty bovine knees of similar bone mineral density to younger human knees were used. The two synthetic grafts used were the TruFit® plug and the Chondroplug®. The knees will be mounted on a MTS 858 Bionix System by a custom jig. Pressures were quantified with the Tekscan system that produced digital analysis of pressure differences. Static loads of 800 N (approximate body weight) were applied to the knees and contact pressures were measured under five conditions: native cartilage, 7 mm diameter defect, 1 mm proud synthetic plug vs. 1 mm proud osteochondral autograft, and after cyclical loading (800 N x 250 cycles x 2). Repeated measures analyses of variance (ANOVA) was used to detect significant differences in contact pressures. When a significant effect was present, we subsequently performed multivariate analyses of variance (MANOVA). Significance was defined as $p<0.05$. Both synthetic grafts were found to conform to native cartilage with cyclical loading. Osteochondral grafts remained proud. There was a significant difference in contact pressure between the autografts and synthetic repair techniques ($p<0.001$). The contact pressure seen over the synthetic technique was significantly lower than the pressure for the autograft immediately after treatment ($p=0.001$) and after the first and second periods of cycling the knee ($p<0.001$ for both). Synthetic grafts will contour with cyclical static loading. Contact pressures of proud synthetic grafts approached normal with cyclical loading, while proud osteochondral autografts continued to have high pressures. The biomechanical properties of synthetic grafts may also allow for contouring to native cartilage which decreases contact pressure.

189. Limitations of a Circular Model in Managing Articular Cartilage Defects in the Knee

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The natural history of femoral condyle chondral defects is not completely understood. Defects progress because of changes to the subchondral bone (SCB) within the defect and stress concentration around the rim of the defect. In addition to location, chronicity, diameter, and depth, the shape of the defect is one of many factors influencing progression. Our study sought to determine the effect of defect shape on SCB contact within a full thickness femoral condyle chondral defect.

Oval shaped defects 5-25 mm in diameter were created in the weight-bearing surfaces of the femoral condyles of 16 bovine knees. Knees in Group 1 (sagittal plane long axis oval defects) and Group 2 (coronal plane long axis oval defects) were loaded to 1,000N and joint contact was recorded using Tekscan sensors. A custom MATLAB program computed the area within the defect demonstrating SCB contact.

Three-way ANOVA statistical analysis showed that defect shape had a significant ($p<0.005$) effect on SCB contact. Group 2 defects had significantly greater SCB contact than Group 1. Also, significantly greater SCB contact occurred on the lateral condyle versus medial. Furthermore, significantly greater SCB contact occurred in Group 2 defects on the lateral condyle. Significant contact occurred at a threshold size less than 2 cm^2 in Group 2 defects on both condyles and in Group 1 defects on the lateral condyle only.

Coronal plane oval defects on the lateral femoral condyle demonstrated the greatest amount of SCB contact within the defect in a static loading model. Our study has shown that in addition to defect location, diameter, and depth, defect shape is a key element influencing management of articular cartilage defects within the knee.

Multiple defect-specific factors influence knee articular cartilage defect management. In addition to location and size, defect shape must be taken into consideration.

MAOA BREAKOUT SESSION #15
BASIC SCIENCE/MISCELLANEOUS/TUMOR
April 24, 2010

190. Blood Borne Exposures in Orthopedics: Perceptions and Habits of Attending and Resident Orthopedic Surgeons

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INTRODUCTION: The prevalence and risk of exposure to blood borne diseases is underestimated by many orthopedic surgeons. This lack of awareness often leads to inadequate utilization of protective devices even in circumstances where risks may be increased. The purpose of our study was to examine the perceptions and habits of attending and resident surgeons at our training program. Through this study we hope to raise awareness and promote use of safe practices in surgery.

METHODS: Twenty-four attending and resident surgeons at our institution were administered a multi-question survey. This survey was done in an anonymous fashion with no personal identifiers. All participants freely agreed to participation in the survey. Exposures and protective practices were assessed.

RESULTS: Level of experience ranged from internship to 36 years of experience. Number of exposures tended to increase with years in practice; however, there was no clear correlation. Twenty of 24 participants had experienced at least one needle exposure. 316 individual events were reported. 306 of these were with solid bore needles and 10 were hollow bore exposures. 244 of the solid bore exposures drew blood while 5 of the hollow bore exposures drew blood. Ten of 24 persons reported 38 injuries with a surgical implement, other than a needle, which drew blood. All surveyed used two layers of latex type gloves. Only 11 of 24 surgeons reported wearing protective liners during high-risk procedures. Ten of 24 reported all exposures to employee health. Only 156 of the 244 (64%) exposures that were noted to draw blood were reported to employee health.

CONCLUSIONS: Blood borne exposures are a significant risk to surgeons. As our survey showed, many surgeons are not as diligent with reporting exposures as they should be. We were also surprised by the lack of utilization of glove liners during high-risk exposures. While recall bias is certainly a limitation of this retrospective survey, we believe that these results demonstrate how common exposures are and why there needs to be more work done to promote awareness.

191. Hand Hygiene Compliance on Inpatient Orthopedic Units

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INTRODUCTION: The best method to reduce the risk of hospital-acquired infections (HAIs), including those caused by resistant organisms, is hand hygiene. The CDC estimates that adherence to hand hygiene guidelines is 48%.

METHODS: During a six-month period (2008-2009), several interventions were implemented to improve hand hygiene. Self-report surveys were distributed to the orthopedic healthcare team prior to implementation and at three and six months.

RESULTS: Survey responders included: physicians (12.6%), RNs (45.8%), unit techs (23.5%), and others (18.1%). 91.4% reviewed the guidelines with a significant improvement in training completion by the end of the six-month period from 80.4% to 94.8% (X^2=0.04). Concern regarding hand hygiene compliance on orthopedic units reduced from 45.1% to 22.4% (X^2=0.017). 100% indicate that evidence indicates a need for hand hygiene compliance. The likelihood to confront other health team members increased over time with a significant increase in likelihood to confront physicians, residents, and physician assistants (X^2<0.05). Physicians had the lowest rate of washing when entering rooms (72.4%) and when exiting rooms (84.9%) and did not show an improvement over time. Other healthcare providers demonstrated a significant improvement over time to >90% (sig<0.01). Most frequent reasons identified for not following hand hygiene guidelines were: only planning to talk with the patient (41.2%) and washed when leaving a previous patient (39.9%). Most frequent reasons identified for not confronting other health team members when hand hygiene is not carried out include: don't feel comfortable confronting others (39.9%); other person will become angry, defensive, or difficult to work with (33.3%); and give the other person the benefit of the doubt (32.0%).

CONCLUSIONS: HAIs can specifically cause devastating orthopedic effects, affecting recovery, length of stay, and costs. While many healthcare providers demonstrated hand hygiene improvement over time, physicians had the lowest rate and did not show improvement.

192. Biologic Response to Orthopedic Sutures: A Histologic Study in a Rabbit Model

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Biologic reactivity to suture materials can have an effect on our patients' outcomes. We sought to determine the histologic response to eight commonly-used orthopedic sutures (Ethibond, Ticron, HiFi, Ultrabraid, Maxbraid, Orthocord, Magnumwire, and Fiberwire) using a rabbit model. We evaluated the suture granulomas at 30, 60, and 120 days with measurement of the fibrous capsule, the number of giant cells in and near the capsule, and the overall inflammatory grade: 1 (mild), 2 (moderate), and 3 (severe). Magnumwire and Ticron initiated a more intense inflammatory reaction when compared to the remaining sutures. By 120 days, Magnumwire ($P=0.0297$) and Ticron ($P=0.1855$) had fewer giant cells at the soft tissue-suture interface when compared to the group. Magnumwire ($P=0.0074$) and Ticron ($P=0.0377$) had fewer giant cells within the capsule by 120 days. By 120 days, Magnumwire ($P<0.0001$) and Ticron ($P=0.1378$) had the greatest capsular thickness of all suture types. Differences exist between the biologic reactivity of commonly used orthopedic sutures that may be attributable to their material composition and/or braid characteristics. In comparison to other high strength sutures, Magnumwire and Ticron stimulated a more intense foreign body inflammatory response.

193. Inflammatory Response of Polyethylene Sutures in a Murine Air Pouch

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BACKGROUND: Polyethylene sutures have gained favor amongst many surgeons; however, some have raised concern that these sutures may stimulate an inflammatory response that could jeopardize a patient's recovery. The purpose of this study was to evaluate the acute inflammatory response of three polyethylene sutures in a murine air pouch model.

METHODS: Air pouches were created on the dorsum of 30 BALB/c mice. Five suture types were tested: silk, polyester (Ethibond), Fiberwire, Ultrabraid, and Maxbraid. Each was cut into 0.5 cm lengths. Fifteen lengths were inserted into each experimental air pouch. The mice were killed at ten days and the pouches were excised. Pouches were divided in half. One half of each pouch was analyzed histologically, while the other half was evaluated using ELISA techniques for IL-1, IL-6, and TNFα. PBS solution was used as a negative control, and UHMWPE particles in solution were used as a positive control. The results were compared using ANOVA methods.

RESULTS: There was no difference in the IL-1, IL-6, and TNFα concentration measured in any of the polyethylene sutures when compared to PBS and Ethibond. Silk suture concentrations of IL-1 and IL-6 were significantly greater than all sutures tested ($P<0.01$). Pouch membrane width and cellularity were greatest in the silk group with no difference seen among polyester and polyethylene sutures, although there was a greater monocyte/fibroblast ratio in the Fiberwire group compared to PBS, Ethibond, and Ultrabraid.

CONCLUSION: Polyethylene sutures failed to demonstrate an acute inflammatory response.

194. Are DXA BMD of Harvested Specimens Equivalent to Patient Scans?

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INTRODUCTION: Bone mineral density (BMD) is an important factor on the performance of many spinal implants as they require a strong bone-implant interface for rigidity. We hypothesize that the BMD obtained from dual-energy x-ray absorptiometry (DXA) scans of harvested specimens are lower than from scans of life subjects.

PURPOSE: To determine if the distribution of DXA BMD of a population sample of dissected specimens is equivalent to population data for patient scans.

METHODS: DXA scans are carried out on 96 male and 67 female lumbar specimens, aged 35-84 and of mixed ethnicity. Scans are carried out in the posterior-anterior direction with specimens placed above a water bath with 14 cm depth of water. Using linear regressions, the correlation functions between Z-score, BMD, and age are determined for male and female groups. Setting Z=0 in these correlation functions give the population reference curves between BMD and age. BMD of harvested specimens are compared against these population reference curves.

RESULTS: A mean Z-score of -0.6 (sd=1.4, CI=-0.4,-0.7) found in our samples is significantly less than zero ($p>0.95$). The functions between Z-score, BMD, and age for male and female populations are: Male: $Z = 9.09\ BMD + 0.03\ Age - 10.90$, $r^2=0.999$ Female: $Z = 1.14\ BMD \times Age^{0.5} - 7.76$, $r^2=0.974$. Mean BMD of the male specimens aged 35-84 are uniformly 0.06g/cm^2 lower than the population reference data. This difference in BMD could be interpreted as (1) a decrease of 0.55 in T-score and (2) an increase in 20 years of age. Mean BMD of female specimens aged 45, 55, 65, and 75 are 0.076g/cm^2, 0.045g/cm^2, 0.023g/cm^2, and 0.007g/cm^2 lower than the population reference data respectively. They correspond to decrease in T-scores of 0.69, 0.41, 0.21, and 0.06 respectively.

CONCLUSIONS: The results of the current study indicate that the DXA BMD of harvested specimens is lower than from scans on life subjects. A correction factor should be used when interpreting BMD and T-score from scans of harvested specimens.

195. Periprosthetic Infection with Propionbacterium Acnes: Different from Conventional Arthroplasty Infection

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INTRODUCTION: Proprionibacterium acnes prosthetic joint infection is poorly understood and probably under-reported. Once thought a contaminant, P. acnes is now recognized to cause true prosthetic infections. The aim of this study was to determine clinical circumstances associated with P. acnes infection and treatment outcome of patients with P. acnes prosthetic joint infections.

METHODS: A retrospective cohort study of all patients with P. acnes total hip or knee infection diagnosed between January 1, 1969, and December 31, 2001, at our institution using a strict case definition was conducted. The presentation, diagnosis, treatment, and outcomes were analyzed. Kaplan-Meier survival methods were used to determine the cumulative probability of success and subset comparisons.

RESULTS: Among 2,335 episodes of prosthetic joint infections treated during the study period 1% (29 of 2,335) were due to P. acnes. Median patient age was 62 years (36-80). There were 20 hips and 9 knees. Thirteen of 29 had previous revisions. Pain was present in 22 of 29. The median peripheral WBC was 7,800. Median ESR of the 24 patients in whom the test was performed was 35 (1-181). In 11 patients, ESR was <25. Twenty of 29 (69%) had radiographic perioprosthetic lucencies at diagnosis. Intraoperatively, 17 of 29 (59%) had prosthetic loosening, but only 9 of 29 (39%) had acute or subacute inflammation on histology. Ten of 29 patients underwent two-stage exchange: 7 of 10 did not require further surgery. Thirteen patients underwent partial component revision or single-stage exchange because infection was not diagnosed until postoperatively: 6 of 13 did not require further surgery. The overall 2- and 5-year survival free of infection or reoperation for any reason was 89% and 84% respectively.

CONCLUSION: P. acnes prosthetic joint infection commonly has nonspecific symptoms and nonspecific radiographic findings at presentation. Erythrocyte sedimentation rate was less than 25 mm/hour in 46% of patients, and histology was negative for acute inflammation in over 60% of patients. With the numbers available, there was no significant difference in outcome of patients treated with two-stage exchange and one-stage exchange or partial component revision.

196. Comparison of the Objective and the Subjective Outcomes for Above Knee Amputation versus Limb Salvage for Treatment of Sarcomas About the Knee

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When adequate margins of resection surrounding a tumor can be achieved, limb salvage surgery (LSS) has replaced amputation as the standard of the care in treating musculoskeletal sarcomas. The knee is one of one the most common sites of presentation of bone sarcomas.

OBJECTIVES: The purpose of this study is to compare the functional status and the quality of life in the patients treated with above knee amputation versus limb salvage surgery. Our hypothesis is that limb salvage leads to a superior objective and subjective outcome than above knee amputation (AKA) surgery.

METHODS: A cohort of 22 patients treated with above the knee amputation or limb salvage surgery for aggressive bone or soft tissue tumors around the knee were identified from a retrospective review of medical records. They must have had at least six months follow-up, and they were subjected to a simple walking test, the Reintegration to Normal Living Index (RNL), the Short Form 36 (SF-36), and the Toronto Extremity Salvage Score (TESS) questionnaires to assess their functional status and quality of life outcomes.

RESULTS: Patients with limb salvage surgery did show superior objective outcomes based on Physiologic Cost Index (PCI) Scores (p=0.002), but did not show any significant improvement in their TESS scores (p=0.176), RNL indexes (0.457), and SF-36 results (p=0.3) compared to the AKA patients.

	SF-36		TESS		RFL		PCI	
	Mean	**P-value**	**Mean**	**P-value**	**Mean**	**P-value**	**Mean**	**P-value**
LSS	95.3	0.3	123.1	0.17	100	0.45	0.029	0.002
AKA	91.6	0.3	110.8	0.17	95.3	0.45	0.077	0.002

Table 1: Statistical analysis results using unpaired two-tail t-test between LSS and AKA patients score.

CONCLUSIONS: These data suggest that the LSS compared to the AKA does offer significant improvement in gait efficiency, but no significant improvement in the patient's perception of the quality of life.

197. Surgical Management of Malignant Proximal Fibula Tumors: A Clinicopathological Study of 112 Patients

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BACKGROUND: Malignant tumors of the proximal fibula are rare, limiting numbers in prior reports. As such, we sought to analyze the presenting characteristics, diagnostic modalities, and clinical outcomes of a large series of malignant tumors in the proximal fibula to aid in the surgical management.

METHODS: We identified 112 histologically confirmed malignant tumors of the proximal fibula presenting to our institution between 1910 and 2007. Sex ratio was equal (54 male, 58 female). Average age was 27.6 years, and average follow-up was 5.7 years.

RESULTS: Osteosarcoma (44%) was the most common diagnosis. Pain (86%), palpable mass (51%), and peroneal nerve symptoms (12%) were the most common presenting symptoms. 103/112 (92%) underwent curative surgical treatment. 50/112 (45%) had amputations (early years), while 24/112 (21%) underwent a Malawer type II resection. Deliberative sacrifice of the peroneal nerve was performed in 74 patients (66%). Postoperative complications occurred in 14/112 patients (12.5%), including wound dehiscence (10/112), peroneal nerve palsy (2/112), and posterior tibial artery thrombosis (2/112). No long-term knee instability was seen in those undergoing resection with lateral collateral ligament (LCL) reconstruction. Fifty-six patients (50%) developed metastases and 12 (11%) had local recurrences.

CONCLUSIONS: Osteosarcomas are the most common malignant tumor of the proximal fibula. Complication rates are modest and long-term knee instability was not seen in patients undergoing reconstruction of the LCL. Local recurrence following resection is not uncommon and metastatic dissemination is the main cause of death. This series represents the largest collection of such tumors with extended follow-up and data on surgical complications.

MAOA POSTER PRESENTATIONS – 2010 ANNUAL MEETING
#1-43

MISCELLANEOUS

1. Inflammatory Response to Suture Material in a Murine Air Pouch Model

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INTRODUCTION: Understanding of the tissue reactivity to different kinds of synthetic, natural, monomer, and polymer sutures is important for the clinical application of suture materials. Having observed suture selection based on limited or anecdotal data, this study was designed to use a murine air pouch model to study the local tissue reactivity to four commercially available suture materials by traditional histological methods and reverse transcription real-time polymerase chain reaction (RT-PCR) analyses.

METHODS: Air pouches were established subcutaneously in the dorsum of 48 BALB/c mice. Eight mice were randomly placed into each experimental group – saline (control), silk, Polysorb, coated Vicryl, coated Vicryl Plus, and orthopedic wear debris polymethylmethacrylate (PMMA-positive control). On day six, the respective materials were introduced into the mouse air pouches. Seven days later, the mice were sacrificed and the air pouch tissue was collected and divided into portions for histological and PCR analysis.

RESULTS: There was a significantly higher expression of IL-1 in the silk group (210-fold, $p=0.02$) compared to saline controls. Gene expression of IL-1 was also elevated in Vicryl (36-fold), Polysorb (132-fold), silk (45-fold), and Vicryl Plus (7-fold), although this difference was not significant. Expression of TNF was not significantly elevated ($p>0.05$) in any of the experimental groups compared with the saline group, although there was a trend towards increased gene expression in the silk (3-fold) and PMMA (3-fold) groups. Histological data will be presented.

CONCLUSIONS: Suture choice is an important issue with real clinical significance. This study used a novel method for objectively evaluating tissue reactivity to suture material. These findings reflect previous studies which showed increased tissue reactivity to silk compared to braided materials. The lack of a significant difference in inflammatory gene expression between chemically similar suture materials (Polysorb, Vicryl) allows for suture selection based on other criteria.

2. A Descriptive Survey of Orthopedic Applicant Opinions on Residency Selection, Musculoskeletal Education, and Various Contemporary Issues in the Field of Orthopedic Surgery

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The purpose of this study is to provide insight in regards to the beliefs and attitudes held by residency applicants on specific issues relevant to our field of practice. This knowledge may not only help to identify and accent diversity in our views, but may also help to reinforce and strengthen our understanding of the selection process, residency education, and ideals guiding the future and success of our field.

A three page, 23-question survey was constructed for distribution to an intended audience of fourth year medical students applying to an orthopedic surgery residency program. The questionnaire was composed predominantly of inquiries based on a Likerd scale with responses ranging from one (strongly disagree) to five (strongly agree). The surveys were distributed to all 54 applicants at our institution on two consecutive days during our campus interviews in 2008.

The mean score designated to the adequacy of musculoskeletal education in the medical school curriculum was noted to be 2 ± 0.824, and when asked to rank characteristics most valuable to an orthopedic surgery application, the students designated the highest score (4.26 ± 0.894) to the USMLE Step I board examination. Additionally, 86% of applicants indicated that they anticipate working more than 80 hours a week as residents, and 68% of respondents expect to work 60–70 hours per a week as attendings.

With a greater understanding of the opinions of students applying for orthopedic surgery, we gain an important evaluation tool of our medical education system and information for the direction of our field as a whole. Careful consideration and insightful analysis of this information can provide conclusions that will help to ensure future success in our field of study and the overall well being of our musculoskeletal health care system and its patients.

3. Efficacy of Adjuvant Therapy in Extending Surgical Margins as Measured by Immediate Osteocyte Death♦

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INTRODUCTION: Locally aggressive, benign bone tumors (i.e., giant cell tumor, chondroblastoma) have traditionally been treated with extended intralesional curettage with or without local adjuvant therapy (e.g., liquid nitrogen [LN2], argon beam [AB]). Polymethyl-methacrylate (PMMA) cement is often used to fill the resultant osseous defect and for its thermal effect on any remaining tumor cells. Use of any one specific treatment appears anecdotal, and the effect of these treatments on immediate survival of local remaining cells within the bone has not, to our knowledge, been rigorously established.

Our aim is to examine the effects of local adjuvant therapies on bone in an animal model, using immediate osteocyte death rate (IODR) as a conservative surrogate for generalized (marrow, tumor, bone) cell death.

METHODS: With IACUC approval, a 5 mm defect was created in each distal femoral epiphysis of 18 NZW rabbits. The defect of one femur was treated with adjuvant (control, AB, or LN2); the contralateral defect was treated with the same adjuvant, followed by PMMA packing. Collected specimens were stained with fluroscein and ethidium to stain live and dead cells, respectively, and visualized under confocal microscopy. IODR was evaluated as a function of treatment and distance from the defect, using three-way repeated-measures ANOVA.

RESULTS: LN2 resulted in a higher ($p<0.01$) IODR (57%) than either curettage alone control (38%) or AB (32%). There was a significant ($p=0.03$) effect of subsequent PMMA application (overall 48% vs. 37% for no-cement controls).

This effect of PMMA was consistent across adjuvants (LN2 66% vs. 48%; AB 41% vs. 24%; curettage alone 37% vs. 38%). There was no demonstrable effect of distance from the lesion ($p>0.32$) or interaction between adjuvant and cement ($p>0.24$).

CONCLUSION: In an animal model simulating a bone defect, IODR after LN2 treatment was significantly higher than with either curettage alone or AB treatment. Subsequent PMMA application increased IODR under both adjuvant treatments.

4. Radiographic Evaluation of Instrumentation Approaching Concave and Convex Surfaces

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BACKGROUND: Orthopedic surgeons frequently depend on radiographic evaluation of operatively placed instrumentation to establish its relationships with surrounding structures. When such instrumentation is intraosseous and approaching cortical bone, it is important to determine whether the cortex has been perforated, especially when the bony surface in question is intra-articular. However, instrumentation position relative to surface anatomy can be difficult to verify when the surface is significantly curved as in the case of screws approaching humeral head or acetabular subchondral bone. The purpose of this paper is to mathematically prove how to evaluate intraosseous instrumentation approaching concave and convex surfaces.

METHODS: We created a mathematical model for a two-dimensional projection (i.e., radiograph) of curved surfaces in three-dimensional space (e.g., cortical surface). Concave and convex surfaces were defined to be surfaces from which all normals are convergent and nonconvergent, respectively. X-rays were represented as cones passing through the surfaces and creating corresponding projections on a plane (radiograph). Edges of cortical projections were considered to be the set of points on the projection created by x-rays tangent to the surfaces.

RESULTS: Using this model, we were successful in proving two theorems: (1) an intraosseous screw approaching a convex surface (e.g., the humeral head) cannot be proven to be extra-articular with a finite number of x-rays (assuming the exact position of the screw relative to the x-ray source is not predetermined); and (2) an intraosseous screw approaching a concave surface (e.g., the acetabulum) is definitively proven to be extra-articular if it appears to be so on a single view.

CONCLUSIONS: Based on these theorems, we have stated two laws. (1) When radiographically evaluating a screw approaching a convex surface, it is impossible to prove that the surface is not breached. Therefore, multiple views must be taken to best assure the viewer that screw placement is acceptable. (2) When evaluating a screw approaching a concave surface, only one view showing the screw to be completely within bone proves that it has not breached the surface.

FOOT AND ANKLE

5. Transmalleolar Osteotomy for Open Reduction and Internal Fixation of Talar Body Fractures

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Fracture of the talar body is rare and difficult to treat. Published rates of avascular necrosis following this injury range from 25-50% due largely to disruption of soft tissues at the time of injury and subsequently during surgery. A variety of surgical approaches have been used to treat talar body fractures. Transmalleolar osteotomies are useful to provide adequate exposure of the fracture while preserving the blood supply to the talus. The use of a medial malleolar osteotomy has been shown as an effective approach to the talar body for medially located injuries. Lateral malleolar osteotomies have also been described, but are less frequently utilized. We present here our technique and reasoning for medial and lateral malleolar osteotomies and one example of a patient treated with a bimalleolar approach for a talar body fracture.

The step-cut medial malleolar osteotomy was first described by Alexander and Watson in 1991. We review this approach and our recommended updates. Medial malleolar osteotomies are advocated to improve visualization of the mid-aspect of the medial talus while preserving the blood supply entering through the deltoid ligament. We also present our approach for the lateral malleolar osteotomy. The lateral malleolar osteotomy provides improved visualization of the mid-aspect of the lateral talar body. Recent studies looking at accessibility of osteochondritis dissecan (OCD) lesions through various surgical approaches show that the mid-20% of the talus both medially and laterally is not readily accessible through standard soft tissue approaches. Therefore, areas of comminution or fracture planes located in this area of the talus may benefit from an osteotomy.

Transmalleolar osteotomies are generally well tolerated. While lateral malleolar osteotomies are not frequently utilized, they can be a helpful tool in the treatment of talar body fractures. Preoperative planning including CT evaluation is essential for localizing fracture planes and areas of comminution. Fracture pattern and location should be used to determine whether medial, lateral, or bimalleolar osteotomies should be used for fracture reduction.

6. Calcaneonavicular Morphological Relationship in Calcaneal Fractures: A Retrospective Review and Analysis for Relationship with Fracture Severity and Achieved Reduction

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INTRODUCTION: The purpose of this study was to evaluate the calcaneonavicular (C-N) morphological relationship in all types of calcaneal fractures and determine if there is any relationship in severity of the calcaneal fracture sustained and in the ability to achieve accurate reduction.

METHODS: A retrospective radiographic review, consisting of plain film radiography and computed tomography (CT) cross-sectional images, was conducted. Variables evaluated were: (1) radiographic type of C-N relationship (C-N 1: wide gap; C-N 2: narrow gap with flattening; C-N 3: narrow gap with irregular cortices; C-N 4: osseous bridge); (2) C-N distance in 3 planes; (3) Sanders Classification; (4) Essex-Lopresti Classification; (5) preoperative/postoperative Bohlers angle; (6) too-long anterior process of the calcaneus (TLAP) presence or absence; and (7) absence of presence of calcaneal anterior process fracture. Patients were grouped according to mechanism of injury.

RESULTS: Calcaneal fractures in 77 patients (62 males, 15 females), with average age of 38.2 years, for a total of 93 fractures. Eighty-seven total fractures, 16 bilateral fractures, 31 right-sided and 30 left-sided. Sixty-six fractures were resultant from falls from a height. Average follow-up time was 299.6 days. The incidence for each C-N Type was 13.8% (12/87) for Type 1, 52.9% (46/87) for Type 2, 32.2% (28/87) for Type 3, and 1.2% (1/87) for Type 4. The results for the Essex-Lopresti classification for joint depression fractures were: 16.7% (2/12) for C-N type 1, 45.6% (21/46) for C-N type 2, 53.5% (15.28) for C-N type 3, and 100% (1/1) for C-N type 4. The percentage of intra-articular fractures (Sanders Classification) in each group was as follows: 25% (3/12) for C-N type 1, 45.7% (21/46) for C-N type 2, 57.1% (16/28) for C-N type 3, and 100% (1/1) for C-N type 4.

CONCLUSION: Our results indicate that the severity of the calcaneus fracture is largely determined by the anterior calcaneal morphology and the rigidity of that relationship.

HIP AND KNEE ARTHROPLASTY

7. Femoral Canal Preparation Using Pneumatic Broaching for Zweymuller-Type, Square-Tapered Hip Stems

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INTRODUCTION: Use of tapered titanium stems has gained popularity for total hip arthroplasty in the United States. Basic stem designs include a grit blast square tapered stem with distal fixation (Zweymuller-type) and a proximally porous coated flat wedge stem with proximal fixation (Muller-type). Both are inserted with a broach only technique, though the Muller stem is associated with a perioperative femoral fracture risk.

HYPOTHESIS: We theorize that pneumatic broaching allows for safe insertion of Zweymuller-type femoral implants and is associated with a low risk of fracture.

METHODS: A prospective evaluation of 300 consecutive total hip replacements was performed for perioperative complications, clinical and radiographic outcomes. Square-taper Zweymuller-type stems from eight different manufacturers were implanted. Surgical approaches were equally divided between posterolateral modified Kocher approach, and anterolateral Watson-Jones approach. A Woodpecker TM pneumatic broaching system was used in each case. Rotating residents (30+), initially unfamiliar with this broaching technique, performed the majority of the procedures.

RESULTS: Perioperative complications included intra-operative femoral fractures (2), post-operative femoral fractures (1), dislocations (1), and deep infections (2). One instance of implant removal occurred for deep infection. No significant differences were found in rates of complication by surgical approach, stem manufacturer, or operating surgeon experience.

CONCLUSION: The incidence of certain perioperative complications can be reduced by using Zweymuller-type stems using pneumatic broaching regardless of approach, implant manufacturer, or surgeon experience.

8. Early Experience with the Web-Based Cormet Hip Resurfacing Registry

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INTRODUCTION: A web-based U.S. registry to examine early data for the Cormet Hip Resurfacing system has been created. The registry template (Stryker Orthopaedics) will allow all implanting orthopedists to input basic data. We used a single site experience to assess ease, viability, and comparative value of this registry approach for data collection.

METHODS: Resurfacing procedures performed between 2002 and 2009 were included. Subjects were evaluated preoperatively and at six months postoperatively. An IRB-approved retrospective review of patient medical records was performed for these patients. Data collected included operative data, surgeon satisfaction rankings, pre- and postoperative comparative UCLA activity scores, visual analogue assessment of pain, and radiographic analysis. These were compared to internally collected records of Harris Hip score results for the study patients. These data sets were compared to assess value and consistency of the information obtained.

RESULTS: Information was available for 37 hips in 31 subjects, of which 27 were males and 4 were female, mean age 44.4 years. The initial results reveal a positive correlation between the UCLA activity scores and Harris Hip score. Additionally, age, BMI, and ASA scores demonstrate an inverse relationship with UCLA activity and Harris Hip scores. Time for completion of the registry data forms averaged five minutes.

CONCLUSIONS: The results support the usefulness of this standardized registry for compiling data from subjects implanted at multiple sites. The registry allows for evaluation of clinical outcomes of all enrolled subjects. Limited but important questions can be addressed using this approach for multicenter quality data assessment. Significant correlations may be recognized by using the pooled data from participating surgeons in the U.S.

9. Early Results of a Porous Tantalum Primary Femoral Hip Prosthesis

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INTRODUCTION: The successful use of proximally-coated tapered hip prostheses has been well-documented in the orthopedic literature. Similarly, a variety of implants utilizing a porous tantalum coating have been shown to have good results in primary and revision total hip arthroplasty (THA). The goal of this study is to report on the early results of a new proximally-coated, porous tantalum femoral hip prosthesis.

METHODS: A retrospective, single-surgeon case review of 74 patients (including 48 THAs and 26 hemiarthroplasties) using a porous tantalum femoral hip prosthesis was performed. Patient demographics were compiled as were pre- and postoperative clinical results including Harris Hip scores, modified Postel scores, and overall results at latest follow-up. Radiographic evaluation was conducted for all patients and assessed for osseointegration, component migration, and osteolysis.

RESULTS: Of the 74 patients, two passed away from causes unrelated to their hip surgery and were unavailable for follow-up. The remaining patients had an average age of 64.6 (range, 36-95) at the time of surgery. The average length of follow-up was 24 months (range, 12-36). Preoperative Harris Hip scores improved from an average of 43 (range, 15-65) to 88 (range, 61-96). There were 5 (6.8%) complications, including 2 (2.7%) intraoperative fractures and 3 (4.1%) dislocations. Radiographic evaluation revealed no cases of implant migration, subsidence, or osteolysis. There were no re-operations in this cohort.

CONCLUSION: At early follow-up, the porous tantalum femoral component provides appropriate improvements in outcome scores with an acceptable rate of complications. Further follow-up is necessary to validate the early success of this implant.

10. Return to Sexual Activity Following Total Hip Arthroplasty in Young Active Patients

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Improvements in THA implant design and advances in bearing materials have resulted in THA being performed in younger, more active patients. Numerous studies have identified return to sexual activity as a high priority for patients undergoing THA. The purpose of this study was to investigate the capacity of young active patients to return to sexual activity after THA.

A retrospective review of patients aged 18-60 who underwent primary THA due to non-inflammatory arthritis over a four-year period at five investigational sites was completed. Data was collected via administration of a telephone questionnaire by an independent third party survey center.

Data was collected on 710 consecutive primary THA patients with preoperative UCLA activity score of $\geq$6 and minimum one-year follow-up. 63.1% were males; 36.9% were females with an average age of 49.4 years; average length of follow-up was 2.4 years. 615 patients stated they have been sexually active since surgery. Of those patients, 68.1% rated the quality of sexual activity as “better” after THA; 27.5% as the “same”; 3.1% as “worse”; 44.1% stated they had sex more frequently after THA; 48.9% stated same frequency; 5.2% stated less frequency. Only 13.5% stated they had to limit their sexual activity due to their hip; 4.2% of patients felt hip instability at least once during sex.

Many young active patients return to baseline or higher level of sexual activity after THA, participating more frequently with higher rates of satisfaction and very few episodes of hip instability.

11. Return to Work Following Total Hip Arthroplasty in Young Active Patients

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There is limited information in the literature to advise patients, employers, and insurance companies about returning to work following THA. The purpose of this study was to investigate the capacity of patients under 60 to return to work after THA.

A retrospective review of patients aged 18-60 who underwent primary THA due to non-inflammatory arthritis over a four-year period at five investigational sites was completed. Data was collected via administration of a telephone questionnaire by an independent third party survey center. Physical job demands were coded according to the U.S. Department of Labor Dictionary of Occupational Titles.

Data was collected on 710 consecutive primary THA patients with preoperative UCLA activity score of $\geq$6 and minimum one-year follow-up. 63.1% were males; 36.9% were females with an average age of 49.4 years; average length of follow-up was 2.4 years. 610 patients (85.9%) were employed in the three months before surgery; jobs were categorized as: 35.6% sedentary; 47.4% light; 12.1% medium; 3.9% heavy; and 0.2% very heavy. After THA, 614 patients (86.5%) were employed (36.2% sedentary, 47.1% light, 11.7% medium, 4.1% heavy, and 0.2% very heavy). Of those who returned to work, 575 patients (93.6%) returned to their preoperative occupation. Fourteen patients (2.28%) who did not return to their preoperative occupation stated this was due to their hip.

Young active patients employed before THA surgery can reasonably expect to return to their preoperative occupation and at the same demand level. Very few will be unable to return to work due to their hip.

12. Augmentation of the Periacetabular Osteotomy with Hip Arthroplasty: Is There a Benefit?

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INTRODUCTION: Periacetabular osteotomy (PAO) is an effective surgical treatment for acetabular dysplasia. However, results can be compromised by residual intra-articular disease not addressed with the osteotomy. The purpose of this study was to evaluate the impact of hip arthroscopy performed in conjunction with a PAO. We recorded arthroscopic findings, arthroscopic techniques utilized, and impact on surgical decision-making.

METHODS: We reviewed 26 patients (26 hips) selected for treatment with a combined hip arthroscopy and periacetabular osteotomy. The mean age was 30 years (range, 16-47). There were 24 females and 2 males. All patients had symptomatic acetabular dysplasia with mechanical symptoms and/or MRA evidence of a labral tear.

RESULTS: Twenty-one (81%) hips had a labral tear, 18 (70%) had chondromalacia, and 11 (52%) had ligamentum teres fraying (9) or tear (2). Two of the chondromalacia lesions were full thickness loss of acetabular articular cartilage. Labral recontouring was performed for 18 tears, while 3 tears were repaired. Acetabular chondroplasty was performed in eight hips and microfracture in two hips. Ligamentum teres debridement was performed in 11 hips. The hip scope provided no additional treatment in 4 or 15.3% of cases. The PAO was aborted in one hip due to advanced articular disease observed at arthroscopy.

CONCLUSION: Hip arthroscopy performed in conjunction with a PAO can provide additional joint preserving treatments not typically performed at the time of PAO. Nevertheless, it is challenging to select patients who may benefit from a combined procedure. Long-term follow-up of this technique is needed to define efficacy.

13. Critical Evaluation of Component Position and Leg Length Measurement Following MIS-2 Incision Total Hip Arthroplasty

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INTRODUCTION: Minimally invasive total hip arthroplasty (THA) has been performed at St. Louis University School of Medicine since 2000. This study is a critical appraisal of acetabular and femoral component positioning and an evaluation of leg length discrepancy observed in a series of 250 consecutive procedures using the Zimmer MIS-2 Incision arthroplasty technique.

METHODS AND MATERIALS: A consecutive case series of 250 patients who had primary total hips performed with Zimmer MIS-2 incision technique had preoperative and postoperative films critically evaluated for acetabular cup positioning as well as femoral stem positioning. Preoperative and postoperative leg length inequality was evaluated as well.

RESULTS AND DISCUSSION: Despite published reports of compromised implant positioning, our experience indicates that both component alignment and restoration of normal leg length is improved over many series using traditional techniques. Our findings indicate that the technique need not be restricted to younger, smaller patients. Evolutionary improvements in the surgical technique and pitfalls of the procedure are discussed. Despite the demonstrated advantages, MIS-2 total hip arthroplasty remains a challenging technical alteration from traditional operative methods.

14. Revisions Following Metal-on-Metal Resurfacing Arthroplasty

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OBJECTIVE: Metal-on-metal (MOM) hip resurfacing is becoming an accepted option to consider when treating younger and more active patients. Advantages include preservation of bone stock and a larger femoral head which increases range of motion without risk of dislocation. The purpose of this study is to examine whether learning curve could be identified for a single operative surgeon over a five-year period of resurfacing procedures.

METHODS: The data presented here were collected as part of an IDE Study to assess the safety and effectiveness profile of the Cormet 2000 device. All patients were followed using standardized questionnaires, physical examinations, and radiographic evaluations. Data presented here is from our single-center experience for patients with a minimum follow-up of three years.

RESULTS: Eighty-nine hips were identified in 88 subjects. Females accounted for 56% of the first 25 subjects enrolled and only 23% of subjects 26-88. Thirteen of 89 hips required revision surgery during follow-up (range 4 months to 6.2 years). Although 33% of all patients were female, they accounted for 62% of the revision cases. Seven of eight failures among subjects 1-25 occurred at or beyond four years. Only two early device failures (<2 years) were identified in the study, and both occurred in the subject 26-89 group.

CONCLUSIONS: Taken together, we propose the apparent “learning curve” may not be technical in nature but rather influenced by changes in patient selection by the operative surgeon. We cannot identify any specific time where changes in patient selection were made and can only assume the criteria evolved as information regarding the risks of resurfacing were reported.

15. National Trends in Primary Total Hip Arthroplasty: A Population-Based Study

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INTRODUCTION: Data on national trends for total hip arthroplasty is limited. The aim of this study was to describe these trends in the past 15 years in patients undergoing primary total hip replacement.

METHODS: The National Hospital Discharge Surveys (NHDS) from 1990 to 1994 and from 2002 to 2006 were used. The data was weighted to allow national estimates. Only patients 50 years or older who underwent primary total hip arthroplasty for osteoarthritis were selected. Changes in demographics, hospital stay, disposition, and payment were reported.

RESULTS: A total of 1,172,332 procedures were estimated in the period 1990-94 and 2,998,348 in 2002-06. Average age in the first group was 70 years vs. 68 years in the second group ($p<0.001$) with 6.9% of patients being non-white vs. 8.8% respectively ($p<0.001$). Mean length of stay was 8.2 days vs. 3.8 days ($p<0.001$) with a higher percentage of patients discharged to short/long-term facilities in the most recent period (22.1% vs. 40.4%; $p<0.001$). Hospitals with less than 300 beds were more common in the most recent group (62.8% vs. 71.5%; $p<0.001$) with Medicare paying less of this procedure (71.5% vs. 61.6%; $p<0.001$).

DISCUSSION: Total hip arthroplasty is being performed in younger patients with increase percentage in minorities. Length of stay has decreased with an increase in the number of patients going to short/long-term facilities. Most surgeries are being performed in smaller hospitals and payment from Medicare has decreased in recent years.

16. Use of a Novel Fibrin Sealant in Total Hip And Knee Arthroplasty

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INTRODUCTION: There are many modalities available to minimize blood loss during total knee (TKA) and total hip (THA) arthroplasty. Evicel is an FDA approved fibrin sealant that may be utilized as a haemostatic agent during THA and TKA. The purpose of this study is to compare intra- and postoperative blood loss parameters in a group of patients using our standard haemostatic protocol (SHP) with and without Evicel as an adjuvant agent.

METHODS: A retrospective review of 91 patients (31 with Evicel and 60 without) who underwent unilateral primary THA or TKA by a single surgeon, over an eight-month time period, was performed. Routine patient demographics, postoperative drainage, intraoperative blood loss, and hematocrit and hemoglobin pre- and post-surgery were recorded. A two-tailed Student's T-test was used to compare the groups with $p<0.05$ representing a significant result.

RESULTS: Mean intraoperative blood loss for the Evicel and SHP groups were 237 ml and 325 ml, total blood loss was 510 ml and 663 ml ($p<0.06$), and mean hematocrit change pre-operatively and in the recovery room was 5.03g/dl and 6.35g/dl ($p=0.05$), respectively. The mean number of allogenic blood transfusions was 0.3 units and 0.13 units for the Evicel and SHP groups. There were no differences in clinical outcomes or complication rates for either group.

CONCLUSIONS: Adding Evicel to our SHP results in a significant decrease in the mean hematocrit change with a favorable trend in hemoglobin change and mean total blood loss; however, there was no significant difference in transfusion rates in this study.

17. Mortality Risk Scores as Outcome Predictors in Geriatric Patients After Knee and Hip Arthroplasty

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INTRODUCTION: The American Society of Anesthesiologist Physical Status Classification Scale (ASA) and Charlson Comorbidity Index (CCI) may predict early adverse outcomes in geriatric patients after total knee or hip arthroplasty (TKA or THA). This may be useful to categorize patients in clinical trials and/or to develop health care policy.

METHODS: A cohort of consecutive geriatric patients (>65 years) undergoing TKA or THA was followed prospectively. Demographics, comorbidities, complications (systemic, local, minor, and major), surgical and hospitalization information, and readmission and/or reoperation within 90 days were collected. Preoperative ASA and CCI were calculated in each patient. Adjusted hierarchical stepwise multivariate regression models were used to analyze associations and relative risks of ASA and CCI with complications, length of stay (LOS), readmissions, and reoperations.

RESULTS: 502 patients underwent 550 procedures (304 TKA, including 48 bilateral [B/L], and 198 THA). Average ASA was 2.5±0.63 (1-4) and CCI was 1.4±1.4 (0-8). Mortality was 0.95%. Patients were 1.22x more likely to have longer LOS per each point of the ASA ($p<0.0001$), and 1.08x more likely per each point of the CCI ($p<0.0001$); 2.3x more likely to have a major systemic complication per each point of the ASA ($p<0.0001$); 1.48x more likely to have a major systemic complication ($p<0.0001$); and 1.23x ($p=0.035$) and 1.28x ($p=0.044$) more likely to be readmitted and have a reoperation per each index point of the CCI.

CONCLUSION: ASA and CCI are good predictors of major systemic complications in geriatric patients after TKA or THA. However, only CCI is a good predictor of readmission and reoperation rates.

18. Early Results with the Posterior Cruciate Referencing Technique and Posterior Sloped Tibial Inserts in Total Knee Arthroplasty

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INTRODUCTION: The Posterior Cruciate Referencing Technique (PCRT) for total knee arthroplasty (TKA) uses innovative instrumentation and tibial inserts with varying posterior slopes, and is designed to maximize motion and stability in cruciate-retaining knees, while preserving bone and ligament integrity. This study evaluated early clinical results for this technique.

METHODS: An IRB-approved, retrospective, single-site, single-surgeon study was conducted earlier this year. Between 2007 and 2008, 50 consecutive patients were put into two groups: Group 1 included patients undergoing CR TKA using standard technique and implants and Group 2 included patients undergoing CR TKA using PCRT. Demographics, surgical time, length of stay (LOS), range of motion, and Oxford Knee Scores (OKS) were collected.

RESULTS: Data sets were complete on 41 patients. Follow-up averaged 14 months for Group 1 and 9 months for group 2. Both groups had a mean age of 66.4, were 51% female, and had an average BMI of 30.6. LOS was 1.25 days for Group 1 and 1 day for Group 2 ($p=0.011$). Surgical time was 48 minutes for Group 1 and 46 minutes for Group 2 ($p=0.184$). Average flexion was 118° for Group 1 and 123° for Group 2 ($p=0.073$). OKS were 92-94% good and excellent with a mean of 20.4 for both groups.

CONCLUSION: The learning curve for PCRT and the associated instrumentation and implants did not adversely affect clinical results. Instead, the data indicated a small savings in surgical time and a moderate, but not statistically significant, increase in flexion. LOS, however, was significantly shortened. PCRT may allow for better PCL function while preserving bone and reducing surgical manipulation, and with tibial inserts of varying posterior slopes, may improve flexion, stability, and function in CR TKA. Further study is warranted.

19. Use of Stature Specific Femoral Components in Total Knee Arthroplasty

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INTRODUCTION: There has been significant interest in gender specific knee implants. The ADVANCE Knee System has taken an approach toward stature specificity rather than gender specificity.

HYPOTHESIS: That the introduction of a stature specific femoral component (narrower medial-to-lateral for same given A-P height with a shorter anterior flange) would be readily adopted in clinical practice

MATERIALS AND METHODS: A retrospective review of 24 months of one surgeon's primary TKR practice was performed to document the utilization of stature components.

RESULTS: 554 primary TKRs were performed during this period. 331 (60%) of the femoral components used were stature specific. 82% of females and 33% of males received the stature component.

DISCUSSION: The release of a stature specific knee has been readily used across gender to better fit the distal femur. This has allowed more appropriate matching of components without the risk of flexion instability from downsizing femoral component (anterior referencing system) to prevent medial-lateral overhang.

CONCLUSION: There is a clinically perceived need for stature specific components in total knee arthroplasty.

20. The Rationale and Validation of an Automated Web-Based Electronic Data Capture Measurement Tool

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INTRODUCTION: The trend toward evidence-based decision-making in orthopedics requires the analysis of large sets of data in real time that can direct clinical decision-making. We have developed an automated web-based electronic data capture (EDC) software system designed to simplify and make more time and cost efficient orthopedic data collection and analysis. The purpose of this study is to validate the radiographic measurement tool of the EDC software system.

METHODS: Twenty-eight consecutive unilateral TKAs were performed on 28 patients. Coronal mechanical axis and sagittal tibial and femoral axis radiographic measurements were obtained preoperatively and one month postoperatively. Two blinded observers analyzed the radiographs; one using an industry standard electronic measurement tool and the other the measurement tool of the web-based EDC software system. A paired t-test was used to evaluate measurement variation between observers.

RESULTS: There was no statistically significant difference in preoperative mechanical axis (.18°, $p>.05$), postoperative mechanical axis (.25°, $p>.05$), postoperative femoral component axis (.68°, $p>.05$), and postoperative tibial component axis (1.07°, $p>.05$) measurements performed using the two separate measuring tools.

DISCUSSION: The results of this study validate the ability of the web-based software system to collect and process radiographic measurements. An automated web-based EDC software system allows for the full integration of patient demographic, radiographic, and perioperative clinical variables in a fully searchable, instantaneously updateable, and easily analyzed database. It is anticipated that this unique approach will allow surgeons to gather a wealth of searchable and quantifiable data that can quickly, accurately, economically, and efficiently shape clinical decisions.

21. An Evaluation of Outcomes of Joint Arthroplasty in Orthotopic Liver Transplant Recipients

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BACKGROUND: The safety of joint replacement in liver transplant recipients has been debated. There have been only a few small studies regarding joint arthroplasty in liver transplant patients which have yielded conflicting results. This study evaluates the outcomes of patients who have undergone joint replacement following liver transplantation at one institution.

METHODS: Thirteen liver transplant patients who underwent a total of 17 arthroplasties, (6 total hips, 1 hip revision, 9 total knees, 1 knee revision), from 1997 to 2007 were followed. The indications for joint replacement were avascular necrosis in 4 hips and osteoarthritis in 2 hips and 9 knees. Two patients underwent revision of a previous arthroplasty; 1 for osteolysis about the hip and 1 for arthrofibrosis of the knee. Patients underwent arthroplasty at a mean of 6.9 years (6 months to 13.8 years) following liver transplantation. The mean age of these patients at the time of surgery was 57.4 years (28 to 76). Hospital stays averaged 5.2 days (1 to 8 days).

RESULTS: The patients were followed for an average of 4.5 years. None of the patients have developed component loosening; however, one did have recurrent hip dislocation which required revision. Postoperative complications included 2 DVTs, 3 blood transfusions, 1 irregular heart rhythm requiring cardioversion, 1 mild superficial wound infection resolved with oral antibiotics, 1 hematoma, and 1 knee manipulation. Despite the immunocompromised status of these patients, there were no reported infections.

DISCUSSION: This study suggests that stable liver transplant recipients may safely undergo joint replacement surgery.

SPORTS

22. Effect of Retrograde and Antegrade Interference Screw Tibial Fixation on Intra-Articular Graft Tension

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INTRODUCTION: Tensile force applied to the graft during tibial fixation may not fully transfer to the intra-articular portion of the graft. The purpose of this study is to determine the effect of retrograde and antegrade bioabsorbable interference screw (BIS) tibial fixation on intra-articular graft tension in soft tissue anterior cruciate ligament (ACL) reconstruction.

METHODS: Ten matched pairs of cadaveric tibias received one of two tibial fixation constructs using quadrupled hamstring grafts. Group 1 was fixed with an antegrade, 35 mm BIS; and Group 2 was fixed with a retrograde, 20 mm aperture BIS. The specimen was mounted proximally to the load cell, with the displacement force vector in line with the tibial tunnel, and distally to the testing jig to ensure measurement of intra-articular graft tension. The construct was pre-tensioned (10-30 N, 0.1 Hz, 10 cycles), a baseline tension of 25 N was introduced, and the change in intra-articular graft tension before and after screw insertion was recorded.

RESULTS: There were no significant segmental (proximal, middle, distal) BMD differences between study groups as measured by quantitative computed tomography (p-value=0.1055, 0.8457, 0.4316). The antegrade BIS had a higher maximum insertion torque (mean±SD: 8.15±2.22 in-lb, 6.42±2.44 in-lb, p-value=0.0273) and exhibited a larger increase in intra-articular graft tension compared to the retrograde BIS (38.34±17.91 N, 7.58 N±14.40, p-value=0.0039), respectively.

CONCLUSIONS: Antegrade bioabsorbable interference screw tibial fixation in soft tissue ACL reconstruction significantly increases the intra-articular graft tension compared to retrograde screw fixation.

23. Biomechanical Comparison of a Single versus Double ACL Tibial Fixation in an Osteoporotic Model

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INTRODUCTION: The purpose of this study was to determine if dual (aperture and distal) tibial fixation offers a biomechanical advantage over traditional distal fixation in cadaveric tibias with low bone mineral density (BMD).

METHODS: Ten matched pairs of cadaveric tibiae underwent simulated ACL reconstruction using quadrupled hamstring grafts with one of two tibial fixation constructs. Group 1 was fixed with an antegrade, 35 mm distal bioabsorbable interference screw (BIS), and Group 2 was fixed with a retrograde, 20 mm aperture BIS, and an antegrade, 17 mm distal BIS. Each construct was cyclically loaded (50-200 N, 1 Hz, 500 cycles) and subsequently loaded to failure (20 mm/sec).

RESULTS: There were no significant segmental (proximal, middle, and distal) BMD differences between groups (p-value=0.1055, 0.8457, 0.4316). Group 1 had a higher maximum insertion torque compared to group 2 (mean ± SD: 8.15±2.22 in-lb, 6.42±2.44 in-lb, p-value=0.0273). Three constructs in group 1 and one construct in group 2 failed due to graft slippage during cyclic loading. Of the remaining specimens, there were no significant differences in cyclic displacement (2.06±1.28 mm, 3.76±1.58 mm, p-value=0.2188), maximum cyclic stiffness (177.95±24.81 N/mm, 165.34±30.40 N/mm, p-value=0.8125), maximum load at failure (461.17±99.30 N, 394.17±106.41 N, p-value=0.5781), or pullout stiffness (203.19±31.43 N/mm, 197.78 ± 39.93 N/mm, p-value=0.9375) between group 1 and group 2, respectively.

CONCLUSIONS: In tibias of low bone mineral density, there was a lower rate of graft fixation failure with double tibial fixation compared to single fixation alone in soft tissue graft ACL reconstruction.

24. The Effect of Femoral Condyle Size on Articular Cartilage Defect Contact Pressures

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Cartilage injuries to the knee are very common. Current algorithms use 2 cm^2 as a threshold to use more advanced articular cartilage restoration techniques in the symptomatic patient. This threshold may be different depending on the size of the individual. The purpose of this study was to determine what effect femoral condyle size would have on defect contact pressure. The hypothesis was that smaller condyles would have a smaller defect size causing subchondral contact than larger condyles.

METHODS: Ten fresh bovine knees and ten fresh porcine knees were used for this study. Specimens were mounted and loaded on a MTS Machine and loaded to ½ body weight. Full thickness cartilage defects were made with dye punches of known sizes and symmetrically enlarged. Pressure readings were made using a Tekscan digital sensor and repeated for each sized defect.

RESULTS: Significant subchondral bone contact in porcine knees was seen at defect areas of 1.27 cm^2. This is in contrast to the bovine knee data, where significant contact occurred at 1.99 cm^2. Porcine knees measured, on average, 39.52 mm in the sagittal plane, while bovine knees averaged 66.33 mm in the sagittal plane.

DISCUSSION: Underlying bone structure, femoral condyle size, does have an impact on progression of articular cartilage lesions. A single cutoff value for initiating treatment is likely inadequate. Further study is needed to elicit the exact relationship between underlying bone structure and cartilage defect sizes at which treatment is indicated.

25. Intra- and Inter-Tester Reliability of the Dial Test

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INTRODUCTION: The dial test is commonly used during physical examination of the knee to evaluate the integrity of the posterolateral stabilizing structures by measuring external rotation of the tibia at 30° and 90° of flexion. There is a paucity of data in the literature on the reliability of this test. The purpose of this study is to report the intra- and inter-tester reliability of the dial test performed on normal knees using a digital inclinometer.

METHODS: Twenty-four healthy subjects (11 males, 13 females) between the ages of 19 and 28 years (mean age=22.5 years) participated. Exclusionary criteria included a prior history of knee injury. Both knees were tested in 30° and 90° of knee flexion with the subject positioned supine. Examiner order and testing position were randomized. The second metatarsal on the plantar aspect of the foot was used as a reference for placement of the digital inclinometer. Examiners were blinded to inclinometer readings.

RESULTS: The mean external rotation for all knees was 39° ± 9° at 30° and 34° ± 8° at 90°. Intra-tester reliability for examiner 1 yielded an intra-class correlation coefficient (ICC) of .81 at 30° and .88 at 90°. ICCs for examiner 2 were .86 and .88 for 30° and 90° respectively. Inter-tester reliability yielded ICCs of .74 at 30° and .83 at 90°.

CONCLUSION: The dial test performed with a digital inclinometer has acceptable intra- and inter-tester reliability for clinical use and interpretation in the office setting.

26. Results of the Supine Dial Test in Asymptomatic Soccer Players

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INTRODUCTION: Previous reports indicate that soccer players have increased knee varus, static external tibial torsion, and premature development of knee osteoarthritis. The purpose of this study was to determine if asymptomatic soccer players demonstrate side-to-side asymmetry in knee external rotation.

METHODS: Forty healthy soccer players (20 male, 20 female), ages 18-40 years, who had been playing soccer for a minimum of ten years, were enrolled in this study. Exclusion criteria were previous knee surgery, history of grade 2 or 3 collateral or cruciate ligament sprain, current knee pain, or abnormal ligamentous knee exam. Demographics including age, gender, BMI, dominant (kicking) leg, and number of years' participation in organized soccer were recorded. The dial test at 30° and 90°of knee flexion was performed in the supine position using a digital inclinometer with both evaluator and subject blinded to the result. Intracondylar distance (ICD) was measured for all patients.

RESULTS: Mean age was 28 years (22-41), BMI was 24.2 (20-31), age at initiation of soccer activity was 7.5 years (4-16), and number of years played was 16.5 (10-24). Mean external rotation at 30° measured 35.9 (20-54) vs. 33 (19-52) in the dominant and non-dominant legs, respectively (p=0.007). Mean external rotation at 90° measured 27 (14-43) vs. 26.5 (15-48) in the dominant and non-dominant legs, respectively (p=0.56). Mean ICD for male and female soccer players was 16.8 mm (0-55) and 3.5 mm (0-25), respectively (p=0.012). There was no correlation between ICD and the dial test at either 30° or 90°.

CONCLUSIONS: Experienced soccer players demonstrated increased external rotation of the dominant leg when the supine dial test is performed at 30° of knee flexion. Male soccer players demonstrated significantly larger ICD, indicating increased varus alignment than female soccer players. However, ICD did not correlate with the dial test result.

27. Halt of Catabolism of Degenerative Chondrocytes with a Growth Factor-Loaded Hydrogel

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We hypothesized that an injectable pentablock co-polymer hydrogel can be created with a specific concentration of tissue inhibitor of metalloproteinase-2 (TIMP-2, a catabolic inhibitor molecule), bone morphogenetic protein-4 (BMP-4, a chondrogenic growth factor), and/or transforming growth factor – b3 (TGF-β3, fibrochondrogenic growth factor), and can stimulate the healing and slow the degradation of the intervertebral disc cells.

MATERIALS AND METHODS: In the Orthopaedic Research Laboratory an injectable synthetic co-polymer hydrogel (PAE-PEG-PCL-PEG-PAE) was created and infused with either TIMP-2, BMP-4, TGF-β3, or a combination of the three. We acquired cells representative of intervertebral disc chondrocytes (initially articular chondrocytes which are similar to nucleus pulposus cells) and induced degenerative changes with the use of chondroitinase ABC for a period of 24 hours. This created cells with phenotypes similar to degenerative disc cells. A batch of cells was designated as the control. We then rinsed and seeded the cells into a synthesized hydrogel containing growth factors (TIMP-2, BMP-4, TGF-β3, or in various combinations). The cells were then allowed to incubate for 24 hours, 48 hours, and 1 week prior to retrieval. After incubation, the cells were examined histologically and quantitative PCR was used to characterize collagen types I, II, X, and aggrecan.

RESULTS: After the treatment of the chondrocytes with chondroitinase ABC, a degenerative cell line was predicatively created, marked by a reduction in collagen I, II, and aggrecan and increased collagen X expression. The cells, once incubated with TIMP-2, BMP-4, and TGF-β3, individually showed regenerative properties both in their synthesis of collagens and aggrecan. However, the addition of the catabolic inhibitor, TIMP-2, in combination with the growth factors in a hydrogel matrix allowed sustained release of these factors and the chondrocytes' growth were enhanced and well sustained.

CONCLUSION AND DISCUSSION: Creation of the synthetic co-polymer hydrogel infused with growth factors can be challenging, but when accomplished one can create a medium with which to deliver these products to degenerative cells and slow their degradation. Chondrocytes harvested from the annulus fibrosus and nucleus pulposus of New Zealand White rabbits is forthcoming.

28. Arthroscopic Treatment of Localized Pigmented Villonodular Synovitis of the Knee

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INTRODUCTION: Pigmented villonodular synovitis (PVNS) is a proliferative disorder that may lead to joint destruction and limitations in activity. The purpose of this study is to describe the results of arthroscopic excision of localized pigmented villonodular synovitis (LPVNS) of the knee.

METHODS: The records of all patients treated with arthroscopic excision of LPVNS of the knee at our institution from 1983 to 2006 were reviewed; no patients were excluded. Patient demographics (age, gender, body mass index, and leg dominance) were recorded. Functional outcome measures including pre- and postoperative Ogilvie-Harris scores (OHS), Tegner activity level, and UCLA activity level scores were calculated. Wilcoxon signed rank test was used for pre- to postoperative analysis.

RESULTS: Thirteen patients were identified and 2 were lost to follow-up, leaving 11 patients (9 men and 2 women) for review with a mean follow-up of 112 months (range, 25 to 223 months). Mean age was 34.1 years (range, 16-72 years). There were minimal improvements in preoperative to postoperative OHS (mean ± SD: 5.91 ± 1.58 to 8.09 ± 3.59, p-value = 0.0742), Tegner (6.73 ± 2.10 to 6.09 ± 1.45, p-value = 0.1172), and UCLA (7.73 ± 2.97 to 8.27 ± 1.49, p-value = 0.9922) activity level scores indicating that in general patients maintained preoperative activity levels over time. There were two cases of pathologically confirmed recurrences requiring re-excision. Both were localized to the posteromedial compartment. One patient developed late osteoarthritis requiring subsequent surgical intervention.

CONCLUSION: Arthroscopic excision of localized pigmented villonodular synovitis of the knee results in maintenance of activity level over time. Recurrence is possible, particularly in posteromedial lesions.

29. Introduction of Dynamic MRI for Kinematic Assessment of Patellar Realignment Procedures

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INTRODUCTION: The clinical presence of patellar maltracking is often described by the "J-sign", or the movement of the patella past the lateral trochlear edge in full extension. This case study introduces pre- and postoperative dynamic MRIs in order to provide quantitative radiographic evidence of the presence of the "J-sign" preoperatively and its elimination following a realignment procedure.

METHODS: Pre- and postoperative MRIs were obtained in order to evaluate patellar kinematics with the quadriceps contracted at 20° of flexion and full extension. Axial CT scans were also used to assess rotational alignment across the entire limb in order to determine the best location for surgical correction.

RESULTS: Preoperatively, the patella moved laterally 4.1 mm upon contraction of the quadriceps muscle. The preoperative congruence angle measured 29.6 mm in the actively extended position. Postoperatively, a congruence angle change of 19.8° and a lateral patellar displacement reduction of 8.8 mm confirmed adequate medialization of the patella post-operatively when in full extension. Additionally, lateral patellar displacement only changed 0.6 mm when moving from active flexion to extension postoperatively.

DISCUSSION/CONCLUSION: The lateral movement of the patella upon contraction of the quadriceps confirms the preoperative clinical finding of the "J-sign" as the leg reaches full extension. Postoperatively, the absence of change in lateral patellar displacement as the leg moves from flexion to extension suggests elimination of the clinical "J-sign". Maltracking is corrected postoperatively as confirmed by the reduction in lateral patellar displacement as well as the congruence angle during active extension, indicating medialization of the patella. Reduction in lateral patellar movement during active extension of the quadriceps, and, thus, the elimination of the "J-sign", is an important finding as patellar instability is greatest as the knee reaches full extension. Dynamic MRI is an excellent tool for the assessment of patellofemoral kinematics both pre- and postoperatively.

30. Sonographically Guided Popliteus Tendon Sheath Injection: Techniques and Accuracy

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OBJECTIVE: To describe two sonographically guided popliteus tendon sheath injection techniques and determine their accuracy in a cadaveric model.

METHODS: A single experienced operator completed 24 sonographically guided popliteus tendon sheath injections, 12 using a longitudinal approach and 12 using a transverse approach relative to the tendon. Injection order was randomized and all injections were completed with diluted colored latex. Co-investigators blinded to the injection technique dissected each specimen and graded colored latex location as accurate (in the sheath), accurate with overflow (within the sheath but also in other regions), or inaccurate (no latex in sheath).

RESULTS: All 12 sonographically guided popliteus sheath injections using the longitudinal approach placed latex into the sheath. Eight of these injections (67%) also resulted in overflow into the knee joint. Ten of 12 transverse approach injections placed latex into the sheath (83%), with 7 of these (70%) also producing overflow into the knee joint. Two of 12 transverse injections (17%) placed latex only into the knee joint and were, therefore, inaccurate.

CONCLUSIONS: Sonographic guidance can be utilized to inject the popliteus tendon sheath with a high degree of accuracy. Although the longitudinal approach is potentially more accurate, both approaches may result in injectate overflow into the knee joint, likely through the popliteus hiatus.

SPINE

31. The Utility of MRI Myelography in the Diagnosis of Spinal Disorders

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MRI is now considered the gold standard of spinal diagnosis. In most settings, it utilizes a series of sagittal and coronal slices in the T1, T2, as well as stir sequence modes. This technology largely replaced standard radiographic contrast myelography enhanced with CT sectioning due to the fact that MRI was largely non-invasive. MRI also provided additional enhanced information regarding intramedullary lesions of the cord, as well as subtle intraosseous marrow replacing pathologies, and qualitative changes in disc hydration. Myelography, however, still plays a major role in patients having pacemakers or other ferromagnetic devices such as mechanical heart valves, aneurysm clips, and other metallic foreign bodies that are not considered candidates for MRI. Myelography as well has continued to be a preferred study in many who have spinal deformity such as scoliosis. At our institution, our radiologist introduced the technique of MRI myelography using T2 HASTE image sequencing as a standard part of our spinal imaging studies in a hope to enhance the diagnostic information available and hopefully decrease the need to require both studies to be performed on the same patient. This has given us a significant amount of experience identifying cases where the diagnostic information contained in the MRI myelogram has enhanced our diagnosis as compared to having only the standard MRI data.

We are presenting five cases that we feel have been of particular interest in enhancing the diagnosis as a result of that information, and to introduce a technique that could be widely used as a simple add on study sequence to the standard MRI providing enhanced diagnostic information. This technique of T2 HASTE image myelography adds an antero-posterior view, a lateral view, and two oblique views each requiring less than two seconds of image sequencing time making these additions easily obtained at virtually no additional cost.

32. The Incidence of C5 Palsy After Multilevel Cervical Decompression Procedures: A Review of 750 Consecutive Cases

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INTRODUCTION: Palsy of the C5 nerve is a well-known potential complication of cervical spine surgery with reported rates ranging from 0-30%. The exact etiology remains uncertain, but has been attributed to iatrogenic nerve injury during surgery, tethering of the nerve root from shifting of the spinal cord, spinal cord ischemia, and reperfusion injury of the spinal cord. It is not currently known whether anterior, posterior, or combined procedures are associated with increased rates of C5 palsy. The purpose of this study was to review the incidence of C5 palsy in a large consecutive series of multilevel cervical spine decompression procedures.

METHODS: A retrospective analysis of 750 consecutive multilevel decompressive cervical spine surgeries performed by a single spine surgeon was conducted. We included patients undergoing multilevel anterior cervical corpectomy, anterior corpectomy followed by posterior fusion, posterior laminectomy and fusion and laminoplasty procedures for the treatment of cervical spinal stenosis. Patients were excluded if there was lack of adequate follow-up data, spinal cord injury preventing preoperative or postoperative motor testing, or if the decompressive surgery did not include the C5 level. Incidence of C5 palsy was determined and compared to determine if statistically significant differences existed among the various procedures, patient age, and gender. Statistical analysis was performed using chi-squared analysis with significance defined as a p-value of less than 0.05.

RESULTS: Of the 750 patients, 120 were eliminated based on the exclusion criteria. The 630 patients included in the analysis consisted of 292 females and 338 males. The mean age was 58 years (range, 19-87). The incidence of C5 palsy for the entire group was 42 of 630 (6.7%). The incidence of C5 palsy was highest in the laminectomy and fusion group (9.5%), followed by the anterior corpectomy-posterior fusion group (8.4%), anterior corpectomy alone group (5.1%), and finally the laminoplasty group (4.8%), although these differences did not reach statistical significance. The majority of cases were noted within one week of surgery, but delayed onset of up to two months was observed. Age at the time of surgery was not identified as a risk factor. Males were more likely to develop C5 palsy 8.6% versus females 4.5%, but this did not reach statistical significance (p=0.056). Almost all patients recovered full strength in the affected extremities although recovery time was variable.

CONCLUSION: The incidence of C5 palsy following cervical spine decompression was 6.7%. This is consistent with previously published studies and represents the largest series of patients to date. Based on these data, there is no statistical difference in the incidence of C5 palsy

based on the surgical procedure although a trend towards higher rates of palsy was observed in our laminectomy and fusion group and our anterior/posterior fusion group.

TRAUMA

33. SIGN Nail versus Standard Stainless Locked Nail Using a Subtrochanteric Fracture Model: A Mechanical Comparison♦

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INTRODUCTION: SIGN nail is an integrated locked femoral nailing system that uses hand reamers and solid core nails combined with an open reduction. Interlocking screws are placed without fluoroscopy. Clinical outcome data is available, but there is little data on the mechanical performance of this device. The purpose of this study was to assess the biomechanical properties of the SIGN system compared to contemporary stainless femoral nailing systems.

MATERIALS AND METHODS: Twenty synthetic femurs were randomly assigned to the SIGN nail or Standard nail. Femurs were potted to simulate single-leg stance using a MiniBionix 858 testing in a fixed position. All femurs were initially tested to confirm specimen consistency. Femurs were then instrumented using a SIGN nail and Standard trochanteric entry nail. An unstable subtrochanteric defect fracture pattern was produced. Specimens underwent axial compressive loads (500 Newtons [N] at 10 N/sec). A final trial to failure was performed. Stiffness and load to failure was calculated for all groups

RESULTS: There was no significant difference in stiffness between the SIGN and Standard nails. The SIGN nail demonstrated a lower mean load to failure, but was not significant. Mode of failure was similar for both nails.

DISCUSSION AND CONCLUSION: For non-comminuted proximal femur fractures, the SIGN nails biomechanical performance is similar to contemporary stainless nailing systems. The ability to reliably apply interlocking screws without the need for fluoroscopy combined with contemporary nail performance biomechanics makes this device an ideal fixation device for those institutions with limited resources for the treatment of femoral pathology.

34. An Electronic Method to Rank Order Fracture Severity Across Multiple Institutions

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PURPOSE: Rank order analysis is a more reliable technique to stratify fracture severity compared to traditional fracture classification. As typically utilized, however, rank ordering has serious limitations: it applies to a specific series of cases, allowing neither addition of new cases nor multi-institutional pooling. We introduce an innovative method that allows clinicians to rank order an ever-expanding series of fractures electronically, portably, and across institutions. We hypothesized that orthopedic surgeons would display excellent inter-observer agreement when using these methods to stratify tibial plateau fractures according to their severity.

METHODS: Apple's iTunes software and its cover flow format for browsing album artwork were utilized to display and stratify AP and lateral radiographs of 26 tibial plateau fractures. Using iTunes podcasting, new cases were added to a growing rank ordering queue, dynamically updated on the computers of observers over the internet, and displayed in continuous cover flow mode. Once received, cases were independently ranked into "playlists" at three centers by experienced orthopedic traumatologists. Individual playlists were electronically uploaded to a central server and concordance values were calculated.

RESULTS: The browsing format allowed radiographs to be viewed in a continuous flip-through mode, or in a detailed full screen mode and permitted surgeons to easily place radiographs in the desired order and then quickly observe the images in sequence. The software allowed the 26 cases to be ranked in 30-45 minutes. Concordance values between the three surgeons were between 89% and 92%.

CONCLUSIONS: This novel electronic interface allows an expanding series of cases to be ranked quickly, conveniently, and across multiple centers. The interface is easy to use and allows real-time retrieval of the most current case series data. Given the excellent inter-observer agreement, this interface holds great promise for establishing prospective, continuously expanding rank orders of various fracture types, which may have great value for clinical research, education about fracture severity, and for prognosis and treatment decisions.

35. Catastrophic Failure of Locked Plate Fixation of the Symphysis Pubis

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INTRODUCTION: The purpose of this case series report is to review cases in which catastrophic failure of partially or fully locked symphyseal plate fixation occurred within 90 days of operative treatment.

METHODS: Ten board certified trauma fellowship trained orthopedic surgeons at various institutions with high volumes of acetabular and pelvic trauma were asked to provide cases involving failure of symphyseal plate fixation in which locking screws had been used in both pubic bodies, creating a locked plate fixation construct. These surgeons provided a total of seven cases. In five of the cases a 4-hole design-specific symphyseal plate was used in which all of the screws were locked. One case involved a 6-hole combination locking/non-locking reconstruction-type plate and one used a 6-hole combination locked/non-locked design-specific symphyseal plate. In both of these cases, 4/6 screws (2 in each pubic body) were locked.

RESULTS: Modes of failure included: screw pullout from bone in one 4-hole plate at less than 90 days, breakage of screws at the screw plate interface in one 4-hole plate at less than 90 days, breakage of the reconstruction plate at 7 days post-operation, and unscrewing of the locked screws and pullout from bone in the 6-hole symphysis plate at 21 days post-operation. Of note, the locking screws that unscrewed and pulled out in this plate were misaligned to the plate during their surgical insertion. These four catastrophic failures resulted in complete loss of reduction. In the remaining three cases, all 4-hole plates, minor failure with loosening of the screw-bone interface and gapping of the pubic symphyseal reduction, recently described as relaxation of symphyseal hardware, occurred at 3, 86, and 90 days postoperatively.

CONCLUSION: Catastrophic failure of locked plate fixation of the symphysis occurs infrequently. Factors that can contribute to this failure are use of a plate not designed specifically for the symphysis and misaligned placement of locking screws in a plate specifically designed for the symphysis. Failure can involve screw pullout, breakage of screws at the screw plate interface, plate breakage, and unscrewing of locked screws.

36. Biomechanical Comparison of Locked versus Non-Locked Plating for Fixation of Open Book Pelvic Injuries

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PURPOSE: The purpose of this study was to compare biomechanical stability of locking plate versus standard plate fixation at the pubic symphysis in an APC-II type pelvic injury tested under cyclic loading and load to failure conditions.

METHODOLOGY: APC-II pelvic injury stability was assessed using 2 surgical constructs in 12 cadaveric pelvises: 3.5 mm 4 hole recon plates and 4.0 mm 4 hole locking recon plates. The two groups were matched for mean bone density and each specimen was tested under cyclic loading and loading to failure. The modes of fixation failure were recorded for each specimen, and the mean group stiffness, failure strength, and failure energies were calculated.

RESULTS: None of the specimens in either group failed with cyclic loading. Failure strength was significantly higher for the locked plate specimens ($p=0.02$). However, when including specimens that failed at sites outside of the pelvic ring, there was a difference in failure energy ($p=0.02$) and no difference in failure strength. Stiffness was found to not be affected by plate type. Mode of fixation failure in the locked plate group was via catastrophic cutout versus screw loosening in the non-locked group.

CONCLUSION: Both the locking and conventional four-hole reconstruction plates can withstand cyclic loads simulating the postoperative period. The locking plate may offer a slight biomechanical advantage in load to failure, although overall pelvic stability is likely unaffected during physiologic loading. Revision surgery may be more difficult after the use of locking plates because they are more likely to fail via catastrophic cutout.

37. Potential Cost Savings of Reusing External Fixation Components in a Deployed Setting

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Up to 80% of surgical cases are orthopedic in nature in modern conflicts. Most surgical cases involve extremity fractures due to blast mechanisms. These fractures require stabilization of the bone for their treatment. Definitive orthopedic fixation is delayed until after resuscitation and the patient is physiologically stable and until the soft tissue bed is ready for orthopedic implants. That is, the wound must be free of contaminants and non-viable tissue and the risk of infection is reduced prior to introducing permanent metal implants into the wound bed. When external fixators are applied in this temporary manner, medical complications from early definitive fixation of fractures from high-energy trauma decrease. Overall, medical device charges increase however, as two fixation devices are ultimately used for each fracture. Often, external fixators only provide stability for a few days, until the patient is ready for their definitive fixation. We undertook an analytical, retrospective study at one tertiary care facility, Craig Joint Theater Hospital (CJTH), in Afghanistan to better understand the potential cost savings to be realized through the routine reuse of external fixation devices, after inspection and sterilization. We found no adverse clinical outcome with the reuse of components in an exhaustive search of available peer reviewed literature. The potential cost savings at the major Air Force Combat Support Hospital in OEF and OIF could be $2,379,280.92 over one year. We recommend a theater wide policy of reuse of non-critical, external fixation components which do not touch the body, following inspection and sterilization.

UPPER EXTREMITY

38. Trace Metal Analysis Following Volar Plating for Unstable Fractures of the Distal Radius

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Dr. Rylander is the recipient of a 2010 Poster Award.

INTRODUCTION: The dramatic increase in use of metallic implants has fueled concern for metal ion release and systemic exposure from these products. Considerable research supports elevated metal ion levels in the serum and urine of patients with metal-on-metal hip and knee implants. However, no studies have examined whether fixed metal implants, such as a distal radial plate, can also result in an increase in systemic metal ion levels. The purpose of the current study is to determine whether serum titanium (Ti) concentrations are elevated in patients who previously received locked volar plates for distal radius fractures.

METHODS: Potential participants were identified by investigator surgical logs. Those identified were contacted, consented to participate, and asked to provide a venous blood sample for trace metal analysis. Planned subgroup comparisons included Ti levels versus controls, plate size and number of screws, time since surgery, and previous evidence of implant loosening. Trace metal analysis was performed by a contract laboratory. Subgroup comparisons were made using analysis of variance (ANOVA) or Students t-test.

RESULTS: A total of 22 potential subjects were identified for potential inclusion in the study. Of the 22, 1 declined to participate and 10 were unable to be contacted or reached. A total of 11 subjects (8 females, 3 males) with a mean age of 63 years agreed to participate. Trace metal analysis revealed that only 1 subject (0.58 microg/L) had a serum Ti concentration above the minimum detectable level (0.25 microg/L). All controls also had levels below the detection limit. A positive control, with daily exposure due to welding, had a Ti level of 2.86 microg/L.

CONCLUSION: Our findings suggest that fixed Ti implants of the size used for volar plating do not result in systemic exposure to trace metal ions. This absence of Ti elevations in this population leads us to conclude that micromotion at plate-screw contact points is not sufficient to yield a systemic increase in Ti levels.

39. Hemiarthroplasty for Proximal Humerus Fractures in Patients with Parkinson's Disease

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BACKGROUND: Currently, there is little information available on the results of fracture management in patients with Parkinson's disease. Therefore, the purpose of this study was to determine the results, complications, and rates of failure of hemiarthroplasty for the management of proximal humerus fractures in patients with Parkinson's disease.

METHODS: Between 1978 and 2005, eight hemiarthroplasties were performed in patients with Parkinson's disease for fracture of the proximal humerus. Seven patients (7 shoulders) with a minimum 2-year follow-up (mean, 9.9 years) were included in the study.

RESULTS: Postoperatively, mean active abduction was 97° and mean external rotation was 38°. The mean postoperative pain score was 2.5 points (1-5 scale). There was a greater tuberosity nonunion in one patient and a superior malunion of the greater tuberosity in three patients. There were two excellent, two satisfactory, and three unsatisfactory results. No patient required revision surgery.

CONCLUSION: The results of hemiarthroplasty for proximal humerus fractures in patients with Parkinson's disease were marginal with three (43%) achieving unsatisfactory results.

41. Treatment of Glenohumeral Sepsis with a Commercially Produced Antibiotic-Impregnated Cement Spacer

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BACKGROUND: Primary shoulder sepsis and infection following shoulder arthroplasty are rare but significant problems. Treatment of infected shoulder arthroplasty with an intraoperatively crafted antibiotic-impregnated cement spacer has been reported to be effective in eradicating infection. The purpose of this study was to report our experience in treating glenohumeral sepsis using a commercially produced antibiotic-impregnated cement spacer.

METHODS: We treated 16 shoulders in 15 patients for glenohumeral sepsis with extensive irrigation and debridement, hardware removal and/or humeral head resection, and placement of an interval articulating hemiarthroplasty with a commercially made gentamicin-impregnated cement spacer. Patients received intravenous antibiotics and were followed clinically and with laboratory indices of infection. Patients were assessed with four shoulder evaluation scales, range of motion, and a visual analog pain scale.

RESULTS: Sixteen shoulders were included, with a mean age of 58.9 years, and mean follow-up 20.5 months. The most common organisms cultured were MRSA and *Staphylococcus epidermidis*. Twelve patients underwent revision. Four refused revision and still have retained antibiotic spacers. Mean time to revision was 11.2 weeks. WBC returned to within normal range in all 12 patients at the time of revision, ESR in 5 of 12 patients, CRP in 8 of 12 patients, and IL-6 in 9 of 11 patients. Mean visual analog pain scale score decreased from 8.4 to 0.5. Active forward flexion increased from a mean of 65˚ to 110˚, and mean active external rotation from -5˚ to 20˚. Mean UCLA score increased from 7 to 26, mean SST from 1.2 to 6.6, mean ASES from 16 to 74, and mean Constants Shoulder Score from 16 to 57. There was no recurrence of infection.

CONCLUSIONS: We treated 16 infected shoulders with staged revision arthroplasty with an interval commercially produced antibiotic-impregnated spacer and observed no recurrence of infection. Serum IL-6 level appears to be useful in the evaluation of shoulder infection.

42. Biomechanical Analysis of Engaging versus Non-Engaging Hill-Sachs Defects within the Functional Shoulder Range of Motion

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INTRODUCTION: The aim of this study was to investigate the effects of the size and orientation of a given Hill-Sachs defect on its ability to contact or "engage" the anterior-inferior glenoid rim at various arm positions within the functional shoulder range of motion. We hypothesized that progressively larger "engaging" Hill-Sachs lesions would engage the anterior-inferior glenoid rim at arm angles of less than 90° abduction and 90° external rotation, and "non-engaging" Hill-Sachs lesions would not engage the anterior-inferior glenoid rim within any functional range of motion, independent of its size.

METHODS: A 3D image of a normal proximal humerus and a normal glenoid was recreated from the Virtual Human data set. Hill-Sachs defects ("engaging" and "non-engaging" orientations) were made by impacting the anterior rim of the virtual glenoid against the humeral head at varying angles. Factors recorded included humeral abduction angle (0 to 90°, 5° increments), humeral rotation angle (45° internal rotation to 90° external rotation, 5° increments, humeral flexion angle (0 and 90°) and defect size (small, medium, large).

RESULTS: At a humeral flexion angle 0°, large and medium sized "engaging" defects engaged the anterior glenoid rim at angles less than 90° abduction and 90° ER. Small "engaging" defects contacted the anterior glenoid rim only at 90° abduction and 90° ER. At a humeral flexion angle 90°, all "engaging" defect sizes engaged the anterior glenoid rim throughout a greater range of humeral angles. For "non-engaging" defect orientations at a humeral flexion angle of 0°, large and medium lesions engaged only the inferior glenoid rim at ER angles of greater than 70°.

CONCLUSION: The results of this study have clinical implications when evaluating patients with Hill-Sachs defects. Larger "engaging" defects may engage the anterior glenoid rim at angles less than the traditional 90° abduction and 90° ER, causing a sense of instability that may be detected preoperatively. This may compel the surgeon to address the bony humeral head defect as well as the soft tissue injury at the time of surgery.

43. Hill-Sachs "Remplissage": Case Series

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INTRODUCTION: The Hill-Sachs lesion still plays a role in failed shoulder stabilization for anterior dislocations. Purchase et al. recently presented an arthroscopic procedure consisting of a posterior capsulodesis and infraspinatus tenodesis to fill in the Hill-Sachs lesion (*Remplissage*) followed up with an arthroscopic Bankart repair. To date, a case series has not been published. We present a retrospective, case series of patients with a history of recurrent anterior dislocations and an associated Hill-Sachs lesion that have been successfully treated.

METHODS: There were a total of 9 cases that were identified as true Hill-Sachs lesions between early 2006 through 2008. The patients ranged from 22 to 64 years of age. Many of these patients had prior attempts at stabilizing their dislocations. Patients were asked to fill out the Disabilities of the Arm, Shoulder, and Head (DASH) questionnaire for both upper extremities after they have finished their course of physical therapy. Functional range of motion data was obtained for both extremities including forward elevation, internal and external rotation at 90°, and internal rotation while sitting. Anterior apprehension was also tested. One case was lost to follow-up, and one case is still in the prescribed course of physical therapy.

RESULTS: The average DASH score was 1.31. It should be noted that the median and mode DASH score was zero with two nonzero values from patients with injuries to their non-dominant extremity. All patients had regained functional range of motion.

DISCUSSION: It is recognized that glenoid deficiency plays a role in the recurrence of anterior instability. This procedure prevents the Hill-Sachs lesion from engaging the anterior rim of the glenoid and causing the humeral head to lever out anteriorly. The Remplissage procedure first described by Purchase and Wolf has led to clinical success in our series of patients, regardless of relevant history. Anecdotally, patients were able to perform activities that were severely limiting prior to the procedure. We advocate the use of this procedure in patients with Hill-Sachs lesions that are functionally limited due to recurrent dislocations.

* = presenter

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and/or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use).

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Barrett, Gene R.	n
Barsoum, Wael K.	a-Brand X, Cool Systems, Inc., Orthovita, Smith & Nephew, Stryker Orthopaedics, TissueLink, Zimmer; please see the Cleveland Clinic web site for a complete listing http://cc-clirb52.cc.ad.cchs.net/coi/companylistings.asp b-Stryker Orthopaedics; c-Exactech, Inc., SS White, Wright Medical Technology, Inc.; d-Otismed; e-SS White, Stryker Orthopaedics, Wright Medical Technology, Inc.
Bart, Gina	n
Bartelt, Robert B.	n
Bartz, Brian A.	n
Baser, Onur	e-Johnson & Johnson
Bashyal, Ravi	n
Baydoun, Hasan E.	n
Beaule, Paul E.	a-Wright Medical Technology, Inc.; e-Getinge USA, Smith & Nephew, Wright Medical Technology, Inc.
Bedair, Hany	n
Bellard, Cody B.	n
Belmont, Philip J., Jr.	a-Synthes
Bennett, D. Lee	n
Berbari, Ellie F.	n
Berend, Keith R.	a-Biomet, MCS, St. Francis Hospital; c-Biomet; d-Angiotech; e-Biomet, Salient Surgical, Synvasive
Berend, Michael E.	a-Biomet, ERMI, MCS, St. Francis Hospital; c-Biomet; e-Biomet
Berger, Richard A.	a-Smith & Nephew, Wright Medical Technology, Inc., Zimmer; c-Zimmer; e-TissueLink, Zimmer
Bernhardt, Mark	n
Berry, Daniel J.	a-Acumed, Ascension, DePuy, DJO, Medtronic, ODC, SBI, Smith & Nephew, Stryker, Tornier, Wolters Kluwer Health – Lippincott Williams & Wilkins, Wright Medical Technology, Inc., Zimmer; c,e-DePuy
Berry, Michael R.	n
Bershadsky, Boris	n

Betz, Lisa H.	n
Bey, Michael	n
Bhadra, Arup K.	n
Bharam, Srino	a-Stryker; e-Smith & Nephew
Blaha, J. David	a-DJO, LLC, Genzyme Corporation, Johnson & Johnson, Medtronic, Inc., Pfizer, Inc., Stryker Corporation, Synthes (U.S.A.), Wright Medical Technology, Inc., Zimmer; b,c,e-Wright Medical Technology, Inc.
Blair, James A.	a-Geneva Foundation
Bledsoe, J. Gary	n
Bloemke, Adam	n
Boese, Clifford K.	a,e-DePuy, a Johnson & Johnson Company
Bohay, Donald R.	a-Biomimetic; c-Innomed; e-MMI, Osteotech, Stryker
Bono, Kenneth	a-Akron Children's Hospital Research Foundation
Boone, Christopher R.	a-DePuy, Medtronic, Stryker, Synthes, Zimmer
Bormann, Kurt T.	n
Bottlang, Michael	n
Bottros, John J.	n
Bozic, Kevin J.	e-Center for Medicare & Medicaid Services, Integrated Health Care Association, Pacific Business Group on Health, United Health Care
Bradley, Jeffrey M.	n
Branovacki, George	n
Brantley, Steven P.	n
Brawner, Clinton	n
Brewer, Becky	n
Brockmeier, Peter	n
Brocone, Matthew	n
Brophy, Robert H.	a-Axial Biotech, Biomet, Breg, Cerapedics, K2M, Medtronic, Midwest Stone Institute, Smith & Nephew, Stryker, Synthes Spine, Wright Medical Technology, Inc., Wyeth; e-DePuy, a Johnson & Johnson Company
Brown, Thomas D.	a-AO, DePuy, a Johnson & Johnson Company, EBI, Journal of Orthopaedic Research, Medtronic, National Institutes of Health (NIAMS & NICHD), Sawbones/Pacific Research Laboratories, Smith & Nephew; e-Smith & Nephew
Bryan, Jason	n
Bucholz, Robert W.	e-Wyeth
Burden, Robert	n
Burks, Rob	n
Burstein, Albert H.	n
Burt, Mark	n
Bushmiaer, Marty	n
Butler, Brian L.	n
Byram, Ian R.	n
Callaghan, John J.	c-DePuy, a Johnson & Johnson Company, Lippincott; e-DePuy, a Johnson & Johnson Company
Campbell, Robert M., Jr.	b,c-Synthes Spine Co.
Canale, S. Terry	a-Bledsoe Brace Systems, Editor-Campbell's Operative, DePuy Orthopaedics, OREF, Saunders/Mosby-Elsevier, Smith & Nephew Endoscopy, Stryker Orthopaedics, Synthes, Wright Medical Technology, Inc.
Cannada, Lisa K.	a-DePuy, a Johnson & Johnson Company, Smith & Nephew, Synthes, Zimmer

Carandang, Gerard	n
Carlson, Chad B.	n
Carlson, Michael J.	n
Carr, Brian J.	n
Carroll, Michael	e-Wright Medical Technology, Inc.
Charters, Michael A.	n
Chavan, Prithviraj R.	n
Chevillotte, Christophe J.	n
Child, Jeremy R.	n
Chinander, Michael	n
Choi, Seongjin	n
Clair, Benjamin L.	n
Clohisy, John C.	a-Axial Biotech, Biomet, Breg, Cerapedics, K2M, Medtronic, Midwest Stone Institute, Smith & Nephew, Stryker, Synthes Spine, Wright Medical Technology, Inc., Wyeth
Coats, Aaron C.	n
Coetzee, J. Christiaan	a-DePuy, a Johnson & Johnson Company; c-Arthrex, Inc., DePuy, a Johnson & Johnson Company; e-Arthrex, Inc., DePuy, a Johnson & Johnson Company, Tornier
Coffey, Michael J.	n
Cofield, Robert H.	a-DJO, Smith & Nephew; c-DJO, Smith & Nephew; e-Smith & Nephew
Cohen, Elizabeth R.	n
Conoley, Jack A.	n
Coulibaly, Marlon O.	n
Courtney, Christopher	n
Covall, David J.	c-Exactech, Inc.; e-Consus Orthopaedics, DePuy, a Johnson & Johnson Company, Exactech, Inc.
Craft, Jason A.	n
Crosby, Lynn A.	a,c,e-Exactech, Inc.
Cross, William W., III	n
Culotta, Brad A.	n
Currier, Bradford L.	a-Synthes; c-DePuy, a Johnson & Johnson Company, Stryker; e-DePuy, a Johnson & Johnson Company
Daccarett, Miguel	n
Dahm, Diane L.	n
D'Apuzzo, Michele R.	n
Davey, Shaunette	n
Davros, Bill	n
Dayton, Michael R.	a-DePuy, a Johnson & Johnson Company, Exactech, Inc., Smith & Nephew, Stryker; e-DePuy, a Johnson & Johnson Company, Smith & Nephew
Dean, D. Brian	n
DeBoer, David K.	b,c,e-Wright Medical Technology, Inc.
DeCoster, Thomas A.	a-Biomet, EBI, Orthofix, Inc., Smith & Nephew, Stryker, Zimmer; c-Innomed; d-Merck, Wyeth; e-EBI, Zimmer
Dee, Michael S.	n
Della Valle, Craig J.	a-Zimmer; b-Stryker; e-Biomet, Kinamed, Smith & Nephew, Zimmer
Deneweth, Jessica	n
DeZee, Kent	n
Dion Neil T.	n
Dirschl, Douglas R.	a-Stryker, Zimmer; c-Biomet
Donaldson, Christopher T.	n

Donaldson, William F., III	a-Stryker
Dong, Huan	n
Dowd, Thomas C.	n
Duchman, Kyle R.	n
Durning, Steven	n
Dyrstad, Bradley W.	n
Eberhardt, Alan	n
Ebinger, Thomas P.	n
Eck, Jason C.	a-ApaTech
Elguizaoui, Sameh	n
El-Hattab, Ahmad	n
Ellis, Henry B., Jr.	n
Elsharkawy, Karim A.	n
Ely, Erin E.	n
Endres, Terrence J.	a-Medtronic
Engh, C. Anderson, Jr.	a-DePuy, a Johnson & Johnson Company, Inova Health Care Services, Smith & Nephew; c-DePuy, a Johnson & Johnson Company; d-Johnson & Johnson; e-DePuy, a Johnson & Johnson Company, LifeNet, Smith & Nephew
Erpelding, Jason M.	a-Arthrex, Inc., Biomet, ESKA Implants, Exactech, Inc., NIH Grant, Spine Medica Corp., Stryker
Esquivel, Amanda	n
Estes, Reed	n
Eunice, Selena E.	n
Evans, Clifford	n
Evans, Peter J.	n
Farrow, Lutul D.	n
Feazell, David	n
Fehringer, Edward V.	a,c,d-Tornier
Fening, Stephen	n
Finch, Joseph C.	n
Finnoff, Jonathan T.	n
Firestone, Daniel E.	n
Fischgrund, Jeffrey S.	a,c-DePuy, a Johnson & Johnson Company, Smith & Nephew, Stryker; e-ApaTech, DePuy, and Johnson & Johnson Company, Fziomed, Smith & Nephew, Stryker
Fitz-Gibbon, Patrick D.	n
Fitzgibbons, Timothy C.	n
Fitzpatrick, Daniel C.	a-NIH (NIAMS & NICHD), Synthes; c-Synthes CMF, Zimmer; e-Synthes CMF
Flanigan, David C.	n
Fleck, Erin E.	n
Fleissner, Paul R., Jr.	a-Orthopedic Device or Equipment Company
Foo, Teresa A.	n
Forbes, Michael	n
Foruria, Antonio M.	n
Foster, Brian	n
Frank, Rachel M.	n
Freitag, Per	n
Froelich, John M.	n
Gabriel, Keith R.	n
Gallo, Theresa J.	n
Garrett, Hunter	n
Garvin Kevin L.	a-Arthrex, Inc., ESKA Implants, NIH Grant, Tornier; c-Biomet

Gatchel, Robert	n
Geeslin, Andrew G.	n
Geller, Adam J.	n
Gerlinger, Tad L.	n
Ghanayem, Alexander J.	a-Simprica, Synthes
Ghate, Raju S.	n
Giannoudis, Peter V.	a-AO, DePuy, GlaxoSmithKline, Kuros, Smith & Nephew, Stryker, Synthes; e-AO, DePuy, a Johnson & Johnson Company, Pfizer, Stryker, Synthes
Gibbons, David J.	n
Gioe, Terence J.	a-DePuy, a Johnson & Johnson Company
Giveans, Marc R.	n
Goebel, Rebecca	n
Goetz, Devon D.	a-DePuy, a Johnson & Johnson Company
Goitz, Henry T.	n
Goldberg, Benjamin A.	e-Acumed, LLC, Allen Medical, Stryker
Goldstein, Daniel J.	n
Golladay, Gregory J.	e-Zimmer
Goodman, Gens P.	n
Gordon, Alexander C.	a-DePuy, a Johnson & Johnson Company
Gratopp, Carly	n
Graziano, Gregory P.	a,e-Medtronic Sofamor Danek
Greenberg, Jeffrey A.	b-Acumed Orthopedics; e-Stryker
Grimshaw, Charles S.	n
Grisell, Margaret K.	n
Grosshans, Kevin T.	n
Gruen, Gary S.	e-Smith & Nephew
Guettler, Joseph H.	a-Arthrex, Inc., Arthrocare, Genzyme, Smith & Nephew, Stryker
Gullung, Gregory	n
Gupta, Purnendu	a-Biomet, JBJS, Stryker, Synthes; e-DePuy, a Johnson & Johnson Company
Habbu, Rohan A.	n
Hall, Nancy	n
Hanssen, Arlen D.	a-Biomet, Clinical Orthopaedics and Related Research, DePuy, a Johnson & Johnson Company, Implex, Stryker, Tornier, Zimmer; c-Stryker Orthopaedic Development Corp.; e-Stryker
Harmsen, William S.	n
Harris, Erika	n
Harris, Joshua D.	n
Hartman, Curtis W.	n
Havey, Robert M.	n
Haydel, Christopher L.	n
Hayden, Brett	n
Haydon, Rex	a-Biomet
He, Tong-Chuan	n
Helmy, Haney F.	n
Henderson, Christopher E.	n
Henning, Troy	n
Herbenick, Michael A.	a-Arthrex, Exactech, Inc.
Hergan, David J.	n
Herkowitz, Harry N.	a-DePuy, Medtronic, Stryker; c-Medtronic, Stryker; d-Globus Medical; e-Magnifi IEP
Hernandez, Victor H.	n
High, Robin H.	n

Higuera, Carlos A.	a-Please visit the website http://cc-clirb52.cc.ad.cchs.net/coi/companylistings.asp Biomet, Cool Systems, DePuy, a Johnson & Johnson Company, Smith & Nephew, Stryker, TissueLink, Wright Medical Technology, Inc., Zimmer
Holcomb, Jason O.	n
Holthusen, Scott M.	n
Hosemann, Chad D.	a-DePuy Mitek
Howard, Krista	n
Hsu, Joseph R.	n
Hughes, Michael S.	n
Hussain, Haroon	n
Hussain, Waqas M.	n
Idusuyi, Osaretin B.	n
Inda, David J.	n
Israel, Heidi A.	n
Iverson, Jamey	n
Izadi, Kayvon D.	n
Jabara, Michael R.	n
Jackson, Nancy	n
Jacobs, Michael A.	n
Jacofsky, Marc	n
Jia, Guang	n
Jiang, Jimmy J.	n
Jindal, Gaurav	n
Johnson, Brian	n
Johnson, Chris	n
Johnson, Michael R.	a-DePuy, a Johnson & Johnson Company
Johnston, Richard C.	c-Zimmer
Jones, Clifford B.	n
Jones, Kerwyn C.	n
Jones, Morgan H.	a-Arthrex, Inc., Breg, DJO, Stryker
Jones, Teresa L.	n
Junko, Jeffrey T.	n
Jurist, Kenneth A.	n
Kaar, Scott G.	n
Kaeding, Christopher C.	a-DJO; e-Biomet
Kang, James D.	a-Advanced Technologies and Regenerative Medicine, DePuy, a Johnson & Johnson Company
Karam, Matthew D.	n
Kaufman, Kenton R.	n
Kay, David B.	d,e-OrthoHelix Surgical Designs
Keeney, James A.	n
Kemp, Bradley J.	n
Kempton, Laurence B.	a-Arthrex, Inc., DePuy, a Johnson & Johnson Company, Medtronic, Medtronic Sofamor Danek, Mitek, Osteotech, Stryker, Synthes, Zimmer
Kennedy, William R.	n
Kennell, Todd	n
Kenter, Keith	a-National Institutes of Health (NIAMS & NICHD), Stryker
Kepley, Robert F.	a-IC Med Tech, Medtronic, Medtronic Sofamor Danek, Stryker
Kersten, Andrew D.	n
Kesman, Thomas J.	n
Keteyian, Steve	n

Khaleel, Mohammed A.	n
Khanna, Gaurav	n
Khoury, Joseph G.	n
Kibuule, Leonard K.	n
Killeen, Kathleen	n
Kirby, Jess M.	n
Klein, Gregg R.	a-Zimmer; e-Biomet, Zimmer
Kleinhenz, Benjamin P.	n
Klika, Alison K.	n
Kline, Stephanie	n
Klock, Allen	n
Knopp, Michael	n
Konigsberg, Beau S.	a-Arthrex, Inc., Biomet, Exactech, Inc.
Koreckij, Jason T.	n
Koroukian, Siran	n
Koueiter, Denise	n
Krause, David A.	n
Krebs, Viktor E.	a-Stryker Orthopaedics, TissueLink; b-Shukla Medical, Stryker, TissueLink; e-Shukla Medical, Stryker Orthopaedics, TissueLink
Kryzak, Thomas J.	n
Kuhl, Taften L.	n
Kwon, Yong	n
Kwong, Louis, M.	a-Astellas, Bayer, Glaxo Smith Kline, Sanofi-Aventis, Takeda, Zimmer
Lafosse, Laurent	n
Lai, Jim K.	n
Laskovski, Dimitar R.	n
Laskovski, Jovan R.	a-IC Med Tech, Medtronic, Medtronic Sofamor Danek, Stryker
Lasota, Ryan	n
Lawler, Ericka A.	n
Lawton, Jeffrey N.	a-Small Bone Innovations; a,e-Innomed, Small Bone Innovations
Lee, Ho H.	n
Lee, Stella J.	n
Lenarz, Christopher J.	n
Leonard, Zachary C.	n
Lervick, Gregory N.	a-Biomet Sports Medicine, Smith & Nephew, Zimmer
Les, Clifford M.	e-AO Foundation
Levine, Brett R.	a-Biomet, Zimmer; b-Angiotech; e-Zimmer
Levy, Bruce A.	a-National Institutes of Health (NIAMS & NICHD); c-VOT Technologies; e-Arthrex, Inc.
Lieberman, Isadore H.	n
Lin, Toni E.	n
Litsky, Alan S.	e-Surgical Energetics, Inc.
Liu, Steve S.	n
Lombardi, Adolph V., Jr.	a,b-Biomet; c-Biomet, Innomed; e-Biomet
Lopez, Robert	n
Lucas, George L.	n
Lujan, Trevor	n
Lynch, Jamie L.	n
Mabrey, Jay D.	a-Synthes; c,e-Exactech, Inc.;
Macalena, Jeff	a-Regions Hospital, St. Paul, MN
Maddox, Grady	n

Maddox, Jeremiah	a-Orthopedic Trauma Association Resident Grant, AO North America Resident Grant
Madey, Steven M.	a-Zimmer; c,e-Synthes, Zimmer
Maerz, Tristan	n
Mai, Matthew C.	n
Mailander, Adam M.	n
Malek, Farbod	n
Malin, Andrew S.	n
Mall, Nathan A.	a-Arthrex, Inc., Medtronic Sofamor Danek, NIH (NIAMS & NICHD), Smith & Nephew, Zimmer
Maloney, William J.	a-AO, Biomet, DePuy, a Johnson & Johnson Company, DePuy Spine, Nuvasive, Smith & Nephew, Stryker, Zimmer; c-Wright Medical Technology, Inc., Zimmer; d-Abbott, Gillead, ISTO Technologies, Johnson & Johnson, Merck, Moximed, Pfizer
Mangla, Jimmi	n
Manning, David W.	a-Biomet, e-Biomet, Smith & Nephew
Markel, David C.	a-OREF, Stryker; d,e-Stryker
Marks, Timothy	n
Marsh, J. Lawrence	a-Smith & Nephew; c-Biomet
Martell, John M.	a-Biomet, Ceramtech, Smith & Nephew, Stryker, Zimmer; e-Smith & Nephew, Stryker, Zimmer
Maschke, Steven	n
Mayer, Theodore	n
Mazzocca, Anthony D.	a,e-Arthrex, Inc.
McCarthy, Robert	n
McCollum, Mark	n
McGill, Robert J.	n
McGovern, Scott C.	n
McIntosh, Amy L.	n
McIntosh, Braden	n
McMullen, Scott T.	d-Orthologic
Medoff, Robert J.	d,e-Trimed
Meininger, Alexander K.	a-Synthes
Mellecker, Chloe J.	n
Merk, Bradley R.	a-Stryker, Synthes; e-Stryker
Michael, Andrew W.	n
Michalson, Jared L.	n
Milbrandt, Joseph C.	n
Mileti, Joseph	n
Milia, Marc J.	n
Miller, John	n
Miniaci, Anthony	a-Arthrex, Inc., DJO, Smith & Nephew, Stryker, Zimmer; c-Arthrosurface, Zimmer; d-Arthrosurface, Johnson & Johnson, Medtronic, Smith & Nephew, Stryker; e-Arthrosurface, NHLPA, Orthomimetics
Mitchel, Shanon	n
Mitchell, Trey	n
Moed, Berton R.	a-DePuy, a Johnson & Johnson Company; Smith & Nephew, Stryker, Synthes
Molloy, Robert	n
Momoh, Enesi O.	n
Moran, Steven L.	n
Morawa, Lawrence G.	b,c-Stryker
Morgan, Joseph A.	n

Moric, Mario	n
Mormino, Matthew A.	a-Arthrex, Inc., Biomet, ESKA Implants, Exactech, Inc., NIH Grant, Spine Medica Corp., Stryker
Morrey, Mark E.	n
Morscher, Melanie	n
Moskowitz, Alan	a-Stryker, Synthes; e-Stryker
Mowad, Laura	n
Muh, Stephanie J.	n
Mulder, Andrew A.	n
Murphy, Dana	n
Murphy, Robert C.	n
Najarian, Robert G.	n
Nambu, Satya	e-Wright Medical Technology, Inc.
Nassr, Ahmad	n
Nemec, Scott A.	n
Nepple, Jeffrey J.	n
Nho, Shane J.	a-Arthrex, Inc., Athletico, DJO, Linvatec, Miomed, Ossur, Smith & Nephew
Nord, Keith D.	a-Arthrex, Inc., Smith & Nephew, Synthes, Zimmer; c-Arthrex, Inc.; d-Johnson & Johnson; e- Smith & Nephew
Novakovich, Paul	n
Noyes, Matthew P.	n
Nunley, Ryan M.	a-Biomet, Smith & Nephew, Stryker, Wright Medical Technology, Inc., Zimmer; e-Salient Surgical Technology, Smith & Nephew, Wright Medical Technology, Inc.
Obert, Richard	e-Wright Medical Technology, Inc.
Ochoa, Leah M.	n
Oh, Luke S.	n
Ojike, Nwakile	n
O'Leary, Patrick T.	n
Olysav, David J.	a-Zimmer; d-Bristol-Myers Squibb, Eli Lilly, Johnson & Johnson, Pfizer
Osmon, Douglas R.	n
Otto, Robert J.	n
Otto, Thomas J.	n
Owen, Sean M.	n
Owens, Brett D.	n
Padgett, Douglas E.	a-Johnson & Johnson, Smith & Nephew, Stryker, Zimmer; d-Mako
Pagnano, Mark W.	a-DePuy, a Johnson & Johnson Company, Musculoskeletal Transplant Foundation, National Institutes of Health (NIAMS & NICHD), Stryker, Zimmer; c-DePuy, a Johnson & Johnson Company
Palmese, Nicholas	e-EcomGlobal Medical
Pangrazzi, Garrett	n
Papagelopoulos, Panayiotis J.	n
Pape, Hans-Christoph	n
Paprosky, Wayne G.	a-Rush University; c-Wright Medical Technology, Inc., Zimmer; e-Zimmer
Parsley, B. K.	n
Parsons, Erin	n
Parsons, Theodore W., III	a-DePuy, a Johnson & Johnson Company, Innovative Health Technologies, Medtronic, Smith & Nephew, Synthes, Tornier, Zimmer

Parvizi, Javad	a-KCI, Medtronic, Musculoskeletal Transplant Foundation, Smith & Nephew, Stryker; e-Stryker
Pashos, Gail E.	n
Patel, Pranay	n
Patel, Ronak M.	n
Patterson, Ryan W.	a-Small Bone Innovations
Patthanacharoenphon, Cameron G.	n
Patwardhan, Avinash G.	a-Synthes
Peabody, Terrance D.	a-Biomet, DePuy, a Johnson & Johnson Company, Smith & Nephew, Stryker, Synthes, Zimmer
Pechey, Carola	n
Pedroza, Angela	n
Pelton, Joanne	n
Pennington, William T.	c,e-Arthrex, Inc.
Perrine, Donald	n
Phillips, Barry B.	a-Breg, DePuy, a Johnson & Johnson Company, Saunders/Mosby-Elsevier, Smith & Nephew, Synthes, Zimmer
Piefer, Jason	n
Pimentel, Elizabeth	n
Pirela-Cruz, Miguel A.	n
Pitts, Ryan T.	n
Podeszwa, David A.	n
Pomeroy, Christopher L.	n
Pomeroy, Donald L.	a,b-DePuy, a Johnson & Johnson Company
Ponce, Brent A.	a-Arthrex, Inc., DePuy Mitek, Inc., a Johnson & Johnson Company; b-Arthrex, Inc., Tornier
Ponnappan, Ravi K.	a-Biomet
Posner, Matthew A.	n
Prewitt, Erin M.	n
Provencher, Matthew T.	a-AANA Research Grant, AOSSM Young Investigator Grant
Prusick, Vincent R.	n
Prusick, Vincent W.	n
Puri, Rajeev D.	n
Raghava, Parthasarathy	n
Ramakrishnan, Rakesh	n
Ramsey, Nicholas A.	n
Randazzo, John L.	n
Reagan, Jeffrey M.	n
Reddan, John	n
Reddy, Deepak	n
Redondo, Luis J., Jr.	n
Redondo, Michael	n
Ren, Weiping	n
Replogle, William H.	n
Rhee, Peter C.	n
Rice, Jaime A.	a-DePuy, a Johnson & Johnson Company
Rice, Robert S.	n
Ringler, James R.	n
Ritzman, Todd	n
Robert, Christopher E.	n
Roberts, Craig S.	a-Stryker, Synthes; b-RRC member, Orthopaedic Trauma Association Public Relations Committee Chair, Mid-America Orthopaedic Association Treasurer, Kentucky Orthopaedic Society Board of Directors; c-Skeletal Trauma

Romeo, Anthony A.	a-Arthrex, Inc., DJO, CONMED Linvatec, Ossur, Smith & Nephew; c,e-Arthrex, Inc.
Rose, Peter S.	a-AO, DePuy, a Johnson & Johnson Company, Implex, Medtronic, Stryker, Zimmer
Rosenberg, Aaron G.	a,c,d-Zimmer; e-TissueLink, Zimmer
Rotstein, Jason L.	n
Rubin, Michael	n
Ruff, Jessica M.	n
Ruh, Erin	n
Ryan, John M.	n
Rylander, Lucas S.	n
Sahai, Vivek	n
St. Clair, Selvon F.	a,b,e-MAZOR Surgical Technologies
St. John, Lauren C.	n
Salvator, Ann	n
Sampat, Manan R.	n
Samuelson, Eric	n
Santaella-Sante, Borja	n
Sassoon, Adam A.	n
Sawyer, Jeffrey R.	a-Medtronic, Smith & Nephew, Wright Medical Technology, Inc.
Sayeed, Siraj A.	n
Scher, Danielle L.	n
Schickendantz, Mark S.	n
Schmeling, Gregory J.	a-Zimmer
Schermerhorn, Thomas	n
Schleck, Cathy D.	n
Schmidt, Philip H.	n
Schoenecker, Perry L.	a-Axial Biotech, Biomet, Breg, Cerapedics, K2M, Medtronic, Midwest Stone Institute, Smith & Nephew, Stryker, Synthes Spine, Wright Medical Technology, Inc., Wyeth
Scholten, Timothy R.	n
Schrader, William C.	n
Schularick, Nathan	n
Schultz, Randal	n
Schwarz, Dana	n
Sengupta, Nishan	d,e-Johnson & Johnson
Shah, Jay P.	n
Shahulhameed, Abdulsalam	n
Shahwan, Tom G.	n
Shen, Jikun	n
Sherman, Robert	n
Shevlin, Michael J.	n
Shukla, Sanjai, K.	n
Siegel, Herrick J.	n
Sierra, Rafael J.	n
Siemionow, Krzysztof B.	b-MAZOR Surgical Technologies; c,d-Tolera Therapeutics, Inc.; e-MAZOR Surgical Technologies AxioMed, Synthes, Tolera Therapeutics, Inc.
Sietsema, Debra L.	n
Silver, Andrew G.	n
Sim, Franklin H.	n
Singer, Mendel	n
Singh, Jasvinder	n
Sink, Ernest L.	e-Biomet

Siston, Robert	n
Slover, James D.	a-Smith & Nephew, Stryker
Smit, Milton J.	n
Smith, Jay	b-Gulf Coast U.S. Institute; e-Tenex
Smith, Keisha	n
Smith, Matthew	n
Smith, Tyler	n
Soloff, Lonnie	n
Sorce, Angelo J.	n
Sperling, John W.	c-Biomet, DJO/Aircast; d-Tornier; e-Biomet, Tornier
Sporer, Scott M.	a,e-Zimmer
Stannard, James P.	a-Kinetic Concepts, Inc., Medtronic, Smith & Nephew, Synthes; c-Theime; e-Medtronic, NovaLign
Stefancin, John J.	n
Steffner, Robert J.	n
Steiner, Richard	n
Stemniski, Paul	d,e-Wright Medical Technology, Inc.
Stewart, Bruce A.	n
Stewart, Cory M.	n
Stewart, Rena	a-Kinetic Concepts, Inc., Pfizer, Synthes, Wyeth
Stinner, Daniel J.	a-Smith & Nephew
Stirton, John W.	n
Stone, Rebecca	n
Stouffer, Mark H.	n
Strand, Greg	n
Stronach, Benjamin M.	n
Stuart, Michael J.	a-Biomet, DePuy, a Johnson & Johnson Company, Stryker, Zimmer; c-Fios; e-Arthrex, Fios
Stuckey, Ryan M.	n
Studzinski, Diane	n
Stulberg, Bernard N.	a-Corin USA, DePuy, a Johnson & Johnson Company, Exactech, Inc., Stryker Orthopaedics; c-Exactech, Inc.; e-Exactech, Inc., Stryker Orthopaedics
Stulberg, S. David	c-Aesculap/B. Braun, OmniLife Science; e-Aesculap/B. Braun
Styron, Joseph F.	n
Sucato, Daniel J.	a-Medtronic
Sullivan, Stephen E.	n
Supina, Dylan	e-Johnson & Johnson
Swiontkowski, Marc F.	e-Baxter Healthcare, Ely Lilly, Medtronic Sofamor Danek, National Institutes of Health (NIAMS & NICHD), Shriners Hospitals for Children Clinical Outcomes Studies Advisory Board, Synthes, Wyeth
Swymn, Jeremy P.	n
Szatkowski, Jan P.	n
Tan, Juay Seng	n
Tarkin, Ivan S.	n
Tate, Janet P.	n
Tatman, Penny	n
Taunton, Michael J.	a-DePuy, a Johnson & Johnson Company
Terpstra, Marlene S.	n
Terry, Michael A.	a-Biomet, Smith & Nephew; c-Smith & Nephew; e-Arthrex, Inc., Encore Medical, Smith & Nephew
Thakkar, Savyasachi C.	n
Than, Khoi D.	n

Thangamani, Vijay B.	a-Stryker Orthopaedics
Thati, Srinivas	n
Thawani, Jayesh P.	n
Thedens, Daniel	n
Theiss, Steven M.	a-Medtronic Sofamor Danek, Synthes; e-Biomet, Synthes
Thoreson, Andrew	n
Thorpe, Bannon	n
Throckmorton, Thomas W.	n
Ting, Nicholas T.	n
Touliopoulos, Steven J.	n
Trousdale, Robert T.	a-DePuy, a Johnson & Johnson Company, Stryker, Zimmer; c-DePuy, a Johnson & Johnson Company, Wright Medical Technology, Inc.; e-DePuy, a Johnson & Johnson Company, Wright Medical Technology, Inc.
Troyer, Joshua	n
Tubbs, Richard	n
Turner, Norman S.	n
Tyson, Jared J.	n
Valdevit, Anthony	n
Vallacis, Diego	n
Van Thiel, Geoffrey S.	n
Vasanji, Amit	n
Verma, Nikhil N.	a-Arthrex, Inc., DJO, Ossur, Smith & Nephew; c-Smith & Nephew; d-Omeros; e-Smith & Nephew
Vetter, Carole S.	n
Volgas, David A.	a-AO, Pfizer, Smith & Nephew, Synthes, Wyeth
Voor, Michael J.	n
Voronov, Leonard I.	n
Walker, John F.	n
Wall, Bradford A.	a-Stryker, Synthes
Wallace, Adam	n
Wang, Anthony C.	n
Wang, Fan Chia	n
Wang, Li	n
Wang, Vincent M.	n
Ward, Joseph	n
Warden, Stuart	n
Warner, Meredith	n
Waterman, Brian R.	n
Waterman, Scott J.	a-Smith & Nephew
Watson, J. Tracy	a-Smith & Nephew; c-DePuy, a Johnson & Johnson Company, Smith & Nephew; e-Smith & Nephew
Weare, Andrea M.	n
Weiner, Dennis S.	e-Senior advisory board of Ortho. Pediatrics Co.
Wells, Christopher	n
Wenke, Joseph C.	a-Smith & Nephew
Wera, Glenn D.	n
Westberg, Jerald	n
Wetzel, Deborah	n
Whitaker, M. Camden	a-Stryker, Synthes; e-Stryker
Whiting, Daniel	n
Wiater, J. Michael	a-ASES, DePuy, Medtronic, Stryker, Synthes, Zimmer; e-AAOS, Zimmer

Wiater, Patrick J.	a-Arthrex, Inc., DePuy, a Johnson & Johnson Company, Medtronic, Medtronic Sofamor Danek, Mitek, Osteotech, Stryker, Synthes, Zimmer; e-Zimmer
Wiebelhaus, John	n
Williams, Ronald P.	n
Wilson, Marty	n
Wilson, Trent J.	n
Wissman, Robert	n
Wolf, Brian R.	a-Arthrex, Inc.
Wolf, Jennifer M.	n
Woodcock, Jessica A.	n
Woodward, Chase	n
Wooley, Paul H.	n
Wright, Rick W.	a-Axial Biotech, Biomet, Breg, Cerapedics, K2M, Medtronic, Midwest Stone Institute, Smith & Nephew, Stryker, Synthes Spine, Wright Medical Technology, Inc., Wyeth
Wright, Timothy	a-Stryker, Synthes, Zimmer; c-Exactech, Inc., Mathys Ltd., Zimmer; d-Exactech, Inc.
Wulf, Corey A.	n
Yaffe, Mark A.	d-Stryker
Yang, Jeffrey	n
Yenna, Zachary	n
Yoon, Patrick	a-Pfizer
Yu, Elizabeth	n
Yu, Joseph	n
Yuan, Brandon J.	n
Zacchilli, Michael A.	n
Zadzilka, Jayson D.	n
Zaltz, Ira	n
Zanoun, Rami R.	n
Zdeblick, Thomas A.	c-Medtronic; e-Anulex, Medtronic
Zehnder, Scott W.	a-Smith & Nephew, Stryker, Synthes, Zimmer
Zhang, Li-Quin	n
Zhang, Zijun	n
Zhao, Heng	n
Zhu, Jinjun	n