

Poster Abstracts

Poster 1

Direct Radial Tuberosity Compression

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Introduction: While full thickness distal biceps rupture often present with associated deformity and ecchymosis, partial thickness tears of the distal biceps are often difficult to definitively diagnose on physical examination and MRI. The purpose of this study was to review the sensitivity and specificity of the radial tuberosity direct compression test to determine whether or not the biceps tendon was injured distally.

Methods: A consecutive series of 43 patients with partial distal biceps tendon avulsions were examined. To perform the direct compression test, the elbow is flexed to 90 degrees and pronated maximally and the radiocapitellar joint is identified. The examiner using his contralateral hand slides his thumb ~ 3 cm distal to the radiocapitellar joint to have the thumb overlying the radial tuberosity. Direct compression is applied by the examiner's thumb to the tuberosity along with gentle passive pronation and supination of the patient's forearm. This is repeated on the patient's contralateral arm. When the direct compression test is abnormal, indicating a diseased distal biceps tendon, the patient has discomfort upon the application of direct pressure along the radial tuberosity.

Results: All 43 patients in the study had a positive direct compression test for a partial thickness biceps tear. The sensitivity and specificity were both higher with the direct compression test (both 100%) than with MRI (85% and 95% respectively).

Conclusion: The direct compression test is a highly sensitive and specific test for assessment of partial thickness biceps tears. The diagnosis of a partial thickness distal biceps avulsion can be made with accuracy using the direct compression test and appropriately compliments findings on MRI.

Poster 2

Musculoskeletal Cell Attachment And Maturation Is Not Affected On A Bacteriocidal Vancomycin-Implant

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Introduction: Periprosthetic infection is a devastating complication of orthopaedic surgery. Proposing an innovative solution, we modified titanium implants with antibiotics that inhibit infection development. We hypothesize that these surfaces will be biocompatible and won't affect normal fracture healing.

Methods: Modification: Ti90Al6V4 rods were modified with APTS, coupled with 2 AEEA linkers, and vancomycin. Activity: Control and vancomycin-modified Ti (Vanc-Ti) rods were incubated with *S. aureus* for 30 h, stained, and visualized with FEI DB235. Tissue Culture: 20,000 MLO-A5 murine osteoblasts or 5,000 N1511 murine chondrocytes were seeded on Ti disks. MTT, PicoGreen, and LDH measurements were used to measure cellular viability, proliferation, and toxicity. Alizarin red staining and alcian blue were used to evaluate mineralization and chondrocyte proteoglycan content respectively. Animals (All studies approved by IACUC): The femoral canals of male Wistar rats were penetrated through intercondylar notch and reamed with 18G needle. One side received a 1x25 mm Vanc-Ti rod with contralateral side receiving control Ti rod. The femurs were fractured using a 3 point blunt bending device. At 21 days, rats were euthanized and harvested femurs were analyzed by microCT and radiography.

Results: We first confirmed that Vanc-Ti surfaces successfully inhibited bacterial colonization relative to control rods which show extensive colonization. At higher magnification, bacteria can be seen encased in a biofilm matrix. On the Vanc-Ti surface, few, if any bacteria are seen. We next asked if the Vanc-Ti supports osteoblast viability and proliferation. There were no significant differences between the Vanc-Ti and control surfaces, with similar cellular proliferation at 1 and 3

days. Cell toxicity was evaluated by measuring released LDH; no difference in surface toxicity of the Vanc-Ti was measured for either cell type. Because there were more cells on the Vanc-Ti surface at day 3, we asked if the Vanc-Ti surface affected differentiated function. At day 10, the osteoblast culture retained abundant alizarin red stain indicating extensive mineralization. Similarly, at day 7, N1511 chondrogenic cells, showed areas of intense Alcian blue staining, suggestive of possible nodule formation and successful maturation. Morphometry of mineral formation and proteoglycan staining showed no significant differences between the Vanc-Ti and control surface, suggesting equivalent maturation and differentiation on both surfaces. Finally, when Vanc-Ti implants were used in a rat femoral fracture model, healing was not affected. There are no radiographic differences in callus formation or bony remodeling between control and Vanc-Ti rods based on intraoperatively as well as harvest x-rays. Femoral microCT analysis confirms fracture progression with abundant mineralization and bone remodeling, fracture gap bridging, and normal healing, with no clear differences between control and Vanc-Ti implants.

Discussion: Periprosthetic infection continues to be a problem in orthopaedics. We have previously shown in vitro/animal models that an implant with covalently linked antibiotic resists bacterial colonization and decreases the progression of infection. To evaluate the host-implant interaction, we demonstrate that musculoskeletal cell lines are able to colonize the surface and differentiate appropriately. In an animal model, Vanc-Ti supports fracture healing. Thus, the Vanc-Ti has antibacterial effects and facilitates host-implant interactions.

Poster 3

Revision of the Unstable Total Knee Replacement; Outcome Predictors

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Introduction: Instability is a well-recognized cause of poor results after total knee replacement. Though the etiology of this problem can be multifactorial, the lack of adequate soft tissue balancing, loss of integrity of ligamentous structures, and/or component malpositioning is usually thought to be the main cause of instability after TKA. Diagnosis of instability, however, can be challenging in some case. Hence, accurate diagnosis is an essential part of management strategy. Revision arthroplasty for

confirmed cases of symptomatic instability is often required. The purpose of this study was to evaluate the results of revision knee arthroplasty specifically performed for an unstable total knee replacement. In particular, this study sought to identify predictive factors for failure of revision arthroplasty.

Methods: Between 2000 and 2005, 70 patients (71 knees) underwent revision knee arthroplasty for tibiofemoral instability at our institution. Patients' records were retrospectively reviewed using our joint registry database. Relevant demographic, clinical and surgical variables were extracted and analyzed for statistical relevance. Patients were followed-up prospectively for at least two years. Outcome measures were objective assessment of knee stability at the time of latest follow-up combined with overall patient satisfaction.

Results: At an average 39 months follow-up, knee instability persisted in 17 patients (24%). 50 (70%) knees had both the femoral and tibial components revised, 10 (14%) had only one component revised and 11 (16%) had only polyethylene exchange. Data at the 95% confidence level revealed that revising both the femoral and tibial components and the use of femoral augments correlated significantly with achieving a stable knee at the time of the latest follow-up. Polyethylene exchange alone was associated with a poor outcome.

Conclusion: This study shows that although revision surgery for an unstable total knee arthroplasty should focus on identifying and treating the cause of instability and balancing the flexion and extension gaps, revision of both components seem to offer the most predictable outcome. The use of augments, most likely resulting in better restoration of the joint line, was also associated with better success to treat instability.

Poster 4

Diagnosing Periprosthetic Infection: High False Rate Results of Microbiological Studies

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Background: Periprosthetic joint infection (PJI), though infrequent, can be challenging to treat. An important part of treatment strategy relies on effective diagnosis and delivery of local and systemic antibiotics based on the type and antibiotic sensitivity of the infecting organism. Identification of the infecting organism hence is crucial for the successful manage-

Disclosure information can be found beginning on page 40.

ment of periprosthetic infection. This study compares the outcome of treatment for PJI when the organism was known versus false negative cases of PJI.

Methods/Materials: All patients with proven PJI who underwent surgical treatment at our institution between 1999 to 2006 were included. There were 384 patients with a mean age of 66.6 years (range, 17-94 years). Preoperative joint aspiration was performed in 254 patients (66%), whereas intraoperative gram stain and culture was done on all cases.

Results: Gram positive cocci were responsible for the majority (90%) of PJI, and gram negative organisms accounted for most of the remaining infections. Positive cultures were identified in 300 patients (78%) intraoperatively, and in 143 patients (71 %) on preoperative aspiration. Infecting organism could not be isolated from the joint aspiration or the culture in 74 cases (19%) that satisfied defined criteria for diagnosis of PPI. The outcome of surgical treatment was successful in about 85% of culture positive cases compared to about 75 % success for culture negative cases.

Conclusion: The inability to isolate an infecting organism causing periprosthetic joint infection appears to compromise the outcome of surgical treatment. The reason for the inability to isolate the infecting organism may be multi-factorial, important of which relates to the use of antibiotics at the time of or close to the date of aspiration or tissue culture. Thus every effort should be made to isolate the infecting organism whenever possible. This includes cessation of antibiotics for sufficient time prior to aspiration, repeat aspiration, or the utilization of molecular techniques for isolation of the organism. There appears to be a dire need for design of diagnostic methods that will enable clinicians to isolate infecting organisms and deliver appropriate antibacterial treatment.

Poster 5

Distal Femoral Replacement for the Treatment of Periprosthetic Fractures Following Total Knee Arthroplasty

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Introduction: Periprosthetic fracture (PPFx) following total knee arthroplasty (TKA) is a rare, yet challenging complication. Periprosthetic fractures most commonly involve the

supracondylar region of the femur and occur in patients with poor bone quality. Majority of these patients require operative intervention with revision arthroplasty being one such option. Periprosthetic fractures around the knee, however, can be complicated by a number of factors such as poor bone quality, retarded fracture healing due to old age, and a high degree of comminution. In these cases distal femoral replacement can be used as an alternative. The purpose of this study was to evaluate the outcome of patients who underwent distal femoral replacement for treatment of PPFx after TKA. We hypothesized that although DFR may provide good pain relief and improvement in functional range of motion, it may be associated with higher complication rates.

Materials and Methods: 13 patients undergoing distal femoral replacement for periprosthetic fracture between 1997 to 2004 were identified. All patients were confirmed to have severe distal bone deficiency with high comminution. The medical records of these patients were reviewed in detail. There were ten women and three men with a mean age of 75 years (Range 62-85 years). The average follow-up was 30 months (range, 15-90 months) with no patient lost to follow-up. One patient died of an unrelated cause during the follow-up period. The clinical outcome was measured using the Knee Society score and the Sf-36 score.

Results: The mean duration between index knee arthroplasty and fracture was 48 months (range, 1-216 months). The outcome was considered to be excellent or good (as indicated by a knee score of >80 points, no use of a walking aid, and a non-painful knee) for 2 knees, fair for 2, and poor for 9. At the time of the latest follow-up, the average SF-36 score was 60 points (Range 42 to 89 points) and the average Knee Society score was 62 points (Range 33 to 87 points). The average post-operative functional status was 47 points (Range 30-67 points). Medical complications included line sepsis from a central line placed for nutritional support (one patient), urinary tract infection (one patient), and pulmonary embolus (one patient). There was one reoperation for drainage of hematoma and wash out. One patient suffered a persistent peroneal nerve palsy.

Conclusion: Distal femoral replacement has long been used for reconstruction of distal femur after resection of neoplasms. However, DFR is being increasingly employed for reconstruction of femur in non-neoplastic cases including those with complicated periprosthetic fractures after TKA. The outcome of this procedure for the latter etiology is largely unknown. Distal femoral replacement used for treatment of PPFx after TKA seems to be a viable option but carries a high rate of complication. This procedure should be reserved for elderly patients who lead a relatively sedentary lifestyle.

Poster 6

Satisfactory Outcome of Trochanteric Femoral Nailing in 235 Cases

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Introduction: Treatment of proximal femoral fractures using a second generation intramedullary locking device is believed to have a good outcome with minimal complications. The purpose of this study was to determine the outcome of surgical treatment of proximal femoral fractures using a 'modern' device (TFN, Synthes) and identify factors that may lead to the failure of this procedure.

Methods: We performed a review of all patients who underwent treatment with TFN at our institution since the year 2000. Our study population included 239 hips in 235 patients with an average age of 71.4 (range, 19-102). Data regarding demographics, comorbidities, type of fracture, number of previous procedures, and the details of the surgical procedure were compiled. We performed trochanteric femoral nailing operation for treatment of IT fractures (79.6%), subtrochanteric fractures (18.5%) and femoral neck fractures (1.7%)

Results: The failure rate for patients who underwent TFN in our institution was 4.0% over 12 months in 217 patients. Outside medical centers referred 3 cases of TFN failure to our institution for conversion to total hip arthroplasty. The most common etiologies for failure were non-union in 7 cases, mal-positioning of the hardware in 5 cases, intolerable pain in 2 cases. Age was not a predictor for failure since there was approximately 96% success rate over 20 months in 29 cases over 87 years old. The one year mortality rate for patients over 87 years old was 29%. We are currently collecting data regarding the functional status of these patients.

Conclusion: The trochanteric femoral nail is an improvement upon previous osteosynthesis devices for treatment of proximal femoral fracture. The use of this device is not without complications, however. The major predictor of failure of this device appears to be mal-positioning of the hardware or distraction of the fracture leading to non-union.

Poster 7

Sterility of C-Arm Fluoroscopy During Spinal Surgery

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Introduction: Intraoperative fluoroscopy is used routinely by the spine surgeon in the operating room. Although the use of the C-arm can help the surgeon assess alignment and safely place instrumentation, there is concern that the C-arm may represent a potential source of contamination and might contribute to postoperative infection. The purpose of this study was to use swab samples to evaluate the sterility of draped C-arms at the end of spine surgery as an assessment of related sterile technique.

Methods: Twenty-five surgical cases of two spine surgeons which required the use of the C-arm were included in this study. Sterile culture swabs were used to obtain samples from five defined locations on the C-arm drape after its use in the surgical case. The non-draped technician's console of the C-arm was sampled in each case as a positive control. Additionally, twenty-five C-arm drapes were swabbed directly after they were applied to the C-arm unit as negative controls. Each swab was then streaked on four quadrants of 5% sheep blood Columbia agar (a non-selective, broad-spectrum media) and incubated at 37 degrees Celsius for 48 hours. Growth was graded on a scale of 0, 1+, 2+, 3+, or 4+ depending on the number of quadrants on each plate where colony growth was observed. Contamination was considered to be a growth pattern of 1+ or higher.

Results: Contamination was noted on only one of 25 negative control drapes at a single location. All positive control swabs (100%) exhibited growth from the negative control drapes, and 96% of the positive controls exhibited growth on the postoperative drapes. At least some degree of contamination was observed at all locations of the clinically used C-arm drape postoperatively. The upper two sites sampled had the greatest degree of contamination. The top of the receiver (56%) and upper front of the receiver (28%) were both significantly greater than the negative controls. The lower front, receiver plate, and mid-portion of the C-arm had lesser rates of contamination (12-20%).

Discussion and Conclusion: The upper portions of the C-arm clearly have the greatest rates of contamination during clinical spine cases. This most likely occurs from contact with non-draped portions when rotated to obtain lateral images or from

contact with light handles above. We no longer regard the top portions of the C-arm drape sterile during spinal operations and believe that minimal handling of these portions may decrease the risk for intraoperative contamination at the operative field.

Poster 8

Is There a Correlation Between INR and Intraoperative Bleeding

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Introduction: Bleeding during surgery is an untoward event. Various coagulation parameters, including International Normalized Ratio (INR), may be utilized to assess coagulation status preoperatively. High INR is expected to correlate with intraoperative blood loss, but little research has actually been done on this relationship. Additionally, accepted ranges for normal INR vary in literature as well as within institutions. In this study we test the hypothesis that higher INR correlates with increased intraoperative blood loss.

Methods: 4288 patients, 2188 female and 2100 males, mean age 70 (range: 13-101), were selected from a pool of patients undergoing primary THA at our institution between 2000 and 2007. Patients' medical records were accessed to evaluate demographic information, preoperative INR values, pre and postoperative hemoglobin values, transfusion information, comorbidities and postoperative complications.

Results: Results show that there was a significant positive association between preoperative INR and the number of postoperative complications, as well as a correlation between preoperative INR and drop in Hgb. Additionally, we found that higher preoperative INR indicated a greater need for blood transfusion, with a significant increase in need for transfusions at an INR value of 1.5.

Conclusion: This study suggests that intraoperative bleeding (measured by drop in hemoglobin and need for blood transfusion) as well as the number of postoperative complications correlated with higher INR values. It also showed that at an INR value of 1.5 the need for blood transfusion, and thus intraoperative bleeding, begins to significantly increase. Considering intraoperative bleeding and blood transfusion are associated with perioperative complication, this information should be used to properly assess the bleeding risk associated with abnormal INR for each patient undergoing THA. Further

study could help standardize a normal range of INR values for widespread use.

Poster 9

Closure of Hip Fracture Wounds with a Topical Adhesive without a Surgical Dressing: Reduction in Post-Operative Tape Blisters

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Introduction: Our hypothesis is that post-operative wound blisters could be reduced with a layered closure of the incision and Dermabond (Ethicon, Raliegh, NC) in the absence of a surgical dressing.

Methods: A retrospective review of 100 consecutive hip fractures (54 femoral neck and 46 intertrochanteric/ subtrochanteric hip fractures) treated with a layered closure using absorbable sutures and Dermabond without a surgical dressing was performed. Patient demographics, living conditions, and mental status were recorded for all cases. Each patient was evaluated daily in the hospital and at routine post-operative follow-up (2, 6, and 12 weeks) for wound drainage, blister formation, and gross evidence of infection. Historical controls were used to compare our "dressing-less" wound closure to various types of post-surgical dressings.

Results: The average age at the time of surgery was 84.2 years (range, 74 to 95 years) and all patients were followed until wound healing. There were no cases of post-operative wound infections or wound dehiscence. In two cases (2%) a dressing was applied on post-operative day one for mild wound drainage and in one case (1%) a peri-incisional blister was found on day two. A correlation between surgery type (hemiarthroplasty, total hip arthroplasty, percutaneous screw fixation, intramedullary hip screw fixation, or open reduction and internal fixation) or length and blister formation was not demonstrated.

Conclusion: Overall, our results compare favorably to historical controls and show it is safe and efficacious to use a "dressing-less" wound closure in treating hip fractures. Significance: A reduction in wound blisters, without an increase in adverse events, can be achieved with a layered wound closure and a topical adhesive without a surgical dressing in treating hip fracture patients.

Poster 10

Safety and Recovery after Total Hip Arthroplasty Using the Superior Capsulotomy Technique

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Total hip arthroplasty (THA) in its conventional forms is extremely reliable with low complication rates. Still, there is the potential for improvement, particularly with management and potential preservation of the soft-tissues surrounding the hip. Less invasive methods of performing THA have been considered controversial after increased complication rates were reported. In August 2003, the superior capsulotomy technique was introduced with the goal to maintain the joint stability and preserve the abductor muscles. We investigated the safety and recovery of the first cases of this novel technique in patients with a minimal follow-up of 2 years. We assessed 83 hips in 77 patients that underwent THA using the superior capsulotomy technique. The technique involves exposing the superior hip joint capsule posterior to the medius and minimus, and anterior to the short external rotators. The femur is prepared with the femoral head in place and then the femoral head is excised without dislocation. The acetabular is prepared and instrumented with angled instruments. The capsule is preserved and closed. The operations were performed between August 2003 and January 2006. In all cases the operation was performed with assistance of surgical navigation. The mean age at operation was 56.2 ± 11.3 years (range, 28 – 77 years). There were 47 (57%) right hips, 47 hips (57%) in males and 10 (13%) patients had bilateral THA. The preoperative diagnosis included primary osteoarthritis (58 hips, 70%), developmental dysplasia of the hip (20 hips, 24%), osteonecrosis of the femoral head (2 hips, 2%), posttraumatic osteoarthrosis (1 hips, 1%), and rheumatoid arthritis (1 hip, 1%). The mean cup diameter was 53.0 ± 3.3 mm (46 – 60 mm). 17 (20%) bearings were 28mm and 66 (80%) bearings were 32mm. The patients were prospectively evaluated before operation, at first follow-up (0-9 weeks postoperatively), at second follow-up (9-24 weeks postoperatively) and at last follow-up (>24 months postoperative). As a clinical scoring system the Merle d'Aubigné score was used. All patients were allowed to progress weight bearing and motion without restriction. The initial Merle d'Aubigné score of 10.5 ± 1.8 (5 – 14) increased postoperatively to a mean of 15.4 ± 1.6 (11 – 18). Sixty-four (77%) patients were discharged directly at home after a mean length of stay of 3.9 ± 1.0 days (3 – 10 days). At the second

postoperative follow up the mean Merle d'Aubigné score increased to 17.1 ± 3.4 (13 – 18) and at the last follow up it was 17.5 ± 0.9 (12 – 18). There were two revisions, one for acute cup displacement and a second for revision of a traumatic ceramic fracture. There were no hip dislocations and no infections. These preliminary experience suggest that the superior capsulotomy provide a method of performing THA with soft tissue preservation in a safe and reliable way. These results show that the patients recovered fast with a low incidence of perioperative complications. With this technique it is possible to allow patients to safely progress without restriction of weight bearing or motion.

Poster 11

Vancomycin Can Be Covalently Bonded to Stainless Steel to Prevent Bacterial Colonization

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Introduction: Despite the development of antibiotic delivery systems and treatment strategies, periprosthetic infection continues to be a serious clinical challenge. Main drawbacks for the current available surface coatings include unpredictable elution kinetics, insufficient antibiotic content, development of resistance and adverse tissue effects. We recently described a novel technique for covalently attaching vancomycin to a titanium surface; this modified surface prevented bacterial adherence in vivo, whilst maintaining steady antibiotic concentrations. This technique has now been successfully applied to a stainless steel surface and shows similar antibacterial characteristics to the derivatized titanium surface.

Methods: 1mm diameter 316L stainless steel rods were passivated with citric acid and dichromate, aminopropylated with APTS, and derivatized with vancomycin according to previous described techniques. Surface-bound vancomycin was visualized by confocal laser microscopy after indirect immunofluorescence, using rabbit anti-vancomycin IgG and Alexa-Fluor 488-coupled goat anti-rabbit IgG. Bactericidal activity was assessed through incubation of both modified and control rods with 10^8 cfu S. Aureus (ATCC 25923) in trypticase soy broth (TSB) at 37°C for 12h. Adherent bacteria were visual-

Disclosure information can be found beginning on page 40.

ized by confocal laser microscopy after staining with the Live/Dead BacLight Kit (Molecular Probes). Numbers of bacteria adherent to the rods was determined after suspension by sonication and serial dilution plating.

Results: The vancomycin modified stainless steel rods show a significant decrease in number of adherent bacteria after incubation with *S. Aureus* compared to the control rods. Images after Live/Dead staining show minimal background fluorescence on the vancomycin-modified rods, whereas the control rods show intense fluorescence, indicative of the presence of bacteria or bacterial DNA. Serial dilution plating of adherent bacteria after suspension by sonication revealed a significant decrease in bacteria adherent to the modified rods when compared to the controls. When stained by immunofluorescence for vancomycin, the modified rods showed intense diffuse staining, while on the control rods no fluorescence was apparent.

Discussion and Conclusions: The technique for covalent bonding of antibiotics to orthopedic implants has been described for titanium alloys. Due to an inferior biocompatibility and higher infection rates, stainless steel devices are less frequently used in human orthopedic surgery. The higher susceptibility for biofilm formation of stainless steel versus titanium however warrants the need for a stable, anti-infective stainless steel implant surface. In addition, economic reasons enforce the use of stainless steel for implants in developing countries; furthermore, stainless steel is the most commonly used material for orthopedic implants in veterinary medicine. The technique described in this abstract circumvents the shortcomings of the currently available antibiotic delivery systems and will facilitate continuing use of stainless steel implants.

Poster 12

Radiation Exposure to Patient and Surgeon During the Use of C-Arm Fluoroscopy. Comparison of Standard and Mini C-Arm

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Background: The use of C-arm fluoroscopy for routine orthopaedic imaging has become commonplace in the operating room, outpatient clinic, and emergency department. Consequently, the increasing reliance on fluoroscopy has led many orthopaedists to raise concerns about the amount of radiation they are exposed to, even when consistently observing recommended safety guidelines. The mini C-arm fluoroscope has

gained popularity in recent years due to its practicality, cost effectiveness, and exposure reducing capabilities. However, few studies have quantified exposure during mini C-arm imaging of a body part that is larger than a hand or wrist. Moreover, few studies have compared exposure during large C-arm fluoroscopy with mini C-arm fluoroscopy. The purpose of this study was to create a series of dose mapping scenarios in order to measure radiation exposure to the patient and surgeon during the use of large and mini C-arm fluoroscopy.

Methods: A standard OEC 9800 C-arm and an OEC MINI6600 C-arm were used to image a cadaveric ankle specimen, which was suspended on an adjustable platform. Film badge dosimeters were mounted at thirteen specific positions and angulations to detect direct and scatter radiation. Testing was conducted in various dose mapping "scenarios" which altered the proximity of the cadaveric specimen relative to the radiation source. We thus attempted to capture a range of exposure data from a best-case to a worst-case scenario, as one may encounter in a true procedural setting.

Results: At all configurations tested, measurable exposure from the large C-arm was considerably higher than the mini C-arm. Exposure to both patient and surgeon was notably amplified when the specimen was positioned closer to the X-ray source. Exposure levels were consistently higher during ankle fluoroscopy than have been previously recorded during hand or wrist imaging. Potential exposure to the surgeon was detectable and of concern.

Conclusions: Radiation exposure to the patient and surgeon is dependant on the tissue density and the shape of the extremity that is imaged. Elevated exposure levels can be expected when imaging larger body parts or when the extremity is positioned closer to the X-ray source. When it is possible to satisfactorily image an extremity using the mini C-arm, it should be used over its large C-arm counterpart. Recommended safety precautions should always be followed when using large and mini C-arm fluoroscopes.

Clinical Relevance: The orthopaedist should exercise caution when using large or mini C-arm units and consistently follow established radiation safety guidelines when imaging.

Poster 13

Biomechanical Importance of the Anterior Longitudinal Ligament in a Corpectomy Model

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Disclosure information can be found beginning on page 40.

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Introduction: Lumbar corpectomy results in significant instability, and the surgical reconstruction remains problematic. Our study evaluated the stability associated with various instrumentation techniques following corpectomy with and without an intact anterior longitudinal ligament (ALL).

Methods: Twenty-four bovine lumbar spines were tested intact under axial rotation (AR), flexion/extension (FE), and lateral bending (LB). An ALL sparing corpectomy was performed at L3, and specimens were randomized as follows (n=8/group): Group 1: titanium mesh cage; Group 2: expandable titanium cage; Group 3: expandable PEEK cage. Instrumented specimens were tested with the following additional instrumentation: anterior plate, posterior pedicles screw fixation from L1 to L5, and posterior pedicle screw fixation from L2 to L4. Subsequently, the ALL was excised at the corpectomy site, and the testing sequence repeated.

Results: In Group 1 with posterior constructs, there was a significant increase in FE without the ALL. When the ALL was intact in Group 1, the anterior construct had significantly more FE and LB than both posterior constructs. When using an expandable cage, there was no significant difference when comparing the same constructs before and after excision of the ALL. Regardless of the status of the ALL in Group 3, the posterior constructs significantly decreased FE compared to the anterior plate, with similar trends observed in group 2.

Conclusion: When using a titanium mesh anterior cage with posterior pedicle screw instrumentation, the anterior longitudinal ligament offers significant biomechanical stability in FE. Conversely, there was no significant advantage in maintaining the ALL with the use of an expandable cage implant. Finally, circumferential instrumentation techniques consistently performed better than anterior alone.

Poster 14

Post-Operative Radiographs after Pinning of Supracondylar Humerus Fractures: Are They Necessary?

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Introduction: The purpose of this study was to evaluate the necessity of early post-operative radiographs after pinning of supracondylar humerus fractures by determining both the percentage of patients who displayed change in fracture fixation

and whether these changes affected their further management and outcome.

Methods: A series of 356 consecutive patients who underwent operative management of Gartland Type II and III supracondylar humerus fractures at our institution between January 2002 and July 2007 were reviewed. Criteria for inclusion were patients with Type II or III supracondylar fractures who underwent closed reduction and percutaneous pinning and subsequent follow-up, including a first post-operative visit within two weeks, radiographs at date of pin removal, and radiographs at final follow-up. Patients with intraarticular fractures or those without complete follow-up were excluded. Demographic data was obtained through chart review, including age, gender, extremity, fracture type, and mechanism. Intraoperative fluoroscopic images were compared to post-operative radiographs to identify changes in fracture alignment and pin placement.

Results: 356 patients (180 females, 176 males) with a mean age of 6.1 years (range 1.3-16.0) were reviewed. 133 fractures were classified as Type II, and 223 were Type III. Our overall complication rate was 3.4% (12/356). All twelve complications were in Type III fractures. 11 patients (3.1%) showed either pin migration or fracture displacement less than 2mm at the first post-operative visit. None of these eleven patients required further operative management. Patients with changes in pin or fracture alignment did not demonstrate a statistically significant difference in time to first post-operative visit, days to pin removal, or average follow-up time. Fracture severity did not correlate with change in alignment. No neurologic complications were observed in patients with alignment changes.

Conclusion: Mild alignment changes and pin migration observed in post-operative radiographs after pinning of supracondylar humerus fractures have little effect on clinical management parameters or long-term sequelae. Thus, post-operative radiographs can be deferred without significant complication until the time of expected pin removal.

Poster 15

A Comparison of CT Scans and Radiographs for the Measurement of Anteversion in Total Hip Arthroplasty Acetabular Components

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Disclosure information can be found beginning on page 40.

Introduction: Correct placement of the acetabular component in total hip arthroplasty (THA) is essential for prosthetic stability and to minimize wear. Anteversion has been tied to implant stability and is frequently quantified when evaluating an unstable THA or planning revision surgery. Despite multiple potential sources for error, cross-table lateral radiographs are widely utilized for evaluation of anteversion and often cited in peer-reviewed journal articles as the sole measure of anteversion. Recently, when precise anteversion measurements are necessary, we have utilized CT scans to provide measurements of cup and stem anteversion. Despite increasing use of this technique, we have been unable to find studies that assess the precision and reliability of measurements made from cross-table lateral radiographs and CT scans.

Methods: 42 patients with a well-fixed THA and multiple cross-table lateral radiographs including 15 with radiographs and a CT scan for anteversion performed within two years of one another were selected. Anteversion on cross-table radiographs was measured as the angle formed by the long axis of the ellipsoid projection of the cup base and a vertical line utilizing a digital goniometer. All measurements were done by a single orthopaedic resident (PGY3) and intra-class correlation was calculated. CT scans were interpreted by one musculoskeletal radiologist. Finally, radiographic measurements were compared to those obtained from CT scans for 15 patients. To determine variability of cross table radiograph measurements, 20 randomly selected radiographs were measured four times by two observers (PGY3 and devoted hip surgeon) for determination of intra- and inter-observer reliability. Two separate measurements for each radiograph were made by each observer in two reading rounds separated one month apart. Finally, 4 sawbones pelvises underwent navigated cup implantation. Measurements of anteversion using radiographs and CT were compared with values determined during navigation.

Results: Pearson correlation coefficients for radiographic anteversion measurements of two observers were 0.9990 and 0.9998, respectively, when comparing two measurements from identical radiographs (intra-observer reliability). Paired values for two observers measuring the same radiograph at the same time point had a Pearson correlation coefficient of 0.9990 (inter-observer reliability). In comparison, measurements taken from serial radiographs of the same component had an intra-class correlation of only 0.74. The Pearson correlation coefficient describing radiographic vs. CT-based measurements was 0.78 and the radiographs averaged 8.7 degrees more anteversion. CT measurements of anteversion had stronger correlations with values determined during computer navigation than did measurements taken by either observer from radiographs of the sawbones pelvises.

Conclusions: Cross-table radiographs can be precisely measured ($p=0.99$) for evaluation of anteversion but accuracy of the measurement depends on the radiographic technique and patient positioning ($ICC=0.74$). In our study, serial cross table radiographs in well-fixed acetabular components demonstrated substantial differences in anteversion. Additionally, higher correlation of CT-based measurements with computer navigated anteversion measurements supports use of CT scan over cross-table radiographs when a precise measurement of cup anteversion is needed. While cost considerations and radiation exposure may prompt use of radiographs for routine imaging, the surgeon and researcher should be aware of the limitations and variability of radiographic measurement.

Poster 16

Attachment of Active Antibiotics on Ti Alloy Surfaces with No Effect on Topography

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Introduction: Periprosthetic infection (PPI) is an increasingly prevalent problem thought to be caused by biofilm-forming bacteria adhering to the implant. Adherent bacteria evade immune surveillance and systemic antibiotics that poorly penetrate the biofilm matrix. Using covalent attachment of antibiotics, we have developed Ti surfaces that resist bacterial adhesion. We describe a new methodology that allows antibiotic attachment to the many different geometries and topographies used for implant manufacture.

Methods: Titanium alloy (Ti6Al4V) wires and smooth/beaded discs underwent cleaning in Alcanox, 1M NaOH and HCl:MeOH. Cleaned surfaces were passivated (1) using H₂SO₄:H₂O₂ (70:30) or (2) autoclaving. Surfaces were reacted with aminopropyltriethoxysilane (APTS), and coupled with two aminoethoxyethylacetic acid (AEEA) linkers and vancomycin. SEM imaging: Surface topography of Ti-VANC alloy discs was visualized using a Hitachi TM-1000 SEM. Immunofluorescence: Vancomycin coupled to discs and rods was detected with mouse anti-vancomycin IgG (12h, 40C) followed by AlexaFluor 488-donkey anti-mouse IgG (1hr), followed by digital imaging using epifluorescence or confocal microscopy. Bacterial Culture: Samples were sterilized in 70% EtOH, washed with Trypticase Soy Broth (TSB) and

incubated with *S. aureus* in TSB (4h, 37°C). Non-adherent bacteria were removed by 3 TSB washes, and samples re-incubated for 4 hrs in fresh TSB. Non-adherent bacteria were then removed with 6 PBS washes, stained with the Live/Dead BacLight™ Viability Kit (live bacteria fluoresce green), and visualized by confocal microscopy.

Results: We first asked if autoclaving successfully created a Ti oxide layer by observing the static contact angle of a 10µl drop of water. On the control disc, the water remained in a drop, even on the beaded side. On the autoclaved disc, the water spread to a thin film indicating an oxide layer. The piranha treated disc had a smaller contact angle than the control but did not spread as much as the autoclaved disc. The piranha beaded and the autoclaved beaded disc were similar with the droplet completely absorbed. Overall, autoclaving appeared to produce a better surface than piranha treatment. Upon SEM, the autoclaved discs looked identical to the controls whereas the piranha treated discs showed extensive pitting. Vancomycin coverage caused no further topographical change for any of the surface treatments. Using the autoclave method, we then derivatized the different Ti surfaces and tested for vancomycin. Uniform/complete vancomycin coverage was observed on all surfaces; no staining was apparent on controls. When challenged with *S. aureus*, Ti-VANC surfaces successfully inhibited bacterial adhesion, whereas control surfaces were extensively colonized with bacteria.

Discussion: Orthopaedic implants may have a heterogeneous surface depending on functionality; smoother surfaces minimize friction whereas rough surfaces provide stability/osseointegration. The outlined scheme is applicable to all surfaces with topographic retention. Importantly, these surface modifications render smooth and beaded Ti6Al4V surfaces and Kirshner wires, bactericidal. Such techniques can be applicable to other topographies and metals, such as stainless steel, to meet the many demands for orthopedic implants.

Poster 17

Return to Competitive Sports Following Medial Epicondyle Fracture in Adolescent Athletes: A Comparison of Operative Vs. Non-Operative Treatment

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Introduction: Medial epicondyle fractures account for about 12% of all elbow fractures in adolescent athletes and are the equivalent of medial collateral ligament tears in the adult. Closed reduction and immobilization or open reduction and internal fixation (ORIF) are both accepted treatments for this injury. However, there continues to be no consensus and much controversy as to the best treatment for displaced fractures.

Methods: IRB approval was obtained. All patients treated for a 2 to 20 mm displaced medial epicondyle fracture over a two-year period were reviewed. Patients with an unstable elbow, intra-articular entrapment of the fracture fragment or ulnar nerve entrapment were excluded. The patient chart and radiographic data was reviewed. All patients completed a detailed questionnaire including the Disabilities of the Arm, Shoulder and Hand (DASH).

Results: Complete data with 2 year follow-up was available for 20 patients, 6 treated non-operatively and 14 treated with ORIF. Initial fracture displacement was similar in both groups (5.32 ± 1.98 mm vs. 7.66 ± 2.74 mm). There were no complications. All of the patients played competitive sports prior to injury and were able to progress to the next level after treatment. DASH scores demonstrated statistically superior outcomes for patients treated non-operatively compared with patients treated operatively, 0.14 ± 0.35 vs. 1.30 ± 1.87 . Eleven of the patients competed in sports with overhead throwing or hitting, 4 were treated non-operatively and 7 were treated with ORIF. Of these overhead athletes, all returned to their sport, although one pitcher in each group stopped pitching to play a position. DASH scores show a trend toward better outcomes with non-operative compared with operative treatment, 0.22 ± 0.43 vs. 1.48 ± 2.37 . This effect was not statistically significant, but the study is underpowered to make any definitive assessment. One pitcher felt as if his pitching improved after non-operative treatment.

Discussion & Conclusions: While all patients did well and were able to return to sports regardless of the treatment selected, DASH scores revealed statistically superior results with non-operative treatment compared with ORIF. These data suggest that non-operative treatment of displaced medial humeral epicondyle fractures is safe and allows full return to competitive overhead sports, even in pitchers and quarterbacks. Significant treatment bias influences this type of analysis and serves to validate the need to conduct prospective trials to elucidate the optimal treatment for this injury.

Disclosure information can be found beginning on page 40.

Poster 18

Do Expandable Cages Improve Segmental Stability Following a Lumbar Corpectomy? An In-Vitro Biomechanical Study

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Introduction: Segmental instability following lumbar corpectomy remains a clinical concern. Therefore, we compared the biomechanical potential of two new expandable cages that offer the advantage of adjusting the implant height to fit the defect size, to a standard titanium mesh cage.

Methods: Lumbar male calf spines (n=24) were obtained and randomized in three groups (n=8/group): 1) Titanium mesh cage, 2) Expandable titanium cage, 3) Expandable PEEK cage. Following intact spine testing under axial rotation(AR), flexion/extension(FE) and lateral bending(LB) (± 6 Nm all planes), an L3 corpectomy was performed and an appropriate implant placed in the defect. Reconstructed spines were tested with the following additional instrumentation: L2-4 anterior plate, L2-4 pedicle screws + crosslink, L1-5 pedicle screws + 2crosslinks. Full ROM (degrees) was measured across the L2-4 levels.

Results: No differences were observed between the three implants augmented with an anterior plate. However, FE ROM was significantly higher for the mesh constructs augmented with posterior fixation spanning either L2-4 or L1-5 compared to both expandable cages. Similar statistical differences were recorded in AR between Groups 1 and 3, while high 'within group' standard deviation precluded significance between Groups 1 and 2. Additional statistical analysis indicated that anterior plate fixation was weaker than L1-L5 pedicle screw augmentation for Group 1 in LB and Groups 2,3 in LB and FE.

Conclusion: Expandable cages offer improved segmental stability over a standard mesh cage when augmented with posterior pedicle screws. These differences are diminished when using anterior only fixation. Furthermore, mesh cages augmented with the anterior plates offer decreased segmental stability than circumferential constructs.

Poster 19

Patient-Oriented Functional Analysis after Distal Biceps Tendon Repair Using the Endobutton Technique

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Introduction: While relatively uncommon, distal biceps tendon ruptures are increasing in prevalence in today's more active middle-aged population. One technique described for the repair of these tendon ruptures involves a single anterior incision with the use of an Endobutton for the fixation of the tendon to the radial tuberosity. The purpose of this study was to assess the results of distal biceps tendon ruptures repaired in this fashion using standard and patient-oriented functional outcome measures.

Methods: Over a five year period (2002-2006), 23 consecutive patients with distal biceps tendon ruptures were repaired by a single surgeon using a single anterior incision and the Endobutton technique. Patients were contacted at an average follow-up of 2.6 years post-operatively and functional outcomes were determined using a subjective survey, a patient-oriented functional outcome measure (Disabilities of the Arm, Shoulder and Hand: DASH), physical examination, and radiographs.

Results: Nineteen patients participated in the study by filling out subjective functional analysis questionnaires and 17 patients had follow-up physical examinations and radiographs. All patients were men with a mean age at injury of 49 years (range: 41 to 66 years) and all were satisfied with their final result. Nine of 19 patients reported no disability and no difference between their operative and uninjured arms. The mean follow-up DASH score was 4.7 ± 6.5 SD (95% CI, 1.6 to 7.8), which was statistically better than the previously published US general population control mean DASH score of 10.1 (see Figure 1). All patients returned to their preoperative level of activity. No patient lost more than 8 degrees of elbow flexion/extension or forearm rotation and all had good strength compared to their uninjured arm. Minor sensory changes on the volar forearm (numbness and tingling) were the only symptomatic complications encountered. There were no wound infections, posterior interosseous nerve palsies, re-ruptures or re-operations. Heterotopic ossification, while clinically asymptomatic, was seen radiographically in 9 of 17 patients.

Conclusion: Distal biceps tendon repair using the Endobutton method is an effective surgical technique for this injury with

minimal to no functional deficits and a low rate of clinical complications.

Poster 20

Treatment of Open Peri-Articular Shoulder Fractures Sustained in Combat-Related Injuries

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Introduction: Open peri-articular shoulder fractures, to include proximal humerus and superior shoulder suspensory complex fractures present a tremendous challenge for orthopaedic surgeons. These injuries albeit rare, typically occur from high energy mechanisms and are associated with a high morbidity and mortality. At our institution, there have been more than six-hundred soldiers treated for open upper extremity fractures throughout Operations Iraqi and Enduring Freedom. There are several articles relating outcomes of closed periarticular shoulder fractures in civilian trauma literature, only one peer-reviewed article has been published on this specific open injury pattern. Our objective was to report on the treatments and outcomes of a case series of forty-four patients with combat-related, open peri-articular shoulder fractures.

Methods: All patients with combat-related open upper extremity long bone fractures treated at our institution after March 2003 were reviewed. Forty-four patients were identified with open grade III periarticular shoulder fractures (33 IIIA, 1 IIIB, and 10 IIIC). The majority of the injuries were incurred through a high-energy blast or gun shot wound mechanism (24 Blast, 15 GSW, 4 motor vehicle crash, 1 helicopter crash). Inpatient/Outpatient records, preoperative and postoperative radiographs, laboratory culture data, and photographic documentation records were reviewed.

Results: Thirty-six patients were available with greater than 1-year follow-up and were included in the study. Average follow-up obtained was 34 months (range: 12-49 months). The patients underwent an average of 2.5 (range: 1-6) orthopaedic surgeries in theater for initial management of their fractures. At our facility, an average of 2.3 (range: 0-13) subsequent orthopaedic surgical procedures were performed prior to the definitive management of their fractures. Initial intraoperative deep wound cultures were positive in 18/26 patients (69%) in which cultures were obtained. The rate of associated neurologic and treated vascular pathology with these injuries were 39% (14/36 patients) and 22% (8/36 patients) respectively.

Other associated injuries occurred in 32/36 patients (89%) with hemo-pneumothorax 10/36 (28%) being the most-common. Internal fixation was used in definitive treatment in 21/36 patients (58%). Bone graft and other osteobiologic products were used in 10/21 patients (48%) treated with internal fixation. Radiographic union was obtained at an average of 4.5 months (range: 3-7 months) postoperatively. Postoperative deep infection/osteomyelitis occurred in 5/36 patients (14%). Secondary surgical procedures and/or readmission to the hospital after definitive fracture treatment occurred in 11/36 patients (31%), with no required delayed bone grafting procedures. There was an overall 11% amputation rate.

Discussion and Conclusions: Open combat-related peri-articular shoulder fractures are complicated injuries that present difficult challenges to treatment. The majority of these do not occur in isolation, but exist with multiple traumatic comorbidities and associated postoperative complications. Meticulous surgical debridement is essential in management of these severely comminuted and contaminated open fractures. Careful timing and patient selection when using internal fixation is required to minimize the risk of deep infection and osteomyelitis. Fracture union can often be predictably obtained in these injuries however final range of motion and functional outcome data will need to be reported.

Poster 21

MRI Evaluation of Bioabsorbable Implants in ACL Reconstruction with Quadrupled Hamstrings Graft

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Introduction: Biodegradable implants are being used increasingly in arthroscopic ACL reconstructions. The rate and pattern of resorption of a bio-degradable implant is of critical importance in predicting the success of the procedure and deciding an appropriate rehabilitation protocol. Resorption pattern after implantation can only be assessed by MRI and it would help in correlating the MRI features with clinical outcome.

Material and Methods: Thirty patients of arthroscopic reconstruction of ACL with quadrupled hamstrings graft using bio-Transfix (femoral side) and bio-screw (tibial side) were included in the study. Accelerated rehabilitation program was used in all patients. Serial MRI (3 Tesla) evaluation of the reconstructed knee was obtained at 6, 12, 18, 24 and 36 months following surgery and features related to implant, tunnels and reconstructed ligament were noted.

Results: After an average follow-up period of 20 months (range 12-36 months) none of patients showed any change in the screw length while one showed reduction in the diameter. No change was noted in the length of bio-transfix while decrease in screw diameter was observed in two patients. Fracture of the bio-transfix was noted in one knee (n=20). Two shapes of tibial tunnels were noted on transverse sections, O-shaped in 23 and 8-shaped in 7. Tibial tunnels were of three types in sagittal sections, parallel in 23, cone like in 4 and cystic in 3 patients. Majority (8 out of 9) of knees with tunnel enlargement were seen with cone/cystic patterns. 80 percent of knees showed graft healing at 6 months MRI.

Discussion and Conclusion: Bio-transfix and PLLA-bio-screw do not show signs of resorption until 2 years in majority of knees. Shape (8 shaped, cone like) of tibial tunnel is associated with screw divergence and tunnel widening although no clinical significance could be attributed to this finding. MRI evidence of complete graft-bone healing is found in majority (80%) at 6 months and in all at 1 year. Fracture of bio-transfix is a cause for concern and a larger study warranted.

Poster 22

A Cadaveric Study: Changes in Length of the First Ray with Two Different First MTP Fusion Techniques

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Background: First metatarsophalangeal joint (MTP) fusions are performed as salvage procedures for a variety of medical conditions ranging from osteoarthritis, rheumatoid arthritis, hallux valgus, and failed first MTP arthroplasty. A number of bone preparation techniques have been described to fuse the first MTP joint, with varying degrees of success. The aim of this study was to characterize and compare the average shortening of the first ray with a crescentric bone cut fusion technique versus a flat bone cut technique.

Methods: Six paired cadaver feet were divided into two groups with one foot from each pair in each group. Preoperative first ray lengths were measured radiographically. Each group then underwent arthrodesis of first MTP joint with one of two different bone cut techniques: flat cuts or crescentric cuts. The postoperative lengths of first rays were measured and the data analyzed using a two-tailed Student's t-tests.

Results: The average shortening that occurred in both groups after the procedure was 7.05mm for the flat cut group (Group I) and 5.67mm for the machined conical reaming group (Group II). Both were statistically significant (p=0.002 for the

flat group, p=0.033 for the crescentric group). Comparing both groups, there was no statistically significant difference in the shortening between the groups.

Conclusions: Both flat bone cut and crescentric bone cut techniques caused a statistically significant shortening of the first ray after first MTP fusion. However, there was no statistically significant difference in the post-procedure lengths of the first ray between the two groups.

Poster 23

Quantifying Normal Ankle Joint Volume: An Anatomic Study

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Background: Little data is currently available in the literature regarding the maximal volume of normal ankle joints. Several investigations have been conducted using ultrasound imaging or MRI in an attempt to distinguish pathologic from normal ankle joint fluid volumes, but these studies have simply looked comparatively between pathologic and normal radiographic ankle and synovial fluid appearance and have not attempted to quantify the volume of the joint. The purpose of this study was to evaluate the volume of normal human ankle joints.

Methods: A needle was passed under fluoroscopic guidance into nine cadaveric adult ankle joints. The needle was connected to a Stryker Intra-Compartmental Measurement System. Radio-opaque dye was introduced into the joint in 2mL boluses while pressure measurements were recorded. Fluid was injected into the joint until pressure measurements remained similar from reading to reading for three consecutive boluses, signifying a maximal joint volume.

Results: The mean maximum ankle joint volume for the nine samples was found to be 20.9mL \pm 4.9mL (range = 16-30mL). The mean ankle joint pressure at maximum volume was 142.2mmHg \pm 13.8mmHg (range = 122-166mmHg). Two of the nine samples showed evidence of fluid tracking into the synovial sheath of the flexor hallucis longus tendon, which has been described as continuous with the ankle joint in approximately 20% of normal individuals.

Conclusions: These data support the conclusion that maximal normal ankle joint volume may vary from person to person between 16 and 30mL. Despite its limitation in its small sample size, this study serves to provide a basis for normal ankle joint volume and confirms previous data supporting the communication between the ankle joint and the flexor hallucis lon-

gus tendon sheath. Exceeding such maximal ankle joint volumes during therapeutic injections, arthrography, or arthroscopy could potentially damage the joint.

Poster 24

The Outcome of Intra-Articular Anti-Inflammatory Injection after Total Knee Arthroplasty: A Prospective Randomized Study

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Introduction: Non opiate derived pain management supplementation is a valuable addition to the side-effect laden regimen of narcotic pain control following primary total knee arthroplasty (TKA). The goal of the current study was to assess the efficacy of a single inter-articular injection containing a corticosteroid as well as a short acting analgesic to decrease pain, opiate consumption, and recovery time following primary TKA.

Methods: From February to June of 2006, 29 unilateral and 19 bilateral patients were enrolled in a prospective blinded randomized study. Comparisons were made with regard to SF-36, KSS, and VAS pain scale scores: at baseline, 6 weeks, and 1 year. To increase the sensitivity of the pain assessment, both VAS pain scale and opiate consumption were documented each day of hospital stay.

Results: Though the experimental group displayed a positive change over the controls in KSS functioning from baseline to 6 weeks, it was minimal. Contrary to this, the control group exhibited a superior increase in the level of functioning from baseline to one year than did the experimental group: 77.50 to 60.93. A comparison of in hospital morphine equivalent opiate consumption showed less experimental intake at 80.22 mg versus control's 104.09 mg.

Conclusion: Further analysis of the cost-benefit relationship of corticosteroids regarding their potential for long term deleterious effects to the possible benefit of decreased pain, opiate consumption, and recovery period is warranted.

Poster 25

Predictors Of Patient Satisfaction Following Unicompartmental Knee Arthroplasty

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Purpose: Unicompartmental arthroplasty may provide better alternative for physiological function, quicker recovery and long-term satisfaction compared to TKA and repeat arthroscopic interventions. The purpose of this study was to prospectively evaluate outcomes following unicompartmental knee arthroplasty as well as predictors for patient satisfaction.

Methods: 62 consecutive patients were prospectively studied (45 medial replacements, 17 lateral replacements)] underwent unicompartmental arthroplasty from 2000-2005. There were 34 males and 49 females [average age of 69.87 (range 40-92)]. Eighty-six percent had at least 2 year follow-up. Assessment included preoperative and postoperative range of motion, subjective questionnaire, KT-1000, plain radiograph knee series including 3-foot alignment films. A 1.5-Tesla MRI was completed in all patients but one who had a pacemaker.

Results: All patients reported severe knee pain preoperatively involving one compartment. One patient died. Two patients were converted to a total knee arthroplasty (medial replacements). Average follow-up was 33 months (range: 24-56 months). The average post-surgical Lysholm score was 91 (range 62 to 100), with a preoperative Lysholm of 57 (range 31 to 92) (p=0.001). The Tegner activity score improved from 2.8 (1 to 7) preoperatively to 4 (1 to 8) postoperative (p=0.001). The preoperative HSS score improved from 67 (45 to 87) to 92 (77 to 100) (p=0.001). For patients who underwent medial replacements, they had lower preoperative Lysholm (42 vs. 57) if they had grade 3 or 4 degenerative changes, as read on the MRI, in the lateral compartment; however, there was not difference in post-op Lysholm (89 vs 92;p=0.419). This was also seen in patients with grade 3 or 4 degenerative changes in the medial compartment that underwent lateral replacement. Age was correlated with post-operative Tegner scores (r=-0.586, p=0.001). Independent predictor of patient satisfaction was postoperative Tegner score (r2=0.26; p=0.04).

Conclusions: Determining specific patient selection criteria improves patient outcomes and helps with patient education. This study demonstrates that patients can return to high level of function and activity following unicompartmental arthroplasty. The presence of degenerative changes seen on MRI on the opposite compartment does not correlate to decreased function or activity. Patient satisfaction is high and it related to activity level, which this type of arthroplasty allows for more

Poster 26

The Impact of Vascularity and Neuromuscular Electrical Stimulation on the Healing of Injured Skeletal Muscle

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Introduction: Skeletal muscle that is injured through direct trauma and indirect sequelae of trauma such as ischemia can regenerate, albeit through a process that culminates in the formation of dense scar tissue. This scar tissue impairs functional recovery and can cause contractures with chronic pain. Accordingly, characterizing and manipulating the healing response to optimize the quality of regenerate muscle has become a major focus in tissue engineering research. Injured skeletal muscle sequentially undergoes cytokine-mediated inflammation with degeneration by infiltrating macrophages, local increases in vascularity and myofiber regeneration that may result in part from extravasating adult muscle derived stem cells, and fibrosis that is mediated by transforming growth factor 1 and peaks by 2 weeks post-injury. A challenge for research on skeletal muscle regeneration is to discover how to maximize repair and minimize inflammation and fibrosis in hopes of optimizing muscle healing.

Methods: We investigated the differences in vascularity between predominantly fast and slow-twitch muscle by harvesting the tibialis anterior (TA) and soleus (Sol) muscles from Sprague Dawley (SD) rats. We quantified the vascular density of each tissue using Northern Eclipse software. We then lacerated the TA and Sol of age and gender-matched SD rats and quantified the vascular density, % myofiber regeneration, and % fibrosis of each muscle at post-laceration days 6, 9, 14, and 21. We further investigated the effects of prophylactic and post-injury neuromuscular electrical stimulation (E-stim) on healing along the zone of cardiotoxin (CTX) injury in the TA of C57BL/10J mice. We stimulated the peroneal nerve for 4 seconds of full dorsiflexion at 7 milli-amps, followed by ten seconds of rest, in sequential cycles for 30 minutes, three times weekly for two weeks. We harvested the TAs for histology in the prophylaxis group at post-injury days 5 and 10, and in the post-injury group at post-stimulation days 5 and 10.

Results: In the SD rats, the Sol had a larger baseline vascularity compared to the TA, less % fibrosis at post-laceration days 6 and 9, and more % myofiber regeneration at days 6, 9, and 14. Following E-stim, the vascularity was greater at post-stimulation days 5 and 10 compared to unstimulated TA muscles.

Both E-stim groups had a markedly greater % myogenesis at post-stimulation day 5 and 10, while the prophylactic group also had a marked decrease in the % fibrosis at both time points.

Discussion and Conclusion: Skeletal muscle healing is proportional to the local vascularity, and both can be enhanced through E-stim. While fibrosis peaks at 10-14 days, we detected marked differences as early as 6 days in the prophylaxis E-stim group. Healing is superior through prophylaxis, although compared to controls, post-injury treatment also increased healing. This modality may provide a novel way for orthopaedists to treat musculoskeletal traumas and patients undergoing elective procedures, including limb salvage, by enhancing their skeletal muscle healing. This may permit earlier mobilization, reduce the incidence of post-operative deep venous thrombi and pneumonias related to prolonged immobilization, and result in healthier and perhaps more functional skeletal muscle for salvaged limbs.

Poster 27

Computed Tomographical Analysis of the Lateral Intercondylar Ridge and Its Relationship to Single-Bundle ACL Reconstructions

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Introduction: Although single-bundle (SB) anterior cruciate ligament (ACL) reconstruction has been considered a clinical success, problems remain related to degenerative changes, instability, and abnormal rotational kinematics. Accuracy of femoral tunnel placement in relation to the lateral intercondylar ridge has gained increased attention in order to maximize proper anatomic position of the femoral insertion and restore joint kinematics. The purpose of this study was to determine the radiographic consistency of the lateral intercondylar ridge and compare its spatial relationship to SB femoral tunnels. We hypothesized that transtibial SB ACL reconstruction will not consistently capture the native femoral attachment of the ACL.

Methods: Twenty six patients (18 M, 8 F) underwent SB transtibial ACL reconstruction. The lateral intercondylar ridge was identified using 3D bone models generated from CT scans

performed 6 months post-operatively. The reconstructed CT images were used to measure the length and topographical relationship of the lateral intercondylar ridge on the non-operated limb and then superimposed to the reconstructed limb to compare its position to the femoral tunnel. Pearson correlations and other inferential statistical measures were employed to compare tunnel position between the high- and low-tunnel groups.

Results: In all 26 specimens (100%), the lateral intercondylar ridge was identified and orientated proximal to distal. Its mean length was 20.56 ± 5.37 mm (mean \pm standard deviation) and its relationship from its midpoint to the distal, mid and proximal rims of the lateral femoral condyle was 5.20 ± 4.07 mm, 12.44 ± 3.00 mm and 6.79 ± 2.80 mm, respectively. In 16/26 (61.5%) SB reconstructions, the femoral tunnel was located anterior (or “high”) to the lateral intercondylar ridge by 3.06 ± 1.89 mm, while in the remaining 10/26 (38.5%) cases, the tunnel was located posterior to the lateral intercondylar ridge by 1.39 ± 2.68 mm. The difference in tunnel locations between these two groups was significant ($p < 0.001$).

Discussion & Conclusions: This study demonstrated that the lateral intercondylar ridge is a reproducible landmark and may be used as a guide for anatomic femoral tunnel placement. In addition, using traditional transtibial techniques, femoral tunnels are still commonly placed anterior to this ridge and outside the native attachment of the ACL. This non-anatomic tunnel placement maybe related to the fact that SB reconstruction produces abnormal knee kinematics and potentially long-term degenerative changes.

Poster 28

Can Lipitor Reduce Femoral Head Intraosseous Pressures in Corticosteroid Treated Rabbits?

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Introduction: Corticosteroid therapy is a major etiologic factor in the development of femoral head avascular necrosis. The precise pathophysiology of avascular necrosis has not been completely elucidated. However, it is thought that blood vessel occlusion due to endothelial activation and lipid deposition is the initial trigger. Prevention of avascular necrosis in corticosteroid treated patients will depend on two factors: (1) a reliable measure/marker to evaluate the progression of the disease and (2) drug therapy that can limit both vascular injury

and lipid deposition. Rabbit studies in the past have shown that femoral head intraosseous pressure rises within two weeks of corticosteroid administration. Statins are known to alleviate vascular endothelial injury as well as reduce serum lipid levels. In this pilot study, the effect of atorvastatin calcium (Lipitor, Pfizer Inc.) on the femoral head intraosseous pressure was evaluated.

Results: Corticosteroid treatment caused severe weight loss (10-40%), increased serum lipids, and a reduction in lymphocyte count in all rabbits. Two rabbits died due to unknown causes. Femoral head intraosseous pressure (measured 5 and 10 weeks after initial corticosteroid treatment) was markedly elevated in a rabbit that did not receive Lipitor. Treatment with Lipitor decreased femoral head intraosseous pressure. The results did not show any direct correlation between blood lipid levels and intraosseous pressure readings.

Methods: Eight New Zealand white rabbits were used for this study and were fed with standard rabbit diet. The study protocol was approved by the IACUC committee. Two rabbits were used as controls; the other six rabbits received a weekly 2-4 mg/kg intramuscular injection of methylprednisolone acetate. Four weeks after initiation of corticosteroid therapy, two of these rabbits received a daily oral dose of 10 mg Lipitor. One more rabbit received a daily dosage of 10 mg of Lipitor after 7 weeks of corticosteroid administration. Blood samples were withdrawn weekly to analyze CBC, C-reactive protein, and blood lipid levels. Femoral head intraosseous pressure was measured under general and local anesthesia with the aid of a digital pressure monitor (Compartmental Pressure Monitoring System, Synthes Inc., PA).

Discussion and Conclusions: Lipitor appears to control the elevation of intraosseous pressure in corticosteroid treated rabbits despite the presence of high serum cholesterol and triglyceride levels. This could be due to the fact that Lipitor may have played a significant role in decreasing lipid deposition inside blood vessels. A larger study combined with histological analysis is needed to confirm this finding. If a larger study proves that statins decrease femoral head intraosseous pressures, patients on corticosteroids can be screened for early avascular necrosis markers (e.g. elevated intraosseous pressures, blood markers). High risk patients can then be prescribed statins that may help prevent the progression of avascular necrosis. In addition, the effect of Lipitor dosage and the timing of the initial Lipitor treatment need further study.

*The FDA has not cleared the drug and/or medical device for the use described in this presentation. (Refer to page 39.)

Disclosure information can be found beginning on page 40.

Poster 29

Open Reduction and Internal Fixation for Unstable, Displaced Fractures of the Proximal Humerus Using a New Locking Plate

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Unstable, displaced fractures of the proximal humerus present a challenging problem to the treating orthopedic surgeon. Currently, there is no universally accepted treatment method for these difficult to treat injuries. Since these fractures commonly occur in osteoporotic bone, the advent of locking plate technology has shown to be a promising option. The purpose of this study was to evaluate the outcomes of displaced, unstable proximal humerus fractures using a novel, anatomically contoured plate with locking, smooth peg fixation into the humeral head. Thirty-four consecutive patients sustaining this injury were treated at two different institutions by three orthopaedic surgeons. Inclusion criteria included all skeletally mature patients sustaining a displaced, unstable fracture of the proximal humerus. Exclusion criteria included all of the following: 1) the patient's inability to participate in postoperative physiotherapy 2) surgical contraindications 3) the presence of concomitant injuries likely to affect outcome (e.g. head injury, ipsilateral upper extremity injuries). A standard deltopectoral approach was used in all patients. Outcomes were measured using the Constant score, the normalized Constant score as described by Katolik et al., and radiographic evaluation. Of the thirty-four patients treated, there were twelve 2-part, twenty 3-part, and two 4-part fractures. Four patients were lost to follow-up, leaving a total of thirty patients that are currently enrolled in the study. The average patient age in the study was 63 years. In regards to mechanism of injury: Twenty-eight patients fell, three patients were involved in a motor vehicle accident, two patients were struck by cars, and one patient sustained a seizure. The Constant score for the three, six, and twelve month intervals were 40.4, 62.3, and 83.7 respectively. The normalized Constant score for these same time intervals were 49, 73, and 92.7. Fracture union occurred at a mean time of eleven weeks. There were three minor complications, including peg protrusion into the joint, plate impingement, and one patient sustaining a nondisplaced fracture at the end of the plate. In all of these instances, removal of hardware, or conservative treatment in the case of the non-displaced fracture led to an excellent functional outcome. There were two major complications which required arthroplasty. In both of these

complications, the patient sustained a fall and refractured the proximal humerus. In this preliminary study assessing the results of a novel proximal humerus plate, patients had an excellent overall functional outcome. Union was achieved in 93% of our patients at an average of eleven weeks. In addition, the average normalized Constant score at the twelve month postoperative interval was 92.7. Of note, there were no incidents of avascular necrosis in any of the patients treated with the plate. The plate design incorporates the anatomic neck-shaft angle as well as the humeral retroversion which offers increased support of the humeral head. This allows for earlier physiotherapy and improved motion. In addition, the plate is designed to sit low on the proximal humerus resulting in decreased postoperative impingement. The preliminary outcomes of this ongoing study using this new plate design have demonstrated promising results.

Poster 30

Large Metal-on-Metal Bearings to Avoid Dislocation: A Matched Comparison Study to Small Metal-on-Polyethylene Bearings in Total Hip Arthroplasty

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Introduction: Large diameter femoral head components are gaining popularity for use in total hip arthroplasty (THA). Their potential benefits include enhanced jump distance and decreased component-on-component impingement which may lead to reduced dislocation rates. The purpose of this study was to evaluate the safety and efficacy of large diameter femoral heads used in metal-on-metal articulations (range, 38 to 54 mm) in THA. We compared the clinical and radiographic results to a matched group of patients who had standard head sizes (range, 26 to 32 mm) metal-on-polyethylene bearing. Subgroups of patients at high risk for dislocation were compared.

Methods: Forty-one patients (52 hips) who had a mean age of 52 years (range, 30-84 years) received a THA with a femoral head implant greater than 38 mm in diameter (mean head size 44, range, 40-56 mm). The group included 27 patients (32 hips) with high-risk diagnoses for dislocation. These diagnoses included: body mass index greater than 30 (18 hips), alcohol abuse (8 hips), hip dysplasia (2 hips), prior hip surgery

(2 hips), and inflammatory arthritis (2 hips). All patients were directly matched to a cohort of patients who received a standard metal-on-polyethylene THA (head size range 26-32 mm) which also included 32 hips with high dislocation-risk diagnoses. Patients were evaluated both clinically and radiographically at an overall follow-up of 37 months (range, 24-55 months). They were assessed for any history of dislocation or degree of hip instability.

Results: There were no failures or revisions in the large diameter head group; however, there were 2 dislocations in the matched group, both occurring in high risk patients. The clinical and radiographic results were similar for large diameter femoral heads and standard THA. Harris Hip scores improved from a mean of 32 points (range, 7-56 points) preoperatively to 94 points (range, 70-100 points) postoperatively in the large diameter group, compared to improvement from 29 points (range 3-61 points) to 92 points (range, 70-100 points) in the matching group. Patients with high risk diagnoses for dislocation in the large femoral head group reported no instability in their hip joints with three patients complaining of hip instability in the small diameter group.

Discussion and Conclusion: These findings support the use of large diameter femoral heads as a viable option for THA in patients at high risk for dislocation. Postoperative dislocation is one of the major complications after THA and the short-term results are encouraging and suggest that large femoral head components can be recommended for THA patients at risk for dislocation. Larger studies are forthcoming to more completely assess the role of these devices in various patient populations.

Poster 31

Complications of Ankle Arthroscopy Using a Contemporary Noninvasive Distraction Technique

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Introduction: Ankle arthroscopy is a surgical technique commonly used to treat intra-articular pathology, including soft tissue impingement, osteochondral lesions, and loose bodies. Distraction of the ankle facilitates visualization as well as maneuverability of the instruments. Prior studies reporting on ankle arthroscopy complication rates have utilized a combination of noninvasive and invasive distraction techniques, which include external fixators and calcaneal traction pins. However, the complication rate of ankle arthroscopy utilizing non-inva-

sive distraction techniques alone has not been reported. We hypothesized that a contemporary non-invasive distraction technique will yield fewer complications than those previously reported with a combination of invasive and noninvasive techniques.

Results: All 304 patient records were located and available for review. The mean duration of post-operative follow-up was 24.2 weeks (range, 2-104). There were thirty-seven (12%) worker's compensation cases included in the data. One hundred ten cases (36%) were performed for isolated soft tissue impingement, and one hundred eighty-six patients (61%) were treated for an osteochondral lesion. Degenerative changes were noted and addressed in fifty-three patients (17%). Ankle arthroscopy was combined with an associated open ankle procedure in twenty-two patients (7.2%). Overall, twenty-one complications were identified for a complication rate of 6.9%. Nerve dysfunction was the most common complication, noted in 13 patients (4.3%), most frequently involving the superficial peroneal nerve. All cases were transient and normal neurological status returned over time. Less common, yet noteworthy, complications included complex regional pain syndrome (3/304, 1%), superficial infection (3/304, 1%), DVT (1/304, 0.33%), and prolonged portal drainage (1/304, 0.33%).

Methods: Between 1999 and 2007, 304 consecutive ankle arthroscopies were performed by a single Foot and Ankle fellowship trained orthopaedic surgeon at a tertiary academic center. All patients underwent the same intra-operative protocol with respect to patient positioning, noninvasive ankle distraction technique, placement of arthroscopic portals, and post-operative splint immobilization. The clinical records of each patient were retrospectively reviewed by two of the authors via electronic medical records or traditional paper chart, and procedure related complications were identified and recorded. In addition, the following information was gathered and entered into a Microsoft Access database: patient demographics, diagnoses, associated procedures, duration of immobilization and non-weight bearing, worker's compensation information, and length of follow-up. Data were stratified and standard statistical methods were applied.

Discussion & Conclusions: Contemporary ankle arthroscopy using a noninvasive distraction technique is a safe and reproducible procedure. Complications do occur, yet the vast majority are self limited and resolve over a period of months. Our observed complication rate of 6.9% is similar to a previous benchmark complication study employing invasive and noninvasive techniques. In both studies, transient nerve dysfunction is the most common complication, underscoring the importance of protecting superficial nerves during the procedure, in particular the superficial peroneal nerve during portal placement and usage. However, contemporary small

joint arthroscopic instruments and noninvasive techniques have eliminated the complications associated with invasive distraction including distractor pin site pain, distractor pin site fracture, and instrument breakage. Regardless of technique, serious complications can still be expected, such as complex regional pain syndrome and deep venous thrombosis.