2013 Poster Abstracts

(An (*) by an author’s name indicates the presenter.)

**Poster 1**

**A Novel Technique for Surgical Treatment of Chronic Osteomyelitis of Long Bones**

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This case report details the presentation, work-up and novel operative technique used to address chronic osteomyelitis of the proximal tibia. A 28 year old male sustained an open, comminuted tibial plateau fracture from a gunshot wound occurring while deployed in military service. He underwent provisional stabilization with an external fixator and serial debridements followed by definitive treatment with open reduction and internal fixation. Five months later he presented with septic arthritis of the knee from adjacent chronic osteomyelitis of the proximal tibia. Cultures from aspirated synovial fluid grew *Pseudomonas aeruginosa*. Magnetic resonance imaging and computed tomography revealed a healed fracture with a cystic lesion in the medullary canal and evidence of chronic osteomyelitis. Operative intervention involved arthroscopic irrigation and debridement of the knee with subsequent hardware removal followed by intraosseous arthroscopic debridement and irrigation of the proximal tibia. The resulting cavitary defect was filled with antibiotic cement beads and the patient was treated with six weeks of oral antibiotics. The cement beads were removed six weeks after implantation and the cavitary defect was filled with allograft bone chips mixed with iliac crest bone marrow aspirate. At latest follow-up he had resolution of his pain, return of nearly full motion, and no evidence of recurrent septic arthritis or osteomyelitis. He was able to continue protective weight bearing throughout the treatment period without need for complicated vascularized bone grafting or stabilization procedures. To our knowledge this is the first report of intraosseous arthroscopic debridement for the treatment of osteomyelitis in the orthopaedic literature. This technique may be considered in the right clinical circumstances to prevent structural destabilization and prolonged disability after surgical treatment of chronic osteomyelitis of long bones.

**Poster 2**

**Antibiotic Sensitivity of 101 P. Acnes Isolates from the Shoulder**

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*Propionibacterium acnes* (*P. acnes*) is becoming more recognized as a cause of infections in shoulder surgery. To date, there are few established CLSI reference ranges for several antibiotics that are used to treat *P. acnes*. The purpose of this paper is to report the operative gram stain and culture results, MIC values and antimicrobial sensitivities from *P. acnes* isolates obtained from cultures at the time of shoulder surgery with E-test after Agar Dilution. From April 2010-Apr 2013, 101 *P. acnes* isolates were reported by our lab for 81 patients undergoing shoulder surgery (range: 1-3). 25% (21/81) patients had positive *P. acnes* cultures during the past six years. All cultures were held for 14-21 days. One specimen had a positive gram stain for an organism at the time of surgery. The intra-operative WBC results were as follows: 56% (57/101) none, 20% (20/101) rare, 19% (19/101) few, 4% (4/101) moderate, and 1% (1/101) many. All specimens had MIC testing for antimicrobial susceptibility. The average number of days for the cultures to become positive was 6 days (range: 0-19); and the cultures to become final were 9.38 days (range: 4-20). The average MIC values for each antibiotic in increasing order were penicillin (.053), cefazolin (.091), ceftriaxone (.107), cephalothin (.128), doxycycline (.170), clindamycin (.185) and vancomycin (.558, MIC range: .25-1.5). Utilizing the known CLSI E-test reference range for sensitivity testing for penicillin (%S ≤ .5 and % R ≥ 2) and clindamycin (%S ≤ 2 and % R ≥ 8), both antibiotics were susceptible in 98% (99/101) and 99% (100/101) of the cultures. 100/101 *P. acnes* specimens had a MIC ≤ 1 for vancomycin, ≤ .50 for ceftriazone and ≤ .38 for cephalothin suggesting no antibiotic resistance among these antibiotics except in rare cases. 95% (96/101) of *P. acnes* specimens have a MIC ≤ .5 for the doxycycline, suggestive of low (5%) (5/101) antibiotic resistance. This is the largest series of shoulder isolates for *P. acnes* reported in the shoulder literature.
**Use of CT-Arthrography and Ultrasound in ACL Surgery During Operation Enduring Freedom in Afghanistan: A Case Report and Practice Recommendations**

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**Introduction:** The availability of Magnetic Resonance Imaging (MRI) is severely limited in a deployed environment. However, advanced imaging for diagnosis and treatment of musculoskeletal soft tissue injuries in theatre does exist. Computed tomography (CT), arthrography and ultrasound are readily available at Role 2 and 3 Medical Treatment Facilities (MTF) in Afghanistan in support of Operation Enduring Freedom (OEF).

**Methods:** In this report, we describe a case using CT arthrogram and ultrasound to assist with the diagnosis, planning and follow-up of an ACL reconstruction on a 25-year old coalition soldier with knee instability performed at a Role 2E hospital in Afghanistan.

**Results:** CT arthrography coronal/sagittal images showed mildly heterogeneous and irregular soft tissue signal at the lateral aspect of the interchondylar notch and demonstrated an abnormal course with discontinuity of the ACL fibers confirming our history and physical exam suspicions of ACL insufficiency. Coronal CT image showed normal appearance of the medial and lateral meniscus and chondral surfaces. The patient underwent a combined intra-articular and extra-articular ACL reconstruction with an autogenous iliotibial band graft. Ultrasound and physical exam confirmed graft integrity during follow-up visits. Stability and function of the knee was successfully restored.

**Discussion:** Musculoskeletal soft-tissue diagnosis and treatment in an austere environment is difficult. Multiple authors, however, have shown that CT arthrography and ultrasound are viable alternatives to MRI for the diagnosis of soft tissue musculoskeletal injuries such as shoulder and knee pathology. Treatment of the local population and coalition soldiers who do not have access to MRI can be improved with the use of existing advanced imaging modalities in theatre.

**Conclusion:** We recommend that military residency training programs, which treat musculoskeletal conditions, continue to incorporate the use of ultrasound in their programs to augment their physical exam skills. Additionally, we recommend that health care providers not dismiss the diagnostic utility of CT arthrography and ultrasound in a deployed environment.

**Pectoralis Major Tendon Insertion Anatomy and Description of a Novel Anatomic Reference**

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**Background:** Pectoralis Major tendon rupture is a common injury in the Active duty population and frequently requires surgical management. Anatomic Repair of the Pectoralis Major muscle is a crucial component of surgical management of these injuries. Knowledge of the normal anatomic insertion as well as an intra-operative reference greatly aids the surgeon in reproducing the normal insertion and thus restoring near normal function. The purpose is to define the insertional footprint of the pectoralis major tendon length and width as well as define the normal anatomic distance between the superior margin of the pectoralis major tendon to articular margin of the humeral head in line with the pectoralis major insertion.

**Methods:** Twelve cadaver shoulders were evaluated and measured using a standard surgical ruler to demonstrate the normal anatomic footprint. Additionally, measurements were taken from the anterior medial margin of the articular surface of the humeral head to the superior margin of the pectoralis major tendon insertion.

**Results:** The average length and width of the pectoralis major insertion were 73.3mm +/- 10.0mm and 3.3mm +/- 0.54mm respectively. The average distance from the articular margin to the superior border of the pectoralis major insertion was 41.2mm +/- 9.27mm.

**Conclusion:** The insertional anatomy of our specimens is within the standard deviation of those previously published, however the new anatomic reference provides a useful reference point when performing operative repair of pectoralis major tendon ruptures.
Outcomes of Posterior Labral Repairs in a United States Army Population

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**Introduction:** Posterior shoulder instability has been studied in athletic cohorts but there is a paucity of studies investigating the outcomes of arthroscopic treatment for posterior shoulder instability and still fewer demonstrating the results in a military population. As such, we sought to examine the outcomes of arthroscopic capsulolabral repair in active duty military personnel. Specifically, our goal is to determine the return to duty rate after surgery.

**Methods:** The United States Army Surgical Scheduling System (S3) was queried for all shoulder labral repairs at our institution from January 1, 2005 to June 1, 2010. Operative reports were individually evaluated to further establish cases of isolated posterior labral repairs. Active duty disposition after surgical procedure was determined based on the United States Army Physical Disability Agency or the Armed Forces Health Longitudinal Technology Application (AHTLA). For those patients who did not remain on active duty after their procedure, a review of the problem list from the Comprehensive narrative summary (NARSUM) was performed to ascertain if the service members’ shoulder condition was responsible for discharge-Medical Evaluation Board (MEB).

**Results:** A total of 21 service members were identified as having undergone isolated posterior labral repairs. Three (14.29%) underwent a MEB and subsequently were not retained on active duty. 85.71% remained on active duty. Mean age of service members was 27.95 years. 62% of cases were performed on junior enlisted personnel, followed by senior enlisted personnel (33%). Mechanism of injury for those having surgery was most common in patients who had sustained a posterior instability event, 71.4%. Patients identified as combat arms were 52.38%, while sustainment personnel factored for 47.62%. Univariate Regression Analysis found no statistical significance of these factors on whether a service member would undergo a MEB after isolated posterior labral repair.

**Conclusion:** To our knowledge, this is the first such study to evaluate retention on active duty after a posterior labral repair. We demonstrate that arthroscopic repair can restore stability and function to these service members and return 85% of them to full active duty.

Femoral Vein Occlusion During Direct Anterior Total Hip Arthroplasty

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**Introduction:** Total hip arthroplasty performed via the direct anterior approach has gained popularity throughout the orthopedic community. One of the proposed benefits of this approach over traditional approaches (posterior) is less kinking of the femoral vein and therefore less potential for blood clots. The purpose of this study was to determine the decrease in flow of fluid through the femoral vein during direct anterior total hip arthroplasty compared to the traditional posterior approach in a cadaveric model.

**Method:** Eight cadaveric specimens were used. The popliteal vein distal to the hip, and the external iliac vein proximal to the hip, were both cannulated. Flow was established and measured from distal to proximal in each side. A direct anterior total hip arthroplasty was performed on the right side and a traditional posterior approach total hip arthroplasty was performed on the left side of each specimen. Flow was measured at several intervals during the procedure as the leg was positioned and recorded.

**Results:** There were eight cadavers used in this study. In the anterior approach group compared to the posterior approach group there was a significant difference in flow found with preparing and implanting the femoral component. The mean decrease in flow rate for the posterior approach was 98%, and the anterior approach was 31% (P < 0.02). There was also a significant difference found with preparing and implanting the acetabular cup. The mean decrease in flow rate at this point for the posterior approach was 58% and the anterior approach was 13% (P<0.04).

**Conclusion:** The direct anterior approach maintained a higher flow in the femoral vein throughout the performance of total hip arthroplasty when compared to traditional posterior approach in this cadaveric model. Further in vivo study is needed to determine if this results in lower venous thromboembolism rate during total hip arthroplasty using the direct anterior approach.
Outcomes of Anterior Shoulder Instability in the Beach Chair Versus Lateral Decubitus Position: A Systematic Review

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Introduction: Arthroscopic anterior shoulder stabilization can be performed in either the beach chair (BC) or the lateral decubitus (LD) position. The purpose of this study was to systematically review the clinical outcomes following arthroscopic anterior shoulder stabilization in either the BC or LD positions. The authors hypothesized that clinical outcomes and recurrent instability rates would be statistically similar regardless of technique used.

Methods: A systematic review of all English language peer reviewed literature from 1990 to 2013 on arthroscopic anterior shoulder instability repair was reviewed. Following an iterative search, Studies that reported clinical outcomes following arthroscopic anterior shoulder stabilization with a minimum two-year follow-up period were included. Two independent reviewers analyzed the studies deemed appropriate for inclusion. Data on return to activity/sport, physical examination including strength and range of motion parameters, as well as subjective outcomes instruments was collected and pooled. Data on recurrent instability rates and repeat procedure(s) was recorded.

Results: Fifty-six studies (34 BC, 22 LD) met inclusion criteria, with Level of Evidence ranging from one to four. A total of 3132 shoulders were included, with 1787 (average age 26.8±4.0, range 18 to 35, 84.5% male) in the BC position and 1345 (average age 25.4±3.3, range 18 to 30, 81.7% male) in the LD position. The average follow-up was 44.1±23.1 months in the BC group (range, 24 to107 months) compared to 37.9±23.0 months in the LD group (range, 24 to 130 months). An average 2.8±0.3 and 2.9±0.3 anchors were used in the BC and LD positions, respectively (P>0.05). Average overall recurrent instability rates were 12.8±2.9% in the BC group (range, zero to 38%) compared to 8.2±3.6% in the LD group (range, zero to 32%), which was statistically significant (P=0.04). The average postoperative loss in external rotation motion was reported in 19 studies in the BC group and 13 studies in the LD group, with an average loss of 2.4±1.0 degrees and 3.6±2.6 degrees in each group, respectively (P>0.05). Average return to activity/sport rates, when reported, were 83.2±11.1% in the BC group, compared to 79.9±18.5% in the LD group, which was not statistically significant (P>0.05).

Discussion and Conclusion: The principle finding of this review is that lower recurrence rates are noted in the LD position. This review supports the belief that based on the best available evidence, the LD position may superior with regard to clinical outcomes. Additional, long-term, randomized clinical trials comparing these positions are needed to better understand the potential advantages and disadvantages of each position and until then surgeons should utilize positioning that provides them with the most consistent good outcomes.

The Outcomes and Surgical Techniques of the Latarjet Procedure: A Systematic Review

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Introduction: The Latarjet procedure of transferring the coracoid process and its attached conjoined tendon to the anterior glenoid has undergone various modifications but still remains an effective method for tackling recurrent instability in patients with recurrent anterior instability and high degrees of glenoid bone loss. A multitude of methods have been developed for bony reconstruction of the glenoid using the Latarjet technique. These have varied from employing the coracoid as a free intra-articular graft to utilizing the triple blocking effect of the bone graft and conjoined tendon sling. Although several of variations have been developed, there is little consensus on the optimal position and orientation of the coracoid bone graft.

Methods: A systematic review of the literature including Cochrane database of systematic reviews, Cochrane central register of controlled trials, Pubmed (1980-2012), and MEDLINE (1980-2012) was conducted. Inclusion criteria for the search included minimum 6 month follow-up, open procedure (not arthroscopic), English language, 1980 or above, and isolated latarjet (no concomitant surgeries). The following search teams
were used: glenoid bone graft, coracoid transfer, glenoid rim fracture, osseous glenoid defect, and Latarjet. Studies deemed appropriate for inclusion were then analyzed. Study data collected included level of evidence, patient demographics, preoperative variables, intraoperative findings, technique details, and postoperative recovery and complications where available.

**Results:** The original search provided a total of 344 studies. A total of 333 studies were subsequently excluded due to irrelevant topic, arthroscopic technique, language, or review paper. Following this review, a total of 40 studies remained included. Thus, a total of 11 studies were deemed eligible for inclusion and underwent further systematic review. Given the different methodology used in each of the studies included in the review, quantitative statistical analysis of the studies as a whole was not possible. Therefore, descriptive analysis was performed. The majority of studies were Level IV and retrospective in design. Duration of follow-up ranged from 6 months to 14.3 years post-operatively. With the exception of two studies, all authors reported on recurrent shoulder instability following Latarjet reconstruction; the rate of recurrent anterior shoulder instability ranged from 0-8%. Overall patient satisfaction was listed in four studies, each of which reported over 90% good to excellent satisfaction rates at final follow-up. Five studies reported on post-operative complications, and while rare, hematoma, hardware failure, delayed wound healing, and infection were among the most common.

**Discussion and Conclusion:** As noted in this review, the current literature on Latarjet outcomes consists mostly of retrospective Level IV case series. Although promising outcomes with regards to low recurrence rate of instability have been seen with these reports, it should be noted that subtle variations in surgical technique may drastically impact the likelihood of glenohumeral degenerative changes arising in these patients.

**Do Routine Radiographs Obtained at the Initial Outpatient Post-Operative Visit Change Management?**

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**Introduction:** Despite a paucity of peer-reviewed evidence to support the practice, routine post-operative radiographs are commonly obtained by orthopaedic surgeons at the initial post-operative visit. In addition to the dubious cost-utility of obtaining routine post-operative radiographs, the practice also exposes the patient to potentially harmful ionizing radiation. The purpose of our study was to demonstrate the clinical utility of routine post-operative radiographs and to quantify the unnecessary radiation exposure to the patient as well as the cost to the healthcare system.

**Methods:** All orthopaedic surgeries performed during 2007 at a single Level-1 trauma center were retrospectively analyzed. Surgical subjects that were likely to require follow-up radiographs were included. Excluded surgical subjects included those subjects who were seen by a provider who did not perform the surgery or those who underwent multi-plane external-fixation. Inpatient and outpatient medical records were reviewed to include type of surgery, radiographs performed, post-operative events, reason for radiographs, and if the radiographs showed unexpected findings or changed patient management. Additionally radiation exposure and cost of radiographs were determined.

**Results:** This ongoing study has analyzed 451/1240 orthopaedic procedures. After further analysis, 94 of these 451 orthopaedic procedures met exclusion criteria. 357 orthopaedic procedures in 291 patients have been included to date. A total of 188 (52.7%) surgical procedures received postoperative radiographs at the initial outpatient visit. Routine radiographs were performed in 180 (95.7%) procedures with 2/180 (1.1%) triggering a change in management. Non-routine radiographs, based on patient assessment, were performed in 8 (4.3%) procedures with 2/8 (25.0%) triggering a change in management. These non-routine radiographs were obtained due to increased pain and a known unstable fracture pattern. Of these four procedures that required a change in management, one procedure required additional advanced imaging and three procedures required additional orthopaedic surgery. Subjects receiving radiographs at the initial postoperative visit underwent a mean 2.33 (2-8) radiographs per procedure with a mean exposure of 0.176mSv (0.002-4.5) with a median cost of $32.73 in 2013 TRICARE reimbursement dollars. The most common surgeries included open-reduction internal-fixation (38.8%), arthroplasty (19.3%), and hardware removal (8.1%). Mean time to the first postoperative visit was 13.6 days.

**Discussion and Conclusion:** Initial findings demonstrate that routine radiographs at the first post-operative visit minimally impact patient management (1.1%), while exposing the patient to an average of 0.176 mSv of unnecessary radiation at a median cost of $32.73 per radiographic series. Necessity of
post-operative radiographs should be based on a clinical rationale at a patient management transition point.

Knot Strength Varies Widely Among Expert Arthroscopists

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Introduction: Arthroscopic knot tying has become a mainstay of resident and fellow education, and most orthopedic surgeons graduating from an accredited residency or fellowship program have mastered at least one arthroscopic knot. While most surgeons can tie knots that appear to be visually appealing, few have had an objective evaluation of their ability to consistently tie knots with maximum loop and knot security. The purpose of the study was to evaluate and compare variations in maximum load to failure and 3 mm displacement (clinical failure) of arthroscopic suture knots tied by 73 independent expert orthopaedic arthroscopists.

Methods: Each surgeon tied 5 of the same type of their preferred arthroscopic knot and half-hitch locking mechanism. Each knot was mechanically tested for maximum load to failure and clinical failure.

Results: For the 365 knots tested, the average ultimate load was 231N (range, 29 - 360N) with a standard deviation of 104N (range, 6 - 133N). The average clinical failure load was 139N (range, 16 - 328N) with a standard deviation of 62N (range, 6 - 87N). The average knot stack height among the 365 knots was 5.61 mm (range, 2.89 - 10.32 mm) with a standard deviation of 1.03 mm. Subgroup analysis was conducted based on surgeons’ years in practice. The ultimate and clinical failure load for surgeons with less than 10 years of practice (n = 39) were 248 ± 93N and 142 ± 56N respectively. The ultimate and clinical failure load for surgeons with greater than 10 years of practice (n = 34) were 211 ± 111N and 136 ± 69N, respectively. Significant differences existed in ultimate load (p = 0.001); however, there were no differences in clinical failure load (p = 0.329). Subgroup analysis based on number of arthroscopic shoulder cases performed annually was also performed. The ultimate and clinical failure load for surgeons whom performed greater than 200 cases annually (n = 43) were 239 ± 103N and 141 ± 61N respectively. There was no significant difference for either ultimate load or clinical failure load between the two groups (p = 0.292 and 0.479, respectively).

Discussion and Conclusion: Considerable variations in knot strength exists between arthroscopic knots of the same type tied by the same surgeon. This variation has the potential to affect the integrity of arthroscopic repairs. Independent objective testing of the ability to tie secure knots as part of a surgeons training may be necessary.

Femoral Head Anteversion Relative to the Linea Aspera: Measurements of Normal Subjects Using CT

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Introduction: We set out to define the anatomical relationship between the linea aspera and the neck of the femur in normal human subjects. Knowledge of this angle will aid optimal positioning of proximal femur replacements and megaprostheses.

Methods: Axial images from CT scans of 68 consecutive patients (136 femora) from 2003-2011 were reviewed. CT scans were examined independently by a fellowship-trained musculoskeletal radiologist, a PGY-2 radiology resident, and a PGY-2 orthopaedics resident. At the midshaft, the angle between the linea aspera and the horizon was measured; next the angle between the femoral neck and the horizon was measured. These angles were added to calculate the angle between the linea aspera and the femoral neck.

Results: Thirty-eight patients (56%) were male. Forty-five patients (66%) were over 50. The average angle between the linea aspera and the femoral neck was 87.6° (standard deviation = 9.3°). The average angle for males was 85.9°(9.3°), and for females 89.6° (8.9°), p = 0.01. Patient age ranged from 21-92 years of age (mean 54.5); the average angle for patients over 50 was 88.0° (9.8°) and the average for patients under 50 was 87.2° (8.3°), p = 0.72. The angle for right femora was 88.5° (8.7°) and for left femora 86.6° (9.9°), p = 0.19. Interrater reliability was R2 = 0.87.
Discussion and Conclusion: The angle between the linea aspera and the femoral neck in our series of normal human patients is relatively uniform, measuring 87.6°, with a standard deviation of 9.3°. There was no significant difference between right and left sides, or between patients older and younger than 50 years. There is a statistically significant difference in the angle of males compared to females. Our method of determining the angle of the femoral neck relative to the linea aspera has a high inter-rater reliability.

Hetertopic Ossification After Lumbar Total Disc Arthroplasty: A Cause of Radiculopathy and a Proposed Modification to the McAfee Classification

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Introduction: To date, no reports of radiculopathy secondary to heterotopic ossification exist following lumbar total disc arthroplasty. To present a previously unpublished complication of lumbar total disk arthroplasty (TDA) secondary to heterotopic ossification (HO) in the spinal canal and to propose a modification to the McAfee classification of HO.

Methods: The patient had undergone a L5/S1 lumbar TDA two years prior for discogenic back pain. His pre-operative back pain was significantly relieved, but he developed new atraumatic onset radiculopathy. Radiographs and a CT myelogram revealed implant malposition posteriorly with heterotopic bone formation into the canal causing impingement of the traversing nerve root. Revision surgery was performed with implant extraction and a L5/S1 anterior lumbar interbody fusion with supplemental posterior decompression and pedicle screw fixation.

Results: The patient tolerated the procedure well with complete resolution of radicular leg pain. At two year follow up, the patient had a solid fusion without subsidence or recurrence of heterotopic bone.

Discussion and Conclusions: The case represents a novel pattern of heterotopic ossification and a previously unreported cause of implant failure in lumbar disc replacement surgery and reinforces the importance of proper intraoperative component positioning. We propose a modification to the existing McAfee classification of HO after TDA with the addition of Class V and VI HO.

Functional Outcomes of Hip Arthroscopy in an Active Duty Military Population Utilizing a Criterion-Based Early Weight Bearing Rehabilitation Protocol

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Introduction: Injuries to the labrum are common and result in hip pain, decreased athletic performance, and limitations in activities of daily living. Hip arthroscopy allows surgeons to address intra-articular pathology while avoiding more invasive open surgical dislocation. Many rehabilitation protocols following labral debridement or repair have prolonged periods of limited motion and minimal weight bearing during the initial three to four weeks. Our hypothesis is that non-weight bearing after hip arthroscopy is counterproductive and may lead to post-operative sequelae including hip flexor contractures, increased capsular tension with internal and external rotation, and altered gait patterns. The purpose of this investigation was to establish a criterion-based early weight bearing protocol following hip arthroscopy and investigate functional outcomes in an active duty population.

Methods: A retrospective case series of 10 active duty service members who underwent hip arthroscopy for correction of hip pain between May 1, 2011 and June 1, 2012 was performed. All subjects underwent hip arthroscopy with hip labrum repair or debridement at a single military institution by one surgeon. Participants were progressed with a standardized hip arthroscopy protocol only limiting hip flexion to 90 degrees for 6 weeks, while utilizing accelerated weight bearing as tolerated, in controlled environments. Modified Harris Hip (MHH) scores and Hip Outcome scores (HOS) were obtained preoperatively and at 6 months. Additionally, a review of each subject’s physical profile was performed 6 months after surgery to determine continued physical limitations.

Results: 10 active duty personnel met enrolment criteria. Of the ten participants, nine (90%) were able to discharge crutch use at an average of 4 days post-operatively with normalized
Preoperative Templating of Anterior Cruciate Ligament Reconstruction Based on Lateral X-Ray: Technique and Results

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Background: Anterior cruciate ligament (ACL) reconstruction incorporating bone-patella-tendon-bone (BPTB) autograft is a common surgery in orthopaedics; however, there are numerous complications. Graft tunnel mismatch, is a condition in which the BPTB autograft or allograft is either too long, and the bone plug is protruding from the tibia, or too short, and the bone plug is intraarticular. Either way, this complication can result in compromised fixation. Techniques have been described to help prevent this complication; as well as how to predict the length of the tibial tunnel to prevent graft tunnel mismatch. These calculations and formulas can be difficult and cumbersome. We have developed a simple, straightforward method of preoperatively templating ACL reconstruction with BPTB autografts, using only a lateral X-Ray. This technique is based upon soon-to-be published research, which demonstrates, that as a general rule, Blumensaats line is the same length as the native ACL. In the same manner that preoperative templating has decreased complication rates in total hip arthroplasty; we feel this preoperative ACL reconstruction template technique can help to eliminate graft tunnel mismatch as a complication.

Hypothesis: Preoperative templating of ACL reconstruction will prevent a graft tunnel mismatch, amount of the tibial bone plug protruding or recessed from the tibial tunnel, upon completion of the case, will be ≤5mm; thus ensuring adequate fixation for the BPTB autograft. Secondary outcome measures compare the length of Blumensaat’s line to reconstructed ACL, the patellar ligament length on lateral X-Ray to interligamental length measured intraoperatively, predicted graft length to Intraoperative graft length, as well as predicted tibial tunnel length to Intraoperative tibial tunnel length.

Materials and Methods: 17 patients have been enrolled in the study to date. All underwent ACL reconstruction using BPTB autograft. All patients tibial and femoral tunnels where drilled independently, with the femoral tunnel being drilled using the accessory anterior medial portal. The full graft length was predicted preoperatively by measuring the length of the patellar ligament on lateral X-ray and adding 45mm (20mm for patellar bone plug and 25mm for the tibial bone plug). The calculation of tibial tunnel length was performed as follows, understanding, that as a general rule Blumensaat’s line is the same length as the native ACL: tibial tunnel = overall graft length – (Blumensaat’s line length + femoral tunnel length). A mean percent difference (MPD), the percent difference between the gold standard and the measurement in question, and the absolute difference (AD) where measured. These two parameters where measured for Blumensaat’s line and the reconstructed ACL length (gold standard), patellar ligament length on lateral X-ray and interligamental length (gold standard), predicted graft length and intraoperative graft length, and preoperative tibial tunnel length and intraoperative tibial tunnel length. Additionally, the amounts of tibial bone plug protruding or recessed after fixation and completion of the procedure was measured. The average measurement of this graft tunnel mismatch was calculated.

Results: There are 11 males and 6 females enrolled in the study to date. The AD between anticipated graft length and intraoperative graft length is 5.1mm±3.9mm, and between predicted tibial tunnel length and intraoperative tibial tunnel length is 5.6mm±4.1mm. The MPD between anticipated graft length and intraoperative graft length is 2.9%±2.2%, and between predicted tibial tunnel length and intraoperative tibial tunnel length is 5.9%±8.2%. When evaluating Blumensaats line and the reconstructed ACL length, the AD is 2.1mm±2.8mm; while the MPD is 0.7%±7.5%. Comparing the measurement of the patellar ligament on lateral X-ray to the interligamental length demonstrated an AD of 4.2mm±3.2mm and a MPD of 4.6%±5%. Finally, the average amount of graft tunnel mismatch at the tibial tunnel upon completion of the 17 cases is 2.4mm±2.9mm. There have been...
no surgical failures to date, and there is no statistical difference between the aforementioned parameters when comparing males and females.

**Conclusion:** Graft tunnel mismatch is a complication of ACL reconstruction, especially when using BPTB autograft or allograft. If graft tunnel mismatch occurs intraoperatively, then fixation of the ACL reconstruction can be compromised. We present a technique that is straightforward and easily reproducible. We utilize lateral x-rays, as opposed to MRI. This affords us the ability to repeat the films if they are compromised; a luxury that would be quite expensive if we based our measurements off a MRI. Thus, our technique is not only reproducible but cost effective. We demonstrate a graft tunnel mismatch of less than 3mm, which provides adequate fixation of the bone plug in the tibia. Additionally, we demonstrated, that the length of the reconstructed ACL, as a general rule, is the same length as Blumensaat's line (the difference between the two is less than 1%). We also demonstrated, with a MPD of less than 6%, that the overall length of the graft and the length of the tibial tunnel can be predicted preoperatively. This is extremely beneficial in the setting of patella alta and patella baja. Finally, we have no failures to date; hence, this method of templating the ACL preoperatively has demonstrated its effectiveness and utility at eliminating graft tunnel mismatch as a complication of ACL reconstructive surgery.

**Spinal Cord Herniation as a Complication of Thoracic Discectomy: A Case Report and Review of the Literature**

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**Introduction:** Spinal cord herniation represents an uncommon cause of myelopathy and can be caused by a variety of causes. We present a case of spinal cord herniation into an anterior vertebral body defect caused by a pseudomeningocele after anterior thoracic discectomy and fusion.

**Methods:** Case report and review of the literature.

**Results:** The patient is a 71-year-old male with a history of right-sided thoracotomy for T5-6 discectomy and fusion complicated by pseudomeningocele which resolved spontaneously. The patient otherwise had an unremarkable postoperative course with mild stable hypoesthesia and gait instability. He presented 11 years after the index procedure with acute neurologic decline with severe gait disturbances, hyper-reflexia, and significant sensory deficit beginning at a T5 level. MRI demonstrated a right-sided vertebral body defect at the area of the prior pseudomeningocele. The spinal cord was herniated into this defect and was tethered and flattened against the dorsal vertebral body. Due to significant neurologic decline, the patient subsequently underwent revision thoracotomy with release of the spinal cord off of the vertebral body and placement of a dural sling to maintain spinal cord position in addition to expansile duraplasty and posterior spinal fusion.

**Discussion and Conclusion:** Spinal cord herniation is a rare and often overlooked cause of myelopathy with a variety of causes. We report the first identified case of spinal cord herniation as a complication of anterior thoracic discectomy and fusion.

**The Impact of Studying Resources and Orthopaedic Review Courses on ABOS Part 1 Exam Scores**

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**Background:** Previous studies have shown that certain Orthopaedic In-Training Examination (OITE) scores can be used to identify which residents may be at risk for failing the American Board of Orthopaedic Surgeons (ABOS) Part 1 examination. However, no studies have examined how study resources may impact residents’ ABOS Part 1 scores. The goal of this study is to determine which review sources or review courses are associated with improved ABOS Part 1 scores.

**Methods:** A survey was sent to 221 of the 865 examinees that took the ABOS Part 1 exam in 2012. The questions asked the respondents how well they performed on previous OITEs and ABOS Part 1, along with the study sources most commonly used, review courses attended and resources recommended for the ABOS Part 1 exam if they were to repeat the examination.

**Results:** 118 of the 221(53%) survey recipients completed the survey. Six (5%) of the respondents failed ABOS Part 1. Respondents who failed were significantly (p=.0475) more likely to score in the 25th percentile or lower during their
PGY 5 OITE and there was a significant correlation between respondents’ PGY 3, 4 and 5 OITE scores and their ABOS score (p<.0169). Orthobullets and the AAOS Self Assessment Exams were recommended as the primary study source significantly more (p<.01) than most other resources and there was an association between study source and improved ABOS Part 1 score (p=.0509). Respondents who did not attend an orthopaedic review course were much more likely (p=.0501) to report higher ABOS Part 1 scores than those respondents who went to a review course.

Conclusions: Question-based study resources are associated with improved ABOS Part 1 scores and orthopaedic review courses may not improve a resident’s chance at passing or scoring higher on ABOS Part 1. Further research into the value of certain educational modalities should be conducted to determine the best ways to educate orthopaedic residents.

A Comparison of Four Methods of Evaluating Patellar Height in Quadriceps Tendon Ruptures

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Introduction: Rupture of the quadriceps tendon is a rare but debilitating injury. There is a need for early and accurate diagnosis as delayed repair can increase morbidity. One of the most common means of assessing quadriceps tendon rupture remains the plain lateral radiograph. Complete quadriceps tendon tears have been associated with a low riding patella (patella baja), however the definition of patella baja is dependent on the method used to measure patellar height. The purpose of this study was to examine the sensitivity of 4 different means of assessing patellar height in detecting patella baja in known quadriceps tendon ruptures using: the Insall-Salvati method, the Plateau-Patella Angle, the Caton-Deschamps method and the Blackburne-Peel index.

Methods: A retrospective chart review was completed for all patients who underwent quadriceps tendon repair at our institution from 1999-2013. Exclusion criteria included: prior joint arthroplasty, partial thickness tears, and lack of radiographs.

Results: Thirty-three patients were identified that met the inclusion criteria (31M, 2F) with mean age of 49 (range 15-80). The Insall-Salvati Ratio indicated patella baja in a mean of 10.2 of 33 patients for a sensitivity of 30% (95% CI= 15%-47%). The Plateau-Patella Angle indicated patella baja in a mean of 13.2 of 33 patients for a sensitivity of 40% (95% CI= 34%-46%). The Blackburne-Peel Index indicated patella baja in a mean of 2.75 of 33 patients for a sensitivity of 8% (95% CI=6%-10.7%). The Caton-Deschamps ratio indicated patella baja in a mean of 0.2 patients for a sensitivity of less than 1 (95% CI=0-2.2%). There was no significant difference between The Insall Salvati Ratio results and the Plateau-Patella Angle results (p=0.542). There was a significant difference between the Insall Salvati Ratio and both the Caton-Denchamps Ratio (p=0.001) and Blackburne Peel Index (p=0.003).

Discussion and Conclusion: The most studied methods of assessing patellar height include the Insall-Salvati, Caton-Deschamps, and Blackburne-Peel methods. This study represents the first direct comparison of these and the newer Plateau Patella Angle in diagnosing patella baja associated with quadriceps tendon rupture. Previously the incidence of patella baja in quadriceps tendon rupture using the Insall-Salvati method was 55% in one study of 15 patients. Our results in this larger series demonstrate a sensitivity of 30%, and indicate that the Plateau-Patella Angle may be as sensitive. More importantly, our results suggest that without modification, the Caton-Deschamps and Blackburne-Peel methods are statistically less sensitive to detect patella baja in an acute quadriceps tendon rupture. Additionally our results suggest that patella baja is not a reliable radiographic sign of this injury. Although further study is required, we recommend the use of the Plateau-Patella Angle or the Insall-Salvati Ratio and recommend against the use of the Caton-Deschamps or the Blackburne-Peel methods in assessing patella baja in suspected quadriceps tendon rupture.
Acute Compartment Syndrome Following Distal Biceps Tendon Rupture in an Otherwise Healthy Male

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**Introduction:** This case presents acute compartment syndrome of the anterior upper arm following a distal biceps tendon rupture in an otherwise healthy 33 year old male. Bicep compartment syndrome following bicep tendon rupture has been rarely reported and to our knowledge appears in the literature only two other times. In both previously reported cases it has been associated with anticoagulation therapy in older men. This is the only case reported of a biceps compartment syndrome in an otherwise healthy young male.

**Methods:** N/A

**Results:** N/A

**Discussion:** Rupture of the biceps tendons can occur distally or proximally at either the long or short heads. Long head tendon ruptures account for 96% of all biceps tendon ruptures. Much less common are the distal tendon ruptures at a rate of 1%. Although it has been shown that bicep tendon rupture occurs predominantly in older men, it has been shown that the less common, distal tendon ruptures, as demonstrated in this case, most frequently occur in males during their fourth decade. Distal tendon ruptures typically occur during the mechanism of excessive eccentric tension as the arm is forced from a flexed position. Non-surgical treatment of distal biceps rupture has been shown to lead to a mean loss of 40% supination strength, and a variable loss of flexion strength averaging 30%. In contrast, immediate surgical repair frequently results in minimal loss of strength at one year after repair. Acute compartment syndromes can typically be diagnosed clinically, but where there is question, intra-compartmental pressures can be measured. Compartmental pressures with less or equal to a 30mmMg difference from the patient’s diastolic pressure, or compartment pressures greater than 30mmHg with worsening and severe symptoms indicates the need for emergent compartmental fasciotomy to prevent further tissue damage. In order to obtain a favorable outcome with decreased morbidity, a high index of suspicion must be maintained to allow for early diagnosis and surgical treatment. This case indicates the need for awareness of the possibility that a compartment syndrome can develop as a result of a bicep tendon rupture in an otherwise healthy patient.

Secondary Periprosthetic Fracture About the Femur: A Case Report

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**Introduction:** Periprosthetic femur fractures about a total hip arthroplasty are increasing in incidence and have been well documented in the literature. The Vancouver classification system is widely used and can help direct treatment. However current literature only addresses primary periprosthetic fractures leaving little evidence for the management of a secondary fracture. The purpose of our case report is to present a patient with a history of a hip hemiarthroplasty who underwent lateral locking plate fixation for a Vancouver B1 periprosthetic fracture and then sustained a second periprosthetic fracture distal to her plate 2 months later.

**Methods:** An 89 year-old female presented to the emergency department after an un-witnessed ground level fall with resultant inability to bear weight on her right lower extremity. Past surgical history was significant for bilateral femoral neck fractures treated with cemented hemiarthroplasties several years prior. Additionally, she had sustained a Vancouver B1 fracture to her right femur 2 months prior which was treated with a lateral locking plate. The treatment of her initial periprosthetic fracture was complicated by wound dehiscence around the greater trochanter which healed with local wound care. Radiographs demonstrated a second periprosthetic femur fracture just distal to her lateral plate which was comminuted in nature.

**Results:** After medical optimization, the patient was taken to the operating room for retrograde intramedullary fixation. The distal aspect of her prior incision was exploited to remove all screws distal to the hemiarthroplasty cement mantle. Reduction of the distal femur was then obtained with flexion of the hip and knee. A retrograde supracondylar intramedullary nail was then used to stabilize the distal fracture. The nail was inserted to the level of the cement mantle. The lateral-to-medial interlocking screws were then placed by internally rotating the nail enough to seat the aiming guide just anterior to the plate on the lateral aspect of the femur. Fixation was then completed with four distal interlocking screws. We then re-affixed the distal portion of the
existing lateral locking plate using a combination of cerclage wires and unicortical locking screws. Postoperatively the patient was made toe-touch weight bearing. At two weeks follow-up, the patient’s incisions were well healed and she was pain-free. Her knee range of motion was 10-60 degrees. There were no radiographic signs of fracture displacement or hardware failure.

**Discussion and Conclusion:** Multiple treatment options were considered to include revision of the lateral plate fixation, distal femoral replacement, or retrograde intramedullary fixation. Given the patient’s previous wound healing problems and medical comorbidities, we wished to avoid a large lateral incision to accommodate revision lateral plate fixation. Distal femoral replacement would have been complicated by the presence and location of the previous periprosthetic fracture. For these reasons, we proceeded with retrograde intramedullary fixation which offered suitable fixation with less of a soft-tissue insult. The use of a short supracondylar retrograde nail allowed us to stop short of the existing cement mantle and stabilize the secondary fracture. We could then reattach the distal aspect of the plate using cerclage wires and unicortical screws to provide continued support for her previous preiprosthetic fracture. We believe this to be the first report of the management of a secondary periprosthetic fracture occurring distal to previously placed hardware. Retrograde intramedullary fixation is a safe and effective option for management of this scenario.

**Poster 20**

**Bizarre Parosteal Osteochondromatous Proliferation in the Radius**

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**Introduction:** Bizarre Parosteal Osteochondromatous Proliferation (BPOP) is typically a lesion of the small tubular bones in the hands and feet. The entity has also been referred to as Nora’s lesion because the lesion was first described by Nora, et al. in the American journal of surgical pathology in 1983. While there are case reports and retrospective series of BPOP in long bones, there are only 6 cases of BPOP in the radius reported in the literature.

**Methods:** A thirty-two-year-old right hand dominant male presents with a painless mass on the volar-radial aspect of right distal forearm that slowly enlarging for eight months prior to presentation. He describes a firm nodule that is tender with direct compression. He sought attention because the pain is interfering with daily activities such as working on a computer. He denies a history of trauma to the area, and has no systemic symptoms. On examination there is a firm, fixed 2cm by 3cm mass on the radial-volar-forearm just proximal to the wrist flexion crease. He has no pain with use of his wrist and hand and has full range of motion that is symmetric with his contralateral side. He is distally neurovasculally intact, to include the superficial radial sensory nerve. His Allen test in normal. Radiographs show extraosseous bone formation at the distal volar radial metaphysis (2.5 x 1.4cm) that appears stuck on to the radius with an intact radial cortex. Our initial differential diagnosis included myositis ossificans, fractured osteochondroma, and neoplasm. A complete blood count, complete metabolic panel, C-reactive protein, and erythrocyte sedimentation rate were all within normal parameters. MRI and CT scan were obtained to better characterize the lesion. CT scan and MRI showed no corticomедullary continuity and no cartilage cap, making osteochondroma less likely. MRI showed reactive edema surrounding the lesion, but no soft tissue extension or marrow changes. Normal laboratory values and imaging were not consistent with neoplasm. BPOP was added to the differential diagnosis and the patient was scheduled for marginal excision of the lesion.

**Results:** The lesion was excised en bloc with some of the adjacent radial cortex. Pathology of the mass was consistent with BPOP. The patient had an uneventful post operative course. At his two year follow up, there is no evidence of recurrence.

**Discussion and Conclusion:** BPOP occurs in the hands and feet in 80% of the cases, with the remaining 20% distributed among the long bones of the upper and lower extremity. The literature is limited to case reports and small case series. The lesion does not appear to have a predilection for sex, race, or age. There is debate in the literature about whether it is a reactive periostitis or a neoplasm. Several studies have discovered a translocation t(1;17) in BPOP lesion, which would support the assertion that it is a neoplasm. There is also debate about BPOP in relation to florid periostitis and turret exostosis as they share many histologic features. Some authors posit that these entities are a continuum beginning with florid periostitis, progressing to BPOP and then maturing to a turret exostosis, suggesting that these different diagnoses are the same process seen at different phases in the natural course of the lesion. When BPOP arises in an atypical location, a higher clinical acumen is needed to make the diagnosis. Awareness that BPOP can arise outside the hand and feet may allow clinicians to arrive at the correct diagnosis and treat an asymp-
tomac BPOP with serial observation. When the lesion is symptomatic excision may be undertaken, and while surgeons need to remain vigilant for malignant processes, making the diagnosis of BPOP prior to surgery may avoid an unnecessarily wide resection.

**Poster 21**

**Duplication of the Spine: A Rare Variant of Split Spinal Cord Malformation**

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**Introduction:** Duplication of the spine is a rare spinal malformation. Pang et al classified spinal cord malformations as type I, which include separate hemicords in their own dural sacs separated by a rigid osseocartilaginous septum; type II, which include hemicords contained within a single dural sac. Spinal cord duplication represents an extreme variant of a type I split cord malformation. Very few reports of duplication of the spine exist, much less those of affected patients with minimal to no neurological findings. We report the presentation of a unique pediatric patient with spinal duplication in order to increase knowledge regarding this unusual malformation.

**Methods:** A 6-year-old girl who had recently been adopted from China with no information regarding her family history presented to our institution for evaluation of an asymptomatic kyphotic deformity. Per report her only other known abnormality was that of a patent foramen ovale. On examination she appeared to be an active child without appreciable weakness or any bowel or bladder dysfunction. The abnormal findings on physical exam included a unilateral cavus foot with associated asymmetry of the size of her lower extremities as well as focal kyphosis at the thoracolumbar junction. Radiographs demonstrated a large area of dysraphism involving the lumbar spine and sacrum. CT, MRI, and abdominal ultrasound were ordered for further evaluation.

**Results:** Abdominal ultrasound did not reveal any further abnormalities. CT of the entire spine revealed a partial failure of segmentation at C2-C3, and complex hemivertebrae with a large midline defect with associated incomplete medial bony elements extending from T10 to the sacrum. This abnormality results in the appearance of two completely separate and distinct spinal columns at the affected regions. MRI demonstrated that each hemivertebra column has an associated thecal sac, each containing neural elements. The thecal sacs reunite at the level of the sacrum.

**Discussion:** Duplication of the spine is an unusual variant of a split cord malformation. Previous recommendations for treatment of spinal cord malformations include resection of the intervening septum and tether release at a young age. However, several case reports of duplication of the spine report incidental findings of this malformation in patients who subsequently were treated with observation alone without the development of any neurologic impairment. Our current plan is to continue to observe this patient closely and intervene in the case of development of neurologic impairment or worsening kyphosis.

**Poster 22**

**Stress-Hyperglycemia is Associated with Surgical Site Infection: A Prospective Observational Study of Non-Diabetic, Non-Critically Ill Orthopaedic Trauma Patients**

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**Introduction:** Multiple studies have demonstrated the detrimental effects of hyperglycemia in trauma patients; however, there is a paucity of data concerning hyperglycemia and non-diabetic orthopaedic patients. We conducted the present study to evaluate the relationship of hyperglycemia and surgical site infections in a cohort of non-diabetic ill, non-critically ill orthopaedic trauma patients.

**Methods:** Prospective observational pilot study over a 9-month period (February 2011-October 2011). Inclusion criteria were patients age >17 years admitted with orthopaedic injuries requiring operative intervention. Patients with a history of diabetes mellitus, current corticosteroid use, multisystem injuries, or who were admitted to the ICU were excluded. Demographics, medical co-morbidities (as classified by the American Society of Anesthesiologist physical status), body mass index (BMI), presence of an open fracture, and number of operations were recorded. Fingerstick blood glucose values were ordered twice daily for each patient. Hyperglycemia was documented for a fasting glucose value >125mg/dL or a random value >200mg/dL on more than one occasion, and was considered prior to the development of an infection. Hemoglobin A1C (Hgb A1C) was obtained from hyperglycemic
patients, and occult diabetes was considered for an Hgb A1C >5.9. Occult diabetes mellitus was excluded from final study analysis. Surgical site infection was considered by a return trip to the operating room and confirmed by positive intra-operative cultures at the operative site.

**Results:** One hundred and seventy-one patients were enrolled. Forty patients (23.4%) were hyperglycemic; 7/40 (17.5%) had Hgb A1C >5.9. The final study population consisted of 164 patients; 33/164 with hyperglycemia (20.1%). There were 12 (7.3%) surgical site infections. There was no significant association with age, gender, race, medical comorbidities, obesity (BMI>29), tobacco use, or the number of operative procedures and the primary outcome. Patients with hyperglycemia were more likely to develop a surgical site infection (7/33, 21.2% vs 5/131, 3.8%; p=0.001). Open fractures (6 Type I, 22 Type II, 22 Type III) were also associated with surgical site infections (7/50, 14% vs. 5/114, 4.4%; p=0.03). However, there was no association with open fractures and hyperglycemia (10/50, 20.0% vs. 23/114, 20.2%; p=0.98).

**Conclusions:** Hyperglycemia was present in twenty percent of non-diabetic orthopaedic trauma patients and demonstrated a significant association with surgical site infection in this prospective observational cohort. While many factors may contribute to surgical site infections, there is presently a lack of data on hyperglycemia in non-diabetic, non-critically ill patients. Future randomized studies are necessary to further determine the impact of glucose control on outcome in orthopaedic trauma.

**Methods:** Two patients undergoing three anterior and lateral compartment releases (one patient bilateral) for exercise induced exertional compartment syndrome were identified at the time of surgery to have bifid superficial peroneal nerves. A review of the English literature was performed using the search terms “superficial peroneal nerve, superficial fibular nerve, anatomy, variation.”

**Results:** The superficial peroneal nerve was found to divide into the medial and intermedial dorsal cutaneous nerves just after emerging from the crural fascia. Both branches remained within the lateral compartment, coursing anterior to the fibula until moving anteriorly just proximal to the ankle. Review of the literature demonstrated the classic branching pattern of the superficial peroneal nerve in approximately 70% of cadaveric specimens and live surgical patients. The nerve is found solely in the anterior compartment in up to 23% of patients, and in both the anterior and lateral compartments in up to 26% of patients. An intra-septal course was found in 6-13% of specimens. Up to 7% of superficial peroneal nerves studied may divide into the medial and intermediate dorsal cutaneous nerves proximal to piercing the crural fascia.

**Discussion and Conclusions:** Anatomic variability within the course of the superficial peroneal nerve is common. Nearly 30% of patients may have a branch of the superficial peroneal nerve in the anterior compartment, and close to 10% may have a bifid nerve in the lateral compartment. Surgeons must be aware of these variations to avoid iatrogenic nerve injury or incomplete nerve decompression at the time of surgery.

The **Bifid Superficial Peroneal Nerve: A Case Series and Review of the Literature**

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**Introduction:** Surgery about the lateral aspect of the ankle is commonly performed by orthopaedic surgeons for fracture care, compartment release, superficial peroneal nerve decompression and flap harvest. The lateral approach to the ankle and distal leg risks injury to the superficial peroneal nerve (SPN). We present a series of patients with a distal bifid SPN with early branching into the medial and intermediate dorsal cutaneous nerves just after piercing the crural fascia, and a review of the literature.

**Discussion:** The improvised explosive device has been a defining weapon used by the insurgents in Operation Enduring Freedom (OEF). The injury patterns that have resulted, including combined mechanism pelvic fractures, have created new challenges in management of the associated injuries and resuscitation efforts. The Young and Burgess is a mechanistic classification system that is theorized...
to predict mortality, transfusion requirements, and nonorthopaedic associated injuries. Trauma surgeons and orthopaedic surgeons use these basic parameters to help guide treatment. Pelvic fractures due to blast injuries do not create the same injury patterns often seen in the civilian sector.

Methods: A retrospective review using the Joint Theater Trauma Registry data of coalition soldiers sustaining a pelvic fracture in Operation Enduring Freedom from 2010 to 2012 were utilized for this study. Main outcome measurements were Massive transfusion, mechanism (classified by Y&B system), and associated injuries—head, chest, and abdomen.

Results: Three hundred and eleven (311) patients met the aforementioned criteria. The analysis below is for 2012 data (51 patients). 47% of the injuries were considered stable by Young and Burgess (LC1/APC1). The latter 53% fell into the APC2, APC3, LC2, LC3, and Combined mechanism. Estimated Blood loss for the CM1 is statistically significantly higher than LC1 & LC2 & APC2 (P<.05) Furthermore, the EBL for APC3 is statistically significantly higher than LC1 (P<.05). ICU length of stay was higher for CM1 although does not reach statistical significance (P>.05). The blood product administration for CM1, APC3 and APC2 are all higher than LC1 (P<.05). Mean total ICU days were 8 (std. dev =16). Estimated total blood loss=1503 (Std Dev 2086). Infection incidence varied for the different classes of injury (with a p<0.0001 by ANOVA). CM1 > LC1(p<.0001) APC3 > LC1 (p<.0001) APC2 > LC1(p<.0001) No statistically significant differences were found for associated injuries of the head, chest, or abdominal region between subgroups.

Discussion: Pelvic fractures sustained in blast injury are different than that seen in blunt trauma in the civilian sector. There were significantly more unstable injuries seen in this population compared to historical controls. Furthermore, the estimated blood loss was also higher for combined mechanism injuries. Transfusion requirements were better predicted by the Young-Burgess system in this series. CM1, LC3, APC2, and APC3 have higher transfusion requirements than other fracture types. The incidence of open injuries was higher in more severe pelvic fracture types. Compared to the original work by Young and Burgess, no significant differences in nonorthopaedic injuries between fracture types were found. However, a large proportion of these patients sustained head injuries, irrespective of the fracture classification.

Conclusion: The ability to predict blood loss and thereby guiding resuscitation treatment was upheld in the military cohort of patients sustaining pelvic fracture. A larger proportion of these injuries were more severe (LC3, APC3, CM1) compared to civilian controls. The ability of the Young and Burgess classification to predict associated injuries was not seen in this series. A larger sample size using 2010-2011 OEF data is currently under analysis to draw further conclusions on blood transfusions, use of TXA, and predicting associated injuries.

“Subcritical” Glenoid Bone Loss Increases Redislocation Rates in Primary Arthroscopic Bankart Repair

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Introduction: While bone loss is increasingly recognized as a risk factor for failure after arthroscopic stabilization, the precise definition of critical bone loss has not been defined. Additionally, there is no clarity on the amount of bone loss routinely present in patients presenting for primary arthroscopic stabilization of anterior glenohumeral instability. The purpose of this study is to report on the average bone loss measured in primary isolated Bankart reconstructions of the shoulder and to determine what amount of bone loss correlated to a recurrence of instability.

Methods: This is a retrospective review of a consecutive series of 94 anterior instability patients (97 shoulders) who underwent arthroscopic labral repair at a single military institution by one of three fellowship trained orthopaedic surgeons. Data was collected on demographics and rate of redislocation as reported by the patient at the most recent follow-up. Glenoid bone loss was calculated from preoperative imagining using a “perfect-circle” technique. Patients were excluded if they had previously undergone any stabilization procedure.

Results: The average age at surgery was 25.6 years (range, 16-42) with average follow-up of 36.8 months (range, 20-57). There were 5 females (5 shoulders) and 89 males (92 shoulders). The average bone loss in all patients was 14.4% (range, 0-34.7%). When analyzed based on the presence or absence of recurrence, there were 77 stable shoulders with
no redislocations. In this group, the average bone loss was 14.5% (range, 0-33.3%) with a follow-up of 36.3 months (range, 20-57). There were 20 patients with recurrent dislocations who had an average of 20.8% (range, 0-33.3%) with a 39.1 month (range, 21-56) follow-up. There was a significantly greater amount of bone loss in those with redislocations (p=0.004). When further analyzed, there was a 95% likelihood of redislocation with 17.1% bone loss there was a 25% likelihood of redislocation with 7.0% bone loss.

Discussion and Conclusions: This study suggests that gelenoid bone loss is a common finding in patients undergoing primary arthroscopic stabilization. Additionally, patients with “subcritical” bone loss of 17.1% are at a higher risk to have a recurrence than those with lesser amounts of bone loss. Patients with bone loss beyond this threshold should be counseled accordingly with consideration for alternative surgical procedures.

Poster 26

Metastatic Lung Cancer Presenting as a Thumb Felon: A Case Report of Acrometastasis

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Introduction: Acrometastases are a rare clinical entity, comprising only 0.1% of all metastatic lesions. The clinical presentation is often indiscernible from paronychial infection, gout, or osteomyelitis. Most commonly, acrometastases develop in the setting of primary lung carcinoma, with preponderance for the distal phalanx. Of the fingers, the middle is most commonly involved, followed by the thumb. Biopsy and culture are required to ascertain the correct diagnosis. Local treatment strategies primarily consist of local resection, or amputation, obtaining clear oncologic margins. However, when involving the thumb, special attention must be paid to maintain functional length of the digit due to the importance of the thumb for manual tasks.

Methods: A 71 year-old female with a history of a persistent cough and progressive neck pain of 3-month duration, was admitted for osteomyelitis of the fourth cervical vertebra (C4), secondary to a right thumb felon. She had been seen 1 week prior in the emergency department where the thumb felon was diagnosed, and treated with an incision and drainage (I&D) and oral Clindamycin. Her past medical history is significant for a large lung mass, diagnosed by bronchoscopy as lipoid pneumonia. At presentation, she described new onset right arm weakness and paresthesias of one-day duration. She was afebrile and normotensive. Laboratory studies revealed a white blood count of 7.2, C-reactive protein 24.2, erythrocyte sedimentation rate 67, and alkaline phosphatase 166. Blood and wound cultures were obtained and she was placed on intravenous (IV) Clindamycin and scheduled for magnetic resonance imaging (MRI) of her cervical spine. The MRI was interpreted as consistent with a diagnosis of C4 osteomyelitis with an epidural abscess. She was placed in a cervical collar and switched to IV Vancomycin and Ceftriaxone. On hospital day (HD) 3, the orthopaedics team was consulted for management of the persistent infected right thumb. Radiographs were reviewed and a repeat bedside I&D was performed. At this time, no growth was reported from the blood or wound cultures. On HD 5, the patient was taken to the operating room for a formal I&D and biopsy. During the operative irrigation and debridement, a complete absence of the distal phalanx was noted, replaced by a firm, expansile, purple tissue. Cultures and intra-operative tissues were obtained for analysis. The dorsal skin and nail had poor capillary refill and was judged to be at risk of necrosis. The absence of the distal phalanx left this tissue unsupported so the distal space was filled with an antibiotic impregnated cement spacer until the dorsal skin declared, and a revision amputation could be performed.

Results: Post-operatively, the patient’s neck pain worsened and became remedial to high dose narcotic analgesia. Repeat radiographs were obtained of the cervical spine, showing progressive collapse and deformity of C4, with extension to C5. Pathology results of the thumb biopsy returned on HD 8 revealing adenocarcinoma of unknown primary origin. The patient required anterior C4-5 corpectomy with fusion on HD 11 for a second metastatic lesion of the cervical spine. The oncologic service was consulted and a bone scan was performed, revealing an additional metastasis to the distal left femur. A revision amputation was performed on HD 21, obtaining an intra-lesional margin to maintain functional length of the digit and she was treated with adjuvant radiation to the thumb as well as distal left femur. Despite medical efforts, the patient died from pulmonary complications of her lung cancer 8 weeks after admission.

Discussion and Conclusion: Acrometastases are a rare clinical entity. Although they commonly present similarly to a local infection, a high clinical index of suspicion, incorporating key elements of a patient’s history, can prevent a delay in
Arthroscopic vs. Arthrographic Diagnosis and Characteristics of Kim’s Lesion in Posterior Shoulder Instability

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Introduction: The Kim lesion is a concealed avulsion of the posterior-inferior glenoid labrum. Little is known about the anatomic differences in shoulders with and without Kim lesions and the utility of magnetic resonance arthrogram (MRA) for diagnosis of this entity. The purpose of this study was to describe the morphologic features of shoulders with and without Kim lesions, define the sensitivity, specificity, and reliability of the MRA for detection of these lesions, and determine the interobserver reliability of the Kim classification for posterior labral tears.

Methods: A retrospective blinded analysis of 41 shoulders was performed. Outcomes measured included morphogenic features of shoulders with and without Kim lesions, sensitivity/specificity, negative/positive predictive value and reliability of the MRA for diagnosis of the Kim lesion as well as interobserver reliability of the Kim classification. The hypothesis was there would be increased retroversion in shoulders with Kim lesions and MRA would have poor sensitivity, specificity, and reliability for detection of concealed posterior-inferior labral tears.

Results: No differences in morphology of the glenoid and chondro-labral complex between shoulders with and without posterior instability and Kim’s lesion were found. The sensitivity and specificity of the MR arthrogram were high (85.7%, 75%), as was the interobserver reliability (k=0.74). The interobserver reliability of the Kim classification was poor (k=0.33).

Discussion and Conclusion: Patients with incomplete posterior-inferior labral tears have similar anatomic features to patients without PSI. The sensitivity and specificity and reliability of MRA for detecting these lesions are good. The interobserver reliability of the Kim classification is poor.

Pediatric Hip Dislocation with Posterior Wall Acetabular Fracture: A Case Report

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Introduction: Traumatic pediatric hip dislocations with associated posterior wall fractures are injuries that can have significant sequelae if not recognized and treated appropriately. Open reduction and internal fixation (ORIF) is recommended if the hip remains unstable after reduction. A second indication for ORIF is the presence of significant incongruity of the articular surface of the hip after reduction. A recently published case series of posterior wall fractures in skeletally immature patients revealed the inadequacy of plain radiographs and CT scans in determining the extent of the injury. MRI has higher sensitivity due to its detection of non-ossified posterior wall acetabulum and therefore, a more reliable indicator of intraoperative findings. In this case report, we describe an unusual case of a skeletally immature patient who sustained a traumatic hip dislocation with an associated posterior wall fracture. Both CT and plain x-ray did not reveal the true extent of this injury. This patient underwent his index surgical procedure to remove intra-articular incarcerated fragments and yet returned for a second surgery based on an MRI performed two weeks after the original surgery.

Methods: An eight year-old boy, status post football tackle injury presented to an outside hospital complaining of left hip pain. Patient was evaluated clinically; radiographs and CT were obtained which revealed a left hip posterior fracture dislocation. Closed reduction was unsuccessfully performed. He was taken emergently to the operating room for an open reduction of his hip dislocation. Two weeks following injury he presented to our hospital for a second opinion. Additional x-rays obtained were suggestive of a slight lateral subluxation of the hip and the possibility of an intra-articular fragment within the hip joint. A Magnetic Resonance Imaging (MRI) scan was then performed in order to fully assess the injuries associated with his posterior hip dislocation including the non-ossified aspect of the posterior wall fragment and cartilage of the femoral head and acetabulum. MRI demonstrated a Posterior Wall acetabular fracture with a significant fragment of acetabular cartilage, 1.3 cm in size, interposed in the hip joint along with the attached transverse ligament all contributing to the observed subluxation of the
A focal small high-grade partial thickness chondral defect to the parafoveal margin of the femoral head was also observed near the intra articular fragment. Revision ORIF was performed expeditiously to prevent further damage to the hip joint associated with a retained intra articular fragment. Through a Kocher-Langenbeck approach the intra articular fragment was carefully identified and repaired along with the labral and capsular attachment using two suture anchors with additional suture repairs of the labrum and hip capsule.

Results: The patient returned for regular follow-up and at 1 year following surgery; he presents with excellent clinical and radiographic results including a healed acetabular fracture, full pain-free hip motion, and a full return to all pre-injury activities including sports.

Discussion and Conclusion: Literature has demonstrated the efficacy of MRI in determining the extent of posterior wall fracture in skeletally immature patients who sustain a traumatic hip dislocation with an associated posterior wall acetabulum fracture. Case series have demonstrated the inadequacy of x-ray and CT to adequately diagnose the extent of the posterior wall fracture, which is vital to determining hip stability. We present the case of a child who underwent surgical intervention with CT only and presented to our institution two weeks later with MRI evidence of incarcerated chondral fragments in the joint as well as an incarcerated, non-reduced labrum, and an unreduced transverse acetabular ligament. We recommend the use of MRI in these patients not only to examine the extent of the bony injury and the potential need for a formal open reduction, but also to evaluate the soft tissues surrounding the hip, which if sufficiently damaged, could also lead to significant articular pathology in the future.

Poster 29

Improved Total Joint Arthroplasty Program Leads to Decreased Length of Stay and Reduced Hospital Costs

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Introduction: In the US, there are over 1,000,000 total joint arthroplasty procedures performed each year. By 2030, it is predicted that 3.48 million total joint replacements will be conducted annually. With the growing elderly population and the rise of medical costs, these surgeries are becoming one of the major contributors to healthcare related economic cost worldwide. Military treatment facilities are unique in that the patient population is extremely diverse with geographic, social, and population based challenges. The purpose of this study was to evaluate the effects of implementing a multidisciplinary arthroplasty program on patient’s length of stay (LOS), outcomes, complication rates, and the overall hospitalization cost.

Methods: A multidisciplinary arthroplasty program was implemented in February 2013 and included a multidisciplinary total arthroplasty pre-operative patient education program, perioperative pain consult, a dedicated RN serving as a discharge planner for the arthroplasty patients, daily goals focused inpatient teaching rounds, and earlier social services involvement. A retrospective chart review was performed on all patients who underwent a primary unilateral total hip or total knee arthroplasty by a single fellowship trained orthopaedic surgeon from September 2012 to April 2013. To evaluate efficacy, medical records for the 30 consecutive patients treated pre and post intervention were reviewed for LOS, patient outcomes, complications and hospitalization cost. Further analysis was performed to identify any risk factors for prolonged LOS.

Results: The pre-intervention group consisted of 30 patients between September 2012 and January 2012. There were 15 THA and 15 TKA procedures in 21 males and 9 females with an average age of 58. The post intervention group consisted of 24 male and 6 female patients who underwent 10 THA and 20 TKA procedures with an average age of 62. There was no significant difference between the two groups for age, sex, procedure performed, or comorbidities. The mean length of stay in the pre intervention group was 6.15 days (7.48 THA, 4.82 TKA). The mean length of stay in the post intervention group was 3.12 days (3.25 THA, 3.05 TKA). There was a statistically significant difference in the LOS in the pre-intervention group compared to the post intervention group (P=0.026). Pain control, delayed physical therapy and occupational therapy treatment, social needs and delayed discharge planning were associated with a prolonged hospital course. There were no complications.

Conclusion: With the growing number of total joint arthroplasties performed in the US and the increasing economic burden of healthcare, measures that decrease healthcare costs are important to both the healthcare system and to the patient. The national average LOS for TKA is 3.3 days and for THA is 4.2 days. In our study, there was a statistically
significant decrease in hospital stay after implementation of our arthroplasty program and a resulting LOS below the national average. With a mean reduction of 3.03 days per patient, the estimated reduction in healthcare cost is $610,000 after 30 patients underwent THAs or TKAs. Although further studies are required, we recommend implementation of a multidisciplinary total joint arthroplasty program to decrease patient hospital stay and reduced hospitalization cost.

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

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Summary: Cervical disc arthroplasty (CDA) has been espoused as a safe, segmental motion-sparing alternative to anterior discectomy and fusion (ACDF) in the treatment of cervical radiculopathy and myelopathy. There are few current studies comparing outcomes between the two techniques. To date, this is largest, single center review comparing single-level CDA to single-level ACDF. We found similar rates of symptom relief and low complication rates between the two groups. Our study demonstrates that CDA continues to be a reliable alternative to ACDF.

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

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

Results: There were 259 patients included in the study. The CDA group contained 171 patients and the ACDF group had 88 patients. Average follow up time was 9.8 ± 9.9 months for the CDA group and 11.8 ± 9.6 months for the ACDF group. The CDA and ACDF groups demonstrated 90.1% and 86.4% rates of complete symptomatic relief, respectively. 93.0% of patients who underwent CDA were able to return to full activity, as compared to 88.6% in the ACDF group. The rates for recurrent laryngeal nerve (RLN) injury and dysphagia were 2.9% and 5.8%, respectively, in the CDA group. The ACDF group had no RLN injuries and 3.4% of patients reported dysphagia. The CDA group had a 15.8% rate of persistent posterior neck pain. The ACDF group had 11 patients (12.5%) with persistent posterior neck pain, and a rate of symptomatic pseudoarthrosis requiring reoperation of 3.4%.

Discussion and Conclusions: In the largest non-sponsored study of its kind to date, our data suggest that both CDA and ACDF result in approximately 90% (90.1% CDA and 86.4% ACDF) of patients with complete preoperative symptomatic relief and a relatively low complication rate. Patients who underwent CDA had a higher rate of persistent posterior neck pain, and patients who underwent ACDF were at risk for symptomatic pseudoarthrosis.

Sacral Screw Strain in a Long Posterior Spinal Fusion Construct with Sacral Alar-Iliac (S2AI) Versus Iliac Fixation

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Introduction: Long instrumented posterior fusion constructs to the lumbosacral spine have a significant rate of pseudoarthrosis and S1 screw failure. With the increasing popularity of Sacral Alar-Iliac (S2AI) fixation with its purported advantages of 1) decreased implant profile and 2) obviating the need for a lateral offset connector, the biomechanical properties with respect to S1 screw strain remain unknown. We set out to compare the biomechanical effect of S2AI versus traditional iliac screw fixation on S1 screw strain.
Methods: Five fresh-frozen human cadaveric specimens were instrumented from L2-pelvis, maintaining all osteoligamentous structures, with bilateral titanium 6.0x40-mm pedicle screws and 5.5-mm cobalt-chromium rods. Bilateral S1 pedicles were instrumented with 8.0x50-mm screws that were centrally cored out and two uniaxial strain gauges inserted at 0° and 90°. S2AI and/or Iliac fixation with 8.0x80-mm titanium pedicle screws was performed to evaluate four different constructs: (1) Bilateral S1 Screws (control); (2) Bilateral S2AI; (3) Bilateral Iliac; (4) Hybrid (S2AI with contralateral Iliac). Bilateral S1 screw strain was measured (microstrain), and pure moment loads (12.0 Nm) were applied in axial rotation (AR), flexion-extension (FE) and lateral bending (LB). One way repeated measure ANOVA was used to analyze the S1 screw strain data.

Results: Compared to S1 screws alone, both S2AI and Iliac fixation significantly reduced sacral screw strain in FE by 58% and 67%, respectively (p<0.05). Hybrid constructs demonstrated a significant reduction in only FE, with reduction in screw strain by 56% for S2AI and 59% for Iliac fixation, with no difference in AR and LB moments. When S2AI and Iliac fixation were compared, there was no significant difference in screw strain for all bending moments (p>0.05). Similarly, hybrid constructs demonstrated no side-to-side significant difference between S2AI and Iliac fixation for all bending moments (p>0.05).

Discussion and Conclusions: Both S2AI and Iliac fixation provide significant reduction in S1 sacral screw strain compared to sacral fixation alone. Bilateral S2AI fixation is a viable and biomechanically comparable alternative to traditional Iliac fixation, and presents another option to achieve protection of the S1 sacral screws for long segment constructs to the pelvis.

Heterotopically Banked Great Toe: Spare Part Salvage of Uninjured Great Toe for Delayed Total Thumb Reconstruction

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Introduction: First described in 1986 by Marko Godina, ectopically banking amputated parts for salvage after mutilating injuries is not only feasible, but has become a necessary tool for the reconstructive surgeon. Current wartime injuries often involve multiple extremity injuries and amputations, typically contaminated with infectious debris and devitalized tissue. Extremity reconstruction can be complicated by these soft tissue concerns, usually requiring delay in reconstruction once adequate wound control is achieved. Our group reports such a case that posed a unique challenge to our multidisciplinary team. Utilizing the heterotopic banking principles of Godina, in combination with the principles described by Wei for great toe to thumb transfer, our group will provide an extensive illustrative series of one of the first successful delayed total thumb reconstructions with a banked spare part from the modern war theater.

Case Report: G.H. is a 27 year-old right hand dominant United States Army Sergeant involved in a mounted rocket propelled grenade (RPG) blast to his armored vehicle. He presented to the Role 3 MMU in Kandahar, Afghanistan with injuries to his left hand and leg and right groin. His left lower extremity injuries consisted of a grade 3B open tibia/fibula fracture with near total degloving of surrounding soft tissue. He had a concomitant left hand injury with a traumatic amputation of his small finger and a near total thumb amputation at the level of the metacarpal shaft. Within theater, the patient underwent a left below-the-knee amputation, debridement of his left hand wound, and a ring finger filet flap for palmar coverage. Given patient’s hand injuries and need for future thumb reconstruction, his great toe from the amputated BKA component was heterotopically transplanted and banked on the ipsilateral radial forearm for future transfer and second stage thumb reconstruction. The patient was stable over the next 24 hours and his banked great toe remained viable and well perfused. He was then transferred through the military trauma transport system arriving at Walter Reed National Military Medical Center (WRNMMC) 4 days after his initial battlefield injury. The patient then underwent periodic debridement for two weeks to optimize the recipient site wound. After wound control was achieved, the patient underwent delayed toe to thumb transfer and reconstruction surgery. The right lesser saphenous vein was endoscopically harvested, incorporating a “y” component. The toe was removed from the banked area, including a long segment of cephalic vein as well as a proximal portion of the radial artery containing the previously performed end-side anastomosis of the banked first toe’s arterial inflow. The toe was anatomically placed to mimic the lost thumb and proceeded similar to a standard thumb replant case. The metacarpal-metatarsal interface was fixed with 90-90 K-wires, the flexor and extensor tendons repaired, and the saphenous vein graft was placed in to permit one branch to be hand-
sewn to the distal remnant of the radial artery in the hand and the other branch to be handsewn to the artery perfusing the previously banked toe. Finally, the vein graft was trimmed to size with the proximal radial artery handsewn to proximal end of the vein graft. The venous outflow for the toe was coupled to a dorsal hand vein for outflow. The medial digital nerve of the toe was then opposed to a right sural nerve graft for recipient sensory nerve repair of the toe digital nerve. The skin was approximated, with any remaining open areas covered by Integra, which were secondarily skin grafted. This innovative reconstruction case outlines one of the few war-related heterotopic banked spare parts, i.e. a great toe, for definitive thumb reconstruction. It also demonstrates the application of multiple individually described techniques in order to provide a successfully transferred, sensate, and functional salvaged thumb reconstruction. With reliance on known ad accepted principles, military surgeons are able to expand reconstructive options for patients with complex and severe injuries to provide a function and aesthetic restoration in truly innovative ways.

**Results:** After review and exclusion of 625 references, 14 studies were identified for subsequent review. At greater than 10-year clinical follow-up, the reported ACL graft rupture rate was 6.2% (173/2782; range, 0-13.4%) and clinical failure occurred in approximately 10.3% (158/1532; range, 1.9-25.6%). The overall cumulative ACL failure rate was 11.9% (Range, 3.2% to 27%).

**Conclusion:** At least one in nine patients undergoing ACL reconstruction will experience re-rupture or clinical failure at long-term follow-up.

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**Poster 34**

### Interventions for Improvement of Hypovitaminosis D

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**Introduction:** The prevalence of hypovitaminosis D in orthopaedic trauma patients is alarmingly high. Vitamin D has an interrelationship with calcium homeostasis and bone metabolism, helping to maintain strong, healthy bones and muscles. Decreased vitamin D levels contribute to osteoporosis and subsequent vertebral body and skeletal fractures. Vitamin D insufficiency has shown to be prevalent in fracture patients admitted at a level 1 trauma center, but mandatory protocol for measurement of vitamin D levels does not exist. Hypovitaminosis D is prevalent in both high- and low-energy fracture patients and needs to be evaluated and treated in an orthopaedic setting. The purpose of the present study was to determine whether educational interventions to raise physician awareness have led to an improvement in evaluation of hypovitaminosis D in orthopaedic patients at a level 1 trauma center.

**Methods:** A retrospective analysis was conducted after institutional review board approval on all patients admitted to the orthopaedic trauma service at an academic level 1 trauma center from June 2010 through November 2010. Educational interventions to raise physician awareness were performed and protocols for evaluation and treatment of hypovitaminosis D were instituted. Data was retrospectively collected over the six month period. Patient data was obtained from medical records and included the number of patients who had vitamin D levels measured and the number of patients who were treated for insufficient vitamin D levels.
Results: There was a progressive increase over time in the evaluation of hypovitaminosis D after educational interventions and protocol implementation. Nevertheless, the percent of patients who are evaluated and treated in an orthopaedic setting remained low. The percentage of patients from June 2010 through November 2010 who received blood draws of vitamin D levels while admitted to the level 1 trauma center was only 9.1% (n=450). The percentage of patients who received blood draws while admitted in each month from June to November was 3.37%, 3.03%, 5.63%, 14.83%, 9.76%, and 12.86%, respectively. Including the patients who had vitamin D levels measured in an outpatient facility after being discharged from the hospital, the percent of values measured increased to 16.4%. The percent of levels measured each month then increased to 11.2%, 13.1%, 15.5%, 16.0%, 18.3%, and 15.7%, respectively.

Discussion and Conclusion: There was an increase over time in evaluation, but the percent of patients being evaluated remains low. Educational interventions alone are insufficient to improve the evaluation of hypovitaminosis D in orthopaedic patients. Physicians need to be aware of the prevalence of hypovitaminosis D in orthopaedic patients and strict protocol for evaluation and treatment of the disorder needs to be implemented.