

## 2014 Poster Abstracts

(An asterisk (\*) by an author's name indicates the presenter.)

### Poster 1

#### Immediate Immobilization In Flexion Speeds Recovery After Acute Lateral Patellar Dislocation

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**Objective:** To describe a novel protocol for the treatment of acute lateral patellar dislocation and its results in the treatment of two collegiate athletes.

**Methods:** Traditional standard of care for acute lateral patellar dislocation after reduction involves 1-7 weeks of immobilization in full extension. Knee stiffness commonly results from this method, and return to full activity typically takes two to four months. We utilize a protocol involving immobilization in maximal flexion for 24 hours, with early aggressive range of motion and quadriceps strengthening in the first week after injury. We performed a search of OVID and EMBASE for anatomic studies discussing the medial patellar stabilizers, as well as described non-operative treatment protocols and published rates of return to sport following acute lateral patellar dislocation. These results were compared to our case series of two patients.

**Results:** Medial patellofemoral (MPFL) ligament injury is nearly universal in acute lateral patellar dislocation. This ligament, extending from the medial femoral epicondyle, inserting on the superolateral patella and blending with the vastus medialis obliquus. Several anatomic studies have shown that the MPFL attains minimum length with the knee at 120 degrees of flexion. While flexed, the patella is also engaged in the trochlea, providing bony stability to subluxation of the patellofemoral joint and limiting joint space available for hemarthrosis collection. We believe that maximal flexion following patellofemoral joint reduction reduces MPFL stress to a minimum while short-circuiting the acute inflammatory

phase and limiting hemarthrosis formation. We have utilized this protocol in two college varsity athletes (water polo, gymnastics) with an average return to sport three days post-injury. Neither athlete has experience recurrence over a mean two year follow-up.

**Discussion/Conclusions:** Knee immobilization in maximal flexion following acute lateral patellar dislocation is based on anatomic studies demonstrating reduced tension on the medial patellofemoral ligament, reduced hemarthrosis, and reduced soft tissue swelling in maximal knee flexion. This method apparently bypasses the knee stiffness and deconditioning commonly seen with traditional non-operative regimens, allowing return to sports weeks or months sooner than previous published protocols.

### Poster 2

#### Traumatic Ulnar Artery Pseudoaneurysm Following A Grenade Blast: Report Of A Case

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Vascular injuries comprised a small percentage of total injuries requiring medevac in the Iraq and Afghanistan conflicts, however their impact cannot be overstated. This case highlights an individual who sustained a grenade blast injury leading to hemorrhage, and forearm compartment syndrome. He was initially treated with irrigation and debridement, forearm fasciotomy and delayed primary closure. The patient subsequently developed ulnar neuropathy and hypothenar atrophy. During reconstructive surgery he was discovered to have a proximal ulnar artery pseudoaneurysm.

Poster 3

## Atraumatic Acute Compartment Syndrome In A Soldier: Case Report And Review Of The Literature

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**Objective:** The diagnosis of exertional compartment syndrome has been described for several decades, with the first reports dating back to the 1940's. In most cases, the condition manifests as self-limited pain and motor dysfunction that resolves rapidly with the cessation of physical activity. Only a few case reports exist of patients with exertional compartment syndrome progressing to acute compartment syndrome requiring urgent fasciotomy. We present one such case treated at our facility.

**Methods:** An active duty U.S. Army Major presented to a civilian Emergency Room with acute onset of severe bilateral anterior shin pain while taking the APFT. He was diagnosed with rhabdomyolysis and acute kidney injury and treated with fluid resuscitation. After approximately 16 hours of treatment he was transferred to Walter Reed National Military Medical Center for further care. Orthopaedic consultation was obtained in the early hours of the following morning for rule out compartment syndrome. On physical exam he had tense and exquisitely tender anterior compartments of both legs, painless passive range of motion of the great toe, and inability to dorsiflex the ankles and extend the great toes. The patient was taken to the operating room for urgent bilateral anterior and lateral compartment fasciotomies. At seven months from initial injury the patient has persistent bilateral foot drops requiring the use of ankle foot orthosis. This clinical scenario has only occasionally been reported in the orthopaedic and military medicine literature.

**Results:** A search of PubMed using the keywords "acute exercise induced compartment syndrome" identified 9 articles relating to the development of atraumatic acute compartment syndrome following physical exercise in otherwise healthy individuals. Of the literature reviewed, seven were case reports and two were case series. A common theme in the literature is a delay in diagnosis of acute exercise induced compartment syndrome, which is similar to the present case.

**Discussion/Conclusion:** In our case, the diagnosis of acute compartment syndrome was initially missed, likely due to

lack of clinical suspicion by the original treating provider and the rarity of this clinical history. While uncommon, the development of acute compartment syndrome can occur as a consequence of pre-existing exertional compartment syndrome. Rapid identification is necessary to prevent muscle necrosis and loss of function. Military physicians in particular should be aware of this phenomenon, given the high level of physical activity seen in our patient population.

Poster 4

## Peroneus Longus Ruptures Resulting In Acute Compartment Syndrome In Athletes: A Case Series

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**Introduction:** Acute compartment syndrome of the leg secondary to peroneus longus muscle rupture is a rare event. Review of the literature has only revealed six well-documented cases. The first documented case was reported in 1979 about a soccer player who sustained an ankle inversion injury. Those previously documented cases were isolated case reports, so this report will be the first case series on acute compartment syndrome secondary to peroneus longus muscle rupture. Moreover, this case series presents a longer period of follow up (longer than one year) than the previously recorded case reports, in addition to documented performance in standardized physical fitness testing after surgery and rehabilitation.

**Methods:** We retrospectively reviewed the cases of two cadets who developed acute compartment syndrome secondary to a peroneus longus muscle rupture at the United States Military Academy (USMA), West Point, New York. Patients' records were used to collect information regarding injury mechanism, physical exam and operative findings, surgical technique, and performance on the biannual Army Physical Fitness Test (APFT).

**Results:** In both cases, the cadets presented to the physical therapy clinic with unrelenting pain after sustaining a twisting injury to the ankle. Both patients were taken emergently to the

operating room where a fasciotomy was completed after findings of elevated compartment pressures. The peroneus longus muscle was found to be avulsed from its proximal attachment with a peroneus longus to brevis tenodesis performed in both cases. Both patients returned to high-level athletics after injury with successful graduation from USMA.

**Discussion and Conclusion:** Our case series was consistent with previous reports in terms of an injury pattern with a relatively long duration between the proposed injury event and the performance of a fasciotomy. This contributes to the theory that the bleeding caused by the proximal avulsion is a slow process and the compartment syndrome evolves over a period of several hours. The late results of acute compartment syndrome can be catastrophic to young cadets at a physically arduous military academy, and it is important for timely diagnosis and treatment by medical providers.

### Poster 5

## The Occupational Impact Of Single-Level Cervical Disease Treated With Cervical Disc Arthroplasty In An Active Duty Military Population

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**Introduction:** Degenerative cervical disease is a common condition affecting the general population. The active duty military population is at increased risk for developing cervical disease due to increased physical and occupational demands. This process can have a detrimental effect on operational readiness and is a concern for military spine surgeons.

**Methods:** Retrospective review of patients treated at one institution by one surgeon with phone call follow-up. We have no relevant disclosures. There were no financial conflicts of interest. No funding was required to complete this study. 62 retrospectively identified active duty patients who had undergone single level cervical disc arthroplasty at our institution were identified in our surgical database. Basic demographic information was obtained from the medical record. Each patient was then contacted via telephone and asked to participate in a follow-up questionnaire about their occupational status within the military after the surgery. 36 patients were reached for followup.

**Results:** The average age was 36.5 years. Average followup was 20.6 months. 73% were noncommissioned officers or senior noncommissioned officers. C5-C6 was the most common level operated on. 32/36 (88.9%) follow-up patients reported relief with surgery. 30/36 (83.3%) follow-up patients were able to return to unrestricted active duty service. Patients referred to medical evaluation board for inability to remain on active duty were noted to be younger (34.8 years) ( $p=0.631$ ), reported less relief with surgery ( $p=0.235$ ), and reported more adverse outcomes ( $p=0.019$ ). Average time to return to duty was 8.2 weeks. 8/30 (26.7%) follow-up return to duty patients had deployed to a combat zone.

**Discussion:** Cervical disc arthroplasty has the potential to allow return to high demand preoperative occupational activities in active duty military patients with single-level cervical disease.

### Poster 6

## Chronic Clavicular Malunion Treated With Corrective Osteotomy

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**Introduction:** The standard of care for the majority of mid-shaft clavicle fractures is non-operative management. Some degree of malunion can be expected in nearly every midshaft clavicle fracture treated non-operatively, although most are asymptomatic. Recent emphasis on patient-reported outcome measures reveal symptomatic clavicular malunions are more prevalent than previously believed. Corrective osteotomies are a potential treatment for symptomatic malunions of clavicle fractures.

**Method:** A 34-year-old female was evaluated in the orthopedic clinic for right shoulder pain. She had a history of 5 fractures of the right clavicle since the age of 9 with noticeable deformity about the shoulder and clavicle. She had been evaluated by several orthopedic surgeons since the time of her initial and subsequent fractures and treated conservatively with non-operative management. The patient experienced persistent pain and right shoulder dysfunction which progressed throughout adulthood to the extent that she would not use her right upper extremity. Radiographs and computed tomography revealed malunion of the right clavicle with approximately 80 degrees of angulation and

1.3 cm of shortening in comparison to the contralateral clavicle. After a failed trial of physical therapy, the decision was made to proceed with a corrective osteotomy using plate fixation. Post-operatively the patient had near anatomic alignment and length of her operative clavicle in comparison to the left clavicle.

**Results:** At her four month follow-up appointment the patient reported full function of her shoulder, and was very satisfied with the procedure. Five months post-operatively the patient underwent hardware removal due to complaints of skin irritation. At the time of surgery an atrophic non-union was evident at the osteotomy site. The plate was replaced and the osteotomy site was augmented with autologous bone graft.

**Discussion and Conclusion:** Prevention of symptomatic malunion with surgical treatment of midshaft clavicle fractures remains controversial especially in children and adolescents. Current reports reveal symptomatic clavicular malunions can be successfully treated with a corrective osteotomy using plate or intramedullary fixation. This case report describes treatment of a midshaft clavicular chronic malunion with a corrective osteotomy and plate fixation. Augmentation with autologous bone graft may be beneficial to prevent non-union of the osteotomy site.

### Poster 7

## A Novel Technique Of Hip Distraction For Arthroscopic Surgery

MAJ David Crawford, MD

**Introduction:** A potentially serious complication of hip arthroscopy is sciatic nerve injury related to traction. The force of traction, rather than duration, has been shown to be more related to nerve injury. The purpose of this study is to describe a technique to minimize the traction needed to distract the hip for safe entry during arthroscopic surgery.

**Methods:** A spinal needle is brought down on a non-articular portion of the anterior femoral neck. Air is then injected into the hip joint until an "air arthrogram" is seen. This breaks the suction seal and then traction is applied as the surgeon continues to inject air.

**Results:** Using this technique I have been able to easily distract the hip and safely gain access to the joint. From October 2012 to May 2014 the author has performed 101 arthroscopic

hip surgeries. No patients have experienced symptomatic sciatic nerve injury.

**Discussion and Conclusion:** Using this technique, the surgeon can safely distract the hip joint without unnecessary force and potentially minimize the risk for sciatic nerve traction injury.

### Poster 8

## Relative Contribution Of Progressively Extending Posterior Approaches To The Acetabulum

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**Introduction:** Our purpose was to (a) objectively quantify the surface area of acetabular exposure using the Kocher-Langenbeck, Trochanteric Osteotomy, and Surgical Dislocation of the hip approaches, and to (b) compare the qualitative ability of a surgeon to see or palpate important anatomic landmarks in each exposure

**Methods:** Ten thawed, fresh frozen hemipelvectomy cadaveric specimens were placed in the lateral decubitus position. Each specimen had three approaches performed in series by a board certified orthopedic surgeon under the direct supervision of a fellowship trained orthopaedic trauma surgeon. The Kocher-Langenbeck approach was performed first. Continuous data collection was obtained by taking a calibrated digital photograph from the surgeon's best view. Discrete data points consisted of relevant anatomic landmarks. These were classified as visualized, palpated but not visualized, or not visualized. The landmarks consisted of the greater and lesser sciatic notches, the margins of the acetabulum anteriorly, superiorly, and inferiorly, the anterior inferior iliac spine, the greater and lesser trochanters, the vastus ridge, the pelvic brim, the quadrilateral surface, the iliopectineal eminence, and the femoral head fovea. Calibrated photographs and discrete data were collected for the first approach at this point.

Next a trochanteric osteotomy was performed. The osteotomy was made from just anterior to the posterior one third

margin of the gluteus medius insertion on the greater trochanter extending distally to the lateral femur just distal to the vastus ridge. The remaining attachments of the gluteus medius to the trochanter were elevated with the osteotomized portion of greater trochanter along with the gluteus minimus off of the superior margin of the acetabulum. Data was collected for the trochanteric osteotomy at this point. Lastly, a surgical dislocation through a Z shaped anterior hip capsulotomy was performed. A sharp homan retractor was then placed anteriorly between the anterior inferior and anterior superior iliac spines. A blunt homan was placed inferior to the transverse acetabular ligament. Two retractors were again placed in the greater and lesser sciatic notches as previously described. Data was collected for the surgical dislocation at this time. We analyzed each photograph using ImageJ software. This software measures a calibrated digital photo and calculates the two dimensional surface area of bony exposure and is useful in quantifying surgical exposure.

**Results:** The acetabular surface area exposed with a Kocher-Langenbeck approach was 27.66 (+/- 6.67) cm<sup>2</sup>, 41.82 (+/- 7.97) cm<sup>2</sup> with a trochanteric osteotomy, and 53.08 (+/- 9.04) cm<sup>2</sup> with the surgical dislocation. The surface area exposed was significantly increased 51.2% for the trochanteric osteotomy and 91.9% for the surgical dislocation when compared to the Kocher-Langenbeck ( $p < 0.001$ ). The ability to see and touch surgical landmarks was similar between the trochanteric osteotomy and surgical dislocation approaches. The trochanteric osteotomy allowed palpable exposure of the exterior surface of the anterior column to the anterior inferior iliac spine in eight of ten specimens and visual exposure of the anterior inferior iliac spine in three of ten specimens. The surgical dislocation allowed palpable exposure of the exterior surface of the anterior column to the anterior inferior iliac spine in all ten specimens and visual exposure of the anterior inferior iliac spine in eight of ten specimens. Performing a surgical dislocation enabled the surgeon to touch the inferior acetabulum and to see femoral head fovea in every specimen whereas the Kocher-Langenbeck and trochanteric osteotomy approaches only allowed palpation of the inferior margin of the acetabulum in three and four specimens respectively.

**Conclusion:** The trochanteric osteotomy improved exposure by 51% over the Kocher-Langenbeck approach, primarily in the anterior column and superior acetabulum, while an additional 40% was achieved with surgical dislocation to include consistent exposure to the anterior inferior iliac spine.

## Poster 9

### Extensor Carpi Radialis Brevis Avulsion Fracture: An Innovative Way To Treat An Uncommon Injury

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**Introduction:** Avulsion fractures about the base of the index and middle metacarpals involving the extensor carpi radialis longus and brevis tendons respectively are rare injuries with few descriptions in the literature and fewer described repair techniques. Only 10 case reports in the literature describe an ECRB avulsion fracture, only one of which describes non-operative management. A variety of operative treatments have been employed, including K-wire tension band, screw fixation, and suture anchors. We present the first reported case of an ECRB avulsion fracture in an active duty service member. This injury was treated in a novel way using a modified hook plate technique.

**Methods:** The patient sustained a fall onto a hyper-flexed left wrist with immediate pain and a palpable deformity about the dorsum of the hand causing skin tenting. Initial plain films demonstrated a fracture about the dorsum of the hand with the fragment overlying the distal carpal row. A CT scan was obtained which demonstrated an avulsion fracture of the base of the middle finger metacarpal which was rotated 90 degrees from its origin and displaced. The patient was taken to the operating room the day following injury. The fracture was exposed via a longitudinal dorsal approach. The ECRB tendon remained attached to the avulsed fragment, resulting in a large deforming force. The hook plate technique was employed, using two plates due to the size of the avulsed fragment. Two 1.5mm modular plates were fashioned with 2 holes intact and the 3rd hole cut at the distal end in order to bend two tines forming hooks. The fracture site was mobilized and fragment reduction verified. The plates were applied, securing the reduction. The wrist was taken through a range of motion and the fragment was found to be stable.

**Results:** The fracture was reduced with anatomic alignment both clinically and radiographically. The patient was splinted in extension for 3 weeks and then began range of motion, and uneventful union occurred. The patient did not report any hardware irritation. The hook plate provided a novel method of fixation using a tension plate construct in line with the deforming force of the ECRB tendon.

**Discussion:** This case represents an uncommon injury that has not been well-described in the literature. This is the first description in an active duty service member, and a novel treatment technique was utilized. Due to the displacement of the avulsed fragment and rotation which caused it to be prominent under the dorsal skin, operative intervention was indicated to prevent permanent deformity and restore full wrist strength. Previous biomechanical studies have demonstrated that ECRB provides radially directed wrist extension resisting the ulnar deviating forces of the ECU. The hook plate technique was first described in 2007 as a technique for phalangeal avulsion fractures but can be modified to provide fixation of small metacarpal avulsion fractures in a “tension plate” construct. This construct has the distinct advantage of not requiring a screw or pin to be placed through the small bony fragment which is easily comminuted. Treatment alternatives would have been K-wires, headless screw fixation, or suture anchors. All of these interventions risk losing fixation through fragmentation of the avulsed fragment in attempting to achieve and maintain a reduction, or anchor pull out from weak cancellous bone. The hooks cause minimal additional trauma to the avulsed fragment, while providing a strong construct to resist tensile forces.

### Poster 10

## Ablative Fractional Photothermolysis For Treatment Of Upper Extremity Contractures

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**Hypothesis:** Ablative Fractional Photothermolysis (AFP) has recently been applied in the treatment of debilitating scars and contractures that limit satisfactory upper extremity range of motion after surgical treatment of orthopedic hand injuries despite ideal surgical repair and compliance with a standard motion protocol postoperatively. Our hypothesis is that AFP is a useful adjunct treatment for improving digital range of motion (ROM) when the primary restraint to motion is hand scarring.

**Methods:** We conducted a retrospective review of patients with limited finger range of motion as a result of hand scars who were treated with AFP at our institution (October 2009 to

October 2012). Exclusion criteria were age less than 18 and any history of or current connective tissue disease. Measures of efficacy were: (1) Changes in total arc of motion from pre- to post-treatment (2) patient satisfaction and (3) Grip strength changes from pre- and post-treatment. ROM, grip improvement and patient satisfaction were assessed with 95% confidence intervals and the Wilcoxon signed rank test, with significance assigned to confidence intervals not including zero and p-values.

**Results:** During the study period, 30 fingers in 19 patients were treated. Twenty-four fingers had pre- and post-treatment ROM measurements and 11 had grip strengths that were directly comparable. The mean age of patients treated was 28 years. Resulting scar and joint contractures were a result of a wide range of injury mechanism requiring various surgeries including tendon repairs, fracture fixation, and soft tissue reconstruction. Patients were treated from one month to 28 months after injury (mean 9.6 months). The number of laser treatments was between one and six per patient (mean 2.7). Median percentage improvement in total arc of motion for each finger was 20.4% (p=0.0001), range -11% to 69%. Median grip strength improved 21 pounds (p=0.002), range -11 to 90 pounds. No unexpected adverse events were associated with 48 treatments performed and all patients noted subjective satisfaction.

**Conclusions:** The study is limited by its retrospective nature as well as the lack of a control group, thus direct correlation of AFP to patient improvements cannot be drawn. The data is promising, suggesting AFP is efficacious in improving digital motion secondary to scarring in the hand when patients have plateaued with standardized treatments and therapy. AFP is a safe procedure with excellent patient satisfaction. Future prospective studies are necessary to prove further effectiveness of AFP.

### Poster 11

## Arthrofibrosis After Hip Arthroscopy: A Case Report

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**Introduction:** Arthrofibrosis is a pathologic state in which inflammation or fibrosis leads to stiffness and loss of motion of a joint. This is a well-recognized complication of knee

and shoulder arthroscopy; however, its occurrence after hip arthroscopy is less well defined. We present the case of a young active male who developed arthrofibrosis of the hip after hip arthroscopy for the treatment of femoroacetabular impingement.

**Methods:** The patient is a 27-year old active male with symptomatic left hip femoroacetabular impingement who initially underwent left hip arthroscopy, femoroplasty, acetabuloplasty and labral repair. After 6 months, he failed to progress with physical therapy which included early hip circumduction, and continued to have increased pain and reduced range of motion of his hip. His range of motion was 0 to 80 degrees of flexion of the hip, 15 degrees internal rotation with the hip flexed to 90 degrees and external rotation to 3 fists from the table. His preoperative hip flexion was 0-110 degrees. An MR arthrogram of the hip demonstrated an enlarged thickened capsule.

**Results:** He underwent revision left hip arthroscopy, capsulotomy and revision femoroplasty. Intraoperatively, his capsule was 1cm thick and fibrotic. There were no intraarticular capsular adhesions. The labrum was probed and found to be without tears. He is now 2 months removed from his revision left hip arthroscopy and doing well with 0-130 degrees range of motion and no pain.

**Discussion and Conclusion:** Arthrofibrosis of the hip after hip arthroscopy has not been well defined in the literature. Reduced hip flexion, internal and external rotation in addition to a thickened capsule on MRI are indicators of this pathology. In this isolated case, revision hip arthroscopy with capsulotomy, revision femoroplasty, and early postoperative hip circumduction exercises provided a successful outcome.

### Poster 12

## A Modified Bohlman Technique Using A Novel Implant For Treatment Of High Grade Spondylolisthesis

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**Introduction:** Several surgical options for managing high grade spondylolisthesis have been described in the literature ranging from posterior only in situ fusion to circumferential

fusion with complete reduction. To the authors' knowledge, the use of the AxiaLif (TranS1) bolt in a modified Bohlman technique has not been described.

**Methods:** Two patients with symptomatic high grade spondylolisthesis refractory to nonoperative management were treated with a modified Bohlman technique utilizing the AxiaLif screw, rather than the fibula graft, supplemented with pedicle screw instrumentation and iliac crest autograft. Both patients were followed for a minimum of two years. No funding was received for this study.

**Results:** Both patients reported relief of preoperative symptoms with no complications during the two year follow up period. The latest radiographs demonstrated successful fusion.

**Discussion and Conclusion:** A single stage, posterior instrumented fusion with the AxiaLif (TranS1) implant in a modified Bohlman technique supplemented with pedicle screw instrumentation for high grade spondylolisthesis can yield beneficial patient outcomes and successful fusion, without the associated co-morbidity of fibula autograft harvest or the possibility of disease transmission with fibula allograft.

### Poster 13

## Evaluation Of Early Heterotopic Ossification And The Effect Of Bioburden In An Established Rat Model

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**Introduction:** Heterotopic ossification (HO) forms in the majority of severe combat-related wounds with a propensity for HO to develop in those exposed to a blast. Current means of prophylaxis for HO in the combat setting are logistically complicated. Additionally, these wounds are often heavily contaminated and require multiple debridements. Expanding on an established rat model for the development of post-traumatic HO, we sought to characterize the process of chondrogenesis and heterotopic ossification formation and study the effects of wound colonization.

**Methods:** We exposed rats to 120kPa blast over pressure using a shock tube followed by femur fracture, thigh crush injury and transfemoral amputation. Rats were euthanized in groups following surgery at days 3, 7, 10, 14, 21, and 28. Histology and gene expression were then used to evaluate the injured extremity. Additional groups of rats had their wound inoculated with either *Acinetobacter Baumannii* or Methicillin Resistant *Staphylococcus Aureus* (MRSA) and were followed for evidence of wound infection, HO formation on micro-CT, and immune response.

**Results:** Histological evaluation of rats showed evidence of immature osteoid formation as early as seven days following injury. At six months from injury there were still active foci of ectopic chondrogenesis and osteogenesis. Animals inoculated with *A. Baumannii* or MRSA developed more substantial HO and did so at an earlier time compared to those in the established model.

**Discussion and Conclusion:** The local inflammatory response of rats with wound colonization may be responsible for the propensity to develop increased HO, emphasizing the important role of the initial wound debridements to decrease bioburden. We have also established a time for the initial signs of chondrogenesis and subsequent HO formation which provides a critical window where possible prophylactic intervention could occur. In the future this model can be used to test novel means or primary prophylaxis and treatment.

## Poster 14

### Heterotopic Ossification Of A Peripheral Nerve Following Blast Injury: A Report Of Two Cases

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**Introduction:** We report on two cases of patients, who had high energy penetrating injuries to their lower extremities. These injuries resulted in transection of their sciatic nerves. At the time of surgical exploration and nerve reconstruction, fibrotic tissue consistent with early heterotopic ossification was encountered. This tissue was not limited to the surrounding muscle, when the residual nerve was opened to identify the fascicles fibrotic tissue and osteoid was also encountered.

To our knowledge this is the first instance of combat related neuritis ossificans or heterotopic ossification of a peripheral nerve but also the first time it has been described as occurring with concomitant ossification of surrounding muscle tissue.

**Methods:** Resected nerve tissue from sciatic nerve exploration and grafting was determined intraoperatively to have ectopic bone in it. Nerve tissue was taken to the National Institutes of Health Orthopedic Basic Science lab and analyzed for osteogenic and fibrotic markers in addition to markers of mesenchymal progenitor cells (MPCs).

**Results:** Two patients sustained sciatic nerve transections as a result of gunshot wounds were taken to the OR for exploration and grafting. The nerves were identified as completely transected and the proximal and distal neuromas removed. The defects were reconstructed with cadaveric allograft and the resected nerve ends were analyzed histologically. H and E staining demonstrated osteoid in the nerve sheath while picosirus red staining displayed high levels of collagen 1 in the nerve consistent with a fibrotic environment. Immunofluorescence demonstrated high levels of BMP2 in the neuron with CD44 (a marker for MPCs) in the surrounding tissue and invading the nerve.

**Discussion:** Heterotopic ossification has been well described in traumatic wounds particularly those relating to combat trauma however this is the first description of it occurring in a peripheral nerve following trauma. The early cases of neuritis ossificans occurred in the absence of trauma without surrounding tissue involvement. This case report not only describes ectopic bone formation in a peripheral nerve but also fibrosis in the muscle surrounding it which we feel is a precursor to heterotopic ossification. When analyzed the nerve stained positive for BMP2 and substance P both proteins have been associated with heterotopic ossification. Substance P is known to be increased at sites of bone regeneration. Staining for BMP2 within the nerve sheath was also positive, BMP2 is known to sensitize tissue to trauma-induced HO. Additionally there was staining for CD44 in the surrounding tissue of the nerve. Previous studies have identified CD44 as a marker of MPCs and demonstrated the capability of MPCs to undergo osteogenesis. These findings would suggest that high levels of BMP2 in the nerve and surrounding MPCs make the peripheral nerve primed for HO development. The intact nerve sheath likely plays a prominent role in prevention of HO formation in peripheral nerves following trauma. Heterotopic ossification remains a problem and the role of nerve damage in development of HO needs further investigation. Furthermore in situations where there is a delay of several weeks for

surgical management of traumatic peripheral nerve injuries the formation of osteoid in the nerve may present an added challenge for the surgeon and should be anticipated.

### Poster 15

## The Departmental Value Of A Research Resident

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**Introduction:** Although many residency programs allow residents to complete a year of dedicated research, the return on investment the department receives for that research year remains unknown. We hypothesized that allowing a resident to complete a research year would greatly increase the research productivity of an orthopaedic surgery residency. Two military residency programs of different services (ie Army and Air Force) joined in 2009 to form a larger residency made up of residents and staff from both services. Service 1 (S1) had permitted a resident to perform a year of dedicated research since 2007 and continued to permit this after combination. However, residents of Service 2 (S2) were not permitted to complete a research year prior before or after the combination. As a result, the combined program allowed for a unique opportunity to evaluate the impact that a research resident can have on a department's research productivity.

**Methods:** The publications produced by S1 and S2 residents and staff from Jan 2007 through Apr 2014 were identified using PubMed. All publications from residents and staff that were published within a year of the resident or staff being at the residency program were included. Results: The members of S1, which has allowed a research resident every year from 2007 through 2014, published significantly more manuscripts than members of S2 (207 vs 42,  $p=0.0124$ ) from 2007 through 2014 (table 1). Research residents were involved in 36% (93/258) of all department publications during the evaluated time period. However, only 12% of the total number of publications produced by the research residents were published during their research year. Only 4% of all publications from both programs included a member of both S1 and S2.

**Discussion:** This study shows the potential departmental value of having a research year for residents. Both before and

after combination, personnel of S1, which allows one resident per year, had significantly more publications than personnel of S2, which does not have a research resident each year. The value of the research resident is not seen during the research year itself but during their subsequent years. Departments looking to improve the research productivity of both staff and residents should consider allowing a resident to complete the research year to stimulate that production. Table 1: Year S1\* S2 Both Total 2007 9 (4%) 2 (5%) 0 (0%) 11 (4%) 2008 11 (5%) 7 (17%) 0 (0%) 18 (7%) 2009 11 (5%) 7 (17%) 0 (0%) 18 (7%) 2010 34 (16%) 4 (10%) 0 (0%) 38 (15%) 2011 39 (19%) 7 (17%) 2 (22%) 48 (19%) 2012 49 (24%) 6 (14%) 3 (33%) 58 (22%) 2013 27 (13%) 7 (17%) 1 (11%) 35 (14%) 2014 20 (10%) 2 (5%) 3 (33%) 25 (10%) Total 207 42 9 258 Table 1: All publications per year by staff and residents of each service (service 1 (S1) and service 2 (S2)). The percentage of the total publications is listed in parentheses for each year. 'Both' represents publications that had both a S1 and S2 author on them. \*S1 personnel produced significantly more publications than S2 personnel and publications that had at least one S1 and one S2 author ( $p=0.0124$ ).

### Poster 16

## Perioperative Intravenous Decadron Decreases The Incidence Of C5 Nerve Palsy Following Posterior Cervical Spine Surgery

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**Introduction:** C5 nerve palsy is a well documented complication of posterior cervical spine surgery with a reported incidence ranging from 0-30%. The pathophysiology of C5 palsies remains elusive. There is some evidence that prophylactic foraminotomies may decrease the incidence; however, they do not prevent C5 palsies entirely. Additionally, studies demonstrate that dexamethasone can decrease the rate of cranial nerve palsies with neck surgery performed for vascular procedures. Significant controversy exists as to the management and prevention of C5 palsies. Medical treatment of cervical nerve palsy includes dexamethasone to minimize swelling postoperative and minimize neurological damage. Dexamethasone has been demonstrated to be safely used in spine surgery in an attempt to decrease airway edema when an anterior cervical approach is used. However, it has not been

evaluated as prophylaxis to prevent palsies. In our study, we examined the use of perioperative prophylactic dexamethasone in posterior cervical spine surgery and evaluated the incidence of C5 palsies.

**Methods:** This was a retrospective cohort study of a single surgeon at an academic institution with the following inclusion criteria: all patients from Sept 2010 to February 2014 undergoing a posterior cervical laminectomy and fusion for spinal stenosis who received 10 mg of dexamethasone at the time of incision and 8 mg of dexamethasone every 8 hours for 24 hrs postoperatively. Exclusion criteria were the following: any associated anterior procedure, any prior posterior cervical surgery, any cervical fractures, any central cord syndrome with muscle grading less than 4 out of 5, diabetes, and prior sensitivity or adverse reaction to steroids. The cohort was examined for rate of C5 palsy as our primary outcome measure. Secondary measures include infection rate and rate of wound drainage requiring operative intervention. 65 patient charts were examined.

**Results:** The overall rate of C5 palsy was 1.5% (1/65). An additional patient had a transient C5 palsy lasting just 12 hours before full recovery. The rate of infection was 1.5% (1/65). There were no persistently draining wounds that required irrigation and debridement.

**Discussion and Conclusion:** While dexamethasone has been used to treat nerve palsies and inflammation in the past, its use as a prophylaxis for C5 palsies has not been examined. We report a low incidence of palsies in this cohort 1.5% (1/65), suggesting that dexamethasone may help prevent C5 palsies.

### Poster 17

## Failure Of Vancomycin Powder Regimen For Prevention Of Surgical Site Infection In Complex Spine Surgeries

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**Introduction:** Wound infections in spine surgery can be a devastating complication. The literature suggests that the

overall rate of infection for all patients ranges from 0.7-11.9%. The rates in diabetic and revision cases have been reported to have up to a 6-fold increased risk. There has been broad acceptance of local vancomycin powder for wound prophylaxis. However, to our knowledge using this drug in a specific patient population of high-risk patients has not been previously reported. The purpose of this study is to describe the incidence of infection in high-risk patient cohort while using vancomycin powder as prophylaxis.

**Methods:** All diabetic and revision surgery patients from a single surgeon at a tertiary care teaching hospital July 27th 2010 to August 20th 2013 were examined for the incidence of repeat trips to the operating room, the rate of culture positive wounds, the need for additional washouts, and finally the type of infection. 499 patients charts were examined. Patients who had prior infections or those with a documented allergy to vancomycin were excluded. The patients were risk stratified according to Charleston co-morbidity index (CCI) as well as BMI and smoking status.

**Results:** The overall rate of repeat trip to the operating room for seroma, hematoma, draining wound, or wound infection was 5.6%. The rate of culture positive infections in this cohort while using vancomycin powder was 3.41%. The average CCI of the cohort was 1.95 in the infected groups while average CCI of patients who were not infected was 1.20. Age-adjusted CCI was 3.55 in the infected group while the age adjusted CCI in the non-infected groups was 2.97.

**Discussion and Conclusion:** While this cohort is limited due to its retrospective nature and the lack of a clean historical control, the rate of infection in this high-risk patient population is higher than that which was previously reported in the literature with the use of vancomycin powder.

### Poster 18

## Bilateral Multipartite Patellae Avulsions Associated With A Unilateral Quadriceps Tendon Rupture: A Case Report

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**Case Report:** The patient is a 48-year-old retired male that presented to the emergency department after sustaining an injury while playing basketball. He stated that when

he landed from a jump that he felt immediate pain in both knees and was unable to ambulate without assistance. He endorsed a short-term history of antecedent pain in his right knee prior to this incident, but no pain in his left knee. He denied any prior history of knee pain, injury, or surgery. The patient stated that he had recently increased his level of activity in an attempt to lose weight and increase his fitness level. He denied any recent antibiotics, diabetes mellitus, or history of collagen disorder. His medical history was significant for asthma and hypertension and his surgical history was significant for an Achilles tendon reconstruction with autologous flexor hallucis longus tendon approximately 13 years prior. His medications included daily fluticasone/salmeterol and albuterol on a PRN basis. He had also recently completed a tapered course of prednisone for low back pain. He denied using alcohol, tobacco, or illicit drugs. Physical examination of his right knee revealed a moderate effusion. Range of motion was -5 to 110 degrees and the patient was able to perform a straight leg raise. He was tender to palpation at the superolateral aspect of the patella with a palpable defect. There was no lateral or medial joint line tenderness, no varus or valgus instability at 0 or 30 degrees, negative anterior and posterior draw tests, and a negative Lachman examination. His left knee had a moderate effusion. Range of motion was -5 to 100 degrees with pain at maximal flexion. He was tender to palpation at the superolateral aspect of the patella with a larger palpable defect than on the contralateral knee. There was no lateral or medial joint line tenderness, no varus or valgus instability at 0 or 30 degrees, negative anterior and posterior draw tests, and a negative Lachman examination. Notably, the patient was unable to perform a straight leg raise with his left leg signifying an incompetent quadriceps tendon. Radiographic examination with plain films showed acute avulsion of bilateral Saupe Type 3 multipartite patellae. Inspection of the left side lateral images also showed obliteration of the quadriceps tendon shadow. Since the patient's right lower extremity extensor mechanism remained intact this side was treated nonoperatively in a knee immobilizer. However, the left knee was operated within one week of the injury to avoid retraction of the quadriceps tendon. Since the avulsed fragments of the synovialized multipartite patella had no articular cartilage on them they were excised. The quadriceps tendon was then reattached to the patella using two #5 Ethibond sutures through the tendon in a Krackow fashion that were passed through three transosseous tunnels drilled into the patella and then tightened and tied with the knee in extension. The patient was most recently seen at his 2-week follow up visit. He was doing well and his staples were

removed. His wound was clean, dry, intact, and without signs of infection. He continued ambulating with bilateral lower extremities in knee immobilizers and crutches. He was to begin physical therapy and will continue to follow up.

**Discussion:** This is the only case of bilateral multipartite patellae avulsions resulting in a unilateral complete quadriceps tendon rupture. There are no similar cases reported in the literature. There are only four reported cases of unilateral bipartite patella avulsions with associated quadriceps tendon ruptures. Within the literature there also is a paucity of reports of bipartite patella fractures or avulsions without quadriceps tendon ruptures. All of these were treated either nonoperatively or with excision of the avulsed fragment. This report is the only case of bilateral multipartite patellae avulsions resulting in a unilateral complete quadriceps tendon rupture and illustrates a rarely seen entity. There will be 6 months of follow up prior to the final submission date.

### Poster 19

## Concomitant Biceps Brachii Pyomyositis And Septic Arthritis Of The Shoulder: A Case Report And A Review Of The Literature On Pyomyositis

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**Introduction:** Pyomyositis is an acute bacterial infection of skeletal muscle that is common in the tropics, but is being recognized with increasing frequency in temperate climates. Septic arthritis is a serious joint infection associated with significant morbidity, but it is relatively uncommon in children. The authors report a rare concomitant pyogenic pyomyositis of the biceps brachii and shoulder septic arthritis in an immunocompetent 12-year-old boy. Additionally, the authors provide a review of the literature on pyomyositis.

**Methods:** A 12-year-old boy was admitted to our institution for a 3-day history of progressive left anterior bra-

chium pain and swelling. There was no history of trauma or obvious etiology for the pain. Upon admission, he denied any shoulder pain. He denied recent travel, illness, or systemic symptoms. Upon examination, the anterior brachium had moderate edema and erythema about the distal brachium and extended proximally to within 3 centimeters of the shoulder. The patient had an appreciable anterior shoulder effusion, however no pain with full range of motion. Laboratory findings revealed a white blood cell count of 26,300 cell/mm<sup>3</sup>, with 91% neutrophils. The erythrocyte sedimentation rate was 80mm/h. C-reactive protein was 22.67mg/dL. Plain film imaging was remarkable for significant anterior brachium soft tissue edema. An MRI was obtained, which demonstrated an irregular multi-lobular fluid collection within the biceps brachii muscle belly that measured 28x4x3cm. Additionally, a large glenohumeral effusion was identified. There was no obvious communication between the glenohumeral joint and the intra-muscular abscess.

**Results:** The patient was taken to the operative suite the day of admission for irrigation and debridement of the left shoulder and brachium. A left shoulder arthrocentesis was performed prior to irrigation and debridement of both areas. Joint fluid analysis of the shoulder aspirate revealed 210,000 white blood cells with 95% polymorphonuclear leukocytes. An open irrigation and debridement of the brachium was performed using a direct lateral approach. A large pocket of mucopurulent discharge identified within the biceps brachii muscle tissue. A left shoulder arthroscopic irrigation and debridement was then performed. Gross purulent material was noted within the glenohumeral joint. During arthroscopic irrigation and debridement, arthroscopy fluid was noted to communicate with the brachium wound. The patient was taken back to the operative suite two days later for repeat irrigation and debridement of the brachium, as well as primary closure. Post-operatively, the patient was given broad-spectrum intravenous antibiotics and transitioned to organism-specific antibiotics once tissue cultures revealed Group A beta-hemolytic *Streptococcus*. After 2 weeks of intravenous and 2 weeks of oral antibiotics, the infection resolved without further sequelae.

**Discussion and Conclusion:** Pyomyositis is an unusual entity outside of tropical climates. Additionally, septic arthritis in the adolescent population is uncommon. This case report describes a concomitant biceps brachii pyomyositis and septic arthritis of the shoulder. While there have

been a few case reports of these concomitant infections in the lower extremity, to our knowledge, no report has described this entity in an upper extremity. Most reports of primary pyomyositis have been either case reports or small case series. A review of the literature demonstrates pyomyositis is most common in the first and second decades of life, while the most common isolated organism is *S. aureus*. In one series, 63% of patients with pyomyositis required surgical incision and drainage. In temperate climates, this diagnosis is usually not considered in the differential diagnosis of patients presenting with musculoskeletal pain; and so, physicians' lack of familiarity with the disease may be a factor in delayed diagnosis.

### Poster 20

## Bony Encasement Of The Ulnar Nerve Secondary To Heterotopic Ossification Of The Elbow

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**Background:** Ulnar neuropathy at the elbow due to heterotopic ossification (HO) is uncommon. The purpose of this study is to report a series of patients with bony encasement of the ulnar nerve at the elbow caused by HO, and to analyze the results of surgical treatment and a standardized post-operative regimen.

**Methods:** A retrospective review of all patients treated with bony encasement of the ulnar nerve secondary to HO over a 13-year period from September 1999 to February 2012 at a single institution was performed. All patients underwent surgery for clinically symptomatic or debilitating HO of the elbow, by a single surgeon. Each patient received HO prophylaxis postoperatively (16 indomethacin, 2 radiation). Subjects underwent regimented physical therapy and utilized a continuous passive motion machine in the post-operative period. Demographics, mechanism of injury, time to surgery and medical history were reviewed for comparison.

**Results:** Eighteen elbows with complete bony encasement of the ulnar nerve secondary to HO were identified (13

Burns, 4 Trauma, 1 Closed Head Injury). The mean arc of motion improved from 14° to 98° following surgery and rehabilitation. Comparison of preoperative and postoperative motion demonstrated a statistically significant improvement in elbow extension, flexion and total arc of motion ( $P < 0.01$ ). There was a statistically significant decrease in ulnar neuropathy symptoms, as evidenced by a reduction of mean McGowan grade (1.5 to 1;  $p < 0.02$ ). Twenty-five percent of symptomatic patients (4/16) had complete resolution of their neuropathy symptoms. Average time from initial visit until surgery was 265 days (range, 76-797 days), while mean postoperative follow-up was 16 months (range, 1-51 months). Gender, age, medical co-morbidities and time to surgery did not have a statistically significant effect on outcome.

**Conclusions:** Surgical management combined with postoperative HO prophylaxis and a regimented rehabilitation program is an effective treatment for treating patients with heterotopic ossification of the elbow with bony encasement of the ulnar nerve, resulting in superior range of motion and improved or resolved ulnar neuropathy.

### Poster 21

#### Analysis Of Scapular Mechanics After Muscle Fatigue With And Without Scapular-Stabilizing Shirt

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**Introduction:** Fatigue of the periscapular musculature has been shown to cause scapular dyskinesis, which may result in impingement, labral injury, and rotator cuff injury. While multiple studies have described the effects of muscular fatigue on scapular motion, none have investigated the influence of supportive clothing on maintenance of proper shoulder mechanics. The purpose of this study was to evaluate the ability of the IntelliSkin™ PostureCue™ shirt to maintain pre-fatigue scapular alignment, and thereby prevent scapular dyskinesis, after fatiguing the surrounding musculature.

**Methods:** Forty male volunteers without any history of known shoulder pathology in their dominant arm were ran-

domly assigned to wear the IntelliSkin™ shirt or not wear any shirt (control group). All subjects performed five humeral elevations and then underwent a shoulder-fatiguing exercise program. Subsequently, they performed a second set of five elevations.

**Results:** Throughout motion in the anterior/posterior tilt and medial/lateral rotation dimensions, the control and IntelliSkin subjects exhibited differences between the pre- and post-fatigue trial measurements. In the retraction/protraction dimension, control subjects exhibited differences between the pre- and post-fatigue trial measurements for a large portion of the motion, while IntelliSkin subjects only had different measurements toward the extreme of shoulder flexion.

**Discussion & Conclusion:** The shirt does not stabilize the scapula in the pre-fatigue position for the anterior/posterior tilt and medial/lateral rotation planes. Conversely, in the retraction/protraction plane, the IntelliSkin™ shirt stabilized the scapula in its pre-fatigue position.

### Poster 22

#### Hemodialysis-Associated Osteomyelitis Of The Cervical Spine

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**Introduction:** Osteomyelitis of the cervical spine is a rare complication in dialysis-dependent patients, requiring individualized treatment for infection eradication and spine immobilization.

**Methods:** A 56 year-old African-American male presents with a one month history of worsening neck pain. The pain began insidiously, without any preceding traumatic event. He relates intermittent paresthesia's to bilateral upper extremities, right greater than left, most notable during neck extension and coughing. He denies unsteady gait, sustained paresthesia's, or any recent illnesses. He has experienced a 75 pound weight loss over the last 6 months following initiation of hemodialysis for his stage V chronic kidney disease secondary to type II diabetes mellitus. There has not been an acceleration in weight loss over the last month. He denies any constitutional symptoms. On

physical examination, he had a mild antalgic gait secondary to chronic knee pain and was able to toe and heel walk with some difficulty. Tandem gait was normal with negative Romberg. Cervical motion demonstrated decreased flexion with minimal extension limited secondary to discomfort. He had no Spurling's and a negative Lhermitte's. Motor strength was full in all major muscle groups in the upper extremities except for the deltoids which were 4 out of 5. Sensation was intact to light touch throughout. Reflexes were 2+ at the biceps, triceps and brachioradialis and there was a positive inverted radial reflex and Hoffman's on the right. Radiographs of the cervical spine demonstrated focal kyphosis at the C5-6 level with destruction of the disc space and erosion through the inferior endplate of C5 and the superior endplate of C6. Flexion and extension x-rays were without signs of instability. Computed tomography of the cervical spine redemonstrated destruction of vertebral bodies at C5 and 6 with focal canal stenosis secondary to vertebral body collapse and osteolysis. A contrasted magnetic resonance study demonstrated bony destruction of the inferior endplate of C5, superior endplate of C6 with collapse and retropulsion of the vertebral bodies into the spinal cord canal resulting in cervical stenosis at C5-6. There was also abnormal signal noted within the intervertebral disc and bodies, consistent with discitis and osteomyelitis. Laboratory studies demonstrated an elevated erythrocyte sedimentation rate at 91, a highly sensitive C-reactive protein at 184.2, and a white blood cell count of 12.3. Other notable labs include prostate specific antigen of 5.37, creatinine 7.0, blood urea nitrogen 33, with a glomerular filtration rate of 9.2.

**Results:** The patient was placed in a c-collar and admitted to the hospitalist service for preoperative optimization prior to operative management, to include staged procedures beginning with an anterior incision and debridement with corpectomies of C5 and C6 and placement of a spanning cage and anterior plate spanning C4-C7, followed by a posterior fusion of C4-C7 two weeks following the initial anterior procedure. Blood cultures were obtained preoperatively which indicated staphylococcus epidermidis bacteremia. The infectious disease service was consulted and the patient was initiated on IV nafcillin for the pan sensitive bacteria but was changed to daptomycin at discharge, with which he completed a 6 week antibiotic course, followed by one year of suppressive antibiotic therapy with oral augmentin. Throughout his hospitalization and post-operative course, his dialysis schedule was maintained by the nephrology service. The patient experienced an uncomplicated post-operative

course and was able to return to work 8 weeks following the second staged procedure.

**Discussion and Conclusion:** Patients requiring hemodialysis secondary to end stage renal disease are susceptible to numerous complications. Infection accounts for 40% of all hemodialysis-associated complications, including bacteremia, tunnel site and catheter infection, endocarditis, osteomyelitis, or epidural abscesses. Cervical osteomyelitis is a rare complication associated with significant morbidity and the potential for rapid deterioration. Early recognition followed with aggressive surgical debridement and spinal stabilization with prompt post-operative initiation of antibiotic therapy is vital. A multidisciplinary approach between the orthopaedic, nephrology, and infectious disease services is essential for optimal patient care.

### Poster 23

## Orthopaedic Osteoporosis Process Improvement Project

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**Introduction:** The Orthopedic Surgery Department frequently treats patients for their fragility fractures as a consequence of an underlying diagnosis of osteoporosis or osteopenia. Following appropriate treatment of the orthopedic fracture, the patient is rarely followed or recommended for treatment of the underlying disease process. Our project is a process improvement (PI) intervention designed to improve the quality of care for patients sustaining fragility fractures seen at our hospital. We also evaluated the rate of diagnosis and treatment of osteoporosis by an Orthopaedic provider following fragility fracture before and after the implementation of this process improvement initiative.

**Methods:** The intervention included two steps to be completed by the orthopaedic provider at the time of initial fracture care. First, they utilize a standardized order set in our electronic medical record system to order calcium and vitamin D supplementation, osteoporosis labs, and a DEXA scan. Second, they provide the patient with a letter informing their primary care provider of the fragility fracture and the inter-

ventions performed by Orthopaedics. The primary outcome measurements include rate of Calcium and Vitamin D supplementation ordered and filled by the patient and the number of DEXA scans completed.

**Results:** Prior to implementation of process improvement initiative, the Orthopaedic Department had poor rates of diagnosis and treatment of osteoporosis after fragility fracture. After initiative implementation, rates for DEXA scans ordered improved by 26%, the number of labs ordered increased 26%, and primary care follow up increased 11%.

**Conclusions:** Our process improvement project was successful in improving the quality of care for patients sustaining a fragility fracture at our hospital. We plan to translate this type outpatient initiative to our inpatient population by developing a multidisciplinary team for inpatient management to include endocrinologists/internists and follow up care in an Orthopaedic fragility fracture clinic.

### Poster 24

## Retrospective Review Of Completed Displaced Femoral Neck Stress Fractures In Young Adults

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Femoral neck stress fractures (FNSFs) are a rare and often devastating injury in young active adults. They arise secondary to repetitive stresses that exceed bone remodeling potential leading to accumulation of microfractures. They represent approximately 5% of all stress fractures. The incidence of these injuries is highest amongst military recruits and high-level athletes secondary to repetitive stress. Vague symptomology and poor radiographic sensitivity makes diagnosis difficult and misdiagnosis is not uncommon. Continued stress with weightbearing may lead to progressive fracture and potential catastrophic completion with displacement. Magnetic Resonance Imaging (MRI) has been shown to be superior for early diagnosis. Therefore, there is an importance of early diagnosis and proper management. These injuries can be incomplete or complete. Increasing primary care provider awareness of this diagnosis in at-risk populations can lead to decreased incidence. Optimal management of incomplete

femoral neck stress fractures is controversial, however excellent short and long term results have been reported in the incomplete and non-displaced FNSF regardless of type management. The most severe injury is a completed displaced FNSF. Given the rarity of this injury, there are limited studies with long-term outcome measures. Management of completed FNSFs is also controversial regarding optimal reduction, approach, and implant choice. The goal of this study will be to review the radiographic and clinical outcomes in a cohort of patients who sustained completed displaced femoral neck stress fractures and underwent operative treatment. This study will be an invaluable contribution to the Orthopaedic literature by providing descriptive prognosis and overall clinical results for this significant injury. It may aid identifying at-risk patients and help to better manage patients and expectations. Inclusion criteria will include both active-duty and civilian patients between 15 and 40 years old who sustained completed FNSFs. Exclusion criteria will include age less than 15 years and greater than 40 years, traumatic mechanism of injury, previous hip condition/surgery prior to initial injury. Utilizing the electronic health record, identified patients will be analyzed with respect to age, gender, activity, and prodromal symptoms, and pertinent medical history. Assessment of union, development of avascular necrosis (AVN), reoperation rate, rate of hip arthroplasty, and return to active-duty will be critically analyzed.

### Poster 25

## Blood Flow Restriction Training: A Novel Post-Operative Therapy Modality

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**Introduction:** Current American College of Sports Medicine guidelines recommends the use of 60-100% of an individual's single maximum repetition (1RM) during rehabilitation. However, a subset of patients fails to respond to this rehabilitation protocol or is unable to participate in this protocol due to reconstructive constraints. Blood Flow Restriction (BFR) training utilizes partial vascular occlusion while performing exercises at 20-30% 1RM to regain muscular strength. We report on three post-operative patients

who failed traditional physical therapy modalities and were enrolled BFR training.

**Methods:** Two post-operative knee arthroscopy and one multiligamentous knee reconstruction patient underwent BFR training after failing to regain adequate muscular strength several months following standard physical therapy protocols. In order to attain partial vascular occlusion an inflatable tourniquet allowing precise control of cuff pressure through variations in muscle tone and length is placed around the patient's mid quadriceps. Each patient performed leg extensions, leg press, and reverse press during each session. The weight used was determined based on that individual's 1RM, and set at 30% 1RM. The cuff was set at 110mmHg, and each exercise performed in 4 sets, with each set to failure, and a 30 second rest between each set. When the patient was unable to perform any one set for more than 120 seconds before muscle failure, the weight was then increased by 10% for that exercise to allow for progression.

**Results:** A 21 year old female collegiate track athlete underwent diagnostic left knee arthroscopy with anterior release following failure to respond to non-operative modalities. Three months post-operatively she continued to be 80% quadriceps deficient in her operative extremity with gait deficiencies. Following two weeks of blood flow restriction training, she experienced an 95% gain in quadriceps power and 51% gain in hamstring power and was able to return to straight line running. Case 2: A 30 year old soldier with progressive knee pain unresponsive to physical therapy underwent knee arthroscopy with debridement and loose body removal. Six months post operatively he continued to be 80% hamstring deficient with severe knee pain and analgesic gait limiting his ability to return to run and duty. Following four weeks of BFR, he experienced a 389% increase in his hamstring power and was able to return to unrestricted running with mild anterior knee pain. Case 3: A 27 year old soldier injured two years prior during an explosion underwent medial collateral and posterior collateral ligament reconstruction. One year post-operatively he had significant pain, quadriceps weakness and gait abnormalities. Following four weeks of BFR he experienced a 213% increase in his quadriceps strength and was able to perform straight line running.

**Discussion and Conclusion:** This is the first report of BFR training as a therapy modality used post-operatively in patients that failed to progress with traditional therapy.

Although our individual results have varied, we have recorded strength gains in all patients utilizing this therapy. Additional research is ongoing to determine its efficacy and safety in post-operative patients.

## Poster 26

### Operative Treatment Of Combat-Related Spine Trauma During The Conflicts In Iraq And Afghanistan

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**Introduction:** Several recent studies have examined the rates of combat-related spinal injury sustained in Operations Enduring and Iraqi Freedom using joint trauma registries; however, a shortcoming of registry data collection has been limited clinical information and follow-up details after surgical intervention. Therefore, we set out to describe the operative treatment of combat-related spine trauma over a ten-year period at three high-volume military treatment facilities.

**Methods:** A retrospective analysis of a surgical database at three military institutions was performed; patients undergoing spine surgery designated as engaged in Operations Enduring and/or Iraqi Freedom between 01JUL2003 and 01JUL2013 were evaluated. Inclusion criteria included trauma sustained in direct relation to combat operations while in theater requiring operative treatment after evacuation. Demographic information included service, age, mechanism of injury, involved spinal regions, and available operative information.

**Results:** 105 patients with combat-related (OIF/OEF) spine trauma requiring operative intervention were identified. The mean age of these casualties was 29.8 years. 74.3% of these casualties were enlisted US Army service members. 49.5% and 48.6% of injuries occurred in Afghanistan and Iraq, respectively. The most common mechanism of injury was mounted improvised explosive device (IED, 42.9%). The lumbar spine was the most commonly involved region (59%), followed by thoracic (43.8%), cervical (33.3%) and sacral (17.1%). 1.5 spinal regions were injured per patient, and two

patients sustained injuries to all four spinal regions. Spinal cord injuries were present in 29.5% of all patients. The mortality rate for all patients after evacuation to the United States was 1.9%. The average time to definitive surgery from date of injury was 57.8 days; however, 62% of all patients were treated within 14 days of being injured. Average estimated blood loss was 711 milliliters, and BMP use was documented in 62.2% of fusion cases. The infection rate was 8%.

**Discussion and Conclusions:** The current conflicts in Iraq and Afghanistan have seen the highest incidence of combat-related spine trauma in recorded history. These injuries involve multiple spinal levels per patient and have a high rate of associated spinal cord injury. There was an overall low documented infection rate. This retrospective evaluation is the largest study evaluating the demographic information, resource utilization and longer-term follow up data for patients sustaining operative war-related spine trauma.

## Poster 27

### Return To Duty Rates In Soldiers With Atraumatic Anterior Knee Pain Treated With Viscosupplementation

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**Introduction:** Knee pain is highly prevalent and morbid among Active Duty Soldiers. It affects a Soldier's ability to deploy and train for war thereby affecting a unit's readiness and capacity to carry out peacetime or wartime missions. Treatment with available viscosupplementation agents, Hyalgan and Synvisc, costs between \$169.08 - \$429.83 per knee, respectively. This cost is only for the medicine and does not include the medical supplies and treatment costs, or the loss of duty time. Although it is widely used, there are no previous studies in a military or high demand cohort that have studied if viscosupplementation is effective in the treatment of anterior knee pain.

**Methods:** A 5-year retrospective chart review of no more than 1000 Active Duty Soldiers with atraumatic anterior knee pain, patellofemoral pain syndrome (PFPS) or chon-

dromalacia patella treated with viscosupplementation was conducted. The inclusive dates were 01 Nov 2008 through 01 Nov 2013 with a minimum follow-up of 2-years. The Armed Forces Health Longitudinal Technology Application (AHLTA), Composite Health Care System (CHCS), Defense Medical Epidemiology Database, U.S. Army Physical Disability Agency (USAPDA), Medical Operational Data System (MODS), Surgery Scheduling System (S3), and Medical Protection System (MEDPROS) will be used to review the Soldiers' charts. Our primary outcomes will be whether Soldiers who receive viscosupplementation were returned to duty or not. Secondary outcomes include physical limitations, surgery, or medical separation. We will collect various demographics such as rank, age, and sex to compare at the end of the study.

**Results:** A preliminary review of records revealed that between November 2008 and November 2011 there were a total of 3797 visits related to anterior knee pain to the Orthopaedic clinic. Of those, 2013 (53%) of all patients received a knee injection and 1093 patients (28.8% of the total) received viscosupplementation. Of the total number of visits, 3560 (93.7%) were enlisted Soldiers and 1783 (50%) received a knee injection. Of these, 985 (55.2%) patients received hyaluronic acid injections. While officers comprised a small proportion of total visits, or 6.2%, a great proportion or 97% of officers received knee injections with 46% of officers receiving hyaluronic acid.

**Discussion and Conclusion:** The majority of patients with anterior knee pain respond to conservative treatment that entails the implementation of a comprehensive rehabilitation program with relative rest, physical therapy, activity modification, and use of analgesics. In very few cases, when patients do not respond well to the above mentioned conservative treatment options, they are referred to Orthopaedics for evaluation and treatment with viscosupplementation, further physical profiling, surgery, or a combination of these modalities. In this study we will be investigating the return to duty rates of Soldiers after receiving viscosupplementation of the knee(s) for atraumatic anterior knee pain, PFPS or chondromalacia patella. There are no previous studies that have examined if viscosupplementation is effective in the treatment of knee pain even though it is widely used and expensive. If viscosupplementation is determined to be effective, it may well have a place in the treatment algorithm for anterior knee pain. We expect that atraumatic anterior knee pain, defined as any knee pain with onset not related to trauma, if managed early with viscosupplementation will be

associated with Soldiers' ability to perform, as measured by return to duty rates. Further, we expect that of those Soldiers that are returning to duty, many of them will have a permanent physical profile.

### Poster 28

## Treatment Of Myofascial Gluteal Pain Presenting As Sciatica

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**Introduction:** Most pain around the spinal column is muscular in nature but is often misdiagnosed as 'discogenic' or 'radicular'. We present a case series of presentations initially misdiagnosed as a compressed lumbar nerve root. These cases were actually caused by myofascial pain primarily in the gluteus medius.

**Methods:** A single, continuous group of patients with signs and symptoms similar to lumbar nerve root compression underwent treatment for muscular-based pain after evaluation in our clinic. Pre-treatment pain, Oswestry and pain disability scores were compared to post treatment. Time to treatment effect was tracked as well as return to work time. In addition, comorbidities, including psychological disorders were accounted for in our evaluation. The data was compared using basic Excel statistical methods to analyze treatment effect.

**Results:** We were able to get an excellent result in over 85% of these patients with less than 4 months of treatment, no narcotic medication and all patients returned to work within 2 weeks of treatment. No patient required invasive injection therapy. MRI imaging findings are discussed; lack of clinical correlation to MRI findings is a secondary study finding.

**Discussion:** Current care of lower back pain and radiating leg pain primarily focuses on the spinal discs and nerve roots. The outcomes from treatment using injection therapy and surgery has not appreciably improved over the past few decades. Muscular pain is often misdiagnosed as discogenic or radicular in nature. By completing a more thorough physical exam, educating the patient and utilizing proven techniques for the treatment of muscular pain, many dangerous and costly therapies can be avoided and better outcomes for LBP achieved.

### Poster 29

## Atraumatic Fracture Dislocation Of The Hip: Case Report And Review Of The Literature

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**Introduction:** Low energy, atraumatic native hip dislocations are uncommon among athletic injuries, and there is a paucity of data describing these occurrences.

**Methods:** The authors describe the case of a posterior fracture-dislocation of the left hip sustained during casual American football. The patient was an athletic 21 year old active duty male with no prior injuries to the left lower extremity. He described collapsing to the ground after performing a "cutting maneuver" and moving quickly to his left to evade another player. No physical contact was involved in the injury. Radiographs on presentation to the emergency department were consistent with a posterior hip dislocation, and prompt closed reduction of the joint under conscious sedation was performed. Subsequent imaging with computed tomography (CT) demonstrated a concentrically reduced hip joint with an associated comminuted fracture of the left posterior acetabulum. The patient was transferred to a higher level of care for definitive fixation. A literature search was conducted to identify previously documented cases of atraumatic dislocation of the hip. Posterior dislocations and posterior fracture-dislocations were reviewed. To be considered atraumatic, the case was required to feature a clearly described mechanism of injury in which the contributing forces were readily identifiable. Cases featuring a collision force (e.g. physical contact with another person) were not considered to be atraumatic. Cases involving forces transmitted through the usual kinetic chain from the foot to the hip were considered atraumatic.

**Results:** The patient had a successful recovery. He was restricted to toe-touch weight bearing for eight weeks. He was able to return to running at twelve weeks and was cleared for full military duty eighteen weeks following his injury. Review of the literature yielded only four clearly described atraumatic posterior dislocations. Three of the four cases described injuries in positions of flexion, adduction, and internal rotation.

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**Discussion:** Existing literature notes that native posterior hip dislocations typically occur during high-energy injuries. The hip is often in the position of flexion, adduction, and internal rotation. Commonly, posterior hip fracture-dislocations feature a direct high-energy posterior force applied to the knee or leg. Although the patient described here could not precisely recall the mechanics of his leg during his injury, his leg was likely flexed and internally rotated given his description of the injury. This serves to support prior theories regarding the mechanics of posterior dislocation, while calling into question the amount of force traditionally thought to be required. This case supports the theory that, under defined circumstances, bodyweight and muscular forces are sufficient to produce posterior fracture-dislocations of the hip.