



# Annual Conference 13th May 2016

DMG(SW) Postgraduate Medical Centre, Derriford Hospital,  
Plymouth.

&

The Officers Mess, RMB Stonehouse Barracks.



## 0910 Session 1: Trauma

**Moderators:** Prof H Simpson and Surg Cdr T Coltman

### **Major trauma centre status affects the presentation and epidemiology of tibial plateau fractures: Does this have implications for training tomorrow's Military Trauma Surgeons?**

**Hipps D**, Robertson G, Keenan A, Wood A

Northern and South East Scotland Training Region

Tibial plateau fractures classically present in a bimodal distribution associated with high energy mechanisms in the younger population and fragility fractures in the elderly populations as a result they are well suited for looking at the effect major trauma centre status. Military trauma surgeons in training should be exposed to as much young high-energy trauma as possible to equip them for operations.

Retrospective review of all tibial plateaus presenting to RVI 20 months before MTC status and 20 months following this.

61 patients pre, 66 post. Schatzker grade 1-4 were similar pre and post change. Post change there was an increase in Schatzger 5 (62%) and 6 (27%). High energy injuries were most common in younger males, cause was falls followed by RTAs.

MTC status has meant an increase in high energy tibial plateaus (Schatzker 5-6) These were predominantly seen in younger males with high-energy mechanisms. As this is likely to be replicated across all injuries, we would recommend military trauma surgeons have a significant period of time training in major trauma centres to ensure adequate exposure to young high energy trauma.

### **Intra-osseous fixation of three and four part proximal humerus fractures: a Case series review and financial costing analysis**

**Sinnott T**, Sabharwal S, Sinha I, Griffiths D, Reilly P

Department of Trauma and Orthopaedics, Imperial College Healthcare Trust

We present a case series of patients who underwent 3 or 4 part proximal humerus fracture fixation using an intra-osseous suture technique. 18 patients are included in the study with follow up data obtained ranging from 1 to 4 years. Oxford Shoulder Scores (OSS) and range of movement measurements were taken for all patients.

The mean OSS for the group was 38/48 with a mean forward flexion of 140°, abduction of 132°, external rotation of 48° and internal rotation to the level 10th thoracic vertebra. Three patients developed adhesive capsulitis, 2 requiring subsequent arthroscopic release. This data compares favourably to outcomes reported in the literature with hemiarthroplasty or locking plate fixation.

An activity based costing analysis estimated that the treatment costs for proximal humerus fractures was approximately £2,055 when performing a soft tissue reconstruction, £3,114 when using a locking plate and £4,679 when performing a hemiarthroplasty. This demonstrates a significant financial saving when using intra-osseous fixation compared to other fixation techniques.

We advocate the use of the intra-osseous suture fixation technique for certain 3 and 4 part fractures. It gives good functional outcomes, significant cost savings and potentially makes revision procedures easier when compared to other fixation techniques.

## **Are plain radiographs of clavicles giving us the information we think they are?**

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Clavicle fractures account for 44-66% of shoulder fractures. Evaluating degree of shortening is important when deciding between operative and non-operative treatment. The clavicle of a skeleton was marked at midpoint and junctions of the thirds along its superior surface. Antero-posterior (AP) and 30-degree upshot radiographs were taken. Images were analysed measuring distance between markers. In both AP and upshot images there were apparent discrepancies between lengths of each third and half. The main differences in apparent length appear in the measurement of the thirds of the clavicle. The AP made the medial third shorter compared to the middle and lateral third, whereas the upshot appeared to make the medial third shorter than the middle third with the lateral third shorter again. This study supports the theory that there is parallax error created by the shape of the clavicle. Middle third fractures account for 80% of fractures and both our AP and upshot images make the middle third appear longer in relation to lateral and medial thirds. This leads us to believe that shortening may be overestimated when measured using AP or upshot images. This leads us to advise caution when using WebPacs tools to measure shortening in clinical decision making.

## **Non-Operative Management of Comminuted Distal Humerus Fractures in the Elderly – a Review of Functional Outcomes**

**Timothy Batten**, Claire Sin-Hindge, Andrew Murphy, Mark Brinsden, Paul Guyver

We aimed to assess the functional outcomes of elderly patients with isolated comminuted distal humerus fractures that were managed non-operatively.

Retrospective analysis of patients over 65 years presenting to our unit between 2005-2015 was undertaken. 67 patients were identified, 7 had immediate TEA, 41 died and 5 were lost to follow-up leaving 14 available for review. Mean Follow-up was 55 months(range 17-131) Patient functional outcomes were measured using VAS scores for pain at rest and during activity, and the Oxford Elbow Score (OES). Need for conversion to TEA and complications were recorded.

The mean age at injury was 76 years(range 65-90) of which 79%(11/14) were females. The mean score on the OES was 46(range 29 – 48). The mean VAS score at rest was 0.4(range 0-6) and the mean VAS score during activity was 1.3(range 0-9). 93%(13/14) of patients reported no pain (0 out of 10 on the numeric scale for pain) in their injured elbow at rest and 79%(11/14) reported no pain during activity. No patients converted to TEA and there were no complications.

Non-operative management of comminuted distal humerus fractures should be considered for elderly patients, avoiding surgical risks whilst giving satisfactory functional outcomes in this low demand group.

## Time to Fracture Clinic Audit

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Data from patients seen in the fracture clinic during 17/08/2015 - 21/08/2015 and 14/08/2015 - 18/09/2015 were used to assess whether patients with fractures referred from the Emergency Department were seen in the fracture clinic within 72 hours of initial presentation, as recommended by the BOAST 7 guidelines. Out of the 276 patients, 90.22% were seen within 72 hours of initial presentation. Out of the 27 patients who breached the 72 hours target, 12 breached on Monday, 8 on Tuesday, 4 on Wednesday, 3 on Thursday and 0 on Friday. In order to decrease the number of breaches, 2 changes could be beneficial; reduce the number of "inappropriate attenders" and start a weekend fracture clinic. However, the pressure on the Orthopaedic department as a whole needs to be considered before reducing the number of non new fracture patients in the clinic. Additionally, it would be difficult to justify the cost of a weekend fracture clinic in light of an already high compliance rate to the guidelines, without a long term outcome comparison of patients seen in fracture clinics within and after 72 hours of initial presentation, demonstrating a clear benefit for the former.

## Humeral supracondylar fracture fixation in children – a change in practice

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The treatment for Humeral Supracondylar fractures in children is percutaneous fixation with Kirschner wires using a unilateral or crossed wire configuration. Capitellar entry point with divergent wires is thought crucial in the lateral entry approach. Crossed wire configuration carries a risk of Ulnar nerve injury. Our department had recorded a number of failures and this required review.

A search was conducted for children with this injury and surgical fixation. A two year time frame was allocated to allow for adequate numbers. The hospital's radiography viewing system and patient notes were utilised to gather required information.

30 patients from 2-14 years all underwent surgery on the day of admission or the following day. 18 had sustained Gartland grade 3 or 4 injuries. Unilateral configuration was used in 10 cases, a loss of reduction was noted in 5 of these with one case requiring re-operation. Crossed wires were used in 20 cases with a loss of reduction in 1.

Crossed wire configuration provides a more reliable fixation with a lower chance of re-displacement. Our DGH policy now advises the use of this configuration. A small "mini-open" ulnar approach is utilised with visualisation and protection of the nerve.



## 1100 Session 2: Basic Science

Moderator: Mr M Gibbons & Wg Cdr J Kendrew

### Pre-clinical evaluation of therapies to prevent or treat bone non-union:

#### a systematic review.

**Sarah K. Stewart**, Philippa M. Bennett, Sarah A. Stapley, Janine Dretzke, Danai Bem, Jowan G. Penn-Barwell

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Bone non-union following fracture is a major cause of morbidity in combat casualties. The various clinical treatments used to prevent or treat non-union remain of limited efficacy. Research therefore continues in animal models in an attempt to identify an effective clinical treatment. The aim of this study was to systematically evaluate emerging pre-clinical therapies in order to rationalise priorities for translational research.

The methodological protocol of this study was registered with the Collaborative Approach to Meta Analysis and Review of Animal Data from Experimental Studies (CAMARADES) and published.

The search identified 3270 animal studies, 140 of which fulfilled the criteria for inclusion as detailed in the protocol. Of these 140 papers, 76 novel therapies are described which are yet to translate to clinical trial. These studies used a range of animal models, with significant heterogeneity between bone defect models and outcome measures.

This review demonstrates that research to treat and prevent non-union is prolific and diverse, with significant scope for translation to clinical trials. It also represents a novel application of an emerging epidemiological technique to address a key priority in Combat Casualty Care research. Ongoing pre-clinical trials with better methodological rigor and bone model protocols is recommended.

### The Biomechanics of Blast Related Amputee Heterotopic Ossification: computational modelling and physical experiments

**Maj D S Edwards**<sup>1,2</sup> and Miss Naomi Rosenberg<sup>3</sup>, Mr Angelo Karunaratne<sup>2,3</sup>, Col J C Clasper<sup>2,3,4</sup>, Prof A M J Bull<sup>2,3</sup>.

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Electron Microscopy and Synchrotron analysis of Heterotopic Ossification (HO) from blast-related amputees' has shown that HO is bone with a disorganised structure and altered remodelling. This research performs mechanical testing of HO to understand its biomechanical properties in an attempt to create an accurate model to predict its morphological appearance. The hypothesis of this work is that HO is mechanically mediated in its formation.

Synchrotron mechanical analysis of HO samples was performed to measure Young's modulus, ultimate strength and density distribution. A novel algorithm based on Wolf's law was implemented in a Finite Element (FE) analysis model of HO to take into account the differing mechanical and biological properties measured and the presence of HO outside the skeletal system.

An HO modeling factor, which considers boundary conditions, and regulates recruitment of the soft tissue into bone formation, results in a re-creatable formation of HO within the soft tissues, comparable to the appearance of HO seen in military amputees. The results and model demonstrates that certain types of HO are under the control of endogenous and exogenous mechanical stimulus. HO can thus be mechanically exploited in the casualty management and rehabilitation process to achieve better clinical outcomes.

## **The Effect of Knee Position on the Severity of Lower Limb Injuries in an Under-Vehicle Explosion: A Cadaveric Study.**

**T.J. Bonner**, S.D. Masouros, N. Newell, A. Ramasamy, A.M. Hill, A.T.H. West, J.C. Clasper, A.M.J. Bull

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The Royal British Legion Centre for Blast Injury Studies at Imperial College, London.

The lower limbs of vehicle occupants are vulnerable to severe injuries during under vehicle explosions. Understanding the injury mechanism and causality of injury severity could aid in developing better protection. Therefore, we tested three different knee positions in standing occupants (standing, knee in hyper-extension, knee flexed at 20°) of a simulated under-vehicle explosion using cadaveric limbs in a traumatic blast injury simulator; the hypothesis was that occupant posture would affect injury severity.

Skeletal injuries were minimal in the cadaveric limbs with the knees flexed at 20°. Severe, impairing injuries were observed in the foot of standing and hyper-extended specimens. Strain gauge measurements taken from the lateral calcaneus in the standing and hyper-extended positions were more than double the strain found in specimens with the knee flexed position. The results in this study demonstrate that a vehicle occupant whose posture incorporates knee flexion at the time of an under-vehicle explosion is likely to reduce the severity of lower limb injuries, when compared to a knee extended position.

## **Intraoperative fluid irrigation for traumatic wounds**

**Penn-Barwell JG**, Peleki A, Chen YF, Bishop JRB, Midwinter MJ, Rickard RF

Institute of Naval Medicine

We present the first systematic review conducted by the UK Defence Medical Services in conjunction with the Cochrane Collaboration. Irrigation fluids are used to remove contamination during the surgical treatment of traumatic wounds in order to prevent infection. This review aims to determine whether there is evidence that one wound irrigation fluid is superior to another at reducing infection. A pre-published methodology was used and two reviewers independently assessed the search results. The search produced 917 studies, of which three met the inclusion criteria. All were studies in open fractures, incorporating a total of 2,903 patients. Each RCT involved a distinct comparison, precluding meta-analysis: i) sterile saline vs. distilled/boiled water; ii) antibiotic solution vs. soap solution; iii) saline vs. soap solution. The odds ratios of infection following irrigation with various fluids was as follows: i) saline vs. distilled or boiled water 0.25 (95%CI 0.08-0.73); ii) antibiotic solution vs. soap 1.42 (95%CI 0.82-2.46); iii) saline vs. soap solution 1.00 (95%CI 0.80-1.26). These results suggest that neither soap nor antibiotic solution is superior to saline and that saline is inferior to distilled or boiled water.

## Progress Towards A Novel Treatment For Heterotopic Ossification

**Major Neil Eisenstein<sup>1,2</sup>**, Dr Richard Williams<sup>1</sup>, Dr Sophie C. Cox<sup>1</sup>, Professor Sarah A. Stapley<sup>2</sup>, Professor Liam M. Grover<sup>1\*</sup>

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Heterotopic ossification is the formation of lamellar bone in soft tissues and is a common complication of high-energy combat injury. This disabling condition can cause pain, joint ankylosis, and skin ulceration in the residua of amputees. This project is aimed at developing a novel treatment to dissolve hydroxyapatite in heterotopic ossification and prevent the crystallisation of this mineral at sites of ectopic bone formation. Previously reported results demonstrated that hexametaphosphate could dissolve hydroxyapatite at physiological pH. Further work has been undertaken to investigate the mechanism of this dissolution and establish a means of temporal control of action. In addition, physicochemical analyses of samples of human heterotopic ossification have yielded important insights into the nature of this pathological tissue. Techniques include mapped micro X-ray fluorescence, mapped Raman spectroscopy, scanning electron microscopy, and micro computed tomography. Formulation engineering work has begun in order to develop an appropriate delivery vehicle for this agent. This includes rheological testing and hexametaphosphate elution profiles. Finally, micro CT analysis has shown that hexametaphosphate is able to dissolve human heterotopic ossification tissue. In summary, this work has moved us closer towards our goal of a novel injectable agent for the treatment and prevention of heterotopic ossification.

## The effect of posture on vertebral fracture patterns in a simulated underbody blast loading scenario.

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Spinal fractures are common following underbody blast. Most injuries occur at the thoracolumbar junction, and fracture patterns suggest the spine is flexed at the moment of injury. However, current mechanistic descriptions of vertebral fractures are based on low energy injuries, and there is no evidence to correlate fracture pattern with posture at the loading rates seen in blast injury.

The T12-L1 segment of 4 human spines was dissected to preserve the paraspinal ligaments and potted in polymethylmethacrylate. The specimens were impacted with a 14 kg mass at 3.5m/s in a drop tower; two specimens were impacted in neutral posture, one in flexion, and one in extension. A load cell measured the load history. CT scans and dissection identified the injury patterns.

Each specimen sustained a burst fracture. The neutral specimens demonstrated superior burst fractures, the flexed specimen demonstrated a superior burst fracture with significant anterior involvement, and the extended specimen showed a posterior vertebral body burst fracture.

At high loading rates, the posture of the spine at the moment of injury appears to affect the resulting fracture. This supports understanding the behaviour of the spine in blast injury and will allow improved mitigation system design in the future.



## **The future of three dimensional printing in military orthopaedics.**

**Maj. AA Johnson**, HQ Army Medical Directorate, Camberley

This paper describes how advances in three-dimensional printing may benefit the military trauma patient, both deployed on operations and in the firm base. Use of rapid prototype manufacturing to produce a 3D representation of complex fractures that can be held and rotated will aid surgical planning within multidisciplinary teams. Patient-clinician interaction can also be aided using these graspable models. The education of military surgeons could improve with the subsequent accurate, inexpensive models for anatomy and surgical technique instruction. The developing sphere of additive manufacturing (3D printing functional end-use components) lends itself to further advantages for the military orthopaedic surgeon. Military trauma patients could benefit from advances in direct metal laser sintering which enable the manufacture of complex surfaces and porous structures on bio-metallic implants not possible using conventional manufacturing. "Bio-printing" of tissues mimicking anatomical structures has potential for military trauma patients with bone defects. Deployed surgeons operating on less familiar fracture sites could benefit from three-dimensionally printing patient-specific medical devices. These can make operating technically easier, reducing radiation exposure and operating time. Further ahead, it may be possible to contemporaneously 3D print medical devices unavailable from the logistics chain whilst operating in the deployed environment.

## **Traumatic amputations and pelvic fracture: is a mechanistic link key to increase future survivors?**

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Severe military pelvic trauma has a high mortality rate with previous work identifying an association between pelvic fracture and traumatic amputation (TA) of the lower limb (LL). Research has also identified casualties with this combination of injuries as the potential 'future unexpected survivors', however, most casualties die early from exsanguination, often before medical interventions can be performed. Therefore targeting injury prevention or mitigation might be the route to increased survivorship. This study investigates this combination of injury and identifies targets for preventative techniques. A search of the JTTR from 2003 to 2014 identified all patients with TA and all pelvic fractures. Of 989 casualties with LL TAs, 19% had an associated pelvic fracture, and this was associated with a 56% mortality rate compared to 24% without. Both pubic symphysis and sacroiliac separation alike were associated positively with traumatic amputation ( $p < 0.01$ ). The combination of pelvic instability and TA had a mortality rate of 52%. We hypothesise that pelvic fracture may share a mechanistic link with TA, meaning fracture may occur as a consequence of the force and direction of the TA, and it may be possible to direct mitigation strategies at this injury in order to improve survival rates.

Notes

**1320 Session 3- Elective Session**  
**Moderator: Mr I Winson and Lt Col M Butler**

**A series of cases of foreign body reaction and synovitis after soft tissue knee reconstruction using LARS ligament.**

**Mike Rodger**, Niel Davis, William Griffiths-Jones, Andrew Lee

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A patient in his thirties developed synovitis with grade 4 chondrolysis and a stiff knee with a fixed flexion deformity between three and six years following PLC and PCL reconstruction using LARS (Ligament Augmentation and Reconstruction System, Corin). There was histologic evidence of foreign body reaction, the knee was painful, swollen and stiff.

We did not use any further LARS ligaments for soft tissue reconstructions of the knee in our practice. We commenced a recall programme for all 83 patients who underwent a soft tissue knee reconstruction using LARS. Of those contacted, 41 replied (49%) and 16 patients had symptoms (19%) and were investigated further with XRay, MRI and arthroscopy as indicated.

We discovered a total of five patients had histologically proven synovitis with foreign body reactions (6%), three of whom had life-changing symptomatic pain, swelling and stiffness with degenerate changes (3.6%). These patients had undergone various reconstructions, including a) PLC only, b) ACL and PCL, c) PCL and PLC and d) ACL, PCL and PLC. A further single case of massive bone cyst formation was noted, following PCL reconstruction using LARS (1.2%).

## **Does Ankle Stabilisation Surgery Improve Functional Outcomes for Royal Marine Recruits?**

**Hemingway R1**, Birley D1, Hales R1 & Wood AM2

1Commando Training Centre Royal Marines

2Royal Marines Reserve SCOTLAND

Ankle ligament injury is a common cause of injury to military recruits, and frequently implicated in failure to complete Royal Marines (RM) recruit training. A minority of patients at Commando Training Centre Royal Marines (CTCRM) with ankle ligament injury undergo arthroscopic ankle stabilisation surgery (Bostrum or Evans procedures). The decision to undertake surgery involves an assessment of functional benefit to the patient, medical and surgical risks, and cost-effectiveness. However, there is currently little data on the efficacy of surgery in enabling recruits to complete RM training.

To assess the number of RM recruits who completed recruit training following ankle stabilisation surgery and entered the trained strength.

A retrospective analysis of all patients at CTCRM who underwent surgery for ankle stabilisation was performed using healthcare records data. The primary outcome measure was completion of RM recruit training after surgery. 27 patients underwent surgical intervention for ankle instability between 2004 and 2015. Patients remaining in rehabilitation following their surgery were excluded, leaving 22 patients suitable for inclusion in the final analysis.

Of the eligible patients undergoing surgical intervention ( $n = 22$ ), six patients – 27% – completed RM recruit training. Average time in rehabilitation 68 weeks. 10 patients underwent a Evans procedure and 9 underwent a brostum repair with 3 unknown.

Based on cumulative data spanning 11 years at CTCRM, operative intervention for ankle instability enables only a minority (27%) of patients to complete RM recruit training. Patients who undergo surgical intervention also undertake prolonged rehabilitation at a cost of £1850 per recruit per week. The poor rates of completing RM training following surgery, and the high costs of rehabilitation, have implications with regards to retaining recruits who sustain ankle injuries requiring surgical reconstruction.

## **Hip arthroscopy for femoroacetabular impingement in the military cohort**

**Capt Sarah K Stewart MBChB BMedSc (Hons) MRCS**

Mr Koushik Ghosh MBBS BSc MSc MRCS

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In the young and highly active population of military patients, femoroacetabular impingement can be a source of serious disability as well as a threat to their career. This morbidity can be treated with hip arthroscopy with debridement of cam lesion, and excision or repair of a corresponding labral tear. We report on the long term outcomes (>1 year) of 26 military cases who underwent hip arthroscopy for femoroacetabular impingement, in a single surgeon's series. Twenty two patients (four bilateral cases) underwent hip arthroscopy as a day case procedure during the period February 2013 to October 2014. Non-Arthritic Hip Scores (NAHS) were obtained from patients pre-operatively, at two months, four months and at least one year post-operatively. There was a significant improvement in NAHS at two months (75.6)( $p < 0.05$ ), four months (85.1)( $p < 0.001$ ) and one year (84.8)( $p < 0.001$ ), compared to pre-operative NAHS (65.8). There was no significant change in NAHS beyond four months. Only three out of the 22 patients were medically discharged secondary to persistent hip symptoms. Hip arthroscopy for femoroacetabular impingement is an effective, viable procedure for military patients. Mobility, pain and function is significantly improved after surgery. This improvement is sustained in the long term up to and beyond one year.

## **A novel method to determine the safe correction for high tibial osteotomy**

**Monk, Boyd, Brown, Gibbons, Alvand, Price**

NDORMS, University of Oxford

The optimal correction of the weight bearing line during High Tibial Osteotomy has not been determined. We used finite element modelling to simulate the effect that increasing opening wedge HTO has on the distribution of stress and pressure through the knee joint during normal gait.

Subject-specific models were developed by combining geometry from 7T MRI scans and applied joint loads from ground reaction forces measured during level walking. Baseline stresses and pressures on the articulating proximal tibial cartilage and menisci were calculated. Progressive osteotomies were then simulated to shift the weight-bearing line from the native alignment towards/into the lateral compartment (between 40 - 80% of medial-lateral tibial width). Changes in calculated stresses and pressures were recorded.

Both stress and pressure decreased in the medial compartment and increased in the lateral compartment as increasingly valgus osteotomies were simulated. The models demonstrated a consistent "safe zone" for weight bearing line position at 50%-65% medial-lateral tibial width, outside of which compartment stresses and pressures substantial increased.

This study suggests a safe correction zone within which a medial opening wedge HTO can be performed correcting the WBL to 55% medio-lateral width of the tibia.

## **Mid-term survivorship of endoprosthetic replacements around the knee joint for non-tumour indications**

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Endoprosthetic replacement (EPR) is an available option for the management of massive bone loss around failed knee implants. The aim of this study was to determine the results of knee EPRs performed for non-tumour indications. Since 2007, 85 EPRs were performed for in a single tertiary centre by seven surgeons. Mean age at surgery was 73.5 years (range:35–95) with infection as the most common indication (49%), followed by aseptic loosening (18%), complex primary replacement (16%), fracture (15%) and mechanical failure (2%). Mean follow up was 4 years (range:1-9). Functional outcome was determined using the Oxford Knee Score (OKS). At follow-up, 21 patients were deceased and 2 lost to follow-up. Complication rate was 19%. Of the 7 infected cases, 6 were treated with DAIR (debridement, antibiotics, and implant retention) and one underwent above knee amputation. Four of the patients undergoing DAIR were cleared of infection and 2 are on long-term antibiotics. Accounting for implant revision, loss to follow-up and those on long-term antibiotics as failures, 5-year survival was 89% with an average OKS of 25 (SD=10). This mid-term study shows that distal femur EPR is a valuable option for the increasing burden of complex revision knee surgery



## 1450 Session 4- Military

Moderator: Mr J Getty and Lt Col Dylan Griffiths

### Combat hindfoot fractures in UK military 2003-2014: Injuries, management and short-term outcomes

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This is a retrospective study examining the injury pattern, management and short-term outcomes of British Military casualties sustaining hindfoot fractures from the conflicts in Iraq and Afghanistan. In the 12-years of war, 114 patients sustained 134 hindfoot injuries. The calcaneus was fractured in 116 cases (87%): 54 (47%) were managed conservatively, with 30 (26%) undergoing internal fixation.

Eighteen-month follow-up was available for 92 patients (81%) and 114 hindfeet (85%). Nineteen patients (17%) required trans-tibial amputation in this time, with a further 17 (15%) requiring other revision surgery. Deep infection requiring surgical treatment occurred in 13 cases (11%) with *S. aureus* the commonest infective organism (46%). Deep infection was strongly associated with operative fracture management ( $p=0.0022$ ). When controlling for multiple variables, the presence of deep infection was significantly associated with a requirement for amputation at 18 months ( $p=0.001$ ). There was no association between open fractures and requirement for amputation at 18 months ( $p=0.926$ ), nor was conservative management associated with amputation requirement ( $p=0.749$ ).

### Hindfoot fractures in UK combat casualties: medium-term patient reported outcomes

PM Bennett, T Stevenson, ID Sargeant, A Mountain, JG Penn-Barwell

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It is unclear whether casualties with hindfoot fractures have an improved outcome with salvage or amputation. This study aims to determine which injury features are predictive of eventual recovery following a battlefield hindfoot fracture.

In 12 years of conflict in Iraq/Afghanistan there were 134 fractures in 114 patients. Telephone follow-up was available for 90 (90/134, 67%) fractures, with median follow-up of 5-years. Twenty-eight limbs (28/90, 31%) had undergone amputation. All respondents underwent SF-12 scoring: in addition those who had retained their limb completed American Orthopaedic Foot and Ankle Society (AOFAS) grading.

A multiple regression model was created to identify factors associated with subsequent poor AOFAS scores in those retaining their limbs. Three variables were identified: coexisting plafond fracture ( $p=0.03$ ), negative Bohler's Angle on initial radiograph ( $p=0.008$ ) and concurrent talus and calcaneal fracture ( $p=0.026$ ). The presence of 2 out of 3 variables at time of injury was associated with a significantly lower Physical Component Score (PCS) of SF-12 compared to amputees (medians: 35 vs. 51,  $p=0.0001$ ).

This finding raises the possibility that severe hindfoot injuries which will go on to an outcome worse than that likely to be achieved with an amputation can be identified at time of initial management.

**Can pre existing NHS and Private Fast Track pathways support the treatment of Military ACL injuries in a timely fashion or is a new approach required? The South West experience.**

**Myatt RW**, Thomas RL, Penn-Barwell JG, Matthews JJ

Anterior Cruciate Ligament injuries are a common cause of downgrade in Service personnel. The Multidisciplinary Injury Assessment Clinic (MIAC) is a service which patients can be referred to for expert musculoskeletal injury management. MIAC has a Fast Track (FT) referral system in place for imaging, and can subsequently refer isolated ACL injuries to a private provider for reconstruction. We examined this pathway in the South West region which has an overall population at risk of 19775. Over 4 years 173 knee injuries were referred to MIAC, of which 32 were ACL injuries. Of the 29 patients referred for MRI, the median time to imaging was 8 days with FT (n=13, range 2-14) and

15 days via the NHS (n=16, range 5-64). The majority of injuries were found to involve multiple pathologies (n=19), excluding them from FT surgery. Time to NHS clinic from point of referral took a median time of 54 days, and onward delay to surgery was 47 days. None of the referrals to the private provider for reconstruction were accepted (n=3). We have identified aspects of current referral and treatment pathways that are inefficient and discuss a current solution utilising Military surgeons.

**An investigation in to the British upper limb amputee burden and related injury severity from recent operations in Afghanistan**

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This work examines the Upper limb (UL) blast-mediated traumatic amputation (TA) significance from recent operations in Afghanistan. It is hypothesized that the presence of an UL amputation at any level is an independent predictor of torso injury.

A joint theatre trauma registry search was performed to determine the number of British casualties with TA and their associated injuries.

UL TA accounted for 15.7% of all amputations; distributed: shoulder disarticulation 2.5%, trans-humeral 30%, elbow disarticulation 10%, trans-radial 20% and hand 37.5%. The presence of an UL amputation was more likely in dismounted casualties (P=0.015) and is a predictor of an increased number of total body regions injured and thoracic injuries (P 0.001 and P 0.026 respectively). An increased Injury Severity Score (ISS) was seen in patients with multiple amputations involving the UL (UL TA present ISS=30, no UL TA ISS=21; P=0.000) and the ISS was not significantly different whether mounted or dismounted (P=0.806).

The presence of an upper limb amputation at any level should insight in the receiving clinician a high index of suspicion of concomitant internal injury; especially thoracic injury. Therefore with regards to blast mediated TA the injury patterns observed reflect a primary and tertiary blast mechanism of injury.

## **Femoral Neck Stress Fractures in Royal Marine Recruits: Diagnosis and Imaging**

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Recruits undergoing arduous training at Commando Training Centre Royal Marines (CTCRM) carry a higher risk of femoral neck stress fractures than many other military populations. This injury has serious sequelae and requires urgent operative fixation if it is displaced. Existing literature advocates a low threshold for imaging patients where this injury is suspected, due to the prognostic advantage conferred by early intervention. CTCRM uses a locally produced scoring system based on history and clinical assessment, to guide the requirement for imaging. Since 2015 access to MRI has been possible through a fast track provider. Between 2012 and 2015, 3522 Royal Marine Recruits entered training. Over the period, 95 MRI scans of the hip were performed, of which 12 utilised private pathways. 13 stress fractures of the femoral neck were identified; 23% (n=3) were displaced and required fixation. The overall incidence rate for this injury is therefore 37 per 10,000, with a displaced incidence rate of 9 per 10,000. We compare these data with previous studies, discuss the use and efficacy of the scoring tool, and assess the benefit conferred by the local private MRI agreement.

## **Service Consultant Supported RRU clinics leads to high service patient satisfaction**

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The Chevasse report published by Professor Briggs in Spring 2014 was a wide ranging review of provision of medical care to service personnel and veterans across the service. Serving personnel are a unique patient group and have differing requirements of medical provision and can have variable care depending on geographical location at home and abroad.

We undertook a consecutive 'satisfaction survey' of the lead author's visiting orthopaedic clinic at RRU Hohnes. All those attending were asked to fill an anonymised questionnaire, which was subsequently analysed.

The results demonstrate that the service patients were extremely satisfied with all elements of the specialist clinic at RRU Hohnes.

In terms of service patient satisfaction, where possible service patients with complex MSK issues should be treated by the appropriate service clinician.



