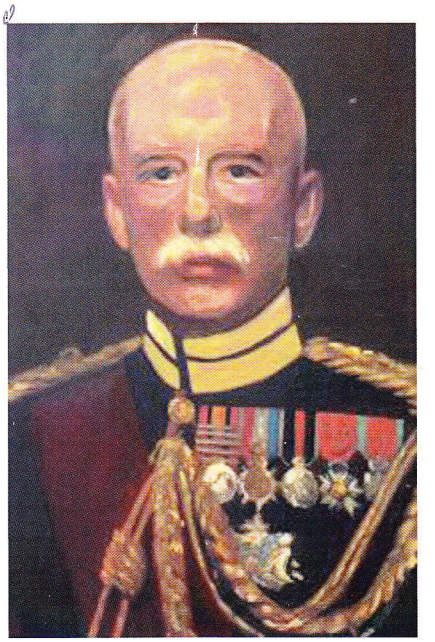
Combined Services Orthopaedic Society



May 11th 2012

Programme

Abstracts

1. "FULL MONTY" REPAIR OF MASSIVE ROTATOR CUFF TEARS

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Introduction- Massive rotator cuff tears in the patient who is too young for a reverse shoulder replacement are a challenging situation. A technique using a 'Grammont osteotomy' of the acromion has been developed to allow a comprehensive approach, the so called "Full Monty".

Aim- To document the functional outcome of patients undergoing an acromial osteotomy for the repair of massive tears of the supraspinatus.

Methods- Ten patients undergoing this procedure where entered in to the study. The mean age of the patients was 57 years (+/-16) and all bar one were male. Each patient had a pre-operative American Shoulder Elbow Score (ASES), Oxford Shoulder score (OSS), and range of movement documented. These outcome measures were repeated at a minimum of two years, as well as a patient satisfaction questionnaire.

Results- The mean ASES preoperatively was 7(+/- 6) and 23(+/-3) post-operatively ($p< 0.001$). The mean pre-operative OSS was 22(+/-5) and 43(+/-4) post-operatively ($p<0.001$). 80% of patients deemed their treatment to be "successful" and 90% would recommend the procedure to a friend in the same plight. The mean post-operative forward flexion achieved was 153° (+/-58) and the mean abduction was 142° (+/-37). All patients could sustain a 1kg weight at arms length at 90° of abduction. One patient suffered a superficial wound infection and one patient had a non-union at the osteotomy site.

Conclusion- These results suggest that this technique is a good surgical option for a patient with a "massive" rotator cuff tear that is not amenable to standard surgical techniques.

2. STERNOCLAVICULAR JOINT RECONSTRUCTION FOR INSTABILITY USING LARS LIGAMENT – REPORT OF SURGICAL TECHNIQUE AND EARLY OUTCOMES

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Traumatic injuries to the sternoclavicular joint (SCJ) are uncommon representing only 3% of all injuries to the shoulder girdle. Acutely, the majority are managed non-operatively with physiotherapy rehabilitation. However, if there is evidence of neurovascular compromise emergency reduction is indicated. There is no consensus on treatment of SCJ dislocations and subluxations that remain symptomatic after conservative treatment. Multiple surgical techniques have been described to alleviate this problem. These include resection of the medial end of the clavicle and various stabilization techniques using Kirschner wires, muscle tendon (subclavius, sternocleidomastoid, semi-tendinosus and palmaris longus) and synthetic materials (Dacron). However, all techniques have reported problems in terms of pain, decreased range of movement and a relatively high complication rate.

We report a new technique using a LARS® ligament (Ligament Augmentation and Reconstruction System) with good early post-operative results. 5 symptomatic SCJ dislocations were repaired over a 3 year period. The operations were conducted by the same surgeon and at the same unit. The patients were on average 20 years old (17-22). Mean follow up time was 21 months (9-41). Functional assessment was made using the DASH (Disabilities of the Arm, Shoulder and Hand) and the OSS (Oxford Shoulder Score) outcome measures. An improvement between pre- and post-operative scoring was observed in both DASH median 51.7 (24.2-75.0) v 13.7 (8.3-20.8) ($p=0.024$) and OSS 20.6 (15-32) v 41.8 (39-47) ($p<0.001$). One patient had a pneumothorax intra-operatively but this resolved with conservative treatment. There were no long term complications experienced during follow up.

3. Global CAP Shoulder Resurfacing: The Norwich Experience

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The Global Conservative Anatomic Prosthesis (Global CAP) is an uncemented press fit humeral resurfacing implant developed by DePuy. We report a single surgeon series of Global CAP prostheses implanted in Norwich.

103 procedures were carried out between 2006 and 2011, in 93 patients. Mean age was 72 years (range 43 to 90). Patients were followed up for a mean 8 months (range 0 to 56). Pre-operative Oxford shoulder scores were recorded in a preadmission clinic and an Oxford score questionnaire was sent to patients post-operatively in December 2011. The mean score preoperatively was 19, rising to 28 postoperatively.

Two patients developed rotator cuff tears and have been revised to reverse polarity arthroplasty. One is pending revision for a cuff tear.

This prosthesis shows promise at this early stage for compensated glenohumeral arthritis when a bone preserving procedure is desirable.

4. Septic Arthritis of the Knee: The use of and effect of antibiotics prior to diagnostic aspiration

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Septic arthritis of the native knee joint and total knee arthroplasty both cause diagnostic and treatment issues. It is accepted by orthopaedic surgeons that antibiotics should be withheld until aspiration has been performed to increase the odds of identifying an organism. Patients often present to other specialties that may not be familiar with these principles.

This study found that twenty-five of the forty-nine patients (51%) treated for septic arthritis of the knee over three years had received antibiotics prior to review by the on-call orthopaedic service. Patients were significantly less likely to demonstrate an organism on initial microscopy (entire cohort $p=0.001$, native knees $p=0.006$, prosthetic knees $p=0.033$) or culture (entire cohort $p=0.001$, native knees $p=0.017$, prosthetic knees $p=0.012$) of their aspirate if they had received antibiotics. The sensitivity of microscopy dropped from 0.58 to 0.12 when patients had received antibiotics (native knees 0.46 to 0, prosthetic knees 0.72 to 0.27). The sensitivity of culture dropped from 0.79 to 0.28 when the patient had received antibiotics (native knees 0.69 to 0.21, prosthetic knees 0.91 to 0.36).

This study demonstrated how the management of patients with suspected cases of septic arthritis of the knee may be compromised by empirical administration of antibiotics.

5. OUTCOME FOLLOWING INFECTION AFTER ACL RECONSTRUCTION

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Aim:

To measure the clinical outcomes following deep infections of those patients undergoing ACL reconstruction, in our local area, since 2007.

Methods:

A prospective record of all the patients that suffered a deep infection following ACL repair had been kept between January 2007 and April 2011 at our teaching hospital NHS trust, and the two local private hospitals. All patients underwent at least 2 arthroscopic washouts, with limited synovectomy if required. Targeted antibiotics were commenced according to the culture results, and following microbiological advice. These patients were reviewed at a minimum of 1 year following eradication of infection (range 12-46 months). There were 7 surgeons performing the ACL reconstructions. The primary outcome measure was graft failure requiring revision. Our secondary outcome measures were a history of ongoing instability, KT 1000™ measurement, Tegner and Lysholm outcome scores.

Results & Conclusion:

There were 19 patients identified as having suffered infection after ACL infection (mean age 24.3 years, range 15-38 years). Average C Reactive Protein (CRP) was 217 on admission (range 59-397). The most common organism isolated was coagulase negative staphylococcus in 47.3% of cases. There were 3 graft failures within the infection group, 2 of which have subsequently undergone revision ACL reconstruction. Of the remaining 16 patients there were no episodes of ongoing instability and mean pivot shift grade was 1.1 in the infection group. Mean KT 1000™ side-to- side difference was +1.8mm in the infection group. The mean drop on the Tegner score was 1.75 (range 0-6) and mean Lysholm score was 89 (range 56-100). The failure rate is slightly higher than that reported in the literature. Patient reported outcome measures in the patients are acceptable. We recommend an aggressive approach to the treatment of deep infection following ACL reconstruction.

6. TREATMENT AND OUTCOME OF CHRONIC EXERTIONAL COMPARTMENT SYNDROME (CECS) IN MILITARY PERSONNEL

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CECS is an exercised induced condition that causes pain, typically in the lower limbs, and is relieved by rest. It is often seen in military personnel significantly restricting their duties. Conservative treatment is rarely successful and patients often require surgical decompression by fasciotomy or fasciectomy.

All IMP (intramuscular pressure) tests (n=286) carried out between December 2007 and October 2010 on patients with suspected CECS in the anterior compartment of the lower leg were reviewed. The treatment and outcomes of those referred for surgery were analysed. Pre- and post-surgery military medical grading for leg function was extracted from the medical records system. Independent t-tests compared differences between patients that had surgery or did not. The Wilcoxon signed-rank test compared grades before and after surgery.

According to the diagnostic criterion, 80% of patients undergoing IMP testing had CECS. Of these, 179 (68%) patients underwent surgery, 17 (9%) of these were for recurrent symptoms. Almost all decompressions were bilateral (95%). The majority of operations (121) were fasciectomies of the anterior compartment only and were performed by 2 surgeons. The remaining operations (58) were performed by 6 surgeons and were fasciotomies of both anterior and lateral compartments. The mean time from testing to surgery was 24 (median 11) weeks. There were 23 (13%) complications other than recurrence including 16 wound infections, 6 seromas and 1 haematoma. Pre- and post-surgery grading was available for 67% of patients. These patients had significantly better leg function after surgery ($Z=-3.67$, $p<0.001$). Of these, 47% improved, 38% showed no improvement and 15% had a poorer outcome. Those who had a fasciectomy were significantly more likely to improve than those who had a fasciotomy ($p=0.023$, $rho=-1.96$).

Our results demonstrate that patients generally improve lower limb function following surgical decompression. However, 53% showed no improvement or deteriorated in their medical grading. In addition, there is a high diagnosis rate for CECS following IMP measurement. This may reflect the poor validity of the diagnostic criterion or this could be due to good clinical selection for testing. Furthermore, fasciectomy shows a greater correlation with improved outcome than fasciotomy. There is a need to develop more accurate diagnostic criteria and to evaluate the benefits of standardising surgical technique.

7. EXTRACORPOREAL SHOCKWAVE TREATMENT (ESWT) FOR REFRACTORY ACHILLES TENDINOPATHY: A NICE DRIVEN AUDIT

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Achilles tendinopathy is characterised by chronic degeneration of the Achilles tendon, usually secondary to injury or overuse. Extracorporeal shockwave treatment (ESWT) is of potential benefit in refractory cases where conservative management with analgesia, physiotherapy and corticosteroid injection have been unsuccessful.

Patients with refractory Achilles tendinopathy enrolled between October 2010 and October 2011 received three sessions of ESWT over three weeks. Patients completed visual analogue scale (VAS) scores for pain at rest and on activity and the Victorian Institute of Sport Assessment-Achilles (VISA-A) questionnaire pre-treatment. These outcome measures and a six-point Likert satisfaction scale were reassessed at six and 16 weeks post treatment.

51 patients completed follow up. Mean age was 56 (34-80) years and mean length of symptoms 34 (4-252) months. Significant improvement ($p<0.05$) in VAS scores (rest and activity) and VISA-A scores was observed between baseline and 16 weeks. Mean Likert score was 3 (somewhat improved) at 16 weeks. Patients suffering Achilles tendinopathy for longer than 25 months had significantly less improvement than those affected for a shorter period.

This study suggests that ESWT improves subjective and objective outcomes in patients with refractory Achilles tendinopathy.

8. The treatment & outcomes of "Jones" Fractures.

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Royal Infirmary of Edinburgh
Little France

The collective orthopaedic literature appears to highlight the Jones fracture of the fifth metatarsal, as being slow to heal, and having a high incidence of non-union. There remains a lot of confusion, throughout the orthopaedic literature, about the exact nature of this fracture.

The authors present the largest case series currently published of 117 patients who sustained a Jones fracture, demonstrating patient outcomes with different modalities of care.

All Medical notes from the Emergency Department are recorded on a database. A computer program was use to search the Emergency department database of the Edinburgh Royal infirmary notes data base for the terms 5th metatarsal combined with a coding for referral to fracture clinic over a 6 years period from 2004-2010. The researchers went through the X-ray archive, identified and classified all 5th metatarsal fractures.

There were 117 patients in our series, refracture rate 7/117 6%. Average time to discharge 13 weeks (4-24). 18% of patients took longer than 18 weeks for their fracture to clinically heal. 34% were clinically healed at less than six weeks, with only 7% radiologically healed at six weeks. There was no significant difference in outcome between cast, moonboot, tubigrip or hard shoe in terms of outcome.

A large proportion of Jones fractures have delayed healing, patients who are clinically asymptomatic may not have radiological healing. Currently in our practice there is no uniform management of Jones fractures. We discuss the difference in healing rates for different management techniques.

9. THE MANAGEMENT OF HUMERAL SHAFT FRACTURES REVISITED

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Introduction: Current practice in the treatment of humeral shaft fractures has been predominantly guided by the work of Sarmiento. He has reported union rates between 96 and 98% for those treated in a functional humeral brace. We hypothesised that the union rates for this mode of treatment at a single British teaching hospital were significantly lower than reported by Sarmiento. The further aim of the study was to ascertain if there was a particular fracture configuration that was less likely to go on to union.

Method: retrospective radiographic and clinical review of 201 consecutive acute (non pathological) adult humeral shaft fractures since January 2007. Exclusion of all fractures operated on acutely (which included all open fractures) left a study group of 158 closed humeral fractures treated in a humeral brace. Non union was determined as those requiring delayed fracture fixation at more than 6 weeks post injury or no evidence of union at 6 months without intervention.

Results: 18 patients lost to follow-up (88.6% follow up). Union rate of those with complete follow up was 82.9%. 16 of the 24 non unions were of the proximal third of the humeral shaft - union rate for this proximal third sub-group of 71.4%. Middle third fractures 87.3% union rate and distal third shaft fractures 89.7% union rate. Union rate of fractures with 3+ parts inclusive of all regions of the shaft was 95.6%.

Discussion: This centre's union rate for the treatment of humeral shaft fractures in a humeral brace is not as high as has previously been reported despite all open fractures being operated on acutely. A lower threshold is suggested in intervening with two part proximal third humeral shaft fractures. A very high threshold is suggested for intervening with any closed comminuted fractures because of their universally high rate of union. This may suggest an ideal 'strain' for fracture healing in this situation.

10. Nanoparticle treatment of intracellular *S.aureus*

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The ability of *S.aureus* to be internalised by osteoblasts has been proposed as a significant factor in its ability to persist causing chronic infections. It has been proven to be able to reinfect osteoblasts in vitro following this internalisation, which protects the bacteria from damage from immune defences and conventional antibiotic therapy. Nanoparticle bound antibiotics have been proposed as a potential method for delivering antibiotics inside infected osteoblasts. We hypothesised that our nanoparticle nafcillin compound would decrease intracellular infection in osteoblasts.

Confluent wells of human osteoblasts on 12 well plates were infected with *S.aureus* with a ratio of 250:1 bacteria to osteoblasts for 3 hours. Treatment wells were then treated with nanoparticle bound nafcillin with gentamicin cell media for 48 hours while control wells received only gentamicin containing cell media. At 48 hours treatment, remaining intracellular *S.aureus* was quantified using conventional microbiological techniques.

The nanoparticle treatment group contained a mean (± SEM) bacterial CFU of $7.4x10^3$ (± $1.4x10^3$); the Control group had $1.6x10^4$ (± $3.1x10^3$). However this was not statistically significant.

Nanoparticle antibiotic delivery may represent one treatment strategy for intracellular *S.aureus*. However, this technology requires further development to optimise function in vitro prior to proceeding to in vivo testing.

11. DESIGN OF A TRAUMATIC INJURY SIMULATOR FOR ASSESSING LOWER LIMB RESPONSE TO HIGH LOADING RATES

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Current military conflicts are characterised by the use of the Improvised Explosive Device (IED). Improvements in personal protection, medical care and evacuation logistics have resulted in increasing numbers of casualties surviving with complex musculoskeletal injuries, often leading to life-long disability. Thus, there exists an urgent requirement to investigate the mechanism of extremity injury caused by these devices in order to develop mitigation strategies. In addition, the wounds of war are no longer restricted to the battlefield; similar injuries can be witnessed in civilian centres following a terrorist attack.

Key to mitigating such injuries is the ability to deconstruct the complexities of an explosive event into a controlled, laboratory-based environment. In this study, an anti-vehicle underbelly injury simulator, capable of recreating in the laboratory the impulse from an anti-vehicle (AV) explosion, is presented and characterised. Tests were then conducted to assess the simulator's ability to interact with human cadaveric legs. Two mounting conditions were assessed, simulating a typical seated and standing vehicle passenger using instrumented cadaveric lower limbs.

This experimental device, will now allow us (a) to gain comprehensive understanding of the load-transfer mechanisms through the lower limb, (b) to characterize the dissipating capacity of mitigation technologies, and (c) to assess the biofidelity of surrogates.

12. DUAL-PURPOSE BONE GRAFTS IMPROVE HEALING AND REDUCE INFECTION

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Research Question: Biocompatible polyurethane (PUR) scaffolds have been developed with tunable delivery characteristics for both growth factors and antibiotics. The antibiotic release remains over 20 times higher than the MIC for 8 weeks, and rhBMP-2 (BMP) is released for 3-4 weeks. The aim was to investigate the ability of these dual-delivery scaffolds to simultaneously regenerate bone and reduce infection.

Hypothesis: The dual delivery of growth factor and antibiotics would result in an improvement in bone healing and reduction in infection compared to the current clinical Standard of Care.

Study design and Methods: The effectiveness to promote bone regeneration and prevent infection was investigated in a contaminated rat femoral defect. There were 6 groups: the clinical control groups were low and high dose BMP on a collagen sponge; the experimental groups were low and high dose BMP on PUR scaffolds; and low and high dose of BMP on PUR with vancomycin.

Results: The infection rate for the low and high BMP on a collagen sponge was 40 and 13%, respectively. The infection rate for PUR low and high groups were similar to the collagen sponge. The low and high BMP with vancomycin PUR groups had an infection rate of 7 and 0%, respectively. Both collagen sponge groups regenerated $14\mu m^3$ of bone. The low dose of BMP on PUR regenerated $9\mu m^3$ while the high regenerated $38\mu m^3$. The low and high BMP dose on PUR with vancomycin regenerated significantly more bone ($p < 0.001$) than the collagen sponge (39 and $44\mu m^3$, respectively).

Discussion: The dual delivery of BMP and antibiotics had the desired effects of regenerating more bone and reducing infection.

Conclusion: These results demonstrate that this scaffold may be capable of reducing complications of open fractures in patients.

13. Chitosan, a Negative Pressure Compatible Local Antibiotic Delivery System

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Local antibiotic therapy has several advantages over systemic delivery. The clinical standard for local antibiotic delivery is polymethylmethacrylate (PMMA) beads. Unfortunately, these are not ideal and negative pressure wound therapy (NPWT) reduces efficacy. This study explores the effectiveness of Chitosan sponge local antibiotic delivery.

PMMA antibiotic beads were compared to antibiotic loaded Chitosan sponge, in a goat infected open tibial fracture model. Animals were assigned to one of four treatment groups with 250mg of vancomycin per animal treatment: PMMA bead pouch, PMMA beads with NPWT, Chitosan sponge pouch, and Chitosan sponge with NPWT. Animals were survived for 48 hours, and the bacteria in the wound quantified.

After treatment, there were significantly fewer bacteria in wounds treated with antibiotic Chitosan sponge delivery than antibiotic PMMA bead depot ($p<0.05$). Chitosan sponge pouch and Chitosan sponge with NPWT groups had 6% and 2% of pre debridement bacterial levels remaining respectively, bead pouch and beads with NPWT groups had 16% and 57% of the pre debridement levels, respectively.

This study demonstrates that a vancomycin loaded biodegradable Chitosan sponge is superior to vancomycin impregnated beads at eradicating *S. aureus* in a complex large animal wound model, either with NPWT or in a wound pouch.

14. FASS IS A BETTER PREDICTOR OF POOR OUTCOME IN LOWER LIMB BLAST INJURY THAN AIS: IMPLICATIONS FOR BLAST RESEARCH.

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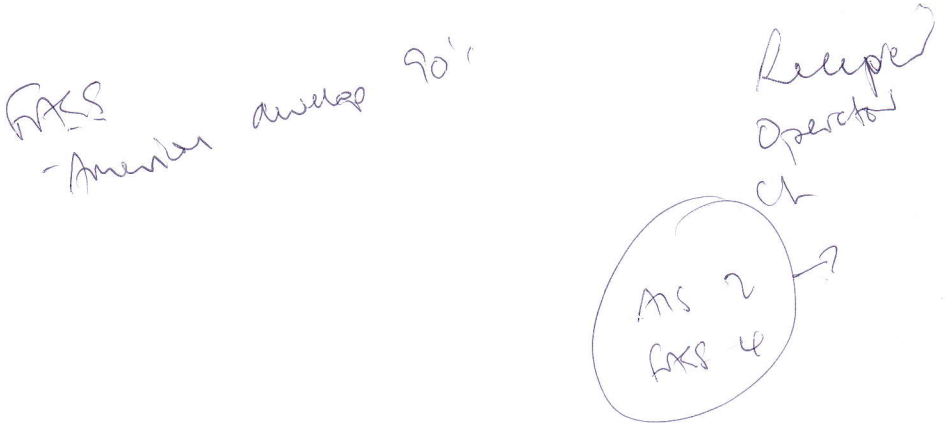
The defining weapon of the conflicts in Iraq and Afghanistan has been the Improvised Explosive Device (IEDs). When detonated under a vehicle, they result in significant axial loading to the lower limbs, resulting in devastating injuries. Due to the absence of clinical blast data, automotive injury data using the Abbreviated Injury Score (AIS) has been extrapolated to define current NATO injury thresholds for Anti-vehicle (AV) mine tests. We hypothesized that AIS, being a marker of fatality rather than disability would be a worse predictor of poor clinical outcome compared to the lower limb specific Foot and Ankle Severity Score (FASS).

Using a prospectively collected trauma database, we identified UK Service Personnel sustaining lower leg injuries from under-vehicle explosions from Jan 2006-Dec 2008. A full review of all medical documentation was performed to determine patient demographics and the severity of lower leg injury, as assessed by AIS and FASS. Clinical endpoints were defined as (i) need for amputation or (ii) poor clinical outcome. Statistical models were developed in order to explore the relationship between the scoring systems and clinical endpoints.

63 UK casualties (89 limbs) were identified with a lower limb injury following under-vehicle explosion. The mean age of the casualty was 26.0 yrs. At 33.6 months follow-up, 29.1% (26/89) required an amputation and a further 74.6% (41/89) having a poor clinical outcome (amputation or ongoing clinical problems). Only 9(14%) casualties were deemed medically fit to return to full military duty. ROC analysis revealed that both AIS=2 and FASS=4 could predict the risk of amputation, with FASS = 4 demonstrating greater specificity (43% vs 20%) and greater positive predictive value (72% vs 32%). In predicting poor clinical outcome, FASS was significantly superior to AIS ($p<0.01$). Probit analysis revealed that a relationship could not be developed between AIS and the probability of a poor clinical outcome ($p=0.25$).

Foot and ankle injuries following AV mine blast are associated with significant morbidity. Our study clearly demonstrates that AIS is not a predictor of long-term clinical outcome and that FASS would be a better quantitative measure of lower limb injury severity. There is a requirement to reassess the current injury criteria used to evaluate the potential of mitigation technologies to help reduce long-term disability in military personnel. Our study highlights the critical importance of utilising contemporary battlefield injury data in order to ensure that the evaluation of mitigation measures is appropriate to the injury profile and their long-term effects.



15. FUTURE 'UNEXPECTED' SURVIVORS? CAUSE OF DEATH ANALYSIS IN EXPLOSIVE BLAST FATALITIES

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Recent advances across many facets of combat casualty care have enabled survival following battlefield injuries that would have been previously considered lethal. Other, more severe, injuries remain beyond our capability to treat at present, but have the potential to be future 'unexpected' survivors Currently, the greatest threat to deployed coalition troops is the improvised explosive device (IED) and therefore, the aim of this study was to conduct an analysis of causes of death and injury patterns in recent explosive blast fatalities in order to best focus research and mitigation strategies.

With the permission of the coroners, we analysed 145 IED blast fatalities that had a PMCT (post-mortem CT) scan and an autopsy between November 2007 and July 2010. Demographic data, mechanism of injury and times of injury, of death and of PMCT were collected. Cause of death was attributed to the injuries with the highest AIS scores contributing to the NISS score. Of the 145, 24 cases had such severe injuries (disruptions) that further study was inappropriate. Of the remaining 121, 79 were dismounted, sustaining their injuries in a free field or open environment – the 'Open' group – and 42 were in vehicles or in cover with the blast exterior to that – the 'Enclosed' group. Leading causes of death overall and by group are shown in table 1.

Table 1. Top 5 causes of death (AIS region, *fatality mechanism subcategory*)

All IED fatalities (n=121)		Open group (n=79)		Enclosed group (n=42)	
Region, *mechanism*	%	Region, *mechanism*	%	Region, *mechanism*	%
Head, *CNS injury*	28.4	Lower extremity, *limb haemorrhage*	38.4	Head, *CNS injury*	47.6
Lower extremity, *limb haemorrhage*	27.0	Head *CNS injury*	18.1	Thorax *haemorrhage*	11.9
Thorax, *haemorrhage*	6.6	Abdomen, pelvic *haemorrhage*	9.7	Thorax, *other mechanism*	11.9
Abdomen, *pelvic haemorrhage*	6.6	Lower extremity, *pelvic haemorrhage*	8.4	Abdomen, *abdo haemorrhage*	7.1
Lower extremity, *pelvic haemorrhage*	6.1	Upper extremity, *haemorrhage*	4.6	Lower extremity, *limb haemorrhage*	5.6

Pelvic and extremity haemorrhage both remain significant causes of death in blast casualties. Research to improve management of these injuries with a focus on optimised haemorrhage control, in conjunction with mitigation techniques, should improve current survival rates.

16. DEVELOPING A PREDICTIVE ANATOMIC SCORING SYSTEM FOR MILITARY PERINEAL AND PELVIC BLAST INJURIES

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Improvised explosive device (IED) yields in Afghanistan have increased. Injuries have become more proximal. The injury severity score (ISS) is an anatomic aggregate of the three most severely injured areas, but unfortunately does not accurately predict mortality in IED-related pelvic and perineal trauma patients. A new scoring system based on abbreviated injury score (AIS) was developed to reflect the severity of these injuries.

Using standard AIS descriptors, injury scales were constructed for the pelvis (1, Minor to 6, Maximal). The perineum was divided into anterior and posterior zones as relevant to injury patterns and blast direction. A cumulative score was then created for structures in the anterior and posterior zones.

Of 2204 UK military trauma patients, 118 (5.4%) had a recorded perineal injury, of these 118, 56 died (47%). Pelvic fractures were identified in 62/118 (53%), 17/62 (27%) survived. Mean survival below a score of 5 was 77% (4/11 [36%] fatalities had an ISS>75). For scores between 6-10 and 11-16, survival was 39% and 49% respectively (10/22 [45%], 3/12 [25%] fatalities had an ISS>75). Only 1/7 (14%) within the group 17-21 (1/8 [13%] survival) had an ISS>75, highlighting that the current method of using ISS does not reflect the severity of injuries that this cohort of patients have sustained. Survival with a score above 22 was 0% (zero ISS>75). In our cohort of 62 survivors, 1 patient with an IED related pelvic and perineal injury had an 'un-survivable' ISS>75 and survived.

In the field, prediction of resuscitation requirements, ICU stay, overall length of stay & potential quality of life outcome would be of benefit.

17. UK Combat-related pelvic injuries 2008-2011

Implications for intervention

Maj NM Walker RAMC, Maj W Eardley RAMC, Lt Cdr Bonner RN, Col J Clasper L/RAMC

Abstract

From August 2008 to July 2011 data were prospectively collected on all injuries sustained in Afghanistan by UK military personnel. Mechanism of injury, Injury Severity Score (ISS), Abbreviated Injury score (AIS) New Injury Severity Score (NISS), anatomic pattern of wounding, and operative management were recorded in a trauma registry. All significant pelvic injuries were identified and analysed. Significant pelvic trauma was defined as trauma to the proximal femur and pelvic girdle or disruption to pelvic vasculature or viscera, graded AIS 3 or greater. Significant pelvic injuries were recorded in 116 casualties, representing approximately 3% of all personnel injured in Afghanistan. Using the injury scoring systems above, the cause of death was identified. 84 deaths were incurred in this group, of which the pelvic injury was directly responsible for the death of 31.

We reviewed the data to identify where death was attributable to vascular injury below the inguinal ligament that was not controlled by a combat action tourniquet. In light of this data we evaluated the potential benefits of junctional tourniquets, recently introduced by the US military. We identified a maximum of four deaths were that were potentially amenable to groin tourniquet, representing 3% of all deaths in those sustaining significant pelvic injury. We are unable to support the introduction in warfare of junctional tourniquets to control groin haemorrhage on the basis of this study.

18. KNEE DISLOCATIONS CAUSED BY IMPROVISED EXPLOSIVE DEVICES

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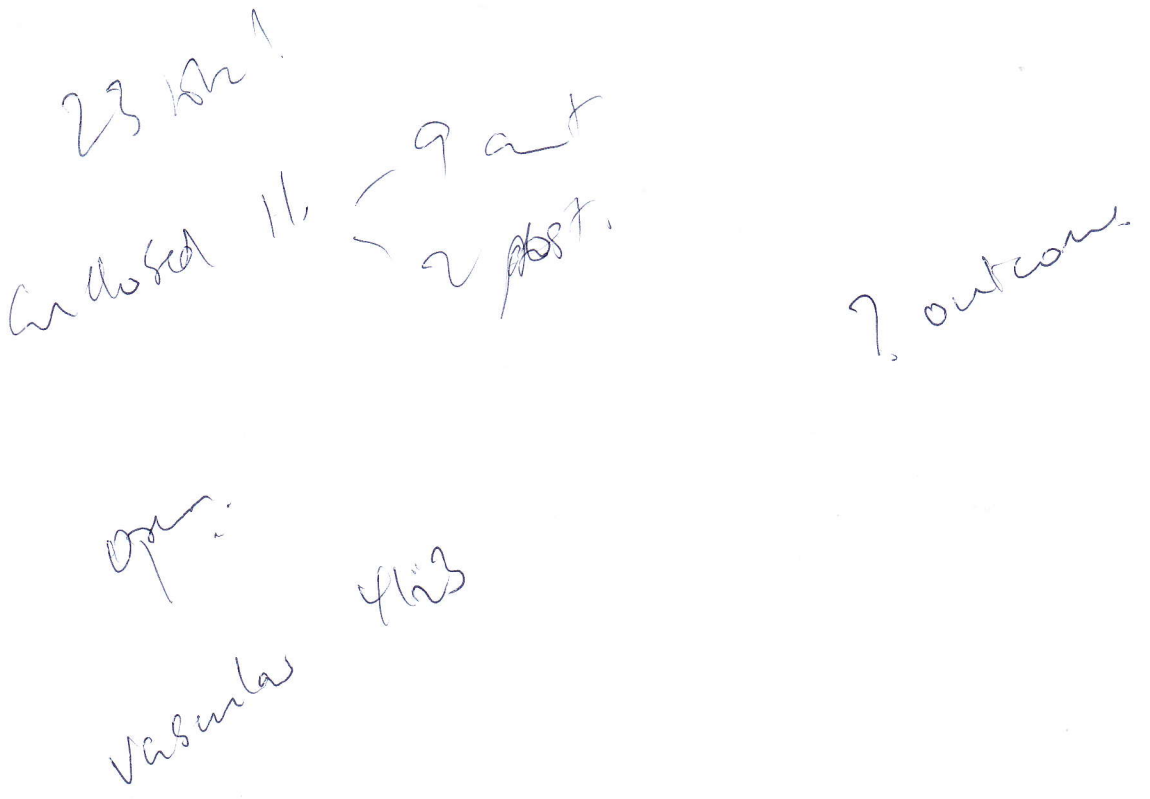
Counter-insurgency warfare in recent military operations has been epitomised by the use of Improvised Explosive Devices (IED) against coalition troops. Emerging patterns of skeletal fractures, limb amputations and organ injuries, which are caused by these weapons, have been described over recent years. This paper describes a retrospective case series of knee dislocations caused by IEDs in recent conflict. To our knowledge, this pattern of injury has not been described before.

Data was obtained about military personnel from 2006 to 2011, who had sustained a knee dislocation while serving in Afghanistan from a prospectively gathered database, the Joint Theatre Trauma Registry (JTTR), maintained by the Academic Department of Military Emergency Medicine, Royal Centre for Defence Medicine. The diagnosis of knee dislocation and its associated skeletal injuries was assessed by review of all relevant plain radiographs, computed tomography scans and magnetic resonance images. The mechanism of injury, incidence of vascular injuries and other skeletal injuries was recorded.

During the study period, 20 casualties sustained a knee dislocation caused by an IED. Four casualties had an associated popliteal vascular injury. Eleven injuries were caused in enclosed spaces, and 9 injuries caused by IEDs out in the open. Anterior dislocations were common in the group caused in enclosed spaces. 19/20 patients had at least one other skeletal fracture.
Knee dislocations represent an uncommon but important diagnosis in modern warfare. Urgent and careful assessment for any associated vascular injuries or other skeletal injuries may help ensure timely treatment and promote future recovery. Mitigation against knee dislocation may be possible in the enclosed environment because of the predictable pattern of injury.



19. Severe open tibia fractures in combat trauma: orthopaedic and plastic surgical management and initial outcomes

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This study aims to characterise severe open diaphyseal tibia fractures sustained by UK military personnel in combat and define their management and initial outcomes. The Military Trauma Registry was searched for all open diaphyseal tibial fractures sustained between 2006-2010; the clinical records were then reviewed of all GA 3 injuries.

Fifty-one patients with 58 severe open tibia fractures were eligible for inclusion. Forty tibias (69%) were initially stabilised with external fixation, with conversion to an intra-medullary nail in 30 cases (51.7%) Vascularised reconstruction by composite tissue auto transplantation was required in 8 cases (14%) and by local flaps in 10 cases (17%). Twenty-five cases (43%) had achieved, or were progressing towards bony union at 12 months. Twenty-one patients (36%) had undergone revision surgery by 12 months, and seven (12%) had required amputation. Five were lost to follow up. Soft tissue loss requiring vascularised requiring reconstruction with a flap was significantly associated with revision or amputation ($p=0.0074$). Bone loss was not associated with poor outcome ($p=0.327$). This study characterises the complexity of open tibial fractures and the surgical challenge inherent in limb salvage in combat injured patients. Soft tissue loss requiring vascularised reconstruction appears to correlate closely with poor outcome.

20. THROUGH JOINT TRAUMATIC AMPUTATIONS FROM EXPLOSIVE BLAST: WHEN, WHY AND WHAT NEXT?

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The mechanism of traumatic amputation (TA) from explosive blast has traditionally been considered to be a combination of blast wave induced bone injury followed by limb avulsion from the blast wind. This results in a transosseous TA, with through joint amputations considered to be extremely rare. Data from previous conflicts has also suggested that this injury is frequently associated with a non-survivable primary blast lung injury (PBLI), further linking the extremity injury to the primary blast wave. However, our current experience in the Middle East would suggest that both the mechanism of TA and the link with fatal primary blast exposure need to be reconsidered. The aim of this study was to analyse the injury profile of the current cohort of TA fatalities to further investigate the underlying blast injury mechanism and to allow hypotheses on injury mechanisms to be developed for further analysis.

With the permission of the coroners, 121 post-mortem CT scans of UK armed forces personnel who died following an IED blast were analysed. All orthopaedic injuries were identified, classified and the anatomical level of any associated soft tissue injury noted. CT evidence of PBLI was used as a marker of significant primary blast exposure.

75/121 (62%) sustained at least 1 TA, with 138 TAs seen in total. 31/138 (22%) were through joints, with through knee amputations most common (23/31, 74%). Only 7/31(23%) through joint amputations had an associated fracture proximal to and contiguous with the amputation site. The soft tissue injury profile of through joint and transosseous TAs were not significantly different ($p=0.569$). The incidence of PBLI was significantly greater in fatalities with no TA (29/46) compared to fatalities with TA (29/75) ($p=0.014$).

The accepted mechanism for traumatic amputation following explosive blast does not adequately explain the significant number of through joint traumatic amputations presented here. Fatalities with amputations also showed less evidence of primary blast exposure than those with no amputations. Analysis of through joint TA incidence and associated injuries in survivors is now indicated. Case studies within this dataset may facilitate generation of injury mechanism hypotheses. To further investigate the injury mechanism, work is required to understand both osseous, ligamentous and other soft tissue behaviour and failure at high strain rates. This should allow characterisation and modeling of these injuries and inform mitigation strategies.

21. EARLY QUALITY OF LIFE CHANGES AFTER ELECTIVE AMPUTATION FOLLOWING COMPLEX LOWER LIMB TRAUMA

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The injury pattern emerging from recent military operations in Iraq and Afghanistan has been increasingly established in the literature; blast and ballistic injuries to the lower limbs have led to a number of amputations either at point of wounding or at role 3. Lower limbs not amputated often require extensive reconstruction, some of which lead to chronic pain and functional problems – some of these patients have sought elective amputation of the problem limb.

We retrospectively analysed the routinely collected EQ5D quality of life scores before and after elective amputation in these patients to ascertain how they were affected by the surgery.

13 patients had undergone elective amputation and their postoperative EQ5D scores were collected at a mean of 199.54 (73-528) days. 7 patients assessed their global health as better after amputation, 5 worse and 1 remained the same. 2 patients reported their mobility as worse, 4 better and 7 the same. 1 patient reported worse self care, 1 better and 11 the same. Usual activities improved for 2 patients, worsened for 2 and remained the same for 9. Pain and discomfort improved for 6 patients and did not change for 7. Anxiety and depression increased in 1 patient, reduced in 4 and were unchanged in 9.

This basic information builds a foundation which may be used to counsel service people who are considering elective amputation, and with the addition of further follow-up scores will enable development of a longitudinal postoperative profile of quality of life.

22. Determining the clinical relevance of statistically significant changes in bacterial counts in a model of extremity war wounds.

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A 7-day randomised controlled pre-clinical trial utilising an existing extremity war wound model compared the efficacy of saline soaked gauze to commercially available dressings. The Flexor Carpi Ulnaris (FCU) of anaesthetised rabbits was exposed to high-energy trauma using a computer-controlled jig and inoculated with 10^6 *Staphylococcus aureus* 3 hours prior to application of dressing. Quantitative microbiological assessment demonstrated reduced bacterial counts in Inadine (Iodine) and Acticoat (Silver) groups and an increase in Activon Tulle (Manuka Honey) group (2-way ANOVA $p<0.05$).

Clinical observations were made throughout the study. Haematology and plasma cytokines were analysed at intervals. Post-mortem histopathology included subjective semi-quantitative assessment of pathology severity using light microscopy to grade muscle injury and lymph node activation. Tissue samples were also examined using scanning electron microscopy (SEM).

There were no bacteraemias, significantly raised white cell counts, abscesses, purulent discharge or evidence of contralateral axillary lymph node activation. There was no significant difference in pathology severity in muscle or lymph nodes (Kruskal-Wallis). There was no evidence of bacterial penetration or biofilm formation on SEM. Interleukin-4 and Tumour Necrosis Factor α levels were significantly higher in the Activon Tulle group (1-way ANOVA $p<0.05$).

This time-limited study demonstrated a statistically significant reduction in *Staphylococcus aureus* counts in wounds dressed with Inadine and Acticoat and an increase in wounds dressed with Activon Tulle. There was no evidence that any of these dressings cause harm but despite careful analysis using a range of other methods we have not yet established any clinical advantage associated with the use of the dressings tested in this study.

23. Freehand 'Figure 4' Technique for Tibial Intramedullary Nailing: Introduction of Technique and Review of 88 cases

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Abstract

Intramedullary nailing of tibial fractures is commonplace and freehand techniques are increasingly popular. The standard freehand method has the knee of the injured leg flexed over a radio-lucent bolster. This requires the imaging C-arm to swing from antero-posterior to lateral position several times. Furthermore, guide wire placement; reaming and nail insertion are all performed well above most surgeons' shoulder height. If instead the leg is hung over the edge of the table, the assistant must crouch and hold the leg until the nail is passed beyond the fracture.

We describe a method of nailing which is easier both for the surgeons and the (often inexperienced) radiographer and present a series of 88 consecutive cases managed with this technique.