Mitigation of Hard and Soft Tissue Pelvic Injuries
Engineering PhD Project | The Royal British Legion Centre for Blast Injury Studies at Imperial College London

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Pelvic fracture, often accompanied by lower extremity and perineal injuries, has become the signature injury of the current conflict in Afghanistan\(^1\)\(^2\), in part due to casualties surviving increasingly mutilating injuries due to body armour and helmets, battlefield vascular control, rapid battlefield medical evacuation, and consultant led surgical trauma teams\(^3\). In both military and civilian injuries, pelvic fracture is frequency associated with soft tissue damage, including genitourinary and vascular injury. In a recent review\(^4\) of patients presenting with an open pelvic fracture across 29 consecutive cases, six had an associated vascular injury, seven a bowel injury, eleven a genital injury and seven a bladder injury. In another recent study\(^5\) of 124 casualties where upper thigh, groin or pelvic injury was recorded, 42 of 92 deaths were attributed to pelvic injury. 21 deaths were attributed to vascular injury between the aortic bifurcation and the inguinal ligament. It was concluded that survivable deaths due to exsanguination may be amenable to increased proximal vascular control. In civilian blunt trauma casualties, 5 to 16% relate to pelvic fracture, with a considerable proportion of deaths attributable to exsanguination, with patients who arrive at the emergency department haemodynamically unstable having a much greater mortality rate than those who arrive stable\(^6\). The use of a pelvic binder is recommended in military and civilian pelvic injury\(^7\), with the binder providing mechanical stability and potentially reducing venous bleeding\(^6\).

There is a primary question for pelvic ring fractures, such as open book and gull wing fractures, as well as localised pelvic and acetabular fractures, as to whether soft tissue injury could be avoided or mitigated through fracture prevention. There are secondary questions as to whether the immediate mechanical stabilisation of a pelvic fracture through the use of a pelvic binder or other device may result in improved vascular control, and whether more can be done to address and mitigate both hard and soft tissue pelvic injuries in military and civilian trauma.

The PhD project seeks to develop a detailed computational model of the pelvic region including the soft tissue systems as well as the hard tissue. The model will allow investigation of whether fracture can initiate soft tissue injury such as vascular and bladder damage. It will also allow investigation of whether mechanical stabilisation of the pelvic ring can aid in vascular management. Finally, coupled with work already being carried out in the Centre it will allow for the assessment and design of mitigation devices and guidance to prevent or reduce the severity of pelvic region, lower extremity and potentially lumbosacral dislocation injuries. While models of the hard tissue components of the pelvis exist in the literature, including one developed by one of the proposed supervisors there are no combined models that we are aware of. A preliminary study carried out as a final year MEng project in Civil Engineering investigating a combined model of the pelvic ring and the bladder provided encouraging results. The development and clinical application of such a model would be a significant advancement in the field.

Candidates are expected to have at least an MEng 2:1 or equivalent masters level qualification in civil, mechanical, structural, biomedical engineering or bioengineering.

Interested parties should contact Dr Andrew Phillips at andrew.phillips@imperial.ac.uk

Funding is available at the standard EU/Home rate.

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1. Current concepts in perineal and pelvic blast injury, Royal Society of Medicine, 22 February 2013
2. Developing a cumulative anatomic scoring system for military perineal and pelvic blast injuries, S Mossadegh et al., J R Army Med Corps. 2013,159, Supp