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## Original Article

# Microbiological and functional outcomes after open extremity fractures sustained overseas: The experience of a UK level I trauma centre

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## ABSTRACT

**Background:** Open extremity fractures carry a high risk of limb loss and poor functional outcomes. Transfer of extremity trauma patients from developing countries and areas of conflict adds further layers of complexity due to challenges in the delivery of adequate care. The combination of extensive injuries, transfer delays and complex microbiology presents unique challenges.

**Methods:** A retrospective review was conducted to analyse the surgical and microbiological themes of patients with open extremity fractures transferred from overseas to our institution (Imperial College NHS Trust) between January 2011 and January 2016.

**Results:** Twenty civilian patients with 21 open extremity fractures were referred to our unit from 11 different countries. All patients had poly-microbial wound contamination on initial surveillance cultures. Five patients (25%) underwent amputation depending on the extent of osseous injury; positive surveillance cultures did not preclude limb reconstruction, with seven patients undergoing complex reconstruction and eight undergoing simple reconstruction to achieve wound coverage. Hundred percent of patients demonstrated infection-free fracture union on discharge.

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*Conclusion:* Patients with open extremity fractures transferred from overseas present the unique challenge of poly-microbial infection in addition to extensive traumatic wounds. Favourable outcomes can be achieved despite positive microbiological findings on tissue culture with adequate antimicrobial therapy. The decision to salvage the limb and the complexity of reconstruction used should be based on the chance of achieving meaningful functional recovery, mainly determined by the extent of bony injury. The complexity of reconstruction was based on the predicted long-term functionality of the salvaged limb.

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## Introduction

Trauma to the extremities represents one of the most common injury patterns encountered by both civilian and military orthoplastic teams.<sup>1</sup> In both instances, a multidisciplinary team (MDT) approach is warranted to achieve optimal outcomes for patients in the form of a stable, painless limb capable of supporting the functional aspirations of patients. Collectively, open extremity fractures signify high-energy transfer, which carry a significant risk of limb loss or dysfunction. However, the differences in the incidence, nature and severity of extremity trauma between military and civilian settings must be considered.

In the military setting, the advent of improvised explosive devices has altered the pattern of injuries seen in both mounted and dismounted personnel. The complexity of resultant extremity injuries and the need to optimise functionality has seen an increasing role for plastic surgeons in military trauma teams, with plastic surgeons involved in 40% of all surgical cases in the Afghanistan conflict.<sup>2</sup> Injuries to the upper and lower extremity form a significant part of the military plastic surgeon's caseload, accounting for 64% and 40% of all cases, respectively.<sup>1–3</sup> The vast majority of long bone fractures sustained in the military setting are open (82%),<sup>3</sup> with high velocity and penetrating mechanisms producing an outside to inside pattern of extremity trauma, implicating multiple functional components.

In the civilian setting, significant extremity injury has been reported in 58.6% of patients admitted following major trauma.<sup>4</sup> Civilian extremity trauma is often blunt in nature, most commonly occurring because of falls, industry-related accidents and road traffic collisions. Regional epidemiological studies demonstrate the incidence of open fractures to be 11.5 per 100,000 individuals, with an estimated 3.3% of all upper limb and 3.7% of all lower limb fractures open at the time of presentation.<sup>5</sup> Anatomical variation exists, with reports of up to 21% of tibial fractures presenting as open, largely due to the paucity of soft tissue covering the anteromedial border of the tibia.<sup>6</sup>

In both military and civilian domains, direct communication between fracture and external environment carries high morbidity, with increased incidence of fracture non-union, soft tissue infection and osteomyelitis in open fractures compared to closed counterparts.<sup>7–10</sup> The correlation between infection risk and degree of soft tissue injury is well documented, with reports demonstrating 27–77% of type III open tibia fractures ending up with deep wound infection.<sup>11,12</sup> The debilitating sequelae of open fractures carries significant physical, psychological and social burden for those concerned. Early transfer to Level 1 Trauma Centres followed by prompt debridement and reconstruction by orthoplastic specialists can improve the overall functional outcome.<sup>13</sup>

The extent of primary wound contamination is dependent on the mechanism of injury and the environment in which the injury was sustained.<sup>14</sup> However, primary colonisation rates for such injuries are high regardless of aetiology, with reported rates reaching 70–80%.<sup>15–17</sup> The degree of primary contamination is associated with delayed presentation to appropriate healthcare facilities. Scarred and oedematous soft tissues present significant challenges to reconstructive trauma surgeons following

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