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Medium-term outcomes following limb salvage for severe open tibia fracture are similar to trans-tibial amputation

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ABSTRACT

Extremity injuries define the surgical burden of recent conflicts. Current literature is inconclusive when assessing the merits of limb salvage over amputation. The aim of this study was to determine medium term functional outcomes in military casualties undergoing limb salvage for severe open tibia fractures, and compare them to equivalent outcomes for unilateral trans-tibial amputees.

Cases of severe open diaphyseal tibia fractures sustained in combat between 2006 and 2010, as described in a previously published series, were contacted. Consenting individuals conducted a brief telephone interview and were asked to complete a SF-36 questionnaire. These results were compared to a similar cohort of 18 military patients who sustained a unilateral trans-tibial amputation between 2004 and 2010.

Forty-nine patients with 57 severe open tibia fractures met the inclusion criteria. Telephone follow-up and SF-36 questionnaire data was available for 30 patients (61%). The median follow-up was 4 years (49 months, IQR 39–63). Ten of the 30 patients required revision surgery, three of which involved conversion from initial fixation to a circular frame for non- or mal-union. Twenty-two of the 30 patients (73%) recovered sufficiently to complete an age-standardised basic military fitness test.

The median physical component score of SF-36 in the limb salvage group was 46 (IQR 35–54) which was similar to the trans-tibial amputation cohort ($p = 0.3057$, Mann–Whitney). Similarly there was no difference in mental component scores between the limb salvage and amputation groups ($p = 0.1595$, Mann–Whitney). There was no significant difference in the proportion of patients in either the amputation or limb salvage group reporting pain ($p = 0.1157$, Fisher's exact test) or with respect to SF-36 physical pain scores ($p = 0.5258$, Mann–Whitney).

This study demonstrates that medium term outcomes for military patients are similar following trans-tibial amputation or limb salvage following combat trauma.

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Introduction

Just as in the wars of the last century, injuries sustained in the recent conflicts in Iraq and Afghanistan more commonly involve the limbs than any other anatomical region [1]. Approximately 25% of extremity wounds from these conflicts were open fractures [2], with only around 3% being open tibia fractures [3].

Open tibia fractures produced by military weapons are characterised by severe soft tissue loss and heavy contamination

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with significant infection risk [4]. The traditional treatment of these injuries by military surgeons was frequently amputation [5]. With the evolution of plastic surgical techniques and development of more sophisticated internal and external fixation devices, there is greater potential for salvaging these severely injured limbs.

Limb salvage is typically regarded as requiring a greater number of surgical procedures and a longer initial hospital stay compared to amputation in order to achieve a potential for greater long-term function. However there remains considerable debate in the literature as to whether the outcome following limb salvage is superior to that of amputation [6].

This study aims to determine the medium-term outcomes in a previously described [3] cohort of UK military patients sustaining severe open tibia fractures and compare these results to those in a similar group of trans-tibial amputees.

Patients and methods

This study was registered with, and approved by, the Joint Medical Command institutional review process. The UK military Joint Theatre Trauma Registry (JTTR) is an electronic database of prospectively gathered information on all casualties sustained in Iraq and Afghanistan. Data are collected by trained research nurses working both in deployed medical facilities and at the Royal Centre for Defence Medicine (RCDM), Birmingham, UK. All cases triggering a 'trauma-alert' on presentation to deployed UK medical facilities or subsequently requiring return to the UK following injury are included [7]. The database is administered by UK Defence Statistics.

We searched for codes that included bony injuries of the knee, tibia or ankle sustained between 1 April 2006 and 30 September 2010 in UK personnel. The clinical records and radiographs of these patients were reviewed and the following excluded: injuries not involving the tibial diaphysis (AO/Muller type 42); injuries other than those graded by the operating surgeon as Gustilo-Anderson grade III; patients who were managed with a primary amputation (either below- or above-knee) within the first three surgical episodes. Data were collected from the JTTR, checked against clinical records, and the details of injury severity, mechanism and treatment recorded. Forty-nine patients with 57 severe open tibia fractures met the inclusion criteria: the characteristics of this cohort has previously been described in detail [3].

Patients were contacted by telephone. They were informed of the nature of the study and asked if they would consent to participate. Patients who wished to participate were briefly interviewed over the telephone and sent a copy of the SF-36 V2 (UK) questionnaire [8,9], along with a letter providing further detail of the study and emphasising the voluntary nature of participation. Patients who did not return their questionnaire within four weeks had a reminder letter and second questionnaire sent to them.

Results from this group of patients were then compared to those of a similar group of unilateral trans-tibial amputees that has previously been published [4]. Patients with an open tibia fracture and contralateral lower limb amputation were excluded from this comparison.

Analysis

Results of individual SF-36 questionnaires were entered into the Quality Metric Health Outcomes™ Scoring Software version 4.0 (Quality Metric, USA). Comparison between limb-salvage and amputee cohorts was performed using a Mann–Whitney analysis for continuous variables. Fisher's exact test was used for comparison of dichotomous data. A threshold for significance was set at $p < 0.05$.

Table 1
Characteristic of salvage and amputation cohorts compared.

	Salvage	Amputation	*p*-Value
Age (median, IQR)	25 (21–28)	24 (21–26)	0.5215 (Mann–Whitney)
Mechanism			
Blast (%)	86%	100%	0.2824 (Fischer's exact test)
GSW (%)	14%	0%	
NISS (median, IQR)	14 (10–20)	20 (17–26)	0.7642 (Mann–Whitney)
Follow-up/months (median, IQR)	49 (39–63)	34 (28–40)	0.0001 (Mann–Whitney)

IQR, inter-quartile range; GSW, gun-shot wound; NISS, new injury severity score.

Results

Of the original data set of 49 patients, 30 patients (61%) completed their telephone interview and SF-36 survey. The median follow-up time from injury to interview was 4 years (49 months, IQR 39–63). The characteristics of this cohort are given in Table 1: comparison with the amputation group demonstrates broad similarities with respect to age and NISS (Fig. 1). The follow-up time was significantly longer in the salvage group, as shown in Fig. 2.

Twenty-two of the 30 patients (73%) had recovered sufficiently to have completed some form of military fitness test. This test varies between services and combat-arms but at a minimum involves a 1.5 mile run to be completed within an age-specific time limit.

Ten of the 30 patients required re-admissions to hospital for revision surgery: in three cases this involved conversion from initial fixation to a circular frame for non- or mal-union.

The median physical component of SF-36 in the limb salvage group was 46 (IQR 35–54) which was similar to the median in the trans-tibial amputation cohort which was 47 (IQR 42–55) ($p = 0.3057$, Mann–Whitney) as shown in Fig. 3. Similarly there was no difference in mental component scores ($p = 0.1595$, Mann–Whitney).

Only six of the 30 cases (20%) with salvaged limbs reported pain symptoms in their injured limb compared to 7 of the 18 amputees (39%, $p = 0.1157$, Fisher's exact test). Similarly, there was no significant difference in SF-36 body pain scores in the two groups ($p = 0.5258$, Mann–Whitney).

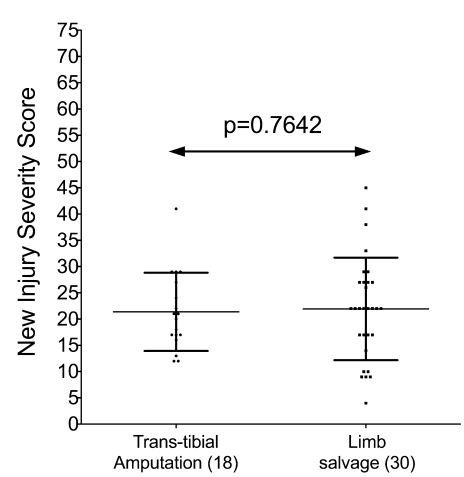

Fig. 1. Scatter plot showing new injury severity score in both cohorts with *p*-value derived from Mann–Whitney analysis shown.

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