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Integra™ permits early durable coverage of improvised explosive device (IED) amputation stumps

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Summary *Introduction:* Improvised explosive device (IED) blasts cause serious injury. Survivors are left with multiple amputations, considerable soft tissue loss and open fractures with gross contamination. We present our early experience of Integra™ in the acute management of military wounds.
Method: The clinical records of all patients with IED injuries who underwent early reconstruction with Integra™ during the six month period between August and December 2009 in our unit were reviewed and data gathered prospectively.
Results: There were 7 male soldiers, aged 21—31 years (mean = 26). All sustained trunk and limb injuries, including multiple amputations. Number of procedures prior to application of Integra™ was 4—10 (mean = 5). Application of Integra™ took place 6—24 days post-injury (mean = 13). Size of wounds covered with Integra™ was 1—11.5% TBSA (mean = 5%). Anatomical sites reconstructed included amputation stumps, and both upper and lower limbs.

There was partial take of Integra in 3 wounds in 2 patients. All wounds were eventually treated with delayed split skin grafting and healed satisfactorily.
Conclusion: IEDs produce a large zone of injury with massive soft tissue damage, multiple discontinuous wounds which are significantly contaminated. The physiological insult is equivalent to a large cutaneous burn and there is a paucity of available donor sites. Multiple amputees also have a greater energy and power requirement[1—4] and cannot spare remaining functional muscles as donors. The literature suggests that microvascular flaps have a high failure rate in military patients.[5] Reconstruction began as soon as wounds were considered sufficiently clean.

Integra™ was applied with the aim of providing higher quality coverage than that provided by split skin grafting alone (particularly for amputation stumps) whilst minimising operative time and morbidity.

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Integra™ allows timely closure of battlefield wounds with minimal operative time and morbidity. The procedure can begin whilst still in the acute phase and certainly before one would consider lengthy complex operations such as free flaps. Our experience suggests that Integra™ can allow early closure with robust tissue, promoting early rehabilitation and return to duties.

Introduction

The modern medical evacuation chain and field surgery provision is a highly efficient process. As a result of these developments, UK service personnel are surviving injuries that in previous conflicts would have been fatal. Up until September 2009, there had been 44 unexpected UK survivors i.e. survivors with an injury severity score (ISS) of greater than 60.[6]

The hallmark injury seen in the current conflict in Afghanistan is a blast injury produced by the improvised explosive device (IED). Improvised Explosive Devices (IEDs) are homemade bombs fabricated in an improvised manner designed to destroy or incapacitate personnel or vehicles. They contain a detonating mechanism, which initiates the electrical charge that sets off the device. Antipersonnel IEDs commonly contain shrapnel-generating objects such as nails or ball bearings. Those designed for use against armoured vehicles may also contain a separate rod or cone propelled by a shaped explosive charge.

Blast injuries are heterogeneous complex events and personnel sustain injuries which differ from civilian injuries by virtue of their distribution, morphology and the degree of wound contamination. The presence of multiple injuries often leads to competing priorities of care and soft-tissue reconstruction cannot be planned in isolation from the rest of the surgical care required.

The torso is relatively well-protected by the current combat body armour. However, survivors are left with multiple amputations, considerable soft tissue disruption, open fractures and highly contaminated wounds. These patients typically have injury patterns at the limits of survivability, with ISS scores between 50 and 60. Severe prolonged systemic inflammatory response syndrome is usual and the individuals require organ support.

Integra™ dermal regeneration template (Integra Life Sciences, Plainsboro, N.J.) was first introduced in 1981 for the treatment of major burn injuries.[7] A multicentre randomised controlled trial of 106 patients with major burns later highlighted the benefits of the use of Integra for coverage in major burns.[8] The use of dermal substitutes has since expanded to include reconstruction of other full thickness defects including reconstruction following release of scar contracture,[9,10] excision of skin tumours[11–13] and flap donor sites. However, there is little experience in the use of dermal substitutes in traumatic wounds,[14–18] particularly in complex, highly contaminated IED blast injuries.

We sought to determine whether it is possible to provide good quality skin cover in these difficult wounds using dermal substitutes in the acute setting. Here, we report our experience of the use of the dermal regeneration matrix, Integra™ in the reconstruction of these wounds. This is used in combination with topical negative pressure therapy and delayed split thickness skin grafting.

Method

All patients with IED injuries admitted to Selly Oak Hospital (SOH), Birmingham, UK between August 2009 and January 2010, who underwent early reconstruction with Integra™ were reviewed. Data were collected on patient demographics, details of the injury, size and site of wound covered, number of procedures and days between injury and application of Integra™, number of days between application of Integra™ and final split thickness skin grafting and clinical outcome.

All patients had undergone primary surgical stabilisation and initial debridement at the Role 3 facility in Camp Bastion, Afghanistan. Upon arrival at the Royal Centre for Defence Medicine at Selly Oak Hospital, Birmingham, the patients were reassessed and stabilised before being taken to theatre. Here, their wounds were re-explored, further debridement was performed and irrigated. Wound swabs and muscle biopsies were taken from all wound sites at each theatre session. A gauze-based topical negative pressure dressing was then applied. Patients were returned to theatre at 1—4 day intervals, depending on their clinical condition and the status of their wounds, until the wounds were deemed clinically clean enough for coverage with Integra. Our experience has been that these wounds are evolving wounds, developing progressive necrosis over time. Wounds were meticulously debrided every forty-eight hours and soft-tissue reconstruction begun as soon as wounds were considered sufficiently clean. Wounds chosen were large soft-tissue wounds with areas of fasciocutaneous loss and exposed muscle.

Either the single- or bi-layer Integra™ was used. Choice of the type of Integra™ used was based on personal preference of the operating surgeon. The Integra™ was soaked in an antiseptic solution containing Amphotericin and Ciprofloxacin. The Integra™ was then meshed in a ratio 1:1 and applied to the wounds. The Integra™ was secured with staples and a topical negative pressure dressing was applied (Figure 1a and b). Repeat dressing changes were performed until the Integra™ was vascularised. Any infected areas were debrided. Throughout this time, topical negative pressure dressings were used. Once vascularised, a thin meshed split thickness skin graft was applied with a topical negative pressure dressing. Percentage of Integra™ take