Journal of Plastic, Reconstructive & Aesthetic Surgery (2016) 69, 888–893

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Success of free flap anastomoses performed within the zone of trauma in acute lower limb reconstruction

Charlotte L. Bendon*, **Henk P. Giele**

Department of Plastic, Reconstructive and Hand Surgery, Oxford University Hospitals NHS Trust, Headley Way, Oxford, OX3 9DU, UK

Received 6 July 2015; accepted 28 February 2016

KEYWORDS
Lower limb trauma;
Free flap reconstruction;
Anastomosis;
Microsurgery

Summary Traditionally, in free flap cover of lower limb injuries, every attempt is made to perform anastomoses proximal to the zone of injury. We report on the success of anastomoses within the zone of trauma, at the level of the fracture, avoiding further dissection and exposure.

The records of free flap reconstructions for fractures of the lower extremity at a tertiary trauma centre between 2004 and 2010 were retrospectively reviewed.

A total of 48 lower limb fractures required free flap reconstruction, performed at 28 days post injury (0–275 days). Anastomoses were proximal (21), distal (5) or within the zone of trauma (22). There was no significant difference ($p > 0.05$) in return to theatre, revision of anastomosis or flap survival between groups. Of the 22 performed within the zone of injury, five returned to theatre but only two for revision of anastomosis and 20 (91%) of these flaps survived.

Of the 48 free flaps, arterial anastomoses were end to end in 34 (71%) and end to side in 14 (30%). There was no significant difference ($p > 0.05$) in return to theatre, revision of anastomosis or flap survival between the end-to-end and end-to-side groups. There was a tendency for arterial anastomoses to be performed end to end outside the zone of trauma (23/26) compared to within the zone of trauma (11/22).

Our data suggest that free flap anastomoses can be performed safely in the zone of trauma in lower limb injuries.

* Corresponding author. Department of Plastic, Reconstructive and Hand Surgery, Oxford University Hospitals NHS Trust, West Wing John Radcliffe Hospital, Headley Way, Oxford, OX3 9DU, UK. Tel.: +44 1865 741166; fax: +44 1865 231091.
E-mail address: charlottebendon@googlemail.com (C.L. Bendon).

http://dx.doi.org/10.1016/j.bjps.2016.02.017

Introduction

Microsurgical free tissue transfer is the standard of care for open fractures of the lower extremity with significant soft tissue trauma. These microsurgical techniques have enabled salvage of limbs previously managed by amputation, with reported free flap success rates of 91—92% in traumatic lower limb injuries.[1,2]

Traditionally, surgeons have favoured the selection of uninjured recipient vessels, proximal to the zone of trauma.[3] In fact, in 1990, Acland wrote that vessels within the zone of trauma should be 'strongly avoided' and used the term 'post-traumatic vessel disease' to describe the changes in vessel calibre and quality within and around the fracture zone.[4] Despite this teaching, more recently equally successful outcomes have been reported performing anastomoses to recipient vessels distal to the zone of trauma.[5,6]

We present a series of traumatic lower-extremity free flap reconstructions where anastomoses were performed within the zone of trauma, at the level of the fracture site. Our data suggest that anastomosis to recipient vessels within the zone of injury is likely to be as safe and successful as anastomosis performed proximally.

Methods

We reviewed the records of consecutive free flap reconstructions for lower-extremity fractures at a tertiary trauma centre between 2004 and 2010. Reconstructions were performed by consultant surgeons at the unit and by trainee surgeons under supervision. Routine preoperative angiography or Doppler studies were not performed. Recipient vessels were chosen on the basis of those lying closest to the fracture and soft tissue defect site allowing for the correct orientation and positioning of the free flap pedicle. Vessels in continuity were judged to be adequate, even if the adventitia appeared injured or haemorrhagic. Once an arteriotomy was performed, the down flow was assessed. If inadequate, a proximal vessel injury was studied and corrected when required. Patients were not routinely anticoagulated but received venous thromboembolism prophylaxis with low molecular weight heparin (dalteparin) according to the Trust protocol.

Data were collected on age, lower limb fracture site and type, Gustillo—Anderson classification, delay from injury to soft tissue reconstruction, type of free flap and outcomes including anastomotic revision, return to theatre and flap survival. The operative records were reviewed to subclassify cases according to the level of the anastomoses (recipient vessels proximal, distal or within the zone of trauma) and whether the arterial anastomosis was performed end to end or end to side.

Data were analysed by chi-squared, Fisher's exact, Kruskal—Wallis and Mann—Whitney tests. A D'Agostino and Pearson omnibus normality test was used to determine whether data were normally distributed. Statistical significance was determined by a value of $p \leq 0.05$.

Results

The study included forty-eight free flap reconstructions for lower limb fractures performed at a single institution. Of these, 39 were open fractures of the lower limb (Gustilo—Anderson classification 2—3B) and nine were initially closed injuries, which later required soft tissue reconstruction for wound breakdown and exposed metalwork. Free muscle transfers constituted 94% of reconstructions and fasciocutaneous free flaps 9%. Overall, the mean delay from the lower limb fracture to soft tissue cover was 28 days (range 0—275 days, 95% confidence interval (CI) 13—43 days).

Level of anastomosis

We compared groups with similar fracture patterns and soft tissue injuries. Anastomoses were performed on recipient vessels proximal (21), distal (5) or within the zone of trauma (22). The mean delay from fracture to free flap reconstruction was 61 days for proximal anastomoses (range 5—275 days), 30 days for distal anastomoses (range 2—214 days) and 18 days for zone of trauma anastomoses (range 0—101 days) and did not differ significantly between groups ($p = 0.88$). Figure 1 shows the time distribution

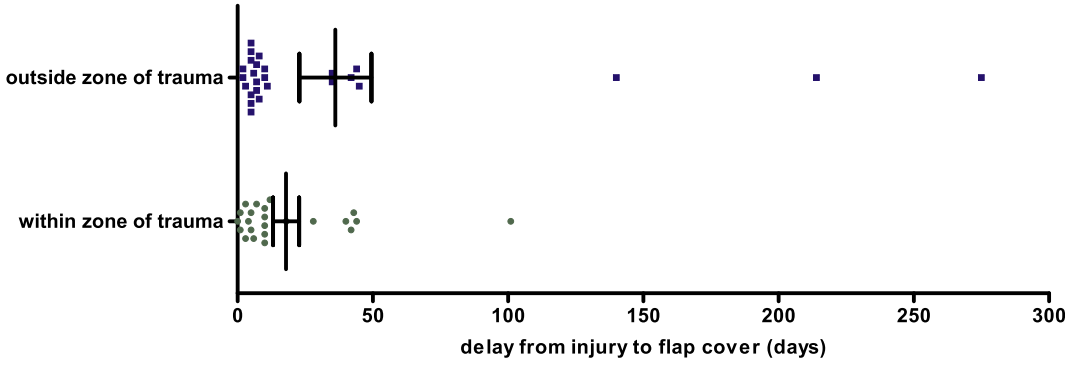

Figure 1 Plot of the distribution of time to flap cover (days) in reconstructions with anastomoses performed within the zone of injury (green circles) versus outside the zone of injury (blue squares), with mean (long black bars) and SEM (short black bars) for each group. There was no difference in delay to flap cover between groups ($p = 0.72$).