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Single-stage orthoplastic reconstruction of Gustilo–Anderson Grade III open tibial fractures greatly reduces infection rates

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ABSTRACT

Background: Grade III open fractures of the tibia represent a serious injury. It is recognised that combined management of these cases by experienced orthopaedic and plastic surgeons improves outcomes. Previous studies have not considered the timing of definitive soft tissue cover in relation to the definitive orthopaedic management. This paper reviews the outcomes in patients treated in an orthoplastic unit where the emphasis was on undertaking the definitive orthopaedic and plastic surgical procedures in a single stage, following initial debridement and temporary stabilisation as necessary.

Methods: We reviewed medical notes of 73 consecutive patients with 74 Grade III open tibia fractures (minimum 1 year follow up), to compare deep infection rates in patients who had (a) a single-stage definitive fixation and soft tissue coverage vs. those who had separate operations, and (b) those who had definitive treatment completed in <72 h vs. >72 h.

Results: (a) Combined Single-stage Orthoplastic Fixation and Coverage: 48 fractures were managed with definitive orthopaedic fixation and plastic surgical coverage performed at the same time, whilst 26 had these performed at separate stages. Of those subjects that had definitive fixation and coverage in one procedure 2 (4.2%) developed deep infections, compared with 9 (34.6%) deep infections ($p < 0.001$) in those who underwent definitive fixation and coverage at separate operations. (b) Timing of surgery: Of the fractures that had definitive fixation and coverage completed within 72 h of injury, 5 (20%) developed deep infections, compared with 6 (12.2%) deep infections ($p = 0.492$) in those whose definitive fixation/coverage was completed at later than 72 h.

Conclusion: Joint orthoplastic operating lists facilitate simultaneous definitive fixation and cover that greatly reduces infection rates. Based on our experience presented in this paper, we believe that emphasis should be placed on timely transfer to a specialist centre, aiming for a single-stage combined orthoplastic procedure to achieve definitive fixation and soft tissue coverage and optimal outcomes.

Introduction

Fractures of the tibial diaphysis are common with an incidence of 20 per 100,000 population per year [1]. Approximately 23.5% of these are open [2]. Godina's landmark paper [3] outlined the advantages of early microvascular reconstruction of open fractures and it is now recognised that combined management of these cases by experienced orthopaedic and plastic surgeons has distinct advantages [4]. In 2009 standards for the management of open fractures of the lower limb in the United Kingdom were suggested by a working party combining orthopaedic (British Orthopaedic Association (BOA)) and plastic surgery (British Association of Plastic and Reconstructive Surgery (BAPRAS)) expertise [5]. This publication also outlined the appropriate infrastructure and personnel required to run a comprehensive 'orthoplastic' service and included microbiologists, interventional radiologists, rehabilitation specialists, limb prosthetic services and psychologists.

The fourth of the British Orthopaedic Association Standards for Trauma (BOAST 4) [6] was also published in 2009. It went further in defining the criteria for management of open tibial fractures suggesting the aim to definitively treat these injuries within 72 h. This part of the standard was then adopted as the orthopaedic measure in the Trauma Audit and Research Network (TARN), a UK based database for trauma patients. In many centres dealing with open fractures the availability of the appropriate plastic surgical expertise makes this target very difficult to achieve. In Britain, even

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in centres where there is appropriate orthopaedic and plastic expertise, the limited availability of resources such as operating list provision mean that the target is often challenging.

This paper reviews the outcomes in patients treated in an orthoplastic unit where the emphasis was on undertaking the definitive orthopaedic and plastic surgical procedures in a single stage, following initial debridement and temporary stabilisation as necessary.

The research question was: 'Is there a difference in the rate of deep infection in patients with Gustilo–Anderson (GA) Grade III open tibial fractures, who have single-stage combined definitive skeletal fixation and soft tissue coverage, compared with those who have definitive orthopaedic and plastic surgery in separate operations?' The study also looked at this in relation to the 72 h BOA standard.

Methods

Between March 2010 and January 2013, 81 patients presented to our major trauma centre with GA Grade III tibial open fractures. Case notes and follow up clinic letters were reviewed. 8 patients were found to have follow-up out of region and were excluded. This left us with complete notes and datasets for 73 patients with 74 GA Grade III open tibial fractures. The GA classification was made after the first debridement undertaken.

The diagnosis of 'deep Infection' was based on the criteria described by the Centers for Disease Control and Prevention (CDC) for 'deep incisional surgical site infection' as per Fig. 1. In particular, the definition was not reliant on positive deep cultures and assumed that any intervention, revision or antibiotic use was indicative of infection in this cohort.

Protocol

The unit aimed to achieve the transfer of patients with open tibia fractures from referring hospitals as soon as possible. On arrival at our centre, patients were placed on a trauma list for debridement and temporary stabilisation as appropriate, with senior plastic surgeons present. If required, patients were taken back to theatre for further reviews and debridements prior to definitive reconstruction. If there was a delay in hospital transfer, the initial wound debridement and temporary stabilisation ± negative pressure dressing was undertaken at local hospitals.

Following these initial procedures, the aim was to place patients on a joint orthoplastic theatre list with senior orthopaedic and lower limb plastic surgeons present, to achieve timely *definitive skeletal fixation and soft tissue coverage in a single-stage*. This is in contrast to previous referral pathways where definitive orthopaedic stabilisation might be performed with subsequent referral onto plastics for further surgery to achieve definitive closure.

Intravenous antibiotics were administered within 3 h of injury, and continued until soft tissue coverage was complete, as per BOA/BAPRAS guidelines. Post-operatively patients were based on a specialist plastics ward with nursing expertise in graft and flap management. Following discharge from hospital patients were seen as required in a joint orthoplastics clinic, with a minimum of one-year follow up. If there were any concerns regarding infection or non-union after patients were discharged from the clinic, they were referred back via their GP/local hospital as appropriate.

Statistical analysis

Study groups were analysed using Fisher's exact test. *P*-values <0.05 were considered significant (SPSS Version 19; IBM; New York).

Results

30 patients presented directly to the Emergency Department of the study centre. 43 attended peripheral hospitals initially and were then referred.

There were 25 males and 48 females with an age range from 16 to 95 years (mean = 46¼ years). The severity of the injury was recorded using the Gustilo and Anderson (GA) classification system: there were 5 Grade IIIa fractures, 66 Grade IIIb fractures and 3 Grade IIIc fractures. Definitive soft tissue coverage were provided in a number of ways, as per Table 1.

Overall deep infection rates

Of the 74 fractures in this study, 11 (14.9%) developed deep infections.

Combined single-stage definitive fixation and coverage

48 fractures were managed with definitive orthopaedic fixation and plastic surgical coverage performed at the same time, whilst 26 had these performed at separate stages (Table 2).

Of the subjects that had definitive fixation and coverage in one procedure, 2 (4.2%) developed deep infections, compared with 9 (34.6%) deep infections ($p < 0.001$) in those who underwent definitive fixation and coverage at separate operations.

Timing of surgery

Of the patients who had fixation and coverage completed within 72 h of injury, 5 (20%) developed deep infections, compared

Infection occurs within 1 year if implant is in place and the infection appears to be related to the operation
and
infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision
and at least *one* of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or
symptoms: fever (>38°C), localized pain, or tenderness, unless site is culture-negative.
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathology
ic or radiologic examination.
4. Diagnosis of a deep incisional SSI by a surgeon or attending physician.

Fig. 1. Centers for Disease Control and Prevention: definition for deep incisional surgical site infection.