Injury, Int. J. Care Injured 46 (2015) 254–258

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Do minimally displaced, closed tibial fractures in children need monitoring for compartment syndrome?

Karan Malhotra *, Sunil Pai, Graham Radcliffe

Department of Trauma & Orthopaedics, Bradford Royal Infirmary, Duckworth Lane, Bradford BD9 6RJ, UK

ARTICLE INFO

Article history:
Accepted 26 April 2014

Keywords:
Tibial fractures
Paediatric fractures
Acute compartment syndrome

ABSTRACT

Introduction: Acute compartment syndrome (ACS) may be seen following tibial fractures in adults. Although the risk of this complication is thought to be lower in children (especially in those under the age of 12 years) it is routine practice in many units to admit all children with this injury for observation. The aim of this study was to ascertain whether all children under the age of 12 presenting with fractures of the tibia merited admission and to provide recommendations on how to manage these patients based on our experience with this injury.

Patients and methods: We retrospectively studied the clinical and radiographic progress of consecutive patients presenting to our institution with tibial fractures over a 5-year period.

Results: A total of 159 tibial fractures were seen in the study period. The mean age of patients treated was 5.8 years. 81% of the injuries occurred in the diaphyseal region and 60% involved the tibia only. A total of 9% of injuries were open and overall 66% of fractures were managed non-operatively. No cases of ACS were seen.

Discussion: Based on our experience we provide a treatment algorithm detailing how children in the under 12 age group presenting with tibial fractures may be managed. Patients with minimally displaced fractures involving the tibia only, whose pain is adequately controlled and who can safely mobilise with suitable parental supervision may be safely discharged from the emergency department in a back slab with early follow up. Although no children under the age of 12 in the present study developed ACS following a fracture of the tibia, certain features such as a history of a high energy injury, displaced fractures or co-existing fibular fractures should raise suspicion that this complication may ensue. In these cases admission and observation may be warranted.

Introduction

Tibial fractures are the 3rd most common fracture of childhood [1,2]. The most common pattern is an oblique fracture involving the distal third of the shaft, often as a result of a rotational force [2–4]. Acute compartment syndrome (ACS) is one of the most feared and devastating complications of this injury and in adults there is a significant incidence associated with tibial fractures [5,6]. However, there is little evidence to suggest that children with closed, minimally displaced tibial fractures are at the same risk [7–9]. The risk is thought to be even lower in children under 12 years [8]. Children with open tibial fractures have however been found to have a high risk of developing ACS, comparable to the risk in adults [10]. Current practice in many units is to admit all children with tibial fractures for elevation and monitoring for ACS. We present our experience of managing such injuries over a period of 5 years. We aimed to determine the risk of developing ACS in children under the age of 12 years with closed minimally displaced tibial fractures, and whether they all require admission.

Patients and methods

Our hospital is a teaching hospital in the North of England receiving a high volume of trauma. We retrospectively examined data of all patients under the age of 12 who presented with tibial fractures over a 5-year period. As per our standard practice, all these patients were admitted for at least overnight elevation and observation for ACS in an above knee Plaster of Paris back-slab. The next day, the patients had their back-slab changed to a light-weight, synthetic, above knee cast and discharged if they met the following criteria: they were comfortable, able to mobilise (or be carried by their parents), were suitable for non-operative

* Corresponding author. Tel.: +44 7986757570.
E-mail address: karan@doctors.org.uk (K. Malhotra).

http://dx.doi.org/10.1016/j.injury.2014.04.046
0020–1383/

treatment, and there was no suspicion of non-accidental injury (NAI).

We gathered demographic data and details about length of stay (LOS). LOS was calculated as the time from admission to the ward to the time of discharge. We also examined radiographs to document fracture pattern and displacement, and the patients' medical notes to determine treatment mode, time to union and complications.

We classified fractures as 'minimally displaced/angulated' or 'significantly displaced/angulated'. When assessing displacement and angulation of fractures we used criteria of acceptable displacement as defined by Wilkins [11]. A fracture was considered to be minimally displaced/angulated if it met the following criteria: less than 5 degrees of varus or valgus angulation, less than 5 degrees of apex-posterior angulation, less than 5 degrees of rotation, less than 5 mm shortening, no apex anterior-angulation, and less than 20% translation in any plane. The judgement of whether a fracture was minimally or significantly displaced was made on the index radiograph taken prior to application of a plaster.

We excluded patients with incomplete notes or inadequate follow-up. We also excluded patients without radiographs available for review and with fractures involving the ankle or knee joints. Distal and proximal fractures involving the physis were included as long as there was no articular extension.

Results

The notes and radiographs of 172 patients were reviewed and 13 patients were excluded (fractures involving the ankle or knee in 10 cases, 1 child lost to follow-up, no radiographs for 1 child and incomplete notes for 1 child). Therefore over the 5-year period a total of 159 tibial fractures in patients 12 years or under were included. 95 of the patients were boys and 64 were girls. The mean age was 5.8 years (range 1–12 years). The age distribution can be seen in Fig. 1. 129 fractures were diaphyseal (81%). There were 15 open fractures (9%) all of which underwent debridement. In total 105 fractures (66%) were managed non-operatively. Fig. 2 documents the location of fractures studied and Table 1 gives a breakdown of the proportion of fractures that were minimally or significantly displaced or angulated and whether such injuries were subject to operative or non-operative treatment. Fig. 3 shows the breakdown of methods of treatment. All fractures were isolated injuries apart from in 1 patient who also sustained an ipsilateral femoral injury. This patient had a displaced fracture and was treated with elastic intra-medullary nailing (EIMN).

The mean LOS for patients managed non-operatively was 1.8 days (range 0–5 days) and the mean LOS of all patients was 2.6 days (0–16 days). In the subgroup of patients requiring surgery and manipulations under anaesthesia (MUA) re-angulation occured in 3 cases: 2 after MUA only and one after EIMN. There was one case of neuropraxia after MUA of a displaced fracture, which settled, and 1 case of skin graft breakdown after treatment of an open fracture. In our non-operated group there were 3 cases of angulation in cast, 2 of which were treated with wedging of the

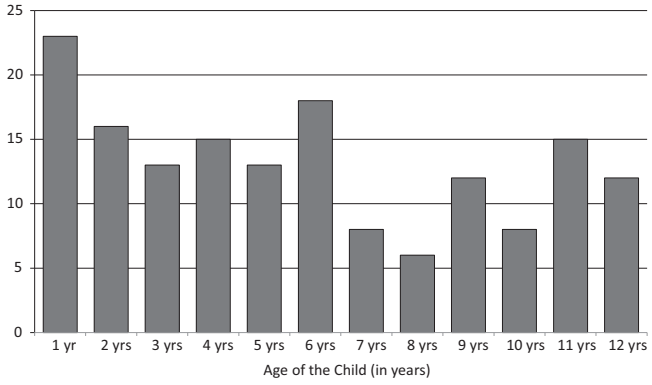

Fig. 1. Figure showing the number of patients in each age group in this study.

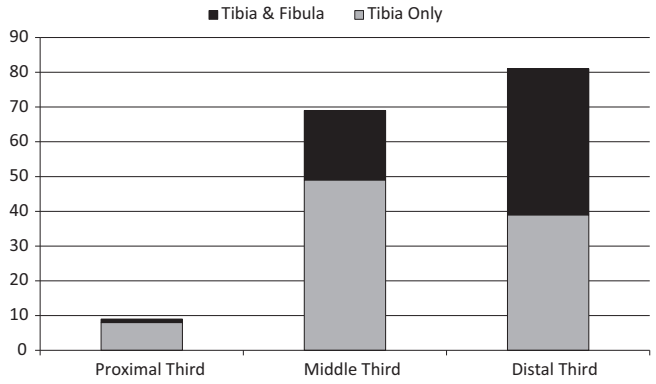

Fig. 2. Figure showing the number and site of diaphyseal tibial fractures (darker segment shows proportion who had a co-existent fibular fracture).

Table 1
Table demonstrating the degree of displacement/angulation and whether the fibula was involved in different subgroups of patients.

Treatment group	Displacement	Tibia fracture only	Tibia and fibula fractured
Non-operated	Minimally displaced	73	16
	Significantly displaced	12	4
Operated	Minimally displaced	0	0
	Significantly displaced	11	43

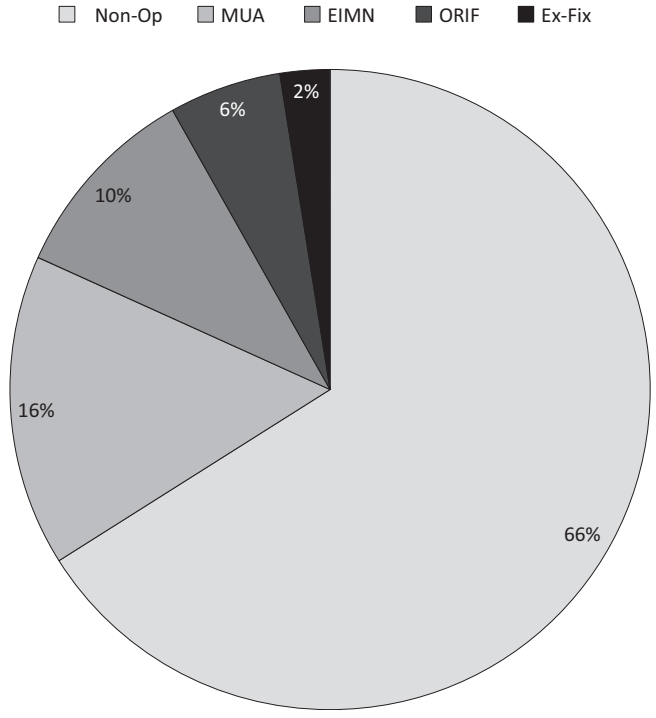

Fig. 3. Figure indicating methods of treatment: non-op = non-operative; MUA = manipulation under anaesthesia; EIMN = elastic intra-medullary nails; ORIF = open reduction and internal fixation; ex-fix = external fixator.