■ CASE REPORT

A completely shattered tibia

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Despite advances in reconstructive surgery, salvage of mangled extremities still requires long periods of treatment with many operations that can be taxing both to the surgeon and the patient. Attempts at reconstruction of severely shattered limbs necessitate counselling with regard to the protracted course of treatment and associated morbidity as well as problems which may require abandoning of the procedure and secondary amputation. We report the successful salvage of a severely comminuted and open fracture of the tibia in a 32-year-old man.

Open fractures of the tibia are common. The sparse anterior soft-tissue cover results in many of these injuries being grouped under type III of the Gustilo-Anderson classification.¹ These are prone to severe complications such as infection and nonunion. Treatment is protracted with a high incidence of secondary amputation in types III B and III C fractures. Surgeons are faced with the dilemma of deciding whether to amputate or save the extremity. This is a report of a patient with a completely shattered type III A fracture of the left tibia sustained at work. Limb salvage finally resulted in a fully functional limb after five surgical procedures during three years. To our knowledge, no similar case of successful salvage of a completely shattered tibia has been reported.

Case report

A 32-year-old man, a manual labourer in a granite quarry, presented after heavy equipment had fallen on his left leg while working. He was in a state of shock and the skin of the entire left leg had multiple sieve-like punctured wounds through which small spikes of bones were visible. There was minimal contamination of the wounds. The leg sagged even when supported distally, but, surprisingly, active toe movements were present and the posterior tibial pulse was palpable. The dorsalis pedis pulse was not palpable and it was only feebly heard with a handheld Doppler.

The sensation on the sole of the foot was normal. However, there was mild sensory blunting over the dorsum of the foot. The knee did not have an effusion and the femur, hip and opposite limb were clinically normal.

Following resuscitation with fluids and blood, radiographs showed a completely shattered tibia and fibula from the proximal metaphyseodiaphyseal junction to the ankle. The medial malleolus was also fractured. The leg was truly a 'bag of bones' (Fig. 1).

Intravenous broad-spectrum antibiotics were started after tetanus immunisation. The limb was splinted after the wounds had been thoroughly washed with saline.

As plantar feeling was intact and the distal vascularity good we decided to aim for limb salvage rather than perform a primary amputation. The Mangled Extremity Severity Score (MESS)² was 5, which was in favour of limb salvage. Most patients in India opt for retaining a mangled extremity, if given a choice. The severity of the injury does not matter and they are willing to undergo protracted periods of treatment with external fixators and many operations in order to retain their limb, regardless of how stiff it may be. The social stigma associated with an amputation is so degrading that many say they would rather die than have an amputation, despite the merits of early amputation and prosthetic fitting.

Our patient was adamant that all efforts should be made to save his limb. The length of tibia for an adequate below-knee stump was not available as the fracture extended to the proximal metaphyseodiaphyseal junction. If an amputation had been undertaken, it would have been either through- or above-knee.

External fixation was excluded as there were no major cortical fragments which could provide purchase for Schanz pins or tensioned Kirschner wires. Calcaneal traction would not

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Fig. 1

Anteroposterior and lateral radiographs of the left lower leg at the time of injury.

Fig. 2

Anteroposterior and lateral radiographs of the left lower leg following index surgery using locked intramedullary nailing.

have provided adequate reduction without additional immobilisation with a posterior splint.

This left us with the option of a locked intramedullary device. Even if the nail did not pass through the medullary canal of the shattered bone, it would help to realign the limb, restore length and provide support until the comminuted fragments were bridged by callus and consolidation occurred. The results of Grosse,³ who successfully treated a case of bilateral shattered femora with a Grosse-Kempf intramedullary nail encouraged us to proceed.

On 5 September 1998, a 9 mm x 360 mm Grosse-Kempf intramedullary nail (Stryker Trauma GmbH, Schonkirchen, Germany) was passed through the comminuted fragments of the tibia and statically-locked proximally and distally (Fig. 2). The patient was placed on a radiolucent table with the knee hyperflexed using a wooden block to support the distal thigh while an assistant applied traction to the leg. An entry point was made with an awl and the proximal metaphysis reamed to 10 mm. A guide wire was passed through the comminuted fragments to the centre of the distal epiphysis. The selected nail was then passed over the guide

wire and locked. Good stability was achieved. A split skin graft was used to cover a small area at the junction of the upper and middle thirds of the tibia while the other wounds were sutured. An above-knee plaster cast was applied after removal of the sutures on the 12th post-operative day.

On review eight months later, radiographs showed union in the lower two-thirds of the tibia with nonunion at the junction of the upper and middle thirds and 1 cm of shortening. In May 1999, a 4.5-mm dynamic compression plate was applied with four screws bypassing the nail and autogenous ipsilateral iliac bone graft was placed around the nonunion. Further plaster immobilisation and partial weight-bearing with crutches was advised.

One year and five months after the injury, there was persistent abnormal mobility at the junction of the upper and middle thirds with 2.5 cm of shortening. The dynamic compression plate was removed and contralateral autogenous fibular and iliac crest grafts were packed around the nonunion. Electrical stimulation was added to improve healing.

Radiographs taken nearly two years after the injury showed a persistent nonunion. The nail was removed and

Fig. 3

Frontal view of the patient demonstrating full weight-bearing capability on the left leg. Persisting sinuses can be seen.

Fig. 4

Lateral view of the patient showing full active knee flexion.

an Ilizarov external fixator applied. The fixator was dynamised two months later and was removed two years and four months after the injury, at the request of the patient. A patellar tendon-bearing cast was applied and the patient was advised to partially weight-bear. On 4 April 2001, the cast was removed. He was subsequently fitted with a weight-relieving caliper. However, three years and three months after the injury the fracture was still visible on x-ray and there was a sequestrum.

The sequestrum was excised and bone substitute (G-Bone modified hydroxyapatite blocks; G-SurgiWear Ltd, Shahjohanpur, India) added. A local flap helped achieve bone cover. When the flap had healed, full weight-bearing with the caliper was allowed.

At this stage nearly all available techniques had been exhausted and there remained a resistant nonunion. We began to regret the decision not to undertake a primary amputation. The patient had lost his job, although his son was granted one in his place. His generous employers, who had paid for his medical expenses, were now reluctant to continue payments. He was now upset that an amputation, which would have enabled him to secure good compensation, had not been performed.

We lost the patient to follow-up after the last operation in December 2001 but were pleasantly surprised when he returned in May 2004, walking without a caliper or an aid. He was free of pain and had a new job as an autorickshaw driver. He walked comfortably, with a short-limbed gait. Clinical examination did not show any tenderness or mobility at the site of the previous nonunion. There were two small sinuses at the junction of the middle and upper thirds of the tibia but there was no active discharge and the patient was afebrile. Full weight-bearing could be demonstrated with a single-leg stance on the affected limb (Fig. 3). There was good alignment of the limb with a full, active range of knee movement (Fig. 4) and plantar flexion of 15° at the ankle joint. The ankle could not be dorsiflexed beyond neutral. There was 4 cm of shortening. Radiographs revealed sound union at the junction of the upper- and middle-thirds with consolidation of the comminuted fragments and acceptable overall alignment (Fig. 5).

Discussion

The incidence of major complications and failure with prolonged salvage surgery for patients with complex tibial

Fig. 5

Anteroposterior and lateral radiographs of the left lower leg 5.5 years after index surgery showing union and consolidation of the 'bag of bones'.

fractures encourages a surgeon to think carefully before attempting limb reconstruction.

Caudle and Stern⁴ reported a nonunion rate of 27% with type III A fractures and of 43% with type III B fractures. In this latter group, the deep infection rate was 29% and 17% required secondary amputation. Type III C fractures had a 78% incidence of secondary amputation with nonunion developing in all those that did not have an amputation.⁴

A variety of injury severity scores such as the MESS and the Hannover score¹ provide guidelines, but they should not be the sole deciding criterion. Bosse et al,⁵ in their study on the clinical use of lower extremity severity scores found that although low scores were valuable for predicting the

potential for limb salvage, high scores were not good predictors for amputation. The injury severity scores should only supplement the surgeon's experience in the treatment of mangled extremities and his assessment of the severity of the injury and the general status of the patient. These are the most important factors in determining the prognosis and outcome.

Our patient required five procedures over three years for a successful result. The severe comminution resulted in extensive periosteal and endosteal damage that probably caused the delay in union. This is in broad agreement with Caudle and Stern's report,⁴ when a mean of four operations were required for type III A open tibial fractures to achieve union.

Grosse³ has reported a case of bilateral shattered femora which was successfully treated with intramedullary nailing. The fact that the femur is surrounded by muscles could have contributed to the excellent result. We were faced with a similar situation, but in a bone which is not so well covered.

Although we were fortunate to have had an excellent functional end result, Hansen's exhortation⁶ in his editorial in 1987 still holds true today despite advances in reconstructive surgery. Long treatment programmes with many hospital admissions and operations are physically, mentally and economically harmful to many patients.¹ A poor result after protracted salvage attempts may ultimately necessitate a secondary amputation. It is important that a patient should be cautioned on all aspects of their treatment and likely outcome before attempting salvage of a mangled extremity.

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