

The Use of an External Fixator to Heal a Pathological Tibial Shaft Fracture

Sandiford Z*, Kocalkowski C and Pillai A

Wythenshawe Hospital, Southmoor Road, Wythenshawe, UK

*Corresponding author: Zara Sandiford, Postgraduate Centre, Wythenshawe Hospital, Southmoor Road, Wythenshawe, M23 9LT, UK, Tel: +447835157040; Email: zara.sandiford@nhs.net

Received date: April 29, 2015; Accepted date: May 18, 2015; Published date: May 24, 2015

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Abstract

Tibial shaft fractures are typically the result of high-energy injuries, however bone that has been substantially weakened may be susceptible to fractures without a preceding traumatic incident. Such bone weakening may occur secondary to malignant disease but also in chronic conditions such as Paget's disease. The altered structural properties of Pagetic bone and cellular changes including increased vascularity complicate the orthopaedic management of fractures in these patients. It is common practice to repair tibial fractures using intramedullary nails which provide full-length fixation of the bone and thus stability and alignment during bone healing. Here we describe an alternative method for the surgical management of a fracture of the tibial shaft in a patient with Paget's disease. We successfully achieved clinical and radiological healing of the tibia in all cortices.

Keywords: Paget's disease; Tibial shaft; Fracture; External fixator; Ilizarov; Pathological fracture

Background

Paget's disease, a disorder characterised by abnormal bone remodelling is often diagnosed incidentally (raised serum alkaline phosphatase or radiologically), yet affects 1-2% of Caucasian adults aged over 55 years of age [1,2]. Increased bone resorption and the resultant increased bone formation leads to altered biomechanics and weakness in the structural properties of bone, particularly the axial skeleton. The aetiology of Paget's disease is not clearly defined however there appears to be a familial link in a number of cases, figures suggest approximately 15% of patients have an affected relative [1]. Some environmental factors have also been proposed to play a role including vitamin D deficiency, viral infections such as the paramyxovirus and dietary influences in childhood (low calcium intake) [1,2].

Typically, patients with Paget's disease remain asymptomatic however the most common clinical feature is bone pain, which may present at rest but also on exertion when using the affected bone. The weakened, and architecturally disorganised Pagetic bone is susceptible to a number of complications; bone deformities, pathological fractures, osteoarthritis, and enlargement which may lead to nerve compression [3]. Management of this disorder is primarily medical; bisphosphonates have been used for more than 40 years in patients who are symptomatic or at risk of secondary complications.

In addition to increased osteoclastic bone resorption, Pagetic bone has also been shown to have increased vascularity and marrow fibrosis [1,3]. The surgical management of orthopaedic conditions associated with Paget's disease is often challenging as substantial blood loss can occur and the deformed bones may not be amenable to open reduction as a result of soft tissue complications. This clinical case report describes a patient who was otherwise asymptomatic until he sustained a non-traumatic, closed tibial shaft fracture.

Case Presentation

An active 75-year-old gentleman presented to accident and emergency after his leg gave way walking down a steep slope whilst playing a game of golf. Aside from playing golf twice a week the patient also reported regularly walking long distances and enjoying gardening without suffering any problems. Ten years prior to this, the patient was diagnosed with Paget's disease by a rheumatologist and was prescribed an eight-week course of a bisphosphonate, following which he required no further intervention. As with many Paget's disease patients, this gentleman's diagnosis was an incidental finding of a raised alkaline phosphatase (ALP) on routine blood investigations as part of this cardiovascular disease follow up. Interestingly, 9 days before this gentleman presented at the emergency department he was seen by his rheumatologist as although the patient did not experience any bone pain or difficulty with activities his ALP was again noted to be raised. On examination of the patient, his left leg was swollen on the tibial side demonstrating a closed injury with no tenderness at the knee or ankle and no distal neurovascular compromise.

Investigations

The key to diagnosing this gentleman was through plain radiograph imaging. We took plain x-rays of this gentleman's lower limb which confirmed a tibial shaft fracture with pathology related to Paget's disease. The images below show a transverse fracture of the midshaft. Figure 1 shows typical pathology associated with the abnormal remodelling process that occurs in Paget's disease.

There was also a proximal shaft fracture of the fibula. Treatment of the tibial shaft fracture provided stability for the fracture of the fibula to heal by callus formation.

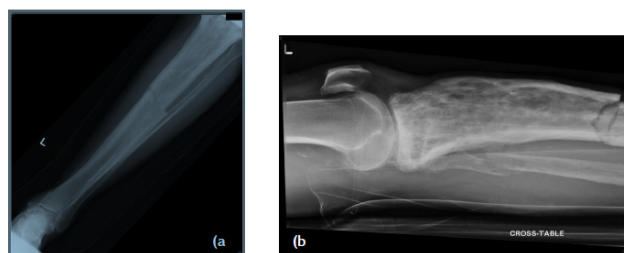


Figure 1: The plain radiographs here demonstrate Paget's disease of the tibia with a midshaft transverse fracture. In addition there is also a proximal shaft fracture of the left fibula which appears to be unaffected by Paget's disease.

Treatment

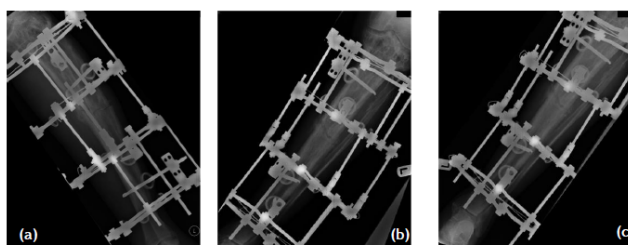


Figure 2: X-ray images following surgical fixation of the tibial shaft fracture using an external ring fixator. This modular external fixator can be applied along the length of the lower leg to provide stability and facilitate healing.

We used an external ilizarov fixator to surgically manage this patient's fracture (Figure 2). It is well known that external ring fixators provide relative stability. The use of pins enable multiplanar fixation and as such ring fixators are particularly advantageous in the management of fractures involving soft-tissue compromise, bone loss or structural deformities. The Ilizarov external circular fixator confers the following benefits of use which were particularly applicable to our patient's clinical case:

- Structural strength of the frame allows the patient to weight bear whilst the bone is remodelling.

- Minimal interaction with or breaches of soft tissue
- Modular components thus application can be modelled around skeletal deformities and adjusted to provide realignment.

Outcome & follow-up

Shortly after the initial fixation of the fracture, radiological evidence demonstrated a healing callus. However, after six weeks, although a posterior callus was forming well, anteriorly there was minimal callus formation. This delayed healing was at the apex of the fracture (the bow of the tibia). Ten weeks after the operation the anterior cortex still remained slow in healing rate thus the frame was adjusted to encourage callus formation. Two weeks later the frame was destabilised to stimulate bone healing and although there was tenderness at the fracture site, x-rays showed good healing in three cortices with the anterior cortex showing improvement. Follow up of the patient at five months showed clinically and radiologically that the fracture had healed.

Discussion

Paget's disease fractures are particularly susceptible to an increased risk of wound breakdown, bleeding and severely delayed healing. It was key to consider in this clinical scenario that due to the bow shaped bone deformity associated with Paget's disease, the fracture was not suitable for internal fixation or conservative management. In particular, this gentleman's tibia was not amenable to the gold standard treatment for tibial shaft fractures, intra-medullary nailing. We identified that to manage this patient's fracture an external Ilizarov fixator would provide stability and facilitate osteogenesis. Furthermore, external fixation of this fracture facilitated weight bearing and provided the least invasive choice of treatment. This case demonstrates the challenges presented when treating fractures of a pathological nature. Through manipulation of an external fixation device we were able to facilitate adequate clinical and radiological healing of the fracture in all cortices.

References

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