



Post-traumatic bone loss of the femur treated with segmental bone allograft and bone morphogenetic protein : a case report

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Reconstruction of a major bone loss remains a challenge for the orthopaedic surgeon. Most of the bone defects result from a bone tumour resection whereas a post-traumatic bone loss is more rare due to the numerous options available for bone fixation. However in high-energy trauma, the injury to bone may be so extensive as to justify removal of fragmented bone. A 57-year-old man presented with a severe injury at the thigh after a hunting accident, including a comminuted fracture of the femoral shaft. After thorough debridement, he was left with a large diaphyseal bone defect which was subsequently treated with a structural bone allograft, autogenous graft and rhBMP-7. Bone healing was achieved after several months.

Keywords : post traumatic bone defect ; bone allograft ; bone morphogenetic protein.

INTRODUCTION

Gun wounds are extremely rare among our emergency cases. Between 2000 and 2005, seven cases of which three occurred with airguns were recorded, excluding suicides. When bone is injured, a severe open fracture results, requiring immediate debridement, pulse water lavage, fixation and dressing. In some cases, the bone has been morcelised and cannot be fixed. If the resulting bone loss is major, it will be subsequently treated with either a vascularised bone graft with (8) or without a bone allograft (6), a bone transport (7) or a

two-stage reconstruction using bone cement first as a spacer, followed by a bone grafting procedure (5).

The use of a bone allograft is another alternative but is not favoured because the quality of the surrounding soft tissues has been altered and may jeopardise bone healing.

We report the combined use of a bone allograft and osteoinductive growth factor to manage a large bone defect at the femur.

CASE REPORT

A 57-year old patient was admitted to our emergency department after being shot at the left thigh by a firearm. The shot was accidentally caused by him. The bullet had impacted the posterolateral aspect of his left thigh and shattered the femur

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Fig. 1. — Antero-posterior (AP) view of the comminuted fracture of the femur before operation.

between the proximal and middle third. Bone splinters had lacerated the surrounding muscles and the skin on the anteromedial aspect of the thigh (fig 1). The open fracture, classified as a Gustilo III A, was multifragmentary and involved one third of the femoral shaft length. Despite the effect of cavitation produced by a high-speed missile when it goes through tissues, there was no sign of vascular or neural injury, and peripheral pulses were palpable.

Faced with this severe compound fracture with a combined bone, muscle and skin defect, external fixation was chosen as a first-line treatment. The wound was largely exposed and debrided, avulsed bone fragments were removed and preserved at -80°C in order to potentially re-use them later on. The wound was primarily closed and drained (fig 2).

One month after the initial injury the tissue had healed sufficiently to consider a reconstruction.



Fig. 2. — AP view after open fracture management and fixation.

There was no evidence of infection. Amongst the various options to reconstruct the femoral shaft, bone transport with the Ilizarov method and reconstruction with a vascularised fibula were considered. Immediate reconstruction with a massive bone allograft was preferred because it would allow rapid weight bearing. A 12-cm femoral bone allograft was fixed by a long Gamma nail (Stryker) with a static locking. The length of the reconstruction was based on the opposite femur. In order to promote bone healing, one dose of rhBMP-7 (Osigraft TN, Stryker Biotec) was applied at either side of the diaphyseal host-allograft interfaces as a paste after being mixed with the reaming products from the proximal and

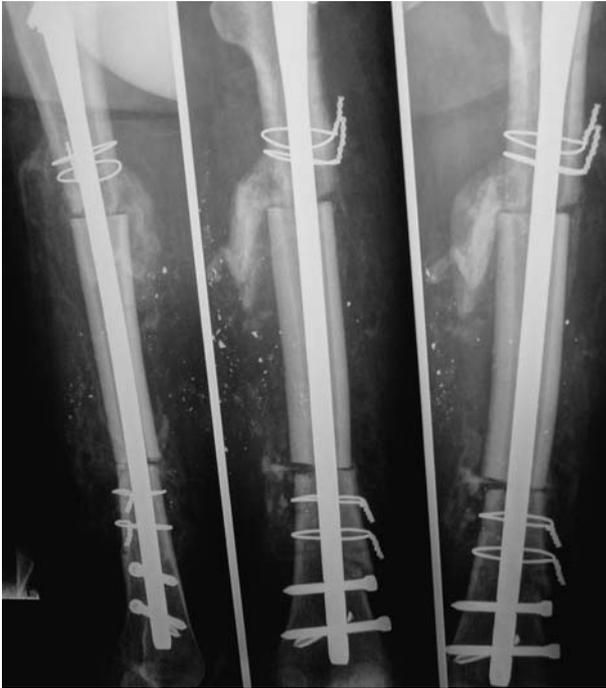


Fig. 3. — AP view of the following surgery performed one month after the initial trauma. Use of a 12-cm femoral bone allograft, interlocked intramedullary nailing and Osigraft® at both junctions.

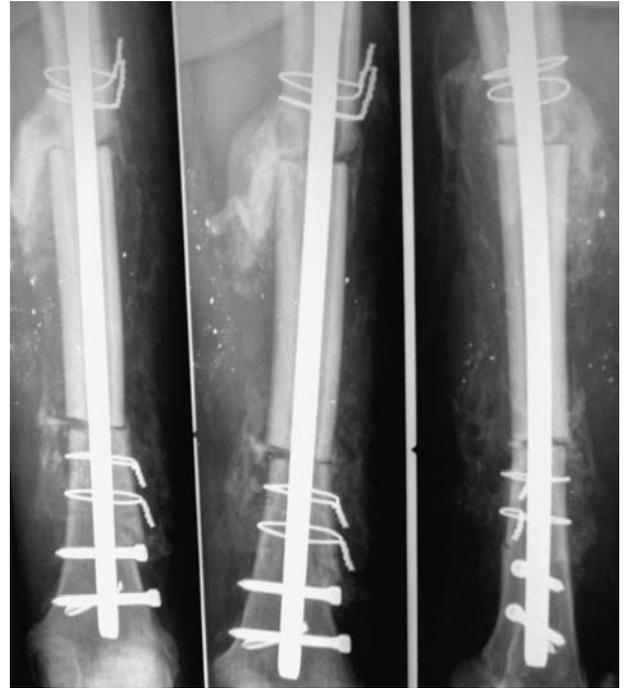


Fig. 4. — Radiological appearance at three months. The nail was dynamised.

distal femur and with blood taken from the operative wound.

The different tissue layers were closed over a suction drain (fig 3).

After a short stay in the intensive care unit, the patient recovered gradually from surgery and physiotherapy was immediately started. He had received a total of 14 blood units. He was discharged full weight-bearing six weeks postoperatively.

He further underwent two knee mobilisations under anaesthetic because of a loss of motion in flexion, with a resulting final flexion of 100°. However, he never recovered from a 15° extension lag of the knee due to a traumatic quadriceps tendon defect.

The first signs of bone healing were evident on radiographs at 7 weeks (fig 4). In order to fasten bone healing, dynamisation of the nail was performed at three months. At four months, the allograft was almost united to the shaft (fig 5).



Fig. 5. — AP view showing good integration of the bone graft

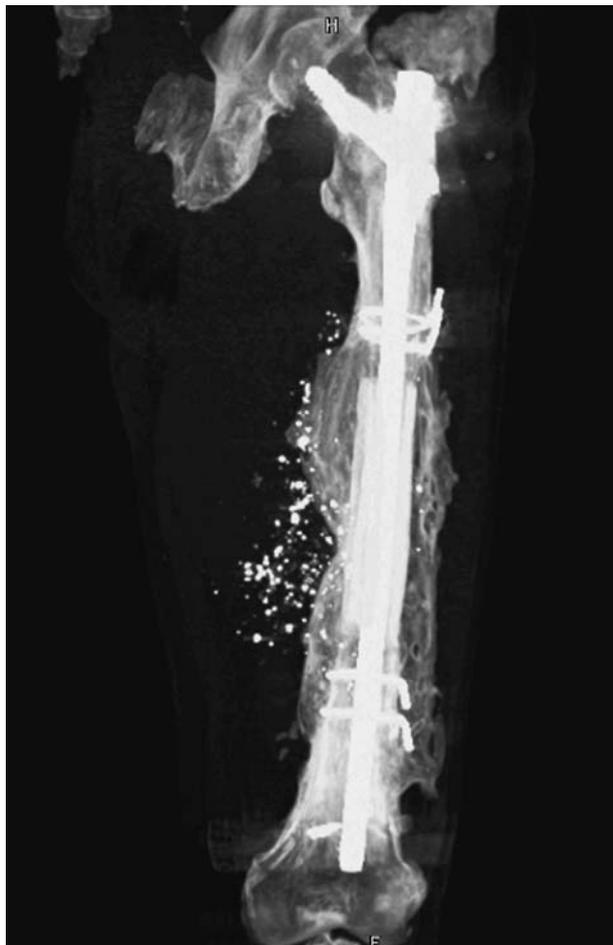


Fig. 6. — AP view reconstruction showing complete union at 13 months, with a hypertrophic callus.

Thirteen months after the reconstruction, union was achieved with a hypertrophic callus at both sites (fig 6). Some degree of heterotopic ossification was observed in the surrounding muscles. There was no axial deformity, and there was 8-mm shortening of the limb.

DISCUSSION

Post-traumatic bone defects are rare because there are currently many options available for bone fixation. For this reason, the use of a bone allograft remains rare, considering the availability of other options such as bone transport using Ilizarov's method or the use of a vascularised fibula. In this

case, bone allografting was decided because it would allow rapid weight bearing and in case of failure, it would not preclude the use of another method.

Bone allografting is associated with a high rate of non-union and fracture (3). In order to promote bone healing at the junction site, recombinant human bone morphogenetic protein (rhBMP-7) was associated at both junction sites. Conflicting results have been reported regarding the effectiveness of such molecules in the presence of allograft. Evidence of healing has been demonstrated in experimental conditions (1, 4) but not so far in human beings (2). It is difficult to evaluate the exact role of the bone morphogenetic protein in this specific case. Nevertheless, union was achieved at 13 months without bone autografting other than the remaining product. It is assumed that the early phase of bone repair initiated at both ends of the femoral defect before the delayed reconstruction provided a favourable environment for the osteoinduction to occur.

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