New way to reconstruct severe injuries to the lower extremity: a case report

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Short title: Reconstruction with cadaver bone graft

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Abstract

The combined use of an avascular cadaver bone graft, and a reverse flow fibular osteoperiosteal, and soleus muscle flap is a reliable option for the reconstruction of severe injury to the lower extremity because of the segmental blood supply from the fibular artery.

Key Words: Reverse flow, fibula, osteoperiosteal flap, soleus, bone graft

Introduction

Reconstruction of large, deep soft tissue defects connected to multiple bony fractures of the lower extremity is a serious challenge [1]. The use of free flaps requires microvascular expertise, lengthens the operating time, and increases the possibility of postoperative complications [2]. Donor site morbidity decreases the possibility of early functional recovery. The combined use of an avascular cadaver bone graft, and a reverse flow fibular osteoperiosteal and soleus muscle flap is a reliable option for reconstruction of a severly injured lower limb, which gives quick recovery of weight-bearing and function.

Case report

A 25-year-old professional motorbike racer had an AO II/B crural fracture with a supramalleolar fibular fracture, a combined tibial fracture, an open and penetrating soft tissue damage of the right lower limb as the result of a road traffic crash (Figure 1). Four hours after the injury, the wounds were debrided (the first operation). As the result of the multiple tibial fractures, avascular bone fragments were found, which had to be removed. As a consequence of this, the tibia had to be shortened. To preserve the length of the extremity, we stabilised the tibia with an Ortofix external fixator. The aim of the subsequent operation was to produce normal length and function of the lower extremity.

Several methods can be used to preserve the length and function of the tibia. The first is to stabilise the bony parts in the original position, keeping the distance of the defect between the ends of the fracture, and secondly to supply the defect with an autologous corticospongiosus bone graft [3]. The disadvantages are prolonged healing, uncertain result, and formation of sequestra [4].

The second choice is stable fixation of the fracture with shortening the bone and then, in a second step, after the healing process, to lengthen the extremity. The bony defects and the inequality in length may be corrected by the Ilizarov distraction technique, but the complication rate during treatment is high and the learning curve is notoriously long [5]. We had to settle for a long healing process and two or more subsequent operations [6].

Another choice is the use of free osteoperiosteal flap reconstruction, which can be derived from the iliac crest or the fibula [7]. The arterial blood supply of a fibular bone flap is more permanent, and stronger. However, taking the flap from the iliac crest or from the fibula on the other side would have harmed the patient, because of his profession. In the second operation 7 days after injury, therefore, the reconstruction of the bony defect and soft tissues was done in one step. We tried to keep the original length of tibia, to supply the bony defect with homologous bone from a bone bank (West Hungarian Regional Tissue Bank, Petz Aladár County Hospital, Győr, Hungary) (Figure 2), and stabilised the region with stable osteosynthesis using intramedullary nailing (Figure 3). The former external fixation was removed. Because the fibula of the injured site was also broken at the level of the lateral malleolus, we tried to use it to stabilise the tibia. We kept the distal two perforating vessels, and after high fibular osteotomy, the fibular segment was rotated 180° distally to the level of the tibial defect and fixed with screws. The blood supply of the rotated fibular segment remained intact after transplantation (Figure 2). The autologous ipsilateral fibular flap with reverse blood flow gave better blood supply to this region. To provide more, and stabilise the

blood supply, the soleus muscle was mobilised, and the operation field was covered with it. Because of the segmental blood supply through the fibular artery, this method did not require microvascular suturing.

Postoperatively the patient was immobilised in a cast, and then began passive and active physiotherapy. His recovery and bone healing were uneventful, and he was discharged on the sixth postoperative day. Eleven weeks after the injury he took part in a motorbike race with total recovery of function (Figure 4).

Discussion

Treatment of bone and soft tissue defects in the lower limb is a challenge, particularly in patients with multiple injuries [8,9]. Several options can be used for reconstruction. The free musculocutaneous flap technique needs more expertise, lengthens the operating time, and often has healing complications, such as necrosis of the flap [2]. We have reported a case in which the combined use of an avascular cadaver bone graft, and a reverse flow fibular osteoperiosteal and soleus muscle flap was used to treat open multiple fractures of the tibia and fibula with a severe soft tissue defect. This method did not need microvascular techniques, and the blood supply and circulation to the flap was safe and constant. Taking the ipsilateral fibula for reconstruction, the other side remained intact and we did not have to deal with functional loss or morbidity at the donor site. With the insertion of a cadaver bone graft into the missing portion of the tibia, we could maintain the length and function of the lower limb. The blood supply of the bone would be maintained by reverse flow from the fibular artery (Figure 2), and from the blood supply of the soleus muscle. Postoperatively the patient made an uneventful recovery, and was fully weight-bearing 11 weeks after injury (Figure 4).

References

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Figure legends:

Figure 1. Radiograph showing the multiple fracture of the lower extremity.

Figure 2. Intraoperative photograph showing (a) the insertion of avascular cadaver bone from a bone bank (black arrow), and (b) the reverse flow fibula osteoperiosteal flap (black arrow), with which the bone defect of the tibia was filled and strengthened.

Figure 3. Postoperative radiograph showing the reconstructed tibia with an avascular cadaver bone graft, and a reverse flow fibular osteoperiosteal flap.

Figure 4. Total weight bearing eleven weeks after operation. There was no functional loss.