



Using a Free Vascularized Fibula Osteoseptocutaneous Flap for Intramedullary Fixation and Soft Tissue Coverage of a Combined Segmental Bone Defect of the Distal Tibia and Soft Tissue Defect

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A 73-year-old man sustained a severe injury to his lower leg, causing a distal tibial bone defect and extensive soft tissue damage. The patient underwent acute conventional debridement and external fixation leaving a 7 cm bone lesion in the tibia and a soft tissue defect in the leg. The contralateral fibula was used to provide bridging vascularized intramedullary fixation and its skin paddle was used to cover the soft tissue defect. This case demonstrates that a free vascularized fibular osteoseptocutaneous flap can be used for simultaneous intramedullary fixation and soft tissue coverage.

Key words: free fibula flap, distal tibial fracture, intramedullary fixation

INTRODUCTION

Despite advances in bone fixation and grafting, micro-surgery and wound debridement, the repair of an open fracture of the tibia remains a difficult reconstructive challenge for the plastic surgeon.^{1,2} Open fractures of the tibia have been classified by Gustilo and Anderson.³ Type III Gustilo fractures are the result of high-energy trauma and constitute extensive soft tissue damage with open or segmental fractures, which can require vascular repair. If such an injury results in tibial defects of less than 6 cm, autogenous cancellous bone grafts can be used generally to bridge the area effectively after the soft tissue envelope has healed.^{4,5} Tibial defects larger than 6 cm might require a vascularized bone graft for adequate reconstruction.⁶ The fibula, iliac crest and ribs have all been employed as donors for microsurgical long bone reconstruction.^{1,6,7} An additional commonly used reconstructive option for tibial defect repair is the application of the Ilizarov technique.⁸ It is generally accepted that

the transfer of a vascularized fibular flap is appropriate for the reconstruction of segmental long bone defects.⁹ This graft type not only resists cortical resorption and provides union independent of soft tissue vascularity, but also shows adaptive cortical hypertrophy.^{10,11} Troughs are usually created in both the upper and lower ends of the tibia for fixation of the fibula. Here we report the micro-vascular transfer of a fibula for intramedullary fixation using an interlocking nail approach; its skin paddle was also used to cover the soft tissue defect.

CASE REPORT

A 73-year-old man sustained a crush injury in a motor vehicle accident resulting in extensive soft tissue damage measuring 15×10 cm² with tibial and fibular fractures. The left leg had a segmental Gustilo type IIIB fracture of the tibia together with trimalleolar fractures. The left tibia was debrided and stabilized using external fixation and the fibula was stabilized with a dynamic compression plate (Fig. 1A). The nonviable fragment was debrided, leaving a 9-cm tibial defect at the site of the fracture (Fig 2). To repair this, a free vascularized fibular osteoseptocutaneous flap containing 21 cm of fibula bone and a 15 ×8 cm skin paddle was harvested from the contralateral leg for simultaneous reconstruction of the tibial defect and soft tissue loss. The donor site of fibular osteoseptocutaneous flap was resurfaced with splint thickness skin graft. After resecting 6 cm of the fibula from the fibular osteoseptocutaneous flap, the fibular strut of the flap was

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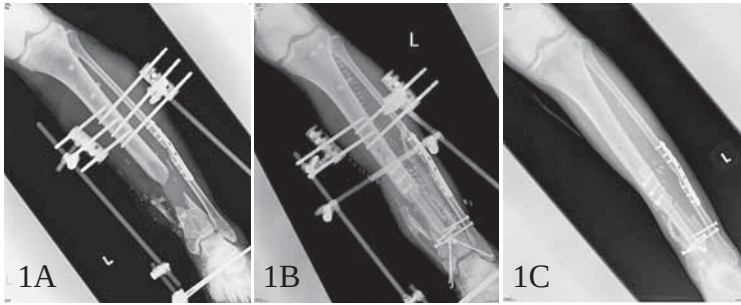


Fig. 1 (A) Radiography of the left leg. Note the tibial defect after stabilization with external fixation. The patient also had trimalleolar fractures and a fibular fracture stabilized with a dynamic compression plate. (B) Radiography of the left leg. The fibular strut was impacted to bridge the tibial defect and screws were used to fix the strut in an interlocking fashion. The trimalleolar fracture was stabilized with pins. Two syndesmotic screws were used to decrease the syndesmotic space. (C) The free vascularized fibular osteocutaneous flap with solid union at a 2-year follow-up.



Fig. 2 The nonviable fragment was debrided, leaving a 9-cm tibial defect at the site of the fracture and $15 \times 10 \text{ cm}^2$ soft tissue loss.

impacted into the medullary canal of the upper tibial segment. We then bridged the tibial defect by tracting the lower tibial segment (Fig. 3). Three cortical screws were used to fix the upper segment of the tibia. Four screws and three pins were used to fix the lower segment of the tibia and the trimalleolar fractures. Two syndesmotic screws were used to decrease the syndesmotic space. The resected fibular strut was split longitudinally into two pieces and the avascular bone was placed near the flap as bone graft. Antibiotic loaded bone cement was also used to fill the defect (Fig. 1B). The peroneal pedicle of the fibular osteoseptocutaneous flap was anastomosed



Fig 3. The fibular osteoseptocutaneous flap was impacted into the tibial defect as an intramedullary nail (black arrow), and soft tissue coverage (yellow arrow).

to the anterior tibial artery and its comitant vein under microscopy in an end-to-end pattern. The total ischemic time was 2.5 hours and the patient's postoperative course was uneventful. Two months later, the external fixation was removed then rehabilitation program including weight bearing and manual therapy was started. Bone union in good alignment was found on 2-year follow-up radiographs (Fig. 1C). The dorsiflexion of left is 0 to 10 degrees; the plantar flexion is 0 to 15 degrees, the patient resumed daily walking, weight bearing and showed good esthetic results (Fig. 4). The donor site of fibular osteoseptocutaneous flap resurfaced with splint thickness skin graft healed well without any complication.

DISCUSSION

The vascularized fibula has become a preferred donor site for reconstructing long bone defects since its introduction by Taylor et al.^{12,13} Inclusion of a skin paddle from the lateral aspect of the leg makes it even more useful in treating composite bone and soft tissue coverage defects, which are common in open lower extremity fractures. The disadvantages of free fibular osteoseptocutaneous flap are highly technical demand and time consuming. Possible complications include flap loss and nonunion.



Fig. 4 The patient resumed daily walking and the surgery showed good esthetic results.

Using a fibular osteoseptocutaneous flap to bridge the tibial defect can be achieved by making a trough in the tibia or by an onlay method using plate or screw fixation. When making a trough in the tibia, some bony structures need to be removed. On the other hand, the onlay method will result in an unnatural axis and less stability.

In our patient, we bridged the bony defect using an impacting fibular strut of the flap into the medullary canal of both upper and lower tibial segments by tracting the lower tibial segment. The fibular strut was fixed using an interlocking nail approach, which provided minimal bony damage and stable fracture fixation. Because the fibular strut was placed in the middle of the medullary cavity, it was situated along the neutral axis in the center of the bone. Therefore, like intramedullary pins it could counteract bending forces very well. The screws that secure the strut to the bone in this approach help to counteract rotational and axial forces placed on the bone-implant construct.

In conclusion, we think that such a fibular osteoseptocutaneous flap can be used for interlocking nailing safely without damage to the skin paddle and vascular pedicle even in a severely crushed leg. Here it was used successfully to achieve good bony union in a 73-year-old patient.

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