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ORIGINAL STUDY

Heel reconstruction with parallel fibular osteoseptocutaneous flap

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Reconstruction of heel defects can be challenging and requires careful consideration in restoring both the functional and aesthetic deficit. This study assessed the use of parallel fibular osteoseptocutaneous flap to repair composite heel defects. Follow-up of the 4 patients included in this study ranged from 24 months to 3 years after their operation. The flap survival rate was 100% in all patients, with good coverage of the heel defects. Postoperative complication was one superficial wound infection. Union of the graft with the host bone was achieved in all patients at an average of 6 months (range : 5-10 months). The parallel fibular osteoseptocutaneous flap is thus a reliable means of reconstruction of composite bone and soft-tissue defect in the heel region.

Keywords : calcaneus ; reconstruction ; surgical flaps.

INTRODUCTION

Heel defects exposing bone and soft tissue defects are common, and not only limit physical activity of the individual, but also have an impact on the patient's ability to work and to socialize (*9*). Unfortunately, reconstruction of such defects may still be challenging in terms of recovery by traditional means (*14*).

Nowadays, advances in microsurgery offer high-level functional and aesthetic restorations with the use of free flaps tailored to individual defects (*17*). Nevertheless, the existing experience with their use in reconstruction of heel composite bone and soft-tissue defect is limited (*2,11,13*).

The aim of the present study was to evaluate the outcomes of parallel fibular osteoseptocutaneous flaps in the reconstruction of heel composite bone and soft-tissue defects.

PATIENTS AND METHODS

A retrospective study was conducted of 4 parallel fibular osteoseptocutaneous flaps used in 4 consecutive patients. The case series included of 3 males (75%) and 1 females (25%), with a median age of 32 (range 26 to 43) years. The patients underwent reconstruction of heel defects. The inclusion criteria were defects of the mid-to-distal calcaneal ; defect < 13 cm wide and < 20 cm long ;

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Doppler-evident perforator artery pulsation in the donor area ; and a nontraumatized and uninflamed donor area. The exclusion criteria were severe peripheral vascular disease, and patients disagreeing with this operation. The etiologies for the defects included 3 motor vehicle accidents (75%), and 1 chronic wound (25%). The locations of the defects were calcaneal with an exposed Achilles tendon in all patients. None of the patients had any known systemic comorbidities.

In all the defects, patients had undergone serial debridement to achieve a necrosis-free wound bed before flap closure was performed. The interval to reconstruction from the initial injury ranged from 2 weeks to 3 months (median 36.5 days). The largest skin paddle size of the parallel fibular osteoseptocutaneous flap was 20 cm × 12 cm. The harvested fibula length ranged from 8 to 17 cm.

All the procedures were performed by the senior orthopedist at 2 different institutions. All perforators were identified using a handheld Doppler probe before harvesting. The flaps were performed according to Lin *et al* (6). When the viability of the flap was checked on release of the tourniquet, the peroneal artery was dissected proximally to the bifurcation with the posterior tibial artery. Adequate length of fibular bone is measured and harvested, and the middle of free fibular segment was dissected into two sections (Fig. 1). The island flap was then rotated to cover up the defect (Fig. 2). Osteosynthesis of the parallel fibular bone to the residual part of calcaneus was achieved with Kirschner wires making sure not to disrupt the periosteum from the bone. Achilles tendon was released, and sutured into the parallel fibular bone. Any twisting, kinking, and pressure on the pedicle were avoided during its transfer of the flap. The donor site was covered with a split-thickness skin graft (Fig. 2). The patient was placed in non-weightbearing casts for ten weeks until radiograph showed incorporation of the bone graft, and progressed to full weightbearing at 12 weeks in a protective boot. Kirschner wires were removed, when fibula segments healed well in its bony recipient site.

The flap viability, donor site complications, achievement of wound closure, the need for revision surgery, and a return to weightbearing ambulation were obtained during clinical visits and retrospective medical record reviews of prospectively recruited patients.

RESULTS

Follow-up of the 4 patients in this study ranged from 24 months to 3 years after the operation (median 30 months). Comprehensive patient data can be found in Table I. The flap survival rate was 100% in all patients, with good coverage of the heel defects. The largest flap was 20 cm × 12 cm in size in the heel region. Only one patient encountered superficial flap tip necrosis in the distal 10% of the flap, which was also the longest flap. The flap tip necrosis did not influence the wound healing under adequate wound debridement and a skin graft, and it recovered well before expiration. None of the other patients had any recipient and flap complications. All fibula segments healed well in its bony recipient site at an average of 6 months (range : 4-8 months). Long term follow-up was performed with the patient at two years (Figs. 3). The visual analogue scale revealed that 3 of 4 patients reported scores of 0 out of 9, while 1 patient reported scores of 1 out of 9. Three patients were able to wear normal shoes, while 1 patient required custom-made shoe. All patients obtained a satisfactory gait through clinical observation, and all patients were able to participate in all pre-injury activities without any assistance.

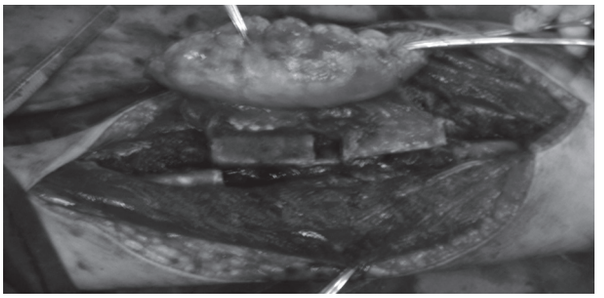

Fig. 1. — Intra-operative image showing fibular segment was dissected into two sections.

Fig. 2. — Intra-operative image showing reconstruction of heel defect with parallel fibular osteoseptocutaneous flap, and the donor site covered with a split-thickness skin graft.

Table I. — Patient demographics

Age/Sex	Etiology	Flap Dimensions (cm)	Interval to Reconstruction (days)	Follow-up (months)	Flap Complications	Bone union time (months)	Delayed ulceration	Pain score[a]	Normal footwear
26/M (Fig. 3)	MVA	15 cm × 13 cm	16	24	None	4	None	0	Yes
30/M	Chronic wound	20 cm × 12 cm	90 d	36	Loss of partial flap	8	None	1	Custom
43/M	MVA	18 cm × 10 cm	18	26	None	5	None	0	Yes
29/F	MVA	15 cm × 9 cm	22	34	None	7	None	0	Yes

Abbreviations : F, female ; M, male ; MVA, motor vehicle accident.

[a] Pain score was evaluated by a visual analogue scale graded from 0 to 9, with 0 indicating no pain and 9 indicating very severe pain.

The fibula bone donor site showed almost no signs of the previous ostectomy. All of the donor sites were covered with split-thickness skin grafts. No complications of necrosis and neuroma were noted in our study.

DISCUSSION

Heel defects exposing bone and soft tissue defects present a difficult problem in reconstructive surgery (*5,22*). They may be solved not only by the soft tissue flap, but also by bone graft (*16,21*). In this article, we report 4 patients of heel defects were successfully reconstructed with parallel fibular osteoseptocutaneous flaps.

Management of large composite tissue defect has been reported with a free soft tissue flap and autogenic or allogenic bone graft (*3,7*). However, the basic problem with this method is that the bone graft repair is dependent on the vascular carrier to be revascularized and regenerate (*4*). Therefore, although it may have promising results,no consensus on its efficacy has been concluded (*10,12,15*).

The historic discovery of free composite tissue flap by Taylor and Daniel four decades ago opened a new chapter with regard to the possibility of developing a treatment for composite tissue defects (*18*). Heel defects treated with the skin-aponeurosis-bone composite free tissue was firstly described in 1988 in our knowledge (*19*). The vascularized fibular graft has recently been considered an ideal reconstructive option, because that the fibula has a high density of cortical bone and a consistent cross section (*1,8,20*). However, free composite tissue flap were confronted with some possible drawbacks, including the requirement of microanastomosis skills, and extended operation durations (*1*).

In this study, the parallel fibular osteoseptocutaneous flaps survival rate was 100% in all patients, with good coverage of the heel defects, and all fibula segments healed well in its bony recipient site. Only one patient encountered superficial flap tip necrosis in the distal 10% of the flap. The flap tip necrosis did not influence the wound healing under adequate wound debridement and a skin graft, and it recovered well before expiration.

It has many advantages of the parallel fibular osteoseptocutaneous flap for reconstruction of composite heel defects. Firstly, parallel fibula might still be small compared to the calcaneus, but compared to single fibula bone it offers many more possibilities for bone and tendon fixation through its greater volume. Furthermore, using Kirschner wires fixation of the calcaneus can prevent the damage risk of periosteum to promote healing of bone grafts, compared with plate fixation. However, loss of the Böhler angle is the main drawback of the procedure. In addition, compared with complex microsurgical operations, owing to vessel anastomosis will not be

Fig. 3. — Patient 1 : **a.** Appearance preoperatively. **b.** Radiograms showing the calcaneus defect. **c.** Bone fixed with Kirschner wires. **d.** Radiogram 24 months after reconstruction with a parallel fibular osteoseptocutaneous flap. **e.** Appearance 24 month postoperatively.

needed, the operation is relatively simple, and the operative times will be shorter. This leads to cost savings.

In conclusion, it is an alternative choice of the reconstruction of composite heel defects with parallel fibular osteoseptocutaneous flap.

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