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Pedicled fibular flap for reconstruction of composite defects in foot

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ABSTRACT

Introduction: Reconstruction of complex injuries involving bone and soft-tissue in foot remains a tough challenge for surgeons. The free fibular flap is a popular flap for treating these composite defects. However, complications caused by microvascular anastomoses are not uncommon. Herein, we designed a pedicled fibular flap elevated in the ipsilateral leg for reconstruction of multiple defects in foot.

Methods: From July 2005 to April 2013, four patients with composite defects in foot were treated by pedicled fibular flaps. The defects were located in the first metatarsal bone and medial cuneiform bone in two patients, in the fourth metatarsal bone in one patient, and in the second to fourth metatarsal bones in one patient. The size of soft-tissue defects ranged from 10 × 7 cm to 15 × 7 cm, and the length of bone defects ranged from 6 to 8 cm.

Results: The length of fibular grafts ranged from 7 to 8.5 cm, and the size of skin flaps ranged from 11 × 8 cm to 16 × 8 cm. All flaps survived completely. Complications occurred in two patients. One suffered moderate venous congestion and the flap survived without intervention. The other one sustained re-infection. Debridement was performed and the wound healed uneventfully. Follow-up ranged from 8 to 32 months. Bone union occurred at an average of 12 weeks, and the skin flaps showed good cosmetic results. No serous donor-site complications occurred.

Conclusion: The pedicled fibular flap transfer could avoid anastomosis complications and preserve healthy limb. It is a good option for reconstruction of complex defects in foot.

Introduction

High-energy foot trauma frequently causes open fractures or comminution of the metatarsal bones and compromise of dorsal soft tissue. The inherent paucity of local skin and muscle renders the violated foot easily susceptible to infection, resulting in complex tissue defects. Although amputation is a viable selection, a reconstructive procedure that provides a functional foot would be recommended [1]. With the advance in microsurgery, numerous surgical options have been developed for salvage of the lower extremity [2–5]. For manage composite tissue loss in extremity, the optimum method is one-stage reconstruction with an osteocutaneous flap tailored to individual defects [1,6–13].

The free fibular osteocutaneous flap is a revolutionized method for repairing complex defects in extremity and head and neck, due to its distinct advantages of appropriate length of vascularized bone graft, reliable skin paddle and acceptable donor-site morbidity [14–16]. Satisfied results of complex foot injuries treated by free fibular flap have been reported by cases [6,8,11–13]. However, certain complications related to microvascular free tissue transfer have been reported [4,5]. Among them, flap loss caused by thrombosis or disruption of microvascular anastomoses is most serious, which could lead to amputation of the violated limb.

Considering both the outcome and the safety of operations for patients, a procedure with lesser risk and more manageable is generally preferred by surgeons [17]. Thus, in this report, we tend to report our experiences of a pedicled fibular flap elevated in the ipsilateral leg for reconstruction of composite foot defects.

Patients and methods

Patients

From July 2005 to April 2013, four patients with composite soft-tissue and bone defects in foot were treated by pedicled fibular flap transfers. All patients were male with an average age of 37 years (range from 29 to 43 years). The causes of injury include two motor vehicle accidents, and two crush injuries.

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The composite defects were located in the first metatarsal bone and medial cuneiform bone in two patients, in the fourth metatarsal bone in one patient, and in the second to fourth metatarsal bones in one patient. The size of soft-tissue defects ranged from 10 × 7 cm to 15 × 7 cm, and the length of bone defects ranged from 6 to 8 cm. Details of these patients are shown in Table 1.

Surgical technique

Before definitive reconstruction, radical debridement was performed to remove all grossly contaminated or nonviable, necrotic tissue, followed by wound conditioning of negative-pressure wound therapy. When a clean and stable wound was obtained (Fig. 1A), the definitive treatment was carried out.

The procedure was performed with the patient supine and with the ipsilateral leg flexed approximately 45 degrees at the knee. A pedicled fibular flap matching the composite defects was outlined in the ipsilateral lower leg. The pivot point of the flap was usually set at 6 cm proximal to the lateral malleolus, where the peroneal artery gives off communicating branch to anterior or posterior tibial vessels [18]. The distance from the bone defect to the pivot point and the length of the bone defect were measured, which were used to determine the location and length of the pedicled bone graft, respectively. The position of skin paddle was determined by the presence and size of peroneal artery perforators that were detected with a hand-held Doppler preoperatively. The location and shape of soft-tissue defect should also be taken into consideration in flap design (Fig. 1B).

Raising the pedicled fibular flap was similar to that of free flap. Briefly, the anterior border of the outlined skin paddle was incised, and carried down to the deep fascia. The flap was then raised in the subfascial plane to the posterior septum. Carefully identify the septocutaneous perforators supplying the skin paddle. Incising along the posterior border of the skin island, and tracing the perforator used for nourish the skin paddle back to its origin. Then the peroneus longus muscle was sharply dissected off the fibula, and ostotomies were performed with wire saws distally and proximally. The bone graft was retracted and rotated to facilitate dissection. All muscles were detached from the bone, and pedicle of peroneal artery was delicately dissected towards the pivot point (Fig. 1C). Finally, the pedicled composite flap was transferred to the recipient site without tension. The bone graft was shaped to fit the defect and fixed by Kirchner wires appropriately (Fig. 1D), followed by wound coverage with the skin paddle (Fig. 1E). The donor-site of the leg was closed primarily or with split-thickness skin grafts.

Postoperative care

Immobilization and bed rest were usually maintained for 5 days, and the foot was elevated above the level of the heart to improve drainage. Special medications included antibiotics, analgesics, and anticoagulant medication such as low-molecular-weight heparin. Flap monitoring was conducted to exclude tension and perfusion failure secondary to haematoma, swelling or external compression.

Results

All four flaps survived completely, though two of them sustained complications postoperatively. One patient suffered moderate venous congestion and the flap survived without intervention. Re-infection occurred in the other patient. A secondary surgery of debridement was performed and the wound healed uneventfully (See Section case report). The length of fibular grafts ranged from 7 to 8.5 cm, and the size of skin flaps ranged from 11 × 8 cm to 16 × 8 cm. Follow-up ranged from 8 to 32 months. The skin flap showed good texture match and contour. Bone union occurred at an average of 12 weeks, when Kirchner wires were removed and the patients were allowed to partial weight bearing. Full weight bearing was permitted 6 months postoperatively by verifying radiographically. Donor-site morbidities in related to composite flap elevation were not noted by any of our patients.

Case reports

Case 1

A 34-year-old male was referred to us with open comminuted foot fractures due to a crush injury one month after initial injury. After debridement, composite defects occurred including the first metatarsal bone, medial cuneiform bone, and their soft-tissue coverage (Fig. 1A). To salvage the foot, a pedicled fibular flap was designed on the ipsilateral leg with the bone graft measured 7 cm in length and the skin paddle measured 12 × 5 cm in area (Fig. 1B and C). The bone graft bridged between the first proximal phalanx and navicular bone, and fixed with Kirchner wires (Fig. 1D and E). The donor site was closed primarily. The pedicled composite flap survived uneventfully. Kirchner wires were removed 10 weeks after operation, and the patient was allowed to partial weight bearing. The patient was satisfied with both the appearance and function of the restored foot at 15 months' follow-up (Fig. 1F and G).

Case 2

A 43-year-old male sustained a crush injury to the dorsum of his right foot, resulting in open fractures of the first to third metatarsal bones and vascular compromise to the third to fifth toes. Initially, the patient was treated at another institution with provisional stabilization and active dress changing. After 1 week, the wound was aggravated by infection and necrosis of regional soft-tissue

Table 1
Patients' demographic data.

Patient	Age (years)/ gender	Aetiology	Location of bone defect	Size of soft-tissue defect (cm^2)	Length of bone defect (cm)	Size of skin paddle (cm^2)	Length of fibular graft (cm)	Flap survival	Complication	Follow-up (months)
1	41/M	Motor vehicle accident	First metatarsal bone and medial cuneiform bone	15 × 7	8	16 × 8	8.5	Complete	None	8
2	34/M	Crush injury	First metatarsal bone and medial cuneiform bone	11 × 4	6	12 × 5	7	Complete	None	15
3	43/M	Crush injury	Second to fourth metatarsal bone	10 × 7	7	11 × 8	8	Complete	Re-infection	32
4	29/M	Motor vehicle accident	Fourth metatarsal bone	11 × 6	8	12 × 7	8.5	Complete	Moderate venous congestion	8