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Repair of bone defect of the lateral forefoot by double segment triangular fibula flap with vascular pedicle: A case report

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ABSTRACT

Objective: To expound the clinical effect of a new operation by transplanting double segment triangular fibula flap with vascular pedicle to repair the forefoot with lateral bone defect, and to study how to improve the operation method in the following stage. *Methods:* The inclusion criteria: More than 2 phalangeal and metatarsal bones defects of the lateral forefoot, widespread skin and soft tissue defects on pelma and dorsal foot, and destruction of the anterior aspect of foot arch, which seriously affects the foot function. There was one case of clinical application in November 2014. The repairing method is as followed: the harvested vascularized free fibula was cut into 2 segments and then they were folded into a right angle. According to selected control points on the residual metatarsals, an optimal stereo triangular net was constructed. Meanwhile, according to flow-through mode, the free anterolateral thigh flap was incorporated to repair the forefoot and foot arch. *Results:* Postoperative bone flaps all survived. After a 17-month following up, it was found that the grafted fibular healed well, shape of the foot was good, weight-bearing walking was practical, a slight limp and discomfort with plantar pain existed, sensory recovery reached S3 level and functional recovery of weight-bearing walking by forefoot reached W3 level, comprehensive evaluation was good, and there were wear scar and ulcer on the plantar flap during long-time walking for patients, such results were excellent according to foot function scoring criteria. *Conclusion:* In this operation the grafted fibula was fold into a triangle according to actual need, which though not completely restores the tridimensional structure of the longitudinal, transverse arches of the lateral foot makes weight-bearing walking possible, besides, its appearance and function is satisfactory. Such an operation has overcome the shortage of non-tridimensional structure of the transverse arch etc. in traditional operations and it should be an ideal operation in repairing serious defects on the lateral forefoot through further improvement.

1. Introduction

The lateral 4, 5th metatarsal of forefoot is one cornerstone for the three-point support balance, also the main component of the lateral longitudinal and transverse arch (Jinfang, 2013). In the clinics, forefoot injury caused by car accidents, mechanical damage is very common. The forefoot damage is mostly due to blunt object hit or mechanical crushing, in which, bone, soft tissue injury is widespread, the foot loses three point stable fusion, and the function is seriously affected. In the case of severe forefoot defects, tissue transplantation for repair and improvement from the structure can restore the function of foot and restore the patient's ability to live and work. Multiple metatarsal defects should be fully reconstructed if condition allows, but there are a lot of existing problems in reconstruction of the entire forefoot. If total reconstruction is impossible, reconstruction should be done for tibia, calf; and the 1st, 5th metatarsal defects should be reconstructed. Repair of the forefoot defect mainly targets at iliac bone flap, fibular flap, scapular flap, and the specific flap should be selected based on the specific circumstances of the injured. Yunsheng et al. (2013) held that free fibula flap repair is the ideal treatment method for composite tissue defects in forefoot. Our hospital repaired large-area lateral bone defects in forefoot with vascularized fibular flap graft. We found in the process that single transplant could not repair multiple metatarsal lesions at the same time, and weight-bearing walk-

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ing was impossible. In November 2014, our hospital folded the transplanted fibula to right angles according to certain ratio to repair large-area lateral bone defects in forefoot, so that a stable triangular bone formed, and patients with serious forefoot bone injury restored weight-bearing walking ability. Good clinical efficacy was achieved, which is reported as follows.

2. Materials and methods

2.1. Clinical data

The 60 years old male patient was the subject. Due to machine crushing in 2014, his right foot had anterior lateral damage, only the first metatarsal and great toe was intact, the 2nd-5th toes were damaged, the third metatarsal was exposed and partially absent, the 4,5th metatarsals were completely absent, the ankle bone to the distal 2nd metatarsal of the dorsal had fibular skin defect in an area of 11 cm × 5 cm, 2 cm from the heel bone to the first metatarsal of the dorsal had fibular skin defect in an area of 10 cm × 8 cm (Figs. 1a and 1b). The arch needed reconstruction to restore the patient's weight-bearing walking ability.

2.2. Surgical method

2.2.1. Recipient area preparation

Patient took supine position. After onset of general anesthesia, the operational field was disinfected to thoroughly debride the wound surface, remove the inactivated tissue, repair stump and expose the bone cross section. The dorsalis pedis artery and two companion veins, small saphenous vein revealed in anatomy were chosen as blood supply vessels for the recipient area. The deep peroneal nerve, sural nerve and plantar lateral nerve were chosen as recipient area nerve. By bipedal contrast, bone defect length and skin area were measured and designed. The wound received pressure dressing by complex iodine diluted gauze.

2.2.2. Design of vascularized fibular flap

Vascularized fibular flap design is shown in Fig. 2. Ultrasound Doppler detection of lateral peroneal artery of contralateral calf was performed before the operation for skin perforation and marking. Flap and fibular length was designed based on dorsal wound surface with the marking point as the center. The flap area was 12 cm × 7 cm, and fibular length was 9 cm. Cut off appropriate length of lateral leg nervus cutaneus so that it remains in the flap.

Fig. 1a. Dorsal view of forefoot with large-area lateral bone defect.

Fig. 1b. Pelma view of foot with large-area lateral bone defect.

Fig. 2. Design vascularized fibular flap Fig. 3 cut fibular flap.

Find the peroneal artery, vein, peroneal artery perforation and fibular nutrition branch in the posteromedial fibula. Clamp the peroneal artery, vein, to facilitate foot blood supply. Cut off the required fibula with the swing saw according to the design line (Fig. 3), the free fibula shall carry a little muscular sleeve to protect the fibular blood vessel bundle. Dissociate appropriate length of the proximal and distal ends of the fibula arteries and veins to fit proximal and distal ends of descending branch of the dorsal and lateral circumflex femoral artery and vein, so that flow-through flap connecting free anterolateral femoral flap was formed.

2.2.3. Dissociate anterolateral femoral flap

Ultrasound Doppler detection of descending branch of lateral circumflex femoral artery of contralateral calf was performed before the operation for skin perforation and marking. Flap was designed and cut based on dorsal wound surface with the marking point as the center. In area of 12 cm × 10 cm, the flap shall carry tensor fasciae latae to increase the plantar thickness, enhance wear resistance of the flap. The proximal and distal ends of descending branch of lateral circumflex femoral artery and vein were protected during the operation. Dissociate appropriate length of lateral femoral nerve for standby use (Fig. 4).