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Case Reports and Series

Reconstruction of a Complex Foot Injury With Free Remodeled Fibular Osteocutaneous Flap: A Case Report and Literature Review

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ABSTRACT

Management of complex foot injuries, which involve open fractures and severe trauma to soft tissues, represent a challenge to orthopedic clinicians. In the present case report, we treated a complex foot injury with a remodeled fibular osteocutaneous free flap to reconstruct the anterior and lateral areas of the foot. The flap survived completely. At the 9-month follow-up examination, bony union of the graft bone was identified by radiographic examination. The reconstructed foot could bear body weight, and the patient could maintain a bipedal gait without discomfort. The remodeled fibular osteocutaneous free flap provides an option for functional reconstruction of foot defects.

Complex foot injuries, which usually involve open fractures or the loss of metatarsal bones, severe soft tissue defects, and the development of early infection, represent a clinical challenge (1). Amputation is a treatment option; however, because the foot is essential for weightbearing and performing daily activities, reconstruction that results in a functional foot is preferable (1–12). With the evolution of microsurgery techniques in recent decades and the development of local pedicle and free flaps, multiple procedures have been used to reconstruct complex injuries of the lower extremities (1,8,12–15). Compared with amputation, foot reconstruction and limb salvage result in improved functional outcomes in patients and improved quality of life in the short and long term (11). However, no conclusions have been reached regarding the best flap procedure to use for foot reconstruction. Pedicle flaps are not indicated for forefoot reconstruction owing to the long distance to the transfer location. Previous reports have suggested that free flaps are a satisfactory option for reconstruction of defects of the foot (10).

Evidence has suggested that the optimal method for managing complex tissue loss is 1-stage reconstruction with an osteocutaneous free flap tailored to the individual defects (1,15–18). An osteocutaneous free flap consists of vascularized isolated bone, subcutaneous tissue, and skin. It can be harvested from any part of body, providing a variety of tissues for use when reconstructing bone and soft tissue defects during a single surgery. Since Taylor et al (19) first reported the use of the fibular osteocutaneous free flap procedure, this revolutionary technique has been used to reconstruct various complex injuries involving both soft tissue and bone defects with the potential to result in functional and aesthetic impairment (20).

In the present report, we describe a rare clinical case in which a novel remodeled fibular osteocutaneous free flap was used to resurface a soft tissue defect and simultaneously reconstruct a lateral longitudinal arch and anterior transverse arch bony defect in the management of a complex foot injury.

Case Report

A 39-year-old male presented to our hospital with a high-energy crush injury to the anterolateral aspect of the right foot. The patient had lost 5 toes and most of the anterolateral part of the foot. Soft tissue defects were present in the dorsal lateral and anteroplantar area of the foot. Applying the principle of Hollenbeck et al (9), the wound involved the first, second, and third subunits of the foot (Fig. 1A,B). Radiographic examination of the injury showed extensive bone defects involving the 5 phalanges and most of the second to fifth metatarsal bones (Fig. 1C). Radical debridement was performed to remove all devitalized and potentially infected tissue, and the wound was treated with vacuum sealing drainage. Seven days later, the wound was visibly clean and infection and necrosis were not apparent. The wound was

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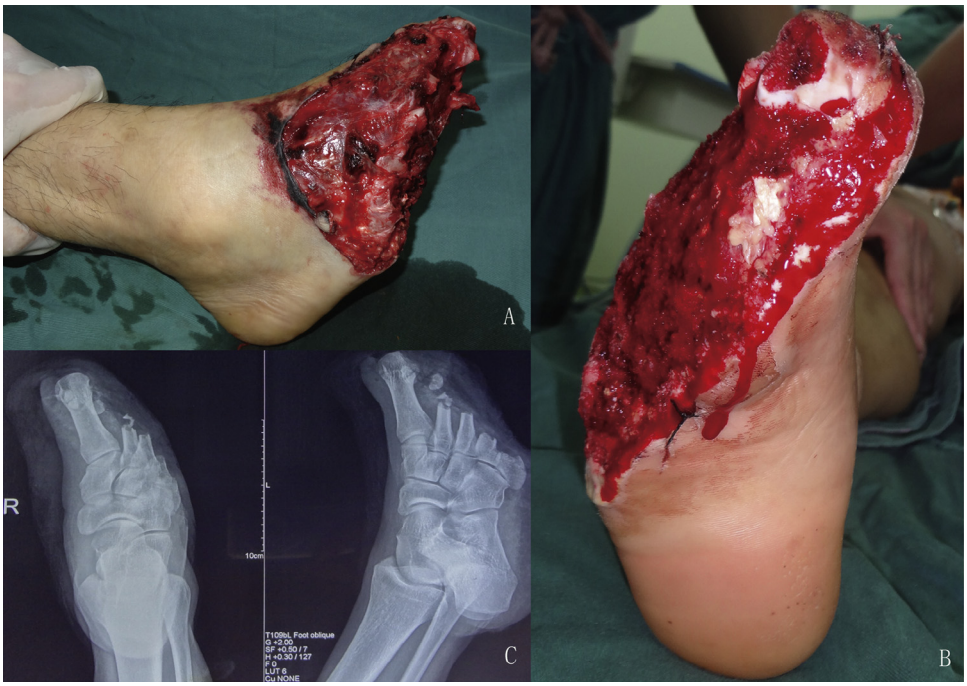

Fig. 1. *(A)* Complex foot defect involving the distal and lateral parts of the right foot. *(B)* The medial and hindfoot remained intact. The first metatarsal bone and underlying tissues of the middle foot were exposed. *(C)* Radiographic examination showed second to fifth metatarsal bone defects.

debrided to healthy bleeding tissue. The soft tissue defect measured 14 cm × 10 cm, and the bone defect measured a maximum of 7 cm × 8 cm.

Reconstruction involved the design of a fibular osteocutaneous free flap from the contralateral leg, with the design determined by the shape and size of the soft tissue and bone defects (Fig. 2A). The bone graft, which was harvested from the middle third of the fibula, measured 15 cm, and the skin paddle, which was harvested parallel to the longitudinal fibular axis, measured 17 cm × 14 cm. The shaft of the fibula was divided into 2 segments: 7 and 8 cm from the distal edge (Fig. 2B). The periosteum was cut carefully along the shaft of the fibula to maintain continuity of the peroneal vessels (Fig. 2B). The left base of the fourth metatarsal bone was resected accordingly. The cartilage and cortical bone of the contralateral surfaces around the base of the third and the fifth metatarsal bones and the cuboid distal to medial surface cortical bone were removed (Fig. 2C). The same procedure was performed at the distal 0.5-cm edge of the fibula and the distal to lateral edge of the first metatarsal bone. Two segments of the fibula were fashioned into a right-angled shape for insertion. The proximal segment of the fibula was placed in the location of the fourth metatarsal bone. The distal segment of the fibula was positioned perpendicularly between the proximal segment of the fibula and the distal edge of the first metatarsal bone to rebuild the transverse bone strut (Fig. 2C). Bone fixation was achieved using intramedullary positioned Kirschner wires under direct vision to avoid compression of the peroneal vessels within the periosteal muscle hinge. The vascular pedicle was insufficient for direct anastomosis with the vessels located at the ankle level. Therefore, a 12-cm vessel graft from the ipsilateral small saphenous vein was harvested to bridge the graft and recipient vessels. The peroneal artery was anastomosed end-to-end with the dorsalis pedis artery. A peroneal vein accompanying the flap was anastomosed with a branch of the greater saphenous vein, and the remaining vein of the graft was connected to the greater saphenous vein. The skin paddle was sutured on the dorsal and plantar surfaces of the foot. The donor site was repaired using a skin graft harvested from the ipsilateral inguinal abdominal region (Fig. 2A). A drain was placed in the recipient site of the injured foot.

The flap and grafted skin had survived completely at the follow-up examination (Fig. 3A). The postoperative course was uneventful. After 9 months of follow-up, radiographic examination showed porosis around the graft bone (Fig. 3B). The bone had healed well enough to bear the patient's body weight (Fig. 3A). The patient was able to walk with a bipedal gait without any discomfort. No ulcerations were present, except for 2 lateral scars and 2 scars on the forefoot plantar area (Fig. 3C). No postoperative complications developed related to the donor site (Fig. 3D). The flap could not distinguish between warm (38°C) and cold (0°C) temperatures. The patient underwent a debulking procedure to remove the bulking of localized soft tissue at the flap site. Twenty-five months following the debulking operation, the patient continued to ambulate well and fit well in a modified sneaker with forefoot filler.

Discussion

Complex foot injuries resulting from trauma, tumors, or infection are commonly seen in clinical practice. Reconstructing and resurfacing complex foot injuries presents a great challenge to surgeons. The heel and forefoot have specific dermal–epidermal histologic characteristics, including a small amount of subcutaneous tissue. This tissue plays a vital role in the physical activities of daily living by providing a dynamic platform on which humans bear their body weight during standing and ambulation (12). Therefore, the tissue chosen to restore defects of the foot must have sufficient thickness to avoid ulceration from long-term activities. Thus, flaps rather than skin grafts should be used to manage these wounds.

Controversy exists regarding the best type of flap to use for reconstruction of the sole of the foot (2,21–23). Pedicle flaps, such as the distally based sural flap (6), medial plantar artery flap (24), and pedicled fibular flap (2), are conventional options for resurfacing complex foot injuries (25). However, owing to the long distance to the