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Reconstruction of Weightbearing Forefoot Defects with Digital Artery Flaps

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ABSTRACT

Reconstruction of a defect of the weightbearing forefoot region remains a challenging problem owing to the limited alternatives available. The digital artery flap can be used for coverage of defects in the weightbearing forefoot. The present study reports our results using a digital artery flap for reconstruction of soft tissue defects of the weightbearing forefoot in 8 patients. The mean patient age was 35 ± 11.3 years. The etiology of the soft tissue defects included 4 (50%) traumatic events, 2 (25%) dysfunctional scars, and 2 (25%) neuropathic ulcerations. The mean postoperative follow-up duration was 22 ± 11.1 months (range 12 months to 4 years). All 8 flaps survived successfully. The complications included 1 case of delayed healing of a neuropathic ulceration. The digital artery flap is a good alternative for soft tissue defects of the weightbearing forefoot. The surgical techniques for harvesting the flaps are easy to manage.

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Reconstruction of a defect at the weightbearing forefoot region remains a challenging problem owing to the limited alternatives available. The unique anatomy of the sole, which contains durable and thick glabrous skin, makes it difficult to be replaced by unspecialized skin from distant sites. Sometimes, the wound will close after a long period of professional local wound care. However, the scar tends to breakdown under the influence of pressure and the constant shearing forces. Local random flaps have also been limited in use because of the excursion potential, and the plantar structures can be compromised by extensive dissection (1).

Moberg (2) first sacrificed the hallux for reconstruction of the heel with similar tissue without disturbing the existing plantar anatomy. Since then, many investigators have reported their experience in foot reconstruction using the neurovascular island flap (3–6). The lateral region of the great toe includes glabrous plantar skin. The digital artery flap harvested from this region can then be used to cover minor size soft tissue defects of the weightbearing forefoot (7,8). We present our experience with the use of the digital artery flap for defect reconstruction of the weightbearing forefoot region in chronic cases to better understand the outcomes of this technique.

Patients and Methods

Patients

From February 2003 to July 2011, we treated 8 patients for soft tissue defects of the weightbearing forefoot using the digital artery flap. Of the 8 patients, 6 (75%) were male and 2 (25%) were female, with an age range of 21 to 56 (mean 35 ± 11.3) years. The etiology of the soft tissue defects included 4 (50%) traumatic events, 2 (25%) dysfunctional scars, and 2 (25%) neuropathic ulcerations. The flap dimensions ranged from 3 × 2 cm to 2 × 2 cm (Table).

Operative Technique

The flap was harvested with the patient in the prone position. All the flaps were raised under tourniquet control for better visualization. Wide excision of the ulcer was performed such that no necrotic or dysfunctional tissue remained. The dimensions of the flaps depended on the size of the defect after debridement. The skin paddle was marked as a teardrop shape on the lateral face of the great toe. All the flaps were designed as an island flap.

Flap incision was begun from the distal border of the flap and then into the deep fascia. Next, the dissection was continued underneath proximally toward to the pivot point. Care should be taken to ensure that the vessels and the nerve are included in the flap. The key is to raise a cuff of adipofascial tissue with the pedicle to protect the artery inflow and venous outflow. The cutaneous segment and underlying tissues should be elevated, full thickness, from the underlying distal phalanx without inclusion of the associated periosteum. The flap was checked for viability after the tourniquet was released. Then, the flap was rotated and passed though an open tunnel to reach the defect in the forefoot. It is necessary to ensure that no pressure is on the vascular pedicle.

The donor sites can be closed primarily using a split-thickness skin graft. The extremity was covered with a soft dressing postoperatively, leaving the flap exposed to monitor the perfusion. Two days later, the dressing was changed. All patients were non-weightbearing postoperatively until full healing of their wounds had occurred. The outcomes assessed included flap complications, wound complications, donor site

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Table
Statistical description of case series (n = 8 procedures in 8 patients)

Patient No.	Age (y)	Sex	Comorbidity	Defect Etiology	Defect Location	Complications	Follow-up (mo)
1	56	Male	Type 2 DM, neuropathy	Neuropathic ulcer	Left bottom first metatarsal head	Delay healing	15
2	27	Male	None	Traumatic event	Right bottom second metatarsal head	None	48
3	34	Male	None	Traumatic event	Left bottom third metatarsal head	None	30
4	21	Male	None	Traumatic event	Left bottom second MTPJ	None	14
5	37	Male	None	Dysfunctional scar	Right bottom second metatarsal head	None	20
6	30	Female	None	Traumatic event	Right bottom first metatarsal head	None	21
7	46	Female	Type 2 DM, Neuropathy	Neuropathic ulcer	Right bottom first metatarsal head	None	12
8	29	Male	None	Dysfunctional scar	Right bottom third MTPJ	None	16

Abbreviations: DM, diabetes mellitus; MTPJ, metatarsophalangeal joint.

complications, contour adaption, and the need for additional procedures. The mean postoperative follow-up duration was 22 ± 11.1 months (range 12 months to 4 years).

Results

All the flaps survived successfully, and the donor sites in all patients healed uneventfully. The complications included 1 case (12.5%) of delayed healing of a neuropathic ulceration. No ulceration occurred in any of the flaps owing to inappropriate or excessive contact with the shoe. No donor site morbidity developed. The visual gait analysis was normal in all patients as determined by the surgeon.

Selected Case Reports

Case 1

A 34-year-old male (patient 3 in the Table) had developed a soft tissue lesion in the weightbearing forefoot that had left an ulcer under his right second metatarsal head after an automobile accident. He had had no healing after 3 months of conservative therapy. The size of the defect in forefoot was 2 × 2 cm. This was successfully repaired with a 2.5 × 2.5-cm digital artery flap. The donor site was closed with a split-thickness skin graft. The donor and recipient sites healed without any complications within 30 months postoperatively. One month later, he had a normal gait (Figs. 1 to 3).

Fig. 1. Preoperative view of the soft tissue defect (2 × 2 cm) of the weightbearing forefoot.

Case 2

A 46-year-old female (patient 7 in the Table) had a neuropathic ulcer under her right first metatarsal head due to type 2 diabetes mellitus. Local wound care and offloading did not facilitate healing. The size of the defect was 2 × 1.5 cm, with exposure of the metatarsal head. This was repaired and covered with a 2.5 × 2-cm digital artery flap. The flap was designed as a teardrop shape on the lateral face of the great toe. The donor site was closed with a split-thickness skin graft. She had had no complications and no ulcer recurrence during a 12-month follow-up period (Figs. 4 to 6).

Discussion

The sole of the normal foot is special tissue composed of a layer of subcutaneous fat and dense fibrous septae that firmly anchor the skin to the underlying bony prominence and plantar aponeurosis. This

Fig. 2. Intraoperative view after completion of the digital artery pedicle flap with the donor site closed by a split-thickness skin graft.

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