Reconstruction with distally based dorsalis pedis fasciocutaneous flap for the coverage of distal toe-plantar defects

Ilteris Murat Emsen MD

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Reconstruction of small defects in the distal portion of the foot has always been a difficult problem. A case involving a young man with a deep electric burn of the distal lateral side of the big toe, successfully treated with a distally based dorsalis pedis fasciocutaneous flap, is presented. The donor site area of the dorsum of the foot was grafted, and deambulation was resumed three weeks later. Advantages, limits and anatomical consideration regarding the viability of the flap are also discussed.

Key Words: *Dorsalis pedis; Fasciocutaneous; Flap; Reconstruction*

The reconstruction of distal foot defects, especially wounds of the toes, is a challenging problem in plastic surgery. Various methods, such as skin grafting, or random, cross-leg and free flaps, have been reported for reconstruction of the forefoot, but all methods have limitations. Skin grafts cannot be used over exposed bone or tendon, while many flaps are bulky and uncomfortable for patients. The reverse dorsalis pedis flap is usually based on the deep plantar branch of dorsalis pedis artery. Its vascular pedicle is generally limited and may not rotate sufficiently to cover the defect (1,2). In the present report, a distally based dorsalis pedis fasciocutaneous flap was used to cover the distal one-third of the foot and toes in one patient. The preoperative clinical evaluation and surgical techniques to treat the distal foot with the distally based dorsalis pedis fasciocutaneous flap are described.

ANATOMY

The anterior tibial artery terminates in the dorsalis pedis artery, which divides into two branches: the deep plantar artery and the first dorsal metatarsal artery. The dorsalis pedis artery also has numerous cutaneous branches between the extensor retinaculum and the deep plantar branch (3). The first dorsal metatarsal artery courses through the first intermetatarsal space distally throughout the subcutaneous tissue or within the first dorsal interosseous muscle. Next, it passes dorsal to the transverse metatarsal ligament and reaches the toe as two dorsal digital arteries. The first dorsal metatarsal artery also has numerous cutaneous branches, which supply the intermetatarsal skin (4). The cutaneous branches from the dorsal pedis artery and the first dorsal intermetatarsal artery supply the essential arterial flow to the base of the fasciocutaneous flap. Adequate arterial inflow is provided by the distal communicating artery from the plantar system (5).

CASE PRESENTATION

An 18-year-old boy presented with a high-voltage electrical burn of the dorsal side of the great toe. Necrosis of skin had occurred (Figure 1). Preoperatively, both the dorsalis pedis and posterior tibial artery were palpable, and Doppler flowmetry confirmed the course of dorsalis pedis artery. Ten days after the injury, the wound was completely debrided and the necrotic skin and bone removed. The patient

Une reconstruction au moyen d'un lambeau fasciocutané de la face distale de la partie dorsale du pied pour couvrir des anomalies de la face distale de l'orteil et de la plante du pied

Les petites anomalies de la face distale du pied ont toujours posé un défi de reconstruction. Est présenté le cas d'un jeune garçon ayant subi une brûlure électrique profonde de la face distale de la partie latérale du gros orteil, traité avec succès au moyen d'un lambeau fasciocutané de la face distale de la partie dorsale du pied. Trois semaines après une greffe de la région du dos du pied provenant d'un donneur, le patient a pu reprendre la déambulation. Les avantages, les limites et les considérations anatomiques relatives à la viabilité du lambeau sont également abordés.

was diabetic, with a blood glucose level of 24.98 mmol/L. The blood glucose level was managed by an endocrinologist until the operation.

Surgical technique for the distally based dorsalis pedis fasciocutaneous flap

A preoperative Doppler examination evaluated the blood flow and positioning of the dorsalis pedis artery. A distally based dorsalis pedis fasciocutaneous flap was designed, excluding the dorsalis pedis artery. The flap included all fascial elements, and extended from the lower margin of extensor retinaculum to the first intermetatarsal area. After the design was finalized, a pneumatic tourniquet was applied and the skin was incised started from the proximal side of the flap, exposing the dorsalis pedis artery. Dissection was continued distally down to expose the deep plantar branch. Care was taken not to damage the communicating branch between the first dorsal metatarsal artery and plantar artery. Once the flap was dissected, the tourniquet was released to observe the colour of flap. The distally based flap, which was supplied by the fasciocutaneous perforating artery, was easily transferred to the distal foot. A split-thickness graft harvested from the groin was used to resurface the donor site. The postoperative period was uneventful, and no evidence of ischemia, necrosis, osteomyelitis or exposed bone was seen at follow-up.

DISCUSSION

Reconstruction of distal foot defects has been always difficult problem in plastic surgery. Various methods have been used in clinical practice. Skin grafting has been the preferred technique because of ease of harvest and application. However, skin grafts cannot be used over exposed bone or tendon. Another reconstruction option is the cross-leg flap. Disadvantages of this technique include the tissue thickness, which may result in a debulking operation in future, and the two-stage operative procedure. Moreover, patients must be immobilized throughout the operation, and this technique is not suitable for older patients. Free flaps are effective for the repair of a wide skin defects; however, they require special instruments and microsurgical techniques, which may not always be available (6). A traditional, distally based dorsalis pedis island has been successfully applied in the reconstruction of the foot after the toes were amputated. When the wound involves the

Education and Research Hospital, Department of Plastic Reconstructive and Aesthetic Surgery, Erzurum, Turkey

Correspondence: Dr Ilteris Murat Emsen, Atatürk Üniversitesi Loj. 4. Blok, No:30 25240, Erzurum, Turkey.

E-mail ilterisemsen@hotmail.com and iemsen@yahoo.com

Figure 1) Exposed metatarsal bone as a result of a high-voltage electrical burn injury

Figure 2) Perioperative view of the elevated, distally based dorsalis pedis fasciocutaneous flap

toes, the vascular pedicle based on the deep plantar branch is limited. The first dorsal metatarsal artery arises from the dorsal pedis artery and continues on to the first intermetatarsal space in the subcutaneous tissue or in the first dorsal interosseous muscle. The first dorsal metatarsal artery has several cutaneous branches that provide the intermetatarsal area with an abundant arterial supply. The venous outflow is through the communication between the deep and superficial venous system. The traditional reverse dorsal pedis flap can be designed to include the area over the extensor retinaculum and even extend proximally over the extensor retinaculum for 3 cm (1,4,5-10). In patients with problematic wounds, island or free flaps have traditionally been the method of choice. No literature on distally based fasciocutaneous flaps for distal foot repair could be found. Generally, fasciocutaneous flaps are not chosen for the repair of defects of the toes or plantar-dorsal area. However, the concept of angiosomes has led to a re-evaluation of the use of this type of flap for wounds to the distal foot. Experience with angiosomes and knowledge of the vascular anatomy of the foot enables the creation of successful, distally based fasciocutaneous flaps. The most important advantage of fasciocutaneous flaps (including those that are distally based) is that no axial vessels are sacrificed. Fasciocutaneous flaps are more likely to become ischemic in patients who are at higher risk for flap loss (eg, diabetic patients and/or high-voltage electrical burn injuries) because of damage to the axial vessels. In general, the only major complication that occurs with fasciocutaneous flaps is flap necrosis.

The main disadvantage of this flap is donor site morbidity, similar

Figure 3) Satisfactory wound closure with no ischemic flap loss one month postoperatively

Figure 4) Healed wound one year postoperatively

to the dorsalis pedis flap. Complications to the donor site include poor take of the skin graft, donor site pain and ulceration (3,8,10,11). To reduce donor site morbidity, it is essential that the peritendon of the exposed tendons on the dorsum of the foot be preserved once the flap is elevated.

CONCLUSIONS

Although a potential risk in applying this flap is insufficient venous drainage, no problems with blood inflow or outflow were encountered in the present case. The flap survived, and the patient had good postoperative outcome. We can recommend the distal-based dorsalis pedis fasciocutaneous flap for the coverage of the distal foot as a good and safe option.

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