

Free Dorsal Toe Flap for Reconstruction of the Hallux

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Summary: Soft tissue defects of the hallux represent a reconstructive challenge. Traditional options include regional flaps based on the first dorsal metatarsal artery (FDMA). However, the resultant bulky neo-hallux and contouring defect of the donor site are significant limiting factors. Here, we present the case of a young male athlete who underwent successful reconstruction of a dorsal defect of the hallux, with open exposed joint, using a free flap from the contralateral toe. We believe this is the first report of a free dorsal toe flap to reconstruct a defect of the hallux. The flap was based on the lateral dorsal digital artery, an extension of the FDMA. The donor site was reconstructed using a full thickness skin graft from the groin. Postoperatively, the flap survived completely, and both the recipient and donor sites healed without complication. There was no contour abnormality and he was able to wear his normal shoes and ambulate normally by week 3. Although the dorsal metatarsal artery perforators that supply the dorsal skin of the forefoot have been well described, there have been limited studies investigating the vascular supply of the dorsal skin overlying the hallux distally. Our experience shows that it is possible to raise a free dorsal toe flap based on the lateral dorsal digital artery only. This flap represents the ideal like-for-like reconstruction for soft tissue defects of the hallux. (*Plast Reconstr Surg Glob Open* 2020;8:e3117; doi: [10.1097/GOX.0000000000003117](https://doi.org/10.1097/GOX.0000000000003117); Published online 21 September 2020.)

The hallux plays an essential role in the biomechanics of the foot. It is a major contributor to the windlass mechanism and essential for effective push-off during the gait cycle. Shortening or loss of the hallux disrupts the integrity of the medial longitudinal arch, affects the stability of the foot, and leads to deformities of the remaining toes.

The main goals of reconstruction in the hallux are to ensure robust soft tissue cover with minimal contour abnormality to permit normal footwear and withstand the shear forces within the footwear. Traditional reconstructive options include regional flaps based on the first dorsal metatarsal artery (FDMA). However, the resultant bulky neo-hallux and contouring defect of the donor site are significant limiting factors.¹⁻⁷ Here, we present a case of hallux reconstruction using a free toe-to-toe tissue transfer.

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CASE

A 39-year-old man sustained an accidental traumatic chainsaw injury to the left hallux. There was a 4 × 2 cm soft tissue defect over the dorsum of the hallux, extending from the level of the metatarsophalangeal joint (MTPJ) to and including part of the eponychium (Fig. 1). The extensor hallucis longus (EHL) was 100% divided and interphalangeal joint was open. There was no underlying fracture. He had no previous medical history and was a keen marathon runner.

We performed a free tissue reconstruction using the equivalent soft tissue from the contralateral hallux (Fig. 2). As the contralateral side was effectively a mirror image, the dorsal toe flap was designed such that the pedicle entered the mid-point of the flap base. This design therefore avoided the pedicle being on the furthest point away from the recipient artery (FDMA), which lies in the first inter-metatarsal space on flap inset and hence reduced the pedicle length needed. A slightly larger area was harvested to prevent compression of the anastomosis. We adopted a 2-team approach. The recipient site was debrided and washed out, and the EHL was repaired with 3-0 nonabsorbable polypropylene. The FDMA and two

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Fig. 1. Preoperative photograph of a 39-year-old male patient with left hallux defect.

superficial veins were exposed using a curvilinear incision proximal to the first webspace. Simultaneously, the dorsal hallux flap was raised over the paratenon of the EHL, based on the lateral dorsal digital artery of the hallux, an extension of the FDMA along with two cutaneous veins (Fig. 3). We approached our toe flap raise using the standard approach to a great toe flap raise, by first dissecting out the FDMA through a curvilinear incision in the first inter-metatarsal space. The flap was then raised distal to proximal. Using a free-style technique, the lateral dorsal digital artery was explored to verify its presence before ligating the plantar digital artery (Fig. 2). The arterial anastomosis was performed in an end-to-side fashion onto the FDMA (both vessels: 1.5 mm diameter) and both venous anastomoses in an end-to-end fashion, all with 10-0 nylon. The donor site was reconstructed using a full thickness skin graft from the hairless region of the groin.

Postoperatively, the flap survived without any complication. The patient was discharged at day 6 with a bi-valve cast to protect the EHL repair. The cast was removed at week 2, during which he was allowed to partially weight bear. There was no contour defect (Fig. 4), and a full active range of motion is noted in both toes. The skin graft had taken without complication at the donor site. At 4 weeks, he was fully weightbearing with a normal gait and good mobility of the MTPJ (Video). (See Video [online], which displays ambulation at 3 months postoperatively.) He was

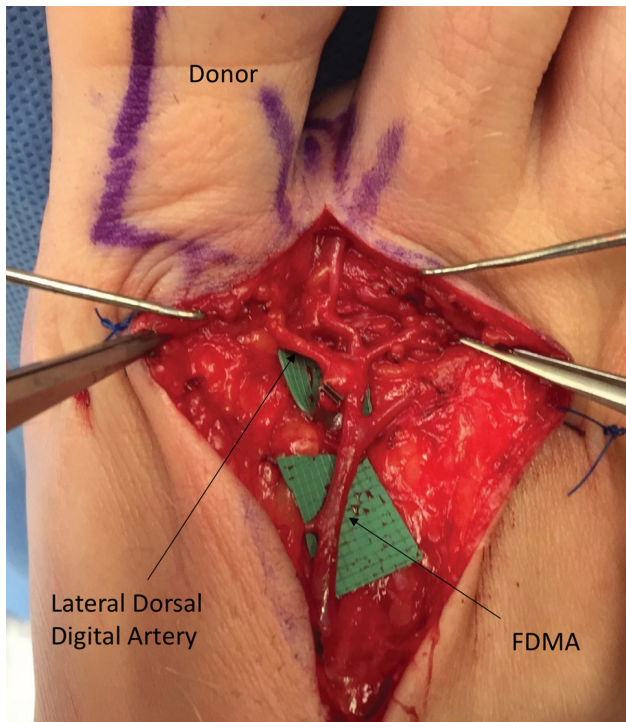


Fig. 2. Dorsal toe flap harvest based on the dorsal digital artery to the hallux, an extension of the FDMA.

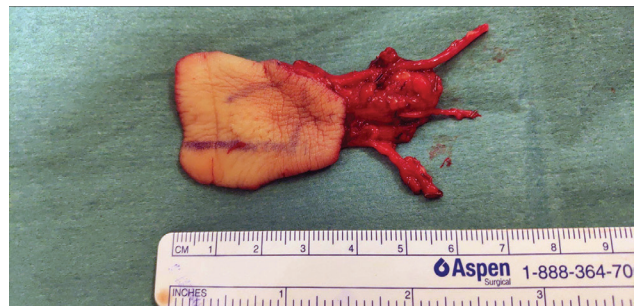


Fig. 3. Dorsal toe flap raised with 1 artery (A) and 2 veins (V).



Fig. 4. Image showing the contour of the recipient foot and hallux at 4.5 months postoperatively.

wearing his normal sports shoes. All wounds were completely healed by week 10, and he had regained mobility of the interphalangeal joint. He returned to full running without limitation at 3 months. There were no complications with pain related to the scars.

DISCUSSION

Because the hallux plays an important role in gait and foot stability, it is important to preserve length whenever possible. Local reconstructive options are limited due to the lack of available skin. Regional flap options have been well described, including those based on the FDMA, but these result in a bulky and unsightly neo-hallux, which causes problems with footwear and significant donor site morbidity.¹⁻⁷ This is not ideal for patients with high demands for their feet.

The vascular anatomy of the dorsum of the foot, particularly the cutaneous perforators arising from the FDMA, has been well described from cadaveric dissections.^{8,9} However, the cutaneous vascular supply of the dorsal skin distal to the MTPJ is not well described. Great toe flaps (including the variants such as the trimmed and wrap-around techniques used for thumb/finger reconstruction) have traditionally been based on either the FDMA or first plantar metatarsal artery, with both the dorsal and proper plantar digital arteries included in the flap. However, in this scenario, as there was a dorsal digital artery branch identified through the free-style technique, it was unnecessary to perform invasive dissection of the proper plantar digital artery and hence the flap was based solely on the lateral dorsal digital artery.

This option was ideal because it offered a like-for-like reconstruction and provided the thin and pliable yet robust fasciocutaneous tissue required for this location. Whilst regional options are reliable reconstructive options, the advantage with the free flap option was to allow the patient to wear normal footwear without extensive scarring at the donor site and return to preoperative functional status. The potential disadvantage is that the uninjured hallux is violated. However, as demonstrated in our case, this is a small price to pay, as the donor site defect was easily reconstructed with a full thickness skin graft with no functional compromise. The potential to wear normal footwear for this keen runner led to the decision to use

the free flap option. We feel that the free dorsal toe flap option provides the best functional and aesthetic outcome for dorsal defects of the hallux. Being small, thin, and pliable, this flap may also be used for covering full thickness defects on the dorsum of fingers and thumb.

CONCLUSIONS

The free dorsal toe flap is an excellent reconstructive option for dorsal defects of the hallux. As an alternative to local pedicled options, it offers thin, pliable, and robust skin replacement as well as the best contour match to allow for normal footwear with minimal donor site morbidity.

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