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CASE REPORT
Reconstructive

Reconstruction of Plantar Forefoot Area with Lateral Toe Pulp Flap: Case Report and Literature Review

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Summary: Reconstruction of the plantar forefoot area is challenging because it performs important functions, including carrying the body weight and balancing the ambulation gait, and lacks similar skin and soft tissues to manage the adjacent region. Herein, we shared our experience of using a lateral toe pulp flap and reviewed the relevant literature on this topic. A 33-year-old man presented with a large granuloma in the left plantar forefoot area after undergoing multiple operations owing to the diagnosis of callus. After tumor excision, the wound exhibited tendon exposure and a large infected dead space in the myofascial layer. After serial debridement with negative pressure wound therapy, the wound, which measured ~3.5 × 2.5 cm^2, was reconstructed using a lateral toe pulp flap. The flap was transposed to obliterate the dead space; the remaining skin defect (size: ~2 × 2 cm^2) was resurfaced with a full-thickness skin graft, harvested from the left inguinal region, followed by primary closure of the flap donor site. The flap completely survived. The lateral toe pulp flap is an easy, effective, and reliable option for reconstruction of the defects in the plantar forefoot area. *(Plast Reconstr Surg Glob Open 2024; 12:e5654; doi: 10.1097/GOX.0000000000005654; Published online 20 March 2024.)*

The plantar forefoot area performs vital functions, such as carrying 45% of the body's weight[1] and balancing ambulation gait; therefore, reconstruction of defects in this region is crucial. However, covering the defect in this region with similar skin and soft tissues is challenging owing to the lack of choice in the adjacent region. Herein, we used a lateral toe pulp flap to obliterate the dead space and cover a skin defect in the plantar forefoot area. We aimed to share our experience of using a lateral toe pulp flap and review the relevant literature.

CASE PRESENTATION

A 33-year-old man presented to our outpatient clinic with a large granuloma in the left plantar forefoot region for 10 years. A 5 × 2.5-cm^2 clavus-like tumor was observed in the left plantar forefoot. (**See figure, Supplemental Digital Content 1**, which displays clavus-like tumor at left plantar forefoot region of approximately 5 × 2.5 cm^2. **http://links.lww.com/PRSGO/D92**). After tumor excision, fibrous sheaths of the flexor tendons, part of the flexor digitorum longus tendon to the second toe exposure, and a large infected dead space were observed in the myofascial layer (Fig. 1). After 1 week, debridement surgery with negative pressure wound therapy was performed. An infected wound in the left plantar forefoot with a skin defect (~3.5 × 2.5 cm^2), tendon exposure, and underlying dead space extending from the wound edge to the first, second, and third plantar web spaces were observed. A handheld Doppler was used to identify the digital artery on the lateral side of the great toe. A lateral toe pulp flap was designed using approximately one-third of the great toe pulp width and harvested in a distal–proximal manner as the pedicled flap, including the plantar digital neurovascular bundle (Fig. 2). (**See figure, Supplemental Digital Content 2**, which displays hand-drawn schematics of the lateral toe pulp flap and its vasculature. **http://links.lww.com/PRSGO/D93**). Thereafter, the plantar skin was incised, and the flap was transposed to obliterate the dead space. The remaining skin defect (size: ~2 × 2 cm^2) was resurfaced with skin graft, followed by primary closure of the flap donor site (Fig. 3).

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Fig. 1. Skin defect of ~3.5 × 2.5 cm^2 with a large infected dead space at the left plantar forefoot region after tumor excision.

Fig. 2. Lateral toe pulp flap designed approximately one-third of great toe pulp as pedicled flap.

RESULTS

The flap completely survived without marginal necrosis; however, minimal underlying dead space still remained. After serial debridement and negative pressure wound therapy, the remaining skin defect was resurfaced using a skin graft. After 4 months, a well-perfused flap without ulceration was observed, and the skin graft was healed (Fig. 4). The donor site showed uneventful healing. The shape and contour of the great toe were acceptable. The static two-point discrimination of the toe pulp flap was 8 mm and that of the donor area of the lateral great toe was 10 mm. The patient could wear shoes and walk without disturbed gait, which was satisfactory for the patient.

DISCUSSION

Reconstructing defects in the plantar forefoot area is challenging for plastic surgeons because of the limited skin laxity, lack of redundant tissues, and its several important restoration functions, including weight bearing and friction resistance. In addition, contouring, less aesthetic deformity, and the ability to wear ordinary shoes are the desired achievable tasks.

We reviewed the armamentarium of flaps for plantar forefoot reconstruction. Toe amputation with a fillet flap,[2] first dorsal metatarsal artery (FDMA) flap,[3] distally based abductor hallucis adipomuscular flap,[4] and medial plantar flap[5] are different types of local flaps. The distal flap includes the distally based sural flap[6] and free flap. Toe amputation, with fillet flap, is a quick and straightforward method for reconstructing small defects; however, it leads to toe loss and in turn results in self-image disfigurement. The application of the FDMA flap is restricted because of the limited arc of rotation and uncertainty regarding the proximation of perforators with the FDMA flap. The distally based abductor hallucis adipomuscular flap provides an appropriate volume to obliterate the dead space (if needed); however, the requirement of a nonsensate flap and an additional skin graft for covering the muscle flap is a limitation. Furthermore, the medial plantar flap affects the medial plantar vascular system. The distally based sural flap is an alternative for reconstruction but results in obvious donor site morbidity. Free flaps can be used for larger defects; however, a long operation period, microvascular anastomosis, and frequent postoperative flap monitoring are required.

The lateral toe pulp flap is an axial pattern sensate flap prepared using the glabrous skin for reconstructing the adjacent region, including the digit and plantar forefoot.[7] The pedicle is the first dorsal metatarsal or plantar digital artery, and venous outflow is achieved via the dorsal subcutaneous vein. The lateral toe pulp flap and its neurovascular bundle are easy to elevate using loupe

Fig. 3. Defect reconstructed with lateral toe pulp flap and skin graft.

Fig. 4. The well-perfused flap showed no ulceration after 4 months.

magnification, thereby not increasing the operation time. No main artery is lost or ligated during flap harvest; therefore, the perfusion of the plantar region is not hampered and the donor site is cosmetically acceptable. Thus, this flap is a suitable option for plantar forefoot reconstruction.

Jeng et al proposed a management algorithm for plantar forefoot reconstruction based on defect size.[8] They hypothesized that the hemipulp toe flap provides better two-point discrimination and replaces like-with-like. In our case, the defect was ~12.5 cm^2; therefore, the flap could obliterate the dead space well; however, some parts of the raw surface remained, which were covered with a skin graft.

In most cases, the donor site could be primarily closed. Kim et al reported achieving primary closure, not exceeding 60% of the entire toe pulp.[9] However, performing the pinch test on the arc-surfaced and fixed-glabrous toe skin is impossible; therefore, estimating a flap width of less than 2 cm is another option.[10]

This flap should not be used in patients with a peripheral vascular disease or trauma history that compromises the pedicle. Pulse volume record or sonography for the vascular study of high-risk patients is recommended. The use of alternative reconstruction methods is also recommended when the signal for handheld Doppler is weak.

CONCLUSIONS

The lateral toe pulp flap is an easy reconstruction method for small defects in the plantar forefoot area. Major advantages of this flap were the replacement of the defect with similar tissue, retention of less donor site morbidity, and an acceptable aesthetic outcome. Thus, this flap is an effective and reliable option for reconstructing defects in the plantar forefoot area.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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