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Medial and Lateral Plantar Artery Angiosome Rotational Flaps for Transmetatarsal and Lisfranc Amputation in Patients With Compromised Plantar Tissue

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ABSTRACT

Traditional incision techniques for midfoot amputation might not provide immediate soft tissue coverage of the underlying metatarsal and tarsal bones in the presence of a large plantar soft tissue defect. Patients undergoing transmetatarsal and Lisfranc amputation frequently have compromised plantar tissue in association with neuropathic ulcers, forefoot gangrene, and infection, necessitating wide resection as a part of the amputation procedure. Open amputation will routinely be performed under these circumstances, although secondary healing could be compromised owing to residual bone exposure. Alternatively, the surgeon might elect to perform a more proximal lower extremity amputation, which will allow better soft tissue coverage but compromises function of the lower extremity. A third option for this challenging situation is to modify the plantar flap incision design to incorporate a medial or lateral plantar artery angiosome-based rotational flap, which will provide immediate coverage of the forefoot and midfoot soft tissue defects without excessive shortening of the bone structure. A plantar medial soft tissue defect is treated with the lateral plantar artery angiosome flap, and a plantar lateral defect is treated with the medial plantar artery angiosome flap. Medial and lateral flaps can be combined to cover a central plantar wound defect. Incorporating large rotational flaps requires knowledge of the applicable angiosome anatomy and specific modifications to incision planning and dissection techniques to ensure adequate soft tissue coverage and preservation of the blood supply to the flap. A series of 4 cases with an average follow-up duration of 5.75 years is presented to demonstrate our patient selection criteria, flap design principles, dissection pearls, and surgical staging protocol.

Soft tissue defects on the plantar surface of the forefoot or midfoot caused by neuropathic ulceration, infection, and gangrene have a significant effect on the success rate and ultimate level of bone resection when performing transmetatarsal amputation (TMA) and Lisfranc level amputation. The traditional transverse incision technique for midfoot amputation (Fig. 1) might not provide immediate soft tissue coverage of the underlying metatarsal and tarsal bones in the presence of compromised plantar tissue. Open amputation will be routinely performed under these circumstances, although healing is compromised by residual bone exposure. Alternatively, the surgeon might elect to perform a more proximal lower extremity amputation, which will allow primary closure but will leave the patient with a less functional amputation stump.

An alternative option for this challenging situation is to modify the plantar flap design to incorporate medial and/or lateral plantar artery angiosome-based rotational flaps, which will provide immediate coverage of the forefoot and midfoot soft tissue defects without excessive shortening of the bone structure. A plantar medial soft tissue defect will be treated with the lateral plantar artery angiosome (LPAA) flap and a plantar lateral defect with a medial plantar artery angiosome (MPAA) flap. A combined LPAA and MPAA flap approach is used for central wound defects.

The published data support TMA as the preferred level of amputation compared with more proximal amputation because of the improved biomechanical function of the foot (1–4) and favorable long-term morbidity and mortality outcomes (2). The TMA level is ideal for patients with forefoot neuropathic wounds, ischemia, infection, or trauma. The primary goals of successful partial foot amputation are to maintain function by preserving the overall foot length and coverage of the

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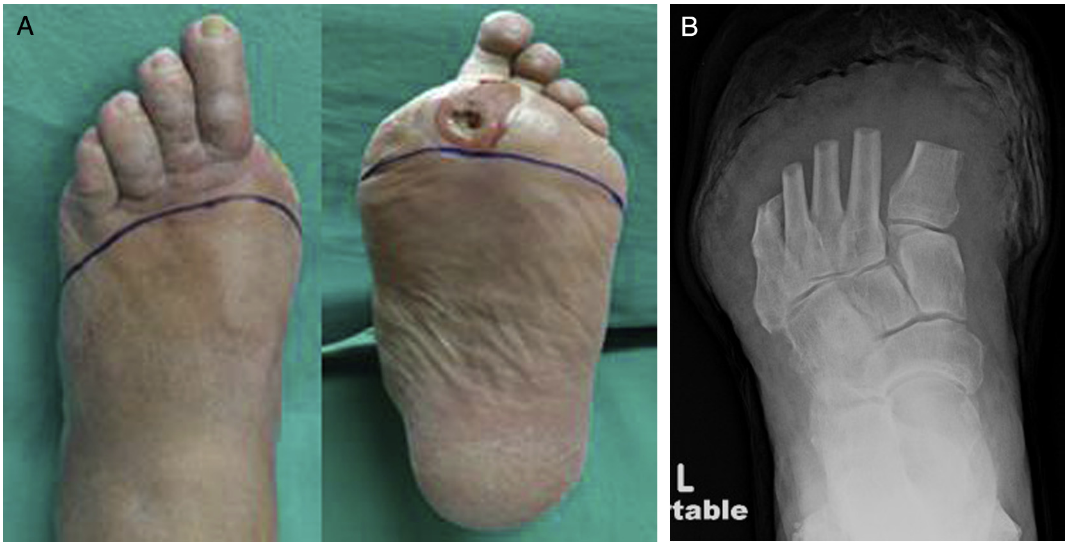

Fig. 1. The traditional transmetatarsal amputation incision design requires intact plantar tissue for coverage of the resected metatarsals. (*A*) The dorsal and plantar incisions should ideally be at the level of the metatarsophalangeal joint; however, compromised soft tissue can be accommodated with more proximal incisions, as shown. The plantar flap is more important, because thick, viable tissue is necessary to withstand the forces of weightbearing. Large soft tissue defects beneath the metatarsal heads will significantly compromise the integrity and utility of the plantar flap. (*B*) The ideal level of bone resection with transmetatarsal amputation is at the neck of each metatarsal just proximal to the distal metaphyseal flare. Metatarsal resection was more proximal in part *B* to accommodate a short plantar flap.

wound defect with viable and durable tissue. The varied success of TMA survival seen in the published data has ranged from 44% to 92%, with one study suggesting a success rate of near 60% with an 88% complication rate, adding emphasis that correct procedure selection and post-operative care are imperative (3,5). Limited information exists regarding the use of MPAA or LPAA flaps for coverage of large plantar soft tissue defects of the forefoot or midfoot, although this approach has been used routinely by the primary author (T.J.B.) for the past 10 years.

Compared with TMA, Lisfranc amputation is a less desirable amputation level with regard to weightbearing function, resistance

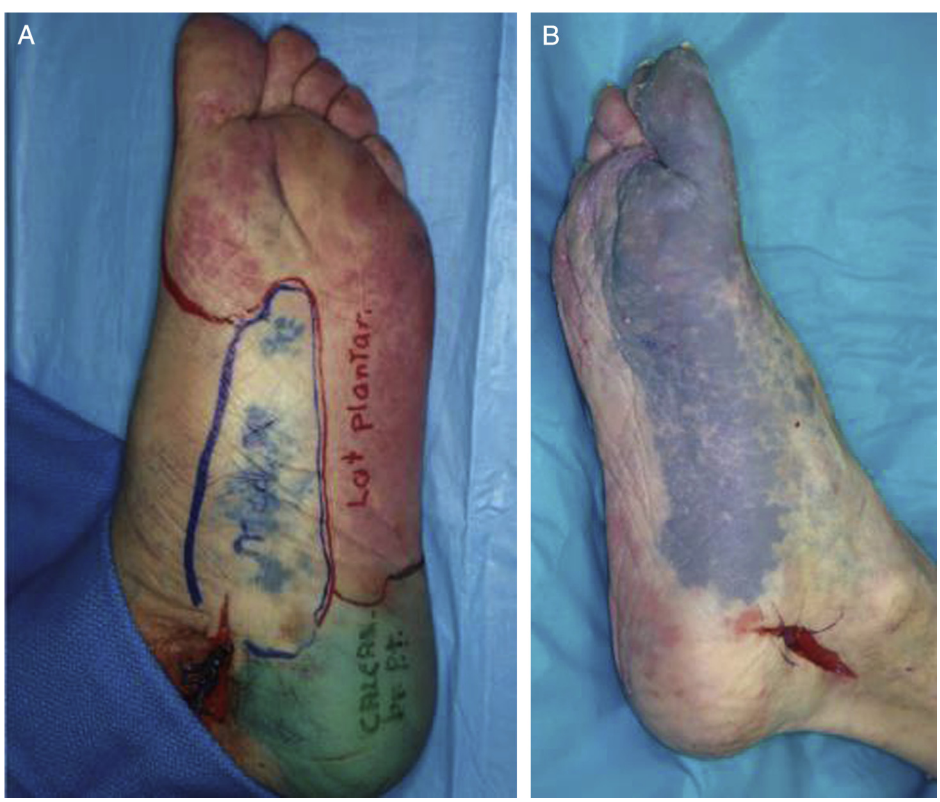

Fig. 2. Distribution of plantar foot angiosomes. Note that the lateral plantar artery angiosome (*red*) is extensive (*A*), and the medial plantar artery angiosome (*blue*) varies. (*A* and *B*, From Attinger CE, Evans KK, Bulan E, Blume P, Cooper P. Angiosomes of the foot and ankle and clinical implications for limb salvage: reconstruction, incisions, and revascularization. Plast Reconstr Surg 117[7S]:261S–293S, 2006.)