

Sole Reconstruction Using Anterolateral Thigh Free Flap: A Review of 4 Cases

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Background: The ideal technique for sole reconstruction should meet such requisite as a durable and comfortable weight-bearing surface, solid anchoring to deep tissue for resistance to shear force and adequate protective sensation. The anterolateral thigh (ALT) perforator free flap provides a large, pliable skin island and sufficient bulk, allowing three-dimensional tailoring to complex defects. The present article is about our experience of sole reconstruction ALT perforator free flap.

Patient and Method: Total of 4 flaps in the foot defects was performed in February 2009 to December 2012. We reconstructed soft tissue defects in the sole using ALT free flaps, the complications, aesthetic and function results were monitored.

Result: ALT perforator free flap provided stable and durable long-term wound cover in all patients, resulting in early rehabilitation and function outcomes were completely achieved. Complications were few and manageable in all cases.

Summary: ALT perforator free flap has become common procedure in many centers around the world. The numerous advantages include stable wound coverage; improve aesthetic and functional outcomes, and minimal donor site morbidity. In our experiences, we found that the use of ALT perforator free flap in sole defect reconstruction, to be technically affordable, reliable and have resulted in excellent outcomes.

Keywords: Sole reconstruction, anterolateral thigh free flap

Latar Belakang: Teknik yang ideal untuk rekonstruksi telapak kaki harus memenuhi syarat permukaan yang kuat dan nyaman untuk menahan beban, jaringan dalam yang solid dan resisten terhadap daya guncangan serta sensasi proteksi yang adekuat. Anterolateral thigh (ALT) perforator free flap menyediakan pulau kulit yang luas dan fleksibel, serta ketebalan yang cukup sehingga memungkinkan menutup defek kompleks secara 3 dimensi. Artikel ini menjelaskan pengalaman rekonstruksi telapak kaki dengan ALT perforator free flap.

Pasien dan Metode: Terdapat 4 kasus flap pada defek telapak kaki dari Februari 2009 hingga Desember 2012. Dilakukan rekonstruksi telapak kaki dengan ALT free flaps. Dilakukan follow up dan monitor terhadap komplikasi, hasil estetik dan fungsional.

Hasil: ALT perforator free flap menyediakan penutupan luka yang stabil dan tahan lama pada semua pasien, menghasilkan rehabilitasi dini dan hasil fungsional yang baik. Hanya sedikit komplikasi yang terjadi dan masih tertangani.

Ringkasan: ALT perforator free flap telah menjadi prosedur yang umum dilakukan di banyak pusat di dunia. Beberapa keuntungan mencakup penutupan luka yang stabil, meningkatkan hasil yang baik secara estetik dan fungsional, serta morbiditas yang minimal pada tempat donor. Menurut pengalaman kami, penggunaan ALT perforator free flap pada rekonstruksi telapak kaki adalah teknik yang terjangkau, dapat diandalkan, dan memberikan hasil yang baik.

Kata Kunci: Sole reconstruction, anterolateral thigh free flap

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The history of foot reconstruction began with an attempted morphologic restoration of the shape. The most ancient description was an Egyptian prosthesis found in pharaoh's sarcophagus. The first written report on foot injuries was found in

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Roman war surgery books, in which amputation was already suggested as the elective treatment for serious foot damages. Snyder (1965) and Kaplan (1969) also highlighted the importance of the sensate reconstruction of the foot sole, particularly for weight bearing (WB) areas.¹

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The treatment of large defects remained unsolved until the middle of the 19th century. In 1854, Hamilton described the cross-leg flap. Filatov (1917) and Gillies (1920) described the tubular pedicled flap, providing another possibility to avoid amputation. The advent of microsurgery in the 1970s and the description by Ponten in 1981 of myocutaneous and fasciocutaneous started a new era in lower limb and foot surgery. In 1973, O'Brien described the first free groin flap for reconstruction of the foot. In 1976, Baudet harvested the free latissimus dorsi. In 1976, Harii first transferred a free gracilis flap and Robinson introduced the dorsalis pedis fasciocutaneous free flap. In 1978, Chang described the radial forearm (RF) flap. In 1980, Dos Santos first transferred a scapular and parascapular flap. In 1984, Song described the free anterolateral thigh (ALT) flap¹.

The reconstruction of the weight bearing sole remains difficult and challenging. The unique and specialized structure of dermal-epidermal histology and the fibrous septae of the subcutaneous layer provide properties for

withstanding pressure and absorbing the shock associated with gait. A defect in the foot requires conventional local flaps from the plantar region and can be used to achieve ideal reconstruction. But the local flaps are limited to small defects. For larger and extensive defect, microvascular flap reconstruction is required.

The ideal flap for reconstruction of the sole should provide a well-vascularized tissue to control infection, adequate contour for footwear, durability and solid anchorage to resist shearing forces. This article will review the efficacy of the anterolateral thigh (ALT) perforator flap as a modality toward the goal of developing the ideal flap to reconstruct the foot defects.

PATIENT AND METHOD

In this article we report 4 patients with sole defect and had performed ALT flap in February 2009 to December 2012. Profile of patients and types of microvascular anastomosis are reported in Table 1.

Table 1. Profile of Patients and Types of Microvascular Anastomosis

No	Age/Sex	Primary Lesion	ALT Flap Size	Recipient (anastomosis)	Donor Site	Complications or Revision
1	29/F	Osteomyelitis in Metatarsal IV-V Pedis Sinistra	15 x 11 cm	Artery Dorsalis Pedis (ETS) Vena Comitantes	Primary Closure	Flap thinning
2	42/M	Plantar Avulsion in right foot due to trauma	10 x 8 cm	Artery Dorsalis Pedis (ETE) Vena Comitantes and Vena Saphena Magna	Primary Closure	N/A
3	51/M	Diabetic Ulcer with Bone Exposed in Calcaneus Dextra Region	10 x 5 cm	Artery Dorsalis Pedis (ETE) Vena Comitantes	Primary Closure	N/A
4	35/M	Chronic Wound in the Left Heel due to Trauma	10 x 5 cm	Artery Dorsalis Pedis (ETE) Vena Comitantes and Vena Saphena Magna	Primary Closure	N/A

F: female; M: male; ALT: anterolateral thigh; ETE: end to end; ETS: end to side; N/A: not available



Figure 1. Case 1 with osteomyelitis in metatarsal IV-V of the left foot. **Left and Middle** : preoperative pictures. **Right** : After debridement procedure.



Figure 2. Case 1. **Above Left:** Design of the free ALT flap. **Above Right** : Free ALT flap harvesting, complete flap elevation with long vascular pedicle. **Below Left** : Early post-operative view after reconstruction of the foot with Free ALT flap. **Below Right** : Six months post-operative view.



Figure 3. Case 2 with Plantar Avulsion in right foot due to trauma **Above Left:** Preoperative view. **Above Middle:** After debridement procedure. **Above Right:** Design of the ALT free flap. **Below Left and Middle** : Early post-operative view. **Below Right** : Follow up view at 6 months.



Figure 4. Case 3 with Diabetic Ulcer with Bone Exposed in Calcaneus Dextra Region **Above Left:** Preoperative view. **Above Middle :** Free ALT flap harvesting. **Above Right :** Post-operative appearance. **Below Left :** Post-operative day-13. **Below Middle and Right :** Follow up at 1 year.



Figure 3. Case 4 with Chronic Wound in the Left Heel due to Trauma. **Above Left and Middle:** Pre-operative view. **Above Right:** Design of the ALT free flap. **Below Left:** Complete flap elevation with long vascular pedicle. **Below Middle:** Early post-operative view. **Below Right:** Follow up at two weeks.



RESULT

ALT perforator free flap provided stable and durable long-term wound cover in all patients, resulting in early rehabilitation and function outcomes were completely achieved. Complications were few and manageable in all cases.

DISCUSSION

The ideal technique for sole reconstruction should meet such requisites as a durable and comfortable weight-bearing surface, solid anchoring to deep tissue for resistance to shear force, and adequate protective sensation. Sometimes, a large dead space occurs and sufficient bulk is required. A muscle flap with skin grafting is believed to yield adequate success in plantar reconstruction, but problem relating to fissures, hyperkeratosis, ulcerations, bulkiness, and lack of sensory reinnervation remain.¹⁷ In contrast, thin, pliable coverage are necessary for flexible joint motion and normal footwear. Ohjimi et al compared conventional flaps and "thinning" flaps in lower extremity reconstruction and concluded that the thin flap reduced secondary operations and was superior in functional and aesthetic aspects.¹⁸ Rautio et al stated that, in foot reconstruction, the optimal thickness of the flap should be less than 6 mm for adequate tightening.²³ The anterolateral thigh perforator flap can be safely thinned to 3 to 4 mm except for the pedicle site, thus providing adequate contour for the usual footwear without laxity or slippage. This flap can be harvested as a musculocutaneous flap with inclusion of the adjacent muscles such as the vastus lateralis or rectus femoris to fill large dead space and to provide good cushioning in the weight-bearing areas. The fascia lata can also be harvested along the flap if fascial structure is needed.

The main concern with the anterolateral thigh perforator flap is the consistency of its vascular anatomy. However, Wei et al reported that reliable skin vessels were identified consistently, with the exception of only six of 672 cases.²¹ In our experience, 68 of 69 cases had reliable perforators; 59 (75%) were musculocutaneous perforators and nine (13%) were septocutaneous perforators. Even if the perforator was not identifiable or injured

during dissection, another perforator could be found adjacent to the flap, or the elevation plan could be changed to a vastus lateralis flap or a fascia lata flap. Various causes of foot plantar defects result in perivascular changes, adjacent tissue scarring, and increased vulnerability of the vessels, leading to a higher failure rate of microanastomosis. Accurate assessment of both perforator and recipient vessel status is critical for successful reconstruction of the sole. According to our experience, preoperative Doppler mapping can sometimes provide false perceptions that may lead one to believe in the presence of a perforator. We experienced one case in which a perforator was confirmed by preoperative Doppler tracing; however, there was no sizable perforator adequate for microanastomosis.

Hage and Woerdeman reported a case of partial necrosis of the foot and calf caused by interruption of the descending branch of the lateral circumflex femoral artery, which acted as critical collateral for the obstructed superficial femoral artery.²⁴ Thus, routine preoperative angiography (or computed tomographic angiography) may be warranted to preclude such risks. As with any plantar surface reconstruction, patient education and compliance are vital in achieving long-term success following reconstruction. To allow early weight-bearing of the reconstructed foot, pressure stockings play an important role in maintaining the integrity of the flap. The pressure of the stocking allows the premature flap to bear weight without shearing and also reduces edema, leading to early molding. In our institution, the patient is required to go through an early rehabilitation program, vigorous education, and serial follow-ups.

SUMMARY

The anterolateral thigh perforator flap provides a large, pliable skin island and sufficient bulk, with adjacent muscles if necessary, allowing three-dimensional tailoring to complex defects. The flap itself can be debulked to provide thin, versatile coverage, allowing exceptional contouring of the plantar surface. It results in acceptable donor-site

morbidity and allows faster rehabilitation. We suggest that this versatile flap deserves special attention apart from fasciocutaneous flap and presents a reliable option in sole reconstruction. With proper preoperative patient evaluation and standardized postoperative management including education and rehabilitation, flap failure and complications can be minimized.

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