

Case Series

Medial plantar artery flap: a versatile workhorse flap for foot reconstruction, our experience

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ABSTRACT

Soft tissue defect in the foot is commonly seen as it is more prone to trophic ulcers since it is the main weight bearing area of the body. Reconstruction of the weight bearing area of the foot requires the provision of a stable, supple, durable and preferably sensate skin coverage. Following Sir Gilli's principle of replacing like with like, medial plantar artery flap provides an anatomically similar, glabrous skin for coverage on the plantar surface. In the present study, we share our clinical experience with the use of medial plantar artery flap for coverage of soft tissue defect over sole of foot. At our institution, a total of 10 patients presented with soft tissue defect of the sole, underwent medial plantar artery flap coverage. All the 10 patients were diagnosed cases of type 2 DM. patient outcome was assessed according to patients' age distribution, duration of surgery, hospital stay, and post operative complications. Out of all the 10 patients, 5 were male and 5 were female. All the flaps healed uneventfully without major complications like partial flap necrosis. Donor site was covered with split thickness skin graft. There was suture site dehiscence in 2 cases which healed with secondary healing. Medial plantar artery flap has been described as an optimal reconstructive option for this type of soft tissue defect.

Keywords: Medial plantar artery flap, Sole defect, Foot reconstruction, Foot reconstruction workhorse flaps, Pedicled flaps

INTRODUCTION

Soft-tissue defects in the foot are especially challenging as there are few reconstructive alternatives and a specific local region requirement. Along with common occurrence this defect is often seen with high rate of osteomyelitis leading to limb loss.¹⁻⁴ it is paramount to cover these defects early with stable durable supple cover to prevent future ulceration and to salvage the at-risk limb. Medial plantar artery (MPA) fascio-cutaneous flap is as an excellent option that full fills these demands by utilising specialised tissue from the more expendable arch of the foot and placing it in the weight-bearing area, this

flap not only replaces "like with like" tissue but also provides protective sensation.⁵⁻¹¹

Masquelet and Romana in the 1990 described this flap for heel reconstruction to provide similar glabrous skin with the minimum donor site morbidity. Multiple studies have been done since then depicting the successful use of this flap as a pedicled flap for local wound coverage.¹²⁻¹⁴

During 2018 to 2021, we performed ten cases of MPA flap for sole defect at our institute. All patients with altered weight bearing pattern in foot leading to pressure over instep area were excluded from study. A written informed consent was taken from all the participants prior to the surgery.

Surgical procedure

MPA was identified using an 8 MHz hand held doppler probe, which was confirmed with a duplex imaging system. As per the defects size and location, marking and planning of flap was done in reverse. The surgery was performed under spinal anaesthesia, tourniquet control and loupe magnification. Thorough debridement was done at the recipient site, margins refreshed, a template was made of the final defect.

Flap elevation technique

The flap marking was done in the instep area, as per the defect, along the course of the MPA. The first vertical incision of about 1 cm was made along the vascular axis just proximal to the flap. The incision deepened till the plantar aponeurosis was identified. It was then incised to expose the neuro vascular bundle containing the MPA underneath. Another incision was then made at the plantar aspect of the flap, which was previously marked. We then enter the fascia over abductor hallucis and then the flap was raised from plantar to dorsal side. Perforators present between abductor hallucis and flexor hallucis tendon are identified and isolated. Abductor hallucis muscle was retracted and the perforators were traced to their origin. Medial plantar vessels were exposed in the intermuscular space and necessary vessel length was dissected. A dorsal incision was made to identify the saphenous vein, and if necessary, a cutaneous nerve can be included and traced proximally. Lateral sensory branch of medial nerve innervating flap was identified. The nerve was either divided at distal end of flap/sensory fibres were identified during the course of distal-to-proximal flap elevation as they penetrate the overlying plantar fascia. These nerve fibres are then split from the medial plantar nerve as dissection proceeds proximally. This nerve-splitting technique is preferred since sensation is preserved in the distal medial plantar foot and at the same time maintained within the skin island. Dissection was done until the tuberosity of the calcaneus was reached. Pedicle length of up to 3 cm can be taken.

Once flap was elevated and isolated, tourniquet was deflated. Haemostasis was achieved.

Flap had been islanded and rotated as per requirement to cover the defect. It was brought to the recipient field, and flap inset was given with nonabsorbable skin sutures. Donor site and the non-weight bearing area was closed with simple skin sutures or split thickness skin graft. Post operatively slab was given for immobilization and limb elevation was given.

CASE SERIES

Case 1

A 60 years old male patient with history of type 2 dm since 10 years came with complaint of non-healing

chronic indolent left heel ulcer of 2x2x1 cm. Defect was debrided and immediately covered with medial plantar artery flap and donor area was managed with STSG.

Case 2

A 42 years old female diabetic patient presenting with right heel ulcer of 5x4x1 cm with talipes equines deformity. Medial plantar artery flap was prepared for this defect and donor site was covered with split thickness skin graft.

Case 3

A 60 years old female patient having a soft tissue tumour over the medial aspect right foot at the base of 1st meta tarsal of about 2x2x1 cm. Patient underwent wide local excision followed by adjuvant therapy after which she developed a recurrent lesion, we performed medial plantar artery flap for this defect as soft tissue coverage was a must for post operative radiation. Donor site was covered with split thickness skin graft.

Case 4

A 45-year-old male, with history of chronic non healing ulcer over the heel since 5 months. Patient had history of infected corn excision 6 months back. Patient has history of diabetes since 5 years, taking medications on and off. Patients' sensation was preserved and gait was normal and arches of foot were preserved.

Case 5

A 45-year-old male patient, developed a post traumatic wound over heel of right foot 2 months back. He is a known case of type 2 DM on regular medication since one year. Patients' weight bearing pattern was normal and sensations in foot were all preserved. Patient underwent medial plantar artery flap coverage with stg for coverage of donor side defect.

Case 6

A 55-year-old female patient with non-healing ulcer over sole of foot for 8 months following trauma arches of foot were preserved but patient had o sensation over affected part. Patient is a known of type 2 DM. Patient was being managed with dressing and off-loading shoes. Patient underwent medial plantar artery flap under spinal anaesthesia for heel defect.

Case 7

A 45-year-old female, was referred to our institute with a chronic non healing ulcer of about 2.5x2.1 cm over sole of foot for 3 months. Patient is a known case of type 2 DM since 8 years. Patient underwent debridement of the wound and was then being managed conservatively with

dressing. Patient underwent medial plantar artery flap along with stg coverage of donor site.

Case 8

A 40-year-old female presented with a chronic non healing ulcer over heel of left foot. She was a known case of type 2 DM since 2 years. Patient underwent debridement followed by medial plantar artery flap coverage under spinal anaesthesia.

Case 9

A 50-year-old male presented to us with a non-healing tropic ulcer over heel of right foot. Patient underwent wound debridement followed by islanded medial plantar artery flap under spinal anaesthesia.

Case 10

A 21-year-old male presented to us with soft tissue defect at the great ball of toe. Patient had history of RTA. As seen in the image underlying flexor tendon was exposed. Patient had no h/o diabetes or hypertension.



Figure 3: Pre-operative defect.



Figure 4: Immediate post-op.



Figure 1: Pre-operative defect.



Figure 2: Post-operative photo.



Figure 5: Post-operative photograph.



Figure 6: Pre-operative lesion along with intraoperative photograph and final inset.



Figure 7: Preoperative photograph and marking.



Figure 8: Immediate post operative.



Figure 9: Preoperative wound and final photograph.



Figure 10: Preoperative wound and final photograph.



Figure 11: Pre-operative sole defect along with final photograph after 1 month.



Figure 12: Preoperative photograph and marking.



Figure 15: Pre-operative photograph and marking.



Figure 13: Intra-operative marking.



Figure 16: Final inset.



Figure 14: Final photograph.



Figure 17: Pre-operative photo with marking.



Figure 18: Intraoperative and final inset photo.

DISCUSSION

Total number of patients who underwent medial plantar artery flaps were 10. The age distribution in this study was between 20 to 60 years. Out of 10 patients that were operated for medial plantar artery flap 5 were female and 5 were male, out of which 9 were diabetic. Surgical time was 1 to 1.2 hours. Average hospitalization was 6 days. Out of 10 patients, 8 patients had developed ulcer due to diabetic neuropathy and arthropathy while one patient had recurrent malignant lesion and other had post traumatic defect. Aetiology of the ulcers was post infectious, post traumatic raw area or trophic ulcer over the foot in patients having long standing type 2 DM and associated neuropathy and arthropathy (Charcot foot). One patient had history of recurrent malignant lesion over the foot for which excision was done followed by medial plantar artery flap coverage. One had history of RTA. Two cases under went islanded MPA flap coverage and remaining were standard pedicled flaps. One of the flaps developed partial necrosis at the distal margin which was managed conservatively with dressing. There was no complete necrosis or donor site complications. Two patients had suture site dehiscence which was managed conservatively. There was no donor site morbidity, infection, graft loss, haematoma or venous congestion.

Soft tissue defect of sole of foot is the 2nd most common ulcer of lower limb presenting with difficult reconstructive challenge due to specialised anatomy and unique weight bearing need of the location. Ulceration in sole of foot has a very high rate of conversion of osteomyelitis leading to limb loss. It is critical to cover this defect to protect the bone providing good vascularity for healing and protective sensation along with minimal patient morbidity. As the MPA is a non-dominant artery

of the foot, and the angiosome may be perfused by retrograde flow, it is considered expendable. The MPA covers a foot defect by utilising acral tissue from a non-weight-bearing portion of the medial plantar medial longitudinal arch, resulting in stable, supple, and durable coverage of a weight-bearing area it also gives the recipient region with protective sensitivity and tissues capable of withstanding forces of weight bearing and shearing of the foot.⁵⁻¹¹

Since there are numerous fibrous septae that connect the deep fascia to the skin, high amounts of collagen and elastin fibres, and the highly compartmentalized fat deposits inside the plantar fat pad make the anatomy of sole of foot quite unique to withstand the forces of motion. These specific traits allow the plantar fat pad to perform a highly specialised function as a shock absorber. To maintain minimal host morbidity, the donor site may be grafted at the time of harvest. In order to improve split-thickness skin graft uptake and mobility after harvest, the donor site can be covered with a dermal regenerative template. Altered weight bearing pattern or loss of arches also pose a unique challenge of reconstruction due to high rate of ulcer recurrence if adequate respect to the weight bearing pattern is not followed the.

Multiple studies have reported ulceration after free tissue transfer to the sole of foot, most likely as a result of sensory deficits and the transplanted tissue's inability to withstand the forces in this area.¹⁵

These findings support the use of an MPA flap as the primary donor tissue to restore the heel's weight-bearing surface. The primary indication for a cross-leg flap is the necessity of flap coverage over an exposed bone, tendon, or joint or defect on the knee, shin, ankle, or foot, or over an unstable scar in a weight-bearing region. But this surgical technique requires meticulous planning and patient immobilization for 3 weeks followed by multiple surgeries, it is used only when there is no other alternative present.

MPA perforator flap satisfies some ideal requisite like sensory feedback and glabrous skin providing stable, supple, sensate and durable cover. It can be utilized to cover heel, mid foot and forefoot because the flap is dissected on an MPA perforator, it was not necessary to establish the patency of the dorsalis pedis artery in every patient because the plantar arterial arch was not affected.^{16,17} It has a steep learning curve due to its difficult dissection, but it is easier than free microvascular tissue transfer, requiring less work and monitoring. Unlike the sensate reverse sural artery flap, which merely provides coverage to heel defects with soft and malleable posterior leg skin, the MPA flap provides glabrous (sensate) skin that meets local area needs. During follow-up, we discovered that the split skin graft used to cover the donor site of the flap was hard and

hyperkeratotic, possibly due to continual strain on the area.

In our series, 9 the patients had co-morbidities like diabetes and 2 had hypertension. Due to these co-morbidities, a local flap was better option and MPA flap was harvested from instep area of foot. As it is an expendable blood supply of foot, there is minimal donor site morbidity and it is easily covered with stg. As compared to cross-leg flap, MPA flap has a great advantage that patient can be mobilised earlier and stiffness of joints is prevented. As it has a long pedicle with constant anatomy, it can be used to cover larger area.

CONCLUSION

In our experience, medial plantar artery flap provides glabrous skin to the foot and is an excellent local choice for soft tissue coverage.

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