

Heel Coverage with Medial Plantar Artery Flap

ZULFIQAR ALI CHAUDHRY, NADIA NISAR, SAADIA EFFENDEE, AAMAR YASIR, AQUEEL MALIK, TAUQEER, FARID AHMAD KHAN

ABSTRACT

Introduction: Coverage of soft tissue defects of the heel has been a challenge to reconstructive surgeons in the past. The medial plantar artery flap has facilitated heel coverage since its development in the 1980s.

Material & Methods: It was a prospective study, done in the Department of Plastic & Burn Surgery Mayo Hospital, Lahore in assessing the complications & durability of the flap primarily in patients with sensory impairment. All patients but 1 had chronic plantar ulceration due to sensory loss.

Results: Twenty one flaps were carried out in 21 patients. One flap underwent necrosis, and delayed healing was seen in 4 cases. Total flap survival was 98%. Minor revision of the flap or its pedicle was required in 3 cases. With a mean follow-up of 12 months, there were recurrences of ulceration in 2 feet. The relevant literature was reviewed.

Conclusion: The medial plantar artery flap is a reliable flap for heel coverage. It is durable and long lasting even in insensate feet.

Key words: Heel defects, medial planter artery flap.

INTRODUCTION

Soft tissue coverage of the sole has been a challenge for the reconstructive surgeon over the years. Soft tissue coverage of the sole must be able to withstand high loading pressures, as well as shear forces. The skin of areas other than the sole is comparatively thin and, without additional nerve grafting procedures, will be insensate, making the flap prone to pressure ulceration. The subcutaneous tissues of the sole have fibrous septa that make it uniquely able to withstand shear forces. The medial plantar artery island flap, first described by Harrison and Morgan¹ in 1981, provides ideal replacement tissues for soft tissue defects of the heel. The flap is based on the medial plantar artery (MPA) using non-weight-bearing skin and fascia from the instep and is able to cover defects of the lateral sole and heel, as well as the lower tendo-Achilles area.

To date, only small- or medium-size series have been published. To determine the overall complication rate, we decided to report on our series, the largest reported to date, and to collate these results with those in the world literature.

Department of Plastic and Burn Surgery, Mayo Hospital, Lahore, Pakistan.

Correspondence to Dr Zulfiqar Ali Chaudhry, Trust Registrar, Plastic Surgery Unit, Northampton General Hospital, Northampton, UK Email: doczulfiqar@gmail.com 0321-7961438

METHODS

All patients who had an MPA flap at Plastic Surgery Mayo Hospital, Lahore, between January 2000 and December 2007 were included in this study. In most cases, the authors were the operating surgeons.

Patients' demographic data, cause of soft tissue defect, presence or absence of sensation of the foot, size and location of the lesion, complications, and follow-up were recorded. The surgical technique is as follows:

The artery was first located by palpation and by Doppler and marked. A single dose of preoperative antibiotics was given. Under tourniquet control, the ulcer excision site was marked, planning to cut back to healthy skin if possible. This exact size was then marked on the instep of the foot, with the artery in the midline. The flap was started 1 cm proximal to the metatarsal head, just proximal to the weight-bearing area. The vessels are easily found between the abductor hallucis and the flexor digitorum brevis muscles.

The flap was then raised in a subfascial plane, sparing the medial plantar nerve only in those cases with intact plantar sensation. There were only 6 such patients, and in these cases the cutaneous nerve fibers to the flap were dissected out of the main plantar nerve. Fibrous septae from the flap to deep structures were divided, working from distal to proximal. The flap was raised on its neurovascular pedicle, including surrounding fat, until the flap could easily reach the defect. For the most posterior of defects, the abductor hallucis was divided to give additional length.

The donor site was skin grafted with split-thickness skin from the thigh. The donor site was opened and all sutures were removed at 2 weeks. Except in cases of delayed healing, ambulation was started at 5 weeks using an 8mm MCR insole. Most patients were given a cup-type heel orthosis and a raised instep for 6 months to try to offload the heel. The patients are put through our standard trial walking routine, with gradually increasing, 2 to 3 times-daily walking, starting with 5 minutes, checking for any evidence of trauma after each session. They are fully weight-bearing within 1 week if no problems are encountered.

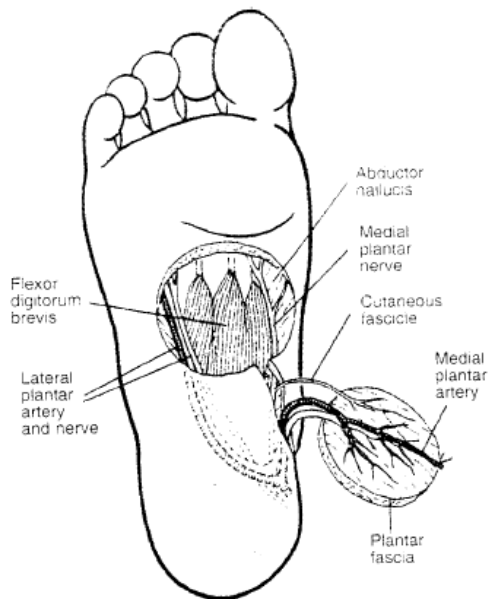


FIGURE 1. Anatomy of flap demonstrating neurovascular bundle and relationship to muscles.

A literature search was carried out for all published English-language series on the MPA flap

Table 3: Literature review of series of MPA flaps

Author	Year	No. of flaps	Complete flap survival %	Ischemic complications
Present study	2007	21	98%	1 total loss
Benito Ruiz et al ⁷	2004	06	83%	1 total loss
Rashid et al ⁶	2003	20	100%	
Gravem ³	1991	24	96%	1 partial necrosis
Baker et al ¹⁰	1990	12	100%	
Miyamaoto ⁸	1987	17	94%	1 total necrosis
Amarante et al ¹⁰	1986	10	100%	
Reading ¹¹	1984	06	33%	4/6 partial necrosis requiring SSG
Morrison, OBrien ⁴	1982	04	100%	

The results reported are listed in Table 3. Nonvascular complications such as delayed healing and infection were discussed in few of the papers, and so these complications are not addressed in this summary. Including the present study, the overall flap

using PubMed. Case reports were excluded. These series are listed below, with complication rates.

RESULTS

There were a total of 21 operations done on 10 males and 11 females. bilateral flaps. The median age was 50 years (range, 6–77). In all patients, sensory loss with unrecognized trauma was the primary cause of the ulcer; 40 patients had leprosy, 3 had spinal bifida, 3 had a previous spinal cord injury and 1 a previous nerve injury. One patient who was operated on for a burn contracture had no history of ulceration. The median maximum diameter of the ulcer was 4cm (range, 2–8 cm) (Table 1).

Table 1: Location of ulcer

Location of ulcer	=n
Posterior heel	15
Lateral boarder	01
Anterior heel	05

In 03 operations (%), an underlying bony spur was removed at the same time. Complications occurred in 05/21 procedures (25%) and are listed in Table 2.

Table 2: Complications

Complications	=n
Infection	03
Delayed wound healing	03
Flap necrosis	01
Necrosis of skin bridge	01
Pressure sore	01

No donor-site complications were encountered. Minor revision of the flap or its pedicle was required in 3 cases. With a mean follow-up of 14 months, there were 3 recurrences of ulceration in 3 feet. Eight series (with greater than 3 patients) were found reporting on MPA or instep flap in the English literature.

survival was 20/21patients (98%), with an additional 5 (3%) undergoing partial necrosis. Of note, over 40 cases have been reported in the non-English literature but are not included in this review as the English abstracts did not present clear results. One

large series in the non-English literature reported failure in 4/30 flaps (87% success)³.



Figure-A Donor site defect and flap insetting



Figure-B Post operative after one month.

DISCUSSION

The MPA flap has proven its place in reconstruction of the hindfoot over the years since its first description by Harrison and Morgan¹. It replaces “like tissue with like,” an important issue in the sole, with its specialized fat pad that contains fibrous septae that help protect against trauma from shearing. As such, it should be more durable than a reverse sural flap or other flaps from extraplantar areas. They concluded that there is an innate mechanical property that allows the sole to withstand weight bearing and shearing forces and that this is as important as the presence of protective sensation in preventing trauma from ambulation⁴. This conclusion is supported by the Gravem⁵ study, which reported that only 1 of 14 patients developed recurrent ulceration in those patients with long-term follow-up. In the present study, 3/21 feet of patients with insensate feet with long-term follow-up developed recurrence of the ulcer. While empirically the MPA flap should be more durable than flaps from extraplantar areas, a direct comparison of the 2 types of tissue has not been carried out to date. Rashid et al⁶ did compare the MPA flap with the reverse sural flap and found

that the MPA flap had fewer complications and a shorter time before return to work, although long-term results (i.e., recurrences) were not reported.

Benito-Ruiz et al⁷ noted no recurrent ulcers in either MPA flaps or reverse sural flaps, with 1 to 2 years of follow-up. This flap can be used to cover large skin defects, up to 8 cm diameter in this study, and will cover posterior heel defects and even defects posterior to the heel (tendo-Achilles insertion). With an intact medial plantar nerve, it is relatively simple to preserve sensation in both the forefoot and flap by dissection of the branches of the medial plantar nerve to the flap. In this study, only 6 patients had functional medial plantar nerves, and so only in these cases was this dissection carried out. None of these patients have had recurrent ulceration in follow-up, although 1 complained of decreased sensation in the forefoot for some months following surgery. Other reports note intact but decreased sensation in the flap following surgery, and Miyamoto et al⁸ reported that 7/13 patients with long-term follow-up had hypo- or hypersensitivity in the forefoot.^{5–11} Small heel ulcers are generally treated by different means, either by conservative treatment or a bucket-handle flap. Those with neither an intact dorsalis pedis nor peroneal artery are not candidates for this flap.

As well, those with occlusion of the MPA or trauma to, or cancer involving, the instep would be unsuitable. This flap has been previously used in patients with diabetic neuropathy with chronic ulcers in insensate areas. Most of the patients in this study and those in the literature also had insensate feet, but with a low recurrence rate in those followed up. While diabetic patients may also have vascular problems, making the flap more hazardous or even not possible, if the flap survives, the ulcer recurrence rate in diabetic patients should also be low. We would therefore recommend this flap in diabetic patients with chronic heel ulcers with an adequate vascular supply. This review demonstrates that using an island flap to just cover the plantar defect is adequate, and there is no need to mobilize and transpose the entire posterior plantar surface, as was practiced in earlier reports^{4,8,11}. Indeed, this technique of large-scale mobilization of the posterior plantar surface appears to be associated with a higher rate of flap necrosis (5/27 complete and partial) and in some cases will leave part of the lateral plantar surface covered with only skin graft, which will predispose to ulceration in the donor location, as well as avoidance of weight bearing¹². Other authors have included part of the flexor digitorum brevis muscles in the flap^{8,11}. Neither we nor other authors have done this in any case, so it would appear to be unnecessary^{4,5,6,8,10,11,13}.

CONCLUSION

The MPA island flap is a versatile flap that can cover defects on the heel, lateral plantar surface, the posterior and medial ankle region, as well as the medial dorsal foot. It has a high survival rate in several series and is technically straightforward. It has strong advantages over other flaps in that it is sensate without the need for nerve grafting and replaces specialized sole tissue with similar tissue. It is particularly recommended for soft tissue defects of the plantar heel area.

REFERENCES

1. Harrison DH, Morgan DG. The instep island flap to resurface plantar defects. *Br J Plast Surg.* 1981;34:315–318.
2. Schwarz RJ. Reverse medial reverse medial plantar artery flap for the treatment of forefoot ulcers. *Lep Rev.* In press.
3. Lortat-Jacob A, Dejean O, Hardy P, et al. Internal plantar flap: apropos of 30 cases. *Rev Chir Orthop Reparatrice Appar Mot.* 1995;80:58–66.
4. Morrison WA, Crabb DM, O'Brien BM, et al. The instep of the foot as a fasciocutaneous island and as a free flap for heel defects. *Plast Reconstr Surg.* 1982;72:56–63.
5. Gravem PE. Heel ulcer in leprosy treated with fasciocutaneous island flap from the instep of the sole. *Scand J Plast Reconstr Hand Surg.* 1991;25:155–159.
6. Rashid M, Hussain SS, Illahi I. A comparison of two fasciocutaneous flaps in the reconstruction of the weight-bearing heel. *J Coll Physicians Surg Pak.* 2003;13:216.
7. Benito-Ruiz J, Yoon T, Guisantes-Pintos E, et al. Reconstruction of soft-tissue defects of the heel with local fasciocutaneous flaps. *Ann Plast Surg.* 2004;52:380–384.
8. Miyamoto Y, Ikuta Y, Shigeki S, et al. Current concepts of instep island flap. *Ann Plast Surg.* 1987;19:97–102.
9. Baker GL, Newton ED, Franklin JD. Fasciocutaneous island flap based on the medial plantar artery: clinical applications for leg, ankle and forefoot. *Plast Reconstr Surg.* 1990;85:47–58.
10. Amarante J, Schoofs M, Costa H, et al. International dermatosurgery: use of medial plantar based skin flaps for correction of foot defects. *J Dermatol Surg Oncol.* 1986;12:693–695.
11. Reading G. Instep island flaps. *Ann Plast Surg.* 1984;13:488–494.
12. Sommerland BC, McGrouther DA. Resurfacing the sole: long-term follow-up and comparison of techniques. *Br J Plast Surg.* 1978;31:107–116.
13. Gravem P. Foot flaps. In: Schwarz RJ, Brandsma JW, eds. *Surgical Reconstruction and Rehabilitation in Leprosy.* Kathmandu: EKTA; 2004:227–236.