

## RECONSTRUCTION OF THE HEEL DEFECT WITH IN-STEP FLAP.

**Dr. Pradeep Gupta**

Mch Plastic surgery, Senior Professor, Department Of Plastic And Reconstructive Surgery And Burns, SMS Hospital, Jaipur

**Dr Shah Pratik\***

Senior Resident, Department Of Plastic And Reconstructive Surgery And Burns, SMS Hospital, Jaipur \*Corresponding Author

**Dr. Kushal Monga**

Junior Resident, Department Of Plastic And Reconstructive Surgery And Burns, SMS Hospital, Jaipur

**ABSTRACT**

**Objective:** soft tissue injury to the heel is difficult to treat as it is complicated with recurrent ulcers and chronic osteomyelitis. It requires the use of a sensate flap cover for weight bearing and normal gait. We report a study of the use of medial plantar (in-step) flap for reconstruction of the heel and foot.

**Material & Methods:** It was a prospective study, done in the Department of Plastic & Burn Surgery SMS Hospital, Jaipur in assessing the complications & durability of the flap primarily in patients with heel defect from January 2017 to March 2019. We treated 11 patients during this period. Trauma was the most common cause of ulcer (6), 2 patients had heel melanoma, while the remaining 3 had trophic ulcers.

**Results:** Out of total 11 flaps, 8 were healthy, 2 had marginal changes while in 1 case there was complete flap necrosis.

**Conclusion:** The medial plantar artery flap is a reliable, durable and sensate flap for heel coverage. It is also a durable flap for diabetic trophic ulcers.

**KEYWORDS :** heel defect, in-step flap, medial plantar artery.**INTRODUCTION**

Soft tissue defects of heel are a great challenge to deal with because of limited reconstructive options and the unique local area demand.<sup>1</sup> The tissue used to reconstruct the heel area must be resistant, innervated, and adapted to take over the body weight.<sup>2</sup> The cause of these defects are mainly trauma, metabolic and vascular diseases, infections and postsurgical defects.<sup>2</sup>

The medial plantar artery island flap, first described by Harrison and Morgan<sup>3</sup> in 1981, provides ideal replacement tissues for soft tissue defects of the heel. In 1990, Masquelet and Romana described medial plantar artery flap to reconstruct heel with the most closely matched skin surface and with lesser donor site morbidity.<sup>4</sup> It consists of a fasciocutaneous flap whose innervation is preserved, which maintains sensitivity, an important protective factor.<sup>5</sup> The flap is based on the medial plantar artery (MPA) using non-weightbearing skin and fascia from the in-step and is able to cover defects of the lateral sole, heel and lower tendo-Achilles area.

**MATERIAL AND METHODS**

This was a prospective study conducted at the Plastic Surgery department, SMS Jaipur, between January 2017 and March 2019. The institutes review board approved the study design. Patient's demographic data, cause of soft tissue defect, presence or absence of sensation of the foot, size and location of the lesion, complications on follow-up were recorded.

**Surgical technique:** The artery was first located by palpation and by Doppler and marked. Under tourniquet control, the ulcer excision site was marked, excised and defect created. The exact size was then marked on the adjoining skin in the instep of the foot, with the medial planter artery in the axis of the flap (figure 1). The vessels were found between the abductor hallucis and the flexor digitorum brevis muscles. The flap was then raised in a subfascial plane (figure 2), sparing the medial plantar nerve only in those cases with intact plantar sensation. 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

(figure 3). 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 graft from the thigh (figure 4). Patients were allowed light weight bearing after 8 weeks and full weight bearing by 12 weeks. All cases were followed for a period from 6-24 months (Figure 5)



**Figure 1:** Heel defect with marking of medial plantar artery flap



**Figure 2:** raising of the medial plantar artery flap



**Figure 3:** placing the flap on the defect



Figure 4: inset of the flap on the defect and grafting (SSG) on the donor site



Figure 5: follow up after 10 days

## RESULT

We treated a total of 11 cases with medial plantar artery flap. Out of the 11 cases, 8 were males and 3 were females. The mean age of patients was 44 years (range, 6–67). The median maximum diameter of the ulcer was 4cm (range, 2–8 cm). Trauma was the most common cause of ulcer (6), 2 patients had heel melanoma, while the remaining 3 had diabetic ulcer. Out of total 11 cases, 8 were healthy, 2 had marginal changes while in 1 case there was complete flap necrosis. Flaps with marginal changes were revised at 3 weeks. At the end of 24 months, all healthy flaps (8) were found to have achieved full weight bearing and were sensate. The flaps had slightly inferior protective sensation compared with the normal side. The diabetic foot with trophic ulcers also had a durable coverage even though they had compromised sensation.

## DISCUSSION

Surgical reconstruction of soft tissue defect in the sole region poses one of the greatest challenges for plastic surgery.<sup>6</sup> It is particularly difficult to transpose the skin of the foot because of multi-directional fibrous septa which reduce flexibility.<sup>7</sup> Medial plantar flap is the flap of choice in terms of sensation and early ambulation. Tissue type and texture are similar to that of the heel. Microvascular free tissue transfer do provide a reliable method for difficult to cover lower leg wounds. Although free flaps work well in these cases, they are labor intensive, usually bulky, insensate, technically demanding and require intense and costly postoperative care.<sup>8</sup> Shanahan and Gingrass first described the medial plantar sensory flap for resurfacing the defects of the heel.<sup>9,10</sup> The medial plantar artery flap with its arc of rotation incorporates the in-step glabrous skin, maintaining an intact tissue over the weight-bearing area of the sole.

The medial plantar artery is the smaller terminal branch of the posterior tibial artery. It passes distally along the medial side of the foot, with the medial plantar nerve being lateral to it. At its origin, it lies deep into the abductor hallucis and then runs distally into the intermuscular space between it and the flexor digitorum brevis, giving muscular branches to both, and terminates by anastomosing with a branch from the first plantar metatarsal artery to the medial side of the great toe. The cutaneous supply to the instep area is provided by one to three cutaneous perforators from the medial plantar artery on each side of the abductor hallucis muscle.<sup>11</sup> The medial

plantar flap is relatively easy to perform, with great versatility, based on a well-defined vascular anatomy pattern. This flap has even been used in patients with diabetes mellitus.

From a practical standpoint, in the reconstruction of the soft tissue of the heel, it is important that the heel is divided into weight-bearing regions (anterior or plantar) and non-weight bearing regions (posterior, on the Achilles tendon). The skin of the heel and plantar arch have the same characteristics; therefore, this is the main reason for the preferential use of medial plantar flap in lesions of the anterior heel. The fact that this flap is innervated by the cutaneous branch of the medial plantar nerve is relevant as it provides sensitivity, an important requirement for patient ambulation. The flap is created a little larger than or the same size as the defect, as there is no significant primary contraction of the flap due to its specific fibro adipose tissue characteristics.

The medial plantar flap has also been indicated for patients with diabetic neuropathy who present chronic ulcers in areas of sensory loss, with a low rate of ulcer recurrence in the long term. Since diabetic patients may have vascular problems, this flap may only be indicated for those with good vascular flow to the flap region.<sup>5</sup> Further modifications have been the inclusion of muscle, a reverse flow island flap design for more distal defects and a free flap to cover defects on the contralateral heel. Similar flaps based on the lateral plantar neurovascular bundle have also been described. The medial design is preferable, as it uses the instep skin, has a wide arc of rotation, and maintain intact tissue over the weight-bearing fifth metatarsal head.<sup>12</sup>

Wu H, Sheng J in their study on Free Medial Plantar Flap Connection with a Posterior Tibial Artery Flap in Reconstruction of Fore-Mid Foot Skin Defect studied advantages of the posterior tibial artery flap connected with a medial plantar flap. They concluded that (1) there are named sensory nerves both in the distal and proximal parts of the medial plantar flap, which can ensure better feeling in the weight-bearing region of the forefoot. (2) The thickness of the flap is appropriate, and the shape is close to that of origin plantar skin. (3) The medial plantar flap should be harvested along the deep layer of plantar aponeurosis; thus, the flap will not easily slide when walking. (4) The posterior tibial artery and medial plantar artery share 1 flow-through vessel, and this can ensure a high survival rate. (5) The posterior tibial artery flap has similar characteristics to the dorsum foot. It has ideal appearance in repairing the dorsal raw surface of the foot without a second-stage rebulking operation; thus, the sensory recovery will be more reliable. (6) The great saphenous vein should be used to reconstruct the blood supply of the donor site.<sup>13</sup> The only comparative study to date that compared the medial plantar artery flap with the reverse sural artery flap was conducted by Rashid et al.<sup>14,15</sup> They concluded that medial plantar artery had fewer complications and resulted in an earlier return to function than the latter.

Rong X, Jian-hua W et al in their study on clinical application of medial plantar artery flap carrying sensory nerve in repairing soft tissue defect of heel concluded that the medial plantar artery flap with sensory nerve can better reconstruct the appearance, sensation and function of the heel. It is an effective way to repair the soft tissue defect of the heel.<sup>16</sup> Chaudhry et al in their study on heel coverage with medial plantar artery flap concluded that there is an innate mechanical property that allows the sole to withstand weight bearing and shearing forces and this is as important as the presence of protective sensation in preventing trauma from ambulation.<sup>17</sup> This conclusion is supported by the Gravem<sup>18</sup> study, which reported that only 1 of 14 patients developed recurrent ulceration in those patients developed recurrent ulceration in those patients with long term follow-up.

Conclusion: From our experience, medial plantar artery flap is a good local option for soft tissue coverage, providing glabrous sensate skin for foot wounds.

## REFERENCES

1. Khan F, Afzal Beg M, Rahman O: Medial Plantar Artery Perforator Flap: Experience with Soft-tissue Coverage of Heel; Department of Plastic and Reconstructive Surgery, Liaquat National Hospital, National Stadium road, Karachi, Pakistan
2. Pertea, Mihaela; Velenciuc, Natalia; Grosu, Oxana; Veliceasa, Bogdan; Poroch, Vladimir; and Lunca, Sorinel (2018) "Reconstruction of heel soft tissue defects using sensate medial plantar flap," *Journal of Mind and Medical Sciences*; Vol. 5 : Iss. 2 , Article 16. DOI: 10.22543/7674.52.P250254
3. Harrison DH, Morgan DG. The instep island flap to resurface plantar defects. *Br J Plast Surg.* 1981;34:315
4. Masquelet AC, Romana MC. The medialis pedis flap: a new fasciocutaneous flap. *Plast Reconstr Surg.* 1990;85:765-772.
5. Jefferson Lessa Soares de Macedoa,b, Simone Corrêa Rosca, Altino Vieira de Rezende Filho Netoa, Adilson Alves da Silvaa, Alex Corcino Silva de Amorim Reconstruction of soft-tissue lesions of the foot with the use of the medial plantar flap; *revbrasortop.* 2017; 52(6):699-704
6. Scaglioni, Mario F; Rittirsch, Daniel; Giovanoli, Pietro (2018). Reconstruction of the heel, middle foot, sole and plantar forefoot with the medial plantar artery perforator (MPAP) flap: clinical experience with 28 cases. *Plastic and Reconstructive Surgery*, 141(1):200-208.
7. Douglas H, Harrison and Brian D. G. Morgan: The instep island flap to resurface plantar defects; *British journal of Plastic Surgery* (1981) 34, 315-318
8. Patel P, Tewari S, Khunteta N. Medial plantar artery perforator flap for reconstruction of the soft tissue defect of heel melanoma. *Indian J Cancer* 2017;54:699-700.
9. Vivek R, Venkataraman J, Kumaran S, Mohan J, Reconstruction of plantar foot defects using medial plantar artery flap: Our experience; *Global Journal for research analysis*; Vol 7, issue 6, June 2018. ISSN No 2277-8160.
10. Shanahan, R. E., Gingrass, R. P. Medial plantar sensory ap for coverage of heel defects. *Plast. Reconstr. Surg.* 64:295,1979.
11. Liu et al.: Heel reconstruction with free instep flap: A case report. *Journal of Medical Case Reports* 2014 8:319.
12. Raymond B, Sudjatmiko G, Medial Plantar Flap for Reconstruction of Heel Defect, *Jurnal Plastik Rekonstruksi* - January 2012
13. Wu H, Sheng J, Zhang C, Free Medial Plantar Flap Connection with a Posterior Tibial Artery Flap in Reconstruction of Fore-Mid Foot Skin Defect *wPlast Reconstr Surg Glob Open* 2016;4:e1091; doi: 10.1097
14. Siddiqi M, Hafeez K, Cheema T, Rashid H: The medial Plantar artery flap; A series of cases over 14 years; *The Journal of Foot and Ankle Surgery*, Vol 51, Issue 6, Nov-Dec 2012, Pages 790-794
15. Rasid M, Hussain SS, Aslam R, Illahi I. A comparison of two fasciocutaneous flaps in the reconstruction of defects of the weight bearing heel. *J Coll Physicians Surg Pak* 13:216-218, 2003.
16. Rong X, Jian-hua W, Yu-qiang Wu. Clinical application of medial plantar artery flap carrying sensory nerve in repairing soft tissue defect of heel[J]. *Chinese Journal Of Clinical Anatomy*, 2018, 36(4): 433-435.
17. Chaudhry Z, Nisar N, Effendee S, Yasir A, Malik A, Tauqeer, khan F; Heel Coverage with Medial Plantar Artery Flap; *PJMHS VOL.2 NO.3 July-sept 2008.*
18. 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.