

# Reverse Sural Artery Perforator Flap: Modified Pedical Dissection Technique

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Reverse Sural  
Artery  
Perforator Flap:  
Modified  
Technique

## ABSTRACT

**Objective:** To study the versatility of reverse sural artery perforator flap by modified pedical dissection technique, as are liable loco-regional flap to reconstruct distal limb and foot defects.

**Study Design:** Case series study

**Place and Duration of Study:** This study was conducted at the Jinnah Burn & Reconstructive Surgery Centre, Lahore from January 2010 to July 2017.

**Materials and Methods:** A total of 62 patients, 19 females (30%) and 43 males (70%) between 3 to 68 years of age with mean age of 19.4 years were included. Patient presenting to emergency department with 8 wounds on anterior distal 1/3 of tibia, 16 of ankle, 29 of heel and 9 wounds on dorsum of foot were included. Pre-operative hand held Doppler was done in all cases to mark the perforators. Per operative perforators were marked and a reliable perforator (> 1mm) size was selected and flap elevated. Adipo-fascial pedicle is elevated, with a width of 4cm to include the sural nerve and vein.

**Results:** Of the 62 cases operated in 50 patients (80%) the 2<sup>nd</sup> distal perforator at 7-10 cm and in 12 patients (20%) proximal perforator at 5 cm was found to be of good size. Adipo-fascial pedical width was kept at 4 cm. All flap survived completely. Only minor complications were seen in 8 (13%) flaps, distal 1cm tip necrosis in 3 flap and distal tip epidermolysis in 5 patients healed completely without intervention.

**Conclusion:** With the appropriate pre-operative planning and per-operative modifications sural flap is a reliable and versatile workhorse flap for distal lower limb and foot defect reconstruction.

**Key Words:** Reverse sural artery perforator flap, Modified pedical dissection technique, Dominant perforator, Pre-operative Doppler ultrasonography

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## INTRODUCTION

Complex Soft tissue defects of distal third of tibia, ankle and foot is always a problematic areas for reconstruction due to paucity of well vascularized local donor tissue.<sup>1</sup> Free tissue transfer can bring a good amount of tissue to desired place in experienced hands only.<sup>2,3</sup> But due to lack of logistics and an experienced microsurgical personal, free tissue transfer is not an option in every centre.<sup>4,5</sup>

Beside free tissue transfer, reverse sural artery flap is a versatile loco-regional flap to reconstruct these defects.

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The major advantage of this flap is a constant blood supply that does not sacrifice any major artery of the lower limb.<sup>6</sup> This flap was first described by Masquelet et al<sup>7</sup> and become a popular option for many of these difficult wounds before the era of microvascular surgery but fell out of fame due to high complication rate. Studies have shown high complication rate in reverse sural artery perforator flap due to venous congestion, which takes place through venae comitantes of the sural nerve and the lesser saphenous vein.<sup>8</sup>

In the popliteal fossa popliteal artery gives a branch to both the heads of gastrocnemius muscle and another branch that continues as the sural artery that divides into median, lateral and medial branches. The median sural artery accompanies the sural nerve and vein and supplies the posterior mid-calf skin and subcutaneous tissue. These sural artery fasciocutaneous vascular network communications with septocutaneous perforators of the peroneal artery in the distal third of the calf along with the neurocutaneous perforators from vasa nervosum of the sural nerve, forms the basis of the distally based sural artery perforator flap.<sup>9</sup>

Classically literature has describes about 3-6 perforators, but more consistent one are present at an average of 5, 10 and 15 cm from the lateral malleolus. The conventional method of flap dissection proceed from proximal to distal, but in our technique we have

first done the distal dissection of pedicle in order to localize a reliable perforator for flap perfusion and then proceeded proximally. For the venous congestion the pedicle width was kept at 4 cm (2cm each on either side of the sural nerve and vein) to avoid this complication.<sup>10</sup>

**MATERIALS AND METHODS**

This study was carried out at Jinnah Burn & Reconstructive Surgery Centre Lahore within 7years from January 2010 to July 2017. A total of 62 patient 19 females (30%) and 43 males (70%) between 3 to 68 years of age with mean age of 19.4 years were included. Patient presenting to emergency department with 8 wounds on anterior distal 1/3 of tibia, 16 of ankle, 29 of heel and 9 wounds on dorsum of foot were included. Patient with varicose vein, severe vascular insufficiency and injury in the zone of pedicle were excluded from the study. A pre-operative hand held Doppler was done in all cases to mark the perforators. Initially anaesthesia fitness and informed consent was taken. Patients were operated in either prone or lateral position. Under tourniquet control debridement was done and wound dimensions were measured. Flap marking was done as follows, posterior midline calf was marked from popliteal fossa to the heel. Flap axis were drawn from mid popliteal point to the tip of lateral malleolus. Provisionally perforators were marked at 4-5cm, 7-10 cm and 13-15 cm from the tip of lateral malleolus along the axis depending upon the initial Doppler signals. Arbitrary Flap marking was done based on pivot around the distal two perforator location. Dissection is started distally with skin and superficial fat layer was dissected of the pedical leaving the deep layer of fat on fascia including sural nerve and vein. Laterally deep fascia was incised along the length of peroneus longus and elevated with muscle retracted laterally. Peroneal artery perforators were identified originating between the soleus and peroneus long muscle and piercing the deep fascia. Per operative perforators were marked and a reliable perforator (> 1mm) size was selected and flap marking readjusted. Adipo-fascial pedicle is elevated, with a width of 4cm to include the sural nerve and vein. At the proximal margin of the flap, the nerve and the vessels are ligated and severed. The skin island is elevated with the deep fascia. The donor site defect and the pedical were closed with split thickness skin graft. Patient was discharged after 1<sup>st</sup> dressing change on 4<sup>th</sup> post-operative day. The data was entered and analyzed through SPSS-20.

**RESULTS**

Of the 62 cases operated in 50 patients (80%) the 2<sup>nd</sup> distal perforator at 7-10 cm was a selected for flap elevation based upon per operative perforator size >1mm diameter. Only in 12 patients (20%) proximal perforator at 5 cm was found to be of good size. In all

cases width of adipo-fascial pedical was kept at 4 cm. All flap survived completely. Only minor complications were seen in 8 (13%) flaps with no intervention required. Distal 1cm tip necrosis in 3 flap healed by secondary intention and distal tip epidermolysis in 5 patients healed completely without intervention. There was no loss of split skin graft and no complaints related to the sacrifice of the sural nerve. Paresthesia on the lateral border of the foot was overcome with in 4-6 months (Tables 1-3, Figs. 1-4).

**Table No.1: Frequency and percentage of genders (n=62)**

Sex	No.	%
Male	43	70.0
Female	19	30.0

**Table No.2: Frequency and percentage of site of defect (n=62)**

Site of defect	No.	%
Distal 1/3 tibia	8	12.9
Ankle	16	25.8
Heel	29	46.8
Dorsum of foot	9	14.5

**Table No.3: Location of dominant perforator for sural flap elevation**

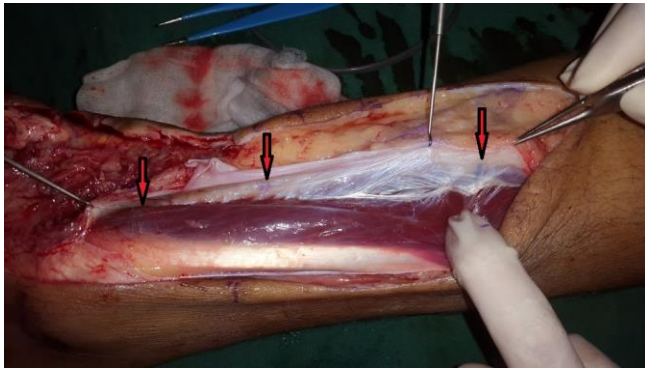
Location	No.	%
Proximal perforator ( at 5 cm from lateral malleolus)	50	80.0
Distal perforator ( 7-10 cm from lateral malleolus)	12	20.0



**Figure No.1: Pre-operative wound**



**Figure No.2: Per-operative Flap and Perforator marking**



**Figure No.3: Per-operative peroneal artery perforators identification**



**Figure No.4: Final Flap Insetting**

## DISCUSSION

There are a number of pedicled flaps used for the reconstruction of lower limb defects. The major disadvantage is their small size, limited arc of rotation and trauma in the vicinity of flap. With limited local viable tissue, free tissue transfers is another option but surgery is mostly lengthy and costly, require expertise and functional donor-site morbidity.<sup>11</sup> The advantages of the reverse sural artery flap, it is a single stage procedure, simplicity of the design, easy to execute and no further damage to limb vascularity. So the reverse sural artery flap is an ideal alternative to all local flap and free tissue transfer, with easy dissection, greater reliability and preservation of limb vascularity and better arc of rotation.<sup>12</sup>

Upon initial adoption of this procedure there was great frustrations among the surgeons due to high venous congestion leading to flap failure. Since then there have been number of operative technique modifications published in literature in order to solve this issue. They included either leaving the skin intact over the pedicle or raising an adipofascial flap, exteriorizing the pedicle or supercharge the flap by doing venous anastomosis distally. Baumeister et al<sup>13</sup> study has shown 36% combined rate of partial and complete flap necrosis. So we revisited the possible flaws in surgical technique leading to high failure and with our modified surgical technique we have been able to achieve a significant low complication rate of as low as 12%.

As literature has shown that reverse sural artery flaps are based on distal 5cm perforator and the flap being

raised from proximal to distal without per operative confirmation of the perforator size and dominance. Our surgical modification of distal pedicle first dissection has shown that peroneal artery perforator at 5cm is dominant (> 1mm diameter on inspection) in only 20 % of the case while in majority 80% of the patient perforator at 7-10 cm is always reliable. So we per operatively modified the flap basis and the flap extended accordingly even up to proximal part of calf without significant complication rate. Also the pedicle width was kept to minimum of 4 cm and in all the cases pedicle was exteriorised and covered with split thickness skin graft.<sup>14</sup> So with these factors avoided we have experienced a very low and minor complications in our flaps with no cases of complete flap loss.

One major drawback of planning the flap on 2<sup>nd</sup> distal perforator is that it increases the pedicle length and the amount of tissue to be perfused. This can be overcome by delaying the flap and have not shown any increase in flap complication rate which we intend to show in our future study.

## CONCLUSION

So with careful pre-operative planning and per-operative modifications this flap is still a reliable and versatile workhorse flap for distal lower limb and foot defect reconstruction other than free tissue transfer.

### Author's Contribution:

Concept & Design of Study:	Kamran Khalid
Drafting:	mmara Rabbani, Imran Shehzad
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Revisiting Critically:	Kamran Khalid, mmara Rabbani, Imran Shehzad
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**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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