



RESEARCH ARTICLE

A PROSPECTIVE COHORT STUDY OF REVERSE PERONEAL ARTERY FLAP FOR LARGE SOFT TISSUE DEFECTS OF THE FOOT IN GMKMCH, SALEM : A RELIABLE COVERAGE

Gopalan G., Mahesh Kumar S., Sivakumar S., Dhanaraju S. and Gowdhaman K.

Department Of Plastic And Reconstructive Surgery,
Govt Mohan Kumaramangalam Medical College And Hospital, Salem, Tamilnadu, India.

Manuscript Info

Manuscript History

Received: 28 July 2023

Final Accepted: 31 August 2023

Published: September 2023

Key words:-

Peroneal Artery Flap, Sural Flap,
Islandised, Foot Reconstruction

Abstract

Background: Islanded Reverse Peroneal Artery Flap (RPAF) can be designed as a large regional flap from the popliteal crease. It can be used in single stage. It is based on the anastomosis around ankle joint from posterior and anterior tibial arteries based on the reverse flow to the peroneal artery. It can be used in peripheral centers where microsurgical options not feasible.

Methods: Twenty patients with large plantar and dorsal defects of the foot operated for Reverse Peroneal Artery Flap for soft tissue reconstruction over a period of 2 years. All patients were operated in a single stage. Mean age of the patients was 38 years.

Results: Of the 20 flaps, all patients showed complete survival without even marginal necrosis. Two patients developed donor site problems settled with conservative management.

Conclusion: Reverse peroneal artery flap is a very reliable flap in soft tissue reconstruction of the large defects of the dorsal and plantar aspects of the foot upto base of the toes. Reverse peroneal artery flap needs meticulous dissection of the peroneal artery from the fibula.

Copy Right, IJAR, 2023,. All rights reserved.

Introduction:-

Large soft tissue defects of the foot lead to exposure of vital structures like vessels, nerves and tendons Which pose a difficult problem in reconstruction due to scarcity of local flaps and but reliable regional flaps for large defects.^{1,2}

Free tissue transfers are good option in reconstruction but only in experienced hands and microsurgical facility.³ Locoregional flaps are cost effective compared to free flaps.⁴

Donski and Fogdestam described Reverse sural artery flap based on the perforator of peroneal artery at 5-7cm located above lateral malleolus through superficial sural artery. Its reach is distally upto posterior heel and some parts of plantar heel and dorsal aspect of ankle because skin is taken only from the middle third of the posterior leg. RSA includes sural artery, sural nerve, short saphenous vein to reduce venous congestion.⁵

Cormack and Lamberty comes with a new idea to utilize the upper part of the posterior leg skin to reach the distal target at the base of the toes by including the perforators from the peroneal artery and posterior

Corresponding Author:- Gowdhaman K.

Address:- Department Of Plastic And Reconstructive Surgery,
Govt Mohan Kumaramangalam Medical College And Hospital, Salem, Tamilnadu, India.

crural septum and peroneal artery and its venae comitants and by reversing the peroneal artery to gain the distal reach with 5-7cm distal perforator kept intact.⁶

Venous congestion will not be a problem due to the presence of large venae comitans of peroneal artery.⁷

Materials And Methods:-

All 20 patients admitted in plastic surgery department of Government Mohan Kumaramangalam Medical College And Hospital, Salem , Tamilnadu during the period Of January 2022 To March 2023.

Details like age, sex, etiology dimensions of the defect, comorbidities, smoking, previous surgery / trauma to limb, procedure, complications. Preoperative Doppler is must in this study.

Inclusion criteria:

Age 18 - 60 yrs, Post Traumatic defects of the dorsal and plantar aspects of the foot.

Exclusion criteria:

Monophasic Flow in anterior and posterior tibial vessels / ischemic foot.

Surgical procedure:

Preoperative localization of peroneal perforators not needed. All procedures are done under spinal anaesthesia. Prone or lateral positioning done.



Figure 1:- Post Traumatic Raw Area Right Dorsum Of Foot.



Figure 2:- Post Debridement Defect With Flap Marking.

After Tourniquet is applied, Wound debridement done. (Figure 1). Flap marking is done. Maximum flap limit is mentioned. 5cm above the lateral malleolus is the pivot point. Upper end of the flap is upto the level of politeal crease. Lateral end of the flap midlateral line on either side. Flap dimension range from 21*10cm to 30*16cm.

Flap planning in reverse done. (Figure 2) Proximal end of the flap dissected subfascially, Sural nerve and short saphenous vein included in this flap. Medial to lateral flap is elevated, after visualising peroneal perforators through posterior intermuscular septum (Figure 3). Soleal perforators cauterised plane between Flexor Hallucis Longus and soleus separated. Lateral aspect incision deepened. Peroneus longus is retracted. Peroneus brevis is delineated suprapariosteally.

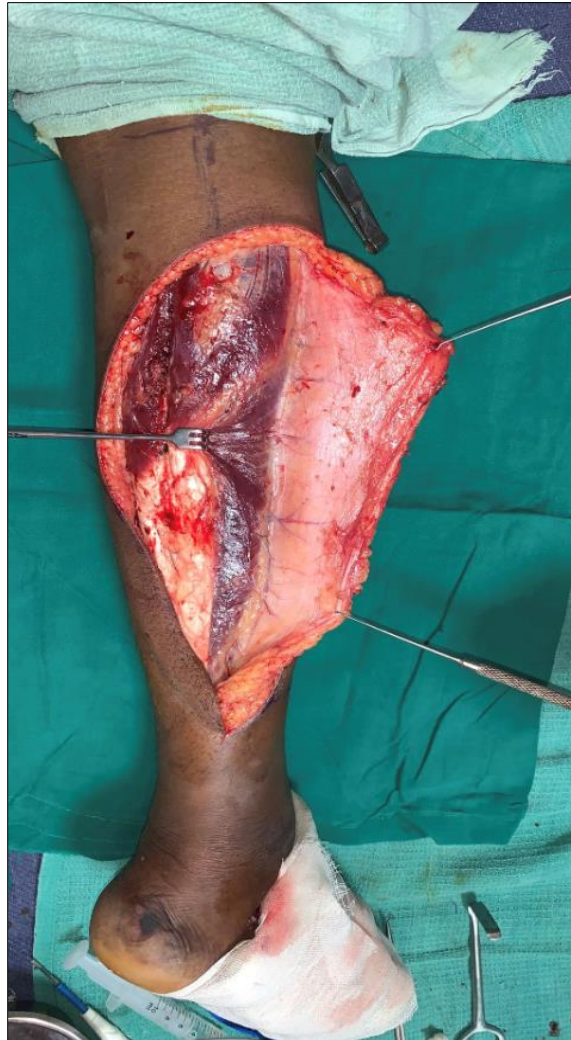


Figure 3:- Medial To Lateral Flap Elevation

Periosteum is incised lateral border of the fibula. Periosteum is elevated upto the posteromedial border of the fibula to delineate the peroneal artery and its venae comitants. Peroneal artery along with its venae comitants ligated just proximal to the good perforator and divided. It is usually in the middle third of leg around 15-18cm from Lateral malleolus. (Figure 4)



Figure 4:- Posterior Crural Septum And Peroneal Artery Perforators.

Meticulous dissection is done to separate peroneal artery from fibula (Figure 5). Branches going away from the septum is cauterized. While separating the peroneal artery and its venae comitantes from the fibula, some part of flexor hallucis longus is taken along with the flap. Dermal flap raised from lower end of the flap to wound site. Flap elevated upto 5cm above the lateral malleolus.



Figure 5:- Separation Of Peroneal Artery From Fibula After Proximal Ligation.



Figure 6:- After Flap Inset And Graft Application.

Tourniquet released. Flap viability assessed. Flap is sutured to the defect with 3'0 ethiylon. In Donor site, suction drain was kept under the fibula. Fibula was covered by suturing the soleus and peroneus brevis muscle with 2'0 vicryl. Dermal flap sutured with 3'0 ethiylon. Remaining area is skin grafted.(Figure 6)

POP applied dorsally in case of plantar defects and plantar aspect in case of dorsal defects with ankle joint in neutral position. Overall Operating time is 2.5-3 hours. Limb elevation with one pillow post operatively done.



Figure 7:- 3 Months After Follow Up.

Results:-

Of 20 patients, 17 were men and 3 were women, with an average age of 38 years. Soft tissue defects of all patients were post traumatic raw area of the dorsum and plantar areas of the foot. Flap dimensions range from 21*10cm to 30*16cm. All patients undergone single stage procedure. All flaps survived good. No partial or marginal skin necrosis. There are minor problems like minimal patchy graft loss over Gastrocnemius tendon. All are managed conservatively. No patient underwent secondary procedure. After 7-10 days, patient discharged and advised to follow up regularly for every week for 1st month and monthly for 3 months. Two patients found seropurulent discharge under wound bed, they are treated with IV antibiotics. They are settled well. After suture removal, patient was allowed to wear elastocreepe bandage for 1 year and scar massage for 3months.(Figure 7)



Figure 8:- For Upto Middle third Sole Defect.



Figure 9:- Perop Picture Showing Flap Inset And Skin Graft Placement.



Figure 10:- Follow Up After 3 Months.



Figure 11:- 3 Months After Follow Up.



Figure 12:-Post Traumatic Both Sole And Dorsal Defect Of Foot.



Figure 13:- After 10 Days Of Flap Inset And Skin Grafting Dorsal View.

Table:- Demographic, Wound And Flap Details And Complications.

Case no	Age/sex	etiology	Site of the defect	Outcome complications and	Size of the defect in cm	Size of the flap in cm includes pedicle length
1	25/m	RTA	Right dorsum	good	11*8	28*11
2	29/m	RTA	Left sole	good	10*8	27*10
3	18/f	RTA	Left heel	good	8*7cm	24*10
4	40/m	RTA	Left sole	Sub flap collection	15*9	26*12
5	60/m	RTA	Mid foot stump	good	11*8	24*10
6	55/m	RTA	Left dorsum	Dermal flap discoloration	16*12	28*14
7	40/f	RTA	Right sole	Patchy graft loss	13*7	26*10
8	43/m	RTA	Right dorsum	good	14*10	25*12
9	52/m	RTA	Left sole	good	16*8	26*12
10	36/m	RTA	Right dorsum	Patchy graft loss	14*6	25*11
11	23/m	RTA	Left sole	good	10*8	21*10
12	38/m	RTA	Left dorsum	good	8*8	21*10
13	43/m	RTA	Right heel	good	7*7	21*10
14	54/f	RTA	Left dorsum	Sub flap collection	16*10	30*14
15	47/m	RTA	Right dorsum	good	14*7	28*10
16	27/m	RTA	Right dorsum	good	12*7	21*10
17	30/m	RTA	Mid foot stump	good	15*10	27*13
18	35/m	RTA	Left dorsum	Dermal flap discoloration	16*10	29*13
19	36/m	RTA	Right dorsum	good	10*10	21*10
20	28/m	RTA	Left heel	good	9*7	21*10



Figure 14:- Pod 10 Showing Plantar View.

Discussion:-

Large soft tissue reconstruction of the foot without microsurgical facility and expertise with regional flap makes the limb salvageable. Free flap provide soft tissue reconstruction but not in comorbidities.⁸⁻¹⁰

Lateral supramalleolar flap is the one flap which can be used to cover the dorsum of foot upto base of the toes with distally based flap but the problem is most of the time perforating branch communication at sinus tarsi is mostly injured and another problems with this flap even though it is harvested it show venous congestion and lack of distal reach to sole defects upto base of the toes.⁸⁻¹⁰

RSA flap , fasciocutaneous flaps , propeller flaps distal reach will be difficult. Large RSA flap shows partial flap necrosis as studied by Grandjean et al and Baumeister et al.¹⁸

Ayappan and Chaddha tried to secure the skin from proximal third by adding all the connective tissue between the heads of the gastrocnemius containing septocutaneous perforators, which only marginally improved the viability of the flap and study have reported 27% complication rates.²³

Perforators were not marked preoperatively in this study, it may be safer for beginners to do so. In our experience, these perforators were from posterior intermuscular septum. Thus dissection to the peroneal vessel is quick. Peroneal artery visualisation and its elevation by meticulous dissection provides comfortable distal reach without marginal necrosis.

In our study we concluded that based on the flap design , we can reduce the graft loss over the pedicle by making the design with skin paddle in the form of converging towards pedicle. (Figure 15,16)

In our study we found during dissection, dermal flap epidermal necrosis is due to loss of subcutaneous tissue, we raised partly subcutaneous flap that shows devoid of epidermal necrosis patient wound healing has been improved earlier.



Figure 15:- Picture Showing Dew Drop Flap Design.



Figure 16:- Picture Showing Base Of Toes Coverage With Dew Drop Skin Paddle To Pedicle.

In our study we found the minimal patchy graft loss over gastrocnemius tendinous region.

In our study, we concluded that RPAF over the heel pad and middle of the sole of foot and soft tissue defects of the dorsum of the foot showed good contour.

The main disadvantage of this flap was sacrificing one compartment vessel and other was bulkiness in TA region for sole defects.

With the existing studies of, Tharayil and Patill, Bhatt et al, Palukiri et al, they have done both pedicled and islanded.^{24,26}

We have done only **Islanded RPAF** in 20 cases in single stage. It is cost effective, time saving in patient recovery, improved wound healing, less hospitalisation, early mobilisation, better cosmetic results, and high patient satisfaction.

We have done liposuction to reduce contour deformity of dorsal foot covered RPAF in two cases after 3 months.

Conclusion:-

Reverse peroneal artery flap is a reliable regional flap for large soft tissue defects of the dorsum and plantar aspects of the foot upto base of the toes in a single stage. It is cost effective. Reverse peroneal artery flap is a flap without venous congestion and marginal necrosis.

Patient consent:

Authors certify that they have obtained all consent forms.

Conflict of interest:

None declared

References:-

1. Benito-Ruiz J, Yoon T, Guisantes-Pintos E, Monner J, Serra-Renom JM. Reconstruction of soft tissue defects of the heel with local fasciocutaneous flaps. *Ann Plast Surg* 2004; 52:380-4.
2. Eren S, Ghofrani A, Reifernath M. The distally pedicled peroneus brevis muscle flap: A new flap for the lower leg. *Plast Reconstr Surg* 2001;107:1443-8.
3. Yang YL, Lin TM, Lee SS, Chang KP, Lai CS, Ruan HJ, Cai PH, et al. The extended peroneal artery perforator flap for lower extremity reconstruction. *Ann Plast Surg* 2010;64:451-57.
4. The distally pedicled peroneus brevis muscle flap anatomic studies and clinical applications. *J Foot Ankle Surg* 2005; 44:259-64.
5. Donski PK, Fogdestam I. Distally based fasciocutaneous flap from the sural region: A preliminary report. *Scand J Plast Reconstr Surg* 1983;17:191-6.
6. Chang SM, Zhang F, Yu GR, Hou CL, Gu YD. Modified distally based peroneal artery perforator flap for reconstruction of foot and ankle. *Microsurgery* 2004;24:430-6.
7. Ozalp T, Masquelet AC, Begue TC. Septocutaneous perforators of the peroneal artery relative to the fibula: Anatomical basis of the use of pedicled fasciocutaneous flap. *Surg Radiol Anat* 2006;28:54-8.
8. Chai Y, Zeng B, Zhang F, Kang Q, Yang Q. Experience with the distally based sural neurofasciocutaneous flap supplied by the terminal perforator of peroneal vessels for ankle and foot reconstruction. *Ann Plast Surg* 2007;59:526-31.
9. Chai Y, Zeng B, Cai P, Kang Q, Chen Y, Wang C. A reversed superficial peroneal neurocutaneous island flap based on the descending branch of the distal peroneal perforator: Clinical experiences and modifications. *Microsurgery* 2008;28:4-9.
10. Ríos-Luna A, Villanueva-Martínez M, Fahandezh-Saddi H, Villanueva-Lopez F, del Cerro-Gutiérrez M. Versatility of the sural fasciocutaneous flap in coverage defects of the lower limb. *Injury* 2007;38:824-31.
11. Lu TC, Lin CH, Lin YT, Chen RF, Wei FC. Versatility of the pedicled peroneal artery perforator flaps for soft-tissue coverage of the lower leg and foot defects *J Plast Reconstr Aesthet Surg* 2011;64:386-93e.
12. Yoshimura M, Shimada T, Imura S, Shimamura K, Yamauchi S. Peroneal island flap for skin defects in the lower extremity. *J Bone Joint Surg Am* 1985;67:935e41.
13. Cormack GC, Lamberty GH. Blood supply by regions: Ankle and foot. In: Cormack and Lamberty, editors. *The Arterial anatomy of skin flaps*. London: Churchill Livingstone; 1994 p. 258-9.
14. Kaufman MR, Jones NF. The reverse radial forearm flap for soft tissue reconstruction of the wrist and hand. *Tech Hand Up Extrem Surg* 2005;9:47-51.
15. Masquelet AC, Romana MC, Wolf G. Skin island flaps supplied
16. Costa-Ferreira A, Reis J, Pinho C, Martins A, Amarante J. The distally based Island superficial sural artery flap: Clinical experience with 36 flaps. *Ann Plast Surg* 2001;46:308-13.
17. Rajacic N, Darweesh M, Jayakrishnan K, Gang RK, Jovic S. The distally based Superficial sural flap for reconstruction of the lower leg and foot. *Br J Plast Surg* 1996;49:383-9.
18. Baumeister SP, Spierer R, Erdmann D, Sweis R, Levin LS, Germann GK. A realistic complication analysis of 70 sural artery flaps in a multimorbid patient group. *Plast Reconstr Surg*. 2003;112:129-40.

19. Touam C, Rostoucher P, Bhatia A, Oberlin C. Comparative study of two series of distally based fasciocutaneous flaps for coverage of the lower one fourth of the leg, the ankle, and the foot. *Plast Reconstr Surg* 2001;107:383-92.
20. Erdmann D, Gottlieb N, Humphrey JS, Le TC, Bruno W, Levin LS. Sural flap delay procedure: A preliminary report. *Ann Plast Surg* 2005;54:562-5.
21. Lo JC, Chen HC, Chen HH, Santamaria E. Modified reverse sural artery flap. *Changgeng Yi Xue Za Zhi* 1997;20:293-8.
23. Ayyappan T, Chadha A. Super sural neurofasciocutaneous flaps in acute traumatic heel reconstructions. *Plast Reconstr Surg* 2002;109:2307-13.
24. Tharayil J, Patil RK. Reverse peroneal artery flap for large defects of ankle and foot: a reliable reconstructive technique. *Indian J Plast Surg* 2012;45(01):45-52 13
25. Bhatt YC, Singh S, Doshi P, Vaghani SG. Reverse peroneal artery flap for large heel and sole defects: a reliable coverage. *World J Plast Surg* 2017;6(02):212-219
26. Palukiri et al, Reverse Peroneal Artery Flap—A Workhorse Flap for Reconstruction of Large, Distal Defects of Ankle and Foot *Indian J Plast Surg* 2022;55:383-390.