

Original Research Article

Reverse sural artery fasciocutaneous flap cover for soft tissue defects in distal one third of leg, ankle and foot in a tertiary care center

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Received: 31 May 2019

Revised: 14 June 2019

Accepted: 15 June 2019

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ABSTRACT

Background: Soft tissue defect management around the lower-third of the leg, ankle and dorsal feet with exposed tendons, bones and orthopaedic implants is a challenge faced by a majority of surgeons. A locally available, versatile, durable flap is the preferred option for coverage of such defects, in the absence of micro vascular surgery facility.

Methods: This prospective study was conducted at Department of General Surgery, Kodagu Institute of medical sciences from March 2018 to May 2019, on 10 consecutive patients with soft tissue defects and exposed bones, tendons and joints of distal-third of leg and foot. We harvested moderate sized reverse sural artery flaps, to cover the defects. After perforator marking with Doppler, flap was planned in reverse, and procedure was performed. Factors like size of defect, flap size, width of pedicle, comorbid factors and complications following surgery were taken into account for the study.

Results: A majority of flaps provided a good coverage for defects and graft was well taken in donor site in all cases. One patient had marginal flap necrosis who was elderly and diabetic, he was managed conservatively, another patient had distal flap venous congestion which settled by itself with conservative management.

Conclusions: Reverse sural artery flap (RSAF) cover is versatile, reliable and safe procedure, which was efficiently used to treat patients with wounds of distal leg, and foot.

Keywords: RSAF, Pedicled flap

INTRODUCTION

With the introduction of concept of microsurgery, the expertise and its advances, free flap is the best option to cover soft tissue defect in leg, around ankle and in foot, however, it is not possible in all centers due to the lengthy procedures and requirements of sophisticated instruments and equipments and team work. In the absence of all these, the reverse sural fasciocutaneous flap is a viable option for the soft tissue coverage of distal third leg and foot. Distally based sural artery fasciocutaneous flap described by Masquelet et al is skin

island flap supplied by arteries accompanying the superficial sensory nerve of leg, and described the anatomical details of this flap in 1992.¹ Following this landmark paper several studies were done and reported that the reverse sural fasciocutaneous flap as a reliable solution to soft tissue defects for reconstructive needs, with low complication rate.²⁻⁵

The purpose of this study was to evaluate the versatility, safety, and success rate of the reverse sural artery flap, for use in soft tissue reconstructions done in leg and around ankle joint.

METHODS

This prospective study was conducted in the Department of General Surgery, Kodagu institute of medical sciences, Madikeri. After getting Ethical Committee clearance from the institute. This study was done over a period of 15 months (March 2018 to May 2019). Ten patients were included in this study. All had soft tissue defects in lower-third of leg, Achilles tendon, heel, malleoli and in dorsum of foot a.

Exclusion criteria

All subjects with scarring or wounds on the posterior calf or pedicle region.

The demographic data of all cases, including age, gender, etiology, size and site of the defect, exposure of bone, vital tendons, presence of chronic osteomyelitis, exposed implants and any associated co-morbid conditions, were recorded (Table 1).

Table 1: Demographic data.

Case no	Age	Gender	Etiology	Site of defect
1	35	M	RTA	Tendo achilles region
2	38	M	Fall from Height	Tendo achilles region
3	11	M	RTA	Medial malleolus
4	26	F	RTA	Posterior aspect of heel
5	16	M	RTA	Ankle and dorsum of foot
6	70	M	Injury in Indian Bath room	Tendo achilles region and heel pad
7	43	M	RTA	Distal 1/3rd leg with exposed bone
8	58	F	Chronic osteomyelitis	Distal 1/3rd leg with exposed bone
9	29	M	RTA	Medial aspect of foot and ankle joint
10	27	F	RTA	Tendo achilles region

RTA- Road traffic accident.

Among them 7 were men and 3 were women. The age ranged from 11 to 70 years with mean age of 35.3. Most of the patients had sustained road traffic c accident. (Figure 1) The soft tissue defect were located on non weight bearing area of heel in the region Achilles tendon which was exposed and posteriors aspect of the foot in 4 patients, Antero medial aspect of distal third tibia in 1 patient, dorsum of the foot with exposed tarsal bone in 2 patients, medial malleolar region in 3 patients and 1 case of chronic osteomyelitis with exposed bone.

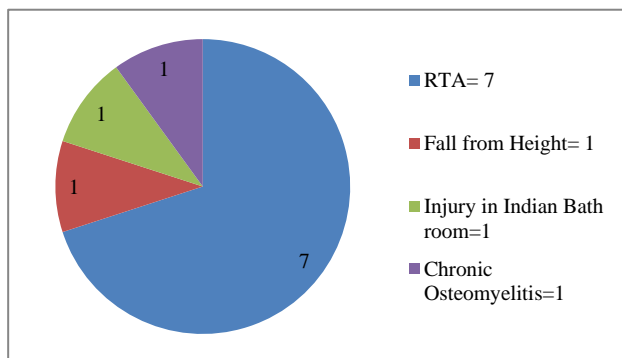


Figure 1: Etiology causing soft tissue defects.

Pre-operative evaluation: All the patients underwent routine laboratory investigation and identification /marking of the site of peroneal perforators, above the lateral malleolus, by using a hand-held Doppler. Two or more perforators were identified above the lateral malleolus. All cases with exposed bones or fractures were radiographed.

Pre-operatively, dimensions of the flap, level of distal flap margin when it was designed on the leg, capillary refills or any congestion which had occurred at the end of the procedure, were recorded. In the immediate post-operative period, the flap was monitored for any venous congestion which had occurred. The outcome was noted in terms of complete or partial flap survival, successful coverage of the recipient defect, and other complications. The pivot point of the pedicle was chosen according to the distal coverage requirement, but was limited by the lowermost perforator, about 5 cm, which is the most constant peroneal perforator from lateral malleolus tip.

Procedure

After obtaining fitness for surgery, an Informed consent for surgery was obtained. In 8 cases regional anaesthesia was given where as in 2 cases general anaesthesia was given. Pre operatively 2-3 peroneal perforators were identified by hand held Doppler and marked. With the patient in a prone position or Lateral position, parts prepared, sural nerve vascular axis was marked which consists of the median superficial sural artery, along with lesser saphenous vein. This axis courses between the heads of gastrocnemius muscle and its several cutaneous branches anastomose with approximately 3–5 septocutaneous perforators from the peroneal artery. The axis of the flap was directed towards an imaginary line which connected the midpoint of popliteal fossa, to a point which was behind the lateral malleolus.⁴ The flap was based distally, wound debridement was done, the recipient raw area was measured with sterile lint then the

flap with 0.5 cm more than that of recipient raw area is designed, over the middle 1/3rd of calf region, and cross checked by doing planning in reverse. The pivot point of the flap was marked 5 cms (3 Fingers Breadth) above the tip of lateral malleolus, The pedicle of the flap between the pivot point and proximal margin of the flap width of approximately 4 cms was maintained in all cases, the proximal and distal limits of the flap was marked. Flap dissection was started; the subdermal layer is dissected to expose the sural nerve, accompanying superficial sural vessels and short saphenous vein. At the distal end of the flap the sural nerve and short saphenous vein is identified, included in the flap and then ligated and cut and fixed to the flap paddle to prevent shearing of small perforators vessel plexuses. After complete elevation of the flap with the pedicle, and viability of the flap is assessed carefully for marginal capillary circulation. After confirmation of viability, the flap is transferred to the recipient area, due care was taken to prevent undue tension over the pedicle. The flap inset was done loosely applying few sutures without any tension. Drains are inserted under the flap. The donor defect was covered with meshed split thickness skin graft. Non-adherent dressing was done over the grafted site and pedicle. Adequate dressing over flap region was done with a window to inspect the flap at regular intervals. The limb is elevated with care to prevent any compression over the pedicle and grafted area.

RESULTS

Out of total 10 patients, 7 patients had sustained injuries following road traffic accidents and one each had sustained injuries after falling from a height and after post surgical debridement for chronic osteomyelitis, one patient sustained injury due to accidental insertion of foot into toilet pit, Defect sizes ranged from 7.5×4 cm and 10×9 cm and sizes of flaps which were harvested, ranged from 8×4.5 cm to 10.5×9.5 cm. The following measurements were observed; pedicle width 4 cm, pivot point, 5-7 cm away from lateral malleolus based on the reach of the flap. Patients were followed up in OPD for 4 months to one year. It was categorically found that none of the flaps had failed completely (Table 2). Although two cases developed venous congestions, of which one

developed marginal necrosis with distal flap loss, which required debridement and secondary skin grafting. (Figure 2) However, none of these complications affected the final outcome of the flap. (Figure 3, Figure 4, Figure 5).

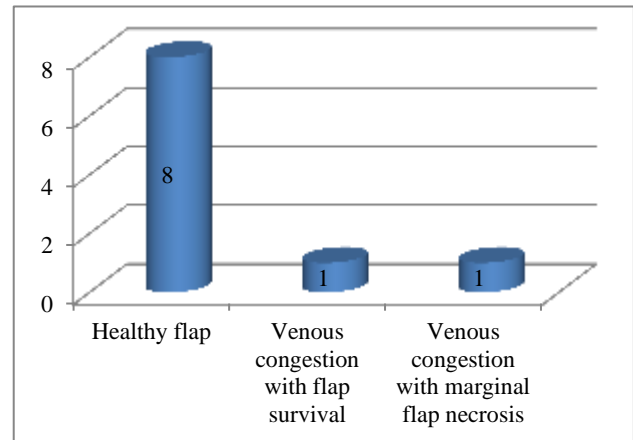


Figure 2: Results depicted in column chart.

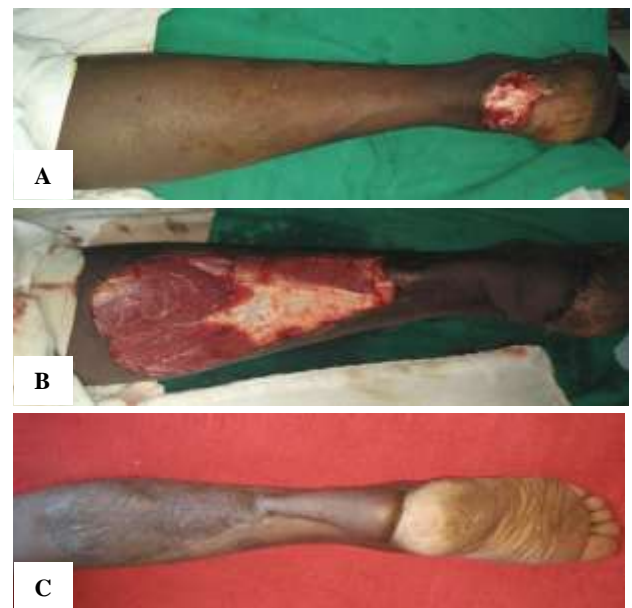


Figure 3: (A) Defect, (B) Flap in situ, (C) Donor site.

Table 2: Result data.

Case no	Size of flap in cms	Complications	Donor site morbidity
1	8×6	Nil	Nil
2	8×5	Nil	Nil
3	8×4.5	Nil	Nil
4	9×5	Nil	Nil
5	7.5×4	Nil	Nil
6	10×9	Venous congestion with marginal flap necrosis	Nil
7	8.5× 6	Nil	Nil
8	8× 5.5	Venous congestion	Nil
9	9×6.5	Nil	Nil
10	8×6	Nil	Nil



Figure 4: (A) Defect, (B) Flap in situ, (C) Donor site.

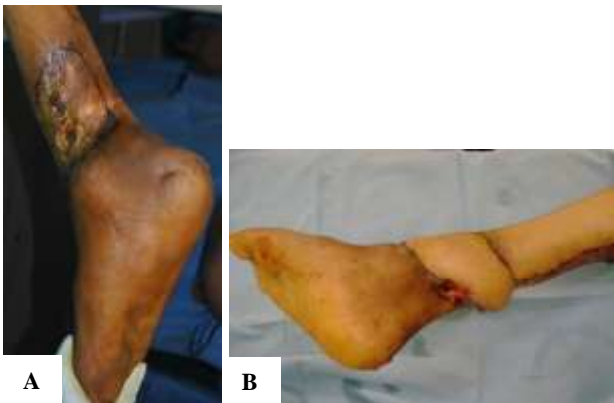


Figure 4: (A) Marked area excised causing defect, (B) Flap in situ with donor site.

DISCUSSION

In 1992 Masquelet et al described Neuroskin flap which is a distally based sural artery flap.¹ This flap is vascularized by a superficial sural artery with reverse flow anastomosis, with four to five fasciocutaneous perforators from the peroneal artery travelling in the crural septum to supply the skin of the lateral leg. These fasciocutaneous perforators from peroneal artery communicate with the axial vessels that accompany the medial sural cutaneous nerve. These vessels typically are

located in the posterior crural septum; starting at a point 5 cm above the tip of the lateral malleolus and extending proximally to a distance of approximately 13 cm above the lateral malleolus.

Nakajima et al further described anatomical details about arteries accompanying cutaneous nerves and veins that run along in the deep adipofascial layer of pedicled fasciocutaneous flap.⁶ The median superficial sural artery, which runs in conjunction with the medial sural cutaneous nerve, and a series of two arteries accompanying the lesser saphenous vein provide the axial pattern blood flow to the suprafascial plexus, subcutaneous vascular plexus, and subdermal plexus, which allows elevation of this flap.^{3,4} A rich plexus of fasciocutaneous and musculocutaneous perforators localized to the lateral aspect of the distal third of the leg that communicate with a series of axial patterned vessels accompanying the sural artery and lesser saphenous vein provide the principal blood supply to the suprafascial plexus, subcutaneous plexus, and subdermal plexus along the posterior calf.^{7,8}

All studies reveals that to get good flap with robust blood supply, reverse sural fasciocutaneous flap should therefore, be designed to incorporate these vital structures in an effort to increase local blood flow.

The age of the patients ranged in present study was 11 to 70 years with a mean of 35.3 years. In comparison to previous studies, the present patient population was relatively of younger age with male preponderance. The average age in other studies was 40 and 38.9.^{9,10}

In the present study, trauma was the major cause of the soft tissue defects in 9 (90%) patients. Among these 7 patients met with road traffic accidents. This is comparable to other studies in which trauma was described as major etiological factor by, 88% by Fraccalvieri et al.¹¹ This is in contrast to the study described by Baumeister et al in which unstable or chronic ulcers were the dominant causative factor in 75% of patients.¹²

A study done by Yilmaz et al reported that the largest flap used in their series measured 12 cm in width and 15 cm in length.⁷ The maximum dimension of the flap in present study was 10.5×9.5 cm, which is almost similar to above and is comparable to other studies reported by Rashid et al.⁹ The success rate of the reverse sural artery flap in present study was 90%, 9 flaps was taken well without secondary salvage with SSG and one patient (10%) of the flaps showed marginal necrosis requiring salvage SSG. This rate is higher than the rates reported in larger series by Yilmaz et al (88%), Rajacic et al (86%).^{7,13} However, this rate is lower than the rates previously reported Touam et al (94%).¹⁴

The success rate of the flap in our study is due to the fact that reverse sural artery flap is used in younger patients

with post-traumatic defects. Having the pedicle width 4 cm in patients has also reduced the complications like venous congestion and flap necrosis. This is supported by the study done by Hollier et al, Ajmal et al, Rao et al providing wider inferolateral pedicle avoids flap necrosis.^{10,15,16} In present study one of the elderly patient who was a Diabetic had marginal flap necrosis which was debrided and grafted secondarily the complication rate was associated with co-morbidity as described in other studies.^{5,12}

There are other studies with good results based on same concept of reverse sural artery flap, but with a flap extension into proximal 1/3rd of calf region, to get large flap, to cover large and distant soft tissue defects.¹⁷

The advantage of reverse sural artery flap is that it is versatile can reach the ankle, dorsum of foot and tendoachilles region due to long pedicle and is easy and relatively quicker to elevate. Furthermore, there is no sacrifice of important vessels, no need of microsurgical technique. There is no significant morbidity at the donor site. The exposed adipofascial pedicle was resurfaced with a skin graft. However, these are insensate flaps and sacrifice of sural nerve leads to hypoesthesia at the lateral part of the foot. The sensitivity improves if other nerves in the lower limb are intact.⁹ In the present study, none of the patients complained about sensory disturbance over lateral border of foot. Limitations of our study is only ten cases were included in the study.

CONCLUSION

Reconstruction of the moderate sized defects over the lower third leg, heel and foot defects is a challenge to surgeon with limited options available like conventional cross leg flap, perforator flaps and microvascular free tissue transfer. From our study, we were to conclude that distally based reverse sural artery flap is a versatile, safe and easy flap which can provide cover to lower third of leg, heel and foot defects.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Prakashkumar MN, Pramod T. Reverse sural artery fasciocutaneous flap cover for soft tissue defects in distal one third of leg, ankle and foot in a tertiary care center. Int Surg J 2019;6:2433-8.