



CASE REPORT

Distally Based Superficial Sural Artery Flap For Coverage of Lower Third Leg Defects

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Abstract

Soft tissue defects in distal third of leg impose a challenge to reconstructive surgeon. The distally based sural neurocutaneous flap based on sural nerve and superficial sural artery has been used for reconstruction of distal third of leg, tendoachilles and heel, medial malleolus and hind foot. We describe our experience and evaluate the reliability of this flap. 12 patients with age range from 20-62 years underwent distally based superficial sural artery flap for coverage of defects of distal third of leg, tendoachilles and heel, medial malleolus over a period of two years. All the flaps survived, one flap showed venous congestion but was managed conservatively. The main advantage of the flap is constant and reliable blood supply without sacrifice of major artery. The flap may be raised as islanded or pedicled flap.

Key Words

Distally Based Sural Artery Flap, Lower Third Leg Defects

Introduction

Management of soft tissue defects of lower third of leg including Achilles tendon, malleoli, and heel present a challenging problem to Plastic Surgeons (1). Most open fractures of lower 1/3 of tibia are associated with soft tissue defects, because tibia is subcutaneous bone with almost no muscles around its lower 1/3rd with tight skin the bearing properties, hence it needs a full thickness skin cover. The distally based Sural artery flap, first described as a distally based neuro cutaneous flap by Masquelet *et al*, (2) is skin island flap supplied by the vascular axis of sural nerve (*Fig-1*). Preoperative View Showing Defect. The aim of this paper is to establish the role of this flap as a workhorse for reconstruction of lower 1/3 leg defects. We treated 12 patients with lower third leg defects employing distally based Sural artery flap over a period of two years. All the flaps survived, one flap showed venous congestion but was managed conservatively. The main advantage of the flap is constant and reliable blood supply without sacrifice of major artery. The flap may be raised as islanded or pedicled flap.

Case Series

12 patients with lower 3rd leg defects were treated over a period of two years employing seven Islanded distally based superficial sural artery flap and 5 pedicled flaps supplied by superficial sural artery. The demographic

data, cause of the defect, site and type of flap used are shown in *table-1*. The flaps were employed in situations as open fracture (3 cases), soft tissue defects due to trauma (8 cases) and non healing ulcer in Hansens disease (1 case). The recipient sites were tendoachilles and heel area (7 cases), medial malleolus (3 cases), anteromedial part of lower 3rd leg (1 case) and anterolateral part of lower 3rd leg (1 case). One patient in series had diabetes and one patient was HIV positive.

Surgical technique: Once the soft tissue defect is ready for coverage, the surgical procedure is performed while the patient is under general /spinal anesthesia. The patient is placed in a prone position and the flap is raised under tourniquet control. The outlining of the flap should proceed as follows:

1. The superior border of the flap should not exceed the middle third of the leg.
2. The pivot point is located 5 cm over the tip of the lateral malleolus.
3. The flap is centered over the sural nerve.
4. The lateral edges do not go beyond the lateral midlines.

The dimensions of the flap as well as its pedicle are determined according to the size of the defect and its site. The incision is started on the proximal edge of the

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Fig 1&2. Preoperative View Showing Defect & Flap elevation



Fig 5& 6. Left Medial Malleolar Defect With Exposed Implant & Postoperative view after 15 days



Fig 9&10. Defect over anterolateral aspect of lower third right leg & Flap elevation



Fig 13& 14. Preoperative view showing defect on anteromedial aspect of right leg & Postoperative view

flap and is continued until reaching the gastrocnemius. The fascia is fixed to the flap by a few separate sutures. At mid-calf, the sural nerve, superficial sural artery, and lesser saphenous vein are easily identified, ligated, and included within the flap. The dissection is continued distally, and the fibroadipose tissue around the pedicle is preserved. The pedicle is 2 to 3 cm wide including the sural nerve with its superficial artery and lesser saphenous vein. The dissection of the pedicle stops at the pivot point. The flap is transposed to the recipient area through a subcutaneous tunnel. If there is any risk of compression of the pedicle, the tunnel is not required. The donor site is immediately closed primarily (in the case of the small flap) or covered with a split-thickness skin graft. The viability the flap is assessed by its color and bleeding borders. Postoperatively, a window was left uncovered to monitor skin colour and temperature of the flap, and the limb remains raised to bed level to improve venous return.



Fig 3& 4. Flap inset & Flap Inset with Grafted Donor Site



Fig 7&8. Late Postoperative View of Recipient Site & Late postoperative view showing healed donor site



Fig 11 & 12 Postoperative View Showing Venous Congestion of Flap & Late postoperative view

The first dressing is changed on the first postoperative day. In the absence of external fixation, the posterior splint with well-padded dressing is applied to avoid compression of both the pedicle and the flap. Out of 12 patients, undergoing superficial sural artery flap for coverage of various defects of lower third leg, 10 were males and 2 were females. Age of the patients range from 20-62 years. Most of the patients were operated in 2nd or 3rd week after injury. In our series successful coverage of lower third leg, medial malleolus, heel and exposed tendoachilles was achieved. All the flaps survived, one flap showed venous congestion but was managed conservatively. *Fig1* shows exposed tendoachilles, *Fig 2* shows elevation of the flap, *Fig 3&4* show flap inset. *Fig 5-8* show the coverage of medial malleolus with the flap. *Fig 9-12* show the coverage of anterolateral defect over lower third leg; *Fig11* showing venous congestion of the flap. *Fig 13-14* show the coverage of anteromedial defect over lower third leg.

Discussion

In 1981, Ponten (3) was the first to describe and propose the fasciocutaneous flap. In fact, he relied on Salmon's study dating back to 1936. Taylor and Palmer in 1987 (4), and then Masquelet *et al* in 1992 (2) showed the abundance of perforating arteries accompanying the

Table 1. Showing Cause, Site and Type of Flap

Case No.	Age (Years) Sex	Cause	Site of Defect	Type of Flap
1	17 yrs/M	Motor Vehicle Accident	Medial Malleolus	Pedicled SA
2	40 yrs/M	Motor Vehicle Accident	Heel	Islanded SA
3	62 yrs/M	Motor Vehicle Accident	TA	Islanded SA
4	19 yrs/M	Motor Vehicle Accident	Medial Malleolus	Pedicled SA
5	21 yrs/M	Motor Vehicle Accident	Heel	Islanded SA
6	49 yrs/M	Hansen's disease	Heel	Islanded SA
7	60 yrs/M	Motor Vehicle Accident	Antero medial leg	Pedicled SA
8	48 yrs/F	Motor Vehicle Accident	TA	Islanded SA
9	37 yrs/M	Motor Vehicle Accident	Medial Malleolus	Pedicled SA
10	21 yrs/M	Motor Vehicle Accident	Heel	Islanded SA
11	27 yrs/F	Motor Vehicle Accident	Heel	Islanded SA
12	48 yrs/M	Motor Vehicle Accident	Anterolateral leg	Pedicled SA

sensory nerves of the lower limb, and how the presence of a real intertwined vascular plexus, or simply an artery, not only assures the irrigation of these nerves, but also provides various cutaneous branches during the extra fascial journey. From these findings, the concept of neurovascular island flap was established.

The distally based sural fasciocutaneous flap was a neurovascular flap introduced by Donski and Fogdestam in 1983 (5). This flap remained unmentioned in the literature between 1983 and 1992. Masquelet *et al* in 1992 (2) reintroduced the sural flap with a detailed description. The sural flap is a useful procedure in the reconstruction of the skin defect of the distal area of the lower limb because of a long vascular malleable pedicle. This type of pedicle offers many advantages: the removal technique is fast, easy, and repeatable. Advantages of this flap are mainly the absence of sacrifice of the principal vascular axes, the vascular reliability related to anastomotic arterial networks, the anatomic constancy of the neurovascular axis, as well as the length of the pedicle conferring a rotation arch that defines its performance (6-10). The flap then can be used in the coverage of soft tissue defects at the level of the lower third of the leg, ankle, lateral side of the heel, and hindfoot. The cutaneous paddle of the sural flap can become large and can cover even 180 cm² (11), with the possibility of limited aesthetic damage each time the donor site is closed (10). A cross-leg sural flap has been used by Atiyeh *et al* (7). Mainard *et al* (12) reported a case of the dual use of the distally based fasciocutaneous sural flap in the coverage of both cutaneous lesions in the ankle and heel within an interval of 3 weeks. This case illustrates the flap's reliability and flexibility in use. It should be noted that in some cases, the length of pedicle is not enough to

cover the forefoot. Despite its reliable vascularization, the neurocutaneous sural flap seems insufficient in cases of chronic or severe infection. In this case, the muscular or free flaps are more appropriate to treat bone infection (13). The drawbacks of the distally based sural flap are trivial compared with its advantages (6-10), in our opinion. In fact, sacrificing the sural nerve causes a quick onset of anesthesia localized to the heel and external border of the foot. In our experience, sacrifice of the sural nerve results in few complaints related to the external border foot anesthesia. In order to spare such trouble, some surgical techniques have been proposed, but they make dissection difficult and increase the risk of failure (11).

The scar left on the donor site depends on the dimensions of the recipient area. The donor site is either immediately closed or grafted (8). The fascial and adipofascial flaps have been used to overcome this problem, but they always leave linear scars on the calf (14). The ligation of the lesser saphenous vein does not impede the venous return of the foot and the survival of the flap. The venous drainage of the neurocutaneous sural flap seems to be the primary complication (15). It has been shown that drainage of such flaps is realized by the concomitant veins of the saphenous vein and their links with the fascia (16). Consequently, the venous drainage will be secured as the pedicle widens (17).

The compression of the pedicle secondary to tunnelling is one cause of venous congestion. In order to avoid this complication, it is preferable to open the tunnel and leave out the pedicle (18). The occlusion of the anterior or posterior tibial artery and the varicose veins of the leg do not discourage the practice of this surgical procedure (19). External fixation is useful because it helps the soft tissue lesions heal faster, facilitates

dressings, and improves venous return when the lower limb is elevated. The necrosis of the flap is the most dreadful complication; it is related to many factors including a mistake in the surgical technique, incorrect posture of the flap, and poor vessels, keeping in mind that the peroneal artery is the last to be subject to atherosclerosis. Thus, older age is not a contraindication to sural flap (19, 20). We confirm this finding because, in our series, 2 patients with flaps were older than 60 years of age. According to series from Akhtar and Hameed (6) and Belfkira *et al* (8), the rate of flap necrosis varies from 15% to 16%. Some authors (6, 8, 21) do not well define the evaluation criteria of their results, which does not allow an objective comparison of the series.

The sural flap cannot be allowed when the peroneal artery or the sural nerve is injured; this is frequently found after trauma of the lateral leg and especially of the lateral malleolus. Sural flap is an interesting procedure for the coverage of lower third leg defects. Its interest lies in the ease and flexibility of use, its coverage of surface, and its vascular reliability.

Conclusion

The distally based superficial sural artery flap is a reliable flap for the coverage of distal third leg defects. The dissection of the flap is easy with almost nil complications and morbidity.

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