# Use of Distally Based Sural Artery Flap to Manage the Soft Tissue Defects of Lower Tibia and Ankle

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**Abstract:** *Objective*: To present experience of soft tissue cover of lower one third of tibia and ankle treated by an orthopaedic surgeon without the presence of a plastic surgeon but of course, depending on the reliability of this flap.

*Patients and Methods*: Nineteen patients, fifteen males and four females, with soft tissue defect of lower one third tibia and ankle requiring soft tissue cover were treated from April 2002 to September 2005. The flap was outlined at the posterior aspect of junction of upper and middle 1/3 leg.

The pivot point of the pedicle was at least 5cm i.e., 3 fingers' breadth above the lateral mallelous to allow anastomosis with the peroneal artery. Skin incision was started along the line in which the fascial pedicle would be taken. The sub dermal layer was dissected to expose the sural nerve, accompanying superficial sural vessels and short saphenous vein. The subcutaneous fascial pedicle was elevated, with a width of 2cm to include the nerve and these vessels. At the proximal margin of the flap, the nerve and the vessels were ligated and severed. The skin island was elevated with the deep fascia. The donor site defect was closed directly when the flap was less than 3cm wide. A larger donor site defect along with the pedicle was covered with a split thickness skin graft.

*Results*: All flaps except two survived. Most flaps showed slight venous congestion which cleared in a few days. There was no loss of split skin graft & none was lost to follow up.

*Conclusion*: Distally based Sural artery flap remains the choice for reconstruction of soft tissue defects of lower 1/3 tibia and ankle. The dissection is easy, quicker and can be done by an orthopaedic surgeon already involved in flap surgery; without the presence of plastic surgeon.

**Keywords:** Soft tissue defects, distally based sural artery flap, Lower third of tibia & ankle.

## INTRODUCTION

Soft tissue defects of distal tibia & dorsum of ankle present a challenging problem. The treatment in these patients usually requires a plastic surgeons [1]. Most of open fractures of lower 3rd of tibia are associated with soft tissue defects, for tibia is subcutaneous bone with almost no muscles around its lower third with tight skin and poor circulation. Heel is another problem site because of weight bearing properties; hence it needs a full thickness skin cover. However, different forms of soft tissue covers are available e.g., muscle flap, fascial flap, septocutaneous flaps, axial flaps and free flaps with their own merits & demerits. 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. He reported using colored latex injection studies in 1992, the blood supply to the skin from the arteries accompanying the nerves and described the concept of neuro cutaneous island flap. The objective of this paper was to present our experience of soft tissue cover of lower third of tibia and ankle treated by an orthopedic surgeon with out any special training, and largely due to the reliability of this flap.

## PATIENTS AND METHODS

Nineteen patients, fifteen males and two females with soft tissue defect of lower one third tibia and ankle requiring soft tissue cover, were treated from April2002to September 2005. The patient's age ranged from 18 to 45 Years (mean 23 Years). Three of the wounds were over the dorsum of foot, eleven were on the lower third of tibia and five were on the posterior heel.

Patient with Diabetes Mellitus, Tuberculosis, I.H.D and cigarette smokers were excluded from this study. The sural neurovascular flap [3-6] is a fasciocutaneous flap that is raised along the course of the sural nerve. The nerve emerges between the two heads of gastrocnemius muscle in the middle of the poplitel fossa and travel to the lateral aspect of the heel between the lateral malleolus and the anterior margin of the Achilles tendon. Its blood supply depends on a constant sural artery that accompanies the nerve along its very proximal course. Distally it depends on perforators coming from the peroneal artery. The most distal set of perforators leave the peroneal artery at

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almost 5 cm i.e., three fingers' breadth proximal to the tip of the lateral malleolus.

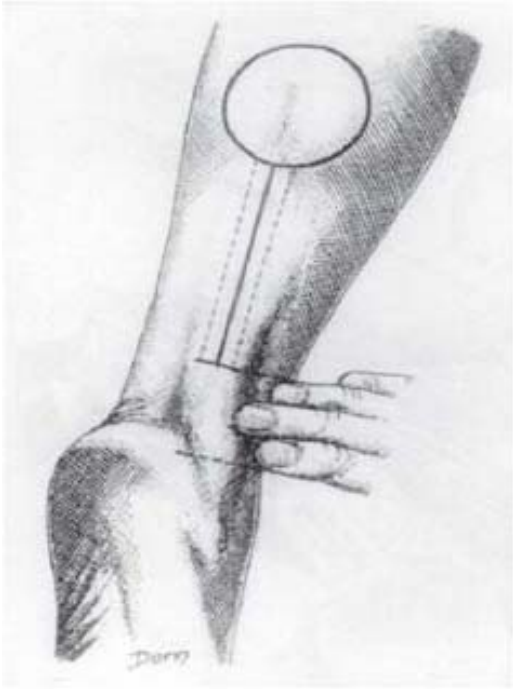

**Figure 1:** Pivotal point 3 fingers breadth above the lateral malleolus.

With the patient in a lateral or prone position, the flap is outlined at the posterior aspect of junction of upper and middle 1/3 leg according to a previously prepared pattern of the recipient defect. The pivotal point of the pedicle must be at least 5cm i.e., 3 fingers' breadth above the lateral malleolus to allow anastomosis with the peroneal artery [3-6] (Figure **1**).

**Figure 2:** Subdermal dissection with pedicle.

Skin incision is started along the line in which the fascial pedicle will be taken. The subdermal layer is dissected to expose the sural nerve, accompanying superficial sural vessels and nerves. At the proximal margin of the flap, the nerve and the vessels are ligated and severed (Figure **3**).

**Figure 3:** Skin island elevated with deep fascia.

The skin island is elevated with the deep fascia.

The donor site defect can be closed directly when the flap is less than 3cm wide .A larger donor site defect along with the pedicle must be covered with a split thickness skin graft.

## RESULTS

The mechanism of injury was road traffic accident in nine patients with open fracture tibia & ankle, spoke-wheel injury in 3 patients, exposed plate used for internal fixation of distal tibial fracture; due to wound dehiscence in five patients & exposed Tendo Achilles resulting from primary soft tissue injury in 2 patients (Table **1**). All flaps except two survived. Most flaps showed slight venous congestion which cleared within a few days. There was no loss of spilt skin graft and no any complaints related to the sacrifice of sural nerve. Paresthesia on the lateral border of foot was not a problem because it disappeared with in two months time.

**Table 1: Mechanism of Injury**

| S. No | Mechanism of injury | Resulting injury |
|---|---|---|
| 1 | RTA 9 | Open fractures tibia / ankle |
| 2 | Spoke wheel injury heel 3 | Visible calcaneus |
| 3 | STI Ankle 2 | Exposed TA |
| 4 | Post op wound dehiscence 5 | Visible metal |

## DISCUSSION

Soft tissue defects of lower third tibia and ankle used to be enigma of orthopaedic and even plastic and

reconstructive surgeon [7]. Trauma due to road traffic accidents or wound dehiscence due to operative treatment account for most of the cases. Various techniques have been developed for the reconstruction of these defects. Split skin graft remains the best option to cover superficial defects over dorsum of foot due to its faster take and early neurotization. Fasciocutaneous flaps first introduced by Ponten in 1981 [8], are in use for the reconstruction of soft tissue defects of lower 1/3 leg and foot. Reversed island flap e.g., peroneal artery flap, anterior tibial artery flap and posterior tibial artery flap can be transferred to the ankle or foot. However it needs sacrifice of a major artery which constitutes a potentially serious. Masquelet et-al. [2] in 1992 first described distally based sural artery flap. The distally based superficial sural artery flap is vascularized by a median superficial artery with reverse flow as this artery has septocutaneous perforators from peroneal artery. Additionally, the sural nerve has an intrinsic arterial system. These systems anastomose freely in the suprafascial plexus; combination of these systems perfuses the distally based superficial sural artery flap. The advantages of the flaps are that relatively large size flap can be harvested with little donor site deformity. Dissection is easy, blood loss is minimal & preservation of the major vascular structure of the lower limbs is possible. It also avoids the need for more sophisticated equipment and expertise. This flap has a wide arc of rotation on its pedicle at approximately 5cm superior to the lateral mallelous. Jeng *et al*. [9] used this technique to cover exposed Achilles tendons and soft tissue defects of the ankle and heel. Of the 22 patients described, 20 had complete success with two minor complications that were treated uneventfully. Huisinga *et al*. [10] used this flap on 15 patients for soft tissue coverage in the lower leg, malleolar, and heel regions. Twelve flaps survived, two partially survived, and one flap failed due to persistent infection. Jeng *et al*. [11] reported their experience with the use of the distally-based sural artery flap for salvage of the distal foot. In seven out of eight patients, the flaps survived completely and only one patient had a partial necrosis of the flap.

Coskunfirat *et al*. [12] performed 11 reverse neurofasciocutaneous flaps for coverage of soft tissue defects in the lower extremities. Six flaps were saphenous and five were sural; all survived completely. Bocchi *et al*. [13] used a reverse sural flap in 14 patients to successfully cover larger defects of the leg and ankle and a reverse adipofascial sural flap in 11 patients to cover moderate-size wounds in heel areas.

Ferreira *et al*. [14] reported that in 36 distally based superficial sural artery flaps, only six partially necrosed and no major complications occurred.

In a larger study, Almeida *et al*. [15] performed a reverse flow island sural flap on 71 patients; 15 partially necrosed and three experienced total loss. Fraccalvieri *et al*. [16] described their experience with 18 distally-based superficial sural flaps. Only one superficial necrosis had to be surgically revised. Singh and Naasan [17] used the reverse sural artery flap to treat acute open fractures of the lower leg associated with soft tissue loss. Two out of seven patients had a partial necrosis of the distal tip of the flap.

We successfully elevated eleven distally based sural artery flaps, only two flaps had necrosis. There was no major complication in rest of the cases although done by an orthopaedic surgeon.

Irrespective of etiology, coverage of exposed soft tissue done in time is mandatory and essential for prevention of complications. Our clinical study recommends distally based sural artery flap as a good choice to cover soft tissue defects of lower third tibia and ankle because the flap has numerous advantages. It is a one stage operation, which does not require microsurgical techniques.

Elevation of the flap is easy and quick. The donor site has minimal morbidity as it can be closed primarily when small flap is raised and skin grafted when large flap is raised. The vascular supply to the arterial network of the sural area is constant and reliable, and there is no need to sacrifice any major artery and or sensory nerve. The pedicle is long, and the flap can easily be transferred around the lower one third of tibia and ankle.

## CONCLUSION

Thus the distally based sural artery flap can be used as a good alternative to microsurgical reconstructions and can be done by an orthopaedic surgeon who is already oriented with flap surgery.

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