



Level of difficulty: Apprentice

## Distally based sural neurocutaneous pedicle flap

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**Abstract:** The distally based sural neurocutaneous flap is technically simple and characterised by limited morbidity. It is one of the therapeutic alternatives for the coverage of small or middle-sized soft-tissue loss in the distal third of the leg, at the level of the ankle and of the heel. This flap is based on a retrograde flux originating from the superficial sural artery. It depends on the perforating arteries originating from the peroneal artery. It can be harvested as a skin paddle or as an island flap. It will not lead to major artery sacrifice. It is a reliable flap, which can be performed on diabetic as well as arteritic patients. Its best indication is for the coverage of heel decubitus ulcer. Finally, it can be used for management of soft-tissue defects, especially related to osteomyelitis with the filling of bone cavities.

**Keywords:** Flap – Sural neurocutaneous – Soft-tissue loss

### Introduction

The distally based neurocutaneous flap was first described by Masquelet [1] in 1992. It belongs to the range of the neurocutaneous flaps, whose vascularisation depends on the vascular axes at the level of the superficial sensory nerves. It is a reliable flap, whose dissection is somewhat simple. It is one of the therapeutic alternatives for the coverage of soft-tissue loss in the lower quarter of the leg, the ankle and the heel (Fig. 1).

### Anatomy

Salmon had described the satellite vascular networks of the sensory nerves in 1936. A vascular network depending on the superficial sural arteries, which are neurocutaneous arteries, accompanied the sural nerve. These arteries anastomose within a suprafascial vascular plexus with the lateral malleolar branches originating from the peroneal artery. The distal pivot point is situated at about 5 cm above the lateral malleolus, at the emergence of the lateral malleolar branches, which are perforating arteries of the peroneal artery.

### Surgical techniques

The patient will be lying in the prone position. The procedure will be carried out under pneumatic tourniquet. The flap size is up to a maximum of 20 cm in length and five to ten centimetres in width. The flap can be harvested as a skin paddle or as an island flap (Fig. 1). The medial incision of the flap is made along the lateral edge of the Achilles tendon. The lateral incision is performed on the other side in the axis of the peroneal diaphysis. First, the dissection will be proximal. The first step is to locate the sural nerve and its external vein, which will be ligatured.

The dissection will be performed from proximal to distal, by elevating the skin paddle, the subcutaneous adipose tissue layer and the leg fascia up to opposite the posterolateral malleolar depression. By taking the sural pedicle and the underlying fascia in this way, the vascular plexus anastomoses will be elevated with the flap. The hemostasis or the ligature of some perforators will be performed when harvesting the flap. The rotation of the flap allows covering the medial malleolus, the lower quarter of the leg by means of the subcutaneous tunneling, or the heel with a 180° rotation. If the donor site cannot be closed primarily a thin expanded skin graft will be sutured on the donor site. The flap will be sutured at the periphery of the soft-tissue loss.

### Postoperative care

Weight bearing on the flap must be avoided, especially with regards to the coverage of the heel's soft-tissue. The patient will be lying in the dorsal or ventral decubitus position while a heel strap would protect the flap in order to avoid an untimely pressure on the latter. The patient will be allowed to walk on two crutch-sticks starting from the first postoperative day, a prophylactic anticoagulation therapy, in order to prevent any thromboembolic

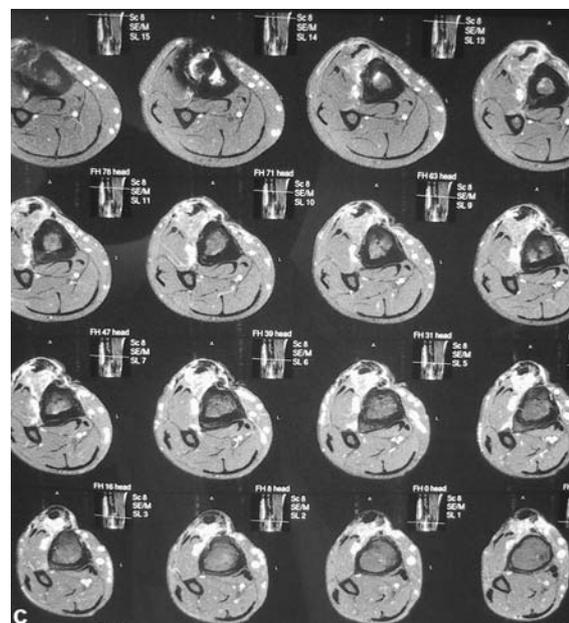


**Fig. 1. a, b:** Coverage of a heel eschar by means of a distally based sural neurocutaneous flap. Primary closure of the donor site. 180° rotation of the flap without any traction

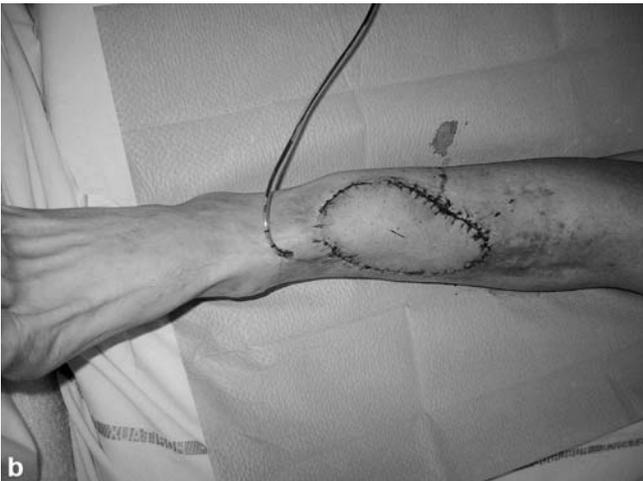
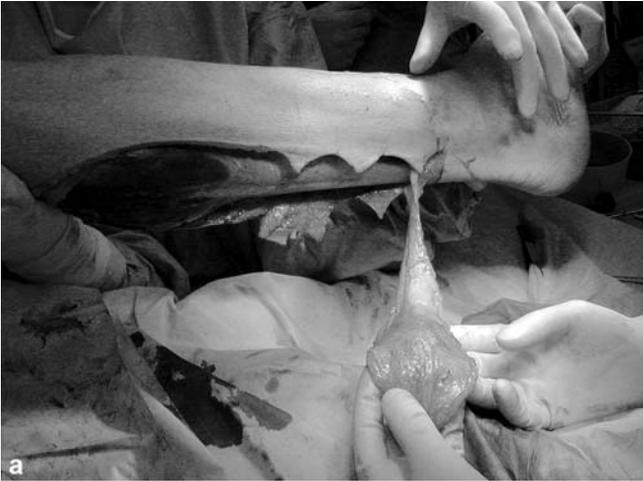
occurrences, may be considered. As a general rule, healing will have occurred between two or three weeks, thus enabling weight bearing on the heel.

**Technical variations**

- The flap can be used to cover the soft-tissue loss with regards to osteomyelitis. In this case the proximal area of the flap is de-epidermised. This part, which is only "adipose" is transferred into the bone cavity to be filled. The skin paddle will be sutured at its periphery (Figs. 2-4).
- The flap can be harvested as an island skin flap. In this case, the pedicle is raised by harvesting the peripheral adipose tissue at 2 cm on both sides of the sural nerve and the fascia of the leg. This will enable to preserve the vascular anastomoses between the superficial sural artery and the arteries originating from the lateral malleolar branches (Figs. 5-6).
- Le Fourn *and al.* [2] performed an anatomic study to establish a relationship between the gastrocnemius



**Fig. 2. a, b, c:** Chronic osteomyelitis of the lower third of the tibia, appearance after debridement-curettage



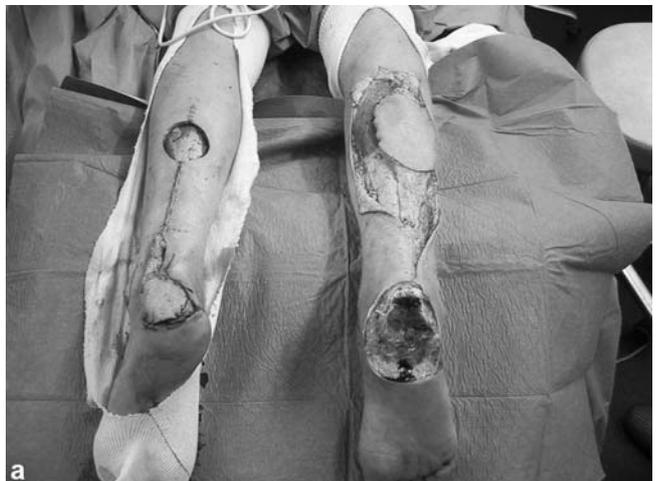
**Fig. 3. a, b:** Coverage by means of a distally based sural flap harvested as a skin island flap. Preaponeurotic subcutaneous tunneling and fixation of the skin paddle by means of a peripheral suture on a Redon drain



**Fig. 4.** Long-term result



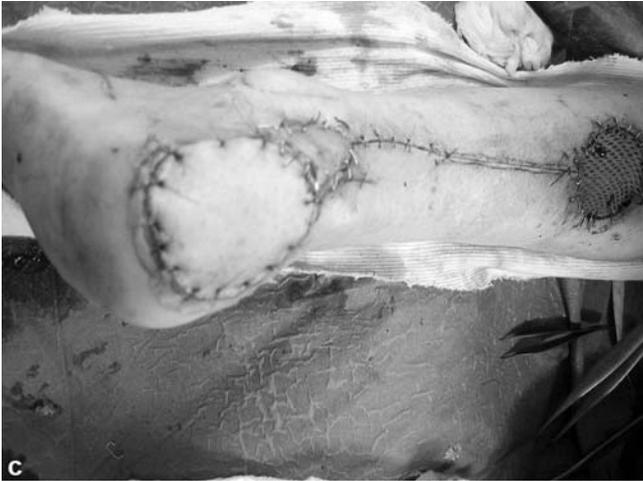
**Fig. 5.** Bilateral heel decubitus ulcer in a 68-year-old arteritic patient affected by absent foot pulse



**Fig. 6. a, b:** Coverage with a distally based sural flap, which is bilateral



**Fig. 6. a, b:** Coverage with a distally based sural flap, which is bilateral



**Fig. 6c.** Coverage with a distally based sural flap, which is bilateral



**Fig. 7.** Venous distress of a sural flap treated by scarification and temporary bleeding control. The whole of the flap will be preserved. This flap has been executed in order to ensure the management of a Cauchoix stages 4 open fracture of the lower quarter of the leg

muscles and the vascular axis of the sural flap. They found two to three constant perforators from the gastrocnemius to the neurovascular axis. It allows to harvest a fasciomyocutaneous or fasciomuscular distally based sural flap. It can be useful to fill bone defect on the distal part of the leg or of the foot.

– As mentioned in the anatomy chapter, the distal pivot point of the sural flap is designed at the lowest septocutaneous perforator from the peroneal artery of the posterolateral septum; which is, on average, 5 cm above the lateral malleolus. New pivot points distally designed

had been explored by Zhang et al. [3]. Peroneal artery terminates into two branches: the posterior lateral malleolus artery and lateral calcaneal artery. These two branches send off cutaneous perforators at about 3 cm and 1 cm above the tip of lateral malleolus, respectively, which can be used as arterial pivot points. A communicating branch between the short saphenous vein and the peroneal venae comitantes was found, accompanying by the perforator of the posterior lateral malleolus artery. This modified distally based sural flap with lower pivot points designed at 1.5 cm proximal to the tip of the lateral malleolus, provides a valuable tool for coverage of foot and ankle soft-tissue defect.

### Limitations

The main disadvantage is a venous ischaemic insult, especially when harvesting as a skin island flap with a subcutaneous tunnelling in order to cover the anterior or the anteromedial aspect of the lower third of the leg. In case of venous distress a scarification with temporary local application of heparin enables save the flap (Fig. 7). Venous distress can lead to a partial necrosis of the flap.

### Contraindications

There is no formal contraindication to the harvesting of this flap contrary to the use of a medial plantar flap or a posterolateral malleolar flap, which require a patient in good health with no alterations of the vascular system.

### Conclusion

The distally based sural neurocutaneous flap is reliable, technically simple to harvest and is associated with limited morbidity.

### References

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