

DISTALLY BASED SURAL ARTERY NEURO CUTANEUS FLAP

The distally based Sural flap was first described by Donski and Fogdestam in 1983⁽³⁰⁾ and later popularized by Masquelet et al.⁽¹⁰²⁾. It is a neurocutaneous flap, which means that the vessel accompanying a cutaneous sensitive nerve, the sural nerve in this case, supplies the skin paddle of the flap. This type of vascularization was already suggested by Salmon in 1936⁽¹²⁹⁾, and Quenu and Lejars⁽¹²⁷⁾ in 1892. Different authors later stated that vessels accompanying cutaneous nerves, routinely penetrate the deep fascia and/or pierce it⁽¹³⁾ while also traversing adipose tissue⁽¹¹⁵⁾. These types of flaps were then named “Neurocutaneous perforator flaps” or “Venoneuro-adipofascial flaps”⁽¹¹⁶⁾.

The distally based sural artery neurocutaneous flap is not a complex flap, it is highly reliable, located far from the involved area and suitable for having its donor site repaired by primary closure.

However, it is not free of complications and as a reverse flow flap it is especially prone to complications in patients with associated vascular comorbidities such as diabetes, venous insufficiency and peripheral arteries diseases. Patients over 40 years old also seem to correlate with a higher risk of flap failure⁽¹⁰⁾.

Indications

This flap is mainly indicated to repair defects on the lower leg⁽⁶⁴⁾, ankle or foot in different circumstances^(2,7,35,71) and particularly, for anterior or lateral post-burn contractures of the ankle⁽¹¹⁴⁾. Even, treatment of calcaneal osteomyelitis has been successfully treated with this type of flap⁽¹⁶⁹⁾.

Vascularization and Anatomy

Vascularization of the distally based sural flap is based on the same mechanisms of arterial retrograde flow and denervation of venous valves that happens

when proximal arteries which have reliable distal interconnections with branches from other main vessels, are divided. Distal anastomoses and the high-pressure system (as it is the arterial system,) allows a good retrograde flow in normal conditions. Venae comitantes, multiple intercommunicating branches and denervation of valves, is enough to ensure venous drainage to the opposite physiologic direction.

The artery accompanying the sural nerve pierces the deep fascia at the proximal posterior aspect of the calf and gives off several branches that vascularize the skin at the middle third of the calf. This artery courses distally with the sural nerve to anastomose with some of the 2 to 5 perforator vessels that originate from the peroneal artery, which can be found proximal to the lateral malleolus⁽¹⁴¹⁾. Anastomoses are located 3 cm-5 cm proximal to the tip of the lateral malleolus and constitute the rotation point for the Sural neurocutaneous flap.

Markings

The pivot point of the flap is localized about three fingers' breadth proximal to the tip of the lateral malleolus, midway between it and the Achilles' tendon and the lateral malleolus (fig. 7.99). The skin paddle is outlined with its vertical axis over the line between both Gastrocnemius muscles. Its upper or proximal limit is slightly above the junction of the two heads of both Gastrocnemius muscles. The skin island is outlined over the middle third of the calf, as the skin of the proximal third is no longer vascularized by the sural artery. Elliptical outlining of the flap (fig. 7.99, 7.100) will facilitate primary closing of the donor area.

Wider flaps will be able to resurface wider defects, but it is important to rationalize between width and the possibility of a primary closing of the defect. One cm may be the difference between a direct closure of the donor area or the need for skin grafting.

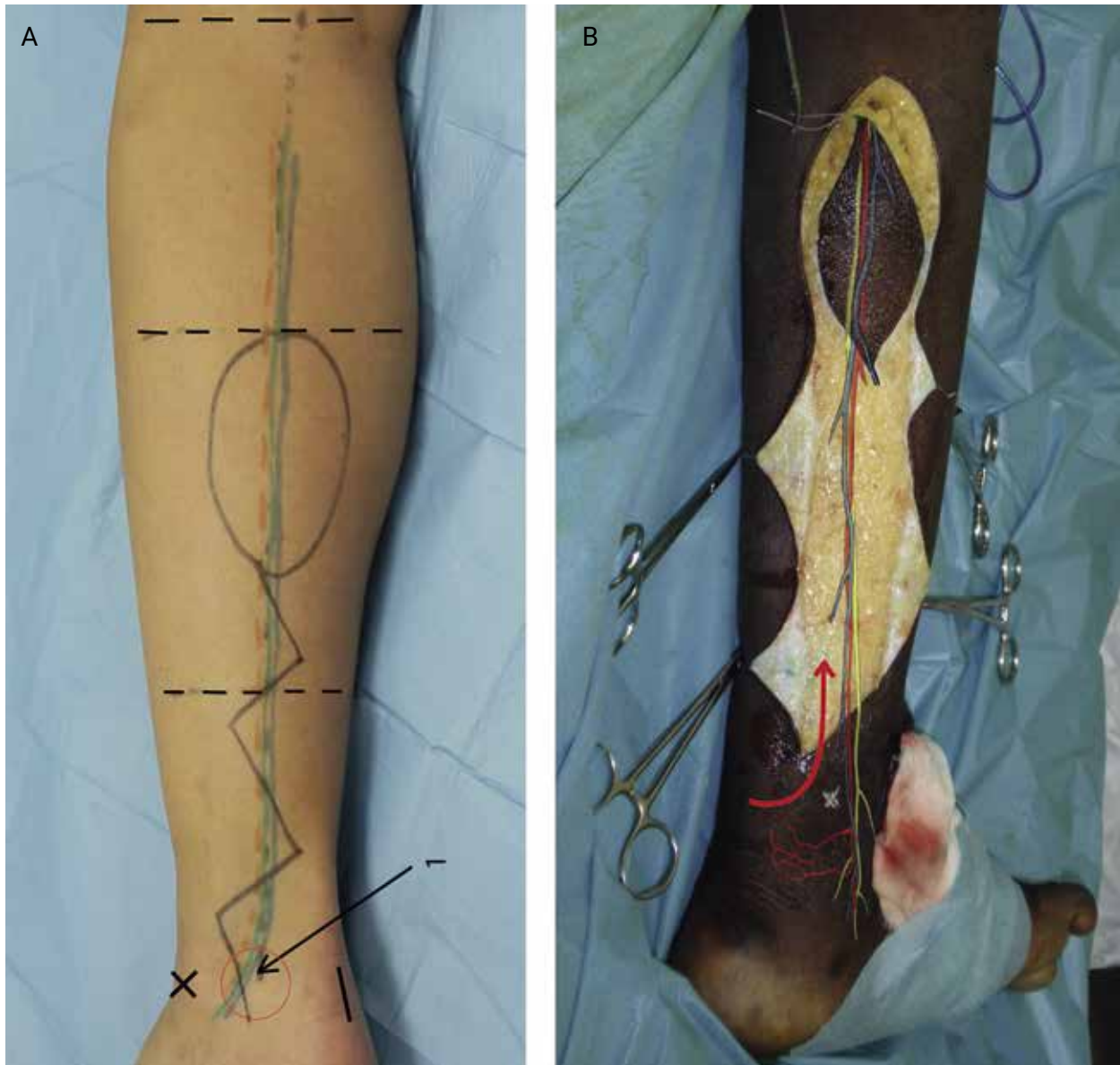


Figure 7.99. A) Markings: The calf is divided in thirds and the skin paddle is outlined on the medial third. Lateral malleolus (black cross) and Achilles tendon (black line) are marked out. At the middle point between these two last markings is the point where the pedicle emerges and the pivot point is located (red circle). The flap is outlined in an elliptical shape to facilitate the primary closure of the donor area. B) How the distal sural pedicle works: the artery nourishing the skin island is fed by communicating vessels at the distal leg and accompanies the sural nerve along its course.

Elevation

Elevation of the flap can be facilitated by the use of a pneumatic tourniquet, as there is no need to precisely identify and isolate small perforator vessels. The flap can be raised with either a complete skin bridge overlying the pedicle or as an island flap with an adipofascial pedicle. For island flaps, an incision is made from the pivot point up to the lower limit of the cutaneous paddle. "W-like" in-

cision is preferred as it allows wide exposure of the fascial-adipose pedicle.

However, dressings are applied. If skin grafts have been used, they are covered with non-adherent dressings and antibiotic ointment applied. The entire lower leg is protected with a well-padded, posterior plaster splint.

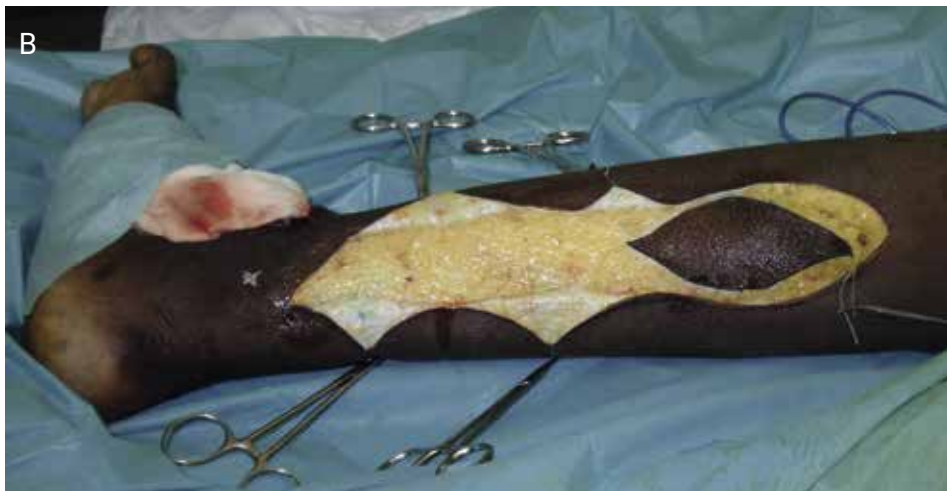


Figure 7.100. First step is to elevate the skin flaps over the pedicle at the subdermal level in both sides to preserve as much adipose tissue as possible which is included in the pedicle where the sural nerve and vessels run.



Figure 7.101. Skin incision on the proximal boundary is done deep to the fascia, which is also incised. Below the fascia the sural nerve and vessels are found between both heads of the gastrocnemius muscles. They are both divided and ligated.



Figure 7.102. The fascia over both heads of the gastrocnemius muscle is incised deep to the muscle. At this stage it is safest to secure the cutaneous island to the fascia with some sutures in order to avoid accidental tearing.



Figure 7.103. Fascia is fully incised around the upper, medial and lateral borders of the skin paddle and elevation continues from proximal to distal.



Figure 7.104. Subfascial plane is completely safe and distal elevation of the flap is an easy and quick procedure. The pedicle is raised until the pivot point is reached (3 fingers width or 5 cm proximal to the lateral malleolus).



Figure 7.105. Flap can easily rotate to cover the entire calcaneus area. After the flap has been inset on the recipient area, the donor area is primarily repaired or skin grafted.



Figure 7.106. The pedicle is long enough for the flap to reach and cover defects on the lateral or anterior aspect of the ankle.

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