CHAPTER **21**

REVERSE SURAL FASCIOCUTANEOUS FLAP

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Chronic nonhealing Achilles tendon wounds pose a difficult and sometimes frustrating problem for both the physician and the patient. Limited mobility and blood supply to the integument over the Achilles tendon contribute to wound development and healing complications. In addition to the lack of blood supply, overall thickness of the tissue layers in the posterior ankle undermines the physician's ability to successfully treat skin breakdown or post-traumatic wounds in this area. Local island flaps have proven to be a reliable alternative to cover defects when conservative methods have failed including localized wound care, wound vac therapy, and synthetic grafts. The reverse sural fasciocutaneous flap offers the surgeon a straightforward procedure that minimizes donor-site morbidity and preserves the major arteries and nerves of the leg.

VASCULAR ANATOMY

In preparation for harvesting a fasciocutaneous flap, knowledge of the vascular anatomy is imperative. The major arteries of the leg have numerous arterial-arterial connections that allow for alternative routes of blood flow to develop when the direct route is disrupted or compromised. Understanding these vascular connections will help the surgeon in planning and will impact the overall success of the flap's survival.[1]

As the posterior tibial artery descends from the popliteal artery, it bifurcates forming the peroneal artery. This artery will continue distally along the medial course of the fibula creating the peroneal angiosome. Angiosomes, as outlined by Taylor, were defined as a three-dimensional anatomic unit of tissue fed by a source artery.[2] The peroneal artery angiosome extends laterally to the central raphe overlying the Achilles tendon and medially by the anterior edge of the lateral compartment. It supplies the muscles in the deep posterior compartment, the fibula, the lower lateral portion of the soleus muscle, the lateral half of the Achilles tendon, and the lower distal two-thirds of the peroneus longus and brevis muscles.[1] Peroneal perforating vessels stemming from the main artery branch off to supply the posterolateral skin of the leg. It is the network of perforators that help secure the survival of the flap as it is transferred.

The superficial sural artery, which also branches off of the posterior tibial artery, connects with the sural nerve in the proximal leg. The artery gives off branches to the tissue and skin along the course of the nerve as it continues distally to the foot. Even if the artery is not well defined along the course of the nerve (65%), the nerve is still enclosed in a vascular network of perforators from the sural artery (35%) that will ensure a true vascular axis along the course of the nerve.[3] In addition to this vascular network, peroneal artery septocutaneous perforators also anastomose with the superficial sural arterial network within the distal two-thirds of the leg.[3-5] Masquelet et al found that the close proximity between the deep vessel axis of the sural nerve and its corresponding peroneal and sural arteries accounts for the logic behind the transfer and subsequent survival of the flap.[3] In more understandable terms, based on this study, one can assume that the flap should maintain its viability due to the close proximity of the arterial and nervous supply to the flap. The venous network of the superficial sural vein, the short saphenous vein, and the associated veins of the peroneal artery provide the venous return for the flap.[6]

SURGICAL TECHNIQUE

Attention is directed to the posterior central third of the proximal leg where a skin island is created based on the dimensions and distance of the recipient site. The flap should be created slightly larger than the defect needing to be covered and when establishing the margins of the flap, it is vital to maintain enough overall length to prevent tension or kinking during rotation of the flap. Finally, the peroneal perforators and lesser saphenous vein need to be identified with Doppler ultrasonography prior to the start of dissection (Figure 1). Located superior to the lateral malleolus, the course of these vessels will influence the overall path of the pedicle and it is imperative to establish these vessels beforehand in order to preserve the major circulation and subsequent survival of the island flap.

The flap is fashioned in the shape of an ellipse with the distal aspect tapered into a teardrop design to aid in final closure (Figure 2). Dissection is begun proximally and carried down through to the deep fascial level until the sural nerve, artery, and lesser saphenous vein are identified. These

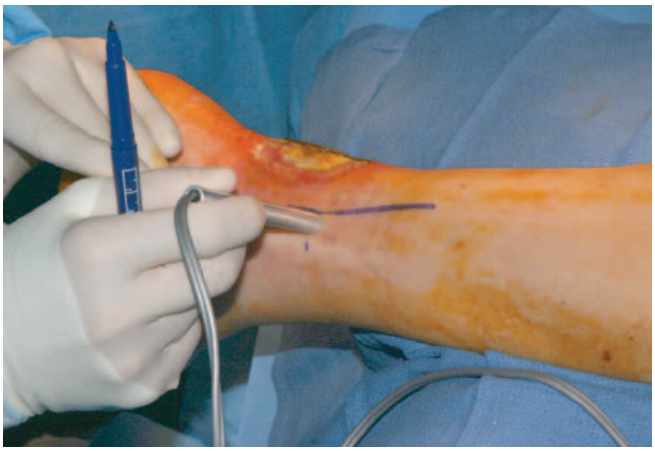

Figure 1.

Figure 2.

Figure 3.

Figure 4.

vessels are ligated and severed (Figure 3). At this point, the island flap including the skin, subcutaneous tissue, and the deep fascial tissues containing the neurovascular structures, are elevated off the surface of the gastrocnemius muscle bellies (Figures 4, 5). The pedicle is created as dissection continues distally, elevating these tissue layers as a single unit until the pivot point of the flap is reached (Figure 6). The pivot point is dependent upon the location of the recipient site and is roughly 5 to 8 cm above the lateral malleolus. The pedicle is approximately 2 to 3 cm in width once dissected freely from the surrounding tissues. Once the flap is mobile, it is repositioned distally and sutured to the recipient site with care to not kink the flap as it is folded back upon itself (Figures 7, 8). Depending on the location of the defect and to aid in preventing venous congestion, transfer of the flap can also be accomplished through a subcutaneous tunnel with the aid of soft-tissue expanders.[7]

The donor site is either primary closed or covered with a split-thickness skin graft that can be taken from the ipsilateral proximal calf (Figure 9). A non-adherent dressing followed by a well padded posterior splint is used to cover and protect the surgical site. The splint maintains stability to the lower extremity and allows for fast in-office dressing changes. The patient is maintained nonweight bearing 4 to 6 weeks until it is established that the flap has survived without any major complications and the surgical wounds have healed.

THE DELAY PHENOMENON

Once the island flap is created, it can either be transferred immediately or the transfer can be delayed to aid in acceptance of the flap at the recipient site, also known as the "Delay Phenomenon." This technique of vascular delay has been used by plastic surgeons for nearly 500 years and has proven useful for reliably transferring tissue.[8] The delay phenomenon is seen when a skin flap is partially devascularized in a staged procedure prior to its definitive placement, resulting in increased blood flow at the time of grafting.[8] It is still unclear how the delay phenomenon

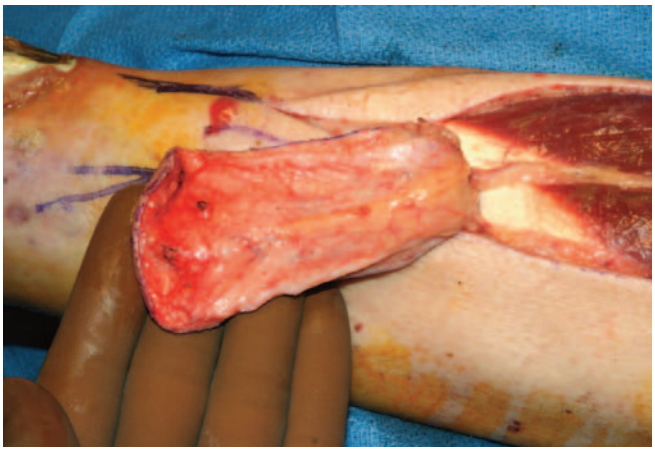

Figure 5.

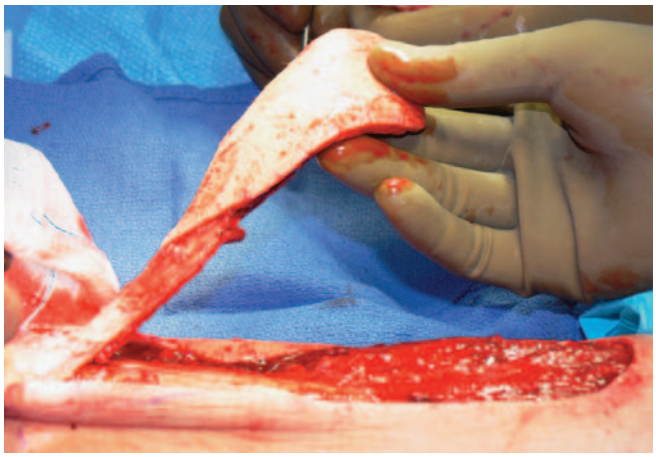

Figure 6.

Figure 7.

Figure 8.

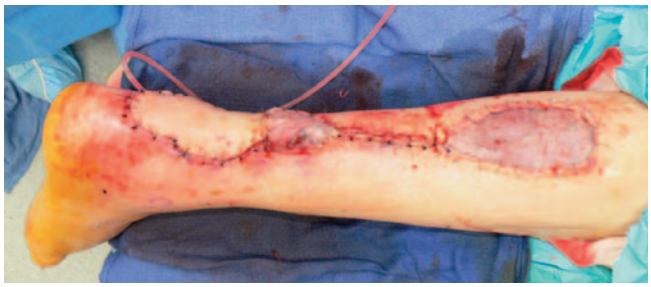

Figure 9.

works, however, various theories have been proposed including changes in metabolism, an increase in new blood vessel formation, and dilation and reorientation of choke vessels within the flap. Intrinsic in these theories is the concept that ischemia is able to act as the primary stimulus for vascular changes.[8]

COMPLICATIONS

Morbidity associated with transposition of the flap includes loss of sensation over the donor site and lateral foot, an unsightly scar, venous congestion, and the need for a split-thickness skin graft to cover the donor-site defect. Partial and total flap necrosis, a non-healing wound, and increased tissue loss are potential setbacks that can occur if the flap does not take. Patients with diabetes mellitus and evidence of peripheral vascular disease have a 5- to 6-time higher complication rate than patients without these comorbidities.[9]

SUMMARY

The reverse sural artery flap is a reliable alternative for treating small to moderate size defects of the lower tibia, ankle, and heel regions. The flap offers the surgeon a simple and fast procedure to cover extensive defects either secondary to trauma or when conservative methods have failed to close chronic non-healing wounds. The procedure allows for minimal donor-site morbidity, preserves the major arteries and nerves of the leg, and has limited aesthetic and functional sequalae.

REFERENCES

1. Attinger CE, et al Angiosomes of the foot and ankle and clinical implications for limb salvage: reconstruction, incisions, and revascularization. Plast Reconstr Surg 2006;117:261-93S.
2. Taylor GI, Palmer JH. The vascular territories (angiosomes) of the body: experimental study and clinical applications. Br J Plast Surg 1987;40:113-41.
3. Masquelet AC, Romana MC, Wolf G. Skin island flaps supplied by the vascular axis of the sensitive superficial nerves: anatomic study and clinical experience in the leg. Plast Reconstr Surg 1992;89:1115-21.
4. Rajacic N, et al. The distally based superficial sural flap for reconstruction of the lower leg and foot. Br J Plast Surg 1996;49:383-9.
5. Dolph JL. The superficial sural artery flap in distal lower third extremity reconstruction. Ann Plast Surg 1998;40:520-2.
6. Nakajima H, et al. Accompanying arteries of the cutaneous veins and cutaneous nerves in the extremities: anatomical study and a concept of the venoadipofascial and/or neuroadipofascial pedicled fasciocutaneous flap. Plast Reconstr Surg 1998;102:779-91.
7. Buluc L, et al. A modified technique for transposition of the reverse sural artery flap. Plast Reconstr Surg 2006;117:2488-92.
8. Ghali S, et al. Vascular delay revisited. Plast Reconstr Surg 2007;119:1735-44.
9. Baumeister SP, et al. A realistic complication analysis of 70 sural artery flaps in a multimorbid patient group. Plast Reconstr Surg 2003;112:129-40.