A reliable method for the treatment of lower third soft tissue defects of the leg: Use of a posterior tibial artery perforator flap

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ABSTRACT

Management of lower third limb defects is a common challenge for the reconstructive surgeon due to a lack of soft tissue in that anatomic area. Traditionally, lower third of the limb defects were usually reconstructed with free flaps. The evolution of reconstructive surgery enabled thinner and pliable flaps to be harvested for the purpose of minimizing morbidity from muscle inclusion into the flap. With the introduction of perforator flaps, repairing of small and medium size defects of the distal lower third of leg and ankle region is possible with minimal donor site morbidity. Perforator flaps are based on cutaneous, small diameter vessels that arise from a main pedicle that adjacently perforates the fascia to reach the skin. In this article, we present our experience with two cases involving the repair of these defects by using posterior tibial artery perforator flaps.

Key words: Perforator flaps, posterior tibial artery, propeller flaps, reconstruction

Introduction

Soft tissue reconstruction of the lower third of the leg is a difficult and challenging procedure. Due to the limited amount and low pliability of local tissue, even a small defect in this region may require microsurgical procedures. In this area, random pattern flaps are used that have limited pliability and size [1].

Traditionally, lower third of the limb defects are reconstructed with free flaps. However, with the evolution of reconstructive surgery, thinner and more pliable flaps are now able to be harvested, thus minimizing morbidity related to muscle incursion into the flap. Local fasciocutaneous flaps from adjacent tissue always require donor-site grafts, while the use of free flaps for the management of this area may lead to significant donor-site morbidity, which involves a time-consuming procedure requiring long-term hospitalization [2]. The propeller flap, first described in 1991 by Hyakusoku et al., is defined as an island flap with an axial rotation [3, 4]. The posterior tibial artery emerges and directly continues from the popliteal artery [5]. In this article, we present our experience with two cases involving the repair of these defects using posterior tibial artery perforator flaps.
Case Reports

Case 1: A 62-year-old diabetic female patient was admitted to our clinic with a soft tissue defect, 5 cm above her medial malleolus, six weeks after a tibia fracture. The reconstructive plate was also exposed. The size of the defect was 3.5 x 4.0 cm. After surgical debridement, the defect was repaired with a posterior tibial artery perforator flap. The follow-up period was six months and the patient was pleased with the cosmetic appearance of the flap and the concealment of the scar at the donor site (Figures 1a-c).

Case 2: A 56-year-old male patient presented to our clinic with a soft tissue defect resulting from a venous insufficiency in the left medial malleolar region. The size of the defect was 3.5 x 4.0 cm. Wound swab cultures revealed an infection from Staphylococcus epidermidis spp. The patient was treated for 14 days with Ciprofloxacin at 1000 mg twice a day, and after obtaining a negative swab culture, the patient underwent an operation with debridement and soft tissue reconstruction using a local propeller perforator flap that was harvested from a posterior tibial perforator vessel. The wound healed completely by the 21st day. The follow-up period was six months, and the result was aesthetically and functionally satisfactory (Figures 2a-b).

Surgical Technique

Pre-operatively, the posterior tibial artery perforators near the defect were identified and marked with the help of an 8 MHz hand-held Doppler. The flap was planned to be placed adjacent to the defect around the identified perforators. The patient was placed in the supine position and the leg was abducted and externally rotated. A tourniquet was inflated to allow the identification of the perforators, which became enlarged from the blood inside.

The surgical procedure was performed with the patient under epidural anaesthesia. Both flaps were harvested under loop magnification. The first incision was made along the inferior side of the flap and the flap was elevated on the same side. The dissection involved the...
subfacial plane. Once a suitable perforator was identified, the planned dimensions and shape of the flap were confirmed and adjusted according to the location of the perforator. After the selection of the best perforator, all of the other perforators were ligated. The dissection of the perforating artery and the concomitant veins should be of sufficient length to prevent a kinking of the vessels. The insetting of the flap was carried out using 3-0 ropilen sutures. In cases 1 and 2, transposition and propeller flaps, respectively, were used in the surgical procedures.

**Discussion**

The management of soft tissue defects in the lower third of the leg remains a challenging problem for reconstructive surgeons. There are a number of possible reconstruction choices, including random pattern flaps, fasciocutaneous flaps, reverse sural fasciocutaneous flaps and muscle flaps [6]. The distant reconstructive options for this area involve cross-leg flaps and free-tissue transfers [7]. The use of fasciocutaneous flaps for the repair of defects to the distal third of the leg are less preferred due to the requirement of a skin graft to the donor area and bulky dog ear. The major disadvantages associated with the free flap method are the long operative time required and the functional donor side morbidity. Furthermore, the free flap coverage of the soft issue defects necessitates a costly hospitalized microsurgical experience involving a two-team approach.

The units of muscle and soft tissue in this region are limited regarding coverage. Distally-based island flaps, such as peroneal artery and posterior tibial artery flaps, have been proposed [8]. However, these require the sacrifice of major arterial vessels from the lower leg. A reverse sural artery fasciocutaneous island flap elevation has no significant impact on the lower extremity perfusion, which makes it suitable for elderly patients; however, reverse sural artery neorocutaneous island flap coverage may result in numbness across the distribution area of the sural nerve [9]. The application of a posterior tibial artery perforator flap provides a good option for the coverage of defects, while preserving major arterial structures and underlying muscles.

The use of muscle flaps is also limited in this area due to the potential sacrifice of function [10]. Muscle flaps are considered to give better coverage in the case of an infected wound and for the reconstruction of resected osteomyelitic areas, but there is no significant difference in presenting eligibility [11]. The characteristic anatomy of the lower third of the leg is thin and fasciocutaneous, as there is limited underlying muscle. For this reason, repairing this area with free flaps and fasciocutaneous flaps may cause thick and bulky tissues, which may be aesthetically unsuitable for the distal lower third of the leg. Therefore, free flap or pedicled flap repairs using tissue from the more proximal anatomical region of the body are aesthetically and functionally unsuitable. In this regard, bulky tissue harvested from the thigh, such as anterolateral thigh free flaps, are thinned inadequately, and large-area, reverse sural flaps do not aesthetically fit the recipient area.

The free radial forearm flap, which is located in a similar anatomic region as the distal third of the leg, may be a better choice; however, lower leg reconstructions necessitate larger flaps and the donor site defect for a radial forearm might be aesthetically unpleasant.
Distal one-third leg defects are difficult to repair due to their distance from common pedicle muscle flaps. Lower third of the leg tissue defects, previously deemed suitable for only free flap repair, are now being reconstructed using perforator flaps from adjacent tissue. The reconstructed region is more aesthetically pleasing and donor site morbidity is minimized. The only drawback is that the harvesting of perforator flaps requires surgical concern and improved microsurgical ability and techniques.

Posterior tibial artery perforator flaps are a versatile option for lower third limb reconstruction, offering the following advantages:

1. Better skin color match, given the adjacency of the donor site;
2. Less time required for elevating flaps; and
3. The patient requires only regional anesthesia.

Small and moderately sized defects in this anatomical area can benefit from perforator flap applications. This technique is convenient, less time-consuming and results in minimal donor site morbidity due to the large skin islands that can be harvested from a single perforator vessel. In our view, despite the delicacy of the surgical technique, the good aesthetic and functional results associated with these flaps makes them an appropriate choice for treating the lower third leg area.

**Conflict of interest statement**

The authors have no conflicts of interest to declare.

**References**

1. Quaba O, Quaba A. Pedicled perforator flaps for the lower limb. Semin Plast Surg 2006;20:103-11.
2. Karki D, Narayan RP. The versatility of perforator-based propeller flap for reconstruction of distal leg and ankle defects. Plast Surg Int 2012;2012:303247.
3. Hyakusoku H, Orgill DP, Teot L, Pribaz JJ, Ogawa R (eds.) Color atlas burn reconstructive surgery. Springer, Dordrecht, 2010;442-51.
4. Hyakusoku H, Yamamoto T, Fumiiri M. The propeller flap method. Br J Plast Surg 1991;44:53-4.
5. Blondeel PN, Morris SF, Hallock GG, Neligan PC (eds.) Anatomy of integument of the lower extremity. In: Perforator flaps, Anatomy, Technique and Clinical Applications. Quality Medical Publishing, Baltimore, MD, 2006;542-77.
6. Akhtar S, Hameed A. Versatility of the sural fasciocutaneous flap in the coverage of lower third leg and hind foot defects. J Plast Reconstr Aesthet Surg 2006;59:839-45.
7. Ignatiadis IA, Georgakopoulos GD, Tsiampa VA, Polyzois VD, Arapoglou DK, Papalois AE. Distal posterior tibial artery perforator flaps for the management of calcaneal and achilles tendon injuries in diabetic and non-diabetic patients. Diabet Foot Ankle 2011;2.
8. Wee JTK. Reconstruction of the lower leg and foot with the reversed-pedicled anterior tibial flap: preliminary report of a new fasciocutaneous flap. Br J Plast Surg 1986;39:327-37.
9. Isenberg JS. The reversal sural artery neurocutaneous island flap in composite lower extremity wound reconstruction. J Foot Ankle Surg 2000;39:44-8.
10. Hallock GG. Lower extremity muscle perforator flaps for lower extremity reconstruction. Plast Reconstr Surg 2004;114:1123-30.
11. Yazar S, Lin CH, Lin YT, Ulusal AE, Wei FC. Outcome comparison between free muscle and free fasciocutaneous flaps for reconstruction of distal third and ankle traumatic open tibial fractures. Plast Reconstr Surg 2006;117:2468-75.