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Posterior tibial artery perforator flaps for coverage of Achilles region defects

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ABSTRACT

Background: Defects of the Achilles tendon region still represent a tricky issue in lower limb surgery. Among the several reconstructive possibilities, local propeller perforator flaps have gained popularity in the last decade.
Materials and methods: We report our experience with eight patients affected by small-to-moderate soft-tissue defects of the Achilles tendon region, who underwent surgical reconstruction with local flaps based on posterior tibial perforator branches.
Results: All patients healed successfully in terms of aesthetic and functional aspect. In only one case a transient venous congestion was observed and this resolved spontaneously.
Conclusions: Although the surgical technique requires much care and skill, including an extremely gentle dissection of perforator vessels, local propeller flaps should be considered the first-line choice for reconstruction in small-to-medium size soft-tissue defects in the Achilles region.

Introduction

Defects of the lower leg with exposed tendons or bones are still one of the most challenging areas in plastic and reconstructive surgery due to the paucity of reliable local cutaneous or muscle flaps [1]. In particular, even a small traumatic or a non-traumatic defect in the Achilles region traditionally requires free-tissue transfer. Thus, free flaps are often recommended as the treatment of choice, but they are relatively complex and require microsurgical expertise and prolonged operating time [2]. Furthermore, not all patients are willing or healthy enough to undergo free tissue transplantations. For these reasons, there is a constant search for reliable local alternatives in lower extremity reconstruction. Since the first description of the fasciocutaneous flap by Ponten in 1981 [3], several flaps have been described to cover skin and soft-tissue defects of the lower third of the leg [4,5]. Loco-regional flaps are often quick and easy to harvest, but the unpleasant bulky sight over the Achilles tendon poses a problem while wearing footwear, hence, they may require secondary debulking. In addition, these flaps are frequently associated with significant donor-site morbidity and poor cosmesis. Harvesting a local perforator flap provides a like-for-like tissue reconstruction in terms of colour, texture, and thickness without significant donor site morbidity. Although local perforator flap technique requires microsurgical dissection, it does not require vascular suturing and can thus be defined as a microsurgical non-microvascular flap, as reported by Georgescu et al. [6] Avoiding vascular sutures means the surgical act is quicker compared with microvascular flaps, and the pedicle can be skeletonised under magnification with a loupe rather than a microscope [7]. In 1982, Zhang et al. first described the reliability of flaps designed on the posterior tibial vessels [8]; subsequently, many authors [9,10] confirmed the safety of basing the flap distally, either on a septo- or musculocutaneous perforator from the posterior tibial artery [11]. The posterior tibial artery perforators are connected in an axial network, which enables the surgeon to raise large designed flaps that can inset into defects of different sizes and shapes [12]. In such settings, posterior tibial perforator flaps are the ideal solution for small-to-moderate soft-tissue defects in the Achilles tendon region.

We report our experience with eight patients affected by small-to-moderate soft-tissue defects of the Achilles tendon region, who underwent surgical reconstruction with local flaps based on posterior tibial perforator branches.

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Materials and methods

Patients

From February 2002 to June 2007, eight patients were admitted to our Department of Plastic and Reconstructive Surgery, I.R.C.C.S Policlinico San Donato, and eight posterior tibial artery perforator flaps were harvested as a primary surgical procedure for reconstruction of soft-tissue defects in the Achilles tendon region. All the patients were male, with a mean age of 46 years (range from 33 to 68 years). All cases were cutaneous dehiscences after subcutaneous tendon rupture repairs with exposure of the Achilles tendon. The average time from the original tendon repair to presentation at our department was 7 months. Angiography was performed before soft-tissue reconstruction in each patient to exclude vascular anomalies or pathologies. All patients were labelled as "vascularly normal". Two patients had the co-morbidity of diabetes mellitus and one was an occasional smoker. The length of the defects varied between 3 cm and 8 cm and the width between 1.5 cm and 4 cm (Table 1).

All cases were treated with debridement. In two out of eight patients, we performed an immediate reconstruction of the Achilles tendon region with a local perforator propeller flap, which was harvested from the posterior tibial artery. The remaining six patients had a local soft-tissue infection, which was efficaciously treated with a targeted antibiotic therapy (based on swab cultures). The presence and treatment of infection delayed the reconstructive phase for an average of 24 days (range 15–36 days). In all cases, the ankle was immobilised with a dorsal below-knee plaster splint in a neutral position of 100° for 3 weeks, followed by 3 weeks offloading mobilisation. After this last period, every patient started a full weight-bearing status without any assistant devices. Follow-up was 15–38 months.

Anatomy

The posterior tibial artery is the largest terminal branch of the popliteal artery. This artery supplies several perforators, each accompanied by two venae comitantes, predominantly septocutaneous, and arising from within two intermuscular septa, as described by Whetzel et al. [13]: one located between the soleus and flexor digitorum longus, and the other between the flexor digitorum muscle or tendon and the medial aspect of the tibia. The posterior tibial artery perforators are consistently the largest of the lower leg, particularly in the middle third of the leg. As studied by Tang et al. [14], the vascular territory (primary zone) of perforators supplied by the posterior tibial artery is 30 cm^2. In the distal zone, septocutaneous perforators of the posterior tibial and peroneal arteries form two longitudinal chains adjacent to the Achilles tendon. These chains anastomose superiorly with the perforators of the middle zone. Thus, a distally based pedicled large skin flap can be safely based on these septocutaneous perforators [15].

Surgical technique

The cutaneous perforators around the defect are identified and marked using a hand-held Doppler flow metre and the axis of the flap is marked in between the perforators. The patient is positioned prone. A pillow is placed under the opposite hip so that the medial aspect of the leg is better exposed. The surgical procedure is performed with the patient under epidural anaesthesia. A pneumatic tourniquet is cautiously placed around the thigh to prevent exceptional bleeding, but normally it is inactivated to enable the perforator pulsatility to be checked continuously. Meticulous homeostasis is achieved using a bipolar coagulator. After surgical excision of any necrotic or infected tissue, the size of the defect is revealed.

The exploratory initial incision is made on the part of the flap proximal to the defect. As a free flap is the alternative, the exploratory incision should be positioned to enable access to the recipient vessels, if possible.

The flap elevation is performed suprafascially, identifying and preserving the reliable perforators encountered. A number of potentially useful perforators are usually exposed. As D'Arpa et al. clearly say, once all the perforators are identified, the best one is chosen based on pulsatility, calibre, number and calibre of accompanying veins, proximity to the defect, subcutaneous course and orientation, and proximity to a sensory nerve [16]. Once the best perforator has been chosen, all of the other perforators are ligated. The perforating artery and the concomitant veins are gently dissected long enough to prevent kinking of the vessels when the flap is repositioned. When high rotations (more than 90–100°) are needed, the skeletonisation of the perforator or exposure of the posterior tibial artery is necessary to reduce the risk of kinking. All the fascial strands that may potentially cause vascular compromise through kinking of the vessels are dissected. The shape of the flap can then be re-evaluated and adjusted according to the location of the perforator. The remaining outline of the flap is then incised and the flap is undermined until it is completely islanded. The raised flap can now be rotated into the defect. When an angle of more than 120° is needed, the apposition of a polar safety stitch can be useful to reduce the risk of venous and arterial occlusion [17]. If there are any signs of kinking of the pedicle by any residual fascial strands, they might need further division. The insetting of the flap and wound closure are performed using 3-0 or

Table 1
Comorbidities, wound sizes and treatment timings.

Patients	Age (years)	Soft tissue defects dimensions (cm)	Comorbidities	Time between dehiscence after tendon suture and presentation at our department (months)	Details	Time between debridement and surgical reconstruction (days)
1	54	3 × 4	Diabetes mellitus	6	Soft-tissue infection	36
2	44	6 × 3		5		Immediate reconstruction
3	68	7 × 4		10	Soft-tissue infection	18
4	37	5 × 1.5		7	Soft-tissue infection	30
5	42	8 × 3	Diabetes mellitus	3	Soft-tissue infection	24
6	33	4 × 4	Occasional smoker	9		Immediate reconstruction
7	55	5 × 4		5	Soft-tissue infection	15
8	35	5 × 3.5		11	Soft-tissue infection	21