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# The Application Of the Distal Posterior Tibial Artery Perforator Flaps In Chronics Wounds

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## ABSTRACT

The reconstruction of lesions in the distal third of the leg is one of the challenges for surgeons. In this scenario, the use of posterior tibial perforator flaps is being used more and more in surgical practice due to their versatility and aesthetic results. This research consists of an integrative review carried out from a bibliographic survey in the PUBMED and Virtual Health Library (BVS) search platforms. After reading the full 20 articles in total, an overlap of four articles present in the two searches was observed, thus resulting in a total of 16 articles included in this review. The treatment of chronic lower limb wounds caused by infection, diabetes mellitus and osteomyelitis has always been a formidable task. Perforator-free flaps are generally recommended as the therapy of choice in the treatment of chronic lower limb wounds. The advantages of the application of the posterior tibial artery skin flap is ideal for small leg defects to reconstruct the exposed bone and tendon. As it is local tissue, it substitutes as tissue. The distal posterior tibial artery perforator flap is a beneficial technique, in the plastic and reconstructive surgery field, especially for the treatment of chronic lower extremity wounds.

**Keywords:** Chronic Wounds, Distal Posterial Tibial Artery, Perforator Flap, Plastic Surgery

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## INTRODUCTION

Lesions located in the leg can come from different etiologies, ranging from infectious, traumatic and neoplastic lesions. They are superficial or deep, with muscle and/or bone involvement. Depending on the evolution, etiology, type of lesion and the characteristics of the leg's anatomy, different reconstructions are proposed. In addition, the location and dimension of the lesion also affect the choice of the reconstruction technique.

The reconstruction of lesions in the distal third of the leg is one of the challenges for surgeons. Due to anatomical characteristics such as scarcity of soft tissue and thin skin, they pose difficulties in the treatment of soft tissue injuries in this location. Tissue injuries in these regions, caused by tumors or trauma, can lead to bone and/or tendon exposure, for whose coverage local or distant flaps are needed. The integuments of the leg, especially in its distal third, are restricted and little elastic, generally contraindicating dermoadipose flaps. In successful reconstruction, it is still important for the surgeon to individualize each wound and choose the initial procedure capable of providing the best chance of success and avoiding morbidity.

In this scenario, the use of posterior tibial perforator flaps is being used more and more in surgical practice due to their versatility and aesthetic results.

Reconstruction using the perforating flap technique began in 1989 using a skin flap from the inferior epigastric artery and without the rectus abdominis for the reconstruction of the floor of the mouth and groin defects, as described by Saint-Cyr and Schaverien (1). A perforating helix flap is defined as a flap with axial rotation (2). It can be rotated from an angle of 90° to 180°. Generally, it is not necessary to rotate beyond 180° as it can simply be rotated in the other direction. The direction of rotation depends on the angle between the long proximal axis of the flap and the defect (3). The posterior tibial artery perforators form three perforating vessels on the medial side of the leg, which may be located between 9 to 12 cm, 17 to 19 cm, and 22 to 24 cm from the tip of the medial malleolus.

In the past, few studies were carried out on the vascularization of the lower limbs, due to a lack of practical applications. Salmon (4), in 1936, published a book on the vascularization of the skin of the whole body, using contrast radiographs. This book, although frequently cited, has only recently had its value recognized due to the use of small-caliber vessel-based flaps. In 1973, Daniel & Williams (5) observed that the skin is vascularized through direct branches or muscle perforating branches. The foundations were laid for the musculocutaneous flaps that revolutionized plastic surgery in the last decade. Many other works have emerged adding new concepts and information.

## MATERIALS AND METHOD

This research consists of an integrative review carried out from a bibliographic survey in the PUBMED and Virtual Health Library (BVS) search platforms. For the search, the terms "distal posterior tibial arterial", "plastic surgery", "chronic wounds" and perforator flaps" were used. As a result, 153 publications were obtained in PUBMED and 142 in the BVS. The following inclusion criteria were established: time of publication in the last ten years, English language, primary studies. The exclusion criteria used were: studies outside the inclusion criteria, presence of other types of flaps in research, studies not available in full for free.

After selection, the results were compared, the differences in choice were discussed and the works for reading were selected. With this first analysis, the PUBMED platform returned a total of 37 results and the BVS returned 45 articles.

After reading the full 20 articles in total, an overlap of four articles present in the two searches was observed, thus resulting in a total of 16 articles included in this review.

## RESULTS AND DISCUSSION

### Anatomical Characteristics

The posterior tibial artery is the direct continuation of the popliteal artery and usually the dominant vessel of the trifurcation (6). It is accompanied by two comitant veins and through its path it provides two to four perforating veins, each accompanied by two comitant veins (venous perforators of the great saphenous vein) predominantly septocutaneous and arising from within two intermuscular septa: one between the soleus and the muscle flexor digitorum longus and the other between the flexor digitorum longus muscle or tendon and the medial aspect of the tibia (6, 7). Although most studies mention that the posterior tibial artery perforators emerge 4 to 26 cm from the intermalleolar line (8), some argue for different levels of emergence, concluding that patients have their own individual patterns (9).

The veins that accompany these arteries present anatomical variations (two, one or even none of the veins that accompany the artery), which is important for the initial survival of these flaps (10). The posterior tibial artery perforators are connected in an axial network, allowing the surgeon to elevate the large projected flaps that can be inserted into defects of different sizes and shapes (11).

### Surgical Technique

Preoperatively, posterior tibial artery perforators are identified and marked on the skin using a portable Doppler probe. The identification of surrounding perforators allows the surgeon to delineate the angiosome provided by a single perforator and the extension of its perfusion (12). The patient is placed in the supine position with the leg slightly abducted and externally rotated. A thigh tourniquet is used without completely exsanguinating the leg to facilitate the

identification of spikes during exploration. After surgical excision of any necrotic or infected tissue, the size of the defect is revealed. A potential tab is then drawn adjacent to the defect (13). The side of the flap closest to the defect is raised first in a subfascial plane and until at least one of the perforators is found. The shape of the flap can then be re-evaluated and adjusted according to the location of the perforator. The remaining contour of the flap is then incised and the flap is undermined until it is completely islanded. The perforating artery and concomitant veins are dissected directly or close to the posterior tibial artery, long enough to prevent the vessels from folding when the flap is repositioned (14). The raised tab can now be rotated around the punch in the default at an angle of 90° to 180°.

Hydration of the patient, elevation of the leg and maintenance of adequate blood pressure and temperature (to avoid spasm of the perforating artery) are essential for the first 48 hours after surgery (15).

Clinical monitoring of the flap to detect intrinsic vascularization problems (vasospasm) as well as extrinsic causes of perfusion impairment (hematoma, edema, and external pressure) is essential for patient success. This involves close monitoring of skin color, capillary refill, skin temperature and evidence of post-operative bleeding. The flap is monitored every hour during the first 24 hours and every 4 hours for the next 24 hours (16). The first skin graft dressing is usually placed on the 5th postoperative day and the flap sutures are removed on the 14th postoperative day.

**Use in Treatment of Chronic Diseases**

The treatment of chronic lower limb wounds caused by infection, diabetes mellitus and osteomyelitis has always been a formidable task. Perforator-free flaps are generally recommended as the therapy of choice in the treatment of chronic lower limb wounds.

Furthermore, they are time-consuming and require microsurgical expertise [7-9]. For these reasons, reliable local alternatives for the reconstruction of chronic lower limb wounds are currently needed. Thus, distal posterior tibial artery perforator flaps are probably a perfect choice.

**Contraindications of The Technique**

Contraindications for the application of the distal posterior tibial artery perforator flap include: suspected presence of a lesion or lesion of the posterior tibial artery. Furthermore, in our study, Gustilo and Anderson grade III-C lesions, the local soft tissue within the lesion zone, were excluded (15,16).

## DISCUSSION

The advantages of the application of the posterior tibial artery skin flap is ideal for small leg defects to reconstruct the exposed bone and tendon. As it is local tissue, it substitutes as

tissue. Flap harvesting requires a shorter operating time and therefore the flap is ideal for patients who are unfit for a lengthy procedure. Perforating flaps of the posterior tibial artery have also been used as regional flaps and as free flaps. Koshima and Soeda used posterior tibial punch flaps without sacrificing the main vessels. The flap is relatively thin and can be used to resurface defects in areas such as the hand and fingers that require thin tissue. Most perforators are septocutaneous, simplifying dissection. However, it has some disadvantages, the main one being: a donor area with a skin graft is when a large skin flap has a proximal or distal base. This leaves an unsatisfactory scar at the donor site. This can be avoided by using a helix flap or a V-Y advancement flap. Loss of sensation distally to the flap as the cutaneous nerve is included in the flap. And limited pedicle length when the flap is based on perforators only. This can be alleviated by including the posterior tibial artery with the flap. In conclusion, the distal posterior tibial artery perforator flap is a beneficial technique, in the plastic and reconstructive surgery field, especially for the treatment of chronic lower extremity wounds.

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