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Research Article **Open Access Journal**

Reconstruction through the Use of the Posterior Peroneum for Coverage of Defects of the Distal Third of the Leg

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Abstract:
The lower limb has objectives such as support, stability and power that allows the human being mobility and ability to perform different movements. The fibula and tibia, being the bones that make up the lower limb, can present injuries or wounds that prevent these actions, whether due to accidents, trauma, ulcers, injuries secondary to fractures, therefore, the use of flaps has been considered an alternative in lower limb reconstruction. The posterior fibular flap, given its anatomical characteristics, irrigates a larger area, which allows it to be widely used in the reconstruction of defects in the distal third of the leg, especially in the ankle and heel. Therefore, in the following review article we focus on the application of the posterior fibular flap in the coverage of the distal third of the leg and its usefulness for the reconstruction of said wounds.

Key words: Distal third of the leg, reconstruction, peroneal, lower extremity, flaps.

Introduction

In relation to the lower limb or extremity, it is characterized by similarities with the upper limb. However, the function of the lower limb is focused on standing, while the upper limb is intended for grasping and expression (1). Therefore, the anatomical characteristics make the lower limb have the objective of support, stability and power, at the expense of losing mobility and delicacy when performing the different movements (2) as can be seen in table 1.

Superior member	Lower member
Predominance of mobility	Stability dominance
Root not congruent, heterogeneous	Congruent, homogeneous root
Fragile but wide distal rotation	Robust but limited distal rotation
Extreme with opposition	Extreme unopposed
Suspended work	Work in compression
Open chain work	Closed chain work
Work in concentric mode	Work in eccentric mode (braking)
Low collagen rate	High collagen rate
Bones of modest size	Bones of considerable size
Short heel end	Long heel end
Long fingers	Short fingers
Movable waist	Fixed waist
Wide and fine distal rotations	Reduced and elementary distal rotations
Absence of a «pivot» ligament system	Ligament systems «pivots»
Modest muscle volumes	Considerable muscle volumes
Muscles with scant venous role	Muscles with significant venous role
Wide cortical representation	Poor cortical representation
Two limbs with independent activity	Two limbs with symmetrical alternating activity

Taken from: Dufour, M. Anatomy of the lower limb. EMC- Podiatry. 2012; 14 (4) : 1-12.

The fibula and tibia are the two long bones that make up the lower leg, located parallel to each other. In the case of the tibia, it is characterized by being the thickest bone in the leg, receiving support from the femur and transmitting it to the foot. It is divided into three parts: the diaphysis has a subcutaneous median facet, in the upper part of which is inserted into the pes anserine (sartorius, semitendinosus and gracilis), a lateral facet for the insertion of the tibialis anterior and a posterior facet for the muscle popliteus, then the linear insertion of the soleus and then inferiorly, for two medial retromalleolar muscles. While the proximal end has a superior face, where the two femoral condyles are supported, separated by an intercondylar area. In the posterolateral part, there is a facet for the head of the fibula and in the medial part the semimembranosus is inserted and in its distal end it presents an inferior surface for the talus, a medial prominence of tibial malleolus and a surface without hyaline cartilage for the fibula. (3).

Unlike the fibula, which is a very thin bone and is arranged against the tibia, slightly separating its distal end like a clamp. It is divided into 3 parts: the diaphysis has a face in the anterior compartment of the leg and fingers, a face in the lateral compartment, in which the peroneus longus and brevis are inserted, and finally a lateral face in the which inserts the soleus and then a portion of the tibialis posterior and the flexor hallucis longus. Likewise, the fibula has a proximal and distal end (3).

Now, the traumas presented in the lower extremity are caused by open injuries in the tibia and in the white tissue, caused by motorcycle or car accidents and that generally require surgical procedures. Fractures such as the tibia are the most common long bone fractures in the body (4). According to the Gustilo classification, as seen in Table 2, it is considered the most widely accepted method for classifying open fractures and different grades have been assigned to it.

Table 2. GUSTILO GRADING SYSTEM FOR OPEN FRACTURES OF THE LOWER EXTREMITY

Gustilo grades	Default Description
Grade I	Open wound smaller than 1 cm2; Simple bone fracture with minimal crushing.
Grade II	1 to 10 cm2 wound, no major soft tissue damage; minimal destruction; moderate crushing and contamination
Grade III	Wounds greater than 10 cm2, with great damage to the tissue, making it difficult to cover exposed bone or osteosynthesis elements; bone crushing. Divided into 3 subgroups:
Grade IIIA	Enough soft tissue to cover bone.
Grade IIIB	Great damage to the tissue with separation of the periosteal (periosteal stripping), making local soft tissue coverage insufficient; need for flap closure
Grade IIIC	Grade IIIB injuries with major vascular damage requiring repair

Taken from: Parret, B, Pribaz, J. Lower extremity reconstruction. Med Clin Condes. 2010; 21(1):76-85.

However, traumatic injuries to the leg and foot, combined with the exposure of vital structures, remain a highly complex problem for any highly experienced reconstructive surgeon (5). Injuries to these areas account for the highest rate of complications due to the subcutaneous position of the tibia and foot bones combined with lack of skin laxity and poor muscle coverage (6). In addition, the blood supply is not adequate due to trauma or peripheral vascular disease (7). Studies of the vessels and microcirculation in the leg and foot allow reconstruction of the angiosomes (8). Therefore, it allows the design of different flaps such as the posterior tibial artery perforator, which is used to cover the posteromedial part of the distal third of the leg (9). The peroneal artery perforator flap is used to cover the posterolateral part of the distal third of the leg (10). The sural flap is used to cover the heel area, the blood supply is supplied by the vasa nervorum along the sural nerve which is accompanied by the small saphenous vein. The pivot point is about 5 cm above the tip of the lateral malleolus (11). The medial plantar artery flap is used to cover the plantar surface of the foot and the heel (12).

Therefore, the recent popularization of microsurgery has rapidly increased the areas to which flap surgery is allowed to be applied. Reconstruction using microsurgery, or free flap surgery, is becoming more and more common and has become an important area of reconstructive surgery. To comply with a good procedure, it is important to choose a suitable donor site and cover the defect completely (13). As a donor site,

the fibular flap was used primarily to graft the vascularized fibula, and a skin flap served only as a skin paddle or buoy that allows blood circulation. Peroneal flap surgery remains an important method of vascularized bone grafting (14).

The defects in the use of the fibular flap include pressure ulcers, skin and non-healing tissue, chronic venous ulcers, soft tissue injury secondary to open fractures and trauma, chronic osteomyelitis, deep burns, unstable scars and coverage of oncological resections (15). The posterior peroneal flap is characterized by being a fasciocutaneous flap whose main arterial source is the perforating vessels of the peroneal artery and secondary sources by perforating vessels of the posterior tibial artery, and as venous drainage the venocutene perforators of the lesser saphenous vein and perforators of the sural nerve (16).

The distally-based sural fasciomusculocutaneous flap includes a cuff of the gastrocnemius muscle together with the sural nerve, and can preserve the retrograde blood supply from the median superficial sural artery of the sural nerve to the musculocutaneous perforators of the gastrocnemius muscle over this critical region (17). This flap has been very useful in patients with diabetes (18). The fibular artery perforator flap according to an anatomical study of the fibular flap showed that it was more adaptable because it supplies a larger area and has a constant supply of arterial blood (19). The distally based posterior tibial artery perforator flap is perfused by septal cutaneous perforators that supply the adjacent deep fascia, adipose tissue, and cutaneous tissues medially and posteriorly (20). The evolution of the posterior tibial artery flap, to include the saphenous vein and nerve and its suprafascial axial vascular network, allows for greater transposition and larger dimensions of the flap. The saphenous neurovascular bundle is a robust vascular plexus irrigated by 11 different arterial sources (21). By including this axial supply, in combination with the distal posterior tibial artery perforators, a 4:1 length-to-width ratio has been shown to be reliably successful in increasing fasciocutaneous flap size for the distal leg (22).

Methodology

In this review article, a detailed bibliographic search of information published since 2010 was carried out in the databases PubMed, Elsevier, Scielo, national and international libraries. We use the following descriptors: distal third of the leg, reconstruction, peroneal, lower extremity, flaps. The data obtained ranges from 2 to 15 records after the use of the keywords. The search for articles was conducted in Spanish and English, limited by year of publication, and studies published since 2010 were used.

Results

Rad & et al in their clinical case report describe a 40-year-old patient who was referred for definitive treatment of a posterolateral digital papillary adenocarcinoma of the left ankle. The patient had noted an asymptomatic black growth measuring 1 inch in size and gradually increasing in size over several months. Clinical examination revealed a well-healed transverse posterolateral ankle scar measuring 2.5 cm in length, with normal posterior tibial and dorsalis pedis pulses. Due to the proximity to the Achilles tendon and possible exposure, the use of a free flap for coverage was considered necessary. The 1808-based peroneal artery perforator helix flap was chosen because it was a one-stage operation (i.e., not delayed), provides an ideal tissue match, had minimal donor site morbidity and it seemed like a simple and elegant solution. Using a Doppler probe, a robust peroneal artery perforator was identified 8 cm proximal to the upper edge of the wound and they designed a flap that extended 14 cm proximal to the perforator so that the more proximal aspect could be rotated to achieve the more proximal aspect. distal to the wound. Therefore, the flap itself measured 223.8 cm. The perforator was designed using the principles of dissecting the perforator flap through a few fibers of the flexor hallucis longus muscle around the fibula to its origin on the peroneal artery. The patient was discharged home without complications on the fifth postoperative day (23).

In another case report, given by Chen & et al, they expose a group of 55 patients in which 3 of them stand out. The use of the peroneal artery perforator flap was the choice for the procedure. The first patient, a 50-year-old woman, suffered a soft tissue defect around the ankle joint due to a traffic accident. After radical debridement, she had a peroneal artery perforator flap measuring approximately 20 cm × 7 cm elevated from the ipsilateral lower leg. Subsequently, the flap was inserted into the defect at 150 degrees depending

on the pivot of the perforator. The donor site was closed by combining the split-thickness skin graft. Postoperative recovery was uneventful; the flap survived completely. A satisfactory result was obtained at one year of follow-up. The other patients, 38 and 46 years old, respectively, were successful in their procedures and were satisfied with the results (24).

Discussion

Reconstruction of soft tissue defects overlying the lower extremities remains a major challenge, as this region is often associated with exposed tendons or bones and metal fixation of fractures. Wound healing is a delayed process due to lack of adequate white tissue coverage and decreased distal perfusion of the lower limbs. Since the construction of free-style perforators and the perophorasome theory were proposed, the use of local flaps has increased (25). With the recent progress in drilling techniques, attention is turning to better methods of reconstruction. The peroneal artery perforator flap is a promising option for lower limb reconstruction, especially for those defects that occur in the ankle and heel (26). Therefore, it is an excellent option to treat defects of the distal third of the leg in young and adult patients without comorbidities because it has a very high survival rate with minimal postoperative complications (27). To organize the reconstruction of the lower limbs, a series of elements must be considered, including the size of the defect and the exposed structures, the vascular condition of the neighboring tissue, the vascular anatomy of the limb, and the length of the vascular pedicle that is required (28). . The helix flap, based on the peroneal artery perforator, is indicated for coverage of defects in the lateral region of the distal leg, ankle and heel (180° rotation). This flap can be rotated up to 180º and it is feasible to obtain a large island of skin from a single perforator vessel, because the perforator vessels of the peroneal artery have an adequate caliber and there are multiple axial communications between them (29). . Currently, perforator-based helix flaps play a key role in the reconstruction of lower extremity coverage defects. Different cases illustrate the advantages of this technique, providing an adequate result of form and function, since flaps are an alternative of choice for coverage of small or medium-sized defects in the leg, if the vascular conditions of the neighboring tissue are found. under suitable conditions (30).

Conclusion

The posterior fibular flap has become an alternative that allows the coverage of distal lesions or of the lower third of the leg and in the proximal region of the foot, which fulfills its desired effect in those wounds such as pressure ulcers, soft tissue injuries secondary to fractures, among others, allowing the patient a reconstruction of the affected area that gives him the protective sensitivity that allows him to withstand pressure, greater stability in his lower limb, supporting adequate displacement and avoiding future injuries. Therefore, to achieve this objective, the posterior fibular flap must comply with the monitoring of certain elements that include vascular and anatomical aspects.

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