Reconstruction of complex lesions of the lower limbs with reverse fasciocutaneous flaps

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Introduction: Complex lesions on the lower limbs have always been challenging because of their difficult resolution. Microsurgical free flaps have been an excellent surgical option; however, they have limited use because there are an insufficient number of clinicians trained in such structured services. Fasciocutaneous flaps, specifically reverse flow, have been shown to be an excellent option in treating lower limb injuries as an alternative to complex microsurgical free flaps.

Methods: From January 2012 to June 2015, nine patients underwent reconstruction of the lower limbs with reverse fasciocutaneous flaps. All had extensive lesions on these limbs. Results: In eight patients, the results were satisfactory, and there were no major complications. In one patient, there was total necrosis of the flap. Conclusion: Because of the relative technical simplicity of performing such a technique, fasciocutaneous flaps are a viable option for the reconstruction of complex wounds of the lower limbs and are an additional therapeutic option for patients with these lesions.

ABSTRACT

Keywords: Surgical Procedures; Reconstructive surgical flaps; Lower extremity; Microsurgery.

■ ABSTRACT

Introduction: Lesões extensas em membros inferiores sempre foram desafiadoras devido a sua difícil resolução. Retalhos livres microcirúrgicos se mostraram como excelente opção cirúrgica, todavia, por carecer de equipe capacitada e serviços estruturados, têm seu uso restrito. Os retalhos fasciocutâneos, especificamente os de fluxo reverso, têm se mostrado excelente opção na abordagem de lesões de membros inferiores, numa alternativa aos complexos retalhos livres microcirúrgicos. Métodos: De janeiro de 2012 a junho de 2015, nove pacientes foram submetidos à reconstrução de membros inferiores com retalhos reversos fasciocutâneos. Todos eram portadores de lesões extensas nos referidos membros. Resultados: Em oito pacientes o resultado foi satisfatório, sem complicações maiores. Em um paciente houve necrose total do retalho. Conclusão: Pela sua relativa simplicidade técnica, os retalhos fasciocutâneos de fluxo reverso vêm se consolidando como opção bastante viável na reconstrução de feridas complexas dos membros inferiores, sendo mais uma opção terapêutica para os pacientes portadores destas lesões.

Keywords: Procedimentos cirúrgicos reconstrutivos; Retalhos cirúrgicos; Extremidade inferior; Microcirurgia.

RESUMO

Descritores: Procedimentos cirúrgicos reconstrutivos; Retalhos cirúrgicos; Extremidade inferior; Microcirurgia.
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INTRODUCTION

Complex injuries of the lower extremities, particularly of the feet and distal region of the leg, are increasingly common, mainly due to the growing number of motorcycle accidents\(^5\). The reconstruction of tissue, damaged by these lesions, is essential for the rehabilitation of the patients, bearing in mind that the exposure of tendons, bones, or neurovascular bundles can compromise the viability of these structures\(^2\).

For years, free flaps have been excellent therapeutic options for reconstructing complex injuries in the distal region of lower limbs\(^3\). However, the lack of skilled teams and structured services for such procedures hampers their routine use.

With the publication by Pontén\(^4\) in 1981 and by Masquelet\(^6\) in 1992, new technical options were disseminated, including the use of pedicled flaps, for the reconstruction of these injuries. Accordingly, fasciocutaneous flaps gained prominence and are currently commonly used in the reconstruction of tissues, damaged by these injuries\(^5-12\).

This type of injury continues to challenge plastic surgeons, with the scarcity of available local tissue to reconstruct the distal region of the lower limb being a major difficulty for such repairs.

The present study describes and discusses the technical options employed in the Plastic Surgery Department of the Hospital das Clínicas, Federal University of Pernambuco (HC-UFPE), in Recife, Pernambuco, using reverse fasciocutaneous flaps for the reconstruction of tissues, damaged by complex lesions of the foot and distal region of the leg.

OBJECTIVE

To describe a series of patients with lesions of the foot and distal region of the leg where reconstruction was performed with different fasciocutaneous flaps.

METHODS

All patients with complex lesions in the foot and distal region of the leg, with exposure of noble structures, and reconstructed with reverse fasciocutaneous flaps were enrolled in the study.

The records and photos of nine patients undergoing this type of reconstruction were analyzed retrospectively.

Eight male patients and one female patient underwent operation at the Department of Plastic Surgery of HC-UFPE between 2012 and 2015. The operations were performed by three plastic surgeons of the service.

Three flaps were used in reconstructions: reverse sural flap, lateral supramalleolar flap and posterior leg flap. These flaps are briefly described below.

RESULTS

Eight male patients and one female patient underwent surgery in this series. Their ages ranged from 22 to 66 years, with an average of 38.5 years.

The average size of the lesions was 27.2 cm\(^2\), ranging from 16 cm\(^2\) to 48 cm\(^2\).

Eight reconstructions were successful, with one minor complication. One case with distal epidermolysis was conducted on an outpatient basis, without generating any impairment to the viability of the flap.

Reverse Sural flap

A skin island was planned on the posterior surface of the leg, between the medial and lateral portions of the gastrocnemius muscle. The height was determined by the distance between the pivot point, 5 cm above the lateral malleolus, and the most distal part to the injury. Incisions were initiated on the top edge of the flap, which continues until the deep fascia, which should compose the flap. The flap was detached from the proximal portion to the distal portion, with the minor saphenous vein and medial sural nerve being identified during dissection and included in the flap\(^3,9\).

Lateral Supramalleolar flap

This flap must be prepared with a pivot point 5 cm from the lateral malleolus, where the perforating branch of the fibular artery penetrates the interosseous membrane\(^10\). During the marking, the anterior and posterior limits of the flap are the tendon of the tibialis anterior muscle and the medial aspect of the fibula, respectively. The flap was dissected in the subfascial plane while maintaining the integrity of the superficial fibular nerve.

Posterior calf flap

This is a bidepicipular flap, with a pivot point located about 10 cm above the medial malleolus, and about 12 cm above the lateral malleolus\(^11,12\). The skin island was planned on the posterior surface of the leg. The incision was initiated at the upper border of the flap, dissecting the subfascial plane to the pivot point, which was the site of concentration of septal cutaneous vessels of the flap (medially, perforators of the posterior tibial artery, and, laterally, perforators of the fibular artery). During dissection, the medial sural nerve and the saphenous vein were visualized and sectioned. These structures were maintained in the flap.

The pedicle of the flaps was sectioned on the third or fourth postoperative week, where it could then be resutured to the donor area and grafted at the time of surgery.
Figures 1 and 2 show the intraoperative planning steps involving in creating a reverse sural flap and the late result of 5 months reconstruction of a neoplasm lesion.

**Figure 1.** Oncologic wound in the medial calcaneal region and reverse sural flap planning.

**Figure 2.** Five months postoperative outcome of reverse sural flap.

Figures 3, 4, and 5 show the reconstruction of a chronic injury on the dorsum of the foot using the lateral supramalleolar flap. Note a slight distal epidermolysis on the flap.

**Figure 3.** Chronic wound on the dorsum of the foot and dissected supramalleolar flap.

**Figure 4.** Intermediate time of lateral supramalleolar flap showing slight distal epidermolysis.

**Figure 5.** Postoperative result 30 days after grafting of donor area.

As shown in Figure 6, which shows the planning involved in creating a posterior leg flap, an initial shorter marking and a subsequent longer marking are used to improve the suitability of the flap for transposition without tension. Figures 7 and 8 show the result before the section of the pedicle and the result 6 months later.

There was one case that evolved into total necrosis of the flap, which was treated with debridement, wound dressings, and skin grafting, after tissue granulation of the base of the lesion 67 days after debridement.

The characteristics of patients and reconstructions are presented in Table 1.

**DISCUSSION**

Treatment of complex lesions of the foot and distal region of the leg is difficult and prolonged, often requiring multiple surgeries and a multidisciplinary team. An early and efficient approach can prevent functional sequelae to the affected limb.
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Advantageous in infected wounds, with osteomyelitis or delayed bone healing, due to its abundant vascularization and easier filling of dead spaces. However, it has the drawback of requiring experienced staff, adequate equipment, and longer surgical time. The Plastic Surgery Service of the HC-UFPE performs such procedures in selected cases; however, currently, in the majority of cases, it has opted for fasciocutaneous flaps.

The circulation of fasciocutaneous flaps of the lower limbs is based on myocutaneous perforators: the fasciocutaneous arteries and the arteries from the intermuscular septa. Among these, flaps of the reverse flow type have gained greater relevance, since they are a good option in the reconstruction of the distal region of the lower limbs.

The vascular pedicle of these flaps derives from the septocutaneous perforating vessels that arise from the fibular and posterior tibial arteries. The posterior tibial artery, through its perforating vessels, dominates the posteromedial portion of the distal third of the leg. While the fibular artery, through its septocutaneous branches, dominates the posterolateral side.

Considering the anatomical axis of the main vessels of the leg, one can empirically plan the longitudinal axis of the flap. The perforator closest to the margin of the lesion should be chosen to be the pivot point, since the position of the latter will define the final length of the flap. These perforating arteries are more likely to be located in a region four to seven centimeters above the malleolus, being the ideal pivot point for rotating the flap.

Some studies mention the use of Doppler ultrasound for vascular mapping and identification of perforating branches of the main arteries. This examination was not conducted in the surgical procedures presented in this study.

The Reverse Sural flap, described by Donski and Fogdestam in 1983, is widely used for reconstruction of the soft tissues of the lower third of the leg and foot. Moderate to large defects can be covered with this flap. This flap has a wide rotation arc, compared with other regional flaps, and does not require the sacrifice of any essential vascular trunk for its preparation since its vascular supply arises from perforating branches of the common fibular artery. Its pivot point is located about 5.0 cm superior and laterally to the lateral malleolus.

El-Shazly and Yassin recommend fixing a pivot point about 7 cm above the lateral malleolus to provide greater vascular safety for the flap. However, most studies still recommend a pivot point of 5 cm above the lateral malleolus.

The flap used in the series by Chang et al. had dimensions of 25 cm x 10 cm (H x W). In our series, the largest flap was 21 cm x 7 cm.

Free flaps are an excellent option for reconstruction of extensive foot lesions in order to provide abundant and richly vascularized tissue. The use of free flaps is...
The presence of the vein is crucial to decreasing the chance of venous congestion. To cover the donor area, skin grafting may be used. It is important that this flap is not subjected to pressure or other mechanical forces, so as not to compromise the viability of the flap.

The lateral supramalleolar flap, as well as the reverse sural flap, also provides good coverage for lesions in the distal third of the leg and foot. Its vascularization is based on the anastomosis of the arterial arcade around the ankle with perforating branches of the fibular artery, which emerge from the interosseous membrane approximately 5 cm from the lateral malleolus. This anastomosis emits cutaneous branches at this point that anastomose with the plexus that accompanies the superficial fibular nerve, which, in turn, constitutes the septocutaneous territory of the anterior tibial artery. Venous congestion is more common in this flap given that it does not carry any major vein, which contributes to venous drainage of the flap. This venous flow is obtained by valve insufficiency through the pressure gradient itself, the communicating capillary, and the collateral veins.

In our series, this flap was used in a patient with a lesion located on the dorsum of their foot. We believe that this flap is quite satisfactory in the reconstruction of small to moderate lesions in the anterior or posterior region of the distal third of the leg and in the dorsal region of the foot because it is an easily reproducible option that involves an easy anatomical dissection that does not interfere in the possible construction of other flaps.

The posterior fasciocutaneous leg flap, unlike previous flaps, has a higher pivot point in relation to the malleolus (10 cm from the medial malleolus and 12 cm from the lateral malleolus). This flap, initially described by Monteiro Júnior et al., associates concepts described by Donski and Fodgestan, who, in 1983, described a similar flap that was based only on septocutaneous vessels originating from the fibular artery, with the flap based on septocutaneous vessels of the posterior tibial artery, as described by Amarante et al. in 1986. Given that it is a bipediculate flap, greater circulatory safety is guaranteed. It further enables the possible use of longer flaps that are capable of covering defects in the more distal topography of the lower limb in patients with comorbidities.

As shown in the diagram, detailing flap planning, an initial marking that is smaller in length and a subsequent, longer marking provides greater convenience for transposition of the flap without tension. It is always important that the flap be slightly longer than is required. All of these flaps described herein have constant vascularization and are safe for vascular supply. Even rotations of up to 180 degrees appear not to affect their vascular viability.

The clinical condition of the patients interferes in the viability of the flap, particularly in the viability of the reverse sural flap. Comorbidities, such as hypertension, diabetes mellitus, peripheral arterial occlusive diseases, advanced age and obesity, are the main risk factors for failure with reverse flaps.

There is still no consensus in the literature regarding which flap type would be the most appropriate for a particular type of defect or location of the lesion. The surgeon’s experience is important in choosing the type of flap.

Total necrosis of the flap in the posterior region in this series increased the risk of major complication development (11%). This necrosis occurred in the older patient from this series. This patient was 66 years old and smoked regularly. These factors may have contributed to the failure of the surgery.

Although the use of reverse fasciocutaneous flaps is well established in the literature, their use to treat...
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In the patients reported in this series, the reverse flaps of the lower limbs were shown to be an excellent option for the reconstruction of complex foot and distal leg lesions.

COLLABORATIONS

RA Analysis and/or interpretation of data; final approval of the manuscript; conception and design of the study; completion of operations and/or experiments; drafting the manuscript or critical review of its contents.

FAMAB Analysis and/or interpretation of data; final approval of the manuscript; conception and design of the study; completion of operations and/or experiments; drafting the manuscript or critical review of its contents.

JZS Completion of operations and/or experiments; drafting the manuscript or critical review of its contents.

ACCRB Completion of operations and/or experiments; drafting the manuscript or critical review of its contents.

GTS Analysis and/or interpretation of data; completion of operations and/or experiments.

REFERENCES


24. Wee JT. Reconstruction of the lower leg and foot with the reverse-pedicled anterior tibial flap: preliminary report of a new

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