

REVERSE SURAL FLAP FOR LOWER LIMB RECONSTRUCTION

RETALHO SURAL REVERSO NA RECONSTRUÇÃO DE MEMBROS INFERIORES

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ABSTRACT

Introduction: Reconstruction of distal wounds in lower extremities can be challenging due to the lack of tissue to perform local flaps. Fasciocutaneous and muscular flaps are some options for coverage, such as the reverse-flow fasciocutaneous sural flap. **Objective:** To present an 18-month experience on ankle, calcaneus, and foot reconstruction using the reverse-flow sural flap, performed by the Complex Wounds Group of the Plastic Surgery Department of the University of São Paulo Medical School. **Methods:** An observational, retrospective and descriptive study was performed through data survey on medical records of all patients treated between November 2018 and June 2020. **Results:** Nine reverse-flow fasciocutaneous sural flaps were performed. All patients were men. The mean age was 38 years old. Five patients had acute wounds for traffic collision, one electrical trauma and three chronic post-traumatic injuries. The ankle was the most common injury site (6), followed by foot (2) and calcaneus (1). Four patients had complications, three of which were partial necrosis and one distal epitheliosis. No case of total necrosis was recorded. The average hospital stay was 30.1 days. **Conclusion:** The reverse-flow fasciocutaneous sural flap proved to be a viable, reproducible, and reliable option for distal lower limb reconstruction. **Level of Evidence IV, Case Series.**

Keywords: Wounds and Injuries. Lower Extremity. Surgical Flaps. Leg Injuries. Plastic Surgery.

RESUMO

Introdução: Reconstrução de lesões distais de extremidades inferiores podem ser desafiadoras devido à limitação de tecido para retalhos locais. Retalhos fasciocutâneos e musculares são opções, como o retalho fasciocutâneo sural reverso. **Objetivo:** Apresentar a experiência de 18 meses do Grupo de Feridas Complexas do Serviço de Cirurgia Plástica da Faculdade de Medicina da Universidade de São Paulo no uso do retalho sural reverso para reconstruções de defeitos em tornozelo, calcâneo e pé. **Métodos:** Estudo observacional, retrospectivo e descritivo, com dados de prontuário de todos os casos operados no serviço entre novembro de 2018 e junho de 2020. **Resultados:** Foram realizados nove retalhos fasciocutâneos sural reverso. Todos os pacientes eram do sexo masculino, com idade média de 38 anos. Cinco foram vítimas de acidente automobilístico, um de trauma elétrico e três apresentavam sequelas pós-traumáticas. Seis lesões localizadas em tornozelo, dois em pé e um em calcâneo. Quatro pacientes apresentaram complicações, sendo três necroses parciais e uma epiteliólise distal. Não houve perda total de retalho. O tempo médio de hospitalização foi de 30,1 dias. **Conclusão:** O retalho fasciocutâneo sural reverso mostrou-se uma opção viável, reproduzível e segura para reconstrução de lesões complexas em terço distal de perna e pé. **Nível de Evidência IV, Série de Casos.**

Descritores: Ferimentos e Lesões. Extremidade Inferior. Retalhos Cirúrgicos. Traumatismos da Perna. Cirurgia Plástica.

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INTRODUCTION

The reconstruction of distal lower limb injuries may be challenging due to the lack of tissue for local flaps, and deficient vascularization in trauma or arteriopathy situations.¹ Muscle flaps for this region are restricted in use, as they are more used for the reconstruction of defects in the proximal and middle thirds of

the leg.² Microsurgical flaps are excellent alternatives, but their surgery is difficult and requires a qualified team, sophisticated equipment, and tertiary hospital centers. Cutaneous and fasciocutaneous flaps with distal pedicle are another alternative to be considered.³

All authors declare no potential conflict of interest related to this article.

The study was conducted at Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo.

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Potén, in 1981, was the first to address the use of fasciocutaneous flaps from the sural angiosome in repairing soft tissue defects, with proximal base.⁴ Two years later, Donski and Fogdestam⁵ introduced the distally based fasciocutaneous flap and, after a long period unmentioned in the literature, Masquelet et al. reintroduced the reverse sural fasciocutaneous flap in 1992.⁶ Since then, it has become a pillar of leg, calcaneus, and foot reconstruction with local flaps.⁷

The reverse sural flap is a well-studied method for covering defects of the lower third of the leg, ankle, and foot.⁶ It is based on communicating and perforating branches of the fibular artery, which originate from 5 to 6 cm cranially to the lateral malleolus. Its indication to diabetic people, smokers, or patients with peripheral vascular disease must be cautious.⁸ Its main limitation is covering more distal defects, especially plantar, due to the limited range of its perforating.⁶

This study aims to present an 18-month experience of the *Grupo de Feridas Complexas do Serviço de Cirurgia Plástica da Faculdade de Medicina da Universidade de São Paulo (FMUSP)* with the use of reverse sural fasciocutaneous flaps for the reconstruction of ankle, calcaneus, and foot defects.

MATERIAL AND METHODS

A retrospective, observational, and descriptive study was performed. All patients who underwent lower limb reconstructive surgery with reverse sural fasciocutaneous flaps from December 2018 to June 2020 were included by the *Grupo de Feridas Complexas do Serviço de Cirurgia Plástica da Faculdade de Medicina da FMUSP*.

The following variables were considered: age, gender, personal medical history, etiology, injury site and size, number of surgeries, associated traumas, surgery time and its technical details, length of hospital stay, postoperative evolution, complications, and outcome. Data were analyzed by descriptive statistical analysis.

The Research Ethics Committee of the *Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo* approved this study, according to the Declaration of Helsinki and the Document of the Americas, under registration no. 4,255,946, with exemption from informed consent form.

Surgical technique (figures 1 and 2):



Figure 1. Male patient, 35 years old, healthy, with post-traumatic chronic wound in the posterior side of the ankle. (a) Initial injury with devitalized tissue area, including a part of the calcaneus tendon; (b) Injury after surgical debridement; (c) Marking of the reverse sural fasciocutaneous flap; (d) Flap dissection; (e) Primary inset and closure of the donor area; (f) Postoperative evolution without complications; (g) Release of the pedicle.



Figure 2. Male patient, 35 years old, smoker, victim of high-voltage electrical trauma (13,000 V). (a) Complex wound on the back of the right foot, with bone exposure; (b) Marking of the reverse sural fasciocutaneous flap; (c, d) Flap dissection; (e) Inset; (f) Primary closure of the donor area; (g) Release of the pedicle.

The patient is placed in ventral or lateral decubitus position, under spinal anesthesia or general anesthesia. The usual procedures are performed and the entire lower limb is kept exposed in the operative field. First, the surgical debridement of the injury is performed, followed by the measurement of the defect and the flap marking. The cutaneous perforators that will irrigate the flap are most commonly found in the posterolateral margin of the distal region of the leg. To be preserved in greater number, the rotation point is marked at least 5 to 6 cm above the lateral malleolus. The skin island is drawn in the proximal and middle thirds of the leg, so that it covers the entire defect without excessive traction of the pedicle.

The dissection begins by incising the skin in the proximal edge of the flap until piercing the deep fascia. The small saphenous vein and the neurovascular bundle are identified in the center of the flap and proximally connected. The flap is lifted so that the pedicle is always well visualized and intact, and dissected to the rotation point. Then, the flap is rotated to reach the defect area and sutured on the bed to cover the exposed deep structures, which are usually tendon, bone, or joint. An interpolated flap can be performed, keeping the pedicle with bloody area on the skin or inserting the pedicle under the skin or defect. Finally, the primary closure of the donor area is performed with suture, or, if the tension is excessive or the closure impossible, the area is covered by an autologous skin graft. The pedicle is released from 2 to 3 weeks after surgery. A tourniquet is applied in the pedicle before its resection to verify the integration of the flap to the bed.

RESULTS

We performed nine reverse sural fasciocutaneous flaps from December 2018 to June 2020. All nine patients were men with a mean age of 38 years old (the youngest was 29 years old and the oldest, 46 years old). Regarding personal medical history, eight patients (88.89%) presented no comorbidities, one (11.11%) presented hypertension, two were smokers, two were alcoholics, one used illicit drugs, and five had no addictions. Table 1 presents epidemiological data and other results.

Table 1. Epidemiological data of the patients included.

	Number	Percentage
Gender		
Man	9	100%
Woman	0	-
Age (years old)		
< 20	0	-
20–30	1	11.1%
30–40	3	33.3%
40–50	5	55.5%
> 50	0	-
Medical: 38.4		
Comorbidities per patient		
Healthy	5	55.5%
Hypertension	1	11.1%
Smoking	2	22.2%
Alcoholism	2	22.2%
Illicit drug use	1	11.1%
Etiology		
Traffic accident	5	55.5%
Motorcycle vs. fixed object	2	22.2%
Motorcycle vs. car	1	11.1%
Motorcycle vs. truck	1	11.1%
Hit-and-run accident	1	11.1%
Electrical trauma	1	11.1%
Post-traumatic chronic wound	3	33.3%
Site		
Calcaneus	6	66.6%
Ankle	2	22.2%
Foot	1	11.1%

Regarding the etiology of injuries, five patients (55.56%) were victims of car accidents, three (33.33%) presented post-traumatic chronic wound, and one (11.11%) was a victim of electrical trauma. Regarding the injury time, five patients (55.56%) presented acute wounds (less than 30 days between trauma and reconstructive surgery), and four (44.44%) presented chronic wounds (more than 30 days). Among the victims of recent trauma, only one patient (16.7%) presented injury exclusively in the lower limb. The other patients (83.33%) presented injuries in other body segments. Regarding the injury site, six patients (66.67%) injured the ankle, two (22.22%) injured the foot, and one (11.11%) injured the calcaneus.

We analyzed technical details of the surgery: all reverse sural fasciocutaneous flaps were pedicled; the mean surgery time was 160 minutes (the quickest surgery lasting 80 minutes and the longest, 220 minutes); five donor areas were treated with skin graft (55.56%) and four of them, with primary closure (44.44%). During the postoperative follow-up, four patients presented complications (44.44%): three of them presented distal necrosis and one presented distal epitheliosis. We observed no total loss of the flap. The mean length of hospital stay was 30.1 days (minimum stay of five days and maximum stay of 57 days).

DISCUSSION

Lower limb reconstruction is traditionally considered a challenge among plastic surgeons, with a progressively higher degree of difficulty, as injuries are more severe.⁹ The lack of donor tissue and potentially deficient vascularization in the region (especially in high-energy traumas) explain this difficulty.¹⁰ Therefore, free flaps gained great popularity and

became the main indication for reconstruction of extensive injuries in the lower third of the leg and foot. However, due to the long surgery time, morbidity in the donor area, and need for a specialized team and center, not all patients would be candidates for this type of reconstruction.¹¹ Pedicled flaps reappear as a reconstruction option, with the benefits of faster dissection and transfer, besides providing local tissue similar to the original.¹² The reverse sural flap is an axial flap commonly used in the treatment of distal wounds in lower limbs.¹ Its arterial blood supply depends on the retrograde flow coming from septocutaneous perforators from the fibular artery. The branches of the posterior tibial artery also contributes to it.⁹ Its venous drainage is performed by venocutaneous branches that heads to the small saphenous vein, maintaining sensitivity by the sural nerve.⁷

The reverse sural flap can be used to cover different injuries; traumatic injuries are the etiology most mentioned in the literature,¹ as all cases included in this study. It is indicated for reconstructions of the distal third of the leg, anterior and lateral sides of the ankle, posterior side of the heel, instep, and lateral side of the hindfoot.¹³ Belém et al. advise caution in its use for total coverage of the calcaneus, at risk of excessive traction of the pedicle.¹⁴ In the experience we presented, this flap was used for this purpose in one case, without postoperative complications. The complication rate for this flap varies widely in the literature, with several authors reporting even no complications.¹⁵ We must consider, however, that most of these studies included only young and healthy victims of trauma. In a systematic review performed by Daar et al. in 2019, the overall complication rate was 33.7%, reaching 50% when considering only the group of older patients.¹ The most common complication is partial necrosis of the flap, especially in its distal part.¹⁶ Technical changes in the surgery, such as the application of adipofascial extension and previous placement of tissue expander, seem to reduce the chance of complications.¹

In this study, we used no technical change. Three cases presented partial necrosis (33.3%), a frequency similar to the literature. We treated the complication of two patients with debridement, flap readvance, and closure. One case needed debridement of the ischemic part and coverage with skin graft. We also observed one case of epitheliosis of the distal edge and treated it in a conservative way. Thus, despite the complication rate similar to those described in the literature, all complications underwent local treatment and minor surgeries, and no additional reconstruction was required. What would be the factors associated with higher risks of flap loss is still a subject in discussion. Patients with peripheral vascular disease present high incidence of necrosis and venous congestion.⁸ Advanced age, diabetes mellitus, and obesity are also involved.¹⁷ However, smoking alone seems to be the main risk factor.¹ The effects of smoking on wound healing are already well studied *in vitro* and include reduced blood flow at the expense of vasospasm, tissue hypoxia, and predisposition to infection.¹⁸ *In vivo*, the risk of loss of free or pedicled flaps is higher.¹⁹ Two of the three patients with partial necrosis in the postoperative period presented smoking history, which may explain this outcome.

CONCLUSION

The reverse sural fasciocutaneous flap proved to be a viable, reproducible, and safe option for reconstruction of complex injuries in the distal third of the leg and foot. It can also be used for the treatment of acute wounds (less than 30 days) and chronic wounds (with more than 30 days).

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