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Case Reports and Series

Reduction of Morbidity With a Reverse-Flow Sural Flap: A Two-Stage Technique

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ABSTRACT

The reverse sural flap has often been used for cutaneous coverage of the distal region of the leg and ankle. When the flap is performed in 2 stages, the vascular pedicle is exteriorized and later resected. Our goal was to assess the reverse sural flap performed in 2 stages regarding its viability and low morbidity along the flap-donor area. Eleven patients with cutaneous coverage loss found in the area between the distal third of the leg and ankle underwent cutaneous coverage surgery with a reverse-flow sural flap with an exteriorized pedicle, without violation of the skin between the base of the flap pedicle to the margin of the wound. After a minimum period of 15 days with flap autonomy, the pedicle was resected. The flap dimensions, its viability before and after the pedicle ligature, and the distance from the intact skin between the flap base and the margin of the wound were evaluated. Any losses were measured as a percentage of the total flap size. The respective length and width of the flap were a mean average of 7.45 cm × 4.18 cm. All the flaps survived. Partial loss of the flap occurred in 3 patients, ranging from 20% to 30%. The mean average distance of the intact skin between the pedicle base and the margin of the wound was 5.59 (range 4 to 8) cm. Our results showed that the 2-stage reverse sural flap ensures good flap survival and low morbidity.

The cutaneous coverage of the distal third of the leg and ankle remains a challenge for reconstructive surgery. These areas are susceptible to trauma and have anatomic particularities, such as the lack of a muscular envelope over the bones, increasing the risk of issues regarding their coverage, along with other noble structures (1–4). The sural flap, such as a reverse-flow fasciocutaneous flap, was described by Masquelet et al (5) in 1992 as a solution to these issues. In recent years, several investigators have reported their clinical experiences with this flap, with favorable results (6–9). However, cases of partial or total loss still occur and can be related to factors such as errors in the flap dissection technique (7,10–12), patient comorbidities, the mechanism of trauma, and the method used to transpose the flap from the donor area to the recipient area.

The most common forms of flap transposition include flap tunneling an incision in the skin between the donor and recipient areas, where the pedicle will be fitted (8,9,13). In the first method, the flap pedicle is folded over itself, generating a volume that is passed through a subcutaneous tunnel. In the second method, the pedicle passes between the margins of the incision. In a third, less common, method that leaves the skin extension along the pedicle present, the subcutaneous tunnel is opened for the pedicle, and the skin is mobilized at each side, creating a very thin skin flap. This tunnel provides sufficient space for a pedicle with a skin extension, and the flap is transposed to the recipient site and sutured, and the opened bridge for the pedicle is repaired to the adjacent skin extension without tension (8,9). The risk of tunneling is pedicle compression, with the attendant risks of venous congestion and flap loss. When the skin is cut to transpose the pedicle, no risk of pedicle compression by the skin is present. However, in addition to local bulging, it will be necessary to use a skin graft to cover the pedicle (1,14).

To avoid the previously described problems, we performed a reverse sural flap, with temporary exteriorization of its pedicle, thereby preventing its compression and any damage caused by its transposition using tunneling or incision of the skin (9,15,16).

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The goal of the present study was to assess the outcome of a reverse sural flap with an exteriorized pedicle, performed in 2 stages, regarding its viability and morbidity along the recipient area.

Patients and Methods

Patients

From February 2010 to November 2016, 11 patients with coverage defects in the distal lower third of the leg, ankle, or hindfoot received a reverse sural flap with exposed pedicle.

The mean average patient age was 39.25 (range 12 to 72) years. The study included 9 (81.8%) males and 2 (18.2%) females. One (9.1%) patient presented with the sequelae of paralysis, and 3 (27.3%) patients had hypertension, including 1 (9.1%) who also had diabetes and 1 (9.1%) with distal arteriopathy.

The mean average size of the defect area was 6.6×2.8 cm^2. The mean average time that had elapsed between the initial trauma and performance of the coverage was 42.72 (range 32 to 64) days. The most frequent location of coverage failure was the lateral malleolus in 4 patients (Table). All procedures were conducted by the same surgeon and always in accordance with the clinical criteria requiring the absence of an active infectious process in the wound.

The postoperative assessment included measurements of the flap and determination of its viability before and after its autonomy. Eventual loss was measured as a percentage of the total flap size. The length of skin that remained intact using the applied technique was measured. The method of closing the donor area (i.e., with or without a graft) and any complications were also recorded. The mean duration of follow up was 87 ± 34 (range 60 to 120) days.

Surgical Technique

The patient was placed in the lateral decubitus position with the involved limb positioned superiorly. The recipient area was explored, and debridement was performed to obtain viable tissue at the margins. The dimensions of the coverage failure were recorded, and a template of the defect area was created to plan the design of the flap in the donor area. A line was drawn from the midpoint between the lateral malleolus and the Achilles tendon to the midpoint of the popliteal fossa. The flap pivot point was marked with a minimum distance of 6 cm proximal to the tip of the lateral malleolus. In addition to the pedicle of the sural nerve, the perforator vessels from the peroneal artery were included, contributing to the nutrition of the flap. The flap was drawn in the donor area, with consideration of the length of the pedicle required to reach the receiver bed without tension.

Proximal dissection was started with a cross-sectional incision of ~2 cm for sural nerve identification. The flap design could be adjusted, if necessary, such that it was centered on the route of the nerve. Proximal to distal dissection was performed in the subfascial plane. The sural nerve bundle and the short saphenous vein were proximally connected.

In the area corresponding to the pedicle (i.e., the distal point from the flap drawing to the pivot point), a curved incision was made without deepening it to the fat plane. The skin was raised, and a segment of adipofascial tissue ~4 cm in width, including the sural nerve, was dissected throughout the incision extension. Thus, a blood supply from the perforator vessels of the peroneal artery was guaranteed.

After full dissection of the flap and its pedicle, the flap was transposed to cover the recipient area, without performing any tunneling. The exposed pedicle naturally took a tubuliform shape and rested on the existing intact skin between the pivot point and the wound (Fig. 1). The donor area was primarily closed or grafted with a partial skin graft. Finally, dressings were applied to the area in a conventional manner, with care not to put pressure on it and using gauze with petrolatum gel on the flap pedicle. A boot splint was applied, with care to avoid external compression of the flap and its pedicle. The postoperative bandages were changed at the outpatient examinations every 3 days, and resection of the exposed pedicle was performed ≥15 days after the flap surgery (Fig. 2).

Results

Flap autonomy was performed in 9 patients (82%) 15 days after the first surgery. One patient (9%) developed suture dehiscence, which justified the need for a review, and 1 patient (9%) could not undergo surgery within the 15-day interval for logistical reasons, and pedicle resection for flap autonomy was performed after 21 days (Table). The flap area was 7.45 cm long × 4.18 cm wide.

Of the 11 patients, 3 (27%) presented with partial loss of the flap (patients 3, 5, and 6), with an area of loss of 20%, 20%, and 30%, respectively. All had the same pattern of loss, which was characterized by venous congestion, epidermolysis, loss of turgor, and tissue necrosis. In 2 patients (18%; patients 3 and 6), local grafting was necessary. For the third patient (patient 5), second intention healing was enough.

The perfusion pattern of the flap remained the same in all patients before and after vascular pedicle ligature. The mean average skin distance that remained intact between the base of the flap pedicle and the margin of the wound was 5.59 (range 4 to 8) cm. It was possible to primarily close the donor area in only 1 patient (9%; patient 4). For the remaining 10 patients, a skin graft was required to close the donor site; this graft was taken from the same leg.

The need for a skin graft at the time of autonomy to complete closure of the lesion area because of partial necrosis of the flap was considered a complication and occurred in 2 patients (18%; patients 3 and 6). Another complication was dehiscence of ~50% of the flap margin with the pedicle still not resected, which justified resuturing of the flap margin in 1 patient (9%; patient 8).

Selected Clinical Case

A 29-year-old patient (patient 1) with a diagnosis of postoperative inframalleolar dehiscence presented with a defect area in the medial distal third of the leg of 7 cm × 3 cm (Fig. 3A). A reverse sural flap was performed using the described technique (Fig. 3B). After 15 days, the pedicle was resected, with flap integration and skin preservation. After 45 days, the final flap aspect and the skin integrity along the pedicle were examined and recorded (Fig. 3C).

Discussion

The reverse sural flap, initially described by Masquelet et al (5) in 1992, is a good option for coverage of the distal third of the leg and the ankle owing to its proximity to the injured area and the good results achieved in flap survival, which has been corroborated in numerous reported studies (1–3,6–8,13,14,17–20). However, we have observed, with variable frequency, the occurrence of partial or total loss of this flap, especially due to congestion (9,12,17,19,21,22). Such complications can be aggravated by tunneling of the pedicle, which can result in its compression (9,22).

Another form of flap transposition, which prevents the formation of a subcutaneous tunnel, is a skin incision between the pedicle base and the flap margin. This associates the pedicle coverage with the partial skin graft or leaves a skin extension along the pedicle (9,20). In addition to the existing possibility of pedicle compression due to graft tension at the time of suturing, the aesthetics will also compromised, represented by local bulking.