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Case Report
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One Stage Distally based Superficial Sural Artery Fasciocutaneous Flap in the Coverage of Forefeet Defects in a High Voltage Electric Burned Patient: A Case Report

Ahlam El Youssoufi[1], Komla Séna Amouzou[2], Elodie Joyce Lucrece Malonga-Loukoula[1] and Mounia Diouri[1]*

[1]Hassan II University, Ibn Rochd Teaching Hospital, Morocco

[2]Department of Surgery, Sylvanus Olympio Teaching Hospital, Togo

Abstract

Defects located on the lower leg and the foot represents a challenging task for the reconstructive surgeon, especially in high voltage electric burned patients.

We admitted a 29-year-old male patient for forefeet defects following high voltage electric burns in our national burn and plastic surgery center. There was an exposition of metatarsal bones on both forefeet. We performed the distally-based superficial artery fasciocutaneous sural flap in a one-stage surgery separately for each side; the fascio subcutaneous pedicles were 5 cm wide buried under skin tunnels. We noticed suture dehiscence on the right foot and tip necrosis on the left foot. The bones were still covered. We used a V-Y advancement flap and split-thickness skin graft to complete the reconstruction.

The wounds healed without any infectious complication. The ambulation was normal. The patient was satisfied with the flaps and did not complain about the donor sites.

Keywords: Electric burn; Foot; Sural flap; Distally-based flap; Fasciocutaneous flap

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Correspondence:

Komla Séna Amouzou, Department of Surgery, Sylvanus Olympio Teaching Hospital, 1, Rue de l'Hopital, PB: 20752, Lomè, Togo, Tel: 22890011413; E-mail: alain.amouzou@gmail.com

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Introduction

Reconstructing the distal part of the lower extremity, including the lower leg and the foot, is challenging. The lack of skin laxity and the scarcity of muscles available to be used as flap hinder the flap surgery in patients with lower limb distal soft tissue defects. Among available options, many authors favor the reverse sural artery flap, which has been first described by Donski and Fogdestam [1]. Masquelet et al. [2] pointed out the role of the neurocutaneous perforators in a concise anatomical description of the vascularization of the skin. These authors showed the possibility of raising a distally-based island flap based on the sural nerve perforators [2]. However, it was only in 1994 that Hasegawa et al. [3] published a detailed description of the flap. Given that the sural nerve was not incorporated in the flap but accompanies the superficial sural artery, which is the main vascular supply to the flap, these authors coined the name of "distally based superficial sural artery flap" [3]. Since then, the distally-based sural flap has gained wide popularity as used for coverage of defects on the distal leg, the ankle, and the hind foot. Many authors used the flap for the coverage of numerous defects of various etiologies, including trauma and tumor excision [4]. Besides, the flap was reported to be safe even on difficult grounds as those with vascular impairment in diabetics and peripheral artery disease [4-7]. Some authors added some refinements to extend the size and the reliability of the flap, including the delayed procedure, widening of the pedicle, an extended dissection of the perforators at the pivot point, and supercharging with vein anastomosis [4,6]. However, the one-step technique for defects located as distal as the forefoot is still rare.

In high voltage electric, the injuries are evolutive and carry vascular damages that, though subclinical, can compromise a flap surgery. The optimal time for coverage in such patients has not reached a consensus yet [8]. Some authors have reported successful outcomes with flaps, including the distally-based sural artery flap in patients with electric injuries [9].

In this article, we report the successful use of the distally-based superficial sural artery flap for defects distally located on the forefeet in a patient with high voltage electric burns.

Figure 1: A) Contact point of electric burn on the hand; B-D) Contact Points on the right and left foot displaying deep skin and soft tissue necrosis.

Case Presentation

We admitted a 29-year-old male patient for high voltage electric burn injury in our National Burn and Plastic Surgery Center, Casablanca, Morocco, on the April 19th, 2019. The patient reported a history of tobacco consumption and no past medical condition.

The contact points were located on the right hand, and the feet were showing deep skin necrosis (Figure 1). The first treatment was based on fluid resuscitation and wound dressing with silver sulfadiazine, monitoring the cardiac activity by regular ECG and biologic markers, and clinical monitoring of the tension in the extremities' compartments.

We performed serial debridement starting on day 3. The necrotized left big and second toes were excised, leaving the head of the first metatarsal exposed (Figure 2). There was an exposition of the shaft of this metatarsal as well requiring coverage (Figure 2).

The patient gave written consent for a distally-based superficial artery fasciocutaneous flap and the publication of the case.

We performed the first surgery for the left foot on day 26.

Operative Technique

We conducted flap surgery, as described by Hasegawa et al. [3]. In our case, the patient was in the lateral position under spinal anesthesia. Also, the proximal part of the flap was at the level of the upper third of the leg; the pedicle was 5 cm wide. The size of the defect was 10 cm over 8 cm (Figure 3). We reported the markings on the calf centered on an imaginary line joining the middle of the popliteal area to the Achilles' tendon. We did not use the handheld Doppler to localize the peroneal artery or any perforator. We elevated the fascio-subcutaneous flap with a fascio-subcutaneous pedicle. We created a skin tunnel over the medial border of the ankle and the foot where we passed the pedicle (Figure 3). The flap covered the entire forefoot defect. We closed the donor site by a direct suture (Figure 3). In the postoperative course, we noticed the dehiscence of sutures on the distal part of the flap and the skin necrosis on the distal part of the donor site. In a second stage, we performed a V-Y advancement plantar skin flap that joined the distally-based superficial sural artery flap to cover the head of the metatarsal (Figure 3).

At postoperative day 10, we performed a distally-based superficial sural artery fasciocutaneous flap for the right foot using the same technique, because the granulating tissue was not advancing on top of the metatarsal to allow a split-thickness skin graft. The size of the defect on this side was 10.5 cm over 8.5 cm (Figure 4). In the postoperative course, there was tip necrosis noticed on day 5 that did not compromise the final result as the bone was well covered.

1.

Figure 2: A) Defect on the left food, exposition of the first metatarsal shaft, the head is covered with some granulating tissue; B) Defect on the right foot, exposition of the shaft of the first metatarsal.

1.

Figure 3: A) The left distally based sural flap with its fasciosubcutaneous pedicle; B) The donor suture by a direct suture; C) Picture showing the pedicle that is buried in a skin tunnel at a stage where partial dehiscence of the sutures happened; D) Complement of the coverage procedure with a V-Y advancement fasciocutaneous flap.

1.

Figure 4: A) Defect on the right foot. The shaft of the first metatarsal is exposed; B) Right distally based sural flap, the pedicle is buried in skin tunnel, and the flap covered the defect entirely; C) Tip necrosis of the flap on day 5; D) Superficial necrosis on the donor site of the left sural flap.

1.

Figure 5: A) The flaps are healed and well inset, bulky appearance at three months; B) Less bulky appearance at seven months; C) Healed donor sites.

Again, the distal part of the donor site presented superficial necrosis. We treated this complication with a secondary wound healing. We covered the raw areas with a split-thickness skin graft that resulted in the dehiscence of the suture on the first flap on the left foot and its donor site. The wound on the hand was debrided and covered with a full-thickness skin graft.

We achieved the healing of all the wounds (Figure 5). The flaps were looking bulky initially, but this aspect decreased over time (Figure 5). The ambulation of the patient was normal. The patient was followed-up in the outpatient department.

The patient was satisfied with the shoe fitting and did not complain about the scar on the donor site. Clinically, there was a decreased sensation on the lateral aspect of the feet, but the patient did not complain about it.

Discussion

The increased knowledge of the vascular anatomy of the leg has empowered the reconstruction of the foot and lower third of the leg with multiple reconstructive options. Among these options, the distally-based superficial sural artery fasciocutaneous flap is deemed as the workhorse of the reconstruction strategies for the distal part of the lower extremity [4,6,10,11]. The advantages are the relatively easy dissection, the preservation of major arteries of the lower extremity, the low morbidity of the donor site. Many refinements have been added to the initial description to decrease the rate of complications and increase its reliability [4]. The distally-based sural artery fasciocutaneous flap was harvested on the middle third of the leg, with the pivot point located up to 5 cm to the lateral malleolus [1-4]. This approach made it useful only for defects located on the distal third of the leg, the ankle region, and the hindfoot. Harvesting the flap 1 cm to 2 cm above the popliteal crease reported later augmented the size of the flap and the length of the pedicle [4]. The debate around the width of the pedicle is still ongoing. In the first description, Hasegawa et al. has mentioned a 2 cm width for the pedicle [3]. However, many authors accept that the pedicle should be around 3 cm wide [4]. Some of the observed complications were venous congestion, partial to total flap necrosis, infections, and wound dehiscence. These complications are reported to be prevalent in the population of patients aged over 40-year-old [4,5,9-11]. Smoking is considered an independent risk factor for complications as well [5] and may have explained the tip and the superficial necrosis of the donor site in our patient. The behavior of the flap on high voltage electric burns is not yet fully documented. Yildirim et al. [9], who used this flap in 24 patients with electric burns, took precautionary measures as a flap delay, a pedicle as broad as 5 cm, and the pivot point at 5 cm above the lateral malleolus [9]. In our case, the flaps were inset without any delay; the pedicles were 5 cm wide, all buried in a skin tunnel.

Based on these cases and the series in the literature, we believe that there is still room for research on the factors associated with complications of the distally-based superficial sural artery flap. In particular, the etiology of the defect, the location and size of the donor site, the location of the recipient site, and the management of the pedicle should be documented in further studies.

Conclusion

We used in a single-stage the distally-based superficial sural artery fasciocutaneous flap for the reconstruction of defects located on the forefeet in a patient with high voltage electric burns.

Following the favorable outcome in this patient and the reports in the literature, we suggest the distally-based superficial sural artery fasciocutaneous flap as a versatile option for the reconstruction of foot defects in young patients presenting with high voltage electric burns.

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