SHORT AND LONG TERM FOLLOW UP RESULTS OF (THE VERSATILE) REVERSE SURAL ARTERY FLAP

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ABSTRACT

Objective: This study was designed to see the long and short term outcome of the reverse sural artery flap.

Study Design: Case series.

Patients and Methods: From January 2009 to December 2011, data was collected and analyzed for this study. Eighty nine patients with wounds on the ankle, heel, sole, distal leg, and foot were included in the study. They were followed up at 01 week, 02 weeks, and then 4 weekly for 06 months and at one year time from operation. They were examined for necrosis, congestion, surgical site infection, dehiscence of suture line, epidermolysis, donor site infection and functional outcome.

Results: Most of the flaps healed nicely but two (2.25%) failed completely. Six flaps were delayed. However early follow up (within 04 weeks) revealed that there was partial loss of the distal 1-1.5 cm of flap in 04 patients (4.50%). Two patients (2.25%) developed superficial surgical site infection. Six patients (6.74%) developed venous congestion of the flaps which recovered within two weeks. Other minor complications included dehiscence of suture line in 3 patients (3.37%), and superficial Epidermolysis in four (4.50%) (Table-2). Twenty two patients (24.72%) returned to their work in 12-16 weeks, 31 (34.83%) in 16-20 weeks and 36 (40.45%) in 20-24 weeks. Long term follow-up to 06 months revealed hypertrophic scars at the donor site in three patients (4.91%) and recurrence of ulcer in 2 patients (3.27%).

Conclusion: The sural fasciocutaneous flap provides reliable supple and durable most single-stage coverage of wounds of the distal third of the leg, heel, and foot with the results comparable to free-tissue transfer.

Keywords: Fascio-cutaneous, Perforator, Sural artery flap.

INTRODUCTION

Foot and ankle is a common site of difficult wounds to manage in term of reconstruction. It posses a challenge because of paucity of locally available skin & soft tissue and special requirement of weight bearing[1]. Plastic surgeons are often consulted regarding the management of these patients. These wounds may be because of trauma, diabetes mellitus, venous insufficiency, ischemia or malignancy. Choices for treatment include; healing by secondary intention, skin grafting, local flaps and free flap[2-4]. Local flaps include adiposo-fascial flap, medial planter artery flap, lateral calcaneal artery Flap; perforator based propeller flaps and sural artery flap[5].

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Healing with secondary intention results in prolonged healing time and unstable scarring that may not be functionally and aesthetically acceptable. Similarly skin grafting does not provide supple coverage which is required for pressure bearing areas. Perforator based propeller flaps are technically demanding and may not be feasible for large wounds[6-8].

Free microsurgical tissue transfer may be treatment of choice but it requires team approach and long operative time, donor site morbidity, and a definitive risk of total failure and prolonged hospital stay[14].

Distally based sural artery flap provides supple coverage to these wounds and the flap territory is usually away from the wound. It was described for the first time by Masquel et al[9]. Several studies have been published on its different anatomical and clinical aspects. This flap is commonly referred as "reverse sural artery island flap" and has become an acceptable and

routine technique for reconstruction of difficult defects around the ankle, foot and lower leg.

At Combined Military Hospital Rawalpindi we frequently use the reverse sural artery flap to cover defects around the ankle and proximal foot. This study was conducted to see the long and short term outcome of the reverse sural artery flap.

Vascular Anatomy of the Reverse Sural Fascio-Cutaneous FLAP

This is an axial pattern flap based on suprafascial and subdermal plexus. These plexus are supplied by the median superficial sural artery, which runs in conjunction with the medial sural cutaneous nerve, and a series of two arteries accompanying the lesser saphenous vein[3-6]. These axial pattern vessels make a series of interconnections with perforating vessels in the region of the lateral malleolus[10-11] such as lateral tarsal artery, which emanates from the anterior tibial vessel. In addition, a series of four to five fasciocutaneous perforators from the peroneal artery travel in the crural septum to supply the skin of the lateral leg. These fasciocutaneous perforators also form intercommunications with the axial pattern arteries that accompany the medial sural cutaneous nerve. These vessels typically are located in the posterior crural septum, starting at a point 5 cm above the tip of the lateral malleolus and extending proximally for a distance of approximately 13 cm above the lateral malleolus[12-14].The reverse sural artery fasciocutaneous flap should be designed to incorporate at least one audible perforator in an effort to maximize local blood flow[15].

Several modifications have been designed to facilitate the safe use of this versatile flap for difficult and special circumstances. These include delaying, exteriorizing the pedicle, keeping the pedicle wider, mobilization of peroneal perforators in the intermuscular septum, supercharging, cross leg sural artery flap, leaving a skin extension over the pedicle, and harvesting a midline cuff of the gastrocnemius muscle.

PATIENTS AND METHODS

Data of all patients who underwent distally based sural artery flap from January 2009 to December 2011 was collected and analyzed for this study. In total 89 patients with wounds on the ankle, heel, sole, distal leg, and foot were included in the study. They were followed up in Plastic Surgery department at 01 week, 02 weeks, and then 4 weekly for 20 weeks and at one year time from operation. These patients were examined for necrosis, congestion, surgical site infection, dehiscence of suture line, epidermolysis, donor site infection, weight bearing, return to work.

Patients with wounds on the heel, ankle, sole and on the distal leg were included in the study. Patients with peripheral vascular disease and diabetes, patients with CCF having ejection fraction less than 30%, patients with trauma/wound over the lateral aspect of leg with possibility of perforator damage were excluded from the study.

Surgical Technique

Pre-operatively the patient was examined by identifying lateral meleollus and head of fibula and marking a line by joining these two landmarks. Hand held doppler probe was then used to identify and mark the peroneal artery perforators to incorporate at least one of them along with lesser saphenous vein into the flap. This was followed by marking of sural nerve and skin island on the posterior calf as a part of reverse planning according to the size of defect in a tear drop shape with the tail tapering distally to facilitate closure after the flap inset (Fig-1).

The base width of the flap was designed obliquely to the lateral malleolus, to include the maximum number of lateral perforators. The dissection was initiated in the upper-medial quadrant of the skin island, the safest zone to ascertain the proper plane of dissection and then continued around the distal aspect of the skin island for several centimeters. At this point, the dissection was carried through the subcutaneous tissue and fascia of the superficial posterior

compartment at the most distal aspect of the flap. Here, the sural neurovascular bundle was encountered. The distal end was ligated, after which the median sural artery was divided. The dissection was done by elevating the fascia off the gastrocnemius muscles. The loose areolar tissue between the two heads of the gastrocnemius and its accompanying venous plexus was incorporated into the flap design. The flap was elevated to a point several centimeters past the lateral muscular compartment. At the midpoint of the gastrocnemius muscles, the sural nerve penetrates the deep fascia. The neurovascular structures may be adherent at this point and incorporation of a small muscular cuff can help prevent damage. Next, the dissection was continued distally to a point about 5, or 10 cm proximal to the tip of the lateral malleolus that represents the most distal point of safe flap elevation. The flap was then turned into the wound and sutured over suction drains under minimal tension. The donor site was then covered with a split-thickness skin graft if not possible to close the wound primarily. The flap was delayed for about 48-72 hours if there was venous congestion. A full-leg posterior splint using foam padding was applied to prevent pressure on the subcutaneous pedicle at the point of rotation.

Analysis was made from the data by using SPSS (version 16). Continuous variables were expressed as mean ± standard deviation (SD), whereas frequencies were shown for nominal variables

RESULTS

The studied 89 patients consisted of 73 men and 16 women. The mean age was 25 years (range: 6 to 54) years. Forty three of them had been injured in motor accidents; 29 had mine explosion, 08 had burns, and 09 had post tumor excision defect.

Defect size ranged from 6×4 to 20×10 cm. They were located on the heel, sole, and dorsum of the foot, ankle, and distal tibia (Table-1). None of the patients had varicose veins. Seven patients were smokers. In 25 patients, at least one of the bones, joints, or tendons was exposed. Three other patients had chronic unstable scars due to previous burns and skin grafts.

The size of Skin Island ranged from 7×5 to 21×12 cm. The pedicles were 7 – 17 cm in length and 2 – 3 cm in width. The pivot point was 5 – 8 cm away from the lateral malleolus.

The patients were reviewed at 01 week, 02 weeks, and then 4 weekly for 20 weeks. Two flaps (2.25%) failed completely both were used to reconstruct wounds on sole of foot. Early follow up (within 04 weeks) revealed that there was partial loss of the distal 1-1.5 cm of flap in 04 patients (4.50%), which were subsequently treated by a small skin graft. The site of partial loss of flaps was as follows: one distal tibia, two heal and one around the ankle. Two patients (2.25%) developed superficial surgical site infection which was treated with appropriate antibiotics. Six patients (6.74%) developed venous congestion of the flap which recovered within two weeks. Other minor complications included dehiscence of suture line in three (3.37%), and superficial Epidermolysis in four (4.50%) (Table-2). Twenty two patients (24.72%) returned to their work in 12-16 weeks, 31 (34.83%) in 16-20 weeks and 36 (40.45%) in 20-24 weeks.

Long term follow-up to 6 months revealed hypertrophic scars at the donor site in three patients (3.37%), recurrence of ulcer in 2 patients (2.25%). However, none of these complications affected the final outcome of the flap.

DISCUSSION

Patients with soft tissue defects of lower third of leg, ankle, heel, and foot are often reviewed by plastic surgeons for reconstruction. Reconstruction in these cases having large wounds can be carried out using reversely based sural artery flap. This method of reconstruction has proved to be reliable therapeutic tool in these patients.

Although coverage of wounds of the lower one-third of the leg can be best undertaken using micro-vascular free-tissue transfer, as these flaps

provide reliable single-stage coverage of these wounds. There are, however, disadvantages to using free flaps. Among these are the need for a remote donor site, increased operative time, use of a major vessel to the leg, and microsurgical expertise. The alternative for coverage of these areas has historically been pedicled fascio cutaneous flaps, as described by Ponten[16]. Unfortunately, even when properly designed with perforators at the base of the flap, the distal-most portion is often random in its blood supply. This may lead to marginal flap necrosis in some cases, requiring additional procedures to achieve coverage.

The design of these flaps has undergone an evolution on the basis of the discovery of neurocutaneous territories. That is, the cutaneous nerves of the body are frequently accompanied by small arteries and veins that supply the nerve and send perforators to the overlying skin. First discovered when vascularized nerve grafts were elevated, experience subsequently demonstrated that the skin overlying these nerve territories could be elevated based on this blood supply, even in retrograde fashion, to cover defects as distal as the forefoot[2-,4,17]. Perhaps the best described of these flaps is the sural nerve flap. In our series, this flap proved successful in a variety of difficult lower extremity wounds.

Figure-1(a): (Preop marking of reverse sural flap).

Figure-1(b): Immediate post-op picture after insetting.

Figure-1(c): Late post op result a healthy pliable flap.

Figure-1: Etiology of wounds reconstructed by reverse sural artery flap.

Table- 1: Locations of wounds reconstructed by reverse sural artery flap.

Site	Heel	Sole	Ankle	Distal tibia	Foot dorsum
No.	36	12	24	3	14

Table- 2: Complications of reverse sural artery flap.

Complication	Total Loss	Distal Necrosis	Congestion	SSI	Dehiscence of suture line	Epidermolysis
No. of Cases	2	4	6	2	3	4
Percentage	2.25%	4.50%	6.74%	2.25%	3.37%	4.50

Also notable in this series is the age range of the patients, with the youngest being only 6 years and eldest more than 54 years of age. Although safe and reliable in the pediatric population, free flaps can be technically demanding due to small sized vessels. The sural artery flap allows reliable single-stage coverage in children without this concern. In addition, the time required for the procedure, approximately 2 hours, is significantly shorter than that would be required for a micro vascular transfer.

A broad infero-lateral pedicle should be maintained to include an extensive network of communicating vessels posterior and superior to the lateral malleolus, because inclusion of this large number of perforators at the base, along with the lesser saphenous vein, will enhance the survival of this flap[18-19].

To maximize the preservation of subcutaneous perforators the pedicle should be elevated deep in the subfascial plane and superficially in the immediate sub-dermal plane,

as it is dissected distally to the point of rotation. The skin flaps overlying the pedicle can usually be closed primarily to the point of rotation. To allow adequate rotation the pedicle should be mobilized generously[20]. Unnecessary overly aggressive inferior back-cutting should be avoided as it may interrupt perforators and jeopardize the viability of the flap[21]. Tunneling the pedicle should be avoided rather it should be exteriorized along a back-cut from the skin incision used for pedicle exposure into the defect. Exposed pedicle in this region should be skin grafted if the skin flaps are not easily mobilized over it. Inevitably, there is a small dog-ear here that should not be a long-term problem. Finally, one must be aware of the proximity of the common peroneal nerve to the dissection as it is begun superiorly and laterally. Here, the common peroneal gives off the lateral sural cutaneous nerve. If there is confusion regarding the identity of the nerves of this area, a nerve stimulator should be used to demonstrate the lack of motor innervations of the lateral sural nerve before it is sectioned.

In summary, the sural fasciocutaneous flap provides reliable supple and durable one-stage coverage of wounds of the distal third of the leg, heel, and foot with the results comparable to free-tissue transfer. Careful pedicle dissection and inclusion of the peroneal artery perforators and lesser saphenous vein maximizes flap blood supply and allows the transfer of large skin islands as far distally as the foot.

CONCLUSION

The sural fasciocutaneous flap provides reliable supple and durable mostly single-stage coverage of wounds of the distal third of the leg, heel, and foot with the results comparable to free-tissue transfer. Careful pedicle dissection and inclusion of the peroneal artery perforators and lesser saphenous vein maximizes flap blood supply and allows the transfer of large skin islands as far distally as mid-foot.

Conflict of Interest

This study has no conflict of interest to declare by any author.

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