ORIGINAL ARTICLE

OUTCOME OF DISTALLY BASED SURAL ARTERY FLAP FOR DISTAL THIRD OF LEG AND FOOT DEFECTS

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Background: Due to precarious blood supply, skin coverage for defects of leg, heel, dorsum of foot and the ankle has been a complicated task for plastic surgeons & orthopaedic surgeons. The present study aimed to prospectively evaluate the outcome of distally based sural flap for coverage of defects distal third of leg, ankle & foot. **Method**: In this study 15 patients with soft tissue defects on distal third of leg in (n=2), heel (n=4), medial malleolus (n=3), lateral malleolus (n=1), Achillis tendon (n=2), anterior ankle (n=2) and in dorsum of foot (n=1) were operated for coverage of defect by distally based sural flap. All the cases were done as secondary procedures. **Results:** All the flaps showed good results except five minor complications. Three flaps showed superficial skin necrosis and two showed partial tip necrosis. **Conclusions:** Distally based sural artery flap is very useful in covering the defects of lower leg, heel and dorsum of foot. It is reliable, easy to raise with minimal morbidity to the patient. This flap does not sacrifice any of the major vessels of the limb and hence it is very safe flap.

Keywords: Sural artery flap; Distal third leg; Dorsolateral foot defect; Posterior heel defect

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INTRODUCTION

Due to increasing incidence of high velocity trauma & mechanization, compound fractures and extensive degloving injuries have become more frequent. Due to a precarious vascular anatomy & thin subcutaneous tissue over dista tibia the task of achieving complete soft tissue and bone coverage is extremely challenging.[1] Skin grafting alone carries guarded prognosis over host tissue like tendons, hardware or bones. Flap remains the choice of treatment. Raising a flap with an intact neurovascular anatomy with a fair amount of mobility to cover a defect at a considerable distance is the key to a successful rehabilitation. It is equally important to consider a meticulous dissection for achieving minimum donor site morbidity & related complications.[2] The pioneers started with muscle flaps initially which yielded promising results. They were followed by musculocutaneous flaps preventing a second surgery. Isolated free vascularised flaps later came to existence but had a major disadvantage in form of need of neurovascular anastomosis with the recipient site. Of the existing options, adipo-fascial flap coverage still remains to be the treatment modality of choice.[2] In the lower limb which is the most commonly predisposed site for compound trauma, sural artery based flaps provide a magnificent option for primary or secondary coverage. Another advantage to use of sural based flap is the ease of dissection and high survival rates with short learning curve. The Superficial sural artery is a branch variably arising for either medial/lateral sural artery or popliteal artery. This branch has been found to be intact even in cases of compound lower limb injuries especially around the ankle, heel and dorsum of the foot. Although colour Doppler is suggested before planning flap coverage, studies show no added advantage.[3] The present study aimed to evaluate the outcome of distally based sural artery flap for soft tissue defects in the distal leg especially around the ankle, heel and dorsum of the foot.

MATERIAL AND METHODS

The case series was done in a tertiary level trauma centre between October 2011 and September 2014. The study was approved by Institutional Review Board. Fifteen patients with soft tissue defects of lower limb were included after taking informed written consent and sural artery based musculocutaneous flap was used to cover tissue defects (Table-1). Patients with compound trauma with associated bone loss were excluded from the study. There were 13 males and 2 females. The average age of patients was 28 years with range of 8–62 years. Flap was used for the soft tissue defect due to trauma (n=11), non-healing ulcer (n=1), electric burn (n=1) and scar contracture (n=2) (Figure-1). Site of defect was distal third of leg in 2 (13%), heel in 4 (27%), medial malleolus in 3 (20%), lateral malleolus in 1 (7%), Achillis tendon in 2 (13%), anterior ankle in 2 (13%) and in dorsum of foot in 1 (7%). The dimensions of the defect ranged from 5–12 cm in length and 4- 10 cm in width. Duration of the defect was from 2 weeks to 2 years. Flap was pen insulated in ten patients and was raised with skin paddle in rest five patients.

Table-1: Details of patients

Case No.	Age/ Sex	Aetiology	Site of the defect	Size (C.M.)	Duration	Complications	Management of complications
1.	30, M	Trauma	Medial Malleolus	10×6	3 Weeks	Uneventful	
2.	22, M	Trauma	Heel	8×5	2 weeks	Uneventful	
3.	40, F	Trauma	Lower 1/3rd leg	12×10	4 weeks	Distal tip necrosis	Split skin graft
4.	19, M	Trauma	Heel	9×6	2 weeks	Distal tip necrosis	Split skin graft
5.	23, M	Trauma	Dorsum of foot	10×7	5 weeks	Uneventful	
6.	18, M	Trauma	Heel	10×5	3 weeks	Superficial skin necrosis	Conservative
7.	45, M	Trauma	Lateral malleolus	6×4	2 weeks	Superficial skin necrosis	Conservative
8.	24, M	Trauma	Medial Malleolus	8×4	4 weeks	Uneventful	
9.	12, F	Post traumatic contracture	Anterior ankle	7×5	2 Years	Uneventful	
10.	35, M	Trauma	Tendo- achillis	5×5	2 weeks	Uneventful	
11.	62, M	Non-healing ulcer	Anterior ankle	7×4	1 year	Uneventful	
12.	8, m	Electric burn	Tendo- Achillis	5×4	6 weeks	Uneventful	
13.	24, M	Trauma	Medial Malleolus	10×8	2 weeks	Superficial skin necrosis	Conservative
14.	40, M	Trauma	Lower 1/3rd leg	9×7	4 weeks	Uneventful	
15.	18, M	Unstable traumatic scar	Heel	7×5	2 years	Uneventful	

A standard lateral or prone position was used after giving regional anaesthesia. Recipient site was debrided off the granulation tissue and made raw before harvesting the flap (Figure-2). Planning in reverse was done with help of lint piece. Pivot point of the flap was kept at a distance of 5–6 centimetres from lateral malleolus (Figure-2) in lateral lower leg. Duplex ultrasound for assessment of flow in the sural artery was not done in any of the cases in the present study. The junction of proximal and middle third of the leg was considered upper limit for graft placement in twelve patients whereas in three patients the flap was required to be placed in proximal third of leg. The skin and fascia were incised along with layer of local sub fascial fat (Figure-3). The sural nerve was sharply divided proximally and the short saphenous vein was ligated. Dissection was done in proximal to distal fashion without any particular difficulty.

The importance of preserving the sub fascial fat lies in the fact that it contains branches arising from the peroneal artery that supply the perineural arterial plexus around the sural nerve. Care was taken to raise the flap along with all the deep fat along the lateral border of the tendo-achillies up to its insertion as this permitted a 180-degree rotation (Figure-4). Donor area was covered with split skin graft (SSG) in all the cases and the adipofascial flap was placed on the raw recipient area with help of staples/sutures.4,5 Ankle foot orthosis was prophylactically applied in all the patients. Patients were asked to lie in prone or lateral position with elevated operated limb. In flaps with Skin Bridge, pedicle was divided after three weeks. Weight bearing was allowed after 4–6 weeks. Patients were followed up for minimum one year.

RESULTS

All flaps except five survived without any complications. Five flaps showed venous congestion relieved with multiple skin incisions (Figure 5 & 6), among these three had superficial skin necrosis and two had partial tip necrosis and resulted raw area which was subsequently skin grafted. The average hospital stay was one week and average healing time was four weeks. There was no incidence of any neuroma formation. No patient had difficulty in walking and weight bearing on the operated limb.

Figure-1: 18-year-old male with heel pad avulsion injury in trauma 2 years back

Figure-2: Actual heel defect after debridement, pivot point marked as 'x', pedicle & flap outline marked

Figure-3: Pear shaped flap elevated with adipofascial pedicle

Figure-4: Flap inset over the primary defect & secondary defect resurfaced with split skin grafting

Figure-5: Flap showing venous congestion

Figure-6: Follow up at two months

DISCUSSION

Compound injuries have become more common with the advent of mechanization and high velocity trauma forms an integral part of admissions to the in-patient department of emergency services. Lower limb is perhaps the most common site of compound trauma due to the tibia being a subcutaneous bone. Soft-tissue defects of the distal third of the leg and foot are difficult to reconstruct especially when the bone or the Achilles' tendon is exposed. There happen to exist many options for coverage of these defects, including fascio-cutaneous flaps, muscle flaps, septo-cutaneous flaps, axial flaps, local transposition flaps and free flaps. Fore mentioned treatments modalities have their own pros & cons. The important advantage among these belongs to the distally based sural fascio-cutaneous flap as it is vascularized by the median/lateral superficial sural artery with presence of unique reverse flow. This artery has inherent septo-cutaneous perforators from the peroneal artery in the distal part of the leg which make it most suitable for flap survival. Also, the sural nerve has an intrinsic arterial system in the form of perineural arcade from the peroneal artery. All the supplying arteries communicate to form a supra-fascial plexus.[4]

In present study, all the distally-based sural artery adipo-fascial flaps survived adequately with minor complications in a few cases. It is an easy to harvest flap with a rich vascular supply, which covers difficult sites on the leg, ankle and foot. Use of these flaps also negates the need of surgical expertise for neurovascular anastomosis as in cases of free muscle pedicle flaps. The basic principles for flap surgery in children are the same as those for adults. Adipo-fascial flaps have come up as the modality of choice in primary/delayed treatment of compound injuries of the lower limb. It is a flap that can be done immediately by the attending surgeon, thus reducing complications and hospital time and saving money.[6] This flap was noticed to have several advantages: 1) it is a two-staged simple procedure in cases where flap is not islanded and was raised with skin paddle without the need of microsurgical techniques. 2) Elevation of the flap is easy and quick. 3) The vascular supply to the arterial network of the sural artery is constant and reliable and there is no need to sacrifice any major artery. 4) The pedicle is long and the skin island can be transferred as far as to the instep area. 5) For weight-bearing heel coverage, the flap potentially provides a protective sensation. 6) The morbidity of harvesting the sural nerve is minimal. 7) For moderate to large defects, the well vascularized flap can obliterate dead space infection. In small flaps, the donor site can be closed primarily with minimal morbidity.

The main disadvantages of this flap are the sacrifice of the sural nerve and donor site scar as distal part of donor site is grafted with skin graft. Some authors reported raising flap and sparing sural nerve, but it is too risky for the vascular supply of the flap. This study and other studies showed that in spite of cutting sural nerve all patients showed improvement of sensation with time on the lateral side of the foot.[7,8]

CONCLUSION

The distally based adipo-fasical flap on the superficial sural artery is a versatile & reliable option for the coverage of soft tissue defects of the distal lower extremity especially the ankle, heel and the dorsum of the foot. The procedure can be done in a single stage and the results are uniformly acceptable

with minor complication rates. Also, the dissection being fast and easy, the time of procedure remains short even in less experienced hands.

AUTHORS' CONTRIBUTION

KS, RR, RS: Performed surgeries, article writing. SS, BS, MT: Collected data, evaluated outcomes, article writing

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