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Research Article

Outcome of Delayed Distally Based Sural Flap for Distal Tibial and Foot Defects

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Abstract: Background: Lower limb defects can be tricky to repair. We have limited options for reconstruction in the leg and foot region. Sural flap is considered as the workhorse for reconstruction of these defects. We present our case series of delayed reverse sural flap.

Objective: To determine the outcome of Delayed Distally based sural flaps for distal tibial and foot defects.

Materials and Methods: Study was carried out at plastic and reconstructive unit HMC and MMC. Over a period of 10 years from January, 2009 to December, 2018. This is a cross sectional study, presenting with soft tissue defects of foot. Patients presented in the emergency, as an outpatient or as referrals from another center. All patients were admitted and operated as elective cases.

Result: In 24 patients, there were no complications. Two patients (6%) had partial flap loss and required revision surgeries. Two patients had marginal flap necrosis and were treated conservatively.

Conclusion: This study presents our experience with use of reverse sural flap. It provides a reliable option for foot and distal leg defects. It is relatively easy to do and easy to learn. It can be attempted in centers where expertise or facilities for microvascular surgery are not available and in patients who are not ideal candidates for a free flap.

Keywords: Sural flap, Foot and leg defects, Delayed reverse sural flap, Peroneal perforators, Fasciocutaneous flap, Sural angiosome.

INTRODUCTION

Leg and foot defects are challenging for reconstructive surgeons because of paucity of local flap options. Most surgeons prefer free flap options and in some cases medial plantar artery flap in the foot. These are very tempting options, but patient selection plays a very important role in these flaps. There is a large demographic of patients who present with co-morbidities like diabetes mellitus and peripheral vascular disease. Reverse sural artery flap has a good success rate in those patients and can be reliably done in elderly with comorbidities [1, 2].

Epidemiology

Masquelet and Gilbert first described the classic distally based Sural flap [3, 4]. It comprises a median Sural artery in the proximal calf and the perforators of the peroneal artery (Fasciocutaneous branches) in the distal part of the leg, sual nerve and small saphenous vein.However these structures are sacrificed proximally [3,5]. In the leg, the sural nerve arises from the branches of the posterior tibial nerve and the peroneal nerve in the proximal leg [3, 4]. The sural neve lies between the heads of gastrocnemius muscle subfascially in the proximal leg [5]. In the middle third of the leg, the sural nerve becomes superficial to the fascia and runs in the subcutaneous plane along the lesser saphenous vein [6]. These structures serve as landmarks to identify the perforator branches of the peroneal artery that supply to the sural nerve lesser saphenous vein, the subcutaneous tissue and the skin in the sural angiosome [6]. Posterior tibial artery perforators al so supply the sural angiosome [7]. If a large flap is needed to cover the defect, the dissection is done deep to the fascia covering the gastrocnemius muscle in order to include the sural nerve [8].

Despite a wide arc of rotation, an adequate coverage and quick dissection,the main complications are congestion attributed to paucity of venous channels or perforators,sensory deficit lateral foot, donor site morbidity and flap necrosis [3, 5].

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Different flap modifications are proposed as a remedy to overcome these complications like distally based Sural artery Peroneus (Brevis) flap and the distally based Sural flap with Gastcnemius muscle [6, 7]. Sural artery flap is the workhorse of distal leg and foot defects. It is a versatile flap and can be used in variety of defects. We want to present our experience with delayed reverse sural artery flap.

The aim of this study is to determine the outcome of Delayed Distally based sural flaps for distal tibial and foot defects.

MATERIALS AND METHODS

Study was carried out at plastic and reconstructive unit HMC and MMC. Over a period of 10 years from January 2009 to December 2018 (IRB: 921/DME/KMC). This is a descriptive cross sectional study, presenting with soft tissue defects of foot. Patients who presented with wheel spoke injury to the heel were admitted and operated as elective cases.

In the first stage, the flap dissection was done and the donor area was grafted. To dissect the flap, patient was put in the prone position. Midpoint between the lateral malleolus and the lateral border of Achilles tendon was measured and marked. This point was then connected to the midpoint of the popliteal crease. This line would mark the sural nerve and lesser saphenous vein. Perforators on which the flap would be based are marked at the 3cm, 7cm and 11cm from the midpoint between Achilles and the lateral malleolus. Defect size was measured. Flap size was marked according to the defect. We dissected the flap in a proximal to distal fashion. After giving skin incision, the sural nerve, lesser saphenous vein and sural artery are identified in the subcutaneous plane and transected. The sural nerve and lesser saphenous vein are carefully dissected along the flap to save the delicate neurocutanoeus and venocutaneous perforators of the flap. Flap dissection was stopped 11 - 7 cm above the lateral malleolus to preserve the perforators form the peroneal artery and the distal perforators of the posterior tibial artery. The flap was then put back on the donor site after dressing with petroleum jelly impregnated gauze. This stage is called delaying the flap. The flap was delayed for 3 to 7 days to give time for the distal perforators to support the flap tissue.

In the second stage, the flap was rotated on its pedicle, 11 cm above the lateral malleolus. The flap was inset at the defect. The lesser saphenous vein was ligated and tagged for possible intermittent phlebotomy in case of untoward venous congestion. In cases where venous congestion occurred, chemical leeching was done by placing heparin soaked gauzes on the flap.

Inclusion Criteria

This was a retrospective chart review study of patients presenting with soft tissue defects of foot sparing lateral malleolus either presented in the emergency, as an outpatient, as referrals from another center or all patients were admitted and operated as elective cases.

Exclusion Criteria

All those with infected wounds were excluded from this study. Ischemic foot, chronic osteomyelitis, chronic venous ulcer, contractures, high voltage electrical burns, occluded peroneal artery. Surgery is conducted in two stages.

RESULT

We operated a total of thirty-one patients. There were 24 (77.4 %) male patients and seven female patients. Age ranged from 5 years to 60 year old with a mean age of 31.5±7.81 years. Most common cause of heel injuries was road traffic accidents.

Wheel spoke injuries of heel were the most common defects; 12 (38.7%) cases, followed by seven (22.5%) cases of soft tissue loss on distal leg (Fig. **1**).

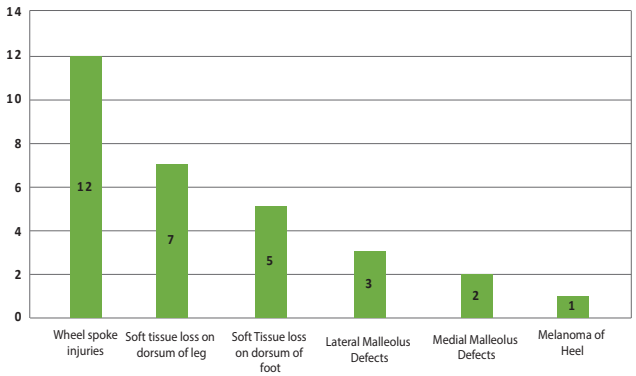

Fig. (1). Type of Injuries & Lesions.

Flap dimensions varied according to the defect size, usually ranging from 6-12 cm in length and 4-8cm in width. Mean dimensions of the flap were 8.4cm x 5.7cm. Flap was delayed from 3-7 days. In one case, the flap was delayed for 3 weeks.

In 25 patients, there were no complications. Two patients (6%) had partial flap loss and required revision surgeries. Three patients had marginal flap necrosis and were treated conservatively. There was complete flap loss in one patient. There was donor site morbidity included complete graft loss in a single patient, while most patients had dryness and itching of the grafted donor areas on follow-up visits (Figs. **2**-**7**).

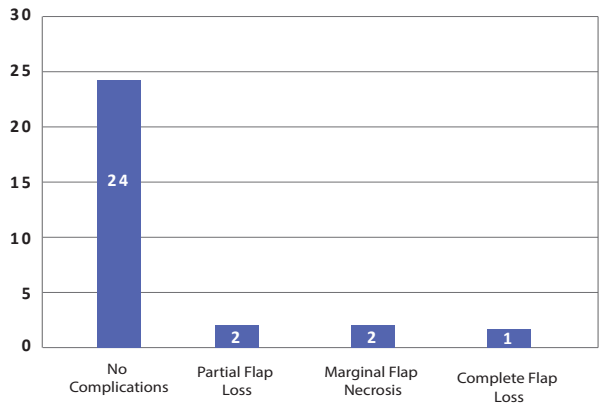

Fig. (2). Complications.

Fig. (3). Post RTA Wheel Spoke Injury, Right Foot.

Fig. (4). Post Traumatic Heel Defect, Right Heel.

Fig. (5). Post Traumatic Dorso-Medial Left Foot with Exposed Medial Malleolus.

Fig. (6). Degloving Injury of Dorsum of Right Foot.

Fig. (7). Squamous Cell Carcinoma Right Heel.

DISCUSSION

Besides a free tissue transfer, reverse sural flap was a good option in the distal leg and foot area [8-11]. The success rate of this flap has improved over time in recent years due to improvement in the understanding of the vascular anatomy of the flap and meticulous dissection techniques [2, 12].

Our mean flap dimensions were 8.4x 5.7cm. We delayed all the flaps to decrease the incidence of venous congestion. In literature, the flap length of 14-8 cm and width of 8-6cm have been reported. Metabolic demand of the flap rises with bigger flaps. To decrease incidence of flap compromise, it is advisable to delay the flap, especially in case where larger flaps are needed to cover the defect [13-16].

Proximal end of the flap is marked with reference to the popliteal crease. The proximal limit of the flap is not extended beyond 1.5 cm to 6cm [17, 18] Chen SL, *et al*. described a proximal limit of 6cm to avoid distal necrosis, however, his case series was based on diabetic patients [17].

A pooled analysis done by De Blacam C, *et al*. showed that diabetes mellitus, peripheral vascular disease and history of smoking are not associated with the increase in the risk of complications [19]. In contrast, some authors report 5-6 fold increase in the risk of complications in patients with the above mentioned co-morbidities [20]. Along with the venous insufficiency, age is also found to be an independent risk factor for increase in complication rate [14, 19]. Parrett BM, *et al*. found a significant increase in flap loss, and partial flap necrosis in patients with history of smoking, diabetes and peripheral vascular disease [21]. The increased complication rate due to co-morbidities led to multiple procedures down the road. It is therefore advisable to go for a delay procedure in patients with co-morbidities to decrease the risk of any complications.

The most common risk factor reported with complications of this flap is the venous insufficiency [19]. Venous insufficiency increases the risk of complications by 9 folds [19]. To remedy this problem, the lesser saphenous vein is used for supercharging the flap by anastomosing with another vein [20]. If venous congestion occurs, it can be treated by heparin, leeches or scoring. Some authors would prefer a delay procedure only when the saphenous vein is not found during the dissection [20]. Surgical delay of the flap causes the choke vessels to be opened between to the neighboring angiosomes. Intermittent drainage of the saphenous vein, supercharging and exteriorization of the pedicle can also be used to reduce venous congestion in the flap [22].

The rate of distal necrosis in our study is 6%. Another study by Noaman HH, *et al*. [23] reported a distal necrosis rate of 8.97%. They also found that the rate of distal necrosis significantly increases with the increase in length to width ratio of the flap. Other studies also showed similar rate of distal necrosis [24-26]. As the width of the flap cannot be increased due to availability of the tissue, therefore if a lengthy flap is required, it is paramount to delay the flap in order to increase the chances of success.

Reverse sural artery flap is a versatile option for the reconstruction of lower leg and heel defects. It has a reliable anatomy. It is relatively easy to do and easy to learn. It can be attempted in centers where expertise or facilities for microvascular surgery are not available and in patients who are not ideal candidates for a free flap. To use this flap effectively, the surgeon should be mindful of the factors that can increase the complication rate. The limitation of this study is that it is a retrospective study. Data was collected from patient records. We were unable to study several other factors because of the retrospective nature of the study; we could not reliably retrieve those variables. To summarize, the increase flap size, co-morbidities like smoking, diabetes mellitus, peripheral vascular disease, old age and venous congestion can significantly increase the complication rate of this flap. Therefore, it is always prudent to perform the delay procedure in such patients [17-21].

CONCLUSION

This study presents our experience with use of reverse sural flap. It provides a reliable option for foot and distal leg defects. It is relatively easy to do and short learning curve. It can be attempted in centers where expertise or facilities for microvascular surgery are not available and in patients who are not ideal candidates for a free flap.

OPERATIONAL DEFINITIONS

Sural Flaps: Fasciocutaneous flap based on the vascular axis of Sural nerve.

Distally Based Flap: Is transfer of normal block of tissue based on distal / minor pedicle from healthy area to reconstruct defect in opposite direction of standard arc of rotation.

Delayed Flap: A technique to enhance flap circulation to ensure flap survival following transposition.

Distal Tibial Foot Defects: A structural loss resulting from surgical debridement or tumor resection or combination of both.

AUTHORS' CONTRIBUTION

- **Syed Mohammad Haider**: Data collection and analysis, Literature review.
- **Muhammad Shadman**: Concept and study design, conducted research, Data collection and interpretation, Analysis, Wrote the initial write up.
- **Firdous Khan**: Manuscript writing, Data collection and analysis, Interpretation of results.
- **Adeeba Ahmad**: Data collection and references, Introduction writing, Critical review of manuscript.
- **Waqas Hayat**: Drafting, Editing, Data analysis, Interpretation of results, Discussion of results, Discussion and conclusion writing, Made necessary changes.
- **Abida Binte Wali**: Contributed equally.

CONFLICT OF INTEREST

Declared none.

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