

Original Article**Surgical Experience of Reconstruction of Distal Lower Limb Soft Tissue Defect with Reverse Sural Artery Flap with Cutaneous Pedicle****Ranjib Kumar Jha^{*}, Santosh Thapa, Asish Rajthala**

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Article Received: 15th September, 2023; Accepted: 25th October, 2023; Published: 31st December, 2023**DOI: <https://doi.org/10.3126/jonmc.v12i2.61112>****Abstract****Background**

The soft tissue reconstruction of distal leg, ankle and foot is always challenging to orthopaedic surgeons. Among many available options, the reverse sural artery flap is technically easy local option to cover soft tissue defect. We aim to share our experience of reverse sural fasciocutaneous flaps for reconstruction of distal leg soft tissue defect.

Materials and Methods

An observational retrospective study was conducted on all cases that had undergone reverse sural flap surgery between February 2019 to January 2023 in orthopedic department of Nobel Medical College Teaching Hospital. The following variables were gathered for analysis: hospital stay duration, postoperative complications, etiology and duration of the wound, wound site and size, number of surgeries, associated trauma, surgery time and technical details, and final outcome in terms of flap survival.


Results

Out of 20 cases, sixteen were male and 4 were female. The mean age was 36 years. Seven cases (35%) had associated comorbidities. The most common etiology was trauma and most common sites was ankle and calcaneus (60%) followed by distal leg (35%) and foot (5%). The graft survival rate was 85%. Three cases (15%) had partial flap necrosis and one (5%) had venous congestion.

Conclusion

The reverse sural artery flap is easy, versatile and reliable technique to cover soft tissue defect in distal leg, ankle and foot.

Keywords: *Leg injuries, Reconstructive surgical procedures, Surgical flaps, Wound healing*

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Introduction

The reconstruction of soft tissue defect of distal lower limb is always challenging for orthopedic surgeons because of lack of musculature in this region, thin in-expandable skin and predisposition to massive edema after injury [1]. Therefore, when soft tissue wounds are not appropriate for primary closure or STSG, these defects frequently require flap coverage. There are so many available flap coverage techniques for lower limb such as free flaps, random flaps, distally based muscle flaps, staged and non-staged fascial and fascio-cutaneous flaps and reverse flow arterial flaps [2]. Although microsurgical free flap is excellent option, but this surgery is technically difficult, time consuming and requires plastic surgeon's help, microscope and tertiary care hospital. So cutaneous and fasciocutaneous flaps with distal pedicle are another alternative technique to be considered for coverage of soft tissue defect of distal leg [3].

Donski and Fogdestam, in 1983, first described the distally based fascio-cutaneous flap and later it was popularized by Masquelete in 1992. Since then, reverse sural fasciocutaneous flap has become pillar for reconstruction of distal leg, calcaneus and foot soft tissue defect [4,5,6]. The arterial supply is based on communicating and perforating branches of fibular artery originating from 5 to 6cm proximal to the lateral malleolus [5]. The venous return for the flap is done by venous network of the superficial sural vein, the short saphenous vein and the associated veins of the peroneal artery [7].

The aim of our study is to present experience with use of reverse sural fasciocutaneous flap for the reconstruction of ankle, calcaneus and foot defects.

Materials and Methods

This was a retrospective study conducted in Nobel medical college, Biratnagar. After getting ethical clearance from IRC of our institute, all patients who underwent lower limb reconstruction with reverse sural fasciocutaneous flaps between February 2019 to January 2023 were searched from our hospital medical record and all were included in our study. Those patients who had multiple flap surgery or who lost follow up and had incomplete record were excluded from our study. The total population sampling method, a non-probability sampling method, was applied in this study. All of the patients who had undergone reverse sural flap during study period and had proper follow up and records were included in this study after receiving their consent. In the

study period from February 2019 to January 2023, a total of 20 patients met the inclusion criteria and thus the sample size of this study was 20.

The variables collected for analysis were demographic parameters, personal medical history, etiology and duration of wound, site and size of wound, number of surgeries, associated trauma, surgery time and its technical details, length of hospital stay, postoperative complications, and final outcome in terms of survival of flap. Data were analyzed by descriptive statistical analysis using SPSS version 20.

All surgeries were performed in prone position under spinal or general anesthesia. After application of tourniquet in proximal thigh, the usual procedures were performed and the entire lower limb was kept exposed in the operative field. First, the surgical debridement was performed and size of wound was measured. A line was drawn from center of popliteal fossa to a point in between posterior border of lateral malleolus and Achilles tendon which approximate the vascular axis of flap. The cutaneous perforators which irrigate the flap are mostly present in the posterolateral margin of the distal region of the leg. To preserve more in number, we marked pivot point at 6 to 7 cm above lateral malleolus. We did not use doppler study or angiographic study to mark perforators or to see vascularity of flap. A template of the defect was used to position the flap along the axis in the proximal and middle thirds of the leg, such that the distance from the chosen pivot point to the end of the flap was greater than the distance from the pivot point to the farthest edge of the defect.

The pedicle of reverse sural flap (RSF) contains the sural nerve, medial superficial sural artery and lesser saphenous vein. The sural nerve runs between the two heads of the gastrocnemius muscle and descends into the deep fascia of the middle third of the leg [5]. The RSF receives retrograde arterial flow through septocutaneous perforators that originate from peroneal artery and anastomose with the medial superficial sural artery. Among many septocutaneous perforators, the distal most is given at 5cm above the lateral malleolus [8]. The lesser saphenous vein transport retrograde venous flow from the flap and bypasses the valves of the deep venous system through anastomosis connections with the venae comitantes of the sural nerve [7].

The flap was raised by incising the marked edges keeping sural artery, vein and nerve at the superior margin of flap in the midline. The nerve was sharply divided and artery and vein was tied and divided. During dissection of the flap, we ensured



that the skin, subcutaneous tissue, and fascia are incised without beveling the margins. The paratenon was left intact. The skin, subcutaneous tissue and fascia were elevated bluntly as a unit. The flaps were raised with complete skin bridge overlying the pedicle (fasciocutaneous pedicle) keeping the width of pedicle at least 4cm to capture more collateral veins and improve venous drainage.

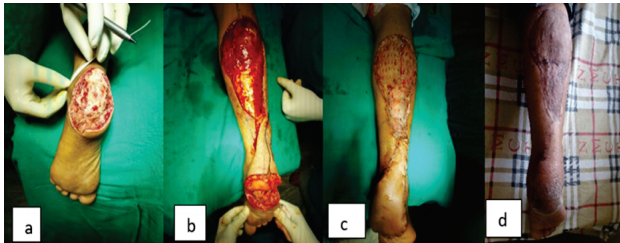


Figure 1: Male healthy, 29years old patients with heel pad injury. (a) Heel pad injury after debridement. (b) Flap dissection. (c) Primary inset of flap and split thickness skin graft of donor area. (d) Postoperative evolution at 6months without any complications.

The flap was checked intraoperatively by deflating the tourniquet. An open passage was created by incising the skin bridge between the donor and recipient area. The raised flap was rotated and placed over the defect and was sutured loosely to edges with 3-0 nylon. We did not use any drains. The donor area was then covered with a split skin graft which was harvested from same thigh. The limb was immobilized with an anterior plaster of Paris slab with non-compressive dressing. The flap was inspected at regular intervals and sutures were removed at 3wks to ensure ingrowth into the flap from the periphery. Weight bearing status was determined by the location of flap and associated fracture fixation.



Figure 2: Postoperative, 56 years male , tobacco chewer patient with exposed implant after fixation of distal tibia. (a) At 3 weeks. (b) Healed flap at 6 weeks of flap surgery.

Results

We performed reverse sural fasciocutaneous flap in 22 cases between February 2019 to January 2023, but two patients did not have proper follow up and documentation. So, they were excluded from our study. The minimum post operative follow up for all patients was at least 6 months. Patient demographics are listed in Table 1. Out of 20 cases, 16 were male and 4 were female. The mean age was 36 years (range 20-64 years). Regarding co-morbidities, seven patients (35%) had associated hypertension, diabetes mellitus or cardiac disease and thirteen patients (65%) had no associated comorbidities.

Table 1: Patient Demographics

Variable	Number	percentage
Age (mean±SD) in years	35.85±13.36	
sex		
Male	16	80%
female	4	20%
Associated comorbidities		
None	13	65%
Hypertension	4	20%
Diabetes mellitus	2	10%
Cardiac disease	1	5%
Personal history		
None	10	50%
Tobacco smoking	6	30%
Alcohol	2	10%

Wound characteristics and post-operative complications are listed in Table 2. The etiology of soft tissue defect was due to RTA in 13 patients (65%), snake bite/post-cellulitis wound in 3 (15%) patients, post-operative complications after distal tibia fixation in 3 (15%) patients and after TA repair in 1 (5%) patient. The injury sites were around ankle and calcaneus in 12 (60%) patients, in distal leg in 7 (35%) patients and in foot in one (5%) patient. Fourteen patients (70%) had acute wound (<30 days) and 6 had chronic wound (>30 days). The mean size of wounds was $27.5 \pm 8.28 \text{ cm}^2$ ranging from 16 cm^2 to 56 cm^2 . The average duration of surgery was 119min (100-150 minutes). The average duration of hospital stay was 16 days ranging from 10 days to 28 days. Out of 20 cases, 16 case (80%) healed uneventfully. Whereas, one case (5%) had venous congestion and 3 cases (15%) had partial flap necrosis (fig.3). We did not find any cases with post operative hematoma, infection or any loss of split thickness skin graft over donor area of flap.

Table 2: Wound Characteristics

Variable	Number	percentage
Etiology		
RTA	13	65%
Post-cellulitis	3	15%
Postoperative for distal tibia fracture	3	15%
Post-operative after TA repair	1	5%
Location		
Ankle and calcaneus	12	60%
Distal leg	7	35%
Foot	1	5%
Wound defect size (cm ²)	27.5±8.28	
Mean operative time		
Duration of wound		
Acute (<30days)	14	
Chronic(>30days)	6	
Post-operative complications		
None	16	
Partial flap necrosis	3	
Venous congestion	1	



Figure 3: Partial flap necrosis in male, 52 years diabetic and smoker patient.

Discussion

The reverse sural flap is popular among orthopedic surgeons for treatment of wounds of the distal leg, calcaneus and foot because it is reliable, the technique doesn't require microsurgery and

microscopes and may be completed faster than free flaps [9,10]. The literature and personal experience of orthopedic surgeons showed that it can be reliably applied by non-plastic surgeons with outcomes similar to standards [11]. The reported survival rates of RSF for reconstruction of the lower extremity is 95.2% [12]. We found graft survival rate of 85% in our study.

In our study the most common cause of soft tissue defect was trauma (65%) and most common site of soft tissue defect was over ankle and calcaneus (60%). In systemic review done by David et al, they found traumatic etiology in 60.4% and most common defect location was heel (40.8%) [13]. The overall complication rate for RSF surgery varies widely in literature, with some literature showing no complications. In meta-analysis of 1592 flaps done by Tripathy et al in 2022, they found overall complication rate of 25.20% with most common complication of partial flap necrosis in 7.85% followed by venous congestion in 3.05% and complete flap necrosis in 2.5% [14]. In our study, we had lesser incidence of overall complication rate of 20% and most common complication was partial flap necrosis in 15% followed by venous congestion in 5%. We did not find any cases of complete flap necrosis. In systemic review of Daar et al., the overall complication rate was 33.7%, which was increased up to 50% when they analyzed in older patient group [13]. Our finding of lesser overall complication rate might be because of younger age of our patients (mean 36 years) and most of the cases had post traumatic and proximal soft tissue defect.

Out of three cases who had partial necrosis, one had history of smoking and DM, one had history smoking and one did not have any associated comorbidity but soft tissue defect was over heel extending up to midfoot. One case was managed with debridement and flap was readvanced for closure. Other two were managed with debridement and split thickness skin graft. Smoking, peripheral vascular disease and advanced age are the main risk factors associated with flap necrosis [13,15,17]. Two cases of flap necrosis had associated risk factors of smoking and DM in our study, which explain the reason of complication.

The venous congestion of RSF is one of the major complications of surgery because of the presence of valves in the deep venous system which prevent uninterrupted retrograde venous flow. In a study of 71 patients by Almeida et al, they found 25% of partial or complete flap necrosis and they described venous congestion as one

of the main causes of necrosis [17]. To improve venous flow and prevent venous congestion, several modifications in RSF technique have been suggested such as supercharging, wide pedicle harvest and adipofascial flap [12, 15, 18, 19]. In our study only one case had venous congestion, which resolved after elevation of leg, without flap necrosis. We harvested wider fasciocutaneous pedicled graft of at least 4cm width and the limb was strictly elevated and patients were asked to lie in prone, lateral or semiprone position postoperatively to avoid pressure on pedicle of graft. These measures might have worked to decrease venous congestion of flap. The limitations of our study are small sample size, retrospective type of study and lack of any objective tools to assess clinical and functional outcomes of reverse sural flap.

Conclusion

The reverse sural fasciocutaneous flap is simple technique for orthopedic surgeons which can be done without use of microvascular techniques and provide excellent coverage for soft tissue defects in the distal leg, ankle and foot.

Conflict of interest: None

Financial disclosure

No benefits in any form have been received and will be received from commercial party related to the subject of this article.

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