

Original Article**Sural Flap- A Prospective Study****Alamgir Adil Samdany¹, Md Abdul Gani Ahsan², Shankar Kumar Roy³****Abstract**

Objective: Soft tissue loss on distal one-third of leg, around ankle and foot is a big problem. There are many options, but each of them has advantages and disadvantages. Sural fasciocutaneous flap is an option for this problem which has excellent results with minimum morbidity.

Methods: Between 2016 and 2020, all patients with open fracture type IIIB on the distal third of the tibia, exposed Achilles tendon, ankle, lateral and medial malleoli or heel reconstruction were performed by sural flap. The flap viability rate and durability of the flap at these sites were evaluated.

Results: Sixteen patients from 15 to 70 years old were included in this study. We obtained excellent result with this type of flap in all the patients and success rate was considered as 100%.

Conclusion: With a few limitations, high success rate and comparative easy operative procedure; sural flap may be a good option for soft tissue loss at distal leg, ankle and foot.

Keywords: Distally based, sural artery flap, reverse flow, fascioneurocutaneous.

JSWMC 2020(10-1) P: 56-61**Introduction**

Soft-tissue resurfacing of the lower extremity remains a challenging but a common problem.¹⁻⁴ To resurface the lower extremity with a huge soft tissue loss, free flaps are recently the standard procedure.⁵ But this flap done by a specialist microsurgical team and there require a long time. A cross-leg flap may be another procedure for coverage soft tissue loss, but has the associated difficulties of immobilization and positioning of the limb from the time of flap resurface to division of the flap.⁶

A distally based sural flap was one of the recently introduced therapeutic possibilities. In 1992 Masquelet et al.⁷ first described the use of a sural neurocutaneous flap based on the vascular axis around the sural nerve. The sural island flap has become popular for soft tissue resurface of the distal leg, ankle and foot.⁸⁻¹¹ The distally based sural island flap gets its blood supply by the reverse flow from the perforators of the peroneal artery, and the pivot point within 5–7 cm above the lateral malleolus.^{10,11} With its constant anatomy and blood supply, this flap can be elevated reliably without micro vascular techniques. As no major artery is needed, the flap may possibly be elevated even in cases with peripheral vascular disease, or when major arteries have been damaged in trauma.^{2,9,10} The flap also has the largest arc of rotation (up to 180°), so can be transferred to any direction.

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Materials and methods

We studied 16 patients over a period of 5 years in whom the sural flap was performed for soft tissue defects of the distal leg, around ankle and foot due to various causes. The patients included 13 males and 03 females. Their ages ranged from 14 to 72 years. The soft tissue loss were over the distal leg anteriorly and posteriorly, over the medial surface distal part of tibia, medial and lateral malleoli, exposed Achilles tendon (AT), calcaneus and proximal sole and dorsal aspect of foot. Some patients had associated fractures of the tibia and fibula, chronic osteomyelitis and chronic ulcers. The age of the defect varied from a few weeks to months. Island flaps were used in majority of patients. The diameter of the flap depended on the area of the defect (Table-1).

Surgical procedure

All wounds were first treated by surgical debridement of necrotic tissue (Fig-5). Open fractures type IIIB was stabilized by external fixator. Within 5 to 10 days the soft tissue defects were covered with the flap. Every operation was performed under spinal anaesthesia, in prone position with tourniquet control. The flap was designed along the course of the short saphenous vein. The distal pivot point was marked 5 cm above the lateral malleolus and the flap was outlined according to the size and shape of the defect. Dissection of the flap was started from upper border of the flap, the deep fascia was also incised and fixed to the skin with 4/0 vicryl.⁵



Fig: 1 Soft tissue defect over Achilles tendon (AT)



Fig 2: Five days later of flap over Achilles tendon



Fig 3: Six months later of sural flap over Achilles tendon.

The medial and lateral borders of the flap were incised and the flap was dissected downward together with the deep fascia. Meticulous dissection essential in the subfascial plane, the sural nerve and artery were included with the skin & flap pedicle. When lesser saphenous vein and its accompanying arteries are included with flap and its pedicle, flap survival rate also increased.¹² The pedicle of the flap contains superficial and deep fascia, sural nerve, small saphenous vein and accompanying vessels, median superficial sural artery (neuro-veno-adipofascial pedicle)^{13,14} with a 2.5–3 cm width soft tissue. The flap proper includes the skin island, subcutaneous tissue and the fascias (neuro-veno-fasciocutaneous flap).^{13,14,15} After complete dissection, the flap was rotated 90-180° according to required and sutured over the defects (Fig-2, 6). No subcutaneous pedicle tunneling was performed. Partial-thickness skin graft was covered the donor

site (Fig- 2, 6) or was closed directly for flaps less than 5 cm in width, depending on the degree of skin laxity.



Fig: 4 Soft tissue defect over right



Fig 5: Wound over right lateral malleolus (LM) after debridement



Fig 6: Three months later with good healing of sural flap.

Results

Among the cases studied (Table-1), the injury to the lower limb was due to road traffic injuries in 9 cases, two patients were injured by Indian type toilet pan over Achilles tendon (AT), two patients had chronic diabetic ulcer, two patients had malignant ulcers and one patient injured by electric burn. Two cases were fractures of the

underlying bones with chronic osteomyelitis. Soft tissue loss over Achilles tendon were 4 cases, skin loss over dorsum foot with exposed extensor tendons in 1 case, and antero-medial lower leg skin and periosteum loss in 3 cases. In 4 patients were exposed calcaneum. The range of rotation of the flaps were 90° to 180° . The flap was rotated by 180° to cover the defects over the AT and heel (Fig-3) in 8 patients. The flaps were raised 15–30 cm above tip of the lateral malleolus. The width of the flap ranged from 4.5 to 8cm. at its widest region and length 5 to 14 cm. The flap survived in all patients and the average healing time was 21 days. Only in one 72 year-old smoker patient of malignant fibrous histiocytoma over dorsum of foot, had partial loss (about 2.5 cm) at distal margin of the flap but the adipofascial tissue was well irrigated and underwent debridement and resurfaced by a partial thickness skin grafting. Mild swelling was only seen in the distal portion of flaps in 3 cases, which resolved a few days postoperatively. No complications were observed in the donor site. No symptomatic neuroma was noted from the proximal stump of the sural nerve, which was buried in the surrounding muscle tissue.

Discussion

In defects exposing the underlying tendons, ligaments, or bone and tissue loss localized in the areas on the distal part of the leg and foot; flaps which are durable to trauma, ensuring the weight-bearing tissue and having a more aesthetic appearance, are preferred to skin grafts. However, local flap has enough limitations, like no adequate soft tissue, and tight skin for reconstruction and scarce blood supply. Distant flaps and free flaps have more disadvantages, such as the need for a microsurgery team and equipment, long operation times, and difficulty finding the appropriate vessels. On the other hand, regional flaps (e.g. muscle or fasciocutaneous) are quite popular.

Table 1. Clinical characteristics of the patients

Patient	Age	Sex	Etiology	Recipient site	Flap size (cm)	Follow-up	Complications	Smoking	DM
1	70	F	MFH	Dorsum of foot	7×13	2 years	Marginal flap necrosis	Yes	No
2	54	M	Trauma	Over AT	5×10	3 years	None	No	No
3	18	M	Trauma	Over AT	5×6	1 years	None	No	No
4	15	F	Trauma	Anterior distal tibia	7×9	2 years	None	No	No
5	38	M	Trauma	Anterior distal tibia	7×8	2 years	Superficial flap necrosis	Yes	No
6	65	M	trauma	Over AT	9×10	6 months	None	No	No
7	42	M	SCC	Heel	5×7	6 months	None	Yes	
8	36	M	Trauma	Over AT	6×6	1 years	None	No	No
9	16	M	Trauma	Anterior distal tibia	7×8	1 years	None	No	No
10	40	F	Diabetic ulcer	Heel	5×6	6 months	Partial rejection of split skin graft		Yes
11	55	M	Trauma	Anterior ankle	6×11	5 months	None	Yes	No
12	45	M	Diabetic ulcer	Heel	7×6	5 year	None	Yes	No
13	42	M	Trauma	Over lateral malleolus	4×6	4 months	None	Yes	Yes
14	53	M	Fourth degree burns	Heel	5×5	5 months	None	Yes	No
15	41	M	Trauma	Over medial malleolus	6×5	7 months	None	Yes	No
16	17	M	Trauma	Anterior ankle	8×6	2 year	None	No	No

SCC, squamous cell carcinoma. MFH, malignant fibrous histiocytoma. AT, Achilles tendon

However, inferiorly based muscle flaps have a high failure rate,¹⁶ while reverse peroneal,¹⁷ posterior tibial,¹⁸ and anterior tibial flaps,^{19,20} sacrifice a major artery in the leg.

Masquelet *et al.*⁷ who were the first describe the “neurocutaneous island flap,” the management of leg and foot defects became easier. They revealed that the superficial sural artery courses on the leg in two different ways, descending to the ankle in 65% or becoming an interlacing suprafacial network in 35%. Sural artery

anastomosis with the septocutaneous perforators of peroneal artery. These are usually 3-5 in number. Thus flap dissection must be performed under the deep fascia, including the pedicle, to preserve this anastomosis on the suprafascial plane.⁷ The last perforator was given off 5 cm above the tip of the lateral malleolus. However, the mechanism of venous drainage of the reverse flow-sural artery flap has not been clarified exactly. Some suggested that the venous drainage

was probably supplied via a suprafacial venous network in the pedicle.^{7, 21}

Invariable anatomy of the sural region, easy and quick dissection, ensuring a reliable arterial supply, not sacrificing of any major artery, wide arc of rotation, elevation of large flap, minimum morbidity, no functional impairment, avoid microsurgery, a single stage procedure and obtaining a thin flap, this flap become more popular.

Excellent result was found by distally-based superficial sural neurocutaneous flap for resurface of the ankle and foot in children.²² It can be safely applied in paraplegic patients. Because the dorsal root ganglia remain intact in paraplegic patients and can preserve neural characteristics in the peripheral sensory nerve system.²³ This also a recommend flap as a primary procedure for soft tissue reconstruction of fourth degree burn, around ankle and foot.²⁴

Arterial insufficiency is rarely encountered because the reverse sural flap has a powerful and constant arterial supply from both the reverse flow system of the median superficial sural artery-peroneal artery perforators and an additional intrinsic arterial system of sural nerves. So this flap can be applied for reconstruction of soft tissue loss in an open tibial fracture with impaired circulation of anterior and posterior tibial arteries.²⁵ Venous congestion is not uncommon in diabetic or elderly cases displaying peripheral vascular disorders,²⁶ or when the large flaps are planned.⁹

Conclusion

Sural neurocutaneous flap is a versatile, dependable technique for soft tissue coverage of the distal leg, ankle and foot. The flap elevation is simple and can provide different size and shape

for resurface of the defects. In addition, these flaps can also provide good outlook and contour the recipient site. In our view, this flap not only provides an alternative to microsurgical procedure, but also can be a good option to cover the defects over mentions area.

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