

The Use of Gastrocnemius Muscle Flap in Reconstruction of Pretibial Defects

Karn B

ABSTRACT

Background: In Western part of Nepal the post traumatic lower leg and bone injuries with infected, open wound is common occurrence. **Aim:** It was to find out whether Gastrocnemius muscle flap is a viable option for pretibial defects. However variations in vascular anatomy of pedicle, use of reverse flow soleus muscle flap based on posterior tibial artery, leads to high failure rate and sacrificing major leg vessels. **Method:** Use of soleus muscle flap supported by perforating arteries, branches of posterior tibial vessels is option to cover small defects. The flap with careful newer modification to preserve vascularity, is used in 32 cases of pretibial defects. **Observation:** All 32 flaps survived with two cases in post operative phase, needing a flap elevation debridement of underlying bone and other skin grafting. **Result:** None of the case showed any vascular insufficiency, graft muscle loss or any functional loss. Use of muscle flap a viable option in pretibial defects.

Key words: Flap, gastrocnemius muscle, pretibial defect

INTRODUCTION

Severe injuries of lower extremities usually result in soft tissue losses and leg defects ranging from small to large ones. They are usually accompanied by bony fractures or losses and even vascular injuries adding another difficulty to reconstruction. The problem of pretibial defects becomes more apparent, especially if it is associated with exposed fractures or chronic osteomyelitis of the tibia. In these situations muscle flaps are needed to cover these defects in order to combat infection and to bring more vascularity to the area to enhance bone healing.

A pretibial defect usually represents a reconstructive challenge. Here the role of local skin flaps and distally based fasciocutaneous flaps may become limited especially if their pedicles fall within the zone of injury. Conventional cross-leg flap is another alternative but in cases associated with fractures and in the presence of external fixator it may be difficult to apply. This article will describe the use of the gastrocnemius muscle flap in reconstruction of various pretibial leg defects in 32 patients and will demonstrate its versatility in coverage of any of these pretibial defects whatever their sizes or sites.

MATERIALS AND METHODS

The study was conducted in the Department of Plastic Surgery of Nepalgunj Medical College, Teaching Hospital, Kohalpur, Banke, Nepal from April 2011 to December 2013 with follow-up of an average 6 months. A total of 32 patients were included in the study. Defect sizes ranged from 12x5 cm to 8x4 cm.

Sixteen patients presented with fractures and had undergone either external or internal fixation by orthopedic surgeons according to the type of their fracture. All of them suffered from bone exposure. Four patients presented with chronic osteomyelitis and long standing discharging sinuses. In three of them the sinuses were located over the middle third of the leg. The one patient had discharging sinuses over proximal 1/3rd of the leg.

OPERATIVE TECHNIQUE:

All cases were operated under Spinal anesthesia at variable intervals according to the time of their presentation. In cases presented with osteomyelitis, aggressive debridement of the wound was done with simultaneous removal of all the sequestered bones (Fig. 1).

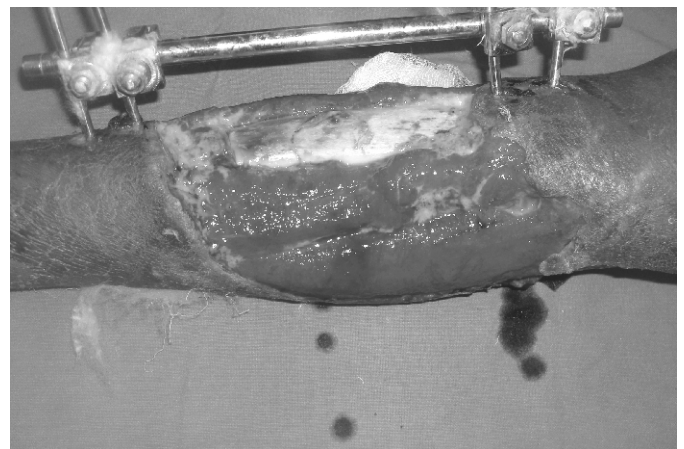


Figure 1: Pretibial defect with exposed tibia.

Address for correspondence:

Dr. Binod Karn
Department of Surgery (Burn & Plastic Unit)
Nepalgunj Medical College Teaching Hospital
Kohalpur, Banke, Nepal
E-mail: drbin2007@gmail.com

Through a medial approach and under pneumatic tourniquet using loop magnification, all the minor pedicles (perforators) of Gastrocnemius muscle were exposed and identified (Fig. 2).

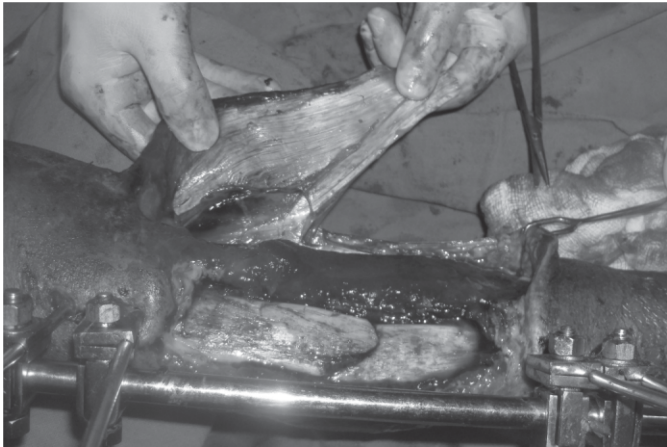


Figure 2: Elevated gastrocnemius muscle flap.

According to the defect size, site and extension, the suitable perforators were chosen and then the exact muscle segment needed was divided proximally and distally changing the flap to an island one. Defects over the medial side of the tibia were covered either by simple advancement or turn over of the muscle flap laterally (Fig. 3).

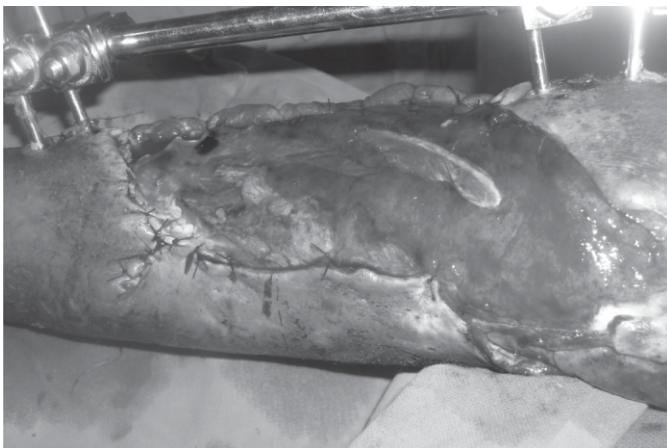


Figure 3: Covered exposed tibia by flap.

On the other hand, defects on the anterior side of the tibia were covered by further advancement of the flap after mobilization of the posterior tibial vessels from the posterior tibial nerve. Skin grafting was done to all the flaps (Fig. 4).



Figure 4: Skin grafting over flap.

Follow up of case after six weeks was advised for the scar massage with Aloe Vera cream (Fig. 5).



Figure 5: Follow up after 6 weeks.

OBSERVATION AND RESULTS

Study was carried on 32 patients. There were 20 males (62.50%) and 12 females (37.50%) (Table I).

Sex	No. of cases	Percentage
Male	20	62.50%
Female	12	37.50%

Table I: Distribution of case by sex

The age ranged from 16 to 72 years (Table II).

Age group	No. of cases	Percentage
15 - 25	5	15.62
26 - 36	12	37.50
37 - 47	4	12.50
48 - 58	7	21.77
59 - 69	3	4.37
70 and above	1	3.12

Table II: Distribution of case by age.

The causes of these defects were trauma & chronic osteomyelitis of the tibia. The sites of these defects were in the proximal third of leg (11cases), middle thirds (9cases) and the combined Proximal and middle third of leg (12 cases) (Table III).

Site of defect	Number of defects
Proximal 1/3 rd of leg	12
Middle 1/3 rd of leg	11
Combined Proximal & Middle 1/3 rd of leg	9
Total	32

Table III: Site and number of defects.

All 32 flaps survived completely without single flap loss. In one patient persistent discharge occurred from the underlying bone infection and partial disruption occurred. This was managed by flap elevation, further debridement of necrotic bone and secondary suturing. Complete take of the skin grafts occurred in all patients, except one patient needed another skin grafting session due to persistence of discharging sinus under the applied muscle flap. All patients had stable wound coverage during the follow-up period without the need of secondary procedures. None of the patients showed any sort of vascular impairment or any manifestations of venous insufficiency during the same follow-up period. No functional deficits were encountered and flap donor sites were esthetically accepted.

DISCUSSION

Free tissue transfer is another good solution¹, yet it is not available in all plastic surgery centers and has a higher failure rate². Local muscle flaps since first reported by Stark³ became an established procedure in reconstruction of pretibial skin defects especially in the presence of osteomyelitis⁴. Proximally muscle flap was described by Mathes et al.⁵ and has been employed in coverage of soft tissue defects of the middle third of the leg especially in cases of compound fractures. It has been also used for treatment of chronic osteomyelitis of leg

bones^{3,5,6}. But it carried the disadvantage of sacrificing the whole or one head of the muscle. The distally based muscle flap was introduced by Townsend⁷ and later by Fayman et al.⁸ is another option but it is associated with a high failure incidence^{6,9}. The reversed flow Soleus flap was described by Guyron¹⁰. However the flap did not gain much popularity because it has the great disadvantage of sacrificing major leg blood vessel^{10,11,12}. The muscle flap was first described by Yajima et al.¹³. This flap was based on one or two perforators and it was used to cover small pretibial defects. It has the advantage of being a reliable flap as it is nourished directly by the posterior tibial artery perforators which should be identified before flap elevation and this explains its high success rate. It has minimal functional deficit due to the use of a small portion of the muscle.

This flap has two disadvantages, the first one is being of small size which limits its use for small defects and the second is that the reconstructed defect should be located very close to the site of the supplying perforator which is unpredictable. Distally based hemisoleus muscle flap is a good solution but it carried a high failure incidence^{9,14}. This was explained by variation in the number and site of its distal perforators. The number of perforators were extremely variable^{11,12,13}.

However, in no single report, there have been no cases in which these pedicles were absent⁹. Yajima et al., found that the most distal perforator was found at fixed distance of about 61-145mm above the medial malleolus¹³. Shaker⁹ studied the site of the second most distal perforator of muscle and it was found to be at a distance of 15cm or more above the medial malleolus in 50% of his dissections. To increase the number of perforators and to augment the vascular supply of the flap, the reversed flow was described by Guyron¹⁰.

However, the flap did not gain much popularity because it has the great disadvantage of sacrificing a major leg blood vessel and cannot also be used if there is associated vascular injury or disease in the same leg. In the present study the island muscle flap was employed in small and large pretibial skin defects but unlike Yajima's report¹³, any number of perforators can be used. Being a muscle flap it resists bone infection and promotes bone healing so it is advisable in cases of osteomyelitis. The whole muscle length can be raised and this can cover any pretibial defect whatever its length omitting the need for free tissue transfer if combined with Soleus muscle flap.

CONCLUSION

The Gastrocnemius muscle flap represents a good option in reconstruction of pretibial defects especially in the proximal and middle thirds of the leg. It is a single stage procedure with high success rate and does not sacrificing any major leg blood vessel. It has reliable vascularity and can be easily harvested with minimal muscle morbidity. It gives the surgeon the opportunity to change his reconstructive plan early if the perforators were found unhealthy or injured. It can be

combined with the Soleus muscle flap to cover the whole exposed tibia as an alternative to free flap if not available.

REFERENCES

1. Harii K and Ohmori K: Free skin flap transfer. *Clin. Plast. Surg.*; 111(3):1976.
2. Yajima H, Tamai S, Mizumoto S, Ono H and Fukui A: Vascular complications of vascularized composite tissue transfer: Outcome and salvage technique. *Microsurgery* 1993;14:473.
3. Stark WJ.: The use of pedicled muscle flaps in the surgical treatment of chronic osteomyelitis resulting from compound fractures. *J. Bone Joint Surg.* 1946;28-A:343.
4. Ger R: The management of pretibial skin loss. *Surgery* 1968; 63:757.
5. Mathes SJ and Nahai F: Clinical applications of muscle and musculocutaneous flaps. St. Lois, Mosby, 1982.
6. Yajima H, Tamai S and Yamaguchi T: Use of the muscle flap covering in the treatment of chronic osteomyelitis of tibia. *Seikeigeka* 39: 1594-1597, (in Japanese) 1988. Quoted from Yajima H, Tamai S, Ishida H and Fukui. A Partial soleus muscle island flap transfer using minor pedicles from the posterior tibial vessels. *Plast. Reconstr. Surg.* 1995;95(5):1162-1168.
7. Townsend PLG: An inferiorly based soleus muscle flap. *Plast. Reconstr. Surg.* 1978;31:210.
8. Fayman MS, Orak F, Hugo B. and Berson SD: The distally based split soleus muscle flap. *Br. J. Plast. Surg.* 1987;40:20.
9. Shaker A: The Use of distally based hemisoleus in reconstruction of lower third leg defects. *Egypt J Plast. Reconstr. Surg.* 1998;22 (2):161-69.
10. Guyuron B, Dinner MJ, Dowlden RV and Labandeter H.P.: Muscle flaps and vascular detour principle: The soleus. *Ann. Plast. Surg.* 1982;8:132.
11. Shaker A, Abd El-Aziz A and Magdy A: The reversed flow hemisoleus in leg and foot reconstruction (an alternative to distally based hemisoleus flap). *Egypt. J. Plast. Reconstr. Surg.*, 26 (2): 347-353, 2002.
12. Wu CM, Chang PY, So CY, Yip FS and Lam LY: The anatomic basis and clinical applications of flaps based on the posterior tibial vessels. *Br. J. Plast. Surg.* 1993;6:470.
13. Yajima H, Tamai S, Ishida H and Fukui A: Partial soleus muscle island flap transfer using minor pedicles from the posterior tibial vessels. *Plast. Reconstr. Surg.* 1995;95 (5):1162-68.
14. Tobin GR, Adock R, Moberg AW and Gemberling RM: Hemisoleus flaps. *Plastic Surgery Forum*, 1988;4:126.