

Peroneus Brevis Muscle Flap as a Tissue Cover for Defect over Lower Mid Leg and Ankle Defects: A Case Series

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ABSTRACT

Mid leg and ankle area are more vulnerable for post-traumatic full thickness soft tissue loss. Implants used in osteosynthesis in this region are also at risk of exposure as its placement is in subcutaneous plane as well as precarious blood supply in shin region. Various options like local flap to free flap are described for reconstruction of small and medium size defects in this region. Peroneus brevis is also well described in literatures. In this case series which was done over the period of six years that includes 10 patients with post-traumatic as well as post orthopaedics surgical intervention defects in lower mid leg and ankle region. Patients were selected for proximally and distally based peroneus brevis muscle flap according to the location of defects. Data regarding age, sex, aetiological factor, size of defect, type of flap, survival of flap, donor site complications were recorded. Out of 10 patients, eight were males and two were females. Major aetiological factor was two wheeler road traffic accident. Majority of the patient had orthopaedic surgical intervention for fracture fixation prior to or along with flap surgery. Only one patient, in this series had marginal flap necrosis. Rest of flaps survived well without any donor site complications. In authors experience peroneus brevis muscle flap is dependable for medium size defects over lower leg and ankle.

Keywords: Dependable, Implant exposure, Post-traumatic, Proximally based

INTRODUCTION

Originally, the peroneus brevis was a type II muscle flap, but it was reclassified by Mathes S and Nahai F as type IV with a dominant pedicle or pedicles from the peroneal artery, located proximally, entering the muscle from its deep surface, and distal minor pedicles from the peroneal or anterior tibial vessels [1]. When the flap is based distally, it is recommended that three fingerbreadths be left intact from the distal tip of the lateral malleolus [2]. Originally proximally based flap was designed for shin defects by Pers M and Medgyesi S [3]. Barr S et al., and Saydam M et al., reported on the reliability of distally based peroneus brevis muscle flaps [4,5]. Reconstruction of soft tissue defects in lower one third of leg and ankle region is a test of skill for plastic surgeon. Use of local skin or fasciocutaneous flaps in this area is very well known. The distally based sural flap requires two stage surgery if not islanded. Free flaps are relatively complex, require microsurgical expertise and are time-consuming. Moreover, not all patients are fit for such complex surgery. So in search of good options for small and medium sized defects over distal one third of leg and ankle region, authors found that peroneus brevis muscle flap is excellent cover when it is distally based. It can also be used as proximally based flap to cover small to medium sized defects of lower mid leg region. In this case series, authors have shared their experience with peroneus brevis muscle flaps, proximally or distally based to cover defects from lower mid leg to ankle region.

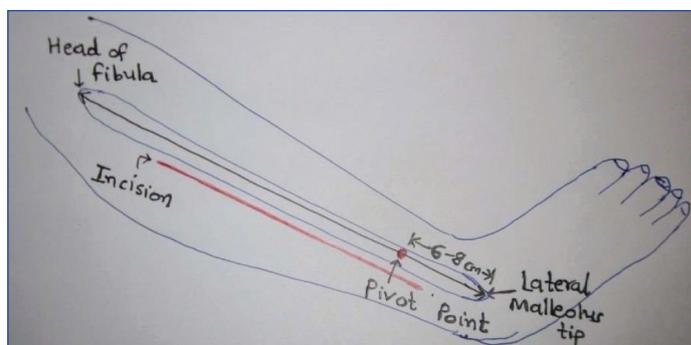
CASE SERIES

This was a case series of 10 patients with defects in lower mid leg to ankle region reconstructed with peroneus brevis muscle flap from August 2014 to July 2019.

Surgical Technique

Flap harvest was done under tourniquet. A line was drawn joining the fibular head with the tip of the lateral malleolus. Skin incision was 1 cm posterior to this line from the middle portion of the leg and going up to 6-8 cm above the lateral malleolus (3-4 finger widths) in view that the distal vascular pedicle was at 6 cm from the tip of lateral

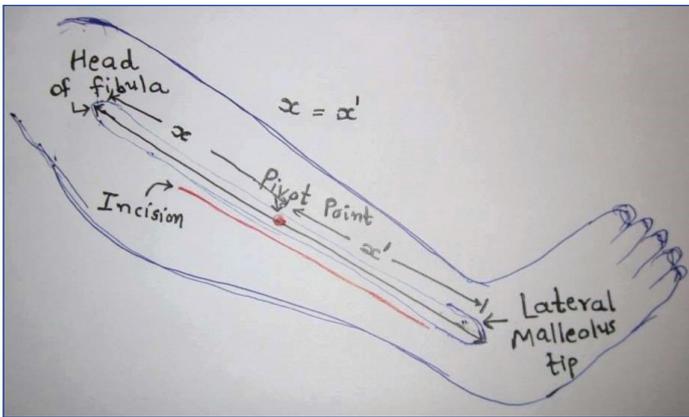
malleolus. After identifying the long and short peroneal muscles, peroneus brevis muscle was detached from the lateral side of the fibula. Peroneus brevis muscle is approximately 25 cm in length, but is harvested as much as it was necessary to cover the defect. After detachment, the proximal muscle portion of peroneus brevis for distally based flap (or distal muscle portion for proximally based flap) was ready to be transported to the defect area by tunneling or by incising the skin bridge interposed between the defect and the flap pivot point. The pivot point was 6-8 cm above tip of the lateral malleolus for distally based flap and near lower mid leg for proximally based flap [Table/Fig-1,2]. After fixing the muscle flap in the defect, it was covered with free split skin graft. The donor site was closed primarily to provide a linear scar. The muscle flap thins with time to provide a good result aesthetically at the primary defect. Immobilisation of operated leg was done for 15 days by applying plaster of paris slab.



[Table/Fig-1]: Diagrammatic representation of distally based peroneus brevis muscle flap.

There were 8 (80%) males and 2 (20%) females patients. Age range was between 16-56 years. The flaps were proximally based for defects of lower mid leg to lower third of the leg in four patients and distally based for reconstruction of defects of the ankle in six patients [Table/Fig-3].

Out of 10 patients, 4 (40%) patients had defect in lower mid leg region or at the junction of middle and lower thirds of leg (average size 16 cm²).



[Table/Fig-2]: Diagrammatic representation of proximally based peroneus brevis muscle flap.

Cases	Age (years)	Sex	Aetiology	Defect site	Defect size (cm)	Orthopaedic surgical interventions
1	25	M	RTA	LML	4x3	+
2	16	M	RTA	Lateral ankle	3x2.5	+
3	25	M	RTA	TA	3x3	+
4	30	F	Domestic accidental injury	Dorsum of ankle	4x4	-
5	56	M	RTA	LML	3.5x3.5	+
6	40	M	RTA	LML	4x3	+
7	32	F	RTA	TA	3.5x3	-
8	34	M	RTA	Lateral ankle	3x2	+
9	45	M	RTA	LML	3.5x3	+
10	21	M	RTA	TA	3x2	-

[Table/Fig-3]: Patient preoperative data.

RTA: Road traffic accident; LML: Lower mid leg; TA: Tendoachilles region; (+)Present; (-)Absent (Orthopaedic surgical interventions)

These defects were covered with proximally based peroneus brevis flap. Operative time for proximally based flap ranged from 55 minutes to 70 minutes. Survival of proximally based flap was 100%. Amongst the other six patients- 2 (20%) patients had defects over lateral ankle with exposed calcaneum and exposed implant, 3 (30%) patients had defects over tendoachilles region and 1 (10%) patient had defect over dorsum of ankle. All these six defects were covered with reversed peroneus brevis muscle flap. For distally based flap operative time was 80 minutes to 90 minutes Out of these six patients, only one patient with dorsal ankle defect had distal flap tip necrosis which was managed conservatively [Table/Fig-4].

Patients	Type of flap	Operative time in minutes	Donor site closure	Flap survival	Functional problems
1	PB	65	PC	100%	Nil
2	DB	90	PC+STG	100%	Nil
3	DB	85	PC+STG	100%	Nil
4	DB	80	PC+STG	100%	Nil
5	PB	60	PC	100%	Nil
6	PB	55	PC	Marginal necrosis of tip of flap	Nil
7	DB	85	PC+STG	100%	Nil
8	DB	80	PC+STG	100%	Nil
9	PB	70	PC	100%	Nil
10	DB	86	PC+STG	100%	Nil

[Table/Fig-4]: Patient operative and postoperative data.

PB: Proximally based; DB: Distally based; PC: Primary closure; STG: Split thickness skin graft

Initially, in seven patients there was fullness over flap. Gradually covered area settled down with satisfactory external appearance.

There was no locomotory dysfunction. No flap required secondary debulking. Postoperatively each patient had thin linear scar without any noticeable contour deformity at harvested site.

Case 1: A 25-year-old male admitted under orthopaedic department for post-traumatic open compound fracture right tibia. For which he underwent fracture fixation with external fixators. He developed soft tissue defect over middle lower leg of 4x3 cm size. Authors covered the defect with proximally based peroneus brevis muscle flap after debridement of it. Postoperatively flap survival was 100%. It offered good soft tissue cover with no functional limitations [Table/Fig-5-9].



[Table/Fig-5]: Defect over distal 1/3rd leg with exposed tibia.

[Table/Fig-6]: Marking of incision for flap harvest. (Images from left to right)



[Table/Fig-7]: Proximally based peroneus brevis muscle flap.

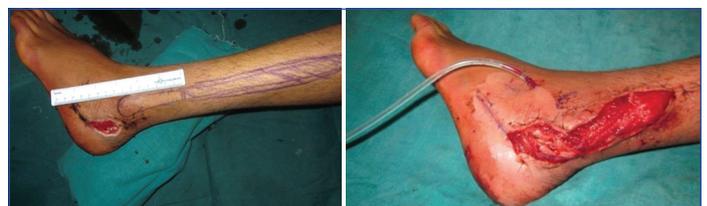
[Table/Fig-8]: Flap inset. (Images from left to right)

Case 2: A 16-year-old male was operated for calcaneal fracture underwent screw fixation. Two weeks later he presented with exposed screws (implants). Implants were covered with distally based peroneus brevis muscle flap. Flap offered excellent cover and acceptable cosmetic appearance with good functional outcome [Table/Fig-10-13].



[Table/Fig-9]: Follow-up result.

[Table/Fig-10]: Exposed implant over ankle joint. (Images from left to right)



[Table/Fig-11]: Markings for flap harvest.

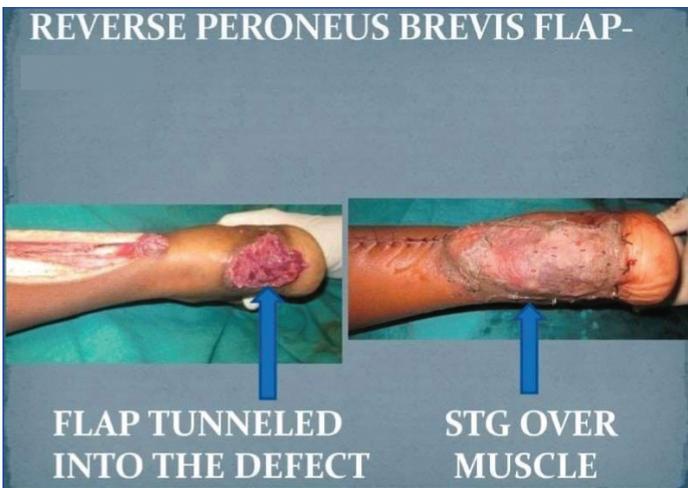
[Table/Fig-12]: Flap inset. (Images from left to right)

Case 3: A 25-year-old male presented with post-traumatic chronic ulcer over tendoachilles region. Ulcer had exposed tendoachilles tendon at its floor. He underwent distally based peroneus brevis muscle flap cover following debridement of the wound. The postoperative course was uneventful and flap with skin graft survival was 100%. He was able to walk normally with good soft tissue cover [Table/Fig-14-16].

Case 4: A 30-year-old female presented with soft tissue defect over right ankle with exposed tibialis anterior tendon. To cover the tendon and to prevent future joint contracture decision to cover the defect



[Table/Fig-13]: Follow-up results. **[Table/Fig-14]:** Defect over right tendoachilles region and distally based peroneus brevis. (Images from left to right)



[Table/Fig-15]: Inset of flap and muscle covered with split thickness skin graft.



[Table/Fig-16]: Follow-up results.

with flap was taken. Defect was covered with distally based peroneus brevis muscle flap. Flap offered excellent cover to anterior aspect of cover and allowed normal ankle movements. [Table/Fig-17,18].



[Table/Fig-17]: Defect over ankle. **[Table/Fig-18]:** Postoperative follow-up result. (Images from left to right)

DISCUSSION

Primary closure is preferred if adequate tissues are available for closure over the defect. If only skin is lost, either a local fasciocutaneous flap or split thickness skin graft is preferred. If bone or implant is exposed local transposition flap or muscle flap like soleus muscle with split-thickness skin graft is considered. If appropriate local skin subcutaneous tissues or muscle is not available, a free flap like anterolateral thigh flap or latissimus dorsi muscle flap with split

thickness skin graft is recommended. Reconstruction of soft tissue loss in lower limb is a continuous test of skill. The use of pedicled muscle flaps for distal 1/3rd of leg is challenging due to type of muscles available in this region, as this region has majority of Type-1 muscle [1].

Free flaps are used to cover defects over lower 1/3rd leg and ankle region with good results. But it is technically and economically more demanding than local muscle flaps. Free muscle flaps are time consuming. Complications like donor or recipient vessel thrombosis are more commonly associated with free flaps. Peroneus provide ideal soft tissue cover for lower end of fibula [6]. Various local muscle and fasciocutaneous flaps can be harvested for soft tissue defects over lower leg and ankle region. Most of these flaps leave a bulky soft tissue cover around ankle joint with a significant donor defect immediately adjacent to covered defect [6,7]. There are inconsistent perforators on lateral side of leg on which these flaps are based. They may also have been damaged in the primary injury. The reverse sural artery flap is widely used flap for ankle and shin defects. Drawback of this flap if not islanded requires two stage procedure. There is loss of sensation in the distribution of sural nerve, and venous congestion of flap and flap necrosis. The soleus muscle flap has been useful in treating small to moderate sized defects but is limited by its small distal rotation arc.

Compare to fasciocutaneous flaps peroneus brevis muscle flap has less contour deformities. Most of the local fasciocutaneous flaps, gives gross disfigurement of harvested as well as covered flap site. This may interfere locomotion and leads to hinderance for wearing footweares.

The peroneus brevis muscle flap is a easy to harvest. It requires less operative time, is single stage procedure, and offers cosmetically acceptable tissue cover [8].

Pers M and Medgyesi S used peroneus brevis muscle as proximally based flap [3]. Eren S et al., used distally based variant of peroneus brevis muscle flap [2]. Schmidt A and Giessler G described a series of 109 cases on peroneus muscle flap [9]. Other smaller series have also been reported [Table/Fig-19] [9-12].

Author	Proximally or distally based peroneus brevis muscle flap	Number of cases	Flap loss	Additional surgery
Eren S et al., [2] (2001)	Distally based	19	Partial necrosis in 2 cases (9.5%)	No
Yang YL et al., [13] (2005)	Distally based	6	Partial necrosis in 1 case (16.7%)	No
Schmidt A and Giessler G (2010) [9]	Both	Proximally based-10, Distally based-98, 1 free flap	Partial loss-18 (16.5%), Total loss-9 (8.3%)	Yes (Flap advancement in 7, Second flap in 13)
Rodriguez C et al., [12] (2013)	Distally based	1	No	No
Ensat F et al., [11] (2014)	Distally based	10	Partial necrosis in 1 case (10%)	Yes (ssg)
Ceran C et al., [10] (2015)	Proximally based	17	No	No
Present series (2021)	Both	Proximally based-4, Distally based-6	Partial necrosis in 1 case (10%)	No

[Table/Fig-19]: Flap survival and outcome in present series as compared to other studies [2,9-13].

Peroneus brevis muscle flap is harvested with ease [6] and is suitable for medium size defects over lower mid leg and distal third of the tibia down to the ankle. Cadaver angiography [13] study by Yang YL et al., showed that by securing at least one pedicle, muscle can be perfused well. It is due to presence of constant blood supply to

posterior aspect of muscle and communicating perforators. Even in majority of ankle injuries these communicating perforators escapes due to its location at deeper plain. This muscle flap has a unique pattern of vascularity. The arterial supply to the peroneus brevis was seen as a consistent branch from the peroneal artery entering the proximal portion of the muscle [14].

It is suitable to use it to cover various small to medium sized soft tissue loss around ankle. Gradual thinning of flap due to muscle denervation over period of time gives cosmetically acceptable appearance. No ankle dysfunction was observed due to sacrifice of peroneus brevis muscle. Sacrifice of the peroneus brevis, with functional peroneus longus, does not cause unstable ankle joint [15]. Each patient with this procedure had linear scar which thins out with passage of time. No obvious contour deformity from sacrifice of the muscle bulk was observed [16].

CONCLUSION(S)

Peroneus brevis muscle is a good, reliable and relatively easy option to cover small to medium sized defects in mid leg and ankle region. Authors highly recommend peroneus brevis muscle flap for small and medium size defects.

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