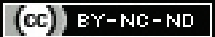


Distally Based Peroneus Brevis Muscle Flap for Soft Tissue Reconstruction in Lower Third of Leg: A Case Series

TANVI RAO¹, JONATHAN VICTOR², J VIJAY³, PP LINGAM⁴

ABSTRACT

Covering soft tissue defects in the distal part of leg and ankle is difficult. Most of the flaps used in reconstructing these defects are bulky and aesthetically unpleasing. The peroneus brevis muscle flap is ideal for covering these defects and providing an aesthetically better outcome. Peroneus brevis is a muscle located in the lateral compartment of the leg. It can be used for covering defects over the ankle and distal part of the leg without causing loss of function. This study was done to assess the surgical technique and clinical outcomes in the use of this muscle flap. This case series presents the authors' experience of six cases of distally based peroneus brevis muscle flap. Three of the six patients were found to have superficial flap necrosis. Two of these three was treated with debridement and Split Skin Grafting (SSG) while one was managed conservatively with daily dressings. This flap is simple, easy to rise and useful in covering small defects of 3-4 cm width in the distal part of the leg and ankle. The donor site to be closed primarily leaving behind only a thin linear scar. Overtime the flap thins down and gives good cosmetic results. Donor site morbidity is minimal as the peroneus longus muscle is preserved and thus the function of the foot (plantar flexion and foot eversion) is intact. The distally based peroneus brevis flap is a reliable flap for covering defects over the distal one third of the leg, the upper half of the medial and lateral malleoli and the posterior aspect of the heel.

Keywords: Ankle defects, Distal leg defect, Pedicled muscle flap, Tendoachilles defects

INTRODUCTION

Covering soft tissue defects in the distal part of leg and ankle is difficult. Most of the flaps used in reconstructing these defects are bulky and aesthetically unpleasing [1]. The peroneus brevis muscle flap is ideal for covering these defects and providing an aesthetically better outcome. It is a small, simple and easy to raise flap allowing the donor site to be closed primarily leaving behind only a thin linear scar [1,2]. They are raised proximally or distally, with perforators which are not constant in size and position [3]. Overtime muscle flaps undergo atrophy and get thinned out.

CASE SERIES

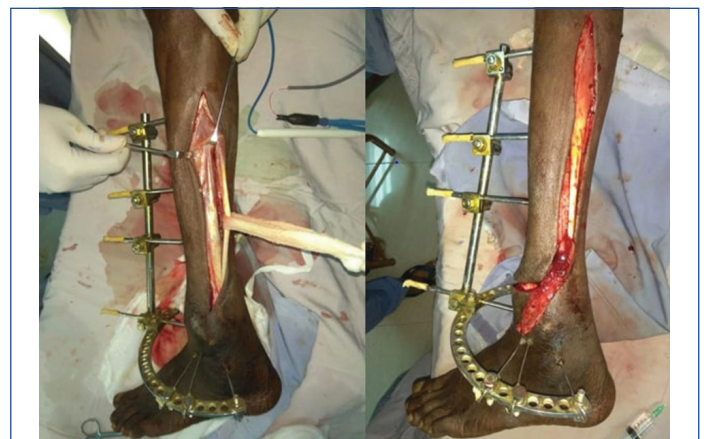
A retrospective analysis of distally based peroneus brevis muscle flap used in reconstruction of soft tissue defects was performed between January 2017 and December 2020.

Surgical Technique

The procedure was done under tourniquet control with spinal or epidural anaesthesia. With the patient in supine position the knee was kept in flexion and the foot was placed over a sandbag. The ankle was held in plantar flexion as this was found to relax the peroneal muscles. It also gave good access to the peroneus brevis muscle that lies deep to the peroneus longus. The planning of the flap was done and incision was made posterior to the line of the fibula. The incision was deepened through the deep fascia and the peroneus longus tendon was identified over the peroneus brevis. The tendon of the peroneus longus was separated from that of the peroneus brevis in a distal to proximal direction.

A distally based flap was raised 6-8 cm from the lateral malleolus to include the constant distal peroneal artery perforator. Perforators of significant size in the distal part of the muscle were preserved [Table/Fig-1]. When the flap was being raised care was taken not to raise the fibular periosteum along with the muscle. This could lead to heterotrophic ossification under the SSG. Dissection between the peroneus brevis and anterior septum was done with great care in order

to preserve any significant branches of anterior tibial vessels. Once the flap was raised the muscle was moved for inset [Table/Fig-2].



[Table/Fig-1]: Technique of flap dissection and harvest.



[Table/Fig-2]: Flap inset and early postoperative picture of the flap showing complete flap uptake.

Muscle was moved to the defect by incising the skin bridge (for lateral malleolar defects) or by tunnelling subcutaneously (for defects over the tibia and anterior ankle). During inset, care was taken to anchor the deep surface of the muscle to the wound while protecting the vessel system on the posterior surface of the muscle. The proximal 2 cm of the flap was discarded as it does not have reliable vascularity and can go in for necrosis postoperatively. The flap was then covered by a SSG.

Postoperatively the reconstruction was protected in a below knee slab. If there are associated fractures, skeletal stability is achieved by external fixation of the fracture [4].

Case 1

A 48-year-old man with no known co-morbidities was involved in a road traffic accident two days earlier before referral [Table/Fig-3]. He was diagnosed to have Gustillo Anderson Type 2 open bimalleolar fracture with dislocation of the left ankle. He underwent ankle sparring external fixation and bimalleolar screw fixation. He was later referred to the Department of Plastic Surgery for reconstruction of a soft tissue defect over the anterior aspect of the ankle measuring 4x3 cm.

Age (years)	Gender	Co-morbidities	Size of defect	Location of defect	Complications	Final outcome
48	Male	Nil	4x3 cm	Anterior ankle defect	Minimal flap necrosis Managed conservatively	Successful
64	Male	T2DM*, HTN†	3x4 cm	Posteromedial aspect of lower 1/3 rd leg	Nil	Successful
55	Male	Nil	3x2.5 cm	Anteromedial aspect of distal 1/3 rd of leg	Superficial Flap necrosis-managed with debridement and SSG‡	Successful
29	Male	Nil	6x3 cm	Posterior aspect of the heel left side	Graft over the PB flap necrosis for which debridement and SSG done	Successful
29	Male	Nil	6x4 cm	Anterior aspect of the distal 1/3 rd of leg	Nil	Successful
60	Male	T2DM, HTN CAD§ Parkinsonism	5x4 cm	Anterolateral aspect distal 1/3 rd leg	Nil	Successful

[Table/Fig-3]: Case details.

*: Type 2 diabetes mellitus; †: Hypertension; ‡: Split skin graft; §: Coronary artery disease

He was taken up for wound cover by distally based peroneus brevis flap cover with SSG. Postoperatively, he developed minimal necrosis of the overlying skin graft which was managed conservatively. The flap demonstrated complete survival. He did not develop any other complications. At six months follow-up the flap had settled well and he was able to weight bear on that limb.

Case 2

A 64-year-old man, a known case of type 2 diabetes mellitus and systemic hypertension had history of trauma to his left leg [Table/Fig-3]. He was diagnosed to have an abscess over the lower third of his left leg with cellulitis.

The cellulitis progressed and he developed a soft tissue defect over the posteromedial aspect of the distal one third of the leg exposing the underlying unhealthy tendoachilles. The soft tissue defect was 3x4 cm. The wound was debrided and the defect was covered using a peroneus brevis flap and SSG.

Postoperative course was uneventful. The flap survival was complete and he did not develop any complications until three months follow-up [Table/Fig-4].

Case 3

A 55-year-old man with no co-morbidities presented with history of trauma to the leg sustained six months ago following a road traffic accident. He presented with a uniting fracture of both bones of the left leg being treated with an ankle spanning external fixator. He had undergone a bone grafting procedure for the healing of the fracture. He had a non healing wound over the anteromedial aspect of the distal one third of the left leg measuring 3x2.5 cm and exposing the underlying tibialis anterior tendon [Table/Fig-3,5]. He was taken up for wound debridement and peroneus brevis flap cover with SSG.

Postoperatively, he developed superficial flap necrosis which was managed by debridement and skin grafting. After good rehabilitation and physiotherapy, he was able to weight bear on that limb. At eight months follow-up the flap had achieved a satisfactory contour.

Case 4

A 29-year-old male with no known co-morbidities presented with history of trauma to the left heel [Table/Fig-3]. He was diagnosed to have post-traumatic heel pad avulsion, tendoachilles avulsion and an underlying calcaneus fracture, and a left medial malleolus fracture. He had also sustained a fracture of the left clavicle. The fractured left clavicle and left medial malleolus was stabilised by open reduction and internal fixation procedures by the orthopaedic team. He was later referred with a soft tissue defect over the posterior aspect of the heel. He was taken up for wound debridement and peroneus brevis flap cover with SSG.

Postoperatively, he developed flap necrosis which required re-debridement and skin graft cover. Subsequently, the graft uptake was complete and the wound healed well. Postoperative follow-up at six months showed complete healing of the flap and a well settled skin graft.



[Table/Fig-4]: Case 2: Defect in the posteromedial aspect of the distal one third of the leg exposing the underlying unhealthy tendoachilles tendon, flap harvest and inset.



[Table/Fig-5]: Case 3: Non healing wound over the anteromedial aspect of the lower one third of the left leg.

Case 5

A 29-year-old male with no known co-morbidities presented with history of trauma due to road traffic accident. He was diagnosed to have sustained a closed fracture of both bones of the middle third of the right leg and open injury of the right ankle with soft tissue loss. He also had sustained associated closed distal one third fracture of the shaft of right femur and an open-book pelvic injury.

He was taken up for wound debridement and arthrotomy of the ankle joint, external fixation of the pelvis and ankle spanning external fixation for the both bone fracture in the leg by the orthopaedic team. Later he underwent removal of the pelvic external fixator with open reduction and internal fixation and plating for pubic diastasis, closed reduction and internal fixation and intramedullary nailing of the right femur and percutaneous corticocancellous screw fixation of the sacroiliac joint. He was then referred to plastic surgery with a soft tissue defect over the anterior aspect of the distal one third of the leg measuring 6x4 cm [Table/Fig-3].

Wound debridement and peroneus brevis flap cover with skin grafting was performed. Postoperative course was uneventful. The flap and graft uptake were complete with no postoperative complications. Follow-up of the patient at eight months showed a well settled flap.

Case 6

A 60-year-old male, a known case of type 2 diabetes mellitus, coronary artery disease and Parkinsonism presented with history of trauma to the right upper and lower limb following a road traffic accident. He was diagnosed to have open fracture of the distal one third of the shaft of femur. He also had fracture of the second, third and fourth metacarpal neck, fracture of the right proximal humerus and gall bladder perforation.

The shaft of femur fracture was fixed using the Limb Reconstruction System (LRS). The fracture of the humerus and the metacarpals were managed conservatively. He was later referred to plastic surgery with soft tissue defect over the anterolateral aspect of the distal third of the leg measuring 5x4 cm [Table/Fig-3].

A peroneus brevis flap cover with skin grafting was performed following debridement of the wound. Postoperative course was uneventful. The flap and graft uptake were complete with no postoperative complications up to six months of follow-up. Postoperative rehabilitation as per orthopaedic team advises was followed.

DISCUSSION

Post-traumatic soft tissue defects in the distal one third of the leg are common. These wounds are usually deep with exposure of the underlying bony structures or tendons stripped of their paratenon. Such wounds cannot be covered by skin grafts and would necessitate the need for a local or free flap [1].

Local fasciocutaneous flaps are mostly used to cover such small to moderate sized defects in the distal part of the leg or the ankle. These flaps, though simple and reliable, cannot be used in all cases. In patients who have peripheral vascular insufficiency or in the elderly these flaps have higher complication rates. These flaps are less resistant to bacterial infections in comparison to muscle flaps [5].

The most commonly used fasciocutaneous flap for cover of soft tissue defects in the distal leg and ankle is the distally based reverse sural artery flap. This is a simple and versatile flap with reach up to the ankle and foot especially when it is delayed. It is commonly used because it is a better alternative when compared to free flaps. The drawback of this flap is that it does not guarantee good blood supply to the injured area, which is especially important while covering defects in patients having type 2 diabetes mellitus or in area with bacterial infection. It is also not cosmetically pleasing as the flap is bulky and the donor site is covered with a SSG which contracts and heals with hyperpigmentation over a period of time [6].

Muscle flaps are a better choice for covering soft tissue defects including situations with underlying osteomyelitis. The denervated muscle flaps provide good vascular supply to the zone of injury because of the lower vascular resistance [7]. Defects in the distal one third of the leg, ankle and heel are better covered by a proximally based flap due to the vascularity of these flaps at the distal end. Free flaps are preferred to a proximally based flap as a proximally based flap, with its limited arc of rotation, poses difficulty of the flap reaching the ankle or the heel comfortably. Free flaps also provide better tissue volume. The drawbacks of free flaps are that the procedure is time consuming (increased operative time), presents with donor site morbidity, is not cost effective when compared to the local flaps and requires using a major vessel of the leg for anastomosis [6].

A distally based peroneus brevis muscle flap is a good alternative for covering defects of the distal one third of the leg, ankle and the heels. The flap was first described by Mathes SJ and Nahai F and later detailed by Yang YL et al., [8,9]. This flap is useful for covering the defects over the distal part of the leg, ankle and foot as it gives an aesthetically better outcome. Additionally, this small and simple flap is easy to raise and allows the donor site to be closed primarily leaving behind only a thin linear scar [1,2]. Overtime this muscle flap undergoes atrophy and gets thinned out (auto thinning) making it cosmetically pleasing [4].

Advantage of peroneus muscle flap is that it is easy to raise, can be raised quickly, cosmetically better than the other bulky flaps and provides a reliable cover over the defect. It also helps preserve the major vessels of the lower extremity. Donor site morbidity is minimal as the peroneus longus muscle is preserved and thus the function of the foot (plantar flexion and foot eversion) is intact [6].

Although, the flap is reliable and has a good vascular supply it is prone for postoperative complications. Barr ST et al., have reported perfusion problems of the flap and high rates of distal flap necrosis which is one of the most common complications of this flap [10].

Yang YL et al., in their case series of five cases of distally based peroneus brevis flaps reported one distal necrosis which required a second flap procedure [9]. Bajantri B et al., in a retrospective study of 39 cases reported partial flap loss in four patients requiring further flap cover and in non critical areas in two patients, which were managed with a skin graft [1]. Three of the four critical losses occurred when used for covering defects over the medial malleolus.

In the method of performing the surgery, after raising the flap, to avoid the distal flap necrosis we discarded the distal 2 cm of the flap intraoperatively. Hence, we did not encounter any case with distal flap necrosis.

Another important complication is superficial necrosis of the flap. In present study three out of the six cases developed superficial necrosis of the flap in the early postoperative period. One was managed conservatively with regular dressings and bedside debridement while the other two cases were taken up for wound debridement and SSG.

Sahu S et al., suggested delayed primary grafting to overcome graft loss in distally based peroneus brevis muscle flaps [11]. Bach AD et al., suggested a good preoperative evaluation of the patients to study the risk factors, age and co-morbidities of the patient [12]. Horch RE et al., used ultrasonic investigation to further enhance the safety of the procedure [13]. Preoperative planning is to get an idea about the length of the flap needed, arc of rotation and kinking of the pedicle. This preoperative evaluation and planning will help in raising a flap reliable, well perfused and cosmetically pleasing especially flap in patients with risk factors such as diabetes and peripheral vascular disease.

CONCLUSION(S)

The distally based peroneus brevis flap is a reliable flap for covering defects over the distal one third of the leg, the upper half of the medial and lateral malleoli and the posterior aspect of the heel.

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