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Original Article

Distally based peroneus brevis muscle flap: A single centre experience

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ABSTRACT

Purpose: Defects around the distal one third of the leg and ankle are difficult to manage by conservative measures or simple split thickness skin graft. Distally based peroneus brevis muscle flap is a well described flap for such defects.

Methods: This is a retrospective analysis conducted on 25 patients with soft tissue and bony defects of distal third of lower leg and ankle, which were treated using distally based peroneus brevis muscle flap from January 2013 to January 2018. Information regarding patient demographics, etiology, size and location of defects and complications were collected. All patients were followed up for at least 3 months after surgery.

Results: There were 21 males and 4 females with the mean age of 39 (5–76) years. The most common cause of injuries was road traffic accident, followed by complicated open injury. The average size of defects was 20 (4–50) cm^2. The mean operating time was 75 (60–90) min for flap harvest and inset. We had no patient with complete loss of the flap. Five patients (20%) had marginal necrosis of the flap and two patients have graft loss due to underlying hematoma and required secondary split thickness skin grafting.

Conclusion: The distally based peroneus brevis muscle flap is a safe option with reliable anatomy for small to moderate sized defects following low velocity injury around the ankle. The commonest complication encountered is skin graft loss which can be reduced by primary delayed grafting.

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Introduction

Coverage of defects of distal third of leg and foot poses a challenge to the trauma surgeons in view of limited elasticity of the local skin, thin soft tissue and precarious vascularity.[1] Despite an armamentarium of local cutaneous, fascial, fascio-cutaneous, muscle and free flaps, reconstruction of these defects is associated with a high rate of complications.[2] The peroneus brevis flap has not only been proved to be a valuable option but also a standard workhorse flap in some centers for coverage of small to moderate sized defects around the ankle.

Peroneus brevis muscle flap has a constant anatomy, reliable vascularity, acceptable donor site scar and can be easily harvested. Hence it has wide application in lower limb reconstruction.[3,4] The muscle has been successfully applied for coverage of small and moderate sized defects of heel, Achilles tendon, medial and lateral malleolus, extending deep into ankle, covering exposed osteosynthetic material, bone and tendons.[5]

We present our experience with 25 patients who underwent successful coverage of soft tissue and bony defects of distal third of leg and ankle using distally based peroneus brevis muscle flap.

Methods

Patient sample

A retrospective analysis of patients who underwent grafting using distally based peroneus brevis flaps for lower third leg and foot defects from January 2013 to January 2018 was undertaken. The records were reviewed for patient demographics, etiology, size and location of defects and complications. All patients were followed up for at least 3 months after surgery. Institutional Research Board (IRB)/ethical committee approval was taken and the patient consent has been obtained.

Surgical technique

All flaps were harvested under tourniquet control following the technique described by Eren and coworkers.[3] All the wounds were debrided and the defect size was measured. The axis of fibula was

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marked from its head to the tip of lateral malleolus and then an incision was made 1 cm posterior to this line. Doppler was not required to identify the perforators.

In the peroneal compartment, peroneus brevis lies deep to the peroneus longus tendon which is easily identified and separated from peroneus brevis in distal to proximal direction. The perforators to peroneus brevis lie on its posterior surface close to the posterior septum. Immediately anterior to these axial vessels lies the origin of the peroneus brevis muscle from lateral surface of fibula. The proximal connection of the muscle to the fibula was detached and the muscle was dissected off the fibula in a proximal to distal direction leaving a thin layer of muscle attached to the fibula. Elevating the flap above the periosteum decreased the chances of heterotrophic ossification over the recipient site. The disadvantage, however, was the possible tattering or fraying of the muscle and continuous minor ooze from the cut end of the muscle fibres which may lead to hematoma formation and graft loss. Care was taken to preserve the superficial peroneal nerve during harvest of flap. Dissection stopped at the point where the flap was adequate to cover the defect without tension.

A constant perforator lies 6–8 cm (mean 6.75 cm) from tip of lateral malleolus which forms the basis of distally based peroneus brevis flap.[6,7] While raising distally based flap, in the course of dissection between peroneus brevis muscle and anterior septum, any significant branches from the anterior tibial vessels were preserved to augment the vascularity. Tourniquet was released before mobilizing the muscle flap into the defect. The flap was delivered into the defect and any intervening skin bridge was incised and laid open. Distal 2 cm of the elevated flap was sacrificed in some patients considering the doubtful viability as described by Bajantri et al.[6] Elevated flap was inset into the defect and covered with a split thickness skin graft.

Table 1
General data of 25 patients.

Case No.	Age (years)	Gender	Cause of defect	Location	Defect size (cm^2)	Complication	Re-surgery
1	48	M	RTA	Medial malleolus	30	None	None
2	40	F	Necrosis of skin following ruptured Achilles tendon repair	Achilles tendon	8	None	None
3	30	M	RTA	Distal 1/3rd tibia	25	None	None
4	47	M	Necrosis of skin following ruptured Achilles tendon repair	Achilles tendon	16	Distal 3 cm necrosis	Debridement, distal advancement of flap and STSG
5	59	M	Multiple discharging sinuses following ruptured Achilles tendon repair	Achilles tendon	12	Graft loss	Re-grafting
6	65	M	Chronic ulcer over Achilles tendon	Achilles tendon	18	None	None
7	22	M	Achilles tendon rupture following Indian toilet injury	Achilles tendon	24	Distal 5 cm necrosis	Debridement, distal advancement of flap and STSG
8	25	M	RTA	Achilles tendon	30	None	None
9	50	M	Blunt injury leg	Achilles tendon	40	Distal 3 cm necrosis	Debridement, distal advancement of flap and STSG
10	9	F	RTA	Distal 1/3rd leg and ankle joint	50	None	None
11	32	M	Chronic osteomyelitis following old tibia fracture	Distal 1/3rd leg	24	None	None
12	15	M	RTA	Distal 1/3rd leg	16	None	None
13	5	M	RTA	Proximal dorsum of foot	24	None	None
14	44	M	RTA	Lateral malleolus	12	None	None
15	44	M	Chronic osteomyelitis following old tibia fracture	Middle 1/3rd leg	15	None	None
16	73	M	RTA	Distal 1/3rd leg	24	Distal 2 cm necrosis	Conservative management
17	15	M	RTA	Heel	18	None	None
18	53	F	Nonhealing ulcer following ruptured Achilles tendon repair	Achilles tendon	4	None	None
19	40	M	RTA	Proximal foot dorsum	20	Distal 1/3rd flap necrosis	Debridement, distal advancement of flap and STSG
20	55	M	RTA	Lower 1/3rd defect with exposed fracture tibia	8	None	None
21	11	M	Achilles tendon defect following RTA	Achilles tendon	12	None	None
22	45	M	RTA	Anterolateral aspect of ankle	20	None	None
23	76	M	Chronic nonhealing ulcer on Achilles tendon	Achilles tendon	16	None	No
24	47	M	RTA	Lateral aspect of lower 1/3 leg	20	Graft loss	Re-grafting
25	27	F	RTA	Left lateral malleolus	24	None	None

RTA: road traffic accident; STSG: split-thickness skin graft.

Results

General data

Out of the total 25 patients, 21 were male and 4 were female. Detailed patient information is shown in Table 1. The average age of patients was 39 (5–76) years. The most common cause of injuries was road traffic accident (RTA), followed by complicated open injury of the Achilles tendon. Achilles tendon region and lower third of leg defects were common indications for the flap. The size of the defect requiring flap coverage was averaged 20 (4–50) cm^2. The mean operating time was 75 (60–90) min for flap harvest and inset.

Complications

There was no incidence of total flap loss. No complications were found in 18 patients. Five patients had marginal necrosis of the flap, of whom 4 were managed by advancement of the flap and 1 was managed conservatively. The last two patients have graft loss due to underlying hematoma and required secondary split thickness skin grafting (Table 1).

Typical cases

We presented three typical cases to describe the versatility of flap in managing wide array of defect location.

Case 1

A 53-year-old lady presented with a non-healing ulcer on Achilles tendon region since 9 months. She had developed rupture of Achilles tendon following steroidal injection for tendonitis at local place. The tendon was repaired at the local hospital, but the wound dehisced postoperatively and did not heal with conservative management. The ulcer had exposed Achilles tendon. She underwent distally based peroneus brevis flap cover following debridement of the wound. The postoperative course was uneventful and flap demonstrated complete survival. She was able to walk normally with a stable soft tissue coverage (Fig. 1).

Case 2

A 9-year-old girl sustained a crush injury of right leg when she was run over by a four-wheeler. She had a complex defect of lower leg and ankle with exposed ankle joint. She immediately underwent debridement and application of ankle spanning external fixator. Six days later, distally based peroneus brevis flap was adopted

Fig. 1. Preoperative (A), early postoperative (B) and 5-month postoperative (C) images of a 53-year-old lady presented with a non-healing ulcer on Achilles tendon region.

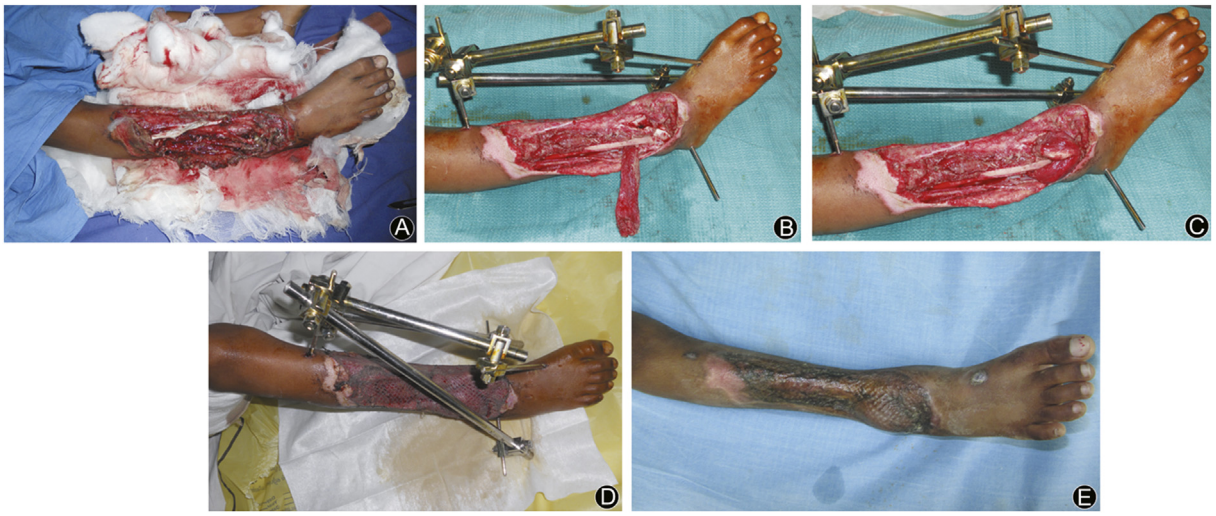

Fig. 2. Preoperative (A), intraoperative–elevated flap (B), intraoperative–flap inset done (C), immediate postoperative (D) and 6-months follow-up (E) images of a 9-year-old girl sustained crush injury of right leg.

to cover the exposed ankle joint and grafting of rest of raw area. Subsequently, the defect healed completely and recovery was uneventful (Fig. 2).

Case 3

A 5-year-old boy presented with crush injury of left foot following run over by a four-wheeler. He sustained extensive soft tissue injury on dorsolateral aspect of foot with crushed and devitalized tendons. He underwent immediate debridement and 4 days later a distally based peroneus brevis flap was used to cover the exposed lateral cuneiform and metatarsal. Postoperatively flap demonstrated complete survival, although due to severe tendon injury any tendon transfer was not possible (Fig. 3).

Discussion

Soft tissue defects of lower third of leg, ankle and proximal foot are quite difficult to manage and are frequently associated with exposure of bones, tendons and implant material. A stable and well vascularized cover is mandatory to allow adequate healing and to control infection. A plethora of options like adipofascial, neurofasciocutaneous, musculocutaneous and microvascular flaps are available, allowing the surgeon the privilege to choose and tailor flaps according to the defect. But still results are mostly unsatisfactory cosmetically and functionally because of bulkiness of flap which does not fit easily in shoe.

Adipofascial flaps have the advantage of simplicity and versatility but fail to provide resistance to infection.[8]

Neuro-fasciocutaneous flaps like sural artery flap are in vogue for reconstruction of large skin and soft tissue defect of lower leg and foot. However they produce obvious cosmetic deformity of donor site and also does not ensure adequate blood supply in setting of infection and compromised vascularity.[9] Kneser et al.[9] compared distal based sural artery flap and peroneus brevis with modified foot and ankle score. They recommended distally based peroneus brevis flap for small to medium defect for distal third of tibia, fibula, ankle and heel. Similar results were published by Thammannagowda et al.[10]

Perforator flaps are another good option because of good tissue match in thickness and texture, but donor site closure can be problematic. Also, it is difficult to fill deep cavity wounds with these flaps after debridement in some cases.

Muscle flaps in view of their robust vascularity remain the first choice in settings of bone and soft tissue infections.[11] But, paucity of local muscle bulk in lower third leg makes the situation more challenging to manage.

All these considerations make free flaps the treatment of choice. They not only provide adequate vascularity and tissue volume for coverage of large defects of ankle and lower leg, but also avoid local scar.[12] However, free flaps were fraught with disadvantages like increased operating time, need of expert technique and instruments, use of major vessels of leg, increased cost and donor site morbidity.

Pers and Medgyesi first described peroneus brevis as proximally based flap.[13] Peroneus brevis muscle flap anatomy was described in detail by Eren et al.[3] and Yang et al.[4] Mathes et al.[14] classified peroneus brevis type II muscle (one dominant and one minor pedicle). Yang et al.[4] re-classified it as type IV muscle. Bajantri et al.[6] proposed a new classification as type VI muscle flap.

Despite the various classifications of peroneus brevis as described above, it has been proved to be a valid alternative. Its major merits are the ease and simplicity of harvest, reliable soft tissue coverage for exposed tendons and bones for small- and medium-sized defects and preservation of major arteries of leg. The surgery can be quickly performed, does not need specialized techniques and provides consistent positive results even in hand of plastic surgery trainees. An added advantage is negligible donor site morbidity because plantar flexion and foot eversion is maintained by peroneus longus muscle.[3,15]

In the series by Schmidt and Giessler,[5] there was complete flap loss in 8.3% of patients whereas in our series none of the patients had total flap loss, similar to the findings in other series.[6,16–18] We had partial (marginal) flap loss in 5 out of 25 patients (20%) which were comparable with the results reported in the review article by Ensat et al.[19] Bach et al.[18] in their study demonstrated success of this flap in patients with severe vascular risk factors, making it safe to utilize in older patients, diabetes, hypertensive, smokers and even those with peripheral vascular disease.

We avoided subperiosteal elevation of flap to prevent calcification of graft at a later date. To avoid graft loss, one has to achieve adequate hemostasis and position the flap with the true muscle tissue facing outwards the skin graft, rather than the tendinous part, as suggested by Bajantri et al.[6] Delayed grafting and application of negative pressure therapy postoperatively are other methods to avoid graft loss.[20] Abd-Al Moktader[21,22] described open book splitting of distally based peroneus brevis muscle flap to cover moderate to large size defects (up to 120 cm^2 area. Barbera et al.[23] recommend preoperative 3D MRI to assess the size of the peroneus brevis muscle before performing the procedure.

Being a muscle flap, it helps in combating against osteomyelitis as reported by Antonini et al.[24] The lower portion of the peroneus brevis muscle has been elevated along with the distally based sural artery flap as a distally based sural artery peroneus flap to increase the chances of flap survival.[25]

The distally based peroneus brevis muscle flap has many advantages. There is negligible donor site morbidity. A single linear scar in hairy leg is hardly evident. There is no functional deficit, and foot eversion or plantar flexion is maintained if peroneus longus is intact and preserved. Over time this muscle flap atrophies and undergoes “auto thinning” giving a better contour. Compression garments for 6 months postoperatively can further help in reducing the bulge. Poor color match due to overlying graft does cause mild compromise with aesthetics.Another benefit of peroneus brevis flap is that a segment of fibula in the proximal and middle third can be included in an osteo-muscular flap to reconstruct bony defects in distal lower leg.[5]

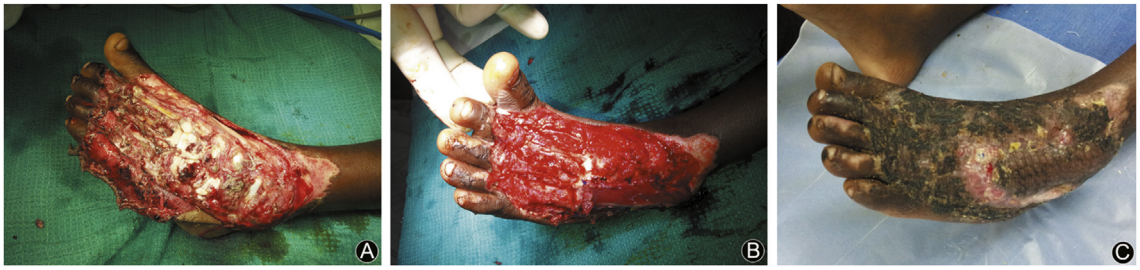

Fig. 3. Preoperative (A), immediate postoperative (B) and 1-months follow-up (C) images of a 5-year-old boy with crush injury of left foot.

In conclusion, the distally based peroneus brevis muscle flap is a safe option for coverage of low velocity small to moderate sized defect around the ankle. It is easy to perform, has reliable anatomy and short learning curve and takes less operating time. The commonest complication encountered is graft loss which can be reduced by primary delayed grafting.

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None.

Ethical statement

Institutional Research Board (IRB)/ethical committee approval was taken and the patient consent has been obtained

Conflicts of interest

There are no conflicts of interest.

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