



A Study on Survival and Other Outcome of the Perforator Based Flaps for Coverage of Traumatic and Non-Traumatic Defects of Ankle and Surrounding Areas in A Tertiary Care Centre

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Abstract

Introduction: The reconstruction of ankle defects remains a challenging task for plastic surgeons because of the frequent exposure of tendon, bones, joints and nerves. Paucity of skin and soft tissues in this area makes the coverage even more difficult. Majority of cases encountered in hospital are results of road traffic accidents. Because of the above-mentioned reasons microvascular free flap surgeries are considered ideal for coverage of such defects. However, a good number of studies have been done which have shown promising results with newer pedicled and perforator based flaps.

Objective: Evaluation of survival, complications, operative time, hospital stay and donor site morbidity arising out of perforator based flap coverage of ankle and surrounding defects

Materials and Methods:

Prospective analytical study conducted in 34 consecutive patients with the age ranging from 6-70 years having soft tissue defects over ankle, were treated with various perforator based flaps, from march 2019 to December 2020 in department of plastic surgery, IPGMR & SSKM Hospital, Kolkata.

Results:

Among 34 patients overall complication rate was 24.35% and survival rate was 85.48%.

Conclusion:

As the survival rate is comparable in both the groups, Reverse sural flap should be a better option given its other favourable parameters like easy learning curve, less duration of operation, coverage of larger defects and a wide arc of rotation enabling it to reach any defects around the ankle. Consequently, it provides a viable alternative to microsurgical reconstruction.

Keywords: Ankle defect, perforator flap, flap survival, Donor site morbidity

Introduction

The foot and ankle are important parts of the body which supports the body in standing posture and provides a stable interface between the ground and the body during walking. Its function depends on many factors which can be affected by variety of

pathological processes like tumor, infection, burn and trauma.

The reconstruction of ankle defects remains a challenging task for plastic surgeons, because of the frequent exposure of tendon, bones, joints and nerves. Paucity of skin and the lack of intervening

muscle between the skeleton make the soft-tissue coverage even more difficult, Majority of cases encountered in hospital are results of road traffic accidents.

Various reconstructive options are there for coverage of exposed bones, tendons, vessels such as local flaps, loco-regional or distant flap. Each procedure has its own merits and drawbacks on indications, technical requirement, flap size, length of vascular pedicle, and limitations of patients' local and general conditions.

Due to paucity of local skin and soft tissue in this region, microvascular free flap surgeries are considered ideal for coverage of such defects. However, this option may not be suitable in all cases due to many reasons like if suitable recipient vessels not available like in severe crush injury, medical condition of patient not permitting long operative hours, lack of experience in microvascular surgery.

Recently, a good number of studies have been done which have shown promising results with newer pedicled and perforator based flaps.

We propose to perform a detailed study where we are going to analyse the various perforator based flaps for reconstruction and its reconstructive challenges and their functional and aesthetic outcome for defects in ankle and its surrounding areas with identification of possible complications of these procedures.

Aims And Objectives

The objectives of the study are to evaluate survival rate of various local and locoregional perforator flaps, operative time, hospital stay, complications and assessment of the donor site morbidities from where the flaps are harvested.

Materials And Methods

The prospective analytical study conducted from March 2019 to December 2020 in department of plastic surgery, IPGMER & SSKM Hospital, Kolkata in 34 consecutive patients with the age ranging from 6-70 years having soft tissue defects over ankle, treated with various perforator based flaps.

Institutional Ethics Committee approval was taken before starting the original work. Informed consent was also taken from each patient.

History taking and clinical examinations of all patients was carried out. Plain Radiograph of ankle joint and foot was done to rule out fractures of the underlying bones, which were evaluated by department of Orthopaedics and prior stabilization of the fractures were done. Doppler/ angiography of lower limb was done as and when required.

Patients of the study population were investigated optimally and pre-anesthetic fitness was obtained. The whole surgical procedure including risk and benefit, possible complications and donor area morbidity was explained to the patients. Informed consent was taken. Patients were operated under regional or general anesthesia.

The plan of coverage decided according to the site and size of defect. Defect measured after debridement or excision. Template of defect taken with the help of lint piece and planning of the flap was done in reverse. A help of hand-held Doppler was used to mark the perforator. Preoperative photographs were taken of the defect and flap markings

Resurfacing of the defects was planned according to standard treatment protocol of the institution from the following options-

1. Posterior Tibial artery perforator based flaps.
2. Peroneal artery perforator based flaps.
3. Lateral supramalleolar flaps.
4. Medial plantar artery flap.
5. Lateral calcaneal flap

Parameters Studied:

Size and location of defect, Aetiology of defect, Type of perforator based flap chosen, Operating time, Percentage of flap survival, Complications- marginal necrosis, partial necrosis, complete loss of flap. Secondary procedures, Donor site morbidity, Duration of hospital stay.

Results

A total 34 patients were included in the study, among whom 29 (85.29%) were male and 5 (14.70%) patients were female. The maximum number of patients were from age group of 41 to 60 years (38.23%) followed by 6-20 years (32.35%).

Most common cause of the defect was road traffic accident (73.52%), other causes were non-healing ulcers, tumor and burn.

Most of the patients had defect on the anterior aspect (38.23%), out of which in 20.5 % patient there was also involvement of dorsum of foot followed by on the posterior aspect (32.35%) (Table 1).

Most of the defects were covered with peroneal artery perforator flaps (38.23%), followed by lateral supramalleolar flap (35.39%), other flaps were posterior tibial artery perforator based flaps, medial plantar artery flaps and lateral calcaneal flaps. (Table 2).

Peroneal artery perforator flaps had the longest Mean operative time (184.6 min) and lateral calcaneal flap took least mean operating time (95 minute) (Table 3).

The average size of defect that was reconstructed by various perforator based flap was 10.5x4.7cm. Largest defect that was measured 14x6 cm and smallest defect measured was 3x3cm.

Complications were categorized as marginal necrosis, partial necrosis and complete loss. Marginal necrosis and other minor complications subsided either with conservative management with antibiotics or by some minor procedures like debridement and secondary closure under local anaesthesia. In case of partial necrosis and complete loss second procedure like another flap coverage or skin grafting was required. Overall complication rate of the flaps was 24.35% (Table 4).

We found that out of 13 peroneal artery perforator based flaps, 08 flaps survived completely, 01 developed minor complications, 4 flaps necrosed partially or completely which required further second procedure. Out of 3 posterior tibial artery based flaps 1 flap survived completely, 1 develop minor complication and 1 flap failed. Out of 12 LSF flap 9 survived, 2 survived with minor complications and 1 flap failed. Out of 4 cases of MPA flap 3 survived completely, 1 survived with minor complication and no flap failed. Out of 2 LCF both survived without complications. Average percentage of flaps survival was 85.48%.

Hospital stay was less than 2 weeks in 23 patients and more than 2 weeks in 11 patients.

Among the 34 patients donor site was covered with partial thickness skin grafting in 33 cases and in one case donor site was closed primarily. In all cases donor site healed uneventfully.

Patients were followed up for 2 months post-operatively. Functional and aesthetic outcome were assessed subjectively according to patients' satisfaction. The outcome was categorized into excellent, good, fair and poor as per patients' response.

DONOR SITE: Among the 34 patients donor site was covered with partial thickness skin grafting in 33 cases and in one case donor site was closed primarily. In all cases donor site healed uneventfully.

Table 1 : Distribution of various perforator flaps used and their relative frequency

Location	Number of cases	Percentage
Anterior ankle	6	17.64
Anterior ankle with dorsum of foot	7	20.58
Posterior ankle	11	32.35
Medial ankle	2	5.88
Lateral ankle	3	8.82
Heel	5	14.70
Total	34	100

Figure 1 : Chart showing number of various perforator flaps used around ankle region

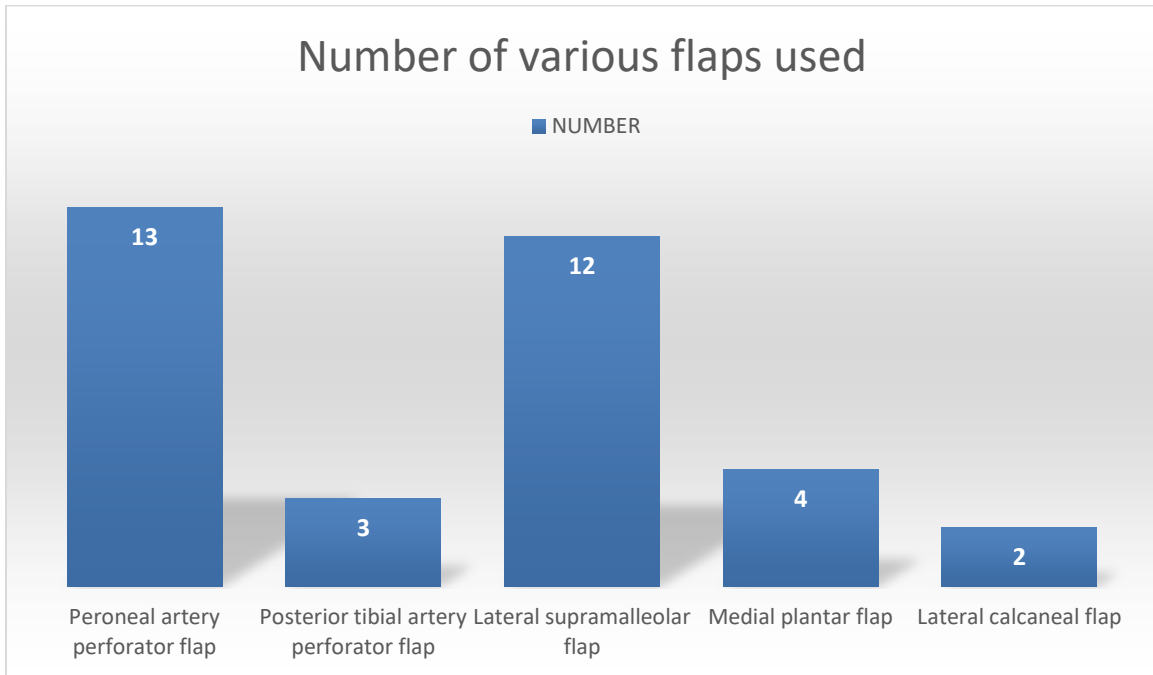


Table 2 : Mean operative time for various perforator flaps

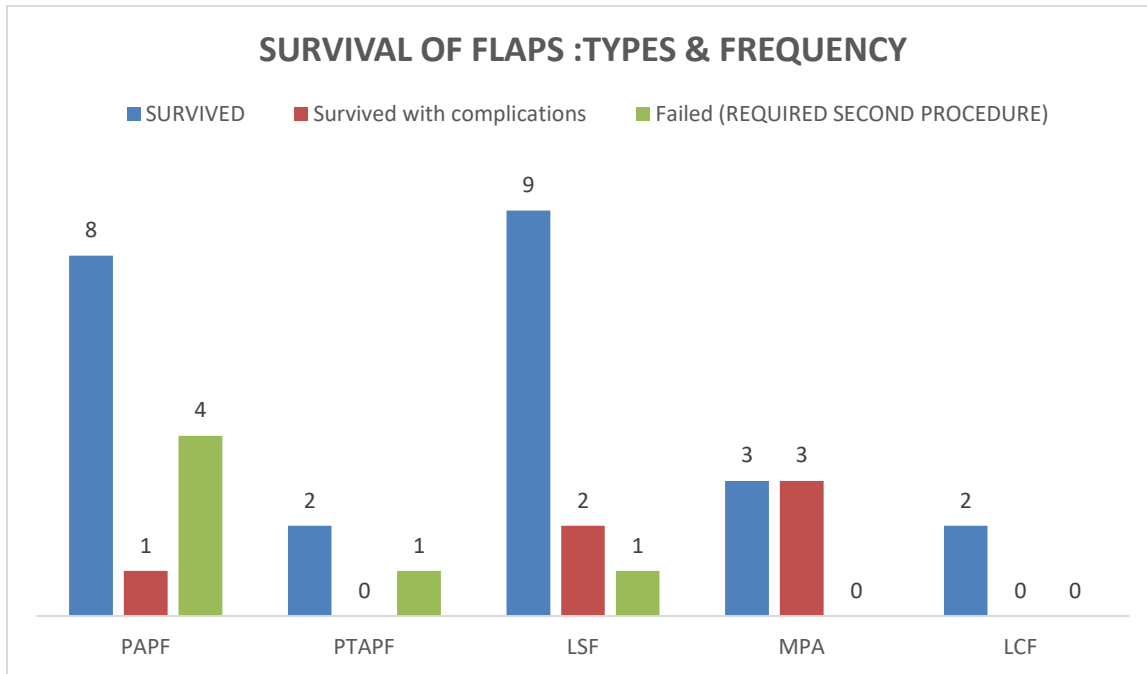
Flap	Mean operative time (minute)
Peroneal artery perforator flap	184.6
Posterior tibial artery perforator flap	180
Lateral supramalleolar flap	152.5
Medial plantar flap	210
Lateral calcaneal flap	95

Table 3 : Distribution of different degree of flap survival and their relative frequency

FLAP	SURVIVED	SURVIVED with complications	Failed (required second procedure)	SURVIVAL RATE (%)
PAPF	08	01	04	69.2%
PTAPF	02	00	01	66.6%
LSF	09	02	01	91.6%
MPA	03	01	00	100%

LCF	02	00	00	100%
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Figure 2 : Chart showing different types of survival of the perforator flaps and their frequency



Discussion

Reconstruction of the foot and ankle wounds, especially when complicated with deep vital structures such as bone, joint, nerves or tendon are exposed, remains a challenging problem for the treating surgeon. The foot with the features of weight bearing requirement, the lack of intervening muscle between the skeleton and the skin, and the limited movement of the overlying skin, make the soft-tissue coverage even more difficult (1).

Various reconstructive options are there for coverage of exposed bones, tendons, vessels such as local flaps, loco-regional or distant flap. Each procedure has its own merits and drawbacks on indications, technical requirement, flap size, length of vascular pedicle, and limitations of patients’ local and general conditions (2).

In this situation perforator based flaps are important tools in the armamentarium of a plastic surgeon. The perforators are given off segmentally by the posterior tibial artery and mainly concentrated in distal two third of the leg. According with Geddes et al. (4), it

gives about 10 ± 4 cutaneous perforators, but other authors found a number of 3 to 5 (4,5). Those perforators with a diameter of about 1 mm (3,4,5,6) are the largest of the lower leg, particularly in the middle third, in the septum between flexor digitorum longus and soleus, where they can reach a diameter up to 1.5 mm (7,8). These perforators courses along the transverse intermuscular septum between flexor digitorum longus and soleus. The perforators may be septocutaneous or musculocutaneous. Some authors found the greatest distribution of perforators from 5 to 14 cm above the internal malleolus (4,5,9), Most recently, Shaverian and Saint-Cyr found that there were three constant clusters of perforators at 4–9 cm, 13–18 cm, and 21–26 cm from the medial malleolus (7).

All the patients were treated with initial resuscitation, control of infection by giving antibiotic and regular dressing and debridement. The patients who had fractures were evaluated by the department of orthopaedics and bony fixation was done before any surgery was performed to resurface the soft tissue defect. Planning of all the flaps was done in reverse

using lint pieces. Hand held colour Doppler were used to locate the perforators.

We have conducted this study on 34 patients, among whom 29 (85.29%) were male and 5 (14.70%) patients were female. The maximum number of patients were from age group of 41 to 60 years (38.23%) followed by 6-20 years (32.35%). The least number of patients were from the group of 61-70 years (5.88%). Regarding incidence of age distribution in other similar studies, the majority of cases were between 20 and 40 years. (10,11)

The defects most commonly resulted from trauma (73.52%), which mainly resulted from road traffic accidents. Similar findings were reported from similar studies conducted before. (11,12,13)

In our study we have found that of 13 (38.23%) out of 34 cases had defects on the anterior aspect, out of which in 7 patient there was also involvement of dorsum of foot. The second most common site was posterior aspect in 11 patients (32.35%). The least number of cases had defects on medial aspect (5.88%). In a similar study of 30 cases, Bhandari et.al (11), found maximum number of cases had defects on the anterior aspect of ankle (41%), followed by posterior (28%).

In 56% cases i.e., 19 out of 34 cases right foot was involved and in 44% cases i.e., 15 out of 34 cases left foot was involved.

Peroneal artery perforator flap surgery had the longest Mean operative time (184.6 min) and lateral calcaneal flap took least mean operating time (95 minute).

Out of 34 patients 13 (38.23%) were operated with peroneal artery perforator flaps, 12 (35.29%) patients with lateral supramalleolar flap, 3 (8.82%) patients with posterior tibial artery perforator based flaps, 4 (11.76%) patients with medial plantar artery flaps and 2 (5.88%) patients with lateral calcaneal flaps.

The average size of defect that was reconstructed by various perforator based flap was 10.5x4.7cm. The largest flap that was used measured 14x6 cm and smallest flap measured was 3x3cm.

Complications were categorized as marginal necrosis, partial necrosis and complete loss. Overall complication rate was 24.35%. Out of 13 patients who were treated with PAPF 1 developed marginal

necrosis, 2 developed partial necrosis and 2 developed complete necrosis (38.46%). Out of 3 patient who were treated with PTAPF 1 developed partial loss (33.33%). 12 patients who were treated with LSF 2 patients developed marginal necrosis and 1 patient developed partial loss (25%). 4 patients who were treated with MPA flap, 1 patient developed marginal necrosis (25%). Out of 2 patients who were treated with LCF both flaps survived without any complications. Marginal necrosis and other minor complications subsided either with conservative management with antibiotics or by some minor procedures like debridement and secondary closure under local anesthesia. In a case of partial necrosis and complete loss, second procedure like another flap coverage or skin grafting was required.

Shen et al (14), studied in 36 patients with soft tissue defects of the distal lower leg, heel and foot who underwent surgery using peroneal perforator-based propeller flaps.

Postoperative complications included venous congestion (nine patients). The flaps in seven of the nine patients with venous congestion survived, but two patients had necrosis at the distal site requiring debridement and skin grafting.

Mir et al (10), studied in 10 patients, out of which Partial flap loss was found in one patient (10%), marginal flap necrosis in one patient (10%), and none of the flaps was lost completely.

Karki and Narayan (15), studied in Twenty patients who were treated with perforator-based propeller flap for distal leg and ankle defect. One patient developed partial flap necrosis, which was managed with skin grafting. Two patients developed transient venous congestion, which subsided spontaneously without complications. Small marginal wound dehiscence was present in one patient, treated with small split skin graft.

We found that out of 13 peroneal artery perforator based flaps, 09 flaps survived (69.2%). Out of 3 posterior tibial artery perforator based flaps, 2 flaps survived (66.6%). Out of 12 LSF flap 11 survived (91.6%). Out of 4 cases of MPA flaps, all 4 flaps survived (100%). Out of 2 LCF both survived (100%). Average percentage of flaps survival was 85.48%.

Survival of posterior tibial artery perforator based flap was 66.6%, Medial plantar artery flap & lateral calcaneal flap were 100%, but the number of cases for these flaps is too less to draw any conclusion.

Mir et al (10), studied in 10 patients with soft-tissue defect around the ankle; the overall success rate of perforator pedicled propeller flap in this study was 80%.

Kefant et al (16), retrospectively studied in thirteen patients, who were managed using a posterior tibial perforator-based flap to cover soft-tissue defects of the leg and foot. The procedure was successful in 11 (85%) patients. Complete flap necrosis due to arterial ischaemia occurred in 1 patient and 1 patient experienced secondary partial necrosis due to venous congestion.

Lee et al (17), performed reconstruction of foot and ankle using a reverse lateral supramalleolar adipofascial flap and skin grafting in eight cases. The mean size of the flaps was 3.5 (3-4) × 4.5 (4-6) cm. Flaps survived in all cases. Neither partial necrosis in the adipofascial flap nor venous congestion was observed.

Prasad et al (18), studied in 20 Patients with traumatic lower limb defects who were treated with perforator-based propeller flaps for reconstruction. The survival rate of island pedicled propeller flaps in this study was 70%; 6 patients (30%) had complete flap loss.

As far as hospital stay is concerned in our study, 23 patients (67.6%) stayed for less than 2 weeks while it was more than 2 weeks in 11 patients (32.3%).

Among 34 patients, donor site was covered with partial thickness skin graft in 33 patients and in 1 patient donor site was closed primarily. In all cases donor site healed uneventfully.

Conclusion

In conclusion, the perforator based flaps provide valuable option for the reconstruction of small to medium size defects at ankle and surrounding areas. It is relatively easy, versatile, less time-consuming procedure, replaces like with like by using tissues of similar texture, pliability and colour. Also, the source vessel is not sacrificed and the underlying muscles are preserved. The donor site morbidity is minimal and the hospitalization time is reduced; thus, avoids

extra costs to the patients. Consequently, it provides a viable alternative to microsurgical reconstruction.

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