PROPELLAR FLAPS FOR LOWER LEG RECONSTRUCTION RESULTS OF A TERTIARY CARE CENTER

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Reconstruction of defects in the foot and distal lower leg, with exposed tendons, bone, and/or hardware continues to be challenging, and they generally need flaps coverage. A variety of flaps were used in the attempt to achieve excellence in form and function. We present our experience with 30 cases of propeller flap for various leg defects. Propeller perforator flaps are best suited for small and medium defects, and in trauma patients for defects without extensive avulsion and degloving injuries.

**Keywords:** Propeller flap, Leg defect, Perforator flap, Free flap

INTRODUCTION

Reconstruction of defects in the foot and distal lower leg, with exposed tendons, bone, and/or hardware continues to be challenging, and they generally need flaps coverage (Byrd et al., 1985; Godina, 1986; Ninkovic et al., 1999; Georgescu and Ivan, 2003; Levin, 2006). A variety of flaps were used in the attempt to achieve excellence in form and function. After a long evolution of the reconstructive methods, including random pattern flaps, axial pattern flaps, musculocutaneous flaps and fasciocutaneous flaps, the reappraisal of the works of Manchot and Salmon by Taylor and Palmer opened the era of perforator flaps. This era began in 1989, when Koshima and Soeda, and separately Kroll and Rosenfield described the first applications of such flaps (Manchot, 1983; Salmon et al., 1988; Taylor and Pan, 1998; Koshima and Soeda, 1989; Kroll and Rosenfield, 1988).

Propeller flaps are a perforator flap based on a skeletonized perforator vessel and rotated 180° (Hallock, 2006).

In this study, we present the experience with perforator-based propeller flap based on posterior tibial and peroneal artery.

MATERIALS AND METHODS

This is a prospective study done in Bangalore Medical College and research center in the department of plastic surgery between January 2012 and June 2013. Patients with defect in the lower 1/3rd of leg are included in the study. All patients are evaluated with preoperative

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investigation such as complete blood count HbA1c and arterial Doppler of the lower limb. Patients with HbA1c of more than 8 or with peripheral arterial disease were excluded from the study. Preoperative marking of the perforators is done in all the cases. 30 patients were treated with perforator-based propeller flap for distal leg and ankle defects. Majority (70%) were post traumatic due to road traffic accidents. There are six cases of post burn contracture. Fourteen patients presented with medial malleolar soft-tissue defect, ten lateral malleolar defects, three anteromedial lower tibial defect and three patients presented with defect over anterior aspect of lower tibia. Defect size is between 3*8 cm to 8*22 cm. Except 4 all are based on posterior tibial artery. A constant perforator of posterior Tibial artery is found 9-10 cm above the medial malleolus in 22 out of 26 cases.

**Technique of Flap Dissection**

Preoperative detection of the perforators in the distal lower leg is done in all cases even though the identification and isolation of a patent perforator can be very easily done intraoperatively through careful dissection, considering the defects’ needs.

One edge of the future flap is incised and this incision is planned for possible alternative flap, if a suitable perforator isn’t found. The incision is made up to or deep to the deep fascia, and is followed by subfascial dissection under magnification and all the identified perforators are preserved. All through dissection, the perforators is humidified with lidocaine to prevent spasm. If two adjacent perforators with same characteristics are found, both of them are preserved until the flap’s dissection is completed and the tourniquet released. Once the best perforator(s) is chosen, according with its location, size, suitability to sustain the flap, number of venae comitantes, course and orientation, the definitive design of the flap is accomplished. First, the long axis of the flap is orientated in the long axis of the leg 2 cm length is added to distance between the perforator and the distal edge of the defect, and the resulting value is transposed proximally to the skin which will cover the defect, ensuring the flap’s comfortable inset, without any tension on the pedicle. Similar, to the width of the defect is added 0.5-1 cm is added to allow the closure without tension. The incision around the flap is done and the harvesting is completed. The flap is rotated in a clockwise or counter-clockwise direction, depending on the right rotational direction to avoid kinking of the vessels. The donor site is closed primarily. If primary closure isn’t possible, the donor-site is partially directly sutured, and the remaining defect skin grafted.

**RESULTS**

Thirty patients with defect over ankle region were operated from January 2012 to June 2013, 80% of them were males. Mean age was 36.4 years. Three patient had diabetes mellitus. Three patient developed partial flap necrosis, which was managed with skin grafting.

Majority of the patients are post trauma with 9 patients is due to post burn contracture with defect around the ankle.

Three patients developed transient venous congestion, which subsided spontaneously without complications. Donor site was closed primarily in all but 2 patients, whose defect is more then 20 cm in length. Skin grafting is done in these patients. Flaps were based on posterior tibial artery in 26 patients and peroneal artery in four patients. All patients provided stable coverage of the defect with good contour and skin cover.
Patient 1

[Images of surgical procedures and medical equipment]
### Patient 2

![Image of Patient 2's injuries](image1.jpg)

### Patient 3

![Image of Patient 3's injuries](image2.jpg)
DISCUSSION

The anatomical features of the lower third of the leg make the wound coverage of the soft tissue loss into a challenging problem. The bones of the lower third are vulnerable to injury. Due to the paucity of soft tissues around them, the fractures that occur are often open. Most muscles become tendons at that level and in the case of soft tissue loss, skin graft may not suffice and flap cover becomes mandatory. The three major arteries to the leg, anterior and posterior tibial, and peroneal are in closed compartments and they do not have significant communications between them. Recently lot of work has been done on the perforators arising from these vessels in the lower third of the leg. The ones from the posterior tibial and the peroneal are significant and could be used for flaps in the region.

The big popularity gained by the local perforator flaps was due to their main advantages: (1) Sparing of the source artery and underlying muscle and fascia, (2) Combining the very good blood supply of a musculocutaneous flap with the reduced donor-site morbidity of a skin flap, (3) Replacing like with like, (4) Limiting the donor-site to the same area, (5) Possibility of completely or partially primarily closure. (6) Technically less demanding, because they are microsurgical procedures, but without microvascular sutures, (7) Shorter operating time (Lecours et al., 2010; Rubino et al., 2006; Georgescu et al., 2007; Parrett et al., 2009; El-Sabbagh, 2011; Lee et al., 2010).

Propeller perforator flaps in distal lower leg provide a valuable option in the reconstructive armamentarium, due to their main advantages. It is a relatively easy and less time consuming procedure, which is beneficial in elderly, multiple injured patients, or with a compromised general status. Besides the fact that the reconstruction can replace like-with-like by using tissues of similar texture, thickness, pliability, and color, this method avoid the complexity, the multiple surgical sites and the extra costs associated with free flaps and microsurgery. Moreover, in case of failure of a local perforator flap, alternative methods can be used, including free flaps. Similar to free flaps, the local perforator flaps reduce morbidity of the donor site, because the source artery and underlying muscle are preserved, and scars are limited to only one region. For defects less than 6 cm wide, the donor site can be primarily closed (Jakubietz et al., 2007), but even bigger defects can be partially direct sutured. A significant drawback can be the cosmetic deficit related to the donor site, which formally contraindicates this procedure in women. Another disadvantage is related to the fact that the perforator can be within the zone of injury, which can prejudice the viability of the flap.

Propeller perforator flaps are best suited for small and medium defects, and in trauma patients for defects without extensive avulsion and degloving injuries. An obvious contraindication of local perforator flaps are patients with peripheral vascular diseases and/or insulin-dependent diabetes. However, because the peroneal artery is least likely to have atherosclerosis, or is the last affected, local perforator flaps based on this artery can be relatively safely harvested in elderly, atherosclerotic and diabetic patients.

The posterior tibial artery propeller perforator flap is indicated for defects over the pretibial and medial aspect of the distal leg, heel, medial malleolus, calcaneum, Achilles tendon, and dorsum of the foot. The best perforator to base
the flap is located 5 cm above the medial malleolus (Georgescu et al., 2007), but with bigger flaps the larger perforators from the middle third of the leg can also be used.

The peroneal artery propeller perforator flap based on the most distal, but very well represented perforator located 5 cm above the lateral malleolus, is very useful in covering the Achilles region, calcaneum, and the lateral malleolus, but, if very long flaps are harvested, is possible to cover also the plantar and dorsal aspect of the foot. Flaps based on more proximal perforators can also be used, but with the price of bigger flaps.

The venous congestion of the tip or of the entire flap is the most common complication, and is due to the insufficient flow in the perforator pedicle, either because of an inadequate selection of the perforator, or because of an insufficient dissection and clearing of the vascular pedicle, especially around the vein. Very rarely it happens to loose the entire flap, and from this point of view, in some cases is better to choose a local perforator flap, rather than a free flap. If a free flap is lost, everything is lost, while generally in a local perforator flap only the superficial part is lost, which means that the flap did its’ job of covering the denuded anatomical elements. After debridement, the remaining part of the flap generally granulates very fast, and can be grafted.

If signs of congestion or ischemia are observed intraoperatively, a venous microsurgical anastomosis or the derotation of the flap in its original position can be attempted. If the vascular problems appear only postoperatively, the flap sometimes can be saved by removing the stitches, performing incisions, applying local heparinization or using leeches.

**CONCLUSION**

Propellar flaps are very reliable in covering defects of the foot and distal lower leg, and may be alternative for free flaps.

**REFERENCES**


