Original Research Paper

Volume-9 | Issue-6 | June-2019 | PRINT ISSN No. 2249 - 555X

Plastic Surgery

PROPELLER FLAPS IN DISTAL LOWER LIMB RECONSTRUCTION : OUR INSTITUTIONAL EXPERIENCE

Dr. Nirmal Kumar Gupta

Dr. Pradeep Gupta*

*Corresponding Author

Dr Arti Gupta

Dr. Mathura Prasad Agarwal

ABSTRACT

Introduction: Reconstruction of soft tissue defect in the lower limb is challenging due to thin non – expandable soft tissue and lack of reliable local flap options. Traditionally in reconstruction of lower limb soft tissues defect, muscle flaps have been the gold standard for Gustillo Anderson grade IIIB. The defect in this area often requires microsurgical free flaps. With an increase understanding of the perforator flap concept, we applied the propeller flap to provide local flap coverage of different defect in lower limb.

Material and Method: We present our experiences with 15 cases of propeller flaps performed between September 2013 to July 2016 in our institute. All defects were traumatic in nature and classified as Gustillo Anderson grade IIIB. Perforator were marked preoperatively with help of hand held doppler. Perforator was identified intra operatively and traced to major vessel. Skin paddle was designed around perforators. Skin paddle was than rotated in to defect.

Result: Outcome of all the flaps was excellent except one case which underwent epidermolysis. There was distal congestion initially in four flaps but improved on day second and third post- operatively. No vascular re-exploration was performed.

Conclusion: Propeller flap are reliable and versatile option for reconstruction of lower and middle leg soft tissue defect with associated grade IIIB fracture.

KEYWORDS : Propeller flap, peroneal artery, posterior tibial artery

INTRODUCTION

Satisfactory coverage for defect of the lower and middle third of the leg with tendon or bone exposure remain challenging. Historically, the principles of surgical management of lower extremity trauma has progressed from that of amputation during world war I and II to one of extremity salvage by improvements in the debridement technique, fracture fixation and soft tissue coverage via local, regional and free tissue transfer.[1]

With the conception of trauma injury severity scores as pioneered by of Gustillo, Anderons and Byrd, traumatic defects of lower limbs were accordingly classified based on severity. It was also noted that local flaps in higher grades of injuries had higher complications rate as the pedicled for these flaps were in the zone of injury. Advancement in technique of flap harvest gave birth to perforator flaps through the innovative work by Koshima and Soeda (2). The anatomical study of the fibula osteoseptiocutaenous flap demonstrated that perforators arising from the peroneal artery were reliable and versatile in supply a wider area of skin with a constant distribution.[3,4.]

Hyakusoka et al[5] first introduced the concept of propeller flap in 1991. The propeller flap is local island fasciocutaneous flap based on a single dissected perforator with a length exceeding the width.[5] For reconstruction involving the distal leg, the skin in the proximal leg can be used for coverage based on the 180 degree propeller flap.[6] Several designs and movement of the perforator flap have been designed by various authors amongst which are the Keystone flap and the propeller flap. We present a series of case of lower extremity reconstruction with perforator based propeller flaps.

PATIENTS AND METHODS

Between September 2013 to July 2016, 15 patients with soft tissue defect in distal leg underwent reconstruction with propeller flap in SMS Medical College, Jaipur Rajasthan. Average age of patient was 31 years. All wounds were classified as Gustillo Anderson grade III B. Perforators were marked and planned preoperatively with an 8 Mhz hand held Doppler device. The skin island based on a perforator. This perforator serves as the Pivot point for the flap that can be rotated up to 180 degree.[6]

Surgical Technique

All patients were operated under spinal anaesthesia. For both posterior tibial artery and peroneal artery perforator flaps, the fasciocutaneous flap were raised. Either an anterior and posterior incision can be employed, depending on the location of the defect and patient position (prone vs. supine). On confirming the presence of preoperatively marked perforators, the most suitable perforator with relations to size and closeness to defect was chosen. We did not predetermine the most suitable perforator by clamping[7] .Suitable perforator were chosen based on proximity to the wound edge and size alone. Once identified the perforators were dissected down to the axial vessels. The design of the flap could be modified depending on the location of the chosen perforator. The size of the flap was designed based to the defect size. This technique of elevation has been found to be safe in case there is inadvertent trauma to the perforator the flap can simply be replaced and another option considered. The flap is now rotated on its perforator to varying degree and inset in to the defect. The donor site was skin grafted.

RESULT

Fifteen patient with defects on leg were operated with this method from Sept. 2013 to July. 2016. The cause of all defect were trauma. There was one flap that was complicated by epidermolysis. Four flaps based on peroneal artery underwent distal congestion but however improved on day three post operatively. Both these patients had no comorbids and the perforators were located away from the zone of injury. No vascular re-exploration was performed.

DISCUSSION

Since propeller flap concept was first applied by Hyakusoku et al.al[5] in 1991 to release scar contracture, the flap has been wide applied to defect all over the body. For a reconstructive surgeon to be able to utilize these perforator flaps in reconstructive surgery, he / she needs to be familiar with the structural anatomy and vascular anatomy of the area involved as it provide a framework for flap elevation. There are a total of 93 perforators in the lower extremity with an average diameter of 0.7 mmm and able to a supply a flap 47 cm^2 in size (8). The structural anatomy of the tissue planned for reconstruction and the flap to be used should also be taken into consideration by reconstructive surgeon. For example, the characteristic anatomy of parent tissue in the lower third of the leg is particularly thin, fasciocutaneous with limited underlying muscles. For this reason free flap or pedicled flaps reconstruction with tissue from more proximal region of the body are anatomically and aesthetically not very suitable for reconstruction of the distal third of

the leg. Propeller flap has recently become popular in lower extremities reconstruction due to advantages such as having a reliable blood supply while sparing the major blood vessel, no need for microvascular anastomosis, and the flap being thin and pliable for soft tissue cover in area like the lower leg and ankle where bulk is undesirable. In addition, its greater rotations arch makes it popular for distal lower leg reconstruction. The pivot point should base on the distal perforators because it allows more healthy skin proximally to be included in the flap to cover distal soft tissue defect.[9] Although there is no definite limitation on the size of the flap that can be harvested, Wei et al. noted that the septocutaneous vessels from peroneal artery can supply a skin paddle of up to 22-25 cm long and 10-14 cm wide. [4,10]

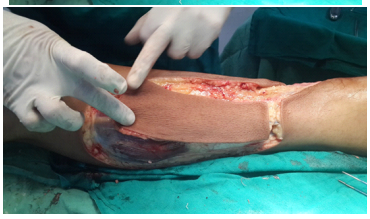
Wong et al. proposed nonlinear finite element stimulations to elucidate the determinants of perforator patency in propeller flaps, and advocated that the chosen perforator be at least 1 mm in diameter and 30 mm in length (11). Therefore, we usually try to mobilize the entire perforator segment to obtain longer length for less strain on the vessels. This will also allow for easier rotation and insetting. It is through the understanding of detailed vascular and tissue anatomy that the reconstructive surgeon is able to employ a suitable solution for a tissue defect in the region. In addition to understanding the vascular and structural anatomy of the region to be reconstructed, the reconstructive surgeon should have at his disposal the accurate surgical technique and equipment to enable him to safety dissect these perforators intra operatively. Dissection of perforator's intra- op should be done with the use of surgical loupes perferably with 3.5 X magnifications. Dissection should be done in blood less field for accurate identification of perforators and adequate size of perforator can be assessed by the visible pulsations of the perforator and the size of the fascial defect through which the vessel has perforated.[8]

This only drawback is that the raising of these flaps requires a certain amount of skill which in time most surgeons are able to master.

The most common complications of the propeller flap design is the higher risk of venous congestion. The problem of venous congestion can often be prevented with adequate dissection, loosely suture and massage.

All over cases were post trauma involving middle and distal third of the lower extremity. We have had 100% success with propeller flap for lower third construction so far. We have also had 100% success in total with all our propeller flap.

No.	Age	Sex	Cause	Comorbid	Size	Location	Perforator	Complications
1	18	M	Trauma	None	6x8 cm	Distal third leg	PTA	NIL
2	34	M	Trauma	None	5x3 cm	Heal	Heal	NIL
3	23	M	Trauma	None	10x6 cm	Medial aspect lower third	PTA	NIL
4	39	M	Trauma	None	6x4 cm	Anterior ankle	ATA	NIL
5	30	M	Trauma	None	4x3 cm	Distal Third Leg	Peroneal	NIL
6	36	M	Trauma	None	7x4 cm	Distal Third Leg	Peroneal	Initial congestion
7	47	M	Trauma	None	8x4 cm	Distal Third Leg	Peroneal	NIL
8	42	M	Trauma	None	12x4 cm	Distal Third Leg	PTA	Epidermiolysis
9	26	M	Trauma	None	6x5 cm	Distal Third Leg	PTA	NIL
10	20	M	Trauma	None	3x4 cm	Distal Third Leg	Peroneal	NIL
11	23	M	Trauma	None	5x3 cm	Distal Third Leg	Peroneal	NIL
12	38	M	Trauma	None	8x4 cm	Distal Third Leg	Peroneal	Initial congestion
13	33	M	Trauma	None	7x3 cm	Distal Third Leg	Peroneal	Initial congestion
14	27	M	Trauma	None	6x4 cm	Distal Third Leg	PTA	Nil
15	29	M	Trauma	None	10x5 cm	Distal Third Leg	Peroneal	Initial congestion



REFERENCES

1. Saint-Cyr M, Schaverian MV, Rohrich RJ (2007) Perforator Flaps: History, Controversies, Physiology, Anatomy and Use in Reconstruction (CME). Plast Reconstr Surg 123: 132e-45e.
2. Koshima I, Soeda S (1989) Inferior epigastric artery skin flap without rectus abdominis muscle. Br J Plast Surg 42: 645-648.
3. Chen YL, Zheng BG, Zhu JM, et al. Microsurgical anatomy of the lateral skin flap of the leg. Ann Plast Surg. Oct 1985;15(4):313-318.
4. Wei FC, Seah CS, Tsai YC, et al. Fibula osteoseptocutaneous flap for reconstruction of composite mandibular defects. Plast Reconstr Surg. Feb 1994;93(2):294-304; discussion 305-296.
5. Hyakusoku H, Yamamoto T, Fumiiri M. et al. The propeller flap method. Br J Plast Surg. Jan 1991;44(1):53-54.
6. Jakubietz RG, Jakubietz MG, Gruenert JG, et al. The 180-degree perforator-based propeller flap for soft tissue coverage of the distal, lower extremity: a new method to achieve reliable coverage of the distal lower extremity with a local, fasciocutaneous perforator flap. Ann Plast Surg. Dec 2007;59(6):667-671.
7. Celik N, Wei FC (2003) Technical tips in perforator flap harvest. Clin Plast Surg 30:469-472.
8. Geddes Cr, Tang M, Yang D (2006) Anatomy of integument of the lower extremity: Perforator flaps. Anatomy, technique and clinical applications. St Louis (MO): QMP: 541-578.
9. Teo TC. The propeller flap concept. Clin Plast Surg. Oct 2010;37(4):615-626, vi.
10. Wei FC, Chen HC, Chuang CC, et al. Fibular osteoseptocutaneous flap: anatomic study and clinical application. Plast Reconstr Surg. Aug 1986;78(2):191-200.
11. Wong CH, Cui F, Tan BK, et al. Nonlinear finite element simulations to elucidate the determinants of perforator patency in propeller flaps. Ann Plast Surg. Dec 2007; 59(6): 672-678.
12. Lu TC, Lin CH, Lin YT, et al. Versatility of the pedicled peroneal artery perforator flaps for soft-tissue coverage of the lower leg and foot defects. J Plast Reconstr Aesthet Surg. Mar 2011;64(3):386-393.