Journal of Plastic Surgery

Research Article
Published: 23 Jul, 2026

Propeller Flaps for Lower Extremity Coverage, Can These Be Used as a Work Horse Flap

Tahir H, Iqbal A, Khan I, Rahman OU and Hossain R*

Department of Plastic and Reconstructive Surgery, Liaquat National Hospital, Karachi, Pakistan

Abstract

Background: Reconstruction of the distal one-third of lower extremity is a challenging task to perform. Among the available reconstructive options, perforator-based propeller flaps are of great value as they allow reconstruction without sacrificing the main vessel. The purpose of this study is to review the usefulness, versatility, and safety of these flaps in lower extremity reconstruction.

Method: During January 2021 to January 2024 a total of 24 patients underwent lower extremity defect reconstruction with perforator-based propeller flaps. The study was conducted at Liaquat National Hospital, Karachi. Flaps were based on anterior tibial, posterior tibial, peroneal artery perforators and dorsalis pedis artery.

Results: Among the 24 patients, 5 underwent reconstruction with peroneal artery perforator propeller flap, 8 based on anterior tibial artery, 8 based on posterior tibial artery, and 3 based on dorsalis pedis artery. Average flap size was 9.9 cm × 4.8 cm. Four patients developed partial flap necrosis and one developed wound infection which was managed conservatively.

Conclusion: Flap reconstruction with like tissue always has a better outcome. Perforator based propeller flaps are safe and easy to harvest, providing good coverage for small lower extremity soft tissue defects.

Keywords: Propeller flaps; Dorsalis pedis artery; Posterior tibial

Introduction

Lower extremity defects are frequently encountered, most commonly secondary to trauma. Other common causes include tumor excision, infection, and chronic wounds. Reconstruction of the distal one-third of lower extremity is a challenging task to perform owing to the limited availability and mobility of tissue. Soft tissue defects in this region frequently result in exposure of the underlying structures such as bone, tendons and neurovascular bundle [1,2].

According to the reconstructive ladder of reconstruction, available options include skin graft, local flaps, regional flaps and free flaps. Although free flaps remain the gold standard for lower extremity defects specially in the distal third of leg. These may not be feasible in all circumstances such as lack of microsurgical expertise, lack of equipment's & post-operative care facilities. Patient factors may also affect this choice, as it may not be feasible because of comorbidities, or vascular injury. The history of perforator-based propeller flaps dates back to 1989 when Koshima and Soeda described the term "perforator flaps and later Hyakusoku described the propeller flaps in 1991 [3,4]. These concepts were later combined and modified by Hallock in 2006 [5]. Among the available reconstructive options, perforator-based propeller flaps are of great value as they allow reconstruction without sacrificing the main vessel. Other advantages of these flaps over conventional local and free flaps include: 1) Similar texture, thickness and color match, 2) less donor site morbidity, 3) Utilization of adjacent tissue. With the advent of more sensitive imaging techniques, hand held Doppler localization and understanding of the anatomy has broadened the horizon of perforator-based propeller flaps [6-9]. Further understanding of flap vascularity and vascular territories was the result of perforasome theory as proposed by Saint-Cyr, et al. [7]. In 2009, the first Tokyo meeting on perforator & propeller flaps was held where Tokyo consensus was proposed [10]. Although a number of studies have been done reporting a favorable outcome of these flaps with survival rates exceeding 85% [11-19], concerns regarding venous congestion, partial or complete flap loss, and technicalities associated with perforator dissection and flap rotation remain till date. The purpose of this study was to review the usefulness, versatility, and safety of these flaps in distal lower extremity soft tissue defects at a tertiary care center.

OPEN ACCESS

Correspondence:
Tahir H, Department of Plastic and Reconstructive Surgery, Liaquat National Hospital, Karachi, Pakistan, E-mail: H.tahir1992@gmail.com

Received Date: *04 Jul 2026*
Accepted Date: *20 Jul 2026*
Published Date: *23 Jul 2026*

Citation:
Tahir H, Iqbal A, Khan I, Rahman OU, Hossain R. Propeller Flaps for Lower Extremity Coverage, Can These Be Used as a Work Horse Flap. J Plast Surg. 2026; 4(1): 1018.

Table 1: Patient demographics and operative details.

S.no	Gender	Age	Etiology	Site of defect	Perforator flap / Source Artery	Size of Flap (L × W)	Donor site management	Complications
1	Male	11	SWI	Lower one third of leg	ATA	10 cm × 5 cm	STSG	Partial Flap Necrosis
2	Male	9	SWI	Lower one third of leg	PTA	20 cm × 6 cm	STSG	Partial Flap Necrosis
3	Female	26	RTA	Lower one third of leg	PA	8 cm × 5 cm	STSG	Partial Flap Necrosis
4	Female	16	RTA	Lower one third of leg	PTA	8 cm × 5 cm	STSG	Nil
5	Male	22	RTA	Lower one third of leg	PA	12 cm × 4 cm	STSG	Nil
6	Male	18	RTA	Lower one third of leg	ATA	5 cm × 4 cm	STSG	Nil
7	Male	32	RTA	Lower one third of leg	ATA	9 cm × 4 cm	STSG	Nil
8	Male	46	FAI	Lower one third of leg	ATA	25cm × 5cm	STSG	Partial Flap Necrosis
9	Male	18	RTA	Lower one third of leg	DPA	10 cm × 5 cm	STSG	Nil
10	Male	14	SWI	Lower one third of leg	PTA	8 cm × 6 cm	STSG	Nil
11	Female	10	RTA	Lower one third of leg	PTA	12 cm × 3 cm	STSG	Nil
12	Female	26	RTA	Lower one third of leg	DPA	10 cm × 5 cm	STSG	Nil
13	Male	16	RTA	Lower one third of leg	ATA	5 cm × 4 cm	STSG	Nil
14	Female	32	RTA	Lower one third of leg	ATA	9 cm × 3 cm	STSG	Nil
15	Female	42	RTA	Lower one third of leg	ATA	11cm × 5 cm	STSG	Nil
16	Female	39	FAI	Lower one third of leg	DPA	5 cm × 6 cm	STSG	Nil
17	Male	24	RTA	Lower one third of leg	PTA	13 cm × 6 cm	STSG	Nil
18	Male	17	RTA	Lower one third of leg	PTA	13 cm × 5 cm	STSG	Nil
19	Male	21	FAI	Lower one third of leg	PA	10 cm × 5 cm	STSG	Nil
20	Male	9	SWI	Lower one third of leg	PA	8 cm × 3 cm	STSG	Nil
21	Female	15	RTA	Lower one third of leg	PA	9 cm × 4 cm	STSG	Cellulitis
22	Male	45	RTA	Lower one third of leg	PTA	8 cm × 6cm	STSG	Nil
23	Female	27	Squamous cell carcinoma	Lower one third of leg	PTA	8 cm × 6cm	STSG	Nil
24	Female	50	Post Cellulitis	Foot	ATA	7cm × 4cm	STSG	Nil

SWI: Spoke Wheel Injury; RTA: Road Traffic Accident; FA: Fire Arm Injury; ATA: Anterior Tibial Artery; PTA: Posterior Tibial Artery; DPA: Dorsalis Pedis Artery; PA: Peroneal Artery

Methodology

During January 2021 to December 2024 a total of 24 patients underwent lower extremity defect reconstruction with perforator-based propeller flaps. The study was conducted at Liaquat National Hospital, Karachi. All Patients had defects involving the distal one-third of the leg, if which majority were post traumatic i.e., road traffic accident, spoke wheel injury, firearm injury. Reconstruction was planned once wounds were healthy with no gross or microscopic evidence of infection. Patients with compromised perfusion, large lower extremity soft tissue defects, and mangled extremity were excluded. Flaps were based on anterior tibial, posterior tibial and peroneal artery perforators. All flaps were based on a single perforator so as to facilitate the axial rotation of the flap into the recipient area. Perforators were identified and marked preoperatively using a handheld Doppler device (8 MHz probe). Flap was designed according to the need keeping the perforator as a pivot point to facilitate the rotation and propulsion of the flap. Flaps were designed a little larger than the defect size so as to facilitate rotation and tension free closure. Tourniquet was inflated keeping the pressure according to the age and blood pressure values of the patient. Lateral incision was first given so as to confirm the location, number and size of the perforator/perforators. The dissection is completed in the supra or sub facial plane. The perforator was freed from all the facial attachments, side branches and dissected up to the main vessel. Rotation was confirmed and then tourniquet was released. Perfusion of the flap was confirmed and then flap was inset into the defect. A couple of flaps showed signs of arterial insufficiency secondary to kinking of the vessel, so one of the two veins of the perforator was ligated and cut, after which the perfusion of the flap was improved.

Result

A total of 24 patients underwent reconstruction using perforator-based propeller flaps. The mean patient age was 24.4 ± 12.4 years (range 9-50 years). Fourteen were males (58.3%) and 10 females (41.7%). The majority of the soft tissue defects were secondary to traumatic injuries. Road traffic accidents accounted for the majority of cases, representing 15 cases (62.5%), followed by spoke-wheel injuries 4 cases (16.7%) and fire-arm injure 3 cases (12.5%). Non-traumatic etiologies were less common and included defects secondary to

Figure 1: Case of a young male, with history of RTA. **a)** defect seen on the distal aspect of lateral leg and lateral aspect of foot, also perforators have been localized and marked (blue dots), **b)** after perforator localization flap has been harvested, **c)** perforator have isolated and dissected, **d)** 3 months post-operative picture, flap healed well and donor site covered with split thickness skin graft.

Figure 2: a) Defect seen on the posteromedial aspect of the distal one-third left leg. **b)** Flap harvested and islanded on the perforator based on posterior tibial artery. **c)** Flap inset and donor site covered with split thickness skin graft (covered with dressing). Partial flap loss/necrosis can be seen.

tumor excision (squamous cell carcinoma) and post cellulitis tissue loss, each accounting for 1 case (4.2%). All defects were in the distal one-third of leg. Reconstruction was performed using the perforator flaps based on, peroneal artery in 5 patients (20.8%), 8 (33.3%) based on anterior tibial artery (Figure 1), 8 (33.3%) based on posterior tibial artery (Figure 2) and 3 (12.5%) based on dorsalis pedis artery. Average flap size was 9.9 cm × 4.8 cm, corresponding to mean flap are of 48.8 cm^2 (range 20 cm^2-125 cm^2). Donor sites were managed with split-thickness skin graft in all patients. Overall, a good flap survival was achieved in 21 out of 24 patients (87.5%) Four patients (16.7%) developed partial flap necrosis, and one patient (4.2%) developed cellulitis (Table 1). These was no total flap loss and all complications were managed conservatively with dressings and local wound care with none requiring secondary reconstruction. Overall complication rate was 20.8%. Despite this limb salvage and definitive coverage was achieved in all patients.

Discussion: Distal lower extremity defect reconstruction remained a challenge because of limited local tissue availability and exposure of the underlying structures. Traditionally, free tissue transfer has been considered the preferred reconstructive option. Being feasible only for small to medium sized defects, perforator-based propeller flap has emerged as an attractive alternat [2,5,13,16]. In our study, 87.5% flap survival was achieved, which is comparable to previously published series reporting a range from 85% to 98% flap survival. Mendieta et al. reported favorable outcomes using perforator-based propeller flaps in middle & distal leg defects, while Gir, et al. [13] demonstrated higher success rates [13,15]. In our cohort, road traffic accidents accounted for the majority of defects, a finding being consistent with studies conducted in developing countries [18,19]. Prevention of infection, preservation of limb function and optimization of long-term outcomes could only be achieved with early coverage, which in our study was done using perforator-based propeller flaps. Among the multiple advantages the principal advantage of these flaps was preservation of the source vessels, while other advantages include similar tissue characteristics, minimal donor site morbidity, no need of microsurgical anastomoses, and reduced operative complexity [10,14,20].

The most common complication that was seen in the cohort was partial flap necrosis (16.7% cases). This is commonly seen secondary to venous congestion, excessive tension, pedicle torsion, or arterial insufficiency after flap rotation [12,13,16]. Transient vascular insufficiency was observed in several cases which was improved after optimization of pedicle geometry and ligation of one venae comitans. Similar technical modifications have been described in literature [12,17]. The versatility of perforator-based reconstruction was demonstrated by successful utilization of anterior tibial, posterior tibial, peroneal and dorsalis pedis artery. This highlights the rich vascular network of the lower extremity and supports the concept that flap design can be tailored according to defect location and available perforators. The perforasome theory proposed by Saint-Cyr, et al. [7] provides the anatomical basis for such flap designs and helps explain the reliability of these reconstructions. Several authors have suggested that perforator-propeller flaps should be considered a “work-Horse” option for lower extremely reconstruction because of their reliability, shorter operative time, preservation of major vessels and reduced donor-site morbidity [10,13,14, 16]. Our finding supports the concept, particularly for small- and medium sized defects of the distal third of leg where local perforators are available and microsurgical free tissue transfer may not be necessary.

This study has several limitations. It is a retrospective single center study with a relatively small sample size and lacks a comparative group. Long term functional outcomes, aesthetic assessments, patient satisfaction and quality-of-life measures were not evaluated. Future prospective multicenter studies comparing perforator propeller flaps with reverse sural flaps and free tissue transfer would provide stronger evidence regarding optimal reconstructive strategies.

Despite these limitations, our results demonstrate that perforator-based propeller flap provide reliable soft issue coverage with acceptable complication rates and excellent limb salvage outcomes. These characteristics make them and effective and versatile reconstructive option for selected distal lower extremity defects.

Conclusion

Based on our experience and the available literature perforator-based propeller flaps can be considered a reliable “work horse” option for reconstruction of small and medium sized distal lower extremities

soft tissue defects. They preserve major vascular anatomy, provide like-with-like tissue replacement, avoid microsurgical complexity and achieve high flap survival rates with acceptable complication profiles.

References

1. Pontén B. The fasciocutaneous flap: its use in soft tissue defects of the lower leg. Br J Plast Surg. 1981;34(2):215-20.
2. Khouri RK, Shaw WW. Reconstruction of the lower extremity with microvascular free flaps: a 10-year experience with 304 consecutive cases. J Trauma. 1989;29(8):1086-94.
3. Koshima I, Soeda S. Inferior epigastric artery skin flaps without rectus abdominis muscle. Br J Plast Surg. 1989;42(6):645-8.
4. Hyakusoku H, Yamamoto T, Fumiiri M. The propeller flap method. Br J Plast Surg. 1991;44(1):53-4.
5. Hallock GG. The propeller flap version of the adductor muscle perforator flap for coverage of ischial or trochanteric pressure sores. Ann Plast Surg. 2006;56(5):540-2.
6. Teo TC. Perforator local flaps in lower limb reconstruction. Cir Plast Iberolatinoam. 2006;32(1):15-17.
7. Saint-Cyr M, Wong C, Schaverien M, Mojallal A, Rohrich RJ. The perforasome theory: vascular anatomy and clinical implications. Plast Reconstr Surg. 2009;124(5):1529-44.
8. Hallock GG. Direct and indirect perforator flaps: the history and the controversy. Plast Reconstr Surg. 2003;111(2):855-65.
9. Saint-Cyr M, Schaverien MV, Rohrich RJ. Perforator flaps: history, controversies, physiology, anatomy, and use in reconstruction. Plast Reconstr Surg. 2009;123(4):132-45.
10. Pignatti M, Ogawa R, Hallock GG, Mateev M, Georgescu AV, Balakrishnan G, et al. The Tokyo consensus on propeller flaps. Plast Reconstr Surg. 2011;127(2):716-22.
11. Panse N, Bhatt Y. Reconstruction of lower limb defects using perforator-based propeller flaps. Indian J Plast Surg. 2012;45(1):37-43.
12. Georgescu AV. Propeller perforator flaps in distal lower leg: evolution and clinical applications. Arch Plast Surg. 2012;39(2):94-105.
13. Gir P, Cheng A, Oni G, Mojallal A, Saint-Cyr M. Pedicled-perforator (propeller) flaps in lower extremity defects: a systematic review. J Reconstr Microsurg. 2012;28(9):595-602.
14. Nelson JA, Fischer JP, Brazio PS, Kovach SJ, Rosson GD, Rad AN. A review of propeller flaps for distal lower extremity soft tissue reconstruction: is flap loss too high? Microsurgery. 2013;33(7):578-86.
15. Mendieta M, Cabrera R, Siu A, Altamirano R, Gutierrez S. Perforator propeller flaps for the coverage of middle and distal leg soft-tissue defects. Plast Reconstr Surg Glob Open. 2018;6(5):e1759.
16. Bekara F, Herlin C, Somda S, De Runz A, Grolleau JL, Chaput B. Free versus perforator-pedicled propeller flaps in lower extremity reconstruction: what is the safest coverage? A meta-analysis. Microsurgery. 2018;38(1):109-119.
17. Innocenti M, Dell'Acqua I, Famiglietti M, Vignini L, Menichini G, Ghezzi S. Free perforator flaps vs propeller flaps in lower limb reconstruction: a cost/effectiveness analysis on a series of 179 cases. Injury. 2019;50(Suppl 5):S11-S16.
18. Yadav P, Thakur S, Agarwal P, Sharma D, Kukrele R. Perforator-based propeller flap for coverage of lower leg: single centre experience. Trop Doct. 2021;51(3):331-8.
19. Rana HA, Mistry KR, Suri MP, Sachde JP, Ganapathy N, Krishna A, et al. Propeller flaps for the coverage of lower 1/3 leg defect. Int J Sci Stud. 2022;9(12):97-100.
20. Hallock GG. Utility of both muscle and fascia flaps in severe lower extremity trauma. J Trauma. 2000;48(5):913-7.