

**CLINICAL OUTCOMES OF KEYSTONE ISLAND PERFORATOR FLAP FOR RECONSTRUCTION OF LOWER LIMB DEFECTS IN A TERTIARY CARE CENTRE IN TELANGANA: A PROSPECTIVE STUDY**

Dr. Rishitha N*	Postgraduate Resident, Dept. of Plastic & Reconstructive Surgery, Osmania General Hospital, Hyderabad. *Corresponding Author
Dr. E. Mahendar	Associate Professor, Dept. of Plastic & Reconstructive Surgery, Osmania General Hospital, Hyderabad.
Dr. Sree Sai Rekha	Assistant Professor, Dept. of Plastic & Reconstructive Surgery, Osmania General Hospital, Hyderabad.
Dr. I. Mugeshwaran	Postgraduate Resident, Dept. of Plastic & Reconstructive Surgery, Osmania General Hospital, Hyderabad.
Dr. Swathi Sankar	Postgraduate Resident, Dept. of Plastic & Reconstructive Surgery, Osmania General Hospital, Hyderabad.
Dr. Palukuri Lakshmi	Professor & HOD, Dept. of Plastic & Reconstructive Surgery, Osmania General Hospital, Hyderabad.

ABSTRACT

Background: Reconstructing soft tissue defects of the lower limb is complex, especially in the presence of exposed bone or implants. The Keystone Perforator Island Flap (KPIF), first described by Behan in 2003, offers a reliable local flap option without the need for microvascular expertise. **Objective:** To evaluate the effectiveness and outcomes of the Keystone Island Perforator Flap in lower limb reconstruction in terms of flap success, complication rates, aesthetic satisfaction, and functional recovery. **Methods:** A prospective clinical study was conducted over 18 months involving 20 patients presenting with lower limb defects at Osmania General Hospital, Hyderabad. Patient demographics, defect etiology, flap dimensions, donor site closure, and complications were analyzed. **Results:** The mean patient age was 36.9 years, with a male predominance (85%). The most common cause was road traffic accidents (90%), and the most frequent defect site was the proximal third of the leg (65%). The mean defect size was 98.3 cm² and average flap size was 109.3 cm². Donor site closure was primarily achieved in 70% of cases, with 30% requiring split-thickness skin grafting. Complications occurred in 3 patients (15%), including partial flap necrosis and graft loss. All flaps survived without total loss, and patients had good functional and aesthetic outcomes. **Conclusion:** The Keystone Perforator Island Flap is a reliable and versatile reconstructive option for lower limb defects of small to moderate size defects. It avoids the complexity and costs of free flaps, with minimal donor site morbidity and high patient satisfaction, making it ideal for resource-constrained settings.

KEYWORDS :**INTRODUCTION**

Soft tissue reconstruction of the lower limb, particularly with exposed bone or implants, remains a surgical challenge. Conventional options like free flaps, while effective, require advanced microsurgical expertise and infrastructure. The Keystone Island Perforator Flap (KPIF), introduced by Behan in 2003, utilizes local tissue perfused by underlying perforators without the need for intricate dissection or anastomosis. Its ease of execution, versatility, and low donor site morbidity make it especially valuable in high-volume, resource-limited settings like urban tertiary hospitals in India.

This study explores the utility of KPIF in lower limb trauma at Osmania General Hospital, assessing outcomes related to flap viability, complication rates, and aesthetic and functional recovery.

Types Of Keystone Flaps According To Behan**Type I – Standard Advancement Flap**

- A curvilinear trapezoidal flap.
- Advanced directly into the defect without incision of deep fascia.
- Donor site primarily closed.
- Best for smaller, shallow defects.

Type II – Fasciotomy And Skin Grafting

Type IIa: Deep fascia is divided along the base to allow greater mobility.

Type IIb: When donor site closure is under tension, split-thickness skin grafting (SSG) is used to close the donor site.

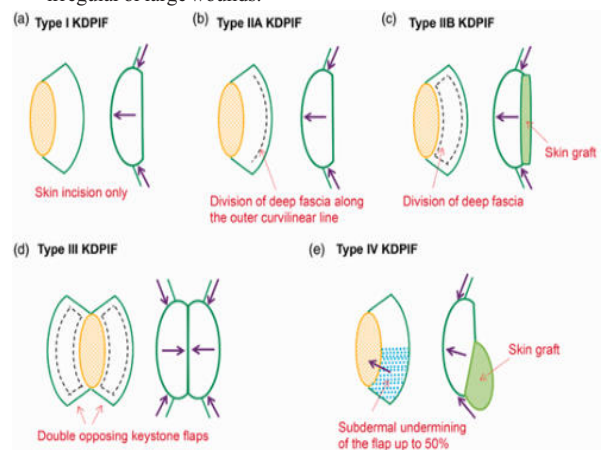
Type III – Double Opposing Keystone Flaps

- Two mirror-image KPIFs are designed on either side of the defect.
- Used for large midline or central defects where single flap coverage is inadequate.

Type IV – Rotational Variant

- A rotational or oblique KPIF design.

- Allows increased arc of rotation and mobility for coverage of irregular or large wounds.

**MATERIALS AND METHODS**

Study Design: Prospective clinical study

Setting: Department of Plastic & Reconstructive Surgery, Osmania General Hospital, Hyderabad Study Duration: July 2023 – January 2025

Sample Size: 20 patients

Inclusion Criteria: Patients with lower limb soft tissue defects with healthy perforator zones and adequate blood flow confirmed by handheld Doppler.

Exclusion Criteria: Complete sole degloving, Doppler-negative limbs, and those medically unfit or unwilling to consent.

Preoperative Workup: Radiographs, Doppler marking of perforators, routine blood tests, and informed consent were obtained. Flap planning was done with lint templates and flap dimensions recorded.

Surgical Technique: The KPIF was outlined adjacent to the defect with a trapezoidal design. The flap was raised en bloc with fascia, preserving underlying perforators. Minimal undermining was performed. Donor sites were primarily closed or skin grafted based on tension.



Postoperative Monitoring: Flaps were assessed for vascularity, complications (necrosis, infection), and healing outcomes. Sutures were removed between day 10–14. Early mobilization was encouraged.

RESULTS

Table 1: Demographic And Clinical Characteristics

Variable	Values
Mean Age	36.9 years
Sex Distribution	17 Males (85%), 3 Females (15%)
Etiology	RTA: 18 (90%), Fall: 2 (10%)
Common Site of Defect	Proximal third of leg (65%)

Table 2: Flap And Defect Characteristics

Variable	Mean (Range) or Distribution
Defect Size	98.3 cm ² (18–195 cm ²)
Flap Size	109.3 cm ² (28–224 cm ²)
Donor Site Closure	Primary: 14 (70%), SSG: 6 (30%)

Table 3: Postoperative Complications

Complication	Number of Cases
Partial Flap Necrosis	2
Donor Site Graft Loss	1
Complete Flap Loss	0

DISCUSSION:

The KPIF offers an optimal reconstructive solution for small to moderate defects of the lower limb. In our study, the majority of defects occurred due to trauma, consistent with other studies in similar populations. The flap's design allows for tension-free closure and robust vascularity without the need for perforator dissection or microvascular anastomosis.

The complication rate of 15% is lower than reported in many traditional fasciocutaneous or muscle flaps. No complete flap loss occurred. Donor site morbidity was minimal, and functional outcomes were excellent, affirming the KPIF as a preferred alternative to more complex procedures.

CONCLUSION

The Keystone Island Perforator Flap is a technically simple, reliable, and effective option for lower limb defect coverage. It is ideal for high-volume centers, especially in developing regions, offering excellent outcomes without the complexity of microsurgical techniques.

REFERENCES

- Behan FC. The Keystone Design Perforator Island Flap in Reconstructive Surgery. ANZ J Surg. 2003;73(3):112–120.
- Bhattacharya V, et al. Keystone Flap in Lower Limb Reconstruction: A Clinical Study. Indian J Plast Surg. 2017;50(2):173–180.
- Godina M. Early Microsurgical Reconstruction of Complex Trauma of the Extremities. Plast Reconstr Surg. 1986;78(3):285–292.
- Mahesh SG, et al. Comparative Evaluation of Local Muscle Flaps in Leg Reconstruction. Indian J Surg. 2016;78(6):446–450.
- Teo TC. The Propeller Flap Concept. Clin Plast Surg. 2010;37(4):615–626.
- Santanelli F. Lower Extremity Reconstruction. Plast Reconstr Surg. 2005;116(7 Suppl):202–212.
- Byrd HS, et al. Primary Management of Complex Open Tibial Fractures with Flap Coverage and Ilizarov Method. Plast Reconstr Surg. 1994;94(5):684–693.
- Laughlin TJ, et al. Outcome of Complex Extremity Trauma Managed with Early Flap Coverage. J Trauma. 1993;35(3):443–449.
- Cormack GC, Lamberty BGH. The Arterial Anatomy of Skin Flaps. Churchill Livingstone; 1986.
- Sharma A, et al. Role of Keystone Flap in Lower Limb Reconstruction. J Clin Diagn Res. 2020;14(3):PC05–PC09.