COMPLICATIONS OF LATERAL CALCANEAL FLAP FOR POSTERIOR HEEL DEFECTS

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ABSTRACT

Background: The lateral calcaneal artery skin flap is preferred by many surgeons for posterior heel reconstruction, as it covers difficult wounds effectively. It does not require sacrificing a major artery in the leg or foot and is relatively thin, with acceptable morbidity at the donor site.

Objective: To determine the frequency of complications of lateral calcaneal flap for posterior heel defects.

Methodology: This descriptive study was conducted at the Department of Plastic Surgery, Lady Reading Hospital Peshawar, after obtaining ethical approval. A total of 126 patients, aged 18-60 years of either gender, with posterior heel defects, were included. Patients with comorbidities or wounds due to malignant resections were excluded from the study.

Results: This study included 126 patients with a mean age of 38.6±10 years, consisting of 57% males and 43% females. Trauma was the leading cause of injury, (48% wheel spokes injury). The mean defect size was 3.8±0.7 cm, and flap size ranged from 3.1 - 5.1 cm ($p < 0.001$). The most common complication was dog ear deformity (39.7%), followed by epidermal necrosis (12.7%) and partial skin graft loss (19.8%). No significant associations were found between complications and age, gender. Rural area residence was found to be independent predictor of complications (odds ratio of 2.1, 95% CI: 1.1–4.0, $p = 0.032$).

Conclusion: The lateral calcaneal artery skin flap can be used safely to provide sensory skin coverage to the posterior heel in one stage with minimal complications and acceptable donor site morbidity.

Keywords: posterior heel defects, lateral calcaneal artery flap, complications, soft tissue defect

INTRODUCTION

Reconstructive surgeons face numerous challenges when addressing soft tissue defects around the posterior heel, especially with an exposed Achilles tendon whether in weight-bearing or non-weight-bearing areas. These challenges are due to the bony structure of the area, limited blood supply, lack of flexible surrounding tissues, high functional demands, and significant mobility.

Several reconstructive techniques, such as skin grafts, regional flaps, and free flap transfers, have been described, each with its own indications, benefits, and drawbacks. The selection of the appropriate reconstructive method depends on factors such as the type and extent of the injury, the condition of the wound bed, available vessels and perforators, and the overall health of the patient.

The lateral calcaneal flap is a fasciocutaneous flap which is supplied by the lateral calcaneal artery, that branches off 6cm above lateral malleolus from the peroneal artery. The flap can be tailored to different forms and sizes, enabling personalization to align with the specifications of the defect [i] [ii]

Numerous complications have been reported in the literature that are associated with lateral calcaneal artery flap such as graft loss, epidermal necrosis, dog ear formation, sensory loss on lateral aspect of foot, depression of donor site. [iii]A study reported the complications of lateral calcaneal flap for posterior heel defect i.e. Dog ear deformity (40%), Epidermal necrosis (30%), and Partial skin graft loss (20%). [vi]

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Posterior heel defects present a challenging clinical scenario, often requiring surgical intervention to restore function and aesthetic appearance. Due to paucity of literature on this subject locally, the goal of this study is to determine the frequency of complications of lateral calcaneal flap for posterior heel defects at our hospital setup. The findings of this study will help our medical professionals to shed light on these complications and implement strategies to minimize their occurrence, including meticulous surgical technique, careful patient selection, and vigilant postoperative monitoring. By understanding the potential pitfalls of the lateral calcaneal flap and adopting evidence-based management strategies, clinicians will optimize outcomes and enhance the overall success of coverage of posterior heel defects.

MATERIALS AND METHODS

This descriptive study was carried out at the Burns and Plastic Surgery Unit of Lady Reading Hospital in Peshawar from july 2024 to February 2025, after obtaining ethical approval from institutional review board (Ref.no:245 /LRH/MTI). The sample size was determined to be 126 patients, with 95% confidence interval, using WHO calculator. [iv] non-probability Consecutive sampling technique was used. patients were followed for up to minimum 6 months after surgery.

Patients aged 18-60 years of both genders presenting with posterior heel defects and exposed tendon and bones were included in this study While Patients with wounds involving lower third of leg and Patients with uncontrolled diabetes, hypertension or peripheral vascular disease, patients with previously unsuccessful flap coverage and those with the extension of the wound involving plantar surface were excluded from this study.

All the patients were operated by single surgical team. Patients were enrolled in the study after taking informed written consent. Pre-operative history and examination was performed and necessary laboratory investigations were carried out. And data was recorded on proforma. Pre-operative and post-operative photographs were taken. Patients were operated under spinal anesthesia. under tourniquet control, after debridement of the wound and refreshing the margins of wound markings for the flap was done along the course of lateral calcaneal artery. fasciocutaneous flap was raised from distal to proximal while leaving Paratenon of peroneal muscles intact. Flap was then insetted over the wound. Tourniquet was released and hemostasis was secured and sutured with vicryl 3/0 and prolene 4/0. Donor site was grafted. Aseptic dressing was done and splint applied in neutral position. Patients were called for follow up in one-week time for wound examination and dressing change. And then at 14 days, and 4 weeks. Sutures were removed at 14 days. Patients whose recipient and donor sites were healed completely without any graft loss of flap loss, were followed up for up to 4-6 months. Patients with flap failure were managed as per standard protocols.

Data Analysis: Data was analyzed suing SPSS VERSION 22. Quantitative variables such as age, duration of trauma, wound and flap size were expressed as mean ± standard deviation (SD). Categorical variables, including gender, injury site, mechanism of injury, and complications, were presented as frequencies and percentages. All the patients were assessed clinically at 1 week, 2 weeks, 8 weeks, 12 weeks and finally at 6 months. Data was stratified by age, gender, duration of trauma, mechanism of injury, wound size and flap size. Post-stratification, the complications across these groups were compared using the chi-square test, with a p-value ≤ 0.05 considered statistically significant. Independent T tests and binary regression was performed to identify the predictors of complications.

RESULTS

A total of 126 patients who fulfilled the inclusion criteria were included in the study. The mean age of the participants was 38.6±10years. FIGURE 1 showing age group distribution. There were 57% (n=72) males and n=54 (43%) females. The majority of the patients (68%) were from rural areas, while the remaining 32% were from urban settings.

Most common mechanism of injury was trauma (wheel spokes injury 48% followed by road traffic accidents 19%). Mean defect size was 3.8±0.7 cm, mean flap size 4.1 ± 0.6 cm ($P < 0.001$).

Following coverage of posterior heel defects with lateral calcaneal artery flaps, the frequency of complications was assessed clinically, post operatively. Dog-Ear Deformity was Found in 39.7% (n = 50) of patients, this was the most common complication. Epidermal Necrosis was Observed in 12.7% (n = 16) of patients, Partial Skin Graft Loss Identified in 19.8% (n = 25) of

patients. (Figure 2 showing frequency of complications)

Post-stratification analysis showed no significant association of complications with age (Chi-Square Statistic (χ^2) 0.716 p = 0.112) gender (p = 0.225), or BMI (p = 0.338). However, there was a significant association among rural residence and higher rates of complications (p = 0.045). Table 1 showing cross tabulation of complications with different age groups.

Independent samples t-test revealed no significant difference in mean age between patients with complications (39.1 ± 9.8 years) and those without complications (37.9 ± 10.3 years) (p = 0.42). Similarly, no significant differences were found in mean defect size (p = 0.36) or flap size (p = 0.27). (TABLE 2)

Binary logistic regression was performed to identify predictors of postoperative complications. After adjusting for age, gender, BMI, defect size, and flap size, rural residence remained an independent predictor of complications with an odds ratio (OR) of 2.1 (95% CI: 1.1–4.0, p = 0.032). Other variables did not reach statistical significance (Table 3).

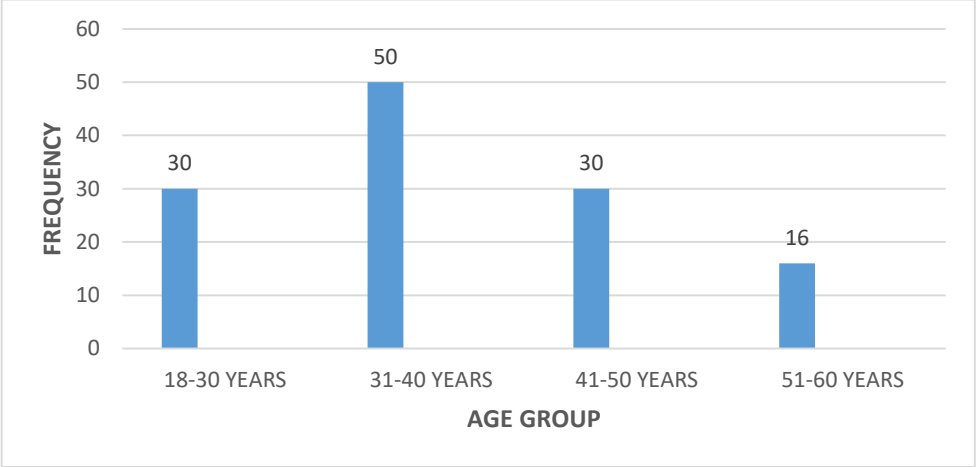

FIGURE 1: SHOWING DISTRIBUTION OF AGE GROUPS

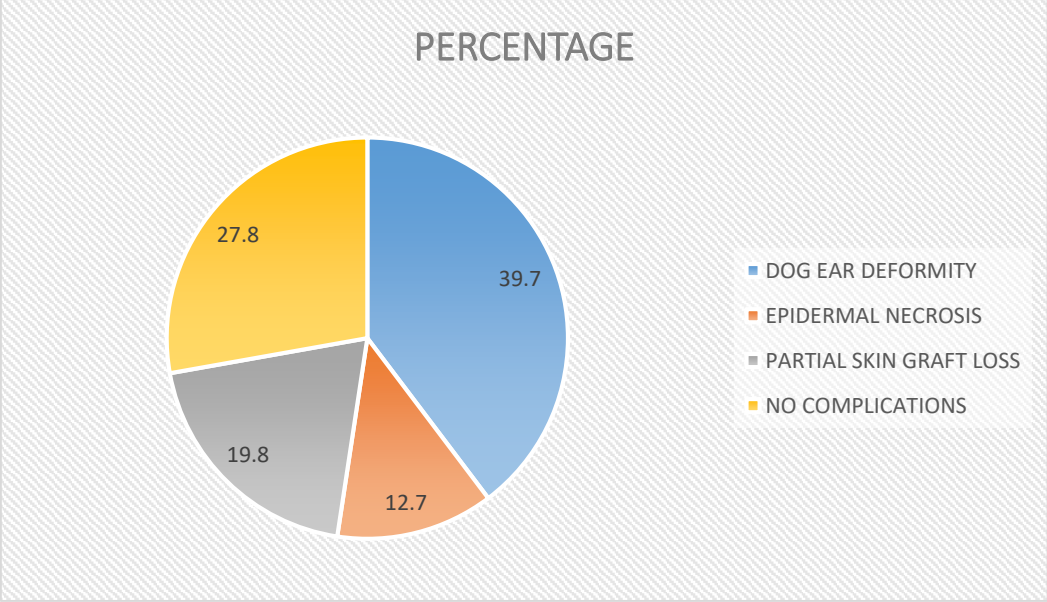

FIGURE 2: FREQUENCY OF COMPLICATIONS

AGE GROUPS (years)	DOG EAR DEFORMITY (39.7%) (n)	Epidermal Necrosis (12.7%) (n)	Partial Skin Graft Loss (19.8%) (n)	
18-30	12	4	6	Chi-Square (χ^2) = 0.716
31-40	20	6	10	p = 0.112
41-50	12	4	6	
51-60	6	2	3	
TOTAL	50	16	25	126

TABLE :1 CROSS TABULATION OF AGE GROUPS WITH COMPLICATIONS

Variable	With Complications (Mean ± SD)	Without Complications (Mean ± SD)	p-value
Age (years)	39.1 ± 9.8	37.9 ± 10.3	0.42
Defect Size (cm)	3.9 ± 0.7	3.7 ± 0.6	0.36
Flap Size (cm)	3.9 ± 0.8	3.7 ± 0.7	0.27

TABLE 2: INDEPENDENT T-TEST (COMPLICATIONS VS WITHOUT COMPLICATIONS WITH VARIABLES)

Variable	Odds Ratio (OR)	95% CI	p-value
Age	1.02	0.98 – 1.05	0.29
Gender (Male)	1.15	0.62 – 2.14	0.64
BMI	1.08	0.95 – 1.22	0.28
Defect Size	1.12	0.83 – 1.51	0.42
Flap Size	1.09	0.88 – 1.36	0.36
Rural Residence	2.10	1.10 – 4.00	0.032*

TABLE 3. Binary Logistic Regression for Predictors of Complications

DISCUSSION

Reconstruction of posterior heel defects continues to be a significant challenge in reconstructive surgery because of the region's distinct anatomical and functional features. The skin in this area is thin, flexible, and loosely adherent, which makes it vulnerable to injury and may result in exposure of the calcaneus or Achilles tendon. [v] Moreover, as the heel bears weight and is constantly exposed to shear and frictional forces, the likelihood of wound breakdown is high, further complicating reconstruction. Hence, successful coverage requires tissue that is durable, pliable, well-vascularized, and sensate to restore function and ensure proper shoe fitting. [vi]

In our study, the lateral calcaneal artery flap provided generally reliable coverage; however, certain complications were observed. The most common was dog-ear deformity (39.7%), and Singh et al [vii], who reported universal occurrence of dog-ear deformity in their series . This complication primarily results from tissue redundancy and flap tension during inset. This complication can be overcome by the island flap modification has been proposed to reduce dog-ear formation and prevent pedicle kinking. Alternatively, adipofascial flap variants can provide more superior aesthetic outcomes, although they need additional grafting.[viii]

Partial skin graft loss was observed in 19.8% of our patients. These findings were comparable to that reported by Islam et al. (20%) .[ix] Graft loss is often attributed to hematoma formation, periosteal injury, or inadequate immobilization. Singh et al. suggested that delayed grafting allows for improved vascular bed preparation and reduces the risk of hematoma-related graft failure .[xii] Although delayed grafting requires an additional procedure, it may enhance long-term outcomes in high-risk patients.

Epidermal necrosis was noted in 12.7% of our cases, higher than the 7.9% reported by Balakrishnan et al. [x] however, in a south Asian series the results were comparable (10–20%) [xi, xii] we managed all our cases conservatively without the need for flap revision, indicating the robust vascularity of the flap despite minor superficial necrosis.

It was noted that none of the other factors like BMI, flap size or defect size significantly affected the success the flap , however , Our findings indicated that rural residence was a significant independent predictor of complications, with patients from rural backgrounds having more than twice the odds of postoperative complications compared to urban residents. This may reflect differences in health-seeking behavior, delayed presentation, poor wound care compliance, or limited access to specialized postoperative care. Pakistani studies have similarly highlighted the disparity in outcomes between urban and rural populations in reconstructive and trauma surgery. [xi] [xii] [xiii] This finding emphasizes the importance of structured postoperative education, rehabilitation, and follow-up, particularly in resource-limited rural settings.

Donor-site morbidity in our study was minimal and aesthetically acceptable in most patients, though contour deformity and lateral foot sensory changes were observed, Importantly, none of these complications compromised ambulation or shoe fitting, making the lateral calcaneal artery flap a reliable option for posterior heel coverage in our patient population.[vii] [xiv]

CONCLUSION

The lateral calcaneal artery flap is an effective reconstructive technique for posterior heel defects, offering durable coverage, minimal bulk with functional coverage. However, complications such as dog-ear deformity, epidermal necrosis, partial graft loss, sensory loss, and donor site depression are common, though most can be managed conservatively. The association of rural residence with higher complication rates highlights the importance for improved patient education, timely presentation, and follow up. By careful surgical technique, proper patient selection, and attentive postoperative care the complications can be easily avoided.

LIMITATIONS AND RECOMMENDATIONS

This was a single center study with limited participants. Future research should focus on long-term outcomes, comparative studies with other reconstructive options, and the development of modifications to reduce complications, as well as optimizing postoperative care and conducting larger multi-center trials for broader validation.

CONFLICTS OF INTREST AND FUNDING: NONE

AUTHORS CONTRIBUTION

Concept and design: Dr Arifa And Dr Riaz

Drafting, data collection and analysis: Dr Arifa, Dr Zahra

Critical revision: Dr Riaz, Dr Zahra

REFERENCES

[i] Deek NF. Comparative Effectiveness Analysis of Complex Lower Extremity Reconstruction: Outcomes and Costs for Biologically Based, Local Tissue Rearrangement, and Free Flap Reconstruction. Plas tReconst Surg. 2021;147(1):171-5.

DOI: 10.1097/PRS.0000000000006589

[ii] Kim YH, Hwang KT, Kim KH, Sung IH, Kim SW. Application of acellular human dermis and skin grafts for lower extremity reconstruction. J Wound Care. 2019;28(4):12-7. DOI: 10.12968/jowc.2019.28.Sup4.S12

[iii] Singh A, Singh R, Sharma A, Singh M, Singh K, Singh RB. Critical Evaluation of Lateral Calcaneal Artery Fascio-Cutaneous Flap in Re-Surfacing Posterior Heel Defects: A Review of 24 Cases. Indian J Orthop. 2023;57(9):1423-34. DOI: 10.1007/s43465-023-00912-8

[iv] Ullah I, Bilal M, Shah SA. Reconstruction of posterolateral heel defect with lateral calcaneal flap: An experience at Burns at plastic surgery center Peshawar. Khyber J Med Sci.2021;14(2):81-7.

DOI: https://doi.org/10.70520/kjms.v14i2.91

[v] Masquelet AC, Romana MC, Wolf G. Skin island flaps supplied by the vascular axis of the sensitive superficial nerves: anatomic study and clinical experience in the leg. Plast Reconstr Surg. 1992;89(6):1115-21. DOI: 10.1097/00006534-199206000-00018

[vi] Mistry RM, Bajantri B. Heel reconstruction: A review. World J Plast Surg. 2016;5(1):3-10.

[vii] Singh A, Singh R, Sharma A, Singh M, Singh K, Singh RB. Critical Evaluation of Lateral Calcaneal Artery Fascio-Cutaneous Flap in Re-Surfacing Posterior Heel Defects: A Review of 24 Cases. Indian Journal of Orthopaedics. 2023 Sep;57(9):1423-34. DOI https://doi.org/10.1007/s43465-023-00912-8

[viii] Li L, Xue C, Li J, Zhang J, Xing X. Application of flap in repair of heel skin and soft tissue defect. Zhongguo xiu fu Chong Jian wai ke za zhi= Zhongguo Xiufu Chongjian Waike Zazhi= Chinese Journal of Reparative and Reconstructive Surgery. 2008 Jul 1;22(7):800-2. https://pubmed.ncbi.nlm.nih.gov/18681278/

[ix] Islam MT, Abdullah SN, Uddin MJ, Rahman TR. Use of lateral calcaneal flap for coverage of posterior heel defects. Mediscope. 2017 Oct 22;4(1):5-10. DOI: https://doi.org/10.3329/mediscope.v4i1.34373

[x] Balakrishnan TM, Liza J, Karthikeyan A, Madhurbootheswaran S, Sugumar M, Sridharan M. Lateral Calcaneal Artery Perforator/Propeller Flap in the Reconstruction of Posterior Heel Soft Tissue Defects. Indian Journal of Plastic Surgery. 2024 Oct 24. DOI: 10.1055/s-0044-1791764

[xi] Samad L, Jawed F, Sajun SZ, Arshad MH, Baig-Ansari N. Barriers to accessing surgical care: a cross-sectional survey conducted at a tertiary care hospital in Karachi, Pakistan. World journal of surgery. 2013 Oct;37(10):2313-21. DOI: 10.1007/s00268-013-2129-z

[xii] Ashraf MN, Fatima I, Muhammad AA, Albutt K, Pigeolet M, Latif A, Meara JG, Samad L. Estimating access to surgical care: A community centered national household survey from Pakistan. PLOS Glob Public Health. 2023 Nov 15;3(11):e0002130. doi: 10.1371/journal.pgph.0002130.

[xiii] Collaborative P. PakSurg 1: determining the epidemiology and risk factors of surgical site infections in Pakistan—a multicentre, prospective cohort study. BMJ open. 2023 Jul 1;13(7):e070831. doi: 10.1136/bmjopen-2022-070831

[xiv] Mahan KT. Lateral calcaneal artery skin flap for posterior heel coverage. Clin Podiatr Med Surg. 1986 Apr;3(2):277-87. PMID: 2938719.