ORIGINAL ARTICLE

RECONSTRUCTION OF SOFT TISSUE DEFECTS AROUND KNEE AND PROXIMAL LEG USING PROXIMAL BASED SURAL ARTERY FLAP

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Background: Soft tissue defects around the knee and proximal leg represent a challenging clinical scenario for plastic and reconstructive surgeons. These defects can arise from a variety of causes, including traumatic injuries, such as crush injuries and road traffic accidents, thermal injuries like burns, and surgical complications such as infection. Objective of the study was to evaluate the success of proximally based sural artery flap for soft tissue defects around the knee and proximal leg in patients presenting to our tertiary care hospital. **Methods:** This prospective observational study was conducted at the Department of Plastic & Reconstructive Surgery, Civil Hospital, Karachi, Pakistan. The study included patients with soft tissue defects around the knee and proximal leg, excluding those with specific comorbidities, high BMI, or active smoking. Non-probability convenience sampling was employed. After ethical review committee approval and informed consent, if needed wounds were optimized with thorough debridement then patients underwent proximal-based sural artery flap surgery for soft tissue defects around knee and proximal leg. Flap survival and complications were assessed over three to six weeks. **Results:** The study included 37 patients, with a median age of 30 years. The most frequent cause of defects was road traffic accidents (73%). Of the patients, 73% were male, and 27% were female. The median duration of soft tissue injury was 5 weeks, and the median duration of surgery was 90 minutes. Flap survival was 97.3%, with 28 flaps surviving without any complications. One patient with a 20-year-old chronic defect experienced partial flap failure. **Conclusion:** The use of the proximally based sural artery flap represents a promising approach for the successful reconstruction of soft tissue defects around the knee and proximal leg.

Keywords: Soft tissue defects; Knee and proximal leg; proximally based sural artery flap; Reconstruction; Surgical outcomes; Flap survival; Complications

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INTRODUCTION

Soft tissue defects around the knee and proximal leg represent a challenging clinical scenario for plastic and reconstructive surgeons. These defects can arise from a variety of causes, including traumatic injuries, such as crush injuries and road traffic accidents, thermal injuries like burns, and surgical complications such as infection.[1,2] The reconstruction of soft tissue defects in this region is crucial not only to restore form and function but also to prevent potential complications, such as joint desiccation, infection, and the risk of limb and implant loss, especially in patients who have undergone joint replacement surgeries.[2,3]

Reconstruction techniques for soft tissue defects around the knee and proximal leg have evolved over the years, each with its advantages and limitations. These include the use of cross-leg flaps, free flaps, local muscle flaps, and fasciocutaneous flaps, but most of the time treatment outcomes are unsatisfactory due to many reasons.[2,4] For example, free flaps require specialized microsurgical expertise and equipment, which may not be readily available in all clinical settings.[5, 6] Local muscle flaps may result in suboptimal cosmetic appearance and restricted muscle function. Cross-leg flaps, while effective, may be associated with patient discomfort, prolonged immobilization, and an increased risk of complications, including pressure sores and deep vein thrombosis.[2,7,8]

In recent years, the proximally based sural artery flap has emerged as a promising alternative for the reconstruction of soft tissue defects around the knee and proximal leg. This flap provides adequate tissue coverage, functional restoration, and favorable cosmetic outcomes, making it an appealing choice for reconstructive procedures in this region.[1,7,9–11] Its vascular supply primarily depends on the median superficial sural artery, which typically originates from the popliteal artery. But local evidence regarding its application is very scarce. Opara et al. discovered that proximal-based

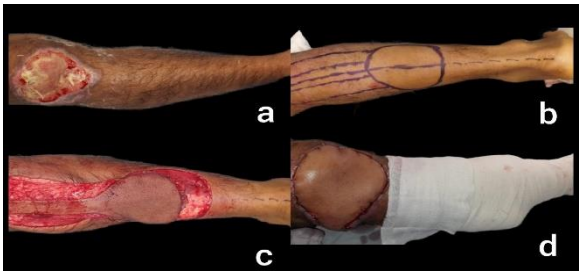
sural artery flaps had up to 100% success rate in the restoration of soft tissue defects around the knee.[3] Pan et al. discovered that in all cases, the proximally based sural artery fascio-cutaneous flap survived.[11] Arafa et al. in their research observed proximally based sural artery fascio-cutaneous flap had acceptable cosmetic appearance and optimal functional outcomes.[9]

In light of the existing knowledge and the pressing clinical need, this study was conducted to assess the effectiveness of proximally based sural artery flaps for the reconstruction of soft tissue defects around the knee and proximal leg in patients treated at our tertiary care hospital in Karachi, Pakistan. The study would help in enhancing patient care and surgical decision-making in this challenging clinical scenario.

MATERIAL AND METHODS

It was a prospective observational study conducted at the Department of Plastic & Reconstructive surgery, Civil hospital, Karachi, Pakistan from 10/04/2023 to 10/10/23. Sample size was estimated using Open epi sample size calculator by taking statistics of satisfactory outcome as 89.5%[12], bond on error as 10% and 95% confidence level. The estimated sample size is 37. Patients having soft tissue defects around the knee and proximal leg of age 20–60 years of either gender were included. Soft tissue defects were due to road traffic accidents, burns and infection Patients with multiple co-morbid not fit for surgery, patients with BMI greater 30 kg/m^2 and current smokers were excluded from the study. Non-probability convenience sampling technique was employed for sample selection.

This study was carried out after taking approval from ethical review committee of Dow University of Health Sciences, Civil hospital, Karachi, Pakistan. Patients were enrolled in the study after taking written informed consent. All patients were managed by same surgical team and treated with proximal based sural artery flap. In the start of treatment, wounds were optimized if needed with thorough debridement before proceeding for covering the soft tissue defects. The proximally based sural fascio-cutaneous island flap consisted of skin and subcutaneous fat, the superficial and deep fascia, sural nerve, lesser saphenous vein, and the superficial sural artery. The flap circulation mainly depended on the median superficial sural artery, which mostly originated from the popliteal artery. The flap size was harvested according the wound size and the donor site was covered by skin graft. Three cases are displayed in the following pictures (Case 1 to 3).



Case-1: 50-year-old male with history of road traffic accident 2 weeks back a) wound on anterior aspect of knee b) preoperative marking of proximal based sural artery flap c) Flap harvest d) flap inset over anterior aspect of knee

Case-2: 35-year-old male with history of road traffic accident 1 week back a) wound on anterior aspect of knee b) preoperative marking of proximal based sural artery flap c) complete flap survival at 2 weeks follow up

Case-3: 20-year-old male with history of road traffic accident 3 days back a) wound on medial aspect of knee and thigh with exposed bone b) pre operative marking of proximal based sural artery flap c) flap inset over knee wound and Split thickness graft over thigh wound d) 2 weeks follow show completely survived sural artery flap and well settled STSG

Patient was discharged after one week of admission and will be followed for 3–6 weeks for the assessment of satisfactory outcome, i.e., flap survival (The flap that survived along with wound healing after 3 weeks on clinical examination without partial or complete necrosis)

and complications. All data was noted by researcher on pre-designed *proforma.*

Data was analyzed using SPSS version 23. Normality of the numeric data was assessed using Shapiro-Wilk's test. All numeric data such as age, duration of injury, duration of surgery, defect size and flap size were non-parametric, therefore, median and interquartile range were reported. Categorical variables like gender, cause of injury, defect site, flap survival, and complications were summarized as frequency and percentage.

RESULTS

The median age was 30 years with IQR as 25–40 years. Of 37 patients, 73% were males and 27% were females. The median duration of soft tissue injury was 5 weeks and median duration of surgery was 90 minutes. The most frequent cause of defects was road traffic accidents (73%), followed by infection (13.5%), respectively. About 43.2% of the patients had defects on anterior site, 35.1% had defects on lateral site and 21.6% had on medial site. The median defect length was 6 cm and width were 7 cm. The median flap length was 7 cm and width were 8 cm. Out of 37 flaps, 36 flaps survived, and 28 flaps survived without any complications. (Figure 1-2) Notably, one patient, who unfortunately has partial flap failure, presented with a chronic soft tissue defect of 20 years. The surgical procedure for this patient took 100 minutes. Additionally, it is worth mentioning that the affected patient was male, aged below 30 years, and the underlying cause of the tissue defect was a burn. In remaining 8 patients no complication on flap site although minor complications on donor site like partial graft loss and unaesthetic scars observed which were managed conservatively.

Table-1: Baseline characteristics of study cases (n=37)

Characteristics	**Statistics**
Age (years)	30 (25-40)
Gender	
Male	27 (73)
Female	10 (27)
Duration of soft tissue injury (weeks)	5 (2-14)
Duration of surgery (mins)	90 (90-100)
Cause of defects	
Burns	1 (2.7)
Malignancy	4 (10.8)
Infection	5 (13.5)
Traffic accident	27 (73)
Defect site	
Anterior	16 (43.2)
Lateral	13 (35.1)
Medial	8 (21.6)
Defect length (cm)	6 (5-6)
Defect width (cm)	7 (6-7)
Flap length (cm)	7 (6-7)
Flap width (cm)	8 (7-8)
Data presented as Median (IQR) or n (%)	

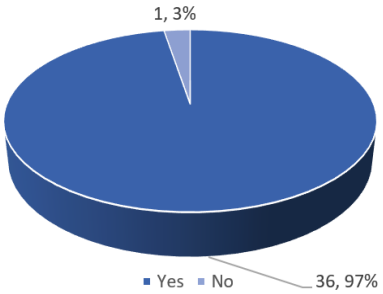


Figure 1: Frequency distribution of flap survival (n=37)

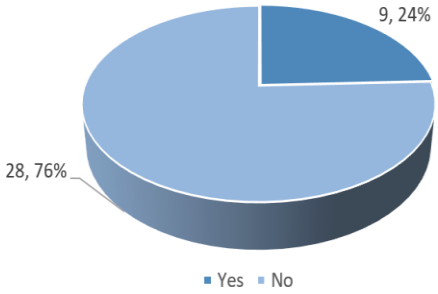


Figure-2: Frequency distribution of complications (n=37)

DISCUSSION

The reconstruction of soft tissue defects around the knee and proximal leg remains a complex and challenging endeavor, given the significance of these areas for maintaining functional mobility and limb integrity.[13–16] Reconstruction techniques for soft tissue defects around the knee and proximal leg have evolved over the years, it includes cross leg flap, free flap, local muscle flaps and fasciocutaneous flaps with their own strength and weaknesses. In recent years, the proximally based sural artery fasciocutaneous flap has emerged as a viable alternative for soft tissue defect reconstruction around the knee and proximal leg.[17,18]

Hence, this study aimed to evaluate the effectiveness of using proximally based sural artery flaps for addressing such soft tissue defects in patients attending our tertiary care hospital. The high survival rate of the flaps (36 out of 37) highlights the efficacy of the proximally based sural artery flap method in addressing soft tissue defects around the knee and proximal leg. Moreover, the fact that 28 flaps endured without any complications further highlights the relative success and safety of this procedure. However, it is crucial to acknowledge the single instance of partial flap failure, which is significant due to the patient's prolonged soft tissue defect history of 20 years. The longer surgical duration of 100 minutes in this case may indicate potential complexities associated with more chronic and severe cases, warranting further investigation into the optimal management of such patients.

The findings of this study align with existing literature, emphasizing the functional and cosmetic benefits of using the proximally based sural artery flap in reconstructive surgery. Although the literature review highlighted the limited evidence regarding its application, studies such as Wei *et al*.'s, Opara *et al*.'s and Pan *et al*.'s confirm the high success rates of this technique.[11,19] Opara *et al*. reported a success rate of up to 100% in the restoration of soft tissue defects around the knee using proximal-based sural artery flaps.[3] Pan *et al*. found that all cases treated with this flap had successful outcomes, indicating its reliability.[11] Additionally, Arafa *et al*.'s research emphasizes the positive cosmetic outcomes and functional efficacy associated with the use of the sural artery fasciocutaneous flap.[9] These studies collectively support the assertion that the proximally based sural artery flap is a valuable and reliable option for reconstructing soft tissue defects around the knee and proximal leg.

However, it is important to acknowledge certain limitations of this study, such as the relatively small sample size and the absence of a control group. Additionally, the lack of long-term follow-up data hinders the comprehensive evaluation of the long-term efficacy and potential complications associated with this surgical approach. Future research endeavors should focus on expanding the sample size, incorporating a control group for comparative analysis, and conducting long-term follow-up assessments to provide a more comprehensive understanding of the outcomes and potential drawbacks of utilizing the proximally based sural artery flap. Further research and larger-scale studies in Pakistan could help solidify its position as a valuable option for soft tissue defect reconstruction in this region. Surgeons should continue to refine their techniques and patient selection criteria to maximize the success of this procedure.

CONCLUSION

The use of the proximally based sural artery flap represents a promising approach for the successful reconstruction of soft tissue defects around the knee and proximal leg.

AUTHORS' CONTRIBUTION

SS, SB: Literature search, data analysis. SS, FA: Conceptualization of the study design. SS, WS, SMS, RF: Data collection. SS, SMS: Data interpretation. SS: Write-up. WS, FA: Proof reading.

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