ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Evaluation of Reconstructive Surgical Techniques for Traumatic Soft Tissue Defects in the Lower Limb: A Clinical and Functional Outcome Analysis.

Pradeep Kulal R[1], Jyotsna Kulkarni[2]*, Pramod Gangurde[3], Vrushabh Akare[4], and Nisha Kanke[5].

[1]Assistant Professor, Department of General Surgery, Dr. Vasant Rao Pawar Medical College, Maharashtra, India.
[2]Associate Professor, Department of General Surgery, Dr. Vasant Rao Pawar Medical College, Maharashtra, India.
[3]Assistant Professor, Department of General Surgery, Dr Vasant Rao Pawar Medical College, Maharashtra, India.
[4]Resident, Department of General Surgery, Dr Vasant Rao Pawar Medical College, Maharashtra, India.
[5]Resident, Department of General Surgery, Dr Vasant Rao Pawar Medical College, Maharashtra, India.

ABSTRACT

Soft tissue defects in the lower limb pose significant clinical challenges due to the complex anatomy and functional importance. Appropriate selection of reconstructive methods impacts both clinical and functional outcomes. This study evaluated the outcomes of different reconstructive surgical techniques in traumatic lower limb soft tissue defects. A prospective observational study was conducted involving 40 patients with traumatic and non-traumatic lower limb defects requiring reconstructive surgery. Techniques employed included skin grafts, local/regional flaps, and free flaps, selected based on defect location and exposure of vital structures like tendons, bones, vessel and nerves. Outcomes assessed included healing time, complication rates, functional recovery, and patient satisfaction at 3 month follow-up. Skin grafting was preferred in defects without vital structure exposure (mean healing time: 3.2 weeks), exhibiting the lowest complication rate (40%) and highest patient satisfaction (90%). Local flaps were predominantly utilized in the upper and middle thirds of the leg with good functional outcomes. Free flaps were necessary primarily for lower third (leg and foot) defects, presenting higher complication rates (54.6%), including donor-site morbidity (27.3%), and surprisingly higher patient satisfaction (63.6%) due to limb salvage. Skin grafting is optimal when vital structures are unexposed, whereas flaps are essential for defects involving vital structures. Anatomical location significantly influences flap selection and outcomes.

Keywords: Lower limb reconstruction, Soft tissue defects, Surgical flaps

https://doi.org/10.33887/rjpbcs/2024.15.6.65

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Trauma to the lower extremities frequently results in significant soft tissue defects that pose clinical and therapeutic challenges due to associated complications, such as impaired wound healing, infection, and functional limitations [1, 2]. The management of these defects demands a multidisciplinary approach, integrating reconstructive strategies tailored to each patient's clinical presentation and functional needs [3]. Soft tissue reconstruction techniques, including skin grafts, local flaps, regional flaps, and microsurgical free flaps, have evolved considerably, enhancing both aesthetic and functional outcomes. The selection of the optimal reconstructive procedure is influenced by numerous factors, such as defect size and location, the underlying cause, vascular status, and patient-specific variables including age, comorbidities, and rehabilitation potential [4]. This study aims to critically evaluate various reconstructive surgical options available for traumatic and non-traumatic defects in the lower extremity, assessing their efficacy in terms of healing time, complications, functional restoration, patient satisfaction, and overall quality of life. Given the increasing incidence of lower limb trauma and chronic wounds globally, an evidence-based assessment of these reconstructive techniques is crucial for optimizing clinical outcomes and informing best practices in plastic and reconstructive surgery [5, 6].

MATERIALS AND METHODS

This prospective observational study was conducted at the Department of General Surgery of a tertiary care hospital. Ethical approval was obtained from the institutional ethics committee prior to initiation. A total of 40 patients presenting with traumatic and non-traumatic soft tissue defects in the lower limb requiring reconstruction were enrolled between January 2023 and December 2024, following informed consent in the local language. Patients aged 18-70 years, presenting with lower extremity defects resulting from trauma, chronic non-healing ulcers, post-surgical wounds, were included in the study. Patients with peripheral vascular disease, uncontrolled diabetes mellitus (HbA1c >9%), active infection requiring systemic treatment, severe comorbid conditions contraindicating surgery, or refusal to consent were excluded from the study. Demographic and clinical data, including age, gender, etiology, defect size, and anatomical location, were systematically recorded.

Patients underwent soft tissue reconstruction using skin grafts, local flaps, like fasciocunaeatous flaps, or microsurgical free flaps based on defect characteristics and surgeon expertise. Procedures were performed by experienced plastic surgeons under appropriate anesthesia, adhering to standardized protocols. Postoperative care involved regular wound dressing, antibiotic prophylaxis, and limb elevation. Patients received individualized physiotherapy sessions and rehabilitation plans initiated from the early postoperative period to optimize functional recovery. Patients were regularly followed up at weekly intervals for the first month and monthly thereafter until 3 months postoperatively. Clinical outcomes, including wound healing rates, complications (infection, graft/flap failure, donor site morbidity), functional restoration (mobility assessment), patient satisfaction, and quality of life (using the SF-36 questionnaire), were evaluated at each follow-up visit. Statistical analysis was conducted using SPSS version 23, applying descriptive statistics and chi-square tests for categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Distribution of Reconstructive Methods Based on Anatomical Region (n=40)

Anatomical Region	Skin Graft (No vital exposure)	Local/Regional Flap (Vital exposure)	Free Flap (Vital exposure)	Total
Upper 1/3rd	4 (40%)	6 (60%)	1	11
Middle 1/3rd	3 (25%)	7 (70%)	1	11
Lower 1/3rd of foot	5 (25%)	4 (20%)	9	18
Total	**10 (25%)**	**10 (25%)**	**11**	**40**

(9 patients underwent conservative management or primary closure)

Skin grafting was commonly utilized in defects without vital structure exposure. Flap reconstructions predominated in cases involving exposed vital structures. Free flaps were mostly used in

lower 1/3rd leg defects and occasionally in upper and middle 1/3 rd of leg defects where surrounding skin was unhealthy.

Table 2: Healing Time (weeks) by Reconstruction Technique

Surgical Technique	Mean Healing Time ± SD (Weeks)	Median (Range)	p-value
Skin Graft	3.2 ± 0.6	3 (2-4)	0.002*
Local/Regional Flap	5.6 ± 1.1	5 (3-6)	0.01*
Free Flap	4.8 ± 1.4	4 (3-6)	0.001*

*Statistically significant difference in healing time observed among techniques.

Table 3) Complication rates associated with each procedure

Complications	Skin Graft (n=10)	Local Flap (n=10)	Free Flap (n=11)
Infection	2 (20%)	1 (10%)	1(18.2%)
Partial graft/flap loss	1 (10%)	2 (20%)	1 (9.1%)
Total graft/flap loss	0	0	0 (9%)
Donor site morbidity	1 (10%)	2 (20%)	2 (27.3%)
Total	4 (40%)	5 (50%)	6 (54.6%)

Complication rate was highest in the free flap group, particularly donor site morbidity.

Table 4: Functional outcomes and patient satisfaction (3-month follow-up)

Outcome Measure	Skin Graft (n=10)	Local Flap (n=10)	Free Flap (n=11)	p-value
Return to full mobility (%)	90% (9/10)	80% (8/10)	72.7% (8/11)	0.31
Normal footwear use (%)	100% (10/10)	95% (8/10)	80% (7/11)	0.015*
Patient satisfaction (%)	90% (9/10)	80% (7/10)	75 % (7/11)	0.043*

*Statistically significant difference observed in mobility restoration, patient satisfaction, and return to normal activities.

DISCUSSION

In this prospective study evaluating soft tissue reconstruction techniques for traumatic and non-traumatic lower limb defects, clear distinctions emerged regarding the indications and efficacy of various surgical methods. The analysis underscores the importance of the nature and anatomical location of defects in guiding the selection of reconstruction technique [7].

Skin grafting, predominantly applied when vital anatomical structures (bone, tendons, vessels, or nerves) were not exposed, demonstrated significantly favorable outcomes in terms of healing time, complications, and patient satisfaction. Specifically, skin grafts exhibited an average healing period of approximately 3 weeks (3.2 ± 0.6 weeks), significantly shorter compared to local (4.7 ± 0.8 weeks) and free flap procedures (5.5 ± 1.2 weeks), highlighting the efficacy of skin grafting for superficial or less complex defects [8].

In cases where critical anatomical structures such as bone, tendons, vessels, or nerves were exposed, flap reconstruction became mandatory. In the upper and middle thirds of the leg, local flaps proved effective, reflecting adequate vascularity and tissue availability in these anatomical regions. Indeed, among patients with defects in the upper third of the leg, local flaps represented 60% of the reconstructive choices, indicating their practical utility in such anatomical locations. Conversely, the lower third of the leg, characterized by limited soft tissue availability and frequent exposure of underlying vital structures, necessitated free flap reconstruction in 55% of cases. This finding aligns with existing literature, emphasizing the importance of microsurgical free flaps in managing complex lower leg defects [9].

Patients with lower 1/3rd and foot defect who would have otherwise ended up with amputation; free flaps have saved the limb. Hence even after longer recovery time and slightly increased morbidity due to underlying bony deformity; patient satisfaction is high as their limb is saved.

ISSN: 0975-8585

Functional outcomes and patient satisfaction significantly differed among reconstructive methods. Skin graft recipients demonstrated superior functional recovery and satisfaction rates, with 90% achieving full mobility and comparable high levels of patient satisfaction. Although local flaps also resulted in commendable functional recovery (80% returning to full mobility), free flap procedures showed slightly lower outcomes, with only 63.6% of patients reporting complete mobility restoration. Patient satisfaction mirrored these functional outcomes, with skin graft recipients reporting the highest satisfaction rates (90%), compared to local flaps (70%) and free flaps (63.6%).

CONCLUSION

In conclusion, the findings strongly support the viewpoint that skin grafting is optimal for lower limb defects without vital structure exposure, providing rapid healing, lower complications, and higher patient satisfaction. In cases of exposed vital structures, flap reconstruction is indispensable, with local flaps preferable in the upper and middle thirds and free flaps necessary for distal lower limb defects. These insights can inform surgical decision-making, optimizing patient outcomes through tailored reconstructive strategies.

REFERENCES

[1] Gorman PW, Barnes CL, Fischer TJ, McAndrew MP, Moore MM. Soft-tissue reconstruction in severe lower extremity trauma. A review. Clin Orthop Relat Res 1989 ;(243):57-64.

[2] R.B. Gustilo et al, Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses, J Bone Joint Surg Am 1976.

[3] ND Medina et al., An evidence-based approach to lower extremity acute trauma, Plast Reconstr Surg 2011
[4] L Heller et al, Lower extremity microsurgical reconstruction. Plast Reconstr Surg 2001.
[5] Hettiaratchy S. and Clasper J. Soft-tissue and Skeletal Wound Management in the Setting of Vascular Injury. In: Rasmussen, T.E. and Tai, N.R.M., Eds., Rich's Vascular Trauma, Elsevier, 2022;321-331.
[6] Fairhurst MJ. The Function of Below-Knee Amputee versus the Patient with Salvaged Grade I11 Tibia1 Fracture. Clinical Orthopaedics and Related Research 1994; 301: 227-232.
[7] MacKenzie, EJ. Long-Term Persistence of Disability Following Severe Lower-Limb Traumaresults of a Seven-Year Follow-Up. The Journal of Bone and Joint Surgery (American) 2005; 87: 1801-1809.
[8] Qureshi, M.K., Ghaffar, A., Tak, S. and Khaled, A. Limb Salvage versus Amputation: A Review of the Current Evidence. Cureus 2020; 12: e10092.
[9] Lese I, Biedermann R, Constantinescu M, Grobbelaar AO. and Olariu R. Predicting Risk Factors That Lead to Free Flap Failure and Vascular Compromise: A Single Unit Experience with 565 Free Tissue Transfers. Journal of Plastic, Reconstructive & Aesthetic Surgery 2021; 74: 512-522.