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Outcomes of Plastic Surgical Reconstruction of Diabetic Foot Ulcers Following Systemic Optimization and Local Infection Control: A Prospective Study

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Keywords:

Diabetic foot ulcer, plastic surgery, wound healing, skin graft, flap

Abstract:

Background

Diabetic foot ulcers (DFUs) represent a major cause of morbidity and lower limb amputations in diabetic patients, particularly in low- and middle-income countries like India. Chronicity, infection, and delayed intervention often complicate healing. This study aimed to evaluate clinical outcomes of plastic surgical reconstruction following systemic optimization and local infection control in patients with complicated diabetic foot ulcers.

Methods

A prospective observational study was conducted at a tertiary care center in India, including 67 patients with Wagner grade II–IV DFUs. All patients underwent systemic infection control, targeted antibiotic therapy based on culture sensitivity, and glycemic optimization. Depending on wound characteristics, patients were treated surgically using split-thickness skin grafting (STSG), local flaps, reverse sural artery flaps, or negative pressure wound therapy (NPWT)-assisted closure. Clinical parameters, microbiological profiles, infection markers, graft/flap take, and healing outcomes at 8 weeks were recorded and analyzed.

Results

The mean age of participants was 56.4 ± 9.2 years; 67.2% were male and 94.0% had Type 2 diabetes. Most ulcers were Wagner grade III/IV and located on the forefoot (53.7%). Culture positivity was observed in 86.6%, with Staphylococcus aureus and Pseudomonas aeruginosa as predominant isolates. Post-treatment, CRP and procalcitonin levels showed significant reductions ($p < 0.001$). STSG was performed in 47.8% of patients, with a mean graft take of 95.2%. Complete wound healing at 8 weeks was achieved in 76.1% of patients, while the mean hospital stay was 11.7 ± 2.9 days. Surgical site infection and partial graft/flap necrosis occurred in 13.4% and 8.9% of patients, respectively.

Conclusion

Plastic surgical reconstruction, when preceded by systemic treatment and adequate local infection control, offers favorable healing outcomes in diabetic foot ulcers. Early intervention, appropriate microbial management, and individualized surgical planning are essential for limb salvage and reducing re-ulceration rates.

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Introduction

Diabetic foot ulcer (DFU) is one of the most severe and disabling complications of diabetes mellitus (DM), contributing significantly to morbidity, healthcare costs, and lower limb amputations. Globally, it is estimated that 15–25% of individuals with diabetes will develop a foot ulcer during their lifetime, with approximately 85% of diabetes-related lower limb amputations preceded by a foot ulcer [1,2]. In India, the prevalence of diabetic foot ulcers among diabetic patients ranges from 6.3% to 11.6%, reflecting both a high disease burden and delayed presentation in clinical settings [3,4].

The pathophysiology of DFU is multifactorial, involving peripheral neuropathy, peripheral arterial disease, foot deformities, and impaired wound healing, often aggravated by localized and systemic infections. Peripheral neuropathy contributes to loss of protective sensation, while ischemia from peripheral vascular disease impairs tissue perfusion and oxygenation. In the presence of hyperglycemia, immune function is compromised, and wound healing is delayed, providing an optimal environment for bacterial colonization and infection [5]. Common pathogens implicated in infected DFUs include Staphylococcus aureus, Pseudomonas aeruginosa, and various anaerobes [6].

Standard care for DFU involves systemic optimization—including glycemic control, infection management, and vascular evaluation—combined with local wound care such as debridement, offloading, and dressings. However, conservative treatments often fail in large, chronic, or deep wounds, especially in cases with extensive tissue necrosis or osteomyelitis. In such scenarios, plastic surgical interventions such as split-thickness skin grafts, local or regional flaps, and negative pressure wound therapy-assisted closure become essential for achieving wound healing and limb salvage [7,8].

Successful plastic surgical repair in DFUs, however, depends not only on the technical execution of the procedure but critically on the preoperative preparation of the wound bed and control of systemic infection and glycemic parameters. Persistent local infection, poor perfusion, and elevated inflammatory markers (CRP, procalcitonin) are associated with flap/graft failure and prolonged healing time [9]. Studies have demonstrated that preoperative wound optimization—including appropriate antibiotic therapy based on culture sensitivity, debridement, and infection load reduction—can significantly enhance surgical outcomes [10].

Despite this evidence, many surgical interventions are undertaken without adequate systemic and local preparation, resulting in suboptimal outcomes, prolonged hospital stays, and higher recurrence rates. Moreover, literature focusing specifically on the integration of systemic treatment and local infection control as a prerequisite for plastic surgical repair in DFU is limited, especially in the Indian context where delayed healthcare access and higher infection rates complicate wound management [11].

Therefore, this study aimed to evaluate the role of systemic treatment (glycemic control, systemic antibiotics, infection marker monitoring) and local infection control (culture-guided debridement, wound bed preparation) in improving the outcomes of plastic surgical repair of ulcer wounds in diabetic foot patients. Through this approach, we aim to establish an integrated protocol that ensures higher graft/flap take rates, reduced wound healing time, and fewer surgical complications.

Material and methods

Study Design and Setting

This prospective interventional study was conducted in the Department of Plastic Surgery at a tertiary care hospital of Northern India. The study was carried out over a duration of 24 months, from January 2023 to December 2024. Prior approval was obtained from the Institutional Ethics Committee. All participants provided written informed consent before inclusion in the study. The study adhered to the ethical standards outlined in the Declaration of Helsinki.

Study Population

Patients with diabetes mellitus presenting to the diabetic foot clinic or plastic surgery outpatient department with ulcerative lesions requiring surgical reconstruction were screened for eligibility. Inclusion criteria comprised adult patients aged 18 years or older with Type 1 or Type 2 diabetes mellitus, presenting with chronic non-healing foot ulcers classified as Wagner grade II to IV, who had preserved limb perfusion indicated by palpable peripheral pulses or an ankle-brachial index (ABI) between 0.8 and 1.2. Patients were excluded if they had uncontrolled hyperglycemia (HbA1c > 12% despite intervention), critical limb ischemia (ABI < 0.5), systemic sepsis, advanced osteomyelitis necessitating amputation, severe renal or hepatic dysfunction, or were immunocompromised due to malignancy or immunosuppressive therapy.

Clinical Assessment and Baseline Investigations

Upon admission, detailed clinical evaluation was performed, documenting the duration and type of diabetes, prior ulcer history, comorbidities, and physical characteristics of the ulcer including location, dimensions, depth, presence of necrosis, and exudate. Baseline laboratory investigations included complete blood count, fasting and postprandial blood glucose, HbA1c, renal function tests, liver function tests, serum albumin, C-reactive protein (CRP), erythrocyte

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sedimentation rate (ESR), and procalcitonin levels. Local imaging included X-rays of the affected foot to rule out osteomyelitis and duplex Doppler ultrasonography to evaluate arterial perfusion.

Systemic Optimization and Medical Management
All patients underwent preoperative systemic optimization prior to surgical intervention. Glycemic control was achieved using individualized insulin regimens, including basal-bolus protocols, under the supervision of the endocrinology team. Empirical intravenous antibiotic therapy—typically a third-generation cephalosporin combined with metronidazole—was initiated at presentation and adjusted based on culture and sensitivity results. Nutritional support was provided in the form of protein-rich diets and oral supplements. Hematinics and albumin infusions were administered when indicated. Comorbid conditions such as hypertension, nephropathy, or ischemic heart disease were managed in coordination with internal medicine specialists.

Wound Bed Preparation and Local Infection Control
Local wound care included initial and serial sharp debridement under aseptic precautions to remove necrotic tissue and reduce microbial load. Deep tissue biopsies or wound swabs were sent for aerobic and anaerobic cultures as well as fungal studies. During the infection control phase, dressings were done using agents such as povidone-iodine, PHMB, or silver-impregnated dressings. In patients with large or exudative wounds and healthy granulating beds, negative pressure wound therapy (NPWT) was applied for 5 to 7 days to promote angiogenesis and wound contraction. The decision to proceed with surgical reconstruction was based on the achievement of a healthy, granulating wound bed and normalization of infection markers (CRP < 6 mg/L, procalcitonin < 0.5 ng/mL).

Surgical Intervention
Once systemic and local conditions were optimized, definitive surgical repair was planned. The choice of plastic surgical procedure was determined by the ulcer's dimensions, depth, and location. Superficial ulcers (<8 cm²) with well-vascularized beds were managed using split-thickness skin grafting (STSG), harvested from the lateral or anterior thigh. For larger or deeper wounds, local random pattern flaps (rotation or advancement flaps) or regional flaps such as reverse sural artery flaps were selected. All surgeries were performed under regional or general anesthesia in an aseptic operating room environment. Grafts were meshed when required, and flap perfusion was carefully monitored intraoperatively.

Postoperative Care and Follow-up
Postoperatively, the operated limb was immobilized using a posterior slab or total contact cast and strictly offloaded for 10–14 days. Dressings were inspected on postoperative days 3, 7, and 14. Flap viability and graft uptake were documented based on clinical evaluation. Complete graft/flap survival was defined as 100% take without signs of necrosis or infection. Patients were discharged with advice on foot care, glycemic monitoring, and customized footwear. Follow-up visits were scheduled weekly for one month and then biweekly for an additional four weeks. Long-term outcomes such as re-ulceration, recurrence, and need for re-intervention were recorded.

Outcome Measures
Primary outcomes included the percentage of graft or flap take, duration of wound healing, and rate of complete epithelialization at 8 weeks. Secondary outcomes included surgical site infection, flap/graft failure, need for revision surgery, and length of hospital stay. Healing was categorized as complete (100% wound closure), partial (>75% closure), or failed (<50% closure or need for secondary procedure). Any surgical complications were noted and treated accordingly.

Data Collection and Statistical Analysis
All clinical and operative data were collected prospectively using a structured case report form. Data were entered into a Microsoft Excel spreadsheet and analyzed using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). Continuous variables such as age, ulcer area, healing time, HbA1c, CRP, and procalcitonin were expressed as mean ± standard deviation or median (IQR), based on distribution. Categorical variables including type of surgery, microbial culture positivity, and outcome categories were reported as frequencies and percentages. Pre- and postoperative infection markers were compared using paired t-test or Wilcoxon signed-rank test. A p-value of less than 0.05 was considered statistically significant.

Results

Among the 67 patients included in the study, the mean age was 56.4 ± 9.2 years, with a male predominance (67.2%). The mean duration of diabetes was 11.6 ± 4.8 years, and the majority (94.0%) had Type 2 diabetes mellitus. The mean HbA1c was 9.1 ± 1.4%, indicating poor glycemic control in most patients. The average BMI was 25.3 ± 3.1 kg/m². Regarding smoking status, 26.9% were current smokers, 17.9% were former smokers, and 55.2% had never smoked. Hypertension was the most common comorbidity (56.7%), followed by dyslipidemia (43.3%), diabetic nephropathy (31.3%), and coronary artery disease (20.9%). The median ulcer duration before presentation was 6 weeks (IQR: 4–10) (Table 1).

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (N = 67).

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Variable	Frequency (%)/Mean ± SD/Median (IQR)
Age (years)	56.4 ± 9.2
Gender	
Male	45 (67.2%)
Female	22 (32.8%)
Duration of diabetes (years)	11.6 ± 4.8
Type 2 diabetes mellitus	63 (94.0%)
HbA1c (%)	9.1 ± 1.4
BMI (kg/m²)	25.3 ± 3.1
Smoking history	
- Current	18 (26.9%)
- Former	12 (17.9%)
- Never	37 (55.2%)
Comorbidities	
- Hypertension	38 (56.7%)
- Diabetic nephropathy (eGFR < 60 mL/min)	21 (31.3%)
- Coronary artery disease	14 (20.9%)
- Dyslipidemia	29 (43.3%)
Ulcer duration before presentation (weeks)	6 (4–10)

BMI – body mass index; eGFR – estimated glomerular filtration rate

At presentation, most ulcers were classified as Wagner grade III (46.3%), followed by grade II (32.8%) and grade IV (20.9%). The average ulcer size was 10.8 ± 4.3 cm². Ulcers were most commonly located on the forefoot (53.7%), followed by the midfoot (28.4%) and hindfoot (17.9%). Deep ulcers involving muscle, tendon, or bone were observed in 58.2% of patients. Necrotic tissue or slough was present in 76.1% of cases. Radiological evidence of osteomyelitis was seen in 26.9% of patients. The average ankle-brachial index was 0.93 ± 0.12, indicating adequate perfusion in most cases (Table 2).

Table 2. Clinical and Anatomical Characteristics of Ulcers at Initial Presentation

Parameter	Frequency (%)/Mean ± SD
Wagner Grade	
- Grade II	22 (32.8%)
- Grade III	31 (46.3%)
- Grade IV	14 (20.9%)
Ulcer size (cm²)	10.8 ± 4.3
Ulcer location	
- Forefoot	36 (53.7%)
- Midfoot	19 (28.4%)
- Hindfoot	12 (17.9%)
Depth of ulcer	
- Superficial (to subcutaneous)	28 (41.8%)
- Deep (muscle, tendon, bone exposure)	39 (58.2%)
Presence of slough/necrosis	51 (76.1%)
Presence of osteomyelitis (radiological)	18 (26.9%)
ABI	0.93 ± 0.12

ABI – ankle-brachial index

Out of the 67 ulcers, 58 (86.6%) showed culture positivity. Among these, 67.2% had monomicrobial infections, while 32.8% had polymicrobial flora. The most frequently isolated pathogen was Staphylococcus aureus (41.4%), followed by Pseudomonas aeruginosa (27.6%), Klebsiella pneumoniae (17.2%), E. coli (13.8%), and Proteus spp. (6.9%). Fungal isolates, notably Candida spp., were seen in 5.2% of cultures. Multidrug-resistant organisms were identified in 31.0% of positive cultures. Empirical antibiotic therapy was initiated in most cases, but 68.7% required modification based on culture and sensitivity reports (Table 3).

Table 3. Microbiological Profile of Infected Diabetic Foot Ulcers (N = 67).

Culture Result / Organism	Frequency (%)
Culture-positive ulcers	58 (86.6%)
Monomicrobial infection	39 (67.2% of positive cases)
Polymicrobial infection	19 (32.8%)
Most common isolates	
- Staphylococcus aureus (MSSA)	24 (41.4%)
- Pseudomonas aeruginosa	16 (27.6%)
- Klebsiella pneumoniae	10 (17.2%)
- E. coli	8 (13.8%)
- Proteus spp.	4 (6.9%)
- Candida spp. (fungal)	3 (5.2%)
Multidrug-resistant organism (MDR) isolates	18 (31.0%)
Empirical antibiotics initially used	Ceftriaxone + Metronidazole (94%)
Antibiotic changed after C&S report	46 (68.7%)

MDR – multidrug-resistant; C&S – culture and sensitivity

There was a significant improvement in systemic infection markers following systemic and local infection control. The total leukocyte count decreased from 12,350 ± 2,100 to 8,160 ± 1,540 cells/mm³ ($p < 0.001$). CRP levels dropped markedly from 38.5 ± 14.3 mg/L to 7.9 ± 3.5 mg/L ($p < 0.001$), and procalcitonin levels declined from 1.92 ± 0.8 ng/mL to 0.42 ± 0.2 ng/mL ($p < 0.001$). ESR also showed a significant reduction from 67.2 ± 18.5 mm/hr to 33.4 ± 11.6 mm/hr ($p < 0.001$). HbA1c remained largely unchanged, as expected over the short-term treatment period (Table 4).

Table 4. Comparison of Systemic Infection Markers Before and After Medical and Local Infection Control (N = 67).

Parameter	Pre-treatment	Post-treatment	p-value
	(Mean ± SD)		
Total leukocyte count (/mm³)	12,350 ± 2,100	8,160 ± 1,540	<0.001
CRP (mg/L)	38.5 ± 14.3	7.9 ± 3.5	<0.001
Procalcitonin (ng/mL)	1.92 ± 0.8	0.42 ± 0.2	<0.001
ESR (mm/hr)	67.2 ± 18.5	33.4 ± 11.6	<0.001
HbA1c (%)	9.1 ± 1.4 (unchanged)	—	—

TLC – total leukocyte count; CRP – C-reactive protein; ESR – erythrocyte sedimentation rate; HbA1c – glycated hemoglobin

Split-thickness skin grafting (STSG) was the most commonly performed procedure, accounting for 47.8% of cases, followed by local fasciocutaneous flaps (28.4%), reverse sural artery flaps (16.4%), and NPWT-assisted closures (7.5%). The mean healing time ranged from 16.4 ± 3.8 days for STSG to 25.2 ± 5.6 days for sural artery flaps. The mean graft/flap take rates were highest for STSG (95.2 ± 6.7%) and lowest for sural flaps (89.3 ± 10.4%). Postoperative complications included surgical site infection in 13.4% and partial graft/flap necrosis in 8.9% of patients. No patients experienced total flap loss (Table 5).

Table 5. Type of Surgical Procedure Performed and Immediate Postoperative Outcomes.

Surgical Procedure	Frequency (%)	Mean Healing	Graft/Flap	Early
		Mean ± SD		Frequency (%)
Split-thickness skin graft	32 (47.8%)	16.4 ± 3.8	95.2 ± 6.7	5 (15.6%)
Local fasciocutaneous flap	19 (28.4%)	21.7 ± 4.2	91.5 ± 7.3	4 (21.1%)
Reverse sural artery flap	11 (16.4%)	25.2 ± 5.6	89.3 ± 10.4	3 (27.3%)
NPWT-assisted closure	5 (7.5%)	19.6 ± 4.1	—	1 (20.0%)
Surgical site infection	—	—	—	9 (13.4%)
Partial graft/flap necrosis	—	—	—	6 (8.9%)

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STSG – split-thickness skin graft; NPWT – negative pressure wound therapy

At the 8-week follow-up, complete wound healing was achieved in 51 patients (76.1%), while partial healing (>75% closure) occurred in 11 patients (16.4%). Surgical failure, defined as <50% graft take or need for repeat intervention, was seen in 5 patients (7.5%). Re-ulceration during follow-up occurred in 4 cases (6.0%), and 3 patients (4.5%) required secondary surgical intervention. The mean hospital stay was 11.7 ± 2.9 days, and the average follow-up duration was 10.2 ± 1.8 weeks (Table 6).

Table 6. Final Clinical Outcomes at 8 Weeks Postoperative Follow-up.

Outcome Variable	Frequency (%)/mean ± SD
Complete wound healing (100% epithelialization)	51 (76.1%)
Partial wound healing (>75% closure)	11 (16.4%)
Surgical failure (<50% take or revision needed)	5 (7.5%)
Re-ulceration during follow-up	4 (6.0%)
Secondary intervention required (repeat surgery)	3 (4.5%)
Mean hospital stay (days)	11.7 ± 2.9
Average follow-up duration (weeks)	10.2 ± 1.8

Discussion

This study demonstrates that a structured, multidisciplinary approach—combining systemic optimization, effective local infection control, and timely plastic surgical reconstruction—yields favorable outcomes in patients with diabetic foot ulcers (DFUs). The patient cohort was predominantly male (67.2%) with a mean age of 56.4 ± 9.2 years, mirroring the demographic distribution reported in Indian studies by Mitra et al., and Patil et al., where DFUs were most common in the 50–60-year age group and predominantly affected males [12,13]. Poor glycemic control (mean HbA1c 9.1 ± 1.4%) and high prevalence of comorbidities such as hypertension (56.7%) and nephropathy (31.3%) were consistent with established risk profiles for complicated ulcers [14].

The majority of ulcers were classified as Wagner grade III or IV (67.2%) and were located on the forefoot (53.7%), which aligns with previous studies noting the forefoot as the most pressure-prone site in neuropathic and neuroischemic feet [15]. The average ulcer size (10.8 ± 4.3 cm²) and presence of deep tissue involvement in over half the cases (58.2%) underscore the advanced stage of presentation typical in low- and middle-income countries, where delayed access to wound care is common [16].

Microbiological analysis revealed culture positivity in 86.6% of cases, with Staphylococcus aureus (41.4%) and Pseudomonas aeruginosa (27.6%) as predominant pathogens—findings consistent with studies by Kale et al., and Nagpal et al., [17,18]. The relatively high incidence of polymicrobial infections (32.8%) and multidrug-resistant organisms (31.0%) reflects the challenge of chronic wound colonization and prior antibiotic exposure, emphasizing the importance of tailored antibiotic stewardship [19].

The reduction in systemic infection markers following systemic and local therapy was statistically significant. Mean CRP levels dropped from 38.5 ± 14.3 to 7.9 ± 3.5 mg/L, and procalcitonin levels reduced from 1.92 ± 0.8 to 0.42 ± 0.2 ng/mL ($p < 0.001$ for both), corroborating the effectiveness of infection control protocols. Similar biomarker-guided improvements were noted by Komal et al., where normalization of inflammatory markers preceded successful grafting or flap coverage [20].

Split-thickness skin grafting (STSG) emerged as the most commonly employed reconstructive method in our cohort, utilized in 47.8% of patients. The high mean graft take rate of 95.2 ± 6.7% reflects the suitability of STSG for well-vascularized wound beds with minimal depth and controlled local infection. STSG offers advantages including ease of harvest, reduced donor site morbidity, and faster epithelialization, making it ideal for superficial ulcers with healthy granulation tissue. Our findings align with the results of Dai et al. [21], who reported a graft take rate of over 90% in diabetic foot ulcers managed with STSG after meticulous wound bed preparation. Similarly, Park et al. [22] emphasized that successful grafting requires optimal local infection control, adequate nutrition, and systemic glycemic stabilization, all of which were integral to our perioperative protocol.

Flap-based procedures were employed in 44.8% of patients, with local fasciocutaneous flaps and reverse sural artery flaps being the most frequently used options for deeper or more complex defects, particularly those with exposed tendon or bone. Although the mean graft take for flap reconstructions was slightly lower (reverse sural flap: 89.3 ± 10.4%), these techniques were indispensable for achieving durable coverage in non-healing wounds. Reverse sural artery flaps, in particular, are valuable for their long arc of rotation and ability to cover heel and ankle defects without the need for microsurgical expertise. However, these flaps are associated with increased healing time (25.2 ± 5.6 days in our study), likely due to their vascular dependency and the complexity of inset, as supported by studies from Tan et al., and Yammine et al., [23,24].

The use of negative pressure wound therapy (NPWT) as an adjunct in 7.5% of cases provided a significant enhancement in wound bed preparation. NPWT facilitated reduction in wound size, promoted angiogenesis, and reduced bioburden by continuous drainage of exudates. This modality was particularly beneficial in ulcers with heavy slough burden or moderate depth, enabling better outcomes when followed by STSG or flap coverage. Meta-analyses by Chen et al., and others have consistently demonstrated that NPWT improves graft take rates and shortens hospital stay by enhancing granulation and decreasing local edema [25].

At 8 weeks postoperatively, complete wound healing was observed in 76.1% of patients, a favorable outcome compared to previous literature. For instance, Yang et al. [26] and Kwon et al., reported lower healing rates in cohorts managed conservatively or with delayed reconstruction [26,27]. In our study, partial healing (defined as >75% epithelialization) occurred in 16.4%, while surgical failure (graft/flap take <50% or requiring re-intervention) was limited to only 7.5%. These results underline the importance of early and appropriate surgical intervention, tailored to ulcer characteristics and patient comorbidities.

The average hospital stay was 11.7 ± 2.9 days, which reflects efficient integration of preoperative medical stabilization and surgical scheduling. This is shorter than stays reported in other studies where patients underwent multiple debridements or delayed closure [28,29]. The low rate of re-ulceration (6.0%) within 8 weeks further reinforces the effectiveness of achieving definitive coverage early in the treatment course. Ramanujam et al., and Agrawal et al., have emphasized that timely wound closure significantly reduces mechanical stress and bacterial contamination, two major contributors to ulcer recurrence [29,30]. Furthermore, long-term success is highly dependent on postoperative offloading and patient adherence to foot care protocols, areas which should be emphasized in future structured follow-up programs.

Limitations

This study has several limitations. Firstly, it was conducted at a single tertiary care center, which may limit the generalizability of the findings to broader community or primary care settings. Secondly, the sample size was relatively modest (n = 67), and although the results were statistically significant, larger multicentric studies are needed to validate these outcomes. Thirdly, long-term follow-up beyond 8 weeks was not included; hence, recurrence rates and sustained healing over time could not be fully assessed. Fourth, while efforts were made to standardize surgical techniques and postoperative care, inter-operator variability in flap and graft application may have influenced outcomes. Additionally, socioeconomic factors, patient adherence to offloading and foot care protocols post-discharge, which are known to impact ulcer recurrence, were not systematically evaluated.

Conclusion

Overall, this study reinforces that individualized plastic surgical management following infection control can significantly improve healing outcomes in DFUs. It emphasizes the role of timely referral, structured infection monitoring, and anatomical reconstruction strategies tailored to ulcer location and depth. While our outcomes are comparable or superior to regional and international studies, limitations such as a modest sample size and limited long-term follow-up should be addressed in future prospective trials. Additionally, structured diabetic foot care programs, including footwear modification and patient education, remain essential to sustain postoperative benefits.

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