ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

To evaluate the role of microvascular procedure in diabetic foot using diabetic foot score

Gopal Singh[1], Amit Agarwal[2]

[1]Senior Resident, [2]Senior Consultant, Department of Plastic Surgery, Vivekananda Polyclinic and Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Submission: 29-01-2025 Revision: 03-03-2025 Publication: 01-04-2025

ABSTRACT

Background: Diabetic foot ulcers (DFUs) pose significant medical and socioeconomic challenges, being a leading cause of non-traumatic lower-limb amputations. Microvascular reconstructive procedures have emerged as vital interventions for limb salvage, but their role in achieving optimal outcomes in DFU management remains underexplored, particularly in northern India. **Aims and Objectives:** This study aimed to evaluate the efficacy of microvascular procedures in DFU management using a diabetic foot scoring system. Objectives included protocol development for surgical management, standardizing practices, assessing procedure success rates, and analyzing post-operative outcomes such as ambulation time, complications, and hospital stay duration. **Materials and Methods:** A prospective observational study was conducted at a tertiary care center, including 40 diabetic patients with non-healing ulcers refractory to conservative management. Patients were stratified into low, moderate, and high-risk categories using diabetic foot scores based on parameters such as ankle-brachial pressure index, necrotizing fasciitis, and osteomyelitis. Free flaps were selected based on individual risk profiles. Outcomes were assessed in terms of wound healing, ambulation, and complication rates. **Results:** Microvascular procedures demonstrated a 100% healing rate, with 18 patients (45%) achieving healing through primary intervention and 22 (55%) requiring additional procedures. Mean healing and ambulation times were 40.55 ± 7.63 days and 60.75 ± 10.17 days, respectively. High-risk patients (9; 22.5%) experienced prolonged hospital stays and higher rates of complications. **Conclusion:** Microvascular procedures are effective for DFU management, especially in high-risk patients. The developed protocol ensured standardized care and optimized outcomes, underscoring the importance of risk stratification and multidisciplinary approaches in limb salvage.

Key words: Diabetic foot ulcer; Microvascular reconstruction; Risk stratification; Limb salvage; Diabetic foot score

Access this article online

Website: https://ajmsjournal.info/index.php/AJMS/index

DOI: 10.71152/ajms.v16i4.4432

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Diabetes mellitus has evolved into a significant global health challenge, with an estimated diabetic population of over 380 million projected by 2025.[1] In India, the prevalence of diabetes is approximately 10.9%, making it one of the countries with the highest burden of diabetes globally.[2] This chronic metabolic disorder is characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[3] Its status has shifted from a mild condition in the elderly to a major cause of morbidity and mortality affecting individuals across various age groups.

The complications associated with diabetes are categorized into macrovascular and microvascular types. Macrovascular complications include coronary artery disease, peripheral

Address for Correspondence:
Dr. Gopal Singh, Senior Resident, Department of Plastic Surgery, Vivekananda Polyclinic and Institute of Medical Sciences, Lucknow, Uttar Pradesh, India. **Mobile:** +91-9794904786. **E-mail:** dr.gops@gmail.com

arterial disease, and stroke, whereas microvascular complications encompass diabetic nephropathy, retinopathy, and neuropathy.[3,4] Among these, diabetic foot ulcers (DFUs) represent a debilitating condition that significantly contributes to the overall morbidity and economic burden on healthcare systems. DFUs often result in hospital admissions, prolonged treatment durations, and, in severe cases, lower-limb amputations. In fact, diabetes accounts for over 50% of non-traumatic lower limb amputations globally, with 85% of these cases being preceded by foot ulcers.[5]

In India, the prevalence of foot ulcers among diabetic patients is estimated at 3%, which is relatively lower than in Western populations.[2] However, due to the growing diabetic population, the absolute number of DFU cases remains substantial. The multifactorial etiology of DFUs – combining neuropathy, ischemia, and infection – presents significant challenges in treatment. In addition, external factors such as trauma, foot deformities, and poor glycemic control further exacerbate the condition, making it one of the most complex complications to manage.[4,5]

The management of DFUs traditionally involves a multidisciplinary approach that includes medical therapy, debridement, and conservative wound care. However, in cases where conservative measures fail, reconstructive surgical interventions become necessary. These include procedures such as debridement, split-thickness skin grafting, local and regional flaps, and free microvascular flaps. Microvascular reconstructive surgery, in particular, has shown promise in addressing large and complex defects associated with DFUs. This technique not only facilitates wound coverage but also improves vascularity and promotes functional recovery, enabling patients to regain mobility and quality of life.[5]

Aims and objectives

The present study aimed to evaluate the role of microvascular procedures in managing DFUs using the diabetic foot score. Objectives included developing a protocol for surgical management, standardizing practices in northern India, and analyzing the frequency and success of microvascular reconstructive procedures. The study also assessed outcomes of sensate microvascular reconstruction, where applicable, and compared results in terms of ambulation time, intra- and post-operative complications, hospital stay duration, and recurrence or need for secondary procedures during the study period.

MATERIALS AND METHODS

Study design

This was a prospective observational study conducted at Vivekananda Polyclinic and Institute of Medical Sciences (VPIMS), Lucknow, over a 3-year period. The study aimed to evaluate the role of microvascular reconstructive procedures in managing DFUs using a diabetic foot scoring system.

Study population

The study included diabetic foot patients attending the Diabetic Clinic and Outpatient Department or referred to the Department of Plastic Surgery. Patients were selected based on defined inclusion and exclusion criteria.

Inclusion criteria

1. Diabetic patients aged between 21 and 70 years.
2. Patients with non-healing ulcers unresponsive to conservative management.
3. Diabetic patients with large, extensive defects or critical areas exposed where local or regional flaps and skin grafting were not feasible.

Exclusion criteria

1. Diabetic patients aged above 70 or below 21 years.
2. Patients with wounds manageable by local/regional flaps or split-thickness skin grafting.
3. Medically unfit patients unable to undergo surgery.

Sample size

The calculated sample size was 24 patients, determined using the Snedecor and Cochran formula. To account for contingencies and follow-up losses, a total of 50 patients were targeted, with 40 completing the study.

Data collection

Patient data were collected through structured questionnaires, clinical evaluation, and photographic documentation. Key data points included demographic information, diabetic history, comorbidities, ulcer characteristics, and post-operative outcomes.

Scoring and risk stratification

A diabetic foot scoring system was employed to stratify patients into three risk categories:

- Low risk: Score <5, suitable for reconstructive procedures.
- Moderate risk: Score 5–10, requiring additional risk assessment and clinical evaluation.
- High risk: Score >10, where amputation was preferred or reconstruction was performed with caution.

The scoring criteria assessed variables such as peripheral arterial disease, necrotizing fasciitis, plantar sensation, sepsis, albumin levels, osteomyelitis, and comorbidities.

Pre-operative evaluation

1. Vascular assessment: Non-invasive Doppler flowmetry and computed tomography angiography were performed to assess arterial patency and ischemic status
2. Glycemic control: Strict monitoring and regulation of blood glucose levels (140–180 mg/dL) were ensured 48 h prior to surgery to avoid hypoglycemia or severe hyperglycemia
3. Comorbidity management: Patients with conditions such as hypertension, nephropathy, and neuropathy were stabilized before proceeding with surgery
4. Debridement and vacuum-assisted closure (VAC) therapy: Aggressive debridement was performed to remove necrotic tissue and infection. VAC therapy was applied as needed to prepare a healthy granulation bed.

Surgical interventions

Reconstructive procedures were selected based on the reconstructive ladder principle, emphasizing the use of free flaps for large and complex defects. The following steps were standardized:

1. Flap selection: Free flaps such as anterolateral thigh, gracilis, and latissimus dorsi flaps were prioritized for large defects or low ischemic index cases
2. Microsurgery: Arterial and venous anastomosis was performed under a microscope, ensuring preservation of distal blood flow
3. Recipient site preparation: The wound bed was assessed for vascularity, and debridement was repeated if necessary.

Postoperative monitoring

1. Flap monitoring: Doppler assessments and tissue oxygen saturation measurements were performed to ensure flap viability
2. Complication management: Complications such as infection, flap necrosis, or graft failure were addressed with additional interventions, including re-anastomosis, flap advancement, or skin grafting
3. Rehabilitation: Patients were encouraged to mobilize as early as possible, with ambulation time recorded.

Follow-up protocol

Patients were followed up at 1 month, 3 months, 6 months, and subsequently every 6 months. Outcomes assessed included wound healing, recurrence, secondary procedures, and functional status.

Outcome measures

The primary outcomes included:

- Time to ambulation
- Healing rates (achieved with primary vs. secondary procedures)
- Complications (intraoperative and post-operative)
- Length of hospital stay.

Data analysis

Data were analyzed using the Statistical Package for the Social Sciences version 21.0. Chi-square tests and analysis of variance were applied to determine statistical significance, with $P<0.05$ considered significant.

Ethical considerations

The study was approved by the Institutional Ethical Committee. Informed consent was obtained from all participants, ensuring confidentiality and the right to withdraw from the study at any time.

RESULTS

The study assessed the effectiveness of microvascular procedures in managing diabetic foot using a diabetic foot score, with results presented in tables. The majority of patients were male (82.5%) and unskilled laborers, with age being a significant factor in determining risk levels ($P=0.005$) (Table 1). High-risk patients exhibited longer durations of illness (49.11±21.22 days; $P=0.025$), a higher prevalence of necrotizing fasciitis (77.7%), and elevated diabetic foot scores (10.44±0.53; $P<0.001$) (Table 2). The anterolateral thigh free flap was the most frequently used technique (65%), with more complex procedures reserved for high-risk cases (Table 3). Common intraoperative findings included infected fascia (70%) and osteomyelitis (87.5%), with severe infections significantly more common in high-risk patients ($P=0.002$, $P=0.031$) (Table 4). Secondary procedures, such as flap advancement or skin grafting, were required in 55% of cases, reflecting the complexity of severe conditions (Table 5). Follow-up outcomes were promising, with 95% of patients achieving healing at 6 months, although 11.1% of high-risk cases remained unresolved (Table 6). These results highlight the critical role of microvascular interventions in managing diabetic foot, particularly in high-risk patients.

DISCUSSION

A total of 40 patients falling in sampling frame were enrolled in the study. Age of patients ranged from 38 to 65 years. According to risk stratification, a total of 19 (47.5%) were assigned to moderate risk, 12 (30%) to low risk, and remaining 9 (22.5%) were assigned to high-risk category.

Demographic profile

In the present study, the age of patients ranged from 38 to 65 years, with a mean age of 52.53±6.66 years, which is

Table 1 : Baseline demographic characteristics of study participants

S. No.	Characteristic	Total (n=40)		Low risk (n=12)		Moderate risk (n=19)		High risk (n=9)		Statistical significance	
1	Mean age±SD (range) in years	52.53±6.66 (38–65)		49.67±8.46 (38–64)		55.95±4.37 (47–65)		49.11±4.68 (40–58)		F=6.034; P=0.005	
		No.	%	No.	%	No.	%	No.	%	χ^2	"P"
2	Gender										
	Male	33	82.5	10	83.3	17	89.5	6	66.7	2.209	0.331
	Female	7	17.5	2	16.7	2	10.5	3	33.3		
3	Occupation										
	Farmer/unskilled labor	14	35	5	41.7	6	31.6	3	33.3	3.389	0.908
	Skilled labor	3	7.5	1	8.3	1	5.3	1	11.1		
	Shopkeeper/business	8	20	3	25.0	4	21.1	1	11.1		
	Service	9	22.5	1	8.3	6	31.6	2	22.2		
	Housewife	6	15	2	16.7	2	10.5	2	22.2		

Table 2: Clinical history, local examination, and investigations of patients with diabetic foot ulcers

S. No.	Characteristic	Total (n=40)		Low risk (n=12)		Moderate risk (n=19)		High risk (n=9)		Statistical significance	
1	Mean duration of current illness±SD (days)	38.25±16.84		40.75±16.61		31.53±11.61		49.11±21.22		F=4.075; P=0.025	
		No.	%	No.	%	No.	%	No.	%	χ^2	"P"
2	Side										
	Left	17	42.5	5	41.7	11	57.9	1	11.1	8.04	0.090
	Right	23	55	7	58.3	8	42.1	7	77.8		
3	Position										
	Dorsum	18	45	8	66.7	6	31.6	4	44.4	14.10	0.294
	Dorsum+Leg	3	7.5	1	8.3	2	10.5	0	0.0		
	Dorsal+Plantar	2	5	0	0.0	2	10.5	0	0.0		
	Dorsal+Plantar+Leg	1	2.5	0	0.0	0	0.0	1	11.1		
	Hindfoot	1	2.5	0	0.0	0	0.0	1	11.1		
	Midfoot	1	2.5	0	0.0	0	0.0	1	11.1		
	Plantar	9	22.5	2	16.7	6	31.6	1	11.1		
4	No. of lesions										
	One	38	95	12	100.0	18	94.7	8	88.9	4.617	0.329
	Two	1	2.5	0	0.0	1	5.3	0	0.0		
	Multiple	1	2.5	0	0.0	0	0.0	1	11.1		
5	Mean size of lesion±SD (cm^2)	130.70±156.76		71.42±70.77		170.37±201.76		126.00±110.83		F=1.509; P=0.234	
6	Mean ABPI±SD	0.74±0.19		0.83±0.16		0.73±0.22		0.65±0.19		F=1.945; P=0.157	
7	Necrotizing fasciitis										
	Absent	12	30.0	8	66.7	4	21.1	0	0	13.71	0.008
	Diffuse	18	45.0	1	8.3	10	52.6	7	77.7		
	Localized	10	25.0	3	25.0	5	26.3	2	22.2		
8	Decreased plantar sensation	26	65.0	3	25.0	14	73.7	9	100.0	2.91	0.233
9	General condition of patient										
	Good	9	22.5	7	58.3	2	10.5	0	0	14.6	0.006
	Satisfactory	14	35.0	3	25.0	9	47.4	2	22.2		
	Poor	17	42.5	2	16.7	8	42.1	7	77.7		
10	Mean Albumin±SD (mg/dL)	2.24±0.09		2.30±0.56		2.29±0.36		2.07±0.09		F=1.136; P=0.332	
11	Mean DFS±SD	7.13±2.71		3.83±0.84		7.63±1.54		10.44±0.53		F=82.78; P<0.001	
12	Osteomyelitis										
	No	5	12.5	4	33.3	1	5.3	0	0.0	10.88	0.028
	Diffuse	10	25	0	0.0	6	31.6	4	44.4		
	Localized	25	62.5	8	66.7	12	63.2	5	55.6		
13	Comorbidities	10	25.0	1	8.3	3	15.8	6	66.7	11.0	0.004

comparable to the findings of Eskelinen et al., who reported a mean age of 54 years, and slightly lower than Schirmer et al.,[6] (65.3 years) and Rose et al.,[7] (61 years). Balakrishnan[8] also reported patients exclusively above 50 years, with ages ranging

Table 3: Type of procedure

S. No.	Type of procedure	Total (n=40)		Low risk (n=12)		Moderate risk (n=19)		High risk (n=9)	
		No.	%	No.	%	No.	%	No.	%
1	Anterolateral thigh free flap	26	65.0	9	75.0	13	68.4	4	44.4
2	Gracilis free flap	5	12.5	2	16.7	1	5.3	2	22.2
3	Latissimus dorsi free flap	2	5.0	0	0	2	10.5	0	0
4	Rectus femoris free flap	4	10.0	1	8.3	2	10.5	1	11.1
5	Vastus lateralis muscle free flap	2	5.0	0	0	1	5.3	1	11.1
6	Radial artery free flap	1	2.5	0	0	0	0	1	11.1

*All the procedures were accompanied with split skin graft, χ^2=9.43; *P*=0.482 (NS)

Table 4: Intraoperative findings

S. No.	Characteristic	Total (n=40)		Low risk (n=12)		Moderate risk (n=19)		High risk (n=9)		Statistical significance	
		No.	%	No.	%	No.	%	No.	%	χ^2	"P"
1	Gangrene	13	32.5	4	33.3	9	47.4	0	0	6.25	0.044
2	Infected fascia/tissues	28	70.0	4	33.3	15	78.9	9	100	12.26	0.002
3	Osteomyelitis	35	87.5	8	66.7	18	94.7	9	100	6.96	0.031
4	Tendon exposure	13	32.5	5	41.7	6	31.6	2	22.2	0.90	0.638
5	Calcification of artery	10	25.0	1	8.3	6	31.6	3	33.3	2.55	0.279

Post-operative donor site complications

S. No.	Characteristic	Total (n=6)		Low risk (n=1)		Moderate risk (n=3)		High risk (n=2)	
		No.	%	No.	%	No.	%	No.	%
1	Graft loss	1	16.7	0	0	1	33.3	0	0
2	Seroma	1	16.7	0	0	1	33.3	0	0
3	Wound dehiscence	3	50.0	0	0	1	33.3	2	100
4	Unhealthy raw areas, deb+ssg cover	1	16.7	1	100	0	0	0	0

Post-operative recipient site complications

S. No.	Characteristic	Total (n=22)		Low risk (n=4)		Moderate risk (n=9)		High risk (n=9)	
		No.	%	No.	%	No.	%	No.	%
1	Partial flap necrosis	16	72.7	4	100	6	66.7	6	66.7
2	Flap failure	6	27.3	0	0	3	33.3	3	33.3

Details of successful primary procedure (n=18)

S. No.	Type of procedure	Total (n=18)		Low risk (n=7)		Moderate risk (n=9)		High risk (n=2)	
		No.	%	No.	%	No.	%	No.	%
1	Anterolateral thigh free flap	14	77.8	5	71.4	7	77.7	2	100
2	Gracilis free flap	1	5.6	1	14.3	0	0	0	0
3	Latissimus dorsi free flap	0	0	0	0	0	0	0	0
4	Rectus femoris free flap	2	11.1	1	14.3	1	11.1	0	0
5	Vastus lateralis muscle free flap	1	5.6	0	0	1	11.1	0	0
6	Radial artery free flap	0		0	0	0	0	0	0

from 55 to 62 years. Similarly, other studies have highlighted a predominance of patients aged over 50 years, with mean ages between 50 and 70 years. Regarding sex, the present study observed a male predominance (82.5%), consistent with findings from studies such as Eskelinen et al.,[9] reported 87.2%, 81.8%, and 85.7% male patients, respectively, attributed to the higher incidence of DFUs in males. Occupational analysis revealed that farmers and laborers were the most affected group (42.5%), likely due to greater exposure to infections and barefoot walking associated with their work.

History of diabetic foot problem, local examination, and investigations

The analysis of Table 4 indicates a significantly longer duration of current illness in high-risk patients (49.11±21.22 days) compared to those in low-risk (40.75±16.61 days) and moderate-risk categories (31.53±11.61 days), demonstrating a statistically significant difference (P=0.025). The distribution of wound positions highlighted that the dorsum (45%) and plantar areas (22.5%) were the most frequently affected regions across

Table 5: Details of additional/secondary procedures (n=22)

S. No.	Characteristic	Total (n=22)		Low risk (n=4)		Moderate risk (n=10)		High risk (n=8)	
		No.	%	No.	%	No.	%	No.	%
Overall (Cases needing improvisation+Failed cases) (n=22)									
1	Code I (Reanastomosis)	1	4.5	0	0	1	10	0	0
2	Code II (Debridement+free flap+split skin grafting)	2	9.1	0	0	1	10	1	12.5
3	Code III (Debridement of partial necrosed flap+Flap advancement+Split skin grafting)	15	68.2	4	100	6	60	5	62.5
4	Code IV (Debridement with Split skin grafting)	4	18.2	0	0	2	20	2	25.0
Cases needing improvisation after primary procedure (n=16)									
S. No.	**Characteristic**	**(n=16)**		**(n=4)**		**(n=6)**		**(n=6)**	
1	Code I	1	6.3	0	0	1	16.7	0	0
2	Code II	0	0	0	0	0	0	0	0
3	Code III	15	93.7	4	100	5	83.3	6	100
4	Code IV	0	0	0	0	0	0	0	0
In cases where primary procedure was failed (n=6)									
S. No.	**Characteristic**	**(n=6)**		**(n=0)**		**(n=3)**		**(n=3)**	
1	Code I	0	0	0	0	0	0	0	0
2	Code II	2	33.3	0	0	1	33.3	1	33.3
3	Code III	0	0	0	0	0	0	0	0
4	Code IV	4	66.7	0	0	2	66.7	2	66.7

Table 6: Follow-up evaluations

S. No.	Characteristic	Total (n=40)		Low risk (n=12)		Moderate risk (n=19)		High risk (n=9)		Statistical significance	
		No.	%	No.	%	No.	%	No.	%	χ^2	"P"
1 month											
1	Good	39	97.5	12	100	18	94.7	9	100	1.134	0.567
2	Required revision surgery	1	2.5	0	0	1	5.3	0	0		
3 months											
1	Good	40	100	12	100	19	100	9	100		
6 months											
1	Good	38	95.0	12	100	18	94.7	8	88.9	1.34	0.511
2	Non-healing ulcer	2	5.0	0	0	1	5.3	1	11.1		

all risk groups. Despite the larger mean lesion size observed in moderate-risk cases, statistical significance was not achieved (P=0.234). Notably, all high-risk patients exhibited decreased plantar sensation and diffuse necrotizing fasciitis, with a significant difference in the presence of necrotizing fasciitis across groups (P=0.008). Osteomyelitis was prevalent in 87.5% of cases, with a higher proportion of diffuse osteomyelitis in high-risk patients, indicating a significant trend (P=0.028).

Type of procedure

The anterolateral thigh free flap emerged as the most commonly used technique (65%), predominantly in low-risk (75%) and moderate-risk (68.4%) groups. Conversely, high-risk patients exhibited a more diverse usage of free flaps, including gracilis (22.2%), rectus femoris (11.1%), and radial artery (11.1%) flaps. Despite the procedural complexity, the selection of flaps appeared tailored to patient risk profiles and wound characteristics. While statistical significance was not reached (P=0.482), these findings underscore the versatility of microvascular reconstruction in addressing varying severities of DFUs. Notably, the application of multiple flap types in high-risk cases highlights the critical need for individualized surgical planning in this patient cohort.

Intraoperative findings

The intraoperative findings outlined in the table demonstrate key differences among risk groups. Gangrene was observed in 32.5% of cases, with a significant association in moderate-risk patients (47.4%, P=0.044). Infected fascia or tissues were present in 70% of cases, significantly higher in high-risk patients (100%, P=0.002). Osteomyelitis was prevalent in 87.5% of patients, with a notable increase in high-risk groups (100%, P=0.031). Tendon exposure and arterial calcification were less frequent, affecting 32.5% and 25% of cases, respectively, without significant differences among risk categories. These findings emphasize the progressive severity of diabetic foot pathology in higher-risk patients.

Post-operative donor site complications

Post-operative donor site complications were observed in a small subset of patients, with wound dehiscence being the most common, occurring in 50% of cases and exclusively affecting moderate- (33.3%) and high-risk patients (100%). Graft loss and seroma each occurred in 16.7% of cases, limited to moderate-risk patients. Unhealthy raw areas requiring debridement and split skin grafting (deb+SSG) were seen in one low-risk patient (16.7%). These findings highlight the increased risk of complications in higher-risk categories, emphasizing the need for meticulous surgical techniques and post-operative care to minimize donor site morbidity.

Post-operative recipient site complications

Post-operative recipient site complications were significant, with partial flap necrosis being the most common issue, affecting 72.7% of cases. All low-risk patients experienced partial flap necrosis (100%), while moderate- and high-risk groups showed slightly lower incidences (66.7% each). Flap failure occurred in 27.3% of cases, exclusively in moderate- and high-risk patients (33.3% each). These findings indicate that while complications can arise across all risk groups, higher-risk patients are more prone to severe outcomes like flap failure, underscoring the importance of tailored post-operative monitoring and timely interventions.

Details of successful primary procedure (n = 18)

Among the 18 successful primary procedures, the anterolateral thigh free flap was the most commonly used technique, performed in 77.8% of cases, with 71.4% in low-risk, 77.7% in moderate-risk, and 100% in high-risk patients. Gracilis free flaps accounted for 5.6% of cases, exclusively in low-risk patients (14.3%). Rectus femoris free flaps were used in 11.1% of cases, evenly distributed between low- and moderate-risk groups. The vastus lateralis muscle free flap was performed in 5.6% of cases, limited to moderate-risk patients. No procedures utilized latissimus dorsi or radial artery free flaps. These results highlight the preference for anterolateral thigh free flaps due to their versatility and suitability across all risk groups.

Details of additional/secondary procedures (n = 22)

The majority of cases (68.2%) underwent debridement with partial flap necrosis management and flap advancement (Code III), particularly in moderate- and high-risk groups. Secondary procedures such as re-anastomosis (Code I) and split skin grafting after debridement (Code IV) were less frequent but necessary for failed primary interventions, emphasizing the challenges in managing advanced cases. High-risk patients required more extensive revisions, underlining the need for tailored approaches to optimize outcomes in severe diabetic foot conditions.

Follow-up evaluations

At 1 and 3 months, 97.5% and 100% of patients, respectively, showed good healing, with only one moderate-risk case requiring revision surgery. At 6 months, 95% of patients achieved complete healing, while 5% of high-risk cases exhibited non-healing ulcers, underscoring the challenges in managing severe conditions. These results affirm the efficacy of microvascular interventions, particularly in achieving long-term healing, but highlight the need for enhanced strategies to address persistent issues in high-risk patients.

Limitations of the study

The study's limitations include a small sample size (n=40), single-center design, and limited follow-up period, which may restrict generalizability and long-term outcome assessment. In addition, variability in patient compliance and the absence of a control group limit the ability to directly compare microvascular procedures with other treatments.

CONCLUSION

Microvascular procedures have proven to be highly effective in managing DFUs, particularly in high-risk patients, by promoting wound healing and limb salvage. Risk stratification using the diabetic foot score facilitated tailored interventions, with the anterolateral thigh free flap emerging as the most versatile option. Despite challenges such as partial flap necrosis and flap failure, the majority of patients achieved satisfactory outcomes. This study highlights the importance of individualized surgical planning, multidisciplinary care, and rigorous post-operative monitoring to optimize results, though larger, multicentric studies are needed for broader validation.

ACKNOWLEDGMENT

I sincerely thank the Department of Plastic Surgery, VPIMS, Lucknow, for their guidance and support, the Institutional Ethical Committee for their approval, and the patients for their cooperation and trust.

REFERENCES

1. Magliano DJ and Boyko EJ, IDF Diabetes Atlas 10th edition scientific committee. IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation; 2021. https://www.ncbi.nlm.nih.gov/books/NBK581934 [Last accessed on 2021 Jul 07].
2. Anjana RM, Deepa M, Pradeepa R, Mahanta J, Narain K, Das HK, et al. Prevalence of diabetes and prediabetes in 15 states of India: Results from the ICMR-INDIAB population-based cross-sectional study. Lancet Diabetes Endocrinol. 2017;5(8):585-596. https://doi.org/10.1016/S2213-8587(17)30174-2. Erratum in:

Lancet Diabetes Endocrinol. 2017;5:e5.

https://doi.org/10.1016/s2213-8587(17)30174-2

3. American Diabetes Association. 2. Classification and diagnosis of diabetes: Standards of medical care in diabetes-2021. Diabetes Care. 2021;44(Suppl 1):S15-S33.

   https://doi.org/10.2337/dc21-S002. Erratum in: Diabetes Care. 2021;44(9):2182.

   https://doi.org/10.2337/dc21-s002

4. Nathan DM, Buse JB, Davidson MB, Ferrannini E, Holman RR, Sherwin R, et al. Medical management of hyperglycemia in type 2 diabetes: A consensus algorithm for the initiation and adjustment of therapy: A consensus statement of the American diabetes association and the European association for the study of diabetes. Diabetes Care. 2009;32(1):193-203.

   https://doi.org/10.2337/dc08-9025

5. Boulton AJ, Vileikyte L, Ragnarson-Tennvall G and Apelqvist J. The global burden of diabetic foot disease. Lancet. 2005;366(9498):1719-1724.

   https://doi.org/10.1016/s0140-6736(05)67698-2

6. Schirmer S, Ritter RG and Fansa H. Vascular surgery, microsurgery and supramicrosurgery for treatment of chronic diabetic foot ulcers to prevent amputations. PLoS One. 2013;8(9):e74704.

   https://doi.org/10.1371/journal.pone.0074704

7. Rose JF, Giovinco N, Mills JL, Najafi B, Pappalardo J and Armstrong DG. Split-thickness skin grafting the high-risk diabetic foot. J Vasc Surg. 2014;59(6):1657-1663.

   https://doi.org/10.1016/j.jvs.2013.12.046

8. Balakrishnan TM. Microvascular reconstruction in revascularised diabetic foot; A perforosome approach. Clin Res Foot Ankle. 2018;4(3):1000206.

   http://doi.org/10.4172/2329-910X.1000206

9. Eskelinen E, Kaartinen I, Kääriäinen M and Kuokkanen H. Successful foot salvage with microvascular flaps in diabetic patients. Scand J Surg. 2015;104(2):103-107.

   https://doi.org/10.1177/1457496914524389

Authors' Contributions:
GS and AA- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article, concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision, design of study, statistical analysis and interpretation, review manuscript, review manuscript, literature survey, coordination, and manuscript revision

Work attributed to:
Department of Plastic Surgery, VPIMS, Lucknow, Uttar Pradesh, India

Orcid ID:
Dr. Gopal Singh- https://orcid.org/0009-0003-2069-2438
Dr. Amit Agarwal- https://orcid.org/0009-0002-5378-8383

Source of Support: Nil, **Conflicts of Interest:** None declared.