International Surgery Journal
Dhinga HI et al. Int Surg J. 2026 Dec;13(12):2524-2529
https://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20264361

Original Research Article

Management and outcome of diabetic foot: a prospective study of 50 cases at a tertiary care teaching hospital in Gujarat

Harshal I. Dhinga, Alimamad O. Noyda*

Department of General Surgery, Shri M. P. Shah Government Medical College and Guru Gobind Singh Government Hospital, Jamnagar, Gujarat, India

Received: 09 October 2026
Accepted: 06 November 2026

***Correspondence:**
Dr. Alimamad O. Noyda,
E-mail: draonoyda@gmail.com

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ABSTRACT

Background: Diabetic foot disease is a leading cause of hospital admission and non-traumatic amputation in India. This study evaluated its clinical profile, risk factors, management and outcome in a tertiary care teaching hospital.
Methods: This prospective study included 50 consecutive cases of diabetic foot admitted to the department of general surgery of a tertiary care hospital in Jamnagar, Gujarat, between August 2025 and June 2026. Risk factors, Wagner grade, wound microbiology and pulse status were recorded. Management followed a standardized protocol of insulin-based glycemic control, culture-guided antibiotics, debridement, amputation and skin grafting as required.
Results: Mean age was 57.86±11.40 years, 68.00% were men and 48.00% had diabetes for over 10 years. Poor glycemic control (70.00%), neuropathy (64.00%), smoking (38.00%) and peripheral arterial disease (38.00%) were the main risk factors. Wagner grades 2 and 3 accounted for 60.00%. Cultures were positive in 76.00%, most often mixed flora (28.00%). Distal pulses were absent more often than proximal pulses (dorsalis pedis and posterior tibial 20.00% each, femoral 2.00%). Thirty-one cases (62.00%) healed without amputation, 13 (26.00%) underwent minor and six (12.00%) major amputation, giving a limb salvage rate of 88.00%. Sepsis occurred in 12.00%, and mean hospital stay was 15.54±6.59 days.
Conclusions: Diabetic foot affected patients with long-standing, poorly controlled diabetes, neuropathy, infection and distal arterial disease. Protocol-based glycemic control, culture-guided antibiotics, early debridement and limb-preserving surgery achieved limb salvage in most patients.

Keywords: Amputation, Debridement, Diabetic foot, Diabetic foot ulcer, Limb salvage, Wagner classification

INTRODUCTION

Diabetes mellitus affects more than 100 million people in India, and its complications are an increasing burden on public hospitals.[1] Foot ulceration develops in an estimated 19% to 34% of people with diabetes during their lifetime, and recurrence after healing is common.[2] The global prevalence of diabetic foot ulceration is about 6%, with higher figures in low- and middle-income settings where late presentation, barefoot walking and limited access to podiatric care are common.[3,4] Diabetic foot disease is the leading cause of non-traumatic lower limb amputation, and it carries high costs, prolonged hospital stay and reduced survival.[5,6]

The pathway to ulceration and amputation is multifactorial. Peripheral neuropathy causes loss of protective sensation and deformity, peripheral arterial disease impairs healing, and infection precipitates tissue loss.[7,8] The Wagner classification grades lesions from superficial ulceration to gangrene of the whole foot and remains widely used in Indian surgical practice to guide treatment.[9] Contemporary management, as set out in the International Working Group on the Diabetic Foot (IWGDF) guidelines, combines metabolic control, offloading, treatment of infection, surgical debridement,

revascularization where possible and multidisciplinary care.[10,11]

Outcomes differ widely between centers and depend on the stage at presentation and the resources available.[12,13] This study evaluated the clinical profile, risk factors, management and outcome of diabetic foot lesions in patients admitted to a tertiary care teaching hospital in Gujarat.

METHODS

Study design and setting

This prospective observational study was conducted in the department of general surgery, Shri M. P. Shah Government Medical College and Guru Gobind Singh Government Hospital, Jamnagar, Gujarat, India, from August 2025 to June 2026.

Participants

Patients aged 30 to 80 years with type 1 or type 2 diabetes mellitus admitted to the surgical units with a foot lesion of Wagner grade 1 to 5 were included after written informed consent, which included consent for clinical photography without identifying features. Patients with non-diabetic foot ulcers and those who declined consent or follow-up were excluded. A total of 50 cases were studied.

Clinical evaluation

A predesigned case record form was used to record age, sex, duration of diabetes, presenting complaints, smoking, previous ulceration or amputation, and comorbidities including hypertension, ischemic heart disease, previous myocardial infarction, dyslipidemia and diabetic nephropathy. Local examination recorded the site, size and depth of the lesion, discharge, slough, gangrene, cellulitis, abscess, deformity and exposure of tendon or bone. Lesions were graded according to the Wagner classification.[9] Peripheral neuropathy was assessed with monofilament testing, vibration sense and ankle reflexes. The femoral, popliteal, anterior tibial, posterior tibial and dorsalis pedis pulses were graded as normal, diminished or absent, and peripheral arterial disease was evaluated by arterial color Doppler study.

Investigations

Complete blood count, fasting and postprandial blood glucose, glycated hemoglobin (HbA1c), renal function, serum electrolytes and urine examination were performed in all patients. Pus or deep tissue swabs were sent for culture and sensitivity in infected wounds. Plain radiographs of the foot were obtained to detect osteomyelitis, soft tissue gas and bony destruction. Poor glycemic control was defined from HbA1c and blood glucose values at admission.

Management protocol

All patients were stabilized with insulin-based glycemic control, correction of fluid and electrolyte imbalance, empirical broad-spectrum intravenous antibiotics later modified according to culture reports, analgesia, nutritional support and daily sterile wound care. Surgical treatment was individualized according to the extent of infection and necrosis, limb perfusion, osteomyelitis and general condition. Surgical debridement of all necrotic and infected tissue to bleeding margins was repeated as needed, and abscesses were drained. Toe, ray and transmetatarsal amputations were performed for localized gangrene or osteomyelitis with adequate forefoot perfusion. Below-knee and above-knee amputations were reserved for extensive gangrene, uncontrolled spreading sepsis, a non-salvageable limb or life-threatening infection, with the level chosen by assessment of perfusion and tissue viability. Split-thickness skin grafting was performed once infection was controlled and a healthy granulation bed had formed. A vascular surgery opinion was obtained for significant peripheral arterial disease. All patients received education on foot care, footwear, glycemic control and smoking cessation.

Outcomes

The outcomes were the final management received, wound healing without amputation, minor amputation (toe, ray or transmetatarsal), major amputation (below or above knee), limb salvage (absence of major amputation), complications and duration of hospital stay.

Statistical analysis

Data were entered in Microsoft Excel. Continuous variables were expressed as mean±standard deviation and categorical variables as frequency and percentage.

RESULTS

The mean age of the 50 cases was 57.86±11.40 years (range 32 to 80 years), and the largest age group was 51 to 60 years (36.00%). Men accounted for 68.00%. Nearly half (48.00%) had diabetes for more than 10 years. Poor glycemic control (70.00%) and peripheral neuropathy (64.00%) were the most frequent risk factors, followed by smoking (38.00%) and peripheral arterial disease (38.00%). Hypertension (56.00%), dyslipidemia (46.00%) and ischemic heart disease (28.00%) were the main comorbidities (Table 1).

Pain was the most common presenting complaint (60.00%), followed by swelling (20.00%), pus discharge (12.00%) and blackening of the toes or foot (8.00%). Most lesions were Wagner grade 2 (32.00%) or grade 3 (28.00%); grade 4 and grade 5 lesions accounted for 16.00% and 8.00%, respectively. Wound cultures grew organisms in 38 cases (76.00%): mixed growth in 28.00%, Staphylococcus aureus in 20.00%, Pseudomonas

species in 16.00% and Escherichia coli in 12.00% (Table 2, Figure 1).

Table 1: Demographic profile, risk factors and comorbidities (n=50).

Variable	N (%)
Age group (years)	
30-40	4 (8.00)
41-50	10 (20.00)
51-60	18 (36.00)
61-70	12 (24.00)
71-80	6 (12.00)
Mean±SD (years)	57.86±11.40
Sex	
Male	34 (68.00)
Female	16 (32.00)
Duration of diabetes	
<5 years	8 (16.00)
5-10 years	18 (36.00)
>10 years	24 (48.00)
Risk factors*	
Poor glycemic control	35 (70.00)
Peripheral neuropathy	32 (64.00)
Peripheral arterial disease	19 (38.00)
Smoking	19 (38.00)
Comorbidities*	
Hypertension	28 (56.00)
Dyslipidemia	23 (46.00)
Ischemic heart disease	14 (28.00)
Diabetic nephropathy	10 (20.00)
Previous myocardial infarction	6 (12.00)

*More than one factor was present in some patients.

Table 2: Presenting complaint, Wagner grade and wound microbiology (n=50).

Variables	N (%)
Presenting complaint	
Pain	30 (60.00)
Swelling	10 (20.00)
Pus discharge	6 (12.00)
Blackening	4 (8.00)
Wagner grade	
Grade 1	8 (16.00)
Grade 2	16 (32.00)
Grade 3	14 (28.00)
Grade 4	8 (16.00)
Grade 5	4 (8.00)
Culture result	
Mixed growth	14 (28.00)
Staphylococcus aureus	10 (20.00)
Pseudomonas species	8 (16.00%)
Escherichia coli	6 (12.00%)
No growth	12 (24.00%)

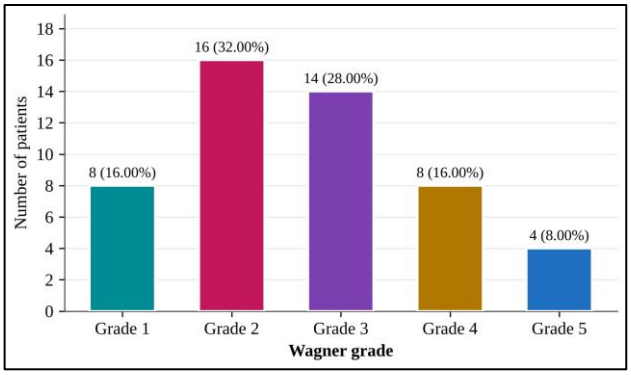

Figure 1: Distribution of diabetic foot lesions by Wagner grade (n=50).

Pulse deficits increased distally. The femoral pulse was absent in 2.00% and the popliteal pulse in 8.00%, whereas the anterior tibial, posterior tibial and dorsalis pedis pulses were absent in 16.00%, 20.00% and 20.00%, respectively (Table 3).

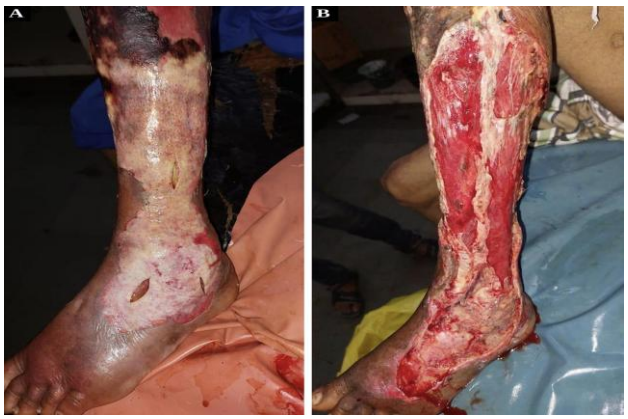

Figure 2: Surgical debridement of a severe diabetic foot infection extending to the leg: (A) at admission, showing extensive skin necrosis with blackened areas and drainage incisions over the leg, ankle and dorsum of the foot; (B) after wide surgical debridement to viable, bleeding tissue.

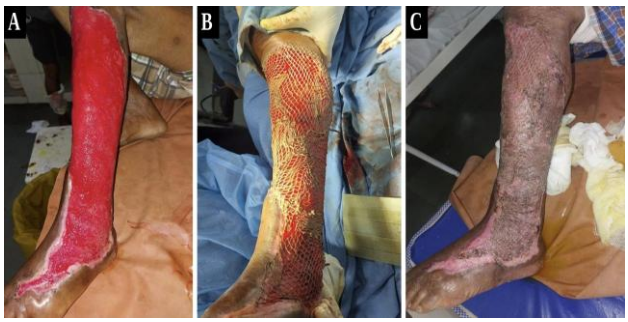

Figure 3: Wound coverage after debridement: (A) healthy granulation tissue over the leg and dorsum of the foot before grafting; (B) meshed split-thickness skin graft applied over the granulating bed; (C) healed graft at follow-up.

Table 3: Status of peripheral arterial pulsations in the affected limb (n=50).

Artery	Normal, N (%)	Diminished, N (%)	Absent, N (%)
Femoral	46 (92.00)	3 (6.00)	1 (2.00)
Popliteal	40 (80.00)	6 (12.00)	4 (8.00)
Anterior tibial	34 (68.00)	8 (16.00)	8 (16.00)
Posterior tibial	26 (52.00)	14 (28.00)	10 (20.00)
Dorsalis pedis	28 (56.00)	12 (24.00)	10 (20.00)

Table 4: Final management, complications and hospital stay (n=50).

Variables	N (%)
Healed without amputation	
Dressing and secondary healing	12 (24.00)
Debridement and secondary healing	8 (16.00)
Split-thickness skin grafting	6 (12.00)
Debridement and skin grafting	5 (10.00)
Subtotal	31 (62.00)
Minor amputation	
Toe amputation with secondary healing	4 (8.00)
Toe amputation with primary closure	2 (4.00)
Toe amputation with skin grafting	2 (4.00)
Debridement and toe amputation	1 (2.00)
Transmetatarsal amputation	3 (6.00)
Debridement and transmetatarsal amputation	1 (2.00)
Subtotal	13 (26.00)
Major amputation	
Below-knee amputation	3 (6.00)
Debridement and below-knee amputation	1 (2.00)
Above-knee amputation	2 (4.00)
Subtotal	6 (12.00)
Limb salvage	
No major amputation	44 (88.00)
Complications	
Sepsis	6 (12.00)
Re-ulceration	5 (10.00)
Progression of gangrene	4 (8.00)
Hospital stay	
<10 days	12 (24.00)
10-20 days	26 (52.00)
>20 days	12 (24.00)
Mean±SD (days)	15.54±6.59

Thirty-one cases (62.00%) healed without amputation: 12 by dressing and secondary healing, eight by debridement and secondary healing, six by split-thickness skin grafting and five by debridement followed by skin grafting. Minor amputation was required in 13 cases (26.00%), including nine toe amputations and four transmetatarsal amputations. Major amputation was performed in six cases (12.00%): four below-knee and two above-knee amputations. The limb salvage rate was 88.00%. Surgical debridement was performed in 16 cases (32.00%) and skin grafting in 13 (26.00%) (Table 4). Representative clinical photographs of surgical debridement and split-thickness skin grafting are shown in Figures 2 and 3, and the final management of all cases is summarized in Figure 4.

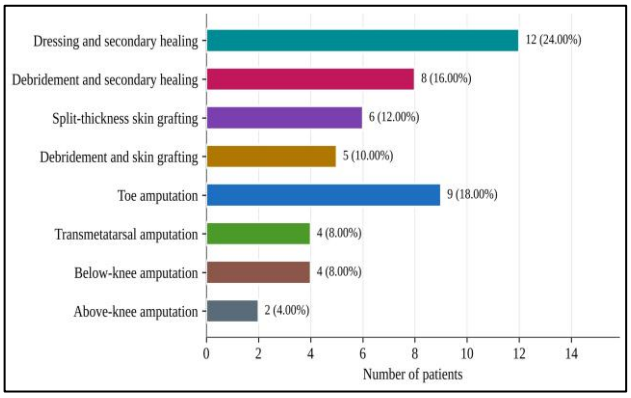

Figure 4: Final management of the diabetic foot cases (n=50).

Dressing, debridement and skin grafting groups healed without amputation; toe and transmetatarsal amputations were minor amputations, and below-knee and above-knee amputations were major amputations.

Complications included sepsis (12.00%), re-ulceration (10.00%) and progression of gangrene (8.00%). The mean hospital stay was 15.54±6.59 days (range 6 to 30 days); 52.00% of patients stayed 10 to 20 days and 24.00% stayed more than 20 days (Table 4).

DISCUSSION

This prospective series describes the profile and outcome of 50 cases of diabetic foot managed under a uniform protocol in a public teaching hospital in western India. Most patients were men in the sixth decade with long-standing, poorly controlled diabetes, neuropathy and infection, and most presented with Wagner grade 2 or 3 lesions. Nearly two thirds healed without amputation, and the limb salvage rate was 88.00%.

The mean age of 57.86 years and male predominance (68.00%) are consistent with Indian and international series.[4,14] Men are more exposed to trauma from outdoor work and barefoot walking, smoke more, and often present later. Diabetes of more than 10 years' duration in nearly half the patients reflects the cumulative effect of hyperglycemia on peripheral nerves and vessels, and poor

glycemic control at admission (70.00%) is important because higher HbA1c is associated with slower wound healing.[15]

After poor glycemic control, neuropathy was the most frequent risk factor in this study. Loss of protective sensation, deformity and unnoticed repetitive trauma are the commonest initiating causes of ulceration, and neuropathy is the first component of most pathways to amputation.[2,7] Peripheral arterial disease was present in more than one third of patients, with a distal pattern of pulse loss involving the tibial and pedal arteries while proximal pulses were largely preserved. This infrapopliteal distribution is characteristic of diabetic arterial disease and is associated with more severe ischemia and a higher amputation rate than in patients without diabetes.[16] In the European EURODIALE cohort, about half of the patients with diabetic foot ulcers had peripheral arterial disease; it was an independent predictor of non-healing, and infection impaired healing specifically in patients with arterial disease.[12,14] Smoking (38.00%) further impairs microcirculation and wound healing.[17] Hypertension, dyslipidemia, ischemic heart disease and nephropathy were frequent, confirming that diabetic foot is a marker of systemic vascular disease and high perioperative risk.

Infection was present in three quarters of wounds, and polymicrobial growth was the most common pattern. In an Indian series, gram-negative bacilli made up about two thirds of isolates from diabetic foot ulcers, and more than one third of them produced extended-spectrum beta-lactamases; and empirical therapy should therefore be broad enough to cover gram-negative organisms and adjusted according to culture results, as recommended by the IWGDF and Infectious Diseases Society of America guidelines.[11,18] Deep or recurrent ulcers and peripheral arterial disease are recognized risk factors for foot infection, and osteomyelitis and peripheral arterial disease are among the strongest predictors of amputation in infected feet.[19,20]

Wagner grade was closely related to the type of treatment. Low-grade ulcers healed with dressings and debridement, whereas grade 4 and 5 lesions required amputation. The Wagner system describes depth and gangrene but does not separately record infection and ischemia, which are better captured by the University of Texas classification; combining grade with perfusion and infection status improves prediction of amputation.[21,22]

Surgical debridement was the cornerstone of local treatment. Debridement converts a chronic wound to an acute one, removes the bacterial burden and allows proper assessment of depth; the IWGDF guidelines recommend sharp debridement as standard care, although comparative trials of debridement methods are limited.[10,23] Split-thickness skin grafting after infection control was used to achieve wound closure in 13 cases. Grafting and tissue replacement are useful adjuncts once the wound bed is clean, although high-quality evidence remains limited.[24]

The major amputation rate of 12.00% and minor amputation rate of 26.00% are close to those reported from a multidisciplinary diabetic foot clinic at a tertiary center in Rajasthan, where minor and major amputations were performed in 28% and 15% of 56 patients, respectively.[25] In a multicentric Indian study of 1,295 people with diabetes who underwent amputation, infection was the main cause in almost 90%, and minor amputations outnumbered major amputations by more than two to one.[13] In the EURODIALE study, 77% of ulcers had healed at one year, but that population was managed in specialized foot clinics.[12] These comparisons suggest that earlier presentation and organized multidisciplinary foot care could further reduce major amputation in our setting. The mean hospital stay of 15.54 days reflects the need for repeated debridement and staged procedures. Prolonged admission is a major part of the cost of diabetic foot care, and the cost of healing rises sharply when amputation is required.[6,26]

This study has limitations. It was a single-center study with a modest sample and no follow-up after discharge, so recurrence and long-term healing could not be assessed. Ankle-brachial index and transcutaneous oxygen measurements were not used systematically, and the effect of revascularization was not analyzed. Wound outcome was recorded at discharge, and the analysis was descriptive without multivariable assessment of predictors.

CONCLUSION

Diabetic foot in this series affected mainly men in their fifties and sixties with long-standing, poorly controlled diabetes, peripheral neuropathy, infection and distal arterial disease. Most presented with Wagner grade 2 or 3 lesions. A standardized protocol of insulin-based glycemic control, culture-guided antibiotics, early and repeated debridement, skin grafting and limb-preserving minor amputation achieved healing without amputation in 62.00% of cases and limb salvage in 88.00%. Earlier presentation, routine foot screening and patient education are needed to reduce the need for major amputation.

ACKNOWLEDGEMENTS

The authors thank the faculty and residents of the department of general surgery, the department of microbiology, the nursing staff of Guru Gobind Singh Government Hospital, Jamnagar, and the patients who participated in this study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Dhinga HI, Noyda AO. Management and outcome of diabetic foot: a prospective study of 50 cases at a tertiary care teaching hospital in Gujarat. Int Surg J 2026;13:2524-9.