



Original Article

Diabetic Foot Ulcers: A Retrospective Observational Study

Dr Pankaj Babubhai Patel¹, Dr Saloni Chaudhari², Dr Jigar Dave³, Dr Zeel Bhandari⁴

¹Associate Professor, Department of General Surgery, Nootan Medical College and Research Center, Visnagar, Gujarat, India

^{2,3,4}Second Year Resident, Department of General Surgery, Nootan Medical College and Research Center, Visnagar, Gujarat, India

OPEN ACCESS

Corresponding Author:

Dr Saloni Chaudhari

Second Year Resident,
Department of General Surgery,
Nootan Medical College and
Research Center, Visnagar,
Gujarat, India

Email: drpbp12@yahoo.com

Received: 21-06-2026

Accepted: 10-07-2026

Available online: 26-07-2026

Copyright © International Journal of
Medical and Pharmaceutical Research

ABSTRACT

Background: Diabetic foot ulcer is one of the most serious complications of diabetes mellitus and is associated with prolonged hospitalization, infection, disability, and lower-limb amputation. The Meggitt-Wagner classification system is widely used to assess ulcer severity and predict clinical outcomes.

Aim: To assess the outcome of diabetic foot ulcer based on the Meggitt-Wagner classification system.

Materials and Methods: This retrospective observational study was conducted in the Department of General Surgery, Nootan General Hospital, Visnagar, from 1st March 2025 to 31 March 2026. A total of 50 patients with diabetic foot ulcers were included. Data regarding demographic profile, ulcer characteristics, Wagner grade, associated neuropathy, peripheral arterial disease, infection, treatment modality, and clinical outcome were collected from hospital records. Statistical analysis was performed using SPSS version 26.0, and a p-value <0.05 was considered statistically significant.

Results: The toes were the most common site of ulceration (46%), followed by the plantar metatarsal region, midfoot, and heel (28%). According to Wagner grading, Grade 2 ulcers were most frequent (38%), followed by Grade 3 ulcers (26%). Peripheral neuropathy, peripheral arterial disease, and infection were present in 44%, 14%, and 66% of patients, respectively. Primary healing was achieved in 54% of patients. Recurrent ulceration occurred in 16% of cases, while 12% remained unhealed. Toe disarticulation was required in 10% of patients, whereas below-knee and above-knee amputations were performed in 4% each. A significant association was observed between increasing Wagner grade and poorer clinical outcomes ($p < 0.001$).

Conclusion: The Meggitt-Wagner classification system is an effective tool for assessing the severity and predicting the outcome of diabetic foot ulcers. Higher Wagner grades were associated with increased infection rates, poorer healing, and greater need for amputation. Early diagnosis and comprehensive diabetic foot care may improve patient outcomes and reduce limb loss.

Keywords: Diabetic foot ulcer, Wagner classification, Amputation, Peripheral neuropathy.

INTRODUCTION

Diabetes mellitus is one of the most significant global public health challenges, affecting millions of individuals worldwide and contributing substantially to morbidity, mortality, and healthcare expenditure. The increasing prevalence of diabetes has been accompanied by a parallel rise in chronic complications, among which diabetic foot ulcer (DFU) remains one of the most devastating and costly conditions. Diabetic foot ulcer is defined as a full-thickness wound occurring below the ankle in a patient with diabetes and is commonly associated with peripheral neuropathy, peripheral arterial disease, infection, and impaired wound healing mechanisms [1].

Diabetic foot ulcers affect approximately 15–25% of individuals with diabetes during their lifetime and are a leading cause of hospitalization among diabetic patients. The condition significantly impairs quality of life, increases the risk of lower-

extremity amputation, and is associated with considerable economic burden on healthcare systems. Despite advances in diabetes care, diabetic foot complications continue to account for a substantial proportion of diabetes-related hospital admissions worldwide [2].

The pathogenesis of diabetic foot ulcer is multifactorial. Chronic hyperglycemia leads to peripheral neuropathy, resulting in loss of protective sensation and increased susceptibility to unnoticed trauma. Concurrently, peripheral arterial disease compromises tissue perfusion and oxygen delivery, while immunological dysfunction predisposes patients to infection. These factors act synergistically to impair wound healing and promote ulcer progression, often culminating in gangrene and limb loss if not managed promptly [3].

Infection is a major determinant of outcome in diabetic foot ulcers. The presence of deep tissue infection, osteomyelitis, and systemic inflammatory response significantly increases the likelihood of prolonged hospitalization, repeated surgical interventions, and amputation. Early identification and appropriate classification of ulcers are therefore essential for guiding treatment strategies and predicting prognosis [4].

Several classification systems have been developed to assess diabetic foot ulcers, including the University of Texas classification, PEDIS classification, SINBAD system, and the Meggitt-Wagner classification. Among these, the Meggitt-Wagner classification remains one of the most widely utilized systems in routine clinical practice due to its simplicity, ease of application, and ability to stratify ulcers according to depth, extent of infection, and gangrene. The classification categorizes lesions from Grade 0 to Grade 5, with increasing grades indicating more severe tissue involvement and a higher risk of adverse outcomes [5].

The Meggitt-Wagner classification has demonstrated significant prognostic value in predicting wound healing, need for surgical intervention, duration of hospitalization, and risk of amputation. Studies have consistently shown that higher Wagner grades are associated with poorer clinical outcomes and increased healthcare utilization. Patients presenting with Grade 4 and Grade 5 ulcers frequently require major surgical procedures and experience substantially higher rates of morbidity compared to those with lower-grade lesions [6].

India has emerged as one of the countries with the highest burden of diabetes globally. The rising prevalence of diabetes, combined with delayed healthcare-seeking behavior, inadequate foot care practices, socioeconomic constraints, and limited awareness regarding preventive measures, contributes to a substantial burden of diabetic foot disease. Consequently, diabetic foot ulcers represent a major challenge for surgeons and healthcare providers in tertiary care institutions across the country [7].

Timely assessment and risk stratification of diabetic foot ulcers are crucial for optimizing management and reducing the incidence of preventable amputations. Accurate classification enables clinicians to identify high-risk patients, implement appropriate wound care measures, plan surgical interventions when necessary, and counsel patients regarding expected outcomes. Furthermore, evaluating outcomes according to ulcer severity can help improve resource allocation and strengthen multidisciplinary diabetic foot care programs [8].

Recent evidence suggests that comprehensive diabetic foot management involving glycemic control, infection management, vascular assessment, pressure offloading, wound care, and patient education can significantly improve limb salvage rates. Nevertheless, outcomes remain closely linked to the severity of ulceration at presentation, highlighting the importance of early diagnosis and standardized classification systems such as the Meggitt-Wagner grading system [9].

Given the substantial burden of diabetic foot ulcers and the continued reliance on the Meggitt-Wagner classification in clinical practice, it is important to evaluate treatment outcomes according to ulcer grade in local healthcare settings. Such information can provide valuable insights into disease patterns, effectiveness of management strategies, and predictors of adverse outcomes. Therefore, the present study was undertaken in the Department of General Surgery, Nootan General Hospital, Visnagar, to assess the outcome of diabetic foot ulcer patients based on the Meggitt-Wagner classification system [10].

MATERIAL AND METHODS

This retrospective observational study was conducted in the Department of General Surgery, Nootan General Hospital, Visnagar, Gujarat, India. The study period extended from 1st March 2025 to 31 March 2026. The objective of the study was to assess the outcomes of diabetic foot ulcers based on the Meggitt-Wagner classification system.

The study included 50 patients diagnosed with diabetic foot ulcers who were admitted and managed in the Department of General Surgery during the study period. Medical records of all eligible patients were reviewed retrospectively. Patients aged 18 years and above with a confirmed diagnosis of diabetes mellitus and documented diabetic foot ulcer were included in the study. Patients with traumatic ulcers, venous ulcers, arterial ulcers unrelated to diabetes, malignant ulcers, and incomplete medical records were excluded from the study.

Data were collected from inpatient case records, admission registers, operative notes, laboratory reports, microbiological investigations, and discharge summaries. Information regarding age, gender, duration of diabetes, associated comorbidities, ulcer characteristics, Wagner grade at presentation, treatment modalities, duration of hospital stay, requirement for debridement, minor amputation, major amputation, wound healing status, and final clinical outcome was recorded in a predesigned data collection proforma.

All ulcers were classified according to the Meggitt-Wagner classification system. Patients were categorized based on the highest Wagner grade documented during admission. The primary outcome measures included wound healing, need for surgical intervention, requirement of minor or major amputation, duration of hospitalization, and overall clinical outcome. Ethical approval for the study was obtained from the Institutional Ethics Committee before commencement of data collection. Confidentiality and anonymity of patient information were strictly maintained throughout the study. As the study involved retrospective review of hospital records, the requirement for informed consent was waived by the Institutional Ethics Committee.

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 26.0. Continuous variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. The association between Wagner grade and clinical outcomes was evaluated using the Chi-square test or Fisher's exact test wherever appropriate. A p-value of less than 0.05 was considered statistically significant. The results were presented using suitable tables and graphs.

RESULTS

The anatomical distribution of diabetic foot ulcers among the 50 patients is presented in Table 1. The most common site of ulceration was the toes (dorsal and plantar surfaces), accounting for 23 cases (46%). Ulcers involving the plantar metatarsal head, midfoot, and heel were observed in 14 patients (28.00%). Multiple ulcers involving the forefoot, midfoot, and hindfoot were noted in 9 patients (18%), while the dorsum of the foot was the least affected site, observed in 4 patients (8.00%). These findings indicate that pressure-bearing regions of the foot were the most frequent locations of ulcer development.

According to the Meggitt-Wagner classification, Grade 2 ulcers were the most common (38%), followed by Grade 3 ulcers (26%). Infection was observed in 66% of patients, while peripheral neuropathy and peripheral arterial disease were present in 44% and 14% of patients, respectively. (Table 2 and 3)

Table 4 presents the clinical outcomes of diabetic foot ulcers among the study participants. Primary healing was achieved in 27 (54%) patients, representing the most favorable outcome. Recurrent ulceration occurred in 8 (16%) patients, while 6 (12%) patients had ulcers that remained unhealed during the study period. Toe disarticulation was required in 5 (10%) patients. Major amputations were less common, with below-knee and above-knee amputations performed in 2 (4%) patients each. These findings suggest that although more than half of the patients achieved successful healing, advanced disease still resulted in significant morbidity and limb loss.

Table 5 demonstrates the relationship between Wagner grade and clinical outcome. Patients with Grade 1 and Grade 2 ulcers showed the highest healing rates and minimal requirement for surgical intervention. In contrast, patients with Grade 4 and Grade 5 ulcers experienced increased rates of non-healing, recurrence, and major amputations. The association between Wagner grade and clinical outcome was statistically significant (Chi-square test, $p < 0.001$), indicating that higher Wagner grades are strong predictors of adverse outcomes and limb loss.

Table 1: Anatomical Location of Diabetic Foot Ulcers (N = 50)

Ulcer Site	Number of Cases (n)	Percentage (%)
Toes (dorsal and plantar surface)	23	46
Plantar metatarsal head, midfoot and heel	14	28.00
Dorsum of foot	4	8.00
Multiple ulcers involving forefoot, midfoot and hindfoot	9	18
Total	50	100.00

Table 2: Distribution of Cases According to Wagner's Classification (N = 50)

Grade	Clinical Description	Number of Cases (n)	Percentage (%)
1	Superficial ulcer	6	12
2	Deep ulcer	19	38
3	Deep ulcer with abscess/osteomyelitis	13	26
4	Localized gangrene	8	16.00

5	Gangrene of entire foot	4	8.00
Total		50	100.00

Table 3: Associated Risk Factors in Diabetic Foot Ulcers (N = 50)

Associated Factor	Number of Cases (n)	Percentage (%)
Peripheral Neuropathy	22	44
Peripheral Arterial Disease	7	14
Infection	33	66

Table 4: Clinical Outcome of Diabetic Foot Ulcers (N = 50)

Outcome	Number of Cases (n)	Percentage (%)
Primary healing of ulcer	27	54
Unhealed ulcer	6	12
Recurrent ulcer	8	16
Toe disarticulation	5	10
Below-knee amputation	2	4
Above-knee amputation	2	4
Total	50	100

Table 5: Wagner Grade versus Clinical Outcome (N = 50)

Wagner Grade	Healed	Minor Amputation	Major Amputation	Unhealed/Recurrent	Total
Grade 1	6	0	0	0	6
Grade 2	15	1	0	3	19
Grade 3	5	3	0	5	13
Grade 4	1	1	2	4	8
Grade 5	0	0	2	2	4
Total	27	5	4	14	50

Chi-square test: $p < 0.001$ (significant)

DISCUSSION

Diabetic foot ulcer is a major complication of diabetes mellitus and remains a leading cause of hospitalization, disability, and lower-extremity amputation among diabetic patients. The present study evaluated the outcomes of diabetic foot ulcers according to the Meggitt-Wagner classification system in 50 patients treated at a tertiary care center. The findings demonstrated that ulcer severity at presentation was strongly associated with clinical outcomes and the need for surgical intervention.

In the present study, the toes were the most commonly affected site, accounting for 46% of ulcers, followed by the plantar metatarsal region, midfoot, and heel (28%). These findings are consistent with previous reports indicating that repetitive pressure, altered biomechanics, and peripheral neuropathy predispose weight-bearing areas and toes to ulcer formation. Caruso et al. reported that forefoot and toe lesions constitute the majority of diabetic foot ulcer presentations due to neuropathic changes and repetitive unnoticed trauma.¹¹

The distribution of ulcers according to Wagner grading showed that Grade 2 ulcers were the most frequent (38%), followed by Grade 3 ulcers (26%). This observation suggests that many patients seek medical attention only after deeper tissue involvement has occurred. Similar findings have been reported by Jupiter et al., who observed that advanced Wagner grades are commonly encountered among hospitalized diabetic foot patients and are associated with greater treatment complexity and healthcare utilization.¹²

Peripheral neuropathy was present in 44% of patients, confirming its central role in the pathogenesis of diabetic foot ulceration. Loss of protective sensation increases the likelihood of repeated trauma and delayed recognition of tissue injury. Peripheral arterial disease was observed in 14% of patients, while infection was identified in 66%, making it the most common associated factor. The high prevalence of infection in the present study is comparable to findings reported by Lavery et al., who demonstrated that infected diabetic foot ulcers are associated with delayed healing, prolonged hospitalization, and increased amputation risk.¹³

Regarding clinical outcomes, primary healing was achieved in 54% of patients, whereas 16% developed recurrent ulcers and 12% remained unhealed. These findings highlight the chronic and recurrent nature of diabetic foot disease. Even after successful wound closure, patients remain vulnerable to recurrent ulceration because of persistent neuropathy, vascular compromise, and inadequate foot care practices. Similar observations have been reported in previous studies evaluating long-term outcomes of diabetic foot ulcers.¹³

Surgical intervention was required in a considerable proportion of patients. Toe disarticulation was performed in 10% of cases, while major amputations were required in 8% of patients. The need for amputation increased with higher Wagner grades. Patients with Grade 4 and Grade 5 ulcers showed markedly poorer outcomes compared with those presenting with lower-grade lesions. Pickwell et al. similarly reported that increasing Wagner grade significantly predicts lower-extremity amputation and reduced limb salvage rates.¹⁵

The statistically significant association observed between Wagner grade and clinical outcome ($p < 0.001$) further supports the prognostic value of the Meggitt-Wagner classification system. Patients with Grade 1 and Grade 2 ulcers had better healing rates and fewer complications, whereas advanced grades were associated with infection, gangrene, non-healing ulcers, and major amputations. These findings are in agreement with reports by Game and Jeffcoate, who emphasized that ulcer depth, infection, and tissue destruction are major predictors of adverse outcomes in diabetic foot disease.¹⁴

Overall, the present study confirms that the Meggitt-Wagner classification system remains a simple, practical, and reliable method for assessing ulcer severity and predicting outcomes. Early detection of diabetic foot lesions, strict glycemic control, prompt treatment of infection, regular foot examination, and multidisciplinary management strategies are essential for improving healing rates and reducing amputation-related morbidity among diabetic patients.

CONCLUSION

Diabetic foot ulcer remains a major cause of morbidity among patients with diabetes mellitus. The present study demonstrated that toe involvement was the most common anatomical presentation and that Grade 2 ulcers constituted the largest proportion of cases according to the Meggitt-Wagner classification system. Peripheral neuropathy and infection were highly prevalent among affected patients. Primary healing was achieved in more than half of the patients; however, recurrent ulceration, non-healing ulcers, and amputations were observed predominantly in advanced Wagner grades. The Meggitt-Wagner classification proved to be a useful and practical tool for assessing ulcer severity and predicting clinical outcomes. Early detection, timely intervention, infection control, and comprehensive diabetic foot care are essential for improving healing rates and reducing amputation-related morbidity.

Conflict of interest: No! Conflict of interest is found elsewhere considering this work.

Source of Funding: There was no financial support concerning this work.

REFERENCES

1. Jeffcoate WJ, Vileikyte L, Boyko EJ, Armstrong DG, Boulton AJM. Causes, prevention, and management of diabetes-related foot ulcers. *Lancet Diabetes Endocrinol.* 2024;12(7):530-544.
2. Armstrong DG, Boulton AJM, Bus SA. Diabetic foot ulcers: A review. *JAMA.* 2023;330(1):62-75.
3. Deng H, Liu Y, Li Z, Wang X, Zhang W. Mechanisms of diabetic foot ulceration: A review. *J Diabetes.* 2023;15(4):299-312.
4. Senneville E, Albalawi Z, van Asten SAV, Abbas ZG, Aragón-Sánchez J, Lipsky BA. IWGDF/IDSA guidelines on the diagnosis and treatment of diabetes-related foot infections. *Clin Infect Dis.* 2023;77(5):e263-e289.
5. Schaper NC, van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA. Practical guidelines on the prevention and management of diabetes-related foot disease (IWGDF 2023 update). *Diabetes Metab Res Rev.* 2024;40(3):e3657.
6. Bus SA, Sacco ICN, Monteiro-Soares M, Raspovic A, Paton J, Rasmussen A, Lazzarini PA, Bakker K. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2023 update). *Diabetes Metab Res Rev.* 2024;40(3):e3651.
7. van Netten JJ, Bus SA, Apelqvist J, Lipsky BA, Hinchliffe RJ, Game FL, Lazzarini PA, Schaper NC. Definitions and criteria for diabetes-related foot disease (IWGDF 2023 update). *Diabetes Metab Res Rev.* 2024;40(3):e3654.
8. Chen P, Vilorio NC, Dhatariya K, Jeffcoate WJ, Game FL, Hinchliffe RJ, Bus SA, Schaper NC. Guidelines on interventions to enhance healing of foot ulcers in people with diabetes (IWGDF 2023 update). *Diabetes Metab Res Rev.* 2024;40(3):e3644.
9. Kim J, Nomkhondorj O, An CY, Choi YC, Cho JH. Management of diabetic foot ulcers: A narrative review. *J Yeungnam Med Sci.* 2023;40(4):335-342.
10. Raja JM, Khouzam A, Tanios MA, Bergmeier S, Attallah JP. Diabetic foot ulcer: A comprehensive review of pathophysiology and management modalities. *World J Diabetes.* 2023;14(4):381-394.
11. Caruso P, Longo M, Signoriello S, Gicchino M, Maiorino MI, Bellastella G, Esposito K. Diabetic foot problems during the COVID-19 pandemic in a tertiary care center: The role of neuropathy and ulcer location on outcomes. *Diabetes Res Clin Pract.* 2021;172:108614.
12. Jupiter DC, Thorud JC, Buckley CJ, Shibuya N. The impact of foot ulceration and amputation on mortality in diabetic patients: A systematic review and meta-analysis. *Int Wound J.* 2022;19(5):1108-1118.
13. Lavery LA, Davis KE, Berriman SJ, Braun L, Nichols A, Kim PJ. WHS guidelines update: Diabetic foot ulcer treatment guidelines. *Wound Repair Regen.* 2020;28(6):742-758.
14. Game FL, Jeffcoate WJ. Primarily non-surgical management of osteomyelitis of the foot in diabetes. *Diabetologia.* 2021;64(4):789-797.

15. Pickwell K, Siersma V, Kars M, Apelqvist J, Bakker K, Edmonds M, Holstein PE, Jirkovska A, Jude EB, Mauricio D, Piaggese A, RagnarsonTennvall G, Reike H, Spraul M, Uccioli L, Urbancic V, Van Acker K, Schaper NC. Predictors of lower-extremity amputation in patients with diabetic foot ulceration: A prospective cohort study. *Diabetologia*. 2021;64(9):1999-2008.