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Original Research Article

Evaluation and Management of Diabetic Foot According To Wagner's Classification

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Abstract

Background: Diabetic foot complications represent a significant healthcare burden globally, affecting approximately 25% of individuals with diabetes during their lifetime. Wagner's classification system serves as a fundamental tool for systematic evaluation and therapeutic planning in diabetic foot management. This grading system categorizes foot lesions from Grade 0 (high-risk foot) to Grade 5 (extensive gangrene), facilitating standardized treatment approaches and outcome prediction.

Methods: A prospective observational study was conducted involving 25 patients with diabetic foot complications presenting to our tertiary care center over 24 months. Each patient underwent comprehensive evaluation and was classified according to Wagner's grading system. Treatment protocols were implemented based on the assigned grade, with regular follow-up assessments to monitor healing progress and clinical outcomes.

Results: The study cohort demonstrated varying healing rates correlated with Wagner grade severity. Higher-grade lesions showed prolonged healing times and increased complication rates. Grade-specific treatment protocols proved effective in achieving optimal clinical outcomes, with early intervention significantly improving prognosis across all patient categories.

Conclusions: Wagner's classification system provides reliable guidance for diabetic foot evaluation and management. The systematic approach enables healthcare providers to implement appropriate therapeutic interventions, ultimately improving patient outcomes and reducing the risk of severe complications including amputation.

Keywords: Diabetic Foot Ulcer, Wagner Classification, Wound Management, Diabetes Complications, Foot Evaluation, Treatment Outcomes.

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Introduction

Diabetes isn't just another chronic illness—it's quietly turning into one of the biggest health challenges of our generation. Right now, more than half a billion people worldwide are living with it. And the numbers? They're only going up. Experts estimate that by 2045, close to 783 million people could be dealing with this condition. India alone carries a massive share—about 74.2 million cases, making it second only to China when it comes to the diabetic population.

But the real problem with diabetes isn't just managing blood sugar. It's everything else that comes along with it. One of the most serious—and honestly, one of the most feared—complications is diabetic foot problems. They might sound simple at first, but they affect 15 to 25% of people with diabetes at some point, and the outcomes can be life-changing.

Why is that? Well, the causes are layered. Nerve damage, or peripheral neuropathy, is common in people with diabetes—especially in those who've

had it for a long time. It dulls the feeling in the feet, so things like cuts or pressure sores can go completely unnoticed. Then there's poor blood flow, another issue that's pretty common. Without good circulation, even small wounds can struggle to heal. Put those two things together, and it's a recipe for serious infections, ulcers, and, in the worst cases, amputations. And it's not just the physical toll—it's emotional too. Living with the constant worry of losing a limb or facing long hospital stays takes a huge mental toll. Families suffer too. It's stressful, frightening, and often financially draining. In many places, diabetic foot ulcers are among the leading causes of hospital admissions related to diabetes—and the treatment costs are steep.

To help doctors and nurses manage these complex cases, a number of classification systems have been introduced over the years. One of the most commonly used is the Wagner classification system, which dates back to 1981. It's a simple tool that helps categorize how bad a foot ulcer is—ranging from Grade 0, where there's no ulcer yet but the risk is high, to Grade 5, where the damage is severe and gangrene has taken over the foot.

What makes Wagner's system so useful is that it's easy to understand and easy to use. Each grade gives clear guidance on what kind of treatment might be needed. That's why it's still widely used around the world, even after several decades. That said, it's not perfect. As healthcare evolves and patient populations change, it's important to keep asking whether tools like the Wagner system are still doing the job well—or whether they need to be adapted to meet modern needs.

Table 1: Wagner's Classification System for Diabetic Foot Disease

Grade	Clinical Description
Grade 0	High-risk foot without ulceration; includes patients with peripheral neuropathy, previous ulceration history, or foot deformity
Grade 1	Superficial ulcer involving full-thickness skin loss
Grade 2	Deep ulcer extending to subcutaneous tissue, muscle, or bone without abscess or osteomyelitis
Grade 3	Deep ulcer with associated infection, abscess formation, or osteomyelitis
Grade 4	Localized gangrene affecting forefoot or heel
Grade 5	Extensive gangrene involving the entire foot

The primary objective of this study was to evaluate the clinical utility of Wagner's classification system in the assessment and management of diabetic foot complications. We aimed to analyze the relationship between Wagner grades and treatment outcomes, including healing rates, time to complete healing, and amputation rates. Additionally, we sought to assess the prognostic value of this classification system in predicting clinical outcomes and guiding therapeutic interventions in our patient population.

Materials and Methods

This prospective observational study was carried out in the Department of General Surgery at Kurnool Medical College & Hospital, Andhra Pradesh, over a 12-month period from July 2024 to June 2025. Ethical clearance was obtained from the Institutional Ethics Committee, and informed written consent was collected from all participants prior to enrollment. A total of 25 patients with diabetic foot complications were included using a convenient sampling method. The sample size was based on the feasibility of close clinical follow-up and detailed assessment within the study timeframe. All patients presenting with diabetic foot complications during the study period were screened for eligibility.

Patients aged 20 years and above, with a confirmed diagnosis of Type 1 or Type 2 diabetes (as per ADA guidelines), and presenting with a diabetic foot ulcer or high-risk foot condition were included. Those willing to attend regular follow-ups and provide written consent were enrolled. Exclusion criteria included patients under 20 years of age, non-diabetic foot ulcers, and terminal illness with life expectancy less than six months, prior major amputation of the same limb, or refusal to participate.

All participants underwent thorough clinical evaluation at presentation. This included a detailed medical history, particularly concerning diabetes duration, prior foot issues, medications, and comorbidities. Foot examination focused on skin integrity, presence of ulcers, infection signs, deformities, and vascular status. Laboratory investigations included HbA1c, fasting and post-prandial blood glucose, complete blood picture, renal and liver function tests, urine analysis, ESR, and CRP levels. Plain X-rays of the affected foot (anteroposterior and lateral views) were taken to assess for osteomyelitis or structural abnormalities. MRI or CT scans were done when necessary. Wound cultures were obtained using sterile technique, with samples tested for aerobic and anaerobic bacteria, and fungi if indicated. Antibiotic sensitivity testing was performed to guide therapy.

Wagner Classification Assessment: Each patient's foot lesion was assessed using Wagner's

classification system by two independent clinicians. Any discrepancies were discussed and resolved by consensus. The classification was done at the initial visit and re-evaluated during follow-ups when necessary.

Follow-Up and Outcome Evaluation: Patients were followed weekly for the first month, then every two weeks until the ulcer healed or definitive treatment was completed. At each visit, wounds were reassessed, photographed, and treatment plans adjusted based on clinical progress.

Statistical Analysis: Data were analyzed using Microsoft Excel 2016 and EpiInfo version 7.2.0. Continuous variables were presented as mean ± standard deviation, and categorical variables as frequencies and percentages. ANOVA was used for comparing means across Wagner grades, while Chi-square and Fisher's exact tests were used for categorical variables. A p-value < 0.05 was considered statistically significant.

Observation and Results

Table 1: Patient Demographics

Parameter	Category	Frequency (n)	Percentage (%)
Age Distribution	30-39 years	2	8%
	40-49 years	6	24%
	50-59 years	4	16%
	60-69 years	9	36%
	70-79 years	4	16%
Gender	Male	17	68%
	Female	8	32%
Type of DM	Type I	8	32%
	Type II	17	68%

Table 2: Wagner Classification Distribution

Wagner Grade	Frequency (n)	Percentage (%)	Clinical Description
Grade 1	2	8%	Superficial ulcer
Grade 2	8	32%	Deep ulcer
Grade 3	4	16%	Deep ulcer with osteomyelitis
Grade 4	7	28%	Localized gangrene
Grade 5	4	16%	Extensive gangrene
Total	**25**	**100%**	

Table 3: Microbiological Profile

Organism	Frequency (n)	Percentage (%)
Mixed infection	15	60%
Klebsiella	4	16%
Staphylococcus aureus	4	16%
Pseudomonas	2	8%
Total	**25**	**100%**

Table 4: Treatment Modalities

Treatment	Frequency (n)	Percentage (%)
Debridement + Antibiotics	14	56%
Toe amputation + Debridement + Antibiotics	5	20%
Above Knee Amputation + Antibiotics	3	12%
Below Knee Amputation + Antibiotics	2	8%
BKA + Debridement + Antibiotics	1	4%
Total	**25**	**100%**

Table 5: Treatment According to Wagner Grade

Treatment	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Total
Debridement + Antibiotics	2 (100%)	8 (100%)	4 (100%)	0 (0%)	0 (0%)	14 (56%)
Toe amputation + Debridement	0 (0%)	0 (0%)	0 (0%)	5 (71%)	0 (0%)	5 (20%)
BKA + Debridement + Antibiotics	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)	1 (4%)
BKA + Antibiotics	0 (0%)	0 (0%)	0 (0%)	1 (14%)	1 (25%)	2 (8%)
AKA + Antibiotics	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (75%)	3 (12%)
Total	**2 (8%)**	**8 (32%)**	**4 (16%)**	**7 (28%)**	**4 (16%)**	**25 (100%)**

Table 6: Type of Diabetes by Wagner Grade

DM Type	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Total
Type I	1 (50%)	2 (25%)	1 (25%)	2 (29%)	2 (50%)	8 (32%)
Type II	1 (50%)	6 (75%)	3 (75%)	5 (71%)	2 (50%)	17 (68%)
Total	**2**	**8**	**4**	**7**	**4**	**25**

Table 7: Mortality by Wagner Grade

Wagner Grade	No Mortality	Mortality	Total	Mortality Rate
Grade 1	2 (100%)	0 (0%)	2	0%
Grade 2	8 (100%)	0 (0%)	8	0%
Grade 3	4 (100%)	0 (0%)	4	0%
Grade 4	7 (100%)	0 (0%)	7	0%
Grade 5	1 (25%)	3 (75%)	4	75%
Total	**22 (88%)**	**3 (12%)**	**25**	**12%**

Table 8: Key Clinical Findings Summary

Finding	Value	Clinical Significance
Most common Wagner Grade	Grade 2 (32%)	Majority present with deep ulcers
Male predominance	68% (17/25)	2.1:1 male-to-female ratio
Most common age group	60-69 years (36%)	Peak incidence in elderly
Overall mortality	12% (3/25)	Acceptable mortality rate
Grade 5 mortality	75% (3/4)	High mortality in extensive gangrene
Mixed infections	60% (15/25)	Polymicrobial nature of diabetic foot
Conservative management success	100% (Grades 1-3)	Early intervention effective

Discussion

In our study involving 25 patients with diabetic foot complications, several patterns emerged that not only reflected clinical trends but also offered insight into how diabetic foot ulcers continue to challenge both patients and physicians, especially in resource-limited settings. By using Wagner's classification system as the core of our assessment, we were able to categorize the severity of ulcers and align treatment decisions accordingly. This classification proved to be a useful clinical tool in guiding us through what are often complex presentations.

To begin with, the majority of our study population was male, accounting for approximately 68% of the cases. This predominance of male patients has been echoed in multiple studies across India and abroad. Waghmare et al. [1] also reported a higher incidence among men, attributing it to increased outdoor activity, greater exposure to potential foot trauma, and in some cases, delayed health-seeking behavior. Similarly, Rajyalakshmi and Amruthavalli [2] observed that male patients, particularly those in rural areas, were more likely to develop foot ulcers, possibly due to a combination of lifestyle factors and a general tendency to neglect minor injuries until they become severe.

When examining age distribution, most patients in our study fell into the sixth decade of life. This aligns with the findings of Shah et al. [3], who noted that foot complications in diabetes are most commonly seen in the elderly population, often due to a longer duration of disease, accumulated nerve and vascular damage, and decreased tissue healing capacity. Gupta et al. [7] also emphasized that advancing age, along with long-standing hyperglycemia, plays a significant role in the development of foot ulcers, which are often compounded by comorbid conditions like hypertension and neuropathy.

It is also important to highlight that nearly all of our patients were diagnosed with Type 2 diabetes. This pattern mirrors global trends, as discussed by Falhammar [8], who pointed out that Type 2 diabetes is far more prevalent than Type 1 and is responsible for the vast majority of diabetes-related foot complications worldwide. In our study, this demographic reality was apparent, reinforcing the urgent need for targeted preventive strategies in this group.

The distribution of Wagner grades in our study revealed that Grade 2 ulcers were the most frequently encountered, affecting 32% of patients. These are deep ulcers penetrating to tendon or joint capsule but without gangrene. This result closely resembles the observations made by Waghmare et al. [1], who also found that Grade 2 ulcers were the most commonly reported among their patients. Likewise, Sachin V. [15], in his thesis work, documented a similar trend, highlighting that mid-grade ulcers are often the turning point where conservative treatment can still be effective, but risks start to increase.

Interestingly, only a small proportion of our patients (8%) presented with Grade 1 ulcers, which are typically superficial and without complications. This is in contrast with findings by Griffin and Ahmed[13], who reported a much higher number of

early-stage ulcers. The discrepancy might be explained by differences in healthcare access and awareness. In our setting, many patients delayed seeking care until the ulcer became more advanced. Kumar [14] also emphasized that while Grade 1 and 2 ulcers were most frequent in his study population, early identification and prompt treatment were key to improving outcomes—something that may be lacking in our context due to factors like patient illiteracy, rural residence, or financial limitations.

We observed a significant number of Grade 4 ulcers (28%), characterized by localized gangrene involving the forefoot or toes. These severe ulcers often necessitated aggressive surgical management, typically in the form of toe amputations. This finding is similar to the experience of Calhoun et al. [12], who noted that higher Wagner grades often correlated with more extensive tissue destruction and a higher likelihood of surgical intervention. Jan et al. [9] also found that patients with advanced ulcers were more likely to require amputations, reflecting both the biological progression of infection and the social factors contributing to late hospital presentation. One of the most concerning aspects of our findings was the microbiological profile of the ulcers. We noted that a majority of our patients (60%) had mixed infections involving multiple bacterial species. This is a well-documented challenge in diabetic foot care. Rodrigues et al. [4] observed that chronic diabetic ulcers frequently harbor polymicrobial flora, often making empirical antibiotic treatment less effective unless guided by culture and sensitivity testing. In our study, Klebsiella and Staphylococcus aureus were each isolated in about 16% of cases, with Pseudomonas identified in 8%. These organisms are not only virulent but also known to exhibit resistance to standard antibiotics. A study by Vankooth and Prasad [6] also highlighted the dominance of Klebsiella and Staph aureus in diabetic ulcers and stressed the importance of culture-directed therapy in improving outcomes. Further emphasizing this point, Sakre and Kishanrao [5] presented a case where delayed microbial identification led to worsening of the infection despite routine antibiotic use, underscoring how critical timely culture reports are in clinical decision-making.

Our treatment approach was based largely on the Wagner grade. For patients in Grades 1, 2, and 3, conservative management was highly effective. This involved local wound debridement, glycemic control, and antibiotics tailored to culture sensitivity. None of the patients in these groups required amputation, and all showed significant clinical improvement. This outcome is encouraging and aligns with the work of Revelli [11] and Gupta et al. [7], who also reported that ulcers in the lower Wagner grades responded well to non-surgical treatment when caught early and managed appropriately.

However, the situation was drastically different for patients in Grades 4 and 5. In our study, about 71% of patients with Grade 4 ulcers required toe amputations. Moreover, every patient who presented with a Grade 5 ulcer—which involves extensive gangrene of the entire foot—underwent major amputation. These outcomes were comparable to the findings of Calhoun et al. [12], who showed that high-grade ulcers are closely associated with poor limb salvage rates. Rajyalakshmi and Amruthavalli [2] also noted a similar correlation between Wagner grade and the likelihood of amputation, suggesting that once tissue necrosis sets in, surgical intervention becomes inevitable.

Tragically, mortality was also a factor in our study. Three patients died during treatment, all of whom had presented with Grade 5 ulcers. This represents a 75% mortality rate in that subgroup. These numbers highlight the substantial systemic burden that advanced diabetic foot ulcers can place on patients. Shah et al. [3] and Jan et al. [9] have previously documented high mortality rates in patients with late-stage ulcers, often due to complications such as septicemia, multi-organ failure, or delayed surgical referral. These deaths remind us that diabetic foot ulcers are not just a localized issue—they can become life-threatening very quickly.

It's also worth discussing the broader implications of our findings. Che-Ahmad [10] proposed a more comprehensive model for diabetic foot care, one that begins with patient education and routine foot inspections at the primary care level. His approach also emphasizes early detection, prompt referral, and individualized care plans. This holistic strategy resonates strongly with what we observed in our study. Many of our patients might have avoided hospitalization or amputation had there been earlier awareness, routine foot checks, or timely primary care interventions.

To summarize, this study reaffirms that Wagner's classification system remains a reliable, easy-to-use method for assessing diabetic foot ulcers and guiding management strategies. It helps clinicians quickly gauge severity and predict likely outcomes. However, our findings also highlight that the real challenge lies in ensuring patients seek help early enough for conservative measures to work. Once the disease progresses to advanced stages, the treatment becomes more invasive, the risk of mortality increases, and the burden on the healthcare system grows.

Conclusion

Wagner's classification continues to serve as a straightforward and reliable tool for evaluating and managing diabetic foot complications. By offering a clear grading system, it helps healthcare providers quickly assess the severity of a patient's condition and choose the most appropriate treatment—whether that's simple wound care or surgical intervention. Our study reinforces its practical value, especially in resource-limited settings, where timely decisions can make a real difference in preventing serious outcomes like amputations or even death. Early identification and intervention, guided by this system, can improve healing, reduce complications, and ultimately lead to better quality of life for patients with diabetic foot problems.

Limitations of the Study

This study had a few important limitations. The number of patients included was small, which may limit how well the results apply to a larger population. Since it was done in a single hospital, the findings may not reflect what happens in other regions. The short follow-up period means we couldn't track long-term recovery or complications. Differences in how treatments were given, along with some missing or inconsistent data, may have affected the results. Also, factors like socioeconomic status, nutrition, and other health issues were not fully considered, which could have influenced the outcomes.

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Abbreviations: DM - Diabetes Mellitus; HbA1c - Glycated Hemoglobin; FBG - Fasting Blood Glucose; PPBG - Post Prandial Blood Glucose; CBP - Complete Blood Picture; RFT - Renal Function Test; LFT - Liver Function Test; CUE - Complete Urine Examination; ESR - Erythrocyte Sedimentation Rate; PVD - Peripheral Vascular Disease.

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