

Research Article

# Bedside Ophthalmic Screening in Diabetic Foot: Correlating Wagner Grade with Diabetic Retinopathy Severity and Visual Impairment

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## ABSTRACT

**Introduction:** Diabetes mellitus is a systemic microvascular disorder with multi-organ involvement. Diabetic foot represents an advanced stage of systemic vascular compromise and is increasingly recognised as a surrogate marker of generalised microangiopathy. Diabetic retinopathy, another manifestation of microvascular disease, remains a leading cause of preventable blindness. Patients admitted with diabetic foot often have limited access to routine ophthalmic screening, providing a unique opportunity for bedside ocular evaluation.

**Aims and Objectives:** To describe ocular manifestations in patients admitted with diabetic foot and to assess whether severity of diabetic foot correlates with ocular microvascular disease.

**Materials and Methods:** This hospital-based descriptive observational study was conducted between November 2025 and January 2026. Eighty consecutive patients admitted under the Department of Surgery with diabetic foot and referred for bedside ophthalmology consultation were included. Systemic evaluation included duration of diabetes, glycaemic status, renal function, ankle-brachial index (ABI), and Wagner grading of diabetic foot. Ophthalmic evaluation comprised visual acuity assessment, lens status, dilated fundus examination with ETDRS grading of diabetic retinopathy, and assessment for macular edema. Duration since diagnosis of diabetic retinopathy and duration of foot ulcer were additionally recorded. Data were analysed descriptively.

**Results:** Eighty patients (mean age  $58.6 \pm 9.4$  years) were evaluated; 52 (65%) were male. Hypertension was present in 45 (56%), chronic kidney disease in 14 (18%), and dyslipidaemia in 44 (55%). Diabetic retinopathy was detected in 51 (63.7%) patients; sight-threatening diabetic retinopathy (severe NPDR or PDR) was noted in 16 (20%). Macular edema was present in 14 (17.5%), with clinically significant macular edema in 9 (11.2%). Severe diabetic foot (Wagner grade  $\geq 4$ ) was observed in 20 (25%) patients. A higher proportion of sight-threatening diabetic retinopathy and macular edema was observed among patients with severe foot disease (90% vs 52.6% for retinopathy overall). Reduced visual acuity ( $<6/12$  in at least one eye) was documented in 38 (47.5%) patients. Mean duration since diagnosis of diabetic retinopathy and mean duration of foot ulcer were longer in patients with advanced retinopathy.

**Conclusions:** A high prevalence of diabetic retinopathy and vision-threatening ocular disease was observed among patients admitted with diabetic foot. Increasing severity of diabetic foot tended to coincide with more advanced ocular microvascular disease. Bedside ophthalmic screening of hospitalised diabetic foot patients may facilitate early detection and timely referral for sight-saving interventions.

**Keywords:** Diabetic Foot, Diabetic Retinopathy, Microvascular Disease, Bedside Ophthalmic Screening, Visual Impairment, Wagner Classification.

## INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterised by progressive macrovascular and microvascular complications that contribute significantly to global morbidity

and mortality<sup>1</sup>. Among these complications, diabetic foot and diabetic retinopathy represent two major causes of disability, resulting in limb loss and vision loss respectively<sup>2</sup>. Diabetic foot is widely recognised as a manifestation of

advanced systemic vascular compromise involving peripheral neuropathy, ischaemia, infection, and impaired wound healing<sup>3</sup>. Similarly, diabetic retinopathy represents a form of retinal microangiopathy secondary to prolonged hyperglycaemia and remains one of the leading causes of preventable blindness worldwide<sup>4</sup>.

Both diabetic foot and diabetic retinopathy share common pathogenic mechanisms, including endothelial dysfunction, capillary basement membrane thickening, oxidative stress, chronic inflammation, and impaired autoregulation of blood flow<sup>5,6</sup>. These shared pathways suggest that the severity of diabetic foot may serve as a clinical surrogate marker of generalised microvascular disease, including ocular involvement<sup>7</sup>.

Patients admitted for diabetic foot management are often systemically unwell, have restricted mobility, and frequently miss routine ophthalmic screening<sup>8</sup>. Hospital admission therefore provides a valuable opportunity for bedside ophthalmic evaluation and early detection of sight-threatening diabetic retinopathy, particularly in patients with limited access to outpatient eye care<sup>9</sup>. However, data exploring ocular findings specifically in hospitalised diabetic foot patients remain limited, especially from the Indian subcontinent<sup>10</sup>.

This study was undertaken to describe ocular manifestations in patients admitted with diabetic foot and to explore the relationship between severity of diabetic foot and ocular microvascular disease.

## **MATERIALS AND METHODS**

This hospital-based descriptive observational study was conducted at a tertiary care teaching hospital over a three-month period from November 2025 to January 2026. The study included patients admitted under the Department of Surgery with a diagnosis of diabetic foot, for whom bedside ophthalmology consultation was requested as part of inpatient care.

Patients aged 40 years and above with known diabetes mellitus and an active diabetic foot ulcer or gangrene were enrolled. Patients were included only if they were clinically stable and cooperative for bedside ophthalmic examination. Patients with recent ocular trauma or intraocular surgery, known retinal vascular diseases unrelated to diabetes, dense media opacities precluding adequate fundus visualisation, or those who were critically ill and

unable to undergo ophthalmic assessment were excluded.

A detailed systemic evaluation was performed for all patients. Data collected included demographic details, duration of diabetes mellitus, glycaemic status (fasting blood sugar, postprandial blood sugar, and glycated haemoglobin), renal function parameters, and associated co-morbidities such as hypertension, dyslipidaemia, chronic kidney disease, ischaemic heart disease, and smoking history. Peripheral vascular status was assessed using the ankle-brachial index, a validated non-invasive marker for peripheral arterial disease and an important prognostic indicator in patients with diabetic foot<sup>11</sup>. Severity of diabetic foot was graded using the Wagner classification system, which remains one of the most widely used clinical grading systems for diabetic foot ulcers and correlates with disease severity and risk of limb loss<sup>12</sup>.

Bedside ophthalmic evaluation was performed for all patients. Visual acuity was assessed using a Snellen chart. Anterior segment examination was carried out using torchlight, followed by fundus examination using indirect ophthalmoscopy after pupillary dilation. Diabetic retinopathy was graded clinically according to the Early Treatment Diabetic Retinopathy Study (ETDRS) classification. Presence of macular edema was noted based on clinical fundus findings. Optic disc appearance, cup-disc ratio, retinal vascular changes suggestive of hypertensive retinopathy, and other co-existing fundus abnormalities such as age-related macular degeneration were documented. Patients with suspected macular involvement were advised detailed ophthalmic evaluation on an outpatient basis.

Data were entered into a spreadsheet and analysed descriptively. Continuous variables are expressed as mean  $\pm$  standard deviation or range, and categorical variables as frequencies and percentages. Associations between diabetic foot severity and ocular findings are presented as proportions across Wagner grade strata; given the descriptive, non-multivariable nature of the analysis, these associations should be interpreted as observed patterns rather than as statistically adjusted independent predictors.

## **RESULTS**

A total of 80 patients admitted with diabetic foot were evaluated during the study period. The mean age of the study population was 58.6

± 9.4 years (range 42–83 years), with the largest proportion of patients in the 50–59-year age group (Figure 1, Table 1).

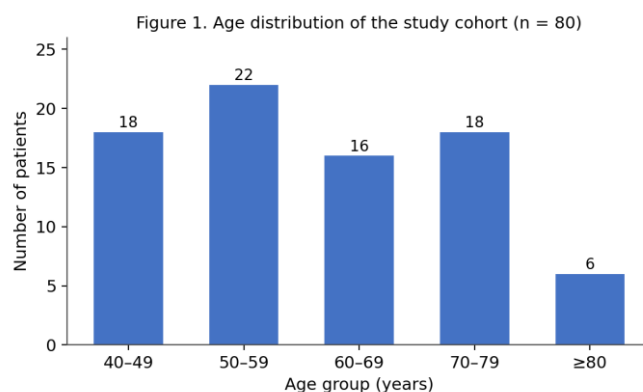


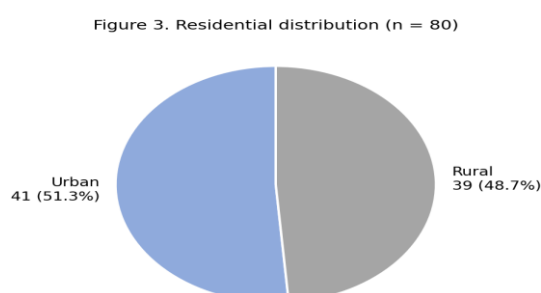
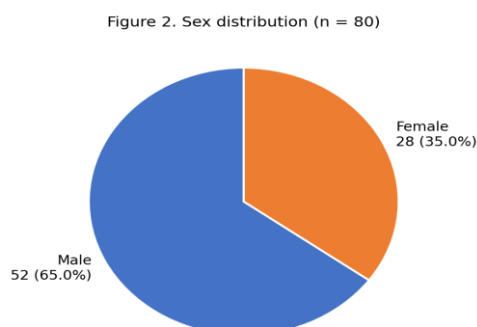
Table 1. Age distribution of the study cohort (n = 80)

| Age group (years) | n (%)     |
|-------------------|-----------|
| 40–49             | 18 (22.5) |
| 50–59             | 22 (27.5) |
| 60–69             | 16 (20.0) |
| 70–79             | 18 (22.5) |
| ≥80               | 6 (7.5)   |
| Total             | 80 (100)  |

### Demographic Profile

There was a male predominance, with 52 patients (65.0%) male and 28 patients (35.0%) female (Figure 2). The residential distribution

was nearly equal, with 41 patients (51.3%) from urban areas and 39 patients (48.7%) from rural areas (Figure 3).



### Systemic Profile and Co-morbidities

The mean duration of diabetes mellitus was  $8.2 \pm 4.6$  years. A duration of diabetes greater than 10 years was noted in 36 patients (45.0%). Hypertension was present in 45 patients (56.0%), dyslipidaemia in 44 patients (55.0%),

chronic kidney disease in 14 patients (18.0%), and a history of smoking in 13 patients (16.0%) (Table 2). Multiple co-morbidities were more frequently observed in patients with longer duration of diabetes.

Table 2. Systemic co-morbidities (n = 80)

| Co-morbidity           | n (%)     |
|------------------------|-----------|
| Hypertension           | 45 (56.0) |
| Dyslipidaemia          | 44 (55.0) |
| Chronic kidney disease | 14 (18.0) |
| History of smoking     | 13 (16.0) |

Systemic investigations demonstrated suboptimal metabolic control in a majority of patients. Elevated fasting and postprandial blood glucose values were observed in 62 patients (77.5%), while 48 patients (60.0%) had HbA1c values  $\geq 8\%$  (Table 3). Renal function abnormalities consistent with chronic

kidney disease were identified in 14 patients (18.0%); among these, 11 patients (78.6%) had diabetes duration exceeding 10 years, compared with 25 of 66 patients (37.9%) without renal involvement, indicating a strong association between prolonged diabetes duration and renal microvascular compromise.

Table 3. Glycaemic control and diabetes duration parameters (n = 80)

| Parameter                                                | Finding             |
|----------------------------------------------------------|---------------------|
| Mean duration of diabetes mellitus                       | $8.2 \pm 4.6$ years |
| Diabetes duration > 10 years                             | 36 (45.0%)          |
| Elevated fasting / postprandial glucose                  | 62 (77.5%)          |
| HbA1c $\geq 8\%$                                         | 48 (60.0%)          |
| Chronic kidney disease with diabetes duration > 10 years | 11 / 14 (78.6%)     |
| Diabetes duration > 10 years without renal involvement   | 25 / 66 (37.9%)     |

### Peripheral Vascular Status and Diabetic Foot Severity

Assessment of peripheral vascular status using the ankle-brachial index showed increasing vascular compromise with advancing diabetic foot severity. Reduced ABI values ( $<0.9$ ) were observed in 9 of 38 patients (23.7%) with Wagner grade 1–2 disease, 12 of 22 patients (54.5%) with Wagner grade 3 disease, and 16 of 20 patients (80.0%) with Wagner grade  $\geq 4$  disease — a clear step-wise gradient (Figure 6).

Based on the Wagner classification, 38 patients (47.5%) had grade 1–2 diabetic foot, 22 patients (27.5%) had grade 3 disease, and 20 patients (25.0%) had severe diabetic foot (Wagner grade  $\geq 4$ ) (Figure 4, Table 4). The mean duration since onset of the current foot ulcer was  $2.4 \pm 1.6$  years, with ulcer duration exceeding two years in 14 of 20 patients (70.0%) with Wagner grade  $\geq 4$  disease, compared with 11 of 38 patients (28.9%) with Wagner grade 1–2 disease.

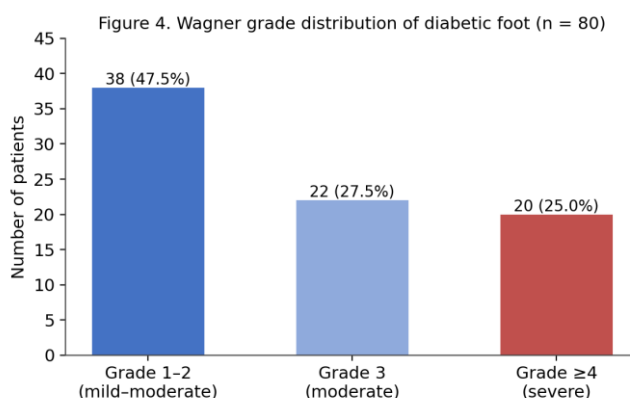
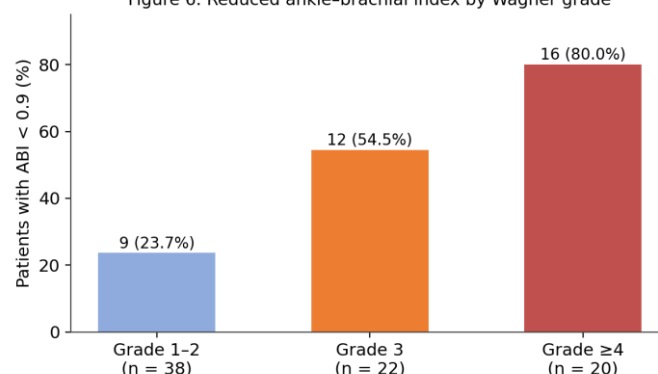


Table 4. Wagner grade distribution and associated peripheral vascular / ulcer findings

| Wagner grade | n (%)     | ABI < 0.9, n (%) | Ulcer duration > 2 y, n (%) |
|--------------|-----------|------------------|-----------------------------|
| Grade 1–2    | 38 (47.5) | 9 (23.7)         | 11 (28.9)                   |
| Grade 3      | 22 (27.5) | 12 (54.5)        | —                           |
| Grade ≥4     | 20 (25.0) | 16 (80.0)        | 14 (70.0)                   |

Figure 6. Reduced ankle-brachial index by Wagner grade



### Visual Acuity and Visual Impairment

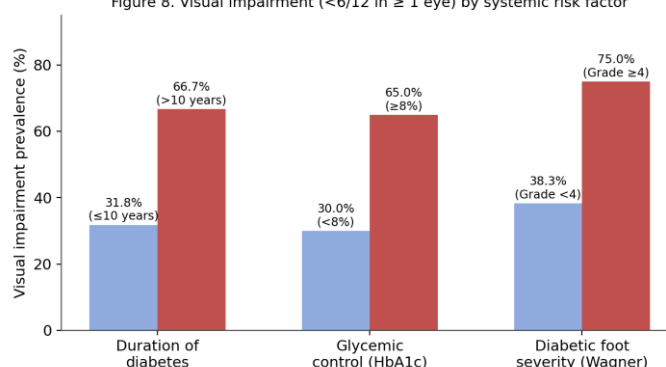
On bedside ophthalmic examination, visual acuity of 6/12 or better in both eyes was noted in 42 patients (52.5%), while 38 patients (47.5%) had visual impairment (<6/12 in at least one eye) (Table 5). Visual impairment was more frequent among patients with longer diabetes duration, poorer glycaemic control, and more severe diabetic foot disease (Figure 8): it was present in 24 of 36 patients (66.7%)

with diabetes duration >10 years, compared with 14 of 44 patients (31.8%) with shorter duration; in 26 of 40 patients (65.0%) with HbA1c ≥8%, compared with 12 of 40 patients (30.0%) with better glycaemic control; and in 15 of 20 patients (75.0%) with Wagner grade ≥4 disease, compared with 23 of 60 patients (38.3%) with less severe (Wagner grade <4) disease.

Table 5. Visual impairment (<6/12 in ≥ 1 eye) by systemic risk factor

| Risk factor                     | Higher-risk group        | Lower-risk group         |
|---------------------------------|--------------------------|--------------------------|
| Diabetes duration               | 66.7% (24/36), >10 years | 31.8% (14/44), ≤10 years |
| Glycaemic control (HbA1c)       | 65.0% (26/40), ≥8%       | 30.0% (12/40), <8%       |
| Diabetic foot severity (Wagner) | 75.0% (15/20), grade ≥4  | 38.3% (23/60), grade <4  |

Figure 8. Visual impairment (<6/12 in ≥ 1 eye) by systemic risk factor



### Diabetic Retinopathy and Macular Findings

Fundoscopy examination revealed diabetic retinopathy in 51 patients (63.7%), while 29 patients (36.3%) had no evidence of retinopathy. Mild non-proliferative diabetic retinopathy (NPDR) was present in 20 patients (25.0%), moderate NPDR in 15 patients

(18.7%), severe NPDR in 8 patients (10.0%), and proliferative diabetic retinopathy (PDR) in 8 patients (10.0%). Overall, 16 patients (20.0%) were classified as having sight-threatening diabetic retinopathy (severe NPDR or PDR) (Figure 5, Table 6).

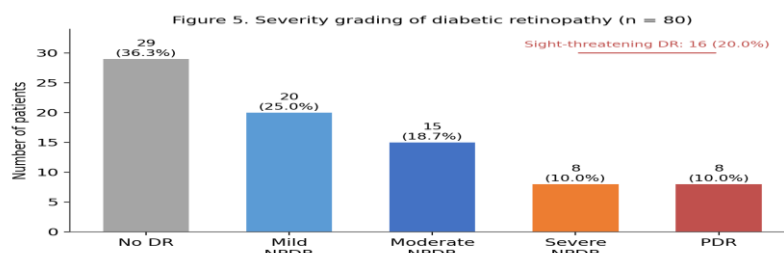


Table 6. Severity grading of diabetic retinopathy (n = 80)

| DR grade                                 | n (%)     |
|------------------------------------------|-----------|
| No diabetic retinopathy                  | 29 (36.3) |
| Mild NPDR                                | 20 (25.0) |
| Moderate NPDR                            | 15 (18.7) |
| Severe NPDR                              | 8 (10.0)  |
| PDR                                      | 8 (10.0)  |
| Sight-threatening DR (severe NPDR + PDR) | 16 (20.0) |
| Total                                    | 80 (100)  |

Clinical macular edema was observed in 14 patients (17.5%), of whom 9 (11.2% of the total cohort) met criteria for clinically significant macular edema. Retinal vascular changes suggestive of hypertensive retinopathy were noted in 21 patients (26.3%), of whom 17

(81.0%) had documented systemic hypertension. Features suggestive of age-related macular degeneration were identified in 8 patients (10.0%), predominantly in those aged over 65 years (Table 7).

Table 7. Macular edema and other fundus findings (n = 80)

| Finding                                       | n (%)          |
|-----------------------------------------------|----------------|
| Clinical macular edema (any)                  | 14 (17.5)      |
| of which clinically significant macular edema | 9 (11.2)       |
| Hypertensive retinopathy changes              | 21 (26.3)      |
| of which with documented hypertension         | 17 / 21 (81.0) |
| Age-related macular degeneration              | 8 (10.0)       |

### Association Between Diabetic Foot Severity and Ocular Microvascular Disease

Clear associations were observed between diabetic foot severity and ocular microvascular disease (Figure 7, Table 8). Among patients with Wagner grade  $\geq 4$  disease, diabetic retinopathy was present in 18 patients (90.0%), compared with 20 of 38 patients

(52.6%) with Wagner grade 1–2 disease. Sight-threatening diabetic retinopathy was identified in 7 patients (35.0%) with severe diabetic foot, compared with 12.0% of patients with milder disease. Clinical macular edema was observed in 6 patients (30.0%) with Wagner grade  $\geq 4$  disease, compared with 8 patients (21.0%) with Wagner grade 1–2 disease.

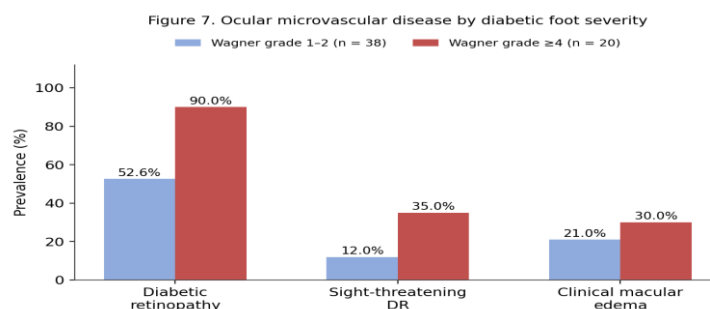


Table 8. Ocular microvascular disease by diabetic foot severity

| Ocular finding | Wagner grade 1–2 (n = 38) | Wagner grade $\geq 4$ (n = 20) |
|----------------|---------------------------|--------------------------------|
|----------------|---------------------------|--------------------------------|

|                            |       |       |
|----------------------------|-------|-------|
| Diabetic retinopathy (any) | 52.6% | 90.0% |
| Sight-threatening DR       | 12.0% | 35.0% |
| Clinical macular edema     | 21.0% | 30.0% |

Overall, increasing severity of diabetic foot was associated with longer duration of diabetes, poorer glycaemic control, lower ankle–brachial index values, higher prevalence of chronic kidney disease, greater severity of diabetic retinopathy, and higher rates of visual impairment, indicating parallel progression of systemic and ocular microvascular disease.

## DISCUSSION

In this hospital-based cohort of patients admitted with diabetic foot, a high burden of ocular microvascular disease was observed, with diabetic retinopathy present in 63.7% of patients and sight-threatening retinopathy in 20%. These figures are markedly higher than those reported in community-based Indian studies, where the prevalence of diabetic retinopathy has been shown to range between 12% and 18%, and sight-threatening disease between 3% and 5%, reflecting the advanced systemic disease profile of patients hospitalised with diabetic foot<sup>13,14</sup>. This disparity highlights that patients with diabetic foot represent a high-risk subgroup for microvascular complications and underscores the importance of opportunistic inpatient ophthalmic screening. A key finding of the present study was the strong association between severity of diabetic foot, as graded by the Wagner classification, and severity of diabetic retinopathy. Patients with advanced diabetic foot (Wagner grade  $\geq 4$ ) demonstrated significantly higher prevalence of diabetic retinopathy, sight-threatening retinopathy, and clinical macular edema compared with those with milder foot disease. Similar associations have been reported in previous hospital-based studies. Hwang et al. demonstrated a graded relationship between diabetic foot ulcer severity and diabetic retinopathy stage, suggesting parallel progression of microvascular disease in the lower limb and retina<sup>15</sup>. Furthermore, a recent systematic review and meta-analysis reported that patients with diabetic retinopathy had significantly higher odds of developing diabetic foot complications, reinforcing the bidirectional relationship between these two microvascular entities<sup>16</sup>.

The present study also demonstrated that longer duration of diabetes and poorer glycaemic control were more frequently observed among patients with advanced

diabetic retinopathy. These findings are consistent with landmark epidemiological studies, including the Wisconsin Epidemiologic Study of Diabetic Retinopathy and the UK Prospective Diabetes Study, which identified duration of diabetes and sustained hyperglycaemia as the strongest predictors of retinopathy progression and vision-threatening complications<sup>17,18</sup>. Indian population-based studies have similarly reported increasing prevalence and severity of diabetic retinopathy with longer duration of diabetes and higher HbA1c levels, supporting the external validity of our findings<sup>13</sup>.

A notable observation in our cohort was the strong coexistence of diabetic retinopathy and chronic kidney disease, with more than half of patients with severe retinopathy demonstrating renal involvement. This clustering of microvascular complications is well recognised, as diabetic retinopathy and nephropathy share common pathogenic mechanisms including endothelial dysfunction, capillary basement membrane thickening, and chronic inflammation<sup>19,20</sup>. Previous studies have shown that the presence of diabetic nephropathy is associated with increased prevalence and severity of retinopathy and poorer visual outcomes, findings that are concordant with our observations<sup>20</sup>.

Peripheral arterial disease, assessed using the ankle–brachial index, also demonstrated a graded relationship with both diabetic foot severity and ocular microvascular disease. Reduced ABI values were more frequently observed in patients with higher Wagner grades and advanced retinopathy, indicating a greater burden of systemic vascular disease. Prior studies have documented a high prevalence of peripheral arterial disease among patients with diabetic foot and have linked PAD with adverse limb outcomes<sup>21</sup>. Our findings extend this association by demonstrating concomitant ocular microvascular involvement, supporting the concept of diffuse vascular pathology in advanced diabetes.

Visual impairment was documented in nearly half of the study population and was more commonly observed among patients with longer duration of diabetes, poorer glycaemic control, advanced diabetic foot, and sight-threatening diabetic retinopathy. In addition to diabetic retinal disease and macular

involvement, other ocular conditions such as cataract, hypertensive retinopathy, and optic disc pathology contributed to reduced vision. Similar studies evaluating visual function in diabetic populations have highlighted the multifactorial nature of visual impairment, emphasising the need for comprehensive ophthalmic evaluation rather than isolated screening for diabetic retinopathy alone<sup>22</sup>.

Several Indian hospital-based studies examining diabetic foot syndrome have reported a high prevalence of diabetic retinopathy and have demonstrated correlations between foot severity and retinal disease<sup>23,24</sup>. These hospital-based estimates are consistently higher than those reported in community surveys, reflecting selection of patients with more advanced systemic disease in inpatient settings. The concordance of our findings with these studies strengthens the inference that diabetic foot severity may serve as a practical clinical marker for identifying patients at increased risk of sight-threatening diabetic retinopathy and widespread microvascular disease.

From a clinical standpoint, the findings of this study support the integration of ophthalmic screening into the inpatient management pathway for patients admitted with diabetic foot. Early identification of sight-threatening retinopathy and macular involvement enables timely referral for definitive management, including laser or intravitreal therapy, which has been shown to reduce the risk of irreversible vision loss<sup>16,18</sup>. Given that patients with diabetic foot often have restricted mobility and limited access to outpatient eye care, bedside ophthalmic evaluation represents a pragmatic and effective strategy to improve eye care delivery in this high-risk population.

### **Strengths and Limitations**

The limitations of this study include its hospital-based design and relatively modest sample size, which limit generalisability and preclude detailed multivariable analysis; associations reported here should therefore be interpreted as descriptive patterns rather than statistically adjusted independent predictors. In addition, reliance on bedside ophthalmoscopy may underestimate subtle macular pathology that could be detected with optical coherence tomography. Nonetheless, the strengths of this study lie in its real-world inpatient setting, comprehensive systemic and ocular assessment, and focus on an often under-

screened yet clinically important population with advanced diabetes.

### **CONCLUSION**

This study demonstrates that patients with diabetic foot represent a subgroup of individuals with diabetes who carry a disproportionately high burden of systemic and ocular microvascular disease. More than half of the patients evaluated had diabetic retinopathy, and a significant proportion had sight-threatening disease and visual impairment. Increasing severity of diabetic foot was consistently associated with longer duration of diabetes, poorer glycaemic control, greater prevalence of chronic kidney disease, lower ankle-brachial index values, and more advanced stages of diabetic retinopathy.

The findings of this study support the concept that diabetic foot and diabetic retinopathy are parallel manifestations of widespread microvascular dysfunction rather than isolated end-organ complications. Severity of diabetic foot, as assessed clinically using the Wagner classification, appears to be a useful marker for identifying patients at increased risk of advanced ocular microvascular disease. Patients with severe diabetic foot were more likely to have sight-threatening retinopathy, macular involvement, and significant visual impairment, emphasising the need for heightened ophthalmic vigilance in this population.

An important clinical implication emerging from this study is the recognition of a self-perpetuating cycle linking diabetic foot, visual impairment, and metabolic control. Development of diabetic foot often leads to reduced mobility due to pain, infection, prolonged bed rest, and surgical interventions such as debridement or amputation. This reduction in physical activity can worsen glycaemic control, thereby accelerating progression of diabetic retinopathy and other vascular complications. Conversely, visual impairment resulting from diabetic retinopathy may further limit mobility, independence, and physical activity, leading to deterioration in metabolic control and potentially contributing to progression or recurrence of diabetic foot disease. This bidirectional interaction highlights the complex interplay between systemic disease, limb involvement, and ocular morbidity.

Routine bedside ophthalmic screening of patients admitted with diabetic foot offers a valuable opportunity for early detection of

sight-threatening retinopathy in a high-risk group that may otherwise have limited access to regular eye care. Incorporating ophthalmic evaluation into the inpatient management pathway for diabetic foot patients can facilitate timely referral, early intervention, and a more integrated multidisciplinary approach. Such strategies may help mitigate visual morbidity, improve overall quality of life, and potentially interrupt the cycle of worsening systemic and ocular complications in patients with advanced diabetes.

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