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Research Article

Correlation between Diabetic Retinopathy Severity and Diabetic Foot Disease in Patients with Type 2 Diabetes Mellitus

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ABSTRACT
Background: Diabetic retinopathy (DR) and diabetic foot disease are important complications of longstanding type 2 diabetes mellitus (T2DM). Both are associated with chronic hyperglycaemia, microvascular dysfunction and cumulative diabetic tissue injury. This study evaluated the relationship between DR severity and diabetic foot disease in patients with T2DM.
Methods: A hospital-based cross-sectional study was conducted among 90 patients with T2DM of more than five years' duration and established diabetic foot disease. Demographic and clinical characteristics, duration of diabetes, glycaemic parameters and best-corrected visual acuity (BCVA) were recorded. Detailed ophthalmological examination was performed, and DR was graded according to the Early Treatment Diabetic Retinopathy Study classification. Diabetic foot disease was assessed clinically according to its severity. Appropriate statistical tests, including chi-square/Fisher's exact test, independent *t*-test and analysis of variance, were used, with $p < 0.05$ considered statistically significant.
Results: The mean age of participants was 54.63 ± 7.97 years, and 66 (73.3%) were male. The mean duration of diabetes was 16.03 ± 7.24 years, while mean BCVA was 0.633 ± 0.614 logMAR. Diabetic retinopathy was frequently observed, with NPDR being more common than PDR. Increasing severity of DR was significantly associated with greater severity of diabetic foot disease. Patients with more advanced retinal disease also demonstrated longer duration of diabetes and poorer glycaemic control. Visual acuity progressively deteriorated with increasing severity of DR.
Conclusion: Greater severity of diabetic retinopathy is associated with more advanced diabetic foot disease in patients with T2DM. This relationship may reflect the cumulative effects of longstanding diabetes, poor glycaemic control and shared microvascular and neurological mechanisms. Routine retinal evaluation in patients with diabetic foot disease and systematic foot assessment in those with advanced DR may facilitate early recognition of multisystem diabetic complications and support comprehensive multidisciplinary management.

Keywords: Diabetic Retinopathy, Diabetic Foot Disease, Type 2 Diabetes Mellitus, Diabetic Neuropathy, Glycaemic Control.

INTRODUCTION
Diabetes mellitus (DM) is a major global public health problem, with its prevalence increasing steadily across the world. [1,2] According to the International Diabetes Federation, approximately 463 million adults were living with DM in 2019, and this number is expected to rise considerably in the coming years [3]. By 2045, the global prevalence of DM is projected to reach 9.9%, corresponding to approximately 770 million individuals [4,5]. The increasing burden of DM has significant implications for individual health as well as healthcare systems and society. Persistent hyperglycemia is associated with multiple microvascular and macrovascular complications, including cardiovascular disease, diabetic kidney disease, diabetic retinopathy (DR), and peripheral neuropathy, which collectively contribute to reduced quality of life, increased healthcare expenditure, disability, and premature mortality [6].

Diabetic foot disease is one of the most debilitating complications of type 2 diabetes mellitus (T2DM). Diabetic foot ulcer (DFU) is characterized by infection, ulceration, and/or destruction of deep tissues of the foot and is commonly associated with peripheral neuropathy and varying degrees of vascular disease [7]. DFU represents an important cause of morbidity, disability, hospitalization, and lower-extremity amputation among individuals with diabetes. Approximately 30% of patients with DM are estimated to develop a DFU during their lifetime, while diabetes-related amputations remain associated with substantial mortality [8]. The prognosis following amputation is particularly poor, with the 5-year mortality rate reported to be as high as 50% [9]. Moreover, recurrence after ulcer healing is frequent, with reported recurrence rates of approximately 40%, 60%, and 65% at 1, 3, and 5 years, respectively [10].

Diabetic retinopathy is another major microvascular complication of diabetes and is the most common ocular complication among individuals with DM [11]. The development and progression of DR are influenced by the duration of diabetes, chronic hyperglycemia, and cumulative vascular injury. Consequently, the severity of DR may serve as an indicator of the extent of systemic microvascular damage in patients with longstanding diabetes.

Increasing evidence has drawn attention to a possible association between DR and diabetic foot disease. Both complications share several underlying mechanisms, including chronic hyperglycemia, endothelial dysfunction, vascular abnormalities, and neuropathic changes. Therefore, increasing severity of DR may potentially reflect a greater overall burden of diabetes-related vascular and neurological complications and could identify patients at increased risk of diabetic foot disease.

However, the relationship between DR severity and diabetic foot disease remains incompletely characterized. Understanding this association may facilitate early risk stratification, targeted foot surveillance, and timely preventive interventions in patients with T2DM. Therefore, the present study aimed to evaluate the correlation between diabetic retinopathy severity and diabetic foot disease in patients with type 2 diabetes mellitus, and to determine whether increasing DR severity is associated with a greater burden of diabetic foot complications.

MATERIALS AND METHODS

This hospital-based cross-sectional study was conducted in the Department of Ophthalmology, Department of General Surgery, and Diabetic Foot Clinic under the Department of General Medicine at Index Medical College Hospital & Research Centre, Indore, Madhya Pradesh, India. The study was conducted over a period of 12 months following approval from the Institutional Ethics Committee. A total of 100 patients fulfilling the predefined eligibility criteria were enrolled in the study.

Patients aged 25-70 years with a diagnosis of type 2 diabetes mellitus (T2DM) for more than five years and established diabetic foot disease were eligible for participation. The study objectives and procedures were explained to all eligible participants, and written informed consent was obtained before enrollment.

Sample Size

A total of 90 consecutive eligible patients were included in the study based on the availability of patients fulfilling the predefined eligibility criteria during the study period.

Inclusion Criteria

Patients were included if they were:

- Aged 25-70 years.
- Diagnosed with T2DM for more than five years.
- Diagnosed with established diabetic foot disease.
- Willing to participate and provide written informed consent.

Exclusion Criteria

Patients were excluded if they had:

- Type 1 diabetes mellitus.
- Gestational diabetes mellitus.
- Other retinal vascular diseases that could interfere with assessment of diabetic retinopathy.
- Refusal or inability to provide informed consent.

Study Variables and Data Collection

Demographic variables, including age and sex, were recorded for all participants. Clinical and laboratory parameters were obtained as part of the study evaluation. Laboratory investigations included fasting blood sugar (FBS), postprandial blood sugar (PPBS), glycated hemoglobin (HbA1c), renal function tests (RFT), fasting lipid profile (FLP),

hemoglobin concentration, and urinary microalbumin.

The diagnosis of diabetes mellitus was based on World Health Organization criteria. Diabetes was defined by fasting plasma glucose ≥126 mg/dL, 2-hour postprandial plasma glucose ≥200 mg/dL, HbA1c ≥6.5%, or random blood glucose ≥200 mg/dL in the presence of classical symptoms of hyperglycemia. Only patients with a pre-existing diagnosis of T2DM for more than five years were enrolled.

Ophthalmological Assessment

All participants underwent a comprehensive ophthalmological examination. Visual acuity was assessed using a Snellen visual acuity chart and converted to logarithm of the minimum angle of resolution (logMAR) equivalents for analysis. Anterior segment examination was performed using slit-lamp biomicroscopy. Fundus examination was performed using a +90-diopter lens, direct ophthalmoscopy, and indirect ophthalmoscopy.

Diabetic retinopathy (DR) was graded according to the Early Treatment Diabetic Retinopathy Study (ETDRS) classification. For the purpose of statistical analysis, patients were categorized into three groups: no diabetic retinopathy (No DR), non-proliferative diabetic retinopathy (NPDR), and proliferative diabetic retinopathy (PDR). When the severity of DR differed between the two eyes, the eye with the greater severity of retinopathy was considered for classification.

Statistical Analysis

Data were entered into a Microsoft Excel spreadsheet and analyzed using IBM Statistical Package for the Social Sciences (SPSS), version 26.0. Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on the distribution of the data. Categorical variables were presented as frequencies and percentages.

The distribution of continuous variables was assessed before selection of statistical tests. The Chi-square test or Fisher's exact test, as appropriate, was used to assess associations between categorical variables. For comparison of continuous variables between two groups, the independent-samples t-test was used for normally distributed data, whereas the Mann-Whitney U test was used for non-normally distributed data. For comparisons involving more than two groups, one-way analysis of variance (ANOVA) was used for normally distributed continuous variables, while the Kruskal-Wallis test was used for non-parametric data.

The association between the severity of diabetic retinopathy and diabetic foot disease was assessed using appropriate tests of association. Where applicable, correlation analysis was performed to evaluate the relationship between the severity of DR and relevant clinical and laboratory parameters.

A two-tailed p-value <0.05 was considered statistically significant. Where applicable, effect estimates were reported with 95% confidence intervals (CIs).

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Institutional Ethics Committee approval was obtained before commencement of the study. Written informed consent was obtained from all participants after explaining the purpose, procedures, potential benefits, and voluntary nature of participation. Patient confidentiality was maintained throughout the study.

RESULTS

A total of 90 patients with type 2 diabetes mellitus and established diabetic foot disease were included in the study. The study population had a mean age of 54.63 ± 7.97 years, and the mean duration of diabetes mellitus was 16.03 ± 7.24 years. There were 66 (73.3%) males and 24 (26.7%) females. The mean best-corrected visual acuity (BCVA) was 0.633 ± 0.614 logMAR.

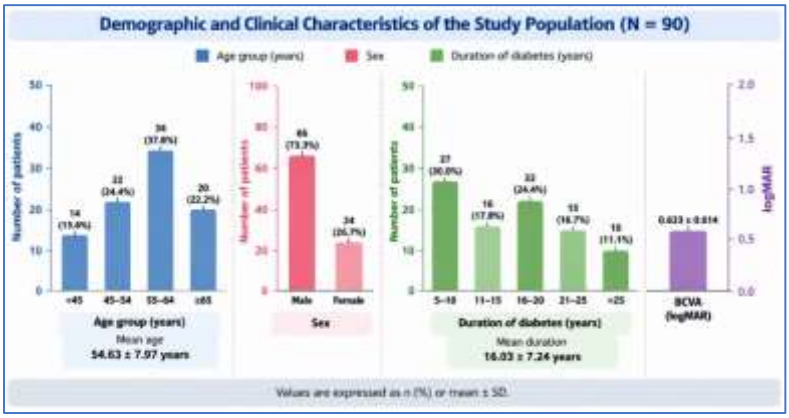
Demographic and Baseline Clinical Characteristics: The demographic and baseline clinical characteristics of the study population are summarized in Table 1. The majority of participants belonged to the 55–64-year age group (34, 37.8%). Males constituted nearly three-fourths of the study population (66, 73.3%). The mean duration of diabetes was 16.03 ± 7.24 years. [Graph 1]

Table 1. Demographic and Baseline Clinical Characteristics of the Study Population

Characteristic	Value
Age group, years, n (%)	
<45	14 (15.6)

45–54	22 (24.4)
55–64	34 (37.8)
≥65	20 (22.2)
Mean age, years	54.63 ± 7.97
Sex, n (%)	
Male	66 (73.3)
Female	24 (26.7)
Duration of diabetes, years, n (%)	
5–10	27 (30.0)
11–15	16 (17.8)
16–20	22 (24.4)
21–25	15 (16.7)
>25	10 (11.1)
Mean duration of diabetes, years	16.03 ± 7.24
Mean BCVA, logMAR	0.633 ± 0.614

Values are presented as n (%) or mean ± standard deviation. BCVA, best-corrected visual acuity; logMAR, logarithm of the minimum angle of resolution.



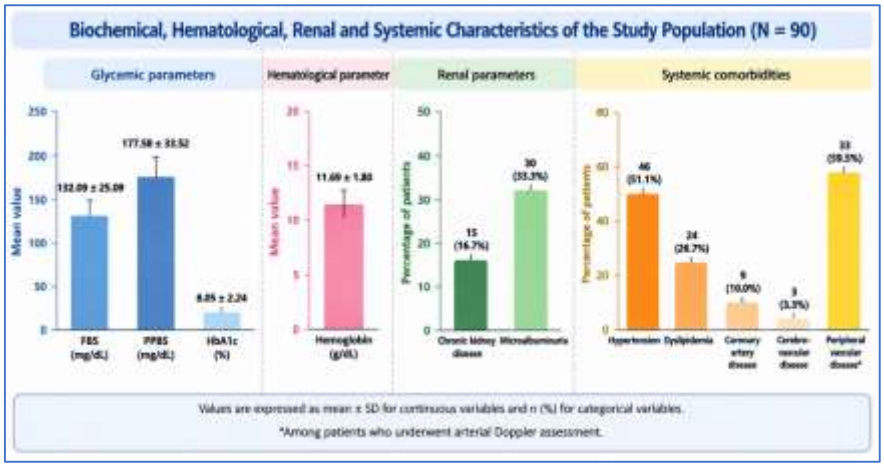
Graph 1. Demographic and Baseline Clinical Characteristics of the Study Population

Biochemical and Systemic Characteristics: The biochemical and systemic characteristics are presented in Table 2. The mean fasting blood sugar, postprandial blood sugar, and HbA1c were 132.09 ± 25.09 mg/dL, 177.58 ± 33.52 mg/dL, and 8.05 ± 2.24%, respectively. Hypertension was the most common systemic comorbidity, occurring in 46 (51.1%) patients. [Graph 2]

Table 2. Biochemical, Hematological, Renal, and Systemic Characteristics

Characteristic	**Value**
FBS, mg/dL	132.09 ± 25.09
PPBS, mg/dL	177.58 ± 33.52
HbA1c, %	8.05 ± 2.24
Hemoglobin, g/dL	11.69 ± 1.80
Hypertension, n (%)	46 (51.1)
Dyslipidemia, n (%)	24 (26.7)
Coronary artery disease, n (%)	9 (10.0)
Cerebrovascular disease, n (%)	3 (3.3)
Chronic kidney disease, n (%)	15 (16.7)
Microalbuminuria, n (%)	30 (33.3)
Peripheral vascular disease*, n (%)	33 (59.5)

*Among patients who underwent arterial Doppler assessment. FBS, fasting blood sugar; PPBS, postprandial blood sugar; HbA1c, glycated hemoglobin

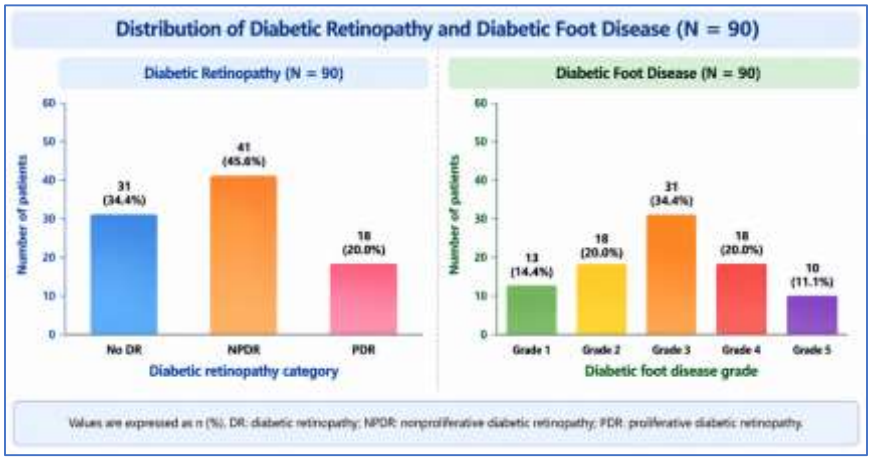


Graph 2: Biochemical, Hematological, Renal, and Systemic Characteristics

Distribution of Diabetic Retinopathy and Diabetic Foot Disease: The distribution of diabetic retinopathy (DR) and diabetic foot disease is shown in Table 3. DR was present in 59 (65.6%) patients. NPDR was observed in 41 (45.6%) patients, whereas 18 (20.0%) had PDR. Grade 3 diabetic foot disease was the most frequently observed grade (31, 34.4%).[Graph 3]

Table 3. Distribution of Diabetic Retinopathy and Diabetic Foot Disease

Characteristic	n (%)
Diabetic retinopathy	
No DR	31 (34.4)
NPDR	41 (45.6)
PDR	18 (20.0)
Diabetic foot grade	
Grade 1	13 (14.4)
Grade 2	18 (20.0)
Grade 3	31 (34.4)
Grade 4	18 (20.0)
Grade 5	10 (11.1)

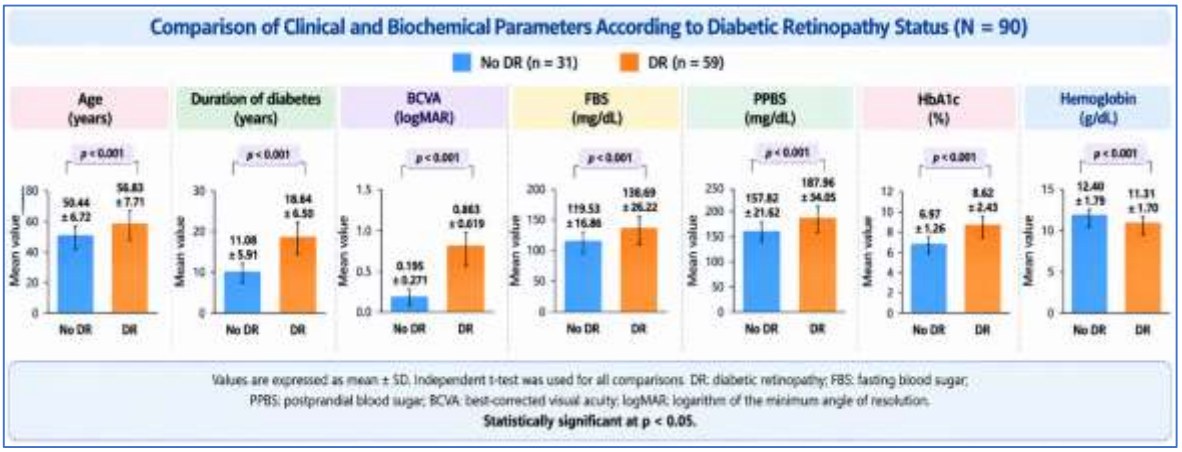


Graph 3: Distribution of Diabetic Retinopathy and Diabetic Foot Disease

Factors Associated With the Presence of Diabetic Retinopathy: The comparison of patients with and without DR is presented in Table 4. Patients with DR were significantly older and had a significantly longer duration of diabetes than those without DR. They also had poorer BCVA and higher FBS, PPBS, and HbA1c levels. All these differences were statistically significant (Independent t-test; $p < 0.001$). [Graph 4

Table 4. Comparison of Demographic, Ophthalmological, and Biochemical Parameters According To Diabetic Retinopathy Status

Parameter	No DR	DR	p-value
Age, years	50.44 ± 6.72	56.83 ± 7.71	<0.001
Duration of DM, years	11.08 ± 5.91	18.64 ± 6.50	<0.001
BCVA, logMAR	0.195 ± 0.271	0.863 ± 0.619	<0.001
FBS, mg/dL	119.53 ± 16.86	138.69 ± 26.22	<0.001
PPBS, mg/dL	157.82 ± 21.62	187.96 ± 34.05	<0.001
HbA1c, %	6.97 ± 1.26	8.62 ± 2.43	<0.001
Hemoglobin, g/dL	12.40 ± 1.79	11.31 ± 1.70	<0.001

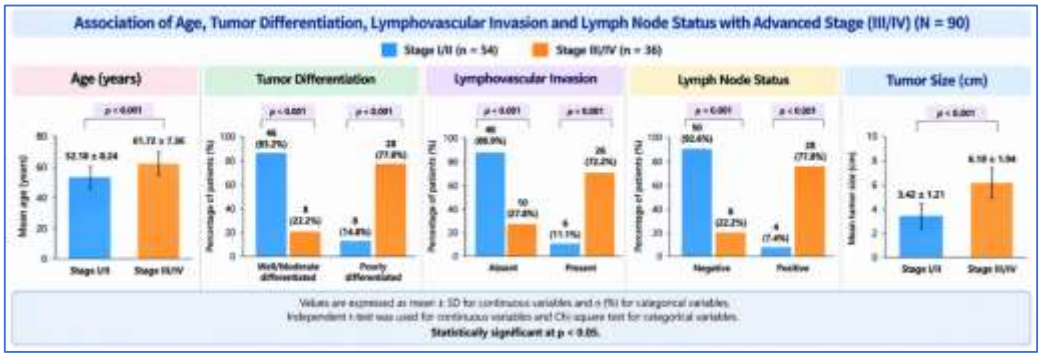


Graph 4: Comparison of Demographic, Ophthalmological and Biochemical Parameters according To Diabetic Retinopathy Status

Clinical and Biochemical Characteristics according To Dr Severity: A progressive increase in the severity of DR was associated with increasing age and duration of diabetes, as well as worsening glycemic parameters (Table 5). Patients with PDR had the longest mean duration of diabetes and the highest mean HbA1c. Visual acuity was also progressively poorer with increasing severity of DR. (One-way ANOVA; $p < 0.001$). [Graph 5]

Table 5. Clinical and Biochemical Characteristics According To Diabetic Retinopathy Severity

Parameter	No DR	NPDR	PDR	p-value
Age, years	50.44 ± 6.72	56.67 ± 7.90	57.29 ± 7.28	<0.001
Duration of DM, years	11.08 ± 5.91	17.51 ± 6.53	21.81 ± 5.29	<0.001
BCVA, logMAR	0.195 ± 0.270	0.660 ± 0.440	1.432 ± 0.697	<0.001
FBS, mg/dL	119.53 ± 16.86	131.80 ± 22.80	158.03 ± 25.85	<0.001
PPBS, mg/dL	157.82 ± 33.52	181.15 ± 33.14	207.05 ± 29.36	<0.001
HbA1c, %	6.97 ± 1.26	8.09 ± 2.15	10.10 ± 2.58	<0.001
Hemoglobin, g/dL	12.40 ± 1.79	11.31 ± 1.80	11.33 ± 1.42	<0.001



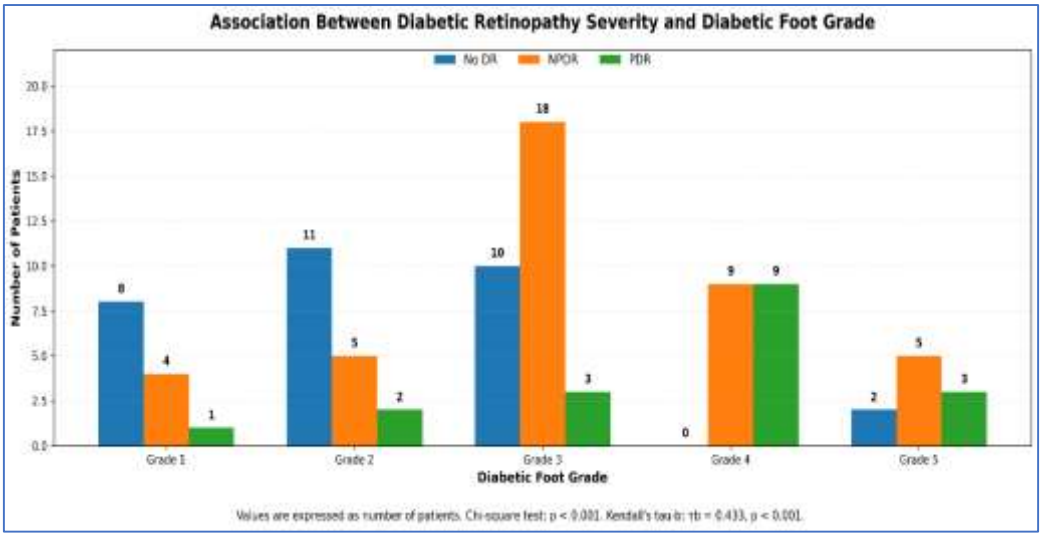
Graph 5. Clinical and Biochemical Characteristics According To Diabetic Retinopathy Severity

Association between Dr Severity and Diabetic Foot Grade: The relationship between DR severity and diabetic foot grade is shown in Table 6. A significant association was observed between the severity of DR and diabetic foot disease (Chi square test; $p < 0.001$). The proportion of patients with more advanced retinopathy increased among those with higher diabetic foot grades. Kendall's tau-b analysis demonstrated a moderate positive correlation (Kendall's tau-b correlation; $\tau b = 0.433$, $p < 0.001$). [Graph 6]

Table 6. Association between Diabetic Retinopathy Severity and Diabetic Foot Grade

Diabetic foot grade	No DR, n	NPDR, n	PDR, n	Total
Grade 1	8	4	1	13
Grade 2	11	5	2	18
Grade 3	10	18	3	31
Grade 4	0	9	9	18
Grade 5	2	5	3	10
Total	31	41	18	90

Kendall's $\tau b = 0.433$, $p < 0.001$.



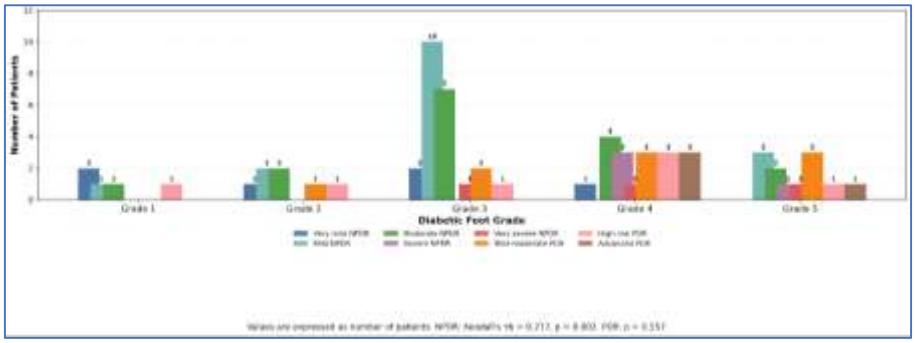
Graph 6: Association between Diabetic Retinopathy Severity and Diabetic Foot Grade

Association of Npdr and Pdr Severity with Diabetic Foot Grade: Further analysis of individual DR severity categories is presented in Table 7. NPDR severity showed a significant positive association with diabetic foot grade (Kendall's $\tau b = 0.277$, $p = 0.002$). In contrast, no statistically significant association was observed between PDR severity and diabetic foot grade ($p = 0.557$).

Table 7. Association of Npdr and Pdr Severity with Diabetic Foot Grade

Retinopathy severity	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
NPDR					
Very mild	2	1	2	1	0
Mild	1	2	10	0	3
Moderate	1	2	7	4	2
Severe	0	0	0	3	1
Very severe	0	0	1	1	1
PDR					
Mild–moderate	0	1	2	3	3
High-risk	1	1	1	3	1
Advanced	0	0	0	3	1

NPDR: Kendall's $\tau b = 0.277$, $p = 0.002$; PDR: $p = 0.557$.

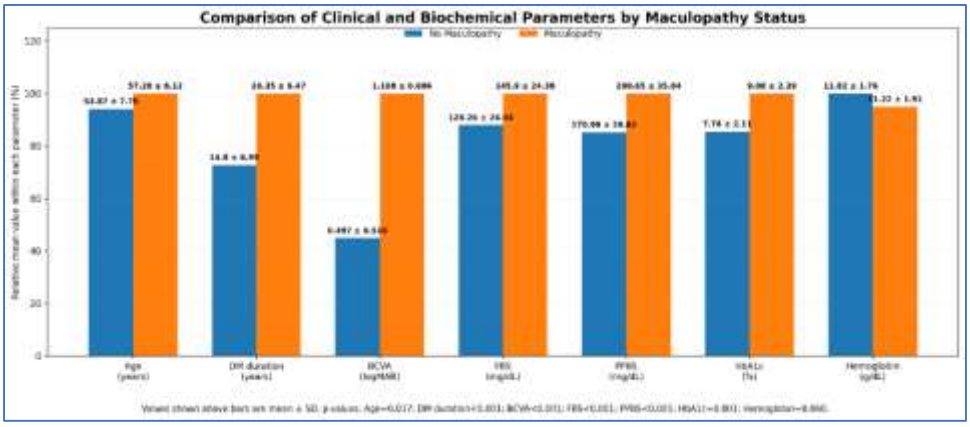


Graph 7: Association of NPDR and PDR Severity with Diabetic Foot Grade

Maculopathy and Diabetic Foot Disease: Maculopathy was evaluated as an additional ophthalmological manifestation of diabetes. Patients with maculopathy had significantly longer duration of diabetes, poorer BCVA, and higher FBS, PPBS, and HbA1c levels than those without maculopathy (Table 8). A significant association was also observed between maculopathy and diabetic foot grade (Independent t-test; $p < 0.001$), with maculopathy being more frequently observed among patients with advanced diabetic foot disease.

Table 8. Association of Maculopathy with Clinical Parameters and Diabetic Foot Grade

Parameter	No Maculopathy	Maculopathy	p-value
Age, years	53.87 ± 7.79	57.28 ± 8.12	0.017
Duration of DM, years	14.80 ± 6.99	20.35 ± 6.47	<0.001
BCVA, logMAR	0.497 ± 0.516	1.108 ± 0.696	<0.001
FBS, mg/dL	128.26 ± 24.04	145.90 ± 24.38	<0.001
PPBS, mg/dL	170.99 ± 29.82	200.65 ± 35.84	<0.001
HbA1c, %	7.76 ± 2.11	9.08 ± 2.39	0.001
Hemoglobin, g/dL	11.82 ± 1.76	11.22 ± 1.91	0.060

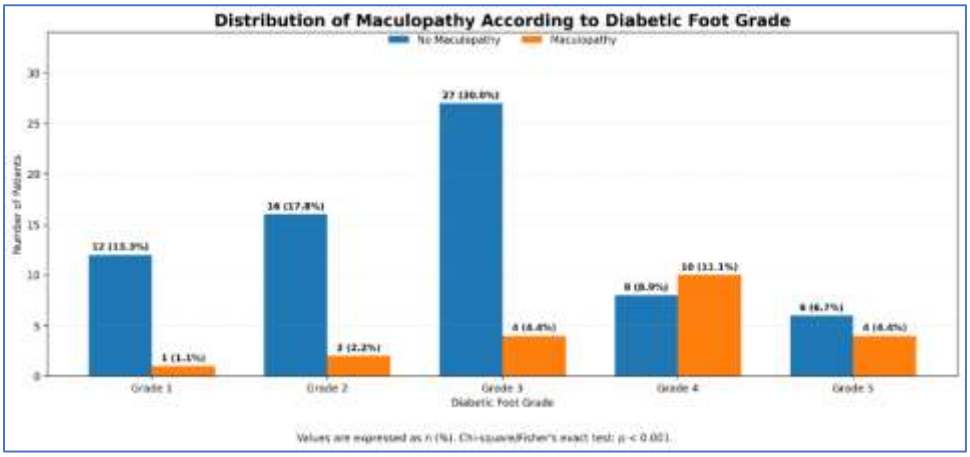


Graph 8: Association of Maculopathy with Clinical Parameters and Diabetic Foot Grade

Table 9: Association between Maculopathy and Diabetic Foot Grade

Diabetic foot grade	Maculopathy, n	No maculopathy, n
Grade 1	1	12
Grade 2	2	16
Grade 3	4	27
Grade 4	10	8
Grade 5	4	6
Total	21	69

Chi C square/Fisher exact test: $p < 0.001$.



Graph 9: Association between Maculopathy and Diabetic Foot Grade

DISCUSSION

Diabetic retinopathy and diabetic foot disease are among the important chronic complications of type 2 diabetes mellitus, and their coexistence may reflect the cumulative effects of prolonged metabolic, microvascular, neurological and vascular injury. The present cross-sectional study evaluated the relationship between the severity of diabetic retinopathy (DR) and diabetic foot disease in patients with type 2 diabetes mellitus (T2DM). Among the 90 patients included, the mean age was 54.63 ± 7.97 years, with males comprising 73.3% of the study population. The mean duration of diabetes was 16.03 ± 7.24 years, indicating prolonged exposure to diabetes-related metabolic and vascular abnormalities. The mean best-corrected visual acuity (BCVA) was 0.633 ± 0.614 logMAR. The long duration of diabetes observed in our population is clinically relevant, as cumulative exposure to hyperglycaemia plays an important role in the development and progression of diabetic microvascular complications.

A substantial proportion of patients with diabetic foot disease had concomitant diabetic retinopathy, with NPDR being more frequently observed than PDR. This finding suggests that patients presenting with diabetic foot disease constitute a high-risk group for associated retinal microvascular complications. Our findings are comparable with those of Karam et al. [12], who reported diabetic retinopathy in 67.58% of patients with diabetic foot syndrome in South India, with NPDR being more common than PDR. Similar observations were reported by Muthulakshmi et al. [1], who demonstrated a high prevalence of diabetic retinopathy among patients with diabetic foot disease. The similarity between these findings and our observations suggests that diabetic foot disease may identify a population with a high prevalence of concomitant retinal microvascular disease.

In contrast, Hwang et al. [9] reported diabetic retinopathy in approximately 90% of patients with diabetic foot, with PDR accounting for approximately 55%. The higher prevalence of both DR and PDR in that population compared with the Indian studies may be related to differences in diabetes duration, glycaemic control and severity of foot disease, referral patterns, demographic characteristics and healthcare settings. These variations indicate that the absolute prevalence of retinopathy among diabetic-foot patients may differ between populations; however, the consistent observation of a substantial retinal disease burden across studies emphasizes the importance of ophthalmological assessment in this group.

The principal finding of our study was the significant association between diabetic retinopathy severity and diabetic foot disease severity. Patients with more severe diabetic foot disease demonstrated a greater burden of retinal involvement and more advanced grades of diabetic retinopathy. This finding suggests that retinal microvascular disease may reflect the overall systemic burden of chronic diabetes. Anunitha et al. [13] reported a significant correlation between diabetic retinopathy severity and diabetic foot-ulcer severity, using ETDRS classification for retinopathy and Wagner grading for foot ulcers. Similarly, Muthulakshmi et al. [1] demonstrated a significant positive correlation between diabetic retinopathy severity and diabetic foot severity. The concordance of these findings with our results supports the clinical relevance of assessing retinal status in

patients with diabetic foot disease. Overall, the association may reflect shared mechanisms of chronic hyperglycaemia, endothelial dysfunction, microvascular injury and cumulative diabetic tissue damage affecting both the retina and lower limbs.

The association observed in our study may be explained by the common pathophysiological mechanisms underlying diabetic retinopathy and diabetic foot disease. Persistent hyperglycaemia results in endothelial dysfunction, oxidative stress, formation of advanced glycation end products, inflammatory activation and progressive microvascular damage. In the retina, these mechanisms contribute to vascular leakage, capillary nonperfusion, retinal ischemia and progressive retinopathy. In the peripheral nervous system and lower limb, similar metabolic and vascular abnormalities contribute to neuropathy, impaired protective sensation, tissue injury and delayed wound healing. Thus, diabetic retinopathy and diabetic foot disease may represent different clinical manifestations of the cumulative systemic effects of longstanding diabetes.

Increasing duration of diabetes was also associated with a greater burden of diabetic retinopathy in the present study. The mean duration of diabetes was 16.03 ± 7.24 years, and patients with more severe retinal disease tended to have a longer duration of diabetes. This finding is consistent with Karam et al. [12], who reported an association between longer duration of diabetes and diabetic retinopathy among patients with diabetic foot syndrome. Hafeez et al. [3] similarly demonstrated a relationship between diabetic retinopathy and diabetic peripheral neuropathy in patients with T2DM. Their findings showed that diabetic microvascular and neurological complications were more frequent among patients with longer-standing diabetes and poor glycaemic control. The cumulative effect of chronic hyperglycaemia may therefore provide an important explanation for the simultaneous development of retinal, neurological and foot complications.

Poor glycaemic control was another important finding in our study. Fasting blood glucose, postprandial blood glucose and HbA1c were higher among patients with diabetic retinopathy, with worsening glycaemic parameters observed with increasing severity of retinal disease. These observations are consistent with Anunitha et al. [13], who reported an association between elevated HbA1c and the severity of diabetic retinopathy as well as diabetic foot-ulcer severity. Hafeez et al. [3] also reported a higher burden of diabetic retinopathy and peripheral neuropathy among patients with poor glycaemic control. HbA1c is particularly relevant because it reflects long-term glycaemic exposure and may therefore better represent the cumulative metabolic burden contributing to chronic complications. Persistent hyperglycaemia promotes oxidative stress, advanced glycation, endothelial dysfunction and inflammatory pathways, which can collectively accelerate microvascular injury.

The present study also demonstrated deterioration of visual acuity with increasing severity of diabetic retinopathy. The mean BCVA was 0.633 ± 0.614 logMAR, and patients with advanced retinopathy tended to have poorer visual function. This finding is clinically expected because progression of diabetic retinopathy may be accompanied by macular oedema, retinal ischemia, macular involvement, vitreous haemorrhage and other structural changes that adversely affect vision. The association between macular involvement and diabetic foot severity is particularly relevant. Muthulakshmi et al. [1] similarly reported an association between maculopathy and diabetic foot severity. Visual impairment in patients with diabetic foot disease may have additional functional consequences because impaired vision can make regular foot inspection, identification of minor injuries and appropriate foot-care practices more difficult.

The association between visual impairment and diabetic foot disease has additional clinical significance. Patients with substantial visual impairment may have difficulty performing regular self-examination of the feet and identifying early skin lesions, pressure areas or minor trauma. Muthulakshmi et al. [1] reported maculopathy in their diabetic-foot population and observed a relationship between macular involvement and diabetic-foot severity. Thus, retinal complications may have implications extending beyond vision itself, potentially affecting a patient's ability to participate effectively in preventive foot-care practices.

Macular involvement may also represent another indicator of advanced systemic diabetic disease. Retinal changes severe enough to compromise central vision often occur in the setting of substantial microvascular injury. When such changes coexist with advanced diabetic foot disease,

they may indicate a patient with a particularly high cumulative burden of diabetes-related complications. This further supports the importance of comprehensive assessment rather than managing ocular and foot manifestations in isolation.

Other systemic diabetic complications may contribute to the observed relationship. Muthulakshmi et al. [1] reported higher frequencies of hypertension, chronic kidney disease, coronary artery disease and microalbuminuria among patients with diabetic retinopathy. These systemic vascular and renal abnormalities may coexist with peripheral vascular disease and contribute to impaired tissue perfusion and wound healing. Venkatesh et al. [14] and Jiang et al. [15] have also highlighted the substantial burden of systemic comorbidities among patients with diabetic retinopathy and diabetic foot ulceration. Although these factors were not the primary focus of the present study, they should be considered when interpreting the association between retinal and foot disease because they may act as potential confounders or markers of overall disease severity.

The clinical implications of these findings are important. Diabetic foot disease should not be regarded solely as a localized lower-limb complication. Its presence may indicate a broader burden of diabetic microvascular and neurological disease. Patients with longstanding diabetes and established diabetic foot disease, particularly those with poor glycaemic control or severe foot involvement, may therefore benefit from systematic ophthalmological evaluation. Similarly, patients with advanced diabetic retinopathy may warrant assessment for peripheral neuropathy, peripheral vascular disease and foot-related risk factors. Such an approach could facilitate earlier recognition of coexisting complications and promote more coordinated care involving ophthalmology, medicine, surgery and diabetic-foot services.

An important strength of the present study is that it evaluated not only the presence of diabetic retinopathy but also its severity in relation to diabetic foot disease severity. The use of ETDRS-based classification provided a standardized approach for grading retinal involvement. The study also incorporated clinical and biochemical parameters, including duration of diabetes, fasting and postprandial blood glucose, HbA1c and visual acuity, allowing the retinal findings to be interpreted in the context of the overall diabetic disease burden.

Several limitations should be considered. The cross-sectional design precludes establishing causality or temporal relationships. The hospital-based sample may limit generalizability. Small numbers in advanced retinopathy subgroups may reduce statistical power. Potential confounders, including hypertension, renal dysfunction, dyslipidaemia, peripheral arterial disease and neuropathy, may also influence the observed associations.

CONCLUSION

Diabetic retinopathy and diabetic foot disease frequently coexist in patients with type 2 diabetes mellitus, particularly in those with prolonged disease duration and inadequate glycaemic control. Greater severity of retinal involvement was associated with more advanced diabetic foot disease, suggesting a shared systemic burden of chronic diabetic microvascular and neurovascular injury. Assessment of retinal status may therefore provide additional information regarding the overall severity of diabetic complications in patients presenting with diabetic foot disease. Regular ophthalmological and foot evaluation, together with optimal glycaemic control and multidisciplinary management, may facilitate earlier recognition of complications and improve comprehensive diabetes care.

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