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Original Article

Evaluation of Optic Nerve Head Changes in Diabetic and Non-Diabetic Glaucoma Patients

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ABSTRACT

Background: Diabetes mellitus could contribute to the development of glaucoma due to vascular/metabolic mechanisms that might lead to optic nerve head and retinal nerve fiber layer damage, but this has not been sufficiently examined in Bangladesh. This study sought to compare the optic nerve head and retinal nerve fiber layer parameters among the glaucoma patients with and without diabetes mellitus. **Methods & Materials:** A cross-sectional comparative study was conducted on 120 glaucoma patients (60-diabetic and 60 non-diabetic) within a time span of January-Dec 2025. In this study, optic nerve head, RNFL thickness, intraocular pressure, central corneal thickness, visual field parameters were analyzed and compared among the groups using optical coherence tomography and standard automated perimetry. The IBM-SPSS statistical software was used to evaluate the collected data, where $p<0.05$ was considered significant. **Results:** Patients with diabetic glaucoma were older than those without diabetes (59.9 ± 6.4 vs. 57.0 ± 7.4 years, p=0.024). They also had larger optic discs, higher vertical cup-to-disc ratios, lower neuroretinal rim and RNFL thicknesses, and poorer visual field parameters ($p\leq0.019$). Moderate-to-severe glaucoma was significantly more prevalent in the diabetic group than in the non-diabetic group (85.0% vs. 51.7%, $p<0.001$), indicating greater structural and functional glaucomatous damage, with more pronounced optic nerve changes and advanced disease severity among diabetic patients. **Conclusion:** Diabetes was associated with greater structural and functional glaucomatous damage and more advanced disease severity, emphasizing the need for regular comprehensive ophthalmic assessment and close glaucoma monitoring in diabetic patients to facilitate early detection of progression and appropriate management.

Keywords: *Diabetes mellitus, Glaucoma, Optic nerve head, Retinal nerve fiber layer, Optical coherence tomography, Visual field, Glaucomatous damage.*

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INTRODUCTION

Glaucoma is a chronic progressive optic neuropathy defined by optic nerve head (ONH), retinal nerve fiber layer (RNFL) and corresponding visual field defects and primary open-angle glaucoma (POAG) is a major cause of irreversible visual impairment. While increased intraocular pressure (IOP) is a key modifiable risk factor for glaucoma, additional vascular, biomechanical and systemic abnormalities contribute to the disease mechanism and diabetes mellitus (DM) may influence the disease through changes in IOP, retinal microcirculation and ONH integrity [1,2].

Diabetes can cause optic nerve damage through hyperglycemia, oxidative stress, endothelial dysfunction, and impaired microvascular autoregulation. Abnormal glucose metabolism can also lead to impaired IOP regulation, while decreased optic nerve head perfusion and RNFL thinning can occur even before the appearance of diabetic retinopathy [3,4].

Studies based on optic nerve imaging have demonstrated discrepancies in ONH and RNFL parameters between patients with and without diabetes who also have POAG [5,6]. Variations in neuroretinal rim, cup-to-disc ratio, optic disc area, and RNFL thickness are crucial indicators of glaucomatous damage and progression. The increased thickness of prelaminar tissue in patients with glaucoma and type 2 diabetes further suggests that diabetes can affect ONH through a combination of metabolic, vascular, and mechanical factors [7].

Diabetes can affect the progression of glaucoma; in particular, studies have reported differences in the progression of structural and functional parameters in patients with POAG and diabetes versus those without diabetes [8]. Diabetes mellitus can also impact vascular parameters in the ONH [9]. However, the relationship is complex and inconsistent, with studies reporting conflicting findings depending on the characteristics of the population, severity of disease, control of diabetes, type of glaucoma, and specific imaging techniques used.

The information on changes in the optic nerve head (ONH) among the Bangladeshi diabetic and non-diabetic glaucoma patients is scarce. Thus, it is essential to evaluate ONH parameters for comparison and understanding the influence of the disease on glaucomatous optic nerve damage in the local population. The aims of this study were to evaluate and compare optic nerve changes in diabetic and non-diabetic glaucoma patients, and to determine the associations of these alterations with corresponding clinical and metabolic features.

METHODS & MATERIALS

Study Design and Study Period

A hospital-based comparative cross-sectional observational study was conducted from January to December 2025 to evaluate and compare optic nerve head changes among diabetic and non-diabetic patients with glaucoma. The study included patients with a confirmed diagnosis of glaucoma who attended the ophthalmology outpatient and glaucoma services during the study period.

Study Population

The study population consisted of adult patients diagnosed with glaucoma. Participants were divided into two groups according to their diabetes status: Group I, diabetic glaucoma patients (n=60) and Group II, non-diabetic glaucoma patients (n=60). Diabetes mellitus was defined based on a previous physician diagnosis or documented use of antidiabetic medication, supported by available clinical or laboratory records.

Inclusion Criteria

Patients aged 18 years or older with a confirmed diagnosis of glaucoma were eligible for inclusion. Patients in the diabetic group were required to have

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documented diabetes mellitus, whereas participants in the non-diabetic group had no previous history or documented evidence of diabetes. Patients with reliable visual-field test results and adequate-quality optic nerve and retinal nerve fiber layer imaging were included.

Exclusion Criteria

Patients with significant media opacity affecting optic nerve or retinal imaging, previous vitreoretinal surgery, advanced retinal disease unrelated to glaucoma, optic neuropathy other than glaucomatous optic neuropathy, or ocular trauma were excluded. Patients with incomplete clinical records or unreliable visual-field examinations were also excluded from the analysis.

Sampling and Sample Size

A total of 120 eligible patients were included using a purposive/consecutive sampling approach during the study period. The final sample consisted of 60 diabetic glaucoma patients and 60 non-diabetic glaucoma patients, allowing comparison of structural and functional optic nerve parameters between the two groups.

Data Collection

Data were collected using a structured data collection form. Sociodemographic and clinical information included age, sex, duration of glaucoma, diabetes status, duration of diabetes, and HbA1c level. A detailed ophthalmic examination was performed for all participants, including measurement of intraocular pressure (IOP), central corneal thickness (CCT), optic disc assessment, optical coherence tomography (OCT), and standard automated perimetry.

Assessment of Optic Nerve Head

Optic nerve head morphology was assessed using optic disc imaging and OCT. The optic disc area, vertical cup-to-disc ratio, and neuroretinal rim area were recorded for analysis. Measurements were obtained using standardized imaging protocols, and scans with inadequate image quality were excluded. The same assessment procedure was applied to participants in both groups.

Assessment of Retinal Nerve Fiber Layer

Peripapillary retinal nerve fiber layer (RNFL) thickness was assessed using OCT. The average RNFL thickness and sectoral RNFL thickness in the superior, inferior, temporal, and nasal quadrants were recorded. OCT measurements were obtained after ensuring adequate scan quality and appropriate centration around the optic nerve head.

Assessment of Intraocular Pressure and Central Corneal Thickness

IOP was measured using standard clinical tonometry, and the recorded value was used for comparison between the diabetic and non-diabetic groups. Central corneal thickness was measured using an appropriate pachymetric technique. These parameters were included to assess whether differences in optic nerve structural characteristics were accompanied by differences in IOP or corneal thickness.

Visual Field Assessment and Classification of Glaucoma Severity

Standard automated perimetry was performed using a standardized visual-field testing protocol. The mean deviation (MD) and visual field index (VFI) were recorded as measures of functional visual impairment. Glaucoma severity was classified according to visual-field MD as mild (>−6 dB), moderate (−6 to −12 dB), and severe (≤−12 dB). Only reliable visual-field examinations were included in the final analysis.

Statistical Analysis

Data were entered, cleaned, and analyzed using IBM SPSS Statistics. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage. The distribution of continuous variables was assessed before selecting the appropriate statistical test. Differences in continuous variables between diabetic and non-diabetic glaucoma patients were assessed using the independent-samples t-test. Categorical variables were compared using the chi-square test. A two-sided p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the relevant institutional ethics committee before commencement of the study. Written informed consent was obtained from all participants before enrollment. Participant information was kept confidential and was used solely for research purposes.

RESULTS

Baseline Characteristics of the Study Participants

Table I shows total of 120 glaucoma patients were included in the analysis, comprising 60 patients with diabetes mellitus and 60 non-diabetic patients. The mean age was significantly higher among diabetic glaucoma patients than among non-diabetic glaucoma patients (59.9 ± 6.4 vs. 57.0 ± 7.4 years, p=0.024). Male participants constituted 53.3% of the diabetic group and 41.7% of the non-diabetic group, with no statistically significant difference in sex distribution (p=0.202). Among patients with diabetes, the mean duration of diabetes was 9.1 ± 4.2 years and the mean HbA1c level was 7.8 ± 1.2%.

Table I

Baseline Characteristics of the Study Participants (*n*=120).

Variable	Diabetic glaucoma (n=60),n(%)	Non-diabetic glaucoma (n=60),n(%)	p-value
Age, years	59.9 ± 6.4	57.0 ± 7.4	0.024
Sex, n (%)			0.202
Male	32 (53.3)	25 (41.7)	
Female	28 (46.7)	35 (58.3)	
Duration of glaucoma, years	6.0 ± 3.1	5.9 ± 2.1	0.804
Duration of diabetes, years	9.1 ± 4.2	—	—
HbA1c, %	7.8 ± 1.2	—	—

Data are presented as mean ± SD or n (%). Independent-samples t-test was used for continuous variables and chi-square test for categorical variables.

Ocular and Clinical Characteristics

Table II shows the mean intraocular pressure (IOP) was 18.9 ± 3.0 mmHg in the diabetic group and 18.1 ± 3.3 mmHg in the non-diabetic group; this difference was not statistically significant (p=0.195). Similarly, central corneal thickness was comparable between the groups (530.7 ± 28.1 vs. 530.5 ± 27.5 µm, p=0.981). The mean optic disc area was significantly larger among diabetic glaucoma patients (2.08 ± 0.31 vs. 1.93 ± 0.32 mm², p=0.010).

Table II
Ocular and Clinical Characteristics of the Study Participants.

Variable	Diabetic glaucoma (n=60)	Non-diabetic glaucoma (n=60)	p-value
IOP, mmHg	18.9 ± 3.0	18.1 ± 3.3	0.195
Central corneal thickness, µm	530.7 ± 28.1	530.5 ± 27.5	0.981
Optic disc area, mm²	2.08 ± 0.31	1.93 ± 0.32	0.010
Duration of glaucoma, years	6.0 ± 3.1	5.9 ± 2.1	0.804

Data are presented as mean ± SD. Independent-samples t-test was used.

Optic Nerve Head Parameters
Table III shows significant differences were observed in several optic nerve head parameters between the two groups. The mean vertical cup-to-disc ratio was significantly higher in diabetic glaucoma patients than in non-diabetic glaucoma patients (0.69 ± 0.08 vs. 0.65 ± 0.09, p=0.012). In contrast, neuroretinal rim area was significantly lower in the diabetic group (0.85 ± 0.19 vs. 1.06 ± 0.19 mm², p<0.001). These findings indicate greater structural loss of the neuroretinal rim among glaucoma patients with diabetes.

Table III
Comparison of Optic Nerve Head Parameters between the Groups.

Optic nerve head parameter	Diabetic glaucoma (n=60)	Non-diabetic glaucoma (n=60)	p-value
Optic disc area, mm²	2.08 ± 0.31	1.93 ± 0.32	0.010
Vertical cup-to-disc ratio	0.69 ± 0.08	0.65 ± 0.09	0.012
Neuroretinal rim area, mm²	0.85 ± 0.19	1.06 ± 0.19	<0.001

Data are presented as mean ± SD. Independent-samples t-test was used.

Retinal Nerve Fiber Layer and Visual Field Parameters
Table IV shows the mean average retinal nerve fiber layer (RNFL) thickness was significantly lower among diabetic glaucoma patients than among non-diabetic glaucoma patients (65.2 ± 9.1 vs. 75.7 ± 9.4 µm, p<0.001). Significant reductions were also observed in the superior, inferior, temporal, and nasal RNFL sectors among diabetic patients, with the greatest difference observed in the superior sector (71.4 ± 10.5 vs. 81.0 ± 13.3 µm, p<0.001). Functional visual field assessment showed significantly worse mean deviation (MD) in the diabetic group (-10.14 ± 4.25 vs. -6.55 ± 4.05 dB, p<0.001) and a lower visual field index (VFI) (76.9 ± 11.0% vs. 84.3 ± 10.9%, p<0.001).

Table IV
Comparison of RNFL Thickness and Visual Field Parameters.

Parameter	Diabetic glaucoma (n=60)	Non-diabetic glaucoma (n=60)	p-value
Average RNFL thickness, µm	65.2 ± 9.1	75.7 ± 9.4	<0.001
Superior RNFL, µm	71.4 ± 10.5	81.0 ± 13.3	<0.001
Inferior RNFL, µm	70.8 ± 10.6	78.1 ± 12.8	0.001
Temporal RNFL, µm	54.2 ± 9.1	63.1 ± 10.6	<0.001
Nasal RNFL, µm	68.6 ± 8.6	72.9 ± 11.1	0.019
Mean deviation, dB	-10.14 ± 4.25	-6.55 ± 4.05	<0.001
Visual field index, %	76.9 ± 11.0	84.3 ± 10.9	<0.001

Data are presented as mean ± SD. Independent-samples t-test was used.

Distribution of Glaucoma Severity
Table V presents based on visual field mean deviation; glaucoma severity differed significantly between the groups (p<0.001). Mild glaucoma was observed in 9 (15.0%) diabetic patients compared with 29 (48.3%) non-diabetic patients. Moderate glaucoma accounted for 36 (60.0%) diabetic and 25 (41.7%) non-diabetic patients, while severe glaucoma was present in 15 (25.0%) and 6 (10.0%) patients, respectively. Thus, a greater proportion of diabetic glaucoma patients had moderate-to-severe disease compared with non-diabetic patients.

Table V
Distribution of Glaucoma Severity According to Visual Field Mean Deviation.

Glaucoma severity	Diabetic glaucoma (n=60),n(%)	Non-diabetic glaucoma (n=60),n(%)	p-value
Mild	9 (15.0)	29 (48.3)	
Moderate	36 (60.0)	25 (41.7)	
Severe	15 (25.0)	6 (10.0)	
Overall	60 (100.0)	60 (100.0)	<0.001

Data are presented as n (%). Glaucoma severity was classified according to visual field mean deviation: mild >−6 dB, moderate −6 to −12 dB, and severe ≤−12 dB. Chi-square test was used.

DISCUSSION

In the current study, diabetic glaucoma patients were significantly older compared to those without diabetes. Patients' sex, as well as the duration of the disease, was similar in the two groups. Furthermore, the mean diabetes duration was 9.1 ± 4.2 years, whereas the hemoglobin A1C was 7.8 ± 1.2%. This is consistent with the results of previous studies that revealed that the prevalence of primary open-angle glaucoma (POAG) increases with age among diabetic patients. Additionally, a similar patient distribution according to the demographic data was also observed by the authors of these studies [10,11].

In the present study, IOP was slightly higher in diabetic than non-diabetic glaucoma patients but the difference was not significant. CCT was also comparable. These findings are similar to previous studies, which reported comparable IOP and corneal parameters between diabetic and non-diabetic patients [12]. However, optic

disc area was significantly larger in the diabetic group, consistent with previous evidence showing diabetes-related differences in optic nerve head parameters [13].

In the present study, diabetic glaucoma patients showed that they have a bigger optic disc region and a bigger vertical cup to disc ratio and a smaller neuroretinal rim area than the control group. Previous studies found similar results which also stated that there was an increase in the cupping and decrease in the neuro retinal rim area in patients of glaucomatous optic neuropathy and this was more evident in diabetic patients with glaucoma [14,15].

In the given study, diabetic glaucoma patients presented with significantly reduced average and sectoral RNFL thicknesses and mean deviation (MD) and visual field index (VFI), as compared to the healthy group. The results were consistent with prior reports on RNFL thinning and visual field defects in patients with diabetic retinopathy who had developed glaucoma at an early stage of the disease. The findings suggest diabetes-induced retina damage [16].

In the present study, a substantially higher prevalence of moderate-to-severe glaucoma was detected among diabetic as compared to non-diabetic patients. This is consistent with previous studies reporting that diabetic patients exhibit greater functional glaucomatous damage and severity of the disease than their non-diabetic counterparts. More recent studies also support an association between diabetes and greater structural and functional impairment in patients with glaucoma [17].

Overall, diabetes was associated with greater structural and functional glaucomatous damage and more advanced disease severity among glaucoma patients.

CONCLUSION

Diabetes was associated with greater structural and functional glaucomatous damage, characterized by larger optic discs, higher vertical cup-to-disc ratios, reduced neuroretinal rim and RNFL thickness, and poorer visual field parameters. Diabetic glaucoma patients also had a higher proportion of moderate-to-severe disease. These findings suggest that diabetes may contribute to more advanced glaucomatous damage and emphasize the importance of regular comprehensive ophthalmic evaluation and close monitoring of diabetic patients with glaucoma.

REFERENCES

1. Yildiz PI, Kebapci MN, Mutlu FE, Yasar S, Gürsoy H, Yildirim Nİ. Intraocular pressure changes during oral glucose tolerance tests in diabetic and non-diabetic individuals. Experimental and Clinical Endocrinology & Diabetes. 2016 Jun;124(06):385-8.
2. Rahman MO, Kumar S. Impact of Type II Diabetes Mellitus on Intraocular Pressure: A Comparative Analysis with Non-Diabetic Individuals. European Journal of Cardiovascular Medicine. 2025 Feb 17;15:367-71.
3. Cao D, Yang D, Yu H, Xie J, Zeng Y, Wang J, Zhang L. Optic nerve head perfusion changes preceding peripapillary retinal nerve fibre layer thinning in preclinical diabetic retinopathy. Clinical & experimental ophthalmology. 2019 Mar;47(2):219-25.
4. Li H, Yu X, Zheng B, Ding S, Mu Z, Guo L. Early neurovascular changes in the retina in preclinical diabetic retinopathy and its relation with blood glucose. BMC ophthalmology. 2021 May 17;21(1):220.
5. Akkaya S, Can E, Öztürk F. Comparison of the corneal biomechanical properties, optic nerve head topographic parameters, and retinal nerve fiber layer thickness measurements in diabetic and non-diabetic primary open-angle glaucoma. International ophthalmology. 2016 Oct;36(5):727-36.
6. Akkaya S, Can E, Öztürk F. Comparison of the corneal biomechanical properties, optic nerve head topographic parameters, and retinal nerve fiber layer thickness measurements in diabetic and non-diabetic primary open-angle glaucoma. International ophthalmology. 2016 Oct;36(5):727-36.
7. Sim YS, Kwon JW, Jee D, Choi JA, Ko SH, Park CK. Increased prelaminar tissue thickness in patients with open-angle glaucoma and type 2 diabetes. PLoS One. 2019 Feb 7;14(2):e0211641.
8. Hou H, Shoji T, Zangwill LM, Moghimi S, Saunders LJ, Hasenstab K, Ghahari E, Manalastas PI, Akagi T, Christopher M, Penteado RC. Progression of primary open-angle glaucoma in diabetic and nondiabetic patients. American Journal of ophthalmology. 2018 May 1;189:1-9.
9. Gonzalez de la Rosa M, de-la-Huerga-Moreno S, Alfonso-Lopez F, Cabrera-Lopez F, Pareja-Rios A, Gonzalez-Hernandez D, Gonzalez-Hernandez M. Comparison of age-related vascular changes in the optic disc of patients with diabetes, with glaucomatous and non-glaucomatous features. BMJ Open Ophthalmology. 2022 Aug;7(1):e001100.
10. Salor J. Prevalence and risk factors associated with primary open angle glaucoma in diabetic patients in a tertiary care centre. International journal of medical ophthalmology. 2021 Jan 1.
11. Dahilkar RP, Havaldar VB, Desai PR. A comparative study on the intraocular pressure among diabetic and non-diabetic patients. Nat J Physiol, Pharm Pharmacol. 2021 Aug 1;11:868-.
12. Chowdhury B, Bhadra S, Mittal P, Shyam K. Corneal endothelial morphology and central corneal thickness in type 2 diabetes mellitus patients. Indian journal of ophthalmology. 2021 Jun 18;69(7):1718.
13. Braha A, Simion A, Timar R, Timar B. Factors associated with increased intraocular pressure in type 2 diabetes patients. Journal of Clinical Medicine. 2024 Jan 24;13(3):676.
14. Un Y. Value of disc topographic measurements for the discrimination of glaucoma suspects from early primary open angle glaucoma cases: a thin discriminative line. Photodiagnosis and Photodynamic Therapy. 2023 Sep 1;43:103746.
15. Hassan FK, Raafat KA, Elrakhawy KE, Allam RS. Optical coherence tomography indices for diagnosis of chronic glaucoma in patients with diabetes mellitus: a pilot study. International Ophthalmology. 2021 Feb;41(2):409-20.
16. Yang C, Zhou C. Observation on the changes of visual field and optic nerve fiber layer thickness in patients with early diabetic retinopathy. Photodiagnosis and Photodynamic Therapy. 2024 Jun 1;47:104197.