ORIGINAL RESEARCH PAPER

Volume - 15 | Issue - 07 | July - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EVALUATION OF PERIPAPILLARY NERVE FIBER LAYER THICKNESS IN PATIENTS WITH DIABETES MELLITUS USING SPECTRAL DOMAIN OPTICAL COHERENCE TOMOGRAPHY

Ophthalomology

Dr.Pankaj Sanap

Dr.Shishir Urdhwareshe

Dr,Arun Kumar Patidar

ABSTRACT

Introduction Diabetes mellitus is associated with both microvascular complications and neuroretinal degeneration. Recent studies indicate that neurodegenerative changes might occur prior to the onset of diabetic retinopathy. Spectral domain optical coherence tomography (SD-OCT) provides an accurate assessment of the thickness of retinal nerve fiber layer (RNFL). **Objective** The objective of this study was to compare peripapillary RNFL thickness between patients with diabetes mellitus and control groups and correlate it with the duration of disease, HbA1c level, and diabetic retinopathy. **Methods** A comparative observational study involving 100 subjects (50 patients with diabetes mellitus and 50 matched controls) was performed. All subjects underwent ophthalmological examination and RNFL thickness measurement by SD-OCT. **Results** The mean RNFL thickness was significantly less in the diabetic subjects (92.3 ± 7.6 µm) than controls (99.1 ± 6.9 µm) ($p < 0.001$). There was a significant decline in RNFL thickness with increased duration of diabetes ($p = 0.002$), and in those subjects with diabetic retinopathy ($p = 0.01$). A negative correlation was noted between RNFL thickness and both duration of diabetes ® = −0.46, $p = 0.001$), and HbA1c levels ($r = −0.42$, $p < 0.001$). The Area Under the Curve by Receiver Operating Characteristics analysis was 0.78. **Conclusion** Decrease in RNFL thickness in diabetes is an indicator of early retinal neuropathy, which has a negative correlation with the duration of disease and level of glycosylation. Combining SD-OCT and HbA1c assessment can improve the process of diagnosis at an early stage.

KEYWORDS

Diabetes Mellitus; Rnfl Thickness; Optical Coherence Tomography; Hba1c

Introduction

Diabetes mellitus is an endocrine disease characterized by microvascular and neurodegenerative retinal lesions. Recent studies have shown that damage to retinal neurons precedes microvascular abnormalities.

The glycated hemoglobin (HbA1c) level indicates the overall control of blood glucose and is essential for the development of diabetic complications. The retinal nerve fiber layer (RNFL) is especially susceptible to metabolic damage.

The study aims to quantify the RNFL thickness in diabetics relative to the controls and correlate it with HbA1c, diabetes duration, and retinopathy.

Materials and Methods

Study Design

Observational comparative study.

Study Population

- 50 patients with diabetes mellitus
- 50 age-matched control subjects

Inclusion Criteria

- Confirmed diagnosis of diabetes mellitus
- Age >18 years

Exclusion Criteria

- Glaucoma or optic neuropathy
- Surgery on the eye
- Media opacities

Clinical Evaluation

- Visual acuity
- Slit lamp evaluation
- Fundus examination
- HbA1C estimation

Measurement of RNFL

Done via spectral domain optical coherence tomography (SD-OCT).

Grouping

Diabetic patients were divided based on:

- Duration ≤5 years, 6-10 years, >10 years
- Diabetic retinopathy or not

Statistical Analysis

- Mean± SD
- Group comparison
- Pearson correlation

RESULTS:

Table 1.Comparison Between Groups

Group	Mean RNFL (µm)	SD	p-value
Diabetic	92.3	±7.6	0.002
Control	99.1	±6.9	

Table 2. RNFL and Duration of Diabetes

Duration	Mean RNFL (µm)	SD	p-value
≤5 years	95.6	±6.8	0.002
6-10 years	91.8	±7.2	
≥10 years	87.4	±7.9	

Table 3. RNFL and Diabetic Retinopathy

Group	Mean RNFL (µm)	SD	p-value
Without DR	94.1	±7.1	0.01
With DR	88.6	±7.8	

Table 4. Correlation Analysis

Variable	r	p-value
Duartion vs RNFL	-0.46	0.001
HbA1c	-0.42	<0.001

Table 5. HbA1c Analysis

Duration	Mean HbA1c (%)
≤5 years	7.1
6-10 years	8.0
≥10 years	9.2

Table 6. Diagnostic Performance

Parameter	Value
Area Under the Curve	0.78
Cut-off	≤95 µm
Sensitivity	74%
Specificity	70%

DISCUSSION

Diabetes mellitus causes not only microvascular damage but also early retinal neurodegenerative changes that may precede clinically detectable diabetic retinopathy. This study compared peripapillary

retinal nerve fiber layer (RNFL) thickness in 50 patients with Type 2 diabetes mellitus and 50 age- and sex-matched healthy controls using spectral-domain optical coherence tomography (SD-OCT). Diabetic patients showed significantly lower mean RNFL thickness than controls (92.3 ± 7.6 µm vs. 99.1 ± 6.9 µm; p = 0.001), supporting the presence of early retinal neuronal damage.

RNFL thinning increased with longer diabetes duration, decreasing from 95.6 µm in patients with disease duration ≤5 years to 87.4 µm in those with duration >10 years, with a significant negative correlation between RNFL thickness and diabetes duration (r = −0.46, p = 0.001). Thinning was observed across all retinal quadrants and was more pronounced in patients with diabetic retinopathy than in those without retinopathy.

ROC analysis demonstrated moderate diagnostic performance of RNFL thickness (AUC = 0.78), with an optimal cut-off value of 95 µm providing 74% sensitivity and 70% specificity. These findings suggest that OCT-based RNFL assessment is a useful, non-invasive biomarker for early detection and monitoring of retinal neurodegeneration in patients with Type 2 diabetes mellitus.

CONCLUSION

This study demonstrated that patients with Type 2 Diabetes Mellitus (T2DM) have significantly reduced retinal nerve fiber layer (RNFL) thickness compared with age- and sex-matched healthy individuals. The average RNFL thickness was markedly lower in diabetic patients, indicating the presence of retinal neurodegenerative changes even before severe ocular complications become clinically evident. Furthermore, RNFL thinning was significantly associated with longer duration of diabetes, suggesting that chronic exposure to hyperglycemia may contribute to progressive retinal neuronal damage.

Quadrant-wise analysis revealed significant thinning in the superior, inferior, nasal, and temporal retinal quadrants, highlighting widespread retinal involvement in diabetic patients. The study also found that individuals with diabetic retinopathy exhibited greater RNFL thinning than those without retinopathy, supporting the concept that retinal neurodegeneration progresses alongside diabetic retinal disease. A moderate negative correlation between diabetes duration and RNFL thickness further reinforced the relationship between disease chronicity and retinal neuronal loss.

These findings emphasize the importance of early retinal evaluation in diabetic patients and support the growing evidence that diabetic retinal disease is not solely a microvascular disorder but also a neurodegenerative condition. Spectral Domain Optical Coherence Tomography (SD-OCT) proved to be a reliable, non-invasive, and sensitive imaging modality for detecting early structural retinal changes. Incorporating OCT-based RNFL assessment into routine diabetic eye examinations may facilitate earlier identification of at-risk patients, improve monitoring strategies, and enable timely interventions aimed at preserving visual function and preventing progression to advanced diabetic retinal complications.

Limitations

Despite providing valuable insights into retinal neurodegeneration in Type 2 Diabetes Mellitus, this study has several limitations. First, the sample size was relatively small, comprising only 100 participants, which may limit the statistical power of the analysis and reduce the generalizability of the findings to broader populations. Larger studies are required to validate these results.

Second, the study employed a cross-sectional design, which allows assessment of associations but does not establish causal relationships between diabetes and RNFL thinning. Longitudinal follow-up studies would be necessary to evaluate the progression of retinal neurodegeneration over time and its temporal relationship with diabetic retinopathy.

Third, important indicators of glycemic control, particularly HbA1c levels and other metabolic parameters, were not assessed. Inclusion of these variables could have provided additional insight into the influence of metabolic status on RNFL thickness and retinal neuronal damage.

Future Recommendations

1. Conduct larger multicenter studies to improve reliability and generalizability of findings.

2. Perform longitudinal studies to evaluate RNFL changes over time and their relationship with diabetic retinopathy progression.

3. Include glycemic control parameters (e.g., HbA1c) to better understand metabolic influences on retinal neurodegeneration.

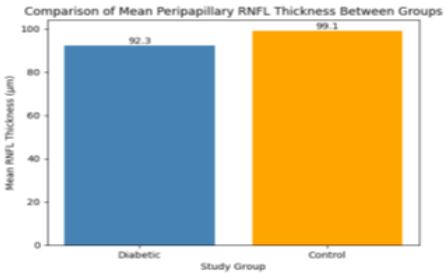
4. Combine OCT with functional retinal assessments such as visual field testing and electroretinography.

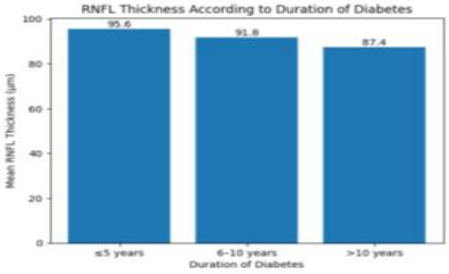
5. Explore routine OCT-based RNFL screening and potential neuroprotective interventions in diabetic patients.

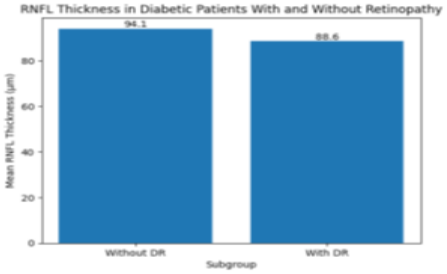
Scope and Strengths:

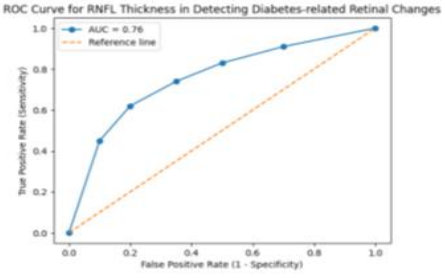
This study contributes to understanding the neurodegenerative component of diabetic retinal disease by evaluating RNFL thickness using SD-OCT in Type 2 Diabetes Mellitus patients. It highlights the value of OCT as a sensitive, non-invasive method for early detection of retinal neuronal damage, supporting its integration into diabetic eye screening programs. The findings provide local baseline data that may aid future comparative research and development of region-specific screening strategies.

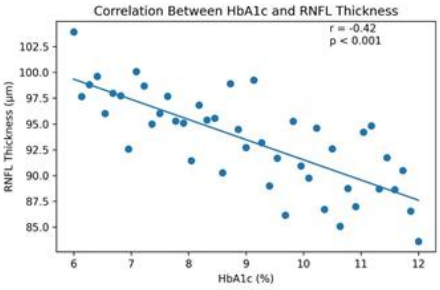
Key strengths include the use of standardized SD-OCT imaging, strict inclusion and exclusion criteria to minimize confounding factors, and age- and sex-matched healthy controls. The study also examined clinically relevant variables such as disease duration, diabetic retinopathy status, and quadrant-wise RNFL measurements. Appropriate statistical analyses further strengthened the reliability of the findings, supporting OCT-based RNFL assessment as a useful marker for early retinal neurodegeneration in diabetes.

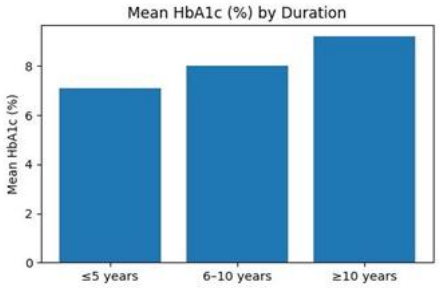












REFERENCES:

1. Mehboob MA, Amin ZA, Islam QU. Comparison of retinal nerve fiber layer thickness between normal population and patients with diabetes mellitus using optical coherence tomography. Pak J Med Sci. 2019 Jan-Feb;35(1):29-33.
2. Gaddewar N, Bharvesh B. Comparison of retinal nerve fibre layer thickness in diabetic patients with and without diabetic retinopathy. Res J Med Sci. 2024;17:272–277.
3. Zheng Y, He M, Congdon N. The worldwide epidemic of diabetic retinopathy. Indian J Ophthalmol. 2012;60(5):428–431.
4. International Diabetes Federation. IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation; 2021.
5. Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R, et al. Prevalence of diabetes and prediabetes in urban and rural India: results of the ICMR–INDIAB study. Diabetologia. 2011;54(12):3022–3027.
6. American Diabetes Association. Microvascular complications and foot care: Standards of medical care in diabetes. Diabetes Care. 2023;46(Suppl 1):S203– S215.
7. Feldman EL, Callaghan BC, Pop-Busui R, Zochodne DW, Wright DE, Bennett DL, et al. Diabetic neuropathy. Nat Rev Dis Primers. 2019;5(1):41.
8. Simó R, Hernández C. Neurodegeneration in the diabetic eye: new insights and therapeutic perspectives. Trends Endocrinol Metab. 2014;25(1):23–33.
9. Sohn EH, van Dijk HW, Jiao C, Kok PH, Jeong W, Demirkaya N, Garmager A, Wit F, Kucukevcilioglu M, van Velthoven ME, DeVries JH, Mullins RF, Kuehn MH, Schlingemann RO, Sonka M, Verbraak FD, Abràmoff MD. Retinal neurodegeneration may precede microvascular changes characteristic of diabetic retinopathy in diabetes mellitus. Proc Natl Acad Sci U S A. 2016 May 10;113(19):E2655-64.
10. Blumenthal EZ, Weinreb RN. Assessment of the retinal nerve fiber layer in clinical trials of glaucoma neuroprotection. Surv Ophthalmol. 2001;45(Suppl3):S305–S312
11. Aslam I, Qayyum S, Firdous M, Ullah S. Comparison of Retinal Nerve Fiber Layer Thickness in Diabetic Patients with and without Diabetic Retinopathy and Healthy Individuals using Ocular Coherence Tomography. Malaysian Journal of Medical Research. 2023 Jul.14;7(3):8-14.
12. Ascaso FJ, Marco S, Mateo J, Martínez M, Esteban O, Grzybowski A. Optical Coherence Tomography in Patients with Chronic Migraine: Literature Review andUpdate. Front Neurol. 2017;8:684