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Structural Evaluation of Retinal Nerve Fiber Layer and Bruch's Membrane Opening–Minimum Rim Width in Pseudoexfoliation Spectrum Disorders Using Spectral-Domain OCT

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Abstract

Purpose

To compare peripapillary retinal nerve fiber layer (RNFL) thickness and Bruch's membrane opening–minimum rim width (BMO-MRW) among eyes with pseudoexfoliation glaucoma (PXG), pseudoexfoliation syndrome (PXS) without glaucoma, and healthy eyes using spectral-domain optical coherence tomography (SD-OCT).

Methods

This retrospective, cross-sectional study included 34 eyes with PXG, 35 with PXS, and 35 age-matched healthy controls. All participants had previously undergone comprehensive ophthalmological examination and SD-OCT imaging with the Glaucoma Module Premium Edition. Global and sectoral RNFL and BMO-MRW measurements were reviewed.

Results

A total of 104 eyes were evaluated. RNFL thickness demonstrated a stepwise reduction from controls to PXS and PXG, with significant thinning in PXG eyes across global and sectoral measures ($p < 0.05$), except in the nasal sector. PXS eyes showed significant thinning only in the temporal-inferior sector compared to controls ($p = 0.004$). Global and sectoral BMO-MRW values were markedly reduced in PXG eyes compared to both PXS and controls (all $p < 0.001$). Notably, PXS eyes exhibited significant reductions in temporal-inferior, nasal-inferior, and nasal-superior BMO-MRW compared with controls. RNFL and BMO-MRW values were strongly correlated.

Conclusions

PXG eyes demonstrated pronounced RNFL and BMO-MRW thinning, consistent with extensive structural damage. PXS eyes exhibited localized BMO-MRW reductions despite preserved visual fields, suggesting early neuroretinal rim loss and potential preclinical glaucomatous changes. Combined RNFL and BMO-MRW assessment may improve early detection and monitoring of patients across the pseudoexfoliation spectrum.

Introduction

Pseudoexfoliation syndrome (PXS) is an age-related systemic disorder characterized by the deposition of extracellular fibrillar material on ocular structures, most prominently at the pupillary margin, lens capsule, and anterior chamber angle [1]. It is the most common identifiable cause of secondary open-angle glaucoma worldwide, referred to as pseudoexfoliation glaucoma (PXG) [2]. Compared to primary

open-angle glaucoma, PXG is typically associated with higher intraocular pressure (IOP), faster disease progression, and poorer visual prognosis [2].

The accumulation of pseudoexfoliative material leads to impaired aqueous humor dynamics, oxidative stress, and vascular dysregulation [3]. These mechanisms contribute not only to IOP elevation but also to direct damage to retinal ganglion cells and their axons [4]. Consequently, imaging biomarkers such as peripapillary retinal nerve fiber layer (RNFL) thickness and Bruch's membrane opening–minimum rim width (BMO-MRW) have become increasingly valuable for assessing structural glaucomatous changes [5]. Glaucoma Module Premium Edition (GMPE)raphy (SD-OCT), particularly with the Glaucoma Module Premium Edition (GMPE), enables precise quantification of these parameters and allows for detailed sectoral analysis.

Although previous studies have demonstrated RNFL and BMO-MRW thinning in glaucoma compared with healthy controls, the structural differences between PXS and PXG, as well as possible subclinical alterations in PXS eyes without glaucoma, remain less clearly defined [6–8]. Clarifying these differences may provide insights into disease pathogenesis and support earlier detection of progression from PXS to PXG.

The aim of this study was to evaluate and compare peripapillary RNFL thickness and BMO-MRW parameters among patients with PXG, PXS, and age-matched healthy controls using SD-OCT. We hypothesized that PXG eyes would show significant thinning in both global and sectoral parameters compared with PXS and control eyes, while PXS eyes might demonstrate subtle changes indicative of early or preclinical glaucomatous alterations.

Methods

This retrospective, cross-sectional, observational study included 34 eyes of 34 patients with PXG, 35 eyes of 35 patients with PXS, and 35 eyes of 35 healthy control subjects. Medical records of patients followed at the glaucoma outpatient clinic of tertiary hospital between August 2020 and July 2022 were retrospectively reviewed. Patients were eligible if they had undergone both OCT imaging and clinical examination during this period. Inclusion criteria were applied based on available OCT images and corresponding visual field tests. All OCT scans were retrieved from the Spectralis OCT database, and only images meeting predefined quality criteria were included. The study was conducted in accordance with the tenets of the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of tertiary hospital. Written informed consent was obtained from all participants prior to inclusion.

Only the right eye of participants with bilateral involvement and of control subjects was included in the analysis, while the affected eye was selected in unilateral cases. In patients with unilateral PXG and contralateral PXS, only the glaucomatous eye was included.

The PXG group included eyes with the presence of pseudoexfoliation material on the anterior lens capsule, pupillary margin, or anterior chamber angle, an IOP ≥ 21 mmHg prior to treatment, glaucomatous optic nerve head changes, and corresponding glaucomatous visual field defects.

The PXS group included eyes with pseudoexfoliation material on the anterior lens capsule, pupillary margin, or anterior chamber angle, but with a nonglaucomatous optic nerve head appearance (cup-to-disc ratio ≤ 0.4), normal visual fields, and normal diurnal IOP measurements (< 21 mmHg).

The control group consisted of age-matched healthy individuals with IOP < 21 mmHg, absence of pseudoexfoliation material, nonglaucomatous optic disc morphology (cup-to-disc ratio ≤ 0.3), and normal visual field test results.

Exclusion criteria for all groups included refractive errors greater than ± 3 diopters (spherical equivalent), presence of retinal or neuro-ophthalmological diseases, significant cataract interfering with image acquisition, history of ocular trauma, uveitis, previous intraocular surgery or laser treatment, and systemic diseases known to affect ocular physiology (e.g., diabetes mellitus, hypertension, vasculopathies).

All participants underwent a complete ophthalmological examination including best-corrected visual acuity (BCVA) assessment, slit-lamp biomicroscopy, applanation tonometry, dilated fundus examination, and standard automated perimetry (Humphrey Visual Field Analyzer, Carl Zeiss Meditec, Dublin, CA, USA).

Spectral-domain optical coherence tomography (SD-OCT) imaging was performed using the Spectralis OCT with Glaucoma Module Premium Edition (GMPE, Heidelberg Engineering, Heidelberg, Germany; software version 4.0). For BMO-MRW analysis, 24 radial B-scans centered on the optic nerve head (15° each) were acquired and aligned to the BMO–fovea axis using the internal fixation and positioning system.

The BMO-MRW was defined as the minimum distance between the Bruch's membrane opening (BMO) and the internal limiting membrane. Measurements were obtained globally and across six predefined sectors: temporal-superior (TS), nasal-superior (NS), temporal-inferior (TI), nasal-inferior (NI), temporal (T), and nasal (N). Automated segmentation was verified by an experienced examiner, and images with motion or segmentation artifacts were excluded. Peripapillary RNFL thickness was measured using the same module, centered on the BMO. Corresponding with the BMO-MRW sectors, global and six-sector Garway-Heath–based values were recorded.

Statistical Analysis

Statistical analyses were performed using Jamovi ver. 1.6 (Computer Software, www.jamovi.org). Quantitative variables were reported as mean and standard deviation and qualitative variables as percentages. Power calculation was not required due to the retrospective and exploratory nature of the

study. Normality of continuous variables was assessed using the Shapiro–Wilk test. The Pearson Chi-square test was used to analyze the distribution of sex and other categorical variables among the groups. Depending on normality, the ANOVA or Kruskal-Wallis test was used to compare age and the thickness parameters, followed by Tukey's post-hoc test for pairwise comparisons. Pearson correlation coefficients were calculated to assess relationships between continuous measurements. Strength of correlations was classified as follows: 0–0.19, very weak; 0.2–0.39, weak; 0.40–0.59, moderate; 0.60–0.79, strong; and 0.80–1.0, very strong.[9] A *p* value < 0.05 was considered statistically significant.

Results

A total of 104 eyes were analyzed: 34 with PXG, 35 with PXS, and 35 healthy controls. There were no significant differences among the groups regarding age, sex, lens status, or BCVA (p > 0.05Table-1). Mean IOP was significantly higher in the PXG group compared to other groups (p = 0.005, Table-1).

Analysis of peripapillary RNFL thickness demonstrated a stepwise reduction from controls to PXS and PXG eyes. This reduction was significant for global RNFL thickness and all the sectors except the nasal sector (p = 0.053 for the nasal sector and p < 0.05 for the remaining sectors; Table-2). Post-hoc analysis revealed that the PXG group was the primary contributor to these differences. Among PXS eyes, only the temporal-inferior sector showed a significant reduction compared to controls (p = 0.004).

Global and sectoral BMO-MRW thickness values were markedly lower in PXG eyes compared to PXS eyes and controls. All sectors and the global measurement demonstrated significant differences, with PXG eyes exhibiting the lowest values (p < 0.001for all, Table-3). In the temporal-inferior, nasal-inferior, and nasal-superior sectors, PXS eyes also showed significantly lower values compared with controls (p < 0.001, p = 0.037, and p = 0.008, respectively), indicating a gradient of thinning from PXG to PXS to controls.

Pearson correlation analysis demonstrated that correlations between BMO-MRW and peripapillary RNFL thickness measurements ranged from moderate to very strong, with a very strong correlation observed in the nasal-inferior sector (Table-4).

Discussion

In this cross-sectional study, we compared structural parameters among eyes with PXG, nonglaucomatous PXS eyes, and age-matched healthy controls using SD-OCT. Our main findings were that PXG eyes exhibited significantly reduced global and sectoral RNFL values as well as markedly lower BMO-MRW measurements compared to both PXS and control eyes. In contrast, PXS eyes showed largely preserved RNFL and BMO-MRW, with only subtle reductions in certain sectors, suggesting early or preclinical glaucomatous alterations. Importantly, BCVA, age, sex, and lens status were similar across groups, indicating that the observed differences were not confounded by these factors.

Previous studies have consistently demonstrated that PXG is associated with more severe structural and functional damage than primary open-angle glaucoma (POAG), attributable to higher IOP fluctuations, impaired trabecular meshwork outflow, and increased oxidative stress [1, 10, 11]. The significant reduction of RNFL thickness in PXG eyes in our study is consistent with earlier findings showing preferential thinning in the inferior and nasal quadrants [12]. Our results reinforce the utility of RNFL assessment as a sensitive marker for glaucomatous damage in the context of pseudoexfoliation.

BMO-MRW has recently emerged as a robust and anatomically precise measure of neuroretinal rim tissue, offering superior diagnostic performance over conventional disc-based measures [13]. In agreement with Faria Pereira et al.'s [14] report, we observed that global and sectoral BMO-MRW values were significantly lower in PXG eyes compared with both PXS and control eyes, with the greatest reductions in the temporal-inferior and nasal-inferior sectors. Interestingly, PXS eyes also showed reduced BMO-MRW in the temporal-inferior, nasal-inferior, and nasal-superior sectors relative to controls. The presence of localized rim thinning in PXS eyes, despite the absence of visual field defects, suggests early neuroretinal rim loss prior to detectable functional impairment, underscoring the need for close follow-up in this population.

Hepokur et al. [8] suggested that BMO-MRW measurements may be more sensitive than RNFL measurements for diagnosing PXG and PXS. Conversely, Ozcelik-Kose et al. [15] demonstrated superior diagnostic performance of RNFL measurements; however, they also observed significant reductions in BMO-MRW both globally and in three sectors of PXS eyes compared with controls, whereas RNFL differences were limited to a single sector. Similarly, Bambo et al. [16] showed that both BMO–MRW and peripapillary RNFL thickness measured with Spectralis OCT can effectively differentiate mild glaucoma from healthy eyes, with global thinning observed in glaucoma patients. However, their linear discriminant function combining BMO–MRW and peripapillary RNFL did not outperform the best single parameters. Saad Ullah et al. [17] further assessed the diagnostic accuracy of RNFL and MRW using cup-to-disc ratio as the gold standard in 300 patients, reporting that RNFL demonstrated slightly higher sensitivity (90.3%) and accuracy (90%) compared to MRW (87.9% sensitivity, 87.7% accuracy), while both showed equal specificity (81.8%). These findings suggest that although RNFL may be superior overall, MRW provides comparable value, particularly in myopic eyes. We observed similar findings: RNFL thickness was significantly reduced in only one sector of the PXS eyes compared with healthy controls, whereas BMO-MRW was reduced in three sectors. Taken together, these studies and our findings, despite some conflicting results, suggest that BMO-MRW is a promising tool for the diagnosis and follow-up of patients with PXG and PXS.

Moreover, our results highlight the complementary nature of RNFL and BMO-MRW assessments. While RNFL thickness reflects peripapillary axonal integrity, BMO-MRW directly quantifies neuroretinal rim tissue. The moderate-to-very strong correlations observed between these two OCT-derived parameters in our study support their combined use for comprehensive structural evaluation. Incorporating both measures may enhance diagnostic sensitivity and improve monitoring of disease progression in pseudoexfoliation spectrum disorders.

Overall, BMO-MRW measurements show notable differences in PXG compared with PXS and healthy eyes, suggesting they may help identify structural alterations associated with PXG, while RNFL analysis provides complementary information. The subtle sectoral changes detected in PXS eyes highlight the importance of close follow-up, as these eyes may be at increased of conversion to glaucoma.

Limitations of this study include its retrospective, cross-sectional design, which precludes assessment of longitudinal progression, and the relatively modest sample size.

In conclusion, PXG eyes show significant structural alterations in both RNFL and BMO-MRW compared with PXS and healthy eyes. Early BMO-MRW reductions in PXS eyes may indicate preclinical glaucomatous changes, underscoring the need for vigilant monitoring in this at-risk population.

Declarations

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Informed consent was obtained from patients regarding publishing their data and photographs.

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The authors declare that they have no conflict of interest.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

This study has not been published.

Declaration of interest

All authors have nothing to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations of beginning the submitted work that could inappropriately influence or be perceived to influence this work.

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The data that support the findings of this study are available on request from the corresponding author, [MT]. The data are not publicly available due to restrictions on their containing information that could compromise the privacy of research participants.

This study is approved by Ethic Commitee of Hitit University Medical School (2022-47 at 05.11.2022)

Author Contribution

M.T. and O.K. and H.Y. wrote the main manuscript text and M.T. prepared tables 1-4. All authors reviewed the manuscript.

Data Availability

The data that support the findings of this study are available on request from the corresponding author, [MT]. The data are not publicly available due to restrictions on their containing information that could compromise the privacy of research participants.

References

1. Tuteja S, Zeppieri M, Chawla H. Pseudoexfoliation Syndrome and Glaucoma. [Updated 2023 May 31]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK574522/
2. Yüksel N,Yılmaz Tuğan B. (2023). Pseudoexfoliation Glaucoma: Clinical Presentation and Therapeutic Options. *Turkish journal of ophthalmology*, *53*(4), 247–256. https://doi.org/10.4274/tjo.galenos.2023.76300.
3. Vazquez LE, Lee RK. (2014). Genomic and proteomic pathophysiology of pseudoexfoliation glaucoma. *International ophthalmology clinics*, *54*(4), 1–13. https://doi.org/10.1097/IIO.0000000000000047
4. Sarkis S, Chamard C, Johansen B, Daien V, Michon F. (2025). Challenging glaucoma with emerging therapies: an overview of advancements against the silent thief of sight. *Frontiers in medicine*, *12*, 1527319. https://doi.org/10.3389/fmed.2025.1527319
5. Zhuang I, Ashrafkhorasani M, Mohammadzadeh V, Nouri-Mahdavi K. (2024). Sources of Discrepancy between Retinal Nerve Fiber Layer and Bruch's Membrane Opening-Minimum Rim Width Thickness in Eyes with Glaucoma. *Ophthalmology science*, *5*(1), 100601. https://doi.org/10.1016/j.xops.2024.100601
6. Park D, Park SP, Na KI (2022). Comparison of retinal nerve fiber layer thickness and Bruch's membrane opening minimum rim width thinning rate in open-angle glaucoma. *Sci Rep*. 12(1):16069. doi:10.1038/s41598-022-20423-0
7. Amini N, Daneshvar R, Sharifipour F, et al.(2017) Structure-Function Relationships in Perimetric Glaucoma: Comparison of Minimum-Rim Width and Retinal Nerve Fiber Layer Parameters. *Invest Ophthalmol Vis Sci*.58(11):4623–4631. doi:10.1167/iovs.17-21936
8. Hepokur M, Elgin CY, Gunes M, Sali F, Oguz H. (2022) A comprehensive enhanced depth imaging spectral-domain optical coherence tomography analysis of pseudoexfoliation spectrum from non-glaucomatous to advanced stage glaucoma in the aspect of Bruch's membrane opening-minimum rim width. *Int Ophthalmol*. 42(6):1835–1847. doi:10.1007/s10792-021-02181-6

9. Evans, J. D Straightforward Statistics for the Behavioral Sciences. Brooks/Cole Publishing, Pacific Grove.1996
10. Kang E, Park JH, Yoo C, Kim YY. (2024) Comparison of intraocular pressure fluctuation and glaucoma progression rate between phakic and pseudophakic eyes in pseudoexfoliation glaucoma. *Sci Rep*. 14(1):6. doi:10.1038/s41598-023-49099-w
11. Pohjalainen T, Vesti E, Uusitalo RJ, Laatikainen L. (2001) Intraocular pressure after phacoemulsification and intraocular lens implantation in nonglaucomatous eyes with and without exfoliation. *J Cataract Refract Surg*.27(3):426–431. doi:10.1016/s0886-3350(00)00691-x
12. Rathinam N, Kasturi N, Kaliaperumal S, Jayaseelan V. (2023) Correlation between retinal nerve fiber layer thickness and anterior segment parameters in patients with pseudoexfoliation: A cross-sectional comparative study. *Oman J Ophthalmol*. 16(2):252–257. Published 2023 Jun 27. doi:10.4103/ojo.ojo_119_22
13. La Bruna S, Tsamis E, Zemborain ZZ, et al. (2020) A Topographic Comparison of OCT Minimum Rim Width (BMO-MRW) and Circumpapillary Retinal Nerve Fiber Layer (cRNFL) Thickness Measures in Eyes With or Suspected Glaucoma. *J Glaucoma*. 29(8):671–680. doi:10.1097/IJG.0000000000001571
14. Faria Pereira A, Mota Moreira P, Coelho-Costa I, Teixeira-Martins R, Estrela Silva S, Oliveira-Ferreira C. (2025) Retinal neurodegeneration, neuroretinal rim analysis and choroid thickness in pseudoexfoliation syndrome with spectral domain optical coherence tomography. *Sci Rep*. 15(1):11576. doi:10.1038/s41598-025-95082-y
15. Ozcelik-Kose A, Yildiz MB, Imamoglu S. (2022) Diagnostic Performance of Optical Coherence Tomography for Pseudoexfoliation Glaucoma. *J Glaucoma*. 31(8):651–658. doi:10.1097/IJG.0000000000002042.
16. Bambo MP, Fuentemilla E, Cameo B, et al. (2020) Diagnostic capability of a linear discriminant function applied to a novel Spectralis OCT glaucoma-detection protocol. *BMC Ophthalmol*. 20(1):35. doi:10.1186/s12886-020-1322-8
17. Saad Ullah M, Shaheen KH, Riaz M. (2023) Comparing Diagnostic Accuracy of Minimum Rim Width (MRW) and Retinal Nerve Fibre Layer (RNFL) in Detection of Glaucoma. *Med Forum* 34(12):24–27. doi:10.60110/medforum.341206.

Tables

Table 1

Demographic and clinical characteristics of the study population.

Parameter	PXG_ (Mean ± SD)	PXS_ (Mean ± SD)	Control (Mean ± SD)	p_value
Age (years)	70.14 ± 6.5	71.25 ± 6.29	71.16 ± 5.93	0.716
Sex (F/M)	16/18	16/19	15/20	0.569
IOP (mmHg)	18.2 ± 3.4	15.0 ± 2.3	14.7 ± 1.6	0.005
Best-Corrected Visual Acuity (logMAR)	0.11 ± 0.11	0.11 ± 0.09	0.12 ± 0.1	0.8385
Lens status (phakic/nonphakic)	18 / 16	17/18	12/23	0.264

IOP: Intraocular pressure, PXG: Pseudoexfoliation glaucoma, PXS: Pseudoexfoliation syndrome, SD: Standard deviation, F: female, M: male.
Significant p values are in bold.

Table 2

Comparison of global and sectoral peripapillary retinal nerve fiber layer thickness among the study groups

Parameter	PXG_ (Mean ± SD)	PXS_ (Mean ± SD)	Control (Mean ± SD)	p_value
RNFL_Global	93.4 ± 15.2	101.2 ± 10.0	103.7 ± 7.7	< 0.001
RNFL_Temporal	65.4 ± 10.5	71.2 ± 7.7	74.7 ± 6.8	0.002
RNFL_TS	119.9 ± 21.2	139.7 ± 15.9	139.9 ± 17.4	< 0.001
RNFL_NS	107.4 ± 16.8	117.2 ± 14.9	118.0 ± 11.3	0.002
RNFL_Nasal	69.9 ± 8.0	71.0 ± 6.9	73.5 ± 7.1	0.053
RNFL_NI	102.2 ± 15.4	114.6 ± 13.2	115.5 ± 12.3	< 0.001
RNFL_TI	121.2 ± 27.0	135.9 ± 19.5	140.9 ± 20.1	< 0.001

RNFL: Retinal nerve fiber layer, NI: Nasal inferior, NS: Nasal superior, TI: Temporal inferior, TS: Temporal superior, PXG: Pseudoexfoliation glaucoma, PXS: Pseudoexfoliation syndrome, SD: Standard deviation.
Significant p values are in bold.

Table 3

Comparison of global and sectoral BMO-MRW values among the study groups

Parameter	PXG (Mean ± SD, µm)	PXS (Mean ± SD, µm)	Controls (Mean ± SD, µm)	p value (ANOVA)
RNFL_Global	205.6 ± 60.2	340.2 ± 54.0	369.8 ± 60.4	< 0.001
RNFL_TS	184.5 ± 75.2	342.2 ± 60.2	349.3 ± 66.3	< 0.001
RNFL_NS	232.3 ± 79.0	398.8 ± 74.9	428.1 ± 84.1	< 0.001
RNFL_TI	196.4 ± 87.0	334.5 ± 80.5	413.1 ± 60.5	< 0.001
RNFL_NI	250.1 ± 77.7	404.2 ± 80.6	448.5 ± 82.7	< 0.001
RNFL_T	141.4 ± 37.5	248.3 ± 39.7	268.9 ± 53.2	< 0.001
RNFL_N	246.3 ± 77.9	370.5 ± 60.0	394.1 ± 76.0	< 0.001

BMO-MRW: Bruch's membrane opening–minimum rim width, N: Nasal, NI: Nasal inferior, NS: Nasal superior, T: Temporal, TI: Temporal inferior, TS: Temporal superior PXG: Pseudoexfoliation glaucoma, PXS: Pseudoexfoliation syndrome, RNFL: Retinal nerve fiber layer, SD: Standard deviation. Significant p values are in bold.

Table 4

Pearson correlation coefficients between BMO-MRW and peripapillary RNFL thickness

		RNFL						
		Global	TS	NS	TI	NI	T	N
BMO-MRW	Global	0.785**						
	TS		0.701**					
	NS			0.652**				
	TI				0.745**			
	NI					0.801**		
	T						0.589**	
	N							0.511**

BMO-MRW: Bruch's membrane opening–minimum rim width, N: Nasal, NI: Nasal inferior, NS: Nasal superior, T: Temporal, TI: Temporal inferior, TS: Temporal superior, PXG: Pseudoexfoliation glaucoma, PXS: Pseudoexfoliation syndrome, RNFL: Retinal nerve fiber layer, SD: Standard deviation. **Significant correlations at p < 0.005