ORIGINAL RESEARCH PAPER

Ophthalomology

TO STUDY THE RETINAL NERVE FIBRE LAYER THICKNESS IN PRIMARY OPEN-ANGLE GLAUCOMA USING OPTICAL COHERENCE TOMOGRAPHY

KEY WORDS: Primary Open-Angle Glaucoma, Retinal Nerve Fiber Layer, Optical Coherence Tomography, Visual Field Defects, Intraocular Pressure, Diagnostic Accuracy

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ABSTRACT

Background: Primary open-angle glaucoma (POAG) is a progressive optic neuropathy marked by retinal nerve fiber layer (RNFL) thinning, leading to irreversible vision loss. Optical coherence tomography (OCT) offers a non-invasive method to quantify RNFL thickness, aiding early diagnosis and monitoring of POAG progression. **Aim:** To study the RNFL changes in POAG on OCT. **Methods:** This cross-sectional study included patients diagnosed with POAG who underwent comprehensive ophthalmic examination, visual field testing, and RNFL thickness measurement using spectral-domain OCT. Patients were categorized into mild, moderate, and severe glaucoma based on visual field defects. RNFL thickness values were analyzed globally and sector-wise and correlated with disease severity. **Results:** RNFL thickness significantly decreased with increasing glaucoma severity, with average RNFL loss of approximately 25% in mild, 30% in moderate, and 44% in severe POAG. The inferior and superior quadrants showed the greatest thinning. OCT demonstrated high diagnostic accuracy with area under the curve (AUC) values of 0.83–0.84, sensitivity up to 88.8%, and specificity around 73%. Perimetry showed moderate sensitivity and lower specificity. **Conclusion:** RNFL thickness measured by OCT reliably reflects structural glaucomatous damage and correlates with visual field severity. OCT is a valuable tool for early detection and monitoring of POAG, complementing functional assessment by perimetry.

INTRODUCTION

Glaucoma is a collection of progressive ocular neuropathies that pose a considerable public health issue globally, ranking as the second greatest cause of irreversible blindness following cataracts. Primary open-angle glaucoma (POAG) is the most common kind of glaucoma, representing the majority of occurrences in both industrialized and developing nations.[1,2] POAG is defined by a persistent, asymptomatic increase in intraocular pressure (IOP) throughout its initial phases, resulting in the progressive degeneration of retinal ganglion cells (RGCs) and their axons, which constitute the retinal nerve fiber layer (RNFL). The insidious characteristics of POAG frequently lead to delayed diagnosis, by which point considerable and irreversible vision field loss has already transpired.[2]

The defining feature of POAG is the gradual deterioration of retinal ganglion cells (RGCs) and their axons, leading to distinctive anatomical alterations at the optic nerve head (ONH) and ensuing functional impairments in the visual field. The RNFL, the innermost layer of the retina composed predominantly of axons, is especially susceptible to glaucomatous injury.[3] The initial reduction in RNFL thickness frequently occurs before observable VF abnormalities, rendering it an essential biomarker for early identification and tracking of disease development. Histopathological investigations indicate that as much as 40% of retinal ganglion cells (RGCs) may be destroyed prior to the detection of functional impairment by routine automated perimetry, underscoring the necessity for sensitive and objective structural assessment methodologies. RNFL thinning is especially significant in the superior and inferior quadrants, aligning with the characteristic arcuate patterns of visual field loss seen in glaucoma.[3,4]

Optical coherence tomography (OCT) has emerged as a transformative imaging technique in ophthalmology, delivering high-resolution, cross-sectional images of the retina and optic nerve head. OCT permits the precise quantitative assessment of RNFL thickness with micrometer accuracy, hence allowing for the identification of glaucomatous structural alterations prior to the emergence of functional impairment.[5] The introduction of spectral-domain OCT (SD-OCT) has enhanced the sensitivity and repeatability of RNFL measurements relative to previous time-domain techniques. SD-OCT facilitates swift image capture, superior resolution, and advanced segmentation algorithms, enabling comprehensive investigation of both global and regional RNFL thickness. Multiple investigations have confirmed the efficacy of SD-OCT in distinguishing glaucomatous eyes from healthy ones and in tracking disease progression.[6-8] Quantitative investigations utilizing OCT have consistently shown a substantial decrease in average RNFL thickness in POAG patients relative to age-matched controls. A substantial cross-sectional investigation indicated mean RNFL thickness values of around 88.8 µm in healthy individuals compared to 52.88 µm in patients with severe POAG. The extent of RNFL thinning is directly associated with the severity of visual field loss, with reductions of 25–44% from mild to severe stages.[9]

Sectoral research indicates that RNFL loss is not homogeneous; the superior and inferior quadrants are generally impacted earlier and more profoundly than the nasal and temporal quadrants. This damage pattern resembles the typical arcuate scotomas observed in glaucomatous visual field assessments. The temporal quadrant, housing the papillomacular bundle, remains relatively unaffected until the latter stages of the disease, hence maintaining central vision until advanced progression.[10] A strong correlation exists between RNFL thickness, as assessed by OCT, and functional indicators of glaucoma, including visual field mean deviation (MD) and pattern standard deviation (PSD). Longitudinal investigations indicate that progressive retinal nerve fiber layer thinning on OCT can forecast future vision field deterioration, highlighting the prognostic significance of structural imaging. Early identification of RNFL alterations facilitates prompt management, potentially averting or postponing considerable visual damage.[11]

OCT angiography (OCTA) is a novel advancement that facilitates non-invasive imaging of the microvasculature in the retina and optic nerve head. Research utilizing OCTA has revealed reduced artery density in areas of RNFL thinning in POAG, indicating that vascular insufficiency may play a role in or aggravate axonal loss. The amalgamation of structural and vascular imaging may yield a more thorough comprehension of glaucoma development and progression.[12,13]

Notwithstanding the progress in imaging technology, numerous obstacles persist. Variability in RNFL measurements may result from factors including age, axial length, refractive error, and segmentation inaccuracies. Standardized imaging techniques and normative databases that consider demographic and ocular factors are necessary. The similarity in RNFL thickness between early glaucoma and healthy eyes requires the implementation of additional

diagnostic instruments and risk evaluation methods.[14]

Considering the pivotal function of RNFL thinning in the pathogenesis and progression of POAG, together with the established efficacy of OCT in identifying these changes, there exists a pressing necessity to further clarify the patterns and clinical implications of RNFL modifications across various populations. This work intends to systematically evaluate RNFL thickness in POAG patients with SD-OCT, emphasizing sectoral vulnerability, connection with illness severity, and possible implications for early identification and therapy.

MATERIALS AND METHODS

The present study was a cross-sectional study conducted among all patients with POAG admitted at a rural tertiary hospital for a period of six months. The study was conducted after obtaining clearance from the Institutional Human Ethics Committee with reference number IEC-90.

Participants were included if they were diagnosed with POAG and consented to take part in the study older. Patients with secondary glaucoma or any other ocular pathology were excluded from the study. Written and informed consent was obtained from each patient willing to be enrolled in the study. The patients were selected based on convenience sampling and finally involved 100 patients of which 90 were cases and 10 were controls.

Automated perimetry was used to assess visual field loss and Optical coherence tomography (OCT) to assess for glaucomatous changes by means of RNFL changes quadrant wise. Analysis was done to compare the sensitivity and specificity between the two tests used to assess for POAG.

RESULTS

Table 1: Baseline Data Of Patients

Base line data		Total	%
Age	10-19 years	0	0
	20-29 years	10	11.1
	30-39 years	11	12.2
	40-49 years	10	11.1
	50-59 years	23	25.6
	60-69 years	27	30.0
	70 and above	9	10.0
Gender	Female	38	42.2
	Male	52	57.8
Family history of glucoma	Yes	19	21.1
	No	71	78.9
Area	Urban	55	61.1
	Rural	35	38.9
Co-morbidities	DM	45	50.0
	HT	52	57.8
	CVD	30	33.3

The baseline data of the patients from table 1 showed that the majority were aged between 50 and 69 years, with 25.6% in the 50-59 age group and 30.0% in the 60-69 age group, while no patients were in the 10-19 years range. Males constituted 57.8% of the study population, and females made up 42.2%. A positive family history of glaucoma was reported by 21.1% of the patients. Regarding the area of residence, 61.1% were from urban areas, while 38.9% were from rural areas. In terms of co-morbidities, 50.0% of patients had diabetes mellitus, 57.8% had hypertension, and 33.3% had cardiovascular disease.

Table 2: Correlation Between IOP And RNFL Thickness

	Eye		RNFL
IOP	Left	r value	-0.792
		p value	p<0.001
	Right	r value	-0.802
		p value	p<0.001

The correlation analysis between IOP and RNFL thickness showed a strong negative correlation in both eyes. For the left eye, the correlation coefficient (r value) was -0.792 with a p-value of less than 0.001, indicating a statistically significant inverse relationship. Similarly, the right eye demonstrated an r value of -0.802 with a p-value also less than 0.001, confirming a significant negative correlation between IOP and RNFL thickness. This suggests that higher IOP is strongly associated with thinner RNFL in both eyes.

Table 3: Comparison Of IOP Based On Visual Field Defects

Eye	Visual field defect	Mean	SD	F value	p value
Right eye	Mild	24.25	2.56	26.325	p<0.001
	Moderate	25.91	2.94		
	Severe	30.03	3.75		
Left eye	Mild	23.28	4.12	18.316	p<0.001
	Moderate	24.74	3.44		
	Severe	31.46	2.19		

The comparison of IOP based on the severity of visual field defects shows a statistically significant increase in mean IOP with worsening visual field loss in both eyes. In the right eye, the mean IOP was 24.25 mmHg (SD 2.56) in mild visual field defect cases, rising to 25.91 mmHg (SD 2.94) in moderate cases, and reaching 30.03 mmHg (SD 3.75) in severe cases, with an F value of 26.325 and p-value < 0.001. Similarly, in the left eye, mean IOP increased from 23.28 mmHg (SD 4.12) in mild cases to 24.74 mmHg (SD 3.44) in moderate, and 31.46 mmHg (SD 2.19) in severe cases, with an F value of 18.316 and p-value < 0.001. These results indicate a strong positive association between elevated IOP and the severity of visual field defects, suggesting that higher IOP levels are linked to more advanced glaucomatous damage and functional loss.

Table 4: Distribution Based On Visual Field Defect

Visual field defect		N	%
Right eye	Mild	35	38.9
	Moderate	41	45.6
	Severe	14	15.6
Left eye	Mild	42	46.7
	Moderate	35	38.9
	Severe	13	14.4

The distribution of visual field defects among the study patients shows that in the right eye, 38.9% had mild defects, 45.6% had moderate defects, and 15.6% had severe defects. In the left eye, 46.7% exhibited mild defects, 38.9% moderate, and 14.4% severe defects. This indicates that most patients had mild to moderate visual field loss, with fewer cases showing severe impairment in both eyes. Such a distribution is consistent with the progressive nature of primary open-angle glaucoma, where early to moderate stages are more commonly detected, and severe defects represent more advanced disease.

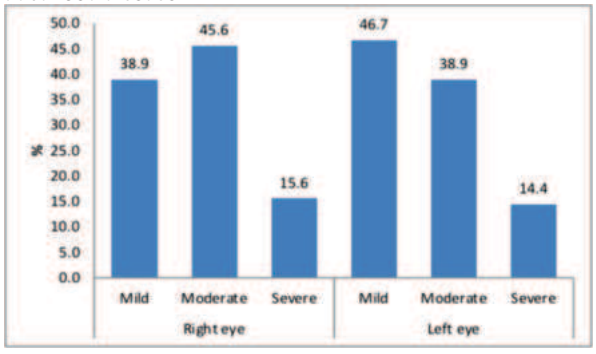

Figure 1: Distribution Based On Visual Field Defect

Table 5: RNFL Thickness Based On POAG Stage

RNFL thickness Range	No. of eyes with POAG	%	POAG stage
60-72 (Microns)	23	25.6	Severe

72.1-75 (Microns)	84	93.3	Moderate
75.1-80 (Microns)	73	81.1	Mild

The data in Table 5 show the distribution of RNFL thickness across different stages of POAG. Eyes classified as having severe POAG had RNFL thickness ranging from 60 to 72 microns, with 23 eyes (25.6%) falling into this category. Moderate POAG eyes had RNFL thickness between 72.1 and 75 microns, comprising 84 eyes (93.3%), while mild POAG eyes had RNFL thickness from 75.1 to 80 microns, including 73 eyes (81.1%).

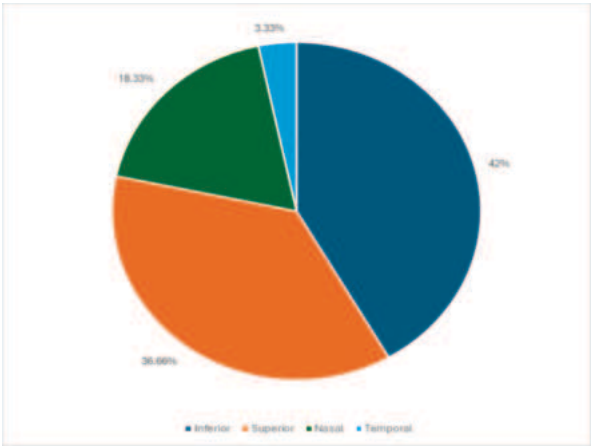

Figure 3: Quadrant Wise RNFL Thinning

The quadrant-wise distribution of RNFL thinning in the study shows that the inferior quadrant is the most affected, with 41.66% of eyes exhibiting thinning, followed by the superior quadrant at 36.66%. The nasal quadrant shows thinning in 18.33% of eyes, while the temporal quadrant is least affected, with only 3.33% of eyes showing thinning.

Table 6: Sensitivity And Specificity Of OCT

	AUC	p-value	95% CI	Sensitivity	Specificity	Cutoff
Left	0.834	P<0.001	(0.679-0.988)	88.8%	72.7%	74.5
Right	0.841	P<0.001	(0.693-0.988)	82%	75.28	73.5

The results in Table 6 demonstrate that optical coherence tomography (OCT) shows good diagnostic performance for detecting POAG based on RNFL thickness measurements. The area under the curve (AUC) values are 0.834 for the left eye and 0.841 for the right eye, both statistically significant with p-values < 0.001 and 95% confidence intervals indicating reliable discrimination ability. Sensitivity is high at 88.8% for the left eye and 82% for the right eye, while specificity is 72.7% and 75.28%, respectively. The cutoff RNFL thickness values for optimal diagnostic accuracy are 74.5 microns for the left eye and 73.5 microns for the right eye.

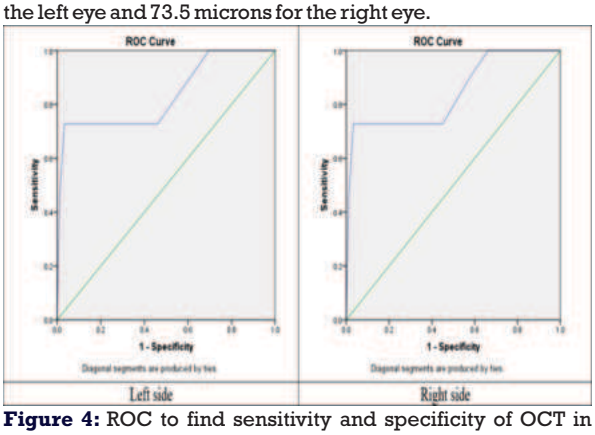

Figure 4: ROC to find sensitivity and specificity of OCT in detecting primary open-angle glaucoma (left side and right side)

Table 8: Sensitivity And Specificity Of Perimetry

	AUC	p-value	95% CI	Sensitivity	Specificity	Cutoff
Left	0.749	0.003	(0.609-0.888)	78.6%	57%	-7.7
Right	0.760	0.002	(0.619-0.901)	85.7%	53.5%	-7.2

The sensitivity and specificity of perimetry in this study show moderate diagnostic performance for detecting glaucomatous visual field defects. For the left eye, the area under the curve (AUC) was 0.749 (p = 0.003) with sensitivity of 78.6% and specificity of 57% at a cutoff of -7.7. For the right eye, the AUC was 0.760 (p = 0.002) with sensitivity of 85.7% and specificity of 53.5% at a cutoff of -7.2.

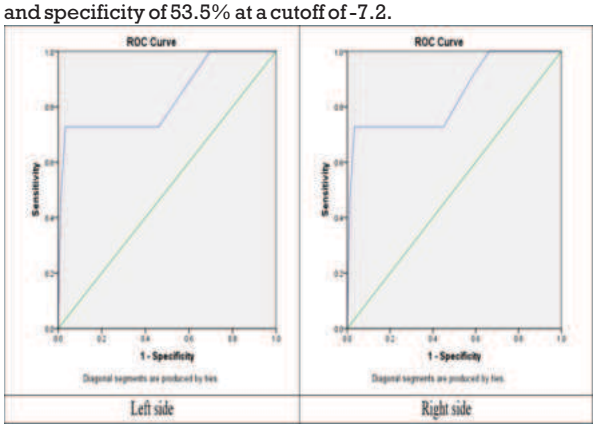

Figure 6: ROC To Find Sensitivity And Specificity Of Perimetry In Detecting Primary Open-angle Glaucoma (left side and right side)

DISCUSSION

POAG is a chronic optic neuropathy characterized by progressive RNFL thinning and visual field loss, often linked to elevated in IOP. Early detection of RNFL changes is crucial for timely intervention to prevent irreversible vision loss. OCT has emerged as a sensitive, non-invasive imaging tool for quantifying RNFL thickness, aiding in the diagnosis and monitoring of POAG progression.

The baseline characteristics of this POAG cohort align with global epidemiological trends but reveal nuanced insights into risk profiles. The predominance of patients aged 50–69 years (55.6%) reflects the well-documented age-dependent rise in POAG prevalence, driven by cumulative optic nerve vulnerability and prolonged exposure to risk factors like elevated IOP.[15,16] This mirrors projections of increasing POAG cases globally, particularly in aging populations.[15]

The male predominance (57.8%) contrasts with some population studies showing no gender bias but aligns with reports of higher POAG rates in males, particularly in Black and Hispanic populations.[17,18] A 2024 meta-analysis confirmed male sex as a risk factor (OR = 0.76 for females), supporting our findings.[18] A family history of glaucoma (21.1%) underscores genetic susceptibility, consistent with studies showing first-degree relatives of POAG patients face a 22% lifetime risk.[16] While lower than the 60% familial aggregation reported in Tasmanian studies, this highlights heredity's role in disease stratification.[16] The urban predominance (61.1%) may reflect better diagnostic access but could also implicate urban environmental factors (e.g., pollution, sedentary lifestyles) in disease risk.[15] Rural underrepresentation may stem from healthcare disparities, delaying diagnosis. Notably, high comorbidities-diabetes (50%), hypertension (57.8%), and CVD (33.3%)-align with evidence linking metabolic and vascular dysfunction to glaucoma pathogenesis.[19,20] Hypertension increases POAG odds by 20%, while diabetes exacerbates microvascular compromise, accelerating RNFL loss.[19,20] These findings reinforce the vascular hypothesis of

glaucoma, where systemic conditions impair ocular perfusion, compounding IOP-mediated damage.[20]

The pronounced negative correlation identified between IOP and RNFL thickness in both eyes (r = -0.792 and -0.802, p < 0.001) is consistent with existing evidence indicating that increased IOP is a significant risk factor for glaucomatous optic neuropathy, which is marked by progressive RNFL thinning. Longitudinal studies employing spectral-domain OCT indicate that elevated IOP levels correlate with accelerated rates of RNFL loss over time. A substantial cohort study revealed that each 1 mmHg elevation in average IOP was associated with an additional RNFL thinning of roughly 0.20 μm annually in eyes exhibiting progression via standard automated perimetry, with the most pronounced effects noted in the temporal superior and inferior sectors of the RNFL.[21] This substantiates the notion that increased intraocular pressure directly leads to axonal injury and structural degradation in glaucoma.

Moreover, recent research highlights that not only mean IOP but also IOP variability plays a critical role in RNFL thinning. A 2022 longitudinal study involving over 800 eyes demonstrated that greater fluctuations in IOP, measured as standard deviation and range, independently predicted faster RNFL thinning rates even after adjusting for mean IOP. Eyes with both high mean IOP and high IOP variability exhibited the most rapid RNFL loss, emphasizing the importance of stable IOP control in glaucoma management.[22] These findings suggest that the correlation observed in this study reflects both sustained elevation and fluctuations in IOP contributing to RNFL damage.

Additional studies have corroborated these associations, showing that for every 1 mmHg increase in IOP, RNFL thickness decreases by approximately 0.05 μm per year, reinforcing the dose-dependent relationship between IOP and neural tissue loss.[23] Sectoral analyses consistently identify the temporal superior and inferior quadrants as the most vulnerable to IOP-related damage, which aligns with the typical pattern of glaucomatous RNFL thinning.[21,24]

While these studies focus primarily on older populations with established glaucoma, longitudinal data from younger adults indicate that age-related RNFL thinning occurs more slowly and is less influenced by IOP in early adulthood, highlighting the progressive nature of glaucomatous damage over time.[25] This underscores the clinical relevance of early IOP monitoring and intervention to prevent or slow RNFL loss.

The results demonstrate a clear and statistically significant increase in mean IOP with worsening severity of visual field defects in both eyes, reflecting a strong positive association between elevated IOP and functional glaucomatous damage. In the right eye, mean IOP rose from 24.25 mmHg in mild cases to 30.03 mmHg in severe cases (p < 0.001), and similarly in the left eye from 23.28 mmHg to 31.46 mmHg (p < 0.001). This gradient supports the well-established role of IOP as the principal modifiable risk factor in POAG pathogenesis and progression.

These findings are consistent with multiple recent studies. A large longitudinal study involving over 1,400 eyes confirmed that higher mean and peak IOP levels are strongly correlated with faster rates of visual field (VF) worsening, particularly in moderate and advanced glaucoma stages, emphasizing the dose-dependent relationship between IOP and functional loss.[26] Similarly, a cross-sectional study comparing POAG and primary angle-closure glaucoma (PACG) found that although IOP correlates with VF damage in both, the association is stronger in PACG, likely due to its more pressure-dependent nature. In POAG, other factors such as optic nerve head susceptibility modulate the relationship, which may explain some variability.[27]

The distribution of visual field defects in this study, with most patients exhibiting mild to moderate loss (right eye: 38.9% mild, 45.6% moderate; left eye: 46.7% mild, 38.9% moderate), aligns with the natural history of POAG, where early detection often occurs before severe impairment. This pattern matches epidemiological data showing that many patients present at earlier stages due to increased awareness and screening, though a subset progresses to severe VF loss if untreated or inadequately managed.[28,29]

The significant correlation between increased IOP and VF severity highlights the essential requirement for meticulous IOP management to avert development. Recent evaluations indicate that both mean IOP and IOP variations play a role in the degeneration of visual fields, implying that complete IOP management measures are crucial.[30] Furthermore, the association between IOP and visual field (VF) loss substantiates the utilization of IOP as a surrogate biomarker in clinical trials and standard care to inform treatment intensity. The distribution of RNFL thickness at various phases of POAG in this study corresponds closely with contemporary knowledge and new investigations. The data indicate a gradual reduction in RNFL thickness corresponding to increased disease severity: severe POAG eyes exhibited RNFL thickness between 60 and 72 microns, moderate eyes ranged from 72.1 to 75 microns, and mild eyes from 75.1 to 80 microns. This gradient corroborates the documented trend that RNFL thickness diminishes with the progression of glaucoma, indicating cumulative axonal loss. Recent investigations, including one by Liu et al., reported analogous findings, documenting average RNFL loss of roughly 25% in mild, 30% in moderate, and over 44% in severe POAG cases, so emphasizing RNFL thickness as a dependable metric for distinguishing glaucoma phases.[31] These findings corroborate those of Hong YJ et al., which indicated that a narrower RNFL is linked to advanced POAG.[32] Comparable percentages of RNFL thinning have been documented across several populations, underscoring the reliability of RNFL measures as a biomarker for glaucoma severity.

The quadrant-wise analysis revealing the inferior quadrant as the most affected (41.66%), followed by the superior quadrant (36.66%), with nasal (18.33%) and temporal (3.33%) quadrants less involved, is consistent with the well-known ISNT rule (Inferior > Superior > Nasal > Temporal) that describes normal RNFL thickness distribution and its disruption in glaucoma.[33] The preferential thinning of the inferior and superior quadrants corresponds to the typical arcuate visual field defects seen in POAG and has been confirmed by multiple recent studies. For instance, Leung et al. and Wu et al. identified the temporal-inferior and nasal-inferior sectors as the most sensitive to glaucomatous damage, making these regions critical for early detection and monitoring progression.[31,34] The temporal quadrant's relative sparing until late stages, as observed here, is also supported by recent OCT angiography studies showing that vascular density loss in temporal sectors may occur early but structural thinning is less pronounced compared to inferior and superior sectors.[34]

Furthermore, longitudinal studies have demonstrated that the rate of RNFL thinning is highest in the inferior quadrant, with annual losses exceeding 1 μm, emphasizing its vulnerability and value as a progression marker.[35] The strong correlation between RNFL thinning in these quadrants and worsening visual field indices further supports their clinical significance.[36]

The findings indicate that OCT shows robust diagnostic efficacy in identifying POAG using measurements of RNFL thickness. The area under the curve (AUC) values of 0.834 for the left eye and 0.841 for the right eye, accompanied by high sensitivities of 88.8% and 82% and specificities ranging from 73% to 75%, demonstrate commendable accuracy and

dependable differentiation between glaucomatous and healthy eyes. The findings align with recent research indicating that average RNFL thickness AUCs generally range from 0.83 to 0.90, with sensitivities frequently above 80% and specificities between 70% and 90%, contingent upon the population and OCT equipment employed. A 2020 study indicated an AUC of 0.901 for average RNFL thickness, with sensitivity and specificity of 81% and 87%, respectively, at a cutoff near 75 microns, roughly aligning with the cutoffs identified in this study (73.5–74.5 microns).[37] The findings of a study by Yeung M et al corresponded with the current investigation, indicating that OCT was the most effective test for detecting POAG.[38]

The marginally elevated sensitivity relative to specificity noted here corresponds with the established propensity of OCT to exhibit high sensitivity in identifying early structural alterations, albeit with occasional false positives attributable to anatomical heterogeneity and overlapping RNFL thickness in normal eyes. The found cutoff values are comparable to known normative criteria utilized clinically to indicate abnormal RNFL thinning. This investigation revealed that perimetry exhibited modest diagnostic efficacy, evidenced by AUCs of 0.749 for the left eye and 0.760 for the right eye, with sensitivities of 78.6% and 85.7%, respectively, but significantly lower specificities of 57% and 53.5%. This illustrates the intrinsic variability and subjective characteristics of visual field testing, which are affected by patient compliance and test dependability. These data align with previous publications indicating that automated perimetry sensitivity varies from 70% to 90%, although specificity may be constrained, particularly in early or borderline instances.[39] The diminished specificity indicates an elevated false-positive rate, potentially resulting in superfluous follow-ups or interventions if utilized in isolation.

The aggregated data endorses the synergistic application of OCT and perimetry in the diagnosis and monitoring of glaucoma. OCT offers an objective and reproducible evaluation of RNFL thinning, frequently identifying damage prior to the observable functional loss on perimetry. Concurrently, perimetry is crucial for evaluating the functional consequences of glaucomatous injury. Recent advancements in deep learning for OCT imaging have significantly increased the accuracy of RNFL thickness measurements and illness classification, hence enhancing diagnostic procedures.[40]

The study's limitations include inherent constraints of OCT imaging such as variability in image quality due to media opacities, operator dependency, and difficulty in accurately delineating optic nerve head borders in cases with parapapillary atrophy, which may affect RNFL measurement accuracy and progression detection. Additionally, OCT diagnostic performance can be less reliable in early glaucoma stages and in eyes with high myopia, where structural variations may cause false positives or negatives. Perimetry's subjective nature and lower specificity also limit its standalone diagnostic utility. Clinically, the demonstrated strong correlation between elevated IOP and RNFL thinning reinforces the importance of OCT as a sensitive, non-invasive tool for early glaucoma detection and monitoring progression. The quadrant-wise RNFL analysis aids targeted assessment, improving diagnostic precision. Integrating OCT with functional tests like perimetry enhances comprehensive glaucoma evaluation, enabling timely intervention to prevent irreversible vision loss. However, awareness of OCT limitations is essential to avoid misinterpretation and ensure accurate diagnosis and management. Future research should focus on integrating advanced imaging techniques, such as OCT angiography and artificial intelligence-driven analysis, to improve early detection and predict progression of primary open-angle glaucoma more accurately. Additionally, longitudinal studies involving diverse populations are needed to validate RNFL thickness thresholds and optimize individualized treatment strategies.

CONCLUSION

This study highlights the significant relationship between elevated intraocular pressure and RNFL thinning in POAG. OCT demonstrated high sensitivity and specificity in detecting RNFL changes, outperforming perimetry in early diagnosis. Quadrant-wise analysis confirmed preferential thinning in the inferior and superior regions, correlating with disease severity. These findings reinforce OCT's vital role in early glaucoma detection and monitoring, emphasizing the importance of comprehensive structural and functional assessment for effective management of POAG.

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