VOLUME - 13, ISSUE - 11, NOVEMBER - 2024 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Ophthalomology

TO STUDY THE FINDINGS OF SPECTRAL DOMAIN OPTICAL COHERENCE TOMOGRAPHY IN HEALTHY AND GLAUCOMA PATIENTS

Dr. Kehkashan Siddiqui*	Junior Resident, Department Of Ophthalmology, B.j Government Medical College And Sassoon Hospital Pune *Corresponding Author
Dr. Sanjeevani Ambekar	Professor & Hod, Department Of Ophthalmology, B.j Government Medical College And Sassoon Hospital Pune

ABSTRACT

Background: - Glaucoma is the leading cause of global blindness second to cataracts. Including refractive errors, glaucoma is one of the top three main causes of visual impairment around the world. **Purpose:** - To study the finding of spectral domain optical coherence tomography in Healthy and glaucoma patients. Methods: - This is hospital-based prospective observational study involving 116 participants aged between 18 and 80 years, divided into two groups: - Control and Glaucoma. Peripapillary RNFL thickness was measured using the Optic Disc Cube 200 × 200 scanning protocol of the Cirrus OCT model 500. **Results:** - A total of 116 participants (58 glaucoma and 58 healthy controls, 55% male) were included. Intraocular pressure (IOP) was significantly higher in glaucoma patients (24 ± 0.05 mmHg). Include finding of OCT RNFL in healthy and glaucoma patients. **Conclusion:** - SD-OCT effectively detects RNFL thinning in glaucoma patients, highlighting its diagnostic value. Normal group follows the normal rule of RNFL thickness (inferior> superior> nasal > temporal). Glaucoma group exhibited generalized thinning of RNFL thickness, with the most pronounced reduction observed in the inferior quadrant, followed by the superior, nasal, and temporal quadrants.

KEYWORDS : Glaucoma, Spectral Domain OCT, RNFL.

INTRODUCTION

Glaucoma is a multifactorial optic neuropathy defined by the gradual degeneration of retinal ganglion cells (RGCs), potentially leading to vision loss and irreversible blindness. It manifests as distinct visual field defects and is characterized by the loss of RGCs and their axons, which form the retinal nerve fiber layer (NFL).[1] The World Health Organization estimates that 285 million people worldwide are visually impaired, including 39 million who are blind and 249 million with low vision.[2] Notably, 80% of these cases of low vision and blindness are preventable or treatable.[3]

Detecting structural loss is key to diagnosing and managing glaucoma. While optic nerve head (ONH) and retinal nerve fiber layer (RNFL) damage can be subjectively assessed, ocular imaging technologies now provide objective, quantitative evaluations of ocular structures.[4,5]

Optical coherence tomography (OCT) is highly effective in detecting early glaucomatous structural damage, providing objective and reproducible measurements of the RNFL and optic nerve head. A single broad-field OCT can achieve early diagnosis with excellent sensitivity and specificity. Functional damage can also be detected early with sensitive perimetry techniques. Studies suggest that combining structural and functional tests can enhance diagnostic sensitivity.[6,7]

Spectral domain OCT (SD-OCT) improves glaucoma assessment over time domain OCT (TD-OCT) by providing higher axial resolution and faster scanning, minimizing eye movement artifacts. While SD-OCT shows improved reproducibility, its diagnostic accuracy for glaucoma is statistically similar to TD-OCT.[8,9]

SD-OCT has ability to evaluate macular parameters is significant, as the macula contains about 50% of RGCs. Additionally, SD-OCT's 3D datasets allow for more accurate ONH evaluation and better detection of glaucoma progression through precise image registration.[10,11]

The primary aim of this study is to examine the findings of SD-OCT in healthy individuals and glaucoma patients.

MATERIALS AND METHODS

This hospital-based prospective observational study was carried out at our tertiary care center, enrolling 116 participants aged between 18 and 80 years, divided into two groups. The control group exhibited RNFL thickness that adhered to the ISNT rule (Inferior > Superior > Nasal > Temporal). In contrast, patients with glaucoma demonstrated generalized RNFL thinning in all quadrants, particularly more pronounced in the inferior and superior quadrants. Cases of normal-tension glaucoma (NTG), a history of trauma, coexisting retinal diseases, and congenital ocular conditions were excluded from the study.

With Institutional Ethics Committee approval and informed consent, each enrolled patient received a comprehensive evaluation, including clinical history, best-corrected visual acuity, slit-lamp biomicroscopy, gonioscopy, Goldmann applanation tonometry, and posterior segment ophthalmoscopy.

Peripapillary RNFL thickness was measured with the Cirrus OCT model 500 using the Optic Disc Cube 200 × 200 protocol, scanning a 6 × 6 mm^2 area centered on the optic disc. A circular scan with a diameter of 3.46 mm, consisting of 256 A-scans, was automatically targeted around the optic disc to provide RNFL thickness measurements for the four quadrants and each of the 12 clock-hour positions. All images were obtained by the same experienced technician, ensuring a signal strength ratio greater than 6/10.

RESULTS

In this study, a total of 116 patients were recruited and divided into two groups: Control and Glaucoma, with 58 cases in each group. The mean age of participants in the control group was 56.07 ± 1.5 years, while the glaucoma group had a mean age of 58.95 ± 1.25 years (p-value = 0.01). Approximately 55% of participants in both groups were male. An important finding was that intraocular pressure was significantly higher in glaucoma patients, measuring 24 ± 0.05 mmHg, compared to 18 ± 0.23 mmHg in the control group (p-value = 0.004).

Table 1 demonstrates that the control group had a significantly higher average retinal nerve fiber layer (RNFL) thickness of 84.57 m, whereas the glaucoma group exhibited a much lower average thickness of 45.57 m. In the control group, the inferior quadrant had the greatest thickness at 131.52 m, followed by the superior quadrant at 123.22 m, the nasal quadrant at 116.33 m, and the temporal quadrant at 84.03 m. In contrast, in the glaucoma group, the temporal quadrant had the highest thickness at 52.33 m, followed by the nasal quadrant at 46.81 m, the superior quadrant at 44.71 m, and the inferior quadrant at 41.81 m (p-value- 0.001). Overall, the glaucoma group showed a significant reduction in RNFL thickness across all quadrants compared to the control group.

Table 1. Comparison Of Control And Glaucoma Groups

Sr. No	Variable	Control	Glaucoma	P value
		Mean	Mean	
1	Age	56.07± 1.5 years	58.95± 1.25years	0.01
2	Gender	Male – 54%	Male- 55%	0.94
		Female- 46%	Female- 45%	
4	IOP	18± 0.23 mm of Hg	24± 0.05 mm of Hg	0.004

Table 2 illustrates that the maximum RNFL thickness in the control group was at H12 (137.26 m), while the highest in the glaucoma group was at H9 (52.48 m). Notably, there was significant thinning observed at H5, H6, H10, and H12 in the glaucoma group. (Fig. 1)

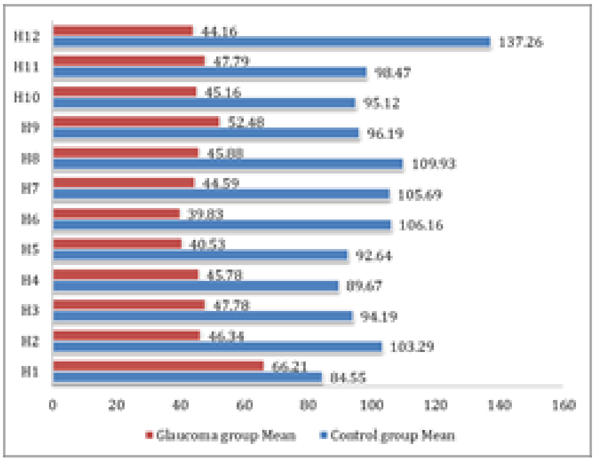

Fig. 1 Mean of RNFL clock hours in normal group vs Glaucoma group

Table 2. Mean of RNFL clock hours in normal group vs Glaucoma group

RNFL clock hours	Control	Glaucoma
	Mean	Mean
H1	84.55	66.21
H2	103.29	46.34
H3	94.19	47.78
H4	89.67	45.78
H5	92.64	40.53
H6	106.16	39.83
H7	105.69	44.59
H8	109.93	45.88
H9	96.19	52.48
H10	95.12	45.16
H11	98.47	47.79
H12	137.26	44.16
Average RNFL Thickness	84.57	45.57

Overall, the glaucoma group showed a substantial reduction in RNFL thickness across all clock hours, indicating significant nerve fiber loss, a hallmark of glaucomatous damage.

DISCUSSION

The significance of glaucoma is underscored by studies showing that one in two affected individuals is unaware of their condition. Therefore, understanding its prevalence, geographic distribution, and associated risk factors is crucial for identifying at-risk populations and ensuring they receive appropriate interventions.

In the current study, the mean age of participants in the control group was 56.07 ± 1.5 years, while the glaucoma group had a mean age of 58.95 ± 1.25 years, with a statistically significant difference ($p = 0.01$). Age is widely recognized as a major risk factor for glaucoma, a finding consistently supported by numerous studies, including those by Zhong H et al[12], Abadia B et al[13], and Hashemi H et al.[14]

In the present study, intraocular pressure (IOP) was significantly higher in glaucoma patients (24 ± 0.05 mmHg) compared to the control group (18 ± 0.23 mmHg) with a p-value of 0.004. These findings are consistent with those of Zhou Q et al.[15] and Kawase K et al.[16]

The present study found significant RNFL thinning in the glaucoma group, with mean values of 40.53 at H5, 39.83 at H6, 44.59 at H7, and 45.88 at H8. Thinning was most pronounced in the inferior quadrant (H6), followed by H12, aligning with the findings of Ndidi-Amaka EO et al.[17] and Tian T et al.[18] Our study identified a significant association between RNFL clock hours H5, H6, H10, and H12 and average RNFL thickness in the glaucoma group, with p-values of 0.04, 0.02, 0.04, and 0.03, respectively. These findings are consistent with those reported by Ndidi-Amaka EO et al.[17]

CONCLUSIONS

Glaucoma can impact individuals irrespective of gender, with the likelihood of developing the condition growing as they age. Raised intraocular pressure is a significant risk factor. All peripapillary RNFL thickness measurements obtained with Cirrus OCT showed significant differences between healthy individuals and glaucoma patients. Normal group follows the normal rule of RNFL thickness (inferior> superior> nasal > temporal). Glaucoma group exhibited generalized thinning of RNFL thickness, with the most pronounced reduction observed in the inferior quadrant, followed by the superior, nasal, and temporal quadrants.

REFERENCES:

1. Ajtony C, Balla Z, Somoskeoy S et al. Relationship between Visual Field Sensitivity and Retinal Nerve Fiber Layer Thickness as Measured by Optical Coherence Tomography. Invest Ophthalmol Vis Sci. 2007;48(1):258-263.
2. North R. Global causes of blindness and visual impairment. Optician. 2011;241:31-38.
3. World Health Organization. Elimination of avoidable blindness: report by the Secretariat. Fifty-sixth World Health Assembly, provisional agenda item 14.17. Geneva: WHO; 2003 April 28. Report No.: A56/26.
4. Quigley HA, Miller NR, George T. Clinical evaluation of nerve fiber layer atrophy as an indicator of glaucomatous optic nerve damage. Archives of Ophthalmology. 1980;98:1564–1571.
5. Sommer A, Miller NR, Pollack I. The nerve fiber layer in the diagnosis of glaucoma. Archives of Ophthalmology. 1977;95: 2149–2156.
6. Brandao LM, Ledolter AA, Schötzau A et al. Comparison of Two Different OCT Systems: Retina Layer Segmentation and Impact on Structure-Function Analysis in Glaucoma. J Ophthalmol. 2016;2016:8307639.
7. Brandao LM, Ledolter AA, Schötzau A et al. Comparison of Two Different OCT Systems: Retina Layer Segmentation and Impact on Structure-Function Analysis in Glaucoma. J Ophthalmol. 2016;2016:8307639.
8. Wong JJ, Chen TC, Shen LQ et al. Macular imaging for glaucoma using spectral-domain optical coherence tomography: a review. Semin Ophthalmol. 2012;27:160–166.
9. Mansouri K, Leite MT, Medeiros FA et al. Assessment of rates of structural change in glaucoma using imaging technologies. Eye. 2011;25:269–277.
10. Quigley HA, Katz J, Derick RJ et al. An evaluation of optic disc and nerve fiber layer examinations in monitoring progression of early glaucoma damage. Ophthalmology. 1992;99:19–28.
11. Juhani AP, Drance DM et al. Diffuse and localized nerve fiber loss in glaucoma. American journal of ophthalmology. Am J Ophthalmol. 1984;98(5), 566-571.
12. Zhong H., Li J., Li C. The prevalence of glaucoma in adult rural Chinese populations of the Bai nationality in Dali: the Yunnan minority eye study. Invest Ophthalmol Vis Sci. 2012;53(6):3221–3225. doi: 10.1167/iovs.11-9306
13. Abadia B, Ferreras A, Calvo P et al. Relationship between Spectral-Domain Optical Coherence Tomography and Standard Automated Perimetry in Healthy and Glaucoma Patients. BioMed Research International. 2014:1-7; ID 514948.
14. Hashemi H, Mohammadi M, Zandvakil N, Khabazkhoob M, Emamian MH, Shariati M, Fotouhi A. Prevalence and risk factors of glaucoma in an adult population from Shahroud, Iran. J Curr Ophthalmol. 2018 Jun 6;31(4):366-372. doi: 10.1016/j.joco.2018.05.003. PMID: 31844784; PMCID: PMC6896457.
15. Zhou Q, Liang YB, Wong TY. Intraocular pressure and its relationship to

ocular and systemic factors in a healthy Chinese rural population: the Handan eye study. Ophthalmic Epidemiol. 2012;19(5):278–284. doi: 10.3109/09286586.2012.708084.

16. Kawase K., Tomidokoro A., Araie M., Iwase A., Yamamoto T. Ocular and systemic factors related to intraocular pressure in Japanese adults: the Tajimi study. Br J Ophthalmol. 2008;92(9):1175–1179. doi: 10.1136/bjo.2007.128819.
17. Ndidi-Amaka EO, Estrela T, Naithani R et al. Comparison of 10-2 and 24-2 Perimetry to Diagnose Glaucoma Using OCT as an Independent Reference Standard. AAOphthalmology Glaucoma. 2023;6:187-197.
18. Tian T, Cai Y, Li M et al. A Comparison Among Microperimetry, Standard Automated Perimetry and Spectral Domain Optical Coherence Tomography in the Evaluation of the Macula in Glaucoma Eyes with Hemifield Defects. Ophthalmology and Therapy. 2021;11(1):239–248.