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Original /Research Article

RETINAL NERVE FIBER LAYER AND VISUAL FIELD ASSESSMENT IN PRIMARY OPEN ANGLE GLAUCOMA A DETAILED CROSS-SECTIONAL EXAMINATION

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ABSTRACT:

Aims and objectives: This study aims to comprehensively investigate the relationship between visual field impairments and Retinal Nerve Fiber Layer (RNFL) thickness across all stages of primary open-angle glaucoma (POAG).

Methods" A cross-sectional observational study was conducted on primary open-angle glaucoma (POAG) patients attending a tertiary eye center in western India. Patients were categorized into groups based on Hodapp, Parrish, and Anderson's criteria. 52 eyes (26 patients) with POAG were included in the study, comprising 26 (50%) right eyes and 26 (50%) left eyes.

Result : The average age of patients in the early, moderate, and severe groups was 50.41 ± 17.06 years, 63.90 ± 8.65 years, and 59.75 ± 7.15 years, respectively. RNFL thickness was compared among early, moderate, and severe POAG cases, revealing values of 86.48 ± 9.15, 70.57 ± 8.65, and 52.93 ± 12.43, respectively. VF indices were also compared, with mean deviation (MD) values of -2.65 ± 1.29, -8.25 ± 1.87, and -19.45±4.30 for early, moderate, and severe cases, respectively. Significant correlations were observed between structural (superior, inferior, average RNFL thickness) and functional (VF MD) changes, while nasal and temporal RNFL thickness and MD exhibited moderate correlation.

Conclusion: This study demonstrated the important role of optical coherence tomography in the early detection of lost RNFL thickness in glaucoma by establishing a correlation between structure and changes, especially RNFL thickness and visual function. This finding not only improves our understanding of the development of glaucoma but also suggests the use of OCT and perimetry as important tools in clinical management.

Key words: OCT, VF, RNFL

INTRODUCTION: Primary open-angle glaucoma (POAG) is a thief of sight, a chronic eye disease that progressively damages the optic nerve, often without noticeable symptoms until significant vision loss occurs.

Early detection and management are crucial to preserve vision.

This study delves into the relationship between visual function and nerve fiber integrity across different stages of POAG, employing a comprehensive cross-sectional design.

AIM: This study aims to comprehensively investigate the relationship between visual field impairments and Retinal Nerve Fiber Layer (RNFL) thickness across all stages of primary open-angle glaucoma (POAG).

OBJECTIVES:

1. Analyse visual field data in primary open-angle glaucoma (POAG) stages.
2. Compare retinal nerve fiber layer thickness using advanced imaging across POAG stages.
3. Investigate correlations between visual field defects and RNFL thickness alterations in POAG progression.

METHODOLOGY

- **Cross-sectional study:** Analyzed participants at one point in time.
- **Participants:** 52 eyes (26 patients) with diagnosed POAG.
- **Data Collection:**
    - **Structure:** SD-OCT measured peripapillary RNFL thickness.
    - **Function:** Humphrey Field Analyzer assessed visual field (VF) defects.
- **Analysis:**
    - Patients categorized by POAG severity (e.g., early, moderate, severe).
    - RNFL thickness & VF indices (MD) compared across stages.
    - Correlations between RNFL & MD explored.
    - **Statistical Analysis:** SPSS software

RESULTS

- 52 eyes (26 patients) with POAG were included in the study, comprising 26 (50%) right eyes and 26 (50%) left eyes.

- Age distribution among subjects was between 40-88 years, with a mean age of 56.65 years and a standard deviation of 11.43 years.

TABLE 1: AGE-WISE DISTRIBUTION OF EYES

AGE GROUP	NO. OF EYES
40-49	15 (29%)
50-59	12 (23%)
60-69	20 (38%)
70-79	4 (8%)
80-89	1 (2%)

TABLE 2: STAGE-WISE DISTRIBUTION OF EYE

STAGE	NO. OF EYES
MILD	34 (66%)
MODERATE	10 (19%)
SEVERE	8 (15%)

TABLE 3: SHOWS MEAN AND STANDARD DEVIATION IN DIFFERENT STAGES OF GLAUCOMA

STAGE	AGE (YEARS)
MILD	50.41 ± 17.06
MODERATE	63.90 ± 8.65
SEVERE	59.75 ± 7.15

TABLE 4: SHOWS DISTRIBUTION OF VISUAL FIELD DEFECTS (N=52)

VISUAL FIELD DEFECT	NO OF EYES (PERCENTAGE %)
WNL(WITHIN NORMAL LIMIT)	20(38%)
SUPERIOR ARCUATE SCOTOMA	15(29%)
INFERIOR ARCUATE SCOTOMA	6(11%)
BIARCUATE SCOTOMA	3(6%)
GENERALIZED DEPRESSION	5(10%)
MACULAR SPLIT	3(6%)

TABLE 5: SHOWS DISTRIBUTION OF EYES BASED ON HODAPP, PARRISH, AND ANDERSON CLASSIFICATION AND THEIR AVERAGE MEAN DEVIATION AND STANDARD PATTERN DEVIATION

MEAN DEVIATION	SEVERITY OF GLAUCOMA	NO OF EYES(%)	AVERAGE MEAN DEVIATION(DB)	AVERAGE PATTERN STANDARD DEVIATION(DB)
<6 Db	MILD GLAUCOMA	34(66%)	-2.65 ± 1.29	2.63±1.30
6-12 Db	MODERATE GLAUCOMA	10(19%)	-8.25 ± 1.87	6.61±2.56
>12 Db	SEVERE GLAUCOMA	8(15%)	-19.45±4.30	11.81±2.35

TABLE 6: RNFL THICKNESS AND AVERAGE CUP DISC RATIO OF EYES DIVIDED BASED ON THE SEVERITY OF GLAUCOMA

RNFL THICKNESS (µM)	MEAN ± SD ALL PATIENTS	MILD GLAUCOMA	MODERATE GLAUCOMA	SEVERE GLAUCOMA	MILD VS MODERATE GLAUCOMA (P-VALUE)	MODERATE VS SEVERE (P-VALUE)
AVERAGE	78.75±15.18	86.41±9.15	70.57±11.29	56.37±12.21	<0.00001	0.019
INFERIOR QUADRANT	97.01±26.66	111.52±14.82	80.5±21.80	56±13.20	<0.00001	0.018 (p<0.05)
SUPERIOR QUADRANT	96.51±22.80	107.82±15.87	88.3±17.64	61.87±16.26	0.0025 (p<0.05)	0.0048 (p<0.05)
NASAL QUADRANT	63.32±10.27	65.47±9.81	61.6±7.12	52.62±13.50	0.25	0.033
TEMPORAL QUADRANT	58.13±12.55	61.58±11.66	58.9±10.60	46.±8.68	0.22	0.013
AVERAGE CD RATIO	0.71±0.12	0.67±0.12	0.76±0.09	0.84±0.03	0.035	0.031

Correlation between visual field analysis with HFA and RNFL thickness

- Average RNFL showed a statistically significant decrease as the severity of glaucoma increased. (table 4)

1. Between moderate and severe glaucoma, the thickness of sectoral RNFL decreased gradually in all sectors, which was statistically significant.
2. Between mild and moderate glaucoma, only the inferior and superior sectors of RNFL showed statistical significance.

The average RNFL thickness values in nasal and temporal sectors showed a decrease between mild and moderate glaucoma and it was not statistically significant. Thus, there is an inverse relationship between the severity of glaucoma and average and sectoral RNFL thickness, in which average RNFL thickness can be considered as the most important RNFL parameter.

DISCUSSION:

• In primary open-angle glaucoma (POAG) patients at all stages, our study examined the association between visual field (VF) defects and retinal nerve fiber layer (RNFL) thickness. The results are consistent with earlier studies showing that as POAG worsens, the RNFL gradually thins and the VF damage worsens [1, 2].

Comparison with Reference Studies:

- **RNFL thinning and glaucoma severity:** The current study shows a significant decrease in RNFL thickness with worsening POAG severity, which is consistent with earlier research [3, 4]. The use of RNFL thickness measurement, such as SD-OCT, as a structural marker of glaucomatous damage is supported by this finding.
- **VF defects and glaucoma severity:** Similar to prior studies [5.6], I observed a correlation between glaucoma severity and VF defects. Their results showed a higher prevalence of normal VF and less severe arcuate scotomas in mild POAG compared to moderate and severe stages.
- **RNFL-VF correlations:** The current study supports the link between RNFL damage and VF loss as reported in earlier studies [7,8]. Their findings demonstrate a statistically significant correlation between thinner RNFL and worse mean deviation (MD) in VF testing.

- Our results confirm the importance of RNFL evaluation in the diagnosis and follow-up of glaucoma. For POAG patients to avoid vision loss, early detection and intervention are essential. Future research could look into how well different treatment approaches maintain RNFL thickness and visual function.

LIMITATIONS

- **Cross-sectional design:** This study design offers a snapshot at a one-time point, limiting the ability to determine cause-and-effect relationships between RNFL and VF changes. Longitudinal studies would be beneficial to track these changes over time.

- **Sample size:** The relatively small sample size (52 eyes) might limit the generalizability of the findings to a broader population. Studies with larger cohorts could strengthen the conclusions.

CONCLUSION

- This study highlights the importance of OCT in the early detection of glaucoma by demonstrating a correlation between RNFL thinning and visual field loss with disease severity. This finding improves our understanding of glaucoma development and emphasizes using OCT and perimetry for clinical management. Future studies could track patients over time and explore additional factors to refine treatment.

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