Original Research Article

Study of correlation of retinal nerve fiber layer thickness and optic disc parameters with visual field changes in glaucoma suspects and diagnosed cases of primary open angle glaucoma

Latha C[1], Praveen Kumar G S[2*]

[1,2]Assistant Professor, Department of Ophthalmology, Shridevi Institute of Medical Sciences and Research Hospital, NH-4, Bypass Road, Tumkur-572106, INDIA.
Email: lathumc@gmail.com

Abstract

Background: POAG is a major worldwide health concern, because of its usually silent, progressive nature. It is one of the leading preventable causes of blindness in the world. Purpose: To study the correlation of retinal nerve fibre layer thickness and optic disc parameters with visual field changes in Glaucoma suspects and Primary Open Angle Glaucoma. **Materials and Methods:** It was a hospital based, prospective, non-randomised case study of 30 eyes of 30 Glaucoma suspect patients and 30 eyes of 30 Primary open angle Glaucoma for duration of 1 year. **Results:** The mean age of patients in POAG group were 54.40±7.51 and in suspect group were 50.90±6.14. Correlation of RNFL thickness and Visual field indices in suspects showed no correlation between two parameters. In POAG, the average RNFL was highly correlated with mean deviation (r = 0.832). Correlation of optic disc parameters and visual field changes in suspects showed no correlation between 2 parameters. In POAG group, Horizontal Integrated rim width, CD ratio were highly correlated with mean deviation (r = 0.502), (r =0.499). The rim area was moderately correlated with mean deviation (r = 0.461). **Conclusion:** OCT is capable of detecting changes at the level of RNFL in Glaucoma suspects with normal appearing discs and visual fields. OCT can serve as a useful guideline in diagnosis, management, prognostication and research in Glaucoma.

Key Word: Glaucoma suspect, POAG, RNFL thickness, visual field indices.

***Address for Correspondence:**
Dr. Praveen Kumar G S, Assistant Professor, Department of Ophthalmology, Shridevi Institute of Medical Sciences and Research Hospital, NH-4, Bypass Road, Tumkur-572106, INDIA.
Email: lathumc@gmail.com

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INTRODUCTION

Primary open angle glaucoma is a chronic, bilateral and often asymmetrical disease in adults in whom acquired loss of optic nerve fibres and abnormality in the visual field occurs with an open anterior chamber angle of normal appearance and an intraocular pressure which is detrimental to the structural and functional integrity of optic nerve head[1]. POAG is a major worldwide health concern, because of its usually silent, progressive nature. It is one of the leading preventable causes of blindness in the world. With appropriate screening and treatment, glaucoma usually can be identified and its progress arrested before significant effects on vision occur. Examining and monitoring the optic nerve head and the RNFL, structurally and functionally is important for diagnosis and treatment[2].Clinically, visual field loss often correlates with nerve fibre layer loss and optic nerve damage. The natural evolution of primary open-angle glaucoma implies the loss of ganglion cells and their axons in the retina. It is well established that significant amount of ganglion cell death (25 to 30%) occurs before any visual field defect is produced, thus giving rise to the

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concept of pre- perimetric glaucoma[3,4,5]. Optical Coherence Tomography is a non-invasive, non-contact technique of measuring thickness of retinal nerve fibre layer. It provides potential means for quantification of RNFL thickness and also for detection and documenting progression of RNFL loss. Careful evaluation of the optic nerve head and RNFL is crucial in glaucoma, not only for diagnosis, but also for providing information about the location and severity of visual field damage. OCT may be useful in glaucoma screening in high risk group[2, 3, 6]. The purpose of this study is to help in early detection and monitoring progression of Glaucoma.

AIMS AND OBJECTIVES

The objectives of this study were to assess and correlate the retinal nerve fibre layer thickness, optic disc parameters with visual field changes in Glaucoma suspects and Primary Open Angle Glaucoma. To detect early structural changes in Glaucoma suspects.

MATERIALS AND METHODS

It was a hospital based, prospective, non-randomised case study of 30 eyes of 30 Glaucoma suspect patients and 30 eyes of 30 Primary open angle Glaucoma over duration of 1 year .All patients needed to undergo a detailed clinical evaluation including Snellen's visual acuity testing, Refraction, Evaluation of intraocular pressure by Goldmann's applanation tonometry, Slit lamp biomicroscopy of anterior segment, Gonioscopy using sussmen lens, fundus evaluation using 90D lens/Indirect ophthalmoscopy, Stratus Optical Coherence Tomography, Humphrey Field Analyzer.

Inclusion criteria: Patients suspected and diagnosed with primary open angle glaucoma.

Exclusion criteria: Normotensive glaucoma, Angle closure glaucoma, Secondary glaucomas like lens related glaucoma, iris neovascularisation, trauma., Macular degenerations/maculopathies, Optic neuritis, Arteritic ischemic optic neuropathy, Chorioretinal degeneration, Toxic amblyopia. Unreliable and unco-operative patients were also excluded. All OCT scans were performed through a dilated pupil. Scan protocols used were Fast Optic Disc Scan and Fast RNFL Thickness protocol. Visual field testing was performed by Humphrey Field Analyser using Swedish interactive threshold algorithm, Strategy 30-2, threshold test pattern. Statistical Methods: Descriptive statistical analysis has been carried out in the present study. Student t, Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. Pearson correlation of OPD and RNFL parameters in POAG and RNFL thickness is performed to assess the relationship.

OBSERVATION AND RESULTS

Table 1: distribution of patients based on age.

Age in years	POAG		SUSPECT	
	No	%	No	%
40-49	10	33.3	11	36.7
50-59	9	30.0	16	53.3
60-69	11	36.7	3	10.0
Total	30	100.0	30	100.0
Mean ± SD	54.40±7.51		50.90±6.14	

This table shows the age wise distribution of patients included in our study. The mean age of patients in POAG group were 54.40±7.51 and in suspect group were 50.90±6.14.

Table 2: Comparison of Optic Disc Parameters Among Poag And Suspect

ODP	POAG	SUSPECT	P value
Vertical Integrated rim area(mm^3)	0.14±0.19	0.18±0.13	0.328
Horizontal Integrated rim width(mm^2)	1.09±0.32	1.42±0.41	0.001**
DA(mm2)	2.82±0.33	2.91±0.43	0.458
CA(mm2)	1.92±0.50	1.87±0.51	0.707
RA(mm2)	0.89±0.29	1.27±0.25	<0.001**
C/D RATIO	0.72±0.12	0.62±0.10	0.001**
CD ratio Horizontal	0.83±0.09	0.69±0.09	<0.001**
CD ratio Vertical	0.78±0.07	0.67±0.07	<0.001**

Comparison of optic disc parameters between POAG and suspects, showed Horizontal Integrated rim width, rim area and cup disc ratio parameters to be statistically significant ($P<0.05$). The other parameters were not statistically significant.

Table 3: comparison of rnfl thickness among poag and suspect.

RNFL thickness	POAG	SUSPECT	P value
Superior RNFL	78.93±26.2	106.33±7.09	<0.001**
Inferior RNFL	76.90±30.27	99.53±8.74	0.021*
Temporal RNFL	48.07±14.16	60.63±12.03	<0.001**
Nasal RNFL	59.40±15.50	68.4±13.72	<0.001**
Average RNFL	66.81±13.51	83.51±2.83	<0.001**

Average RNFL thickness in POAG was found to be 66.81±13.51 and in suspects was 83.51±2.83. This was shown to be statistically significant (P<0.05).

Table 4: comparison of visual field indices among poag and suspect

VF	POAG	SUSPECT	P value
MD(decibels)	-15.49±8.26	-2.82±0.73	<0.001**
PSD(decibels)	7.75±2.80	2.20±0.65	<0.001**

Results are presented in Mean ± SD This table depicts comparison of Mean deviation indices. In POAG, the mean deviation was found to be –15.49±8.26 and in suspects -2.82±0.73. This was shown to be statistically significant (P<0.05).

Table 5: correlation of optic disc parameter and visual fields among poag and suspect

ODP	Visual fields			
	POAG		SUSPECT	
	MD	PSD	MD	PSD
Vertical Integrated rim area(mm^3)	0.254	-0.005	0.072	-0.102
Horizontal Integrated rim width(mm^2)	0.502**	-0.027	0.034	-0.142
DA(mm2)	0.231	-0.521*	-0.324	0.109
CA(mm2)	-0.063	-0.271	-0.186	0.070
RA(mm2)	0.461*	-0.177	-0.175	0.041
C/D RATIO	-0.499**	0.069	0.179	0.076
CD ratio Horizontal	-0.701**	0.100	0.094	0.064
CD ratio Vertical	-0.440**	0.056	0.090	0.113

Values are Pearson correlation r values * Significant ** Strongly in Significant +Suggestive of significance. Correlation of optic disc parameters and visual field changes in POAG, showed Horizontal Integrated rim width, CD ratio and mean deviation were highly correlated. Rim area and mean deviation were moderately correlated; the corresponding correlation coefficient was statistically significant. Correlation of optic disc parameters and visual field changes in suspects showed no correlation between 2 parameters.

Table 6: correlation of rnfl thickness and visual fields among poag and suspect

RNFL thickness	Visual fields			
	POAG		SUSPECT	
	MD	PSD	MD	PSD
Superior RNFL	0.786**	-0.237	0.078	0.068
Inferior RNFL	0556**	-0.306	0.028	-0.353
Temporal RNFL	0.460*	-0.028	-0.102	0.304
Nasal RNFL	0.447*	-0.094	0.009	-0.413
Average RNFL	0.832**	-0.314+	0.004	-0.262

Values are Pearson correlation r values * Significant ** Strongly in Significant+Suggestive of significance Correlation of RNFL thickness and Visual field indices in POAG showed, superior, Inferior, Average RNFL thickness and mean deviation were highly correlated. Nasal and temporal RNFL and mean deviation were moderately correlated, and the corresponding correlation coefficient was highly significant. Correlation of RNFL thickness and Visual field indices in suspects showed no correlation between two parameters.

DISCUSSION

Accurate and objective methods of detecting disc and RNFL abnormalities, and their progression, would facilitate the diagnosis and monitoring of glaucomatous optic neuropathy[7].In our study, we have analysed correlation of optic disc parameters and RNFL thickness with visual field changes in 30 eyes of 30 patients with Primary open angle glaucoma and 30 eyes of 30 Glaucoma suspect patients. In our study, the mean age in the suspect group was 50.90±6.14 and in POAG group was 54.40±7.51Optic disc parameters: Horizontal

Integrated rim width, rim area and cup disc ratio parameters were found to be statistically significant (P<0.05) between POAG and suspects. The other parameters were not statistically significant. RNFL thickness: Superior RNFL thickness in suspects was found to be 106.33±7.09 and in POAG was found to be 78.93±26.2 (P value <0.001). Inferior RNFL thickness in suspects was found to be 99.53±8.74 and in POAG was found to be 76.90±30.27 (P value 0.021). Temporal RNFL thickness in suspects was found to be 60.63±12.03 and in POAG was found to be 48.07±14.16. (P value <0.001). Nasal RNFL thickness in suspects was found to be 68.4±13.72 and in POAG was found to be 59.40±15.50 (P value <0.001). Average RNFL thickness in suspects was found to be 83.51±2.83 and in POAG was found to be 66.81±13.51 (p value <0.001).Visual field indices: The mean deviation in suspects was -2.82±0.73 and in POAG was -15.49±8.26 (P value <0.001). The pattern standard deviation in suspects 2.20±0.65 and in POAG was 7.75±2.80 (P value <0.001). Optic disc parameters and Visual field indices: Correlation of optic disc parameters and visual field changes in suspects showed no correlation between 2 parameters. In POAG group, Horizontal Integrated rim width was highly correlated with mean deviation (r = 0.502). The rim area was moderately correlated with mean deviation (r = 0.461). The CD ratio was highly correlated with mean deviation (r = 0.499). RNFL thickness and Visual field indices: Correlation of RNFL thickness and Visual field indices in suspects showed no correlation between two parameters. In POAG, the superior RNFL was highly correlated with mean deviation (r = 0.786), the Inferior RNFL was highly correlated with mean deviation (r = 0.556) the temporal RNFL was moderately correlated with mean deviation (r = 0.48). The nasal RNFL was moderately correlated with mean deviation (r = 0.447). The average RNFL was highly correlated with mean deviation (r = 0.832). Christopher Bowd *et al*, analysed results of 30 normal, 30 ocular hypertensive and 30 glaucoma patients. Mean RNFL was significantly thinner in ocular hypertensive eyes than normal eyes, 72.8µ (66.4 to 78.1) and 85.8µ (80.2 to 91.7) respectively. More specifically, RNFL was significantly thinner in ocular hypertensive eyes than in normal eyes in inferior quadrant. 84.8µ (75.6 to 94.0) versus 107.6µ (99.3 to 115.9). It is possible that thinner RNFL in the inferior quadrant of ocular hypertensive eyes is an early form of glaucoma that precedes detectable optic nerve and VF defects. RNFL was significantly thinner in glaucoma eyes than in ocular hypertensive eyes and normal eyes throughout 360 degrees and in all quadrants[8]. Study by Badlani Vandana et. al, highlights measurement of retinal nerve fibre layer thickness has potential for detection of early nerve fibre loss owing to glaucoma[9].

CONCLUSION

In glaucoma suspects, RNFL thinning was present with minimal or no visual field sensitivity loss. In POAG group, the RNFL thickness and optic disc parameters were well correlated with visual field changes. OCT is capable of detecting changes at the level of RNFL in Glaucoma suspects with normal appearing discs and visual fields. OCT has been shown to obtain accurate and reproducible RNFL thickness measurement. OCT has been shown to have greater diagnostic accuracy in RNFL measurements. OCT can serve as a useful guideline in diagnosis, management, Prognostication and research in Glaucoma.

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