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Original Research Article

SD-OCT guided analysis of retinal nerve fibre layer in ammetropes in central India

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A R T I C L E I N F O

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A B S T R A C T

Introduction: The retinal nerve fibre layer is a most crucial indicator of optic nerve damage in glaucoma as it advances visual field loss. Thickness of the RNFL can be measured using high resolution OCT. We conducted this study to evaluate the alterations in retinal nerve fibre layer thickness measured by SD- OCT in ametropes and to find various factors affecting RNFL thickness.
Aim: Study of retinal nerve fibre layer thickness (RNFL) by Optical Coherence Tomography (OCT) in ametropes in tertiary care hospital of central India.
Setting and Design: Hospital based prospective observational study included 300 eyes of 150 participants. Visiting ophthalmology outpatient department Gandhi medical college and fulfilling the inclusion and exclusion criteria.
Materials and Methods: Patients were divided into five groups of 60 eyes each on the basis of refractive status of eyes into emetropia, low hypermetropia, moderate hypermetropia, low mypopia and moderate mypopia. Subjects were subjected to OCT scan and RNFL thickness was measured. All groups were evaluated and observations were noted and results were analysed.
Statistical Analysis used: To find the association between degree of ametropia and RNFL thickness one way ANOVA test was used. Correlation between axial length and RNFL was assesed by pearson correlation coefficient. p value <0.05 was considered as significant.
Result: RNFL thickness in different groups followed ISNT rule with inferior quadrant showing the greatest thickness followed by the superior, nasal and temporal quadrants. The average RNFL thickness in emmetropics, Low hyperopic, Moderate hyperopic, Low myopic, Moderate myopic was 111.90μm, 110.58 μm, 114.59 μm, 103.33 μm, 93.33 μm respectively, wheras average axial length was 23.85mm, 22.36mm, 21.33mm, 24.72mm, 25.63mm.
Conclusion: With the help of OCT, we can differentiate the changes in RNFL thickness in various refractive errors. So, the refractive status of the eye should be kept in mind before making any ocular diagnosis in which the RNFL is a diagnostic criteria.

1. Introduction

The retinal nerve fibre layer is a most crucial indicator of optic nerve damage in glaucoma as it advances visual field loss.[1,2] Age,[3–5] gender,[6] axial length,[7–9] refractive status of the eye,[7–9] can affect the RNFL thickness. Optical Coherence Tomography (OCT) is a non-invasive technique which gives high resolution cross-sectional images of various ocular structures with an axial resolution of 10 microns. Thickness of the RNFL can be measured using high resolution OCT.[10,11]

Ametropia is defined as a state of refraction wherin the parallel rays of light coming from infinity are focussed

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either in front or behind the retina, in one or both the meridian, accomodation being at rest. It includes myopia, hypermetropia and astigmatism. It could be due to differences in axial length, corneal curvature, refractive index or abnormal position of lens. Studies reporting alteration in retinal thickness using optical coherence tomography (OCT) have been performed with various degrees of refractive error, producing inconsistent results. Therefore, we conducted this study to evaluate the alterations in retinal nerve fibre layer thickness measured by SD- OCT in myopic and hyperopic patients compared to emetropes and to find if there is any correlation between ametropia, axial length and RNFL thickness.

2. Materials and Methods

Subjects were recruited from the outpatient service of the Department of Ophthalmology, Gandhi medical college and associated hamidia hospital. This hospital based prospective observational study included 300 eyes of 150 participants. Informed consent was obtained from each subject. This study was performed after approval from the institutional review board and ethics committee. All subjects underwent a full medical and ocular history and a detailed ocular examination including measurements of visual acuity, intraocular pressure using the Goldman applanation tonometer, wet retinoscopy, subjective correction, slit lamp and fundus examinations. Axial length was measured using sonomed PACSCAN 300A digital biometric ruler.

Group 1 included 60 emetropic eyes. Group 2 comprised of 60 eyes of low hypermetropia (+0.75 to +3 D). Group 3 comprised of 60 eyes of moderate hypermetropia (+3.25 to + 6D). Group 4 comprised of 60 eyes of low mypopia (-0.75 to -3D) and Group 5 comprised of 60 eyes of moderate mypopia(-3.25 to -6D). Patients with corneal pathology, pre existing glaucoma, lenticular opacity, nystagmus, strabismus, retinal pathologies, status post refractive surgery, high myopia >6D, high hyperopia > 6D, astigmatism, amblypoia and patients of extremes of age (<15 and > 50 years) were excluded.

2.1. *Optical coherence tomography*

Subjects were subjected to OCT scan with a Stratus OCT. The OCT scan was performed by a single observer through a dilated pupil. Fast RNFL thickness protocols were carried out with internal fixation. The selected fundus image was adequate enough to distinguish the optic disc and the scanning circle. Images with poor scan quality, decentration, poor focus, low analysis confidence, or low signal strength (less than 7) were excluded. The analysis algorithm reported global RNFL thickness around the entire circumference, average thickness within the four quadrants (temporal, superior, nasal, and inferior).

All groups were evaluated and observations were noted in Table 1.

2.2. *Statistical test*

Descriptive statistical analysis has been carried out. Results on continous measurements were presented on Mean+/-SD and results on the categorical measurements were presented in number and percentage. Graphs and tables were generated using microsoft excel. To find the association between degree of ametropia and RNFL thickness one way ANOVA (analysis of variance) test of significance was used. Significance was assesed at 5% level of significance. Correlation between axial length and RNFL was assesed by pearson correlation coefficient. p value <0.05 was considered as significant.

3. Observation and Results

Total 150 subjects with 300 eyes fulfilling the inclusion criteria were studied.

Table 1 shows that RNFL was thicker in moderate hypermetropes and thinner in moderate myopes as compared to emetropes. On comparision of RNFL thickness between emetropia and low hyperopia, change in superior and inferior RNFL thickness was found to be statistically significant, wheras when compared between emetropia and moderate hyperopia, thickening was found to be statistically significant in all quardrants except inferior. On comparision of RNFL thickness between emetropia and low myopia, change in superior, nasal and global RNFL thickness was found to be statistically significant, wheras when compared between emetropia and moderate myopia, thickening was found to be statistically significant in all quardrants. The quadrant wise assesment of RNFL thickness in different groups followed ISNT rule with inferior quadrant showing the greatest thickness followed by the superior, nasal and temporal quadrants.

In Table 2 pearson coefficient showed moderately negative correaltion between axial length and RNFL in all quadrants except in nasal quadrant where it showed a weak correlation and p value is <0.0001 that means result is statistically strongly significant. It showed that, as axial length of eye increases, it leads to decrease in RNFL thickness.

Table 3 shows that ametropia affects RNFL thickness. Low and moderate hyperopia groups have thicker global average RNFL as compared to emetropes wheras low and moderate myopia groups have thinner average RNFL. Higher axial length have thinner RNFL as compared to smaller axial length which have thicker RNFL. Myopic subjects have longer average axial length wheras hypermetropic have shorter average axial length as compared to emetropes. In short, the amount of refractive error also correlates with the axial length of the eye.

Table 2: Comparision of axial length and RNFL thickness in all quadrants

Axial length	RNFL Average (micrometer)	RNFL superior (micrometer)	RNFLInferior (micrometer)	RNFLNasal (micrometer)	RNFLTemporal (micrometer)
19.1mm-20mm	124+/-9.24	137.94+/-12.93	157+/-14.31	103+/-9.86	98.51+/-7.95
20.1mm-21mm	116.52+/-9.17	135.94+/-12.71	151.52+/-14.09	94.35+/-9.85	84.44+/-7.81
21.1mm-22mm	110.94+/-9.16	132.61+/-12.72	145.08+/-14.14	92.61+/-9.79	81.44+/-7.81
22.1mm-23mm	111.38+/-9.46	129.97+/-13.55	143.77+/-14.89	91.57+/-9.79	80.2+/-7.85
23.1mm-24mm	111.44+/-9.18	132.20+/-12.78	145.59+/-14.15	89.38+/-9.90	78.75+/-7.88
24.1mm-25mm	104.86+/-9.23	122.2+/-12.68	133.71+/-14.20	86.87+/-9.92	76.57+/-8.24
25.1mm-26mm	99.83+/-9.23	118.16+/-12.72	130.19+/-14.12	82.35+/-9.92	70.92+/-8.16
26.1mm-27mm	89.19+/-9.90	100+/-13.60	114.82+/-15.75	80.17+/-10.11	63.47+/-7.98
(r) value	-0.447	-0.58	-0.56	-0.39	-0.57
P value	<0.001	<0.001	<0.001	<0.001	<0.001

Table 3: Comparison of average rnfl thickness and average axial length in the groups

Groups	Average RNFL (Micrometer)	Averageaxial length (Millimeter)
Group 1 (N=60) Emetropic	111.90	23.85
Group 2 (N=60) Low hyperopic	110.58	22.36
Group 3 (N=60) Moderate hyperopic	114.59	21.33
Group 4 (N=60) Low myopic	103.33	24.72
Group 5 (N=60) Moderate myopic	93.33	25.63

4. Discussion

To detect glaucoma in the early stage even before the field loss occurs (preperimetric glaucoma), several new instruments and techniques have developed in recent years. OCT being one of them, which uses near infrared beam (814nm). As per the current literature conflicting data existed regarding the influence of ametropia on RNFL thickness.

Some studies showed no correlation wheras others found significant association as measured by SD OCT. As the normative database of SDOCT largely comprise data collected from normal eyes with no or low myopia, interpreting the RNFL thickness deviation map in eyes with moderate to high myopia can be problematic. Myopic eyes may have thinner RNFL measurements and may lead to overdiagnosis of glaucoma and other retinal pathologies with RNFL affection. The present study was done with the aim to evaluate correlation between ametropia and peripapillary RNFL thickness as measured by SD OCT and to evaluate the correlation between the peripapillary RNFL thickness with axial length.

In our study, in patients with myopia progressive thinning of RNFL was seen as power increased whereas there was significant increase in RNFL thickness in patients with hypermetropia as the power increased. In both myopes and hypermetropes significant changes in RNFL thickness($p<0.01$) were observed when ametropia was of higher degree more than 3D.

In this study it was found that the axial length and RNFL thickness shares an inverse relationship such that there was significant decrease in Rnfl thickness as the axial length increased and vice versa. The quadrant wise evaluation of RNFL thickness in the different groups showed that all the groups followed ISNT rule irrespective of thickening and thinning of RNFL with respect of degree of ametropia.

Our current studies findings were consistent with Sung-won Choi et al,[12] Leung CK et al,[13] who studied peripapillary RNFL thickness in various groups of myopic patients using stratus OCT and concluded that peripapillary RNFL thickness significantly decreased with increase in myopia. Donald L Budenz et al[14] also showed that RNFL thickness was significantly related to both axial length and refractive error, whereas our study was inconsistent with that reported by Mrugacz et al,[15] who showed that as myopia increased, peripapillary RNFL remain unchanged. Since high myopia and glaucoma can independently cause RNFL thinning, therefore RNFL thickness have limited role as a diagnostic tool for glaucoma in high myopic patients.

5. Conclusion

RNFL thickness is affected by the refractive status and axial length of the eye. Thus, the contemporary normative database could be confusing while diagnosing glaucoma in ametropic patients. The normative RNFL thickness data for emmetropic, hypermetropic and myopic eyes provided by this study may assist in identifying changes in RNFL thickness in glaucoma and other diseases. RNFL thinning in myopes may be confused with glaucomatous RNFL thinning on SD-OCT, but it was observed that ISNT pattern remains unaffected in myopes, whereas in glaucomatous thinning, the ISNT rule is disturbed. Hence, in myopes with thinner RNFL, if the ISNT rule is disturbed then these patients should be labelled as glaucoma suspects and should be further investigated to rule out glaucoma.

Table 1: Comparision of ametropia with the various parameters

Parameter	**Group 1 N=60 Emetropic**	**Group 2 N=60low hypermetropia (< +3 D)**	**P value and significance**	**Group 3 N=60moderate hypermetropia (+3 to + 6D)**	**P value and significance**	**Group 4 N=60low mypopia (<-3D)**	**P value and significance**	**Group 5 N=60moderate mypopia <-3D to -6D)**	**P value and significance**
Superior rnfl (micrometer)	132.58+/- 12.68	128.93+/- 12.96	<0.00001 Significant	134.85+/- 12.75	<0.0093 Significant	119.8+/-12.68	<0.00001 significant	112.45+/- 12.77	<0.00001 significant
Inferior rnfl (micrometer)	146.36+/- 14.20	142.7+/- 14.14	<0.007 Significant	147.83+/- 14.09	>1.85 Non significant	130.4+/-14.20	0.185	125.61+/- 14.14	<0.00001 significant
Nasal rnfl (micrometer)	89.96+/- 9.85	91.13+/- 9.61	>0.284	92.81+/-9.73	<0.00086 Significant	86.7+/-9.85	<0.05 significant	81.1+/-9.79	<0.00001 significant
Temporal rnfl (micrometer)	78.83+/- 7.75	79.58+/- 7.71	>0.445	82.88+/-7.91	<0.000018 Significant	77.01+/-7.79	0.11179	67.6+/-7.77	<0.00001 significant
Global average rnfl (micrometer)	111.90+/- 9.22	110.58+/- 9.13	>0.063	114.59+/-9.17	<0.000017 Significant	103.3+/-7.87	<0.00001 significant	93.37+/-9.17	<0.00001 significant

Future recommendation- More multicentric studies involving larger samples should be done and studies should be done considering refractive status and glaucoma status of patient like comparing RNFL thickness in ammetropic with glaucoma,myopic with glaucoma and hypermetropic with glaucoma.

6. Source of Funding

None.

7. Conflict of Interest

None.

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