COMPARISON OF RETINAL NERVE FIBER LAYER THICKNESS BETWEEN EMMETROPES AND HIGH MYOPES

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Abstract

Background: The present study aims to compare RNFL thickness of high myopes of $> -6D$ and compare with emmetropic patients, so as to interpret and distinguish the physiological changes of high myopia from accompanying diseases in such individuals.

Methods: This was a prospective cross-sectional study. All subjects underwent a full ophthalmic examination, refraction and visual field analysis. Optical coherence tomography was used for RNFL thickness measurement. The mean peripapillary RNFL thickness between groups was compared using both analysis of variance and analysis of covariance.

Results: The mean value of average RNFL thickness in both groups was found to be 85.40 in group 1 and 99.34 in group 2. P value was 0.0001, showing that there was significant statistical difference between both the groups and average RNFL thickness was thinner in myopic group.

Conclusion: RNFL was found to be significantly thin in high myopia.

Keywords: RNFL thickness, Myopia, Emmetropes

Introduction:

Myopia, a form of refractive error, in which parallel rays coming from infinity focus in front of retina with accommodation at rest. It is a leading cause of visual disability throughout the world. In India uncorrected refractive errors are the most common cause of visual impairment and second major cause of avoidable blindness. The prevalence of myopia has been reported to be as high as 70-90% in some Asian population like Taiwan. The earliest survey conducted in India in the 1970's by Jain *et al.*, has shown a prevalence of myopia of 4.79% among the school children in Chandigarh. It was higher in urban population (6.9%) in comparison to rural population (2.77%)¹.

The retinal nerve fibre layer (nerve fibre layer, stratum opticum, RNFL) is formed by the expansion of the fibres of the optic nerve; it is thickest near the porus opticus, gradually diminishing toward the ora serrata. RNFL is a sensitive structure. Some process can excite its natural apoptosis. Harmful situation can make some damage on RNFL such as inflammation, vascular disease and any kind of hypoxia¹⁸, high intra ocular pressure and high fluctuation on phase of intraocular pressure. RNFL thickness is well known to

be different within the part of the ONH in a normal disc's so called "ISNT rule". Specifically, the inferior is the thickest, followed by the superior, nasal and temporal. Since the RNFL is thickest in the inferior and superior portions of the optic nerve head, the relative blood perfusion within these portions is lower among the optic nerve head, and thus, these portions are known to be the most susceptible to glaucomatous optic nerve damage.

The present study aims to compare RNFL thickness of high myopes of $> -6D$ and compare with emmetropic patients, so as to interpret and distinguish the physiological changes of high myopia from accompanying diseases in such individuals.

MATERIAL AND METHODS

❖ **Study Site:** Patients (Meeting our inclusion criteria) presenting to out-patient department of our centre (Sahai Hospital and Research Centre, Bhabha Marg, Moti Dungri, Jaipur, Rajasthan) were recruited in this study after the informed consent.

❖ **Study Population:** Patients were recruited from out-patient department of our hospital (Sahai Hospital and Research centre, Bhabha Marg, Moti Dungri Jaipur Rajasthan).

- ❖ **Study type:** Hospital based comparative analysis.
- ❖ **Study design:** This was a cross-sectional study.
- ❖ **Sample size:** Sample size was calculated at 80% study power and alpha error of 0.05 assuming standard deviation of 10.37µm in RNFL thickness among myopes and 12.6µm among emmetropes as found in study of malakar et al.²

For minimum detectable mean difference of 10µm in RNFL thickness minimum 21 cases in each group were required as sample size which was further enhanced and rounded off to 30 cases in each group as final sample size of present study expecting 20% attrition/sample loss.

$$n = \frac{2(Z_{1-\alpha/2} + Z_{1-\beta})^2 \times \sigma^2}{(M_1 - M_2)^2}$$

Here, n=sample size

$Z_{1-\alpha/2} = 1.96$ (corresponding to Z value of α error of 0.05)

$Z_{1-\beta} = 0.84$ (corresponding Z value for 80% study power)

σ = assumed standard deviation

$M_1 - M_2$ = difference of means to be detected

- ❖ **Time frame:** Consecutive cases of myopia and emmetropia presenting to our centre from May 2017 to April 2018 were included in our study.

❖ Inclusion Criteria

- Individuals having Myopia >- 6D
- Emmetropes
- Individuals giving consent for the study
- Individuals willing to go for OCT
- Individuals with age >18 yrs and <76 yrs

❖ Exclusion Criteria

- Patients showing any evidence of Glaucoma
- Patients with history of Refractive surgery
- Patients with history of any intra ocular surgery
- Patients with Amblyopia
- Patients with poor media clarity
- Patients with history of ocular trauma

- Patients with history of previous retinal laser treatment
- Patients with Neurological disease
- Patients with history of Diabetes mellitus
- Patients with history of Hypertension

METHODOLOGY

After obtaining clearance from institutional ethical committee, subjects were recruited from consenting individuals paying visit to out patient department of our institute.

- Visual acuity was assessed using Snellen chart. Autorefractometry was done after full pupillary dilatation with 0.8% tropicamide and 5% phenylephrine using Accuref-K 9001 (Shinnipon) autorefractometer. Based on refractive error subjects were divided into two groups – Group 1 – myopes(refractive error > - 6D) and group 2 – emmetropes(refractive error < ±0.5 DS).

- Intraocular pressure was measured three times in each eye with the Goldmann applanation tonometer. An average of 3 measurements was computed for analysis; if they differed by more than 2.0 mm Hg, a fourth reading was taken and the average of the 3 closest values was taken. Subjects having IOP>21 mm Hg were excluded from the study.

- Every patient was instilled with 0.8% tropicamide and 5% phenylephrine hydrochloride to dilate the pupil and a precise fundus examination was performed with +90D lens along with indirect ophthalmoscopy and scleral indentation after the IOP was measured.

Eye drop used was Tropicacyl plus (Sunways Pvt. Ltd.)

- Axial length measurement was done by using amplitude scan (MD – 1000 A, ULTRASONIC BIOMETER MEDAco).

- Optical coherence tomography for RNFL thickness measurement- Optical coherence tomography (Optovue, Inc.; Fremont, California, USA) The machine was properly aligned after seating the subject with the chin comfortably resting in the chin rest. The OCT lens was adjusted for the patient's refractive error. The subject was instructed to fixate with the eye being tested on the internal target, to enable the optic nerve head to come into focus. The Z-Offset was adjusted to view the OCT image, and polarization was optimized to maximize the reflective signal. Only good quality OCT scans were included in

the final analysis. To be acceptable for inclusion, the OCT scans had to fulfill the following criteria:

- The fundus image must have been clear enough to see the optic disc and scan circle or spokes,
- Signal strength should be > 6
- Color saturation must have been even and dense across the entire scan, and there must have been red color visible in the retinal pigment epithelium and RNFL.

❖ Statistical analysis

- Continuous variables were summarized as mean and standard deviation and were analyzed using unpaired t- test
- Normal/categorical variable were expressed as proportions and were analyzed by chi-square test/Fisher exact test.

- P-value <0.05 was taken as significant.
- Data entry was done in Microsoft excel.
- SPSS version 20 software was used for all statistical purpose.

RESULTS

A total number of 112 eyes of 56 patients, who fulfilled the inclusion criteria, were included in the study from the outpatient department, Sahai hospital and research centre, Jaipur from May 2017 to April 2018.

Analysis of the collected data was done using SPSS version 20. Significance of difference of RNFL between myopic (Group I) and emmetropic (Group II) were determined by using unpaired t-test and quadrant comparison by paired t-test.

P-value ≤ 0.05 was considered statistically significant.

Table 1: Age distribution between groups

Age Group	Group 1 (N=30)		Group 2 (N=26)		Total (N=56)	
	No.	%	No.	%	No	%
<35	23	76.66	18	69.23	41	73.2
>35	7	23.33	8	30.76	15	26.8
Total	30	100.00	26	100.00	56	100.00
Min. Age – Max. Age	18-67		19-60			
Mean Age	26.86		32.53			

Chi-square = 0.105 with 1 degree of freedom; P = 0.746 NS

In this study maximum number of patients were of <35 years of age (73.2 %). Mean age in group 1 was 26.86 and in group 2 was 32.53. P value between these group was 0.746 which indicates that there was no statistical difference between these groups in terms of age distribution.

Table 2: Sex distribution between both groups

Sex	Group 1 (N=30)		Group 2(N=26)	
	No.	%	No.	%
Male	19	63.33	9	34.61
Female	11	36.66	17	65.38
Total	30	100.0	26	100.0

Chi-square = 3.518 with 1 degree of freedom; P = 0.061 NS

This study included 56 patients, out of which 28 were male and 28 were female. There were 30 patients in group 1 and 26 patients in group 2. Out of which, 19 were male and 11 were female in group 1 and 9 were male and 17 were female in group 2. There was no statistical significant difference between the two groups (p >0.05).

Table 3: Average RNFL thickness

	Group 1 (N =60)		Group 2 (N =52)		95% CI	P value
	Mean	SD	Mean	SD		
Avg. RNFL	85.40	15.45	99.34	10.26	-18.93 to -8.94	0.0001 (S)
Range	51.75-138.25		85-143.5			

Table 3 is showing mean value of average RNFL thickness in both groups. It was found to be 85.40 in group 1 and 99.34 in group 2. P value was 0.0001, showing that there was significant statistical difference between both the groups and average RNFL thickness was thinner in myopic group.

DISCUSSION

Importance of imaging in the diagnosis of ocular diseases has increased over the last 20 years. Out of a variety of techniques such as scanning laser polarimetry and confocal scanning laser ophthalmoscopy, optical coherence tomography (OCT) has emerged to the forefront of ocular imaging because of the wide variety of information it can provide like high resolution and the complex 3-dimensional (3D) data.³

For measurement of RNFL thickness, OCT is the most commonly performed investigation nowadays.

RNFL thickness measurement is important in diagnosing pre perimetric glaucoma. But it has been reported that high myopia is also associated with significant RNFL loss in some cases. Therefore it is important to collect RNFL thickness data of emmetropes and high myopes to distinguish glaucomatous changes found on OCT.⁴

Our study was a horizontal cross sectional study which focussed on measuring the RNFL thickness on OCT in healthy emmetropes and otherwise healthy high myopes (normal, non-glaucomatous) and comparison between the two.

In this study we have found that average RNFL thickness in all quadrants in emmetropic group was $99.34 \pm 10.26\mu$ and in myopic group it was $85.40 \pm 15.45\mu$. So, high myopes have thinner values of RNFL as compared to emmetropes and it was statistically significant difference ($p < 0.05$).

Malakar M et al also studied RNFL changes in high myopes and emmetropes in Indian population and as per their study average RNFL thickness was significantly less in high myopes. They observed that this decrement was present in all the quadrants. Mean RNFL thickness in high myopia group was 87.89μ which is comparable to our study i.e. 85.40μ . But according to their study average RNFL thickness in emmetropia was 111.64μ while in our study it was 99.34μ . This difference in average RNFL thickness with our study can be explained by age factor. In our

study the mean age for emmetropes was 32.53yrs while in Malakar et al study it was 23.04 yrs.²

Yi Zha et al compared retinal nerve fibre layer thickness in emmetropes, low myopia ($< -3DS$), median myopia ($-3DS$ to $-6DS$) and high myopia ($> -6DS$) and found that it was significantly thin in high myopes. They found that it was $90.57 \pm 10.07\mu$ in high myopes, $99.15 \pm 8.94\mu$, 101.46 ± 10.15 and $104.76 \pm 10.15\mu$ in emmetropes. They concluded that, as the negative spherical error increases, decrease in RNFL thickness occurs. In our study mean RNFL thickness was $85.40 \pm 15.45\mu$ in high myopia and $99.34 \pm 10.26\mu$ in emmetropia. Our data is comparable to Yi Zha's study in terms of mean RNFL thickness values and comparison results between these groups.⁵

Kamath et al studied RNFL thickness in myopia. They classified myopia into 3 groups, low myopia ($< -3DS$), median myopia ($-3DS$ to $-6DS$) and high myopia ($> -6DS$). Average RNFL thickness was 94.9μ in low myopia, 87.1μ in moderate myopia and 80.45μ in high myopia. Additionally in their study 360 degree mean peri-papillary thickness was found to be less as the degree of myopia increases and it was significant in high myopia group than in low and moderate myopia group. In our study average RNFL thickness was $85.40 \pm 15.45\mu$ in high myopia group which is comparable to RNFL thickness of moderate myopia group in Kamath et al study, but thicker as compared to high myopia group.⁶

CONCLUSION

The present cross-sectional study was designed to quantify and compare the retinal nerve fibre layer (RNFL) thickness in emmetropic and high myopic eyes with normal intraocular pressure and those without any other risk factors for glaucoma via spectral domain optical coherence tomography. RNFL was found to be significantly thin in high myopia.

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