Original Article

Analysis of RNFL Thickness among Different Refractive States Using OCT

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Purpose: To measure the retinal nerve fiber layer (RNFL) thickness in myopic and hyperopic eyes and to compare it with emmetropic control eyes by Optical Coherence Tomography.

Study Design: Cross sectional comparative study.

Place and Duration of Study: Done in Makka eye complex Alkalakla, Sudan, from May to November 2017.

Material and Methods: In this study 150 participants (300 eyes) of myopia, hypermetropia and emmetropia were recruited and arranged in three groups having 50 cases each. Myopia and hypermetropia greater than 2.00 D, and emmetropia (+0.50 to -0.50 D) were recruited. The participants were 15-30 years old and they were free from ocular disease and had not undergone any surgery. Objective refraction by auto refractor and corrected visual acuity by snellen projector chart was checked. RNFL Thickness was measured by OCT.

Results: The nerve fiber layer thickness mean in myopic (92.32μ) group was significantly different from hyperopic (102.12μ) and emmetropic (98.80μ) groups. After applying ANOVA test the difference between the Myopes against Hypermetropes, and myopes against emmetropes were found statistically significant ($p < 0.05$) as compared to hypermetropes against emmetropes ($p = 0.152$). The mean values of RNFL thickness were thinner in nasal, temporal, superior and inferior in myopes than hypermetropes and were statistically significant ($p < 0.05$). But the mean value of RNFL thickness of temporal and superior part was thicker in emmetropes than hypermetropes.

Conclusion: The RNFL thickness was found thinner in myopic participants as compared to hyperopic and emmetropics.

Keywords: Retinal nerve fiber layer, Optical Coherence Tomography, Refractive error.

Optical coherence tomography (OCT) is non-contact and non-invasive device which provides real time cross-sectional images of the retina and an underlying sub retinal tissues, which are helpful to diagnose and manage different retinal diseases and glaucoma[1].

The OCT performs on the principle of interferometry, where the device works as an optical biopsy by using reflected light to determine the interface between different ocular tissues and produces a cross-sectional image for tissue of interest. Because RNFL is a highly reflective layer due to the distinctive perpendicular arrangement of nerve fibers in relation to the direction of the OCT light beam[1,2]. The retinal nerve fiber layer is the most susceptible tissue which gets damaged in glaucoma patients leading to visual field loss[3,4]. For the diagnosis of early glaucoma, one requires accurate and reliable measurement of RNFL thickness, as well as adequate knowledge of the normal values of the RNFL thickness and optic disc arrangement in normal subjects. The thickness of the RNFL is affected by age, gender, axial length, optic disc size, and refractive error of the eye[5-12] and is also affected by ethnicity and race[13].

The RNFL thickness may be affected by different refractive errors and it may be relevant for the inspection of perceptual processes by studying the effect that is used in the diagnosis of glaucoma and other optic nerve disorders including the follow-up.

This discrepancy is important when RNFL loss is observed during the disease process. Therefore, this study was carried out to scrutinize RNFL thickness, in different refractive states among Sudanese.

MATERIAL AND METHODS

In this cross sectional comparative study, 150 participants (300 eyes) having myopia, hypermetropia and emmetropia were recruited from Makka eye complex Alkalakla and arranged 50 in three groups of 50 each. The participants were free from ocular disease and had not undergone any surgery. Myopia and hypermetropia greater than 2.00 D and emmetropia (+0.50 to -0.50 D) was considered for study with age range from15-30 years.

The objective refraction was determined in both eyes using auto-refractometer (version AR 510A. NIDEk), whereas visual acuity was obtained by projector Snellen vision chart (version Cp-77o NIDEK).

All the three groups underwent retinal nerve fiber layer thickness measurement using Spectral Domain OCT in the four quadrants (Cirrus HD OCT, model 5000, Zeiss, Germany). Data analysis was done by using statistical package for social sciences (SPSS). ANOVA test was used to find statistical significance and the *p*-value of < 0.05 was chosen to be statistically significant.

RESULTS

In this study 300 eyes of 150 individuals were arranged in three groups of different refractive states. The age ranged from 15-30 years in both gender.

The mean refractive error (SE) of myopic, Hypermetropic and Emmetropic group was – 4.8300 (std. D ± 2.95737), +5.1550 (std. D ± 3.15900), - .1400 (std. D ± .35771) respectively and the mean age of the participants was 21.87 years as shown in (Table 1 & 2).

The mean value of RNFL thickness was found thinner in myopic (92.32μ) participants as compared to hypermetropic (102.12μ) and emmetropics (98.80μ). All the details are given in (Table: 3, Fig. 1).

As per ANOVA test as shown in (Table 4), the mean value differences between the Myopes against Hyperopes, and myopes against emmetropes were statistically significant ($p < 0.05$) as compared to hypermetropes against emmetropes ($p = 0.152$).

The quadrantic assessment for different retinal sectors was evaluated further in ANOVA test and found that the mean value of RNFL thickness was thinner in nasal, temporal, superior and inferior in myopes compared to hypermetropes and was statistically significant ($p < 0.05$). But the mean value of RNFL thickness of temporal and superior part was more in emmetropes compared to hypermetropes as shown in (Table 5).

Table 1: Refractive error in different groups.

Refractive State	Mean	Std. Deviation	Minimum	Maximum
Myope	-4.8300-	2.95737	-16.50-	-2.25-
Hypermetrope	+5.1550	3.15900	1.75	17.00
Emmetrope	-.1400-	.35771	-.50-	.50

Table 2: Mean ages of different groups.

Refractive State	Mean	Std. Deviation	Minimum	Maximum
Myope	22.14	5.334	15	30
Hypermetrope	20.98	4.736	15	30
Emmetrope	22.42	4.554	15	29
Total	21.85	4.893	15	30

Table 3: Distribution of retinal nerve fiber layer thickness average (μ) according to refractive state.

Refractive State	Mean	Std.	N
Myope	92.32	10.127	50
Hypermetrope	102.12	15.285	50
Emmetrope	98.80	7.936	50
Total	97.75	12.163	150

Table 4: Comparison of retinal nerve fiber layer thickness average mean (μ) according to refractive state.

Refractive State	p- value
Myope vs. hypermetrope	0.000
Myope vs. emmetrope	0.006
Hypermetrope vs. emmetrope	0.152

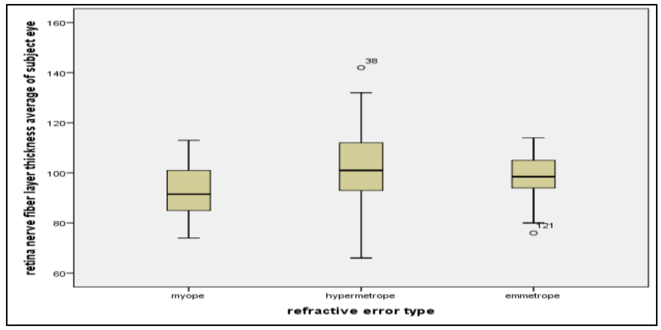

Fig. 1: **R**etinal nerve fiber layer thickness average (μ) based on refractive state.

Table 5: RNFL thickness means (μ) of different quadrants in three groups.

Refractive State	Average	Nasal	Temporal	Superior	Inferior
Myope	92.32 ± 10.13	68± 15.93	66 ± 10.80	114.16 ± 16.02	121.56 ± 20.27
Hypermetrope	102.12 ± 15.29	82.22 ± 18.60	67.94 ± 10.10	122.4 ± 32.69	135.82 ± 21.25
Emmetrope	98.80 ± 7.94	71.46 ± 10.98	70.14 ± 13.21	126.62 ± 13.93	123.46 ± 20.24
All errors	97.75 ± 12.16	73.89 ± 16.54	68.31 ± 11.46	121.06 ± 22.95	126.95 ± 21.42

DISCUSSION

Measurement of retinal nerve fiber layer thickness is essential for early diagnosis of glaucoma, because the thinning of the retinal nerve fiber layer would be the earliest clinically detectable sign in glaucoma before visual field loss[14]. With the new revolution and advancement technique of OCT, the RNFL thickness can be measured reliably. Studies conducted previously have concluded that RNFL thickness analysis using OCT is quite reproducible[15] as well as reliable[16].

Therefore, it is important to know the knowledge of normal distribution of nerve fiber layer thickness to avoid confusion with physiological and pathological variations[17].

In our study 300 eyes of 150 individuals were arranged in three groups of different refractive stateswith age ranges of 15-30 years in both genders. The refractive error of myopic group (SE) mean was –4.8300 (std. D ± 2.95737). Hypermetropic (SE) mean was 5.1550 (std. D ± 3.15900) and the mean of Emmetrops was - .1400 (std. D ± .35771) as shown in (Table 1). Whereas the author V. Sowmya, et al, had analyzed the same number of individuals but divided into five groups, which were almost equally in range of refractive error and between 20-40 years of age[12]. In our cases, the mean age of the participants was 21.87 (Table 2) and similar average age of subjects 21.70 was selected in other study[18].

In our study, the distribution of retinal nerve fiber layer thickness according to refractive error type shows that the mean value differences between the Myopes against Hypermetropes, and myopes against emmetropes are statistically significant (p < 0.05) as compared to hypermetrope against emmetropes (p= 0.152) (Table 3 & 4, Fig. 2).

A study done by V Sowmya et al, also detected significant changes in RNFL thickness (p < 0.001) in different refractive errors. It showed that there was a progressive thinning of RNFL as the power increased in myopic people and there was significant increase in the RNFL thickness as the power increased as in hypermetropic people[12]. Our findings were also consistent with Sung-Won Choi et al, who conducted peripapillary RNFL thickness study in 3 groups of myopic patients (less than -2, -2 to -4 and more than -4D)[19].

In our study, the quadrantic assessment for different retinal sectors was analyzed and found that the mean value of RNFL thickness was thinner in nasal, temporal, superior and inferior in myopes then hypermetropes, which was statistically significant ($p < 0.05$). Whereas the similar findings in other study by Oner V et al. found that the RNFL thickness values were thinner in the myopic eyes than in the hyperopic eyes, except for lower and upper nasal sectors. On the other hand, the average RNFL thickness and the RNFL thicknesses of the upper temporal and inferonasal sectors were significantly different between the hypermetropic and emmetropic[20], but in our study, the mean value of RNFL thickness of temporal and superior part was generally thicker in emmetropes than hypermetropes as shown in (Table 5).

CONCLUSION

The RNFL thickness was found thinner in myopic participants as compared to hyperopic and emmetropics. Mean RNFL thickness values in this population may be providing a point of reference for comparison with findings in disease situation like glaucoma. In this respect, Ophthalmologist and optometrist should be vigilant when measuring the RNFL thickness in myopic or hyperopic eyes to diagnose glaucoma.

Conflict of Interest

None.

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Conceivement of idea and Data collection.

Nuha Mohamed Fath Elrahman
Introduction and literature review of Optometry.

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Discussion and Literature review in ophthalmology.

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Methodology Data Analysis.

Dr. Muhammad Ijaz Ahmad
Discussion and proof reading.

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