Original Article

Mean Retinal Nerve Fiber Layer Thickness in High Myopes using Optical Coherence Tomography in a Tertiary Care Hospital in Karachi, Pakistan

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Purpose: To assess the mean retinal nerve fiber layer thickness in high myopic patients using optical coherence tomography in Pakistan.

Study Design: Cross Sectional with non-probability, purposive sampling.

Place and Duration of Study: The Ophthalmology Department, Jinnah Postgraduate Medical Centre, from 25th January 2014 to 25th July 2014.

Material and Methods: This study was conducted at the Ophthalmology Department, Jinnah Postgraduate Medical Centre from 25th January 2014 to 25th July 2014. There were 161 patients between 12 to 40 years who were analyzed. Patients with highly myopic eyes were selectively enrolled in the study while those with other eye diseases were excluded. Data was analyzed in SPSS version 19.

Results: The average age of patients was 26.02 (SD ± 7.15) years. Mean duration of myopia was 2.74 (SD ± 1.38) years. There were 78 (48.44%) males and 83 (51.56%) females. The mean RNFL thickness was 88.61 ± 7.41 and 87.88 ± 7.12 in right and left eyes respectively. A significant mean RNFL difference between right and left eyes in male patients (p = 0.016) was observed.

Conclusion: Individuals with high myopia have a tendency to develop decreased thickness of retinal nerve fiber layer and are subjected to various sight threatening pathologies.

Key Words: High myopia, Optical coherence tomography, Retinal nerve fiber layer thickness.

Myopia is reported to be 26% among adults[1]. With an axial length greater than 25.5 mm and/or a minimum refractive error of 6 diopters[2] and globe elongation, the condition is termed High Myopia[3]. Current stats claim that as much as 30% of the world population is myopic. With chances of the disease affecting almost 5 billion people by 2050, this would make it 50% of the global population[4]. As per Sydney Myopia study conducted recently, it was found that 17-year old myopic adults around the world collectively constituted 31%, which is twice the number obtained in a similar study done almost a decade ago[5].

Prevalence of myopia was found to be 6% among adults aged 30 and above at a local village in Northern Pakistan[6]. Another study conveyed that in the 5-10 year age group, 0.45% patients presented with myopia whereas in 10 – 16 year olds[7] it was about 1.44%. On the contrary, a study done in a district of Northern

Pakistan it was found that myopia was 52.6% among school children[8]. Myopia was also found to be the most common refractive error in adults aged 25 to 80 years at a teaching hospital in Bannu, Pakistan where 44.06% patients were noted to have this visually debilitating disease[2].

Time differences in reflected light from each part of the tissue are used to calculate the RNFL thickness using the Optical coherence tomography (OCT). Individuals with high myopia have a tendency to develop decreased thickness of retinal nerve fiber layer along with various sight threatening pathologies that include peripheral retinal degenerations, retinal detachment and posterior pole chorioretinal lesions[9].

This study aims to encourage the practice of RNFL assessment in high myopes, thereby enabling the health care system to manage such cases satisfactorily. It further aims to investigate the link between myopia and RNFL thickness, particularly the high myopes, in such a manner that its diagnostic value in the assessment of myopia and other detrimental conditions of the eye is made transparent. The myopic patients studied in the research have also been subdivided into groups based on the gender, age and the level of disease for individual comparison of variables.

MATERIAL AND METHODS

This was a cross sectional study conducted at the Department of Ophthalmology, Jinnah Postgraduate Medical Centre (JPMC) from 25th January 2014 to 25th July 2014. Non-probability purposive sampling was used. JPMC is a tertiary care public hospital in Karachi, Pakistan. Approval from the institutional ethical review committee was taken, before commencement of the study. All patients diagnosed with high myopia between the ages of 12 to 40 years who presented during the study duration were included in the study. Patients with glaucoma, history of underlying Diabetes and hypertension or any other retinal abnormality, media opacities (cataract, corneal opacities) reported to have undergone any retinal surgery, were excluded from the study. Informed consent for inclusion in the study was taken from all patients. The refractive error from the manifest refraction (MR) was adjusted to spherical equivalent. Mild to moderate myopia group was between -3.00 diopters to -6.00 diopters whereas from -6.00 diopters to values greater were termed High myopia. Patients having spherical equivalent ≥ -6 (high myopia) underwent optical coherence tomography evaluation of both eyes following pupillary dilatation with 1% tropicamide and 5% phenylephrine. Measurements were conducted under direct supervision of consultant ophthalmologist having 5 years' experience to control the bias in observation. Statistical package for social sciences (SPSS version 19.0) was used to analyze and interpret data. The measurement of quantitative variables like retinal nerve fiber layer thickness, age, duration of myopia were presented by their mean ± SD values. The stratification of age, duration of disease and gender was made to control the effect modifiers and to see the effect of these on outcomes.

RESULTS

A total of 161 patients with highly myopic eyes were analyzed in this study. The average age of patients was 26.02 (SD ± 7.15) years and mean duration of myopia since diagnosis was observed to be 2.74 (SD ± 1.38) years. Out of the total 161 patients, 78 were (48.44%) males while 83 (51.56%) were females.

The mean RNFL thicknesses found in patients enrolled for the study was 88.61 ± 7.41 and 87.88 ± 7.12 in right and left eyes respectively as shown in table 1. Stratification analysis was performed to observe and compare the RNFL thickness with respect to age groups, gender and duration of myopic disease.

No significant difference in the mean RNFL was observed in the different age groups but among the 26 to 30 year olds, which included a total of

Table 1: Mean Retinal Nerve Fiber Layer Thickness in High Myopic Patients Using Optical Coherence Tomography.

Statistic		Retinal Nerve Fiber Layer Thickness (RNFL)	
		Right Eye	Left Eye
Mean		88.61	87.88
Std. Deviation		7.41	7.12
95% Confidence Interval for Mean	Lower Bound	87.46	86.79
	Upper Bound	89.76	88.97
Median		87	86

Table 2: Comparison of mean retinal nerve fiber layer thickness in high myopic patients among age groups and both genders.

Age Groups (years)	N	Right Eye RNFL	Right Eye RNFL	P-Values
		Mean ± SD	Mean ± SD	
12 – 20 Years	30	92.17 ± 5.28	92.20 ± 5.65	0.93
21 – 25 Years	45	87.98 ± 7.47	87.42 ± 6.94	0.12
26 – 30 Years	40	86.63 ± 8.02	84.83 ± 6.65	0.024
31 – 35 Years	30	89.13 ± 7.66	88.97 ± 6.92	0.73
36 – 40 Years	16	87.69 ± 7.05	86.81 ± 6.75	0.23
Male	78	88.96 ± 8.06	88.10 ± 7.63	0.016
Female	83	88.28 ± 6.77	87.66 ± 6.38	0.16

Table 3: Comparison of mean retinal nerve fiber layer thickness in high myopic patients between duration of myopia.

Duration of Myopia	N	Right Eye RNFL	Right Eye RNFL	P-Values
		Mean ± SD	Mean ± SD	
1 to 3 Years	120	88.62 ± 7.31	88.21 ± 7.04	0.15
4 to 7 Years	41	88.59 ± 7.78	86.90 ± 6.86	0.02

40 patients, mean RNFL slightly differed in left and right eyes. It was found to be 86.63 ± 8.02 and 84.83 ± 6.65 for the right and left eyes (p = 0.024) as denoted in table 2. The same age group presented with the most striking reduction of the RNFL thickness (p = 0.024) while no such discrepancy was noted for other groups.

Analysis of the RNFL thickness on the basis of gender revealed that the difference was significant between right and left eyes in male patients (p = 0.016) as compared to females (p = 0.16) (Table 2). A significant thinning of the RNFL was also seen among male patients as compared to the females with values of 88.96 ± 8.06 and 88.10 ± 7.63 for the right and left eyes (p = 0.016) respectively (Table 2).

Though majority patients presented with disease duration of 1 to 3 years (n = 120), cases with time interval between 4 to 7 years (n = 41) had considerably reduced mean RNFL thicknesses of 88.59 ± 7.78 (right eye) and 88.59 ± 7.78 (left eye) (p = 0.02) as shown in Table 3.

DISCUSSION

Myopia is a very common refractive error of the eye. The disease has managed to progress rapidly in the recent years; particularly in the Asian countries[10]. Current data reporting the influence of myopia on the retinal nerve fiber layer thickness is rather conflicting. Some studies show no association[11] whereas Budenz et al[12] and Leung et al[1] reported significant correlations.

Retinal Nerve Fiber Layer (RNFL) is the innermost retinal layer closest to vitreous. It was found that the normal mean retinal nerve fiber layer thickness for various age groups analyzed by a research for various ethnic groups obtained in a study estimated to a mean of around 97.3 ± 9.6 µm.[13] whereas in a multi linguistic and urban hub like Karachi, it equalized to around 99.02 ± 9.08 µm[14]. Our mean (± SD) RNFL thickness in myopic patients were 88.61 ± 7.41 in right eye and 87.88 ± 7.12 in left eyes. In view of this comparison, it can be deduced from our results that the RNFL

thickness tends to decrease with degree of myopia.

The retinal nerve fiber layer thickness diminishes owing to various medical conditions like Myopia and Diabetes. The mean RNFL thickness noted in high myopic groups was quoted to be 80.0 (18.6) μm.[9] Posterior staphyloma, scleral thinning, large irregular tilted optic discs, fuch's spot, chorioretinal atrophy, large cup-to-disc ratios, peripheral retinal degenerations, lacquer cracks, myopic crescent, retinal detachment, thin lamina cribrosa and localized retinal nerve fiber layer (RNFL) defects are various defects associated with myopia[1].

In patients with pseudo-exfoliation syndrome, a reduction in the mean RNFL thickness has been deciphered[15]. A reduced RNFL thickness was also seen with unilateral retinal vein occlusion[16] as well as optic neuritis[17].

RNFL thickness can be directly measured using OCT by calculating the area between the internal limiting membrane (ILM) and RNFL border. The OCT has emerged as one authentic technique that heralds the presence of glaucoma prior to visual fields anomalies, preventing loss of 30 – 50% of the retinal ganglion cells[18]. Multiple studies have been directed at measuring the RNFL thickness via OCT in high myopes but the data from our region stands limited. One of the few, conducted at the Mayo hospital (Lahore) elucidated the significance of OCT in determining a link between the axial length and RNFL thickness in myopic patients[19].

This method of OCT utilization was found to provide highly reproducible measurements of retinal thickness[21]. In our study, repeated scans were not performed but the scan quality can be considered a reliable representative of those encountered in clinical practice by experienced technicians under similar conditions with similar patients.

With reference to a study conducted in China, it was ascertained that the mean RNFL thickness in high myopes (≥ − 6 D) was significantly reduced compared to those with myopia[1]. Similar results were obtained in a Korean study which confirmed links between the mean RNFL thickness and degree of myopia[21]. A thin RNFL has also been linked to thinning and elongation of the retina and sclera[1] and could be representation of an actual decrease in nerve fiber number contradictory to histological analysis. Another research inferred that an unevenness of the RNFL thickness is seen with varying degrees of myopia; the adverse the myopia, the more the elongation of the AP axis and greater the attenuation of the RNFL[22]. While such studies lay the basis for the mean RNFL and high myopia linkage, a study done in Singapore by Hoh *et al* concluded that there was no significant correlation between the two using a 4.5 mm scan diameter[23]. Similar outcomes were identified in numerous prior studies[24]. Such refutation can be explained by poor resolution of earlier OCTs and the low sensitivity, early confocal laser devices.

The potency of this study lies in the utilization of high-quality, high-repetition scanning current generation OCT instruments. Moreover, the homogenous nature of our subjects provided increased sensitivity by controlling for confounders that could have affected RNFL measurements. A tertiary care centre, Jinnah Postgraduate Medical Centre was chosen for the study so that a variety of subjects representing diverse socioeconomic classes, ethnic groups and occupational backgrounds are enrolled; which helped make the result much more assorted and coherent. An almost equally sized sample from both genders ensures that conclusions regarding RNFL thickness, myopia and gender can be considered authentic.

In opposition, the limited sample size stands as a drawback; though the magnitude and strength of the findings in the study indicate that only a small size is required to amply power. Another limitation for the study would be unequal representations from each age group; 45 entries for patients aged 21 to 25 years while only 16 for the 36 to 40 years group. This prevents reliable comparisons of results age wise.

Myopia has proved to be a leading source of impaired vision and blindness round the globe. This study helps identifying the risks earlier in patients, thereby allowing them to be rescued with a guarantee of vision. In a third world country where people are burdened with various other expenses, a simple monitoring of the RNFL thickness via OCT can help estimate the risk for hazardous conditions like glaucoma much earlier, saving huge sums that go into treatment. When the expenditure and loss related to a condition as passive as myopia are cut short, major health risks can be assessed in the country efficiently.

CONCLUSION

In the present study it was perceived that the average RNFL thickness decreases with the degree of myopia. Since individuals with high myopia overtime develop a decremented retinal nerve fiber layer, they are prone

to suffer from various pathologies that are a serious threat to vision. Hence, adequate prophylactic measures aided with monitoring the mean RNFL thickness to determine the risk for vicious outcomes should be practiced so that long term vision is guaranteed to the patients.

Disclosures

Human subjects: Consent was obtained by all participants in this study.

Animal subjects: This study did not involve animal subjects or tissue.

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Contributed further ideas to the study design and concept; also defined some of the intellectual content; participated in the clinical studies and data analysis. Final approval and agreement.

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