

Influence of dioptric power on retinal nerve fiber layer thickness in myopic subjects

Iqra Nehal¹, Umer Kazi², Asiya Saleem¹

ABSTRACT

Objective: To evaluate myopic impact on thickness of nerve fiber layer of the retina in healthy myopic subjects.

Study Design: Prospective Observational study.

Place and Duration: Investigative Department of Ophthalmology of Al-Ibrahim Eye Hospital, Karachi from 1st May 2018 to 30th October 2018.

Methodology: In this study 80 eyes of myopic subjects (SE -0.5 to -11.0 DS) were enrolled. Each eye underwent through comprehensive ocular examination beginning with visual acuity, refraction, fundoscopy by slit lamp and ending up to optical coherence tomography of Nidek. Mean average peripapillary thickness of nerve fiber layer and thickness in superior, inferior, nasal and temporal quadrants was taken into consideration, calculated by Spectral Domain Optical Coherence Tomography (version 1.5.5.0).

Results: Forty subjects volunteered for study protocol among which 21 were male and 19 were female with a degree of refractive breakdown of 30% mild myopic, 50% moderately myopic and 20% highly myopic. The calculated average age was 25.0 ± 5.0 years (range 16-40 years). The average total nerve fiber layer thickness in myopic respondents was $90.85\mu\text{m}$; superiorly $112.37\mu\text{m}$; inferiorly $117.52\mu\text{m}$; temporally $71.85\mu\text{m}$ and in nasal quadrant was $61.55\mu\text{m}$. Retinal nerve fiber layer thickness was statistically significant in superior and temporal quadrant. In high myopes thickness was clinically significant in inferior quadrant in terms of quantity as compared to mild and moderate myopia

Conclusion: Average retinal nerve fiber layer thickness was significantly decreased in high myopia as compared to mild myopia while moderate group had slightly thicker thickness than high myopic group. Hence impact of dioptric power on nerve fiber layer thickness in myopic patients is significant.

Keywords: Myopia, RNFL thickness, Optical coherence tomography, Superior quadrant, Temporal quadrant.

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INTRODUCTION

From the last past decades, myopic prevalence had been increasing day by day and leading to decreased vision worldwide. Myopia has a higher prevalence in East Asia¹. Degeneration of macula is a serious issue in short-sighted patients particularly in East Asia and it is also the leading cause of visual morbidity. Higher prevalence of 80 to 90% was reported in East Asian countries like South Korea, Taiwan, Singapore,

China and Japan but an astounding prevalence of 42% was also found even in USA². In 2006, the National Blindness and Visual Impairment Survey, reported myopia in 36.5% of adult Pakistani population³. In 2015, worldwide survey of refractive error shows myopic prevalence of 21.3% in which Pakistan had contributed 3.7%. With the increasing progression of myopia, entire length of the eye ball also increases, causing thinning of Retinal Nerve Fiber Layer (RNFL)⁴. Myopic individuals often have enlarged optic discs with more oval configuration and large areas of peripapillary atrophy, hence similar to glaucomatous damage⁵. Retinal changes were extensively studied which were related to both high myopia and concomitant glaucoma. A retinal change in isolated high myopia is still unclear and this emphasizes for measurements of RNFL thickness even in early stage⁶. Retinal nerve fiber layer is a sensitive indicator for early glaucomatous damage, but it is uncertain whether RNFL thickness would vary with the refractive error⁷.

Optical coherence tomography (OCT) is a visual signal acquirement and processing approach that acquires micrometer resolved images from within the visual scattering media⁵. The modern production spectral domain (SD) OCT with rapid image acquisition, superior axial-resolution ($1-5\mu\text{m}$) and feature of stereoscopic images provides comprehensive measurements

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of retinal nerve fiber layer and the macula.

Rationale of this study was that myopia is a highly significant problem in Pakistani population³, not only because of its high prevalence, but also because it can contribute to visual morbidity and increase the risk for vision-threatening conditions. It is important to investigate RNFL changes in myopic patients considering the risk of developing glaucoma with the severity of myopia. This study aids in diagnosing and managing early glaucomatous changes. Hence this study was conducted for the fulfillment of the degree program so glaucomatous parameters like IOP measurement and visual field measurements were the limitations of the study. On the other hand optic neuropathies were excluded and healthy myopic subjects were included due to these limitations. Further the objective of this study was to evaluate the myopic impact on retinal nerve fiber layer thickness in healthy myopic subjects.

METHODOLOGY

In this prospective observational study, 80 myopic eyes of 40 subjects i.e. both male and female were assessed. This study was conducted at Al-Ibrahim Eye Hospital, Karachi, Pakistan, in the time period of 1st May 2018 to 30th October 2018.

The myopic patients were randomly selected attending the general outdoor patient department of Al-Ibrahim Eye Hospital. Mean age was considered as between 20-40 years in both genders. Three groups on the basis of refractive error were made among the respondents were; mild myopia (range= <-3.0 D), moderate myopia (range= -3.0 D to -6.0 D), and high myopia (range= >-6.0 D). Patients were included without any cylindrical component in first two groups, and ≤ 2.0 DC in high myopes. Subjects were excluded having any other ocular pathology such as any ocular media opacity, retinopathy, maculopathy, optic neuropathy, amblyopia, diabetes and hypertension. Subjects having visual acuity after best possible refraction less than 20/30 (6/9) were also excluded. Further, those patients who were not giving consent and those who have age more than 40 were excluded because of increased risk of systemic diseases like hypertension, diabetes mellitus, sarcopenia (age-related degeneration of muscular mass), muscular fibrosis etc. which can affect ocular health.

Ethical confirmation of the study has been given by the ethical committee of the institution. An informed approval has been signed by every patient to participate in this study. Non-probability sampling technique was used for sampling. In this study new generation spectral domain Optical Coherence Tomography used was of Nidek Company (software version was 1.5.5.0). The data was collected by the researcher through the general OPD and investigative department of the hospital. All patients were undergone full ophthalmic examination, starting with visual acuity on Snellen chart, objective refraction, subjective refraction and funduscopy. After that, scans of SD-

OCT were taken on each eye of each patient comprising a single map, i.e. Disc map was taken into consideration to evaluate RNFL thickness, CD ratio, disc area, rim area, RNFL symmetry. Hence conclusively disc map is very important in the interpretation and administration of glaucoma.

In objective refraction refractive error was ruled out by Nidek autorefractometer. The mid points of the horizontal and vertical axis were aligned subjectively by the operator to focus centration around the optic nerve head. RNFL thickness was calculated according to 4 types of divisions; average thickness, superior and inferior thickness, four quadrant thickness and clock hour thickness. A 6.0x6.0 mm cube was selected with fine quality to measure the ONH parameters. Scans including artifacts whether central or peripheral, quality index less than 3/5 and signal strength index less than 7/10 were excluded from the study to avoid variations in measurements.

Data Analysis: Data inquiry was done by SPSS version 20. Average RNFL thickness and thickness in the four quadrants was compared as according to increasing refractive error in myopes. Statistical significance was set at $P < 0.05$.

RESULTS

There were 80 healthy myopic eyes recruited in our study of 40 myopic subjects. Gender distribution was 22(55%) males and 18(54%) females. Average age was calculated as 25.0 ± 5.0 (range= 20 to 40 years). Spherical equivalent was -2.00 ± 0.7 for mild group, -5.00 ± 1.6 for moderate group and -8.00 ± 1.3 for high myopic group. Visual acuity after best possible correction was 20/20 for mild and moderate group and 20/30 for high myopic group. There were 12 (30%) mild, 20(50%) moderate and 08 (20%) highly myopic patients (Table-I).

Table-I: Frequency of subjects according to degrees of myopia (N=40)

	FREQUENCY	PERCENT
Mild myopia	12	30.0%
Moderate myopia	20	50.0%
High myopia	8	20.0%
Total	40	100.0%

Average, superior, inferior and nasal thickness was decreased comparatively in high myopic group other than mild and moderate myopia, but surprisingly inferior quadrant thickness was clinically significant in terms of quantity in high myopic group among all other groups (Figure-1). Average thickness, inferior and nasal quadrant thickness was insignificant among three groups (p -value >0.05) (Figure-1). Decrease in thickness was significant in superior and temporal quadrants between the three groups (p -value <0.05) (Table-I).

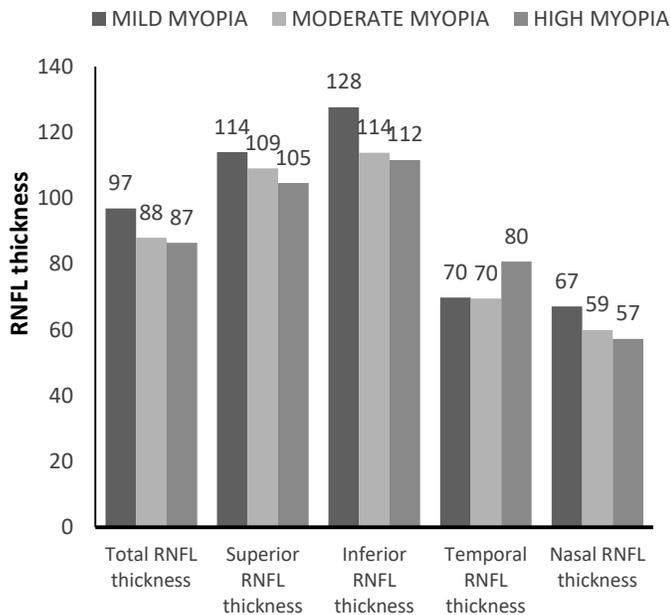


Fig-1: Graphical representation of RNFL thickness compared between different degrees of myopia (N=40)

DISCUSSION

Researchers are striving to identify risk factors for short-sightedness because its epidemic has attracted growing concern worldwide^{8,9}. The optimal management of the disease and its complications are also being studied rapidly¹⁰⁻¹². Mean of average RNFL thickness was $97.28 \pm 8.15 \mu\text{m}$ conducted by Akhter et al.² in Islamabad. Correlation analysis among all subjects showed that the average, mean nasal quadrant, upper nasal, and inferonasal sub-quadrant RNFL thickness had positive correlation with spherical equivalent ($p=0.045$). In this study mean RNFL thickness was $90.85 \pm 11.45 \mu\text{m}$. Analysis shows superior and temporal quadrants had a positive correlation with RNFL.

In spite of that, some studies¹³⁻¹⁶ are conducted on axial length correlated with RNFL thickness. Mehboob et al. researched in Pakistan in which they used laser interferometer (IOL master) and SD-OCT to measure axial length and RNFL thickness respectively. Three groups based on axial length were made in this study. A strong negative correlation between axial length and nerve fiber layer thickness of the retina was analyzed ($p\text{-value} < 0.001$). They observed that axial length significantly effects measurements of RNFL thickness and on basis of thickness of RNFL; diagnosis of glaucoma should be counted. In this current study axial length was not measured while SD-OCT was used to measure RNFL thickness. Results of our study shows that there was a strong significant correlation in superior and temporal quadrant among 3 groups based on refractive error and average, superior and inferior thickness shows insignificant correlation with the refractive error.

Some studies suggest that thickness of nerve fiber layer varies with the type of refractive error and as well as the amount of refractive error. Lee et al.¹⁷ studied RNFL thickness in short-

sighted, long-sighted and emmetropic children. He found that RNFL thickness was thickest in the hyperopic group followed by myopic and emmetropic group. When the age was adjusted myopes had a thinner RNFL other than two groups while emmetropes and hyperopes had equal RNFL thickness. In our study only, myopic group was considered and mean adult age was taken between 20 to 40 years. We hadn't adjusted age by any statistical formula because our study aimed to evaluate impact of myopic intensity on RNFL. In contrast studies which discussed about amount of refractive error like Kamath and his colleague¹⁸ discussed RNFL thickness in 3600 quadrants of variable degrees of myopic patients. Group III (High myopia) showed statistically significant thinning in 3600 in all quadrants except temporal quadrant compared to group I and II (low and moderate myopia). Results of our study indicate that only superior and temporal quadrant shows statistically significant thinning in high myopes.

Amongst studies with SD-OCT similar results were noted by Kang et al.¹⁹, Wang et al.²⁰, and Savini et al.²¹ who noted that peri-papillary thickness of RNFL decreases with increments in the dioptric power of myopia. Although Kang et al. and Wang et al. found significant decrease only in superior and inferior and in nasal quadrant while change was insignificant in temporal quadrant. Savini et al also noted decrease in RNFL thickness with weakest correlation of decrease in temporal quadrant. Results of our study represent significant positive correlation in superior and temporal quadrant ($p=0.04$ and $p=0.03$ respectively) while significantly negative correlation was found in average ($p=0.08$), inferior ($p=0.10$), and nasal quadrants ($p=0.28$).

In contradiction Hoh et al²² suggested that the peri-papillary thickness of RNFL does not alter with degree of myopia or length of the eyeball. These discrepancies can be associated with the different OCT imaging equipment used. They used OCT-1 which obtains only 12 RNFL thickness values from each scan, while rest of the studies, as well as ours, used stratus, Cirrus or SD-OCT. It is likely that the values obtained in OCT-1 scans may be insufficient to pick up differences due to length of the eye ball or degree of refractive error.

CONCLUSION

Average RNFL thickness was significantly decreased in high myopia as compared to mild myopia while moderate group had slightly thicker thickness than high myopic group. Hence impact of dioptric power on nerve fiber layer thickness in myopic patients is significant.

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