

Original Article

Comparative Analysis of Retinal Nerve Fiber Layer Thickness between Normal and Mild to Moderately Myopic Eyes

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ABSTRACT

Purpose: To determine the difference between mean retinal nerve fiber layer (RNFL) thickness in myopic eyes (up to -6.00D) and normal eyes.

Study Design: Descriptive observational study.

Place and Duration of the Study: Eye department of Mayo hospital Lahore, from February 2019 to April 2019.

Methods: We compared the mean RNFL between 58 myopic eyes (up to -6.00 D) and age matched 60 normal eyes. The age of the participants was between 12 to 42 years. Complete ocular examination was done and RNFL thickness was measured by using Optical coherence tomography (NIDEX RS-33.0, software-ex 1.5.2). Data was analyzed by independent sample t-test by using SPSS; with $P < .05$ as significant.

Results: The mean difference among these groups was $5.852 \mu\text{m}$ with (SE: 1.929). Mean RNFL thickness in myopic group was $(95.93 \pm 10.158 \mu\text{m})$ with (SE: 1.334). The result for mean RNFL thickness in myopic eyes was distributed normally as $P < .03$. Mean RNFL in normal group was $(101.78 \pm 10.774 \mu\text{m})$ with (SE: 1.391), and the result of mean RNFL thickness measured in normal eyes was not distributed normally as $P < .20$. The results showed that there is a statistically significant difference between mean RNFL thickness measured in normal versus myopic eyes as ($P < .003$).

Conclusion: There is a significance difference between mean RNFL thickness between myopic eyes and normal eyes as measured by OCT. Careful interpretation of RNFL data in myopic eyes is recommended to avoid misdiagnosis with glaucoma.

Key Words: Retinal Nerve Fiber Layer thickness, Myopia, Optical Coherence Tomography.

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INTRODUCTION

Myopia has appeared as a major health problem in East Asia. The high occurrence of myopia in east Asian cities is likely to be associated with increasing educational pressures and with other changes in life style, which have reduced the time children spend outdoors.¹ The prevalence of myopia has been increasing over the past decades, with a projected half of the world population estimated to be myopic by 2050.¹ This condition is especially very common in East Asia, where the prevalence has been estimated to

be as high as 90%. Myopia has been connected with an increased risk of different other ocular diseases, of which glaucoma remains one of the main ocular problems.² Myopia is more common in children of urban area, Chinese and Asians.³ Percentages of myopia is high in east and southeast especially in young adults.⁴

Myopia is vision threatening if Choroid neovascularization occurs which is considered to be a major risk factor for vision loss in pathologic myopia.⁵ Measuring RNFL thickness without testing refractive error or optical status of the eye may lead to misdiagnosis of glaucoma, especially in myopic eyes. Disc changes in myopic eyes may make it difficult to distinguish glaucomatous optic neuropathy from the myopia-related optic nerve and retinal abnormalities that may complicate both the diagnosis and treatment of glaucomatous disease.⁶

Optical Coherence Tomography is used to measure per-papillary retinal nerve fiber layer thickness. It is a non-contact technique.⁷ OCT measurements are important and have become an essential part of diagnosis of different ocular conditions and assessing the prognosis and outcomes of surgery.⁸

As myopia leads to decrease in RNFL thickness, it is important to differentiate between the RNFL thinning caused by myopia and glaucoma. Rationale of the current study was to compare the mean RNFL thickness in myopic eyes with normal eyes and to interpret the effect of age on the physiological and structural changes of RNFL in myopic and normal eyes.

METHODS

It was a comparative cross-sectional study. Sixty normal eyes and 58 myopic eyes were included in the study by convenient sampling technique, from outpatient department of Ophthalmology, Mayo hospital, Lahore from February 2019 to April 2019. Group 1 comprised of normal eyes and group 2 included myopic eyes with less than -6.00 diopters. Age of the participants ranged between 12 – 42 years. Individuals with history of any systemic disease, any organic ocular pathology, uncooperative individuals, glaucomatous eyes, high myopia above -6.00D and any other refractive error were excluded from the study.

Mild myopia was defined as myopia of -0.5D to ≤ -3 D and moderate as values between -3 D and < -6 D.⁹ The mean RNFL thickness was defined according to the ISNT rule; thickest inferior quadrant with RNFL = $126 \pm 15.8 \mu\text{m}$, superior RNFL = $117.2 \pm 16.13 \mu\text{m}$, Nasal = $75 \pm 13.9 \mu\text{m}$ and thinnest temporal quadrant with $70.6 \pm 10.8 \mu\text{m}$.¹⁰

Relationship of mean the RNFL thickness of two groups was analyzed by independent sample t-test with $P < 0.05$ as significant.

Data collection was started after approval from the Ethics committee. Informed consent were obtained from the participants and a detailed history was taken along with a complete ophthalmological examination. Auto refraction and retinoscopy was performed to check the amount of refractive error. Retinal nerve fiber layer thickness measurement was performed by using OCT (NIDEX RS-33.0, software-ex 1.5.2). Data was analyzed using SPSS-23. Quantitative variables (age) was shown as mean \pm standard deviation. Relationship of mean retinal nerve fiber layer thickness among two groups 'myopic and normal' eyes was analyzed by independent sample t-test with P value of 0.05 taken as significant.

RESULTS

The mean difference of RNFL between the two groups was $5.852 \mu\text{m}$ (SE: 1.929). Mean RNFL thickness in myopic group was $95.93 \pm 10.158 \mu\text{m}$ (SE: 1.334). Mean value of RNFL thickness in myopic eyes was distributed normally as $P < 0.03$. Mean RNFL in normal group was $101.78 \pm 10.774 \mu\text{m}$ (SE: 1.391) and it was not distributed normally as $P < 0.20$. The results showed statistically significant difference between mean RNFL thickness of normal and myopic eyes ($P < 0.003$).

Mean age of myopic group was 27.21 ± 7.360 years, with mean RNFL thickness of right eye as $95.276 \pm 9.9135 \mu\text{m}$, and left eye as $97.276 \pm 10.853 \mu\text{m}$. Results showed that age has a weak positive correlation with mean RNFL thickness in myopic eyes as ($r = 1.89$, $P < 1.66$, $n = 58$). Age has a moderately positive correlation ($r = .364$, $P = .001$, $n = 60$.) with mean RNFL thickness in normal eyes.

RESULTS

Table 1. The normal distribution of data is tested by using Shapiro-Wilk test and Kolmogorov-Smirnov^b

test. The result for mean retinal nerve fiber layer thickness in myopic eyes was distributed normally as $P < 0.05$.

Table 1: Tests of Normality in myopic eyes.

	Kolmogorov-Smirnov ^b			Shapiro-wilk		
	Statistic	df	Sig.	Statistics	df	Sig.
Mean RNFL thickness	.123	58	0.03	.965	58	.090

Table 2: Descriptive analysis of myopic eyes.

Descriptive analysis			Statistic	Std. Error
Mean			95.93	1.334
95% Confidence Interval for Mean	Lower Bound		93.26	
	Upper Bound		98.60	
5% Trimmed Mean			95.65	
Mean RNFL Thickness	Median		95.00	
	Variance		103.188	
	Std. Deviation		10.158	
	Minimum		76	
	Maximum		122	
	Range		46	
	Interquartile Range		13	
	Skewness		.548	.314
	Kurtosis		.329	.618

Table 2: Shows the descriptive analysis of mean RNFL recorded in myopic eyes. The mean retinal nerve fiber layer thickness was (95.93±10.16 mm) with (SE: 1.33).

Table 5: Independent sample T test.

		Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower		Upper
Mean RNFL Thickness	Equal variances assumed	1.161	.283	3.034	116	.003	5.852	1.929	2.032	9.673
	Equal variances not assumed			3.037	115.930	.003	5.852	1.927	2.035	9.669

Table 5: The above table shows comparison between normal subjects and subjects having myopia. Independent sample Levene's test has been applied for equality variance and t-test done measure equality of mean. The results showed that there is significant difference comparing mean retinal nerve fiber layer thickness measured in normal and myopic eyes as $P < .05$. The mean differences among these groups are 5.852mm with (SE: 1.929).

Table 3: Descriptive analysis of normal eyes.

		Statistic	Std. Error
Mean		101.78	1.391
95% Confidence Interval for Mean	Lower Bound	99.00	
	Upper Bound	104.57	
5% Trimmed Mean		101.59	
Mean RNFL thickness	Median	101.50	
	Variance	116.071	
	Std. Deviation	10.774	
	Minimum	81	
	Maximum	127	
	Range	46	
	Interquartile Range	17	
	Skewness	.214	.309
	Kurtosis	-.582	.608

Table 3 shows the descriptive analysis of mean RNFL recorded in myopic eyes. The mean retinal nerve fiber layer thickness was (101.9 ± 10.78 mm) with (SE: 1.4).

Table 4: T test for group statistics.

		Refractive Status	N	Mean	Std. Deviation	Std. Error Mean
Mean RNFL Thickness	Normal	60	101.78	10.774	1.391	
	Myopia	58	95.93	10.158	1.334	

Table 4: Shows comparison between normal subjects and subjects having myopia. Independent t-test was applied. Mean retinal nerve fiber layer in normal group was (101.78 ± 10.774mm) with (SE: 1.391), and mean retinal nerve fiber layer thickness in myopic group was (95.93 ± 10.158mm) with (SE: 1.334).

DISCUSSION

The results of this cross-sectional study established that there was significant difference in mean RNFL thickness between myopic group and normal group. Myopes have lower RNFL values and myopia is also a risk factor for primary open angle glaucoma.¹¹ Myopia is not a simple refractive error, but an eyesight-threatening disease¹². According to WHO, a large population of the world is going to be affected by myopia by 2050.¹³ Myopia presents a significant challenge to the ophthalmologists as myopic discs are often seen large, tilted, with deep cups and have a thinner neuro-retinal rim making diagnosis of glaucoma as a challenge. Optic disc changes and malformations in myopic eyes may lead to progression of glaucoma.^{14,15} A recent cohort study stated that myopia can significantly affect GCIPL (Ganglion cell inner Plexiform layer) and RNFL thickness profiles, and optic disc size has a significant effect on RNFL thickness¹⁶. Though the current study does not include a detailed evaluation of the optic nerve head and retina it evaluated average RNFL thickness of the four quadrants. It showed that mean RNFL thinning was seen in myopic eyes. Atta Allah and coworkers found that myopia has an effect on the retinal nerve fiber layer thickness distribution. Patients with high myopia have characteristic altered distribution pattern of RNFL thinning.¹⁷ High myopes were excluded from our study and we evaluated low to medium myopic eyes. Kelly D and co-workers concluded from their study that OCT measurements and evaluations of thickness of nerve fiber layer of the retina in patients with high myopia must be done carefully in order to avoid any misdiagnosis with glaucoma.¹⁸ Study by ELM tai and et al suggested that Status of refractive error must be evaluated with caution when evaluating or assessing OCT report of individuals with myopia as nerve fiber layer of the retina and its thickness changes with the increase in myopia.¹⁹ Others suggested that eyes with high level of myopia have an unusual reduction of RNFL thickness in two years duration than in emetropes.²⁰ A study showed that in hyperopia the retinal thickness increases and it decreases in myopic eyes.²¹ A significant change was seen when both myopic and hyperopic eyes were compared with normal group. The change in myopia was seen more significant ($P = 0.001$) than hyperopia ($P = 0.031$)²¹.

Optic disc tilt and torsion along with peri-papillary atrophy seen in myopic eyes makes detection of glaucomatous optic disc changes difficult. With

increasing axial length, the optic disc alters in shape from an almost round one to a vertically oval structure.²² Another study from Pakistan also showed similar effect of myopia on RNFL thickness.²³

Studies on Ganglion cell layer (GCL) thickness has revealed more thinning of the GCL in subject with high myopia than with low myopia and moderate myopia.²⁴

There are certain limitations of this study. We included all patients of mild to moderate myopia in this study and the type of myopia based on axial length, curvature of lens and cornea were not taken into account. Myopic and normal individual outside 12 to 42 years of age were not studied.

CONCLUSION

There is a significance difference between mean RNFL thickness between myopic eyes and normal eyes as measured by OCT. Careful interpretation of RNFL data in myopic eyes is recommended to avoid misdiagnosis with glaucoma.

Ethical Approval

The study was approved by the Institutional review board/ Ethical review board. (332/RC/KEMU)

Conflict of Interest

Authors declared no conflict of interest.

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Authors' Designation and Contribution

Gul Nasreen; Optometrist: *Concepts, Design, Literature Search, Data Acquisition, Data Analysis, Statistical Analysis, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

Shaheer Suhail Sarwar; Assistant Professor: *Concepts, Manuscript Review.*

Irfana Bibi; Optometrist: *Statistical Analysis, Manuscript Preparation.*

Muhammad Arslan Ashraf; Diagnostic oculist: *Manuscript Preparation, Manuscript Editing, Manuscript Review.*

