



Original Research Article

Evaluation of retinal nerve fibre layer thickness by optical coherence tomography in emmetropic and myopic patients

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ABSTRACT

In myopic eyes, the elongation of the globe leads to mechanical stretching and thinning of the retina. Therefore, it is conceivable that the extent of the elongation would be related to the degree of retinal thinning, although it is yet to be ascertained whether the retinal nerve fibre layer (RNFL) thickness is decreased at the histologic level.

Aim and Objectives: To evaluate RNFL by OCT in Emmetropic and Myopic patients and evaluate the relationship between RNFL thickness and the grade of myopia and Axial Length.

Materials and Methods: The present study was carried out at the department of ophthalmology, Teerthanker Mahaveer Medical College & Research Centre, Moradabad. Peripapillary RNFL thickness of all subjects were tabulated for group 1 (emmetropics) and Group 2 comparing them to grades of myopia, axial length, age, refractive status and cup disc ratio.

Results: The mean right and left side axial length was significantly more among myopic subjects compared to emmetropic subjects. The mean RNFL superior, Inferior, Temporal and Nasal was significantly more among emmetropic compared to low myopia which was significantly more than moderate myopia which was significantly more than high myopia thereby showing a decrease in the RNFL thickness with grades of myopia.

Conclusion: We observed that with increasing grades of myopia the RNFL thickness decreased. On comparing emmetropes and myopes on the basis of axial length, we observed that with increasing axial length in various degrees of myopia, the average RNFL thickness also decreased in various quadrants.

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1. Introduction

Refractive errors, that are not corrected are the most common cause of visual disability and second cause of avoidable blindness in India.¹ Globally, it is a public health issue with estimates that one third of the world's population may be affected by the year 2020.¹ Myopia is one of the most common health issues in Asia.

Myopia varies with country, age and ethnic group and is a major cause of visual impairment globally.² NFL(Nerve fibre layer) defects, posterior staphyloma, Fuchs spot are several pathological changes that occur in high myopia.^{3,4}

Myopia can be graded as mild myopia(<3D), moderate (3-6 D) and severe myopia (>6D). The pathophysiology of myopic progression is not well understood, although both genetic and environmental factors have been implicated in this apparent dysregulation of the emmetropization process.⁵

There is mechanical stretching of the globe in myopia with retinal thinning.⁶ Retinal nerve fiber layer thickness varies significantly with age, ethnicity, axial length, and optic disc area.^{7,8}

NFL changes happen before changes in perimetry and is proportional to the loss. NFL can be measured by fundus photography, scanning laser polarimetry, Heidelberg retinal tomography (HRT) and optical coherence tomography (OCT).⁹ OCT being a non-invasive,

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non-contact, transpupillary imaging method performs objective high resolution cross-sectional images of retinal tissue.¹⁰

Significant relations have been seen between NFL measurements and axial length and refractive status of the eye. There are conflicting reports in literature on whether RNFL thickness varies with grade of myopia and axial length of eye.

2. Materials and Methods

The present study entitled “Evaluation of retinal nerve fibre layer thickness by optical coherence tomography in emmetropic and myopic patients” was conducted after clearance from clinical research committee and Ethical committee in the department of ophthalmology, Teerthanker Mahaveer Medical College & Research Centre, Moradabad during the period 2017-2018.

2.1. Sample Size

The sample size was calculated with 80% of the power and 5% of the significance level. Hundred subjects are required to be included in each group. The study subjects were divided into 2 groups: emmetropic patients and myopic patients between 18-40 years of age satisfying inclusion and exclusion criteria.

2.2. Inclusion criteria

For Group 1: All emmetropic patients between 18-40 years of age of either sex.

For Group 2: All myopic patients between 18-40 years of age of either sex.

2.3. Exclusion criteria

1. Patients with any pathologic ocular condition that could cause a visual disturbance.
2. Patients with any ocular trauma
3. Patients diagnosed with glaucoma
4. Patients with history of previous intraocular or refractive surgery.
5. Patients with any other ocular / systemic comorbidities which will hinder examination on OCT.

2.4. Study procedure

After selecting the patients, following the exclusion criteria, the following were done.

1. Axial lengths were measured using PacScan Plus 300A+
2. RNFL thickness using OCT Cirrus HD were measured.

Peripapillary RNFL thickness of all subjects were tabulated for group 1 (emmetropics) and Group 2 comparing them to

grades of myopia, axial length, age, refractive status and cup disc ratio.

3. Results

The age was compared between emmetropic, low myopia, moderate myopia and high myopia where no significant difference was found for the inter-group comparisons.

The mean right and left side Axial Length was significantly more among Myopic subjects. (Table 1)

The mean NFL thickness in quadrants was assessed between superior, nasal, inferior and temporal quadrants in emmetropic eyes where significant difference was found. Superior and Inferior quadrants compared to Nasal and Temporal quadrants were found to be thicker. (Figure 1)

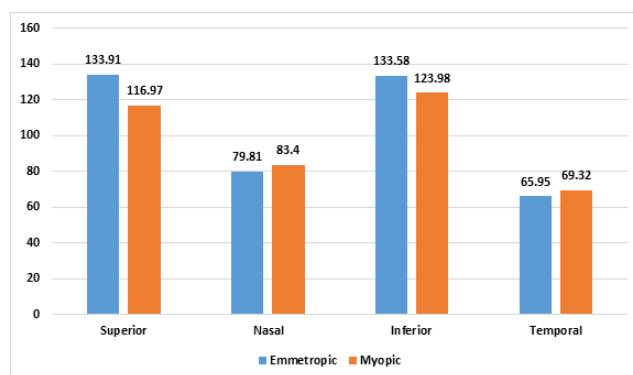


Fig. 1: Comparison of RNFL thickness in emmetropic and myopic subjects in quadrants (Right eye)

The mean NFL thickness in quadrants was observed in superior, nasal, inferior and temporal quadrants in myopic eyes where significant difference was found. Superior and Inferior quadrants compared to Nasal and Temporal quadrants were found to be thicker. (Figure 1)

The mean NFL in superior, inferior, temporal and nasal was observed in emmetropic, low myopia, moderate myopia and high myopia. The mean NFL superior, inferior, temporal and Nasal was significantly more among emmetropic compared to low myopia which was significantly more than moderate myopia which was significantly more than high myopia thereby showing a decrease in the NFL thickness with increasing values of myopia.(Figure 2)

The mean right and left side axial length was compared between emmetropic and myopic subjects using the unpaired t-test. The mean right and left side axial length was significantly more among myopic subjects.

4. Discussion

OCT is a sensitive, quantitative, reliable and reproducible method by which the NFL can be assessed. Previous studies have shown that the RNFL thickness is affected by changes

Table 1: Comparison of axial length among emmetropic and myopic subjects

Axial Length	Emmetropic		Myopic		p-value
	Mean	Std. Deviation	Mean	Std. Deviation	
Right eye	23.07	0.38	23.78	0.92	< 0.001*
Left eye	23.07	0.38	23.79	0.92	< 0.001*

Unpaired t-test * Significant difference

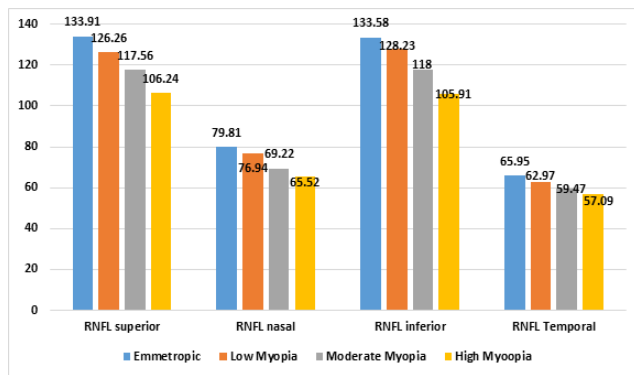


Fig. 2: Mean RNFL thickness in compared emmetropic and myopic subjects in varying grades of myopia (Right eye)

in the axial length and refractive errors.¹¹

The myopia epidemic has attracted growing concern worldwide, with researchers striving to identify risk factors for this condition¹² as well as the optimal management of the disease and its complications.

Myopia is known to be associated with extensive remodelling of the sclera. On a cellular level, the sclera of myopic individuals demonstrates less proteoglycan synthesis and collagen content relative to emmetropes.^{13,14} In theory, this characteristic results in thinner scleral tissue, increased deformability and reduced resistance to IOP in myopes.

In the current study, we compared the mean age between emmetropic, low myopia, moderate myopia and high myopic subjects and found no significant difference in inter-group comparisons and found no correlations of age with various degree of refractive error.

4.1. NFL thickness

In our study, as the degree of myopia increased, the mean over-all RNFL thickness decreased. Similar results of mean average RNFL thickness in moderate and high myopes were shown by Singh et al.¹⁵ The NFL thickness was significantly lower in highly myopic eyes compared to emmetropic eyes as seen in similar studies by Parvaresh et al.,¹⁶ Sowmya V et al.¹⁷

4.2. NFL thickness with grades of myopia

In a study by Mrugacz et al.,¹⁸ the NFL thickness was reducing as the grades of myopia increased. Our study findings were consistent with Choi et al.,¹⁹ who studied peripapillary NFL thickness in three groups of myopic patients (less than -2, -2 to -4 and more than -4D) concluded that peripapillary NFL thickness significantly decreased with increase in the degree of myopia. Budenz et al. correlated axial length and refractive error²⁰ concluding that longer eyes (increased axial length) and more myopic eyes had a thinner measured NFL.

4.3. NFL thickness in different quadrants

Tai et al.²¹ observed no differences in NFL thickness of the superior and nasal quadrants. Which was inversely correlated to the studies cited above,²² showing NFL thicker in the Low Myopic group than in the moderate and/or High Myopic groups for the superior, nasal and inferior quadrants. This difference may be due to factors like age.²²

4.4. Axial length

In the current study, we found the Mean Axial Length in emmetropia as 23.07±0.38. Parvaresh et al¹⁶ and Sowmya V et al¹⁷ had similar values of emmetropia in their study, as against Singh et al¹⁵ who had slightly lower values of axial length than our study.(Table 1)

We found that as the degree of myopia increased, the Axial Length decreased. Sowmya V et al.,¹⁷ Parvaresh et al¹⁶ and Singh et al¹⁵ showed similar results in low, moderate and high myopic cases.

In our study there was an association between NFL thickness and AL which was similar to the study by Parvaresh et al.¹⁶ explained by the fact that the number of axons which forms the the nerve fibre layer are equal and not proportional to AL.

Also, greater AL causes larger surface area and distribution of an equal amount of retinal nerves in larger area, giving rise to a thinner layer.²¹

Taking everything into account, this investigation showed the “double hump pattern” in nerve fiber layer thickness in both (myopes and emmetropes) like Lee et al.²³ Our results also showed the characteristic ‘double hump pattern’ of the normal eye and myopic eye, where the superior and inferior retinal nerve fibre layer were thickest.

5. Conclusion

Therefore, in our study we showed an association between NFL thickness and various grades of myopia. We observed that with increasing grades of myopia the NFL thickness decreased. On comparing emmetropes and myopes on the basis of axial length, we observed that with increasing axial length in various degrees of myopia, the average NFL thickness decreased in various quadrants.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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