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Original Research Article

Measurement of Peripapillary Retinal Nerve Fiber Layer Thickness in Myopia Using OCT

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Abstract:

A total of 50 eyes of 25 healthy subjects, comprising 20 eyes with moderate to high myopia (spherical equivalent [SE] >-3.00 D) and 30 eyes with low myopia (SE between -0.50 D and -3.00 D), were analyzed in this cross-sectional study. Total average and mean quadrant RNFL thicknesses were measured by Stratus OCT and associations between RNFL measurements and spherical equivalent refraction were evaluated by linear regression analysis. The RNFL measurements were significantly lower in the moderate to high myopia group compared with those of the low myopia group. Significant correlations were evident between RNFL measurements and the spherical equivalent. The average RNFL thickness decreased with increasing negative refractive power (P = 0.000). Out of 50 eyes 13 were classified as below normal limits and 15 as borderline with reference to the normative database of the RNFL thickness. The most frequently abnormal sector was at the nasal quadrant, where 36% of myopic eyes were below normal limits. There was a decrease in the average RNFL thickness as the refractive error became more myopic. So a careful interpretation of RNFL measurements, especially the nasal quadrant, should be done among myopic subjects to avoid mislabeling them as glaucoma suspects.

Keywords: Myopia, Retinal nerve fiber layer, Optical coherence tomography, Stratus OCT, Refractive error.

Introduction

Myopia is one of the most common ocular abnormalities reported worldwide, and its association with glaucoma is well recognized. The prevalence of myopia in adults has been reported to be 22.7% and 26.2% in the Baltimore Eye Survey and the Beaver Dam Study, respectively [1–2]. The risk of developing glaucoma is two to three times higher in myopic individuals than in nonmyopic individuals, and this risk is independent of other risk factors for glaucoma [3]. An important approach to detecting early structural change in glaucoma is based on assessment of the retinal nerve fiber layer (RNFL). Numerous studies have confirmed that RNFL measurement is sensitive for detection of glaucoma, and the extent of RNFL damage correlates with the severity of functional deficit in the visual field [4]. Myopic individuals often have enlarged optic discs with a more oval configuration and larger areas of peripapillary atrophy [5]. Because of these features, glaucomatous changes cannot be easily interpreted in myopic discs, possibly leading to a misdiagnosis of glaucoma. The optical coherence tomography (OCT) is a modern imaging device designed to measure the RNFL in a noncontact and non-invasive manner. With the high axial scanning resolution < 10μm provided with the latest model of OCT (Stratus OCT), RNFL measurements have been reliable and reproducible. The relationship between the RNFL thickness and myopia has been extensively investigated [6]. However, whether the RNFL thickness could vary with the refractive status of the eye remains unclear. It is therefore important to investigate whether there is any correlation between RNFL measurements and the refractive error in myopic patients, considering that the risk of developing glaucoma increases with the severity of myopia [7]. Keeping this in mind the present study was done to determine the relationship between myopia and the RNFL thickness by OCT.

Materials and Methods

A total of 50 eyes of 25 myopic subjects were included in the present study. The study was conducted at the department of Ophthalmology MKCG. Medical College (Berhampur, Odisha) between September 2022 to December 2022. Myopic subjects between 19-39 years of age, with spherical equivalent (SE) -0.50D to -7.00D and no ocular or systemic conditions that can affect the refraction, were included in the study. Subjects less than 19 years old, spherical equivalent <-0.50 D diagnosed glaucoma or glaucoma suspect with CD ratio ≥ 0.5, and those with ocular diseases such as cataract and any form of retinopathy were excluded. A detailed ophthalmologic examination was done in all subjects including visual acuity determination,

refraction, applanation tonometry, slit lamp evaluation, stereoscopic biomicroscopy of the optic nerve head at the slit lamp using a 90 D lens, and Indirect ophthalmoscopy. RNFL thickness was measured using Stratus OCT. Average measurements of three sequential circular scans with a diameter of 3.4 mm cantered on the optic disc were recorded. Parameters including average RNFL thickness and mean RNFL thickness in each quadrant were generated automatically in the analysis report of the Stratus OCT. Correlations between refraction (spherical equivalent) and RNFL thicknesses were determined by linear regression analysis and expressed as the Pearson coefficient of correlation (r), with $p<0.05$ considered statistically significant.

Results

50 eyes of 25 myopic subjects were included in the present study. Total no. of eyes with low myopia (SE -0.50D to -3D) was 30 and moderate to high myopia (SE > -3D) was 20. Male and female constitutes 56% and 44% respectively. The mean age and spherical equivalent were 23.52 ± 5.26 years (range, 19 to 39) and -2.87 ± 1.82 D (range, - 0.50D to -7.00D) respectively.

The average RNFL thickness in myopic eyes with -0.50 D to -3.00 D was 97.16±11.96 µm (range,53.25 to 123.75 µm) and in myopic eyes with >-3.00 D was 81.11±10.74 µm (range, 64.5 to 101.5 µm) i.e the average RNFL thickness in moderate to high myopic eyes were significantly thinner than low myopic eyes. 26% of eyes were classified as outside normal limit and 30% as borderline with reference to the normative database of the retinal nerve fiber layer measurement of the Stratus OCT. There was a significant correlation between refraction and average RNFL thickness (p=0.000) with Pearson coefficient 0.675.

The most frequently abnormal sector was at the nasal quadrant, where 36% of the myopic eyes were below normal limits. A significant correlation was seen between refraction and nasal RNFL thickness (p=0.000) with Pearson coefficient 0.706. There was also a significant correlation between refraction and superior RNFL thickness (p=0.000) with coefficient 0.510 and inferior RNFL thickness (p= 0.001) with coefficient 0.455. There was, however, no significant correlation between the refraction and temporal RNFL thickness (p = 0.274) with Pearson coefficient 0.158.

Table 1: Correlation of RNFL thickness (µm) and refraction (D) in 50 myopic eyes

RNFL subfield	RNFL thickness	P value	Coefficient
Superior	116±23.38	0.000	0.510
Inferior	118.62±23.62	0.001	0.455
Nasal	59.50±18.90	0.000	0.706
Temporal	67.46±10.14	0.274	0.158
Average	90.42±13.94	0.000	0.675

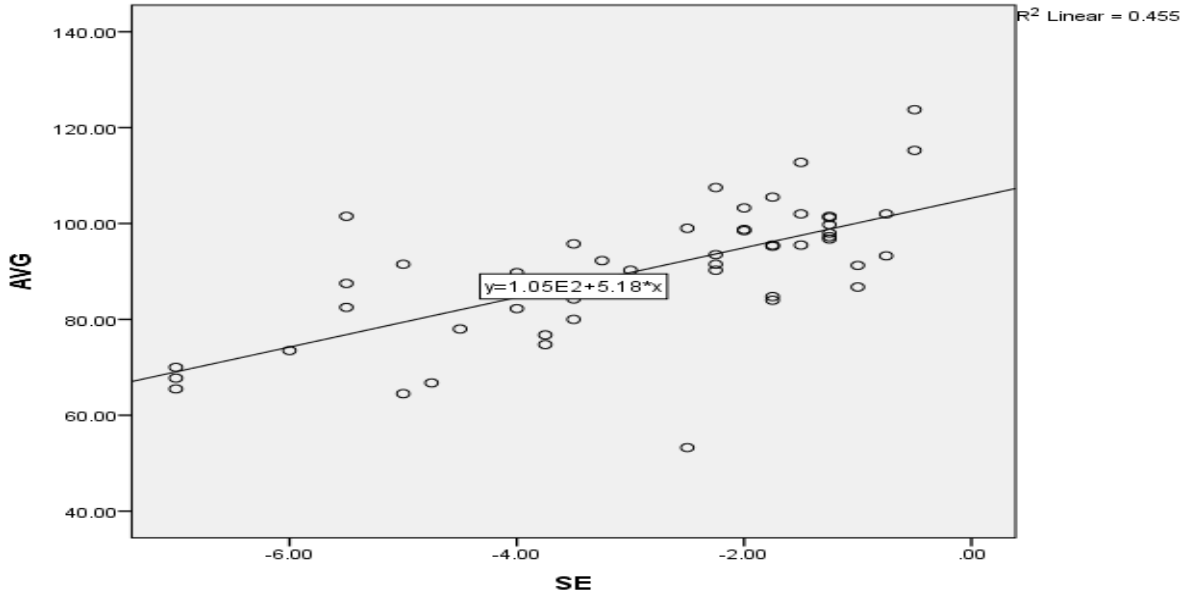

Figure 1:

Scatterplot showing the average RNFL thickness against the SE (P = 0.000 simple linear regression) analysis)

Discussion

In our study we found that the average retinal nerve fiber layer thickness decreases as the refraction

becomes more myopic. These data supported the findings of Schweitzer [8] and Leung [9] that there is a positive correlation between refraction and RNFL thickness. This is in contrast to the results found by Hoh [10] where the mean RNFL thickness did not vary with the degree of myopia when investigated by OCT. In this study we found that the mean RNFL thickness in moderate to high myopic eyes were significantly thinner than low myopic group. A study by Lim and Chun [11] compared the peripapillary RNFL thickness of high myopic eyes (SE≤-6.0 D) with those of low myopic eyes (SE from -0.25 to -3.0 D) in children and found that the mean overall thickness of the peripapillary RNFL in the high myopic subjects was significantly lower than that in the low myopic subjects. A study by Mohammad Salih [12] compared the peripapillary RNFL thickness of three different degrees of myopic groups and found that the mean RNFL thickness was thinner in highly and moderately myopic eyes compared with low myopic eyes. In this study we found that there was a positive correlation between the degree of myopia and RNFL thickness at all quadrants except temporal quadrant. The most frequently abnormal sector was at the nasal quadrant, where 36% of the myopic eyes were below normal limits. This data supported the findings of Leung [13], but the study was on Chinese myopic eyes. However Rauscher noted that thin RNFL in myopic subjects occurred preferentially at the superior and inferior quadrants [14].The Stratus OCT used in this study provided superior image quality and higher resolution scanning of the RNFL compared to earlier models. The Stratus OCT provides a database with age-matched controls for comparative analysis aiding the detection of ocular diseases involving the RNFL but the validity of applying this database to healthy myopes is yet to be verified.

The study of Rauscher [9] pointed out that extremes of refractive error were excluded, and the normative database lack the exclusionary criteria based on refractive error. Several explanations for RNFL thinning in myopia have been reported [14]. The decreased RNFL thickness among myopes could represent a predisposing factor for future development of glaucoma that could partly explain the increase incidence among myopes in some studies like the Blue Mountain Eye Study where data showed strong relationship between open-angle glaucoma and myopia [15].

Conclusion

RNFL thickness decreases with the negative spherical equivalent of the eye. There is a decrease in the average RNFL thickness as the refractive error becomes more myopic which may suggest the need for the Stratus OCT RNFL normative database to have corrective factors for refractive error among myopic patients and to verify these data with the use of the new generation Cirrus OCT. Although all the quadrants except temporal quadrant positively correlate with myopia, majority of the nasal quadrant showed below normal thickness based on the Stratus OCT normative database. A careful interpretation of RNFL measurements, especially the nasal quadrant, should be done among myopic subjects to avoid mislabeling them as glaucoma suspects.

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