Original Article

The Peri-papillary Choroidal and Retinal Nerve Fiber Layer Thickness in Mild to Moderate Axial Myopia

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Abstract

Background: This study aimed to measure Peri-papillary Choroidal Thickness (PCT) and Retinal Nerve Fiber Layer Thickness (RNFLT) in mild to moderate axial myopic eyes and compare their average values with those of normal control participants.

Methods: Twenty-five mild to moderate axial myopic eyes were included in this study. The data of 27 normal eyes were also considered as the control group. Subjects underwent a refractive error examination and axial length measurements. Then, the RNFLT, as well as the choroid borders (outer and inner) were measured. Optical Coherence Tomography (OCT) measurement of both eyes was done using Spectral Domain Optical Coherence Tomography (SD-OCT).

Results: The average PCT of the eyes of the myopic subjects and normal controls was 161.7±29.6 and 166.18±39.8 μm, respectively. All the regional values of PCT and its average were not significantly different between myopic and the control eyes. However RNFLT values were significantly lower in the superior ($p=0.004$), inferior ($p=0.01$), and nasal ($p<0.001$) sectors among the myopic eyes in comparison with the control eyes. There was a negative association between axial length and choroidal thickness in temporal $r=0.12$ ($p=0.023$), superior $r=-0.2$($p=0.04$), nasal [$r=-0.34$ ($p<0.001$] and inferior [$r=-0.32$ ($p=0.001$)] segments, respectively that of them it was not statistically significant for the temporal segment.

Conclusion: Although RNFLT values were lower in the most regions of myopic eyes versus the controls, no significant difference was statistically found in the PCT using Enhanced Depth Imaging Optical Coherence Tomography (EDI-OCT) from mild to moderate axial myopic cases and the control eyes. The choroidal thickness in temporal, superior, nasal segments were negatively correlating with axial length.

Keywords: Myopia, Nerve Fibers, Peri-papillary Choroidal, Refractive Errors

Introduction

The choroid provides substances to the external layers of the retina and there is a fresh interest to study its role in retino-choroidal diseases. Studies on the role of choroidal layer might be essential in understanding pathophysiology of numerous eye diseases including diabetic retinopathies, maculopathies, choroidopathies and the age-related macular degenerations[1-3].

Spectral-Domain Optical Coherence Tomography (SD-OCT) can measure the retinal Nerve Fiber Layer Thickness (RNFLT) and Peri-papillary Choroidal Thickness (PCT) via the Enhanced Depth Imaging Optical Coherence Tomography (EDI-OCT) technique. A few studies have reported normal PCT data in the normal population[4-6]. The role of the PCT has also been assessed in glaucoma and myopia[7-10]. Thinning of the PCT has been shown recently in large numbers of young Asians. Nevertheless, no study has managed to show the distribution of choroidal thickness next to the optic disc in mild to moderate myopia. The objectives of the this study were to quantitatively measure PCT and RNFLT in mild to moderate myopic eyes and to compare their average values with those in normal participants as controls.

Materials and Methods

This study is a comparative case series. Between January 2013 and march 2013, subjects with mild to moderate axial myopia who had met the inclusion criteria were consecutively included in this cross-sectional study at Farabi Eye Hospital. The inclusion criterion of this study was mild to moderate myopia ≤ -6 D. The protocol of current study was approved by Tehran University of Medical Sciences Ethics Committee.

A positive history or any clinical evidence of glaucoma, intraocular pressure of more than 21 *mmHg*, retinal disease, neurologic disease, intraocular surgery or laser therapy was considered as exclusion criteria. The Best Corrected Visual Acuity (BCVA) was calculated by a Snellen chart at 6 *m* and was transformed into the Logarithm of the Minimum Angle of Resolution (LogMAR) for statistical analysis. Subjects also underwent a refractive error examination using an automated refractometer (RM-8900; Topcon, Tokyo, Japan) and axial length measurements were carried out using partial optical coherence interferometry (IOL Master, Carl Zeiss Meditec, Meditec, Dublin, CA).

Spectral Domain Optical Coherence Tomography (SD-OCT) (Heidelberg Spectralis SD-OCT; Heidelberg Engineering; Spectralis Software Version 6) was used for the OCT quantity and all procedures for both subjects and controls were executed by the same operator. Quality scores for scans were described as the signal-to-noise ratio in *decibels* (*dB*), and quality scores above 20 *dB* were considered up to standard. RNFLT was measured using a 360º peri-papillary circle scan in the region of the head of optic nerve within a diameter of 3.4 *mm*. The peri-papillary circle scan was prepared by improved depth imaging for the choroidal thickness measurement[11].

Accordingly, one blind investigator manually outlined the upper and lower segmentation lines, in such a way that they corresponded to the sclera-choroidal interface and the posterior edge of the retinal pigment epithelium for presenting the outer and inner margins of the choroid, respectively. Another investigator confirmed the segmentations. The intraobserver and interobserver consistency of the PCT measurements were evaluated by a random sample of 20 images by 2 another examiners who were blind to the primary results. The interval of intraobserver assessments was 2 months. In addition, eyes of control participants without abnormalities in optic nerve head or retinal or neurologic disorders were recruited. All examinations were carried out using unique methods for all myopic patients.

Statistical analysis was performed using SPSS software version 17 (SPSS Inc., Chicago, IL). The intraclass correlation coefficient was used to evaluate the intraobserver and interobserver reproducibility. Data is presented as mean and standard deviation. We used GEE (Generalized Estimating Equation) to evaluate the differences between study groups whenever the potential correlation of the outcomes of the two eyes was considered.

Results

Twenty-five myopic eyes were included in the study and data from 27 normal eyes was also used as the control group. There was no significant difference between the demographic data of the eyes of the myopic subjects and normal controls (Table 1).

Table 1. Demographic data of the myopic subjects with and healthy controls

	Myopic eyes	Controls	p value
Age (year)	27.8±2.87	30.65±4.82	0.2
Refractive error, D	-2.93±1.38	0.21±0.33	<0.001
Axial length, *mm*	24.69±0.92	22.96±0.89	<0.001

Table 2. Age-adjusted Intraclass correlation coefficients for peri-papillarychoroidal thickness

	Intra-observer variability (95% confidence interval)	Inter-observer variability (95% confidence interval)
Average	0.998 (0.992-0.999)	0.998 (0.992-0.999)
Superonasal	0.996 (0.989-0.998)	0.996 (0.989-0.998)
Superotemporal	0.970 (0.925-0.988)	0.943 (0.856-0.9787)
Inferonasal	0.994 (0.984-0.998)	0.988 (0.970-0.995)
Inferotemporal	0.984 (0.949-0.994)	0.987 (0.962-0.995)
Nasal	0.977 (0.942-0.991)	0.969 (0.921-0.988)
Temporal	0.990 (0.949-0.997)	0.968 (0.914-0.987)

Table 3. Age-adjusted mean ±SD of OCT Measurement of RNFLT* and peri-papillarychoroidal thickness in myopic subjects and healthy control participants

	Myopic eyes	Controls	p value
Temporal RNFLT	68.31±11.52	66.33±11.46	0.14
Superior RNFLT	112.1±13.34	124.48±15.51	0.004
Nasal RNFLT	66.54±11.52	80.64±11.44	<0.001
Inferior RNFLT	121.44±15.8	134.6±24.51	0.01
Choroid superior Temporal	165.62±38.07	183.21±46.42	0.19
Choroid superior Nasal	168.72±43.50	174.15±49.65	0.61
Choroid Inferior Temporal	148.42±32.58	145.11±63.52	0.72
Choroid Inferior Nasal	156.94±39.72	151.24±56.89	0.64
Choroid Temporal	156.16±31.20	172.76±51.75	0.13
Choroid Nasal	174.84±41.09	175.44±57.25	0.9
Choroid superior	167.17±38.98	179.41±44.50	0.35
Choroid Inferior	152.68±33.47	146.52±57.98	0.59

RNFLT: Retinal Nerve Fiber Layer

Table 2 shows intraobserver and interobserver reproducibility of the PCT in different sectors. All the parameters showed excellent reproducibility on intraobserver and interobserver tests ranging from 0.970 to 0.998 for the former and 0.943 to 0.998 for the latter. The average PCT for the myopic eyes and normal controls were 161.7±29.6 and 166.18±39.8 μm, respectively. The average PCT and all the regional values were not significantly different between myopic and the control eyes (GEE, 79 p = 0.01 for average PCT) (Table 3).

The analysis also demonstrated that the inferior peri-papillary regional choroid (152.6±33.4 and 146.52±57.98 μm in the myopic and control eyes, respectively) was significantly thinner than the superior choroidal region (167.1±38.9 and 179.41±44.50 μm in myopic and control eyes, respectively) (t test; p=0.04, p=0.03, respectively).

RNFLT values were significantly lower in the superior, inferior, and nasal sectors in the myopic eyes compared with the control eyes (Table 3). There is a negative correlation between choroidal thickness and axial length [r=0.12 (p=0.023), r=-0.2 (p=86 0.04), r=-0.34 (p<0.001), r=-0.32 (p=0.001) in temporal, superior, nasal and inferior region respectively] which was not significant in temporal region.

Discussion

Although the sample size in this study was small, according to the OCT images (improved depth imaging technique for PCT) from mild to moderate myopia cases, we managed to find that the mean and every single sector (e.g.: superior, inferior, nasal, etc.) of PCT showed no difference in our study subjects compared with our control eyes. RNFLT was thinner in the myopic eyes in comparison with the control eyes.

A recent study[12], which analyzed 448 high myopia subjects and 116 emmetropic individuals, claimed that the mean PCT was 142.62± 43.84 μm that was even significantly thinner than the control eyes. One may infer that low myopia is not necessarily reflected in structures of the eye such as choroidal thickness but we replicated the previous association between retinal thickness and myopia. In that study, the average value of PCT was 181.90±46.43 μ in control eyes that was thicker than our healthy eyes. In the current study, thinner choroids were reversely in relation with axial length for all regions but temporal, which is in favor of findings of the previous study representing a correlation between longer axial lengths and thinner

choroid found in children with high myopia[13].

In another study, thicker PCT was negatively in relation with age, axial length and peri-papillary zone, however it was positively in relationship with Best Corrected Visual Acuity (BCVA) and higher prevalence of early and intermediate age-related macular degeneration. It should be noted that our subjects had mild to moderate myopia and our study was restricted to age and globe size. In agreement with other studies[4,8,10], we also found a mean choroidal thickness of 167 μm in normal controls. In fact, our data in control eyes was very similar to the results of a study by Harb *et al*[12] that might be due to the fact of using similar OCT equipment and measurement method. In our study, the inferior choroidal regions showed a reduction trend in the superior regions among mild to moderate myopic eyes similar to the healthy eyes. Similarly, the PCT in both the high myopic and healthy eyes was the same as the thinnest in inferior region from another study[10-12.]

Several studies have reported that the regional PCT tends to be thicker superiorly and thinner inferiorly[4, 6,8,14.] Additionally, we showed a thinning of RNFLT in mild to moderate myopia in comparison with normal controls. Previous studies have also revealed that the RNFLT is significantly less in myopic eyes compared to emmetropic eyes of both adults and children[15,16].

Conclusion

In conclusion, there is no significant difference in the PCT using EDI-OCT between mild to moderate myopic and normal control eyes. In both myopic and control eyes, inferior peri-papillary regional choroid was significantly thinner than the superior choroidal sector. RNFLT values were significantly lower in the superior, inferior, and nasal sectors among myopic eyes compared with the control eyes. The choroidal thickness in temporal, superior and nasal was negatively correlated with axial length.

Conflict of Interest

This manuscript has not been published or submitted for publication elsewhere.

Authors declare that there was no financial support or relationships that might cause a conflict of interest.

The corresponding authors had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis as well as the decision of submission of any article coming from this study for publication.

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