

The relation between central corneal thickness, axial length and myopia among a sample of patients in Erbil

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Kurdo Mohammedamin Omer *

Ahmed Kareem Joma **

Abstract

Background and objective: Myopia is a common refractive error in the estimation of corneal barrier and well-being of endothelial function, the central corneal thickness is important to manage corneal diseases. This study aimed to explore the relationship between central corneal thickness, axial length and myopia among a sample of patients in Erbil.

Methods: This cross-sectional study was conducted from June 2015 to February 2016. Forty six emmetropes as a control group and 46 myopes were studied. Axial length was measured with A-scan ultrasound biometry and central corneal thickness with corneal topography. Central corneal thickness was correlated with myopia and axial length using the Pearson's correlation coefficient.

Results: This study included 92 patients. The mean age of myopes was 31.87 years and 33 years for emmetropes. Myopia ranged from -0.5 to -11 diopters. The mean central corneal thickness was 541.80 micrometers for myopes and 548.93 micrometers for emmetropes. The mean axial length was 25.77 millimeters for myopes and 24.37 millimeters for emmetropes. The Pearson's correlation coefficient (r) of the central corneal thickness and myopia was -0.0245 ($P = 0.872$), while that of the central corneal thickness and axial length in myopes was 0.035 ($P = 0.566$) and of the central corneal thickness and axial length in emmetropes was 0.26 ($P = 0.091$).

Conclusion: There was no correlation between central corneal thickness, axial length and myopia.

Keywords: Myopia; Central corneal thickness; Axial length.

Introduction

Myopia is reported to be a common refractive error in Asian countries.¹ It results from a complex genetical and environmental factors.² In this situation, parallel rays of light which are entering the eye cannot be focused on the retina, and the picture falls in front of the retina.³ Various subsets of myopia have been recognized. Juvenile-onset myopia, described as myopia which starts between 7 and 16 years of age, is primarily due to growth in the axial length of the eyeball.⁴ Adult-onset myopia starts at about 20 years of age, and it is mainly caused by extensive near handiwork.⁴ However, the etiology of the development

of myopia is not well known, Two-thirds of the optical refraction is produced by the cornea. Therefore, its role in myopia has been studied greatly over many years.⁵ The myopic changes of the eyes involve increased depth of anterior chamber, elongation of axial length, thinning of the retina which is associated with lattice changes and a higher rate of retinal detachment, decreased choroidal blood flow, and decrease in thickness and elasticity of sclera.¹ It is known that the myopic eye is longer than the emmetropic eye. If this resulted from the general growth of the eyeball, we might expect that the cornea is growing thicker than normal. If instead,

* Erbil Directorate of Health, Erbil, Iraq.

** Department of Surgery, College of Medicine, Hawler Medical University, Erbil, Iraq.

the mechanism behind myopic eye enlargement is similar to that of balloon inflation, the expectation will be thinner cornea than normal according to the stretching theory.⁵ It has been reported that central corneal thickness (CCT) is a well-known indicator of corneal health. In the estimation of the corneal barrier and endothelial functional well-being, CCT is important to assess and manage corneal diseases.⁶ Furthermore, CCT is an indicator of corneal rigidity and it affects the accuracy of measuring the intraocular pressure. In addition, CCT values are highly important during the pre-operative assessment of patients undergoing corneal refractive surgeries. These values are also helpful in the decision making as for whether or not to perform surgery, the type of suggested procedure, and the rate of complications after surgery.¹ Studies that were undertaken to explore the effect of refractive errors on CCT have revealed conflicting results. Some studies have reported that myopic patients have a thicker CCT.⁷ Others have found that CCT is thinner in myopic eyes,⁸⁻¹¹ while some studies have reported no association between central corneal thickness and degree of myopia.¹²⁻²² The results of this study will help the refractive surgeons how to evaluate and choose the type of the refractive surgeries like the laser in situ keratomileusis and photorefractive keratectomy for myopic patients and to assess the risk of postoperative complications. The purpose of this study was to determine the correlation between central corneal thickness, axial length and myopia.

Methods

Design of the study:

A hospital based cross-sectional study (with a control group) was conducted in ophthalmology department of Erbil and Rizgary teaching hospitals in Erbil city from June 2015 to February 2016. 92 consecutive patients were enrolled in the study. Patients were divided into an

emmetropic group and a myopic group. The inclusion criteria included adults 18 years of age or older, patients with normal visual acuity for the emmetropic group and patients with spherical myopia from -0.50 and greater for the myopic group. The exclusion criteria included subjects with active ocular or corneal disease and corneal dystrophies, patients who had been treated previously for glaucoma and ocular hypertension, diabetics or other systemic disease possibly affecting the corneal thickness, eyes with keratoconus as demonstrated by corneal topography, previous corneal or ocular surgery and contact lens use for 2 weeks in case of soft lenses and 3 weeks for hard lenses before examination were excluded. Complete ophthalmic evaluation and slit lamp (Topcon, Tokyo optical CO., LTD. Japan) examination was done for all patients. Manifest refraction was done for all patients by Auto kerato-refractometer K.R8800 (Topcon Corporation, Japan). The axial length of both eyes was measured by using ultrasonic A scan AL -6000 (Honda electronics CO., LTD, Japan) after installation of a drop of tetracaine 0.5% into each eye. Corneal topography was done by using Galilei G4 [dual scheimpflug analyzer] (Ziemer ophthalmic systems AG allmendstrasse 11 CH-2562 port, Switzerland) for measuring central corneal thickness. Galilei measurements were obtained as per the manufacturer's instructions. The patient was comfortably sat with chin fully placed on the chin rest and forehead against the strap. The patient looked at the target (red spot) and allowed to blink. The device was brought in focus by aligning the measurement head of the Galilei. Alignment was considered correct when the red cross passed through the white spots and the single red line touch the corneal epithelium. The iris was seen in sharp focus on the screen. The patient was asked to blink once, open the eye wide and the reading was taken.

Ethical issue:

The study was approved by the Research Ethics Committee of the College of Medicine of Hawler Medical University and verbal informed consent was taken from each participant before being enrolled in the study.

Statistical analysis:

The data were entered and analyzed using the statistical package for the social sciences computer program (version 21). The calculated descriptive statistics were tabulated by mean and standard deviation (SD). The correlation between CCT, axial length and myopia was studied using Pearson's correlation co-efficient (r-value more than 0.7 was considered as strong correlation). Student t-test was used to

compare means from two independent groups and statistical significance is assumed at the $P < 0.05$ level.

Results

A total of 92 patients (184 eyes) were recruited for the study; 46 patients were myopes and 46 patients were controls. There were 48 female patients and 44 male patients. Patients in the age group 19 to 49 years in myopic patients and 19-50 in emmetropic group were included in the study. The mean age was 31.87 years (SD 7.99, median 31 years) in myopic group and 33 years (SD 8.08, median 33yrs) in emmetropic group (Table 1). The distribution of patients according to the degree of myopia is shown in Figure 1.

Table 1: Characteristics of study patients.

	Myopic group	Control group
No. of patients	46	46
Age		
Mean(SD)	31.87(7.99)	33(8.08)
Median	31.00	33
Range(years)	19-49	19-50
Gender		
Male	22	22
Female	24	24

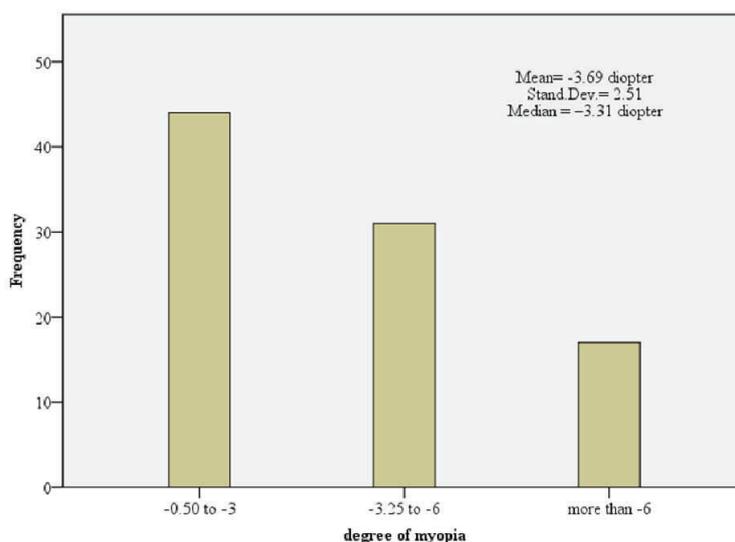


Figure 1: Histogram showing distribution of patients according to the degree of myopia.

CCT was split into groups (Table 2). 48 of the 92 myopic eyes had a CCT range of 500 – 549 micrometers and 36 of 92 emmetropic eyes had a CCT range of 500 – 549 micrometers. Table 3 summarizes the features of CCT and axial length in patients. In the myopic group, the mean CCT was 541.8mm (SD 40.09, range 432-619 mm, median 540.25 mm) and the mean axial length was 25.77 millimeters (mm) (SD 1.55, range 23.26 – 28.78 mm, median 25.42 mm). In the emmetropic group, the mean CCT was 548.93 mm (SD 38.87, range 467–626 mm, median 547mm) and the mean axial length was 24.37 mm (SD 0.95, range 22.06 – 25.83 mm, median 24.60 mm).

The difference between the two CCT means was statistically significant ($p < 0.05$, students t-test) and the difference between the two axial means was statistically significant ($P < 0.05$, Students t-test). The correlation between CCT, axial length and myopia was analyzed using the Pearson's Correlation Coefficient. There was no significant correlation between CCT and axial length in myopes, $r = 0.035$, $P = 0.566$ and there was no significant correlation between CCT and axial length in emmetropes, $r = 0.26$, $P = 0.091$. There was no significant correlation between CCT and degree of myopia, $r = -0.024$, $P = 0.872$ (Table 4).

Table 2: Distribution of eyes by degree of central corneal thickness.

CCT(micrometer)	No. of myopic eyes	No. of emmetropic eyes
Less than 500mm	14	12
500 – 549mm	48	36
550 – 600mm	24	35
More than 600 mm	6	9
Total	92	92

Table 3: Characteristics of CCT and axial length in patients.

	Myopic group	Emmetropic group
CCT(micrometer)		
Mean(SD)	541.80(40.09)	548.93(38.87)
Median	540.25	547.0
Range	432 – 619	467 – 626
Axial length(millimeter)		
Mean(SD)	25.77(1.55)	24.37(0.95)
Median	25.42	24.60
Range	23.26 - 28.78	22.06 - 25.83

Table 4: Correlation between CCT, axial length and myopia.

Pearson's correlation analysis	Correlation co-efficient	P value
CCT and myopia	-0.0245	0.872
CCT and axial length in myopes	0.035	0.566
CCT and axial length in emmetropes	0.26	0.091

Discussion

Although numerous investigators have studied the effect of refractive error on CCT investigators, conflicting results have been found. Myopia increases with advancing age. In the United States, the prevalence of myopia varies in different age groups, it's about 3% among children 5 to 7 years old age, 8% among 8 to 10 years age group, 14% among 11 to 12 years age group, and among those aged 12 to 17 years it is about 25%. In particular racial groups, a similar trend has been recognized, however the percentages may differ in each age group.⁴ During progression of myopia the eyeball is elongated. This progression makes the eyeball become longer also makes the sclera to become thinner²³⁻²⁵ and the posterior part of sclera is involved more significantly.^{26,27} In addition to the fact that the anterior chamber is deeper in higher myopia²⁸ there are dimensional alterations in the anterior segment during progression of myopia, but they are not well documented. Goss and his colleagues²⁹ have found flatter corneal surfaces in eyes with deeper vitreous cavities. If the whole corneal size is not increased, we suppose that the cornea becomes thinner in a similar manner to sclera during progression of myopia. However, in our study we didn't find any statistically significant relation between central corneal thickness and myopia (Pearson $r = -0.0245$ $P = 0.872$). This finding agrees with the most of the earlier studies.¹²⁻²² According to such findings, we consider that if the stretching process is actually active, the thinning is likely to be restricted only to the sclera and the cornea is not involved. The current study has the limitation that we measured CCT in the morning and there are studies that investigated the diurnal changes of corneal thickness with various techniques. One of these studies is by Muller-Treiber et al.³⁰ who studied the diurnal variations with the optical low coherence reflectometry (OLCR) pachymeter, and reported that the cornea is thickest in the morning and

about 5 micrometer lower in the late afternoon. The inconclusive findings of earlier studies could be clarified by each of the following factors: low reproducibility of pachymeters, inexperienced examiners, racial and genetic variations in CCT, the effect of contact lenses, deficiency of high myopic subjects, the difference in exclusion criteria and small sample sizes. In our study, we used corneal topography which is the most precise instrument nowadays for measuring corneal thickness than older instruments which were used by previous studies. There looks to be no general agreement regarding the relation between CCT and axial length. The present study showed no association between CCT and axial length. This result agrees with a conclusion by Oliveira et al.²⁰ who reported no association between CCT and axial length in American patients. In addition, Mitsugu Shimmyo et al.³¹ who studied ocular parameters of 1084 eyes. They didn't find a statistically significant correlation between CCT and axial length. They also analyzed the subgroups by gender, age and race, but failed to find a significant association. In contrary, Chang et al.¹⁰ showed that eyes with greater axial lengths have significant thinner CCTs. They considered that the cornea became thinner as its surface area is increased, and decreased corneal thickness might be anticipated as the axial length of the eye increases. Their subpopulation is possibly very small to give a reliable relation between CCT and axial length in the whole population. Myopia may become a progressing problem in the future as its prevalence is increasing. Investigations in Japan, Iceland, Denmark and North American native populations have found that the prevalence of myopia is increasing. Therefore, in the future years there will be a higher rate of refractive surgeries for correction of myopia. There is a general agreement that with Lasik, the cornea should not be thinned further than a given value. Therefore, the measurement of corneal thickness

is necessary before surgery.

Conclusion

In our study, we didn't find significant relations between central corneal thickness, axial length and the level of myopia. Our findings add to the fact that CCT and axial length are independent elements and are not related to other ocular parameters. Therefore, we consider that the central corneal thickness is not involved with the growth changes in ocular tunics of myopic patients. We recommend that in the future studies the central corneal thickness to be measured in the late afternoon to avoid the diurnal variation in corneal thickness.

Competing interests

The authors declare that they have no competing interests.

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