Original Article

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Correlation of Central Corneal Thickness and Axial Length in Myopes, Emmetropes, and Hypermetropes

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Abstract

Introduction: The cornea is responsible for approximately two-thirds of optical refraction and its role in myopia has consequently been studied intensely over the years. An emmetropic eye is comparable with a sphere and myopic eye to a prolate spheroid. Myopia is increasing in prevalence among the populations of East Asian origin. Estimates of the proportion of myopia in the young population of South East Asian countries range from 30% to 60%.

Purpose: To determine the correlation between central corneal thickness (CCT) and four variables, namely, the degree of myopia, corneal curvature, axial length, and age of the patient.

Methods: 150 eyes were studied for a prospective observational study done at the Department of Ophthalmology, New Civil Hospital, Surat, Gujarat, India. All patients underwent a complete ophthalmic evaluation. CCT was measured with an ultrasonic pachymeter. Axial length was measured using an A-scan (Echorule2, Biomedix). Corneal curvature was measured using a Keratometer.

Results: Total numbers of 150 eyes were evaluated for the study. 66 were myopes, 51 were emmetropes, and 33 were hypermetropics. The mean CCT was 547.80 ± 28.6 μ. This study showed no statistically significant difference between CCT in myopes, hypermetropes, and emmetropes. There was no correlation between the degree of myopia and CCT (r = −0.006, P = 0.96). There was a negative correlation (r = −0.26) (P = 0.001) between CCT and corneal curvature. The correlation was significant at the 0.01 level (2-tailed). There was thinner cornea with increase axial length in our study. There was no statistically significant association between CCT and age or sex.

Conclusion: This study has shown that CCT has no correlation with degree of myopia. CCT was significantly associated with corneal curvature and axial length. There was no association between CCT and age or sex.

Key words: Central corneal thickness, Emmetropia, Hypermetropia, Myopia

INTRODUCTION

Although the exact etiology of myopia is still unknown, approximately two-thirds of optical refraction is due to the cornea and its relation with myopia has been studied since a long time. It mostly affects the posterior segment of the eye such as posterior staphyloma, choroidal atrophy, and thinned retina and sclera, inducing more chances of retinal detachment. Changes in the anterior segment associated with myopia are still under controversies. The myopic eye is known to be longer than the normal emmetropic eye. If this is the result of general growth, one might expect the cornea to have grown thicker than normal. If instead, the myopic eye is larger due to a mechanism similar to that of a balloon being inflated, one would expect the cornea to be thinner than normal according to physics. An emmetropic eye is comparable to a sphere and a myopic eye to a prolate spheroid. Myopia is increasing in prevalence among the populations of East Asian origin. Estimates of the proportion of myopia in the young population of South East Asian countries range from 30% to 60%. With increasing rates of myopia, refractive surgery such as the laser *in situ* keratomileusis (LASIK) has become popular in

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Asia. When undertaking such surgery to correct refractive error, central corneal thickness (CCT) is an important consideration to prevent the cornea from becoming too thin after treatment. Studies that have attempted to investigate the effect of refractive errors on CCT have reported conflicting results. Some of them have found the cornea to be thinner in more myopic eyes. The purpose of our study was to determine the correlation between CCT and four variables, namely, the degree of myopia, corneal curvature, axial length, and age of the patient.

MATERIALS AND METHODS

In this prospective observational study of 150 patients; 66 were myopic, 33 were hypermetropic, and 51 were emmetropic. They were in the age group of 18-45 years. Subjects with previous ocular surgery, glaucoma, or any disease affecting the corneal thickness were excluded. All patients underwent a complete ophthalmic evaluation. CCT measurement was done with an ultrasonic pachymeter. Axial length was measured using an A-scan (Echorule2, Biomedix). Corneal curvature was measured using a Keratometer (Table 5). Statistical analysis was done using SPSS V.11 and Microsoft Excel. Correlation between CCT and four factors, namely, the degree of myopia, axial length, corneal curvature, and age of the patient was studied using. A probability of 0.05 was considered statistically significant.

RESULTS

Among 150 eyes studied, 66 were myopic, 51 were emmetropic, and 33 were hypermetropic. There were 67 female participants and 54 male participants. Participants in the age group 18-55 years were included in the study. Mean age was 26.88 years (standard deviation [SD] 6.66); median age was 25 years (Table 1). Refractive error splits into groups in Table 2. Table 3 shows the mean of all measured variables of myopia, hypermetropia, and emmetropia.

Correlation between CCT and four variables studied using Karl Pearson's correlation coefficient. This study showed no statistically significant difference between CCT in myopics ($r = -0.006$, $P = 0.96$), emmetropics ($r = -0.131$, $P = 0.360$), and hypermetropics ($r = -0.147$, $P = 0.626$). Changes in axial length were statistically significant in myopes, emmetropes, and hypermetropics. Changes in the mean of corneal curvature in myopia, emmetropia, and hypermetropia were not statistically significant ($F = 1.48$, $P = 0.161$). Mean anterior chamber depth and refractive error were directly correlated in the myopic group ($r = 0.357$, $P = 0.003$), but there was no significant correlation found in emmetropic and hypermetropic groups.

DISCUSSION

The study attempted to determine the relation between CCT and four variables, namely, the degree of myopia, corneal curvature, axial length, and age of the patient. The mean (SD) CCT was 547.80 ± 28.6 μ. Fam *et al*. in a study on 714 Chinese patients had a mean of 534.5 μ.[1] Chang's series had 533 μ, whereas Vijaya *et al*. reported it in the rural South Indian population as 505.9 μ.[2] This study showed no statistically significant difference between CCT in myopes, hypermetropics, and emmetropes. There was no correlation between the degree of myopia and CCT ($r = -0.006$, $P = 0.96$).This result is in agreement with the majority of previous studies (Table 4). There was a negative correlation ($r = -0.26$) ($P = 0.001$) between CCT and corneal curvature. The correlation was significant at the 0.01 level (2-tailed). Similar results were there in Tomidokoro *et al*. in the Tajimi Study from Japan.[3] A study was done on Singaporean children showed that the radius of corneal curvature correlated with CCT (Pearson $r = 0.19$, $P < 0.001$) significantly. There was a thinner cornea in patients having a more axial length in our study. Chang *et al*. and Bueno-Gimeno *et al*.[4] found similar results, whereas Bhat *et al*. and Chen *et al*.[5] found no correlation between them. Subgroup analysis by age, gender, and race failed to show an association. There was no statistically significant association between CCT and age. Myopia is increasing in prevalence and may be a growing problem in the future. Consequently, there is a higher rate of refractive surgeries to correct it. With LASIK, there is a general concern that one should ablate the cornea further than a given amount. It is, therefore, necessary to

Table 1: Demographic features of study participants

Total participant	121
Total eyes	150
Myopes	66
Hypermetropes	33
Emmetropes	51
Male	54
Female	67

Table 2: Distribution of participants according to refractive error

Refractive error (diopters)	Number of participants	Percentage
Myopia (*n*=66) 44%		
2	33	50
>4-6	26	39
>6	7	11
Hypermetropia (*n*=33) 22%		
2-4	27	82
>4	6	18
Emmetropia (n=51) 34%	51	
Total	150	

Table 3: Mean of measured variables of myopia, hypermetropia, and emmetropia

Refractive error (diopters)	Number of participants (%)	Mean CCT±SD	Mean AL±SD	Mean K±SD	Mean ACD±SD
Myopia (*n*=66)		549.16±27.02	24.01±0.88	44.00±1.60	3.19±0.42
2-4	33 (50)	551.51±21.5	23.72±0.69	43.58±1.59	3.09±0.25
>4-6	26 (39)	543.34±27.4	24.25±0.75	43.83±2.08	3.34±0.39
>6	7 (11)	552.51±46.17	24.50±0.79	44.98±1.47	3.53±0.00
Hypermetropia (*n*=33)		549.84±31.75	21.67±1.30	43.42±1.28	2.88±0.35
2-4	27 (82)	551.44±30.15	21.58±0.39	43.33±1.33	2.82±0.25
>4	6 (18)	542.66±40.62	22.75±2.95	43.81±1.85	3.19±0.44
Emmetropia (*n*=51)		545.68±27.02	22.37±0.83	44.21±1.59	3.00±0.32
Total	150	547.80±28.665	22.97±1.33	43.87±1.55	3.08±0.39

ACD: Anterior chamber depth, CCT: Central corneal thickness, SD: Standard deviation

Table 4: CCT and degree of refractive error

Authors	Years	Country	Results CCT and myopia
Pedersen *et al*.	2005	Denmark	No correlation
Kunert *et al*.	2003	India	Thicker CCT in high myopic
Touzeau *et al*.	2003	France	Thinner CCT when myopic
Shrivannaboon *et al*.	2002	Thailand	Thinner CCT when myopic
Chang *et al*.	2001	Taiwan	No correlation
Liu and Pflugfelder *et al*.	2000	China	No correlation
Cho and Lam *et al*.	1999	China	No correlation
Price *et al*.	1999	USA	No correlation
Tanaka *et al*.	1996	Brazil	No correlation
Alsbirk *et al*.	1978	Greenland	Thinner CCT when myopic
Ehlers and Hansen *et al*.	1976	Denmark	No correlation
Hansen *et al*.	1971	Denmark	No correlation
Martola and Baum *et al*.	1968	USA (Boston)	No correlation
Von Bahr *et al*.	1956	Sweden	Thinner CCT when myopic
Blix *et al*.	1880	Sweden	No correlation
Present study	2013	India	No correlation

CCT: Central corneal thickness

Table 5: Comparison of correlation between different variables with other studies

Authors	Axial length and CCT	Corneal curvature and CCT	ACD and CCT	Axial length and corneal curvature	Axial length and ACD	ACD and corneal curvature
Lee *et al*.	Thicker CCT with ↑ AL		Thicker CCT with ↑ ACD		Shallow ACD with ↑ AL	
Chang *et al*.	Thinner CCT with ↑ AL	No correlation		Flat K with ↑ AL		
Chen *et al*.	No correlation	No correlation	No correlation	Flat K with ↑ AL	Deep ACD with ↑ AL	Flat K with ↑ ACD
Bueno-Gimenol *et al*.	Thinner CCT with ↑ AL			Flat K with ↑ AL		
AlMahmoud *et al*.		Thinner CCT with ↑ K				
Bhat *et al*.	No correlation	Thinner CCT with ↑ K				
In this study	Thinner CCT with ↑ AL	Thinner CCT with ↑ K	No correlation	Flat K with ↑ AL	Deep ACD with ↑ AL	No correlation

ACD: Anterior chamber depth, CCT: Central corneal thickness, ↑: Increase

measure CCT before surgery. A thin central cornea is a risk factor for the development of glaucoma in patients with ocular hypertension. In the ocular hypertension treatment study, a multivariate model that included intraocular pressure, CCT was an important component of the predictive model.

CONCLUSION

CCT in every person is under genetic control. This study has shown that CCT has no correlation with degree of myopia. It was significantly associated with corneal curvature and axial length. There was no association between CCT and age or sex.

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