Original Article

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Correlation Between Central Corneal Thickness and Degree of Myopic Refractive Error : An Indian Study

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Abstract

Aim: To assess the correlation of central corneal thickness (CCT) with the degree of myopia. *Methods:* This is a prospective observational study. A total 280 patients were enrolled in a refractive surgery clinic. Total ophthalmic assessment including refraction was performed. CCT was determined in each eye of the all patients using ultrasonic pachymeter. Five different reading were taken during morning time and average of it was considered. The correlation of CCT and the degree of myopia in dioptres (D) was identified by Pearson's correlation coefficient and multiple comparisons Dunnett's t test. *Results:* Mean age of patients 24.85 ± 1.41 in males and 24.61 ± 7.77 in females. Mean value of myopia was -5.70 ± 2.12 D and -5.87 ± 3.18 D in males and females respectively. Mean corneal thickness was 539.19 ± 42.42 µM in males while it was 531.46 ± 12.02 µM in females. The correlation between CCT and the degree of myopic spherical equivalent was statistically insignificant (r=20.13, p=0.72). The insignificant (p > 0.05) association was found between the CCT and myopia groups while CCT was divided in to two groups. *Conclusion:* There is no significant difference noted among myopic refractory error and CCT. There was no significant difference between CCT, which remains nearly same in all degree of myopic eyes. This is clinically irrelevant and it does not affect the management of patients.

Keywords: Pachymetry; Myopia; Central Corneal Thickness.

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Introduction

Corneal thickness is considered as a significant marker of corneal physiology and its changes may be demonstrating the various pathologies [1]. It is most important to collect the trustworthy corneal pachymetry value of all the patients so that thickness of cornea is measured accurately. Thickness of cornea is also considered as important factor while arranging the corneal refractive surgery (these values affect the concluding decision as to whether surgery is essential, the choice of a particular surgical procedure, problems related to follow up or the rate of postoperative complications) and determining the intraocular pressure (IOP) [2,3]. Various factors have been implicated in affecting the corneal thickness pachymetry such as the existence of any corneal deterioration, patient age, timing, using the contact lens [4]. The effect of refractive error on thickness of cornea has not been till date evidently established [5–7].

Myopia is one of the most ordinary eye abnormalities in the globe. The myopia or short sightedness is a nothing but the one type of refractive abnormality where in the resting condition of eye the parallel rays of light concentrate before the neurosensitive layer of the retina. This is the inverse condition to hypermetropia and the eye is comparative too large as compared to non myopic eye [8]. Myopia is determined with help of spherical power in diopters of the diverging lens needed to concentrate light onto the retina that can be represented as the spherical equivalent or refraction in the least myopic meridian [9]. Myopia influences about 25% and more than 80% of the people in the West and some Asian regions, respectively [8]. The modulations in choroid, elongated axial length (AL) and stretching of the retina and sclera are associated with myopic eyes [9]. Numerous of reports suggested that the deeper

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anterior chambers, more Steepened corneas and major white-to-white corneal diameters found in the myopic eyes as compared to emmetropic, low-myopic and hyperopic eyes [10,11]. Multiple studies have been found the relationship of CCT with degree of myopia. However, the results of these studies are controversial and none of the studies have considered the mid-peripheral corneal thickness (PCT) in severe myopic eyes [10-15]. Numerous of studies showed that CCT was thicker in the myopic eyes [12] and studies reported that CCT was thinner in the myopic eyes [7,13] while some found no association of CCT with myopia [10,11,14,15]. These diversifying results suggested that the association of CCT with severe myopia is a controversial. Therefore, there is need of further study to generate evidences related to issue. The principal aim of current study was to assess the association of central corneal thickness (CCT) and degree of myopia in Indian population.

Methodology

Study setting: This was a cross sectional study involving 280 patients (498 eyes) who were admitted in ophthalmology department of a tertiary care teaching rural hospital for LASIK operation.

Ethical consideration: The experiment protocol was permitted by the institutional ethics committee and written informed consent was collected from all patients.

Patients selection: Inclusion criteria for the patients were adults of 18 years and more of either gender, having spherical myopia between -0.2 and -15.0 D; cylinder of -1.50 D or less, steady refraction since one year, no contact lens use from 2 weeks in case of soft lenses and 3 weeks in case of hard lenses prior to preoperative investigations. Patients having keratoconus or forme frusta keratoconus as showed by scan and/or pentacam were expelled from the study. Patients having suspected corneal dystrophy in eye, known ocular abnormality or previous ocular surgeries were also expelled.

Study procedure in detail: Each patient was passed through full ophthalmic examination. CCT measurement was done with an ultrasonic pachymeter (PACH SCAN of sonomedpachymetry) and detailed examination of both eyes carried out (both dilated and undilated pupils). Topical anesthesia with proparacaine hydrochloride 0.5% was given. CCT was determined in upright position of patient. A hand-held probe was aligned as perpendicular as possible on the central cornea. Five readings were taken and average of the readings was recorded. Also four readings from four points at peripheral cornea were taken because CCT is always less than peripheral corneal thickness. All the relevant data were recorded in a structured case record form.

Statistical analysis: Data is represented as actual frequencies, mean, and standard deviation as appropriate. Pearson correlation analysis was performed to assess the association of CCT with degree of myopia. The statistical analysis was performed by one way ANOVA followed by multiple comparisons Dunnett t test (two-sided) to evaluate association of CCT with various degree of myopia like 0 to –8 D, and –8 to -15 D. A similar comparison was done between the degree of myopia and CCT groups such as those with <480 µM and ≥ 480 µM. Data were analyzed using SPSS V.11.0, and significance was considered as $p<0.05$.

Results

The total number of patients meeting the inclusion criteria was 280 (496 eyes). Out of this 280 patients, 160 (57.14%) were males and

Table 1: Demographic parameters of the patients (n=280, 498 eyes)

Parameter	No. of patients
Sex	
Male	160 (57.14%)
Female	120 (42.86%)
Age (years)	
Mean age in males	24.85 ± 1.41
Mean age in females	24.61 ± 7.77
Range	15.4 – 59.0
Spherical equivalent (D)	
-2 to -8	408 (81.92%)
-8 to -15	90 (18.07%)

Table 2: Association of myopic spherical equivalent (SE) and mean CCT (n=498 eyes)

Myopic Spherical Equivalent (D)	No. of patients	Mean CCT	P value
-2 to -8	408 (81.92%)	532.54	>0.05
-8 to -15	90 (18.07%)	521.15	

CCT – central corneal thickness

Table 3: Comparison between myopia and central corneal thickness (CCT) groups

Group	Number	Mean (SD)	Range	P value
Myopia groups		CCT µM		
-2 to -8	408	532.54 (42.7)	447–618	0.2
-8 to -15	90	521.15 (48.4)	473–618	0.7
CCT groups		Myopia (D)		
Pachymatry > 480 µM	402	-4.71 (1.9)	(-2.25 to -8.00)	0.5
Pachymatry < 480 µM	96	-10.86 (1.8)	(-8.25 to -15.0)	

120 (42.86%) were females. Mean age of patients 24.85 ± 1.41 in males and 24.61 ± 7.77 in females. Mean value of myopia was -5.70 ± 2.12 D and -5.87 ± 3.18 D in males and females respectively. Mean corneal thickness was 539.19 ± 42.42 µM in males while it was 531.46 ± 12.02 µM in females. Demographic details of the study patients are shown in table 1.

The current study showed no relationship between CCT and the degree of myopic spherical equivalent (r = 20.13, p = 0.72). No significant association was found between CCT and degree of myopic spherical equivalent (p > 0.05) as showed in table 2. When CCT was split in to two groups, and compared with myopia, no significant association was found (p > 0.05) as shown in table 3.

Discussion

The CCT has dominant significance in clinical practice for numerous rationales like its affection on IOP determination. It is a very significant while arranging refractive surgery or other medical conditions. The mean CCT of subject was 542 ± 46 µM. This value was to some extent more than which suggested in their meta-analysis by Doughty and Zaman [4]. The mean CCT was 535 µM when taking healthy corneas with CCT values between 503 and 565 µM. Garcia- Medina *et al.* found got a CCT of 550 ± 36 µM, investigated a total 310 myopic eyes, which a little more as compared to result of current study. [16]. Al Mahmoud *et al.* [11] also got same CCT, which observed in the current study (543 ± 34 µM in 3091 eyes with myopia).

Multiple studies have been showed the association of CCT with refractive error. However, the results of studies are divisive. The previous studies showed that myopic eyes have a thicker CCT, [12] while some studies suggested that a thinner CCT in myopic eyes, [7,13] and multiple studies demonstrated no association of CCT with myopia [10,11,14,15]. Therefore, there is need to perform further study, which demonstrate the influence of refractive error on corneal thickness (by means of the AL or the SE). We got an insignificant relationship between the CCT with SE.

Kunert *et al.* evaluated the total 1214 myopic-eye and they obtained insignificant difference in association of cornea with severe and low degree of myopia [12]. Sanchis-Gimeno et al. evaluated the CCT in severe myopic eyes (range 12.00–24.00 D) as compared to low myopic eyes and they obtained insignificant differences in association of CCT with high and low degree of myopia. However, they found a same trend for the corneas with severely myopic eyes to be thicker as compared to low myopic eyes. Chang *et al.* [17] has demonstrated an opposite correlation of CCT with AL, which suggested that corneas are thinner in longer eyes (i.e., they have an extreme myopia condition). However, Chang *et al.* did not involve highly myopic eyes in a sample of 216 myopic eyes, showing an average SE of −4.17 D.

Some studies have not found any correlation of the CCT with SE or AL. Chen *et al.* [14] found insignificant correlation in evaluated 500 emmetropic, hyperopic and myopic eyes. Study sample as an exclusive group (without separation as per the degree of myopia) may have affected their conclusions. In the same way, AlMahmoud *et al.* [11] found a mean SE of −4.58 D, varying from

−0.13 to −14.00 D with an insignificant correlation of CCT with SE in a 3091 myopic eyes. AlMahmoud *et al.* did not evaluate the groups in section to identify any relationship that consequence from modulation in the degrees of myopia.

Another probable clarification for divisive results produced in various studies was to use of different corneal pachymeters to evaluate the CCT and SE. Notably, somewhat more CCT values were obtained with ultrasound pachymetry as compared to slitlamp-based pachymetry. [4] The thickness of cornea also affected by the time of day, which showed that corneal thickness was elevated in the morning as compared to afternoon. [4] The current study has been used PACH SCAN (sonomedpachymetry) in majority of patients at morning time only.

The absence of ocular abnormalities in the eye, the cornea thickens was independent to the SE from the center to the periphery [18] because of increase of Bowman's layer thickness as well as the stroma while reaching the corneal periphery [19]. The current study showed a thinner CCT for each sample and for each study group as compared to demonstrated by nasal, temporal, superior and inferior pachymetry. As predicted, each pachymetry (temporal, nasal, central, superior and inferior) was directly correlated ($r > 0.78$ $P < 0.05$). The evaluation of the corneal thickness of central and peripheral is also significant to assess the corneal biomechanical characteristics [20]. The previously reported studies showed the correlation of the corneal hysteresis with myopia [20,21]. They demonstrated low corneal hysteresis and thicker CCT in high myopic eyes (more than 6.00 D) [20], suggested that the mechanical strength is compromised in anterior part of the severe myopic eyes. But, they did not evaluate the peripheral pachymetry. Also, Jiang *et al.* [20] did not get the significant differences between CCT in without myopic (SE >−0.50 D) and various degrees of myopia [low myopia (SE between −0.50 and −3.00 D), moderate myopia (SE between −3.00 and −6.00 D) and high myopia (SE <−6.00 D)]. These findings consistent with our results and concluded that biomechanical aggravation relayed on severe myopia could be more correlated with corneal biologic changes as compared to anatomical disparity in central thickness. Corneal thickness is most significant in excimer laser refractive surgery of myopia.

The prevalence of myopia is raising and may be a developing issue in the future. Previous studies in Japan, Iceland, Denmark and North American native populations have demonstrated the raising prevalence of myopia. As a result there is an increased rate of refractive surgeries to correct myopia. With Lasik there is a general worry that one should not thin the cornea more than a given amount. So, it is careful to determine CCT before the surgery. The results showed the requirement of pachymetry investigation in preoperative as collection of excimer laser surgery in any degree of myopia to prevent post-surgery complications [22].

Though our study has evaluated the association of CCT with myopia among Indian population, it had few limitations. The axial lengths of the patients were not been determined to differentiate people with axial myopia from those with index myopia. But, patients were enrolled from a refractive surgery clinic and involved patients of myopia who were assessed for LASIK. These patients were not expected to have index myopia. We did not use an emmetropic sample for comparison and it was compared the data with population-based study data from the other regions and other countries in the current study.

Conclusion

There are insignificant association of CCT and myopic as well as very severe myopic. CCT remains nearly same in all degree of myopic eyes with minor variation, which are clinically inappropriate to myopic patient management.

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