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Original Research Article

Study of Central Corneal Thickness by Pachymeter in Myopic Eyes

Abhilasha Yadav[1], Chhaya Shinde[2], Rajarathna Hegde[3], Shruti Shirwadkar[4]

[1]Resident, Department of Ophthalmology, Lokmanya Tilak Municipal Medical College and General Hospital, Sion, Mumbai, Maharashtra, India
[2]Professor and Head, Department of Ophthalmology, Lokmanya Tilak Municipal Medical College and General Hospital, Sion, Mumbai, Maharashtra, India.
[3]Senior resident, Department of Ophthalmology, Lokmanya Tilak Municipal Medical College and General Hospital, Sion, Mumbai, Maharashtra, India
[4]Associate Professor, Department of Ophthalmology, Lokmanya Tilak Municipal Medical College and General Hospital, Sion, Mumbai, Maharashtra, India.

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Corresponding author: Dr. Shruti Shirwadkar
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Abstract

Background: The approximate thickness of cornea is around 500-600 micrometer at its centre and increases gradually towards periphery upto 670 micrometer. Myopia is public health concern, having rapid increasing prevalence in world in recent decades, so myopia is considered multifactorial. With increasing rates of refractive errors, refractive surgeries are becoming very popular. Central Corneal thickness (CCT) is an important consideration to rule out abnormally thin corneas. The purpose of our study was to determine the correlation between CCT and degrees of myopia. Despite of widespread clinical use of refractive surgeries of cornea, there are only few studies from the general population on the distributions and correlations of pachymetry measured corneal thickness in myopic patients. A major concern in refractive surgery is accurate measurement of corneal thickness. It is critical in patients with high myopia because more tissue needs to be ablated to achieve emmetropia; while overestimation can be associated with the risk of postoperative keratectasia, underestimation may lead to inadvertent exclusion of patients because of concerns about insufficient corneal thickness.

Material & Methods: In this prospective, observational study of patients aged 15 to 50 years who attended Ophthalmology OPD of Tertiary care Hospital, Central Corneal Thickness was measured in 304 eyes of 152 myopic patients using Ultrasound Pachymetry.

Ophthalmic evaluation included

1. Visual acuity (Unaided and aided Best corrected visual acuity)
2. Torchlight examination
3. Slit Lamp Examination
4. Intraocular Tension
5. Axial length
6. Direct ophthalmoscopy
7. Indirect ophthalmoscopy
8. Fundus photo if required

Results: There was no correlation found between degree of myopia and central corneal thickness in the subjects studied.
Conclusion: There was no correlation found between degree of myopia and central corneal thickness in the subjects studied.
Keywords: Myopia, Central corneal thickness, Refractive surgery.

Introduction

The cornea is a transparent avascular structure responsible for approximately two-third of optical refraction. It forms anterior one-sixth of outer fibrous coat of eyeball and measures around 11-12 mm horizontally and 10-11 mm vertically. The approximate thickness of cornea is around 500-600 micrometer at its centre and increases gradually towards periphery upto 670 micrometer. Its role in myopia has consequently been studied intensely over the years[1].

Cornea is aspheric structure; central portion of anterior surface is described as a spherocylindrical convex mirror. Central 5 mm of cornea is powerful refracting surface. An emmetropic eye is compared with a sphere and myopic eye to prolate spheroid[2,3,4,5].

Myopia is significant, public health concern, having rapid increasing prevalence in world in recent decades, various genetic and environmental factors implicated in development of myopia, so myopia is now considered as multifactorial trait[6, 7,8].

Myopia is an underestimated, important eye disease. It is estimated that globally 153 million people, over 5 years of age, because of uncorrected myopia, are visually impaired[9].

With increasing rates of myopia and other refractive errors, refractive surgeries are becoming very popular nowadays.

Central Corneal thickness (CCT) is an important consideration to rule out abnormally thin corneas. The purpose of our study was to determine the correlation between CCT and degrees of myopia.

Despite of widespread clinical use of refractive surgeries of cornea, there are only few studies from the general population on the distributions and correlations of pachymetry measured corneal thickness in myopic patients.

A major concern in refractive surgery is accurate measurement of corneal thickness. This issue is critical in patients with high myopia because more tissue needs to be ablated to achieve emmetropia; while overestimation can be associated with the risk of postoperative keratectasia, underestimation may lead to inadvertent exclusion of patients because of concerns about insufficient corneal thickness.

Pachymetry (Measurement of Corneal Thickness) gained importance for planning any refractive surgeries. It can be performed by two ways:

Optical Pachymetry: It is used with slit lamp and works on the principle of optical image doubling.

Ultrasonic Pachymetry: It is currently the gold standard for measuring corneal thickness, however it suffers from limitations including the necessity for topical anesthesia, direct contact of the probe with the cornea and hence the risk of infection, the risk of incorrect probe placement, poor fixation and variations in sound wave speed due to different degrees of corneal hydration. The accuracy of ultrasonic pachymetry requires perpendicular placement of the probe onto the corneal surface, therefore examiner's experience can affect the reliability of

measurements[10].

This prospective observational study was planned to compare central corneal thickness (CCT) measurements in myopic eyes.

Aims & Objectives of the study

1. To measure the central corneal thickness in patients diagnosed as myopics
2. To find out the relation between central corneal thickness and degree of myopia.

Material & Methods

This was a Prospective, observational study of 304 eyes of 152 patients (Both male and female), aged 15 to 50 years attending Ophthalmology OPD of Tertiary care Hospital. Central Corneal Thickness was measured on 304 eyes of 152 myopic patients using Ultrasound Pachymetry.
Study Duration: November 2017 to November 2019.

Sample size: 304 eyes.

Subjects & Selection Method: The study population was drawn from consecutive myopic patients, ages 15 to 50 years who attended Ophthalmology OPD during the duration of the study and were willing to participate in the study.

Inclusion criteria:

1. Patients diagnosed with myopia
2. Either sex
3. Age group 15 to 50 years

Exclusion criteria:

1. Subjects with any previous ocular surgery.
2. Subjects with history of glaucoma.
3. Subjects having any disease affecting cornea.
4. Subjects using contact lens in the previous 2 weeks of study.
5. Subjects not willing to participate in the study.

Procedure methodology

Institutional Ethics Committee- Human Research approval was obtained before commencement of the study. Patients were informed about the study, those who consented were included in the study. Written informed consent was obtained. It was explained that it would be a completely non – invasive procedure and will require his/her cooperation for a few minutes. All patients information was kept confidentially and was not accessed by staff not concerned with the study.

A detailed history was obtained from patients/relatives. Questions were asked in order to rule out systemic disorders according to our exclusion criterias. A detailed history was followed by a thorough ophthalmic evaluation comprising of

1. Visual acuity (Unaided and aided BCVA Best corrected visual acuity)
2. Ocular examination
3. Slit Lamp Examination
4. Intraocular Tension
5. Axial length
6. Direct ophthalmoscopy
7. Indirect ophthalmoscopy
8. Fundus photo if required

The patient was seated comfortably and ultrasonic pachymetry machine started and its probe attached. Proparacaine HCl 0.5% eye drops used for corneal anesthesia (1 drop, 2 times at interval of 5 minutes). Patient was asked to look straight, and probe was placed perpendicular over the center of cornea and 5 readings were taken. Average of these 5 readings which displayed on screen of machine after removing the probe was recorded.

Statistical analysis

Data were analysed using SPSS V15.0 (Statistical Package for Social Sciences, Version 15.0) package. Data were given as Mean, SD and N for continuous normal data & Number and Percentage for categorical data. Comparison of means of 2 groups was carried out by Student's unpaired t test for numerical normal data. ANOVA one-way statistical test was applied to compare means of more than 2 groups. Pearson Correlation Coefficient was calculated between 2 variables and its significance was tested. All statistical tests were two tailed. Alpha (α) Level of Significance was taken as$P \leq 0.05$.

Results

Study population studied N=304 [Sample size]

Table 1: Demographic Features

Variable	Value
Sex	
Male	138(45.4%)
Female	166(54.6%)
Age (yrs)	
Mean (SD)	27.47 (7.28)
Range	16.0-48
Median	27.0
MYOPIA IN DSPH	
Mean (SD)	-3.66 (2.12)
Range	-9.00-0.50
Median	-1.32
CCT (micrometer)	
Mean (SD)	546.43(18.52)
Range	480.0-630.0
Median	548.0
KERATOMETRY(D)	
Mean (SD)	44.24 (0.98)
Range	42.25-46.50
Median	44.25
IOP (mm of Hg)	

Mean (SD)	17.06 (2.30)
Range	12.0-21.0
Median	17.0
FUNDUS	
TESELLATED/ MYOPIC CRESCENT/ LATTICE DEGENERATION	120 (39.5%)
WNL	184 (60.5%)

Data: Number (%) or Mean ± SD

Table 2: Comparison of CCT among Myopia Groups

SR	Compared Myopia groups	Number	CCT Mean (SD)in micrometres	Range
1	0 to – 4 D	202	547.69 ± 16.53	480 - 615
2	> – 4 to – 8 D	86	544.22 ± 19.54	485 - 630
3	> – 8 D	16	542.44 ± 32.25	490 – 605

Statistical test:
ANOVA One Way
F=1.5, DF=2, NS, P=0.24

Conclusion: No significant difference in CCT among 3 myopia groups.

Table 3: Comparison of Myopia (D) among CCT Groups

Sr.No.	Compared CCT groups in micrometres	Number Of patients	Myopia (D) Mean (SD)	Range of Myopia (D)
1	< 500	13	-3.75 ± 3.02	-9.00 to -0.5
2	500 to <550	177	-3.88 ± 2.08	-9.00to -0.75
3	550 to 600	104	-3.23 ± 1.89	-8.50 to -1.00
4	> 600	10	-3.93 ± 3.18	-9.00 to -0.75

Statistical test:
ANOVA One Way
F = 2.1, DF = 3, NS, P = 0.095

Conclusion: No significant difference in CCT among 3 myopia groups.

Table 4: Distribution of Spherical Equivalent(D) according to Various Degrees of Myopia

Sr.No.	Compared Myopia groups	Number	Percentage(%)
1	>-2 to 0	94	30.9
2	>-4 to – 2	108	35.5
3	>-6 to – 4	61	20.1
4	>-8 to – 6	25	8.2
5	> – 8	16	5.3
	Total	**304**	**100.0**

Table 5: Comparison of CCT and BCVA/ Spherical Equivalent(D) between Genders

Variables/ Gender	Males (n = 138)	Females (n = 166)	t value, Significance & P value
BCVA (D)	-3.79 ± 2.16	– 3.54 ± 2.08	t = 1.0, NS,P = 0.31
CCT	547.77 ± 19.11	545.32 ± 18.00	T = 1.2, NS, P = 0.25

Statistical test:

Student's unpaired t test

Conclusions: No significant difference in BCVA & CCT between Males and Females.

Discussion

This study demonstrates that CCT does not correlate with degree of myopia. From this study it appears that cornea is not thinning in myopic eyes as compared to sclera thinning. This result was consistent with most of the earlier studies done, which investigated CCT in various populations by using different corneal pachymeters.

Chang et al. studied 216 young myopic patients with mean refractive error of – 4.17 ± 5.03 diopters and the mean CCT was 533 ± 29 µm.

They established that corneas were thinner in more myopic eyes however the association did not reach statistical significance. (r = – 0.11, p = 0.14)

In our study, total of 304 eyes of myopic patients, 138 (45.4 %) were males and 166 (54.6%) were females. Age group included in study, ranged from 16 to 48 years with mean as 27.47 ± 7.28 and median value for Age in years was 27.0.

The BCVA ranged from – 0.50 Diopters to – 9.00 diopters and mean as – 3.66 ± 2.12 diopters, with median BCVA value was – 1.32 diopters.

The CCT ranged from 480.0 µm to 630 µm, with mean CCT as 546.43 ± 18.52 µm and median value of CCT measured was 548 µm.

In this study, 3 myopia groups were made.

In group 1, myopia of refractive error (BCVA) ranged from 0 to – 4 diopters and total number of eyes evaluated in this group were 202, with mean CCT as 547.69 ± 16.53 µm.

In group 2, myopia of refractive error (BCVA) ranged from – 4 to – 8 diopters and total number of eyes evaluated in this group were 86, with mean CCT as 544.22 ± 19.54 µm.

In group 3, myopia of refractive error (BCVA) was more than –8 diopters and total number of eyes evaluated in this group were 16, with mean CCT as 542.44 ± 32.25 µm.

P value obtained was 0.24 and conclusion made that no significant difference in CCT among these three myopia groups.

In this study, comparisons of myopia (D) among 4 CCT groups, were also done.

In group 1, which had CCT value < 500 µm, total number of patients were 13 with mean myopia (D) as – 3.75 ± 3.02.

In group 2, which had CCT value ranged from 500 µm to < 550 µm, total number of patients were 177 with mean myopia (D) as – 3.88 ± 2.08.

In group 3, which had CCT value ranged from 550 µm to 600 µm, total number of patients were 104 with mean myopia (D) as – 3.23 ± 1.89.

In group 4, which had CCT value > 600 µm, total number of patients were 10 with meanmyopia (D) as – 3.93 ± 3.18.

P value obtained according to this was 0.095 and conclusion was made that there was nosignificant difference.

Comparison of CCT and spherical equivalent (D) between Genders were done.

BCVA in males (n = 138) was – 3.79 ± 2.16 diopters and in females (n = 166) was – 3.54 ± 2.08 diopters.

t value obtained was 1.0 and P value was 0.31.

CCT in males (n = 138) was 547.77 ± 19.11 and in females (n = 166) was 545.32 ±18.00.

t value was 1.2 and P value was 0.25.

According to student's unpaired t test, conclusion was made that there was no significant difference in BCVA and CCT between males and females.

In a study the thickness before Lasik measured by ultrasound device ranged from 500 um to 620 um, with a numerical average value of 552.43 μm ± SD 26.95 and median 553 μm[11].

In a study, the mean reading was 555μm (SD±32.021) in Ultrasound Pachymeter while with Pentacam HR was 566μm (SD±37.367). So, a tendency of overestimation of CCT measurements with Pentacam HR was noticed.

According to another study, the average measurements of CCT were 526.8±35.3 and 529.1±37.9 for the Pentacam and US pachymetry values, respectively.

US pachymetry depends on the reflection of ultrasonic from the anterior and posterior corneal surfaces. In ultrasonic pachymetry, the exact posterior reflection point is not known; it may be located between Descemet's membrane and the anterior chamber. If the reflection point is located at the anterior chamber, this will cause overestimation of the corneal thickness[12].

In another study, a total of 30,245 individuals were included. Mean age was 28.2 ± 8.6 years, and 45.9% were females. Mean refractive error was 4.02 ± 2.17 D (range 0.25-19.5), and the mean CCT measurement was 533.5 ± 35.5 μm (range 404-794). Younger individuals showed higher degree of myopia ($p = 0.006$). No difference in CCT was found between women and men (533.0 ± 35.1 and 533.6 ± 35.9 μm, respectively, $p = 0.19$). Though CCT showed no correlation with age ($p = 0.226$) participants above age 40 expressed higher CCT values ($p < 0.001$). No significant correlation was found between the CCT and cylinder ($p > 0.05$). An increase in mean keratometry was associated with a decrease in CCT ($p < 0.001$). There was a direct correlation between the degree of myopia and CCT ($r = 0.94$, $p < 0.001$). The result remained the same after adjusting for age group and gender in stepwise backward regression analysis ($p < 0.001$). This study found that central corneal thickness correlated with the degree of myopia among adults undergoing refractive surgery[13].

Conclusion

Corneal thickness in myopic patients is extremely important as they are the candidates for refractive surgical procedures such as LASIK and other refractive surgeries. So, by knowing central corneal thickness value in myopic patients, it can be determined that a person is proper candidate for refractive surgical correction or not, as sufficient residual corneal thickness is must for optimal corneal functions.

The findings of previous studies on central corneal thickness measured in myopic individuals were inconsistent, with some studies reporting a decreased central corneal thickness or normal central corneal thickness. In our study total of 304 eyes of 152 myopic patients were examined by Ultrasonic Pachymeter.

Central corneal thickness was measured and compared with BCVA (degree of myopia in Diopters).

Degree of myopia is measured in DSPH and recorded as BCVA. Degree of myopia

is classified in 3 groups and compared with central corneal thickness measured among these groups. After doing statistical analysis of compared data, P value obtained was 0.24 and according to this P value, conclusion made was that there was no correlation between central corneal thickness and degree of myopia.

One more comparison was done by dividing central corneal thickness of patients in four groups and individuals within corresponding groups were studied for the refractive error (degree of myopia – BCVA in DSPH) P value obtained from this comparison was 0.095 and from this, conclusion was made that, there was no significant difference between central corneal thickness and degree of myopia in individuals.

Final conclusion:

The conclusion from this study is:

Central Corneal thickness was measured using ultrasonic pachymeter in 304 eyes of Myopic patients.

There was no correlation found between degree of myopia and central corneal thickness in subjects studied.

Although there was no correlation found between degree of myopia and central corneal thickness, still central corneal thickness remains one of the important investigations to be done before planning for any refractive surgery.

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