## Research Article

# Central Corneal Thickness: Important Considerate in Ophthalmic Clinic

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## Abstract

**Purpose:** To evaluate the relationship of central corneal thickness with age, sex, refractive status and keratometry.

**Method:** In this cross sectional study, 1000 eyes from 500 patients from outpatient department were randomly selected between July 2014 and December 2015. Central corneal thickness was measured with Humphrey Ultrasonic Pachymeter. Horizontal and vertical curvature of cornea was measured with Bausch &Laumb Keratometer and mean was calculated. Refractive state was measured with Priestely Smith retinoscope and converted to SE. The patients were divided into three groups as per their age [Group A (16 to 30 yrs); Group B (31 to 45 yrs) and Group C (46 to 60 yrs)]. Subsequently data was analyzed statistically.

**Results:** The mean SE, KM and CCT of the patients under the study were (-) 0.47 ± 2.26,43.79 ± 1.18D and 528.41 ± 19.1µm. Mean CCT was higher in age group C (46 to 60 yrs) than other groups (p = 0.008) but no impact was found on increasing age after regression analysis. CCT was not affected by gender (p = 0.168). Mean CCT for Myopic was found to be 522.87±18.03µm which was lower compared to in Hypermetropic (536.39 ±17.753µm) (p = <0.001). There was a positive correlation between CCT and SE (r = 0.520, p = <0.001). However KM showed negative correlation with CCT (r = -0.288, p = <0.001).

**Conclusion:** From above study we concluded that CCT was related to age, refractive status and keratometry but not to sex.

**Keywords:** Central corneal thickness; Mean Keratometry; Refractive state; Age; Sex

## Abbreviations

CCT: Central Corneal Thickness; KM: Mean Keratometry; SE: Spherical Equivalent

## Introduction

The Cornea occupy one third of ocular tunic and forms the anterior meniscus-shaped transparent portion of the ocular globe. It serves as the principal refractive element in the eye, while maintaining a highly impermeable barrier between an eye and environment.

It serves as transparent window of an eye that allows the entry of light. Maintenance of corneal shape and transparency is critical for light refraction, considering the cornea accounts for more than two third of total refractive power of an eye.

Central Corneal Thickness (CCT), one of the most important corneal parameter, plays an important role in planning various intraocular procedure, refractive surgeries, corneal transplantation etc. Recently there have been increased interests in corneal thickness [1]. Different aspects such as correlation between CCT & intraocular pressure and progressive thinning in cornea have been well established in many studies [2-6].

CCT is an important diagnostic and prognostic factor in determining whether patient is suitable for refractive surgery and also to determine the required procedure. It also helps in classification as well as diagnosis of glaucoma.

Pachymeter measures corneal thickness, which is now in routinely used and its use is increasingly important in ophthalmic practice to avoid postoperative complications. Other uses of corneal pachymetry include determining the 'health' of a corneal transplant, evaluating a patient with keratoconus, and monitoring the degree of stromal edema. In contact lens wear, corneal edema and hypoxia can be assessed in daily wear easily.

Non corrected refractive error is increasingly recognized as a significant cause of avoidable visual disability worldwide and has been included as one of the priority areas of Vision 2020 [7]. In-depth knowledge of ocular biometric parameters is therefore required in understanding the risk factors and determinants of ammetropia [8-11] and in formulating appropriate preventative and treatment strategies. The most important factor in the refractive errors is relationship to the ocular components [9].

Stephan J. et al [2] evaluated 4600 eyes to study relationship between thinnest point in corneal thickness and the refractive state, keratometry, age, sex and the ocular side. They concluded that refractive state, Mean Keratometry (KM) and age were statistically significant, although marginal impact, on the thinnest point in corneal thickness. Sex and the ocular side had no effect. Altinoket al

[12] and Archana Prasad et al [13] found no correlation for age, sex, refractive status with CCT.

Recently phakic intraocular lenses are being used increasingly to correct refractive error [14] which require different ocular parameter to consider. Effective visual rehabilitation after cataract surgery also depends on accurate intraocular lens power calculations which are primarily derived from normative ocular biometric data [15-19]. Therefore, it is important to understand the factors that have an influence on the CCT.

In our study, we had analyzed different biometric ocular factors and investigated the possible influences of age, sex, refractive state, keratometry on CCT.

## Methods

This cross sectional study was conducted at Dr. Mohal Lal Memorial Gandhi Eye Hospital, Aligarh. Permission for this study was obtained from the ethical committee of the hospital. Informed consent was taken from the patients in their own language in a prescribed bilingual format. 500 patients (1000 eyes) who fulfilled the inclusion criteria were selected from all those attending outpatient department.

### Inclusion criteria

Patients between the age of 16 years and 60 years of both the genders having Visual Acuity 6/6 using Snellen's Chart and Landolt's C Chart were selected.

### Exclusion criteria

Patient below 16 years and above 60 years, patient with any ocular surgery or ocular trauma, patient with pre-existing eyelid disease or anterior segment pathology like conjunctivitis, keratitis, uveitis, glaucoma, corneal dystrophy, corneal degeneration, Keratoconus, congenital corneal disease (Keratoglobus), patient with systemic disease like diabetes mellitus, hypertension etc. and patient with contact lens wear.

**Table 1:** Means of SE, KM, CCT.

|  | Mean ± SD | Median | Min – Max |
|---|---|---|---|
| SE | (-)0.47 ± 2.26 | 0.50 | (-)14 – 6 |
| KM | 43.79 ± 1.18 | 43.88 | 40.25 - 47.88 |
| CCT | 528.41 ± 19.1 | 530.00 | 446 – 595 |

**Table 2a:** Correlation of CCT with age groups.

|  |  | Age groups | | | p value |
|---|---|---|---|---|---|
|  |  | 16-30 yrs | 31-45 yrs | 46-60 yrs |  |
| CCT | Mean ± SD | 527.20 ± 19.30 | 526.94 ± 20.86 | 531.66 ± 16.43 | 0.003 |
|  | Min – Max | 446 – 595 | 465 - 589 | 482 – 580 |  |

**Table 2b:** Impact of increasing age on CCT.

| Coefficients[a] | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | Unstandardized Coefficients | | Standardized Coefficients | T | P value | 95% Confidence Interval for B | |
|  | B | Std. Error | Beta |  |  | Lower Bound | Upper Bound |
| (Constant) | 524.694 | 2.496 |  | 210.197 | 0 | 519.79 | 529.599 |
| AGE | 0.103 | 0.065 | 0.071 | 1.584 | 0.114 | -0.025 | 0.231 |

a. Dependent Variable: CCT.

Detailed histories of all patients were elicited and thorough ophthalmic examination was done. Patients were divided into three groups according to their age {Group A (16 to 30 yrs); Group B (31 to 45 yrs) and Group C (46 to 60 yrs)}.

### Visual acuity

Visual acuity of both eyes were recorded by Snellen's Chart or Landolt's C Chart and refractive state was determined by Priestely Smith retinoscope. Spherical Equivalent (SE) was calculated as sphere plus half cylindrical power for left and right eye. Refraction subgroups were again subdivided into Myopic & Hypermetropic as per their SE (myopic SE < 0.00 D and hypermetropic SE > 0.00 D).

### Slit lamp examination

A Haag Streit 900 slit lamp was used for examination. Both the eyes were examined under diffuse, focal and retro illumination on the day of examination. The cornea was examined carefully for any abnormality such as corneal opacity, corneal dystrophy, corneal degeneration, keratitis, corneal ulcer, stromal thinning as in Keratoconus etc. The anterior chamber, lens and pupillary reactions were examined to rule out any abnormality. Slit lamp biomicroscopy 90 D was done to rule out fundus abnormality. Specific examination like Pachymeter and keratometer were included as a part of examination.

### Pachymetry

CCT was measured with Humphrey ultrasonic pachymeter for left and right eye. Three consecutive readings were taken and mean was calculated.

### Keratometry

Curvature of cornea was measured with Bausch and Laumb Keratometer. Vertical and horizontal curvature of cornea was measured. Three consecutive readings were taken and mean KM was calculated for each eye separately.

## Results

41.2% of the patients were under 16-30 years of age, 29.8% were under 31-45 years and 29% were under the age group of 45-60 years. The mean age of group was 36.09 ± 13.05 years with median age of 35 years. 53.2% of the patients were males while 46.8% were females.

Table 1 shows the mean SE was (-) 0.47 ± 2.26 with median of 0.50, while mean KM was 43.79 ± 1.18 D with median of 43.88 D. Mean CCT was 528.41 ± 19.1μm with median of 530μm.

Table 2a shows the mean CCT was 527.20 ± 19.30 μm under 16-30 year of age group, 526.94 ± 20.86 μm under 31-45 years and 531.66 ± 16.43 μm under 46-60 years of age group. It was also observed that there was a significant difference in mean CCT among the various age groups (p value 0.003). There was significant difference in mean CCT

**Table 3:** Correlation of CCT with sex.

| | Female | | | Male | | | P Value |
|---|---|---|---|---|---|---|---|
| | Mean ± SD | Median | Min – Max | Mean ± SD | Median | Min – Max | |
| CCT | 529.19 ± 18.38 | 530.00 | 470 – 595 | 529.19 ± 18.38 | 530.00 | 446 - 589 | 0.168 |

**Table 4:** Comparison of CCT between Myopic and Hypermetropic.

| | Myopic (n=590) | | Hypermetropic (n=410) | | p value |
|---|---|---|---|---|---|
| | Mean | Std. Deviation | Mean | Std. Deviation | |
| CCT | 522.87 | 18.034 | 536.39 | 17.753 | <0.001 |

**Table 5:** Correlation between CCT and SE.

| | | SE |
|---|---|---|
| CCT | R | 0.520 |
| | p value | <0.001 |

**Table 6:** Correlation of KM with CCT.

| | KM | |
|---|---|---|
| | R | p value |
| CCT | -0.288 | <0.001* |

between 16-30 years and 46-60 years (p value 0.006) and between 31-45 years and 46-60 years (p value 0.008) by using Hoc analysis.

After linear regression analysis, it was observed that CCT has no impact on increasing age (B = 0.103, SD = 0.065, P = 0.114) as shown in Table 2b.

Table 3 shows the mean CCT was 529.19 ± 18.38 μm for females and 529.19 ± 18.38 μm for males. Further it was observed that there was no significant difference in mean CCT when compared amongst two genders.

Table 4 shows mean CCT was 522.87 ± 18.03 μm for myopic patients and 536.39 ± 17.753 μm for hypermetropic patients. Further it was observed that there was significant difference in CCT between Myopic and Hypermetropic patients (p value <0.001).

Table 5 shows significant positive correlation between CCT and SE (r= 0.520, p <0.001).

Table 6 shows significant negative correlation between KM and CCT (r= -0.288).

# Discussion

Cornea is an important refractive element in the eye. Maintenance of corneal structure is crucial for its physiological role in refraction and biodefense. The widespread application of corneal surgery including keratoplasty and refractive surgery has necessitated a more detailed understanding of recent advances in cellular and molecular biology of cornea.

CCT measurements are important when monitoring glaucoma and ocular hypertensive patients. Corneal pachymetry abnormalities include both thinning disorders such as keratoconus and pellucid marginal degeneration and thickened cornea with endothelial compromise.

Various studies have been conducted to evaluate the relationship between central corneal thickness, and its correlation with refractive error, age, sex, keratometry with significant association.

Nangia V et al [20] did population based study in rural area and found that CCT was significantly associated with younger age, male gender and lower corneal refractive power. CCT was not associated significantly with refractive error. In accordance with above study

we found CCT was associated with age (p = 0.003) and had negative correlation with mean keratometry values (r = -0.88). But we found no association with the gender of the patient.

Tomidokoro et al [21] conducted population based cross sectional study to evaluate CCT and its relating factors in Japan. They found that CCT was thicker in men than in women and was correlated with age (right eyes only) and corneal curvature. In our study we found statistically significant correlation of CCT with age (p = 0.003) and keratometry (p < 0.001). But no correlation with sex was seen (p = 0.168).

Yi-Chun Chen et al [22] observed that CCT has no association with age while its significance was less in females than in males. It also showed that CCT has no significant association with refractive error. They found CCT was significantly less in females than in males. Finally he concluded that there was no correlation between CCT and degree of myopia among Taiwanese population and central corneal thickness of myopia and emmetropia did not differ significantly. In contrast to above mentioned study we found no correlation between CCT and sex (p = 0.168). But we found statistically significant correlation of CCT with age (p = 0.003) and refractive status (p < 0.001).

Touzeauet al [23] studied the correlation between subjective refraction and biometry parameters. They found that corneal biometric parameters did not correlate with subjective SE and showed no differences between the refractive groups except for CCT. High myopic group (-6D) had thinner cornea. In our study we observed CCT was thin in myopic individuals (mean CCT = 522.87 ± 18.034 μm) than hypermetropic (mean CCT = 536.39 ± 17.753 μm). But we also found statistically significant correlation between mean keratometry, CCT with SE.

Shu-Wen Chang et al [24] found that mean corneal thickness was 533 (SD 29)μm and were thinner in more myopic eyes (P=0.021). Similarly in our study we found that CCT in myopic individuals was thinner than hypermetropic which was statistically significant (p < 0.001).

Mei-Ju Chen et al[1]found no significant correlations between CCT and refractive error, corneal curvature, anterior chamber depth and axial length. They concluded that CCT is an independent factor unrelated to other ocular parameters. In contrast we found that CCT was significantly correlated with mean keratometry (p < 0.001), refractive error (p < 0.001).

# Conclusion

From above study we found significant correlation between

different ocular biometric parameters. CCT was on high in elderly individuals but there was no impact on CCT with increasing age. CCT was thinner in myopic individuals than hypermetropic. So it is important to do a detailed preoperative workup for such patient undergoing refractive and cataract surgery. As already mentioned in ocular hypertension study CCT plays an important role in glaucoma therefore its value should be predetermined to measure intraocular pressure especially in an elderly and myopic group.

CCT was positively correlated with SE but no correlation with sex was observed. Significant negative correlation between mean keratometric values and CCT was also found in our study. From above study we conclude that CCT is correlated with age, refractive status and keratometry but not sex.

## References

1. MJ, Liu YT, Tsai CC, Chen YC, Chou CK, Lee SM. Relationship between central corneal thickness, refractive error, corneal curvature, anterior chamber depth and axial length. Journal of the Chinese Medical Association. 2009; 72: 133-137.

2. Linke SJ, Steinberg J, Eddy MT, Richard G, Katz T. Relationship between minimum corneal thickness and refractive state, keratometry, age, sex, and left or right eye in refractive surgery candidates. Journal of Cataract & Refractive Surgery. 2011; 37: 2175-2180.

3. Sherwin T, Brookes NH. Morphological changes in keratoconus: pathology or pathogenesis. Clinical & experimental ophthalmology. 2004; 32: 211-217.

4. Romero-Jimenez M, Santodomingo-Rubido J, Wolffsohn JS. Keratoconus: a review. Contact Lens and Anterior Eye. 2010; 33: 157–166.

5. Iester M, Mete M, Figus M, Frezzotti P. Incorporating corneal pachymetry into the management of glaucoma. Journal of Cataract & Refractive Surgery. 2009; 35: 1623-1628.

6. Brandt JD. Corneal thickness in glaucoma screening, diagnosis, and management. Current opinion in ophthalmology. 2004; 15: 85-89.

7. He M, Huang W, Li Y, Zheng Y, Yin Q, Foster PJ. Refractive error and biometry in older Chinese adults: the Liwan eye study. Investigative ophthalmology & visual science. 2009; 50: 5130-5136.

8. Warrier S, Wu HM, Newland HS, Muecke J, Selva D, Aung T. Ocular biometry and determinants of refractive error in rural Myanmar: the Meiktila Eye Study. British Journal of Ophthalmology. 2008; 92: 1591-1594.

9. Shufelt C, Fraser-Bell S, Ying-Lai M. Refractive error, ocular biometry, and lens opalescence in an adult population: the Los Angeles Latino Eye Study. Investigative ophthalmology & visual science. 2005; 46: 4450-4460.

10. Wong TY, Foster PJ, Ng TP, Tielsch JM, Johnson GJ, Seah SK. Variations in ocular biometry in an adult Chinese population in Singapore: the Tanjong Pagar Survey. Investigative ophthalmology & visual science. 2001; 42: 73-80.

11. Uranchimeg D, Lee PS, Devereux JG, Machin D, Johnson GJ, Baasanhu J. Ocular biometry and refraction in Mongolian adults. Investigative ophthalmology & visual science. 2004; 45: 776-783.

12. Altinok A, Sen E, Yazici A, Aksakal FN, Oncul H, Koklu G. Factors influencing central corneal thickness in a Turkish population. Current eye research. 2007; 32: 413-419.

13. Prasad A, Fry K, Hersh PS. Relationship of age and refraction to central corneal thickness. Cornea. 2011; 30: 553-555.

14. Hosny M, Alió JL, Claramonte P, Attia WH, Pérez-Santonja JJ. Relationship between anterior chamber depth, refractive state, corneal diameter, and axial length. Journal of Refractive Surgery. 2000; 16: 336-340.

15. Lim LS, Saw SM, Jeganathan VS, Tay WT, Aung T, Tong L. Distribution and determinants of ocular biometric parameters in an Asian population: the Singapore Malay eye study. Investigative ophthalmology & visual science. 2010; 51: 103-109.

16. Kalogeropoulos C, Aspiotis M, Stefaniotou M, Psilas K. Factors influencing the accuracy of the SRK formula in the intraocular lens power calculation. Documentaophthalmologica. 1994; 85: 223-242.

17. Menezo JL, Chaques V, Harto M. The SRK regression formula in calculating the dioptric power of intraocular lenses. British journal of ophthalmology. 1984; 68: 235-237.

18. Olsen T, Thim K, Corydon L. Theoretical versus SRK I and SRK II calculation of intraocular lens power. Journal of Cataract & Refractive Surgery. 1990; 16: 217-225.

19. Sanders D, Retzlaff J, Kraff M, Kratz R, Gills J, Levine R. Comparison of the accuracy of the Binkhorst, Colenbrander, and SRK™ implant power prediction formulas. American Intra-Ocular Implant Society Journal. 1981; 7: 337-340.

20. Nangia V, Jonas JB, Sinha A, Matin A, Kulkarni M. Central corneal thickness and its association with ocular and general parameters in Indians: the Central India Eye and Medical Study. Ophthalmology. 2010; 117: 705-710.

21. Tomidokoro A, Araie M, Iwase A, Tajimi Study Group. Corneal thickness and relating factors in a population-based study in Japan: the Tajimi study. American journal of ophthalmology. 2007; 144: 152-154.

22. Chen YC, Kasuga T, Lee HJ, Lee SH, Lin SY. Correlation between central corneal thickness and myopia in Taiwan. The Kaohsiung journal of medical sciences. 2014; 30: 20-24.

23. Touzeau O, Allouch C, Borderie V, Kopito R, Laroche L. Correlation between refraction and ocular biometry. Journal francaisd'ophtalmologie. 2003; 26: 355-363.

24. Chang SW, T sai IL, Hu FR, Lin LL, Shih YF. The cornea in myopic adults. British Journal of Ophthalmology. 2001; 85: 916-920.

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