Original Article

# Central Corneal Thickness from a Subset of Normal Population in Pakistan Using Anterior Segment Optical Coherence Tomography

Central Corneal Thickness with Intraocular Pressure

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## ABSTRACT

**Objective:** To measure central corneal thickness and study its association with intraocular pressure (IOP), age and gender.

**Study Design:** Cross-sectional study

**Place and Duration of Study:** This study was conducted at the tertiary eye care health centre during Feb 2019 and Feb 2020 for one year.

**Materials and Methods:** 324 normal individuals were recruited. They followed the routine eye examination protocol and in the end we performed anterior segment OCT on one eye of each participant.

**Results:** The mean CCT was found to be 533.01µm and mean the IOP was 12.6mmHg. When we compared CCT with age, significant correlation was not found (Pearson's correlation coefficient (R) = 0.022, P-value = 0.692). Similar results were obtained when CCT was tested against IOP (Pearson's correlation coefficient (R) = 0.056, P-value = 0.315). The difference of CCT between the two gender was also not significant (p-value = 0.774).

**Conclusion:** The CCT from our study was not found to be associated with age and intraocular pressure. Also the difference in CCT values of males and females was not statistically significant.

**Key Words:** Corneal Thickness, Anterior Segment, Optical Coherence, Tomography

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## INTRODUCTION

Cornea is the outer most transparent layer of the eye. Along with protection, cornea also adds to the refractive power of the eye [1]. The corneal thickness varies from periphery to the central region, being thinnest at the center[2]. The famous landmark study Ocular Hypertension Treatment Study (OHTS) has reported that corneal thickness can be used as an important predictor for the primary open angle glaucoma. According to OHTS, people with a corneal thickness of less than 555µm have a three-fold greater risk of developing glaucoma within 5 years as compared to the people having central corneal thickness of 588µm[3].

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This clearly signifies the role of central corneal thickness in the normal eyes. IOP is created when aqueous humor exerts force on the structures of the anterior chamber of eye[4]. It is most commonly measured by applying a contact tonometer to the middle portion of the cornea. Literature suggests that changes in intraocular pressure may result in change in corneal thickness[1].

Numerous studies have been carried out to measure corneal thickness; most of which have involved a contact method, ultrasound pachymetry[5]. Other researchers have employed an instrument called "Corneal Topographer" for the same purpose[6]. Although it is more sensitive than pachymetry, a topographer has a different set of limitations[5]. With the advent of Anterior Segment optical coherence topography (AS-OCT), more accurate results for the corneal thickness have been obtained[7]. Research data from different sources has shown that AS-OCT is a more sensitive and reliable tool for the estimation of corneal thickness[8]. This study explores corneal thickness in a subset of normal Pakistani population and its relationship with IOP and other baseline characteristics like age and gender.

# MATERIALS AND METHODS

This was a cross sectional study conducted at a tertiary care eye hospital. Purposive sampling technique was used for the recruitment of cases and included patients coming for eye checkup. Sample composed of 324 normal individuals. Patients with any ocular disease were excluded. We also excluded the patients with systemic or endocrine disorder e.g. hypertension and diabetes.

Thorough eye examination was performed by an experienced ophthalmologist. Intraocular pressure was measured using Goldmann Applanation Tonometer. Nidek RS-3000 Advanced (Nidek, Japan) was used to measure the corneal thickness. The procedure was performed by a trained professional and all the standard protocols and guidelines were followed. All examinations were performed in dim light during 5pm and 8pm in the evening. The dedicated software, Navis-Ex was used to accumulate the data. The data was analyzed using IBM SPSS version 23. All quantitative variables are shown in mean and standard deviation whereas percentages and frequencies are used to depict the qualitative data. In all analysis, p-value of <0.05 was considered as significant.

# RESULTS

Data from a total of 324 normal individuals who met the inclusion criteria was taken in this study. Out of 324 normal subjects, 184 were males and 140 were females. Mean age of the normal participants was 43.55 years. (Table 1).

**Table No.1: Gender and mean age of study participants**

| | Gender | | Mean Age |
|---|---|---|---|
| | Male | Female | |
| Normal | 184 | 140 | 43.55 |

The mean IOP of normal subjects was 12.6mmHg. The mean central corneal thickness was 533.01µm. Table 2 depicts these results.

**Table No.2: Mean IOP and CCT**

| | Mean (Std. Deviation) |
|---|---|
| **IOP** (mmHg) | 12.6 (3.03) |
| **CCT** (µm) | 533.01 (35.27) |

**Table No.3: Comparison of CCT between genders**

| Gender | CCT (Mean) | Std. deviation | P-Value |
|---|---|---|---|
| Male | 532.52 | 34.65 | 0.774 |
| Female | 533.66 | 36.19 | |

P- value ≤ 0.05 is considered as significant

When CCT values were correlated with age of the individuals included in the study, no significant correlation was found (Pearson's correlation coefficient (R) = 0.022, P-value = 0.692). This is shown in figure 1. Similarly when the mean CCT of different gender was compared, the difference was non-significant (p-value = 0.774), as shown in table 3.

In the same way when we tried to look for any correlation between the intraocular pressure and central corneal thickness, it was also found to be insignificant (Pearson's correlation coefficient (R) = 0.056, P-value = 0.315). Figure 2 shows this result.

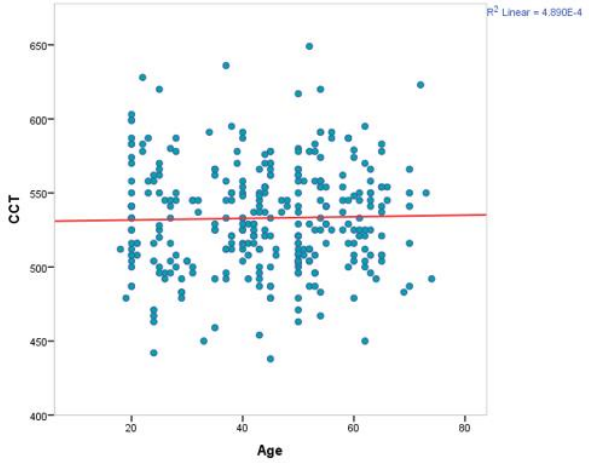


**Figure No.1: Correlation between CCT and age**

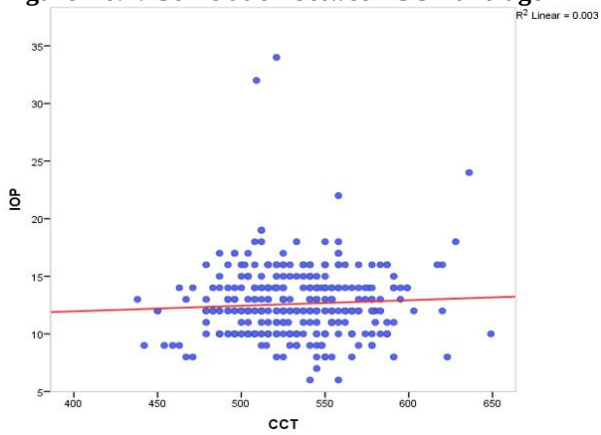


**Figure No.2: Correlation between CCT and IOP**

# DISCUSSION

The present study is yet another attempt to measure the central corneal thickness in normal individuals, and to find its relationship with the intraocular pressure, gender and age of the participants by using AS-OCT. In the discussion that follows, we have compared our results with previous studies from Pakistan which have employed different modalities and thus our results differ in many ways.

According to literature, the first study that reported CCT in Pakistani population was carried out by R. Channa et al in 2009. They reported a mean CCT of 531.08 and 531.29 in the right and left eye respectively[9]. These results are quite similar to ours. A more recent study on corneal thickness was performed by Hashmani et al in 2017, which shows a median thickness value of 541microns. These findings are quite significant because they performed it on a very large

group of individuals (sample size = 5,171 eyes)[6]. However, they used data from participants with varying ages and the median age was 26 with the youngest age group between 11 to 20 years. In our study, we restricted the sampling to the lower age limit of 18 years. The difference of CCT values between these studies can be explained by the use of different method of measurement employed. Channa et al used Pachymetery and Hashmani's employed Pentacam for the assessment of CCT. On the contrary, we used anterior segment OCT for the same purpose. These three instruments have different working principles and show varying intra-observer variability[10]. AS-OCT has been proved to be a highly sensitive and accurate instrument in measurements of anterior segment structures[11]. It has maintained its reproducibility and sensitivity even when it was compared with other scheimpflug imaging instruments[12,13].

In the Indian population, we found that their CCT values are quite similar to our values. In a study conducted on 600 subjects from Uttar Pradesh region, the researchers found a mean CCT of 532.44±31.46 in the right and 533±31.03 in the left eyes of male participants. In females the value was 525.63±31.72 and 526.26±33.86 respectively[14]. Looking at other neighbors, in a Chinese study the mean CCT was found to be 539.2±37.8[16]. Results of CCT values from different South East Asian countries show that our values follow the pattern of CCT values found in the Indian and Chinese population. As a part of Tehran Eye Study, mean CCT was calculated in the Iranian population and it was found to be 555.6±39.9 microns[17]. In another study carried out on South Indian population, the mean CCT values were 511.4 microns[15]. These differences of CCT values can be explained by the fact that these studies were performed on the people belonging to different ethnic groups, the genetic variations among these participants is also an important factor that cannot be neglected.

In our study, we did not find any significant correlation between ages and mean CCT. This result contradicts the findings of Mercieca and colleagues who demonstrated a significant negative correlation with age[18]. This finding is also supported by Weizer et al while working on a British cohort[19]. Archna Prasad reported a negative correlation of CCT with age but only in female subjects. The males showed non-significant results[20]. In a retrospective study on 5,171 eyes from Pakistani population, Hashmani and colleagues found a weak but negative correlation of CCT and age[6]. This can be explained by considering the fact that they included much younger participants as compared to our study participants. This age difference is sufficient to give variable results. Our findings of an insignificant negative correlation is also supported by a study carried out at Aga Khan University by Roomasa et al as they were unable to find any significant correlation between age and CCT while looking at data from 200 eyes[9]. Similar results were reported in a more recent study by Wang et al from 1190 subjects[16].

Although the males in our study had smaller values of CCT as compared to females, but this difference was not statistically significant. These findings are supported by the results from a study done on young students in Lahore[21]. This is also endorsed by a Nigerian study done on 359 subjects, as the researchers were unable to find any statistically significant difference in the corneal thickness among males and females[22]. In another study done on Karachi population, the researchers found thinner corneas in females as compared to males but this difference was not statistically significant[23]. Similar results are reported by a study done on 200 eyes by Roomasa and colleagues from Karachi[9]. The researchers of Tehran Eye Study, published in Cornea May 2009, have also reported that there is no significant difference between male and female in terms of central corneal thickness[17]. Contradictory data is reported by Hasmani et al, who found statistically significant difference between male and female corneal thicknesses with the male population having thinner corneas[6]. These differences can be explained by the variations in female sexual hormone level during different phases of menstrual cycle[24]. However, this association needs further investigation to validate association between these parameters.

In a previous study done on Karachi population, the IOP was found to be 13.86 in the right and 13.67mmHg in the left eye[9]. In 2010, Mazhar ul Hassan reported IOP values quite similar to ours i-e. 12.75 and 12.98mmHg in male and female respectively[23]. According to the Yazd eye study, the mean IOP in Iranian population was 14.2mmHg[25]. We were unable to find any statistically significant correlation between IOP and CCT. These findings are supported by a similar study published in Nature in 2012 by Lester et al. They reported no significant correlation between the IOP and CCT[26]. The authors explained these results with possible inaccuracies in measurement of IOP with contact tonometry. We have also used the same instrument and there are chances of inappropriate handling of instrument when a large sample size is studied upon. The only limitation we encountered during our study is related with the use of a contact tonometer. We employed Goldmann applanation tonometer that is a widely used instrument for the measurement of IOP, but with the advent of non-contact tonometers more reliable and sensitive measurements can be made. We did not compare the CCT values with metabolic or systemic disorders, we recommend further studies on a larger sample size. We also recommend a multicenter study to obtain CCT values to have a better idea of CCT in Pakistani population from different ethnicities.

# CONCLUSION

In this study we used the anterior segment module of Retina Scan (RS-3000, Nidek, Japan) OCT machine. It yielded the CCT from 324 normal individuals as 533.01µm and IOP was 12.6mmHg. The central corneal thickness was not correlated with age or gender. There was no association between CCT and IOP. This is the first study in Pakistan that used AS-OCT to find CCT and its correlation with age and gender.

**Author's Contribution:**

| | |
|---|---|
| Concept & Design of Study: | Inayatullah |
| Drafting: | Nuzhat Hassan, Kevin Joseph Jerome Borges |
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| Revisiting Critically: | Inayatullah, Nuzhat Hassan |
| Final Approval of version: | Inayatullah |

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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