



STUDY OF CENTRAL CORNEAL THICKNESS IN NORMAL ADULT INDIAN POPULATION BY PENTACAM

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ABSTRACT

The present study was conducted in 250 normal Indian subjects (500 eyes) of either sex to assess central corneal thickness (CCT) to establish normal values in the adult Indian population without any eye disease for reference for future studies. The CCT was assessed by using pentacam. CCT was found to be $542 \pm 26.87 \mu\text{m}$. There was no significant difference in CCT values of right and left eyes ($p = 0.8380$). CCT values were not comparable with different studies due to variation in ethnicity of various countries.

KEYWORDS: Central corneal thickness, Pentacam, Eye.

INTRODUCTION

Imaging devices for measuring corneal thickness include slit-scan pachymetry, anterior segment optical coherence tomography (OCT) and rotating Scheimpflug imaging (Pentacam). These techniques permit easy, non-invasive, and good inter-observer reproducibility for examination of corneal thickness at different locations.^[1-3]

Central corneal thickness (CCT) can be considered as an indicator of corneal health. However, peripheral corneal thickness is of interest in many clinical conditions, to identify peripheral pathologic conditions such as keratoconus, pellucid marginal degeneration, and others.^[4] Intraocular pressure measurement may be differentially affected by CCT and non-central thickness, especially when non-contact tonometry is used.^[5] Moreover, after photorefractive keratectomy different nasal and temporal changes of the corneal thickness profile have been reported and such differences in regional anatomic features of the cornea may need to be considered in photorefractive surgical procedures to improve the postoperative corneal shape and quality of peripheral optics.^[6,7] The periphery of cornea is also of interest in contact lens practice, especially in corneal swelling assessment, scleral contact lens fitting, and keratoconus management.^[8-12] Measurement of corneal thickness is essential in many ocular disorders such as glaucoma, keratoconus, and atopic keratoconjunctivitis.^[13-15]

MATERIALS AND METHODS

OCULUS Pentacam, sterile cotton/gauzes, spirit, black cloth were required. After obtaining the written informed

consent, participants were examined using the OCULUS Pentacam. Subjects were examined in sitting position. The study was conducted in 250 Indian participants (500 eyes) attending Ophthalmology OPD in NIMS Medical College and Hospital, Jaipur. Both eyes of each participant were scanned by same observer. All participants underwent a complete ophthalmological and optometric examination, including visual acuity evaluation, slit lamp examination and ocular fundus examination. Testing was done with natural pupils under same conditions in ambient lighting. The machine was used in automatic release mode to rule out confounding operated related variables. The imaging device was automatically calibrated prior to the start of each new set of measurements. Participants were made to sit comfortably on examination stool. Participants were instructed to keep both eyes open and look directly at black fixation target for 2 seconds. The chin was placed at chin rest and forehead was placed on forehead rest. A black cloth was placed on subject's head to omit any light. The eyes were randomly examined. In order to avoid the documented daily changes in corneal thickness and other parameters, all measurements were conducted between 9:00 am to 2:00 pm and at least 4 hours after waking. It was ensured that all participants had at least 6 hours of overnight sleep. Three readings of CCT were taken and their mean was taken. The study included 250 normal subjects (500 eyes) in the age group of 19 to 50 years of both sexes without any ocular pathology over a period of one year. The mean age of subjects was 34.16 ± 8.319 years. There were 111 female subjects (222 eyes) and 139 male subjects (278 eyes). The anterior

segment parameter recorded by Pentacam was CCT. The mean values of 500 eyes of CCT, was $542.7 \pm 26.87 \mu\text{m}$. The statistical analysis was done by using unpaired student's 't' test for various parameters of anterior segment of eye. The p value ≤ 0.05 was considered statistically significant, p value ≥ 0.05 was considered as

not statistically significant and p value < 0.0001 was considered as very highly significant.

RESULTS AND DISCUSSION

Minimum, Maximum, Median, Mean, SD, SEM, Lower and Upper 95% CI of CCT in 250 left eyes, 250 right eyes and 500 both eyes are tabulated.(Table 1).

Table 1: Minimum, Maximum, Median, Mean, SD, SEM, Lower and Upper 95% CI of CCT in 250 left eyes, 250 right eyes and 500 both eyes .

	CCT of left eyes (μm)	CCT of right eyes (μm)	CCT of both eyes (μm)
Minimum	452	450	450
Maximum	602	600	602
Median	544	544	544
Mean	542.5	543	542.7
SD	26.68	27.10	26.87
SEM	1.687	1.714	1.201
Lower 95% CI of mean	539.1	539.6	540.4
Upper 95% CI of mean	545.8	546.3	545.1
Mean \pm SEM of CCT (μm)	542.5 ± 1.687	543 ± 1.714	

When mean of CCT of left eye were compared with right eye, then the difference of CCT was found not significant (p 0.8380).

DISCUSSION

Several studies investigated variations in central corneal thickness (CCT) among children from various ethnic groups and the influence of age and gender within the same group. African American children found to have thinner CCT values than Caucasians or Hispanics.^[16-18] Similarly, average central corneas of Japanese children were thinner than Caucasians but thicker than in African American children, whereas Chinese children were found to have thicker corneas than Malayan or Indian children.^[19, 20] Other authors failed to discover any significant difference among racial subgroups.^[21] These values were lower than previously reported and can only be considered comparable to those of a sample of African-American children of similar age.^[18-23]

Zhao et al studied in 272 cases (544 myopic eyes). Among these cases, 122 cases (244 eyes) were Mongolian (within three generations), which included 65 male cases (130 eyes) and 57 female cases (114 eyes). Meanwhile, 150 cases were Han (300 eyes), including 83 male (166 eyes) and 67 female cases (134 eyes). The age ranged from 18 to 40 years (mean 22 ± 5). The central corneal thickness in Mongolian male and female was 536.33 ± 24.27 and $552.50 \pm 29.92 \mu\text{m}$, while in Han male and female was 554.48 ± 35.03 and $546.27 \pm 29.88 \mu\text{m}$. The values of CCT by pentacam on comparing different genders and nationalities were (Mongolian) M-F 0.149, (Han) M-F 0.076, (M) Mongolian-Han 0.083 and (F) Mongolian-Han 0.291.^[24]

Wang et al studied CCT by using Galilei Dual Scheimpflug analyzer (GSA) in 153 normal subjects (58 males, 95 females) at Shanghai sixth People's Hospital.

Han Chinese participants were included in the study. The subject's age ranged from 12 to 85 years (mean 34 ± 17 years). The mean value of CCT was $552 \pm 26 \mu\text{m}$ (minimum 483 and maximum 621).^[25] Fernández-Vigo et al studied CCT with pentacam in normal Caucasian subjects of mean age 49.1 ± 15.2 years (range 18-84) and 61% of participants were women. The mean value of CCT was $548.6 \pm 32.5 \mu\text{m}$, maximum being 643 μm and minimum 472 μm .^[26]

Aghaian et al observed mean CCT of all participants was 542.9 μm . Central corneal thicknesses of Chinese (555.6 μm), Caucasian (550.4 μm), Filipino (550.6 μm), and Hispanic (548.1 μm) participants did not significantly differ. The CCT of Japanese participants (531.7 μm) was significantly less than that of Caucasians, Chinese, Filipinos, and Hispanics (all, $p < 0.001$) and greater than that of African Americans ($p = 0.03$). African Americans had a CCT (521.00 μm) less than that of all races ($p < 0.05$). Thus studies examining individual Asian subpopulations in isolation suggest that differences in CCT may exist among different Asian groups. The results of this study indicate that CCT does, in fact, vary among Asian subpopulations; Japanese have thinner corneas than Chinese and Filipinos. Caucasians, Chinese, Hispanics, and Filipinos have comparable CCT measurements, whereas the corneas of African Americans are significantly thinner.^[27]

Hwang et al studied CCT in Korean population aged ≥ 40 years in Namil-meon area, located in central South Korea. The mean CCT of 1259 right eyes was 530.9 (31.5) μm .^[28] Suzuki et al studied corneal thickness in normal 7313 (2848 men and 4465 women) Japanese population. Average CCT was $517.5 \pm 29.8 \mu\text{m}$.^[29]

Torres et al studied CCT in Northwestern American Indian/Alaskan natives (AI/AN) and compared it to

White and African Americans. Average AI/AN CCT was $554.8 \pm 33.9 \mu\text{m}$. AI/AN CCT was found to be thicker than African Americans (528.5 ± 33.2) but similar to Whites (551.9 ± 28.3). CCT was greater in AI/AN females than males (557.6 ± 33.3 vs 550.1 ± 34.5 , $p=0.03$). Thus CCT measurements for Northwest AI/AN population were similar to those of Whites but thicker than those of African Americans.^[30]

Mostafa et al reported CCT by Sirius was $532.83 \pm 38.69 \mu\text{m}$. The readings of CCT in various quadrants were: superior $573.9 \pm 43.54 \mu\text{m}$, $588.7 \pm 42.1 \mu\text{m}$; nasal 565.8 ± 42.1 , $579.6 \pm 41.3 \mu\text{m}$; inferior 568.9 ± 39.1 , $569.6 \pm 38.1 \mu\text{m}$; and temporal 572.9 ± 43.4 , $559.3 \pm 36.3 \mu\text{m}$.^[31] Hahn et al studied CCT in single eyes of 1699 Latinos persons. The mean CCT was $546.9 \pm 33.5 \mu\text{m}$. Thus CCT in Latinos was found less than that reported in whites but greater than that reported in African Americans and Asians. CCT is an important indicator of corneal health status.^[32] Sardiwalla et al compared CCT in university of KwaZulu-Natal students of black and Indian ethnicity in 200 persons (100 black and 100 Indian) of both genders aged 18-25 years. The mean CCT value was $519.5 \pm 38.6 \mu\text{m}$ and CCT was higher in Indians ($526.5 \pm 37.2 \mu\text{m}$) than in blacks ($512.4 \pm 38.9 \mu\text{m}$) ($p=0.01$). It was higher in females ($522.3 \mu\text{m}$) than in males ($516.7 \mu\text{m}$), but the difference was insignificant ($p=0.07$). The mean CCT was higher in Indian males ($520.1 \mu\text{m}$) than in black males ($513.2 \mu\text{m}$), but the difference was insignificant ($p=0.39$). However, it was significantly higher in Indian females ($533 \mu\text{m}$) than in black females ($511.6 \mu\text{m}$) ($p=0.003$).^[33]

Iyamu and Eze studied relationship between CCT in adult Nigerians in 95 subjects (56 males and 39 females) aged between 20-69 years. The average values of $550.1 \pm 33.1 \mu\text{m}$ were obtained for CCT.^[34] Mercieca et al compared CCT in sub-Saharan cohort to African Americans and Afro-Caribbeans. The mean CCT of all participants was $532.00 \mu\text{m}$. Thus CCT values in African populations were less than those of whites. Mercieca et al concluded that the average CCT was similar between populations living in sub-Saharan Africa and African Americans and Afro-Caribbeans.^[35] Iyamu et al reported CCT value was $547.0 \pm 29.5 \mu\text{m}$.^[36]

Uçakhan et al reported mean CCT value of $557.6 \pm 6.5 \mu\text{m}$ in normal persons with pentacam.^[37] Shanker et al observed the mean CCT was $540.59 \pm 36.88 \mu\text{m}$.^[38] Martin et al found the CCT value was $554 \pm 36 \mu\text{m}$.^[39] Perez-Cambrodi et al observed that the mean CCT of Sahrawi (Spain) ethnicity was $521.70 \pm 31.92 \mu\text{m}$.^[40] We observed mean CCT value of $542 \pm 26.87 \mu\text{m}$. The CCT value of the present study is at variance from all the above studies. This is due to the fact that CCT is different depending upon the ethnicity and race of the population as was also emphasized by Aghaian et al.

Hosseini et al observed CCT value of $544.95 \pm 35.42 \mu\text{m}$ in Indians in Malaysia which is similar to present study.

We compared CCT between right and left eye and did not find any significant difference between the two eyes. The p value of CCT was 0.8380. Hosseini et al also found no significant difference between right and left eye values of CCT.^[41]

CONCLUSION

The mean value of CCT in normal Indian adult population was $542 \pm 26.87 \mu\text{m}$. There was no significant difference between right and left eyes.

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