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ORIGINAL RESEARCH

Central corneal thickness measurement in different refractive errors, gender and age group

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ABSTRACT

Objective: To study the central corneal thickness measurement in different refractive errors, gender and age group**: Methods:** This Hospital based, Observational, Cross sectional study was conducted among patients presenting to Department of Ophthalmology, Lady Hardinge Medical College and Associated Hospitals, New Delhi, India(either as outpatient or requiring admission). Duration of study was November 2017 – March 2019. **Result:** Males had thicker cornea than females. Mean CCT value in male by noncontact pachymetry was 497.82 ± 30.41µm and in females was 491.27 ± 26.34µm but P value was insignificant =0.12.Similarly mean CCT in male by ultrasonic pachymetry was 534.02 ± 31.57µm, and in females was 526.61 ± 27.26µm which also showed insignificant result P =0.10. Hence we conclude that CCT has no statistically significant differences in the two sexes. Mean CCT in myopes was 478.58 ± 25.54 µm by noncontact pachymetry and 516.92 ± 27.19µm by ultrasonic pachymetry which was lower than hypermetropes 491.67 ± 24.95µm (nonpachymetry), 527.15± 26.49µm (ultrasonic pachymetry) followed by emmetropes 497.73 ± 28.43µm (noncontact pachymetry),534.03 ± 28.16 µm(ultrasonic pachymetry). These results were significant as P value obtained was < 0.01.Hence we can conclude that differences of CCT value between two instruments in different refractive error group were significant. **Conclusion:** CCT has no statistically significant differences in the two sexes. Males showed thicker CCT value than females both by noncontact and ultrasonic pachymetry but the intersex differences were statistically insignificant. CCT values obtained in different age groups had not much difference signifying no change in CCT according to age group but CCT compared between noncontact and ultrasonic pachymetry in different age group with P value obtained < 0.01 which is significant. Differences of CCT value between two instruments in different refractive error group were significant.

Keywords: Central corneal thickness, refractive errors, age group

INTRODUCTION

The normal corneal thickness varies from central to peripheral limbus. It ranges from 700µm to 900µm at the limbus and varies between 490µm and 560µm at the centre. The central corneal thickness (CCT) reading of 700µm or more is indicative of endothelial decompensation. The mean CCT as shown by various studies is 510-520 µm (standard deviation 20 - 40 µm). It has been found that cornea is significantly thicker in the age group of 40 – 80 years than in the individuals below 40 years as it seems to undergo age-related anatomic changes. Peripheral corneal thickness is asymmetric such that temporal cornea is thinnest followed by the inferior cornea.[(1)]

In various studies CCT was found to be higher in younger patients, male and diabetic patients. Some studies prove that central corneal thickness does not correlate with refraction, while some say that CCT correlates with refraction. CCT values differ among various ethnic groups. CCT is affected in contact lens wearers also. Several investigators have recently provided further evidence that African-American subjects tend to have thinner corneas than their white counterparts.[(1)]

Several authors have reported a significant reduction of CCT with age[(2)] . Hahn et al[(3)] found that compared with those aged 40 to 49 years, individuals aged 50 to

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59 and 60 to 69 years had, on average, a moderately thinner CCT (3.4 and 4.1 μm, respectively). However, the most clinically significant finding was in age 70 or more years. They had substantially thinner corneas on average (9.0 μm, $P < 0.05$).These age-related differences have also been observed in other ethnic groups and have two possible explanations. The first explanation, suggested by Hahn et al is more probable, supported by histologic evidence, is that older individuals have thinner corneal curvature because of a decline in the density of keratocytes and a probable breakdown in the collagen fibers in the aging cornea. Second, possibility that a cohort effect is responsible for this finding perhaps an environmental factor that older individuals may have been exposed to longer than younger ones may have and that could have affected the structure or the integrity of the cornea.

Several studies have reported that gender influences CCT values. Shimmyo et al[4], Hahn et al[3] reported that males had thicker corneas than females. Hahn et al[2,3] found that the difference in CCT between the genders was only 4.6 μm, which is less than the mean interocular difference in CCT (7.7 μm) for their normal subjects. Therefore, they concluded that the difference between men and women CCT was statistically but not clinically significant. Nangia et al[5] found mean CCT was 514 ± 33μm (median, 517μm) & CCT was significantly ($P < 0.001$) thicker in men (518 ± 34 μm) than in women (511 ± 33μm). Bron et al [6] found that gender had no significant effect on CCT.

MATERIAL AND METHODS

This Hospital based, Observational, Cross sectional study was conducted among patients presenting to Department of Ophthalmology, Lady Hardinge Medical College and Associated Hospitals, New Delhi, India(either as outpatient or requiring admission). Duration of study was November 2017 – March 2019. Ethical clearance was taken before the study from the thesis review board and the Institutional Ethics Committee.

Sample size

A convenient sample size of 100 patients visiting to the Ophthalmology department of LHMC fitting into inclusion and exclusion criteria were enrolled for the purpose of this study.

Inclusion criteria

- Patients in age group (16 year and above)
- Patients willing to give consent

Exclusion criteria

- Patients with corneal pathology.
- Patients who wear contact lens.
- Patients who underwent refractive or any other type of intraocular surgery within last 3 months.

Methodology

Written informed consent was taken from patients and patients with age 16-18year consent from parent/ guardian was taken. Patients fulfilling the inclusion and exclusion criteria were taken for the study and a structured predesigned proforma was filled.

All patients were subjected to thorough history and ophthalmological examination which included visual acuity assessment, best corrected visual acuity with cycloplegic refraction, torch light examination, Hirschberg test, pupillary reflex examination (direct/indirect), slit lamp evaluation, direct ophthalmoscopic examination.

Central corneal thickness readings from both eyes was taken by pachymetry. CCT readings was first evaluated by noncontact pachymetry followed by ultrasonic pachymetry. All the measurements were done by a single observer.

1. Noncontact Pachymetry (Topcon Trk-2p)

The patient's face was accurately aligned to a fixed target within the device by keeping chin at chin rest and forehead at head rest. An image of the patient's eye was visible on the computer screen, with the machine marking the pupil edge and center, and the corneal apex.

The image was focused and centered manually. Five central corneal thickness readings from both eye were taken and mean value calculated.

2. Ultrasonic Pachymetry (Pachette)

CCT was measured with the help of DGH 555 Ultrasonic Pachymeter (Pachette 3) which was caliberated with CAL box. The patient was laid in supine position looking the ceiling above and the probe was placed perpendicular to the centre of the cornea, after instillation of topical anesthesia 0.5% proparacaine hydrochloride ophthalmic solution. The measurements were performed after 60 seconds of drop application to avoid increase in corneal thickness due to the topical anesthesia. Proper precautions were taken to place the probe to the center of the cornea. Five consecutive measurements from both eyes were taken with ultrasonic pachymetry, and the mean value of these five measurements used as central corneal thickness reading.

A questionnaire was provided to the patient after taking central corneal thickness measurement for evaluation of discomfort, redness, blurring of vision and examination was done to look for corneal staining, abrasion.

Individual files were allotted a unique serial number. All proforma was filled by the primary investigator after appropriate evaluation by the supervisor and co-supervisors. All records were managed by the primary investigator.

Statistical Analysis

Tabulation of data with Microsoft excel spreadsheet and analysis of value by an open source freely

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available statistical software was done. Application of appropriate statistical tests like mean percentage. Student t-test, Mann-Whitney U test was used to compare (quantitative data) mean central corneal thickness values obtained from two instruments. Spearman correlation coefficient was used to see correlation between quantitative variables. Bland Altman plots, 95% limits of agreement was plotted to see agreement between noncontact and ultrasonic pachymetry. P value < 0.05 considered significant.

RESULTS

Maximum patients were in age group 31-45 year (43%). Mean age of study subjects was 43.09 ± 12.87 years.

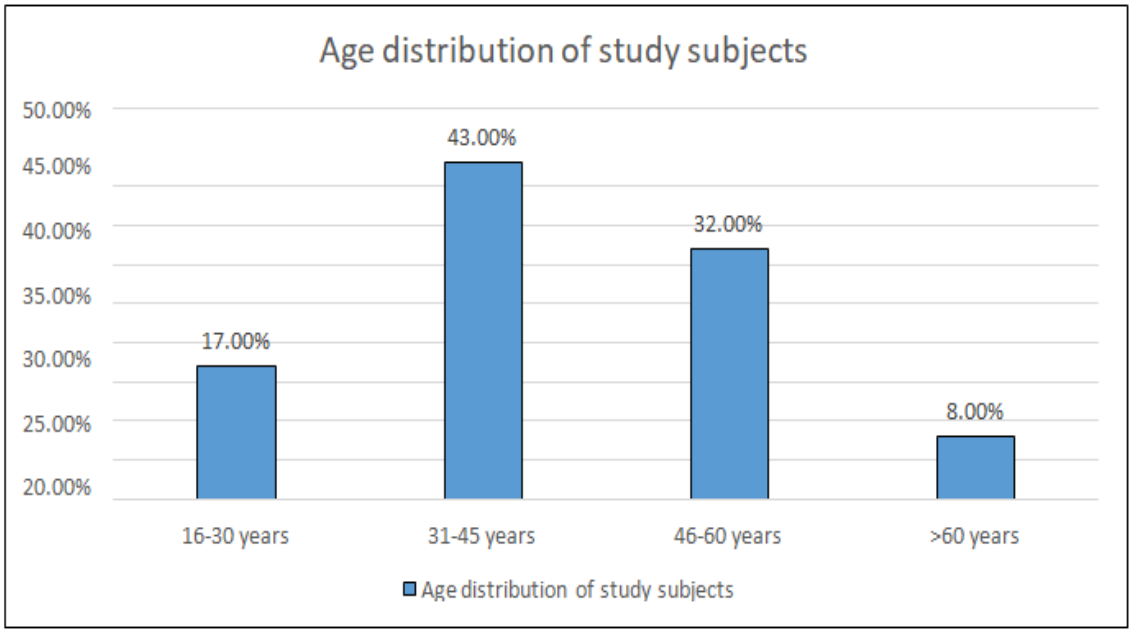

Figure 1: AGE DISTRIBUTION OF STUDY SUBJECTS

As depicted Figure 2, out of 100 patients enrolled 33 patients (33%) were male and 67 (67%) were female.

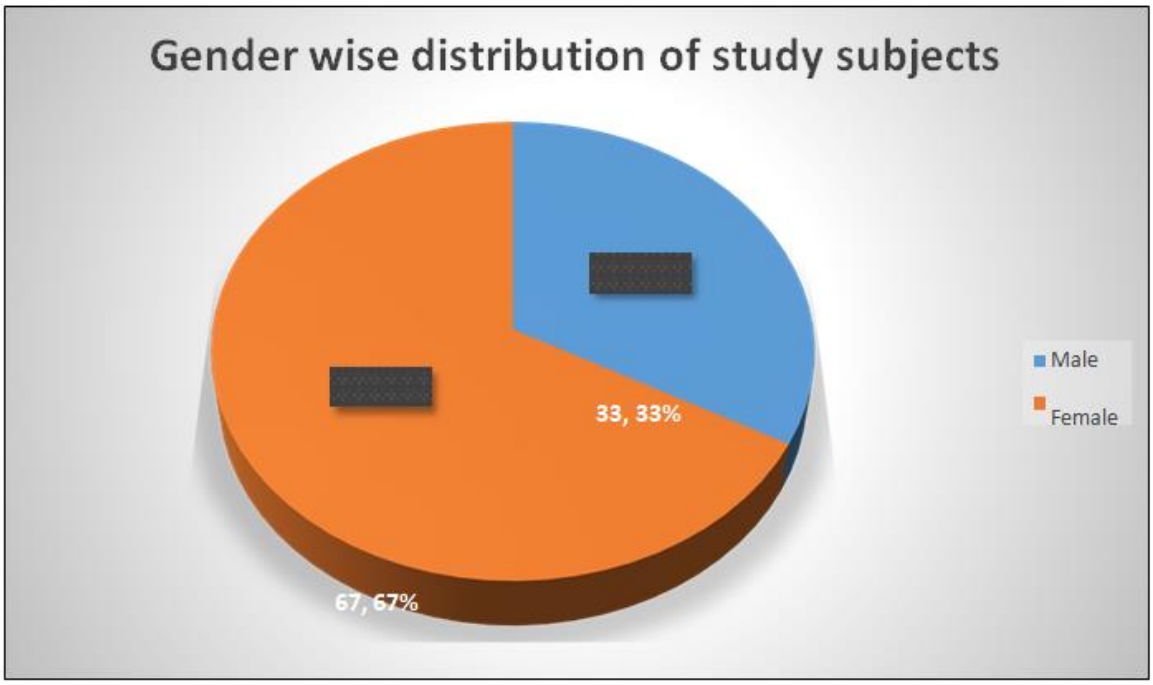

Figure 2: GENDER WISE DISTRIBUTION OF STUDY SUBJECTS

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Table 1: REFRACTION IN RIGHT AND LEFT EYE OF STUDY SUBJECTS

This shows type of refractive error in enrolled patients. In this most of the eyes studied were hypermetrope.

Refraction	Right eye		Left eye	
	No.	%	No.	%
Emmetropia	15	15.0	15	15.0
Myopia	12	12.0	12	12.0
Hypermetropia	34	34.0	31	31.0
ɔmpound myopic astigmatism	12	12.0	10	10.0
ınd hypermetropic astigmatism	19	19.0	21	21.0
Simple Myopic astigmatism	7	7.0	9	9.0
le Hypermetropic astigmatism	1	1.0	2	2.0
Anisometropia	0	0.0	0	0.0

Figure 3 is depicting that most eyes were hypermetrope

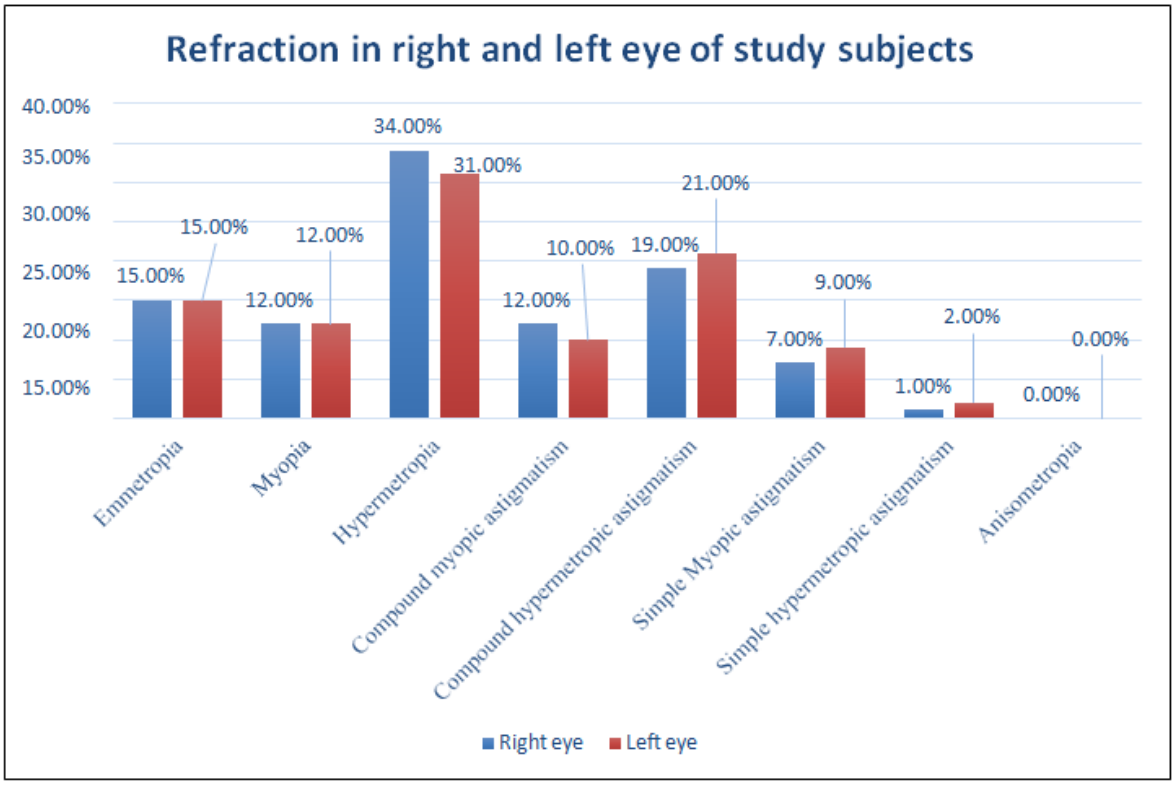

Figure 3: REFRACTION IN RIGHT AND LEFT EYE OF STUDY SUBJECTS

Table 2: CENTRAL CORNEAL THICKNESS BY NONCONTACT AND ULTRASONIC PACHYMETRY IN DIFFERENT AGE GROUP

This shows mean CCT compared between noncontact and ultrasonic pachymetry in different age group with P value obtained < 0.01 which is significant.

Age		Noncontact Pachymetry		Ultrasonic pachymetry		P value
		Mean	SD	Mean	SD	
16-30 years	Right CCT (µm)	493.53	25.15	531.59	26.50	<0.01
	Left CCT (µm)	494.88	25.68	532.00	27.04	<0.01
31-45 years	Right CCT (µm)	493.65	32.64	529.79	32.69	<0.01
	Left CCT (µm)	495.74	31.52	531.49	32.46	<0.01
46-60 years	Right CCT (µm)	491.06	25.36	525.50	25.98	<0.01
	Left CCT (µm)	492.13	25.78	526.78	27.38	<0.01
>60 years	Right CCT (µm)	490.38	21.02	525.38	25.28	<0.01
	Left CCT (µm)	494.25	20.19	527.38	24.23	<0.01

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Table 3: CENTRAL CORNEAL THICKNESS BY NONCONTACT AND ULTRASONIC PACHYMETRY IN DIFFERENT REFRACTIVE ERRORS

This table is showing mean CCT in various types of refractive error by two instruments showing P value < 0.01. Here myopic patients showed lower value.

Refraction	Noncontact pachymetry		Ultrasonic pachymetry		P value
	Mean	SD	Mean	SD	
Emmetropia	497.73	28.43	534.03	28.16	<0.01
Myopia	478.58	25.54	516.92	27.19	<0.01
Hypermetropia	491.67	24.95	527.15	26.49	<0.01
Compound myopic astigmatism	499.86	36.63	535.95	38.81	<0.01
ound hypermetropic astigmatism	496.17	29.68	529.77	31.02	<0.01
Simple myopic astigmatism	497.06	19.16	532.00	19.63	<0.01
Simple hypermetropic astigmatism	504.00	5.19	541.66	2.08	<0.01

DISCUSSION

In our study 100 patients of age 16 year & above were enrolled out of which maximum patients were in age group 31-45 year (43%) with mean age being 43.09 ± 12.87 years.

In our study there were 33 (33%) male and 67 (67%) females in which we found that,Mean CCT in right eye of male, by noncontact pachymetry was 497 ± 30.97µm and by ultrasonic pachymetry was 533.61 ± 31.74µm and results were significant , P < 0.01. Similarly mean CCT in left eye of male, by noncontact pachymetry was 498.64 ± 30.29µm and by ultrasonic pachymetry was 534.42 ± 31.88µm and results were significant, P < 0.01.

Mean CCT in right eye of female, by noncontact pachymetry was 490.34 ± 26.52µm and by ultrasonic pachymetry was 525.79 ± 27.11µm and results were significant P < 0.01. Similarly mean CCT in left eye of female, by noncontact pachymetry was 492.19 ± 26.32µm and by ultrasonic pachymetry was 527.43 ± 27.59µm and results were significant P < 0.01. This signifies that mean CCT compared between both the instruments in male and in female is significant.

We also compared mean CCT values between male and female with both instrument to find any difference in CCT in the two sexes. We found males had thicker cornea than females. Mean CCT value in male by noncontact pachymetry was 497.82 ± 30.41µm and in females was 491.27 ± 26.34 µm depicted in Table 8 but P value was insignificant =0.12.Similarly mean CCT in male by ultrasonic pachymetry was 534.02 ± 31.57µm ,and in females was526.61 ± 27.26µm which also showed in significant result P =0.10. Hence we conclude that CCT has no statistically significant differences in the two sexes.

Various studies showed that CCT is unrelated to gender . Price et al[7] found no correlation between refraction and CCT. Ortiz et al [8]analyzed the relationship between the CCT and the degree of myopia in 175 myopic eyes. They did not find statistically significant differences in CCT between the myopic groups in their study. Chen et al[9] stated that CCT is not associated with refractive error, corneal curvature, anterior chamber depth and axial length. CCT is an independent factor unrelated to other ocular parameters

We also compared CCT values among different refractive error groups .In our study myopic patients showed lower CCT as compared to other refractive errors. Mean CCT in myopes was 478.58 ± 25.54 µm by noncontact pachymetry and 516.92 ± 27.19µm by ultrasonic pachymetry which was lower than hypermetropes 491.67 ± 24.95µm (nonpachymetry), 527.15± 26.49µm (ultrasonic pachymetry) followed by emmetropes 497.73 ± 28.43µm (noncontact pachymetry),534.03 ± 28.16 µm(ultrasonic pachymetry). The mean CCT difference in each refractive error group compared between both instruments was significant as P value obtained was < 0.01.

CONCLUSION

Males had thicker cornea than females. Mean CCT value in male by noncontact pachymetry was 497.82 ± 30.41µm and in females was 491.27 ± 26.34µm but P value was insignificant =0.12.Similarly mean CCT in male by ultrasonic pachymetry was 534.02 ± 31.57µm, and in females was 526.61 ± 27.26µm which also showed insignificant result P =0.10. Hence we conclude that CCT has no statistically significant differences in the two sexes.

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