Research Article

A comparative study of central corneal thickness measurement in four different groups by specular microscope

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ABSTRACT

Background: A prospective, randomized, single-site clinical trial conducted on patients attending our eye outpatient department. **Objective:** To compare central corneal thickness (CCT) measurements by noncontact specular microscope in young, elder, cataract, and chronic primary open-angle glaucoma (POAG) patients. **Materials and Methods:** Total 120 patients were selected which were divided into four groups of 30 patients in each group, i.e., Group A, B, C, and D. CCT was measured by noncontact specular microscopy. Group A was considered control group for rest of the groups while Group B was considered as a control for Group C and D. The *P* value was calculated using student paired *t*-test and $P < 0.005$ was considered significant. **Results:** In our study, out of 120 patients 74 (61.66%) were male while 46 (38.33%) were female. Male predominance is seen in all groups. In Group A the mean CCT was 545.17 ± 31.43 μm, in Group B it was 547.67 ± 21.16 μm, in Group C CCT was 524.03 ± 27.48 μm while in Group D it was 467.53 ± 31.21 μm. POAG patients have significantly lesser CCT as compared to other three groups. **Conclusion:** In this study, no significant difference in CCT of male and female was seen. Aging and cataract had no significant effect on CCT. Glaucoma patients had significantly lower CCT than young patients ($P < 0.001$) and elder patients ($P < 0.001$). It concludes that POAG patients have thinner cornea.

KEY WORDS: Central Corneal Thickness; Glaucoma; Specular Microscope

INTRODUCTION

Cornea (Latin-horny) has a smooth, convex outer surface and concave inner surface which resembles a watch glass. The important function, which it subserves includes protection against potential pathological agents and micro-organisms, and the smooth surface of the cornea forms a part of the refractive system of eye. Thickness of cornea varies from 520 μm at center to 800 μm at periphery and about 1200 μm at limbus.

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Central corneal thickness (CCT) is an important biometric measurement in several ocular conditions such as corneal edema, corneal dystrophies, corneal endothelial diseases, and glaucoma.[1,2] It has been found that approximately every 100 μm change in corneal thickness causes changes in intraocular pressure (IOP) by 6-7 mm/Hg.[3] The fact that a relatively minor change in CCT can produce a statistically significant change in mean IOP measurement suggests that CCT may be more important in the overall management of glaucoma than previously suspected.[4] CCT has been recognized as a significant risk factor for progression of ocular hypertension to primary open-angle glaucoma (POAG) in the ocular hypertension treatment study (OHTS). OHTS found that a decrease in CCT of 40 μm added a 70% increase in risk of glaucoma.[5]

Ultrasound pachymetry is the most common method used for CCT measurement.[6] This is performed by direct apposition of an ultrasound probe to the anterior corneal surface.[7] Noncontact

techniques such as Orbscan,[8] specular microscope, and OCT[9] have been used to measure CCT. In our study, we had measured CCT with specular microscope. Specular microscopy uses reflections of light from the anterior and posterior surfaces as a means to distinguish corneal layers and measures corneal thickness.[10] In this study, we had done comparison between four groups to know how value of CCT changes with gender, age, ocular disease especially cataract and glaucoma, early identification of glaucoma suspect by the CCT.

MATERIALS AND METHODS

The study was the prospective, randomized, and single site study. Total 120 patients were enrolled who attended our outpatient department from July 2013 to June 2014. The study was approved by Institutional Review Board. All the patients were informed about the design of the study and informed consent was taken. Patients with chronic POAG on medical management, in which eye drops are effective in lowering IOP to normal values and taking drops since more than 6 months written consent was taken. Patients were divided into four groups of 30 each as follows:

- Group A: Young healthy patients (25 ± 5 years) acting as a control group to rest 3 group.
- Group B: Elderly patients (55-65 years) acting control group to Group C and D.
- Group C: Senile cataract patients. At least in one eye undergoing cataract surgery ages 50-60 years. CCT measured preoperatively.
- Group D: Already diagnosed chronic POAG patients.

Patients having diabetes mellitus, hypertension, history of previous intraocular surgery or ocular trauma, corneal or conjunctival irritation, h/o chemical trauma, uveitis, known corneal degeneration, dystrophies, opacity, high myopia >5 D pregnant or lactating women, contact lens wearer, dry eye, and family h/o corneal decompensation were excluded.

After enrollment, a thorough clinical examination with slit lamp was carried out. Visual acuity was recorded using Snellen's chart for distance and Jaeger's chart for near. Intraocular pressure was recorded using Goldmann applanation tonometer. Routine investigation - hemoglobin, bleeding time, clotting time, urine albumin and sugar, and blood pressure measurement were done.

Noncontact Tomey EM 3000 specular microscope with automated analysis was used to measure the corneal thickness and endothelium biometry parameters of both eyes; each eye was treated as a single patient, but only CCT reading was used for this study.

RESULTS

Out of 120 patients, 74 were male and 46 were female. Sex distribution in all four groups is shown in Table 1.

The age group of patients included for the study ranged from 22 to 65 years. The mean age ± standard deviation (SD) of the study was 53.24 ± 15.19 years. The mean age ± SD in the various group is displayed in Table 2.

The mean ± SD CCT in Group A was 545.17 ± 31.43 μm. In Group B CCT was 547.67 ± 21.16 μm. In Group C, it was 524.03 ± 27.48 μm while in Group D it was 467.53 ± 3 1.21 μm as shown in Table 3.

Table 4 summarizes the CCT distribution between gender and defined study groups. *P* value was calculated using student *t*-test. It was considered significant when $P < 0.05$. No statistically significant difference was seen in CCT between sex and all four groups. Hence, sex does not seem to influence CCT. Overall, mean CCT was lower in glaucoma group compared to young, elderly, and cataract groups.

In Table 5 comparison was made between young age group with elderly and cataract groups with respect to CCT. No significant difference was found in CCT between young and elderly, young and cataract, and elderly and cataract ($P > 0.05$). This signifies that neither age nor cataract has any effect on CCT.

In Table 6 comparison was made between young age group with elderly and glaucoma group with respect to CCT. It shows that CCT has no relation with age. ($P = 0.175$). Glaucoma patients have significantly lower CCT than young ($P < 0.001$), and elderly ($P < 0.001$) which signifies that glaucoma causes significant changes in CCT.

Table 1: Sex distribution

Gender	Group *n* (%)				
	Young	Elderly	Cataract	Glaucoma	Total
Male	18 (60)	16 (53.34)	16 (53.34)	24 (80)	74 (61.66)
Female	12 (40)	14 (46.66)	14 (46.66)	06 (20)	46 (38.33)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

Table 2: Age distribution in defined groups

Group	Mean age±SD*
Group A	26.06±2.59
Group B	62.4±1.96
Group C	61.8±2.47
Group D	62.7±2.00

*SD: Standard deviation

Table 3: CCT in defined study group

Group	CCT (μm)
Group A	545.17±31.43
Group B	547.67±21.16
Group C	524.03±27.48
Group D	467.53±31.21

CCT: Central corneal thickness, SD: Standard deviation

Table 4: CCT distribution between sex in study population

Group parameter	Group A	Group B	Group C	Group D
Male	564.08±18.98	549.75±19.90	533.78±15.90	471.83±33.14
Female	540.89±24.59	545.29±21.55	515.50±31.49	454.33±16.48
Overall mean	545.17±31.43	547.67±21.16	524.03±27.48	467.53±31.21
P value	0.08	0.55	0.069	0.25

CCT: Central corneal thickness, SD: Standard deviation

Table 5: Comparison of CCT in young, elderly, and cataract groups

Group	Group A	Group B	*P* value (between Group A and B)	Group C	*P* value (between Group A and C)	*P* value (between Group B and C)
CCT (μm)	545.17±31.43	547.67±21.16	0.175	524.03±27.48	0.069	0.068

CCT: Central corneal thickness, SD: Standard deviation

Table 6: Comparison of CCT in young, elderly, and glaucoma groups

Group	Group A	Group B	*P* value (between Group A and B)	Group D	*P* value (between Group A and D)	*P* value (between Group B and D)
CCT (μm)	545.17±31.43	547.67±21.16	0.175	467.53±31.21	<0.001	<0.001

CCT: Central corneal thickness, SD: Standard deviation

DISCUSSION

The cornea is an important ocular structure involved in the mediation of visual perception. It is the principal refractive surface of the eye and vision can be significantly affected by relatively small changes in its structure and parameters. Measurement of corneal parameters is important in the diagnosis and management of variation ocular diseases. CCT was first measured in 1880,[11] since then methods for investigating the cornea have significantly improved. New techniques for measuring corneal thickness and corneal endothelial cell were developed. A number of studies have examined CCT and endothelial cell to determine their clinical significance and the correlation of these values with age, sex, and eye disease. Our present study aimed at the comparison of CCT in healthy young, elderly and diseased group of cataract and glaucoma by specular microscopy. These patients were examined for CCT with a noncontact type TOMEY EM 3000 specular microscope with automated analysis. The age group of patients included for the study ranged from 22 to 65 years. The mean age ± SD in our study was 53.24 ± 15.91 years. In Group A, B, C, and D it was 26.06 ± 2.59 years, 62.4 ± 1.96 years, 61.8 ± 2.47 years, and 62.7 ± 2.00, respectively. Mean CCT in young was found 545.17 ± 31.43 μm with average value in male was 564.08 ± 18.48 μm and in females 540.89 ± 24.59 μm. No significant difference in CCT was noted in males and females ($P = 0.08$). Mean CCT in elderly persons was found 547.67 ± 21.16 μm with average value in male was 549.75 ± 19.90 μm and in females was 545.29 ± 21.55 μm. No significant difference was noted in CCT between males and females ($P = 0.55$). Mean CCT in cataract patients in our study was found 524.03 ± 27.48 μm with average value in male was 533.78 ± 15.90 μm and in female was 515.50 ± 31.49 μm. There was no significant difference found between males and females in CCT in cataract patients ($P = 0.069$). Mean CCT in glaucoma patients in our study was found 467.53 ± 31.21 μm with average value in males was found 471.83 ± 33.14 μm and in females was 454.33 ± 16.48 μm. There was no significant difference found between males and females in CCT in glaucoma patients ($P = 0.25$).

Study conducted by Casson et al.,[12] Bron et al.,[13] and La Rosa et al.[14] and had similar results as of our study, proves that there is no correlation between gender and CCT which matches with our study. Our study had similar results as of results obtained by Noche et al.[15] and Doughty and Zammas[1] that proves that aging has no effect on CCT ($P = 0.175$) whereas few studies showed a tendency for the CCT to decrease with the age.[16,17] Findings similar to our study were also seen by Praveen et al.[18]

Our study results showed that glaucoma patients have significantly lower CCT than young ($P < 0.001$) signifies that glaucoma causes significant changes in CCT. OHTS[5] results showed that patients with a CCT of <535 μm had a 3-fold increase in the risk of glaucoma development compared with those having CCT >588 μm. Various reports published by the American Academy of Ophthalmology[19] and European glaucoma prevention study[20] also concluded that patients having thinner corneas are at more risk of developing glaucoma than persons having normal corneal thickness.

Early Manifest Glaucoma Trial[21] also found that thinner CCT significantly predicted progression of visual loss in patients with POAG. While different results were obtained by Natarajan et al.[22] as they reported that there was no difference in CCT in POAG patients (CCT = 536 μm) when compared with normal subjects (CCT = 531 μm) ($P = 0.16$).

They also observed no significant difference in CCT between sex in glaucoma persons ($P = 0.21$).

In our study, we had compared four groups which had been done in few studies only; it was a prospective study a large study is indicated to find any new correlation between CCT and gender, age, cataract, and glaucoma in North-West Rajasthan.

CONCLUSION

The most important finding of our study is that CCT is not affected by age, gender, and cataract. Glaucoma patient had significant lower CCT in comparison to other groups. Hence, CCT measurement in glaucoma patients may help to identify those patients who are at higher risk of developing glaucomatous sequel thus enabling the ophthalmologist to treat the disease more aggressively.

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