

## CENTRAL CORNEAL THICKNESS IN NORMAL SUDANESE POPULATION

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### ABSTRACT

**Objective:** To determine the average central corneal thickness (CCT) of healthy adults in Sudan.

**Methods:** This is a cross-sectional study conducted in the ophthalmology clinics of Khartoum state ophthalmic Hospitals. 340 normal subjects from different ethnic groups were studied. An ultrasound pachymeter was used to measure CCT.

**Results:** The mean ( $\pm$ SD) age of the study population was  $44.29 \pm 15.18$  years with average of 47 years (range: 20-79). The mean (SD) CCT measurements were  $517.1853 \pm 32.026$  micrometers. There was no statistically significant correlation between CCT and other independent variables like age, sex. There was statistically significant correlation between CCT and ethnic groups. Conclusions: The average CCT values obtained in this study closely match those of the Australians and Japanese and differ from African American and Indians. Further studies would be needed to provide more information about the cornea in Sudanese population.

### INTRODUCTION

Measurement of CCT has become routine for the diagnosis or monitoring of several corneal diseases, such as keratoconus, bullous keratopathy, Fuchs' endothelial dystrophy and macular corneal dystrophy<sup>[1,2]</sup>. Patients wishing to undergo laser refractive eye surgery also require CCT measurements to determine their eligibility for the procedure, as do corneal graft recipients to monitor the health of the donor cornea<sup>[2,3]</sup>. There are also several systemic disorders where measurement of CCT may be utilised to aid in diagnosis, including Ehlers-Danlos syndrome, Marfan syndrome, and osteogenesis imperfecta<sup>[4]</sup>. However, the most widely employed application for measuring CCT is in the diagnosis and management of open-angle glaucoma (OAG)<sup>[3]</sup>.

Thin central corneal thickness (CCT) has been shown to be a powerful risk factor for the progression of ocular hypertension (OHT) and preperimetric glaucoma to primary open-angle glaucoma (POAG)<sup>[4,5,6]</sup>. It varies amongst racial

subpopulations, with thinner CCT found in African-American groups and is associated with more severe glaucoma progression<sup>[3,7]</sup>. Patients with a CCT of  $555\mu$  in the ocular hypertension treatment study (OHTS) had a 3-fold increase in the risk of glaucoma development compared with those having CCT of  $\geq 588\mu$ <sup>[1,3,8]</sup>. CCT is positively related to IOP with thinner corneas requiring less force than expected to achieve applanation by Goldmann applanation tonometry (GAT)<sup>[8,9]</sup>. Thinner corneas give falsely low IOP readings while thicker corneas give falsely high readings<sup>[3,7,9,10]</sup>.

CCT measurement is still not a routine part of eye examinations in Sudan ophthalmic clinics. This study aimed to determine the central corneal thickness and its correlation with age, gender, ethnic group in healthy Sudanese subjects, and to analyze any change in management decisions based on a CCT measurement being revealed to a masked observer.

### MATERIALS AND METHODS

A cross-sectional study was performed during 2014, and subjects included were healthy Sudanese adults aged from 20 to 80 years. Three hundred forty subjects (140 males and 200 females) participated in this study. They were divided into 6 age groups 10 years apart (decade wise). Routine eye ocular

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examination for both eyes was done including visual acuity, refractive error, anterior and posterior segment examination, intraocular pressure (IOP) with tonometry.

Subjects included were those more than 20 years of age, with normal visual acuity, reliable visual fields, and intra ocular pressure (IOP) < 17 mHg. Subjects excluded were those with history of ocular trauma, intraocular laser or surgery, diabetes, family history of glaucoma. Subjects were asked about their tribes, and according to the frequency, the major tribes included in this study were Gaalia, Shaygia, Mahas, Danagla, Halfawia, and Foor. The other tribes in Sudan were categorizes as others.

The CCT measurements were recorded from a seated position using a non contact ultrasonic pachymeter probe (Pachmate™ DGH 55, DGH Technology Inc, PA) gently placed in the mid-pupillary axis of the cornea in the undilated eye. All measurements were taken by expert technician and the pachymetry was taken in each subject from both eyes.

### Data analysis

Data was analyzed using SPSS version 20 software. Means, standard deviations and ranges were calculated for CCT and other variables. Influence of age, gender and tribe was evaluated on CCT using independent t test.

### Ethical approval

Local ethics committee approval was obtained for this study. Measurements were only taken after informed consent was taken.

## RESULTS

Sample included a total of 340 normal subjects of which 140 were males and 200 were females. Mean age of the study sample was 47.64±13.63 years. Subjects were divided decade wise for analysis (20-29 y, 30-39, 40-49, 50-59, 60-69y, and 70-80y).

CCT were analyzed for the right and left eyes separately. The mean (SD) CCT measurements were 517.19 ±32.03 and 515.92±31.84 micrometers in the right and left eye respectively (Table 1). The two means were not significantly different

For correlation and analysis, CCT measurements for the right eye were chosen.

Mean central corneal thickness (CCT) was found to be 517.186 ±32.027.

**Table 1 : Average CCT in right and left eyes**

	N	Mean/	Std. Deviation	Std. Error Mean
CCT(right)	340	517.19	32.03	1.74
CCT(left)	340	515.92	31.84	1.73

Mean central corneal thickness in this study was found to be 513.28±31.74 in males and 519.92±32.01 in females (Table 2). No significant difference of CCT was seen between males and females (p=0.86).

**Table 2 ; Average CCT in males and females**

	Sex	N	Mean	Std. Deviation	Std. Error Mean
CCT	male	140	513.28	31.74	2.68
	female	200	519.92	32.02	2.26

Average CCT in different age groups (decade wise) were as follows (Table 3).

**Table 3; Average CCT in different age groups**

Age (years)	Mean	N	Std. Deviation
20-29	530.07	54	40.35
30-39	522.81	64	22.67
40-49	511.39	94	31.61
50-59	510.40	65	36.74
60-69	514.98	54	22.31
70-79	522.56	9	26.73
<b>Total</b>	<b>517.19</b>	<b>340</b>	<b>32.03</b>

No significant difference of CCT was seen between different age groups.

Average CCT in different ethnic groups (tribes) were as shown in (table 4).

**Table 4; Average CCT in different ethnic groups (tribes)**

Tribe	Mean	N	Std. Deviation
Gaalia	528.71	89	31.26
Shaygia	507.26	50	34.51
Danagla	530.96	54	23.37
Mahas	521.65	31	23.16
Halfawia	521.63	9	32.35
Foor	494.46	69	18.75
Others	532.79	38	22.55
<b>Total</b>	<b>517.16</b>	<b>340</b>	<b>32.07</b>

There was statistically significant difference of CCT, ( $p < 0.005$ ), seen between all different tribes (Gaalia, Shaygia, Mahas, Danagla, Halfawia, others) and Foor, also there was statistically significant difference of  $C^{-*} + CT$ , ( $p < 0.005$ ), seen between different tribes (Gaalia, Mahas, Danagla, Halfawia, others) and Shaygia.

No significant difference of CCT ( $p = 0.846$ ) was seen between Gaalia, Mahas, Danagla, Halfawia, and others.

## DISCUSSION

Whitacre et al.<sup>[11]</sup> reported that thin corneas may result in a 4 to 9 mm Hg underestimation of IOP, and thick corneas may result in overestimation of the IOP by 6.8 mmHg. Mean central corneal thickness (CCT) in the present study was found to be 517.1853  $\pm$  32.02651 which was similar to that of Australian (514.99)<sup>[12]</sup> of Japanese populations (518.3)<sup>[7]</sup>.

Corneal thickness in this study did not show any correlation with gender and age as in other studies.

Table (5) below shows some study results of the CCT in different ethnic groups from different countries.

According to the results of this study and in comparison with previous studies on different countries, Sudanese subjects have thin corneas and they are more liable to be affected by glaucoma. Racial subpopulation affects CCT and in this study subjects related to Foor tribe seems to be more liable to glaucoma because they have thinner corneas than other tribe's subjects. The readings of

**Table 5: CCT differences in different populations:**

Ethnicity	Country	Mean CCT ( $\mu\text{m}$ )	Reference
African	Barbados	529.8	Nemesure <sup>[13]</sup>
Asian	Burma	521.9	Casson <sup>[14]</sup>
Asian	India	520.7	Vijaya <sup>[15]</sup>
Asian	Singapore	541.2	Su et <sup>[16]</sup>
Caucasian	Australia	539.5	Healey <sup>[12]</sup>
Caucasian	Iceland	529	Eysteinnsson <sup>[17]</sup>
Caucasian	Netherlands	537.4	Wolfs <sup>[18]</sup>
Eskimo	Greenland	523.7	Alsbirk <sup>[19]</sup>
Asian	Canada	532.8	Dohadwala <sup>[20]</sup>
Black	Canada	529.7	Dohadwala <sup>[20]</sup>

IOP are underestimated due to thin corneas and more studies about IOP and glaucoma in Sudan should be conducted to clear any correlation between glaucoma and CCT.

## CONCLUSION

Implementation of routine central corneal thickness measurement could change patient's management in the ophthalmology practise.

CCT is one factor that is necessary to adjust IOP to achieve a more accurate IOP and it allows monitoring for the risk of progression to be more precise. Any decision in glaucoma, in the absence of CCT is an uninformed one.

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