# Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects

# Wafa Majed Alotaibi\*

Department of Optometry, King Saud University, Saudi Arabia

\*Corresponding Author: Wafa Majed Alotaibi, Department of Optometry, King Saud University, Saudi Arabia.

Received: April 08, 2025; Published: May 09, 2025

# Abstract

**Purpose:** To establish the normative values of central corneal thickness (CCT) and anterior chamber depth (ACD) and compare it between males and females among young healthy Saudi subjects.

**Methods:** Sixty healthy young Saudis from both genders aged between 18 to 29 years old participated in this prospective crosssectional study. Subjects without ocular or systemic diseases were included. The mean of two automatic readings of the CCT and ACD at the same session to assess the repeatability and in two separated sessions to assess the reproducibility of Pentacam HR (Oculus, Wetzlar, Germany).

**Results:** The (Mean  $\pm$  SD) of the overall CCT value was 540.58  $\pm$  31.37  $\mu$ m. While the overall ACD value was 3.02  $\pm$  0.26 mm. There was no significant difference between males and females in CCT mean values with P-value 0.276, and there was no significant difference between males and females in ACD mean values with P-value 0.729. The intra-class correlation coefficient (ICC) values for CCT and ACD measurements were 0.968 and 0.992 respectively, such results indicate an excellent level of repeatability. While inter-class correlation coefficient (ICC) values for CCT and ACD measurements were 0.973 and 0.993 respectively, such results indicate an excellent level of repeatability.

**Conclusion:** Pentacam is highly repeatable and reproducible in measuring CCT and ACD. There was no significant difference between males and females in those parameters. This study revealed a valuable information about the normal values of anterior segment parameters of healthy Saudi population and the results may help optometrist and ophthalmologist in clinical applications.

Keywords: Pentacam; CCT; ACD; Normative Values; Comparison Between Males and Females; Saudi Population

# Background

Accurately measurement of central corneal thickness (CCT) is vital for diagnosing diseases such as keratoconus and advanced glaucoma [1,2]. Moreover, evaluation of CCT is essential in refractive surgery in order to prevent corneal ectasia development [3]. It is also helpful for accurate glaucoma diagnosis and management [4,5].

Another important preoperative parameter for ophthalmologists and surgeons in anterior segment surgeries is the anterior chamber depth (ACD), it represents the distance between the corneal endothelium layer and the anterior capsule of the crystalline lens [6]. The construction of normal reference ranges for ACD is challenging since it contributes to multiple variables. Anterior chamber depth is

*Citation:* Wafa Majed Alotaibi. "Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects". *EC Ophthalmology* 16.2 (2025): 01-08. affected by gender and negatively correlated with age [7], while the effect of refractive error has been less consistent to this parameter [8]. Moreover, it is an inheritable characteristic affected by race. The ACD of the eye differs in people from 1.5 to 4.0 mm, and the average is 3.0 mm. As getting older in age the ACD tends to become shallower as well as in eyes with hypermetropia [9]. The risk of getting angle closure glaucoma increases in case if ACD reaches below 2.5 mm [10]. Primary angle closure disease (PACD) occurs due to anatomical changes in the structure of the anterior chamber [11]. The most important risk factors for PACD is the narrow of anterior chamber angles [12], this will increase the risk of glaucoma.

There are several factors affect the measurements of ACD and CCT including age, gender, race/ethnicity, corneal curvature and refractive error [13,14].

There are several devices used to assess CCT and ACD such as anterior segment optical coherence tomography (AS-OCT), Orbscan and Pentacam. Previous studies showed that a non-contact rotating Scheimpflug technology Pentacam HR (Oculus, Wetzlar, Germany) has a good repeatability and reproductivity in measurements of CCT [15,16].

There is no study yet done to investigate the repeatability and reproducibility of Pentacam among Saudi population, therefore the purpose of this study is to evaluate the normative values of healthy Saudi individuals, repeatability and reproducibility of CCT and ACD by using Pentacam. As well as, to compare the difference of these values between genders. The results of this study may help in explaining why prevalence of angle closure rates are higher in female gender? and may help optometrist and ophthalmologist in clinical applications.

## **Materials and Methods**

In this prospective cross-sectional study sixty healthy young Saudi individuals aged between 18 to 30 years old included. Screening tests were performed for each subject using slit lamp to exclude any ocular abnormalities and autorefraction was taken from each subject. Healthy subjects without ocular or systemic diseases were included. Participants who use to wear contact lenses had stopped it three days before taking the exam. Any ocular abnormalities or history of ocular surgery, spherical equivalent of more than ±4.00D, ocular pathology as glaucoma and keratoconus, pregnancy, smoking, and participants who are taking any systemic or ocular medications were excluded. This study was performed at king Saud university, Collage of Applied Medical Sciences, from September 2020 to March 2021. It was conducted in accordance with the tenets of the Declaration of Helsinki [17] regarding research involving human subjects. The study was approved by the ethical committee at King Saud University Medical City (ethics number E-20-5504) and the informed consent was obtained from the participants included in the study. The repeatability of Pentacam HR (Oculus, Wetzlar, Germany) was assessed by taking mean of two readings of the CCT as well as ACD from one eye (right eye) in one session, then the reproducibility of Pentacam was assessed by taking the mean of two readings for each parameter in two separated sessions. Before taking each measurement, the subject is asked to place his/her chin on chain rest, and the forehead against the forehead strap. The room illumination was in the mesopic condition. The subject was asked to keep both eyes open and focus at the fixation target. Only the image of good quality was taken and selected.

The data were calculated using Excel 2019. It presented as Mean ± SD. Paired t-test used to assess the difference between genders in terms of CCT and ACD. The Bland-Altman of agreements was used to calculate the repeatability and reproducibility of the device.

#### Results

### Demographic data and normal values of CCT and ACD

Data collected from sixty individuals distributed equally into both sexes. The overall age (Mean  $\pm$  SD) for all participants is 21.7  $\pm$  3.1 years, where males had higher age mean of 22.93 compared to females. In addition to that, the (Mean  $\pm$  SD) overall spherical equivalent value was -0.67  $\pm$  1.19 D, where males had lower spherical equivalent mean value of -0.57 D. Furthermore, the (Mean  $\pm$  SD) overall ACD value was 540.58  $\pm$  31.37  $\mu$ m, where males had lower CCT mean value of 537.45  $\mu$ m. Moreover, the (Mean  $\pm$  SD) overall ACD value was 3.02  $\pm$  0.26 mm, where males had also lower ACD mean value of 3.01 mm (Table 1).

*Citation:* Wafa Majed Alotaibi. "Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects". *EC Ophthalmology* 16.2 (2025): 01-08.

	N=	Age (Years) Range Mean ± SD	Spherical Equivalent of Refractive Error (D) Range Mean ± SD	Normal values of CCT (μm) Range Mean ± SD	Normal values of ACD (mm) Range Mean ± SD
Male	30	(18 - 29 Years) 22.93 ± 3.7 Years	(-3.25 – +1.00 D) -0.57 ± 1.09D	(454.5 - 584 μm) 537.45 ± 30.95 μm	(2.54 - 3.64 mm) 3.01 ± 0.27 mm
Female	30	(18 - 23 Years) 20.4 ± 1.5 Years	(-3.50 - +1.25 D) -0.78 ± 1.29D	(481 - 590.5 μm) 543.71 ± 31.72 μm	(2.54 - 3.53 mm) 3.03 ± 0.25 mm
Total Participant	60	(18 - 29 Years) 21.7 ± 3.1 Years	(-3.50 - +1.25 D) -0.67 ± 1.19D	(454.5 - 590.5 μm) 540.58 ± 31.37 μm	(2.54 - 3.64 mm) 3.02 ± 0.26 mm

Table 1: Shows demographic data and normative values of CCT and ACD.

#### **Comparison of CCT and ACD between genders**

The results showed that there was no significant difference between males and females in CCT and ACD mean values with P-value 0.276 and P-value 0.729 respectively. Despite the results shows that there are no significant differences in CCT and ACD, the mean values of females had a slightly higher CCT and ACD compared to males (Table 2).

<b>Measurement</b> s	(Mean ± SD)	P-value
ССТ		0.276
Males (n = 30)	537.45 ± 30.95 μm	
Females (n = 30)	543.70 ± 31.72 μm	
ACD		0.729
Males (n = 30)	3.01 ± 0.27 mm	
Females (n = 30)	3.03 ± 0.25 mm	

Table 2: Shows comparison of CCT and ACD between genders.

## **Repeatability of Pentacam in measuring CCT and ACD**

The inter-class correlation coefficient (ICC) and the corresponding 95% confidence interval (CI) calculated for evaluating the repeatability of Pentacam in measuring CCT and ACD. Where a value between 0.50 and 0.75 of ICC indicates a moderate repeatability of measurements, between 0.75 and 0.90 of ICC indicates a good repeatability of measurements, while an ICC value of 0.9 indicates an excellent repeatability of measurements [18].

Results showed that the ICC values for CCT and ACD measurements are 0.938 and 0.985 respectively such results indicate an excellent level of repeatability (Table 3). There were no significant differences between the two readings of CCT and ACD with P-value = 0.963, P-value = 0.934 respectively. The Bland-Altman plot showing the agreement of CCT measurements, where the line shows the mean difference, and the lower and upper 95% confidence levels (-22.0386, 21.90323) respectively (Figure 1). While ACD measurements shows (-0.09154, 0.090542) respectively (Figure 2).

	Inter colors	95% Confidence Interval	
Measurement	Correlation	Lower Bound	Upper Bound
ССТ			
Single Measures	.938	.899	.963
Average Measures	.968	.947	.981
ACD			
Single Measures	.985	.974	.991
Average Measures	.992	.987	.995

Table 3: Inter-class correlation coefficient (ICC) for CCT and ACD measurements - (n = 60) in one session.



Figure 1: Bland-Altman level of agreement plot for CCT measurements - in one session.



Figure 2: Bland-Altman level of agreement plot for ACD measurements - in one session.

*Citation:* Wafa Majed Alotaibi. "Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects". *EC Ophthalmology* 16.2 (2025): 01-08.

## **Reproducibility of Pentacam in measuring CCT and ACD**

The ICC value for CCT measurement is 0.947 that indicates an excellent level of reproducibility. In addition, the ICC value for ACD measurement is 0.985 which indicates an excellent level of reproducibility (Table 4). There were no significant differences between the two measurements in case of CCT and ACD in two separated sessions with P-value= 0.425, P-value = 0.316 respectively. Bland-Altman plot showing the agreement of CCT measurements in two separated sessions. The line shows the mean difference, and the lower and upper 95% confidence levels (-21.1003, 19.58366) respectively (Figure 3). While ACD measurements show (-0.09122, 0.083022) respectively (Figure 4).

	Intro alaga	95% Confidence Interval	
Measurement	Correlation	Lower Bound	Upper Bound
ССТ			
Single Measures	.947	.925	.963
Average Measures	.973	.961	.981
ACD			
Single Measures	.985	.979	.990
Average Measures	.993	.989	.995

Table 4: Intra-class correlation coefficient (ICC) for CCT and ACD measurements - in two separated sessions (n = 60).



Figure 3: Bland-Altman level of agreement plot for CCT measurements - in two separated sessions.

*Citation:* Wafa Majed Alotaibi. "Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects". *EC Ophthalmology* 16.2 (2025): 01-08.

06



Figure 4: Bland-Altman level of agreement plot for ACD measurements - in two separated sessions.

#### Discussion

CCT is routinely measured in the clinic before and after corneal refractive surgeries and for following up with keratoconus patients. The ACD plays an important role in the diagnosis and treatment of glaucoma. In this present prospective cross-sectional study, by using Pentacam, the normative values of CCT and ACD for young Saudi population with mean refractive error of -0.67 D was 540.58  $\mu$ m and 3.02 mm respectively.

The study demonstrated that males had lower CCT and ACD compare to female, with mean value of 537.45 µm and 3.01 mm respectively, however these differences were not statically significant P>0.05. Similarly, CCT measured using pentacam was not found to be significantly different between males and females among Saudis [19] and Chinese populations using AS-OCT [20]. This study also agreed with [19] regarding the ACD that showed no statistically significant differences between Saudi genders with low myopia. However, [20] found that ACD showed statically significant difference between gender.

The present study showed that Pentacam has excellent repeatability and reproducibility in measuring CCT and ACD. Which is compatible with results from previous studies [15,16]. However, there was difficulty to find more studies about Pentacam repeatability and reproducibility in measuring CCT and ACD.

The study is limited by some conditions mainly due to COVID-19 situation. On the good side, it is the first study of CCT and ACD that have been done in Saudi Arabia and its beneficial since those measurement differs among ethnicities.

#### Conclusion

The study added more information about the normative values of CCT and ACD among young healthy Saudi individuals, and concluded that Pentacam is highly repeatable and reproducible in measuring CCT and ACD. There was no statistically significant difference between genders in those parameters. The anterior chamber parameters are important in refractive error surgeries, Keratoconus and Glaucoma management and in clinical implications. The study recommends further research with wider age group and large sample size.

*Citation:* Wafa Majed Alotaibi. "Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects". *EC Ophthalmology* 16.2 (2025): 01-08.

# **Bibliography**

- 1. Waring GO., et al. "The corneal endothelium. Normal and pathologic structure and function". Ophthalmology 89.6 (1982): 531-590.
- 2. Kopplin LJ., *et al.* "Relationship of Fuchs endothelial corneal dystrophy severity to central corneal thickness". *Archives of Ophthalmology* 130.4 (2012): 433-439.
- 3. Meghpara B., *et al.* "Keratectasia after laser *in situ* keratomileusis: a histopathologic and immunohistochemical study". *Archives of Ophthalmology* 126.12 (2008): 1655-1663.
- 4. Gordon MO., *et al.* "The ocular hypertension treatment study: baseline factors that predict the onset of primary open-angle glaucoma". *Archives of Ophthalmology* 120.6 (2002): 714-720 discussion 829-730.
- 5. Hoffmann EM., *et al.* "Distribution of central corneal thickness and its association with ocular parameters in a large central European cohort: The Gutenberg Health Study". *PLOS ONE* 8.8 (2013): e66158.
- 6. Feng MT., *et al.* "Anterior chamber depth in normal subjects by rotating scheimpflug imaging". *Saudi Journal of Ophthalmology* 25.3 (2011): 255-259.
- 7. Orucoglu F., *et al.* "Analysis of age, refractive error and gender related changes of the cornea and the anterior segment of the eye with Scheimpflug imaging". *Contact Lens and Anterior Eye* 38.5 (2015): 345-350.
- 8. Zengrui Zhang., *et al.* "Correlation between refractive errors and ocular biometric parameters in children and adolescents: a systematic review and meta-analysis". *BMC Ophthalmology* 23.1 (2023): 472.
- 9. Anterior chamber of eyeball (2025).
- 10. Tarongoy P., *et al.* "Angle-closure glaucoma: The role of the lens in the pathogenesis, prevention, and treatment". *Survey of Ophthalmology* 54.2 (2009): 211-225.
- 11. Zhou S., *et al.* "Refractive error and anterior chamber depth as risk factors in primary angle closure disease: the Chinese American eye study". *Journal of Glaucoma* 32.4 (2023): 257-264.
- 12. Huang W., *et al.* "The anterior and posterior biometric characteristics in primary angle-closure disease: Data based on anterior segment optical coherence tomography and swept-source optical coherence tomography". *Indian Journal of Ophthalmology* 69.4 (2021): 865-870.
- 13. Hashmani N., *et al.* "Effect of age, sex, and refractive errors on central corneal thickness measured by Oculus Pentacam(®)". *Clinical Ophthalmology* 11 (2017): 1233-1238.
- 14. Kim WK., *et al.* "Effect of gender, age, and ocular and growth-related factors on corneal epithelial and stromal thickness in children". *Journal of Clinical Medicine* 9.12 (2020): 3849.
- 15. Baghdasaryan E., *et al.* "Reproducibility of central corneal thickness measurements in normal eyes using the Zeiss Cirrus 5000 HD-OCT and Pentacam HR". *The Open Ophthalmology Journal* 12 (2018): 72-83.
- 16. Huang J., *et al.* "A comparison between Scheimpflug imaging and optical coherence tomography in measuring corneal thickness". *Ophthalmology* 120.10 (2013): 1951-1958.
- 17. "Issue Information-Declaration of Helsinki". Journal of Bone and Mineral Research 34.3 (2019): BMi-BMii.
- 18. Daly L and Bourke G. "Interpretation and Uses of Medical Statistics, Fifth Edition" (2000).

*Citation:* Wafa Majed Alotaibi. "Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects". *EC Ophthalmology* 16.2 (2025): 01-08.

## Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects

08

- 19. Al-Rajhi L., *et al.* "Measurement of anterior segment parameters in Saudi adults with myopia". *Saudi Journal of Ophthalmology* 32.3 (2018): 194-199.
- 20. Huang W., *et al.* "Anterior and posterior ocular biometry in healthy Chinese subjects: data based on AS-OCT and SS-OCT". *PLOS ONE* 10.3 (2015): e0121740.

Volume 16 Issue 2 February 2025 ©All rights reserved by Wafa Majed Alotaibi.

*Citation:* Wafa Majed Alotaibi. "Central Corneal Thickness and Anterior Chamber Depth Measurements among Young Healthy Saudi Subjects". *EC Ophthalmology* 16.2 (2025): 01-08.