Normative Values and Contralateral Comparison of Anterior Chamber Depth Measured by Orbscan II in an Iranian Population

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Abstract: *Purpose*: The objective of study was (i) to determine the normative values of anterior chamber depth (ACD) with Orbscan II Topography System and (ii) to compare right and left eyes data in the normal young population. *Methods*: A total of 1001 healthy participants aged 18-45 years participated in this observational cross-sectional study. The study population consisted of 616 female and 385 male subjects. The ACD was measured with the Orbscan II. In our study, ACD was defined as the distance between the corneal epithelium and the anterior lens surface. The differences between genders, between right and left eyes and age-related changes were evaluated. Statistical analyses were performed using student t test. *Results*: The average ACD in our study population was recorded as 3.653 ± 0.306 mm (median: 3.670 mm, mode: 3.70 mm, minimum: 2.35 mm and maximum: 6.60 mm, 95% Confidence interval: 3.640 to 3.666). The ACD was 3.64±0.30 mm in males and 3.67±0.32 mm in females which was statistically different between genders ($P < 0.01$). There was a much similarity in ACD values in both eyes. ACD was decreased with age ($r= -0.250$, $p<0.001$). *Conclusion*: Detailed description and analysis of ACD with Orbscan demonstrated that the obtained average value of ACD was higher in female than male and decreased slightly with increasing age. There was no difference between the eyes.

Keywords: Anterior Chamber Depth, Normative Values, Orbscan II.

INTRODUCTION

The anterior chamber depth (ACD) is the distance between the cornea and the anterior surface of crystalline lens. ACD plays important applications in several aspects of modern anterior segment surgery such as intraocular lens (IOL) calculation in cataract surgery (third generation formulas) [1, 2], anterior chamber and iris claw IOL implantation [1], either phakic or aphakic and angle closure glaucoma [1,3-4]. There are several techniques for measurement of ACD. One of the practical and mostly reliable methods for ACD measurement is Orbscan II [5]. The other methods applied are optical coherence tomography (OCT) like Visante OCT, optical methods as IOL Master, and scheimpflug imaging techniques as Pentacam or Galilei [6,7]. On the other hand, methods applied in the clinic using the slit lamp like grading of limbal chamber depth using van Herick's technique is also used as a surrogate for measuring central ACD [5].

In our region, Orbscan and clinical grading techniques are most commonly used techniques. The aim of the current study was to determine the normal ACD values in a normal Iranian population using Orbscan II. In addition, the differences between genders, between right and left eyes and age-related changes were investigated.

MATERIAL AND METHODS

Patients

1001 healthy volunteers (age range: 18 to 45 years; 616 females, 385 males) were enrolled in this observational cross-sectional study. A detailed ocular history was taken from each subject and the following exclusion criteria were adopted: a history of any deviation or strabismus, previous ocular or/and refractive surgeries, contact lens wear, corneal anomalies, hyperopiac spherical refraction more than +3, and myopic spherical refraction less than -5.00 diopters (D) or cylindrical refraction more than 2.00 D, any ophthalmic or systemic drug consumption.

The study was registered with the Ethics Committee of Mashhad University of Medical Sciences and clearance was obtained. Cases were informed and consent was signed by them.

Examinations

To ensure that all volunteers met the inclusion/exclusion criteria, complete ophthalmologic

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and orthoptic examination were performed prior to the experiment. ACD was measured in all participants with the Orbscan II (Bausch & Lomb, Technolas, NY, USA). The Orbscan is a non-contact scanning-slit topography system that employs a slit beam to produce multiple slit images of the anterior segment. It uses digital image processing for ACD measurements. A digital grey-scale anterior segment image is reconstructed from 140 slit images. The computer automatically detects the corneal surface and the anterior lens surface by comparing the grey-scale steps and calculates the depth of the anterior chamber. This technique automatically rejects the low quality images and the maximum resolution of the Orbscan is 2 mm within the central corneal surface. As we aimed to have clinically applicable values, such as measurements using in phakic IOL calculations, ACD was measured ~~form~~ from the epithelium in all the patients.

In the current study, all ACD measurements were performed by the same examiner and three valid repeated measurements were made for each eye and then averaged. For accurate measurement, all participants were asked to keep their head position stable (straight ahead) and the examiner tried to make adjustment and have a focused sharp image of each eye, using the joystick of the instrument.

Ethical Consideration

Informed consent was obtained from each participant after the nature of the experimental procedures had been explained. The research followed the tenets of the Declaration of Helsinki and was approved by the Mashhad University of Medical Sciences Research Ethics Committee.

Data Analysis

Statistical analyses were performed using SPSS Windows version 16 (SPSS, Inc., Chicago, IL). The variables are expressed as mean ± SD and the student t test was used to compare differences. The Pearson correlation coefficient was calculated and linear regression analysis was applied to the data to investigate the relationship between age and the ACD. The level of significance was set at P value of 0.05 or less.

RESULTS

The present study comprised 1001 individuals (2002 eyes, age range: 18-45 years). Of all participants recruited, 616 (61.54%) cases were females and 385 (38.46%) were males. The mean ± SD age was 29.07 ± 5.86 years (male: 28.86 ± 5.53 and female: 29.01 ± 3.77 years).

The average ACD in the study population was as 3.653 ± 0.306 mm. In addition, median, mode, minimum, maximum, and 95% Confidence interval of ACD from all participants were 3.670 mm, 3.70 mm, 2.35 mm and 6.60 mm, and 3.640 to 3.666 respectively (Figure **1**).

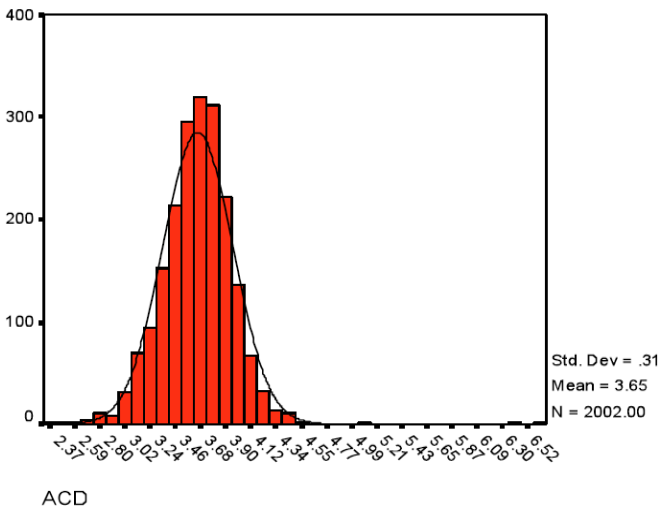

Figure 1: The distribution of ACD measurements in the studied population.

The mean ± SD of ACD was 3.64±0.30 mm in males and 3.67±0.32 mm in females. Difference in gender was statistically significant different in the student t test (P = 0.01).

Considering age in our study, we classified all participants into 5 age groups (Table **1** and Figure **2**). Pearson's correlations showed significant correlation between the corneal diameter and age (r= -0.250, p<0.001). Anterior chamber depth measured with the Orbscan II decreased with increasing age (Figure **2**).

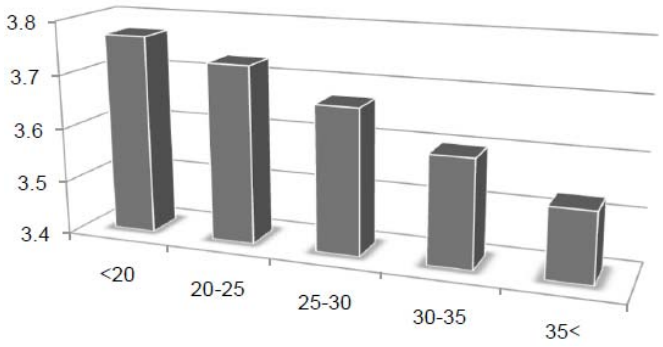

Figure 2: The distribution of ACD with ageWe measured the variables in right and left eyes separately in this

Table 1: The Comparison of Mean ACD between Right and Left Eye in Different Age Groups and Total Values

	OD		OS	
	Mean± SD	**range**	**Mean ±SD**	**range**
Males (age, y)				
Under 20	3.80±0.13	2.52-4.00	3.79±0.12	2.53-4.00
20-25	3.72±0.27	2.93-4.44	3.72±0.26	3.01-4.43
25-30	3.60±0.33	2.81-6.60	3.66±0.26	2.81-4.40
30-35	3.60±0.27	2.90-4.29	3.60±0.27	2.98-4.28
Over 35	3.48±0.31	2.76-4.04	3.50±0.37	2.53-5.12
Females (age, y)				
Under 20	3.67±0.43	2.47-4.29	3.83±0.79	2.35-6.46
20-25	3.75±0.24	3.16-4.51	3.74±0.26	2.58-4.41
25-30	3.69±0.24	2.36-4.41	3.64±0.27	2.84-4.49
30-35	3.61±0.28	3.00-4.40	3.61±0.29	3.03-4.37
Over 35	3.56±0.34	2.66-4.31	3.56±0.34	2.74-4.49
Total (Males and females) (age, y)				
Under 20	3.72±0.35	2.47-4.29	3.81±0.62	2.35-6.46
20-25	3.73±0.26	2.93-4.51	3.73±0.26	2.58-4.43
25-30	3.67±0.31	2.36-6.60	3.67±0.27	2.81-4.49
30-35	3.60±0.27	2.90-4.40	3.60±0.28	2.98-4.37
Over 35	3.51±0.33	2.60-4.31	3.52±0.36	2.53-5.12
Males	3.64±0.30	2.74-6.60	3.64±0.29	2.53-5.12
Females	3.67±0.30	2.36-4.51	3.67±0.33	2.35-4.46
All	3.65 ±0.30	2.36-6.60	3.66±0.31	2.35-6.4

study (Table **1** and Figure **3**). The mean ACD in right eye was 3.65 ±0.30 compared with 3.66±0.31 in the left eye. There was a much similarity in ACD values in both eyes (p value = 0.72).

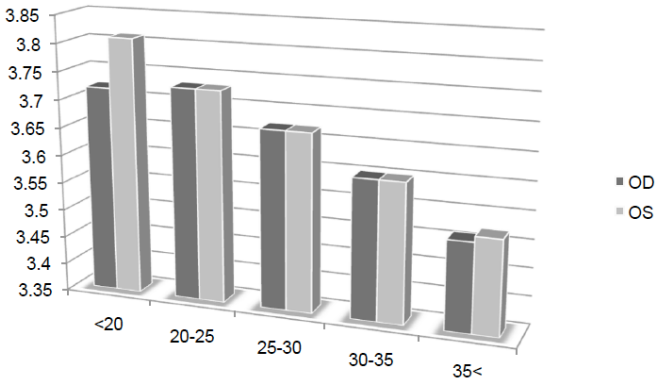

Figure 3: The comparison of mean ACD between right and left eye in different age groups.

DISCUSSION

The ACD values are using in IOL power calculations [3] and the more precise the ACD, the more precise prediction of postoperative IOL position [1]. In phakic eye; IOL calculation needs accurate ACD measurement. Moreover, ACD is a very important factor in precise IOL calculation in phakic IOL implantations, more accurately, weather it is contraindicated or not. In the other hand, with measurement of ACD, patient at risk to angle closure glaucoma can be identified and the risk of angle closure attack after pupillary dilation can be predicted [4].

There are several methods for ACD measurement, including ultrasonic devices and optically based instruments. In order to several complications of the conventional method of ultrasonic wave, like patient discomfort, risk of infection and off-axis measurements, the new instruments using optical devices are seems to have an important role in ACD measurement [6].

In this study, we measured the ACD in normal young population (range 18 to 45 years old) to evaluate the distribution and normal values of this variable frequently using by clinicians. All of individuals were between +3 and -5 diopter spherical and less than 2 diopters cylindrical refractive error. There was no history of previous intraocular or corneal surgery

contact lens wear, corneal anomalies, ocular trauma, systemic or topical drug usage and ocular or systemic disease. For this purpose we measured ACD using Orbscan II (Bausch & Lomb, Technolas, NY) in only one acquisition in front of each eye. There was only one person as an operator because of the least systematically bias.

1001 individuals (2002 eyes) were examined. The mean age was 29.07 ± 5.86 years (range: 18 to 35 years). The mean ACD was 3.65±0.30 and it was 3.64±0.30 millimeter in males and 3.67±0.32 mm in females (p- value = 0.04). There is a statistically significant difference and it is greater in females.

In the study of Eperjesi *et al.* in 2010 mean ACD was 2.89±0.43 which is shallower than our results [6]. Yazici and colleagues found the Orbscan II as a device that calculate the ACD smaller that other devices [5]. The mean ACD by Orbscan measured as 3.49±0.30 by Utine *et al.* [8] and 3.54±0.07 by Salouti and colleagues [9]. In Tehran Eye Study by Hashemi and colleagues the mean ACD was 2.79±0.02 and it was about 0.1 millimeter deeper in men which in contrast to our results [10]. The mean AC depth in Indian people was 3.15±0.36 in the study of Pan and colleagues [11]. In another study done by Olurin in Nigeria then mean was reported as 3.23 mm [12]. Some of the differences were related to the measurement of ACD from the epithelium or endothelium. However, even by considering the corneal thickness in these measurements, the results of our study are still different.

As we know, age, gender and race are three important factors influencing ACD values. The ACD was thought to be deeper in men conventionally which is in contrast to our results. It should be considered that all of our cases were restricted to low myopic and hyperopic did not indicate the distribution in normal population. As mentioned before, and noted previously in all of studies, the ACD values decreasing by advancing age and it seems to be interesting that decreasing is obvious even in such limited range of distribution; (the range was between 18 to 34 years old) and the 5 year grouping does not influence it. In fact, there is 0.013 mm decrease per year by linear regression analysis; surprisingly in Tehran eye study the linear regression was also exactly 0.013 mm per year and this can indicate that the race as a critical factor in decreasing ACD by advancing age.

The measurements were done in right and left eyes separately and the mean ACD in right and left eyes were 3.65 ±0.30 and 3.66±0.31 respectively (p value = 0.72). There was a much similarity in ACD values in both eyes. Up to now, as far as we are aware, no previous report supported this result and all the previous reports have evaluated the patients unilaterally.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

[1] Olsen T, Corydon L, Gimbel H. Intraocular lens power calculation with an improved anterior chamber depth prediction algorithm. J Cataract Refract Surg 1995; 21: 313–319. http://dx.doi.org/10.1016/S0886-3350(13)80140-X

[2] Hoffer KJ. Clinical results using the Holladay 2 intraocular lens power formula. J Cataract Refract Surg 2000; 26:1233-7. http://dx.doi.org/10.1016/S0886-3350(00)00376-X

[3] Koranyi G, Lydahl E, Norrby S, Taube M. Anterior chamber depth measurement: A-scan versus optical methods. J Cataract Refract Surg 2002; 28: 243–247. http://dx.doi.org/10.1016/S0886-3350(01)01039-2

[4] Congdon NG, Youlin Q, Quigley H, Hung PT, Wang TH, Ho TC, *et al.* Biometry and primary angle-closure glaucoma among Chinese, white, and black populations. Ophthalmology 1997; 104: 1489-1495. http://dx.doi.org/10.1016/S0161-6420(97)30112-2

[5] Yazici AT, Bozkurt E, Alagoz C, Alagoz N, Pekel G, Kaya V, *et al.* Central Corneal Thickness, Anterior Chamber Depth, and Pupil Diameter Measurements Using Visante OCT, Orbscan, and Pentacam. J Refract Surg 2010; 26 (2): 127-133. http://dx.doi.org/10.3928/1081597X-20100121-08

[6] Eperjesi F, Holden C. Comparison of techniques for measuring anterior chamber depth: Orbscan imaging, Smith's technique, and van Herick's method. Arch Clin Exp Ophthalmol 2010; 249: 449-454. http://dx.doi.org/10.1007/s00417-010-1500-0

[7] Reinstein DZ, Gobbe M, Archer TJ. Anterior segment biometry: a study and review of resolution and repeatability data. J Refract Surg 2012; 28(7): 509-20. http://dx.doi.org/10.3928/1081597X-20120620-02

[8] Utine CA, Altin F, Cakir H, Perente I. Comparison of anterior chamber depth measurements taken with the Pentacam, Orbscan IIz and IOL Master in myopic andemmetropic eyes. Acta Ophthalmol 2009; 87: 386–391. http://dx.doi.org/10.1111/j.1755-3768.2008.01278.x

[9] Salouti S, Nowroozzadeh MH, Zamani M, Ghoreyshi M, Salouti R. Comparison of anterior chamber depth measurements using Galilei, HR Pentacam, and Orbscan II. Optometry 2010; 81: 35-39. http://dx.doi.org/10.1016/j.optm.2009.04.100

[10] Hashemi H, KhabazKhoob M, Mehravaran S, Yazdani K, Mohammad K, Fotouhi A. The distribution of anterior chamber depth in a Tehran population: the Tehran eye study. Ophthalmic Physiol Opt 2009; 29 (4): 436-42. http://dx.doi.org/10.1111/j.1475-1313.2009.00647.x

[11] Pan CW, Wong TY, Chang L, Lin XY, Lavanya R, Zheng YF, *et al.* Ocular biometry in an urban Indian population: the Singapore Indian Eye Study (SINDI). Invest Ophthalmol Vis Sci 2011; 52(9): 6636-42. http://dx.doi.org/10.1167/iovs.10-7148

[12] Olurin O. Anterior chamber depths of Nigerians. Ann Ophthalmol 1977; 9(3): 315-26.

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