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Is Partial Coherence Interferometry More Accurate than A Scan Ultrasonography in The Estimation of Anterior Chamber Depth?

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ABSTRACT

Purpose: To assess the degree of agreement of anterior chamber depth (ACD) measurements by optical device (NIDEK AL-scan biometer) and contact ultrasound A-scan (Mentor [R] - Advent [TM] A/B system US biometry).
Setting: Department of Ophthalmology at ALAZHAR University, Cairo, Egypt.
Methods: This prospective observational cross sectional comparative study of 50 normal healthy eyes were included in this study, ACD estimation was done by 2 methods partial coherence interferometry(PCI), and contact ultrasound A-scan. The measurements was performed by the same observer. The difference in measurements between the two methods was assessed using the t-test.
Results: The mean ACD (±SD) by the two methods were (2.8 mm) and (3.5 mm), respectively. There was a statistically significant difference between measurements recorded by the 2 methods ($P<0.01$).
Conclusion: there was a statistically different between the two methods the PCI values were significantly higher (by 0.7 mm) than the U/S values with no correlation between the two sets of values. So PCI is more accurate but we still need U/S measurements in some situations (e.g., tear film abnormalities, corneal pathologies).
Keywords: AC depth, ultrasound, partial coherence interferometry, phakic IOL.

INTRODUCTION

Accurate measurements of ocular dimensions have gained considerable importance with the development and increasing popularity of cataract and keratorefractive surgeries [1]. The anterior chamber depth (ACD) measurement provides valuable information in different fields in ophthalmology. It is important for the new theoretical biometric formulas used to calculate the power of intraocular lenses (IOLs) [2]. Phakic IOL implantation requires precise ACD measurement for both surgical planning and IOL power calculation [3]. The ACD is also implicated as a screening risk factor for closed -angle glaucoma [4].

Different methods for measuring the ACD are available, based on ultrasonic, optical and photographic techniques. The most common method for ACD measuring has been ultrasound (U/S) biometry. This method requires corneal contact, which may lead to false results due to the indentation of the cornea, and the exact axial placement of the probe relative to the center of the cornea. Like all contact methods, it may be uncomfortable for the patient or even lead to damage of the corneal epithelium. Thus, non-contact methods are preferred for the ACD measurement [5, 6].

The uses of the optical low coherence reflectometry (OLCR) and 820nm super luminescent diode technology has emerged to provide a variety of data including CCT and ACD readings [7].

In this study, I evaluated the agreement between the ultrasound biometry (mentor advent A/B System) (U/S) and the non-invasive partial coherence interferometry (PCI) (NIDEK AL-scan) biometer in normal healthy eyes in determining the AC depth.
Our results provide strong backing to use the new imaging modalities partial coherence interferometry for anterior chamber depth estimation.

MATERIALS AND METHODS

A prospective observational cross sectional comparative study. The study was carried out at Alzahraa University hospital between February - July 2017. A total of 50 eyes of 25 healthy young nurses school students were enrolled in the study.

The study protocol was in accordance with the tenets of Declaration of Helsinki and was approved by the Local Ethics Committee of ALAZHAR University. Informed consent was obtained from each participant.

Comprehensive anterior segment examinations of all eyes were performed using slit lamp bio- microscopy. The exclusion criteria were: history of any intraocular or corneal surgery, contact lens wear, glaucoma of any type, systemic diseases such diabetes mellitus, intraocular pressure (IOP) of 20 mmHg or more, corneal anomalies, spherical refraction of 2.00 diopters (D) or more; or cylindrical refraction of 2.00 D or more.

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The same experienced examiner performed all measurements with the two devices. The examiner was masked to the results obtained with each device.

Instruments and measurements

ACD was measured by NIDEK (Fremont, CA, USA) PCI biometer and U/S (Mentor [R] - Advent [TM] A/B system U/S biometry) biometer respectively. The PCI Optical Biometer uses the partial coherence interferometry principle to measure the axial length and anterior segment measurements ACD and CCT. The anterior chamber depth is determined by calculating the distance along the visual axis from the corneal epithelium to the anterior crystalline lens.

For U/S measurement we used a contact applanation method with probe positioned in the center of the cornea, for the sound beam to be directed perpendicular on the lens. Five repeated measurements were taken consecutively and average reading is taken.

Statistical analysis

Statistical analyses were performed using the statistical package for the social sciences, version 15.0 (SPSS Inc. Chicago, Illinois, USA).The following were calculated: the mean, standard deviation (SD), standard error of the mean (SEM), t-test was used to explore statistical differences between mean ACD measurements obtained with both instruments.

RESULTS

The study included 50 normal eyes. Their mean age was 18 ±1ys. The mean spherical equivalent refractive error ± standard deviation (SD) was -0.50 ± 1.00 D. The mean IOP (± SD) was 10.00 ± 2 mmHg. The mean ACD (± SD) measurements using PCI, and contact ultrasound A-scan were (3.5 mm) and (2.8 mm), respectively and Difference between two measurements were 0.7359.

Confidence interval:

The mean of Group One minus Group Two equals -0.7359 (21%).

95% confidence interval of this difference: From -0.9171 to -0.5547 the two-tailed, P value is less than 0.001 by conventional criteria; this difference is considered to be extremely statistically significant.

Table (1): Average values of anterior chamber depth measurements obtained with the U/S and PCI.

Measurement	u/s	PCI	Difference between the two	P value
Mean	2.7673	3.5032	-0.7359 (21%)	< 0.0001
SD	0.3055	0.2898	-0.0157	
SEM	0.0651	0.0618		
N	50	50		

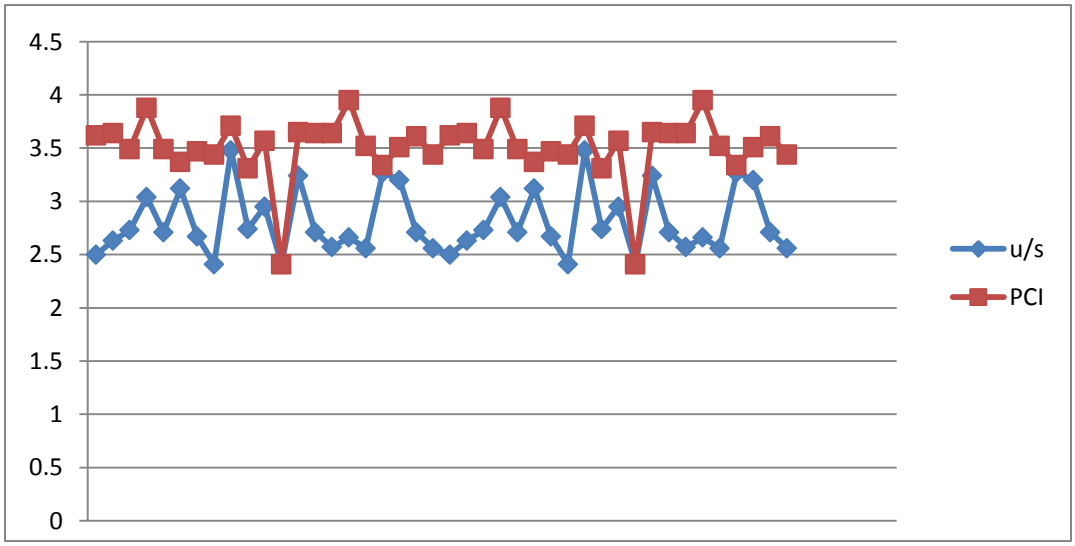

Figure 1: average values of anterior chamber depth measurements obtained with the U/S and PCI

DISCUSSION

The accuracy of a measuring instrument is an essential factor when selecting a device for clinical purposes. In the present study, the measurements of ACD were evaluated by two modalities; the U/S by contact applanation methods and AL-Scan Optical Biometry. We found that there is a statistical different between the two measurement. The AL-Scan values were significantly higher (by 0.7 mm) than the U/S values with no correlation between the two sets of values. The U/S values are almost always less than PCI this can be explained by many factors, corneal indentation by examiner, decentration and misalignment with the visual axis, the pupil diameter and accommodative state of the lens, accommodation would be expected to lead to reduction in anterior chamber depth. These cause pronounced differences in ACD measurement. All this factors were absent in AL-Scan so it is not examiner dependent and its result is reproducible.

In accordance with our result, many authors conclude the same results, **Németh *et al.*** [8] reported that the ACD values with the IOL Master in 252 eyes were significantly higher (by 0.28 mm) than the US values with no correlation between the two sets of values. Reddy et al. [9] found that contact U/S measured ACD is 13% shorter, while the Orbscan and IOLMaster showed good correlation. And also **Wissa *et al.*** [10] found that there was a mean difference in the measured ACD obtained with AL scan and contact A-scan US of 0.01 mm (range −0.53–0.56 mm).

CONCLUSION

Although the sample size is limited but there was a statistically difference between the two groups the PCI values were significantly higher (by 0.7 mm) than the U/S values with no correlation between the two sets of values. Although PCI is more accurate but we still need U/S measurements in some situations (e.g., tear film abnormalities, corneal pathology).

REFERENCE

1-Olsen T, Olesen H, Thim K, Corydon L (1992): Prediction of pseudophakic anterior chamber depth with the newer IOL calculation formulas. J Cataract Refract Surg., 18: 280–285.

2- Holladay JT (1997): Standardizing constants for ultrasonic biometry, keratometry, and intraocular lens power calculations. J Cataract Refract Surg ., 23: 1356–1370.

3- Fechner PU, Haubitz I, Wichmann W *et al.* (1999): Worst-Fechner biconcave minus power phakic iris-claw lens. J Refract Surg., 15(2):93-105.

4- Devereux JG, Foster PJ, Baasanhu J *et al.* (2000): Anterior chamber depth measurement as a screening tool for primary angle-closure glaucoma in an East Asian population. Arch Ophthalmol., 118: 257–263.

5- Rainer G, Petternel V, Findl O (2002): Comparison of ultrasound pachymetry and partial coherence interferometry in the measurement of central corneal thickness. J Cataract Refract Surg.,28:2142–2145.

6-Rainer G, Findl O, Petternel V (2004): Central corneal thickness measurements with partial coherence interferometry, ultrasound, and the Orbscan system. Ophthalmology, 111:875–879.

7-Buehl W, Stojanac D, Sacu S, Drexler W, Findl O.(2006): Comparison of three methods of measuring corneal thickness and anterior chamber depth. Am J Ophthalmol., 141(1):7–12

8-Németh J, Fekete O, Psztenlehrer N. (2003): Optical and ultrasound measurement of axial length and anterior chamber depth for intraocular lens power calculation. J Cataract Refract Surg., 29:85–88.

9- Reddy AR, Pande MV, Finn P, El-Gogary H. (2004): Comparative estimation of anterior chamber depth by US, Orbscan II, and IOLMaster. J Cataract Refract Surg., 30:1268–1271.

10- Wissa, Wahba S S,Roshdy M M. (2012): Agreement and relationship between ultrasonic and partial coherence interferometry measurements of axial length and anterior chamber depth. Clin Ophthalmol., 6: 193–198.