Comparison of anterior chamber depth measurements using Orbscan II and IOLMaster

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PURPOSE. *To To evaluate and compare anterior chamber depth (ACD) measurements using Orbscan II (Bausch & Lomb, Rochester, NY) and IOLMaster (Carl Zeiss Meditec AG, Jena, Germany).*
METHODS. *In this prospective clinical study, the authors measured ACD of 145 phakic eyes of 30 healthy volunteers and 115 patients using Orbscan II and IOLMaster. Average patient age was 52.9±19.4 (range 16 to 87) years. ACD was evaluated from corneal epithelium to anterior lens surface. Additionally, axial length (AL) was measured using the Zeiss IOLMaster to calculate the regression coefficient between AL and ACD.*
RESULTS. *Mean ACD was 3.35±0.43 mm (range 2.01 mm to 4.37 mm) using Orbscan II and 3.36±0.41 mm (range 2.09 mm to 4.24 mm) using IOLMaster. Mean total axial length was 24.04 mm ± 2.1 mm (range 20.7 mm to 31.41 mm). The linear regression coefficient of ACD between both methods was R=0.95. ACD and AL correlated only slightly (R=0.57). The Spearman coefficients of rank correlation were 0.94 and 0.61, respectively. A p value less than 0.01 (paired Wilcoxon test) was considered statistically significant. However, a significant difference was not calculated comparing ACD measurements using both systems and the Bland-Altman-Plot showed 95% of the differences ranging between 0.25 and –0.27 mm.*
CONCLUSIONS. *Regarding clinical application, both systems seem to be equally good and interchangeable in clinical practice in terms of ACD evaluation. (Eur J Ophthalmol 2007; 17: 327-31)*

KEY WORDS. *Anterior chamber, IOLMaster, Orbscan II*

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INTRODUCTION

Evaluation of anterior chamber depth (ACD) can provide important information when planning cataract, glaucoma, or refractive surgery in terms of phakic intraocular lenses (IOL).

Several methods are available for measuring ACD, including photographic (based on Scheimpflug's principle), ultrasonic (based upon reflected sound waves), and optical procedures (based upon Jaeger's principle) (1).

The Orbscan II Topography System (Bausch & Lomb, Rochester, NY, USA) combines a three-dimensional scanning slit beam system with an added placido attachment for evaluating corneal surfaces with elevation (anterior and posterior) and curvature, pachymetry, as well as depth of the anterior chamber (2). Therefore, it provides a large spectrum of clinical applications regarding refractive (3-5) and cataract surgery (6-8), detection of corneal diseases (9, 10), or glaucoma (11, 12).

IOLMaster (Carl Zeiss Meditec AG, Jena, Germany) biometry includes axial length (AL), keratometry, and ACD measurements, which can be performed consecutively in one examination. Afterwards, calculation of IOL dioptric power can be performed by determining the postoperative target refraction and by choosing a formula incorporated in the software.

Compared to the ultrasound technique, Orbscan II as well as IOLMaster measurements offer some advantages for

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patients as well as for examiners: more comfort and no need for topical anesthesia due to a noncontact procedure, quick performance, and requirement of only minimal training (13). Nevertheless, there are some disadvantages, including impossible measurements due to insufficient fixation in children and elderly patients or in nystagmus, corneal scars, or dystrophies. Using the IOLMaster, a dense cataract, retinal detachment, or vitreous bleeding can cause additional problems in terms of axial length measurements (14). Those patients are better evaluated using ultrasound (15).

The purpose of this clinical trial was to evaluate and compare ACD measurements using the Orbscan II Topography System and the IOLMaster.

METHODS

This prospective clinical trial was performed at the Department of Ophthalmology, University of Heidelberg, Germany. Thirty healthy volunteers and 115 phakic patients with a mean age of 52.9±19.4 years (range 16 to 87 years) were enrolled. Mean spherical equivalent was –1.1±5.44 diopters and mean best-corrected visual acuity was 0.74±0.29. In order to exclude patients with other ocular pathologies of the anterior eye segment than cataract, a slit-lamp examination was performed prior to ACD evaluation. Thirty-five patients presented with cataract for preoperative workup and 80 patients showed posterior segment pathologies (e.g., macular pucker, age-related macular degeneration, or diabetic retinopathy). Only one eye of each patient was included in the study and ACD measurements using Orbscan II and IOLMaster were performed consecutively. Additionally, axial length was measured using the Zeiss IOLMaster to calculate the regression coefficient between AL and ACD.

The Orbscan II System evaluates different parameters of the anterior eye segment by 40 scanning slits, 20 from the right and 20 from the left side. Reflected surface data points are measured in the x, y, and z axes, creating color-coded true surface topography maps. Each slit image consists of 240 single data points. Regarding ACD evaluation, four different maps can be displayed: epithelium, endothelium, apex plane, and normal depth. We used the epithelium map to compare ACD values of the two devices.

Using IOLMaster, partial coherence interferometry (PCI) is used to determine axial length, whereas ACD is evaluated by calculating the distance between the corneal epithelium and lens using lateral slit illumination. Once the examination process is started, five consecutive ACD measurements are performed and displayed together with the corresponding mean value.

The Bland-Altman-Plot was used to detect major deviations between ACD values evaluated with both systems. It illustrates the ACD mean value (x-axis) against the ACD difference of the two measurements (y-axis) for each patient. Therefore, not only the distribution of differences, but also the dependence between the order of deviations and the absolute order of the measurement values can be assessed in a more detailed fashion (16).

Statistical analysis

Statistical evaluation was performed by calculating mean values and standard deviations and by analyzing the data using paired Wilcoxon test. Due to the high accuracy of the two optical systems, a p value <0.01 was considered statistically significant.

RESULTS

Comparison of ACD IOLMaster vs Orbscan II

Mean ACD was 3.35±0.43 mm (range 2.01 mm to 4.37 mm) using Orbscan II and 3.36±0.41mm (range 2.09 mm to 4.24 mm) using the IOLMaster (Fig. 1). The Bland-Altman-Plot illustrates that 95% of the ACD difference values ranged between 0.25 and –0.27 mm (Fig. 2). A statistically significant difference between the two systems was not found (paired Wilcoxon Test, p value=0.03) and a good correlation between both systems was noted (R=0.95). The Spearman coefficient of rank correlation (rho) was 0.94, indicating a significant correlation (p<0.0001) with a 95 % confidence interval between 0.91 and 0.95.

Correlation of ACD and AL

Mean axial length was 24.04 mm ± 2.1 mm (range 20.7 mm to 31.41mm). There was only a slight correlation between ACD and axial length measurements (R=0.57) (Fig. 3). The Spearman coefficient of rank correlation was 0.61, indicating a significant correlation (p<0.0001) with a 95% confidence interval between 0.5 and 0.71.

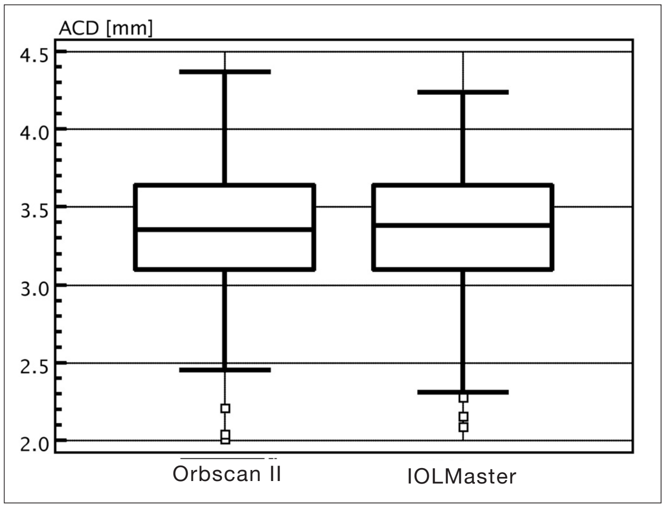

Fig. 1 - *Box-and-whisker plot: Anterior chamber depth measurement, Orbscan II vs IOLMaster.*

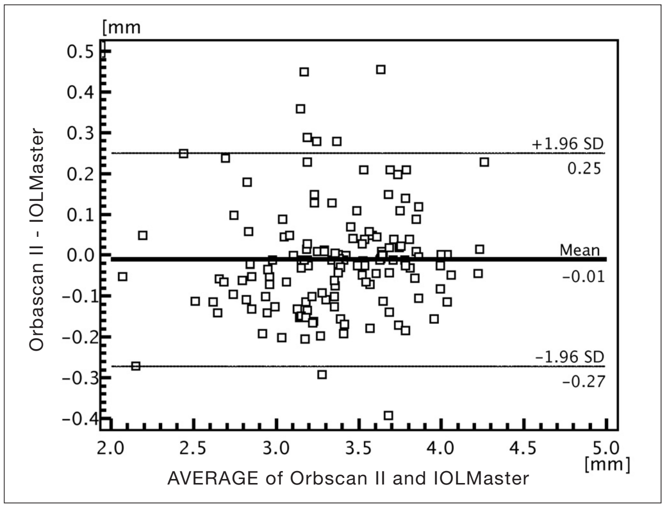

Fig. 2 - *Bland-Altman plot: Anterior chamber depth mean values vs anterior chamber depth differences of both systems.*

DISCUSSION

Measurements of ACD are very important, especially when screening for glaucoma risk factors (17, 18) or performing refractive and cataract surgery (19, 20).

Regarding the implantation of anterior chamber lenses in phakic eyes as a refractive treatment, an accurate ACD calculation has to be performed in order to prevent potential endothelial cell damage (21). In high hyperopic eyes, the anterior chamber is often shallower than the emmetropic one, even if racial differences were described. In high myopic eyes, there is not a direct relation between ACD and refraction, which is more related to axial length. However, in both high myopia and high hyperopia, phakic anterior chamber lens implantation is hazardous when the ACD is shallower than 3 mm (22).

By measuring ACD, eyes with a relative anterior microphthalmos (RAM) can be detected prior to cataract surgery. They are characterized by a disproportional small anterior segment but no further malformation with a corneal diameter smaller than 11 mm, a total axial length of more than 20 mm, a shallow anterior chamber depth (approximately 2 mm), and a central lens thickness of approximately 5 mm. Two-thirds of all cases are associated with glaucoma (23).

Jünemann and coauthors found significantly smaller anterior segments in eyes with pseudoexfoliation syndrome and nanophthalmus (24). Therefore, preoperative ACD may indicate zonular instability in eyes with pseudoexfoliation syndrome and should alert the cataract surgeon to the possibility of intraocular complications related to zonular dialysis (25).

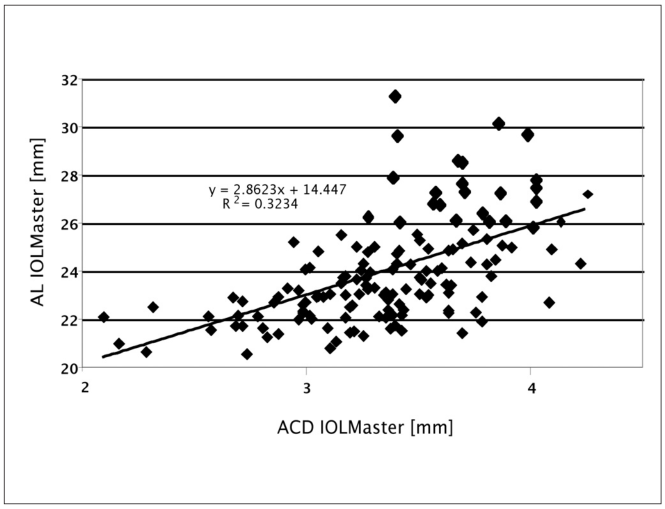

Fig. 3 - *Correlation: Anterior chamber depth and axial length using the IOLMaster.*

IOL power calculation prior to cataract surgery depends very much on keratometry readings, axial length, and an accurate ACD measurement (26).

Eleftheriadis (27) evaluated the refractive outcome after cataract surgery comparing IOLMaster and ultrasound biometry and found improved postoperative results using optical biometry. Moreover, the IOLMaster showed good repeatability using different examiners regardless of their medical training (28).

Standard deviation of repeated ACD measurements using Orbscan II showed values ranging between 13 and 15 µm, indicating a good reliability (29).

Several studies evaluated different optical devices in terms of ACD evaluation. A high degree of agreement between the optical devices was found (29-32). When comparing ultrasound measurements, different results were described. Auffarth et al (2) found a high correlation between Orbscan and immersion ultrasound when performing ACD measurements. Vetrugno et al (22) compared Orbscan and applanation ultrasound and concluded that the optical system underestimated ACD slightly but accurate values are provided in high myopic and hyperopic eyes. Reddy and coauthors (31) evaluated ACD of 81 eyes using Orbscan, IOLMaster, and contact A-scan. Similar to our results, they found comparable mean values of 3.32 and 3.33 mm, respectively, using the two optical devices (correlation coefficient: 0.91) but lower ACD values using ultrasound (2.87 mm). The applanation of the cornea during the measuring process was discussed in order to explain their findings. Kriechbaum et al (32) investigated the ACD using IOLMaster, partial coherence interferometry, and applanation ultrasound. In phakic eyes, they found no statistically significant difference between the optical methods but lower ACD values using the contact A-scan.

In conclusion, ACD measurements using Orbscan II and IOLMaster are user- and patient-friendly as well as less observer dependent when compared to applanation ultrasound. Nevertheless, optical biometry cannot entirely replace ultrasound measurements since the optical evaluation can be difficult in some eyes, as discussed earlier.

No statistically significant difference was calculated in this study between the two optical devices and a high correlation was found (R=0.95). Both devices are interchangeable in clinical practice.

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