·Basic Research·

Comparison of IOL master and ultrasound biomicroscopy in anterior chamber depth measurement

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Abstract

• AIM: To compare the measurement of anterior chamber depth (ACD) inclusive of corneal thickness using intraocular lens (IOL) master and ultrasound biomicroscopy (UBM) and evaluate the repeatability of each method.

• METHODS: Two consecutive measurements of ACD were prospectively performed using IOL master and UBM in 60 eyes in 60 individuals. Mean values were compared using the paired *t* test. For each individual, ACD measurements was performed 5 times to estimate the repeatability of each method by a coefficient of variation (CV).

• RESULTS: The mean ACD was 2.95? .25mm with the IOL master and 2.96± 0.22mm with the UBM. This difference was not statistically significant (P=0.631). The coefficient of variation (CV) was 0.56%± 0.26% and 0.65%± 0.36% in IOL master and UBM, respectively.

• CONCLUSION: The mean ACD of IOL master is the same as UBM. The repeatability of IOL master is better than UBM.

• KEYWORDS: anterior chamber depth; intraocular lens master; ultrasound biomicroscopy

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INTRODUCTION

The anterior chamber depth (ACD) is defined as the distance, measured along the eye's optical axis, from the posterior vertex of the cornea to the anterior surface of the crystalline lens exposed by the pupil [1]. ACD measurement provides valuable information in different fields of ophthalmology. In cataract surgery and phakic intraocular lens (IOL) implantation, precise ACD measurements are required to determine IOL power and position and to prevent endothelial cell damage. Studies have demonstrated that errors in prediction of effective lens position (ELP) may account for 20% to 40% of the total refractive prediction error [1]. Newer theoretical formulas such as that by Haigis use preoperative ACD to predict ELP. ACD assessment can also provide an assessment of glaucoma, with the anterior chamber being shallower in patients at risk. In performing refractive surgery such as excimer laser photorefractive keratectomy, ACD is important to set a correct optical zone ablation diameter. So the accurate of the ACD measurement is becoming more and more important in the clinic.

Now, the most commonly used routine method is the ultrasonic method, and this kinds of measurement of ACD represent the "gold standard" for this biometric dimension. Another routine method is optical methods. IOL master (Carl Zeiss, Jena, Germany) is another new way that makes axial length, keratometric, and ACD measurements for use in IOL dioptric power calculation and claims ±0.01mm resolution for ACD measurements [2]. In this system, partial coherence interferometry is used to assess the axial length, and ACD is determined by calculating the distance between the corneal and lens surfaces through lateral slit illumination. This study was designed to compare ACD measurements in healthy eyes assessed by the two devices of IOL master, and ultrasound biomicroscopy (UBM) equipped with a 10-MHz A-probe. Moreover, another purpose was to compare the repeatability of each measurement.

MATERIALS AND METHODS

Subjects Sixty eyes of 60 consecutive volunteers had ACD measurements by different methods in the following

order-IOL master, UBM .This order can prevent the irregularities of the cornea caused by applanation UBM. The exclusion criteria was silicone-oil-filled eyes and eyes with severe ocular disease.

Methods The IOL master uses a photographic technique for ACD measurement .A flickering lateral slit beam produces a cross-sectional image of the anterior eye segment. To calculate the ACD, defined as the distance between the anterior corneal surface and the anterior lens surface, the corneal radius must be known. If keratometry is performed before, the values are automatically used for the calculation. The ACD is measured along the visual axis. A computed average of five serial measurements is automatically generated and displayed on the screen. The central ACD was measured 5 times in five different images obtained by the IOL master.

The UBM was performed using ODM 3000 machine (MEDA Co. Ltd), with the subject supine. Topical anesthesia of 5g/L proparacaine was applied. The eyes of each subject were imaged using an appropriate-size eye cup filled with 20g/L methylcellulose as a coupling agent. Care was taken not to exert pressure on the globe. Variation in accommodation was minimized by fixation with the contaslateral eye on a standard distance target on the ceiling[3]. Each eye was examined in its axial section with the probe kept perpendicular to the corneoscleral surface. The depth of the ACD was measured by the freezing images, and the measurement was performed 5 times. The UBM measures the ACD as a distance between the corneal endothelium and anterior lens surface by a built in manually controlled caliper. Corneal thickness, which was simultaneously measured by the device, was added to the ACD to achieve the correct anatomical ACD created by the UBM. All measurements were done consecutively by an experienced ophthalmologist.

Statistical Analysis SPSS software was used with data described as means±SD and range. The differences in values between methods were recorded with the paired t test. $P<0.05$ was considered significant. The associations between values were described by the spearman correlation (r). Repeatability was described by the observer coefficient of variation (CV), and the CV was defined as the ratio of the standard deviation to the mean (in percentage).

Table 1 Comparison between UBM and IOL master

	UBM	IOL master	*P*
Mean ACD±SD(mm)	2.96±0.22	2.95±0.25	0.631
CV(%)	0.65±0.36	0.56±0.26	0.075

RESULTS

Sixty eyes of 60 phakic volunteers met the inclusion criteria and were enrolled to the study. The mean anterior chamber depth was 2.95 ±0.25mm with the IOL master and 2.96 ± 0.22mm with the UBM in Table 1. The difference between ACD value with the IOL master and the UBM was not statistically significant. The correlation (r) between them was 0.9999. The CV of the ACD measurement by the two methods were also shown in Table 1, the repeatability were better with the IOL master.

DISCUSSION

In 1997, Foster *et al* [4] described shallower ACDs with contact ultrasound (US) method than with an optical method. Since then, many comparative studies have been published confirming the difference in ACD measurements between optical techniques and US. The IOL master is a new method of optical techniques, and the UBM is also a method of US, our study revealed no significant difference in the ACD measurements between UBM and IOL master. And a statistically high correlation was noted between ACD measurements by UBM and IOL master. In other literature, the UBM was regarded as a non-contact method for biometric measurement. But when we operate the UBM, the liquid in the eye cup also has gravity. We wonder weather or not it can cause the cornea applanation. And we can not find any literature refer to the applanation of the UBM. Though our study we can ignore it during the process of the ACD measurement.

Compared to optic method, as a non-contact device, the UBM also has disadvantages for various reasons, such as the infection danger and the uncomfortable feeling. And this method need experienced user to operate. Because the ACD measurement must be central ACD depth. And the operator should find the central ACD expertly. Compared to UBM in operation, the IOL master is easily operated. Since the repeatability of IOL master is better than UBM, we think it is essentially operator independent, gives significantly more reliable biometry, especially when performed by less experienced operator. But the measurement of the ACD

depth with IOL master need exact cornea keratometry. And this should be used in the calculation of the ACD depth[5]. If the patient has cornea scar and the ulceration, the calculation of the ACD depth should be difficult, and the result is not precise.

So we can draw the conclusion that the ACD depth with IOL master is the same as UBM. When it comes to the measurement of the ACD depth, we can say the IOL master and the UBM are also right. The UBM imagine is more intuitive, we can use it to assess the ACD structure [6,7]. And it is not influenced by the state of the cornea. As a non-contact method, the IOL master is easily operated, and it has less uncomfortable feeling, and also decrease the danger of cornea infection. It can be used in the IOL calculation, because it has the IOL calculation system. It is convenient for the IOL implantation.

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