Comparison of Anterior Chamber Depth in Healthy Myopic Thai Eye Using Orbscan and Ultrasound

Winai Chaidaroon, MD*, Atchareeya Jengjalern, MD*

* Department of Ophthalmology, Faculty of Medicine, Chiang Mai University, Chiang Mai

Objectives: To compare the anterior chamber depth (ACD) using ultrasonic and optical measurements.

Material and Method: In this prospective study, ultrasound and optical (Orbscan) devices were employed to measure ACD in 42 eyes of 21 myopic volunteers. ACD values were compared using the paired-sample Student t test. The correlation of ACD values obtained from two groups was assessed by linear regression analysis.

Results: The difference of mean ACD values between the ultrasound (3.02 ± 0.37 mm) and Orbscan (3.56 ± 0.42 mm) method was statistically significant difference (p < 0.0001).

Conclusion: The optical measurement of ACD in healthy myopic Thai eyes is, on average, 0.54 mm greater than ultrasonic measurement; however, both methods posses a significant linear correlation.

Keywords: Anterior chamber depth, Orbscan, Ultrasound

In order to correct severe refractive errors, intraocular lenses (IOL) are being placed in phakic eyes as an alternative to keratorefractive surgery to eliminate contact lenses or thick spectacles. The result of phakic IOL demonstrates a high predictive outcome and reduction of aberrations. Anterior chamber depth (ACD) evaluation is necessary to prevent damage to the anterior chamber structures during phacorefractive surgery. Moreover, when referring to the mostly used nomogram, an exact IOL power depends on the accuracy of ACD measurement. Nowadays, the clinical measurement of ACD, in which indirectly technique, is primarily by ultrasonography or optical methods. Although ultrasound has been used in a clinical setting for over 30 years, the values of measurement may be affected by various factors, such as the differences of probe handling, and the operator’s technique and experience. The optical system has become more widely used in refractive surgery. It provides not only accurate topographical evaluation, but also ACD information without direct corneal contact.

The purpose of the present study was to compare ACD measurements between the ultrasonic and optical (Orbscan) method in healthy myopic eyes.

Material and Method

This prospective study was performed in 21 healthy myopic subjects who visited the refractive unit for refractive error evaluation at the Department of Ophthalmology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand between November 2002 and August 2003.

Approval from the research ethical committee was obtained and all subjects provided written informed consent. All cases of the present study met the inclusion criteria that comprised age of at least 20 years, the best corrected visual acuity of 20/20 or better, manifest refraction spherical equivalent error of at least -5.00 dioptries (D), refractive astigmatism of less than 1.00 D, no contact lens worn for at least 3 (soft contact lens) or 7 days (hard or semi-hard contact lens), and healthy eyes after slit-lamp biomicroscopic and indirect ophthalmoscopic examinations. The exclusion criteria consisted of patients who had a history of ocular surgery, topical ocular medication, and ocular disease.

Correspondence to: Chaidaroon W, Department of Ophthalmology, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand. Phone: 0-5394-5512, Fax: 0-5394-6121, E-mail: wchaidar@mail.med.cmu.ac.th
The Orbscan corneal topography system (Orbscan II®; Bausch & Lomb Surgical, Salt Lake City, UT, USA) is an optical topography that consists of a three dimensional scanning slit beam system for analyzing corneal surfaces as well as ACD. One Orbscan operator performed ACD measurements in all eyes first in order to avoid corneal surface irregularities that might occur during contact ultrasonic measurements. The subjects were instructed to sit and place their chin on the chin rest of the instrument. When the Orbscan system was ready, they were asked to open both eyes widely and look at a fixation target. After having 3-time measurements of Orbscan, the cornea was anesthetized with topical benoxinate hydrochloride 0.4 percent and the ACD was measured by A/B-5500 ultrasound (Sonomed, Inc., Lake Success, NY, USA). Patients were asked to observe the fixation target during measurement to ensure optimal alignment and centration of the ultrasonic probe. The probe was sterilized and applied as perpendicularly as possible to the cornea, and 10 programmed consecutive measurements of ACD were achieved.

The study was powered to detect a difference in the Orbscan versus ultrasonic measurement of ACD of 0.17 mm, with an assumed standard deviation of 0.12 mm (a power of 80 percent and a two-sided alpha level of 0.05), given the enrollment of 4 eyes. According to this small number of eyes and many patients who volunteered to participate, we recruited 42 eyes for this study. The outcomes were analyzed using linear regression analysis and the paired-sample Student t test. A p value less of than 0.05 was considered statistically significant.

Results

The mean age of the subjects (9 men and 12 women) was 27.9 years ± 8.8 (SD). The mean manifest refraction spherical equivalent error was -8.49 D ± 4.0 (SD).

Table 1 shows ACD of all patient eyes which were measured by ultrasound and Orbscan. The mean ACD using the ultrasonic measurement of 42 eyes was 3.02 ± 0.37 mm and by Orbscan measurement, 3.56 ± 0.42 mm. There was a statistically significant difference between the ACD values of the two methods (p < 0.0001).

The regression analysis was performed on the ACD values of Orbscan and ultrasound. The regression coefficient was 0.6 (p < 0.0001), which demonstrated that the two methods had a significant linear correlation (Fig. 1).

Discussion

ACD measurement has provided useful information in many studies, including cataract surgery (biometric formulas), glaucoma screening in epidemiological studies, and glaucoma surgery. Recently,
the relevance of phakic IOL implant in either the anterior or posterior chamber is increasing because of higher predictability outcome and ability to correct a large refractive error if compared with keratorefractive surgery\(^{14-16}\). With modern surgical techniques and instruments, patients expect a perfect result from their refractive surgery. ACD is an important factor that determines the achievement of implanting lens power calculation. Furthermore, ACD evaluation before phacorefractive surgery is necessary in order to prevent IOL-corneal endothelium contact.

Two methods commonly used to evaluate ACD are ultrasound and optical analysis. A prospective study of ACD measurements was performed using the ultrasound and optical (Orbscan) system. The authors' conclusions demonstrated that different methods of measuring ACD gave results that differed considerably. The mean ACD values were significantly larger with the Orbscan (\(p < 0.0001\)) than with ultrasound. These outcomes were different to the values in normal cataract affected eyes obtained by Auffarth\(^{17}\). Such a difference between the two measurement systems may be caused by age. The mean age in Auffarth's\(^{17}\) study was 70.4 years, while it was 27.9 years in the present study. The depth and volume of the anterior chamber diminishes with age, which may result from a thickening and forward displacement of the lens\(^{18}\). In the present study, the reason why the values of ACD measured using ultrasound is less than those by the optical method may be explained by the excessive indentation of the cornea, which occurs during ultrasonic measurement. The immersion ultrasound method will obviate such an error. Unfortunately, this instrument is not available in this hospital. However, Giers and Epple found that ACD values measured using the immersion ultrasound technique were larger by 0.3 mm compare to those measured by contact ultrasound\(^{19}\).

There is a significant linear correlation of ACD measurements between ultrasound and optical method. This result is comparable to other studies\(^{3,17}\). The present study also showed that the ACD measured by the Orbscan was 17.8 per cent higher than that using the ultrasonic method.

With increasing refractive surgery numbers, an Orbscan is an optical instrument useful for pre-
operative corneal topographic analysis, and it also provides ACD values because the measurement is based on a Scheimpflug type slitlamp scanning system(17). The advantages of this method are the ease in which it is used and its noncontact performance property. Moreover, no anesthesia is needed and there is no risk of infection. However, the ACD measured by ultrasound is considered a gold standard(3). It has also become the most commonly used routine method(20).

In summary, the present study demonstrated that the Orbscan measurements of ACD in normal myopic eyes were, on average, 0.54 mm greater than ultrasonic measurements. These two methods had a significant linear correlation. The Orbscan is becoming a popular instrument, the higher value of ACD measured by this method may guide the surgeons that ACD is deeper than actual depth. Therefore, the Orbscan should be used in conjunction with ultrasonic measurement, particularly when the measurement of ACD is critical, as in phacorefractive surgery.

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References

การเปรียบเทียบการวัดความลึกของช่องตาด้านหน้าในคนไทยสายตาสั้นที่ปกติโดยใช้วิธีออปติคัลและอัลตราซาวด์

วัตถุประสงค์: เพื่อศึกษาเปรียบเทียบความลึกของช่องตาด้านหน้าจากการวัดด้วยวิธีออปติคัลและวิธีออปติคัลวัสดุและวิธีการ: เป็นการศึกษาไปข้างหน้าโดยการวัดความลึกของช่องตาด้านหน้าของอาสาสมัครที่สายตาสั้นทั้งหมด 21 คนใน 42 ตาดวยวิธีอัลตราซาวด์และวิธีออปติคัล (Orbscan) และเปรียบเทียบค่าเฉลี่ย รวมทั้งความสัมพันธ์ของความลึกของช่องตาด้านหน้าทั้งสองวิธีด้วยวิศวิทยาทางสถิติ paired-sample Student t test และ linear regression analysis ตามลำดับ

ผลการศึกษา: มีความแตกต่างของค่าเฉลี่ยของความลึกของช่องตาด้านหน้าของสายตาสั้นที่วัดด้วยวิธีออปติคัลเท่ากับ 3.02 ± 0.37 มิลลิเมตร และวัดด้วย Orbscan ทำกับ 3.56 ± 0.42 มิลลิเมตร (p < 0.0001)

สรุป: ความลึกของช่องตาด้านหน้าในคนไทยสายตาสั้นจากการวัดด้วยวิธีออปติคัลจะมากกว่า 0.54 มิลลิเมตรโดยเฉลี่ย เมื่อเทียบกับการวัดด้วยวิธีออปติคัล และทั้งสองวิธีมีความสัมพันธ์ในแนวตรงอย่างมีนัยสัมพันธ์