Assessment of Anterior Chamber Depth and Iridocorneal Angle Using Scheimpflug-Placido Combined System and Spectral Anterior Segment Optic Coherence Tomography

Deniz Kilic[1], Mahmut Erkam Arslan[2], Soner Guven[1], Zeynep Duru[1], Ender Sirakaya[1], Necati Duru[1]

ABSTRACT

Purpose: To compare anterior-chamber-depth (ACD) and iridocorneal-angle (ICA) measurements taken by Scheimpflug-Placido system (Pentacam; Oculus, Germany) and anterior-segment optic-coherence-tomography (Cirrus AS-OCT; Carl Zeiss, Germany).

Materials and Methods: In this cross-sectional study, 40 eyes of 40 individuals were examined. ACD was defined as the axial-length between corneal epithelium and anterior surface of lens. ICA was defined as the angle between posterior surface of cornea and the anterior surface of iris, with the trabecular mesh being top of the angle. The values of ACD and ICA were compared.

Results: The mean ACD and ICA measurements were similar between two devices (ACD; 3.34±0.66 mm vs. 3.27±0.60 mm; p=0.211; ICA; 41.55±6.69º vs. 41.50±6.47º, p=0.860). ACD and ICA were found to be correlated with each other (p <0.001, r = 0.851 for ACD and p <0.001, r = 0.964 for ICA).

Conclusion: Both devices give the similar values of ACD and ICA in healthy individuals.

Keywords: Anterior chamber depth, Cirrus anterior segment optical coherence tomography, iridocorneal angle, Scheimpflug Pentacam.

INTRODUCTION

The measurement of anterior segment parameters, anterior chamber depth (ACD) and iridocorneal angle (ICA), are important in ophthalmology practice. The ACD is not only used for estimation of intraocular lens (IOL) power but also used as risk factor to screen glaucoma patients.[1,2] The ICA is another anterior segment parameter used in primary classification of glaucoma.[3] The anterior chamber depth can be visualized via biomicroscopy without using additional device while ICA cannot be visualized directly due total internal reflection of cornea. Thus, gonioscopy is used to assess ICA in clinical practice.[4] However, the major disadvantages for biomicroscopy and gonioscopy are being subjective and affected from corneal condition (edema, opacity etc.).[5]

The Scheimpflug anterior chamber topography and anterior segment optical coherence tomography (AS-OCT) are widely used to perform objective assessment with no contact and minimal effect of cornea problems.[6,7] Pentacam (Oculuss Inc., Wetzlar, Germany) is a non-invasive topography device that combines Scheimpflug camera and Placido disc technology and provides detailed and reproducible data about anterior segment parameters including ACD and ICA.[6] Although Cirrus HD-OCT 5000 (Carl Zeiss Meditec Inc., Dyblin, CA, USA) is a spectral-based OCT (SD-OCT), it can provide high-resolution, detailed information about anterior segment using a separate lens. To best of our knowledge, there is no study assessing correlation between ACD and ICA measurements obtained using these two devices.

Thus, it was aimed to compare ACD and ICA values obtained using Pentacam and Cirrus SD-OCT in health individuals and to assess their correlation.

MATERIALS AND METHODS

Patient selection

This cross-sectional study was approved by Kayseri City Hospital Ethics Committee (17.09.2020/151). The

1- Ophthalmologist, Kayseri City Hospital, Ophtalmology Department, Kayseri, Turkey

2- Ophthalmologist, Develi City Hospital, Ophtalmology Department, Kayseri, Turkey

Received: 29.01.2021
Accepted: 26.10.2021

Glo-Kat 2022; 17: 24-27

DOİ: 10.37844/glauc.cat.2022.17.4

Correspondence Adress:
Deniz Kılıç
Kayseri City Hospital, Ophtalmology Department, Kayseri, Turkey
Phone: +90 505 920 3928
E-mail: dnz_kilic@hotmail.com

study was conducted in accordance to tenets of Helsinki Declaration. All participants gave written informed consent.

The study included right eyes of 40 healthy individuals aged 18-50 years. In all participants, best-corrected visual acuity and intraocular pressure by automated pneumotonometer were measured.

All patients underwent a comprehensive ophthalmological examination including anterior and posterior segment assessment. The patients with any ocular or systemic disease and those with history of ocular surgery and ocular laser were excluded. Thereafter, all participants referred to Pentacam and Cirrus SD-OCT for detailed anterior segment measurements.

Measurement method

All measurements were performed at 09:00-11:00 AM in order to minimize diurnal alterations in anterior segment parameters.[8] All measurements were performed by same clinician (D.K) in triplet manner and mean values were recorded. The measurements were performed in a dim room under same light conditions in order to exclude effects of lightening. ACD (mm) was defined as the axial-length between corneal epithelium and anterior surface of lens. ICA (degree) was defined as the angle between posterior surface of cornea and the anterior surface of iris, with the trabecular mesh being top of the angle.

Pentacam anterior segment topography

Pentacam device is a 360-degree rotating, high-resolution Scheimpflug camera system combined with 22-ring placido disk. In addition to detailed imaging of cornea, iris and lens, it measures refractive indices including corneal aberrations and anterior chamber parameters (ACD and ICA) in automated manner.

Cirrus SD-OCD imaging

Cirrus HD-OCT 5000 is a device with non-invasive, advanced imaging technique that deliver 840 nm infrared light to tissues and measures latency and severity of reflection, providing images as tomography sections at micron level. It provides objective measurements such as ACD on images obtained by an anterior segment lens which can be readily attached to device. Moreover, device can perform non-contact gonioscopy (ICA measurement) in automated manner.

Statistical analysis

All statistical analyses were performed using SPSS 23.0 (Statistical Package for the Social Sciences, IBM Inc., Armonk, NY, USA). Descriptive statistics are presented as mean ± standard deviation, median (minimum-maximum) and percent (%). The normal data distribution was assessed using Kolmogorov-Smirnov test. Paired data from two devices were compared using Paired-sample t test. The relationship among measurements was assessed using Pearson's correlation analysis. A p value<0.05 was considered as statistically significant.

RESULTS

Demographic characteristics

Of 40 healthy individuals included, 21 (52.5%) were women and 19 (47.5%) were men. Mean age was 33.4±8.25 years (19-48 years). The measurement quality for both devices was considered as eligible.

Measurements

Mean ACD was measured as 3.34±0.66 mm by Pentacam whereas 3.27±0.60 mm by Cirrus AS-OCT, indicating no significant difference (p=0.211) (Table 1) There was significant correlation between ACD measurements obtained using two devices(p<0.001, r= 0.851).

Mean ICA was measured as 41.55 ± 6.69° by Pentacam whereas 41.50 ± 6.47° mm by Cirrus AS-OCT, indicating no significant difference (p=0.860) (Table 1) There was significant correlation between ACD measurements obtained using two devices(p<0.001, r= 0.964).

DISCUSSION

We found that both Pentacam and Cirruss provided similar results regarding ACD and ICA measurements in our

Table 1: *Anterior chamber depth and iridocorneal angle values from two devices*

	Pentacam	Cirrus AS-OCT	95% confidence interval (lower and upper limits)	P*
Anterior chamber depth (µm) Mean ± SD	3.34 ± 0.66	3.27 ± 0.60	(-0.04 - 0.18)	0.211
Iridocorneal angle (°) Mean ± SD	41.55 ± 6.69	41.50 ± 6.47	(-0.52 - 0.62)	0.860

*Paired sample t test, OCT, optical coherence tomography; SD, Standard deviation.

study aimed to assesses correlation between Pentacam and Cirrus AS-OCT devices which can reliably measure anterior segment parameters manner using a non-invasive technique.

The ACD is most commonly used to estimate IOL power in ophthalmology practice; thus, devices that provides accurate ACD measurements have been designed to prevent undesired refraction errors after IOL implantation.[9-11] These devices are classified as ultrasonic-, optic- and photographic-based according to principle used.[12] In our study, Pentacam is a photographic-based device while Cirrus AS-OCT is a optic-base device. There are studies comparing ACD measurement obtained using Pentacam device and distinct AS-OCT devices. In a study by Yazici et al.,[13] Pentacam device and Visante OCT device (Carl Zeiss Meditec Inc, Dublin, CA, USA) were evaluated regarding correlation of ACD measurements and the results from both devices were found to be comparable.[13] Similarly, Dinc et al. showed Visante AS-OCT devices provided ACD measurements similar to those obtained using Pentacam device.[14] In our study, it was found that there was a correlation between ACD measurements obtained by two devices. When assessed regardin advantages, both device can provide rapid measurements in non-contact manner. In particular, Pentacam device can be preferred as it provides accurate results in a single procedure in patients with difficulties in compliance (pediatric patients, those with mental disorders etc.) and when qualitative data regarding cornea are required in addition to ACD measurement.

In our study, it was found that ACD measurements as well as ICA measurements were comparable when performed using two devices. The ICA is another anterior segment parameter that should be assessed before IOL implantation since determination of anatomy can prevent potential peri-operative and post-operative problems.[15,16] Although gonioscopy remains to be gold standard for ICA assessment, somewhat pressure is applied by lens having contact with cornea; thus, owing the effect of light used in biomicroscopy together with pressure, the angle can be observed falsely.[17] These advantages have promoted the need for methods that can provide rapid and reliable ICA analysis. AS-OCT, ultrasound biomicroscopy (UBM) and Scheimpflug imaging are methods termed as digital gonioscopy, which qualitatively assess ICA.[18] There are studies evaluating correlation of ICA measurements obtained by Pentacam and several AS-OCT devices.[19,20] In a study by Yi et al., it was shown that ICA measurements by SL-OCT (Heidelberg Engineering GmBH, Heidelberg, Germany) and Pentacam were correlated.[19] In a study by Hong et al. it was confirmed that SL-OCT and Pentacam devices provided comparable results in eyes with closed angle.[20] In our study, we showed that AS-OCT and Pentacam devices provided comparable results regarding ICA.

This study has some limitations. Firstly, reproducibility analysis is lacking for the measurements. However, we believe that using mean value from multiple measurements by single clinician has addressed such limitation. Secondly, no ICA measurement was performed by gonioscopy and we did failed to compare ICA measurements with other non-contact methods. It should be kept in mind that peripheral anterior synechia can be observed in details. However, this limitation can be omitted as the study aimed to compare non-invasive novel devices. Finally, although our study included healthy individuals alone, it should be considered as a pilot study for further studies with patients with closed-angle or angle that may be closed.

In conclusion, our study showed that ACD and ICA measurements were comparable in two advanced, non-invasive anterior segment imaging methods (Pentacam and Cirrus OCT). Both devices can be preferred due to their reliability and ease to use. However, our results should be supported by larger studies involving other methods.

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;21:313-9.
2. Devereux JG, Foster PJ, Baasanhu J, et al. Anterior chamber depth measurement as a screening tool for primary angle-closure glaucoma in an East Asian population. Arch Ophthalmol (Chicago, Ill 1960). 2000;118:257-63.
3. Chong RS, Sakata LM, Narayanaswamy AK, et al. Relationship between Intraocular Pressure and Angle Configuration: An Anterior Segment OCT Study. Invest Ophthalmol Vis Sci. 2013;54:1650-5.
4. Sakata LM, Lavanya R, Friedman DS, et al. Comparison of gonioscopy and anterior segment ocular coherence tomography in detecting angle closure in different quadrants of the anterior chamber angle. Ophthalmology. 2008;115:769-74.
5. Aykan Ü. Glokomda ön segment görüntülenmesi. Turkiye Klin J Ophthalmol Spec Top. 2012;5:69.
6. Mokbel TH, Elhesy A-E, Alnagdy A, et al. Pentacam changes in primary angle-closure glaucoma after different lines of treatment. Int J Ophthalmol. 2020;13:591-8.
7. Pan X, Maram J, Nittala MG, et al. Reproducibility and agreement of four anterior segment-optical coherence tomography devices for anterior chamber angle measurements. Graefes Arch Clin Exp Ophthalmol 2020l;258:1475-81.
8. Xu BY, Penteado RC, Weinreb RN. Diurnal Variation of Optical Coherence Tomography Measurements of Static and Dynamic Anterior Segment Parameters. J Glaucoma. 2018;27:16-21.

9. Haigis W, Lege B, Miller N, et al. Comparison of immersion ultrasound biometry and partial coherence interferometry for intraocular lens calculation according to Haigis. Graefe's Arch Clin Exp Ophthalmol. 2000;238:765-73.
10. Holladay JT. Standardizing constants for ultrasonic biometry, keratometry, and intraocular lens power calculations. J Cataract Refract Surg. 1997;23:1356-70.
11. Ning X, Yang Y, Yan H, et al. Anterior chamber depth - a predictor of refractive outcomes after age-related cataract surgery. BMC Ophthalmol. 2019;19:134.
12. Utine CA, Altin F, Cakir H, et al. Comparison of anterior chamber depth measurements taken with the Pentacam, Orbscan IIz and IOLMaster in myopic and emmetropic eyes. Acta Ophthalmol. 2009;87:386-91.
13. Yazici AT, Bozkurt E, Alagoz C, et al. Central corneal thickness, anterior chamber depth, and pupil diameter measurements using Visante OCT, Orbscan, and Pentacam. J Refract Surg. 2010;26:127-33.
14. Dinc UA, Gorgun E, Oncel B, et al. Assessment of anterior chamber depth using Visante optical coherence tomography, slitlamp optical coherence tomography, IOL Master, Pentacam and Orbscan IIz. Ophthalmol J Int d'ophtalmologie Int J Ophthalmol Zeitschrift fur Augenheilkd. 2010;224:341-6.
15. Pradhan S, Leffler CT, Wilkes M, et al. Preoperative iris configuration and intraocular pressure after cataract surgery. J Cataract Refract Surg. 2012;38:117-23.
16. Prata TS, Dorairaj S, De Moraes CG V, et al. Is preoperative ciliary body and iris anatomical configuration a predictor of malignant glaucoma development? Clin Experiment Ophthalmol. 2013;41:541-5.
17. Sarıcaoglu MS, Karaca EE. Glokomda ön segment görüntüleme yöntemleri. J GloKat. 2014;9:1-8.
18. Bayhan HA, Bayhan AS, Can İ. Ön kamara açısının spektral optik koherens tomografi ve scheimpflug-placido kombine sistemi ile değerlendirilmesi. J GloKat. 2014;9:9-13.
19. Yi J-H, Hong S, Seong GJ, et al. Anterior chamber measurements by pentacam and AS-OCT in eyes with normal open angles. Korean J Ophthalmol. 2008;22:242-5.
20. Hong S, Yi JH, Kang SY, et al. Detection of occludable angles with the Pentacam and the anterior segment optical coherence tomography. Yonsei Med J. 2009;50:525-8.