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Research Article

Comparative study between Pentacam and anterior segment OCT in measuring anterior segment parameters in myopic patients

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ABSTRACT

Background: Accurate quantitative measurements of central corneal thickness (CCT), Anterior chamber depth (ACD), and Aqueous depth (AD) provide valuable clinical information and are important for preoperative assessment, surgical planning, and follow-up in phakic IOL implantation. Ultrasound (US) is typically widely used for measuring these parameters. But, nowadays, noncontact devices such as the Visante Anterior Segment optical coherence tomographer (AS-OCT) and Pentacam are more popular in measuring ocular parameters, so we need to study the degree of agreement between these two optical devices, to get precise measurement for anterior segment parameters.

Purpose: To study the degree of agreement between two optical devices Pentacam and AS-OCT for measuring anterior segment parameters.

Materials and Methods: A total of 61 eyes of 61 subjects aged (18-24) years were examined with Pentacam and AS-OCT. One eye per subject was examined three times with both devices to record their CCT, ACD and AD. Three consecutive measurements of each device were obtained by the same investigator.

Results: Current study carried out on 61 eyes of 61 subjects revealed that there was a statistically significant differences in the mean CCT and AD between Pentacam and Visante OCT. The Pentacam has more reliability in measuring CCT and Visante OCT in measuring AD in myopic patients. However, good agreement was found between these two devices in measuring ACD. There was no correlation between spherical equivalent (SE) of the subjects and parameters measured by both Pentacan and Visante OCT and a strong positive correlation between ACD and AD given by Pentacam as well as Visante.

Conclusion: In conclusion, results succeeded to demonstrate that the Pentacam and Visante-OCT are correlated in measuring anterior segment parameters. The differences between these two devices were statistically significant in measuring CCT and AD. However, these differences were not highly significant clinically, and therefore the Pentacam and AS-OCT can be used interchangeably in clinics.

Keywords: Central corneal thickness, Anterior chamber depth, Aqueous depth, Anterior segment optical coherence tomographer

INTRODUCTION

Central corneal thickness measurement is significant for the evaluation of assorted corneal diseases, intraocular pressure readings accuracy, and patients' eligibility for refractive surgery. A 10% change in CCT results in 3.4 mmHg alteration in intraocular pressure (IOP) (Doughty MJ, 2000). Moreover, corneal thickness variation may notify endothelial cell loss (Cheng H, 1988), which is helpful in considering the stability of iris-fixated phakic intraocular lenses.

Nowadays, a diversity of non-contact imaging devices are assessable for measuring CCT. Technologies such as the Visante anterior segment optical coherence tomography, Orbscan II, and Pentacam, can all estimate CCT without contact to the eye. Non-contact devices are appropriate, because they preclude the disadvantages of ultrasound biometry, like the possibility of corneal erosions and infections caused by corneal contact, in addition to the discomfort experienced by the patient.

AS-OCT, Orbscan II and Pentacam also measure anterior chamber depth. ACD is peculiarly essential while assessing patients' eligibility for iris-fixated posterior intraocular lens implantation. It is a secure treatment for high refractive errors (Tahzib NG, 2007). As a consequence, an accurate measurement of ACD is of massive importance in assuring the safety of corneal endothelium.

All of these imaging devices were counterweighted in normal eyes, eyes diagnosed with keratoconus and eyes after corneal refractive surgery (Ho T, 2007; Amano S, 2006; Kim SW, 2007; de Sanctis U, 2007; Hashemi H, 2007; Lavanya R, 2007; Haque S, 2006; Lackner B, 2005). In this study, we compared the degree of agreement between Pentacam and anterior segment optical coherence tomography for measuring anterior segment parameters, CCT, ACD, and AD and evaluated their repeatability.

METHODS

A total of 61 eyes of 61 subjects aged 18 to 24 years old with spherical equivalent ranged (-0.50 to -9.00 dioptres) were eligible for this study. Subjects' younger than 18 years, astigmatic >3.0 D and those who had a history of retinal diseases, ocular injury or surgery, and contact lens usage (within 4 weeks for rigid contact lens and 2 weeks for soft contact lens wearing) were excluded from the study. All subjects underwent full ophthalmological examinations in ophthalmology department of a tertiary care hospital including the following

Visual acuity using snellen shart and refraction using autorefractometer.

Slit- lamp biomicroscopy.

IOP measurement using noncontact tonometry.

Fundus examination

Anterior chamber parameters (central corneal thickness, anterior chamber depth, and aqueous depth) measurement using Pentacam Rotating Scheimpflug Camera (Pentacam HR-70900 Oculus) and Visante AS OCT.

One eye per subject was examined three times with both devices to record their CCT, ACD and AD. All procedures were performed by the same operator. Procedure of image acquisition by pentacam and OCT has been previously described (Lackner B, 2005; Jain R, 2009; 3 D OCT-2000, 2016).

Ethical consideration

The study was approved by the concerned Ethical Committee. Its protocol was explained to each participant at the time of recruitment and informed consent was obtained according to the Declaration of Helsinki

Statistical Analysis

Statistical analysis was performed using SPSS version 24.0. All variables were expressed as Mean ± Standard deviation. Shapiro-Wilk test showed that the data were normally distributed (Table 1). The paired T-test was used to evaluate the difference between measurements of each device. The confidence interval was set at 95% and probability values of $P<0.05$ were considered statistically significant (Figure 1).

Table 1. Test of normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SE	0.095	61	.200*	0.971	61	0.162

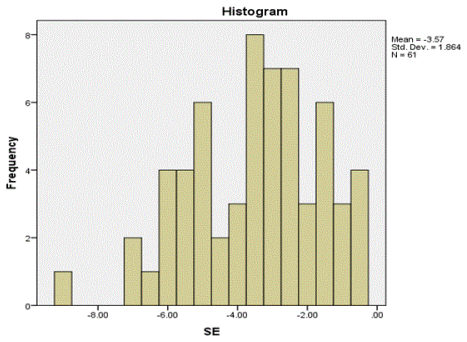

Figure 1. Histogram plot showing normality chart for spherical equivalent (SE) among subjects

RESULTS

Demographic data

The mean age was 20.67 ± 1.42 years (age range 18-24 years). Mean spherical equivalent was -3.56 ± 1.86 Dioptres (range -9.00, -0.50), and mean intraocular pressure (IOP) was 17.29 ± 2.2 mmHg (range 13-21) (Table 2).

Table 2. Demographic data

	Range	Mean
Age (years)	(18, 24)	20.61 ± 1.42
SE (dioptres)	(-9.00, -0.50)	-3.56 ± 1.86
IOP (mmHg)	(13.00, 21)	17.29 ± 2.2

CCT in Pentacam and AS-OCT

The mean CCT measured by Pentacam and AS-OCT were 551.07 ± 33.12 µm, and 548.14 ± 32.95 µm, respectively. There was a statistically significant difference in the mean CCT between two devices (Table 3,4). The Pentacam has more reliability in measuring CCT (Figure 2).

Table 3. Paired sample t-test for CCT

Mean CCT	Mean CCT	Mean Difference ± SD	confident interval	P-value*
Pentacam	AS-OCT			
551.07 ± 33.12(µm)	548.14 ± 32.95	2.9 ± 9.4	(0.515 , 5.34)	0.018*

Table 4. Limits of Agreement (LOA) between Pentacam and Visante in CCT

Limits of agreement (LOA)	Value	95% CI
ULOA	21.32	(26.36, 16.28)
LLOA	-15.52	(-10.48, -20.56)
*ULOA: upper limit of agreement *LLOA: Lower limit of agreement		

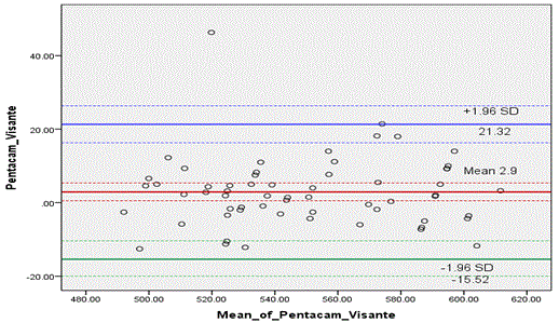

Figure 2. Bland Altman blot CCT

ACD In Pentacam and AS-OCT

The mean ACD measured by Pentacam and AS-OCT was 3.69 ± 0.23 mm and 3.71 ± 0.28 mm, respectively (figure 3). There was a statistically insignificant difference in the mean ACD between two devices (Table 5,6). Good agreement was found between these two devices in measuring ACD.

Table 5. Paired t-test for ACD

Mean ACD	Mean ACD	Mean Dif ± SD	95% CI	P-value*
Pentacam	AS-OCT			
3.69 ± 0.23(mm)	3.71 ± 0.21	-0.01 ± 0.11	(-0.04, 0.01)	0.207

Table 6. LOA between Pentacam and Visante in ACD

Limits of agreement (LOA)	Value	95% CI
ULOA	0.2	(0.17, 0.23)
LLOA	-0.22	(-0.25, -0.19)

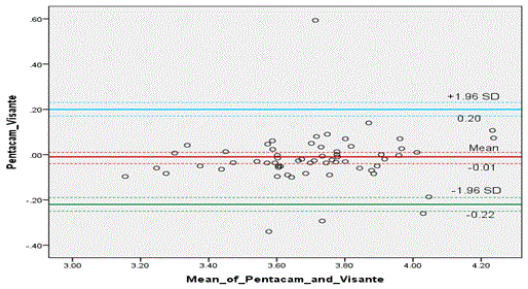

Figure 3. Bland Altman Plot of ACD

AD In Pentacam and AS-OCT

The mean AD measured by Pentacam and AS-OCT was 2.35 ± 0.17 mm and 3.16 ± 0.23 mm, respectively. The paired t-test shows significant differences in the mean AD between two devices (Table 7,8). The AS-OCT was more reliable in measuring AD in myopic patients (figure 4).

Table 7. Paired sample t-test for AD

Mean AD P	Mean AD V	Mean Difference ± SD	confident interval	P-value*
2.35 ± 0.17(mm)	3.16 ± 0.23	-0.80 ± 0.12	(-0.83,-0.77)	0.000*

Table 8. LOA between Pentacam and Visante in AD

Limits of agreement (LOA)	Value	95% CI
ULOA	-0.56	(-0.51, -0.60)
LLOA	-1.03	(-1.07,-0.99)

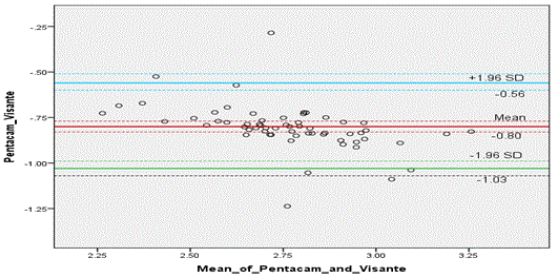

Figure 4. Bland Altman blot of AD

There are no correlation between spherical equivalent (SE) of the subjects and parameters measured by both Pentacan and Visante OCT (Figure 5-10). However, there are a strong positive correlation between ACD and AD given by Pentacm as well as Visante OCT (Table 9, 10).

Table 9. Demonstrates the correlation between SE and parameters (Pentacam)

		SE	CCT_P	ACD_P	AD_P
SE	Pearson Correlation	1	-0.086	-0.082	-0.047
	Sig. (2-tailed)		0.51	0.528	0.719
	N	61	61	61	61
CCT_P	Pearson Correlation	-0.086	1	0.013	-0.156
	Sig. (2-tailed)	0.51		0.922	0.229
	N	61	61	61	61
ACD_P	Pearson Correlation	-0.082	0.013	1	0.979**
	Sig. (2-tailed)	0.528	0.922		0.000*
	N	61	61	61	61
AD_P	Pearson Correlation	-0.047	-0.156	0.979**	1
	Sig. (2-tailed)	0.719	0.229	0.000*	
	N	61	61	61	61
**. Correlation is significant at the 0.01 level (2-tailed).					

Table 10. Demonstrates the correlation between SE and parameters (Visante)

		SE	CCT_V	ACD_V	AD_V
SE	Pearson Correlation	1	-0.093	-0.05	-0.03
	Sig. (2-tailed)		0.476	0.705	0.816
	N	61	61	61	61
CCT_V	Pearson Correlation	-0.093	1	0.001	-0.109
	Sig. (2-tailed)	0.476		0.996	0.402
	N	61	61	61	61
ACD_V	Pearson Correlation	-0.05	0.001	1	0.982**
	Sig. (2-tailed)	0.705	0.996		0.000*
	N	61	61	61	61
AD_V	Pearson Correlation	-0.03	-0.109	0.982**	1
	Sig. (2-tailed)	0.816	0.402	0.000*	
	N	61	61	61	61
**Correlation is significant at the 0.01 level (2-tailed)					

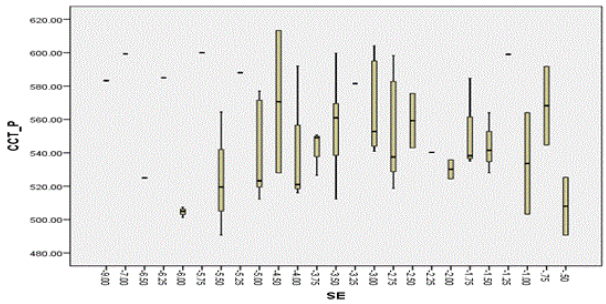

Figure 5. Correlation between CCT and SE in Pentacam

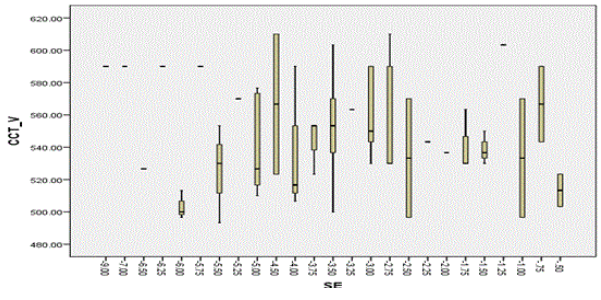

Figure 6. Correlation between CCT and SE in Visante OCT

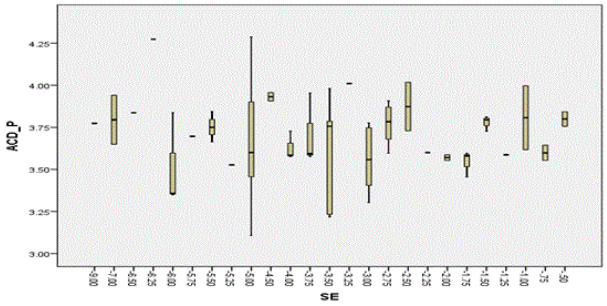

Figure 7. Correlation between SE and ACD in Penatacm

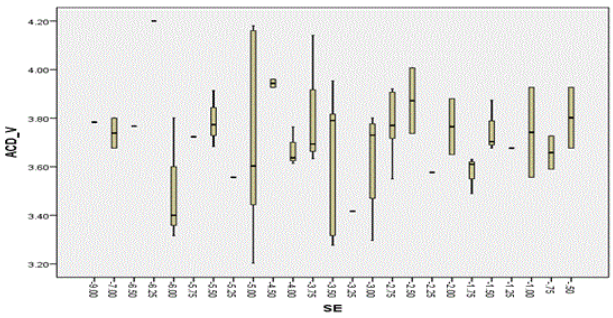

Figure 8. Correlation between SE and ACD in Visante OCT

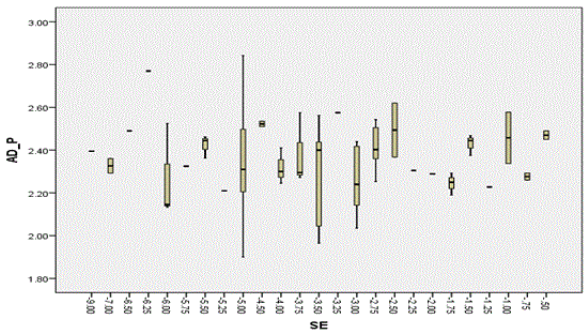

Figure 9. Correlation between SE and AD in Pentacam

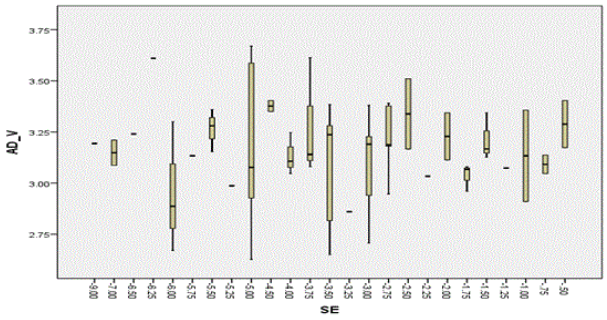

Figure 10. Correlation between SE and AD in Visante OCT

DISCUSSION

Current study revealed that there was a statistically significant differences in the mean CCT and AD between Pentacam and Visante OCT. The Pentacam has more reliability in measuring CCT and Visante OCT in measuring AD in myopic patients. However, good agreement was found between these two devices in measuring ACD. There are no correlation between spherical equivalent (SE) of the subjects and parameters measured by both Pentacan and Visante OCT and a strong positive correlation between ACD and AD given by Pentacam as well as Visante.

Regarding a study comparing pentacam, lenStar LS900 and Visante Anterior Segment OCT measuring CCT in one eye of 23 healthy subjects, it showed that the three devices provide measurements that are in agreement with published values for CCT and ACD in human subjects, and this research is supporting our study (O'Donnell C, 2012).

Al-Mezaine et al had investigated the accuracy and agreement between CCT measurements by oculus pentacam and ultrasonic pachymetry (UP) and found that the CCT measurements by the pentacam and UP are highly correlated. The pentacam is compatible with and is a reliable alternative to UP in CCT measurements; this study is in agreement with our results (Al-Mezaine H, 2008).

A recent study conducted on 100 eyes of 50 healthy subjects of both genders with mean age 25 years measuring CCT, ACD, and pupil diameter using Visante OCT, Orbscan, and Pentacam, showed insignificant differences among the optical methods used, this study is inconsistent with our research (Yazici A, 2010).

Another study measured the accuracy of RTVue Fourier-domain optical coherence tomography (FD-OCT), Pentacam, and ultrasonic pachymetry (USP) for the measurement of CCT, and the results showed that FD-OCT is a rapid and reliable noncontact mean of measuring CCT, this study is not in agreement with our findings (Nam S, 2010).

CONCLUSION

In conclusion, results succeeded to demonstrate that Pentacam and Visante-OCT are correlated in measuring anterior segment parameters.

The differences between these two devices were statistically significant in measuring CCT and AD. However, these differences were not highly significant clinically, and therefore the two devices can be used interchangeably in clinics.

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