



COMPARISON BETWEEN AS-OCT, SCHEIMPFLUG IMAGING AND GONIOSCOPY IN EVALUATION OF ANTERIOR CHAMBER ANGLE

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ABSTRACT

Background: The gold standard technique for estimating the anterior chamber angle (ACA) width is gonioscopy; however, there are certain disadvantages with this method, Recently, a number of instruments have been introduced to provide more precise, objective, and quantitative measurements of the anterior ocular segment. These instrument include anterior segment optical coherence tomography (AS-OCT)and Scheimpflug camera.

Aim of the work: To compare between imaging devices;(AS-OCT) and Scheimpflug camera in (ACA) evaluation and assess the correlation between quantitative data obtained by them, qualitative data derived from gonioscopy.

Results: No significant difference was found between AS-OCT ,Sirius Scheimpflug imaging and gonioscopy in measurement of anterior chamber angle (ACA).

Conclusion: Rotating Scheimpflug camera and anterior segment OCT both are presumed to be very useful for the anterior chamber angle examination in normal open angles. They may provide good images and quantitative data about the angle structures.

Keywords: AS-OCT ,Scheimpflug camera, Gonioscopy, Anterior chamber angle.

INTRODUCTION

The anterior chamber angle is the actual anatomical angle between the root of the iris and the peripheral corneal vault. It contains the structures involved in the outflow passage of the aqueous, namely the trabecular meshwork and the Schlemm's canal . The depth of the angle in a healthy eye is approximately 30°, with the superior part usually narrower than the inferior half. The depth is influenced by gender, age and refractive error. Females has the greatest influence on iridocorneal angle reduction, then age and spherical equivalent (1)

The gold standard technique for estimating the anterior chamber angle (ACA) width is gonioscopy; however, there are certain disadvantages with this method,Placing the goniolens in direct contact with the cornea may alter the angle's configuration,It is also imaging speed and eliminating motion artifacts.(3)

dependent on the examiner's skill and experience.(2)

Recently, a number of instruments have been introduced to provide more precise, objective, and quantitative measurements of the anterior ocular segment. These instrument include anterior segment optical coherence tomography (AS-OCT)and Scheimpflug camera. (2)

Anterior segment optical coherence tomography (AS-OCT) has rapidly become popular for ACA assessment. A wavelength of 1310 nm was preferred for AS-OCT. This increases the depth of penetration by reducing the amount of light scattered by the sclera and limbus, allowing for visualization of the ACA morphology in greater detail. In addition, the 1310 nm light incident on the cornea is strongly absorbed by water in the ocular media, with only 10% reaching the retina. This enables the AS-OCT to utilize higher power, enhancing Scheimpflug camera is non-contact approach for angle assessment and can be used for

screening purposes. In short duration of two seconds, the camera is able to take 25 slit images of the anterior segment of the eye. Anterior segment 3D model can therefore be built providing valuable data. These data are corneal thickness, corneal topographic parameters, anterior chamber depth (ACD), anterior chamber volume (ACV), anterior chamber angle (ACA), and other parameters. (4)

Subjects and method:

An observational (cross sectional) study carried out on 40 subjects aged between (20-45) years, collected from outpatient clinics of ophthalmology department, Zagazig university hospitals.

Inclusion Criteria :

- Subjects between (20-45) years of age.
- Emmetropic eyes
- Subjects with no ocular diseases, no history of Previous ocular surgery or inflammation that could affect the anterior chamber angle (ACA).

Exclusion Criteria:

- Patient with previous ocular surface surgery and/or intraocular surgery or inflammation
- Systemic disease with ocular implications such as diabetes
- Cases with glaucoma (open angle, angle closure)

Method:

Operational Design

1-Complete ophthalmic examinations were performed to all subjects.

2- **Gonioscopy** for assessment of anterior chamber angle.:

- Using Ocular Goldmann three mirror lens.

3-Imaging of anterior chamber angle using :

a- Anterior segment optical coherence tomography.

- It was done to assess the anterior chamber angle. The device Nidek OCT retina scan advance (RS-3000 Advance) from NIDEK co., LTD Japan.

b. Scheimpflug camera:

- Imaging of anterior segment using Sirius 3D Rotating Scheimpflug Camera-Topography System (serial N. 13021766 Italy).

The results were recorded, tabulated and statistically analysed using the program (Statistical Package for the social sciences version 21) to detect the percentage of agreement between OCT and Gonioscopy, Scheimpflug camera and gonioscopy while repeated measure ANOVA was used to compare both instruments together with gonioscopy

RESULTS

Table (1): demographic and personal data:

Variables	N	%
Age	34.4±6.3* 35.5(25-45)**	
Sex		
Male	17	42.5
Female	23	57.5
Side		
OS	25	62.5
OD	15	37.5
BCVA		
6/6	33	82.5
6/9	7	17.5

*(mean±sd)

**median (range)

This study included 40 eyes of 40 subjects, 17 males and 23 females. Mean age ± SD was 34.4±6.3 years.

Table 2: parameters obtained by AS-OCT

variables	Mean ± sd	Range (min-max)
AOD temporal	626±22	(411-1653)
AOD nasal	739±29	(399-1846)
TISA temporal	0.40±0.14	(0.13-0.69)
TISA nasal	0.54±0.22	(0.23-1.10)

Angle opening distance (AOD) temporal, AOD nasal, Trabecular iris surface area(TISA) temporal and TISA nasal were 626±22, 739±29, 0.40±0.14 and 0.54±0.22 respectively.

Table 3: measure of agreement between gonioscopy and schiempflug temporal:

Schiempflug temporal	Gonioscopy temporal			kappa
	10:20	20:35	35:45	
10:20	2(50.0%)	0(0.0%)	0(0.0%)	0.846
20:35	2(50.0%)	25(96.2%)	0(0.0%)	
35:45	0(0.0%)	1(3.8%)	10(100.0)	

This table show significant agreement between gonioscopy and schimpflug (temporal) kappa about 85.0% agreements according to the test of agreement kappa.

Table 4: measure of agreement between gonioscopy and ASOCT temporal:

ASOCT temporal	Gonioscopy temporal			kappa
	10:20	20:35	35:45	
10:20	4(100.0%)	0(0.0%)	0(0.0%)	0.951
20:35	0(0.0%)	25(96.2%)	0(0.0%)	
35:45	0(0.0%)	1(3.8%)	10(100.0)	

This table show significant agreement between gonioscopy and ASOCT (temporal) kappa about 95.1% agreements.

Table 5: measure of agreement between gonioscopy and schiemflug nasal:

Schiemflug nasal	Gonioscopy nasal			P value	kappa
	10:20	20:35	35:45		
10:20	2(100.0%)	2(8.0%)	0(0.0%)	<0.001	0.806
20:35	0(0.0%)	23(92.0%)	2(15.4%)		
35:45	0(0.0%)	0(0.0%)	11(84.6%)		

This table show significant agreement between gonioscopy and schiemflug (nasal) kappa about 81.0% agreements.

Table 6: measure of agreement between gonioscopy and ASOCT nasal:

ASOCT nasal	Gonioscopy nasal			kappa
	10:20	20:35	35:45	
10:20	2(100.0%)	0(0.0%)	0(0.0%)	0.90
20:35	0(0.0%)	24(96.0%)	1(7.7%)	
35:45	0(0.0%)	1(4.0%)	12(92.3%)	

This table show significant agreement between gonioscopy and ASOCT (nasal) kappa about 90% agreements

Table 7: association between gonioscopy, schiemflug and ASOCT (temporal):

temporal	Gonioscopy			F	P1
	Grade2(a)	Grade 3(b)	Grade 4 (c)		
Schiemflug	17.50±1.29	31.14±3.02	32.65±3.16	0.760	0.389
ASOCT	17.50±1.29	31.27±3.24	32.33±2.10		
P2	0.20				

P1: significance between schimflug and ASOCT

P2: interaction between gonioscopy and schimflug & ASOCT

Table 7 show that there is no significant difference between gonioscopy, schimflug and ASOCT but there is significant difference between the 3 grades of gonioscopy.

Table 8: association between gonioscopy, schiemflug and ASOCT (nasal):

Nasal	Gonioscopy			F	P1
	Grade2(a)	Grade 3(b)	Grade 4 (c)		
Schiemflug	20.26±6.55	31.13±3.25	42.30±3.16	1.21	0.28
ASOCT	17.00±2.8	29.78±6.09	39.33±3.61		
P2	0.18				

P1: significance between schiemflug and ASOCT

P2: interaction between gonioscopy and schiemflug & ASOCT

F:repeated measure annova

Table 8 show that there is no significant difference between gonioscopy, schiemflug and ASOCT.

DISSCUSION

The gold standard for evaluating the anterior chamber angle (ACA) configuration is gonioscopy, an examination that involves contact with the cornea. Furthermore, gonioscopic findings may be affected by inadvertent pressure on the gonioscopy lens and by increased illumination (which tends to open the ACA) during the examination. Previous studies have shown that even experienced, trained examiners have only moderate agreement in determining angle width.(5)

New anterior segment imaging instruments promise to overcome these limitations. They aim to improve imaging of the anterior segment and to enhance clinical practice and research in ophthalmology. Anterior segment imaging has become a rapidly advancing field of ophthalmology. New modalities as ultrasound biomicroscopy (UBM), rotating Scheimpflug imaging and anterior segment Optical Coherence Tomography (AS_OCT), have recently become available. They provide quantitative information and qualitative imaging of the cornea, anterior chamber, iris, irido-corneal angle and the lens.(6)

Our study was performed on 40 eyes of 40 subjects, their age ranged from 25.0 – 40.0 years with a mean of 34.4±6.3 years. About 57.5 % of cases were of female gender and 42.5% were males.The study was carried out on left eyes with 62.5% and right eyes with 37.5%. (table 1)

In our study we used both Scheimpflug imaging and OCT in assessing and measuring the nasal and temporal anterior chamber angle (ACA) and correlating the obtained measurements of the two instruments with the Shaffer system of Gonioscopy.

Regarding measurement of agreement between gonioscopy and schiemflug temporal, it was found that there was significant agreement between gonioscopy and schimflug (temporal) with kappa about 85.0% agreements.(table 3)

Regarding measurement of agreement between gonioscopy and schiemflug nasal, it was found that there was significant agreement between gonioscopy and schiemflug (nasal) kappa about 81.0% agreements.(table 5)

So, and according to the previous results, there was a very good agreement between Sirius rotating Scheimpflug camera and gonioscopy as agreement is considered very good when Kappa is between 80% and 100%.

In consistence with our study **Kurita et al.,2009** found that Scheimpflug imaging shows significant correlation with Shaffer’s grading system of Gonioscopy in ACA measurement ,but it was found that Scheimpflug camera was unable to visualize the most peripheral part of the iris which may cause discrepancy with the results obtained from other imaging techniques in eyes with narrow angles.(7)

But see **JLS 2007** stated that the angle recess can not be directly visualized,

Scheimpflug imaging doesn't allow angle assessment in detail.(8)

In our study ,Regarding agreement between gonioscopy and ASOCT temporal, it was found that there was significant agreement between gonioscopy and ASOCT (temporal) , kappa about 95.1% agreements.(table 4)

Regarding measurement of agreement between gonioscopy and ASOCT temporal, it was found that there significant agreement between gonioscopy and ASOCT (nasal), kappa about 90% agreements.(table 6)

So, according to our results, there was a very good agreement between AS-OCT and gonioscopy as agreement is considered good when Kappa is between 80% and 100%.

Kim et al.,2011 reported that reproducibility of the superior and inferior quadrants was low because of lid effect, and an excellent reproducibility of nasal and temporal angles. In agreement with this, we used only nasal and temporal quadrant data for comparison although Nidek AS-OCT can measure nasal, temporal, superior and inferior angles.(9)

Similar results to our study **Nolan, et al.,2005** examined ACA by gonioscopy as well as AS-OCT and reported that there was no significant difference between OCT and gonioscopy. This study evaluated the sensitivity of OCT in detecting angle closure compared with gonioscopy. AS-OCT showed a sensitivity of 81.5% and a specificity of 68.5% in the nasal quadrant; 66.1% and 77.2% in the temporal area. (10)

On the other hand **Cindy X. Hu et al.,2016** reported that Visante and Cirrus had moderate agreement with each other in detecting angle closure with greeter agreement in the dark, but only slight-to-fair agreement with gonioscopy. The study found also that OCT imaging in their current forms may not be able to identify angle closure because of difficulty in identifying angle structures ,while Gonioscopy by well-trained clinicians had remarkably consistent agreement in identifying angle closure risk.(11)

In our study , By comparing the data we got from AS-OCT ,Sirius Scheimpflug imaging and

gonioscopy in assessment of the temporal compartment of ACA, it was found that there was no significant difference between gonioscopy, scheimpflug and ASOCT.(table 7).

Regarding association between gonioscopy, schiemflug and ASOCT (nasal), it was also found that there was no significant difference between gonioscopy, scheimpflug and ASOCT.(table 8)

In consistence with our results, **Jeong-Ho Yi et al.,2008** stated that both Scheimpflug camera and AS-OCT are very useful for the anterior chamber angle examination,they provide good images and quantitative data about the angle structures including ACA and ACD,the values of temporal and nasal ACAs measured by two instruments were not significantly different ,they showed good intra-observer and inter-method agreements (all >0.9).(12)

On the other hand, in a study by **Dinc et al 2010** on a sample of 40 healthy eyes of 40 normal subjects, mean nasal and temporal ACA detected by Visante OCT were found significantly different from ACA calculated by Scheimpflug camera. Mean nasal and temporal ACA were detected as 31.2±8.7 and 32.1±8.5 degrees by Visante OCT and 41.6±5.9 and 41.8±5.8 degrees by Sceimpflug camera respectively.(13)

According to American academy report carried out to assess the published literature of the PubMed and Cochrane Library databases which were last conducted on July 6, 2011 to assess the association between anterior segment imaging and gonioscopy and to determine whether such imaging aids in the diagnosis of primary angle closure (PAC) , the report stated that Quantitative and qualitative parameters obtained from anterior segment optical coherence tomography (OCT) and Scheimpflug photography show a strong association with the results of gonioscopy ,but non of those imaging methods provides sufficient information about the ACA anatomy to be considered a substitute for gonioscopy . (14)

CONCLUSION

Rotating Scheimpflug camera and anterior segment OCT both are presumed to be very useful for the anterior chamber angle examination in normal open angles. They may provide good images and quantitative data about the angle structures. Also AS-OCT provides direct visualization of the angle that leads to more accurate result. AS-OCT and Scheimpflug imaging can provide documented data about ACA which may be useful for follow up.

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