Original Article

Comparison of Gonioscopy and Anterior Segment OCT for Detecting Angle Closure in Different Quadrants of Anterior Chamber Angle in Angle Closure Glaucoma

Khadeeja Imran[1], Nida Armoghan Khan[2], Hafiz Muhammad Jahan Zaib[3], Fahmina Nazir[4]
Amina Khalid[5]
[1-4]Pakistan institute of Medical Sciences, Islamabad, [5]Holy Family Hospital, RMU, Rawalpindi

ABSTRACT

Purpose: To measure angle of anterior chamber with Gonioscopy and compare with anterior segment OCT.

Study Design: Descriptive observational study.

Place and Duration of Study: This study was conducted at the Department of Ophthalmology, Pakistan institute of Medical Sciences, Islamabad from 1st March 2021 to 31st August 2021.

Methods: A total number of 102 patients participated in the study. Study included participants older than 30 years of age, of either gender, who were either diagnosed as a case of angle closure-Glaucoma or were angle closure-Glaucoma suspect. Sampling was done using convenient sampling technique. The selected patients underwent gonioscopy and the anterior segment OCT and the grades of the angle were determined. Grading was compared between the two techniques. The collected data was analyzed by using SPSS 23 version.

Result: The mean age of patients was 59.16 ± 6.03 years. Out of 102 patients, 34 (33.3%) patients were male and 63 (66.7%) patients were female. The mean intraocular pressure was 17.80 ± 4.25 (mmHg). The accuracy of angle closure detection by Gonioscopy was 35.3% and by anterior segment, OCT was 60.8%. The p value was significant in both the groups. The Anterior segment OCT turned out to be better than Gonioscopy.

Conclusion: Anterior segment OCT is more efficient in determination of angle of anterior chamber than gonioscopy. Using anterior segment OCT to examine anterior chamber angle and surrounding tissues helps in diagnosing early stages of disease and directing therapy.

Key Word: Angle closure glaucoma, Optical Coherence Tomography, Gonioscopy.

Correspondence: Hafiz Muhammad Jahan Zaib
Pakistan institute of Medical Sciences, Islamabad
Email: ikhlaqbhatti1168@gmail.com

INTRODUCTION

Primary angle closure glaucoma (PACG) is one of the common causes of visual loss in people all over the world. PACG is the most severe type of primary angle closure disease (PACD), which is characterized by peripheral iris closing the anterior chamber angle (ACA) either by synechiae or apposition. Aqueous humor outflow through the trabecular meshwork (TM) may be hampered by partial or full closure of the ACA, which can lead to increase in intraocular pressure (IOP) that is a risk factor for glaucomatous optic neuropathy. As a result, a precise assessment of ACA structure is critical in treatment and diagnosis of PACD patients.[1]

Gonioscopy is still the most commonly employed

method for determining angle of anterior chamber of eye. It is low-cost, can be done quickly using a slit-lamp, provides dynamic observation of whole angle quadrant, and allows the indentation to distinguish between the synechial and appositional angle closure. However, because this is subjective approach, it is easily influenced by the patient compliance, examiner competence, gaze direction, lens type, accidental pressure on cornea, and ambient light.[2]

Anterior Segment Optical Coherence Tomography (AS-OCT) is light-based, non-contact imaging modality, non-invasive diagnostic technique that provides higher image resolution than the UBM (axial resolution of 18 μm in Visante-Optical tomography vs. 50 μm in ultrasound bimicroscopy).[3]

Studies found that closed angles are more clearly detected by AS-OCT, especially in inferior and superior quadrants,[4-6] than Gonioscopy, probably due to inadvertent pressure on the globe and exposure of the pupil to the light, artificially widening of the angle, during gonioscopy.[7] In 1991, Pavlin et al, introduced ultrasound bimicroscopy (UBM), a clinical application of high frequency ultrasound. UBM uses greater frequency (52 – 102 MHz) than routine ultrasound (6 – 21 MHz), achieving a higher axial resolution (approximately 25 μm). Since its invention, UBM dominated the field of AS imaging until 2005, when the first commercial AS – OCT unit was introduced.[8]

There is scarcity of local data regarding anterior segment OCT. Our purpose of conducting this study is to measure angle of anterior chamber with both gonioscopy and anterior segment OCT and compare their results.

METHODS

An observational study was conducted at the Department of Ophthalmology, Pakistan Institute of Medical Sciences, Islamabad. The study duration was six months from 1st March 2021 to 31st August 2021. The sample size was determined using WHO sample size calculator which was 102. Study included participants older than 30 years of age, of either gender, who were either diagnosed as a case of angle closure – Glaucoma or were angle closure-Glaucoma suspect. Sampling technique non-probability consecutive sampling. The selected patients underwent gonioscopy to determine the grades and later on the same patients underwent anterior segment OCT and the grade of the angle was determined. A single

experienced ophthalmologist performed Gonioscopy with researcher using a Goldmann 1-mirror lens at high magnification ($\times 16$) with eyes in the primary gaze position. The grade of ACA in each quadrant was classified and recorded with the Shaeffer grading system.[9]

The OCT machine used for this particular study was Huvitz. Collected data was then statistically analyzed using SPSS version 23.0. The descriptive statistics were presented as mean with standard deviation for the continuous variables such as age and IOP. The categorical variables such as grades in the different quadrants of the anterior chamber with gonioscopy and anterior segment OCT were presented as frequency and percentages. The efficacy of one of the methods was determined by comparing the grades in different quadrants between two methods by applying chi square test. A P value of ≤ 0.05 was taken as significant.

The study was approved by the Institutional Ethical Committee of ………. Informed consent was taken in written from all of the participants of study.

RESULTS

We enrolled 102 patients by convenient sampling. The mean age of patients was 59.16 ± 6.03 years. Out of 102 patients, 34 (33.3%) patients were male and 63 (66.7%) patients were female. The mean intraocular pressure was 17.80 ± 4.25 (mmHg).
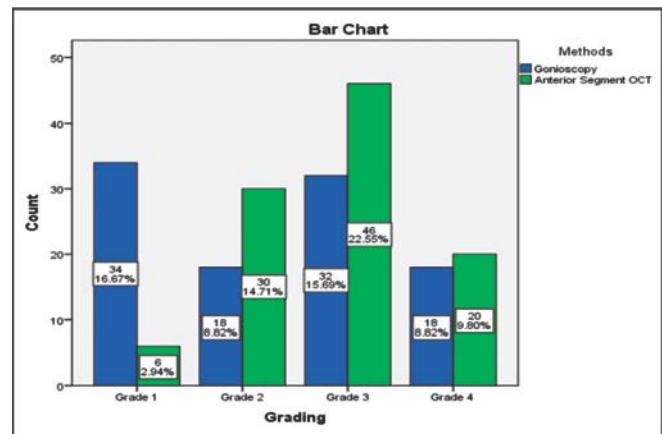
Figure-1: Frequency distribution of grading by Gonioscopy and AS-OCT.

In our study, the mean value of intraocular pressure (mmHg) for angle closure patients was 20.39

Table-1: *Frequency distribution of angle closure in different quadrants.*

Quadrant	Methods		Total	p value
	Gonioscopy	Anterior Segment OCT		
Superior	38 37.3%	12 11.8%	50 24.5%	
Inferior	24 23.5%	32 31.4%	56 27.5%	
Nasal	26 25.5%	26 25.5%	52 25.5%	0.0001*
Temporal	14 13.7%	32 31.4%	46 22.5%	
Total	102 100.0%	102 100.0%		

*Significant (p < 0.05)

± 3.85 mmHg and in non-angle closure patients, it was 15.49 ± 3.22 mmHg. Figure 1 shows frequency distribution of angle grading by both methods. The frequency of angle closure detection by Gonioscopy was 35.3% and by anterior segment OCT was 60.8%. Figure 2 shows frequency distribution of angle closure by Gonioscopy and AS-OCT. Table 1 shows frequency distribution of angle closure in different quadrants by both techniques.
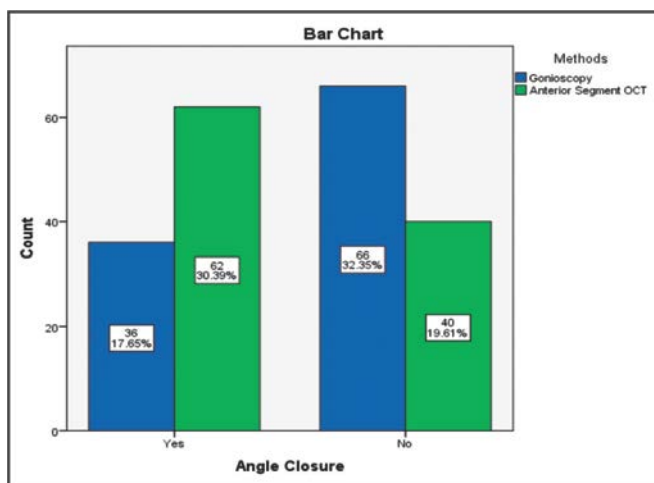
Figure-2: Frequency distribution of angle closure by Gonioscopy and AS-OCT.

DISCUSSION

Glaucoma is a progressive optic neuropathy marked by anatomical abnormalities in the optic nerve head and visual field defects.[10] While the eventual route of functional and structural loss for many forms of glaucoma is similar, a thorough assessment of drainage angle is necessary for proper therapeutic management and diagnosis.[2] In both affected and normal eyes, there is wide range of the anatomical variance in drainage angle. Many individuals might have occludable or narrow angles without additional abnormalities; others will have primary angle closure with the peripheral anterior synechiae or/and increased intraocular pressure; and still others will have the PACG with the optic nerve injury.[11]

In our study, mean age of patients was 59.16±6.03 years. Age of our patients was similar to the studies by Xu et al[1] and Sakata et al.[6] Out of 102 patients 34 (33.3%) patients were male and 63 (66.7%) patients were female. These results also matched with results of studies by Xu et al[1] and Sakata et al.[6]

Aqueous humor outflow through TM "trabecular meshwork" can be hampered by partial or full closure of the ACA, which can lead to increased IOP "intraocular pressure", a risk factor for the glaucomatous optic neuropathy. Thus, a precise assessment of ACA structure is critical in treatment and diagnosis of PACD patients.[12-14]

In our study Angle closure detection by Gonioscopy was 35.3% and by Anterior Chamber OCT was 60.8%. The Anterior segment OCT is better in detecting angle closure than Gonioscopy. These results are similar to earlier studies.[15]

There is literature evidence that anterior segment imaging provides useful information in the evaluation of PAC, but none of the imaging techniques provides sufficient information about the ACA anatomy to be considered a substitute for gonioscopy.[16,17]

Gonioscopy still gold standard for determining angle of anterior chamber of eye.[18] It is low-cost, can be done quickly using by a slit-lamp, provides dynamic observation of whole angle quadrant, allows the indentation to distinguish between the synechial

and appositional angle closure.[19]

However, because this is subjective approach, it is easily influenced by patient compliance, examiner competence, gaze direction, lens type, accidental corneal pressure, and ambient light.[6]

In contrast to Gonioscopy, Anterior Segment OCT produces high-resolution cross-sectional pictures of anterior segment of the eye using the technique of low-coherence interferometry.[20]

Limitations of our study are inability to measure sensitivity and specificity values for each technique. It was a single center study with no population heterogeneity.

CONCLUSION

Anterior segment OCT is better for determination of angle in patients with shallow anterior chamber angles.

Conflict of Interest

Authors declared no conflict of interest.

Ethical Approval

The study was approved by the Institutional review board/Ethical review board
(F.1-1/2015/ERB/SZABMU/707).

REFERENCES

1. **Xu BY, Pardeshi AA, Burkemper B, Richter GM, Lin SC, McKean-Cowdin R, et al.** Differences in Anterior Chamber Angle Assessments Between Gonioscopy, EyeCam, and Anterior Segment OCT: The Chinese American Eye Study. Transl Vis Sci Technol. 2019; **8 (2):** 5. Doi: 10.1167/tvst.8.2.5.

2. **Salim S.** The role of anterior segment optical coherence tomography in glaucoma. J Ophthalmology, 2012; **2012 (476801):** 9. https://doi.org/10.1155/2012/476801

3. **Muñoz-Rodriguez P, Salinas-Gallegos J.** Measurement of Anterior Chamber Angle with Optical Coherence Tomography. The Mystery of Glaucoma: Intech Open; 2011. Doi: 10.5772/18478

4. **Li H, Leung CKS, Cheung CYL, Wong L, Pang CP, Weinreb RN, et al.** Repeatability and reproducibility of anterior chamber angle measurement with anterior segment optical coherence tomography. Br J Ophthalmol. 2007; **91 (11):** 1490-1492. http://dx.doi.org/10.1136/bjo.2007.118901

5. **Angmo D, Singh R, Chaurasia S, Yadav S, Dada T.** Evaluation of anterior segment parameters with two anterior segment optical coherence tomography systems: Visante and Casia, in primary angle closure disease. Indian J Ophthalmol. 2019; **67 (4):** 500. Doi: 10.4103/ijo.ijo_641_18

6. **Sakata LM, Lavanya R, Friedman DS, Aung HT, Gao H, Kumar RS, 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 (5):** 769-774. https://doi.org/10.1016/j.ophtha.2007.06.030

7. **Baskaran M, Iyer JV, Narayanaswamy AK, He Y, Sakata LM, Wu R, et al.** Anterior segment imaging predicts incident gonioscopic angle closure. Ophthalmology, 2015; **122 (12):** 2380-2384. https://doi.org/10.1016/j.ophtha.2015.07.030

8. **Istikawa H.** Imaging of Anterior Segment OCT and UBM.Tech Guide, 2016

9. **Riva I, Micheletti E, Oddone F, Bruttini C, Montescani S, De Angelis G, et al.** Anterior Chamber Angle Assessment Techniques: A Review. J Clin Med. 2020; **9 (12):** 3814. Doi: 10.3390/jcm9123814.

10. **Mélik Parsadaniantz S, Réaux-le Goazigo A, Sapienza A, Habas C, Baudouin C.** Glaucoma: A Degenerative Optic Neuropathy Related to Neuroinflammation? Cells. 2020; **9 (3):** 535. Doi: 10.3390/cells9030535

11. **Khazaeni B, Khazaeni L.** Acute Closed Angle Glaucoma. 2022 Apr 30. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan–. PMID: 28613607.

12. **Stamper RL, Lieberman MF, Drake MV.** Becker-Shaffer's diagnosis and therapy of the glaucomas E-Book. Elsevier Health Sciences; 2009 Jun 18.

13. **He M, Foster PJ, Ge J, Huang W, Wang D, Friedman DS, et al.** Gonioscopy in adult Chinese: the Liwan eye study. Invest Ophthalmol Vis Sci. 2006; **47 (11):** 4772-4779.

14. **Dai Y, Zhang S, Shen M, Zhou Y, Wang M, Ye J, et al.** Modeling of gonioscopic anterior chamber angle grades based on anterior segment optical coherence tomography. Eye and Vis. 2020; **7 (1):** 1-10. Doi: 10.1186/s40662-020-00196-1

15. **Farooq S, Muid J.** Role of Anterior Segment OCT in the Management of Primary Narrow Angle Disease. Pak J Ophthalmol. 2020; **36 (4):** 348-354. Doi: 10.36351/pjo.v36i4.1039

16. **Smith SD, Singh K, Lin SC, Chen PP, Chen TC, Francis BA, et al.** Evaluation of the anterior chamber angle in glaucoma: a report by the american academy of ophthalmology. Ophthalmology, 2013; **120 (10):** 1985-1997. Doi: 10.1016/j.ophtha.2013.05.034.

17. **Wong HT, Chua JL, Sakata LM, Wong MH, Aung HT, Aung T.** Comparison of slitlamp optical coherence tomography and scanning peripheral anterior chamber depth analyzer to evaluate angle closure in Asian eyes. Arch Ophthalmol. 2009; **127 (5):** 599-603. Doi: 10.1001/archophthalmol.2009.41.

18. **Porporato N, Baskaran M, Husain R, Aung T.** Recent advances in anterior chamber angle imaging. Eye (Lond). 2020; **34 (1):** 51-59.

19. **Barkana Y, Dorairaj SK, Gerber Y, Liebmann JM, Ritch R.** Agreement between gonioscopy and ultrasound biomicroscopy in detecting iridotrabecular apposition. Arch Ophthalmol. 2007; **125 (10):** 1331-1335.

20. **Radhakrishnan S, Goldsmith J, Huang D, Westphal V, Dueker DK, Rollins AM, et al.** Comparison of optical coherence tomography and ultrasound biomicroscopy for detection of narrow anterior chamber angles. Arch Ophthalmol. 2005; **123 (8):** 1053-1059. Doi: 10.1001/archopht.123.8.1053.

Authors' Designation and Contribution

Khadeeja Imran; Postgraduate Resident: *Design, Literature search, Data acquisition, Data analysis, Statistical analysis, Manuscript review.*

Nida Armoghan Khan; Postgraduate Resident: *Concepts, Design, Literature search, Data acquisition, Statistical analysis, Manuscript editing.*

Hafiz Muhammad Jahanzaib; Medical Officer: *Concepts, Literature search, Data acquisition, Manuscript preparation, Manuscript review.*

Fahmina Nazir; Postgraduate Resident: *Design, Literature search, Data acquisition, Data analysis, Manuscript preparation, Manuscript editing.*

Amina Khalid; Postgraduate Resident: *Design, Literature search, Data acquisition, Statistical analysis, Manuscript editing, Manuscript review.*

····☆····