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Evaluation of Anterior Segment Parameters by using Pentacam and Gonioscopy after Prophylactic Laser Peripheral Iridotomy among primary angle close suspect

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Abstract

Aim: To evaluate laser Perifheral iridotomy (LPI) changes on anterior segment parameters (ASP) among primary angle closure suspect (PACS) using the Pentacam and gonioscopy.

Methods: A comparative, prospective, interventional study was conducted between August 2019 to May 2021. We included 100 eyes of 100 PACS. Anterior chamber angle (ACA), central anterior chamber depth (ACD), anterior chamber volume (ACV) and central corneal thickness (CCT) were recorded from the Pentacam before and one month after LPI. ACA was graded according to Shaffer classification using the Goldmann gonioscopy. The paired samples t-test was used to compare the difference in ASP while Wilcoxson signed-rank test was used to assess the ACA grading.

Results: Among enrolled males were 41% & mean age was 50.56 ± 6.03 SD (ranged 40 to 60 years). 27% had previous glaucoma treatment history and 88% had positive family history of glaucoma. Mild lenticular sclerosis was present in 49%. Maximum number of cases had BCVA in > 6/18 (68%). Pentacam evaluation pre-intervention found mean ACA, ACD, ACV and CCT were 26.73 ± 1.05°, 2.09 ± 0.12 mm, 78.51 ± 7.12 mm^3 and 510 ± 6.5 µm, respectively. Following LPI mean ACA, ACD and ACV showed an increase of 1.47 ± 0.72°, 0.08 ± 0.07 mm and 51.08 ± 20.56 mm^3, respectively. Statistically, these changes were significant ($p<0.001$) except for central corneal thickness ($p=0.454$). Gonioscopic evaluation pre and post-LPI reveal that the angle width increased significantly in all quadrants ($P<0.001$) except the inferior quadrant ($p=0.025$).

Conclusion: Both Gonioscopy and Pentacam can easily access the efficacy of LPI. Pentacam is more sensitive to minor changes.

Introduction

Glaucoma, a multifactorial optic neuropathy resulting in loss of visual function.[1] About 21 million worldwide were predicted to have Angle Closure Glaucoma (ACG) by 2020, contributed by 87.6% Asians.[2] Angle closures glaucoma, an be classified into two types: primary and secondary, depending on the nature and cause of angle closures.[3] Primary ACG can be divided as primary angle closure suspect (PACS), primary angle closure (PAC) and primary angle closure glaucoma (PACG).[4] PACS

comprises irido-trabecular contact (ITC) ≥180° with normal intraocular pressure (IOP) and optic disc with no peripheral anterior synachiae.[5] If untreated about 22% of PACS may progress to PAC and 28.5% PAC will form PACG within 5 years.[6]

Acute ACG attack can be prevented by laser peripheral iridotomy (LPI).[7] LPI causes changes in anterior segment morphology that can be evaluated by various means. One of the oldest and gold standard methods of assessment of eye is Gonioscopy, that is uncomfortable contact procedure and time-consuming.[8,9] On the other hand, Pentacam is a noncontact and fast method to evaluate anterior segment parameters (ASP).[10] Esmaeili *et al.* evaluated ASP of PACS pre- and post-LPI among Iranian population using the pentacam and gonioscopy and concluded that pentacam more effective.[11] Bevara *et al.* and Kaur *et al.* compared the pre- and post-LPI using pentacam and gonioscopy among south India population and west India, respectively.[10,12]

ASP measured by pentacam and goniscopy in the PACS eye have been previously studied but to the best of our knowledge, this has not been systematically analyzed and compared among PACS patients in North Indian population. We present a study of LPI impact on ASP using Pentacam and gonioscopy among PACS patients in North Indian population.

Method

This comparative, prospective, interventional study was conducted between August 2019 to May 2021. We obtained clearance from institutional ethics committee (IEC) and the scientific research committee (SRC). This study follows the Declaration of Helsinki. Written informed consents were taken**.** Inclusion Criteria was patients of both genders, aged 40 years to 60 years old attending the ophthalmology department of our tertiary care hospital with occludable angles. Exclusion criteria were the patients who were not willing to participate, Uncooperative patient, previous ocular trauma, surgery or ocular pathology, or previous laser.

The sample size was calculated by Charan and Biswas formula based on the finding of Esmaeili *et al.*[11,13] To achieve 95% confidence interval (CI), 5% error margin, and 2% design effect, 91 individuals were required. After making contingency arrangements we targeted a sample size of 100.

LASER IRIDOTOMY PROCEDURE

We used 1% Pilocarpine (4 times) one hour before the LPI. The used YAG (neodymium yttrium-aluminum-garnet) laser and Abraham capsulotomy lens. We applied a single pulse of 5-6mJ shot to the site and it was repeated till LPI was achieved. Patency was confirmed by retroillumination fundus glow. Post LPI topical Dexamethasone 0.1% for 3 days and oral Acetazolamide (250 mg) stat were advised. One hour after LPI the IOP was checked and if found > 21 mmhg than topical Timolol 0.5% twice daily was advised for 3 days

ANTERIOR SEGMENT MEASUREMENTS

Pentacam (Oculus, Germany) was used to measure the anterior segment of the eye before LPI and one month post-LPI. The subject was seated in front of Pentacam with chin on chinrest and forehead against forehead strap. Blue fixation target is for fixation of eye and when real image becomes stable the Scheimpflug camera capture 50 images automatically around the optical axis of eye. If the image quality was bad, the procedure was repeated. The following parameters were recorded from the Pentacam maps: anterior chamber angle (ACA, degrees) anterior chamber depth along the optical axis (ACD, mm); anterior chamber volume (ACV,mm^3), central corneal thickness (CCT, µm). Post Pentacam imaging, the IOP was recorded by Goldmann Applanation tomometry and gonioscopy was performed by 2 mirror gonio (Ocular Instruments Bellevue, WA, USA) contact lens under magnification of 16x. We used topical corneal anesthetic Benoxinate hydrochloride 0.3% and lens coupling medium 2% Hypromellose solution in saline. We recorded ACA superiorly (S), nasally (N), inferiorly (I) and temporally (T) followed by Shaffer grading. A very narrow angle (10°) was grade 1 and closed angle (0°) was grade 0.[11] Rest other were grade 2 narrow (10°-20°), grade 3 Open (20°-35°) and grade 4 wide open (35°-45°).[11]

STATISTICAL METHODS

Table 1: Demographic Profile of Study Population

S.N.	Characteristic	Statistic
1-	Mean age ± SD (Range) in years	50.56 ± 6.03 (40-60yrs)
2-	**Gender** Male Female	 41 (41.0%) 59 (59.0%)
3-	**Occupation** Work from home Work out side home	 42 (42%) 58 (58%)
4-	**Family history of glaucoma** Yes No	 88 (88%) 12 (12%)
5-	**Previous glaucoma treatment** Yes No	 27 (27%) 73 (73%)
6-	**Socioeconomic status (as alleged by patients)** Low Middle High	 18 (18.0%) 62 (62.0%) 20 (20.0%)

Data was entered into Microsoft Excel 2013 sheet and analyzed by Statistical Package for the Social Sciences (SPSS) Version 21.0. The qualitative data were presented as frequency and percentages while quantitative data were presented as mean, standard deviation (SD) and range. Paired t'-test and Wilcoxon signed rank test was used to compare the change in anterior chamber parameters pre and post-LPI values. A $p < 0.05$ was considered to be significant statistically.

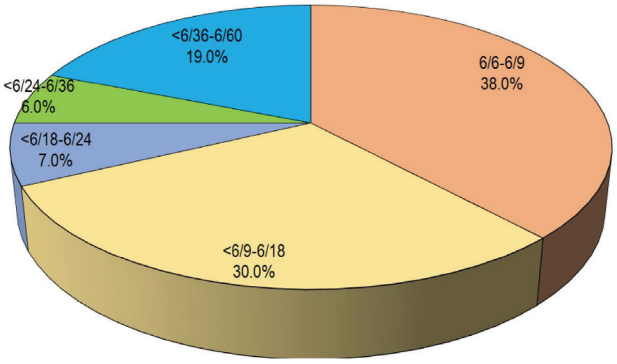

Figure-1 Distribution of cases according to BCVA status

Result

We examined 100 eyes of 100 patients, 41% of them were male and mean age was 50.56 ± 6.03 SD (ranged 40 to 60 years). Demographic profile presented in Table 1. A total of 27 (27%) patients had previous treatment history of glaucoma and 88 (88%) patients have positive family history of glaucoma. Mild lenticular sclerosis was present in 49% .Maximum number of cases had BCVA in 6/6-6/9 range (38%) followed by <6/9-6/18 range (30%), <6/36-6/60 range (19%), <6/18-6/24 (7%) and <6/24-6/36 range (6%) respectively (Figure 1).

Pentacam evaluation prior to intervention reported mean ACA ranged from 24.7° to 29.3° with a mean value of 26.73 ± 1.05°. ACD ranged from 1.87 to 2.29 mm with a mean of 2.09 ± 0.12 mm. ACV ranged from 67 to 97 mm^3 with a mean of 78.51 ± 7.12 mm^3. CCT ranged from 491 to 522 µm with a mean of 510

Table 2: Evaluation of pre and post LPI changes in Anterior Segment Parameters (ASP) using Pentacam.

SN	Parameter	Before LPI		After LPI		Change between pre- and post LPI		Statistical significance (Paired 't'-test)	
		Mean	SD	Mean	SD	Mean	SD	t	P
1.	Anterior chamber angle (°)	26.73	1.05	28.20	1.18	1.47	0.72	20.79	<0.001
2.	Anterior chamber depth (mm)	2.09	0.12	2.17	0.12	0.08	0.07	10.63	<0.001
3.	Anterior chamber volume (mm^3)	78.51	7.12	129.59	17.90	51.08	20.56	24.85	<0.001
4.	Central corneal thickness (µm)	510.0	6.5	510.18	6.8	0.17	2.26	0.752	0.454

Table 3: Evaluation of pre and post LPI changes in Anterior Segment Parameters (ASP) using Gonioscopic (Shaffer's Grades)

S N.	Quadrant	Shaffer's Grade					Statistical significance (Wilcoxon signed rank test)
		0	**1**	**2**	**3**	**4**	
1	**Superior**						
	Pre-intervention	30	12	19	28	11	z=8.345; p<0.001
	Post-intervention	0	2	40	46	12	
2	**Inferior**						
	Pre-intervention	0	0	0	7	93	z=2.235; p=0.025
	Post-intervention	0	0	0	2	98	
3	**Nasal**						
	Pre-intervention	72	25	3	0	0	z=8.703; p<0.001
	Post-intervention	0	15	73	12	0	
4.	**Temporal**						
	Pre-intervention	43	46	11	0	0	z=8.145; p<0.001
	Post-intervention	0	21	65	13	1	

± 6.5 µm. Following LPI mean ACA, ACD and ACV showed an increase of 1.47 ± 0.72°, 0.08 ± 0.07 mm, and 51.08 ± 20.56 mm^3, respectively. Statistically, these changes were significant (p<0.001) except for central corneal thickness (p=0.454) (Table 2).

Gonioscopic evaluation pre and post-LPI reveal that the angle width increased significantly in all quadrants (P<0.001) except I quadrant (P=0.025). In I quadrant, prior to intervention, all the cases had grades 3 and 4, however, following intervention, there was a significant increase in number of patients in Grade 4 (Table 3).

Discussion

We evaluated LPI impact on ASP using Pentacam and gonioscopy. Our study has the majority of female with a higher mean age group. Family History (FH) was positive in more than two third patients. About one-fourth of the patients have previous treatment history of glaucoma. Thirty-two percent of cases in our study have BCVA more than 6/18. Eighty percent of cases were from lower & middle socioeconomic status and lesser physical activity was reported in 42% of patients. Statistically significant changes in pre- and post-intervention LPI were observed in ASP on both Gonioscopy and Pentacam.

Our study has the majority of female with higher mean age group. Bevera *et al*, Esmaeili *et al*. and Xiaoyu *et al*. found mean age to be slightly higher with a higher proportion of females.[10,11,14] In another study, Kaur et al. reported a higher mean age of patients but a dominance of males.[12] Women generally are at a higher risk of PACG owing to anatomical predisposition.[15] However, our study also has patient profiler similar to most of the other literature that reported dominance of females and mean age between 50 and 60 years.[10,12,16-18]

FH was positive in more than two third patients. The role of FH and glaucoma is already been established.[18] Our study has female dominance with higher FH. It was found that positive FH was more reported among females and development of disease was more among males, further study is needed to confirm this.[18] One of the reason could be that females uses positive FH as a impetus to make eye appointment. Thus, we acknowledge that the rates of FH may be elevated owing to inclusion and exclusion criteria.[18]

About one-fourth of the patients have previous treatment history of glaucoma. O'Brien et al. reported more than half patients taking glaucoma medications.[18] Our study subjects were only PACS whereas O' Brien has open angle as well as close angle as study subjects which may be a reason of lower report in our study.

Thirty-two percent cases in our study have BCVA < 6/18. We only selected PACS so this maybe due to

Cataract (nuclear sclerosis) that is present in 49% of our cases. Another study also reported more than half cases of PACS with nuclear sclerosis.[18] Since study population was 40 to 60 yr old so senile cataract may leads to decrease visual acuity.

Eighty percent of cases were from lower & middle socioeconomic status. Late presentation of many diseases can be associated with Socioeconomic deprivation (SED). Health and mortality are linked with SED. Studies have reported advance stage of glaucoma related with greater SED. SED may delay identification of latent cases, awareness programme, eye care utilization and healthcare seeking behaviour. It has become more significant during the COVID pandemic with long term effect on health specially among SED.[19]

Our study reported 42% have work from home. Physical activity is a modifiable risk factor. However, there is a possibility of the severity of glaucoma restricted the physical activity of PACG patients as our study has only PACS but other eye may have severalty of glaucoma. Less severe PACG was reported among physically active patients.[20]

Pre-intervention gonioscopy grades for S, N and T quadrants were mostly grade 0 or grade 1 except I quadrant that has mostly grade 4. However, Esmaeili *et al.* and Kaur *et al.* in their study reported none of the patients with grade 0 or 4 prior to intervention, rather majority of S quadarent had grade 1and I quadarent had grade 2.[11,12] The Shaffer grades for gonioscopy were thus highly diverse in different studies probably owing to the difference in patient characteristics and severity of angle closure. Esmaeili *et al.* and Bevera *et al.* found I compartment to have better gonioscopy grades as compared to other quadrants.[10,11] A better gonioscopy grade in I compartment is often attributed to gravitational effect.

Pre-intervention Pentacam reported mean ACA, ACD, ACV and CCT values were 26.73 ± 1.05°, 2.09 ± 0.12 mm, 78.51 ± 7.12 mm^3 and 510 ± 6.5 µm, respectively. Esmaeili et al. and Bevara et al. reported pre-intervention ACD values ranged from 2.06mm & 1.91 mm respectively and ACA 25.59° & 24.4°, respectively.[10,11] Thus most of study reported mean ACD and mean ACA similar to present study range.

Post-intervention shows significant change in gonioscopy grades for all the four quadrants. After intervention, none of the eyes had grade 0, and only 2% in S, 0% in I, 15% in N and 21% in T quadrant had grade 1. Esmaeili et al. also found significant upgradation in all the quadrants.[11] It was maximum upgradation in I quadrant while it was minimum in T quadrant. This finding is contrary to our observations where I quadrant had minimum upgradation (I quaderant already open) while maximum upgradation was seen in N quadrant. Kaur et al. found significant upgradations in all the quadrants and found maximum upgradation in I followed by S, T and N quadrants respectively.[12] These findings suggest that while upgradation as a result of angle opening was very common in all the quadrants, however, the extent of upgradation in different quadrants was dependent probably on the pre-iridotomy status of that particular quadrant.

Post intervention pentacam reported mean change in ACA, ACD and ACV to be statistically significant, however, no significant change was observed in anterior chamber CCT. Esmaeili et al. has same finding.[11] Kaur et al. found a significant change in ACA and ACV but did not find the changes in ACD and CCT to be significant.[12] Bevera et al. in their study assessed only ACA and ACD and were significant statistically as observed in present study.[10] Jain et al. in their study measured ACD and ACV but found signiicant change in ACV only.[17] In fact, the parameter selection in different studies shows variability, however, most of these studies find significant change in one or more parameters following laser iridotomy. The findings thus suggest that following angle opening the anterior chamber morphology is affected resulting in the change in ASP. However, one must understand that while gonioscopy mainly focuses on the angular changes, Pentacam guided ASP help to assess both linear as well as angular changes. Thus, Pentacam adds additional dimension to morphometric assessment of anterior chamber changes taking place following laser iridotomy. Moreover, pentacam changes are quantitative in nature as compared to graded / ordinal changes studied by gonioscopy, thus giving the opportunity to study the changes in a more objective manner.

The findings of our study were in agreement with most of the previous literature. It could be seen while gonioscopy changes in different studies show a high degree of variability with studies like ours and that of Bevara et al. showing two or more grade upgradations in majority of cases whereas studies by Esmaeili et al. and Kaur et al. do not show such phenomenal changes, thus showing that gonioscopy is not as objective as Pentacam guided anterior chamber parameters.[10,11,12] Keeping in view the quantitative nature of Pentacam measurements and its ability to measure even the minor changes, it could be regarded as a more objective method of measurement of ASP following laser iridotomy.

Limitation

Further studies on a larger population with inclusion of other morphometric parameters including posterior chamber should be evaluated as the outcome measurements of laser iridotomy.

Conclusion

Post-laser iridotomy majority reported a significant increment in proportion of patients from lower grades of gonioscopy (0 and 1) to higher grades (2 and above) in all the quadrants. Changes in pre-laser iridotomy ASP were observed on both Gonioscopy and Pentacem after laser iridotomy. Pentacam was more sensitive to minor changes both angular and linear parameters.

References

1. Chaurasia RK, Kapil V, YasirZHCorrelation Of Visual Acuity With Macular Thickness In Early And Advanced Stages Of Primary Open Angle Glaucoma.DJO 2021;31:37-42.
2. Quigley HA. Number of people with glaucoma worldwide. Br J Ophthalmol. 1996; 80(5):389–93.
3. Cyrlin M.N. (2014) Primary and Secondary Angle-Closure Glaucomas. In: Samples J., Schacknow P. (eds) Clinical Glaucoma Care. Springer, New York, NY.
4. Foster PJ, Buhrmann R, Quigley HA, Johnson GJ. The definition and classification of glaucoma in prevalence surveys. Br J Ophthalmol. 2002; 86(2):238–42.
5. Prum BE, Herndon LW, Moroi SE, et al. Primary Angle Closure Preferred Practice Pattern(®) Guidelines. Ophthalmology. 2016; 123(1):P1–40.
6. Thomas R, Parikh R, Muliyil J, Kumar RS. Five-year risk of progression of primary angle closure to primary angle closure glaucoma: A population-based study. Acta Ophthalmol Scand. 2003; 81(5):480–5.
7. Mingguang He, David S. Friedman, Jian Ge et al. Laser Peripheral Iridotomy in Primary Angle-Closure Suspects: Biometric and Gonioscopic Outcomes. Ophthalmology 2007; 494–500.
8. Dabasia PL, Edgar DF, Murdoch IE, Lawrenson JG. Noncontact Screening Methods for the Detection of Narrow Anterior Chamber Angles. Invest Ophthalmol Vis Sci. 2015;56(6):3929-35.
9. Shinoj VK, Hong XJJ, Murukeshan VM, Baskaran M, Aung T. Progress in Anterior Chamber Angle Imaging for Glaucoma Risk Prediction—A Review on Clinical Equipment, Practice and Research. Med. Eng. Phys. 2016;38:1383–1391
10. Bevara A, Banigallapati S, Medikonda M, Potti S. Pentacam Based Quantification of the Changes in Anterior Chamber Morphology Following Laser Peripheral Iridotomy in Primary Angle Closure Suspects – A Novel Approach. DJO 2020; 30: 51-56.
11. Esmaeili A, Barazandeh B, Ahmadi S, et al. Assessment of the anterior chamber parameters after laser iridotomy in primary angle close suspect using Pentacam and gonioscopy. Int J Ophthalmol. 2013;6(5):680-4.
12. Kaur P, Gusain P, Singh J, Mahajan. Evaluation of the anterior chamber parameters after laser iridotomy in primary angle closure suspect: pentacam and gonioscopy study. Global Journal For Research Analysis. 2019; 8(1): 14-16.
13. Charan J, Biswas T. How to Calculate Sample Size for Different Study Designs in Medical Research? Indian J Psychol Med. 2013; 35(2): 121–126.
14. Xiaoyu Li, Zheng Wang, Qun Cao, et al. Pentacam could be a useful tool for evaluating and qualifying the anterior chamber morphology. Int J Clin Exp Med 2014; 7(7): 1878-1882.
15. Zebardast N, Kavitha S, Krishnamurthy P, et al. Changes in Anterior Segment Morphology and Predictors of Angle Widening after Laser Iridotomy in South Indian Eyes. Ophthalmology. 2016;123(12):2519-2526.
16. Jain R, Grewal D, Grewal SPS. Quantitative Analysis of Anterior Chamber following Peripheral Laser Iridotomy using Pentacam in Eyes with Primary Angle Closure. 2013;23(1):55-60.
17. Vajaranant TS, Nayak S, Wilensky JT, Joslin CE. Gender and glaucoma: what we know and what we need to know. Curr Opin Ophthalmol. 2010;21(2):91-99.
18. O'Brien JM, Salowe RJ, Fertig R, et al. Family history in the primary open-angle African American glaucoma genetics study cohort. American journal of ophthalmology. 2018 1;192:239-47.
19. Saxby E, Cheng K, O'Connell N, Sanders R, Agarwal PK. Is there an association of socioeconomic deprivation with acute primary angle closure?. Eye. 2021;11:1-7.
20. Chong Seong NT, Yaakub A, Jalil RA, et al. Effect of physical activity on severity of primary angle closure glaucoma. Therapeutic advances in ophthalmology. 2019;11:2515841419864855.