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Article

Study of variations in angle width following laser peripheral iridotomy using gonioscopy and biometry in primary angle closure suspects

Neelam N[1,*] and Jayashree C J[2]

[1] Associate Professor, Department of Ophthalmology, Koppal Institute of Medical Sciences, Koppal, Karnataka, India.
[2] Assistant Professor, Department of Ophthalmology, Koppal Institute of Medical Sciences, Koppal, Karnataka, India.
* Correspondence: dr.neelam890@yahoo.com

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Abstract: Background: Primary angle closure glaucoma (PACG) contributes considerably to the global burden of visual impairment.
Objective: To prospectively evaluate changes in anterior chamber width after laser iridotomy in primary angle closure suspect using GONIOSCOPY and BIOMETRY.
Material and Methods: This was a prospective non-randomized interventional hospital based study. 50 eyes of 29 patients with primary angle closure suspects (PACS) requiring Laser Peripheral iridotomy were included in the study.
Results: The study showed a statistically significant change between pre PI and post PI peripheral anterior chamber depth(PACD) 1.1±0.4 Vs 2.70±0.8(P<0.05) Statistically significant change in gonioscopic grading between pre and post PI, superior (0.20±0.40Vs2.20±1.10), inferior (1.0±1.0Vs.2.50±0.90), nasal (0.3±0.6Vs.2.40±0.90), and temporal quadrant (0.4±0.8 Vs. 2.30±1.0) (P<0.05). There was an overall increase of 2 units in Shaffer angle grading in all 4 quadrants. There was a significant decrease in IOP post iridotomy (16.44±2.70mmHg Vs 14.18±2.62mmHg),(P<0.05), almost 2mmHg of fall in IOP. The study showed statistically no significant change between pre and post PI biometry values-AXL and ACD.
Conclusion: Laser iridotomy produced a significant widening of the anterior chamber angle in patients with primary angle closure suspects as studied by gonioscopy and biometry. Gonioscopy is a viable tool to assess the effect of laser iridotomy.

Keywords: Primary angle closure suspect; laser iridotomy; gonioscopy; biometry anterior chamber angle.

1. Introduction

Glaucoma is the leading cause of irreversible blindness worldwide and is second only to cataracts as the most common cause of blindness overall (14%) [1]. The mainstay of treatment is early diagnosis and prevention of progression. According to an estimate in the year 2006, there would be 60.5 million people worldwide with open-angle glaucoma (OAG) and angle-closure glaucoma (ACG) in 2010, increasing to 79.6 million by 2020 [2].

Paragraph 2: Primary angle-closure glaucoma (PACG) is a common form of glaucoma in South India. The overall prevalence of primary angle closures (PAC and primary angle-closure glaucoma) in southern India is 1.58% [3]. Laser peripheral iridotomy is done prophylactically in primary angle-closure suspects. The purpose of laser peripheral iridotomy is to preserve visual function and maintain the quality of life by preventing acute angle closure crisis or primary angle-closure glaucoma from developing [4].

Paragraph 3: Laser peripheral iridotomy is a non-surgical, less expensive procedure. It is a cost-effective single one-time intervention, done as there is poor compliance of patients in developing countries like India for follow-up. Even in patients who are on certain medications (like decongestants, motion sickness medication, anticholinergic agents), there is a risk of acute angle closure crisis [5]. It is essential to evaluate the response to laser iridotomy by studying changes in anterior segment morphology. These changes can be quantified by gonioscopy and biometry [6].

2. Material and methods

This was a prospective interventional non-randomised hospital based study. The main source of data for this study were the patients with primary angle closure suspects attending the department of ophthalmology at Minto Hospital, in Bangalore during the study period from Nov 2011 to May 2013. Totally, fifty eyes were studied of patients who satisfied the inclusion and exclusion criteria. The study consists of 50 eyes of 29 patients with primary angle closure suspects which were thoroughly evaluated before the diagnosis was confirmed. Approval for this study protocol and clearance were obtained from The Ethical Review Committee in Bangalore Medical College and Research Institute, in Bangalore.

2.1. Inclusion criteria

1. Subjects who have given written consent for the study
2. Participants in whom 180 degree or more of posterior trabecular meshwork not visible during static gonioscopy with normal intraocular pressure.
3. Age group of 40-70years

2.2. Exclusion criteria

1. Patients with established Primary angle closure or Primary angle closure glaucoma
2. Patients with secondary angle closure glaucomas like Phacomorphic,Inflammatory,Neovascular glaucoma etc.,
3. Patients in whom angle structures are not visible secondary to opacities in the cornea.

2.3. Procedure of the study

It was a prospective hospital based study. 50 eyes of 29 patients with primary angle closure suspects (PACS) requiring laser peripheral iridotomy were included in the study. They were subjected to anterior segment evaluation including visual acuity, IOP measurement by applanation tonometer, peripheral anterior chamber depth assessment by Van Hericks method and angle assessment by Goldmann 2 mirror,and indentation gonioscopy done by Posner four mirror,using slit lamp. A narrow, vertical beam 1mm in length was offset horizontally for superior and inferior quadrants and was offset vertically for nasal and temporal quadrants. Fundus examination was done with the central lens of Goldmann two mirror lens and direct ophthalmoscope. Post iridotomy, the eyes were dilated with 1% tropicamide and slit lamp biomicroscopic examination was done with 78/90D lens. The disc size and cup:disc ratio was measured with the aid of a graticule (measuring eyepiece, Haag-Streit). Measurement of axial anterior chamber depth and axial length by A-scan ultrasound before pupil dilatation. In cases where the standard deviations of 10 measurements of ACD were less than 0.13 mm, the single best tracing was selected. After confirming the diagnosis of primary angle closure suspects, Laser peripheral iridotomy was done using Nd-YAG laser.

Pre-operative brimonidine [7] eye drops and post operative topical steroids and anti glaucoma medications were used as indicated in each patient. 2 weeks following laser iridotomy repeat gonioscopy and biometry was done.

Angle width compared using gonioscopy and biometry before and after procedure:

- In each patient a detailed history was taken and the proforma of the same is attached.
- A detailed ocular examination was done.
- Examination of the vision, intraocular pressure, anterior segment, gonioscopy, fundus was done for both eyes.

The study involved the following investigations and interventions on patients;

- Visual acuity testing
- Applanation tonometry
- Slit lamp examination
- Gonioscopy done with Goldmann 2 mirror and indentation gonioscopy with Posner 4 mirror before laser iridotomy
- Direct Ophthalmoscopy/ Slit lamp biomicroscopy
- A-scan biometry before laser iridotomy

- Nd:YAG Laser iridotomy
- Gonioscopy after laser iridotomy
- A-scan biometry after laser iridotomy
- Visual acuity testing
- Applanation tonometry
- Slit lamp examination
- Gonioscopy done with Goldmann 2 mirror and indentation gonioscopy with Posner 4 mirror before laser iridotomy
- Direct Ophthalmoscopy/ Slit lamp biomicroscopy
- A-scan biometry before laser iridotomy
- Nd:YAG Laser iridotomy
- Gonioscopy after laser iridotomy
- A-scan biometry after laser iridotomy

All the results of the various examinations and investigations were tabulated and evaluated statistically.

2.4. Statistical Analysis

Results are expressed as Mean ± SD, Range, numbers and percentages. Student t- test was used for comparing means of two groups. A p- value of 0.05 or less was considered for statistical significance.

3. Results

Most patients (55%) belonged to the age group of 51-60 years (Mean). 21 patients (72%) were female and 8 (28%) were male patients. Family history of glaucoma was present in 2 (7%) patients.

The change in intraocular pressure (IOP) after peripheral iridotomy in 50 PACS cases. some eyes showed a considerable drop in IOP while others did not. Overall, there was a statistically significant decrease in IOP post iridotomy (16.44±2.70mmHg Vs 14.18±2.62mmHg),($P < 0.05$).

Table 1. Comparison of pre and post PI intra ocular pressure scores by paired t test

Time	Mea n	Std.Dv	Mean Diff.	SD Diff.	% of change	Paired t	P-value
Pre PI	16.4 4	2.70	2.26	1.10	13.75	14.487 6	0.00001 *
Post PI	14.1 8	2.62					

*p<0.05

The change in peripheral PACD after peripheral iridotomy in 50 PACS cases.Mean PACD pre PI(1.1±0.4) and postPI (2.70±0.8). As seen from the table/graph most eyes showed a considerable increase in angle width following laser iridotomy, P<0.05.

Table 2. Comparison of pre and post PI PACD(Van herick grade) by Wilcoxon matched pairs test

Time	Mea n	Std.Dv .	Mean Diff.	SD Diff.	% of change	Z- value	P-value
Pre PI	1.1	0.4	-1.6	0.8	-140.4	5.9683	0.00001 *
Post PI	2.7	0.8					

*p<0.05

The change in gonioscopic grading of superior quadrant in 50 eyes after laser peripheral iridotomy. As seen by the above graph, most eyes showed a noteworthy improvement in gonioscopic grading post laser peripheral iridotomy. There was a statistically significant increase in mean gonioscopic grading post PI (0.20±0.40 Vs. 2.20±1.10),(P<0.05)

Table 3. Comparison of pre and post PI PACD(Van herick grade) by Wilcoxon matched pairs test

Time	Mea n	Std.Dv .	Mean Diff.	SD Diff.	% of change	Z- value	P-value
Pre PI	1.1	0.4	-1.6	0.8	-140.4	5.9683	0.00001 *
Post PI	2.7	0.8					

*p<0.05

None of the patients had any serious iridotomy related complications. A statistically significant change was noted in the angle width using gonioscopy two weeks following laser iridotomy in primary angle closure suspects. There was an overall increase of 2 units in Shaffer angle grading in all 4 quadrants.
A long-term follow-up of this cohort of patients is required to have a better understanding of the natural history of angle closure and to confirm the risk-to-benefit ratio of LPI for the prevention of PACG in people with narrow angles.

The change in gonioscopic grading of inferior quadrant in 50 eyes after laser peripheral iridotomy. As seen by the above graph, most eyes showed a noteworthy improvement in gonioscopic grading post laser peripheral iridotomy. There was a statistically significant increase in mean gonioscopic grading post PI. (1.0±1.0 Vs. 2.50±0.90)(P<0.05)

Table 4. Comparison of pre and post PI of Inferior gonioscopic scores by Wilcoxon matched pairs test

Time	Mea n	Std.Dv .	Mean Diff.	SD Diff.	% of change	Z- value	P-value
Pre PI	1.0	1.0	-1.5	1.1	-140.4	5.3028	0.00001 *
Post PI	2.5	0.9					

*p<0.05

The change in gonioscopic grading of nasal quadrant in 50 eyes after laser peripheral iridotomy. There was a statistically significant increase in mean gonioscopic grading post PI (0.3±0.6 Vs. 2.40±0.90), (P<0.05).

The change in gonioscopic grading of nasal quadrant in 50 eyes after laser peripheral iridotomy. There was a statistically significant increase in mean gonioscopic grading post PI (0.3±0.6 Vs. 2.40±0.90), (P<0.05).

The change in gonioscopic grading of temporal quadrant in 50 eyes after laser peripheral iridotomy. As seen by the above graph, there was a statistically significant increase in mean gonioscopic grading post PI (0.4±0.8 Vs. 2.30±1.0), (P<0.05).

The change in AXL in 50 eyes after laser peripheral iridotomy. There was a statistically no significant increase in mean AXL post PI (21.9720±0.9440mm Vs 21.9724±0.9406mm), (P=0.9166).

Table 5. Comparison of pre and post PI Axial length scores by paired t test

Time	Mean	Std.Dv.	Mean Diff.	SD Diff	% of change	Paired t	P-value
Pre PI	21.9720	0.9440	-0.0004	0.0269	-0.0018	-0.1052	0.9166
Post PI	21.9724	0.9406					

The change in ACD in 50 eyes after laser peripheral Iridotomy. There was statistically no significant increase in mean ACD post PI (2.5444±0.2247 Vs 2.5516±0.2262), (P=0.0649).

Table 6. Comparison of pre and post PI of anterior chamber depth scores by paired t test

Time	Mean	Std.Dv.	Mean Diff.	SD Diff.	% of change	Paired t	P- value
Pre PI	2.5444	0.2247	-0.0072	0.0270	-0.0283	- 1.8886	0.0649
Post PI	2.5516	0.2262					

4. Discussion

Laser peripheral iridotomy is the standard first-line intervention for acute and chronic angle Closure5. It prevents recurrence of acute episodes and eliminates the risk of acute attacks in fellow eyes. Iridotomy acts by eliminating relative pupil block which is one mechanism underlying the development of angle closure. By allowing aqueous to flow directly through the iridotomy site, LPI equilibrates the pressure between the

anterior and posterior chambers. Eliminating this pressure gradient flattens the iris, allowing the peripheral iris to fall backward, resulting in a wider angle configuration. However, the prophylactic efficacy of LPI for disease control is dependent primarily on the underlying mechanism. Gonioscopy technique used to examine structures in the anterior chamber angle. Anterior chamber depth (ACD) and axial length of the globe measured with hand-held A- mode ultrasound . Response to laser iridotomy quantified by gonioscopy and biometry.

Participants in whom 180° or more of the posterior (usually pigmented) trabecular meshwork was not visible during static gonioscopy were eligible for this study. All patients with established PAC (with evidence of previous acute episode or established peripheral anterior synechiae) or PACG (with established glaucomatous optic neuropathy) were excluded. The definition was based on the International Society of Geographical and Epidemiological Ophthalmology classification system.

Laser peripheral iridotomy (LPI) was performed using Neodynium-yttrium– aluminum–garnet laser. One drop pilocarpine 1% was instilled into the intervention eye 15 minutes before treatment. Energy levels of 3 to 8 mJ were used. The LPI was placed in the superior region (between the 10 and 2 o'clock) in the peripheral third of the iris. An opening of 150 to 200 microns was aimed for. The iridotomy site was examined for patency by retroillumination and direct visualisation of structures posterior to it. Post LPI patients a drop of 0.2% brimonidine was instilled and were given oral carbonic anhydrase inhibitor stat 2 tablets. All patients were given 1% dexamethasone drops to apply 4 times daily for 1 week. Pilocarpine was not used after the treatment. At least 2 weeks after the LPI treatment, the patients returned for a postoperative examination.

During the follow up visit, about 2 weeks after LPI, a complete ophthalmic evaluation was repeated. Gonioscopic and biometry examination was done under the same conditions as before. Changes in angle width were noted.

The practice of Nd-YAG laser peripheral iridotomy (LPI), is effective in lowering the intraocular pressure (IOP),as a prophylactic measure in preventing angle closure crisis. Khaw PT 6 et al noted without any ocular hypotensive medication use, the IOP decreased by almost 3 mmHg ($P<0.001$) after LPI. The mean pre-operative IOP was 14.4 ± 0.7mmHg Vs mean post-operative IOP of 11.3 ± 0.6mmHg.

Nolan WP, Foster PJ, Devereux JG, Uranchimeg D, Johnson GJ, Baasanhu8 noted sixty four subjects who were treated with YAG laser iridotomy ,27 eyes had an IOP recorded as>19 mmHg before iridotomy.Of these 15(55.5%) had IOP </= 19mmHg.(Mcnemar test for matched pair was with $P<0.01$)

In our study of fifty eyes with PACS, we found IOP decreased by almost 2mmHg ($P<0.05$) after LPI. The mean pre-operative IOP was 16.44 ± 2.70mmHg and the mean post-operative IOP was 14.18 ± 2.62mmHg. Most patients were not on topical/systemic antiglaucoma medications. Hence the drop in IOP can be entirely attributed to LPI.

Khaw PT 6et al studied 72 people with PACS and were subjected to laser PI and noted Limbal ACD (LACD) increased significantly after LPI. All patients had an LACD of one fourth or less of corneal thickness (traditional van Herick grade </=2).

5. Conclusion

Laser iridotomy produces a significant widening of the anterior chamber angle in patients with primary angle closure suspects. Gonioscopy is a viable tool to assess the effect of laser iridotomy. Biometric parameters did not significant change following LPI. Study confirms that iridotomy widens the anterior chamber angle in most PAC suspects, long-term prospective studies with a larger sample size are required to determine if the risks of PAC glaucoma and other related pathologic sequelae are reduced after prophylactic LPI and to investigate the risk-to-benefit ratio before recommending widespread use of prophylactic LPI in this population

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References

[1] Allingham, R. R., Moroi, S., Shields, M. B., & Damji, K. (2020). *Shields' textbook of glaucoma.* Lippincott Williams & Wilkins.

[2] Quigley, H. A., & Broman, A. T. (2006). The number of people with glaucoma worldwide in 2010 and 2020. *British journal of ophthalmology, 90*(3), 262-267.

[3] Vijaya, L., George, R., Arvind, H., Baskaran, M., Paul, P. G., Ramesh, S. V., ... & McCarty, C. (2006). Prevalence of angle-closure disease in a rural southern Indian population. *Archives of Ophthalmology, 124*(3), 403-409.

[4] Myron Yanoff., Jay S. Duker. Ophthalmology, 3rd edition- 2009, Mosby Elsevier. Pg no. 1162-1170 *American Acamedy of Ophthalmology Glaucoma panel*.Preferred practice pattern guidelines.AAO;2010

[5] He, M., Friedman, D. S., Ge, J., Huang, W., Jin, C., Lee, P. S., ... & Foster, P. J. (2007). Laser peripheral iridotomy in primary angle-closure suspects: biometric and gonioscopic outcomes: the Liwan Eye Study. *Ophthalmology, 114*(3), 494-500.

[6] Robin, A. L., & Pollack, I. P. (1984). A comparison of neodymium: YAG end argon laser iridotomies. *O*phthalmology, 91(9), 1011-1016.

[7] Nolan, W. P., Foster, P. J., Devereux, J. G., Uranchimeg, D., Johnson, G. J., & Baasanhu, J. (2000). YAG laser iridotomy treatment for primary angle closure in east Asian eyes. *British journal of ophthalmology, 84*(11), 1255-1259.

[8] Robin, A. L., & Pollack, I. P. (1984). A comparison of neodymium: YAG end argon laser iridotomies. *Ophthalmology, 91*(9), 1011-1016.