

ORIGINAL RESEARCH

Role of laser peripheral iridotomy in primary angle closure suspects

Neelam N¹, Jayashree C J^{2*}

¹Associate 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.

Corresponding Author: Dr. Jayashree C J, Assistant Professor, Department of Ophthalmology, Koppal Institute of Medical Sciences, Koppal, Karnataka, India.

ABSTRACT

Background: Laser peripheral iridotomy done prophylactically in primary angle closure suspects. Purpose of laser peripheral iridotomy is to preserve visual function and maintain quality of life by preventing acute angle closure crisis/Primary angle closure glaucoma from developing. Objective: To study the Role of laser peripheral iridotomy in primary angle closure suspects.

Materials and Method: This prospective interventional non-randomised hospital based study was conducted among 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.

Results: We included 50 eyes of 29 patients that satisfied our inclusion criteria. This consisted of 8 male and 21 female patients in the age group of 40 to 70 years. After complete evaluation and confirming the diagnosis of primary angle closure suspects, patients were subjected to Nd-YAG laser iridotomy. Angle width, ACD and AXL parameters using gonioscopy and A-scan ultrasound before and after the procedure were compared. 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.

Conclusion: Laser iridotomy produces a significant widening of the anterior chamber angle in patients with primary angle closure suspects.

Keywords: laser iridotomy, angle closure suspects, gonioscopy

INTRODUCTION

Glaucoma is leading cause of irreversible blindness worldwide and is second only to cataracts as most common cause of blindness overall(14%). As the main stay of treatment is early diagnosis and prevention of progression¹. Laser peripheral iridotomy done prophylactically in primary angle closure suspects. Purpose of laser peripheral iridotomy is to preserve visual function and maintain quality of life by preventing Acute angle closure crisis/Primary angle closure glaucoma from developing². Even done prophylactically in fellow eye to prevent from the acute attack in patient having primary angle closure glaucoma.

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) are at risk of Acute angle closure crisis.³

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.⁴

Liwan eye study done by Khaw PT et al showed that Laser peripheral iridotomy results in a significant increase in the angle width in Chinese people with narrow angles. Mean IOP decreased by 3mmHg, but axial anterior chamber depth did not change significantly after LPI. Median limbal anterior chamber depth increased from 15% to 25% of peripheral corneal thickness. Median iridotrabecular angle width increased. This report also confirms that iridotomy widens the anterior chamber angle in most Primary angle closure suspects⁴.

Study done by Narayanaswamy A, Vijaya L, Shantha B, Baskaran M, Sathidevi AV, Baluswamy S. Compared anterior chamber angle measurements using ultrasound biomicroscopy (UBM) and gonioscopy and showed that subjective assessment by gonioscopy resulted in an overestimation of angle width within the occludable group when compared with values obtained by Ultrasound biomicroscopy. This did not affect the segregation of occludable versus nonoccludable angles by gonioscopy. Biometric parameters in eyes with occludable angles were significantly lower in comparison with eyes with nonoccludable angles⁵

Study done by Li S et al to investigate the 3-D morphology changes of anterior segment in primary angle-closure suspect and primary angle-closure after laser peripheral iridotomy (LPI) using rotating Scheimpflug camera. Before and after Laser peripheral iridotomy, peripheral anterior chamber depth deepened. Anterior chamber angle widened from after Laser peripheral iridotomy and concluded that it induces dramatic changes of 3-D anterior segment morphology in primary angle-closure suspect and primary angle-closure⁸.

MATERIALS AND METHOD

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.

Inclusion Criteria

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

Exclusion Criteria

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

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 57 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
- All the results of the various examinations and investigations were tabulated and evaluated statistically

Statistical Analysis

Results are expressed as Mean \pm 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

RESULTS

Age wise distribution of the 29 patients included in our study. Majority of our patients (55.17%) belonged to the age group between 51 to 60 years.

Table 1: Age distribution (according to number of patients, n=29)

Age (years)	No of patients	% of patients
41-50	7	24.00
51-60	16	55.00
61-70	6	21.00
Total	29	100.00
Mean ± SD Age	55.90	7.08
Range	41-70	

We studied 50 eyes of 29 patients. That is, out of 29 patients, 21 patients had both eyes included in the study. Hence a separate table depicting the age distribution according to the number of eyes. Again, majority (54% or 27 eyes) of the eyes belonged to the age group of 51-60 years.

Table 2: Age distribution (according to number of eyes, n=50)

Age (years)	No of eyes	% of eyes
41-50	12	24%
51-60	27	54%
61-70	11	22%
Total	50	100%
Mean ± SD Age	56.06	7.03
Range	41-70	

Gender distribution of the patients included in our study. Majority of the patients were female(72.41%).

Table 3: Sex distribution (according to number of patients, n=29)

Sex	No of patients	% of patients
Male	8	28.00
Female	21	72.00
Total	29	100.00

We studied 50 eyes of 29 patients That is, out of 29 patients, 21patients had both eyes included in the study. Hence a separate table depicting the sex distribution according to the number of eyes. Again, a female preponderance was observed.

Table 4: Sex distribution (according to number of eyes, n=50)

Sex	No of eyes	% of eyes
Male	14	28.00
Female	36	72.00
Total	50	100.00

A female predominance is seen in all age groups.

Table 5: Age Distribution of patients according to Gender

Age groups	Male		%	Female	%	Total
41-50	2		28.57	5	71.43	7
51-60	5		31.25	11	68.75	16
61-70	1		16.67	5	83.33	6
Total	8		27.59	21	72.41	29

The number of patients having a positive family history. In our study, 7% (2 patients) had a family history of glaucoma.

Table 6: Family history of Glaucoma

Status of Glaucoma	No of patients	% of patients
Present	2	7.00
Absent	27	93.00
Total	29	100.00

The systemic illness in our study subjects. Out of 2 patients, 1 had diabetes, 2 had hypertension and 6 had both.

Table 7: Medical illnesses associated

Medical illnesses associated	No of patients	% of patients
Diabetes	1	3.00
Hypertension	2	7.00
Diabetes + Hypertension	6	21.00
No systemic illnesses	20	69.00
Total	29	100.00

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 8: Comparison of pre and post PI PACD(Van herick grade) by Wilcoxon matched pairs test

Time	Mean	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

Graph illustrate 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), ($P < 0.05$).

DISCUSSION

Glaucoma is leading cause of irreversible blindness worldwide and is second only to cataracts as most common cause of blindness overall (14%)¹. Primary angle closure glaucoma (PACG) contributes considerably to the global burden of visual impairment.⁸ Several population based studies in our country have highlighted its implication in the Indian^{3,27,28,31,32}

Laser peripheral iridotomy is the standard first-line intervention for acute and chronic angle Closure³. 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.

In our study, 50 eyes with PACS were subjected to gonioscopy and biometry examination before and after they underwent laser peripheral iridotomy. We assessed the change in angle width post iridotomy using gonioscopy and biometry.

Informed consent for the study was taken from all patients included. Snellen visual acuity were measured in all cases. Intraocular pressure (IOP) was measured with applanation tonometer (Perkins). A slit lamp examination was carried out on every subject, noting down the Van Hericks grading. Ischaemic sequelae of angle closure and any signs of secondary glaucoma were specifically looked for to exclude from the study. Gonioscopy was performed with Goldmann two mirror. A narrow, vertical beam 1mm in length was offset horizontally for superior and inferior quadrants and was offset vertically for nasal and temporal quadrants. The width of the irido- trabecular recess was recorded in the four quadrants. Care was taken to avoid the slit beam light falling on the pupil. Dynamic (indentation) gonioscopy using Posner four mirror lens was used to assess the presence or absence of peripheral anterior synechiae (PAS) in each quadrant. Patient in whom 180° or more of the posterior trabecular meshwork cannot be seen, in the absence of elevated IOP, PAS, or disc changes were included. Each quadrant of the anterior chamber angle was graded numerically using Shaffer's gonioscopic grading¹¹.

Fundus examination (undilated) prior to iridotomy 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).

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 Neodymium-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.

This study included 50 eyes of 29 patients. Out of the 29 patients, both eyes were included in 21 patients. In the rest, the other eye was excluded due to various causes like Primary angle closure glaucoma, and no angle closure suspect in other eye. 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.

Khaw PT⁴ et 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) before LPI, and this proportion decreased to 67% after laser treatment. Although 77.1% of treated eyes had an increase in LACD, only 7.1% had a decrease. Median LACD increased from 15% to 25% of peripheral corneal thickness after treatment ($P < 0.0001$, Wilcoxon signed-rank test).

Li S⁶ et al studied 37 eyes of 25 patients of PACS and PAC compared anterior segment parameters using rotating Scheimpflug camera before and after laser PI, peripheral anterior chamber depth deepened from 0.89 ± 0.26 to 1.14 ± 0.26 mm ($P = 0.000$);

In our study, the Peripheral anterior chamber depth increased from 1.1 ± 0.40 to 2.70 ± 0.8 after laser iridotomy. The difference was statistically significant ($P < 0.05$).

Laser peripheral iridotomy overcomes the pupillary block and hence flattens the peripheral iris. This leads to widening of the anterior chamber angle

Khaw PT⁴ et al observed statistically significant ($P < 0.0001$) increase in angle width in both superior and inferior quadrants. In the superior quadrant, the median Shaffer grade increased from 0 to 1. Shaffer grade increased in 50 eyes (72.4%), remained unchanged in 14 eyes (20.3%), and decreased in only 5 eyes (7.2%) Nolan WP, Foster PJ, Devereux JG, Uranchimeg D, Johnson GJ, Baasanhu.¹⁰ reported an increase in the Median angle width increased by two Shaffer grades following iridotomy, statistically significant ($P < 0.01$) Narayanaswamy A, Vijaya L, Shantha B, Baskaran M, Sathidevi AV, Baluswamy S⁵ studied Comparison of anterior chamber angle measurements using ultrasound biomicroscopy (UBM) and gonioscopy in 500 subjects. Gonioscopic grading was used to segregate occludable (slit-like, grades 1 and 2) from non occludable (grades 3 and 4) angles. Subjective assessment by gonioscopy resulted in an overestimation of angle width within the occludable group when compared with values obtained by UBM

In our study, the Shaffer's gonioscopic grading increased from 0.20 ± 0.40 to 2.20 ± 1.10 (superior quadrant), 1.0 ± 1.0 to 2.50 ± 0.90 (inferior quadrant), 0.3 ± 0.6 to 2.40 ± 0.9 (nasal quadrant), 0.4 ± 0.8 to 2.30 ± 1.0 (temporal quadrant). The difference was statistically significant ($P < 0.05$). There was an overall increase of 2 units in Shaffer angle grading in all 4 quadrants.

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.

REFERENCES

1. M. Bruce Shields, R. Rand Allingham, Karim F. Damji, Sharon Freedman, Sayoko E. Moroi, George Shafranov. Shields' Textbook of Glaucoma, 6th edition, Lipincott Williams & Wilkins. Pg no. 149-163.
2. Myron Yanoff., Jay S. Duker. Ophthalmology, 3rd edition- 2009, Mosby Elsevier. Pg no.1162-1170
3. American Academy of Ophthalmology Glaucoma panel.Preferred practice pattern guidelines.AAO;2010
4. Khaw PT, Foster PJ, He M, Friedman DS, Lee PS, Jin C et al.Laser Peripheral Iridotomy in Primary angle closure suspects:Gonioscopic and biometry outcomes the Liwan eye study.ophthalmology 2007;114(3):494-500
5. Narayanaswamy A, Vijaya L, Shantha B, Baskaran M, Sathidevi AV, Baluswamy S. Anterior chamber angle assessment using gonioscopy and ultrasound biomicroscopy.Jpn J Ophthalmol 2004;48(1):44-9
6. Li S ,Wang H ,Mu D, Fu J, Wang x, Wang N et al.Prospective evaluation of changes anterior segment morphology after laser iridotomy in Chinese by rotating Scheimpflug camera imaging.Clin Experiment Ophthalmol 2010;38(1):10-4
7. Robin AL, Pollack IP. A comparison of neodymium YAG and Argon laser iridotomies. Ophthalmology. 1984(9) : 1011-1016.
8. Ramanjit Sihota, Radhika Tandon. Parsons' Diseases of the Eye, 20th edition- 2007, Elsevier. Pg no. 270.
9. Dandona L, Dandona R, Mandal P et al. Angle-closure glaucoma in an urban population In southern India. The Andhra Pradesh eye disease study. Ophthalmology 2000 Sep; 107(9):1710-6.
10. Jacob A, Thomas R, Koshi S P et al. Prevalence of Primary Glaucoma in an urban south Indian population. Indian J Ophthalmol 1998; 46: 81-6.
11. Kolker A.E., Hetherington Jr. J.: , eds. Becker and Shaffer's diagnosis and therapy of the glaucomas. 5th ed. St Louis: CV Mosby; 1976
12. Nolan WP, Foster PJ, Devereux JG, Uranchimeg D, Johnson GJ, Baasanhu.YAG laser peripheral iridotomy treatment for primary angle closure in east asian eyes.Br J Ophthalmol 2000;84:1255-1259