International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

The Study of Effects of Nd: Yag Laser Peripheral Iridotomy on Refraction, Gonioscopy and Intraocular Pressure in the Spectrum of Primary Angle Closure Glaucoma

Dr. D. Swetha[1], Dr. D. Udayakumar[2], Dr. Neelapareddy Likhitha Reddy[3]

Post Graduate 3rd Year, Department of Ophthalmology, Narayana Medical College and Hospital, Chinthareddypalem, Nellore, India (Corresponding Author)

Professor, Head of the Department, Ophthalmology, Narayana Medical College and Hospital, Nellore

[3]Post Graduate 3rd Year, Department of Ophthalmology, Narayana Medical College and Hospital, Nellore

Abstract: ***Introduction: Glaucoma is currently one of the leading cause of irreversible blindness worldwide. Glaucoma is becoming more prevalent and is anticipated to impact 111.8 million individuals globally by 2040. People with PACG are 2.5 times more likely to become blind than those with POAG. The most common procedure for angle closure is Neodymium: yttrium-aluminum-garnet (Nd: YAG) laser peripheral iridotomy (LPI). Peripheral iridotomy (PI) acts by eliminating relative pupil block which is the mechanism underlying the development of angle closure. Thus, in our country where PAC spectrum disease accounts for almost 50% of the case load of glaucoma, the effectiveness of LPI as the first-line treatment for PAC spectrum eyes needs to be evaluated. Objectives: To evaluate the effects of laser peripheral iridotomy on intra ocular pressure (IOP), gonioscopy and refraction in cases diagnosed as Primary angle closure disease (PACD). Materials and Methods: We conducted a Hospital-based, prospective, interventional study during a study period from October 2021 to September 2022. During our study period, we evaluated a total of 100 eyes diagnosed as having Primary angle closure disease and treated them with Nd: YAG laser peripheral iridotomy. All 100 eyes were closely followed upto document the changes in IOP, gonioscopy grading and refraction. Results: Post LPI, we observed that overall there was a significant reduction of IOP. The values declined to a mean IOP of 19.25 ±9.35 mmHg during week one follow up and further reduced to18.83±9.47mmHg by one-month post-procedure. We observed that in PACG cases LPI was alone, not effective in controlling the IOP. During our final follow up, 35 eyes had angles narrow angles without peripheral anterior synechiae (PAS) i.e.>270 degrees of iridotrabecular contact (ITC) without PAS, open on indentation and 30 eyes had <270 degrees of ITC and were considered occludable angles. 35 eyes had persistent narrow angles with PAS i.e. >270 degrees of ITC with PAS. All these 35 cases with persistent narrow angles had significant PAS of ≥ 6 clock hours. There was no statistically significant change in the refraction post LPI. Conclusion: LPI as a single effective procedure was successful in controlling IOP and gonioscopic improvement of angle grades was seen in all PACS cases and PAC cases which had less than six clock hours of PAS. In PAC and PACG cases with more than six clock hours of PAS, LPI alone was not effective and such cases required additional treatment for glaucoma management. LPI does not alter there fractive status of the eyes.***

Keywords: PACS, PAC, PACG, Nd: YAGLPI, Gonioscopy, IOP.

1. Introduction

According to WHO, glaucoma is the second most common cause of blindness worldwide. Glaucoma is becoming more prevalent and is anticipated to impact 111.8 million individuals globally by 20401. Around the world, 66.8 million people are thought to be affected by primary glaucoma, with the primary angle-closure glaucoma accounting for approximately half of cases[2]. If primary angle-closure glaucoma, which is more common among Asian than Western countries, is not detected and treated at an early stage, it can substantially impair visual function. People with PACG are 2.5 times more likely to become blind than those with POAG[3, 4].

Hospital based data from India report PACG to be as common as primary open angle glaucoma (POAG), with 45% to 55% of primary glaucomas being PACG. In the glaucoma clinic of an eye hospital, in north India 45.9% of all primary adult glaucomas were of angle closure type.[5]

PACG is a condition in which elevation of intra ocular pressure (IOP) occurs as a result of obstruction to aqueous outflow by partial or complete closure of theangle by peripheral iris. The diagnosis is dependent largely on examination of anterior segment and careful gonioscopy.

According to the classification of Primary angle closure (PAC) spectrum disease adapted from foster et al, the chronic primary angle closure (CPAC) spectrum of disease ranges from primary angle closure suspects (PACS) to CPAC to chronic PACG. 6 Since then the definition of angle closure has undergone change. Angle closure is now described as an anatomical disorder where symptomatology does not specify the involved mechanism. [7] In Asian eyes, the majority of the closures arise from a combination of a pupil block and non pupil-blocking mechanisms[8]. Regardless of mechanism, angle closure prevents aqueous from leaving the eye through the trabecular mesh work, leading to elevated IOP. This rise in IOP may cause progressive loss of ganglion cells and axons at the optic nerve head, resulting in vision loss.[9]

Lasers have made the task of treating PAC spectrum simpler

and these procedures are being used routinely by most ophthalmologists even at a very basic level. The most common procedure for angle closure is Neodymium: yttrium-aluminum-garnet (Nd: YAG) laser peripheral iridotomy (LPI). Peripheral iridotomy (PI) acts by eliminating relative pupil block which is the mechanism underlying the development of angle closure.10 Thus, in our country where PAC spectrum disease accounts for almost 50% of the case load of glaucoma,[5] the effectiveness of LPI as the first-line treatment for PAC spectrum eyes needs to be evaluated. The purpose of this study was to determine the outcome of laser PI on angle morphology, IOP and refraction and to evaluate its efficacy as the first line of treatment in chronic primary angle closure spectrum.

Objectives

1) To study the gonioscopic changes of angle morphology following laser peripheral iridotomy.
2) To evaluate the effects of laser peripheral iridotomy on intra ocular pressure.
3) To evaluate changes in refraction post laser peripheral iridotomy

2. Materials and Methods

Source of Data

Patients attending the Glaucoma clinic and OPD at Narayana Medical College, Nellore.

Methods and Collection of Data

Study Design: Hospital based, prospective interventional study.

Study Period: October 2021 to September 2022.

Place of Study: Glaucomaclinic and OPD at Narayana Medical College, Nellore..

Sample Size: Minimum of 50 eyes which include Primary angle closure suspects, primary angle closure and Primary angle closure glaucoma. These subjects adhered to the inclusion and exclusion criteria.

Inclusion Criteria:

1) Patients with primary angle closure
2) Primary angle closure suspects
3) Patients with Primary angle closure glaucoma

Exclusion Criteria:

1) Patients on pupil altering drugs.
2) Patients with secondary angle closure glaucomas like Phacomorphic, Inflammatory and Neovascular glaucoma.
3) Patients in whom angle structures are not visible secondary to opacities in the cornea.
4) Penetrating eye injury/ prior intraocular surgery (incisional or laser).
5) Open angle glaucoma (primary and secondary), normal tension glaucoma and ocular hypertension patients.
6) Patients with any angle pathology other than primary angle closure glaucoma.

Methodology

Patients were selected based on the inclusion and exclusion criteria and their demographic data was documented. A detailed history was taken. The baseline ocular characteristics were examined and documented in the case proforma.

Visual acuity and best corrected visual acuity were examined for distance vision (using Snellens chart) and for near vision (using times new roman font). Dryrefraction was using streak retinoscopy or auto refractometry and was correlated with subjective refraction findings. The spherical equivalent was calculated. Emmetropiawas defined as a spherical equivalent between -0.50 diopter sphere (DS) and +0.50DS. Myopia was defined as a spherical equivalent lesser than -0.50 DS. Hypemetropia was defined as spherical equivalent greater than +0.50 DS.

Examination of anterior segment of the eye was done using both diffuse lightand slit lamp. This includes the grading of the anterior chamber using Van Herrick's split limbal technique. The intraocular pressure was measured using Goldman applanation tonometer. Undilated fundus evaluation was done with 90 D or directophthalmoscope.

Under topical anaesthesia with 0.5% proparacaine, the angle was evaluated in all four quadrants by both static and dynamic (indentation) gonioscopy using Ziess four mirror gonio lens. With low ambient illumination and 1-mm narr narrow beam, the width of the angle was graded in all four quadrants according to Shaffer grading system as occludable or open. The angle was examined to look for iris configuration; the presence, insertion and extent of PAS and pigments on the angle structures. Appositional versus synaechial closure was confirmed using both static and dynamic onioscopy.

The pre-procedure gonioscopy findings were categorized as follows

- $<270^{O}$of iridotrabecular contact
- $>270^{O}$ of iridotrabecular contact without PAS. That is narrow angles which open on indentation
- $>270^{O}$ of iridotrabecular contact with PAS. That is narrow angles with synaechial closure as evidence by indentation.
- PAS was categorized according to clock hours of involvement

Visual field analysis was done if disc changes are noted on fundus examination.

After complete ocular examination, a final diagnosis was made based on classification of PAC spectrum disease adapted from foster et al and patients were started on antiglaucoma medications according to standard protocol if required.

LPI Procedure

1) Patients were explained in detail about the nature of the disease and the importance of timely intervention. Those with advanced disease were informed regarding the possible need for additional surgical intervention. The willingness of the patients for further follow-up

visits was ensued prior to enrollment in study. The benefits and complications of Nd: YAG laser iridotomy were clearly explained to the patients.

2) An informed consent was taken.
3) Pupillary miosis: pilocarpinenit rate 2% one drop every fifteen minutes minimum three times beginning two hours before the procedure.
4) Control of glaucoma:
   a) Pupillarymiosis with Pilocarpine nitrate 2% also causes reduction in IOP.
   b) In glaucomatous eyes additionally carbonic anhydrase inhibitors (Acetazolamide 250 mg) one or two tablets was given orally thirty minutes before the procedure.
5) Anesthesia: Topical proparacaine HCL 0.5% eye drop was used before insertion of contact lens.
6) Comfortable positioning of patient with steady fixation obtained by the use of head strap and by adjusting fixation light
7) Iridotomy technique proper:

LPI was performed using VISULAS YAG- III Plus Laser machine- Q switched Nd: YAG laser in all study subjects and an Abraham Lens is used to perform the procedure

- Location: Between 10 o'clock and 2 o'clock so that it is covered by eyelid, at about three fourth of the distance between papillary margin and iris periphery
- Energy:3-8mJ per shot, 1-3pulse per shot
- PI size-around 300-500 microns
- Successful PI was confirmed in all cases by retro-illumination technique

Post-LPI Protocol:

1) Topical Brimonidine (0.15%) was applied to subjected eye after recording the IOP spike.
2) Patient is given prescription of Topical Antibiotic+ Steroids QID for 1 week and tapered
3) Patients were asked to review after one week and one month
4) Patients were started on antiglaucoma medications according to standard protocol if required.

Follow Ups

During the subsequent follows ups one week and one month later, patients underwent a comprehensive ophthalmic examination and any changes in the refraction, IOP and gonioscopy were noted using the same methods as mentionedabove.

During the one month follow up, based on the IOP, gonioscopy and disc findings, antiglaucoma medication were started, continued or discontinued.

Any complications occurring due to laser PI were documented during each visit.

3. Observation and Results

1) Demographic Data:

Age: In the current study, the average presenting age was 51.62 (±9.15) years.

Table 1: Age Distribution of cases

Age in Years	Total, N=50(%)
31-40	8 (16%)
41-50	18(36%)
51-60	13(26%)
61-70	10(20%)
71-80	1(2%)

The highest incidence of cases i.e. 36% were between 41- 50 years. Second highest incidence of the cases i.e. 26% were between 51-60 years.

a) Gender Distribution

The present study has a majority of female patients accounting for 70% of the total cases. 30% of the cases were male patients.

Table 2: Gender Distribution of Cases

Gender	Number of cases, N= 50 (%)
Male	15(30%)
Female	35(70%)

2) Baseline Ocular Characteristics:

Case Diagnosis:

The present study contains a total of hundred eyes diagnosed to have Primary angle closure disease. All cases were treated with Nd: YAG laser peripheral iridotomy.

Case Diagnosis

Diagnosis	Frequency (N=100)	Percent (%)
PACS	22	22
PAC	53	53
PACG	25	25
Total	100	100

It included 22 cases of PACS, 53 cases of PAC and 25 cases of PACG.

Baseline IOP:

The pre procedure baseline IOP was calculated for all 100 cases before LPI procedure and the average IOP was calculated

Baseline IOP

Diagnosis	IOP Mean	STD Deviation
PACS (N=22)	14.86	2.36
PAC (N=53)	24.38	6.68
PACG (N=25)	41.96	7.51

At the time of initial diagnosis, the average IOP of cases diagnosed as PACS was 14.86 ±2.36mmHg. The average IOP of cases diagnosed with PAC was 24.38±6.68mmHg and those diagnosed as PACG had an average IOP value of 41.96±7.51mmHg.

Baseline Gonioscopy

Baseline Gonioscopy	Cases (N=100)	Frequency
$<270^{O}$ITC	0	0
$>270^{O}$ITC without PAS	54	54
$>270^{O}$ITC with PAS	46	46

Initial examination revealed that 54% eyes had >270 degrees of angle closure without Peripheral anterior synechiae, 46 eyes had >270 degrees of angle closure with Peripheral anterior synechiae. Cases with <270 degrees of ITC were not included in our study as LPI was not performed in such cases. PAS was present in 46% of the cases comprising of PAC and PACG cases. None of the cases which were diagnosed as PACS had PAS.

Baseline Modified Shaffer's Grading of Angles

Modified Shaffer's grading	Frequency (n=100)
0	32
1	45
2	23
3	0

In all the cases, the baseline grading of the angle according to modified Shaffer's grading was grade two or lesser (i.e.>270 degree of ITC). 32% of the cases had grade zero angles which were narrowed to slit. 45% of the cases had an angle width 10o or lesser i.e. grade one angle. Gonioscopic grade two angles were seen in23% of the cases.

Total Clock Hours of PAS

Clock Hours of PAS	Frequency, N=46(%)
<6 clock hours	11(23.9%)
≥ 6clock hours	35(76.1)

Out of the 46 cases with >270 degree of ITC with PAS, 11 cases had <6 clockhoursof PAS. 35 cases had ≥ 6 clock hours of PAS.

Refraction

Out of the 100 eyes, refraction findings were documented in 74 cases. Emmetropia was defined as a spherical equivalent between -0.50 diopter sphere (DS) and +0.50 DS. Myopia was defined as a spherical equivalent lesser than -0.50 DS. Hypemetropia was defined as spherical equivalent greater than+0.50 DS

Base Line Refraction

Refractive error	Frequency (N=74)	Average spherical Equivalent (±SD)
Myopia	25 (33.78%)	-1.77(±1.29)
Hypermetropia	30(40.54%)	+1.42(±0.66)
Emmetropia	19(25.67)	0.05(±0.25)

3) Treatment Outcome

Overall change in IOP

IOP	Mean(SD)	Repeated measure ANOVA test
Pre-Procedure	26.68(±11.45)	F= 18.98
Week one post LPI	19.25(±9.35)	
One month post LPI	18.83(±9.47)	p < 0.0001

In our study we noted that, the overall Mean Pre- Procedure YAGPIIOP was 26.68 (±11.45) mmHg which declined to a mean IOP of 19.25 (±9.35) mm Hg during week one follow up and further reduced to 18.83 (±9.47) mmHg by one month post procedure, irrespective of patients who required additional medications or additional filtration surgery which was statistically significant (p<0.001).

IOP Change INPAC Cases

IOP in PAC cases	Mean (SD) N=53	Repeated measure ANOVA test
Pre-Procedure in PAC	24.38(6.68)	F=33.22 p <0.0001
Week one post LPI in PAC	16.72(5.38)	
One month post LPI in PAC	16.34(4.99)	

We observed that the mean Pre-procedure IOP in the cases diagnosed as PACwas 24.38 ± 6.68 mmHg which declined to a mean IOP of 16.72 ± 5.38 mmHg during the week one post procedure follow up and a further reduction of IOP to a mean valueof 16.34± 4.99 mmHg was observed during our final follow up at the end of one month post procedure. The IOP reduction observed post LPI in PAC cases was statistically significant.

IOP Change Post LPIINPACG Cases

IOP in PACG cases	Mean (SD) N=25	Repeated measure ANOVA test
Pre-procedure	41.96 (±7.51)	F=13.73 p<0.0001
Week one post LPI	31.12 (±8.61)	
One month post LPI	31.16 (±9.09)	

In our study, the cases which were diagnosed as PACG has a pre-procedure mean IOP value of 41.96 ± 7.51 mmHg. During the post procedure follow up the mean IOP value was 31.12± 8.61 mmHg one week post procedure and by one month post procedure the mean IOP value was 31.16±9.09 mmHg.

Gonioscopic Outcome

Gonioscopy	Pre Procedure (N=100)	One week Post LPI (N=100)	One month post LPI (N=100)	Chi Square test
<270^{O}ITC	0	30	30	35.33 p<0.0001
>270^{O}ITC without PAS	54	33	35	
>270^{O}ITC with PAS	46	37	35	

On follow up visit at one month, of the 100 eyes which had undergone YAGPI , 35 eyes had persistent narrow angles with PAS i.e.>270 degree of ITC with PAS, 35 eyes had > 270 degree ITC without PAS, open on indentation. 30 eyes had occludable angles i.e. <270 degree of ITC. There was a statistically significant improvement in the angle grading.

Overall Improvement of angle Grades

Grades of Improvement	Frequency	Percent
One grade improvement	38	38
Two grade improvement	51	51
O improvement	11	11

At the end of one month post procedure, we observed in our study that there was definite improvement of 1 to 2 shaffer's grades on angle of anterior chamber in 89% of cases. There was one grade improvement of angle in 38% of the cases. Two grade improvement of angles was noted in 51% of cases. In 11% of eyes, there was no improvement in shaffer's grading post LPI during the one month follow up.

Patency of Yagirido to my hole:

PI Status during Week One Follow Up

PI Status Week One	Frequency	Percent
Patent	97	97
Repeat PI	3	3
Total	100	100

During the one week post LPI procedure follow up, we observed that three cases needed a repeat LPI procedure. The PI was patent in 97% of the cases.

PI Status during One Month Follow up

PI Status One Month	Frequency	Percent
Patent	93	93
Repeat PI	7	7
Total	100	100

During the one month post LPI procedure follow up, we observed that seven cases needed a repeat LPI procedure. The PI was patent in 93% of the cases.

Changes in refraction

Refraction	PRELPI	One Week	One Month	Repeated Measure ANOVA
MYOPIA	-1.77(±1.29)	-1.79(±1.27)	-1.81(±1.26)	F= 2.02 p = 0.148
HYPERMETROPIA	+1.42(±0.66)	+1.39(±0.65)	+1.39(±0.65)	
MMETROPIA	+0.05(±0.25)	+0.01(±0.33)	+0.01(±0.33)	

In our study, we found no statistically significant change in refractive status of the eye post LPI procedure during our one week and one month follow ups

Final Outcome of Treatment

Status AT1M	Frequency	Percent
AGM	15	15.0
Filtration Surgery	14	14.0
No Further Treatment	71	71.0
Total	100	100.0

Complications of LPI

Complications of LPI

LPI Complications	Frequency	Percent
NIL	52	52
IRIS BLEED	14	14
MILD UVEITIS/ IRITIS	31	31
Corneal Burns	3	3
Post LPII OP Spike	38	38

Out of the 100 cases which underwent LPI, we observed that the procedure was uneventful in 52% of the cases. An IOP spike of ≥8 mmHg than baseline was observed in 38% of the cases .The second most common complication observed was mild uveitis /irits with aqueous flare/debris which was seen in 31% of the cases. Iris bleed at PI site was seen in 14% of the cases. Corneal burns as a complication has been documented in 3 cases.

4. Discussion

This study titled – "THE STUDY OF EFFECTS OF Nd: YAG LASER PERIPHERAL IRIDOTOMY ON REFRACTION, GONIOSCOPY AND INTRAOCULAR PRESSURE IN THE SPECTRUM OF PRIMARY ANGLE CLOSURE GLAUCOMA" was conducted in the department of ophthalmology, .Narayana Medical College, Nellore.

We conducted a Hospital based, prospective ,interventional study during a study period of October 2021 to September 2022. During our study period we evaluated a total of 100 eyes diagnosed as having Primary angle closure disease and treated them with Nd:YAG laser peripheral iridotomy. All 100 eyes were closely followed up to document the changes in IOP, gonioscopy grading and refraction.

Demographics Age Distribution

In our study, the mean age (±SD) among patients presenting with PACG who had undergone YAG PI is 51.62(±9.15) years and it ranges from 36 years to 72 years. Similar wide age group range has been reported in studies conducted by Ching-Hsi Hsiao et al 11 where the age group range was 40-83 years and in a study by Salmon et al 12 where the age group range was 56- 68 years which was almost similar to our group.

Gender Distribution

In the current study, the gender analysis revealed a female preponderance of cases. Among the total 50 patients, 15 patients were males, which comprised 30%. The female population represented 70% of the total number of patients. Similar observation of female preponderance has been observed in the study by Winfred P Nolan et al 13 where out of the 98 cases of PAC spectrum disease, 71.4% cases were female and only 28.5% cases were male. In a similar study by Ching-Hsi Hsiao et al 11, out of the 138 cases included; 78.2% of the cases were female and only 21.7% of cases were male. This increased prevalence of angle closure in women probably reflects the fact that women have shallower anterior chambers than men.

Baseline Ocular Characteristics Case Diagnosis

The present study contains a total of hundred eyes diagnosed to have Primary angle closure disease. Out of which, 22% of cases were diagnosis as PACS. 53% cases were diagnosed as PAC and 25% of cases were diagnosed as PACG.

Pre procedure IOP:

At the time of initial diagnosis, the overall Mean Pre-Procedure YAG PI IOP was 26.68 (±11.45) mmHg. The average IOP of cases diagnosed as PACS was 14.86±2.36 mmHg. The average IOP of cases diagnosed with PAC was 24.38±6.68 mmHg and those diagnosed as PACG had an average IOP value of 41.96±7.51 mmHg. At baseline, out of 100 eyes, 55% had IOP≤ 21 mm Hg. 45% had IOP > 21 mm Hg.

Gonioscopic grading

During the baseline pre-procedure gonioscopic evaluation of the cases, it was found that all the cases had narrow angles

i.e. grading of the angle according to modified Schaffer's grading was grade two or lesser. Out of the 100 eyes evaluated, 54% eyes had >270 degree of iridotrabecular contact (ITC) without peripheral anterior synechiae (PAS) on indentation. 46 eyes had >270 degree of ITC with PAS on indentation. Cases with <270o during baseline were not included as LPI was not performed in those cases and there were advised for regular follow-up.

Out of 46 eyes with PAS, 11 cases had <6 clock hours of PAS and 25 cases had >6 clock hours of PAS.

Refraction Status

Out of the 100 eyes, refraction findings were documented in 74 cases. In 26 cases, refraction could not be recorded due to significant cataract in the visual axis.

We found that out of the 74 cases in which AR was recorded, 40.54% were hypermetropes, 25.67% were emmetropes and 33.78% were myopes.

In analyzing the refractive status of our patients with angle-closure in our study, we found there was an almost equal distribution of myopia (33.78%) and hyperometropia (40.54%). Although this may be due to our small study population, but as shown in our study myopia in angle closure is not as rare as was previously believed.

In a study by Mohd. Noor et al 14, results similar to our study were observed. Out of 137 cases studied, the distribution of myopia (n=51; 37.2%) and hyperopia (n=49; 35.8%) was similar.

In a study by Sarah M. Simpson et al 15, which was retrospective evaluation of refractive status in patients with narrow angles; out of the 272 eyes, 28% (n=62) were myopic and 72% were hyperopic (n=161).

Treatment Outcomes IOP

In our study we noted that, the overall Mean Pre-Procedure YAG PI IOP was 26.68 ±11.45 mmHg. It was comparable to the study by Ching-Hsi Hsiao et al 11, which showed a mean IOP of 25.4 ± 7.1 mmHg, in the study by Alsagoff Z et al 16, which showed a mean IOP of 40 ± 15 mmHg, and the study by Rosman M et al 17, which showed a mean IOP of 31 ±12.5 mmHg.

Post LPI, we observed that there was a significant reduction of IOP. The values declined to a mean IOP of 19.25 ±9.35 mmHg during week one follow up and further reduced to 18.83 ±9.47 mmHg by one month post procedure. Thus there was a statistically significant reduction of IOP (at p-value<0.0001) and was controlled in 80% of cases.

There was an overall reduction in post LPI IOP in PAC cases from a pre- procedure average value of 24.38 ±6.68 mmHg to 16.72 ± 5.38 mmHg by week one and 16.34 ± 4.99 mmHg by one month post LPI which was statistically significant. Among the PACG cases, although there was a reduction of IOP from pre produce average of 41.96 ±7.51 mmHg to 31.12±8.61 mmHg during week one and 31.16±9.09 by one month. We observed that PACG cases LPI was alone not effective in controlling the IOP. Possible reason being the presence of significant PAS of more than six clock hours and not just pupillary block as the mechanism for IOP elevation in these cases.

These findings correlate with a study conducted by Jovina L S See et al 18 in 2011. The study showed that in 72% patients IOP got controlled with iridotomy. 28% of the cases required additional measures to manage the IOP.

In a study conducted by Pandav SS et al 19 to study the effectiveness of Nd: YAG laser PI for primary angle closure in Asian Indian patients, it was reported that iridotomy alone, controlled the intraocular pressure in 66.7% of cases with chronic PAC spectrum disease.

Gonioscopic Outcome

During the follow up visit at one month , of the 100 eyes which had undergone YAG PI , 35 eyes had persistent narrow angles with PAS i.e. >270 degree of ITC with PAS. 35 eyes had angles narrow angles without PAS i.e. >270 degree of ITC without PAS, open on indentation. 30 eyes had <270 degree of ITC and were considered occludable angles.

Post LPI during the one month follow up, we found that there was a definite improvement of one to two shaffer's grades of angle of anterior chamber in 89% of cases.

The results of gonioscopic improvement seen in our study are comparable with several other studies which report similar findings.

In a study by Jiang et al 20 in 2014 on 774 eyes with PACD spectrum, in 75% of the cases there was definite gonioscopic improvement of one to two grades. But there was persistent angle closure in 25% of the cases which has significant PAS. All the 35 cases with persistent angle closure even after LPI has significant PAS of ≥ 6 clock hours. The poor effectiveness of LPI for for these cases with ≥6 hours of PAS would seem important in selecting treatment within the well-known constraints of a developing country, including a possible one shot at treatment.

Similar findings have been reported in a study by Chen et al 21. He reported that the 111 eyes with significant PAS which were treated initially with laser iridotomy required further treatment as compared to the other group which underwent trabeculectomy as initial treatment.

Patency of Yag Iridotomy Hole.

During our overall follow up period post LPI of one month duration, a total of 10 cases needed repeat PI. It has been recorded that most of these cases had small iridotomy holes at the time of treatment or with intense aqueous flare and tissue reaction after iridotomy. Second time iridotomy was good enough and found patent in six eyes at follow up. The rest four eyes were advised filtration surgery and were started on antiglaucoma medication.

In a study by Jiang ye et al 20, the iridotomy was closed in 6% of eyes at 6 months follow up. N Naveh et al 22, showed that in 10% of post PI cases iridotomy was closed due to pigment epithelial proliferation.

Refraction Changes Post LPI

In our study, we compared the AR readings of 74 cases pre and post LPI procedure to document any significant change in refraction status of the eyes. We could not find any statistically significant change in the AR readings during our one week and one month follow up.

Complications of LPI

Out of the 100 cases which underwent LPI, we observed that the procedure was uneventful in 52% of the cases. An IOP spike of ≥8 mmHg than baseline was observed in 38% of the cases makingit the most common complication observed in our study .The second most common complication observed was mild uveitis /irits with aqueous flare/debris which was seen in 31% of the cases. Mild bleeding/microhyphema at PI site was seen in 14% of the cases. Corneal burns as complication has been documented in 3 cases.

In another study by N Naveh et al 23 in 1987 in 40 eyes, it showed that immediate post procedure increases the IOP in 42% of eyes, Causes iris bleed in 20% of eyes. In 3 eyes localised corneal oedema with Descemet folds corresponding to the area of laser application was noted a few hours after lasing and lasted up to four days

Final Treatment Outcome

Of the 100 eyes which underwent Nd: YAG LPI, during our final follow up71% of the cases did not require any additional treatment. 29% of cases required further treatment with antiglaucoma medications (AGM) and/ or filtration surgery. Out of 29% cases, 15% of the cases were controlled with AGM. 14% of the cases had uncontrolled IOP even with AGM which were advised filtration surgeries.

Baseline (pre-LPI) factors that were associated with persistent angle closure after LPI were the (i) presence of PAS ≥ 6 clock hours and (ii) increased IOP. There were the common baseline ocular characteristics in all 14 cases which required further filtration surgery.

The persistence of PAS even post LPI implies that it is in an effective measure to halt the disease progression in eye with narrow “occludable” angles rather than in eyes with narrow wangles with significant PAS of ≥ 6 clock hours.

In our study, none of the PACS cases required any further treatment. This proves that LPI has acted as an effective prophylactic measure in all cases of PACS by preventing progression of the disease.

5. Conclusion

LPI as a single effective procedure was successful in controlling IOP and gonioscopic improvement of angle grades was seen in all PACS cases and PAC cases which had less than six clock hours of PAS. In PAC and PACG cases with more than six clock hours of PAS, LPI alone was not effective and such cases required additional treatment for glaucoma management.LPI does not alter the refractive status of the eyes.

6. Summary

- This was a Hospital based, prospective, interventional study in which we evaluated a total of 100 eyes diagnosed as having Primary angle closure disease and observed the outcome of Nd:YAG laser peripheral iridotomy in them.
- The average presenting age was 51.62±9.15 years with a wide range of 36 years to 72years
- Female patients were 3 times more common than male patients.
- Among the 100 eyes treated, it included 22 cases of PACS, 53 cases of PACand25 cases of PACG.
- The overall average IOP at the time of initial diagnosis was 26.68±11.45 mmHg.
- The average IOP of cases diagnosed as PACS was 14.86±2.36 mmHg. The average IOP of PAC cases was 24.38±6.68 mmHg and those diagnosed as PACG had an average IOP value of 41.96±7.51 mmHg.
- Initial examination revealed that 54% eyes had >270 degree of angle closure without Peripheral anterior synechiae, 46 eyes had >270 degree of angle closure with Peripheral anterior synechiae. Cases with <270 degree of ITC were not included in our study as LPI was not performed in such cases. PAS was present in 46% of the cases comprising of PAC and PACG cases. None of the cases which were diagnosed as PACS had PAS.
- We found that out of the 74 cases in which refraction was recorded, 40.54% were hypermetropes, 25.67% were emmetropes and 33.78% were myopes.
- Post LPI, we observed that overall, there was a significant reduction of IOP. The values declined to a mean IOP of 19.25 ±9.35 mmHg during week one follow up and further reduced to 18.83 ±9.47mmHg by one month post procedure. This was statistically significant. IOP was controlled only by LPI in71% of the cases.
- There was an overall reduction inpost LPIIOP in PAC cases from a pre-procedure average value of24.38 ±6.68 mmHg to 16.72 ± 5.38 mmHg by week one and16.34±4.99mmHg by one month post LPI which was statistically significant.
- Among the PACG cases, although there was a reduction of IOP from pre produce average of 41.96 ±7.51 mmHg to 31.12 ±8.61 mmHg during week one and 31.16±9.09 by one month. We observed that in PACG cases LPI was alone not effective in controlling the IOP. Possible reason being the presence of significant PAS of more than six clock hours and not just pupillary block as the mechanism for IOP elevation in these cases.
- During our final follow up, 35 eyes had angles narrow angles without PAS i.e.>270 degree of ITC without PAS, open on indentation and 30 eyes had <270 degree of ITC and were considered occludable angles. 35 eyes had persistent narrow angles with PAS i.e.>270 degree of ITC with PAS.
- All these 35 cases with persistent narrow angles had significant PAS of ≥ 6clock hours.
- There was no statistically significant change in the refraction post LPI.
- Of the 100 eyes which underwent Nd: YAG LPI, during our final follow up71%of the cases did not require any additional treatment.
- 29% of cases required further treatment out of which 15% of the cases were controlled with AGM. 14% of the

cases had uncontrolled IOP even with AGM which were advised filtration surgeries as they as these cases could not be controlled by even after LPI.

- In all the PACS group and fellow eyes of PAC & PACS groups, LPI was found to be an effective prophylactic measure in controlling the IOP and in widening of the angle.

Limitations of our Study

1) Small sample size.
2) Short duration of study.

References

[1] Kang JM, Tanna AP. Glaucoma. Med Clamong North Am. 2021 May;105(3):493-510. doi: 10.1016/j.mcna.2021.01.004. Epub 2021 Apr 2. PMID: 33926643.
[2] Quigley HA. Number of people with glaucoma worldwide. Br J Ophthalmol. 1996;80(5):389-93. Comment in: Br J Ophthalmol. 1996;80(5):385-6. Br J Ophthalmol. 1997;81(1):93.
[3] Foster PJ, Johnson GJ. Glaucoma among China: how big is the problem? Br J Ophthalmol 2001; 85(11): 1277–1282
[4] Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol 2006; 90(3): 262–267. Different stages of primary angle-closure glaucoma Y-Y Chen et al 1075 Eye
[5] Sihota R, Agarwal HC. An Indian perspective on angle closure and glaucoma. Indian J Opthalmol2011;Jan;59(Suppl 1): S 76-S 81.
[6] Foster PJ, Buhrmann R, Quigley HA, Johnson GJ. The Definition and Classification of Glaucoma in Prevalence Surveys. Br J Ophthalmol. 2002 Feb. 86 (2):238-42.
[7] He M, Foster PJ, Johnson GJ, Khaw PT. Angle closure glaucoma in East Asian and European people. Different Diseases- Eye 2006:20:3-12.
[8] Congdon N, Wang F, Tielsch JM. Issues in the epidemiology and populationbased screening of primary angle-. closure glaucoma Surv Ophthalmol.1992;36:411-23. Bibliography 73
[9] Weinreb RN, Aung T, Medeiros F. The pathophysiology and treatment of glaucoma: a review. JAMA. 2014;311(18):1901–1911.
[10] Nolan WP, Foster PJ, Devereux JG, Uranchimeg D, Johnson GJ, Baasanhu J. YAG laser iridotomy treatment for primary angle closure in east Asian eyes. Br J Ophthalmol2000;84:1255-9
[11] Hsiao C, Hsu C et al .Mid-Term Follow-up of Nd : YAG Laser Iridotomy in Asian Eyes. Ophthalmic Surg Lasers Imaging 2003;34:291-298.
[12] J.F Salmon et al. Long-Term IOP Control after Nd-YAG Laser Iridotomy in Chronic Angle closure Glaucoma. Journal of Glaucoma 2:291-296 1993.
[13] Nolan WP et al. YAG laser iridotomy treatment for primary angle closure in east Asian eyes. Br J Ophthalmology 2000 Nov 1;84(11):1255–9.
[14] Mohamed-Noor J, Abd-Salam D. Refractive errors and biometry of primary angle-closure disease in a mixed Malaysian population. Int J Ophthalmol 2017;10(8):1246-1250
[15] Sarah M. Simpson, Daniel C. Warder et al. ; Refractive Status In Patients With Narrow Angles. Invest. Ophthalmol. Vis. Sci. 2012;53(14):6374.
[16] Alsagoff Z, Aung T et al Long-term clinical course of primary angleclosure glaucoma in an Asian population. Ophthalmology. 2000 Dec;107(12):2300
[17] Rosman M, Aung T et al. Chronic angle-closure with glaucomatous damage. Ophthalmology. 2002 Dec;109(12):2227–31.
[18] Jovina L S et al. Management of angle closure glaucoma. Indian journal of ophthalmology vol. 59 Suppl, Suppl1 (2011): S82-7. doi:10.4103/0301-4738.73690 Bibliography 79
[19] Pandav SS, Kaushik S, Jain R, Bansal R, Gupta.Laser peripheral iridotomy across the spectrum of primary angle closure. Can J Ophthalmol 2007; 42(2):233-7.
[20] Jiang Y, Chang DS, Zhu H, et al. Longitudinal changes of angle configuration in primary angle-closure suspects: the Zhongshan Angle-Closure Prevention Trial. Ophthalmology.2014;121:1699e1705
[21] Yan Yun Chen, Su Jie Fan, Yuan Bo Liang, et al. Laser Peripheral Iridotomy versus Trabeculectomy as an Initial Treatment for Primary Angle-Closure Glaucoma. Journal of Ophthalmology, vol. 2017.Article ID 2761301. https://doi.org/10.1155/2017/2761301.
[22] H.Naveh et al. Neodymium-YAG laser iridotomy in angle closure glaucoma: preliminary study. British Journal of Ophthalmology.1987 ;71e: 257-2