

EFFICACY OF ND:YAG LASER PERIPHERAL IRIDOTOMY IN PATIENTS IN THE SPECTRUM OF PRIMARY ANGLE CLOSURE

Ophthalmology

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ABSTRACT

Introduction: Glaucoma is a chronic progressive multifactorial optic neuropathy caused by a group of ocular conditions which damage the optic nerve with a resultant loss of visual function. 60 million people are affected with glaucoma worldwide and more than 20 million have PACG. Of these, more than 5 million with PACG are blind which is twice more than POAG. Laser iridotomy is an effective treatment and now has become the preferred method in almost all cases of angle closure glaucoma. **Aims And Objectives:** To study the efficacy of laser iridotomy as a primary therapy for primary angle closure spectrum. **Method:** 48 eyes of 31 patients with primary angle closure disease (PACD) requiring Laser Peripheral iridotomy were included in the study. Detailed Ophthalmic evaluation including visual acuity, IOP measurement by Applanation tonometer, peripheral anterior chamber & angle assessment by Van Herick and gonioscopy using Slit lamp. Measurement of Intraocular pressure before and after 1 hour, 2 weeks and 6 weeks of Laser peripheral iridotomy were recorded. The patients were followed up for 6 weeks. **Results:** This study included 48 eyes of 31 patients. Most patients (41.9%) belonged to the age group of 41-50 years. most of the patients belonged to 41 to 60 years of age group. 18 (58%) patients were female and 13 (42%) were male patients. Out of 31 patients, 1 (3.22%) had diabetes only, 4 (12.90%) had hypertension only and 11 (35.48%) had both. Our study included 19 patients with PACG, 6 patients with PAC and 6 patients with PACS. Family history of glaucoma was present in 3 (9.68%) patients. The IOP reduction after 1 hour, 2 weeks and 6 weeks were statistically significant (P value <0.05), thus, showing the efficacy of Laser peripheral iridotomy as the standard first-line intervention for acute and chronic angle closure for both therapeutic and prophylactic purpose. **Conclusion:** Nd:YAG laser iridotomy has now become treatment of choice in angle closure glaucoma. Efficacy of iridotomy depends on IOP at presentation, presence or absence of PAS, stage of the disease & pre-existing glaucomatous optic neuropathy.

KEYWORDS

INTRODUCTION

Glaucoma is a chronic progressive multifactorial optic neuropathy caused by a group of ocular conditions which damage the optic nerve with a resultant loss of visual function⁽¹⁾

The most important risk factor is a raised intra ocular pressure⁽²⁾

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 progression⁽³⁾

60 million people are reported to be affected with glaucoma worldwide and more than 20 million have PACG. Among these people, more than 5 million with PACG are blind. This is twice more than POAG⁽⁴⁾

The chronic primary angle closure spectrum is divided into 3 groups- primary angle closure suspects (PACS), Primary angle closure (PAC) and Primary Angle closure glaucoma (PACG).

Asians are mostly affected by PACG while in the western countries open angle glaucoma is more common⁽⁵⁾

At present 12 million people in India are affected by glaucoma which accounts for 12.8% of the blindness in the country.

Hospital based data from India reports POAG to be as common as PACG, with 45% to 55% of primary glaucomas being PACG^(6,7). In the glaucoma clinic of an eye hospital, 45.9% of all primary adult glaucomas were of angle closure type⁽⁷⁾

Laser peripheral iridotomy is a non-surgical, inexpensive and effective treatment of Angle Closure Glaucoma. The current popular lasers in use are Nd:YAG and Argon Lasers. Iridotomy acts by eliminating relative pupil block which is one mechanism behind the development of angle closure. It allows aqueous to flow directly through the iridotomy site and equalises the pressure between the anterior and posterior chambers. By eliminating this pressure gradient, it flattens the iris, allowing the peripheral iris to fall backward, resulting in a wider-angle configuration.

Laser iridotomy has proven to be an effective primary therapy for early PACG although the advanced cases usually require further treatment

with topical medication or filtration surgery. The unaffected fellow eyes of patients who have had angle closure have a 50% risk of developing an episode of angle closure if they are not treated with prophylactic iridotomy. Iridotomy acts by relieving the relative pupillary block which is the mechanism underlying the development of angle closure.

As it is a cost-effective, one-time intervention, it has now become the preferred method in almost all cases of Angle Closure Glaucoma.

MATERIALS AND METHODOLOGY

The present study was conducted at a tertiary care centre during the study period from 1st August, 2021 to 31st July, 2022.

Approval and clearance were obtained from the Ethical Review Committee of the Institute.

A detailed history was taken from each patient regarding onset, duration and progression, aggravating & relieving factors associated with symptoms. History of any treatment taken previously for the same symptoms was enquired and noted. History of previous ocular problems, procedures and ocular trauma were enquired. A total of 48 eyes of 31 patients were chosen for the study (the study was conducted during COVID pandemic period)

Study Design

This was a prospective, interventional, non-randomised hospital-based study.

Criteria Of The Patients

1. Patients in the Primary Angle Closure Spectrum treated with ND-YAG peripheral iridotomy.
2. Subjects who have given written consent for the study.

Exclusion Criteria

1. Patients with corneal edema
2. Excessive shallow anterior chamber or completely sealed angle
3. Patients with secondary angle closure glaucoma
4. Patients on anti-coagulants.

MATERIAL USED

Snellen's visual acuity was measured on all the patients.

A slit lamp examination was done on every patient for anterior segment

evaluation.

IOP was measured with a Goldmann Applanation tonometry

METHODOLOGY

Before LPI, IOP was controlled medically and counselling was done. After proper informed consent for LPI, Nd:YAG laser was performed using Abrahams lens under topical anaesthesia using proparacaine eye drops. Pilocarpine eye drop was instilled 3-4 times every 15 minutes, one hour prior to LPI to make iris crypts prominently visible. YAG energy levels between 3-8 milli joules, 1-2 pulse in burst mode with 2-4 shots were used to make a sufficient opening. 10-1 o'clock is usually chosen as the site for LPI.

Post LPI antiglaucoma drug and steroid drops were given for 2 weeks. Intraocular pressure was recorded after 60 min, subsequent recording at 2nd week and 6th week was done after peripheral iridotomy. Vision, slit lamp examination, IOP measurement were recorded in each follow-up. Patency of Iridotomy hole, complications post LPI if any were assessed. Results were evaluated for IOP control and need of repeat intervention. All the results of the various examinations and investigations were tabulated and evaluated statistically.

RESULTS

Table:1 Age Distribution According To Number Of Patients N=31

Age (years)	No of patients	Percentage of patients
21-30	1	3.22
31-40	0	0
41-50	13	41.9
51-60	4	12.9
61-70	8	25.8
71-80	5	16.1
Total	31	100

Age Distribution(according To Number Of Patients, N=31).

This table and graph show the age wise distribution of the 31 patients included in our study. Majority of patients belonged to age group 41-50 years (41.9%) followed by 61-70 years (25.8%)

Table 2: Gender Distribution (According To Number Of Patients, N=31)

Sex	No of patients	% of patients
Male	13	42
Female	18	58
Total	31	100

Gender Distribution (according To Number Of Patients, N=31).

The above table and graph show the gender distribution of the patients included in our study. Majority of the patients were female (58%)

Table 3: Age Distribution Of Patients According To Gender

Age groups	Male	%	Females	%	Total
21-30	0	0	1	100	1
31-40	0	0	0	0	0
41-50	6	46	7	54	13
51-60	2	50	2	50	4
61-70	2	25	6	75	8
71-80	3	60	2	40	5

Graph 3: Age Distribution According To Gender

Table 4: Medical Illness Associated

Medical illness associated	No of patients	% of patients
Diabetes	1	3.22
Hypertension	4	12.90
Diabetes + hypertension	11	35.48
No systemic illness	15	48.38
Total	31	100

Table 5: Family History Of Glaucoma

Family history	No of patients	% of patients
Present	3	9.68
Absent	28	90.32
Total	31	100

The above table and graph show the number of patients having a positive family history. In our study, 9.68% (3 patients) had a family

history of glaucoma.

Table 6: Initial Diagnosis In Eyes Treated With Yag Laser Iridotomy

PACG	19
PAC	6
PACS	6
TOTAL	31

The above table shows initial diagnosis in eyes treated with YAG laser iridotomy. 19 PACG, 6 PAC and 6 PACS were included in the study

Table 7: Need For Repeat Pi

REPEAT PI	NO OF PATIENTS	% OF PATIENTS
YES	2	6.45
NO	29	93.55

The above table shows need for repeat YAG laser iridotomy. Our study had 2 patients who were previously treated with YAG laser Iridotomy and needed a repeat YAG

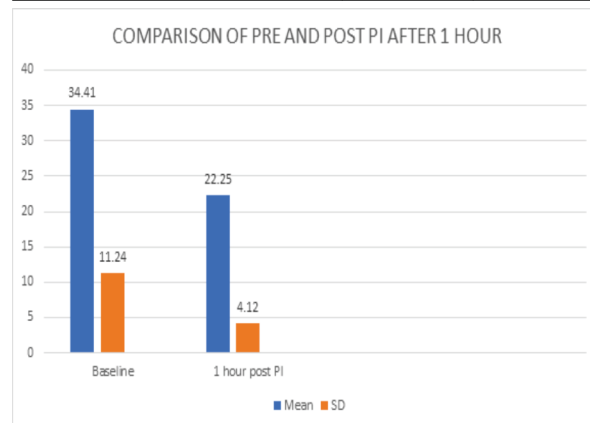
Table 8: Complications Of Yag Iridotomy

COMPLICATION	NO OF CASES	Percentage
TRANSIENT RISE IN IOP	5	16.1
AQUEOUS FLARE	3	9.67
BLEEDING OF IRIS	2	6.45
CORNEAL BURNS	1	3.22
LENS DAMAGE	0	0

The above table shows complications in patients treated with YAG laser Iridotomy

Table 9: Comparison Of Baseline (pre- Pi) And Post Pi (1 Hour) Intra Ocular Pressure Scores By Paired T Test

IOP	MEAN	SD
BASELINE	34.41	11.24
AFTER 60 MINS POST LASER	22.25	4.12



Graph 9: Comparison Of Iop Pre Versus Post Pi After 1 Hour

The above table and graph depict the change in intraocular pressure (IOP) after 1 hour of peripheral iridotomy in 48 PACS eyes. n = 48 degree of freedom= n-1 =47

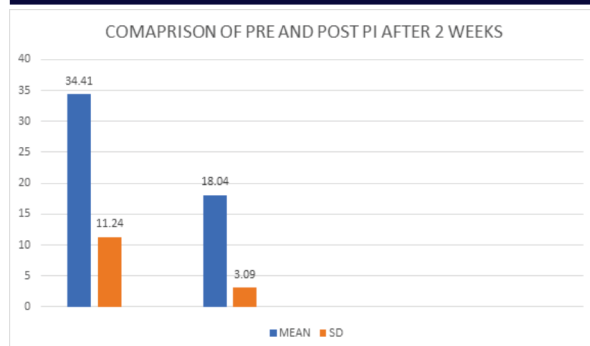
- t-stat= 8.161
- t critical= 2.012 (t-stat> t-critical suggesting there is significant difference)
- P-value

The p-value is less than 0.05. It means that the chance of type I error (rejecting a correct null hypothesis) is small.

- Overall, there was a statistically significant decrease in IOP post iridotomy after 1 hour (34.41±11.24) mm Hg Vs (22.25±4.19) mm Hg, (P<0.05)

Table 10: Comparison Of Baseline (pre Pi) And Post Pi (2 Weeks) Intra Ocular Pressure Scores By Paired T Test

IOP	MEAN	SD
BASELINE	34.41	11.24
2ND WEEK	18.04	3.09



Graph 10: Comparison Of Iop Pre Versus Post Pi After 2 Weeks

The above table and graph depict the change in intraocular pressure (IOP) after 2 weeks of peripheral iridotomy in 48 PACS eyes.

Here, $n = 48$

degree of freedom = $n - 1 = 47$

$t\text{-stat} = 11.767$

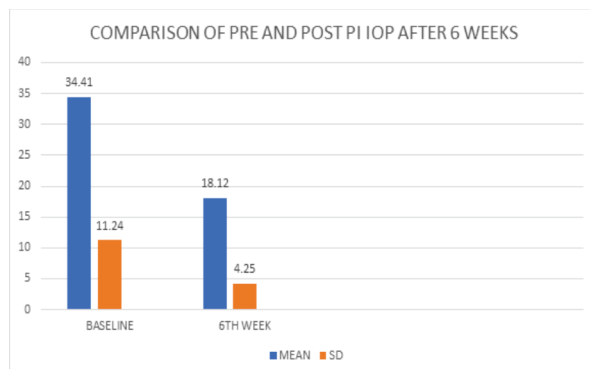
$t\text{ critical} = 2.013$ ($t\text{-stat} > t\text{-critical}$ suggesting there is significant difference) $P\text{-value}$

The $p\text{-value}$ is less than 0.05. It means that the chance of type I error (rejecting a correct null hypothesis) is small

Overall, there was a statistically significant decrease in IOP post iridotomy after 1 hour (34.41 ± 11.24) mm Hg Vs (18.04 ± 3.09) mm H, ($P < 0.05$)

Table 11: Comparison Of Baseline (pre Pi) And Post Pi (6 Weeks) Intra Ocular Pressure Scores By Paired T Test

IOP	MEAN	SD
BASELINE	34.41	11.12
6TH WEEK	11.24	4.25



Graph 11: Comparison Of Iop Pre Versus Post Pi After 6 Weeks

The above table and graph depict the change in intraocular pressure (IOP) after 6 weeks of peripheral iridotomy in 48 PACS eyes.

Here, $n = 48$

degree of freedom = $n - 1 = 47$

$t\text{-stat} = 12.032$

$t\text{ critical} = 2.013$ ($t\text{-stat} > t\text{-critical}$ suggesting there is significant difference) $P\text{-value}$

The $p\text{-value}$ is less than 0.05. It means that the chance of type I error (rejecting a correct null hypothesis) is small

Overall, there was a statistically significant decrease in IOP post iridotomy after 1 hour (34.41 ± 11.24) mm Hg Vs (18.12 ± 4.25) mm Hg, ($P < 0.05$)

Statistical Analysis

Results are expressed as Mean $\pm$ SD, Range, numbers and percentages. Student $t\text{-test}$ (paired $t\text{-test}$) was used for comparing means of two groups.

$A\text{-value}$ of 0.05 or less was considered for statistical significance

DISCUSSION

In this study the IOP changes following Neodymium YAG laser peripheral iridotomy was evaluated on 48 eyes of 31 patients with Primary Angle Closure Glaucoma on a therapeutic and prophylactic basis. All the patients were followed up for a period of 6 weeks during which the changes in IOP and complications were monitored.

Nd-YAG laser iridotomy for the primary angle closure glaucoma was performed at a tertiary care centre during the period of 1st August 2021 to 31st July 2022.

Patient Profile:

Age

This study included 48 eyes of 31 patients. Most patients (41.9%) belonged to the age group of 41-50 years.

41-60 years age group had 17 patients whereas 51-70 years age group had 12 patients. Thus, in our study most of the patients belonged to 41 to 60 years of age group.

Studies from European community prove incidence of angle closure is more between 51-70 years group. Thus, angle closure glaucoma has occurred a decade earlier in our population study

Sex

18 (58%) patients were female and 13 (42%) were male patients.

This study showed a female predilection of the disease which too is in good concurrence with the previous studies of Drance S.M (1973)^{(8),(9)} Fontana S.T and Brubacker R.F (1980)⁽¹⁰⁾.

Co-morbidities

Out of 31 patients, 1 (3.22%) had diabetes only, 4 (12.90%) had hypertension only and 11 (35.48%) had both. While 15 (48.38%) patients did not have diabetes or hypertension.

Our study included 19 patients with primary angle closure glaucoma, 6 patients with primary angle closure and 6 primary angle closure suspects.

Family history of glaucoma was present in 3 (9.68%) patients.

Intra-ocular Pressure Changes Following Nd:YAG Laser Peripheral Iridotomy

In our study of 48 eyes of 31 patients, we found the mean baseline (pre-PI) IOP was 34.41 ± 11.24 mmHg. The mean post-PI IOP was 22.25 ± 4.19 mm Hg (after 1 hour). There was significant decrease in IOP after 1 hour of post PI.

The IOP reduction at the end of 2nd week was statistically significant ($P\text{ value} < 0.05$). The mean post-PI IOP was 18.04 ± 3.09 mm Hg (after 2 weeks).

The mean post-PI (at 6 weeks) IOP was 18.12 ± 4.25 mm Hg ($P < 0.05$) which is statistically significant.

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The results, thus, shows the efficacy of Laser Peripheral Iridotomy as the standard first line intervention for acute and chronic angle closure for both therapeutic and prophylactic purpose.

These Findings Correlate With,

1. Jovina LS See et al; 2011. Which showed that in 72% patients IOP got controlled with iridotomy⁽¹¹⁾
2. AAO publication 2007; showed 86.7% patient's IOP got controlled with iridotomy⁽¹²⁾

Need for Repeat YAG PI

Second time iridotomy was performed at another site with appropriate size hole in 2 patients. 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 all 3 eyes of 2 patients at follow up.

These Findings Correlate With,

1. In a study by Jiang ye at human medical university, Changsha iridotomy was closed in 6% of eyes at 6 months follow up⁽¹³⁾. In our study we had 6.25 % of eyes with closed iridotomies.

Complications of YAG PI

In present study 5 patients showed an increase of IOP over the baseline following YAG PI. The greatest rise observed was at 1 hour after YAG laser iridotomy.

In a study by Hsiasoch, shensc at Chang-Ghung Memorial Hospital, Taipei, Taiwan transient elevation of IOP was noted in 23.5% patients and mild iris bleeding in 12.2% patients.

In our study transient elevation of IOP was noted in 5 (16%) patients and iris bleeding was noted in 2 (6.45%) patients. These complications were attributed to the increased amount of laser energy required for dark brown Indian iris. Other complications were aqueous flare in 3 (9.67%) patients and corneal burn in 1 (3.22%) case.

These Findings Correlate With,

1. Naveh et al; 1987, showed that post YAG increases the IOP in 42% of eyes, Causes iris bleed in 20% of eyes⁽¹⁴⁾
2. D J Brazier et al; 1986, showed that in 33% of eyes IOP increased after YAG PI is done⁽¹⁵⁾

CONCLUSION

Glaucoma is leading cause of irreversible blindness worldwide and is second only to cataracts as most common cause of blindness overall (14%). It should be diagnosed and managed timely and effectively to prevent visual loss.

Laser peripheral iridotomy is the standard first-line intervention for acute and chronic angle closure. It prevents further recurrence of acute episodes and decreases the risk of acute attacks in fellow eyes. Once an acute attack has been controlled with anti-glaucoma medication, a Nd YAG laser iridotomy is indicated and it can be safely and successfully done to prevent the attack from recurring. It has also been found to be of much safety and efficacy in the fellow eyes of patients in whom one eye suffered an attack or gives a past history suggestive of it.

All the patients undergoing YAG laser iridotomy showed considerable reduction in IOP & increase in the angle of the anterior chamber. Statistically significant reduction of IOP from baseline was seen when measured 1 hour, after 2 weeks and 4 weeks of Laser PI. Anti-glaucoma medications could be stopped as soon as the IOP starts lowering following a functioning laser peripheral iridotomy.

There were very minor complications like transient elevation of IOP, corneal burns, aqueous flare, iris bleeding in patients after iridotomy. These were treated effectively after iridotomy with topical steroids and anti-glaucoma medications.

Nd.YAG laser iridotomy has proven to be effective in reducing elevated IOP in primary angle closure patients. Thus, Nd.YAG laser iridotomy is a safe, inexpensive, non-invasive but effective procedure for both acute and chronic angle closure.

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Conflict Of Interest- NIL

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