DOI: 10.5603/OJ.2022.0034

Study of power use and complication frequency of Nd:YAG laser iridotomy in the management of primary angle closure glaucoma

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ABSTRACT

BACKGROUND: The aim of the study was to assess the power use and efficacy of Nd:YAG laser iridotomy in the management of primary angle closure (PAC).

MATERIAL AND METHODS: A prospective cross-sectional analysis was done in 146 eyes of 81 cases who underwent neodymium: yttrium-aluminum-garnet laser iridotomy. There were 42 patients with chronic primary angle closure glaucoma (PACG), 46 with acute and subacute PAC, and 11 with PACS (suspects). After initial intraocular pressure (IOP) controlling, all patients were treated with Nd:YAG laser iridotomy. Before and after the laser therapy, IOP, laser parameters, mean power use, and complications, if any, were noted.

RESULTS: The average total power used was 78.56 ± 8.1 mJ per eye. The anatomy of angle structures improved by one or two of Shaffer's grades. Controlled IOP was noted in 71% (17) of patients with PACG (chronic) and 93% (43) of patients with PAC (acute and subacute). The average total power used was 78.568.1 mJ per eye. Junior residents used more power than senior residents (88.5 62.5 mJ *vs.* 63.55 ± 5.8 mJ, p = 0.011). Complications included elevated IOP in 38.27% (31/81), aqueous flare/debris in 34.56% (24/81), iris bleeding in 18.51% (15/81), corneal burns in 4.93% (4/81), and lens damage in 3.71% (3/81). Laser peripheral iridotomy (LPI) was repeated in 48.14% of cases (39/81), with junior residents having a higher rate of repeat LPI than senior residents (p = 0.02). Complication rates differed between residents who performed the procedure (p = 0.16). In PACS subjects, 63.6% had a history of repeated LPI, followed by 58.33% in PACG and 39.1% in PAC cases. At follow-up, 3% of PAC eyes had glaucomatous optic neuropathy.

CONCLUSION: Laser iridotomy in managing early PACG reduces IOP and improves patient acuity. Nd:YAG laser iridotomy is effective in widening the drainage angle and lowering elevated IOP in patients with PAC.

KEY WORDS: primary angle closure glaucoma; intraocular pressure; Nd:YAG laser iridotomy; complications

Ophthalmol J 2022; Vol. 7, 211–218

INTRODUCTION

Angle-closure disease due to glaucoma accounts for half of global blindness [1–4]. Early treatment prevents permanent optic nerve damage also visual loss. Primary angle closure glaucoma (PACG) is distinguished from primary angle closure (PAC) by glaucomatous optic neuropathy, as well as visual field, nerve fibre layer changes, and optic nerve damage [5].

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PACG affects 6% of glaucoma patients but only 0.6% of the general population; women are more affected than men [6–8].

PACG needs immediate treatment to reduce intraocular pressure (IOP) and the risk of vision loss [9]. In the last decade, the preferred method for creating an opening in the irides has shifted from incisional surgery to laser surgery [10].

This is because there is no risk of infective endophthalmitis, and it can be done as an outpatient procedure [11]. Nd:YAG Laser iridotomy reduces IOP in PACG patients [12–15].

Iridotomy alleviates angle closure development by removing the relative pupil block. Non-pupil block mechanisms influenced angle closure in the Asian population as well.

In theory**,** laser peripheral iridotomy (LPI) should prevent the onset of chronic and acute angle closure glaucoma. However, once chronic angle closure glaucoma has developed, limited evidence suggests that laser peripheral iridotomy may be sufficient to control IOP [10].

LPI is thought to be safe, but complications were also possible. Transient blurred vision, increased IOP, dysphotopsia, hyphema, iridotomy closure, and tissue damage are complications [16–18].

A number of studies have reported on the typical power use and complication rates among LPIs performed by ophthalmologists, but none have reported on the power use, IOP improvement, and complication rates among resident-performed LPIs [19–22].

The purpose of this study was to assess the efficacy of YAG laser in the treatment of PACG and IOP control. Anatomical changes in the anterior chamber following peripheral iridotomy were also evaluated.

MATERIAL AND METHODS

Study design

The study was prospective, descriptive, and observational. It was conducted on 146 eyes of 81 consecutive patients with PACG who attended a glaucoma clinic at a tertiary care centre.

The institutional ethics committee approved this protocol, and all subjects provided informed consent. The current study adhered to the Helsinki Declaration's tenets.

Sample size measurement: The prevalence of PACG in south India ranges from 0.5% to 4.3% [23, 24]. The sample size of 81 patients was calculated at the 5% significance level with an 80% power.

Sampling technique: Purposive.

Patients were followed from January 2012 to August 2013. The average period of follow-up was 6 months.

Procedure: A static Humphreys automated field analyzer was used to analyse the visual fields. A slit-lamp examination was performed to look for ischaemic sequelae of angle closure as well as glaucoma signs. The patency of the laser iridotomy site was assessed using retro illumination and direct visualisation of structures in the posterior pole. A Goldmann applanation tonometer was used to determine IOP. To calculate the final IOP of each eye, the median of the three tonometer readings was used. For the gonioscopy, a Goldmann gonioscopy lens was used. The iridotrabecular recess was measured in each of the four quadrants. The angle was classified as either occluded or open. To determine the presence or absence of PAS, dynamic gonioscopy with a Zeiss four mirror gonioscopy lens was used.

Procedure: This study followed routine clinical practice.

Two hours before the procedure, one drop of pilocarpine nitrate 2% was infused into the eyes every fifteen minutes. Iris stretching and thinning are maximised by intensive pretreatment with miotics such as pilocarpine nitrate 2% topically. Because a tense iris tears more easily, laser penetration or perforation of iris tissue is made easier.

Glaucoma was treated with pupillary miosis and 2% pilocarpine nitrate, which reduced IOP. 1% acloclonidine or 0.15–0.2% brimonidine tartrate eye drops were instilled one hour before a laser session to prevent post-laser pressure spikes. One or two carbonic anhydrase inhibitor tablets (acetazolamide 250 mg) were administered orally thirty minutes before the procedure in glaucomatous eyes.

Improved corneal clarity was achieved by instilling 5% sodium chloride into the eye to reduce corneal oedema.

Before inserting the contact lens, a topical lignocaine 4% or preferably proparacaine HCL 0.5% eye drop was used to provide anaesthesia.

The procedure was completed with a YAG laser and 1–3 shots. A full-thickness opening in the iris in a single shot was the ideal target. It is not uncommon to perform up to four shots to perforate the iris. The contact lenses axis should be parallel to the axis of the focusing beam. The pulse energy should be no more than 10–12 mJ if the anterior

chamber depth is zero. Burst mode was not used because an iris hole could occur prior to the burst, resulting in anterior lens capsule damage.

Laser beams are typically directed at the iris's periphery, onto iris crypts, or into areas of thin stroma where the iris thickness is less. This also prevents anterior lens capsule injury due to the peripheral location. The lens curves backwards towards the equator and the periphery. As a result, the anterior lens capsule's periphery is not adjacent to the iris's posterior surface.

Patients were followed one day, one week, two weeks, one month, and six months after the procedure, with particular emphasis on IOP, visual acuity, and angle status.

If the IOP measured after 1-hour iridotomy was 30 mm Hg, oral steroid was administered, and the eye undergoing LPI was treated with tobramycin + dexamethasone (Tobradex) eye drops four times daily for three days.

For statistical analysis, SPSS software was used (version 20, SPSS Inc., Chicago, IL, United States). The range and mean ± standard deviation (SD) of variables were used. To compare quantitative variables, the unpaired t-test was used. The Student's t-test, Pearson's correlation coefficient test, multivariate logistic regression analysis, and Fisher's exact test were used whenever possible. A p-value of 0.05 was deemed significant.

RESULTS

A total of 146 eyes of 81 consecutive patients with PAC, treated with Nd:YAG laser iridotomy, were included in this study. Demographics are depicted in Table 1.

A mean age of patients was 59.5 ± 20.5 years; 69.13% were female. The majority of subjects (56.7%) had a diagnosis of PACS. The anatomy of angle structures improved by one or two of Shaffer's grades. 41.78% of the study subjects underwent bilateral YAG laser iridotomy. The baseline mean IOP before treatment was 19.45 ± 10.9 mm Hg, and at 45–50 minutes after the procedure, the mean IOP was 16.2 ± 7.7 mm Hg. IOP was well controlled in 71% (n = 17) patients of PACG (chronic) and 93%(n = 43) of the PAC (acute and subacute) group.

Junior residents performed 35 (37.03%) of the procedures, and senior residents performed the remaining.

The mean total power used by both residents was 78.56 ± 8.1 mJ per eye, which decreased significant-

Table 1. Baseline characteristics of study subjects

Characteristics	Subjects
Total number of procedures done (n)	146
Total number of cases (n)	81
Total number of eyes [n(%)]	146 (100%)
Right eye	80 (54.79%)
Left eye	49 (33.56%)
Bilateral	61(41.78%)
Age distribution [n(%)]	
31–40 yr	3 (3.71%)
41–50 yr	32 (39.5%)
51–60 yr	31 (38.27%)
61–70 yr	15 (18.51%)
Age (yr) mean ± SD	59.5 ± 20.5
Sex [n(%)]	
Male	25 (30.86%)
Female	56 (69.13%)
Residence [n(%)]	
Urban	49 (60.49%)
Rural	32 (39.5%)
Diagnosis	
PACG	24 (29.6%)
PAC	46 (26.8%)
PACS	11 (13.58%)
IOP [mm Hg]	
Mean baseline IOP	19.45 ± 10.9
Mean post IOP	16.2 ± 7.7

PACG — primary angle closure glaucoma; PAC — primary angle closure; PACS — primary angle closure suspects; IOP — intraocular pressure

Table 2. Post- Nd:YAG laser iridotomy and their characteristics

Characteristics	Subjects
Mean power used in all study subjects	78.5 ± 68.1 (n = 146)
Failures [n(%)]	
PACG (chronic)	7 (8.64%)
PAC (acute and subacute)	3 (3.7%)
PACS	0 (0%)
Complications [n(%)]	
Transient elevation of IOP (> 8 mm)	31(38.27%)
Aqueous flare/debris	28(34.56%)
Bleeding of iris	15(19%)
Corneal burns	4(4.93%)
Lens damage	3(3.71%)

PACG — primary angle closure glaucoma; PAC — primary angle closure; PACS — primary angle closure suspects; IOP — intraocular pressure

Table 3. Mean power use and complication rates in different diagnoses				
Complication	**PACG (chronic) (n = 24)**	**PAC (acute and subacute) (n = 46)**	**PACS (n = 11)**	**p-value**
Mean power ± SD [mJ]	108.2 ± 88.9	89.5 ± 63.9	70.8 ± 60.5	0.025*
Mean power used by junior residents	130.2 ± 126.4	86.2 ± 46.9	71.8 ± 68.3	0.011
Mean power used by senior residents	76.5 ± 62.5	61.5 ± 39.6	72.8 ± 59.2	0.011
Elevated IOP	11	15	5	0.03
Aqueous flare/debris	9	17	2	0.04
Bleeding of iris	3	10	2	0.02
Corneal burns	1	2	1	0.85
Lens damage	0	2	1	0.5
Repeat	14/24	18/46	7/11	-

PACG — primary angle closure glaucoma; PAC — primary angle closure; PACS — primary angle closure suspects; IOP — intraocular pressure

Table 4. Comparison of mean power use and complication rates among rural and urban population			
Complication	**Rural (n = 32)**	**Urban (n = 49)**	**p-value**
Mean power ± SD	69.84 ± 62.5	84.5 ± 81.5	0.39
Elevated IOP	11	20	0.08
Aqueous flare/debris	8	20	0.1
Bleeding of iris	7	8	0.9
Corneal burns	3	1	0.45
Lens damage	3	0	–
Total repeat	20	19	0.9

SD — standard deviation; IOP — intraocular pressure

ly with increasing residency years (p = 0.011). Junior residents used significantly more electricity than senior residents (88.5 ± 62.5 mJ *vs.* 63.5 ± 55.8 mJ, p = 0.011).

The mean power use decreased with increasing experience years among urban subjects, but there was no significant change in power use among rural subjects (p = 0.39). Among the various subclasses of angle closure, mean power use on LPIs performed on eyes with PAC decreased with increasing residency years, whereas mean power usage for other subclasses of angle closure did not change significantly over the years.

The majority of the uncontrolled group presented with synechial angle closure at follow-up visits and were treated with filtration surgeries, with only a few receiving long-term medications.

Prophylactic YAG laser iridotomy was performed on all PACS (suspect) eyes and fellow eyes from the PAC and PACS groups. During their follow-up visits, none of them experienced symptomatic angle closure or glaucomatous optic neuropathy.

Complication rates differed between residents who performed the procedure (p = 0.16). In PAC suspect cases, 63.6% had repeated LPI, followed by 58.33% in PACG and 39.1% in PAC cases.

30% of glaucomatous optic neuropathy eyes were classified as treatment failures because IOP was poorly controlled or visual acuity had deteriorated due to glaucoma progression. At follow-up, 3% of PAC eyes were found to have glaucomatous optic neuropathy, but other features, such as pseudoexfoliation, could explain the poor prognosis.

After iridotomy, there were minor complications, such as transient elevation of IOP in 38% of patients and iris bleeding in 19% of patients.

There was no glaucomatous optic neuropathy or symptomatic angle closure in any PACS eyes. Once extensive synechial angle closure and glaucomatous optic neuropathy have developed, it appears that an iridotomy would less likely reduce IOP and protect visual function than in eyes treated earlier in the disease's progression.

The mean power and complication rates for the various types of PI indications were com-

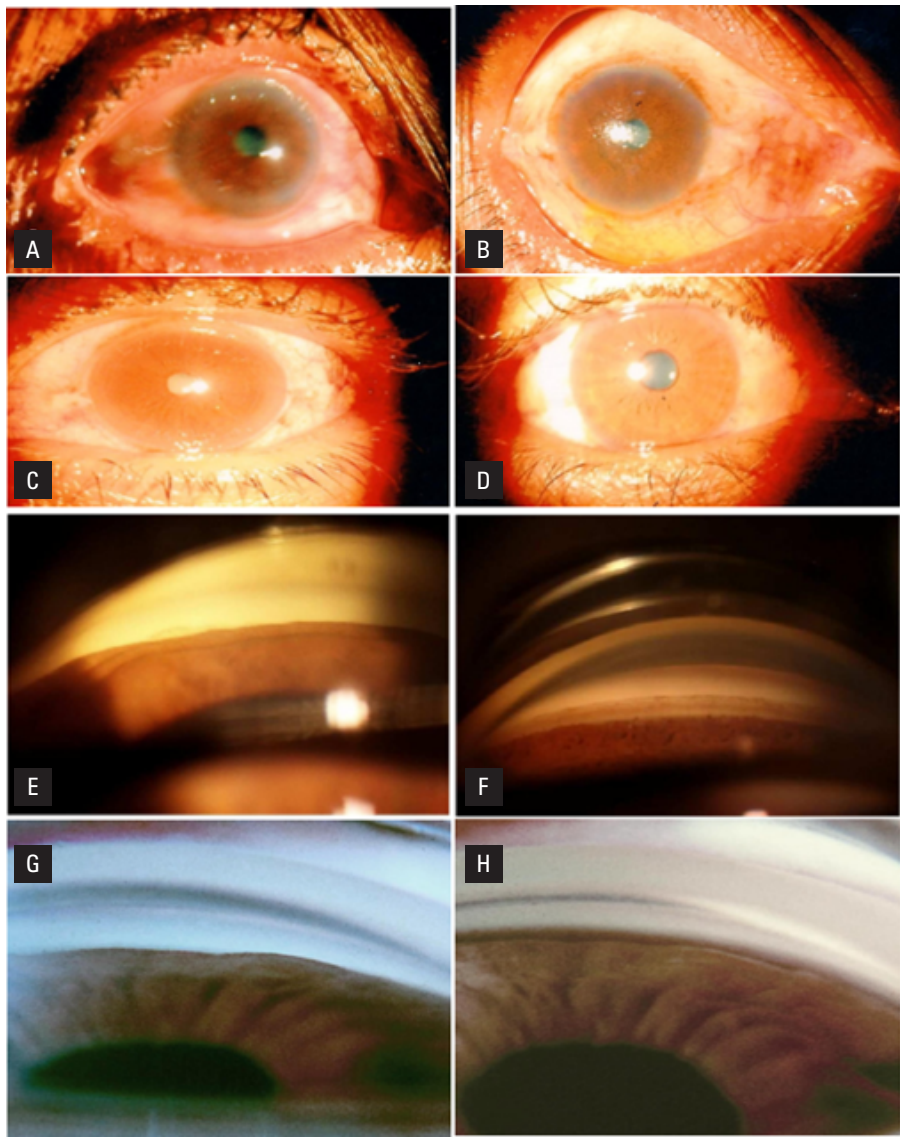

Figure 1. A. Acute angle closure glaucoma, the right eye of case 1; **B.** Post Yag iridotomy eye of case 1; **C.** Post Yag iridotomy of chronic angle closure glaucoma — left eye; **D.** Prophylactic Yag iridotomy — right eye; **E.** Gonioscopy showing closed angle before iridotomy; **F.** Gonioscopy showing open angle in the right eye after iridotomy; **G.** Closed angle before iridotomy of the right eye of case 6; **H.** Open angle after iridotomy — the right eye of case 6

pared. The power used in PACS patients was significantly lower than in PAC and PACG patients ($p = 0.0025$), and the complication rates did not differ significantly.

DISCUSSION

This study presents the findings of a single-center study of YAG LPI procedures performed by junior and senior residents. The study aimed to assess the efficacy of YAG laser iridotomy as a treatment for PACG. Also, the anatomical changes in the anterior chamber were assessed following peripheral iridotomy.

Among the patients included in the study, the majority, 61 (75%), were females, with a 3:1 ratio of female:male.

According to Lewis et al., the mean energy used ranged from 41.0 to 49.0 mJ among various types of glaucoma. Jiang et al. presented mean energy values ranging from 146.01 ± 85.2 mJ to 205.8 ± 118.5 mJ in Asian subjects [19, 20].

Vera et al. study found that the mean total energy ranged from 41.5 ± 48.2 mJ to 47.1 ± 107 mJ.

In senior residents, the mean power usage in rural and urban patients' eyes was 69.84 ± 62.5 mJ and 84.5 ± 81.5 mJ, comparable to the literature data.

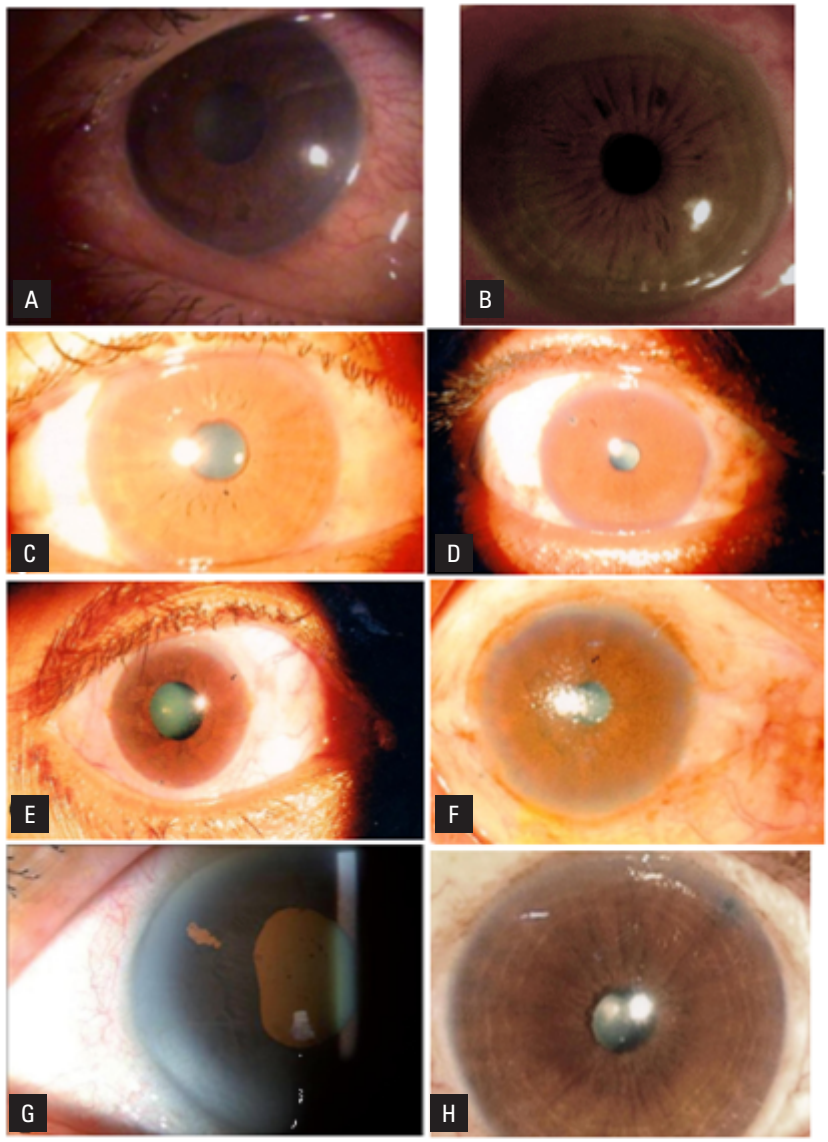

Figure 2. A. Acute angle closure — left eye; **B.** Prophylactic iridotomy of the right eye of case 10; **C.** Primary angle closure suspect — the right eye of case 9; **D.** Prophylactic Yag iridotomy — the right eye of case 9; **E.** Pre-Yag PI of acute angle closure glaucoma of the right eye of case 8; **F.** Post Yag iridotomy of the right eye of case 8; **G.** Open angle after iridotomy of the left eye of case 7; **H.** Prophylactic iridotomy of Right eye of case 7

The amount of power used was also significantly different between PACS patients and PACG patients, with PACG patients requiring significantly more power. Other studies have not analysed or investigated this trend [9, 10, 25, 26].

In our study, the angle of the anterior chamber improved by 1 to 2 Shaffer's grades. 65% of patients improved by 2 Shaffer's grades. Improvement observed in 1 Shaffer's grade was noted in 25%, and little or no improvement was noted in Shaffer's grades in 10% of eyes with PAS in three quadrants of the anterior chamber angle.

At follow-up visits, 17 (71%) of 24 PACG (chronic) patients had good IOP control and stable visual acuity improvement. Neither the PAC nor the fellow eyes developed glaucomatous optic neuropathy or symptomatic angle closure during the follow-up period. During follow-up visits, 7 (30%) of the PACG group patients had uncontrolled IOP. On follow-up gonioscopy, 5 of the 7 chronic angle closure patients had PAS in > 3 quadrants of angle structures, and 2 had PACS in more than 2 quadrants. Three of them underwent trabeculectomy, while three underwent a combined procedure.

Three patients with uncontrolled IOP in the primary angle closure (acute and sub-acute) group were advised to undergo filtration surgery. Two of

them were linked to synechial angle closure, while the third was linked to pseudoexfoliation. Two of them had trabeculectomy 1 with a combined procedure and maintained good IOP control at follow-up visits. These findings are similar to See et al. [27]. Another study observed that iridotomy controlled 86.7% of patients' IOP. According to Bithi Chaudary et al., iridotomy controlled IOP in 90% of patients [28].

The iridotomy hole is no smaller than 0.2 mm^2. Within 4-8 weeks of follow-up, most of them were occluded. Iridotomy was performed a second time in a different location with a larger hole. The majority of cases had small iridotomy holes at the time of treatment or experienced severe aqueous flare and tissue reactions following iridotomy. These findings are similar to Jiang ye et al., who noted that 6% of eyes at 6 months were affected. At the end of the study, 4% of the eyes had closed iridotomies. Jing et al. [20] and Naveh et al. show iridotomy was closed in 10% of post-PI cases due to pigment epithelial proliferation [29].

YAG LPI was effective in all PACG and PAC fellow eyes and in PACS prophylactic iridotomies. There was no symptomatic angle closure or glaucomatous optic neuropathy in any of the PACS or fellow eyes of PACG or PAC. These findings are consistent with Stefanescu's findings that LPI is highly effective in controlling IOP in the other eye. i.e., preventative [30].

Before treatment, 25 of the 81 patients had IOPs of 30 mmHg or higher. In our study, 31 (38%) patients experienced transient elevation of IOP, and 15 (19%) experienced iris bleeding. Corneal burns were treated with a pad and bandage. Mild topical steroids (fluoromethalone) were used for 3–4 days to treat mild iritis. These findings are consistent with those of Naveh et al., who show that post-yag increases IOP in 42% of eyes and causes the iris to bleed in 20% of eyes. Brazier et al. [31] show that IOP increased in 33% of the eyes after Yag LPI.

Complications included increased IOP in 38.27% (31/81), aqueous flare/debris in 34.56% (24/81), iris bleeding in 18.51% (15/81), corneal burns in 4.93% (4/81), and lens damage in 3.71% (3/81). LPI was repeated in 48.14 percent of the cases (39/81). Due to occluded iridotomies, all repeat procedures were performed, similar to another study.

Another study found no association between total energy consumption and the risk of post-LPI IOP elevation [19,20].

Similarly, our study found no association between post-LPI IOP elevation and energy consumption.

No correlation was observed between pre-laser IOP and energy used ($r = 0.11$, $p = 0.13$). Our research found no association between post-LPI IOP elevation and energy consumption.

In our study, 30% of eyes with glaucomatous optic neuropathy and 7% with primary angle closure failed to control IOP and maintain or improve visual acuity. Surgery for filtration is also required. These findings support Gray et al. study [14].

Our re-treatment rate was higher than the 2% to 9% reported in the literature [21].

Except for two, which were deemed insufficient in size after gonioscopic examination, all repeat procedures were performed due to occluded iridotomies. The rate of re-treatment did not differ significantly between junior and senior residents.

Several studies have found that as IOP rises above 21 mm Hg, the percentage of patients experiencing visual field loss increases rapidly, most notably at pressures greater than 26–30 mm Hg. A patient with an IOP of 28 mm Hg is 15 times more likely to develop field loss than a patient with an IOP of 22 mm Hg. Iridotomies must be performed with the least amount of laser energy to avoid complications [21, 32].

A limitation is the lack of a standardised post-LPI assessment of iridotomy efficacy.

CONCLUSION

The higher frequency of repeat procedures calls for further investigation, and it suggests that additional training is required. Laser iridotomy effectively lowers the IOP and improves patient acuity in managing early PACG. Early laser iridotomy treatment also reduces the risk of developing primary angle glaucoma.

Funding

None to declare.

Conflicts of interest

The authors state no conflict of interest.

Informed consent and human and animal rights statement

Informed consent has been obtained from all study individuals included in this study.

Ethical approval

The research related to human use complies with all the relevant national regulations and institutional policies, is in accordance with the tenets of the Helsinki Declaration, and has been approved by Institutional Ethics Committee, Narayana Medical College, Nellore, India.

Acknowledgements

Nil.

REFERENCES

1. Wright C, Tawfik MA, Waisbourd M, et al. Primary angle-closure glaucoma: an update. Acta Ophthalmol. 2016; 94(3): 217–225, doi: 10.1111/aos.12784, indexed in Pubmed: 26119516.
2. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol. 2006; 90(3): 262–267, doi: 10.1136/bjo.2005.081224, indexed in Pubmed: 16488940.
3. Foster PJ, Johnson GJ. Glaucoma in China: how big is the problem? Br J Ophthalmol. 2001; 85(11): 1277–1282, doi: 10.1136/bjo.85.11.1277, indexed in Pubmed: 11673287.
4. Maurya RP. Biomarkers of Primary open glaucoma. Indian J Clin Exp Ophthalmol. 2019; 3(1): 1.
5. Foster PJ, Buhrmann R, Quigley HA, et al. The definition and classification of glaucoma in prevalence surveys. Br J Ophthalmol. 2002; 86(2): 238–242, doi: 10.1136/bjo.86.2.238, indexed in Pubmed: 11815354.
6. Erin AD, Steven JG. How to perform Laser Peripheral Iridotomy. Ophthalmic Pearls 2001. 2001; September/October: 1–3.
7. Louis BC. Laser iridotomy. Clin Signs Ophthalmol. 1998; 15(1): 2–8.
8. Kitazawa Y, Taniguchi T, Sugiyama K. Use of apraclonidine to reduce acute intraocular pressure rise following Q-switched Nd:YAG laser iridotomy. Ophthalmic Surg. 1989; 20(1): 49–52, indexed in Pubmed: 2648232.
9. Sood D, Sood NN. Angle closure and India. Indian J Ophthalmol. 2006; 54(3): 147–148, doi: 10.4103/0301-4738.27063, indexed in Pubmed: 16921209.
10. Quigley HA, Broman AT. The number of people with glaucoma world wide. Br J Ophthalmol. 2006; 90: 262–267, doi: 10.1136/bjo.2005.081224, indexed in Pubmed: 16488940.
11. Ramakrishnan R, Nirmalan P, Krishnadas R, et al. Glaucoma in a rural population of southern India. Ophthalmology. 2003; 110(8): 1484–1490, doi: 10.1016/s0161-6420(03)00564-5, indexed in Pubmed: 12917161.
12. Casson RJ, Newland HS, Muccke J, et al. Gonioscopic findings and prevalence of occludable angles in a Burnese population: the Meiktila eye study. Br J Ophthalmol. 2007; 91: 856–859, doi: 10.1136/bjo.2006.108688, indexed in Pubmed: 17576708.
13. Baig R, Khan A, Khan AH, et al. Vitamin d deficiency osteomalacia: the continuing challenge. J Coll Physicians Surg Pak. 2008; 18(10): 666–223, doi: 10.2008/JCPSP.666666, indexed in Pubmed: 18940135.
14. Gray RH, Nairne JH, Ayliffe WH. Efficacy of Nd-YAG laser iridotomies in acute angle closure glaucoma. Br J Ophthalmol. 1989; 73(3): 182–185, doi: 10.1136/bjo.73.3.182, indexed in Pubmed: 2706208 .
15. Ammar M, Rahman H, Butt IA, et al. Role of YAG laser Iridotomy as Initial Treatment of Primary angle closure. Rawal Med J. 2005; 30: 300–7.
16. Laser peripheral iridotomy for pupillary-block glaucoma. American Academy of Ophthalmology. Ophthalmology. 1994; 101(10): 1749–1758, doi: 10.1016/s0161-6420(13)31434-1, indexed in Pubmed: 7936574.
17. Robin AL, Pollack IP. A comparison of neodymium: YAG and argon laser iridotomies. Ophthalmology. 1984; 91(9): 1011–1016, doi: 10.1016/s0161-6420(84)34199-9, indexed in Pubmed: 6387569.
18. Vera V, Naqi A, Belovay GW, et al. Dysphotopsia after temporal versus superior laser peripheral iridotomy: a prospective randomized paired eye trial. Am J Ophthalmol. 2014; 157(5): 929–935, doi: 10.1016/j.ajo.2014.02.010, indexed in Pubmed: 24531024.
19. Lewis R, Perkins TW, Gangnon R, et al. The rarity of clinically significant rise in intraocular pressure after laser peripheral iridotomy with apraclonidine. Ophthalmology. 1998; 105(12): 2256–2259, doi: 10.1016/S0161-6420(98)91225-8, indexed in Pubmed: 9855156.
20. Jiang Y, Chang DS, Foster PJ, et al. Immediate changes in intraocular pressure after laser peripheral iridotomy in primary angle-closure suspects. Ophthalmology. 2012; 119(2): 283–288, doi: 10.1016/j.ophtha.2011.08.014, indexed in Pubmed: 22036632.
21. Schwartz LW, Moster MR, Spaeth GL, et al. Neodymium-YAG laser iridectomies in glaucoma associated with closed or occludable angles. Am J Ophthalmol. 1986; 102(1): 41–44, doi: 10.1016/0002-9394(86)90207-2, indexed in Pubmed: 3728623.
22. Golan S, Levkovitch-Verbin H, Shemesh G, et al. Anterior chamber bleeding after laser peripheral iridotomy. JAMA Ophthalmol. 2013; 131(5): 626–629, doi: 10.1001/jamaophthalmol.2013.1642, indexed in Pubmed: 23538479.
23. Vijaya L, George R, Arvind H, et al. Prevalence of primary angle-closure disease in an urban south Indian population and comparison with a rural population. The Chennai Glaucoma Study. Ophthalmology. 2008; 115(4): 655–660.e1, doi: 10.1016/j.ophtha.2007.05.034, indexed in Pubmed: 17869343.
24. Thomas R, Parikh R, Muliyil J, et al. Five year risk of progression of primary angle closure suspects to primary angle closure: a population based study. Br J Ophthalmol. 2003; 87(4): 450–454, doi: 10.1136/bjo.87.4.450, indexed in Pubmed: 12642309.
25. Sihota R, Agarwal HC. Profile of the subtypes of angle closure glaucoma in a tertiary hospital in North India. Indian J Ophthalmol. 1998; 46(1): 25–29, indexed in Pubmed: 9707844.
26. He M, Foster PJ, Johnson GJ, et al. Angle-closure glaucoma in East Asian and European people. Different diseases? Eye (Lond). 2006; 20(1): 3–12, doi: 10.1038/sj.eye.6701797, indexed in Pubmed: 15688051.
27. See JL, Aquino MC, Adeun J, et al. Management of angle closure glaucoma. Indian J Ophthalmol. 2011; 59(Suppl1): S82–S87, doi: 10.4103/0301-4738.73690, indexed in Pubmed: 21150039.
28. Chowdhury B, Gupta YK. Long Term Outcome and Predictors of Success of Nd YAG Laser Iridotomy in Chronic Primary Angle Closure Glaucoma. (PACG).
29. Naveh A, Zboronsky-Gutman LZ, Blumenthal M. Neodymium-YAG laser iridotomy in angle closure glaucoma: preliminary study. Br J Ophthalmol. 1987; 71(4): 257–261, doi: 10.1136/bjo.71.4.257, indexed in Pubmed: 3580337.
30. Stefănescu-Dima A. [Preventive iridotomy — a prospective study]. Oftalmologia. 2004; 48(3): 61–71, indexed in Pubmed: 15598054.
31. Brazier DJ. Glaucoma, ocular hypertension, cataract, and glucose tolerance. Br J Ophthalmol. 1993; 77(7): 464, doi: 10.1136/bjo.77.7.464-a, indexed in Pubmed: 8343484.
32. World Health Organization. Fact Sheet No. 282. Visual impairment and blindness June 2012. http://www.who.int/mediacentre/factsheets /fs282/en.Google Scholar.