



## Original Research Article

## Outcome of laser peripheral iridotomy in the spectrum of primary angle closure disease

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## ABSTRACT

**Aim:** To study the effectiveness of Nd: YAG laser peripheral iridotomy (LPI) in whole spectrum of primary angle closure disease including primary angle closure suspect (PACS), primary angle closure (PAC) and primary angle closure glaucoma (PACG).

**Materials and Methods:** It's a retrospective analysis of 171 eyes (87 patients) of primary angle closure disease who have undergone laser peripheral iridotomy (LPI) after proper pre-laser evaluation. Patients with prior LPI, glaucoma surgery and secondary glaucoma were excluded. Results were analysed for IOP control, progression of disease and need of antiglaucoma medicine or surgery following LPI.

**Results:** Out of 171 eyes of angle closure diseases, PACS was observed in 23 eyes, PAC in 51 eyes and PACG in 97 eyes. Overall progression was 23.97% (41 amongst 171 eyes) and none of the eyes with PACS shown progression. In PAC group, 5 eyes (9.8%) progressed to PACG and were managed on one antiglaucoma drug. In PACG group of 97 eyes, 36 eyes (37.11%) progressed and managed surgically while 61 (62.89%) eyes did not show any progression. Out of 61 non progressed PACG eyes, IOP was controlled without medication in 14 eyes (29.2%), with one anti glaucoma drug in 17 eyes (27.8%), and with 2 or more drugs in 30 eyes (49.18%).

**Conclusion:** LPI is a very good treating modality, especially in PAC & PACS cases, but in PACG with medical treatment, it is a good tool. Majority of the patients included in the study did not show any disease progression and remained stable following LPI.

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## 1. Introduction

Glaucoma is leading cause of irreversible blindness worldwide. In 2010, 15 million people were affected by angle closure disease and 3.9 million people suffered from blindness due to primary angle closure glaucoma (PACG). It has been estimated that by 2020, 21 million people will be affected by angle closure disease and 5.3 million will suffer from blindness. Angle closure disease is responsible for half of the world's blindness due to glaucoma.<sup>1-3</sup>

The chronic primary angle closure (CPAC) spectrum is divided into 3 groups - primary angle closure suspects (PACS), primary angle closure (PAC) and primary angle

closure glaucoma (PACG). PACS consist of eyes with anatomically narrow angles, potentially occludable angle which are predisposed to angle closure. PAC is evidenced by elevated intraocular pressure (IOP), peripheral anterior synechiae (PAS) and trabecular pigments. Primary angle closure glaucoma (PACG) is evident by glaucomatous optic neuropathy in addition to PAC which is diagnosed by visual field, nerve fibre layer changes and optic nerve damage.<sup>4</sup>

It's an anatomically small eye with proportionately larger lens, which leads to greater contact of lens iris diaphragm. Closed work in dim illumination or emotional stress leads to pupillary dilatation which is further aggravated by accommodation. Trapped aqueous behind the iris, balloons the iris forward known as iris bombe and blocks angle of anterior chamber also known as appositional closure and

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leads to increased IOP. Early treatment prevents permanent optic nerve damage and visual loss.

Intraocular pressure (IOP) is either managed medically<sup>5,6</sup> or by eliminating the mechanism of angle closure by either YAG laser iridotomy (YPI) or surgical peripheral iridectomy (SPI). ND- YAG Laser peripheral iridotomy (LPI) is currently considered as the first line of treatment for angle closure diseases. It is effective, safe and performed as an OPD procedure however, long-term follow-up studies of laser peripheral iridotomy may not be satisfactory.<sup>7,8</sup> If it does not work then, iridoplasty may be performed.<sup>9</sup> Surgical iridectomy is more effective but damage to lens is more likely to occur. Lens extraction (LE) can be effective as initial treatment in CPAC as artificial lens is thinner and occupies less space than natural lens and it minimizes lens-iris contact by creating space behind iris to relieve pupillary block. The role of clear lens extraction in CPAC/CPACG is controversial due to risk of surgery related complications and then in younger patients not recommended due to loss of accommodation. Also the laser PI and chronic topical use of medication can accelerate lens opacification, leading to progressive vision loss requiring further intervention.<sup>10-12</sup> Trabeculectomy is reserved as last option for patients with prolonged attacks not responding to treatment or who have significant angle damage and PAS more than 180 degree or those who need a second procedure when the laser PI fails. Combined surgery is also one of the option when cataract is coexisting or it's iatrogenic and LPI fails. The aim of the current study is to evaluate the outcomes of LPI as initial management of the CPAC spectrum.

## 2. Materials and Methods

This is a retrospective analysis of 171 eyes (87 patients) of primary angle closure (3 patients were one eyed), who have undergone LPI and completed one year follow up, registered during a period of 2016 December to 2018 December in a tertiary care centre. Patients in the spectrum of primary angle closure disease were included the study. Cases with secondary angle closure and patients with prior LPI or surgery were excluded.

Information regarding age, sex, IOP, gonioscopy, disc findings and perimetry were recorded. The eyes were classified as PACS, PAC & PACG. Level of IOP control and number of medications required to control IOP were noted.

All patients were examined in detail with slit lamp, applanation tonometry, susman four mirror gonioscopy, disc examination with 78D lens and standard white on white automated Humphrey visual field analysis.

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 local anaesthesia using proparacaine(0.5%) eye drops. Pilocarpine 2% eye drop was instilled 3-4 times

every 15 minutes, one hour prior to LPI to make iris crypts prominently visible. Yag energy level between 3 to 8 mili joules, 1-2 pulse in burst mode with 3-4 shots were used to make a sufficient opening (150-200 nm). Depending upon location of crypts, site of LPI was chosen between 10 to 1 o'clock position on iris. End results of PI were either retro illumination, direct visualization of capsule, sudden gush of aqueous along with pigments or deep anterior chamber. In some patients with thick Iris, LPI was done in next sitting or another site was selected. Post LPI antiglaucoma drug and steroids drops were given for one week. Follow up was done after 1 week and then at 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup> and 12 months following LPI. Vision, IOP, gonioscopy and fundus examination were performed at each visit and fields were repeated at 3<sup>rd</sup> and 12<sup>th</sup> month. Depending upon the level of IOP, disc changes and amount of field damage, decision to start medical treatment with one or more drugs was taken and patients were followed up again. For visual field defects, the global indices of perimetry such as mean deviation, pattern standard deviation (PSD) and glaucoma hemifield test were used. Results were evaluated for IOP control, progression of disease and need of antiglaucoma medicine or surgery after LPI.

**Table 1:** Profile of the patients (171 eyes, 87 patients)

Age group	No. of patients
20 -30	09 (10.35%)
31-40	17 (19.54%)
41-50	21 (24.13%)
51-60	16 (18.39%)
61-70	13 (14.94%)
71-80	11 (12.65%)
<b>Mean age</b>	<b>64.60 ±9.49 years</b>
<b>Sex</b>	
Male	38
Female	49
Total No.	87

**Table 2:** Pre LPI evaluation

Gonioscopy (Shaffer's grading)	No of eyes
Grade 0	82 (48%)
Grade 1	51 (30%)
Grade 2	38 (22%)
PAS	140 (82%)
Abnormal Disc Findings	102 (60%)
Abnormal Fields	97 (57%)

### 2.1. Statistical analysis

Data was entered in excel sheet and appropriate tools were used. Chi-square test was used to analyse the data and to find out the significance statistically.

**Table 3:** Distribution of cases pre LPI

Clinical types	No. of eyes
PACS	23 (13%)
PAC	51 (30%)
PACG	97 (57%)
Total	171 eyes

**Table 4:** Showing progression of disease

Disease	No. of eyes
PACS to PAC or PACG	Nil
PAC to PACG	05 (9.8%)
PACG to further progression	36 (37.11%)
Overall progression	41 (23.97%)

**Table 5:** Showing results of post LPI in PACG

Status	No of eyes (97)
Progressed	36 (37.11%)
Non progressed	61(62.88%)
No drug	14 (22.95%)
1 drugs	17 (27.87%)
2 drugs	30 (49.18%)
Total medically controlled	47 (48.45%)
Total surgically controlled	36(37.11%)

**Table 6:** Overall results post LPI

Status	Total No. of cases = 171 eyes
<b>Total non progressed</b>	<b>130 (76.02%)</b>
PACS non progressed	23(13.45%)
PAC non progressed	46(26.90%)
PACG non progressed	61(35.67%)
<b>Total progressed</b>	<b>41(23.97%)</b>
PACS Progressed	0
PAC Progressed	5(2.92%)
PACG Progressed	36(21.05%)
Total medically controlled	52(30.40%)
Total surgically controlled	36(21.05%)
Total eyes without any treatment	83(48%)

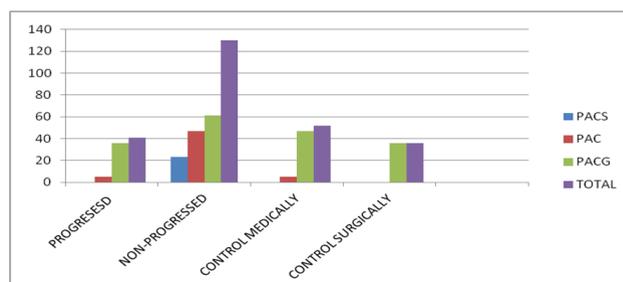
### 3. Results

A total of 171 eyes of 87 patients with primary angle-closure diseases treated with Nd: YAG laser iridotomy were included in this study. Inclusion and exclusion criteria were justified. Mean age was 64.60±9.49 years with 38 (43.68%) males and 49 (56.32%) females. Age and sex distribution of study participants are shown in Table 1. On the basis of gonioscopic findings, clinical presentation, slit lamp examination, IOP, field defects and disc findings; cases were classified into 3 categories (Tables 2 and 3). Mean IOP was 57.17±14.94 mm Hg before Nd:YAG laser iridotomy and the mean IOP at the end of first week was 21.64±11.79 mmHg. This difference was statistically significant (p=0.01%). On final follow up mean IOP was 17.94 ± 17.34

mm Hg. Results were evaluated on the basis of IOP control, progression of disease, need of any medical and surgical treatment after LPI.

After LPI, none of the eyes with PACS progressed to PAC or PACG, while out of 51 eyes of PAC, 5 eyes (9.8%) showed progression to PACG and were kept on one antiglaucoma drug (Table 4). In PACG group of 97 eyes, a total of 61 eyes (62.88%) did not showed any progression after LPI, while 36 eyes (37.11%) showed progression and managed surgically (9 phaco trabeculectomy and 27 trabeculectomies).(Table 5) Overall progression and non progression and individually category wise is shown in Table 6.

Efficacy of the procedure was determined by IOP control, post LPI treatment and progression rate. Difference in mean pre LPI IOP(57.17±14.94 mm Hg) and post LPI IOP (21.64 ±11.79 mmHg) at the end of 1st week was found statistically significant (p = 0.01%). Highest progression rate (37.11%) was seen in PACG group in comparison to PACS (nil) and PAC (9.8%). This difference was statistically significant (p=0.05%). Treatment required (medical or surgical) or not was another measure. In PACS (100% eyes), in 90.19% eyes in PAC group and in 14.43% eyes no treatment was required and this difference is statistically significant (p= 0.01%).

**Fig. 1:** Bar chart showing overall results in all groups

### 4. Discussion

Commonest cause of angle closure is pupillary block and Nd:YAG laser iridotomy is effective in reducing IOP and opening the drainage angle in primary angle-closure. After LPI re assessment is required when inflammation and IOP spike following treatment subsides to check extent of residual synechial and appositional closure.

After LPI, uncontrolled IOP and progression of the disease are the deciding factors. In most of the studies, post LPI medical or surgical treatment was required.<sup>13</sup> Some studies however reports that Nd:YAG laser iridotomy may be unable to maintain IOP control on long term medication.<sup>14</sup>

So LPI alone is not enough and patients has to be on 2 drugs or 3 drugs regime and surgical treatment if required.<sup>15</sup>

In our study Mean IOP was  $57.17 \pm 14.94$  mmHg. After Nd:YAG laser iridotomy the mean first IOP was  $21.64 \pm 11.79$  mm Hg and on final follow up mean IOP was  $17.94 \pm 17.34$  mmHg

So in all 47 eyes (non progressed) out of 97 eyes (48.45%) in the category of PACG and 5 eyes (Progressed) from PAC group [Total 52 eyes out of 171(30.94%)], required medical treatment and 36 eyes (37.11%) in PACG group shown progression required surgical treatment. In all 88 eyes out of 171(52%) required medical and surgical intervention.

Rosman et al. in their study of 80 PACG eyes found that despite a patent PI of all 80 eyes (100%) of PACG patients required medical and/or surgical intervention to control IOP. Total 33 eyes (41.3%) required additional medication, 22 eyes (27.5%) required additional laser, while 25 eyes (31.3%) required additional surgical intervention. Rosman et al., did not include PACS or CPAC eyes and studied only PACG patients.<sup>16</sup>

Alsagoff et. al studied 83 eyes of PACG from different Asian ethnicities (e.g. Chinese, Malay, Indian) noted that 53% of eyes after laser iridotomy became medically uncontrolled, 44 eyes required surgery with 20 eyes (45.5%) needed combined filtering surgery.<sup>17</sup>

As far as progression is concerned it is less common with PACS group but still there are certain indications for doing iridotomy, like PAC or PACG in other eye, diabetic patients who require frequent dilatation, patchy pigmentation in PTM and family History of blindness due to PACG or patients doesn't turn up for follow up. As such role of LPI in preventing progression to PAC or PACG in angle closure suspects is not established.

In some of the studies progression from PACS to PAC or PACG was reported. Sihota R et.al studied long term course of PAC after laser iridotomy in 72 eyes, at 1 year 10 eyes and 26 eyes at the end of 4<sup>th</sup> year developed ocular hypertension and 8 eyes developed field defects.<sup>18</sup> Thomas et.al found in a population based study of PACS, the 5 year incidence of PAC was 22%; none developed functional damage. Bilateral PACS was a clinical risk factor for progression.<sup>19</sup>

While contrary to this there are some studies which shows non progression in PACS group. Study from Pandav SS et al., in their study reports that out of 55 patients (103 eyes), 27(PACS-none progressed), 43(PAC-4 eyes progressed), 33(PACG-8 eyes progressed).<sup>20</sup>

In the study by Peng et al., 9 of 239 PACS (3.8%) eyes progressed. Although progression in PACS patients was less common but patients required close monitoring to rule out cataract formation which may develop after LPI requiring cataract extraction. Secondly Peng et al. found that lens extraction was potentially protective of progression to PAC from PACS.<sup>21</sup>

In our study also none of the eye in PACS group (23 eyes) progressed. In other groups, 5 eyes from PAC group (out of

51 eyes) and 36 eyes from PACG group(out of 97 eyes) have shown progression so in all only 41 eyes out of 171 have shown progression.

Apart from adding one or two drugs post LPI when IOP is uncontrolled, iridoplasty is also one option particularly when PAS is < 180 degree in presence of clear lens.<sup>(21)</sup> If PAS is more than 180 degree trabeculectomy or combined surgery is the option. In one of the study favourable response is being reported with laser trabeculoplasty in case of residual glaucoma following LPI.<sup>22</sup>

Lam et al. reported the results of an RCT in which 62 eyes of 62 Chinese patients and compared role of early phacoemulsification (PKE) and LPI. The prevalence of IOP elevation at 18 months following treatment was 3.3% in the PKE group and 46.7% in the LPI group.<sup>23</sup>

Azuor-Blanco et al. (Eagle Study) also conducted RCT using clear lens extraction and LPI with medical treatment and considered clear lens extraction as an option for first-line treatment of PAC and PACG because of greater efficacy.<sup>24</sup>

Tham et.al conducted 2 trials in CACG cases following LPI. In one medically controlled patients with PACG with cataract either phacoemulsification or combined surgery was done. Rate of progression and IOP control was same but less medication was required in 2<sup>nd</sup> group.

In 2<sup>nd</sup> RCT the cases were medically uncontrolled and without cataract. They compared results of phacoemulsification and trabeculectomy. IOP control was almost same but more complications in trabeculectomy group were noticed. So lens extraction plays a definitive role but role of clear lens extraction is a little bit controversial in our scenario and then a bit restricted below 50 years because of loss of accommodation.<sup>25,26</sup>

## 5. Conclusion

LPI is a very good treating modality, especially in PAC & PACS cases, but in PACG with medical treatment, it is a good tool. Majority of the patients included in the study did not show any disease progression and remained stable following LPI. Nd-YAG Laser peripheral iridotomy appears to alter the natural course of primary angle closure disease favourably.

## 6. Source of Funding

Nil.

## 7. Conflict of Interest

Nil.

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