

Original article: Role of argon laser peripheral Iridoplasty in primary angle closure / plateau iris configuration

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Abstract:

Purpose: To study the efficacy and safety of Argon Laser Peripheral Iridoplasty in Primary Angle Closure / Plateau Iris Configuration **Methods:** This is a prospective study conducted in 10 patients with Primary Angle Closure/ Plateau Iris Configuration, with uncontrolled IOP (despite maximal medical therapy and patent Peripheral Iridotomy), in whom Argon Laser Peripheral Iridoplasty was performed. Post procedure, IOP reduction and gonioscopic changes, anterior depth Analysis, observed for a follow up period of 1 year. **Results:** In this prospective study, out of 10 eyes, there is significant IOP reduction in 8 eyes, with open angles and increased anterior chamber depth except in two cases which had peripheral anterior synechiae. **Conclusion:** Argon laser peripheral iridoplasty (ALPI) is a safe and effective procedure to reduce IOP, halt the optic disc changes, delay surgical intervention in primary angle closure / plateau iris configuration with uncontrolled IOP (despite maximal medical therapy and patent Peripheral Iridotomy).

Introduction:

Primary angle-closure glaucoma (Primary angle closure disease) accounts for half of all glaucoma-related blindness globally. (ALPI) Argon Laser Peripheral Iridoplasty is a treatment modality to open appositional closure of the angle of the anterior chamber in cases where peripheral LI (Laser Iridotomy) cannot be carried out or is ineffective. The iris is retracted, and the trabecular meshwork is pulled away using contraction pulses applied to the periphery of the iris.¹⁻⁴

Indications of ALPI are acute attack of angle closure glaucoma as an initial procedure in the presence of corneal clouding, in primary angle closure with LI, in non-pupillary block mechanisms like plateau iris syndrome, pseudo-plateau iris (ciliary body cysts), lens-induced angle closure, obstruction posterior to the lens (ciliary body inversion syndrome)to widen the angle prior to argon laser trabeculoplasty. Contraindications of ALPI are severe corneal edema, extensive corneal opacification, flat anterior chamber, secondary angle closure due to synechiae, neovascular membranes, and iridocorneal endothelial syndrome. Complications of ALPI are mild iritis, diffuse endothelial corneal burn, transient IOP (intraocular pressure) increase, pigmented scars, iris atrophy, and permanently dilated iris.⁵⁻⁷

This study aims to evaluate the effectiveness and safety of ALPI in treating primary angle closure and plateau iris configuration. The study aims to investigate the potential of ALPI to successfully address appositional closure of the anterior chamber angle. Additionally, the study will evaluate the safety profile of ALPI as a treatment option, with particular attention to any adverse events that may arise from the procedure. Ultimately, the study aims to contribute to understanding ALPI as a viable treatment option for primary angle closure and plateau iris configuration and to inform clinical practice in managing these conditions.

Material and Methods:

This prospective interventional case series was conducted at the Gitam Institute of Medical Sciences and Research over two years, from January 2020 to January 2022. This study involved ten patients who met the following inclusion criteria: they were above 40 years, provided informed consent to participate, were diagnosed with either primary acute angle closure or plateau iris configuration, exhibited persistent narrow angles despite having undergone a laser peripheral iridotomy that was patent, had an IOP (intraocular pressure) greater than 21 mmHg, either on or off topical medication, for at least four weeks following the laser iridotomy and the patients with progressing optic disc changes and visual field changes. Patients with congenital/developmental glaucoma, primary open-angle glaucoma, or secondary causes of angle closure, advanced glaucoma (vertical cup-disc ratio of 0.9 or greater), peripheral anterior synechiae greater than six clock hours, patients who had undergone previous intraocular surgery, patients with cataract other ocular surface diseases and retinal disease were excluded from the study.

The ten patients were divided into three groups. Group 1 included PAC patients with occludable angle with elevated IOP and patent LI, group 2 included plateau iris configuration patients with LI, and group 3 included patients with post-acute primary angle closure with LI and primary angle closure glaucoma with LI. The ALPI procedure was done after taking written consent. Before the procedure, pilocarpine 2% eye drops were administered thrice at 5-minute intervals (to constrict the pupil). Under topical anesthesia (proparacaine 0.5%), argon laser was delivered through Abraham's iridotomy lens over 360° of the peripheral iris (25 burns in total), with spot size 200-500 µm, duration 300 ms, power 200-400 mW. The burn is titrated based on a visible contraction of the iris tissue, and the endpoint is considered as a widening of the angle of the anterior chamber.⁵⁻⁶ After the procedure, medications advised are topical anti-inflammatory eye drops three times daily for seven days. IOP (intraocular pressure) after the procedure was recorded after 2 hours. Follow-up was done after three days, three months, six months, and 12 months. During the follow-up visit, IOP reduction, angle configuration, peripheral anterior chamber depth, and associated complications were observed. [Figure 1]

Figure 1: Right eye showing peripheral laser burns in the iris after argon laser peripheral iridoplasty



The data was described statistically as percentages. The study followed ethical guidelines, and approval was taken from the Institute's ethics committee.

Operational definitions:

Primary angle closure disease was classified according to the American Academy of

Ophthalmology's preferred practice pattern glaucoma committee PACS (Primary Angle Closure Suspect) is defined as $\geq 180^\circ$ ITC (iridotrabecular contact), normal IOP, and no optic nerve damage. PAC (Primary Angle Closure) is defined as $\geq 180^\circ$ ITC with PAS (peripheral anterior synechiae) or elevated IOP but no optic neuropathy. PACG (Primary Angle Closure Glaucoma) is defined as $\geq 180^\circ$ ITC with PAS, elevated IOP, and optic neuropathy. AACG (Acute Angle Closure Crisis) is an occludable angle with symptomatic high IOP. Plateau iris configuration is defined as a narrow-angle due to an anteriorly positioned ciliary body with a deep central anterior chamber. Plateau iris syndrome is a narrow-angle due to an anteriorly positioned ciliary body, with a deep central anterior chamber and any ITC persisting after peripheral patent iridotomy.

Results:

A total of ten ALPI procedures were performed in ten eyes of ten patients participating in this study. The mean age of the patients was 51.7 years (range 45 - 60 years). Eight (80%) are females, and two (20%) are males. Before the procedure, the mean IOP [CCT (central corneal thickness) corrected] of these ten patients was 26 mm Hg (range 22- 30 mm Hg). Angle configuration showed five patients had occludable angles, one with occludable angles with peripheral anterior synechiae, two patients with plateau iris, one with a closed angle, and one with a closed angle with peripheral anterior synechiae. All the patients' peripheral anterior chamber angle was graded to be 20° according to Shaffer's angle grading method. Six patients were diagnosed as PAC with occludable angle with LI who constituted group 1; two patients with plateau iris configuration with LI constituted group 2; one with post-acute primary angle closure with LI; and one with primary angle closure glaucoma with LI constituted group 3. [Table1]

Table 1:

| The age, gender distribution and the parameters of IOP, angle configuration, angle grading and diagnosis before ALPI | | | | | | |
|--|-----|--------|---------------------|---------------------|--|---|
| Sl No | Age | Gender | IOP (CCT corrected) | Angle configuration | Peripheral Anterior chamber depth (Shaffer's grading in degrees) | Diagnosis |
| 1 | 56 | Female | 18 | Occludable angle | 20 | PAC with occludable angle with elevated IOP and patent LI |
| 2 | 50 | Female | 28 | Occludable angle | 20 | PAC with occludable angle with elevated IOP and patent LI |

| | | | | | | |
|----|----|--------|-----|---|----|---|
| 3 | 48 | Female | 28 | Occludable angle | 20 | PAC with occludable angle with elevated IOP and patent LI |
| 4 | 55 | Male | 27 | Occludable angle with Peripheral Anterior Synechiae | 20 | PAC with occludable angle with elevated IOP and patent LI |
| 5 | 50 | Female | 267 | Occludable angle | 20 | PAC with occludable angle with elevated IOP and patent LI |
| 6 | 50 | Female | 26 | Occludable angle | 20 | PAC with occludable angle with elevated IOP and patent LI |
| 7 | 45 | Female | 20 | Plateau iris configuration | 20 | Plateau Iris configuration with LI |
| 8 | 48 | Male | 18 | Plateau iris configuration | 20 | Plateau Iris configuration with LI |
| 9 | 55 | Female | 26 | Angle closed | 10 | Post Acute Primary Angle Closure with LI |
| 10 | 60 | Female | 30 | Angle closed with Peripheral Anterior Synechiae | 10 | Primary Angle Closure Glaucoma with LI |

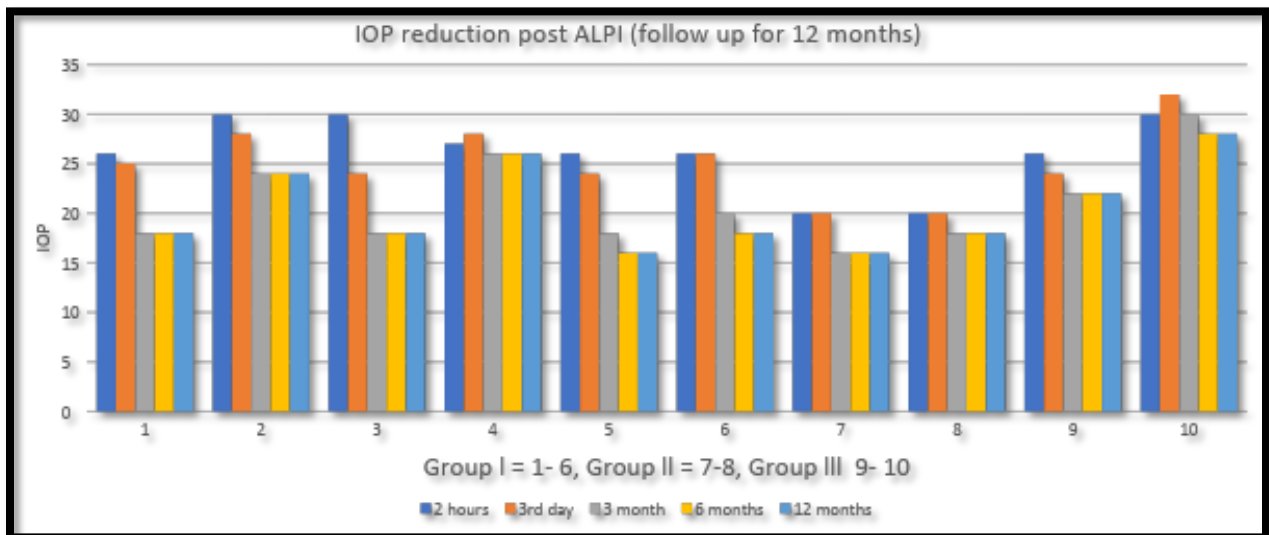
IOP reduction after twelve months in group 1 was present in all groups, which ranged from 6 - 10 mm Hg (25% - 38%) reduction in five cases except in one case where there is occludable angle with peripheral anterior synechiae, the IOP reduction was only 1 mm Hg (4%). In group 2, IOP reduced from 5 - 6 mm Hg (18% - 22%). In group 3, there was a 4 mm Hg (15%) reduction in one case, whereas the case with a closed angle with peripheral anterior synechiae had only a 2 mm Hg (7%) IOP reduction. There was a decrease in IOP in all ten cases except in two cases

(one in group 1 and one case in group 3) which had associated peripheral anterior synechiae. [Table 2; Figure 2]

Table 2:

| IOP reduction after ALPI at 1 year follow up | | | |
|--|-----------------|---------------------|---------------|
| Sl no | IOP before ALPI | IOP after 12 months | % of decrease |
| 1 | 24 | 18 | 25% |
| 2 | 28 | 21 | 25% |
| 3 | 28 | 18 | 35% |
| 4 | 27 | 26 | 4% |
| 5 | 26 | 16 | 38% |
| 6 | 26 | 18 | 30% |
| 7 | 22 | 16 | 18% |
| 8 | 23 | 18 | 22% |
| 9 | 26 | 22 | 15% |
| 10 | 30 | 28 | 7% |

Figure 2:



The angle configuration also widened in all ten cases except in the above two cases, where the IOP did not decrease much. [Table 3]

Table 3:

| Angle configuration before ALPI and post ALPI | | | | | | | | |
|---|---------------------------|---------------------------|-----------|----------------------------|------------|------------|-----------------------|-----------------------|
| Group I | | | Group II | | | Group III | | |
| | Before ALPI | After ALPI | | Before ALPI | After ALPI | | Before ALPI | After ALPI |
| Patient 1 | Occludable angle | Open angle | Patient 7 | Plateau iris configuration | Open angle | Patient 9 | Closed angle | Open angle |
| Patient 2 | Occludable angle | Open angle | Patient 8 | Plateau iris configuration | Open angle | Patient 10 | Closed angle with PAS | Closed angle with PAS |
| Patient 3 | Occludable angle | Open angle | | | | | | |
| Patient 4 | Occludable angle with PAS | Occludable angle with PAS | | | | | | |
| Patient 5 | Occludable angle | Open angle | | | | | | |
| Patient 6 | Occludable angle | Open angle | | | | | | |

This finding correlated with Shaffer’s grading in the follow-up. [Table 4] **Table 4:**

| Peripheral Anterior Chamber Depth before & post ALPI (Shaffer’s Grading) | | | | | | | | |
|--|-------------|------------|-----------|-------------|------------|------------|-------------|------------|
| Group I | | | Group II | | | Group III | | |
| | Before ALPI | After ALPI | | Before ALPI | After ALPI | | Before ALPI | After ALPI |
| Patient 1 | 20° | 30° | Patient 7 | 20° | 30° | Patient 9 | 10° | 30° |
| Patient 2 | 20° | 30° | Patient 8 | 20° | 30° | Patient 10 | 10° | 10° |
| Patient 3 | 20° | 30° | | | | | | |
| Patient 4 | 20° | 20° | | | | | | |
| Patient 5 | 20° | 30° | | | | | | |
| Patient 6 | 20° | 30° | | | | | | |

The complications observed were transient IOP spike in three cases (30%), mild iritis in four cases (40%), hyphema in two cases (20%), and mild corneal edema in one case (10%). [Table 5]

Table 5:

| Complications | Number | Percentage |
|-----------------------|--------|------------|
| IOP spike (transient) | 3 | 30% |
| Mild iritis | 4 | 40% |
| Hyphaema | 2 | 20% |
| Corneal edema (mild) | 1 | 10% |

Discussion:

Primary angle closure glaucoma is one of the causes of blindness world wide. Primary Angle

Closure Glaucoma is classified as Primary angle closure suspect (PACS: narrow angles [visible

270° of posterior trabecular meshwork] with IntraOcular Pressure [IOP] ≤21mmHg, normal Optic disc and no Peripheral Anterior Synechiae [PAS]), Acute primary angle closure (APAC: narrow angles ± PAS with IOP >21mm Hg, with symptoms of pain, nausea/vomitings, halos, signs of conjunctival injection, microcystic corneal edema, mid-dilated pupil, and shallow anterior chamber), and Primary angle closure glaucoma (PACG: narrow angle with PAS, with chronically elevated IOP >21 mm Hg, with Glaucomatous Optic Neuropathy and typical Visual Field Defects).¹¹ Plateau iris syndrome is a kind of primary angle closure glaucoma caused by a large or anteriorly positioned ciliary body that causes trabecular meshwork mechanical obstruction.¹²

The prevalence of Primary Angle Closure Glaucoma in Andhra Pradesh was 0.94%. Risk factors were an increase in age, IOP, Diabetes mellitus, and female gender.¹³ In Indian eyes, 30% of PACG eyes exhibited plateau iris in UBM (Ultrasound Biomicroscopy) and a common cause for persistent angle closure after Laser Peripheral Iridotomy.¹⁴

Existing treatment modalities of Primary Angle Closure Glaucoma (depending on its stages) are antiglaucoma medications, Laser Peripheral Iridotomy (LPI), Argon Laser Peripheral Iridoplasty (ALPI), Lens extraction, Trabeculectomy, and Endoscopic cyclophotocoagulation (ECP).¹⁵

Although LPI and Lens extraction are initial definitive therapy, ALPI can mechanically open the angle in PAC and Plateau Iris configuration. ALPI involves the use of an argon laser on the peripheral iris, which causes rapid shrinking owing to collagen coagulation, followed by the creation of fibroblastic membranes that compress the iris over time, eventually pushing it away from the angle. ALPI is usually indicated in PAC with LPI, Plateau iris configuration, and contraindicated in severe corneal oedema, flat anterior chamber and synechial angle closure.

ALPI is a potential technique to deter the need for invasive surgery.¹⁶

The present study aimed to evaluate the efficacy of argon laser peripheral iridoplasty (ALPI) in lowering intraocular pressure (IOP) and widening the angle configuration in patients with different types of angle-closure glaucoma. The results showed that ALPI effectively reduced IOP and widened the angle configuration in most cases, with a few complications that were mainly transient and mild.

The study population included ten patients in three groups comprising PAC with occludable angle, plateau iris configuration with patent LI, and primary angle closure glaucoma, with a mean age of 51.7 years. Most patients were females (80%), and the mean baseline IOP was 26 mm Hg (range 22-30 mm Hg). The angle configuration was assessed using Shaffer's angle grading method. It showed that five patients had occludable angles, one with occludable angles with peripheral anterior synechiae, two patients with plateau iris, one with a closed angle, and one with a closed angle with peripheral anterior synechiae.

The study showed a significant reduction in IOP after twelve months in most cases, ranging from 4-10 mm Hg (15%-38%). The IOP reduction was present in all groups except two cases with associated peripheral anterior synechiae. The angle configuration also widened in all cases except those mentioned above. These findings were consistent with Shaffer's grading in the follow-up.

The study also reported some complications associated with ALPI. Transient IOP spikes were observed in three cases (30%), mild iritis in four cases (40%), hyphema in two cases (20%), and mild corneal edema in one case (10%). These complications were mainly transient and resolved without any intervention.

The present study provides valuable insights into the efficacy and safety of ALPI in lowering IOP and widening the angle configuration in patients with primary angle closure and plateau iris configuration patients. The presence of peripheral anterior synechiae has unfavorable results.

Conclusion:

In conclusion, this study demonstrated that ALPI is an effective and safe treatment option for primary angle closure and plateau iris configuration. The procedure resulted in a significant reduction in IOP and widening of the anterior chamber angle in most cases. The complications observed were mild and transient, indicating a favorable safety profile of ALPI. Therefore, ALPI can be considered as an alternative treatment option for patients with primary angle closure and plateau iris configuration who are not amenable to peripheral LI or in whom LI is ineffective. Further studies with larger sample sizes and longer follow-up periods are warranted to confirm these findings and optimize the use of ALPI in clinical practice.

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