



Original Article

Efficacy of Nd:YAG Laser Peripheral Iridotomy in Primary Angle Closure Glaucoma and Its Role in Prophylactic Management of Fellow Eyes

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ABSTRACT

Background: Primary angle closure glaucoma (PACG) is a major cause of irreversible blindness, particularly in Asian populations. Nd:YAG laser peripheral iridotomy (PI) is the primary intervention aimed at relieving pupillary block and preventing disease progression.

Objectives: To evaluate the efficacy of Nd:YAG laser peripheral iridotomy in controlling intraocular pressure (IOP) in primary angle closure disease, to assess its prophylactic role in fellow eyes, and to analyze post-procedure anatomical changes and complications.

Methods: This prospective study included 100 patients with primary angle closure disease managed at a tertiary care center. Detailed ophthalmic evaluation, including Goldmann applanation tonometry and gonioscopy, was performed. Nd:YAG laser peripheral iridotomy was carried out in all affected eyes and 82 fellow eyes, with a follow-up period of six months.

Results: Females constituted 73% of the study population, with most patients aged 40–60 years. Improvement of one or more Shaffer's grades was observed in the majority of eyes. Good IOP control with stable or improved visual acuity was achieved in 92.2% of primary angle closure eyes and 71.4% of PACG eyes. All prophylactically treated fellow eyes maintained satisfactory IOP control. Transient IOP elevation and iris bleeding were the most common complications.

Conclusion: Nd:YAG laser peripheral iridotomy is a safe and effective treatment for primary angle closure disease. Early detection and timely intervention significantly improve anatomical outcomes and IOP control, thereby reducing the risk of visual morbidity.

Keywords: Primary angle closure glaucoma; intraocular pressure; gonioscopy; Nd:YAG laser peripheral iridotomy.

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INTRODUCTION

Glaucoma is a chronic, progressive, multifactorial optic neuropathy characterized by damage to the optic nerve, resulting in irreversible loss of visual function [1,2]. Elevated intraocular pressure (IOP) remains the most important and modifiable risk factor associated with the development and progression of glaucomatous optic neuropathy [2]. Globally, approximately 60 million individuals are affected by glaucoma, of whom more than 20 million have primary angle closure glaucoma (PACG) [3]. PACG accounts for a disproportionately higher burden of blindness, with over 5 million affected individuals being blind, a figure nearly twice that seen in primary open angle glaucoma (POAG) [3].

PACG shows marked geographic variation, with a higher prevalence among Asian populations, whereas POAG is more common in Western countries [4]. It is estimated that nearly half of the global glaucoma burden occurs in Asia, with angle closure disease constituting a significant proportion [3,4]. In India alone, glaucoma affects approximately 12 million individuals and contributes to nearly 12.8% of total blindness [5]. Hospital-based studies from India indicate that PACG is as prevalent as POAG, accounting for 45–55% of primary glaucomas, highlighting its public health significance [6,7].

The understanding of angle closure disease has evolved over time. Angle closure is now regarded as an anatomical disorder, independent of symptomatology, and encompasses a spectrum of disease severity [8]. Primary angle closure suspect (PACS), primary angle closure (PAC), and PACG are recognized as distinct clinical entities [8]. In Asian eyes, angle closure commonly results from a combination of pupillary block and non-pupillary block mechanisms [4,9].

Nd:YAG laser peripheral iridotomy is the treatment of choice for relieving pupillary block and is effective as primary therapy in early stages of angle closure disease [2,10]. Prophylactic iridotomy is recommended for fellow eyes due to the substantial risk of developing angle closure [11]. The present study aims to evaluate the clinical profile of primary angle closure disease, assess the efficacy of Nd:YAG laser peripheral iridotomy in IOP control, and analyze post-laser anatomical changes and complications.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted at Karwar Institute of Medical Sciences, Karwar, Karnataka from March 2023 to February 2024, after obtaining approval from the Institutional Ethical Review Committee. Written informed consent was obtained from all participants.

Study Population and Sample Size

A total of 100 patients with primary angle closure disease were included in the study. Nd:YAG laser peripheral iridotomy was performed on 182 eyes, including affected eyes and eligible fellow eyes. Patients were followed up for a minimum period of six months.

Inclusion Criteria

- Eyes diagnosed with primary angle closure glaucoma associated with elevated intraocular pressure.
- Eyes with occludable angles undergoing prophylactic Nd:YAG laser peripheral iridotomy to prevent acute angle closure.

Exclusion Criteria

- Eyes with secondary angle closure glaucoma due to causes such as neovascularization, uveitis, trauma, or lens-induced mechanisms.
- Eyes with primary open angle glaucoma or other non-angle closure glaucomas.
- Eyes with a history of prior intraocular surgery or laser procedures affecting the anterior segment.
- Eyes with corneal opacity or media haze precluding adequate gonioscopic evaluation or laser application.
- Patients unwilling or unable to comply with follow-up visits.

Diagnostic Criteria

An occludable angle was defined as non-visibility of the posterior trabecular meshwork for $\geq 75\%$ of the angle circumference on gonioscopy [8]. Primary angle closure glaucoma was diagnosed in eyes with occludable angles, peripheral anterior synechiae, and glaucomatous optic neuropathy (cup-disc ratio ≥ 0.7 or inter-eye asymmetry ≥ 0.2) [8]. Primary angle closure was defined as occludable angles with normal optic discs and visual fields, with raised intraocular pressure (>19 mmHg), peripheral anterior synechiae, pigment smearing, or sequelae of prior acute angle closure [8].

Ophthalmic Evaluation

All patients underwent comprehensive ophthalmic evaluation including best-corrected visual acuity assessment, slit-lamp biomicroscopy, intraocular pressure measurement using Goldmann applanation tonometry, and gonioscopy with indentation where required. Visual field analysis was performed using automated perimetry when indicated.

Nd:YAG Laser Peripheral Iridotomy Procedure

Nd:YAG laser peripheral iridotomy was performed under topical anesthesia using an Abraham contact lens [10]. Pupillary miosis was achieved with pilocarpine nitrate 2%, and apraclonidine or brimonidine was administered to prevent post-laser intraocular pressure spikes; oral acetazolamide was given in glaucomatous eyes [2,10]. Laser energy ranged from 3 to 8 mJ per pulse, and iridotomy was placed between the 10 and 2 o'clock positions [10]. Patency was confirmed clinically, and patients were monitored for intraocular pressure control, angle status, and procedure-related complications during follow-up [10,11].

RESULTS

A total of 100 patients with primary angle closure disease were included in the study. Females constituted 73% (n=73) of the study population, while males accounted for 27% (n=27). Most patients belonged to the 40–60 years age group.

Table-1: Age and sex distribution of the study population

Age (years)	Male	Female	Total
31-40	0	4	4
41-50	1	29	39
51-60	14	23	37
61-70	3	17	20

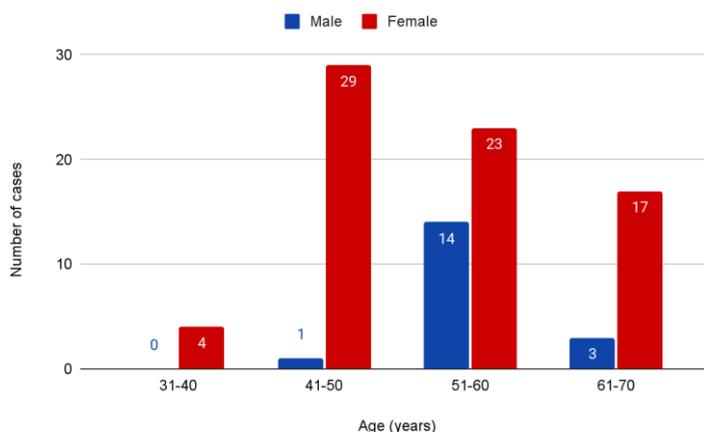


Figure 1: Age and sex distribution of the study population

Table 2: Gender distribution

Sex	Number of cases
Male	27
Female	73

Gender Distribution

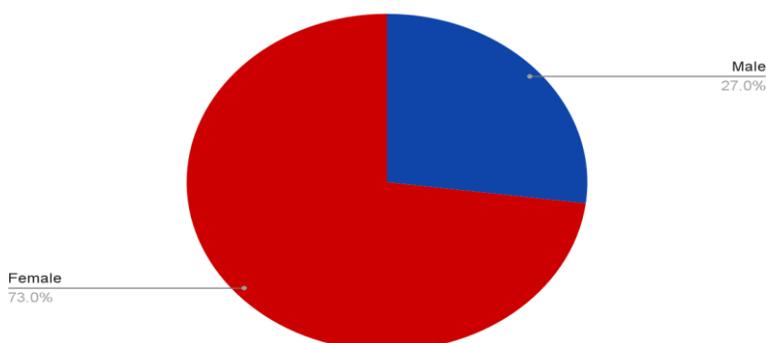


Figure 2: Pie chart showing gender distribution

Based on clinical classification, 57 patients (57%) were diagnosed with primary angle closure (PAC), 28 patients (28%) with primary angle closure glaucoma (PACG), and 15 patients (15%) with primary angle closure suspects (PACS).

Table 3: Initial diagnosis in eyes treated with YAG laser iridotomy

Diagnosis	Number of cases
PACG-Primary Angle CLOsure Glaucoma(Chronic)	28
PAC-Primary Angle Closure (Acute and Subacute)	57
PACS-Primary Angle CLOsure Suspects	15
Total	100
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PAC-Primary Angle Closure (Acute and Subacute)	57
PACS-Primary Angle CLOsure Suspects	15
Total	100

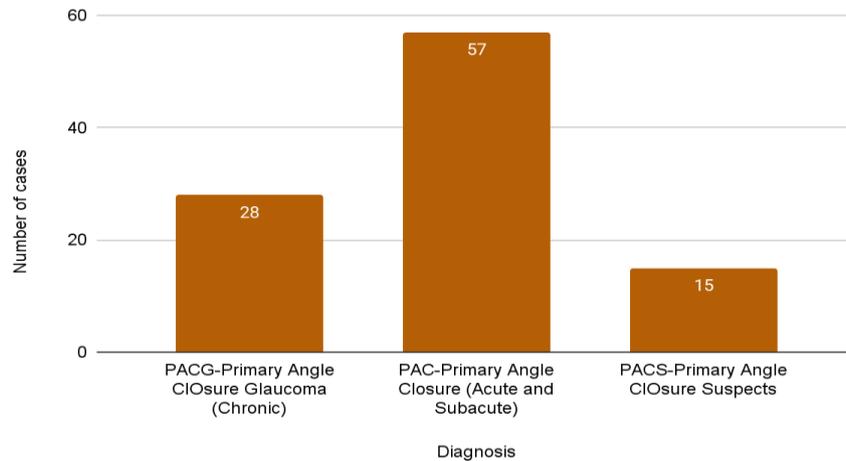


Figure 3: Bar graph showing distribution of initial diagnosis in eyes treated with YAG laser iridotomy

Nd:YAG laser peripheral iridotomy was performed on 182 eyes, including affected eyes and 82 fellow eyes treated prophylactically. Post-laser gonioscopic assessment demonstrated significant widening of the anterior chamber angle. Improvement of two Shaffer's grades was observed in 65% of eyes, while one-grade improvement was noted in 25% of eyes. Minimal or no change in angle configuration was seen in a small proportion of eyes.

Among eyes with PAC, 53 of 57 eyes (92.2%) achieved good intraocular pressure control with stable visual acuity during follow-up. In the PACG group, 20 of 28 eyes (71.4%) demonstrated satisfactory intraocular pressure control with stable or improved visual acuity, while the remaining eyes required additional medical or surgical intervention. All PACS eyes and prophylactically treated fellow eyes maintained normal intraocular pressure and stable visual acuity throughout the follow-up period.

Table 4: Intraocular pressure control after Nd:YAG laser peripheral iridotomy

Clinical group	Total eyes	Eyes with good IOP control	Percentage (%)
PAC	57	53	92.2
PACG	28	20	71.4
PACS / Fellow eyes	15	15	100

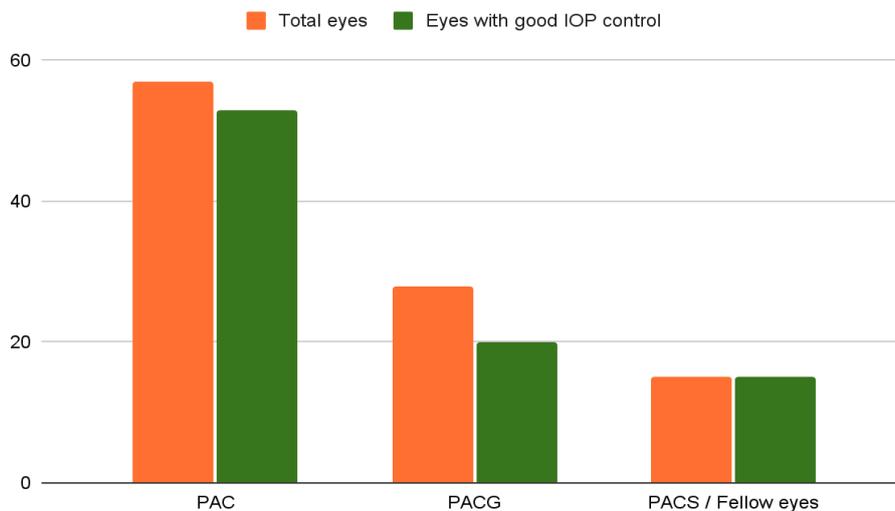


Figure 4: Bar graph showing intraocular pressure control after Nd:YAG laser peripheral iridotomy

Iridotomy closure was observed in 6 eyes (3.4%) during follow-up, associated with shallow anterior chamber and persistently narrow angles. Transient elevation of intraocular pressure following laser iridotomy was noted in 38 patients (38%) and was managed medically. Iris bleeding was observed in 19 patients (19%) and resolved spontaneously. Overall, failure to achieve adequate intraocular pressure control with stable or improved visual acuity was observed in 28.5% of PACG eyes and 5.2% of PAC eyes.

Table 5 :Complications of YAG iridotomy

Complication	Number of cases	Percentage
Transient elevation of IOP(>8inm)	38	38
Aqueous flare/debris	34	34
Bleeding of iris	19	19
Corneal bums	5	5
Lens damage	4	4

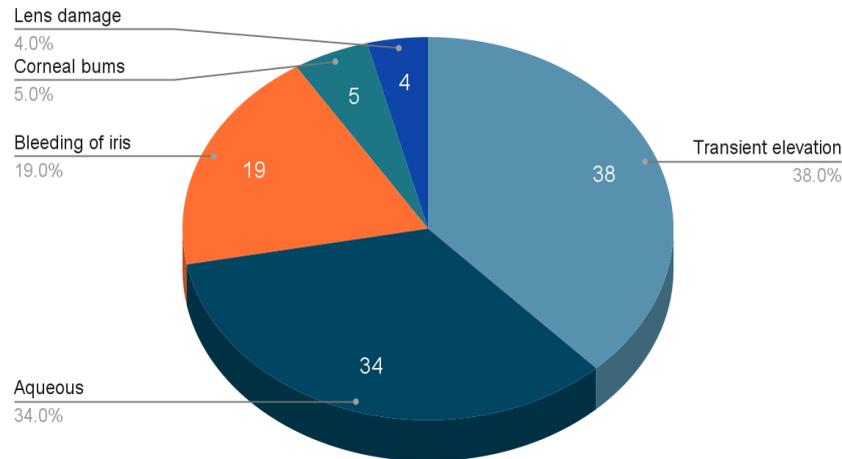


Figure 5: Pie chart showing complications of YAG iridotomy

DISCUSSION

Nd:YAG laser peripheral iridotomy remains the primary intervention for primary angle closure disease by relieving pupillary block and improving aqueous outflow [2,10]. In the present study, laser iridotomy was effective in the majority of eyes with PAC and PACS, demonstrating good feasibility and safety with modest laser energy requirements [10].

Post-laser gonioscopy showed significant widening of the anterior chamber angle, with improvement of one or more Shaffer's grades in most eyes [9,10]. Limited gonioscopic improvement was mainly observed in eyes with extensive peripheral anterior synechiae, emphasizing the benefit of early intervention before irreversible angle damage occurs [8,9]. Intraocular pressure control was excellent in PAC and PACS eyes, with stable visual acuity maintained during follow-up [10,11]. In contrast, eyes with chronic PACG showed comparatively lower success rates, and a proportion required additional medical therapy or filtration surgery [10]. Failure of laser iridotomy was predominantly associated with advanced disease and extensive synechial angle closure, consistent with previous reports [9,10].

Prophylactic laser iridotomy in fellow eyes and PACS eyes was effective in preventing symptomatic angle closure and glaucomatous optic neuropathy, supporting its role as a preventive strategy in anatomically predisposed eyes [11].

Iridotomy patency was maintained in most cases, with closure occurring in a small proportion during early follow-up and successfully managed with repeat laser treatment [10]. Transient intraocular pressure elevation and mild iris bleeding were the most common complications [10,11]. Their slightly higher incidence compared to Western studies may be attributed to increased iris pigmentation in the Indian population; however, these events were self-limiting and responded well to medical management [10].

Overall, the findings of this study support Nd:YAG laser iridotomy as an effective and safe procedure for primary angle closure disease, particularly when performed early [2,10]. Early detection and timely intervention remain critical in achieving optimal anatomical and intraocular pressure outcomes and in preventing disease progression [8,9].

Comparison with Other Studies

The outcomes of the present study are comparable with those reported in earlier published literature evaluating the efficacy of Nd:YAG laser peripheral iridotomy in primary angle closure disease. A comparison of key outcomes from selected studies is summarized in Table 5.

Table 5: Comparison of outcomes of Nd:YAG laser peripheral iridotomy with other studies

Study	Study population	IOP control after LPI	Iridotomy closure	Key observations
See JL et al.[4]	PAC / PACG	~72%	Not specified	Better outcomes in early disease
AAO Report[2]	PAC / PACG	~86.7%	Not specified	LPI effective as primary therapy
Jiang Y et al.[12]	PAC / PACG	Not specified	~6%	Closure related to small iridotomy size
Naveh N et al.[10]	PAC / PACG	Not specified	~10%	Pigment epithelial proliferation implicated
Present study	PAC / PACG / PACS	92.2% (PAC), 71.4% (PACG)	3.4%	Higher success with early intervention

CONCLUSION

Nd:YAG laser peripheral iridotomy is a safe and effective procedure for the management of primary angle closure disease. In the present study, significant anatomical widening of the anterior chamber angle and satisfactory intraocular pressure control were achieved, particularly in eyes with PAC and PACS. Prophylactic iridotomy in fellow eyes and PACS eyes effectively prevented symptomatic angle closure and glaucomatous optic neuropathy during follow-up.

The efficacy of laser iridotomy was strongly influenced by the stage of disease at presentation. Eyes with chronic PACG and extensive synechial angle closure demonstrated lower success rates and frequently required additional surgical intervention. Complications associated with the procedure were generally mild and transient, responding well to standard medical management.

These findings underscore the importance of early detection and timely Nd:YAG laser iridotomy in preventing disease progression and preserving visual function in patients with primary angle closure disease.

Declaration:

Conflicts of interests: The authors declare no conflicts of interest.

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