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To Compare Intraocular Pressure changes and Anterior Chamber Angle Depth Changes after Nd-Yag Laser Peripheral Iridotomy

Deepa Sonawane, Komal Parikh.

Author: *Deepa Sonawane: Department of Ophthalmology, Associate Professor, NAMO medical and research institute and Shri Vinoba Bhave Hospital,Silvassa, DNH, India*

Corresponding Author: *Komal Parikh, Professor, Department of Ophthalmology, NAMO medical and research institute and Shri Vinoba Bhave Hospital,Silvassa, DNH, India*

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ABSTRACT

Aim: To compare intraocular pressure and anterior chamber angle depth changes after Nd-Yag laser peripheral iridotomy in primary angle closure, primary angle closure suspect and primary angle closure glaucoma.

Materials and methods: In this clinical trial study, 34 eyes of 29 patients with primary angle-closure and primary angle closure suspect were prospectively enrolled between November 2020 and February 2023. Intraocular pressure and anterior segment optical coherence tomography were performed at three separate times: on the initial conditions 1 week after laser iridotomy. Anterior chamber angle parameters were the angle opening distance (AOD) and trabecular–iris space area (TISA).

Results: The intraocular pressure reduction following Nd-Yag laser was significant after laser iridotomy: 3.9 mm Hg to 4.5 mmHg ($p = 0.002$).

Meanwhile, the increment of angle parameters following laser iridotomy was significantly increased. The AOD750 increment of both nasal and temporal quadrant following laser iridotomy was significant 0.13 mm (−0.27 to 0.28) vs 0.05 mm (−0.35 to 0.29) ($p = 0.003$) and 0.12 mm (−0.10 to 0.34) vs 0.04 mm (−0.27 to 0.19) ($p = 0.002$), respectively. The TISA750 increment of both nasal and temporal quadrant following laser iridotomy was also significant 0.05 mm^2 (−0.06 to 0.20) vs 0.02 mm^2 (−0.12 to 0.13) ($p = 0.023$) and 0.04 mm^2 (−0.04 to 0.17) vs 0.01 mm^2 (−0.14 to 0.18) ($p = 0.012$), respectively.

Conclusion: Nd-Yag Laser peripheral iridotomy not only widens the angle and also causes significant decrease in IOP.

Keywords: Anterior chamber angle, Clinical trial, Intraocular pressure, Nd-yag Laser peripheral iridotomy.

I. INTRODUCTION

Visual impairment in primary angle closure glaucoma is 2–3 times more common compared to primary open angle glaucoma despite the less prevalence of primary angle-closure glaucoma compared to primary open angle glaucoma. Acute attack of angle closure glaucoma causes blindness in 10% of the total cases.[2,3] Quigley et al.[4] predicted the number of patients with bilateral blindness due to angle closure glaucoma in 2020 would reach 5.3 million.

Relative pupillary block is the main mechanism of aqueous flow obstruction in angle closure glaucoma patients. In pupillary block, there is an aqueous flow obstruction from posterior to anterior chamber through pupil, causing higher pressure in posterior chamber than the anterior chamber. This pressure gradient pushes peripheral iris to anterior, closing the anterior chamber angle.[5,6]

Anterior chamber angle evaluation with gonioscopy is the gold standard until now, but it has several limitations such as subjective result, dependency on examiner expertise, anatomical distortion due to pressure effect, and difficulty in quantitative measurement.[2,7–9]

Anterior segment optical coherence tomography (ASOCT) is an imaging technique which is able to give cross-sectional images of the anterior segment with high resolution. The advantages of ASOCT are faster and easier procedure, more comfortable for the patients with no contact involved, less anatomical distortion caused by contact pressure, as well as quantitative and more objective results.[2,8,10]

Therapeutic principle in angle closure is by removing pupillary block. Nd-Yag Laser peripheral iridotomy (Nd-Yag LPI) is the treatment of choice by making a hole in iris, allowing aqueous flow shunt from the posterior to anterior chamber and causing convex iris configuration to

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be more flattened and opening anterior chamber angle.

Nd-Yag Laser peripheral iridotomy is the standard first line therapy for primary angle closure and primary angle closure suspect. The objective of this study was to measure IOP and note the anterior chamber angle depth changes following Nd-Yag laser peripheral iridotomy.

II. MATERIALS AND METHODS

We conducted this interventional clinical trial between November 2020 and February 2022 in NAMO meri and Shri Vinoba Civil Hospital, Silvassa,DNH.

Study Participants

Patients with primary angle-closure, primary angle closure glaucoma and primary angle closure suspect were included in this study.

Individuals excluded if they had cup disc ratio (CDR) ≥0.8, previous intraocular laser or surgery, hazy cornea, and any form of secondary angle closure.

Primary angle-closure included in this study were patients diagnosed as primary angle closure suspect (PACS), primary angle closure (PAC), and primary angle-closure glaucoma (PACG). The diagnosis of PACS was made in eyes with iris and trabecular meshwork contact ≥180° on gonioscopy, IOP ≤ 21 mm Hg, and without presence of peripheral anterior synechiae (PAS). Primary angle closure (PAC) was diagnosed as iris and trabecular meshwork contact ≥180° on gonioscopy, with either IOP > 21 mm Hg, and/or with the presence of peripheral anterior synechiae (PAS). Meanwhile, the diagnosis of PACG was made in eyes with iris and trabecular meshwork contact ≥180° on gonioscopy plus evidence of glaucomatous damage to optic disc and visual field.

The patients were recruited consecutively. If both eyes met the criteria, both were included, with a 1 week interlude between them.

Each patient underwent a standardized ophthalmic examination that included fundus examination, visual acuity determination with Snellen visual acuity chart, IOP measurement using Goldmann applanation tonometry, gonioscopy with 4-mirror lens, and ASOCT examination (Topcon - optovue). Examinations were performed at three separate times 1 week following Nd-Yag laser peripheral iridotomy.

Nd-Yag Laser Peripheral Iridotomy (LPI)

Laser peripheral iridotomy was performed in the superior region of the iris (10-o'clock to 2-o'clock position) using topical anesthesia Nd:Yag lasers. It was performed by two glaucoma consultants (VD and WA) under miotic condition of eye. Prednisolone acetate 1% eyedrops and antibiotic combination 4times a day along with brimonidine twice a day were prescribed for two weeks after procedure. Evaluation was done a week after Nd-Yag laser.

Measurements of Anterior Chamber Angle

Using Topcon optovue OCT, two anterior chamber angle parameters (AOD750 and TISA750) were measured. It was performed by one operator for all cases. Angle opening distance was calculated as the perpendicular distance measured from the trabecular meshwork at 750 µm anterior to the scleral spur to the anterior iris surface (AOD750). Trabecular–iris space area was calculated as an area bounded anteriorly by the AOD750, posteriorly by a line drawn from the scleral spur perpendicular to the plane of the inner scleral wall to the opposing iris, superiorly by the inner corneoscleral wall, and inferiorly by the iris surface (TISA750). Measurements were taken at both nasal and temporal quadrants.

Statistical Analysis:

The primary outcome of this study was to access anterior chamber angle depth parameters and IOP. Statistical analysis was done using SPSS 21.0.

III. RESULTS:

A total of 34 eyes with angle closure were recruited for the study. No participant had ever dropped out.

Table 1 summarizes the demographic and clinical data of the participants including age, gender, visual acuity, diagnosis group, and amount of PAS in PAC and PACG group. The mean (SD) age was 58.1 (8.9) years (age range, 46–80 years). Most of the participants were female.

The baseline IOP and angle parameters were not significantly different among diagnosis groups (Table 2). The IOP reduction by LPI (p 0.002) were moderate. Meanwhile, changes of anterior chamber angle post-LPI were significantly greater with decrease in IOP.(Table-3)

Primary angle closure glaucoma had significantly the greatest IOP reduction among other diagnosis group post-LPI ($p = 0.002$) (Table 4). There were no significant differences of anterior chamber angle changes post-LPI among diagnosis groups (Table 4).

Table 1: Baseline characteristics

Variable	
Age (year)	58.1 ± 8.9
Gender	
Male	8
Female	21
BCVA	Snellens Visual acuity chart 6/6 to 6/18)
Diagnosis	
PACS	16
PAC	11
PACG	7
PAS amount (clock hour)	
PAC	0–9
PACG	3–11

Table 2: Baseline intraocular pressure and angle parameters among groups

Variable	PACS	PAC	PACG	P*	p*
IOP (mm Hg)	14.77 ± 3.71	17.16 ± 3.29	18.70 (16.00–50.50)	0.054	0.054
AOD750 (mm) nasal	0.238 ± 0.16	0.214 ± 0.17	0.130 (0.08–0.65)	0.635	0.635
AOD750 (mm) temporal	0.260 ± 0.15	0.246 ± 0.16	0.140 (0.10–0.47)	0.477	0.477
TISA750 (mm^2) nasal	0.123 ± 0.07	0.084 ± 0.07	0.05 (0.03–0.21)	0.327	0.327
TISA750 (mm^2) temporal	0.141 ± 0.06	0.110 ± 0.07	0.07 (0.02–0.21)	0.087	0.087

* Kruskal–Wallis test

Table 3: Changes of IOP and anterior chamber angle after laser peripheral iridotomy

Variable	Median	Range	Median	Range	P*	
ΔIOP	−3.90	−32.5 to 0.20	−1.80	−33.5 to 2.30	0.002	0.002
ΔAOD750 nasal	0.05	−0.35 to 0.29	0.13	−0.27 to 0.28	0.003	0.003
ΔAOD750 temporal	0.04	−0.27 to 0.19	0.12	−0.10 to 0.34	0.002	0.002
ΔTISA750 nasal	0.02	−0.12 to 0.13	0.05	−0.06 to 0.20	0.023	0.023
ΔTISA750 temporal	0.01	−0.14 to 0.18	0.04	−0.04 to 0.17	0.012	0.012

Wilcoxon rank

Table 4: Comparison of IOP and anterior segment changes after laser peripheral iridotomy.

Variable	Δbaseline-laser peripheral iridotomy				p
	PACS	PAC	PACG	P*	
ΔIOP (mm Hg)	−1.11 ± 1.87	−2.88 ± 3.13	−7.40 (−33.50 to −2.00)	0.002[a]	0.002[a]
ΔAOD750 (mm) nasal	0.119 ± 0.12	0.14 (−0.01 to 0.17)	0.021 ± 0.17	0.205[a]	0.205[a]
ΔAOD750 (mm temporal	0.139 ± 0.14	0.101 ± 0.11	0.032 ± 0.04	0.442[b]	0.442[b]
ΔTISA750 (mm^2) nasal	0.049 ± 0.06	0.05 ± 0.03	0.017 ± 0.06	0.345[b]	0.345[b]
ΔTISA750 (mm^2) tempor	0.060 ± 0.06	0.039 ± 0.05	0.00 (−0.30 to 0.15)	0.268[a]	0.268[a]

[a] Kruskal–Wallis

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IV. DISCUSSION

We observed that afer Nd-Yag LPI the IOP was significantly lower and also laser peripheral iridotomy widened the angle.

As-Oct also concurred that angle changes by LPI were wider and with statistically significant decrease in IOP.

The results of this mechanism determined the angle alteration and reduced IOP.

The greatest change in angle parameters of each group post-LPI was in the PACS group, followed by PAC, and the least was PACG, although statistically not significant probably due to PAS.This was similar to a study by Han et al.[20] who observed a greater change in PAC than PACG, although not statistically significant. Another study by Ang et al.,[10] divided the group into 2, PACS and PAC in 1 group with PACG in another group. There was no difference of angle parameter change post-LPI between the two groups. The greatest change in angle parameters post-LPI was observed in the PACS group in this study because in PACS the iridotrabecular apposition was still reversible. Meanwhile, there was already synechiae in PAC and PACG, making the angle more difficult to be opened. There were also some patients in PAC (5 patients) and PACG group (4 patients) in this study had PAS at the superior quadrant, which was the site of LPI. In PACG, besides synechiae, there was also more damage of trabecular meshwork and optical nerve. Therefore, the angle change in PACG post-LPI was the smallest among other diagnosis groups.[21]

Intraocular pressure change Nd-Yag LPI showed the greatest reduction in PACG, followed by PAC and PACS. This was caused by the higher initial IOP of PACG compared to PAC and PACS. In the PACS group, despite having an initial IOP value within the normal range, it still showed a reduction of IOP after LPI. This suggested that LPI induced an IOP reduction effect. However, it should be noted that in the PACG or PAC group with initial IOP > 21 mm Hg, antiglaucoma medicine was administered since the beginning of this study until post-LPI measurements were performed. None of the participants in this study got rescue treatment within a 1 week post-LPI follow-up phase.

The strengths of this study were no dropped-out participants, and was the first study comparing the effect of Nd- Yag LPI on IOP and anterior chamber angle changes. The limitation of this study was that angle parameters assessed using AS-OCT were only at the nasal and temporal quadrant.

V. CONCLUSION

The effect of Nd- Yag LPI on IOP and anterior chamber angle changes both were significant . Laser peripheral iridotomy widens the angle and also reduces the intraocular pressure of primary angle closure groups. Their effect was decreased in accordance with the severity of the disease. After Nd-yag laser Primary angle-closure glaucoma showed the greatest result in IOP reduction, followed by primary angle closure, and primary angle closure suspect was the least.

Nd-Yag Laser peripheral iridotomy significantly increases the AC depth more in primary angle closure suspect followed by primary angle closure followed by primary angle closure glaucoma.

CLINICAL SIGNIFICANCE

By assessing the changes in intraocular pressure and anterior chamber angle after Nd-Yag laser iridotomy, we can identify the mechanism and response of the eye to both the parameters.

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