

# Comparison of Nd: YAG Laser Iridotomy Alone Versus Sequential Argon-Nd: YAG Laser Iridotomy in Patients with Primary Angle Closure Spectrum



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## ABSTRACT

**Purpose:** To compare the mean Nd: YAG energy used and mean decrease in IOP 3-hours post-laser, in Nd: YAG Laser iridotomy alone versus sequential Argon-Nd: YAG iridotomy in patients with primary angle closure spectrum.

**Study Design:** Quasi experimental Study.

**Place and Duration of Study:** Department of Ophthalmology, Allied Hospital, Faisalabad from March 2022 to August 2022.

**Methods:** After taking approval from Ethical review board, 70 patients with angle closure spectrum were included in the study. Out of 70, 25 patients were primary angle closure suspect (PACS), 28 had primary angle closure (PAC) and 17 patients had primary angle closure glaucoma (PACG). We sorted patients into Group A (those who underwent sequential Argon-Nd: YAG Laser peripheral iridotomy) and Group B (those who underwent Nd: YAG laser alone). Mean Nd: YAG energy used was noted in each group and compared using SPSS version 25.0. Mean decrease in IOP 3-hours post-laser was also noted and compared.

**Results:** Mean decrease in IOP 3 hours post-laser was  $5.46 \pm 3.70$  mmHg for sequential Argon-Nd: YAG LPI versus  $3.46 \pm 2.38$  mmHg for Nd: YAG LPI alone ( $p$ -value = 0.009). Mean Nd: YAG energy used in sequential Argon-Nd: YAG LPI group was significantly lesser when compared to Nd: YAG LPI alone group ( $32.70 \pm 38.87$  versus  $139.37 \pm 62.32$  mJ) which was found to be statistically significant ( $p = 0.0001$ ).

**Conclusion:** Sequential Argon-Nd-YAG laser iridotomy uses significantly less Nd:YAG energy than conventional Nd:YAG only method with better IOP control.

**Key Words:** Primary angle closure glaucoma, Argon laser. Nd-YAG laser, Iridotomy, Laser Peripheral Iridotomy.

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## INTRODUCTION

After cataract, glaucoma is the second most common cause of blindness worldwide.<sup>1</sup> The World Health

Organization (WHO) has estimated that 12.3% of world's blindness is due to glaucoma. Angle closure glaucoma (ACG) constitutes almost half of the glaucoma cases<sup>2</sup> and has affected more than 16 million people worldwide. It is most prevalent in Inuit and Asians.<sup>3,4</sup> It can be primary or secondary angle closure. The European Glaucoma Society stages the patients of primary angle closure spectrum into primary angle-closure suspect (PACS), primary angle closure (PAC), and primary angle closure glaucoma (PACG), according to course of disease progression.<sup>5,6</sup>

Laser peripheral iridotomy (LPI) is indicated for the treatment of all the patients having primary angle closure spectrum disease with pupillary block.<sup>7-9</sup> It is easier and less invasive than surgical peripheral iridectomy.<sup>10,11</sup> LPI can employ either the photodisruptive lasers such as Neodymium-Yttrium-Aluminium-Garnet (Nd: YAG) laser, or photocoagulative lasers such as Argon laser or frequency doubled Neodymium-Yttrium-Aluminium-Garnet laser, or a sequential use of both.<sup>12</sup>

Nd: YAG iridotomy alone is efficient for lighter coloured irides, reaching full perforation with few shots. However, in darker thicker irides, especially of Asians, the higher photodisruptive energy of Nd:YAG is needed to have an adequate effect, which leads to increased risk of complications like haemorrhage, post laser IOP spike, corneal endothelial burns, trabeculitis, lenticular opacities, macular damage, decrease in endothelial cell count and iris chaffing.<sup>13,14</sup> The complications are sometimes so severe that laser has to be halted in favour of a repeat trial, and multiple sittings may be needed to create a patent iridotomy.<sup>15,16</sup>

Sequential Argon-Nd-YAG LPI on the other hand, uses photocoagulative energy of Argon laser to breach two-thirds of initial iris thickness, remaining one-third being breached by Nd: YAG laser. Since fewer shots of Nd: YAG laser energy are needed, fewer Nd: YAG related complications are encountered.<sup>17,18</sup> Some studies report that in sequential LPI, as compared to Nd: YAG LPI alone, approximately three times less total energy is needed to create iridotomy. On the other hand, some studies report that the total Nd: YAG energy, post laser IOP control, total number of shots and perforation rates are comparable in the two techniques.

We conducted this study to compare the outcome of Nd: YAG laser iridotomy alone versus sequential Argon-Nd: YAG laser iridotomy in terms of mean Nd: YAG energy used and mean IOP decrease post-iridotomy. Its results will add to the existing body of knowledge, helping in achieving more effective iridotomies with lesser complications in our South-Asian population with thick and heavily pigmented irides.

## METHODS

This quasi experimental study was conducted at Department of Ophthalmology, Allied Hospital Faisalabad after approval from the Ethical Review Committee (ERC). Sample size of 70 cases (35 in each

group) was calculated by using WHO sample size calculator for two means, taking power of study as 80%, level of significance as 5%, and pooled standard deviation as 3.9. The mean values used for calculating sample size were taken from a reference study by Singh MD et al.<sup>8</sup> By using non-probability, consecutive sampling 70 patients, of both genders, 40-80 years old, who were diagnosed at least 3 months before as PACS, PAC and PACG were enrolled after informed consent. Patients with glaucoma other than caused by pupil block mechanism, 360 degree synechial angle closure, flat anterior chamber, hazy cornea, rubeosisiris, and with history of ocular trauma, or any intraocular surgery were excluded. Following information was collected: demographic information, detailed history, visual acuity on Snellen chart, IOP by applanation tonometry, examination findings on slit lamp, gonioscopy and funduscopy. Patients were sorted into Group A (those who were treated with sequential Argon-Nd: YAG laser iridotomy), and Group B (those who were treated with Nd: YAG laser iridotomy alone). Each patient was administered with topical pilocarpine 2% eye drops. One hour later, under topical anaesthesia, Abraham YAG Iridotomy contact lens was placed on patient's cornea using 2.5% hydroxypropyl methylcellulose as the coupling agent. Iridotomy was created in peripheral 1/3 of iris, possibly over a crypt, anywhere from 11 to 1 O'clock position.

For the sequential Argon-YAG LPI procedure, Argon laser was used for pre-treatment with following settings: shot duration of 0.1 sec, spot size of 50um, and 800 to 1200 mW energy. This was followed immediately by Nd:YAG laser shots, keeping the settings as 50 um spot size, 7-10 mJ energy, with single pulse per shot. For the Nd:YAG iridotomy alone, the settings were 8 to 12mJ, 50 um spot size, with 1 to 3 pulses in single shot as needed.

In all cases, we recorded total Nd: YAG energy used, IOP 3 hours after the procedure, and calculated its difference from pre-laser IOP. We used SPSS version 25.0 to analyse data, and calculate the means and standard deviations of quantitative variables such as age, disease period, total Nd: YAG energy required, and mean decrease in IOP 3 hours post-laser. Gender was presented as frequency and percentage. By using independent sample T test, we compared the mean Nd:YAG energy required and mean decrease in IOP 3 hours post-laser between the two groups and took p-value <0.05 as significant.

**Table 1:** Comparison of mean Nd: YAG energy used and mean decrease in post-laser IOP, in Nd: YAG laser iridotomy alone versus sequential Argon-Nd:YAG laser iridotomy in patients with primary angle closure spectrum.

Outcome	Group A (n=35) Mean ± SD	Group B (n=35) Mean ± SD	p-value
Decrease in IOP after 3 hours (mmHg)	5.46 ± 3.70	3.46 ± 2.38	<b>0.009</b>
Energy used (mJ)	32.70 ± 38.87	139.37 ± 62.32	<b>0.0001</b>

## RESULTS

Total 70 patients, 35 in each group, with age range from 40 to 80 years (mean age of  $59.75 \pm 7.21$  years) were enrolled in the study. Thirty-seven were males and thirty-three were females. Thirty-eight left eyes and thirty-two right eyes were treated. Twenty-five were primary angle closure suspect (PACS), twenty-eight had primary angle closure (PAC), and seventeen (17) patients had primary angle closure glaucoma (PACG). Mean duration of disease was  $10.21 \pm 2.47$  months. The mean baseline IOP in group A was  $23.66 \pm 4.41$  mmHg and in group B was  $22.2 \pm 4.51$  mmHg. The mean decrease in IOP after 3 hours (mmHg) and mean energy used in sequential group A was significantly shorter when compared to group B with  $p = 0.0001$ ) as shown in Table 1.

## DISCUSSION

In patients with angle closure spectrum, LPI allows the aqueous humor to flow through iridotomy opening from the posterior chamber into anterior chamber directly, rather than through the pupil, thus relieving the pupillary block. It can be created using only Nd: YAG laser, only Argon laser, or both.<sup>12</sup> Argon laser exerts a thermal effect on the tissue since it is a continuous wave laser. Its photocoagulative energy does not cause as much tissue disruption as compared to Nd:YAG laser. The latter has a much greater photodisruptive effect on tissue because it has a short pulse and delivers a very high power to a small and highly localized focus. This is why Argon laser energy has lesser chances of secondary rise of IOP, trabeculitis, hyphema, corneal endothelial burns, lenticular opacities, macular damage, decrease in endothelial cell count and iris chaffing as compared to Nd:YAG laser.<sup>18,19</sup> These complications with Nd:YAG energy are more pronounced in heavily pigmented irides like those of Asians.<sup>20</sup>

Transient spike in IOP is a short-term post iridotomy complication reported by some studies.<sup>21</sup> This spike of IOP was not observed in our study. Rather we observed an overall mean decrease in post

laser IOP, consistent with the observation of de Silva et al who found a statistically significant ( $p < 0.001$ ) decrease in mean IOP in both groups: from 19.0 mm Hg to 14.4 mmHg in Nd:YAG laser iridotomy group and from 19.8 mmHg to 13.8 mmHg sequential iridotomy group.<sup>20</sup>

There are several limitations to consider: small sample and single center study might not be representative of the entire population with angle closure spectrum. There may have been inherent differences between Group A and Group B patients that could have influenced the results. The study only assessed the decrease in IOP 3 hours post-laser without a longer follow-up period which could provide more insight into the sustained efficacy of the interventions and potential complications that may arise over time. Addressing these limitations in future studies would strengthen the evidence base and provide more reliable conclusions regarding the efficacy and safety of sequential Argon-Nd: YAG laser iridotomy compared to conventional Nd: YAG laser alone.

## CONCLUSION

Sequential Argon-Nd:YAG iridotomy technique is much safer than Nd:YAG alone technique because of use of lesser disruptive energy.

**Conflict of Interest:** Authors declared no conflict of interest.

**Ethical Approval:** The study was approved by the Institutional review board/Ethical review board (48-ERC/2020-21/PHRC/FMU/116).

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### Authors Designation and Contribution

Paras Khan; Postgraduate Resident: *Concepts, Design, Literature search, Data acquisition, Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review.*

Rizwan Khan; Assistant Professor: *Manuscript preparation, Manuscript editing, Manuscript review.*

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