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**Objective:** To observe the role of Nd: YAG laser capsulotomy in terms of visual outcome (Best Corrected Visual Acuity) and the changes in IOP and other complications after the procedure.

**Material and Methods:** A hospital-based, observational, prospective study was carried out at R. M. Kedia Eye Hospital from July 2018 to June 2019. 200 eyes of 200 patients with PCO were included in the study. Complete ocular examination including visual acuity (VA), anterior and posterior segment examination with a slit lamp, and IOP measurement using Goldmann appplanation tonometer were performed pre and post-laser in all cases.

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**GJMR-F Classification:** NLMC Code: WW 290



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# Role of Nd: YAG Laser in Visual Outcomes and IOP Changes Pre and Post Nd: YAG Laser Capsulotomy

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**Results:** Out of 200 subjects 108 were male and 92 were female. The average time interval of cataract surgery and Nd: YAG laser capsulotomy was 25-36 months. The maximum number of patients developing pco was under the age group of 51-60 years with a mean age of 55 ±5.52years. After performing Nd-YAG laser capsulotomy, 56% of patients had better VA ranging from 6/36-6/18, and 28% had improved VA between 6/12-6/6. The percentage of patients with better VA increased gradually during the follow-up period at one hour, one week, and one month. In our study, only 4 cases showed IOP of more than 21 mm Hg, IOL pitting in 40 and iris bleeding, and uveitis in 2 patient's each.

**Conclusion:** Nd: YAG Laser is a non-invasive, immediate recovery and OPD-based procedure that provides excellent posterior capsulotomies with minimal complications. From the study, it is clear that Nd: YAG laser posterior capsulotomy is safe and an effective method for treating capsular opening compared to invasive surgical procedures with excellent patient satisfaction.

**Keywords:** Nd: YAG laser, posterior capsular opacification, visual acuity, intraocular pressure.

## I. INTRODUCTION

A cataract is opacification of the crystalline lens and its capsule. It is due to the loss of transparency of the lens because of abnormality of lens fibres.<sup>1</sup> It is the most common cause of visual impairment in the world following cataract surgery. Nepal Blindness Survey (1981) has identified cataracts and their sequels responsible for 72% of all blindness.<sup>2</sup> Posterior Capsular Opacification (PCO) is the most common late post-operative consequence of cataract surgery. PCO results from migration and proliferation of residual lens epithelial cells (LECs) onto the central posterior capsule, leading to a decrease in visual function.<sup>3</sup> PCO is a significant factor for ocular morbidity and is the key cause of decreased vision after cataract surgery.<sup>4</sup> PCO results from migration and proliferation of residual lens epithelial cells onto the central posterior capsule, leading to a decreased visual function.<sup>5</sup> Patients who have PCO with significantly reduced visual acuity (VA) need opening up of the posterior capsule to improve their vision. The ways for posterior capsulotomy are Neodymium Yttrium Aluminium Garnet (Nd: YAG), LASER (light amplification by stimulated emission of radiation), Capsulotomy and Surgical Capsulotomy.<sup>6</sup> Currently Nd: YAG laser capsulotomy is the standard and one of the most common procedures with a success rate of more than 95% for PCO following cataract surgery due to its non-invasive nature, immediate recovery and it being an OPD procedure.<sup>7</sup>

Laser capsulotomy uses a quick-pulsed Nd: YAG laser to apply a series of focal ablations in the posterior capsule and create a small circular opening in the visual axis.<sup>8</sup> Although safe and effective, the reported complications of Nd: YAG laser posterior capsulotomy include retinal detachment,<sup>9-11</sup> cystoid macular edema (CME),<sup>11-12</sup> and rise in IOP.<sup>13-14</sup> The decreased rate of

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complications and faster recovery has made Nd: YAG laser capsulotomy a popular approach for the treatment of PCO.<sup>15</sup> Some authors consider the increased risk of complication to be as a result of opening the capsule and not a specific problem of the laser procedure itself.<sup>15-17</sup>

Nd: YAG laser posterior capsulotomy is frequently carried out in our hospital, but no work has been done on the subject yet in our region. This study has been designed to determine the visual outcome and the changes in IOP and other YAG laser-related complications in patients with PCO.

## II. MATERIAL AND METHODS

This hospital-based, observational, prospective study was conducted at the outpatient department of R.M.Kedia Eye Hospital from July 2018 to June 2019. A written informed consent was taken from the patients before the intervention. Patients above the age of 40 years were selected. 200 Pseudophakic eyes having decreased vision due to capsular opacity were taken. The VA was taken, and all patients were examined on the slit lamp for IOP, and fundus examination was done to exclude the other causes for reduced vision and raised IOP before laser capsulotomy.

### a) Inclusion criteria

1. All the patients with PCO with VA <6/18
2. Patients above 40 years of age having PCO

### b) Exclusion criteria

1. Patient with associated corneal scar, irregularities, or edema that interferes with central visualization
2. Patient with increased IOP > 21 mmHg (measured by Goldmann applanation tonometer)
3. Patient with decentralised posterior chamber IOL
4. Patient with a known case of glaucoma, ocular hypertension, amblyopia, optic atrophy, and uveal, macular or retinal pathology
5. Any history of ocular surgery besides cataract surgery.

After enrollment in the study, detailed ocular examinations including visual acuity (VA) using standard Snellen’s visual acuity chart, slit lamp examination, IOP

by Goldmann applanation tonometer, direct and indirect ophthalmoscopy, B-scan Ultrasonography in cases of dense PCO was carried out by the author’s before YAG laser capsulotomy to control bias in the study. Patient’s pupil was dilated using tropicamide 1% eye drop and prepared before the procedure. Patients were instructed regarding the process, and then comfortably seated on a stool in front of the laser slit lamp with chin on chin rest and forehead on forehead rest and headband applied, and were asked to fixate the red light with the other eye (non-operating). The energy levels was fed, usually starting with 1–2 MJ / pulse, and gradually increased till a 3-4 mm of capsulotomy was made, with Q-switched Nd: YAG Laser after topical anesthesia. Capsulotomy was done by the same author using the same laser machine to control bias in the study, and was enlarged with different energy levels depending upon the clinical conditions. Visual acuity and IOP were noted after 1 hour. Detailed examination of the anterior and posterior segments was carried out with the help of a slit lamp. IOP was recorded at every visit after examining VA and near vision i.e. at one week, and one month intervals to determine the improvement in vision and IOP changes.

Posterior segment pathologies and postoperative complications were also excluded at every visit by dilating the pupil after recording VA, near vision, and IOP. Bias was controlled by strictly following exclusion criteria and by proper follow-up. Those patients whose IOP were increased just after one hour after capsulotomy was put on timolol 0.5% twice a day for seven days. On follow-ups the IOP and VA were examined on the seventh day with Goldman’s tonometer. The data was noted in pre-formed proforma. All the analyses were done by Microsoft-office to generate graphs, tables, and data. Significance level was analysed by calculating the “p” value, and observations were taken as significant at a “p” value less than 0.05 (“p” < 0.05).

## III. RESULTS

The age distribution of the 200 cases included in this study is presented in the following table.

Table 1: Age-wise distribution

Age Distribution		
Age (Years)	Cases	Percentage
40-50	16	8%
51-60	76	38%
61-70	60	30%
>70	48	24%
Total	200	100%

In this study, subjects ranging from 40 years to above 70 are enrolled. The age of the patients ranged from 51-78, minimum being 51 years and maximum at

the age of 78 years who fulfilled the inclusion criteria and were ready to come for follow-up.

The maximum number of patients with PCO was found between 51- 60 years with a mean age of  $55 \pm 5.52$  years.

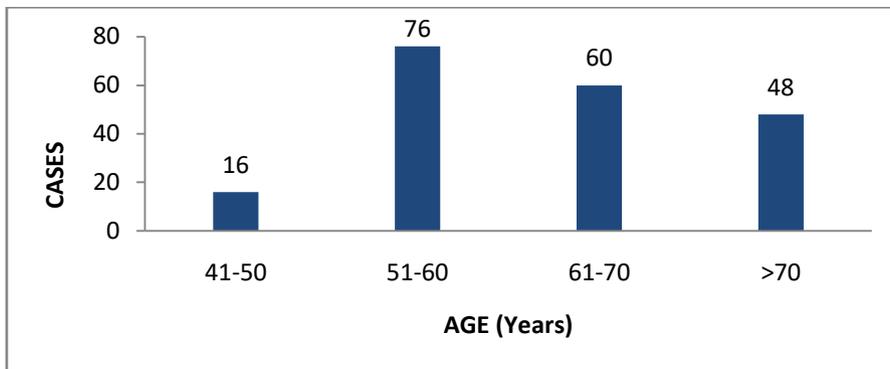


Fig. 1: Age wise distribution

Out of 200 patients, 108 (54%) were male, and 92 (46%) were females.

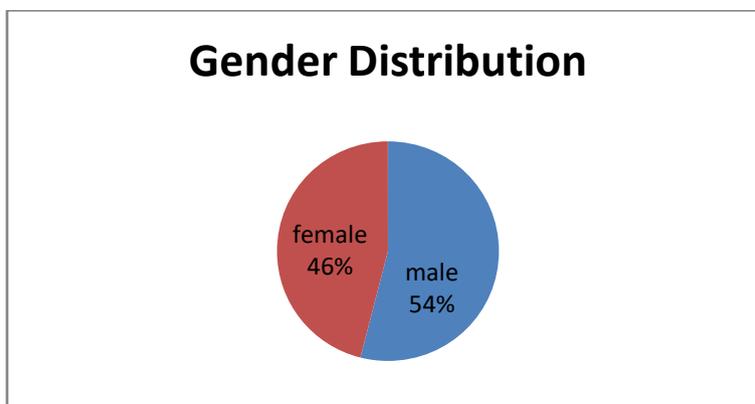


Fig. 2: Gender Distribution

84 (42%) patients who had PCO in the Right Eye, while 116 (58%) patients had PCO in the Left Eye after cataract surgery with posterior chamber intraocular lens implantation.

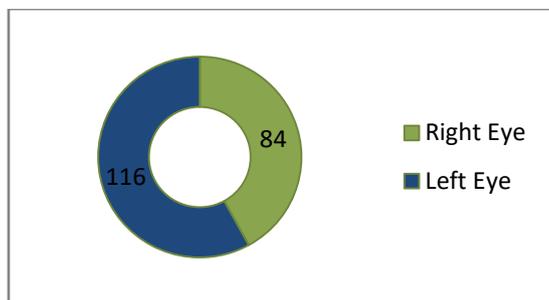


Fig. 3: Laterality

In this study period, we found that the maximum number of patients developed PCO after a period ranging from 25-36 months (i.e. 38%), followed by 37-48 months (i.e. 34%), 13-24 months (20%), 49-60 months (2%), and only one patient each developed PCO after 0-12 and >61 months respectively.

Table 2: Duration between Cataract surgery and Nd: YAG laser

Duration between cataract surgery and Nd: YAG laser capsulotomy		
Duration (months)	Cases	Percentage
0-12	4	2%
13-24	40	20%
25-36	76	38%
37-48	68	34%
49-60	8	4%
>61	4	2%
Total	200	100%

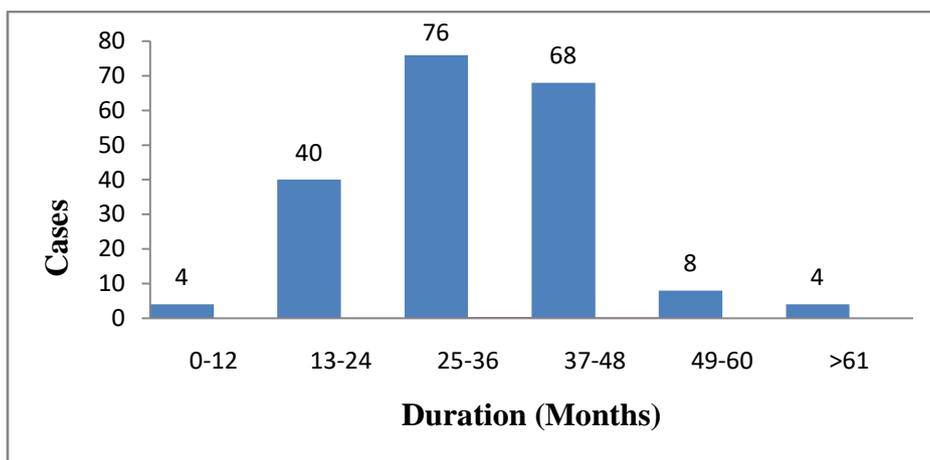


Fig. 4: Duration between Cataract surgery and Nd: YAG laser

The BCVA of all the patients included in this study was recorded pre-laser, post-laser, after one hour, one week, and one month as shown in the figures.

Table 3: Pre laser BCVA

Pre laser BCVA		
BCVA	Cases	Percentage
<3/60	20	10%
3/60-6/60	152	76%
6/36-6/18	28	14%
Total	200	100%

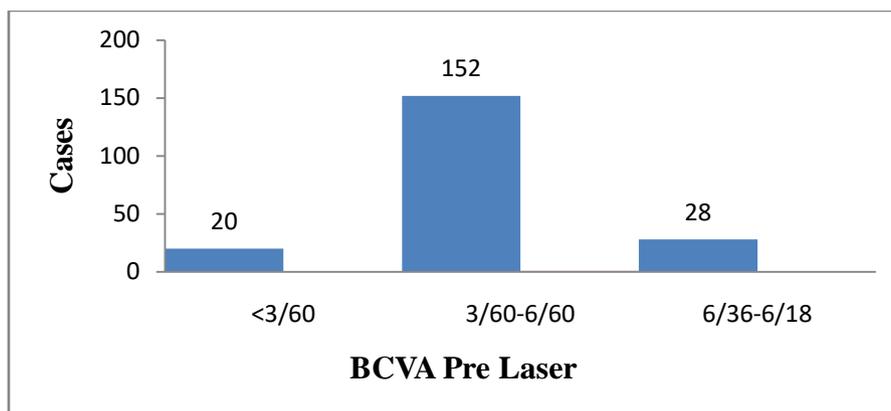


Fig. 5: Pre laser BCVA



Table 4: Post laser BCVA

Post laser BCVA			
BCVA	1 hour	1 week	1 month
<3/60	8	8	4
3/60-6/60	24	4	4
6/36-6/18	112	76	64
6/12-6/6	56	112	128

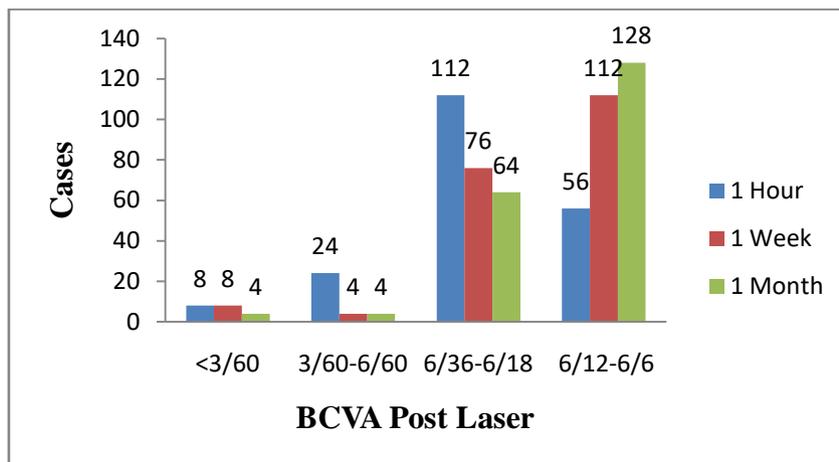


Fig. 5: Post laser BCVA

The IOP of all the patients was taken pre-laser, post-laser, after one hour, one week, and one month with the use of GAT, as shown in the respective tables and figures.

Table 4: IOP Measurement

IOP Measurement				
IOP (mm Hg)	Pre-laser	1 hour	1 week	1 month
5-10	20	12	20	24
11-15	108	96	108	108
16-20	72	88	72	68
>20		4		

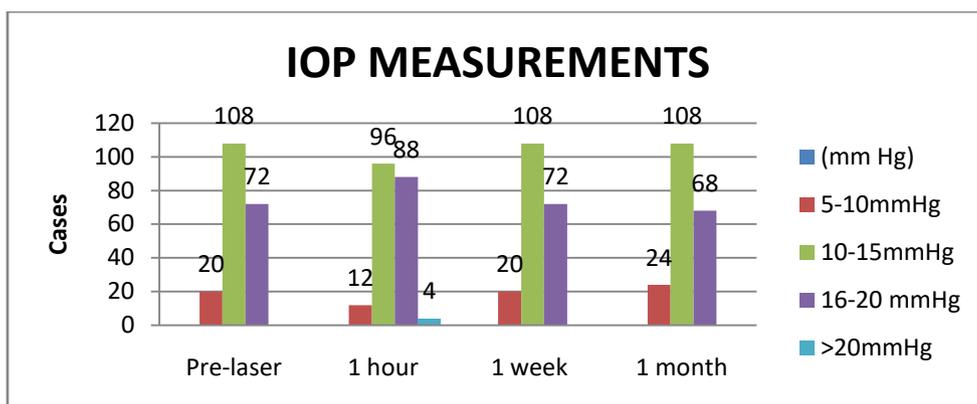


Fig. 5: IOP Measurement

In all cases, combination of steroid and antibiotic eye drop was given for a week to control the inflammatory changes, if any, following laser. About 30% of cases showed transient elevation of IOP, within a

normal range of 20mm Hg, and only four patients showed raised IOP at 1-hour post-laser, which was managed with topical timolol 0.5% for one week along with topical steroid.

Following Nd: YAG laser capsulotomy, patients were examined for any complication post-laser besides elevation of IOP with the help of a slit-lamp examination.

The following table and figure show the list of complications that were noticed post-Nd-YAG laser in this study.

Table 4: Complications post YAG laser

Complications	Cases	Percentage
IOP elevation	4	2%
Iris bleeding	4	2%
Pitting of IOL	40	20%
Uveitis	4	2%
CME	0	0%
RD	0	0%
Endophthalmitis	0	0%

Out of 200 patients treated with Nd-YAG laser capsulotomy, 56 patients developed complications which included IOP elevation seen in four patients (i.e. 2%), pitting of IOL in 40 patients (i.e. 20%), and iris bleeding and uveitis in four patients (i.e. 2%) each.

These four patients' were managed with topical steroid and mydriatics in the successive follow-ups. In this study, no patient developed CME, RD and endophthalmitis.

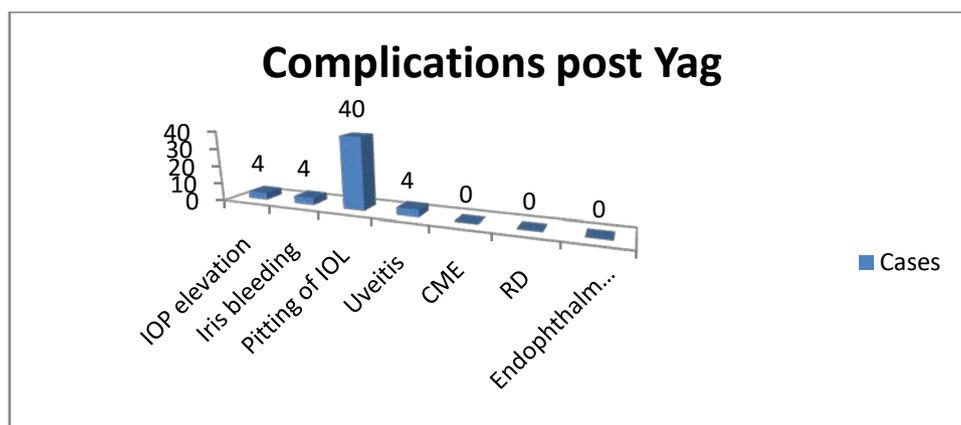


Fig. 6: Complications post YAG laser

#### IV. DISCUSSION

200 patients having PCO after cataract surgery were evaluated in this study. 76 patients with PCO had been operated on our hospital, while 124 patients were operated on elsewhere. Gender distribution showed more males as compared to females having PCO comparable to other studies<sup>18</sup> because the males have more outdoor activity as compared to females, and in our context, males are the only sources of earning in the rural family. So, the overall concern for vision is more for males in our scenario.

In our study, the maximum number of cases having PCO was from the age group of 51-60 years (38%), which may be due to the inclusion criteria whose lower limit was more than 40 years and lack of follow-up by the older age patients which is in agreement with that of Soni P et al.<sup>19</sup>, where the maximum patients also fell under the age group of 50-60 years (i.e. 52%).

Patel OV et al.<sup>20</sup> and Durham DG et al.<sup>21</sup> in their study showed the mean duration of development of

PCO after cataract surgery was around two years and Bari KN<sup>22</sup> to be 23 months which correlates with our study where the mean duration for the development of PCO is 2.2 years (26 months).

Raised intraocular pressure (IOP) remains one of the frequent complications of Nd: YAG laser capsulotomy. It is usually acute but transient. In our study, 2% of subjects showed increased IOP of more than 21 mm Hg which returned to the average level within one week. However, transient elevation of IOP of 3-5 mm Hg from their basal level was noted in about 30% of subjects within 24 hours but not exceeding 20 mm Hg, which was similar to the study conducted by Nirankari et al.<sup>23</sup> where out of the 60 eyes, transient raise of IOP was prominent in 10 eyes.

Similarly, Channell et al.<sup>13</sup> in their study found transient rise in IOP in the first 24 hours in addition, Wasserman et al.<sup>24</sup> noted the average maximum induced IOP rise was 1.4 mmHg which occurred within 1 hour of the capsulotomy. Though the cause remained undetermined, the possible mechanisms would be, the



more the energy used during the procedure, the more particles liberated from posterior capsular breakdown, resulting in the clogging of the angle of the anterior chamber and leading to the raised IOP.

Lens pitting is most likely to occur when the lens and capsule are closely approximately. In our study, IOL pitting was seen in 40 out of 200 (20%) subjects. A similar study conducted by Shah GR et al.<sup>25</sup> IOL pitting after capsulotomy was observed in 12% cases. Similarly, Terry AC et al.<sup>26</sup> in their study reported IOL damage in 12 of 30 eyes with IOL implants, and Gardner<sup>27</sup> reported 39% of subjects with IOL damage. However, there was no harmful effect seen on the VA, and the patients were satisfied with their post-laser corrected vision with glasses in our study.

The documented visual improvement of the subjects in our study confirms the efficacy of Nd: YAG laser for the treatment of posterior capsulotomy. 96% of subjects showed significant visual acuity improvement. The statistical analysis between pre and post-visual acuity showed a 'p' value to be 0.02, which was statistically significant. At one week after capsulotomy, 56% of patients had the visual acuity of 6/12 to 6/6, and at one month, it was increased up to 64%. The vision of 2% of subjects was unsatisfactory by laser capsulotomy due to preexisting optic atrophy and retinal pigment epithelium atrophy. Our study coincides with Gardner KM et al.<sup>27</sup>, who analyzed 100 cases of Nd: YAG laser posterior capsulotomy and reported that at one week, 73% of entire population was in the 20/15 to 20/40 group, in contrast the vision of 5% of subjects was not improved by laser capsulotomy due to documented progression of preexisting retinal disease.

Iris bleeding was seen in 4 patients during YAG laser in preexisting posterior synechiae, which were not released by the dilating drops. Shah GR<sup>25</sup> reported 0.1% subjects of postoperative uveitis and Chambless WS et al.<sup>28</sup> in their study and found persistent anterior uveitis in 1.4% of the patients, which is in accordance with, where post-laser uveitis was reported in 4 patients at one week follow up and was managed with topical steroid and mydriatics, who improved on consecutive follow-ups.

In another comparable study carried out by Khanzada MA et al.<sup>29</sup> in 500 patients, 8.0% patients developed the complications due to YAG laser, which included IOL pitting in 5.40% eyes, raised IOP in 0.80%, vitreous in the anterior chamber in 0.40%, and cystoid macular edema (CME) in 0.20% patient's eyes. In contrast, none of the patient developed sight threatening complications like cystoid macular edema, retinal detachment, macular hole, or endophthalmitis in our study. Based on our study, it is evident that the Nd: Yag laser is a very effective, cheap, and easy mode of treatment for PCO with minimal post-laser complications.

## V. CONCLUSION

Though various methods are available to treat PCO, Nd: YAG laser capsulotomy remains the most common and safe procedure. It is very economical, convenient, fast, and a non-invasive OPD procedure with immediate results. Although non-invasive and generally considered safer, it carries a low but finite risk of complications. These complications are rare and rarely sight-threatening. The Nd: YAG laser is established to provide immediate excellent visual outcomes post YAG laser.

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