

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

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Abstract

Background: Posterior capsular opacification (PCO, secondary cataract, after cataract) is a post-surgical complication following cataract surgery. PCO results from the migration and proliferation of residual lens epithelial cells onto the central posterior capsule, leading to decreased visual function. Neodymium Yttrium Aluminium Garnet (Nd: YAG) LASER (light amplification by stimulated emission of radiation) Capsulotomy is one of the most common procedures for PCO following cataract surgery due to its non-invasive nature, immediate recovery and is an OPD procedure. 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 applanation tonometer were performed pre and post-laser in all cases.

Index terms— Nd: YAG laser, posterior capsular opacification, visual acuity, intraocular pressure.

1 Introduction

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. 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. Posterior Capsular Opacification (PCO) is the most common late postoperative 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. PCO is a significant factor for ocular morbidity and is the key cause of decreased vision after cataract surgery. PCO results from migration and proliferation of residual lens epithelial cells onto the central posterior capsule, leading to a decreased visual function. 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. 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. 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. Although safe and effective, the reported complications of Nd: YAG laser posterior capsulotomy include retinal detachment, [9][10][11] cystoid macular edema (CME), [11][12] and rise in IOP. [13][14] The decreased rate of complications and faster recovery has made Nd: YAG laser capsulotomy a popular approach for the treatment of PCO. 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. [15][16][17] 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

45 determine the visual outcome and the changes in IOP and other YAG laser-related complications in patients with
46 PCO.

47 2 II.

48 3 Material and Methods

49 This hospital-based, observational, prospective study was conducted at the outpatient department of R.M.Kedia
50 Eye Hospital from July 2018 to June 2019. A written informed consent was taken from the patients before the
51 intervention. Patients above the age of 40 years were selected. 200Pseudophakic eyes having decreased vision
52 due to capsular opacity were taken. The VA was taken, and all patients were examined on the slit lamp for
53 IOP, and fundus examination was done to exclude the other causes for reduced vision and raised IOP before
54 laser capsulotomy. After enrollment in the study, detailed ocular examinations including visual acuity (VA) using
55 standard Snellen's visual acuity chart, slit lamp examination, IOP by Goldmann applanation tonometer, direct
56 and indirect ophthalmoscopy, B-scan Ultrasonography in cases of dense PCO was carried out by the author's
57 before YAG laser capsulotomy to control bias in the study. Patient's pupil was dilated using tropicamide 1% eye
58 drop and prepared before the procedure. Patients were instructed regarding the process, and then comfortably
59 seated on a stool in front of the laser slit lamp with chin on chin rest and forehead on forehead rest and headband
60 applied, and were asked to fixate the red light with the other eye (non-operating). The energy levels was fed,
61 usually starting with 1-2 MJ / pulse, and gradually increased till a 3-4 mm of capsulotomy was made, with Q-
62 switched Nd: YAG Laser after topical anesthesia. Capsulotomy was done by the same author using the same
63 laser machine to control bias in the study, and was enlarged with different energy levels depending upon the
64 clinical conditions. Visual acuity and IOP were noted after 1 hour. Detailed examination of the anterior and
65 posterior segments was carried out with the help of a slit lamp. IOP was recorded at every visit after examining
66 VA and near vision i.e. at one week, and one month intervals to determine the improvement in vision and IOP
67 changes.

68 4 a) Inclusion criteria

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

76 5 III.

77 6 Results

78 The age distribution of the 200 cases included in this study is presented in the following table. In this study,
79 subjects ranging from 40 years to above 70 are enrolled. The age of the patients ranged from 51-78, minimum
80 being 51 years and maximum at the age of 78 years who fulfilled the inclusion criteria and were ready to come
81 for follow-up.

82 The maximum number of patients with PCO was found between 51-60 years with a mean age of 55+5.52
83 years.

84 7 Fig. 1: Age wise distribution

85 Out of 200 patients, 108 (54%) were male, and 92 (46%) were females. Fig. ?? : Gender Distribution 84 (42%)
86 patients who had PCO in the Right Eye, while 116 (58%) patients had PCO in the Left Eye after cataract surgery
87 with posterior chamber intraocular lens implantation.

88 8 Fig. 3: Laterality

89 In this study period, we found that the maximum number of patients developed PCO after a period ranging
90 from 25-36 months (i.e. 38%), followed by 37-48 months (i.e. 34%), 13-24 months (20%), 49-60 months (2%),
91 and only one patient each developed PCO after 0-12 and >61 months respectively. The IOP of all the patients
92 was taken pre-laser, post-laser, after one hour, one week, and one month with the use of GAT, as shown in the
93 respective tables and figures.

94 9 Fig. 5: IOP Measurement

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

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

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

101 The following table and figure show the list of complications that were noticed post-Nd-YAG laser in this
102 study. Out of 200 patients treated with Nd-YAG laser capsulotomy, 56 patients developed complications which
103 included IOP elevation seen in four patients (i.e. 2%), pitting of IOL in 40 patients (i.e. 20%), and iris bleeding
104 and uveitis in four patients (i.e. 2%) each.

105 These four patients' were managed with topical steroid and mydriatics in the successive follow-ups. In this
106 study, no patient developed CME, RD and endophthalmitis. Discussion 200 patients having PCO after cataract
107 surgery were evaluated in this study. 76 patients with PCO had been operated on our hospital, while 124
108 patients were operated on elsewhere. Gender distribution showed more males as compared to females having
109 PCO comparable to other studies 18 because the males have more outdoor activity as compared to females, and
110 in our context, males are the only sources of earning in the rural family. So, the overall concern for vision is more
111 for males in our scenario.

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

116 Patel OV et al. 20 and Durham DG et al. 21 in their study showed the mean duration of development of PCO
117 after cataract surgery was around two years and Bari KN 22 to be 23 months which correlates with our study
118 where the mean duration for the development of PCO is 2.2 years (26 months).

119 Raised intraocular pressure (IOP) remains one of the frequent complications of Nd: YAG laser capsulotomy. It
120 is usually acute but transient. In our study, 2% of subjects showed increased IOP of more than 21 mm Hg which
121 returned to the average level within one week. However, transient elevation of IOP of 3-5 mm Hg from their
122 basal level was noted in about 30% of subjects within 24 hours but not exceeding 20 mm Hg, which was similar
123 to the study conducted by Nirankari et al. 23 where out of the 60 eyes, transient raise of IOP was prominent in
124 10 eyes.

125 Similarly, Channell et al. 13 in their study found transient rise in IOP in the first 24 hours in addition,
126 Wasserman et al. 24 more the energy used during the procedure, the more particles liberated from posterior
127 capsular breakdown, resulting in the clogging of the angle of the anterior chamber and leading to the raised IOP.

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

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

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

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

154 V.

155 10 Conclusion

156 Though various methods are available to treat PCO, Nd: YAG laser capsulotomy remains the most common
157 and safe procedure. It is very economical, convenient, fast, and a non-invasive OPD procedure with immediate
158 results. Although non-invasive and generally considered safer, it carries a low but finite risk of complications.

10 CONCLUSION

159 These complications are rare and rarely sight-threatening. The Nd: YAG laser is established to provide immediate excellent visual outcomes post YAG laser.¹

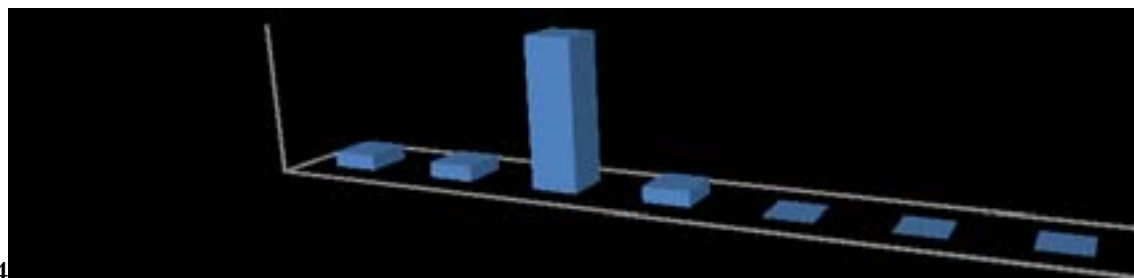


Figure 1: Fig. 4 :

1

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

Figure 2: Table 1 :

2

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%

Figure 3: Table 2 :

160

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3

Figure 4: Table 3 :

4

3/60-6/60

6/36-6/18

Figure 5: Table 4 :

4

IOP (mm Hg)	Pre-laser	IOP Measurement		
		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		

Figure 6: Table 4 :

4

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%

Figure 7: Table 4 :

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10 CONCLUSION

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