

# A Clinical Study of Visual Outcome in Nd: YAG Laser Capsulotomy in Posterior Capsular Opacity

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## ABSTRACT

**Introduction:** Cataract is common cause of blindness worldwide which is curable, its prevalence is high in Indian population. Study aimed to see the visual outcome after Nd-YAG laser Capsulotomy in posterior capsular opacity at Regional Eye hospital, Warangal, and to study Correlation between PCO and visual acuity before and after Nd:YAG laser posterior capsulotomy.

**Material and Methods:** Nd: YAG laser capsulotomy was carried out in 100 eyes of 100 patients. It was a hospital based prospective study on outpatient basis who underwent extra capsular cataract extraction with PCIOL implantation elsewhere diagnosed PCO by red reflex evaluation by retinoscopy. PCO followed ECCE with PCIOL implantation with decreased BCVA of two or more lines.

**Results:** Out of 100 patients (100 eyes) overall visual outcome after Nd-YAG laser capsulotomy is 95%. There sex predilection was not present among the patients who developed PCO and were treated with Nd YAG laser. Males were 52 and females were 48. Most patients 78% were in the 41- 80years age range. A large proportion of these patients 65.% had the diagnosis of PCO between 3-12 months post-surgery. Majority of the patients, 75% presented with visual acuity of <3/60 before the laser procedure while this reduced to 5% post laser procedure.

**Conclusion:** Nd-YAG laser therapy presented the advantage of a noninvasive, effective, relatively safe technique to manage intact posterior capsular opacity and it does not require patients hospitalization.

**Keywords:** Visual Outcome, Nd: YAG, Laser Capsulotomy, Posterior Capsular Opacity

## INTRODUCTION

Cataract is the most common cause of blindness worldwide which is curable. Prevalence of blindness due to senile cataract is high in Indian population. There is a need to undertake quality cataract surgery for both rural and urban population. It is universally accepted at this point of time that 'Extra Capsular Cataract Extraction' with 'Posterior chamber Intra Ocular Lens' is superior to 'Intra Capsular Cataract Extraction' and free of major complications. Posterior capsular opacification (PCO) is commonest complication following ECCE with PC-IOL. When "PCO" evolves following "ECCE", it leads to the same symptoms of cataract, like blurring of vision and glare. At present, the most widely practiced procedure for the management of symptomatic "Posterior capsular opacification" is Nd: yag laser capsulotomy. PCO causes the deterioration of visual acuity, however there is no effective methods to prevent it. Nd: YAG laser therapy presents the advantage of a non-invasive, effective, relatively safe technique to manage intact posterior capsule that opacify post operatively and it does not require patient hospitalization.<sup>1,2</sup> Various published articles on PCO estimate a postoperative PCO incidence of 11.8% at 1

year, 20.7% at 3 years and 28.5% at 5 years. PCO is a major problem in paediatric cataract where the incidence approaches 100% between two months and 5 year after the initial surgery. In this study, with this background knowledge we undertook a hospital based prospective study of visual outcome after Nd-YAG laser therapy in posterior capsular opacity after subjecting them to detailed eye examination.

## MATERIAL AND METHODS

The study includes 100 eyes of 100 patients attending outpatient department at Regional Eye Hospital, Warangal, Telangana state, during the period from July 2013 to August 2014 who underwent extra capsular cataract extraction with PCIOL in our hospital or elsewhere diagnosed PCO by detailed eye examination. And patients treated with LASER capsulotomy were followed up over a period of 6 months and final visual outcome is evaluated.

## Methodology

Study was done on patients attending out patient department at Regional eye Hospital, Warangal, during July, 2013 to August 2014. Nd: YAG laser capsulotomy was carried out in 100 eyes of 100 patients. It was a hospital based prospective study on outpatient basis who underwent extra capsular cataract extraction with PCIOL implantation in Regional eye Hospital, Warangal or elsewhere diagnosed PCO by red reflex evaluation by retinoscopy. These patients were followed up for a minimum period of 6 months. Chief complaints of all the cases was diminished vision which varied from hand movements to 6/18. Each patient was evaluated before undergoing laser capsulotomy to confirm that the visual loss was only due to after Cataract. Following tests were done in each case prior to posterior capsulotomy which were namely - Complete ophthalmic history and medical history, Best corrected visual acuity, Intraocular pressure recording by schiotz tonometer and gonioscopy was done to exclude Pseudophakic glaucoma, Slit lamp examination done to evaluation of red reflex and anterior segment Pathology, Fundus examination- Direct and Indirect ophthalmoscopy was carried out to look for posterior segment pathology like CME or retinal detachment. The single and most reliable technique for assessing capsular opacity is direct ophthalmoscopy. Fundus

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**How to cite this article:** B. Dharmaraju, S. Vijayasree, K. Sridhar. A clinical study of visual outcome in Nd: YAG laser capsulotomy in posterior capsular opacity. International Journal of Contemporary Medical Research 2016;3(9):2665-2668.

view with Hurby lens may also allow accurate assessment of capsular clouding where as the indirect ophthalmoscopy can penetrate significant capsular opacity.

**Inclusion Criteria:** Posterior capsular opacity following ECCE with PCIOL implantation. Patients aged above 14 years and elderly patients were included. Patients having more than 3 months follow up after cataract surgery. Patients with decreased best corrected vision of two or more lines.

**Exclusion Criteria:** Patient unable or unwilling to fixate adequately for the procedure, Patients aged below 14 years were excluded, Dislocated IOL and Simple extra capsular cataract extraction, Patients who underwent combined procedures [like trabeculectomy with PCIOL], PCO associated with ocular diseases and complications like Retinal degenerations, Glaucoma, Complicated and traumatic cataract and Patient with significant media opacities – corneal opacity etc., were excluded.

**Procedure of Nd: YAG Laser posterior capsulotomy:** Preparation of patients: After complete evaluation, the patients were taken to the laser. Informed consent was taken from the patient. The patient was told that she will feel a slight stinging sensation, see a bright flash with each shot and hear a clicking sound. He was told to immediately inform if he feels giddy indicating a syncopal attack. Adjustment of stool, chin rest and foot rest was be done for patient's optimal comfort. Head strap was applied. Room was darkened optimally. Capsulotomy was done in single sitting under topical anaesthesia using 4% lignocaine in dilated pupil.

**STATISTICAL ANALYSIS**

Microsoft office 2007 was used to make tables and graphs. Descriptive statistics like mean and percentages were used to interpret the results.

Age	Number of cases	Percentage
14-21 yrs	3	3%
21-40 yrs	10	10%
41-60 yrs	37	37%
61-80 yrs	42	42%
>80 yrs	8	8%
Sex		
Male	52	52%
Female	48	48%
Eye		
Right eye	44	44%
Left eye	56	56%
Types		
Fibrous	20	20%
Elsching's Pearls	65	65%
Mixed	15	15%

**Table-1:** Demographic distribution in study

Grade	Fundus details	No. of cases
Grade- 0	No evidence of PCO	0
Grade- 1	Opacification limited to periphery, the central part is clear	14
Grade- 2	Diffuse opacity appreciated with slit lamp – mild obscuration of fundus details	30
Grade- 3	Opacity of posterior capsule with marked obscuration of fundus details	34
Grade- 4	Total thick opacity with no fundal glow	22

**Table-2:** Grading of posterior capsular opacity,

**RESULTS**

After a short term study of 12 months the following observations were made, 100 patients were identified having posterior capsular opacity diagnosed by red reflex evaluation by retinoscopy, slit lamp examination, direct and indirect. These Cases were divided according to age/sex wise and also according to duration between cataract extraction and development of PCO. PCO was graded based on view of fundus details and Nd: yag laser capsulotomy done for all the cases. Pre-laser and post-laser visual acuity recorded, compared and analyzed. Safety, efficacy and Post-laser complications of Nd: yag laser were recorded, followed and treated.

Table-1 shows M:F ratio of 1.1:1 which was not significant. PCO may occur equally in both males and females. Most of the patients about 78% were in the 41-80years age range. This is perhaps the age at which patients with age related cataract present to the Ophthalmologist due to visual incapacitation. Left eye (56%) involvement was more than Right eye (44%) in this study group. Elschnig's Pearl type of PCO was the most common type (65%) than Fibrous type (20%) and Mixed type (15%).

PCO was graded based on Fundus details seen by direct or indirect ophthalmoscopy where Severe PCO (Grade-4) diagnosed were about 22%, moderate (Grade 2 and 3) were 64% and mild (Grade-1) were 14%.

The total cumulative energy (energy per pulse in mj x number of pulses) required to perform adequate capsulotomy ranged from 25 to 125 mj. The mean total cumulative energy delivered for elsching pearl type PCO was 65 ± 15 mj while for fibrous and mixed type PCO it was 85 ± 20 mj. Overall it was 75 ± 15 mj but maximum patients required less then 100 mj & in those who required more than 100 mj risk of rise in Intra ocular pressure was more. A large proportion of these patients about 65% had the diagnosis of PCO between 3-12 months post-surgery, 15% diagnosed 12 months after surgery and 20% developed PCO within 3months after surgery.

Shows improvement in visual acuity was excellent in this study. Visual acuity improved to 6/6 in 22 cases, 6/9 in 35 cases, 6/12 in 15 cases, 6/18 in 8 cases, 6/24 in 5 cases, 6/36 in 7 cases, 6/60 in 3 cases. Overall, 95% of the patients studied had visual improvement. However, 5% of the patients did not have visual improvement.

**DISCUSSION**

The study was carried out in 100 eyes of 100 patient which was a hospital based prospective study on outpatient basis who underwent extra capsular cataract extraction with PCIOL implantation in Regional eye Hospital, Warangal or elsewhere diagnosed PCO by red reflex evaluation by retinoscopy. These patients were followed up for a period of 6 months. Chief complaints of all the cases was diminished

vision which varied from hand movements to 6/18. Before undergoing laser capsulotomy each patient was evaluated to confirm that the visual loss was only after Cataract. Advantages of Nd:YAG laser capsulotomy: Nd-YAG laser capsulotomy therapy presents the advantage of a non-invasive, effective, out patient procedure, relatively safe technique to manage intact posterior capsule that opacify post operatively. As the Surgical Procedure for PCO is associated with many complications like endophthalmitis, the utilization of Nd YAG laser in the treatment of PCO, has improved the visual outcome of cataract surgeries. Polak M Zarnowski. T Zogorski Z<sup>3</sup>, have included 25 & 26 eyes respectively and visual outcome was 89%, 95% and in our present study it was 95%. In one case visual acuity was not improved due to glaucomatous optic atrophy - low tension glaucoma which could be found only after capsulotomy. In another case due to diabetic neuropathy of the optic nerve and one more case due to myopic degeneration of the retina. Study conducted by Hasan, et al<sup>4</sup>, Wilkins et al<sup>5</sup>, Panezai MN<sup>6</sup>, Shawani MA and Hameed K, Hayashi, K., Hayashi, H., et al.<sup>7</sup>, Wang, J,et al.<sup>8</sup> Yilmag S., et al.<sup>9</sup> Stark W.J.<sup>10</sup> had similar results as that of our study.

**Incidence of PCO:** The incidence of Nd: YAG laser capsulotomy at this institution is approximately 10-12% per year, as we use only PMMA lenses while the foldable Intra ocular lenses were associated with much lower Posterior capsular opacification rate (15%) compared to rigid once (25%). According to Meta analysis by Schaumberg et al<sup>11</sup>, the incidence of PCO in adults is 10% 1 years after surgery, 20% 2 years after surgery and greater than 25% 3 to 5 years after surgery.

**Sex ratio in PCO:** There was no significant sex predilection among the patients who developed PCO. Cataract is the leading cause of blindness worldwide, equal among male and female, therefore when routine cataract surgery are performed, complications such as PCO can also occur in equal proportions. In our study, males were 52% and females were 48% with a Male to Female ratio of 1.1:1. This probably reflects that female population less commonly undergo surgery for cataract or present to hospital for their reduced vision after surgery. Tayyab and colleagues<sup>12</sup> have found sex ratio as 60% vs 40%

Cumulative laser energy in mj.	Elschnig pearl	Fibrous and mixed	Total
<50	9%	1%	10%
51-60	12%	0%	12%
61-70	20%	3%	23%
71-80	14%	4%	18%
81-90	10%	15%	25%
91-100	--	8%	8%
>100	--	4%	4%
Total	65%	35%	100%

**Table-3:** Energy required in different types of PCO (n=100).

Pre laser visual acuity	Post laser visual acuity							
	6/6	6/9	6/12	6/18	6/24	6/36	6/60	Cf 5 mts – hm
CF 5 mts – HM	0	3	11	4	5	7	3	5
6/36 – 6/60	14	30	4	4	0	0	0	0
6/18 – 6/24	8	2	0	0	0	0	0	0

**Table-4:** Visual improvement after Nd: YAG laser posterior capsulotomy,

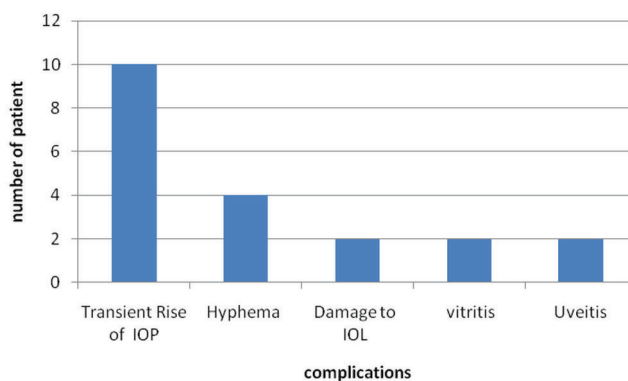
in one group of patients and 50% vs 50% in second group of their study.

**Age distribution of PCO:** 78% of patients were in 41-80 years age group. This is perhaps the age at which patients with age related cataract present to the Ophthalmologist. Left eye (56%) involvement was more than Right eye (44%) in this study group.

**Duration between surgery and PCO:** A large proportion of these patients about 65% had the diagnosis of PCO between 3-12 months post-surgery, 15% diagnosed 12 months after surgery and 20% developed PCO within 3months after surgery. This may be that people who had received visual restoration after initial cataract surgery would have become so dependent on the good vision and so would be visually disabled when PCO sets in, hence the early presentation.

**Types of PCO:** Elschnig’s Pearl type of PCO is the most common type (65%) than Fibrous type (20%) and Mixed type (15%). PCO has been graded based on the Fundus details seen by direct or indirect ophthalmoscopy where Severe PCO (Grade-4) diagnosed were about 22%, moderate (Grade 2 and 3) were 64% and mild (Grade-1) were 14%. In a retrospective study by Baratz,<sup>13</sup> cumulative probability of Nd-YAG posterior capsulotomy was more in 9 years (38%) and less (6%) in one year. Elschnig pearl type Posterior Capsular Opacification was common (65%) then fibrous and Mixed type (35%).

**Total cumulative energy for capsulotomy:** The total cumulative energy ( energy per pulse in mj x number of pulses) required to perform adequate capsulotomy ranged from 25 to 125 mj. The mean total cumulative energy delivered for elsching pearl type Posterior Capsular Opacification was 65 ± 15 mj while for fibrous and mixed type Posterior Capsular Opacification higher energy 85 ± 20 mj was required. The mean total energy delivered was 75 ± 15 mj but maximum patients required less then 100 mj for capsulotomy & in those who required more than 100 mj risk of rise in Intra ocular pressure was more. Maximum studies used energy per pulse ranging from 0.8-3.2 mj but the number of pulses was high. In this study individual pulse energy used was higher due to some



**Figure-1:** Complication in study

machine setting problem but we performed less laser shot. So cumulative energy was nearly equal in both or study and other studies. In another study by Richter et al.<sup>14</sup> they found that maximum patients required less than 200 mj for capsulotomy & in those who required more than 200 mj risk of rise in Intra ocular pressure was more.

**Complications of Nd: YAG laser:** Complications with Nd:YAG laser capsulotomy are very minimal and transient which can be managed on outpatient basis in regular follow-up. It concluded that reducing PCO and associated use of Nd: YAG laser capsulotomy contribute to preserving visual acuity. Careful follow up with Nd:YAG laser capsulotomy is important and topical Timolol maleate 0.5% drops after capsulotomy prevents spikes of IOP which may occur in some cases. Oral Acetazolamide along with topical Timolol can be used in patients who show rise of IOP uncontrollable with topical Timolol alone. Proper selections of cases is important. Pitting of IOL may occur in uncooperative patients. Patients having retinal detachment in other eye, increase in axial length, peripheral degenerations should be taken with caution. Nd: YAG laser capsulotomy should be postponed and followed by at least 3 months after cataract surgery to decrease the incidence of iritis. Transient rise of intra ocular pressure and hyphema were the commonest early post laser complications seen. No serious complications have been observed following Nd-YAG laser capsulotomy like cystoid macular oedema, retinal detachment, iridocyclitis, except transient intraocular pressure elevation in 10 cases, hyphema in 4 cases, intra ocular lens pitting in 2 cases. Vitreous in Ac in 2 cases and Uveitis/Vitritis in 2 cases. These were managed conservatively. Steinert, R.F., Puliafito, C. A., et al.,<sup>15</sup> in 1991 studied 897 patients who underwent Nd: YAG laser capsulotomy. After laser therapy, 11 patients (1.23%) developed CME, 8 patients (0.89%) developed RD. 7 patients developed glaucoma. The number of laser pulses and energy delivered were not risk factors. Patients require long-term follow-up to detect complications.

**Increased Ocular pressure:** After all anterior segment laser surgeries evaluation of intraocular pressure has been well documented. Early researchers as Aron-Rosa et al.<sup>16</sup> did not find any permanent elevation of IOP, but subsequent studies revealed that it might occur. Keates et al.<sup>15</sup> found elevation of IOP in 0.6% of his patients, whereas Stark et al. reported 1.0% in their study. Cobo et al.<sup>17</sup> in their 3 month follow up study also did not find any persistent rise in IOP. In this study there rise of IOP up to 2 mm Hg within 4 hrs was 32%, 8% cases showed IOP rise of 3 mm Hg and 1 case showed rise of 5 mm Hg.

**Retinal detachment:** Many studies are done on Nd: YAG laser posterior capsulotomy and development of retinal detachment. Initial studies by Aron – Rosa et al.,<sup>16</sup> claimed an incidence of 0.08%, Steinert et al.,<sup>15</sup> reported 0.89%. In this study there was no case of retinal detachment. This could be because of the absence of risk factors in our cases.

**Cystoid Macular edema:** The development of cystoid macular edema after Nd: YAG laser posterior capsulotomy has been observed in many studies. The incidence of cystoid macular edema according to Winslow and Taylor<sup>18</sup> was 0.55% and they attributed this occurrence to vitreous instability secondary to Hyaluronic acid and prostaglandin diffusion through the

compromised posterior capsule.

## CONCLUSION

Nd-YAG laser therapy presented the advantage of a noninvasive, effective, relatively safe technique to manage intact posterior capsular opacity and it does not require patients hospitalization.

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**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 27-07-2016; **Published online:** 09-09-2016