

A study of visual outcome and complications following Nd: YAG laser posterior capsulotomy in posterior capsule opacification

Dr. Jitendra Kumar¹, Dr. Punam Tiwari²

¹. Associate Professor & Head, Dept. of ophthalmology, MLB Medical college Jhansi, India.

². Junior Resident, Dept. of ophthalmology, MLB Medical college Jhansi, India.

Corresponding author Dr. Punam Tiwari

Abstract: Posterior capsular opacification is the most common delayed complication following cataract surgery. Nd-YAG laser capsulotomy is the gold standard treatment for PCO which is both simple and effective. This study was to find out the immediate visual outcome after performing Nd:YAG laser posterior capsulotomy for PCO and find out various complications after posterior capsulotomy. This observational prospective interventional type of study was conducted at Department of Ophthalmology, MLB Medical College Jhansi, U.P, India, over a period of 12 month duration (Feb 2019 to Mar. 2020). 112 patients with PCO who met the inclusion criteria were taken up for Nd-YAG laser. After thorough pre laser assessment Nd:YAG laser posterior capsulotomy was performed with Nd-YAG laser in 112 eyes of 112 patients under topical anaesthesia. Visual acuity and complications like rise in IOP, aqueous flare and pitting of IOL (intra ocular lens) were noted. Out of 112 patients 65(58%) were male and 47 (42%) were female. The average age of these patients was 52 years, ranging from 18 years to 83 years. Of the 112 eyes, 98 (87.5%) had implanted posterior chamber IOL, while 14(12.5%) eyes were aphakic. Maximum patients 51 (45.5%) with PCO, had a history of cataract surgery >24 month back. Capsular fibrosis 71(63.4%) was the predominant type of PCO. Elschnig's pearls were present in 23(20.5%), capsular wrinkling in 16 (14.3%) and pigmentary deposits on capsule in 2 (1.8%) of cases. Most of patients were having grade 2 PCO 58 (51.8%). All posterior capsulotomies were performed for reduced vision. Majority of patients 82(73.1%) had VA of 6/36 or less before capsulotomy. The VA after Neodymium-YAG laser capsulotomy showed dramatic improvement. Visual acuity was improved by one or more snellen's lines in 103 (92%) out of 112 eyes. 82(73.3%) patients recorded VA of 6/18 or better and with no improvement in the VA after laser treatment in 9(8%) eyes. None of these eyes showed further deterioration in VA. The complications were seen in 37 patients. Most common complication observed was transient rise in IOP in 13 eyes (35%). Others were aqueous flare in 11(30%), IOL pitting in 6 (16.2%), Vitritis, floaters and Cystoids Macular Edema were found in 2 (5.4%) cases of each, 1 (2.6%) had hyphema and none had corneal complications, RD, RH, MH and Endophthalmitis. Nd:YAG laser posterior capsulotomy is a rewarding procedure for PCO and is universally accepted with good visual outcome. Patients should be carefully followed up and looked for any complications.

Keywords: Cataract surgery, Nd:YAG (neodymium-doped yttrium aluminium garnet) laser, PCO (posterior capsular opacification), VA (Visual acuity), IOP (intra ocular pressure), IOL (intra-ocular lens) pitting.

Date of Submission: 02-04-2020

Date of Acceptance: 18-04-2020

I. Introduction

A cataract is one of the most leading cause of curable blindness all over world. In the developing world, most popular method of cataract surgery is extracapsular cataract extraction with posterior chamber intraocular lens (PCIOL). Posterior capsular opacification (PCO) is the commonest complication of cataract surgery occurring in up to 50% of patients after 2–3 years of surgery¹. PCO also known as secondary cataract or after cataract is a late complication of extra capsular cataract extraction or small incision cataract surgery or phacoemulsification with or without intraocular lens implantation. PCO results from growth and trans-differentiation of LECs left on the anterior capsule at the time of cataract surgery^{2,3}. These cells proliferate to form monolayers on the capsular surfaces and such monolayers continue to line the anterior capsule leaflet many years after surgery. Equatorial differentiation of cells to Fibre-like structures leads to Soemmerring's ring formation and peripheral thickening of the capsular bag. Closer to the rhhexis, cell swelling can result in globular Elschnig's pearls, which may occlude the visual axis⁴⁻¹⁰. As a result of this opacification, there is gradual deterioration of visual function which ultimately become symptomatic in the form of decreased VA, decreased contrast sensitivity, glare or even monocular diplopia^{11,12}. Although Visual symptoms do not always correlate to the observed amount of PCO. Some patients with significant PCO on slitlamp examination are relatively asymptomatic while others have significant symptoms with mild apparent haze, which is reversed by

capsulotomy⁴ The interval between surgery and opacification time ranges from 3 months to 5 years with an average opacification duration being 26 months¹³. In younger age group, it develops earlier but in elderly, its incidence declines.¹⁴

PCO can be treated either with surgical (or) laser capsulotomy, Today Neodymium doped yttrium aluminium garnet (Nd :YAG) laser capsulotomy has become a gold standard approach for treating PCO, due to its ease and effectiveness to improve the dropped visual acuity.¹⁵ Though being a non-invasive and simple outpatient procedure, it is not without complications. though majority of them are transient and treatable.^{16,17} Nd:YAG Laser is a photo disruptive laser which produces extreme heat with acoustic shock wave at the site being focused and thus causes disruption of tissue. This property of Nd:YAG Laser is used to disrupt the posterior lens capsule in order to create an opening in it. This causes significant improvement in visual acuity. While doing Nd:YAG Laser capsulotomy some complications are likely to be encountered like rise in intraocular pressure, inflammations in eye and retinal problems like cystoid macular edema. enhanced risk of retinal detachment (particularly marked in axial myopia), cystoid macular oedema, lens damage pitting, endophthalmitis, vitreous prolapse into the anterior chamber and anterior hyaloid disruption. In this study an attempt has been made to evaluate the visual outcome of Nd:YAG laser capsulotomy for posterior capsular opacification and also to evaluate the complications following laser capsulotomy.

II. Method and Material

This observational prospective interventional cross-sectional type of study was conducted at Department of Ophthalmology, MLB Medical College Jhansi, U.P, India, over a period of 12 month duration (Feb 2019 to Mar. 2020). Total 200 patients who were previously operated for cataract by routine ECCE/SICS or Phaco emulsification with or without intraocular lens attending OPD in Ophthalmology department and satisfied the eligibility criteria, were included in this study After thorough ocular examination. Nd-YAG capsulotomy for PCO was done. The procedures followed were in accordance with the ethical standardised committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000. The necessary permission from the Ethical and Research Committee was obtained for the study.

Inclusion criteria

- Patients who were previously operated for cataract by small incision cataract surgery (SICS)/phacoemulsification with visually significant PCO like Elschnig pearls and fibrous PCO.
- Patients undergoing Nd:YAG laser posterior capsulotomy.
- Patients willing to give informed consent for treatment and study.
- Patients ready to come for follow up.

Exclusion criteria

- Patients with thick PCO who needed surgical intervention were excluded from the study.
- Active ocular pathology such as uveitis, infection.
- Pre-existing ocular condition which can lead to decrease in vision after laser capsulotomy such as glaucoma, any retinal pathology, optic nerve pathologies, and high myopia trauma, intraocular lens decentration.
- Any media opacity preventing focussing of laser.
- Patients not willing to give informed consent or not attending follow up.

A complete ocular examination was done which included complete ophthalmic history and medical history, Visual Acuity; unaided and best corrected with Snellens' chart, Intra-ocular pressure measurement by applanation tonometry, Complete and detailed Slit lamp examination. for evaluation of red reflex and anterior segment pathology Grading of PCO was done . Fundus examination with direct and indirect ophthalmoscope to rule out posterior segment pathology like cystoid macular edema, retinal breaks and tears, hole or detachment. After explaining the procedure informed consent was obtained from all the patients. Dilatation of the pupil was done with 10% phenylephrine or 1% tropicamide eye drops. All capsulotomies were performed under topical anaesthesia with 0.5% proparacaine. Nd:YAG laser was used for capsulotomy. As capsulotomy was done for the optical purpose, its size was restricted to 2-3 mm in diameter.

Post laser evaluation was carried out including slit lamp examination and intraocular pressure (IOP) examination. is checked and noted after 1 hour. Patients were kept on Timolol 0.5% eye drops twice a day and NSAIDS eye drops four times a day for 7 days post laser best corrected VA (BCVA) was recorded after 1-week. Cases were carefully followed up and looked up for incidence of rise in intraocular pressure, aqueous flare, vitritis, cystoid macular edema and other complications.

III. Results

Data of all 112 patients were studied and were tabled under various headings. We used the Neodymium-YAG laser to perform posterior capsulotomies on 112 eyes of 112 patients that had undergone extracapsular cataract extraction. In our study 65(58%) were male and 47 (42%) were female. The average age of these patients was 52 years, ranging from 18 years to 83 years. Of the 112 eyes, 98 (87.5%) had implanted posterior chamber IOL, while 14(12.5%) eyes were aphakic.

Table 1: Time period between cataract extraction and Nd: YAG laser capsulotomy (n = 112)

Time Period	No. of eyes	Percentage (%)
Less than 6 months	7	6.3
6 months to 1 year	19	17
1 year to 2 year	35	31.2
2 year and above	51	45.5
Total	112	100

In this study maximum number 51 (45.5%) patients who were having PCO, had a history of cataract surgery >24 month back. 35 (31.2%) patients developed PCO in a period of 12 months to 24 months of cataract surgery. In 19 patients duration between cataract surgery and PCO was 6-12 months. In 7(6.3%) patients PCO developed within 6 months of cataract surgery.

Table 2. Types of posterior capsule opacification (n = 112)

Type of PCO	No. of eyes	Percentage
Capsular fibrosis	71	63.4
Elschnig's pearls	23	20.5
Capsular wrinkling	16	14.3
Pigmentary deposits on capsule	2	1.8
Total	112	100

As table 2 showed, Capsular fibrosis were found in 71(63.4%), Elschnig's pearls in 23 (20.5%), capsular wrinkling in 16 (14.3%) and pigmentary deposits on capsule in 2 (1.8%) of cases.

Table 3: Different grading of posterior capsular opacity

Grade	No. of patients (%)
Mild (Fundus seen with direct ophthalmoscope)	28 (25)
Modrate (Fundus seen with indirect ophthalmoscope)	58 (51.8)
Severe (No fundus seen as view is hazy)	26 (23.2)

The maximum number of patients were having grade 2 PCO 58 (51.8%), followed by grade 1 with 28 (25%) and grade 3 with 26 (23.2%) cases.

Table 4: VA before and after Nd: YAG laser capsulotomy (n = 112)

Visual Acuity	Pre-laser VA (%)	Post-laser VA (%)
Less than 6/60	52 (46.4)	8 (7.1)
6/60	20 (17.8)	14 (12.5)
6/36	10 (8.9)	8 (7.1)
6/24	11(9.8)	15 (13.4)
6/18	13 (11.6)	31 (27.7)
6/12	5(4.5)	19(17)
6/9	1(1)	13 (11.6)
6/6	0(0)	4 (3.6)

In this study, majority of patients 82(73.1%) had VA of 6/36 or less before capsulotomy. Among these 82(73.1%) patients,52 (46.4%) had VA of less than 6/60 ranging from hand movement to counting of fingers. The VA after Neodymium-YAG laser capsulotomy showed dramatic improvement as shown in (Table 4). Visual acuity was improved by one or more snellen's lines in 103 (92%) out of 112 eyes. 82(73.3%) patients recorded VA of 6/18 or better. It was also observed that no one had further deterioration of VA after Neodymium-YAG laser capsulotomy. There was no improvement in the VA after laser treatment in 9(8%) eyes.

Table 5: Early and late post Nd:YAG Laser complications

Complications	No. of eyes	Percentage %
Raised IOP	13	35
Aqueous Flare	11	30
Vitritis	2	5.4
Floater	2	5.4

Pitting of intra-ocular lens	6	16.2
Cystoid Macular Edema	2	5.4
Hyphema	1	2.6
Total	37	100

The complications were seen in 37 patients. Most common complication observed was transient rise in IOP which were seen in 13 eyes (35%). Second most common complications noted was aqueous flare found in 11(30%)of patients. IOL pitting was present in 6 (16.2%) patients. Vitritis, floaters and Cystoids Macular Edema were found in 2 (5.4%) cases of each. 1 (2.6%) had hyphema and none of them had corneal complications, RD, RH, MH and Endophthalmitis.

IV. Discussion

With the introduction of refined techniques of extracapsular cataract extraction and the phacoemulsification, posterior capsular opacification has become the commonest cause of postoperative reduction in vision following cataract surgery¹⁸. The emergence of Nd:YAG Laser in the management of PCO has improved the visual outcome of cataract surgeries¹⁹. A total of 112 patients (112 eyes) who developed PCO were treated with Nd:YAG Laser. In our study 65(58%) were male and 47 (42%) were female. Which probably reflects that female population less commonly undergo surgery for cataract or present to hospital for their reduced vision after surgery. The average age of these patients who developed PCO was 52 years, ranging from 18 years to 83 years. As more cataract surgeries being performed in that age group This is in accordance with the study by Emery et al, in which the average age of the patients developing PCO was 55 years.²⁰

Of the 112 eyes, 98 (87.5%) had implanted posterior chamber IOL, while 14(12.5%) eyes were aphakic. In this study maximum number 51 (45.5%) patients who were having PCO, had a history of cataract surgery >24 month back. 35 (31.2%) patients developed PCO in a period of 12 months to 24 months of cataract surgery. In 19 patients duration between cataract surgery and PCO was 6-12 months. In 7(6.3%) patients PCO developed within 6 months of cataract surgery. The time period between cataract extraction and performing Neodymium-YAG laser capsulotomy at an average was 2.49 years in study by Hasan et al²¹, and 24 months in another national study²². In our study maximum number of patients 58(51.8%) had moderate grade of PCO (fundus seen with indirect ophthalmoscope). Out of total 71(63.4%) of patients were having capsular fibrosis, 23(20.5%) were having Elschnig's pearls, this finding is consistent with the study by Mohammad Younas Khan et al in 1998 showed 62% of patients with capsular fibrosis and 21% having Elschnig's pearls, while study by LalMuhammadKhattak et al in 2007 showed Elschnig's pearls in 50% of cases and capsular fibrosis in 44% of cases. These studies suggest capsular fibrosis as predominant type of PCO.^{21, 23}

The VA after Neodymium-YAG laser capsulotomy showed dramatic improvement as shown in (Table 3). In this study, majority of patients 82(73.1%) had VA of 6/36 or less before capsulotomy. Among these 82(73.1%) patients, 52 (46.4%) had VA of less than 6/60 ranging from hand movement to counting of fingers. Visual acuity was improved by one or more snellen's lines in 103 (92%) out of 112 eyes after laser capsulotomy. Study by Ajite K.O. et al in 2013 showed 94.4% of patients visual improvement after laser capsulotomy²⁴. The study by Mohmmad et al 2006 also reported visual improvement in 88% of cases^{21, 25}. Similar study reported improvement of VA of one or more snellen's lines in 56 out of 63 eyes²². Other study showed improvement in the VA of an average of three lines on snellen chart after laser treatment in 87.5% cases²⁶. In 82(73.3%) patients recorded VA of 6/18 or better. It was also observed that no one had further deterioration of VA after Neodymium-YAG laser capsulotomy. There was no improvement in the VA after laser treatment in 9 (8%) eyes. Comorbidities found in these 9 (8%) eyes causing limited or no visual improvement after Neodymium-YAG laser capsulotomy. Ajite K.O. et al reported 5% of their patients did not show improvement in VA, Hsai MI 2009 also reported 4% of patients did not show improvement in visual acuity.²⁷

In present study post Nd-YAG laser complications were seen in 37 patients. Elevated IOP is recognized as the most common, although usually transient, complication were seen in 13 eyes (35%)²⁸. Second most common complications noted was aqueous flare found in 11(30%) of patients. Pitting was present in 6 (16.2%) patients²⁹. Vitritis, floaters and Cystoids Macular Edema were found in 2 (5.4%) cases of each³⁰. 1 (2.6%) had hyphema and none of them had corneal complications, RD, RH, MH and Endophthalmitis.

V. Conclusion

The posterior capsular opacification is a common complication after cataract surgery worldwide and it can be managed safely by Nd:YAG Laser posterior capsulotomy. Nd: YAG laser capsulotomy is a safe and effective method to treat PCO. It is non-invasive and avoids all the complications associated with surgical capsulotomy and local anaesthesia. There is excellent improvement in visual acuity in majority of the patients. However, Nd: YAG laser capsulotomy also carries risks like IOL pitting, CME, IOP spikes, aqueous flare and vitritis, etc. IOP monitoring is mandatory both before and after Nd -YAG laser capsulotomy. In majority of the patients, the IOP spikes are transient and can be treated with topical medication It may however require

augmentation with proper optical correction. By minimising energy and number of precisely focused shots with proper follow-up, Nd: YAG capsulotomy becomes the management of choice for PCO for posterior capsular opacification.

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Dr.Punam Tiwari,etal. “A study of visual outcome and complications following Nd: YAG laser posterior capsulotomy in posterior capsule opacification.” *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(4), 2020, pp. 36-40.