

Original research article

A Prospective Interventional Assessment of the Visual Outcomes and Complications After Neodymium-doped Yttrium Aluminium Garnet Laser Capsulotomy

Dr. Pradeep Karak¹, Dr. Ojaswita Singh², Dr. Farhat Perween³,
Dr. Priyanka Bharti⁴

¹Associate Professor, Department of Ophthalmology, Nalanda Medical College and Hospital, Patna, Bihar, India

²Assistant Professor, Department of Ophthalmology, Nalanda Medical College and Hospital, Patna, Bihar, India

³PG-Student (2nd year), Department of Ophthalmology, Nalanda Medical College and Hospital, Patna, Bihar, India

⁴PG-Student (2nd year), Department of Ophthalmology, Nalanda Medical College and Hospital, Patna, Bihar, India

Corresponding Author: Dr. Priyanka Bharti

Abstract

Aim: Visual outcomes and complications after Neodymium-doped yttrium aluminium garnet laser capsulotomy in Posterior capsular opacification

Materials and methods: A prospective interventional study was conducted in the Department of Ophthalmology, Nalanda Medical College and Hospital, Patna, Bihar, India. Total 100 patients who were previously operated for cataract by routine ECCE/SICS or Phacoemulsification 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.

Results: In this study maximum number 43(43%) patients who were having PCO, had a history of cataract surgery >24 month back. 32(32%) patients developed PCO in a period of 12 months to 24 months of cataract surgery. In 18 patients duration between cataract surgery and PCO was 6-12 months. In 7(7%) patients PCO developed within 6 months of cataract surgery. As table 2 showed, Capsular fibrosis were found in 61(61%), Elschenig's pearls in 22 (22%), capsular wrinkling in 15 (15%) and pigmentary deposits on capsule in 2 (2%) of cases. The maximum number of patients were having grade 2 PCO 50(50%), followed by grade 1 with 26 (26%) and grade 3 with 24 (24%) cases. In this study, majority of patients 71(71%) had VA of 6/36 or less before capsulotomy. Among these 71(71%) patients, 43(43%) 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.

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.

Keywords: capsular opacification, Nd:YAG, laser capsulotomy

Introduction

Cataract dates back to ancient times being the leading cause of preventable blindness worldwide, contributing to 33.4% of all blindness.

The number of people in the age group of >60yrs is shown to increase from 901 million to 1.4 billion in 2030 in the world. Thus the increasing life expectancy will add up the current scenario.¹

In the modern era of cataract surgery, the lens capsule is left intact to preserve a site for the implantation of the intraocular lens which is the most practiced mode of visual rehabilitation, but this posterior capsule may lead to the significant secondary visual loss due to the development of PCO, acting as a substrate for the proliferating remnant epithelial cells.

Due to its multi-factorial causation and pathogenesis, it is difficult to target one specific pathway to alter its development. Many techniques were advocated to reduce the incidence including surgical techniques, IOL biomaterial, IOL design and pharmacological methods.²⁻⁴ with YAG- capsulotomy rates of upto 1.3%-14%,⁵ although nearly 100% opacification occurs in cases of children. The interval between surgery and opacification time ranges from 3months to 5 years with an average opacification duration being 26 months.⁶ PCO can be treated either with surgical (or) laser capsulotomy, either of them have their own pros & cons. 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.⁷ Though being a non-invasive and simple outpatient procedure, it is not without complications. Several complications have been listed in various studies, though majority of them are transient and treatable.^{8,9} Hence I have undertaken this study to evaluate the visual outcomes and complications following Nd -YAG laser capsulotomy in patients with PCO.

Materials and methods

A observational prospective interventional cross-sectional study was conducted in the Department of Ophthalmology, Nalanda Medical College and Hospital, Patna, Bihar, India for 1 year. Total 100 patients who were previously operated for cataract by routine ECCE/SICS or Phacoemulsification 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.

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.

Results

Data of all 100 patients were studied and were tabled under various headings. We used the Neodymium-YAG laser to perform posterior capsulotomies on 100 eyes of 100 patients that had undergone extracapsular cataract extraction. In our study 57(57%) were male and 43(43%) were female. The average age of these patients was 51 years, ranging from 18 years to 79 years. Of the 100 eyes, 87 (87%) had implanted posterior chamber IOL, while 13(13%) eyes were aphakic.

Table 1: Time period between cataract extraction and Nd: YAG laser capsulotomy (n = 100)

Time Period	No. of eyes	Percentage (%)
Less than 6 months	7	7
6 months to 1 year	18	18
1 year to 2 year	32	32
2 year and above	43	43
Total	100	100

In this study maximum number 43(43%) patients who were having PCO, had a history of cataract surgery >24 month back. 32(32%) patients developed PCO in a period of 12 months to 24 months of cataract surgery. In 18 patients duration between cataract surgery and PCO was 6-12 months. In 7(7%) patients PCO developed within 6 months of cataract surgery.

Table 2: Types of posterior capsule opacification (n = 100)

Type of PCO	No. of eyes	Percentage
Capsular fibrosis	61	61
Elschnig's pearls	22	22
Capsular wrinkling	15	15
Pigmentary deposits on capsule	2	2
Total	112	100

As table 2 showed, Capsular fibrosis were found in 61(61%), Elschnig's pearls in 22 (22%), capsular wrinkling in 15 (15%) and pigmentary deposits on capsule in 2 (2%) of cases.

Table 3: Different grading of posterior capsular opacity

Grade	No. of patients (%)
Mild (Fundus seen with direct ophthalmoscope)	25 (26)
Moderate (Fundus seen with indirect ophthalmoscope)	50(50)
Severe (No fundus seen as view is hazy)	24 (24)

The maximum number of patients were having grade 2 PCO 50(50%), followed by grade 1 with 26 (26%) and grade 3 with 24 (24%) cases.

Table 4: VA before and after Nd: YAG laser capsulotomy (n = 100)

Visual Acuity	Pre-laser VA (%)	Post-laser VA (%)
Less than 6/60	43 (43)	7 (7)
6/60	19 (19)	12 (12)
6/36	9 (9)	7 (7)
6/24	10(10)	13 (13)
6/18	11 (11)	29 (29)
6/12	5(5)	17(17)
6/9	1(1)	11 (11)
6/6	0(0)	4 (4)

In this study, majority of patients 71(71%) had VA of 6/36 or less before capsulotomy. Among these 71(71%) patients, 43(43%) 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 93 (93%) out of 100 eyes. 71(71%) 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 7(7%) eyes.

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

Complications	No. of eyes	Percentage %
Raised IOP	11	36.67
Aqueous Flare	8	26.67
Vitritis	2	6.67
Floater	2	6.67
Pitting of intra-ocular lens	5	16.67
Cystoid Macular Edema	1	3.33
Hyphema	1	3.33
Total	30	100

The complications were seen in 30 patients. Most common complication observed was transient rise in IOP which were seen in 11 eyes (36.67%). Second most common complications noted was aqueous flare found in 8(26.67%)of patients. IOL pitting was present in 5 (16.67%) patients. Vitritis, floaters and Cystoids Macular Edema were found in 2 (6.67%) cases of each. 1 (3.33%) had hyphema and none of them had corneal complications, RD, RH, MH and Endophthalmitis.

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 surgery.¹⁸ The emergence of Nd:YAG Laser in the management of PCO has improved the visual outcome of cataract surgeries.¹⁹ A total of 100 patients (100 eyes) who developed PCO were treated with Nd:YAG Laser. In our study 57(57%) were male and 43(43%) 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 was 51 years, ranging from 18 years to 79 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 100 eyes, 87 (87%) had implanted posterior chamber IOL, while 13(13%) eyes were aphakic. In this study maximum number 43(43%) patients who were having PCO, had a history of cataract surgery >24 month back. 32(32%) patients developed PCO in a period of 12 months to 24 months of cataract surgery. In 18 patients duration between cataract surgery and PCO was 6-12 months. In 7(7%) 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. Capsular fibrosis were found in 61(61%), Elschnig's pearls in 22 (22%), capsular wrinkling in 15 (15%) and pigmentary deposits on capsule in 2 (2%) of cases, 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 Khattak LM 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}

In this study, majority of patients 71(71%) had VA of 6/36 or less before capsulotomy. Among these 71(71%) patients, 43(43%) 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.

Visual acuity was improved by one or more snellen's lines in 93 (93%) out of 100 eyes. 71(71%) 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 7(7%) eyes. Study by Ajite K.O. et al in 2013 showed 94.4% of patients visual improvement after laser capsulotomy.²⁴ The study by Mohammad 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 eyes.²² Other study showed improvement in the VA of an average of three lines on snellen chart after laser treatment in 87.5% cases.²⁶ Visual acuity was improved by one or more snellen's lines in 93 (93%) out of 100 eyes. 71(71%) 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 7(7%) eyes. Ajite K.O. et al.²⁴ reported 5% of their patients did not show improvement in VA. Hossain MI et al. 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 35 patients. Elevated IOP is recognized as the most common, although usually transient, complication was seen in 11 eyes (36.67%).²⁸ Second most common complications noted was aqueous flare found in 8(26.67%)

of patients. Pitting was present in 5 (16.67%) patients.²⁹ Vitritis, floaters and Cystoids Macular Edema were found in 2 (6.67%) cases of each.³⁰ 1 (3.33%) had hyphema and none of them had corneal complications, RD, RH, MH and Endophthalmitis.

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.

Reference

1. United Nations, Department of Economic and Social Affairs, Population Division. World Population Ageing; 2015. ;.
2. Jaffe NS, Jaffe SM, Jaffe FG. Cataract surgery and its complications. company Missouri CVM, USA, editors ; 1997,. 6th edition.
3. Auffarth GU, Golescu A, Becker KA. Quantification of posterior capsule opacification with round and sharp edge intraocular lenses. *Ophthalmol.* 2003;110:772–780.
4. Auffarth GU, Peng Q. Posterior capsule opacification: Pathology, clinical evaluation and current means of prevention. *Ophthalmic Pract.* 2000;18(4):172–182.
5. Apple DJ, Peng Q, Visessook N. Eradication of posterior capsule opacification: documentation of a marked decrease in Nd:YAG laser posterior capsulotomy rates noted in an analysis of 5416 pseudophakic human eyes obtained postmortem. *Ophthalmol.* 2001;108:505–518.
6. Soni P, Srivastava A, Yadav D. Nd-YAG laser posterior capsulotomy and visual outcomes. *Indian J Clin Exp Ophthalmol.* 2016;2(3):271– 277.
7. Hayashi K, Hayashi H, Nakado F, Hayashi F. Correlation between posterior capsule opacification and visual function before and after Nd: YAG laser posterior capsulotomy. *Am J Ophthalmol.* 2003;136(4):720–726.
8. Channell MM, Beckman H. Intraocular pressure changes after Nd: YAG laser posterior capsulotomy. *Arch Ophthalmol.* 1984;102:1024– 1026.
9. Gopinath GS, Satish K, Srivastava N, Patil S, Afshan R. Visual Outcome and Complications of YAG Laser Therapy for Posterior Capsular Opacification Following Cataract Surgery. *Int J Sci Study.* 2015;3(3).
10. Aslam TM, Patton N. Methods of assessment of patients for Nd: YAG laser capsulotomy that correlate with final visual improvement. *BMC Ophthalmol.* 2004; 4:13.
11. Claesson M, Klaren L, Beckman C, et al. Glare and contrast sensitivity before and after Nd:YAG laser capsulotomy. *Acta Ophthalmol.* 1994; 72: 27-32.
12. Sunderraj P, Villada JR, Joyee PW, et al. Glare testing in pseudophakes with posterior capsule opacification. *Eye* 1992; 6: 411-3.
13. Soni P, Srivastava A, Yadav D. Nd-YAG laser posterior capsulotomy and visual outcomes. *Indian J Clin Exp Ophthalmol.* 2016;2(3):271– 277.

14. Capone A Jr, Rehkopf PG, Warnicki JW, Stuart JC. Temporal changes in posterior capsulotomy dimensions following neodymium: YAG laser discission. *J Cataract Refract Surg* 1990;16:451-6.
15. Hayashi K, Hayashi H, Nakado F, Hayashi F. Correlation between posterior capsule opacification and visual function before and after Nd: YAG laser posterior capsulotomy. *Am J Ophthalmol.* 2003;136(4):720–726.
16. Channell MM, Beckman H. Intraocular pressure changes after Nd: YAG laser posterior capsulotomy. *Arch Ophthalmol.* 1984;102:1024–1026.
17. Gopinath GS, Satish K, Srivastava N, Patil S, Afshan R. Visual Outcome and Complications of YAG Laser Therapy for Posterior Capsular Opacification Following Cataract Surgery. *Int J Sci Study.* 2015;3(3).
18. Aslam TM, Devlin H, Dhillon B. Use of Nd: YAG laser Capsulotomy. *Survey Ophthalmol.* 2003; 48: 594-612.
19. Hasan KS., Adhi MI., Aziz M and Hassan M (1996).Nd: YAG laser posterior capsulotomy. *Pak J Ophthalmol.* 12: 3-7. 452.
20. Emery JM, Wilhelmus KA, Rosenberg S. complications of phacoemulsification ; 1978,.
21. Hasan KS, Adhi MI, Aziz M, et al. Nd:YAG laser posterior capsulotomy. *Pak J Ophthalmol.* 1996; 12: 3-7.
22. Kundi NK, Younas M. Nd-YAG Laser posterior capsulotomy. *J Med Sciences.* 1998; 8: 90-4.
23. Mohammad YK., Sanaullah J., Mohammad NK., Shafqatullah K and Niamatullah K (2006). Visual xOutcome after Nd:YAGCapsulotomy in Posterior Capsule Opacification. *Pak J Ophthalmol,* 22:87-89.
24. Ajite K.O., Ajayi I.A., Omotoye O.J and Fadamiro C.O. Department of Ophthalmology Ekit
25. Niranjana A., Suqin G and Wagner B (2009). Posterior Capsular Opacification A Problem Reduced but Not Yet Eradicated. *Arch Ophthalmol.* 127(4):555-562
26. Latif E, Aasi NA. Treatment of Postoperative papillary membranes with Nd-YAG laser. *Pak J Ophthalmol.* 1996; 12: 8– 12
27. Hossain MI., Hossain MA and Hossain MJ (2009). Visual Outcome after Nd: YAG Laser Capsulotomy. *Journal of Armed Forces Medical College, Bangladesh.*5(2):29-31.
28. Shankar Ganvit 1, Meera Shah 2, Utkarsh Parmar2, Aanal Shah2, Priya Joshiyara2, Niyant Pandya3 Visual outcome and complications following Nd:YAG laser posterior capsulotomy . *Int J Int Med Res.* 2015; 2(2):31-35.
29. Keates RH, Steinert RF, Puliafito CA, Maxwell SK. Long-term follow-up of Nd: YAG laser posterior capsulotomy. *J Am Intraocul Implant Soc* 1984;10:164-8.
30. Soujanya G, Kanthamani K. Visual outcomes and complications after Neodymium-doped yttrium aluminium garnet laser capsulotomy in Posterior capsular opacification *Indian Journal of Clinical and Experimental Ophthalmology* 2019;5(4):491–495

Received :15-11-2021.

Revised:29-11-2021.

Accepted:16-12-2021