

# Visual benefits and complications following neodymium-doped yttrium aluminum garnet (Nd: YAG) capsulotomy



Ajay R Kamath<sup>1</sup>, Ramya Gundapaneni<sup>2</sup>

<sup>1</sup>Professor and Head, Department of Ophthalmology, Kasturba Medical College, Mangaluru, Karnataka, <sup>2</sup>Assistant Professor, Department of Ophthalmology, Nimra Institute of Medical Sciences, Vijayawada, Andhra Pradesh, India

Submission: 17-08-2023

Revision: 29-10-2023

Publication: 01-12-2023

## ABSTRACT

**Background:** The incidence of posterior capsule opacification (PCO) noted at the end of 5 years following cataract extraction is 33%. With the advent of phacoemulsification various materials and designs of intraocular lenses, the incidence of PCO has been reduced. Following pediatric cataract surgery, the incidence of PCO was found to be 100%. Nd: YAG capsulotomy is considered a safe, effective, and non-invasive technique to treat PCO. **Aims and Objectives:** The aim of the study was to evaluate the visual acuity among the patients with PCO and to assess the complications following Nd: YAG capsulotomy. **Materials and Methods:** A total of 100 eyes of 100 patients with study period being 2 years from October 2015 to July 2017. The study was prospective study, and sampling was purposive sampling. After recruiting, the participants were divided into 2 case groups - pseudophakia and aphakia. A complete ophthalmological evaluation was done which included best-corrected visual acuity, torchlight and slit-lamp examination, and measurement of IOP which was followed by a fundus examination. **Results:** The minimum and maximum age of the patient observed in our study was 34 and 88. Most of the study population was in the age group of 51–60 years. Majority of patients presented with PCO with an interval of 25–36 months following cataract surgery and were noted in about 52% of study population. Majority of the patients had visual acuity 6/36-6/18 and observed in 36% of study population. Comparison between pre-YAG and post-YAG day 1 visual acuity was done using significance test and  $P=0.000$  which was highly significant, visual acuity at 4<sup>th</sup> week was compared to that of 6<sup>th</sup> week, and it was significant. **Conclusion:** The loss of vision due to PCO is a distressing complication for a patient who has spent time and money getting their surgery done and finds that their vision is dropping again. YAG laser capsulotomy is a simple, outpatient solution that will bring the smile back on the patient's face instantly. Capsulotomy improves visual acuity immediately after the procedure and more after 4 or 6 weeks with least complications.

**Key words:** Posterior capsule opacification; Visual acuity; Nd: YAG capsulotomy

## INTRODUCTION

As quoted in the Yiddish proverb “The eyes are the mirror of the soul,” they are considered to be a precious gift. The major curable cause of loss of vision in India is cataract<sup>1</sup> which is defined as opacification of the crystalline lens. The long-term complication following cataract surgery is posterior capsule opacification (PCO) which has symptoms similar to that of cataract,<sup>2</sup> leading to decreased vision, glare,<sup>2</sup> and monocular diplopia. Sir Harold Ridley in his

first case documented the complication of late capsular opacification following cataract surgery.

The incidence of PCO noted at the end of 5 years following cataract extraction is 33%.<sup>3</sup> With the advent of phacoemulsification various materials and designs of intraocular lenses (IOLs), the incidence of PCO has been reduced. Nd: YAG capsulotomy is considered a safe, effective, and non-invasive technique to treat PCO and can be done on outpatient basis<sup>4</sup> and is gradually replacing surgical capsulotomy<sup>5</sup> for the treatment of PCO.

### Access this article online

#### Website:

<http://nepjol.info/index.php/AJMS>

DOI: 10.3126/ajms.v14i12.57719

E-ISSN: 2091-0576

P-ISSN: 2467-9100

Copyright (c) 2023 Asian Journal of Medical Sciences



This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

### Address for Correspondence:

Dr. Ramya Gundapaneni, Assistant Professor, Department of Ophthalmology, Nimra Institute of Medical Sciences, Vijayawada, Andhra Pradesh, India. **Mobile:** +91-9440139869. **E-mail:** gundapaneniramya@gmail.com

LASER is an acronym for Light Amplification by Stimulated Emission of Radiation and Gordon Gould coined the term. Nd: YAG laser is a solid type of laser with a wavelength of 1064 nm which is invisible, requiring He-Ne laser red aiming beam<sup>6</sup> and acts by the principle of photo disruption using infrared radiation. It is usually Q switched when it is used to treat the eye. Although Nd: YAG capsulotomy is considered a safe and effective procedure, it has its own complications associated with it. Transient raise in intraocular pressure, intraocular damage, and cystoid macular edema<sup>6</sup> are the complications associated with it. Other rare complications include corneal endothelial damage, vitreous hemorrhage, retinal detachment, and endophthalmitis.<sup>7</sup>

### Aims and objectives

The aim of the study was to evaluate the visual gain among the patients with PCO and to assess the complications following Nd: YAG capsulotomy.

## MATERIALS AND METHODS

### Study design

The study design was an observational study.

### Study setting

This study was conducted at Kasturba Medical College Hospital, Attavar and Government Wenlock Hospital, Mangalore.

### Study participants

100 eyes of 100 patients with study period being 2 years from October 2015 to July 2017 were included in the study. The study was approved by the institutional human ethical committee. The participants were recruited using the following criteria.

### Inclusion criteria

Pseudophakic/Aphakic patients of various age groups and either sex with PCO which is sufficient to cause decreased vision and normal IOP attending ophthalmology OPD were included in the study.

### Exclusion criteria

Those with a history of active ocular infection, corneal pathology in whom assessment of PCO is difficult, any pre-existing rise in IOP, cystoid macular edema, and any individual less than the age of 8 years were excluded from the study.

After recruiting, the participants were divided into two case groups - pseudophakia and aphakia. A complete ophthalmological evaluation was done which included best-corrected visual acuity, torchlight and slit-lamp

examination, and measurement of IOP which was followed by a fundus examination.

### Methods

Under topical anesthesia with the help of Abraham posterior capsulotomy lens, with the patient head mounted on the slit lamp equipped with YAG laser, procedure was done with ZEISS VISULAS YAG II PLUS laser. In patients whose pupil diameter was <3 mm, dilation was done by 1% tropicamide drops.

Depending on the thickness of PCO, the energy and number of shots had been given to achieve adequate capsulotomy opening. Following YAG capsulotomy topical Bromofenac drops 0.09% was advised 3 times daily.

The patients then underwent Nd: YAG capsulotomy and measurement of IOP was done at the end of 1 h and 2 weeks following laser using Goldmann Applanation tonometry. The average pulse energy used for Nd: YAG laser posterior capsulotomy was 1.6 mj and energy was delivered as single pulse per burst and the number of pulses required for an adequate capsulotomy opening were 14 on average. Best-corrected visual acuity was noted on day 1, 4, and 6 weeks following laser capsulotomy. Complications following Nd: YAG capsulotomy were noted in the patients.

### Ethical considerations

The present study protocol was approved by the institutional human ethical committee of Kasturba Medical College, Mangalore.

### Statistical analysis

Statistical data analysis was performed with SPSS for Windows, version 17.5 using "Chi-square test,"  $P < 0.05$  was considered statistically significant.

## RESULTS

89 patients were pseudophakic and 11 patients were aphakic. Total number of males who underwent YAG capsulotomy was 56 (56%) and the number of females was 44 (44%). There was slight male preponderance observed in our study (Table 1). The minimum and maximum age of the patient observed in our study was 34 and 88 years. Most of the study population was in the age group of 51–60 years (Table 2). Majority of patients presented with PCO with an interval of 25–36 months following cataract surgery and was noted in about 52% of study population (Table 3). Majority of the patients had visual acuity 6/36–6/18 and observed in 36% of study population (Table 4). Table 5 presents the comparison between pre-YAG and post-YAG day 1 visual acuity was done using significance test and  $P = 0.000$  which was highly significant (Table 6).

**Table 1: Gender-wise distribution of the participants**

Gender	Number	Percentage
Males	56	56
Females	44	44
Total	100	100

Data were presented as frequency and percentage

**Table 2: Age-wise distribution of the participants**

Age in years	Frequency	Percentage
50 and <50	9	9
51–60	34	34
61–70	29	29
71–80	23	23
80 and above	5	5
Total	100	100

Data were presented as frequency and percentage

**Table 3: The interval between the cataract surgery and onset of PCO**

Interval in months	Frequency	Percentage
24 months and below	26	26
25–36 months	52	52
Above 36 months	22	22
Total	100	100

Data were presented as frequency and percentage, PCO: Posterior capsule opacification

**Table 4: Pre YAG VA**

Pre YAG VA	Count	Percentage
6/60 and <6/60	36	36
6/36–6/18	46	46
6/12–6/9	18	18

Data were presented as frequency and percentage, VA: Visual acuity

Following YAG capsulotomy, visual acuity was compared on day 1, 4, and 6 weeks and comparisons done were statistically significant (Table 7). Post YAG capsulotomy, visual acuity at 4<sup>th</sup> week was compared to that of 6<sup>th</sup> week and it was significant (Table 8).

## DISCUSSION

Several studies have been done around the world in various groups to prove the visual benefits and the complications following Nd: YAG capsulotomy. In our study, 100 patients were studied out of which 56% were males and 44% were females. There was slight male preponderance observed in our study similar to earlier studies where 200 patients were studied, and 59% were males and 41% were females.<sup>8</sup> This result was similar to other study where 70 patients were studied, out of which 40 were males and 30 were females.<sup>9</sup> Case groups

were made into pseudophakic and aphakic out of which 89% were pseudophakic and 11% were aphakic similar to previous study.<sup>10</sup> 95% of the patients were in the age group of 41–80 years, perhaps this is the age at which the senile cataract patients present to the ophthalmologist. It was observed that PCO was more in the age group of 51–60 years. The study agrees with earlier studies.<sup>11,12</sup> The interval between the cataract surgery and development of PCO was noted between 25 and 36 months in about 52% of the study population which was similar to earlier studies.<sup>13</sup> It was reported that the incidence of PCO noted was about 50%, 2 years postoperatively.<sup>14</sup> Before intervention, 36% of patients were having poor best-corrected visual acuity that is 6/60 and <6/60, and 46% of patients were having best-corrected visual acuity between 6/36 and 6/18, and 18% of patients were having best-corrected visual acuity between 6/12 and 6/9. After intervention, 8% of the patients were having best-corrected visual acuity 6/60, 6/36–6/18 best-corrected visual acuity was noted in 20% of the patients, 6/12–6/9 visual acuity was noted in 32% of the patients, and 40% of the patients were having 6/6 vision. In our study, 92% of the patients showed improvement after Nd: YAG capsulotomy similar to earlier studies.<sup>11,12</sup> Most of the studies showed good visual acuity after Nd: YAG capsulotomy. It was also observed that no one had further deterioration of visual acuity after YAG capsulotomy and it was supported.<sup>2</sup> After 6 weeks, 8% of the patients had shown no improvement in the best-corrected visual acuity. Raised IOP after Nd: YAG capsulotomy has been documented in different studies 36.56. In our study, raised IOP at the end of 1 h was seen in 17% of the patients similar to earlier study.<sup>13</sup> At the end of 2 weeks, raised IOP was noted in 8% of the study population. The rise in IOP after YAG capsulotomy could be due to deposition of debris in the trabecular mesh work, pupillary block, and inflammatory swelling of the ciliary body or iris root associated with angle closure. In earlier studies, rise in IOP was not noted but subsequent studies proved the rise in IOP.<sup>14</sup> There were 6% in 100 eyes and none of them accounted for significant visual impairment. Studies have proven that retro-focusing of laser aiming beam can reduce the risk of damage to IOL.<sup>59</sup> The incidence of cystoid macular edema noted in our study was 2% which was high as compared to earlier studies.<sup>15,16</sup> The incidence of cystoid macular edema noted was 4.4% in earlier study. The mechanism of CME is unclear, but it is suggested that, in response to YAG laser, the prostaglandin released from anterior segment reached the retina through the vitreous which alters the permeability of paramacular capillaries to develop CME.<sup>17–20</sup>

### Limitations of the study

Sample size of the study was less to generalize the results.

**Table 5: Comparison of visual acuity pre-YAG and post-YAG capsulotomy- Day 1**

PRE-YAG	6/12-6/9	6/6	6/60	6/36-6/18	Total
6/12-6/9	3 (16.7)	15 (83.3)	0 (0)	0 (0)	18 (100)
6/36-6/18	23 (50)	15 (32.6)	0 (0)	8 (17.4)	46 (100)
6/60-<6/60	0 (0)	4 (11.1)	17 (47.2)	15 (41.7)	36 (100)
Total	26 (26)	34 (34)	17 (17)	23 (23)	100 (100)

Data were represented as frequency and percentages

**Table 6: Comparison of visual acuity pre-YAG and post-YAG capsulotomy- 4 weeks**

PRE-YAG	6/12-6/9	6/6	6/60	6/36-6/18	Total
6/12-6/9	1 (5.6)	17 (94.4)	0 (0)	0 (0)	18 (100)
6/36-6/18	25 (54.3)	17 (37)	0 (0)	4 (8.7)	46 (100)
6/60-<6/60	2 (5.6)	4 (11.1)	10 (27.8)	20 (55.6)	36 (100)
Total	28 (28)	38 (38)	10 (10)	24 (24)	100 (100)

Data were represented as frequency and percentages

**Table 7: Comparison of visual acuity pre YAG and post YAG capsulotomy- 6 weeks**

PRE-YAG	6/12-6/9	6/6	6/60	6/36-6/18	Total
6/12-6/9	20 (76.9)	6 (23.1)	0 (0)	0 (0)	26 (100)
6/36-6/18	0 (0)	34 (100)	0 (0)	0 (0)	34 (100)
6/60-<6/60	2 (11.8)	0 (0)	8 (47.1)	7 (41.2)	17 (100)
Total	32 (32)	40 (40)	8 (8)	20 (20)	100 (100)

Data were represented as frequency and percentages

**Table 8: Comparison of visual acuity Post YAG 4 weeks-6 weeks**

PRE-YAG	6/12-6/9	6/6	6/60	6/36-6/18	Total
6/12-6/9	24 (85.7)	4 (14.3)	0 (0)	0 (0)	28 (100)
6/36-6/18	2 (5.3)	36 (94.7)	0 (0)	0 (0)	38 (100)
6/60-<6/60	0 (0)	0 (0)	8 (80)	2 (20)	10 (100)
Total	32 (32)	40 (40)	8 (8)	20 (20)	100 (100)

Data were represented as frequency and percentages

## CONCLUSION

The loss of vision due to PCO is a distressing complication for a patient who has spent time and money getting their surgery done and finds that their vision is dropping again. YAG laser capsulotomy is a simple; outpatient solution that will bring the smile back on the patient's face instantly.

## ACKNOWLEDGMENT

The authors were thankful to the participants for their support and cooperation throughout the study.

## REFERENCES

- Ninn-Pedersen K and Bauer B. Cataract patients in a defined Swedish population, 1986 to 1990: V. Postoperative retinal detachments. *Arch Ophthalmol.* 1996;114(4):382-386. <https://doi.org/10.1001/archophth.1996.01100130378003>
- Lamoureux EL, Fenwick E, Pesudovs K and Tan D. The impact of cataract surgery on quality of life. *Curr Opin Ophthalmol.* 2011;22(1):19-27. <https://doi.org/10.1097/ICU.0b013e3283414284>
- Allen D and Vasavada A. Cataract and surgery for cataract. *BMJ.* 2006;333(7559):128-132. <https://doi.org/10.1136/bmj.333.7559.128>
- Rao GN, Khanna R and Payal A. The global burden of cataract. *Curr Opin Ophthalmol.* 2011;22(1):4-9. <https://doi.org/10.1097/ICU.0b013e3283414fc8>
- Chan WH, Biswas S, Ashworth JL and Lloyd IC. Congenital and infantile cataract: Aetiology and management. *Eur J Pediatr.* 2012;171(4):625-630. <https://doi.org/10.1007/s00431-012-1700-1>
- Raj SM, Vasavada AR, Johar SR, Vasavada VA and Vasavada VA. Post-operative capsular opacification: A review. *Int J Biomed Sci Master Publ Group.* 2007;3(4):237-250.
- Vasavada A, Raj SM, Shah GD and Nanavaty MA. Posterior capsule opacification after lens implantation. Incidence, risk factors and management. *Expert Rev Ophthalmol.* 2013;8(2):141-149. <https://doi.org/10.1586/eop.12.80>
- Bar-Sela SM, Har-Noy NB and Spierer A. Secondary membrane formation after cataract surgery with primary intraocular lens implantation in children. *Int Ophthalmol.* 2014;34(4):767-772. <https://doi.org/10.1007/s10792-013-9873-9>
- Boureau C, Lafuma A, Jeanbat V, Smith AF and Berdeaux G.

- Cost of cataract surgery after implantation of three intraocular lenses. *Clin Ophthalmol.* 2009;3:277-285.  
<https://doi.org/10.2147/oph.s4890>
10. Keates RH, Steinert RF, Puliafito CA and Maxwell SK. Long-term follow-up of Nd: YAG laser posterior capsulotomy. *J Am Intraocul Implant Soc.* 1984;10(2):164-168.  
[https://doi.org/10.1016/s0146-2776\(84\)80101-9](https://doi.org/10.1016/s0146-2776(84)80101-9)
  11. Bath PE and Fankhauser F. Long-term results of Nd: YAG laser posterior capsulotomy with the Swiss laser. *J Cataract Refract Surg.* 1986;12(2):150-153.  
[https://doi.org/10.1016/s0886-3350\(86\)80031-1](https://doi.org/10.1016/s0886-3350(86)80031-1)
  12. Billotte C and Berdeaux G. Adverse clinical consequences of neodymium: YAG laser treatment of posterior capsule opacification. *J Cataract Refract Surg.* 2004;30(10):2064-2071.  
<https://doi.org/10.1016/j.jcrs.2004.05.003>
  13. Aslam TM and Patton N. Methods of assessment of patients for Nd: YAG laser capsulotomy that correlate with final visual improvement. *BMC Ophthalmol.* 2004;4:13.  
<https://doi.org/10.1186/1471-2415-4-13>
  14. Murri CA, Stanfield DL and Van Brocklin MD. Capsulotomy. *Optom Clin.* 1995;4(4):69-83.
  15. Riggins J, Pedrotti LS and Keates RH. Evaluation of the neodymium-YAG laser for treatment of ocular opacities. *Ophthalmic Surg.* 1983;14(8):657-682.  
<https://doi.org/10.3928/1542-8877-19830801-10>
  16. Hasan KS, Adhi MI, Aziz M, Shah N and Farooqui M. Nd: YAG laser posterior capsulotomy. *Pak J Ophthalmol.* 1996;12:3-7.
  17. Karahan E, Tuncer I and Zengin MO. The effect of Nd: YAG laser posterior capsulotomy size on refraction, intraocular pressure, and macular thickness. *J Ophthalmol.* 2014;2014:846385.  
<https://doi.org/10.1155/2014/846385>
  18. Arya SK, Sonika KS, Kumar S, Kang M and Sood S. Malignant glaucoma as a complication of Nd: YAG laser posterior capsulotomy. *Ophthalmic Surg Lasers Imaging.* 2004;35(3):248-250.
  19. Silverstone DE, Brint SF, Olander KW, Taylor RB, McCarty GR, deFaller JM, et al. Prophylactic use of apraclonidine for intraocular pressure increase after Nd: YAG capsulotomies. *Am J Ophthalmol.* 1992;113(4):401-405.  
[https://doi.org/10.1016/s0002-9394\(14\)76162-8](https://doi.org/10.1016/s0002-9394(14)76162-8)
  20. Ozkurt YB, Sengor T, Evciman T and Haboğlu M. Refraction, intraocular pressure and anterior chamber depth changes after Nd: YAG laser treatment for posterior capsular opacification in pseudophakic eyes. *Clin Exp Optometry.* 2009;92(5):412-415.  
<https://doi.org/10.1111/j.1444-0938.2009.00401.x>

**Authors' Contributions:**

**ARK** - Concept and design of the study, results interpretation, review of the literature, and preparing the first draft of the manuscript; **RG** - Concept and design of the study, statistical analysis and interpretation, revision of the manuscript.]

**Work attributed to:**

Department of Ophthalmology, Kasturba Medical College, Mangaluru, Karnataka, India and Government Wenlock Hospital, Mangaluru, Karnataka, India.

**Orcid ID:**

Dr. Ramya Gundapaneni -  <https://orcid.org/0009-0005-6619-8659>

**Source of Support:** Nil, **Conflicts of Interest:** None declared.