

Clinical Study of Visual Outcome and Complications of Nd:YAG Laser Capsulotomy in Posterior Capsular Opacification Following Small Incision Cataract Surgery at a Tertiary Eye Care Centre in Rural Maharashtra - A Prospective Observational Study

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ABSTRACT

BACKGROUND

Posterior capsule opacification (PCO) is the most common delayed complication of cataract surgery. Nd:YAG (Neodymium yttrium aluminium garnet) laser posterior capsulotomy presents the advantages of a non-invasive, effective, relatively safe technique to manage intact posterior capsule that opacifies postoperatively. With this background we want to study the visual outcome and complications following Nd-YAG laser posterior capsulotomy in posterior capsular opacification following small incision cataract surgery (SICS).

METHODS

The study includes 64 patients attending outpatient department of a tertiary eye care hospital at Latur from June 2018 to May 2019 who have undergone SICS with PMMA PC IOL (polymethyl methacrylate posterior chamber intraocular lens) implantation and clinically diagnosed with posterior capsular opacification. 64 eyes with PCO were subjected to Nd:YAG laser posterior capsulotomy after detailed slit lamp bio microscopic examination pre- and post-capsulotomy. Follow-up was done at 1 hour, 1 week, 2 weeks and 4 weeks and patients were examined for visual outcome and any complications at each visit.

RESULTS

There were 16 males (25 %) and 48 females (75 %) with a mean age of 65 years. Posterior capsule opacification occurs within 3 years accounting for 46.9 % of the cases. Elschnig pearls type of PCO was more common when compared to fibrous type of PCO. Best corrected visual acuity (BCVA) before Nd:YAG laser capsulotomy was less than 6 / 60 in 35 patients (54.7 %) and within 6 / 60 to 6 / 24 in 23 patients (35.9 %) with 6 patients (9.4 %) accounting for visual acuity between 6 / 24 to 6 / 18. After Nd - YAG Laser Capsulotomy, 46.9 % gained best corrected visual acuity of 6 / 18 or better, 39.1 % cases improved 6 / 12 and better and BCVA of 6 / 9, 6 / 6 was observed in 11 cases and 1 case respectively. Only 12 out of 64 patients had complications. Raised intraocular pressure (IOP) was found in 4 patients. Intraocular lens (IOL) pitting was found in 8 patients.

CONCLUSIONS

Nd:YAG laser capsulotomy is a safe, effective and a non-invasive procedure which avoids all the complications of surgical capsulotomy in patients of posterior capsule opacification.

KEYWORDS

Posterior capsule opacification (PCO), Nd:Yag Laser Capsulotomy, Best Corrected Visual Acuity (BCVA), Central Subfield Macular Thickness (CSMT)

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DOI: 10.18410/jebmh/2021/268

How to Cite This Article:

*Dhakne VR, Karad SH, Waghambare SB,
et al. Clinical study of visual outcome and
complications of Nd:YAG laser
capsulotomy in posterior capsular
opacification following small incision
cataract surgery at a tertiary eye care
centre in rural Maharashtra - a
prospective observational study. J Evid
Based Med Healthc 2021;8(19):1409-
1413. DOI: 10.18410/jebmh/2021/268*

Submission 13-01-2021,

Peer Review 19-01-2021,

Acceptance 24-03-2021,

Published 10-05-2021.

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BACKGROUND

Posterior capsule opacification (PCO) is the most common late post-operative complication following small incision cataract surgery. It can occur between few months and many years after implantation of intraocular lenses (IOLs), with incidence figures ranging from < 5 % to as high as 50 %.^{1,2} PCO in paediatric age group is a major problem where the incidence approaches 100 %.³ PCO can be treated by primary or secondary posterior capsulotomy, but these procedures are reflected with a lot of disadvantages.⁴ Neodymium - doped yttrium aluminum garnet (Nd:YAG) laser capsulotomy is a widely accepted surgical method to treat PCO. Nd:YAG laser capsulotomy is a non-invasive and safe treatment but it carries risk of some complications.⁵ Although Nd:YAG laser capsulotomy is accepted as standard treatment for PCO and has been found to be safe and effective, it is not without complications, some of which can be sight - threatening such as retinal oedema and detachment.⁶

Several studies have described damages in the intraocular lens (IOL), increased intraocular pressure (IOP), glaucoma, retinal haemorrhage, iritis, vitreous prolapse, corneal injury, vitritis, pupil blockage, hyphma, cystoid macular oedema, retinal detachment (RD), IOL dislocation or exacerbation of endophthalmitis.^{7,8,9-11}

With this background knowledge a hospital based prospective study of visual outcome and complications following Nd:YAG laser posterior capsulotomy was done.

Objectives

1. To determine the visual outcome after Nd:YAG laser capsulotomy therapy in posterior capsular opacity following small incision cataract surgery.
2. To study the complications if any following Nd:YAG laser capsulotomy therapy in posterior capsular opacity following small incision cataract surgery.

METHODS

A prospective observational study was performed on 64 eyes of 64 patients attending the out patient department of a tertiary eye care centre, Latur, from June 2018 to May 2019 and who had undergone small incision cataract surgery and had come to the out patient department with complaints of post operative reduction in vision or glare and clinically diagnosed to have PCO.

Formula for Sample Size Calculation

$$n = ([Z1] ^2 \{P(1 - P)\} / d^2)^{12}$$

We considered here prevalence of posterior capsular opacity (62 %) for sample size calculation. By using above formula minimum sample size came to 64. All patients underwent a detailed eye examination.

The examination included

1. Visual acuity measurements using Snellen’s vision chart
2. Retinoscopy
3. Slit lamp bio microscopy
4. Intraocular Pressure recording with Nidek Non - Contact Tonometer
5. Fundus examination - Direct / Indirect ophthalmoscope - 78 D / 90 D
6. OCT evaluation of macular thickness.

P	Your guess of population P (any value < 1)	0.62
1 - α	Confidence level set by you	0.95
Z	Z value associated with confidence	1.96
d	Absolute precision (Value less than P)	0.12
N	Minimum sample size	64

Procedure for Nd:YAG capsulotomy : Patient was explained in detail about the purpose of the procedure, duration, painless nature, importance of maintenance of steady fixation, and the associated complication. Following which an informed written consent was taken from the patient. Antiglaucoma medication Brimonidine 0.5 % eye drop, one drop one hr before laser procedure was instilled into the cul-de-sac and 10 minutes before the procedure 4 % lignocaine drop was instilled in the cul-de-sac.

At the laser table the procedure was explained once again to the patient, the table, stool and chin reset was adjusted for optimal patient comfort, the room was darkened to improve visualization of the target and consequently help in accurate focusing of the laser beam. The slit lamp beam was narrowed and obliquely angled to minimize meiosis.

Using 1 to 2 mJ per pulse from Q switched Nd:YAG laser a sufficient opening in the posterior capsule was made, minimal energy of 1 mJ was used with increment of 0.5 mJ; in calcitrant condition up to 4.5 mJ was used. Capsulotomy was preferably started in an existing area of separation between posterior capsule and IOL, further areas of separation were achieved by placing the shots in a cruciate pattern starting from 12 'o'clock and progressing towards 6 'o' clock, in clock wise direction, residual posterior capsular flaps if noted in the pupillary area were directly fired with laser shots to cut them so that they retract and fall back towards the periphery.

Post Procedural Care

All patients were examined under the slit lamp and were advised prednisolone eye drops four times daily for 1 week to counter anterior uveitis. After capsulotomy follow up was done at the end of 1 hour, one week, two weeks and at four weeks. The visual acuity and IOP were measured at each follow up and also examined for any associated complication and appropriate intervention were made during the study. OCT evaluation of central subfield macular thickness was done at each follow up to look for any statistically significant increase in the same.

Statistical Analysis

Data entered in MS Excel sheet and analysed by using SPSS 24. 0 version IBM USA. Qualitative data was expressed in

terms of percentages and quantitative data was expressed in terms of mean and standard deviation. Comparison of mean and SD carried out by one way anova test and P value < 0.001 considered as highly significant in our study. Post hoc Tukey's test was applied in order to assess the significance.

RESULTS

64 eyes were subjected to Nd:YAG capsulotomy and followed up at 1 hour, one week, two weeks and at four weeks. Female sex was found to be dominant with 48 females contributing to 75 % and 16 males contributing to 25 % among the total patients. The average age was 65 years with the youngest patient of 40 years and the oldest patient of 90 years. Posterior capsule opacification occurred within 3 years of surgery accounting for 46.9 % of the cases. Causation of PCO increased after 1 year of surgery. Elschnig pearls type of PCO was more common when compared to fibrous type of PCO. A combination of both was also observed in few cases. 54.7 percent of the patients best corrected visual acuity was between CF 1 mts to 6 / 60 before laser application. There were 35.9 % patients with visual acuity between 6 / 60 and 6 / 24 and 9.4 percent patients had visual acuity 6 / 18 before treatment.

Age Group Wise			According to Duration from Surgery			Sex Wise		
Group	Frequency	Percentage	Group	Frequency	Percentage	Sex	Frequency	Percentage
40 - 50	3	4.6	< 1 yr.	11	17.2	Male	16	25.0
51 - 60	14	21.9	1 - 3 yrs.	30	46.9			
61 - 70	36	56	3-5	15	23.4			
>	11	17	> 5 yrs.	8	12.5	Female	48	75.0
Total	64	100	Total	64	100	Total	64	100

Table 1. Data Distribution According to Age, Sex and Duration in Years from the Date of Surgery

After Nd:YAG laser capsulotomy 14 % patients gained 6 / 24 BCVA, 46.9 % gained best corrected visual acuity of 6 / 18 or better and 39.1 % cases improved 6 / 12 and better. BCVA of 6 / 9, 6 / 6 was observed in 11 cases and 1 case respectively. Only 12 out of 64 patients had complications. Raised IOP was found in 4 patients. Raised IOP was managed successfully instilling eye drops brimonidine twice daily for a week in 4 patients. IOL pitting found in 8 patients needed no treatment as it did not cause any vision reduction. Though there was statistically significant increase in central subfield macular thickness at 1 week post Nd:YAG Laser Capsulotomy, it decreased to pre procedural levels after 4 weeks of procedure irrespective of the capsulotomy size.

In our study female sex was predominantly found to be affected with 48 cases as compared to 16 males. The average age was 65 years with the youngest patient of 40 years and the oldest patient of 90 years. Out of 64 patients, 3 patients (4.6 %) were lying in the age group of 40 - 50 yrs., 14 patients (22 %) were in the age group of 51 - 60

yrs., 36 patients (56 %) were in age group of 61 - 70 yrs. and 11 patients (17 %) were above 70 yrs. of age.

Our study showed that posterior capsule opacification occurred within 3 years accounting for 46.9 % of the cases. Causation of PCO increased after 1 year of surgery according to the present study. PCO occurred within 1 yr. of cataract surgery in 11 cases (17.2 %) whereas 30 patients (46.9 %) presented with PCO within 3 yrs. of surgery which accounted for maximum cases. 15 patients (23.4 %) presented with PCO after 3 yrs. following cataract surgery and 8 patients (12.5 %) presented with PCO 5 yrs. after cataract surgery.

BCVA after Nd:YAG Laser	No. of Patients	Percentage
CF = 1 m to 6 / 60	0	0
6 / 60 to 6 / 36	7	11.0
6 / 24 to 6 / 18	32	50.0
6 / 12 to 6 / 6	25	39.0
Total	64	100

Table 2. Data Distribution According to BCVA after Nd:YAG Laser Capsulotomy

Following Nd:YAG laser capsulotomy 11 % patients gained 6 / 36 BCVA after seven days, 50 % gained best corrected visual acuity of 6 / 18 after 4 weeks and 39 % cases improved 6 / 12 and better at the end of 4 weeks. BCVA of 6 / 9, 6 / 6 was observed in 11 cases and 1 case respectively.

Complications after Nd:YAG Capsulotomy	No. of Patients	Percentage
None	52	81.3
IOL pitting	8	12.4
Raised IOP	4	6.3
CME	0	0
Iridocyclitis	0	0
Retinal detachment	0	0
Total	64	100

Table 3. Distribution of Data According to Complications after Procedure

Only 12 out of 64 patients had complications. Raised IOP was found in 4 patients (6.3 %) which was managed successfully with eye drop Brimonidine 0.5 % for 1 week. IOL pitting found in 8 patients (12.4 %) needed no treatment as it did not cause any vision reduction.

	N	Mean	SD	F	P	Inference
Before Nd:YAG	64	17.15	0.64	9.7	0.0001 (< 0.001)	Highly significant
1 hr after	64	17.84	0.91			
1 week after	64	17.98	1.60			
2 weeks after	64	17.17	1.20			
4 weeks after	64	17.06	0.98			
Total	320	17.44	1.17			

Table 4. IOP at 1 Hour, 1 Week, 2 Weeks and 4 Weeks

Post hoc Tukey's test is applied in order to see whether the difference between two groups was significant or not.

	1 Hr After	1 Week After	2 Weeks After	4 Weeks After
Before Nd:YAG	-0.68*	-0.83*	-0.01	0.08
1 hr after		-0.14	0.66*	0.77
1 week after			0.81*	0.92*
2 weeks after				0.1

Table 5. Data Showing the Statistical Significance between the 2 Groups

*indicates that the difference was significant at 0.05 level

Above given data shows that though there is a slight increase in the IOP at around 1-week post Nd:YAG

Capsulotomy, it reached the pre procedural levels at the end of 4 weeks suggesting no significant change in IOP.

	N	Mean	SD	F	P	Inference
Before Nd:YAG	64	220.59	16.65	25.48	0.0001 (< 0.001)	Highly significant
1 week after	64	252.66	16.77			
2 weeks after	64	237.38	31.35			
4 weeks after	64	232.58	15.07			
Total	256	235.80	23.86			

Table 6. CSMT before and after Nd:YAG Laser Capsulotomy

Post hoc Tukey’s test is applied in order to see whether the difference between two groups was significant or not

	1 Week After	2 Weeks After	4 Weeks After
Before Nd:YAG	- 32.06*	- 16.78*	- 11.98*
1 week after		- 15.28*	4.79
2 week after			0.81*

Table 7. Data Showing Statistical Significance between the 2 Groups

*indicates that the difference was significant at 0.05 level

Above given data suggests that though there was statistically significant increase in central subfield macular thickness at 1-week post Nd:YAG Laser Capsulotomy, it decreased to around pre procedural levels after 4 weeks of procedure irrespective of the capsulotomy size.

DISCUSSION

Since the introduction of refined techniques of Extracapsular cataract extraction (ECCE), opacification of posterior capsule has become the commonest cause of postoperative reduction of vision following cataract removal.¹³ The non-invasive technique of Nd:YAG laser has become popular for doing posterior capsulotomy and it has been established as a standard treatment for PCO replacing surgical capsulotomy.^{14,15,16,17} In our study out of 64 patients, 48 were females (75 %) and 16 were males (25 %). This differs from a study done by Tayyab and colleagues in which 60 % were males and 40 % females in one group of patients and 50 % vs 50 % in second group of their study.¹⁸

In this study the time period between cataract extraction and performing Nd:YAG laser capsulotomy on average was 3 years while it was reported as 2.49 years by Hasan et al.¹⁹ and 24 months in another study done by Kundi and Younas.²⁰ The predominant type of PCO was Elschnig pearls which was in line with Hasan et al.¹⁹ who reported Elschnig's pearls to be the predominant type in pseudophakic eyes. There was significant improvement in BCVA in all the subjects after Nd:YAG laser capsulotomy. It was also noted that there was no further deterioration of BCVA in any case which was supported by the study conducted by Hasan et al.¹⁹ who noted that improvement in BCVA after Nd:YAG laser capsulotomy on Snellen’s chart was 1 - 3 lines in 42 and 4 - 6 lines in 31 out of 86 patients. A study conducted by Latif and Aasi²¹ using Nd:YAG laser showed overall 87.5 % improvement in the BCVA of an average 3 lines on Snellen’s chart.

82 % of the patients had no complication post procedure, 12 % patients had IOL pitting, and 6 % patients

ended up with raised IOP which was managed by 0.5 % brimonidine eye drop for 1 week. Nd:YAG laser capsulotomy is fast and non-invasive procedure with immediate improvement. Although, it is non-invasive and considered safer than surgical approach it carries the risk of some complications. Some recent studies including our study observed the effects of capsulotomy size and laser energy levels on postcasulotomy complications.²²⁻²⁴ The most common complication of Nd:YAG laser posterior capsulotomy is increased IOP. In the absence of antiglaucoma or anti-inflammatory prophylaxis, 59 – 67 % of patients showed IOP increment of at least 10 mm Hg following Nd:YAG laser capsulotomy.^{25,26} Despite the prophylactic treatment, increased IOP was reported in 15 – 30 % of patients in several studies.^{27,28} In our study IOP raise was observed in 4 patients accounting for 6.3 % which was successfully managed by instilling eye drops brimonidine 0.5 % following which IOP was in control which is in line with the study conducted by Ozkurt et al.²⁹ where he concluded no significant change in IOP after Nd:YAG capsulotomy.

Ari et al.²³ observed significant increase in macular thickness following Nd:YAG capsulotomy and that the increment was higher in patients who received higher energy. Karahan et al.²² found significant increase in central macular thickness after Nd:YAG capsulotomy at 1 week which decreased to preoperative levels at 4 weeks irrespective of the capsulotomy size. In our study, though there was statistically significant increase of macular thickness at 1 week post Nd:YAG Capsulotomy, the mean macular thickness decreased to pre-procedural levels at 1 month. Retinal tears and detachments were established complications of Nd:YAG capsulotomy. It has been estimated that the risk of retinal detachment is four times higher after laser capsulotomy.^{30,31,32} however, none of our patients developed these complications.

CONCLUSIONS

The PCO is the most common late onset complication of cataract surgery which can be safely managed as an outdoor procedure by Nd:YAG Laser. Improvement in visual acuity with this procedure is excellent. Careful follow up with Nd:YAG laser capsulotomy is important although the Nd:YAG laser is an effective device to improve vision hindered by posterior capsular opacification; it carries a low but definite risk of few complications. Pitting IOL and raised IOP are some of the few treatable complications that can occur post procedure. These complications are minimal and transient. No other complications were found in our study.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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