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Original Article

Study of Effect of Nd:YAG Laser Capsulotomy on Intraocular Pressure, Anterior Chamber Depth, and Macular Thickness in Patients of Posterior Capsular Opacification

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Abstract

Introduction: Cataract surgery is one of the most common procedures performed worldwide. Posterior capsular opacification is one of the most common complications following cataract surgery. It is one of the most common causes of diminution of vision after cataract surgery.

Purpose: To study the effect of (1064 nm) Neodymium yttrium aluminium garnet (Nd:YAG) laser posterior capsulotomy on intraocular pressure (IOP), refraction, anterior chamber depth (ACD), and macular thickness.

Methods: This prospective study was conducted on 80 pseudophakic patients at the Regional Institute of Ophthalmology, Amritsar. Pre-operative complete ophthalmic workup was done which included best corrected visual acuity using snellen's chart, IOP measurement with the use of Goldmann's applanation tonometry, slit lamp examination, pentacam for ACD measurement, examination of fundus with indirect ophthalmoscopy and optical coherence tomography for macular thickness. Informed written consent was obtained from each of the patients. Pupillary dilatation was done before the procedure.1064 nm Nd:YAG laser posterior capsulotomy was performed. Post-operative measurement of IOP, visual acuity, ACD, and macular thickness was taken, and patients were evaluated for the following follow-up period – 1 h, 1 day, 1 week, 1 month, and 3 months. The data collected was analysed using suitable statistical tests.

Results: Visual acuity gradually improved, with 90% reaching 6/9–6/6 by 3 months after YAG laser capsulotomy. No statistically significant changes in IOP were found post-treatment. There was a statistically significant reduction in ACD However, there was no significant change in macular thickness after the procedure.

Conclusion: Nd:YAG laser posterior capsulotomy leads to a statistically significant improvement in visual acuity and no changes in IOP. The procedure results in a decrease in ACD but does not significantly affect macular thickness.

Key words: Cataract, Neodymium yttrium aluminium garnet laser capsulotomy, Posterior capsular opacification

INTRODUCTION

Cataract is the commonest cause of blindness. Cataract surgery is one of the most common procedures performed worldwide. Posterior capsular opacification (PCO) is one of the most common complications following cataract surgery. It is also known as secondary cataract or after cataract. PCO occurs due to migration, proliferation, collagen deposition, and differentiation of lens epithelial cells.

The appearance of PCO differs from months to years after cataract surgery, in adults. The incidence of opacification decreases with age. There is a 100% incidence of opacification in the younger age group within 2 years post-cataract surgery.[1] It is one of the most common causes

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of diminution of vision after cataract surgery. PCO can present as diminished visual acuity, contrast sensitivity reduction, diplopia, and complaints of glare.

Visual improvement post Neodymium yttrium aluminium garnet (Nd:YAG) laser posterior capsulotomy is well documented in patients having PCO.[2-4] There are other important outcomes like improvement in contrast sensitivity and glare for many patients.[5-7]

Nd:YAG laser (1064 nm) posterior capsulotomy is a non-invasive, effective technique, and it creates a relatively safe opening in the opacified posterior capsule; hence, it is an excellent treatment modality for the management of PCO.

The aim of the present study is to investigate the effects of Nd:YAG laser posterior capsulotomy on visual acuity, intraocular pressure (IOP), anterior chamber depth (ACD), and macular thickness.

MATERIALS AND METHODS

This prospective study was conducted on 80 patients with PCO following cataract surgery. All these patients were selected from the OPD of the Regional Institute of Ophthalmology, Government Medical College, Amritsar, over a period of 1 year. The permission for conducting the study was taken from the Thesis Committee and the Institutional Ethics Committee of Government Medical College, Amritsar. The demographic data of each patient, including age, sex, address, and occupation, was recorded. Written informed consent was obtained from the patient before recruitment.

Patient Selection Criteria: Inclusion Criteria

- Patient has a decrease in best-corrected visual acuity (BCVA) of two or more lines.
- Age more than 18 years.
- Only those cases that had undergone uncomplicated small incision cataract surgery or phacoemulsification with posterior chamber intraocular lens (PCIOL) implantation.

Exclusion Criteria

- Uncooperative patient, compromising fixation required for the procedure.
- Patients <18 years
- Dislocated intraocular lens (IOL).
- Patients who underwent combined procedures (such as trabecullectomy with PCIOL).
- PCO is associated with ocular diseases and complications such as degenerations of the retina, glaucoma, complicated cataract, traumatic cataract, and patients with significant media opacities.

Methodology

All patients requiring ND: YAG laser posterior capsulotomy were analyzed. Data regarding the age and sex of the patient, cataract surgery date, IOL presence and its type, current ocular treatment, and any systemic medications were collected.

Complete ophthalmic workup was done which included: Best-corrected visual acuity (BCVA) with glasses using snellen's chart, IOP measurement with the use of applanation tonometry, anterior segment examination with oblique illumination and then examination using slit lamp (for ACD), pentacam (for ACD measurement), examination of fundus with indirect ophthalmoscopy, optical coherence tomography for macular thickness.

Pupillary dilatation was done before the procedure. ND: YAG laser posterior capsulotomy was performed. Non-steroidal anti-inflammatory drugs eye drops were prescribed for all the patients for 1 week after the capsulotomy. Post-laser follow-up was done after 1 h, 1 day, 1 week, 1 month, and 3 months.

During the follow-up period – BCVA, IOP, ACD, fundus examination with indirect ophthalmoscopy, macular thickness, and any complications after the procedure.

Statistical Analysis

The data were documented, tabulated, and analyzed using appropriate statistical methods, wherever applicable.

RESULTS

The majority of patients were aged between 61 and 70 years group (35%). The mean age was 62.25 years, showing a concentration in older adults. Females made up a larger proportion (57.5%) compared to males (42.5%). A higher number of cases were from urban areas (62.5%) than rural ones (37.5%). Most patients were illiterate (62.5%). The right eye was affected more frequently (55%) than the left eye (45%).

Nearly 44% cases had visual acuity between 6/60 and 6/24, and 43% cases had visual acuity between 6/18 and 6/12 prior to laser capsulotomy.

Visual acuity gradually improved, with 90% reaching 6/9–6/6 by 3 months after YAG laser capsulotomy. No patients remained in the <6/60 or 6/60–6/24 ranges after 1 month. Statistically significant improvements were recorded at 1 h, 1 day, 1 week, 1 month, and 3 months post-treatment, with *P*-values ranging from 0.0001 to 0.034.

Most patients remained within the 9–15 mmHg IOP range throughout the follow-up period. No statistically

significant changes in IOP were found post-treatment. In our study, after laser capsulotomy, IOP elevation more than 21 mmHg was seen in four patients at 1 h and 1 day, and all these four patients were prescribed antiglaucoma eye drops (brimonidine 0.1%).The IOP elevation returned to normal limits at 1 month and 3 months follow-up periods.

ACD decreased progressively after 1 week, with significant reductions noted at 1 week, 1 month, and 3 months ($P < 0.05$). Mean ACD dropped from 3.85 mm to 3.33 mm over 3 months.

No notable changes in CMT were observed over time; the distribution remained consistent across all follow-up periods.

Table 1 showing distribution of cases in accordance with visual acuity during follow-up periods of 1hr,1 day, 1 week,1 month and 3 months. Table 2 showing distribution of cases in accordance with anterior chamber depth before laser capsulotomy and during follow up periods.

DISCUSSION

The pre-laser visual acuity distribution in our study reveals that 13.75% of patients had a visual acuity worse than 6/60, which indicates severe visual impairment, whereas 43.75% had visual acuity between 6/60 and 6/24, indicating moderate visual impairment, and 42.5% had visual acuity between 6/18 and 6/12, suggesting mild visual impairment.

The post-laser visual acuity outcomes in this study show a significant improvement in patients' vision over time, with a rapid recovery observed within the 1st month following treatment. At 1 h post-procedure, only 2.5% of patients achieved a visual acuity of 6/9–6/6, while a majority (43.75%) had acuity between 6/60 and 6/24, indicating that the visual improvement was still in the early stages. By 1 day, there was some improvement, with 28.75% achieving 6/9–6/6 acuity, demonstrating an early response to the laser treatment. This rapid initial improvement continued at 1 week, with 28.75% of patients attaining the best visual acuity range (6/9–6/6).

By 1 month, an overwhelming 91.25% of patients achieved 6/9–6/6 visual acuity, and at 3 months, 90% of patients maintained the same optimal visual outcome. Importantly, no patients remained in the lower acuity categories (<6/60), signifying the effectiveness of the laser treatment and its ability to rapidly restore vision in the majority of cases.

The results of our study are consistent with the similar studies conducted at BRD Medical College, Gorakhpur, Uttar Pradesh, in which 256 eyes with PCO were examined. 87.3% had visual acuity of 6/12–6/6, 7.6% had visual acuity of 6/36–6/18 and 5.1% had visual acuity of <6/60 after YAG laser capsulotomy.[8]

Another prospective study was conducted on 100 patients who developed PCO after extracapsular cataract extraction, in the Department of Ophthalmology, Government Medical College, Jammu. The BCVA of 6/6 was achieved in 41 (41%) patients, whereas 6/12–6/9 in 42 (42%) patients on day 7th following Nd-YAG laser capsulotomy. These results were consistent with our study.[9]

The results of our study reveal that the majority of eyes remain within the IOP range of 9–15 mmHg both before and after treatment. The counts for this category are 42 (52.5%) pre-treatment, 40 (50%) at 1 h, 38(47.5%) at 24 h, 41(51.3%) at 1 week, and 45 (56.3%) at both 1 and 3 months post-treatment.

For eyes in the 16–20 mmHg IOP range, there is a slight increase in numbers post-treatment: From 33 (41.2%) pre-treatment to 36 (45%) at 1 h, 38 (47.5%) at 24 h, 36 (45%) at 1 week, and 35 (43.7%) at both 1 and 3 months post-treatment. Notably, eyes exceeding 21 mmHg IOP decreased from counts 5 (6.3%) pre-treatment to 4 (5%) at 1 h and 24 h, 3(3.7%) at 1 week, and none at 1 and 3 months post-treatment. The *P*-values associated with these comparisons indicate that the differences between pre-laser and post-laser IOP measurements are not statistically significant. This suggests that laser treatment does not induce significant changes in IOP over the observed period.

In a 2017 study by Patel *et al.*, changes in IOP following Nd:YAG laser capsulotomy were assessed in 100 eyes with significant PCO. It was found that 36% of patients experienced no change in IOP, while 64% had an increase in IOP. Most of these patients returned to their baseline IOP within 1 day, with only 7% showing a higher IOP on day 1 compared to their pre-laser values. These findings were consistent with the results observed in our study.[10]

The baseline ACD was 3.85 ± 0.55 mm, with minimal change observed at 1 h (3.85 ± 0.54 mm) and 1 day (3.80 ± 0.55 mm) post-laser treatment, both of which had $P = 0.625$ and 0.425, respectively, indicating no statistically significant change. However, starting from 1 week post-treatment, a progressive decline in ACD was observed: 3.47 ± 0.52 mm at 1 week, 3.34 ± 0.46 mm at 1 month, and 3.33 ± 0.47 mm at 3 months. These reductions were statistically significant with $P = 0.025$, 0.012, and 0.045, respectively, suggesting that the laser treatment resulted in a significant decrease in ACD over time. A study conducted at Imam Khomeini Hospital, Ahvaz, 50 patients with PCO were

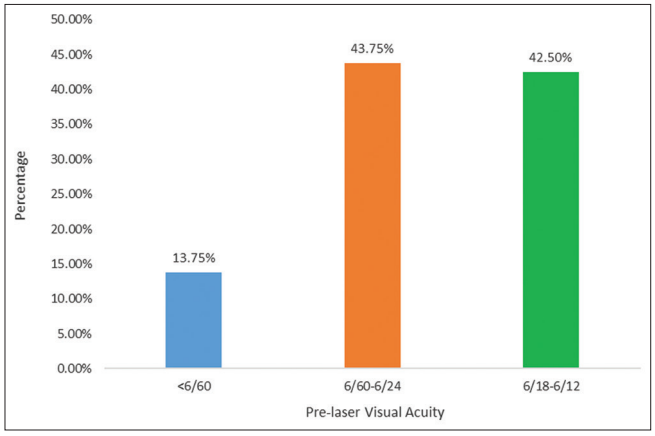
Table 1: Post-laser visual acuity

Visual acuity	1 h		1 day		1 week		1 month		3 months	
	No. of cases	% Age	No. of cases	% Age	No. of cases	% Age	No. of cases	% Age	No. of cases	% Age
<6/60	11	13.75	5	6.25	5	6.25	0	0.00	0	0.00
6/60–6/24	35	43.75	20	25.00	20	25.00	0	0.00	0	0.00
6/18–6/12	32	40.00	32	40.00	32	40.00	7	8.75	8	10.00
6/9–6/6	2	2.50	23	28.75	23	28.75	73	91.25	72	90.00
Total	80	100.00	80	100.00	80	100.00	80	100.00	80	100.00

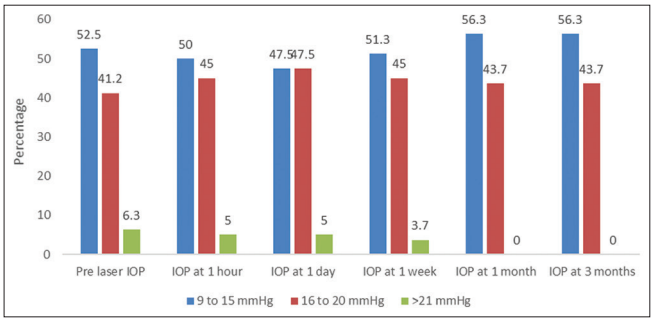
Table 2: Distribution of anterior chamber depth

ACD (in mm)	Pre-laser ACD		ACD at 1 h		ACD at 1 day		ACD at 1 week		ACD at 1 month		ACD at 3 months	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
2.0–3.5 mm	24	30.0	24	30.0	29	36.3	44	55.0	57	71.3	54	67.5
3.5–4.0 mm	21	26.3	21	26.3	20	25.0	29	36.3	18	22.5	23	28.8
>4.0 mm	35	43.7	35	43.7	31	38.7	7	8.7	5	6.2	3	3.7
Total	80	100.0	80	100.0	80	100.0	80	100.0	80	100.0	80	100.0

ACD: Anterior chamber depth



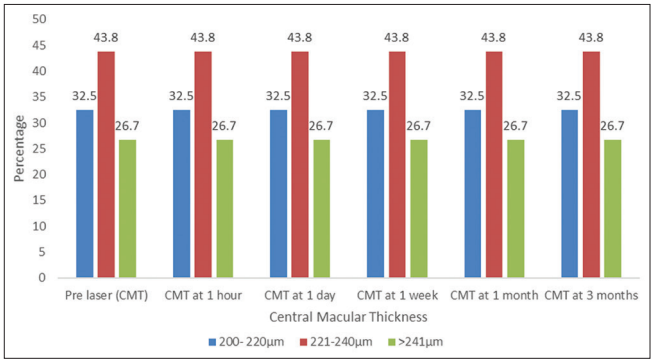
Graph 1: Pre-laser visual acuity



Graph 2: Distribution of patients in various intraocular pressure ranges

studied. ACD decreased significantly from 4.38 to 4.04 after YAG laser capsulotomy. These results were consistent with our study.[11]

The result of our study suggest that laser capsulotomy did not cause significant alterations in central macular thickness



Graph 3: Central macular thickness

(CMT) over the post-laser periods of 1 h, 1 day, 1 week, 1 month, and 3 months. These results were consistent with a similar study conducted by Shah *et al.* in 2023 on 30 patients with PCO. After laser capsulotomy, there was no significant change in CMT.[12]

Graph 1 showing percentage distribution of cases in accordance with prelaser visual acuity. Graph 2 showing percentage distribution of cases in various intraocular pressure ranges before laser and during follow-up periods of 1 hr,1 day , 1 week ,1 month and 3 months. Graph 3 showing percentage distribution of cases in accordance with central macular thickness before laser and during follow-up periods of 1 hr, 1 day, 1 week, 1 month and 3 months

CONCLUSION

This prospective investigation substantiates the clinical efficacy and safety profile of Nd:YAG laser capsulotomy in the treatment of PCO. The procedure elicited significant

improvement in visual acuity and negligible perturbations in IOP and CMT. However, a statistically significant reduction in ACD was observed, but with no associated clinical implications.

Based on my research, the findings in my study reinforce Nd:YAG laser capsulotomy as a precise, and minimally invasive modality that offers substantial visual rehabilitation in patients with PCO.

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