e-CliniC 2024; Vol. 12, No. 3: 330-334
DOI: https://doi.org/10.35790/ecl.v12i3.58044
URL Homepage: https://ejournal.unsrat.ac.id/index.php/eclinic

Long-Term Outcomes of Cataract Surgery: Analysis of Visual Acuity and Intraocular Pressure in a Tertiary Care Center

Ade J. Nursalim,[1] Vera Sumual,[1] Andrew Chietra,[1] Ardelia Emily,[2] Richardo Rusli[2]

[1]Department of Ophthalmology, Prof. Dr. R. D. Kandou Hospital, Manado, Indonesia
[2]Specialist Program of Universitas Sam Ratulangi - Prof. Dr. R. D. Kandou Hospital, Manado, Indonesia
Email: dr.adejn@gmail.com
Received: September 17, 2024; Accepted: October 14, 2024; Published online: October 20, 2024

Abstract: Posterior capsule opacity (PCO) is a common complication following cataract surgery, caused by the proliferation of residual lens epithelial cells. This study aimed to evaluate the long-term effects of Nd:YAG laser capsulotomy on intraocular pressure (IOP) and visual acuity in PCO patients. This was a retrospective descriptive study. Samples were 24 patients diagnosed with PCO who underwent Nd:YAG laser capsulotomy at Prof. Dr. R. D. Kandou Hospital, Manado, from January 1, 2022, to January 1, 2024. The study recorded pre- and post-procedure IOP and best-corrected visual acuity (BCVA) data. Descriptive analysis, including paired t-tests, was used to assess changes in IOP and BCVA over an average follow-up period of 19.2 months. The results showed a statistically significant improvement in BCVA (p=0.000), with mean values improving from 0.72 to 0.27 LogMAR. A significant reduction in IOP was also observed (p=0.015), with long-term IOP remaining stable. A weak correlation was found between follow-up duration and IOP variation (p=0.02). In conclusion, Nd:YAG laser capsulotomy significantly improves visual acuity and stabilizes intraocular pressure in the long term for PCO patients, suggesting its effectiveness in managing post-cataract surgery complications.
Keywords: posterior capsule opacity; Nd:YAG laser capsulotomy; intraocular pressure; visual acuity; cataract surgery

INTRODUCTION

Posterior capsular opacity (PCO) is a relatively common complication that can occur after cataract surgery. This PCO is mainly caused by the migration and proliferation of residual lens epithelial cells (LECs) that are left behind in the capsular bag after cataract surgery. [1,2] A real-world evidence study published in Eye found that the incidence of PCO ranged between 4.7-18.6% at 3 years and 7.1-22.6% at 5 years after cataract surgery,[3] or simply occur in roughly one in five eyes after cataract surgery.[4] This ailment hinders the quality of a patient's vision by causing a decrease in visual sharpness, diminished contrast perception, sensitivity to glare, and the occurrence of monocular double vision.[1] Silicone intraocular lenses (IOLs) have been implicated in the development of PCO. Additional factors thought to play a role in PCO formation encompass IOL and capsulorhexis decentration, capsule tears, and inadequate zonular support.[5]

Nd:YAG laser capsulotomy is the most common and effective treatment for PCO. This is a minimally invasive and time-efficient technique, suitable for outpatient settings, and generally well-received by patients. It is a painless, low-risk, and expeditious procedure that typically requires only a few minutes for completion.[6] However, numerous complications are associated with Nd YAG laser capsulotomy, including factors such as IOL displacement, alterations in refractive characteristics, and potential IOL damage. Furthermore, there is the propensity for conditions like iritis and uveitis to induce an elevation in intraocular pressure (IOP). The occurrence of cystoid macular edema (CME) accentuates the risk of retinal tear and retinal detachment (RD). In rare instances, additional complications may arise, including pupillary block glaucoma, aqueous misdirection syndrome, macular hole, retinal hemorrhage, endophthalmitis, and the potential for secondary closure of the capsulotomy aperture.[6]

The effect of Nd:YAG laser posterior capsulotomy on IOP is complex and depends on various factors. While some studies have reported a short-term increase in IOP after the procedure, others have found no significant effect on IOP control in the long term.[7] However, Ge et al[8] found that Nd:YAG laser capsulotomy could cause a sustained elevation of IOP that lasts for up to 3 years or more. The difference between baseline and final IOP was significantly associated with the IOP measured one hour after the capsulotomy. There were 17% of patients required initiation of or additional pressure-lowering medications after the capsulotomy. On the other hand, Mehmood et al reported that the rise in IOP after Nd:YAG laser posterior capsulotomy was statistically significant but transient.[9] Therefore, the effect of Nd:YAG laser capsulotomy on IOP is not straightforward and depends on various factors such as the patient's individual condition, the severity of PCO, and the presence of glaucoma. While some studies have reported a short-term increase in IOP after the procedure, others have found no significant effect on IOP control in the long term.

In light of these varied findings, the relationship between Nd:YAG laser capsulotomy and IOP remains a subject of ongoing investigation and debate. Given the potential for sustained IOP elevation and the associated risk of glaucomatous complications, understanding the long-term effects of this procedure on IOP is crucial for optimizing patient outcomes and safety.

METHODS

This research employed a retrospective descriptive research design. Patient data were collected from medical records available at Prof. Dr. R. D. Kandou Hospital, Manado. The study was conducted at the ophthalmology outpatient clinic of Prof. Dr. R. D. Kandou Hospital. The study participants consisted of 24 patients who visited the ophthalmology outpatient clinic with a diagnosis of PCO following cataract extraction surgery who had undergone Nd Yag capsulotomy within the period from January 1, 2022, to January 1, 2024. The IOP data collected consisted of two sets of measurements: the first set obtained at the initial Nd:YAG laser procedure, recorded as pre-operative IOP, and the last set documented in the medical records as post-operative IOP. Premedication before the procedure was tropicamide 0,5%. Each patient signed an informed consent before the procedure. Exclusion criteria for this study included patients with a history of post-cataract surgery complications other than PCO that could potentially affect the research

outcomes and patients with other ocular conditions that could lead to posterior lens capsule opacification apart from PCO.

The collected data underwent descriptive analysis employing statistical methods. To assess the significance of changes in IOP before and after Nd:YAG laser treatment, a paired t-test was conducted. Additionally, relevant variables were subject to calculations of frequency, proportion, mean, and standard deviation. The findings derived from this analysis were then visually presented through the utilization of tables. It is pertinent to note that this research adhered to established principles of medical research ethics, ensuring the confidentiality of patient data by excluding any identifying information that could potentially disclose individuals' identities. Furthermore, this study obtained ethical approval from the Ethics Committee of Prof. Dr. R. D. Kandou Hospital, Manado, bearing reference number 048/EC/KEPK-KANDOU/IV/2023.

RESULTS

There were 24 patients included in this study. Table 1 showed the demographic and clinical features data. The average age of the participants was 63.92 years (SD 6.16), with the youngest participant being 53 years old and the oldest being 76 years old. The mean follow-up period after Nd:YAG capsulotomy procedure was 19.2 months (SD 9.51), ranging from 6 to 26 months. The dataset included an equal distribution of 12 male and 12 female participants.

Regarding best-corrected visual acuity (BCVA), the mean BCVA before the procedure was 0.72 (SD 0.17), and it improved to 0.27 (SD 0.12) after the procedure. In terms of IOP, the mean IOP before the procedure was 15.83 mmHg (SD 2.37), and it decreased to 14.29 mmHg (SD 2.20) after the procedure.

Table 1. Demographic and clinical features

Case	Age (years)	Gender	Follow up (M)	BCVA pre (logmar)	BCVA post (logmar)	IOP Pre (mm Hg)	IOP Post (mm Hg)
1	66	Female	12	0,7	0,4	18	15,5
2	54	Male	24	0,8	0,3	17	19,7
3	60	Male	14	0,7	0,4	14,5	15,6
4	58	Female	12	1	0,3	16,6	15,5
5	62	Female	15	0,8	0,3	18,9	15,6
6	76	Female	24	0,7	0,1	10	13,3
7	58	Male	6	0,5	0,1	13,8	15,6
8	65	Female	17	0,6	0,1	14,5	13,2
9	60	Male	12	0,6	0,1	17,7	14,8
10	72	Male	28	0,7	0,3	18,4	13,2
11	66	Male	36	0,8	0,3	12,1	10,7
12	68	Female	36	0,7	0,4	13,1	11
13	67	Male	18	1	0,4	16,9	14,9
14	59	Female	6	0,5	0,3	14,7	16,6
15	55	Female	12	0,7	0,3	15,2	11,9
16	53	Male	12	0,4	0,1	16,8	12,4
17	64	Female	18	0,4	0,1	17,8	15,7
18	62	Male	24	0,7	0,3	13,4	16,7
19	70	Male	15	0,6	0,3	15,5	11,2
20	66	Female	12	0,8	0,3	16,5	12,4
21	75	Female	12	0,7	0,4	15,5	15
22	69	Female	36	1	0,4	17,7	16,6
23	63	Male	24	0,8	0,1	20,4	12
24	66	Male	36	1	0,3	14,9	13,9

Table 2 showed that the difference between BCVA before and after the Nd:YAG laser procedure was statistically significant (p=0.000). Similarly, the difference in IOP before and after the Nd:YAG laser procedure was also statistically significant (p=0.015). Moreover, a weak correlation has been identified using the Pearson correlation test between the duration of the follow-up and the variation in IOP (p=0.02).

Table 2. Correlation and difference

Test and variables	Mean	SD	Significance
Paired sample test			
BCVA Pre Nd:YAG - BCVA Post Nd:YAG	0.45	0.15	.000
IOP Pre Nd:YAG - IOP Post Nd:YAG	15.375	28.684	.015
Correlation			
Follow up - IOP difference			0,02

DISCUSSION

Our findings indicate that the average age at which individuals underwent Nd:YAG laser capsulotomy was 63.92 years old. Cataracts are commonly associated with the aging process, and advanced stages of cataracts were observed in approximately one-third of subjects between the ages of 60 and 69, and in two-thirds of subjects aged 70 or older. [10] The primary etiology of cataracts is the progressive deterioration of proteins within the ocular lens.[11]Additionally, certain genetic and environmental factors can elevate the susceptibility to cataract development or lead to their occurrence at an earlier age compared to others.[12] Based on the collected, it can be inferred that individuals who had undergone prior cataract surgery followed by Nd:YAG laser treatment likely exhibit senile cataracts.

One of the most notable findings in this research is the follow-up duration, which had a mean of 19.2 months (SD 9.51), ranging from 6 to 26 months. This duration represents the period from the initial treatment of patients with Nd Yag laser capsulotomy to the last recorded measurement of IOP.[13] This particular finding serves as the basis for the title of this paper, suggesting that long-term IOP remains relatively stable. Intraocular pressure increased for a short time after Nd Yag procedure.[9] However, in our specific case, it is important to note that the mean IOP was lower after Nd Yag laser treatment compared to the pre-treatment measurements.

An increase in IOP following Nd: YAG laser capsulotomy can affect up to 30% of all patients undergoing this procedure. Various factors have been proposed to account for this rise in IOP, including the build-up of debris in the trabecular meshwork, pupillary block, and inflammation-induced swelling of the ciliary body or iris root, which can lead to angle closure. Moreover, research has indicated a correlation between pulse energy levels and IOP elevation, with higher pulse energies, particularly those exceeding 1.5 mJ, associated with increased IOP. Notably, smaller capsulotomies carry a lower risk of IOP elevation when compared to larger ones.[6]

The long-term stability and reduction in IOP observed in our study are contrast with some earlier reports. While previous studies reported a transient increase in IOP immediately following Nd: YAG laser capsulotomy,[14] our findings show a more sustained decrease in IOP over an extended follow-up period. This discrepancy may be due to differences in patient populations, laser energy settings, and capsulotomy sizes.[15,16] Moreover, the long-term IOP reduction observed in our study suggests that Nd: YAG laser capsulotomy can potentially facilitate improved aqueous outflow by relieving capsular blockage, thereby enhancing IOP control over time.[17]

The preeminent focus of this study also lies in the evaluation of BCVA. A notable discrepancy is evident when comparing BCVA measurements before and after the Nd: YAG laser capsulotomy procedure. The Nd: YAG laser capsulotomy, a non-surgical outpatient treatment for PCO, results in a significant improvement in BCVA. Moreover, this therapeutic approach has a minimal impact on

refractive errors and IOP. It is characterized by its simplicity, swiftness, and a generally high level of safety.[18]

The findings of this study demonstrate a statistically significant enhancement in BCVA and a long-term decrease in IOP following Nd: YAG laser capsulotomy in patients diagnosed with PCO. These outcomes are consistent with prior research, which has similarly reported improvements in visual acuity and reductions in IOP after Nd: laser posterior capsulotomy.[19,20] Specifically, a study by Moshirfar et al[21] found that Nd laser therapy effectively managed PCO and led to significant improvements in visual acuity. Additionally, another study evaluated changes in contrast sensitivity and glare disability, alongside visual acuity, following Nd: YAG laser posterior capsulotomy, and demonstrated improvements in these visual parameters.[21]

CONCLUSION

Nd:YAG laser capsulotomy effectively enhances visual acuity and maintains stable intraocular pressure (IOP) in the long term for patients with posterior capsule opacification (PCO), confirming its role as a reliable intervention for managing post-cataract surgery complications.

Conflict of Interest

The authors confirm no conflict of interest in this study.

REFERENCES

1. Konopińska J, Młynarczyk M, Dmuchowska DA, Obuchowska I. Posterior capsule opacification: a review of experimental studies. J Clin Med. 2021;10(13):2847. Doi: 10.3390/jcm10132847
2. Raj SM, Vasavada AR, Johar SR, Vasavada VA, Vasavada VA. Post-operative capsular opacification: a review. Int J Biomed Sci. 2007;3(4):237-50. Available from: https://pubmed.ncbi.nlm.nih.gov/23675049/
3. Ursell PG, Dhariwal M, O'Boyle D, Khan J, Venerus A. 5 year incidence of YAG capsulotomy and PCO after cataract surgery with single-piece monofocal intraocular lenses: a real-world evidence study of 20,763 eyes. Eye. 2020;34(5):960-8. Doi: 10.1038/s41433-019-0630-9
4. Bhangra JS. A review of posterior capsular opacification. CRO (Clinical & Refractive Optometry) Journal. 2023. Doi: https://doi.org/10.57204/001c.82056
5. Georgalas I, Petrou P, Kalantzis G, Papaconstantinou D, Koutsandrea C, Ladas I. Nd: YAG capsulotomy for posterior capsule opacification after combined clear corneal phacoemulsification and vitrectomy. Ther Clin Risk Manag. 2009;5(1):133-71. Doi: 10.2147/tcrm.s4754
6. Karahan E, Er D, Kaynak S. An Overview of Nd:YAG Laser Capsulotomy. Med Hypothesis Discov Innov Ophthalmol. 2014;3(2):45-50.
7. Parajuli A, Joshi P, Subedi P, Pradhan C. Effect of Nd: YAG laser posterior capsulotomy on intraocular pressure, refraction, anterior chamber depth, and macular thickness. Clinical Ophthalmology. 2019;13:945-52. Doi: 10.2147/OPTH.S203677
8. Ge J, Wand M, Chiang R, Paranhos A, Shields MB. Long-term effect of Nd: YAG laser posterior capsulotomy on intraocular pressure. Arch Ophthalmol. 2000;118(10):1334-7. Doi: 10.1001/archopht.118.10.1334
9. Mehmood F, Mazhar SA, Farooq N, Zahid S, Masood H, Iqbal N. Effect of Nd: YAG Laser Posterior Capsulotomy on Intraocular Pressure. Pakistan Journal of Medical & Health. 2022;16(1):109-10. Doi: https://doi.org/10.53350/pjmhs22161109
10. Prokofyeva E, Wegener A, Zrenner E. Cataract prevalence and prevention in Europe: a literature review. Acta Ophthalmologica. 2013;91(5):395-405. Doi: https://doi.org/10.1111/j.1755-3768.2012.02444.x
11.Truscott RJ, Friedrich MG. The etiology of human age-related cataract. Proteins don't last forever. Biochim Biophys Acta. 2016;1860(1PtB):192-8. Doi: 10.1016/j.bbagen.2015.08.016
12. Bell SJ, Oluonye N, Harding P, Moosajee M. Congenital cataract: a guide to genetic and clinical management. Therapeutic Advances in Rare Disease. 2020;1:2633004020938061. Doi: 10.1177/2633004020938061
13. Ge J, Wand M, Chiang R, Paranhos A, Shields MB. Long-term effect of Nd:YAG laser posterior capsulotomy on intraocular pressure. Arch Ophthalmol. 2000;118(10):1334-7. Doi: https://doi.org/10.1001/archopht.118.10.1334
14. Kaur P, Gusain P, Mohan C, Bedi J. Effect of Nd: YAG laser capsulotomy on IOP rise and its variation with energy used. Ind J Clin Exp Ophthalmol. 2018;4(3):396-400. Doi: 10.18231/2395-1451.2018.0086
15. Ota A, Ota I, Kachi S, Miyake G, Haga F, Miyake K, et al. Factors associated with reclosure of posterior capsule aperture by flat opacifications with pearls after Nd:YAG laser posterior capsulotomy. Diseases.

2023;11(2):82. Doi: 10.3390/diseases11020082
16. Teshigawara T, Akaishi M, Mizuki Y, Takeuchi M, Hata S, Meguro A, et al. Modified technique of setting capsulotomy thickness in reducing capsulotomy-related complications during femtosecond laser-assisted cataract surgery: a prospective, comparative cohort study. Ophthalmology and Therapy. 2023;12(5):2621-30. Doi: https://doi.org/10.1007/s40123-023-00770-5
17. Jain S, Chandravanshi SL, Jain G, Tirkey E, Jain SC. Effect of ND: YAG laser capsulotomy in pseudophakic eyes with special reference to IOP changes. Journal of Evolution of Medical and Dental Sciences. 2014;3(55):12627-35. Doi: 10.14260/jemds/2014/3672
18. El Kady I, Eliwa E-SM, Ibrahim M. Refraction and intraocular pressure changes after YAG laser posterior capsulotomy in posterior capsular opacification. Al-Azhar International Medical Journal. 2022;3(5):75-82. Doi: https://doi.org/10.21608/aimj.2022.113898.1769
19. Shrivastava A, Singh K. The impact of cataract surgery on glaucoma care. Curr Opin Ophthalmol. 2014;25(1):19-25. Doi: 10.1097/icu.0000000000000010.
20. Magno BV, Datiles MB, Lasa MSM, Fajardo MRQ, Caruso RC, Kaiser-Kupfer MI. Evaluation of visual function following Neodymium:YAG laser posterior capsulotomy. Ophthalmology. 1997;104(8):1287-93. Doi: https://doi.org/10.1016/S0161-6420(97)30146-8
21. Moshirfar M, Basharat NF, Seitz TS, Peterson CM, Stapley SR, Ziari M, et al. Refractive changes after Nd: YAG capsulotomy in pseudophakic eyes. Clin Ophthalmol. 2023;17:135-43. Doi: 10.2147/OPTH.S395605