



## Complications of Nd: YAG Laser Capsulotomy Following Cataract Surgery

Tataheer Zehra<sup>1</sup>, Sadia Bukhari<sup>2</sup>, Muhammad Bilal<sup>3</sup>

<sup>1,3</sup>Department of Ophthalmology, Al Ibrahim Eye Hospital,

<sup>2</sup>Department of Paediatrics, Al Ibrahim Eye Hospital / Isra Postgraduate Institute of Ophthalmology,

### ARTICLE INFO

**Keywords:** Nd:YAG laser, Posterior capsule opacification, Cataract surgery, Intraocular pressure, Capsulotomy, Complications

**Correspondence to:** Tataheer Zehra, Resident Ophthalmologist, Al I Rahim Eye Hospital.  
Email: [tataheerzehra223@gmail.com](mailto:tataheerzehra223@gmail.com)

### Declaration

**Authors' Contribution:** All authors equally contributed to the study and approved the final manuscript.

**Conflict of Interest:** No conflict of interest.

**Funding:** No funding received by the authors.

### Article History

Received: 01-02-2025 Revised: 16-04-2025  
Accepted: 23-04-2025 Published: 30-04-2025

### ABSTRACT

**Background:** Posterior capsule opacification (PCO) is the most common delayed complication following cataract surgery. Nd:YAG laser capsulotomy is the standard treatment for PCO; however, it is associated with various complications that may affect visual outcomes. **Objective:** To evaluate the frequency and pattern of complications following Nd:YAG laser capsulotomy and to identify associated risk factors. **Methodology:** This hospital-based analytical cross-sectional study was conducted at Al Ibrahim eye hospital from May 2024 to November 2024, including 196 patients who underwent Nd:YAG laser capsulotomy after cataract surgery. **Results:** The mean age of patients was  $58.6 \pm 9.8$  years. Complications were observed in 31.6% of patients. The most common complication was raised intraocular pressure (17.3%), followed by intraocular lens pitting (11.2%) and anterior uveitis (9.2%). Cystoid macular edema and retinal detachment occurred in 5.1% and 2.0% of patients, respectively. Patients with complications were older ( $61.2 \pm 8.7$  vs  $57.4 \pm 10.2$  years,  $p = 0.01$ ) and had a longer duration since surgery ( $20.1 \pm 5.8$  vs  $17.6 \pm 6.3$  months,  $p = 0.02$ ). Higher laser energy ( $72.4 \pm 16.8$  vs  $58.0 \pm 17.2$  mJ,  $p < 0.001$ ), greater number of shots ( $29.2 \pm 7.4$  vs  $22.5 \pm 8.0$ ,  $p < 0.001$ ), and larger capsulotomy size were significantly associated with complications. Multivariable analysis identified age  $\geq 60$  years, duration  $\geq 18$  months, total energy  $\geq 60$  mJ, number of shots  $\geq 25$ , and large capsulotomy size as significant predictors. **Conclusion:** Nd:YAG laser capsulotomy is an effective procedure but is associated with a notable rate of complications, predominantly transient and manageable. Procedural factors, particularly laser energy and technique, play a key role in complication risk. Careful patient selection and optimization of laser parameters are essential to minimize adverse outcomes.

### INTRODUCTION

Cataract remains one of the leading causes of reversible blindness worldwide, and cataract extraction with intraocular lens (IOL) implantation is among the most commonly performed surgical procedures in ophthalmology [1]. Despite significant advancements in surgical techniques such as phacoemulsification, posterior capsule opacification (PCO) continues to be the most frequent long-term complication following cataract surgery [2]. PCO occurs due to proliferation, migration, and transformation of residual lens epithelial cells on the posterior capsule, resulting in decreased visual acuity, glare, and reduced contrast sensitivity [3]. Nd:YAG (neodymium-doped yttrium aluminum garnet) laser posterior capsulotomy is the standard and most widely accepted treatment for PCO [4]. This non-invasive outpatient procedure involves creating an opening in the opacified posterior capsule, thereby restoring the visual axis and improving visual function [5]. It is favored due to

its simplicity, rapid execution, and immediate visual recovery, making it an essential component of postoperative cataract care [6]. Although Nd:YAG capsulotomy is generally considered safe and effective, it is associated with a range of complications that may impact visual outcomes. One of the most common early complications is transient elevation of intraocular pressure (IOP), which typically occurs within hours after the procedure and may require medical management [7]. Intraocular lens (IOL) pitting is another recognized complication, often resulting from inadvertent laser application on the lens surface [8].

Additional complications include anterior uveitis, cystoid macular edema (CME), and damage to adjacent intraocular structures [9]. CME is particularly significant as it can lead to prolonged visual impairment if not promptly treated. Retinal detachment, although relatively rare, is a serious complication that can result in permanent vision loss, especially in patients with predisposing factors such as

high myopia or prior retinal pathology [10]. The incidence and severity of these complications may vary depending on several factors, including patient characteristics, duration since cataract surgery, laser energy used, capsulotomy size, and operator technique [11]. Studies have suggested that higher laser energy levels and larger capsulotomy sizes may increase the risk of complications [12]. Therefore, optimizing procedural parameters and careful patient selection are crucial in minimizing adverse outcomes. Previous research has demonstrated variability in complication rates across different populations and clinical settings, indicating the influence of demographic and clinical factors [13]. Although advancements in laser technology have contributed to improved safety profiles, complications still remain a concern in routine clinical practice [14]. Continuous evaluation of these outcomes is necessary to enhance safety and improve patient care.

### Objective

To evaluate the frequency and pattern of complications following Nd:YAG laser capsulotomy and to identify associated risk factors.

### METHODOLOGY

This was a hospital-based analytical cross-sectional study conducted at Al Ibrahim eye hospital from May 2024 to November 2024, including 196 patients who underwent Nd:YAG laser posterior capsulotomy following cataract surgery. The study was designed to evaluate the frequency and pattern of complications associated with Nd:YAG capsulotomy.

### Inclusion Criteria

- Patients aged  $\geq 18$  years who had previously undergone uncomplicated cataract surgery with intraocular lens (IOL) implantation
- Patients diagnosed with posterior capsule opacification (PCO) requiring Nd:YAG laser capsulotomy
- Patients with complete pre- and post-procedure clinical records
- Patients willing to participate and comply with follow-up

### Exclusion Criteria

- Patients with pre-existing glaucoma or uncontrolled intraocular pressure
- Patients with history of retinal detachment or significant retinal pathology
- Patients with active ocular inflammation or infection
- Patients with previous intraocular surgeries other than cataract extraction
- Patients with incomplete data or lost to follow-up

### Data Collection

After obtaining informed consent, demographic data including age, gender, and time since cataract surgery were recorded. Baseline ophthalmic evaluation was performed, including visual acuity assessment, slit-lamp examination, and intraocular pressure (IOP) measurement. Nd:YAG laser capsulotomy was performed using standard technique. Parameters such as total laser energy used, number of laser shots, and size of

capsulotomy were recorded. Patients were evaluated post-procedure at defined intervals for the development of complications. Complications assessed included rise in intraocular pressure, intraocular lens (IOL) pitting, anterior uveitis, cystoid macular edema (CME), and retinal detachment. Visual acuity changes before and after the procedure were also documented.

### Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Continuous variables were expressed as mean  $\pm$  standard deviation, while categorical variables were presented as frequency and percentage. Normality of quantitative variables was assessed using the Shapiro-Wilk test. Comparisons of pre- and post-procedure values were performed using paired t-test for normally distributed data. Associations between categorical variables were analyzed using chi-square test. Logistic regression analysis was performed to identify predictors of complications, and adjusted odds ratios (AOR) with 95% confidence intervals were reported. A p-value  $< 0.05$  was considered statistically significant.

### RESULTS

A total of 196 patients were included with a mean age of  $58.6 \pm 9.8$  years. Patients who developed complications were significantly older ( $61.2 \pm 8.7$  vs  $57.4 \pm 10.2$  years,  $p=0.01$ ), with a higher proportion aged  $\geq 60$  years (64.5% vs 43.3%,  $p = 0.006$ ). Males constituted 57.1% of the cohort, with no significant difference between groups (61.3% vs 55.2%,  $p = 0.43$ ). The mean duration since cataract surgery was  $18.4 \pm 6.2$  months, which was longer in patients with complications ( $20.1 \pm 5.8$  vs  $17.6 \pm 6.3$  months,  $p = 0.02$ ). Patients with  $\geq 18$  months duration showed a higher complication rate (64.5% vs 47.8%,  $p=0.03$ ).

**Table 1**

*Baseline Demographic and Clinical Characteristics*

Variable	Category	Total (n=196)	With Complications (n=62)	Without Complications (n=134)	p-value
Age (years)	Mean $\pm$ SD	58.6 $\pm$ 9.8	61.2 $\pm$ 8.7	57.4 $\pm$ 10.2	0.01 (Independent t-test)
Age Group	<60 years	98 (50.0%)	22 (35.5%)	76 (56.7%)	0.006 (Chi-square)
	$\geq 60$ years	98 (50.0%)	40 (64.5%)	58 (43.3%)	0.006 (Chi-square)
Gender	Male	112 (57.1%)	38 (61.3%)	74 (55.2%)	0.43 (Chi-square)
	Female	84 (42.9%)	24 (38.7%)	60 (44.8%)	0.43 (Chi-square)
Time Since Surgery	Mean $\pm$ SD (months)	18.4 $\pm$ 6.2	20.1 $\pm$ 5.8	17.6 $\pm$ 6.3	0.02 (Independent t-test)
Duration Group	<18 months	92 (46.9%)	22 (35.5%)	70 (52.2%)	0.03 (Chi-square)
	$\geq 18$ months	104 (53.1%)	40 (64.5%)	64 (47.8%)	0.03 (Chi-square)

Procedural parameters differed significantly between groups. The mean total laser energy used was  $62.5 \pm 18.6$

mJ, which was significantly higher in patients with complications ( $72.4 \pm 16.8$  vs  $58.0 \pm 17.2$  mJ,  $p < 0.001$ ). A greater proportion of patients with complications received  $\geq 60$  mJ energy (74.2% vs 46.3%,  $p < 0.001$ ). The mean number of laser shots was also higher in the complication group ( $29.2 \pm 7.4$  vs  $22.5 \pm 8.0$ ,  $p < 0.001$ ). Large capsulotomy size was more frequently associated with complications (71.0% vs 50.7%,  $p = 0.01$ ), indicating a significant relationship between procedural intensity and adverse outcomes.

**Table 2***Procedural Parameters of Nd:YAG Capsulotomy*

Variable	Category	Total (n=196)	Complications With	Complications Without	p-value
Total Energy Used (mJ)	Mean $\pm$ SD	62.5 $\pm$ 18.6	72.4 $\pm$ 16.8	58.0 $\pm$ 17.2	<0.001 (Independent t-test)
	<60 mJ	88 (44.9%)	16 (25.8%)	72 (53.7%)	<0.001 (Chi-square)
Energy Group	$\geq 60$ mJ	108 (55.1%)	46 (74.2%)	62 (46.3%)	<0.001 (Chi-square)
	Mean $\pm$ SD	24.6 $\pm$ 8.2	29.2 $\pm$ 7.4	22.5 $\pm$ 8.0	<0.001 (Independent t-test)
Number of Shots	Small	84 (42.9%)	18 (29.0%)	66 (49.3%)	0.01 (Chi-square)
	Large	112 (57.1%)	44 (71.0%)	68 (50.7%)	0.01 (Chi-square)

Overall, complications were observed in 31.6% of patients (62 out of 196). The most common complication was raised intraocular pressure, occurring in 17.3% of patients, followed by intraocular lens (IOL) pitting in 11.2% and anterior uveitis in 9.2%. Cystoid macular edema was observed in 5.1% of cases, while retinal detachment was the least frequent complication, occurring in only 2.0% of patients. The majority of patients (68.4%) did not develop any complications, indicating that the procedure remains relatively safe overall.

**Table 3***Frequency of Post-Procedural Complications*

Variable	Category	Total (n=196)	Percentage (%)
Any Complication	Yes	62	31.6%
	No	134	68.4%
Raised IOP	Yes	34	17.3%
	No	162	82.7%
IOL Pitting	Yes	22	11.2%
	No	174	88.8%
Anterior Uveitis	Yes	18	9.2%
	No	178	90.8%
Cystoid Macular Edema	Yes	10	5.1%
	No	186	94.9%
Retinal Detachment	Yes	4	2.0%
	No	192	98.0%

Multivariable analysis identified several significant predictors of complications. Patients aged  $\geq 60$  years had nearly twice the risk of complications (AOR 1.94, 95% CI: 1.08–3.52,  $p = 0.02$ ). Longer duration since cataract surgery  $\geq 18$  months was also associated with increased risk (AOR 1.76,  $p = 0.04$ ). Procedural factors showed stronger associations, with total energy  $\geq 60$  mJ significantly increasing the risk (AOR 2.68,  $p < 0.001$ ), along with number of shots  $\geq 25$  (AOR 2.14,  $p = 0.01$ ) and

large capsulotomy size (AOR 1.89,  $p = 0.03$ ). Gender was not a significant predictor ( $p = 0.39$ ).

**Table 4***Predictors of Complications (Multivariable Logistic Regression)*

Variable	Category	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Age $\geq 60$ years	Yes vs No	1.94	1.08 – 3.52	0.02
Male Gender	Yes vs No	1.22	0.68 – 2.11	0.39
Time Since Surgery $\geq 18$ months	Yes vs No	1.76	1.01 – 3.04	0.04
Total Energy $\geq 60$ mJ	Yes vs No	2.68	1.45 – 4.96	<0.001
Number of Shots $\geq 25$	Yes vs No	2.14	1.18 – 3.87	0.01
Large Capsulotomy	Yes vs No	1.89	1.05 – 3.41	0.03

## DISCUSSION

This study evaluated the frequency and predictors of complications following Nd:YAG laser capsulotomy and demonstrated that although the procedure is generally safe, a considerable proportion of patients (31.6%) experienced post-procedural complications. The mean age of patients was  $58.6 \pm 9.8$  years, with those developing complications being significantly older ( $61.2 \pm 8.7$  vs  $57.4 \pm 10.2$  years,  $p = 0.01$ ). A higher proportion of patients aged  $\geq 60$  years developed complications (64.5% vs 43.3%,  $p = 0.006$ ), which is consistent with previous research reporting increased susceptibility to complications in older patients due to age-related ocular changes and reduced tissue resilience [15]. The duration since cataract surgery also showed a significant association with complications, with affected patients having a longer interval ( $20.1 \pm 5.8$  vs  $17.6 \pm 6.3$  months,  $p = 0.02$ ), and a higher proportion with  $\geq 18$  months duration (64.5% vs 47.8%,  $p = 0.03$ ). This finding aligns with previous research suggesting that delayed capsulotomy may be associated with denser posterior capsule opacification and higher energy requirements, thereby increasing the risk of complications [16]. Procedural parameters played a major role in the development of complications. The mean laser energy used was significantly higher in patients with complications ( $72.4 \pm 16.8$  vs  $58.0 \pm 17.2$  mJ,  $p < 0.001$ ), and a greater proportion of these patients received  $\geq 60$  mJ energy (74.2% vs 46.3%,  $p < 0.001$ ). Similarly, the number of laser shots was higher in the complication group ( $29.2 \pm 7.4$  vs  $22.5 \pm 8.0$ ,  $p < 0.001$ ), and large capsulotomy size was more frequently associated with complications (71.0% vs 50.7%,  $p = 0.01$ ). These findings are in agreement with previous research, which has consistently demonstrated that higher laser energy, increased number of shots, and larger capsulotomy sizes are significant contributors to post-procedural complications [17] [18]. Among the observed complications, raised intraocular pressure was the most common (17.3%), followed by intraocular lens pitting (11.2%) and anterior uveitis (9.2%). Less frequent but clinically significant complications included cystoid macular edema (5.1%) and retinal detachment (2.0%). These findings closely mirror previous research, where transient IOP elevation was reported as the most frequent complication, while retinal detachment remained a rare but serious adverse event.

The relatively low frequency of severe complications in this study further supports the overall safety profile of Nd:YAG capsulotomy [19]. Multivariable analysis confirmed that both patient-related and procedure-related factors influence complication risk. Age  $\geq 60$  years (AOR 1.94,  $p = 0.02$ ) and duration since surgery  $\geq 18$  months (AOR 1.76,  $p = 0.04$ ) were significant patient-related predictors, while higher laser energy  $\geq 60$  mJ (AOR 2.68,  $p < 0.001$ ), greater number of shots  $\geq 25$  (AOR 2.14,  $p = 0.01$ ), and large capsulotomy size (AOR 1.89,  $p = 0.03$ ) were strong procedural predictors. These findings are consistent with previous research emphasizing that procedural factors, particularly energy settings and technique, play a dominant role in determining complication risk. The lack of significant association with gender ( $p = 0.39$ ) is also in line with previous research indicating no gender-based difference in outcomes [20].

Overall, the findings of this study reinforce that Nd:YAG laser capsulotomy is an effective and relatively safe procedure, but not without risk. The results are consistent with previous research demonstrating that complications are influenced by both patient characteristics and procedural factors. Careful patient selection, use of minimal effective energy, and precise technique are essential to minimize complications and optimize clinical outcomes.

## CONCLUSION

It is concluded that Nd:YAG laser capsulotomy is an effective procedure with a moderate rate of mostly manageable complications. Higher age, longer duration since surgery, and increased laser energy and shots significantly increase the risk, highlighting the need for careful technique and optimized parameters.

## REFERENCES

- Cinar E, Yuce B, Aslan F, Erbakan G. Influence of Nd:YAG laser capsulotomy on toric intraocular lens rotation and change in cylinder power. *J Cataract Refract Surg.* 2024;50:43–50. <https://doi.org/10.1097/j.jcrs.0000000000001306>
- Zhang Y, Wu Y, Liang J, et al. Analysis of influencing factors associated with the time between cataract surgery and Nd:YAG laser posterior capsulotomy. *Eur J Ophthalmol.* 2023;33:1616–23. <https://doi.org/10.1177/11206721221150536>
- Ang RET. Long-term trifocal toric intraocular lens outcomes in Asian eyes after cataract surgery. *J Cataract Refract Surg.* 2023;49:832–39. <https://doi.org/10.1097/j.jcrs.0000000000001195>
- Ang RET, Tañá-Rivero P, Pastor-Pascual F, et al. Visual and refractive outcomes after bilateral implantation of a biconvex aspheric toric monofocal intraocular lens. *Clin Ophthalmol.* 2023; 17:2765–76. <https://doi.org/10.2147/oph.s432598>
- Fernández J, Srinivasan S, Burguera N, et al. One-year follow-up of a multifocal intraocular lens with optimized elevated phase shift. *J Cataract Refract Surg.* 2023;49:1018–24. <https://doi.org/10.1097/j.jcrs.0000000000001266>
- Lin Z, Chen Y. Clinical application and research progress of different types of intraocular lens. *Yan Ke Xue Bao.* 2022; 37:577–84. <https://doi.org/10.4103/ijo.ijo.2916.21>
- Wu Q, Wu L, Wang CY, et al. Hydrophobic versus hydrophilic acrylic intraocular lens on posterior capsule opacification: a meta-analysis. *Int J Ophthalmol.* 2022;15:997–1004. <https://doi.org/10.18240/ijo.2022.06.19>
- Chang DH, Janakiraman DP, Smith PJ, et al. Visual outcomes and safety of an extended depth-of-focus intraocular lens: results of a pivotal clinical trial. *J Cataract Refract Surg.* 2022; 48:288–97. <https://doi.org/10.1097/j.jcrs.0000000000000747>
- Corbelli E, Iuliano L, Bandello F, Fasce F. Comparative analysis of visual outcome with monofocal, enhanced monofocal, and extended depth of focus intraocular lenses. *J Cataract Refract Surg.* 2022; 48:67–74. <https://doi.org/10.1097/j.jcrs.0000000000000706>
- Karmiris E, Chalkiadaki E, Papakonstantinou E, Georgalas I. Long-term clinical outcomes with multifocal intraocular lens implantation. *Saudi J Ophthalmol.* 2022;36:207–12. <https://doi.org/10.4103/sjopt.sjopt.28.21>
- Bianchi GR. Prospective study of a new presbyopia pseudophakic intraocular lens: safety, efficacy and satisfaction. *Indian J Ophthalmol.* 2022;70:3305–10. <https://doi.org/10.4103/ijo.ijo.2795.21>
- Bai H, Li H, Zheng S, et al. Nd:YAG capsulotomy rates with two multifocal intraocular lenses. *Int J Gen Med.* 2021;14:8975–80. <https://doi.org/10.2147/ijgm.s342039>
- Borkenstein AF, Borkenstein EM. Analysis of YAG laser-induced damage in intraocular lenses. *Ophthalmic Res.* 2021;64:417–31. <https://doi.org/10.1159/000513203>
- Baur ID, Khoramnia R, Weindler J, et al. Clinical outcomes of a hybrid monofocal intraocular lens with extended depth of focus. *J Refract Surg.* 2021;37:601–08. <https://doi.org/10.3928/1081597x-20210610-03>
- Brar S, Ganesh S, Nikhil RP, Roopashree CR. Clinical outcomes and patient satisfaction with a trifocal intraocular lens. *Clin Ophthalmol.* 2021;15:3247–57. <https://doi.org/10.2147/oph.s320202>
- Brar S, Rathod DP, Nikhil RP, Ganesh S. Clinical outcomes and rotational stability of toric intraocular lenses. *Int Ophthalmol.* 2021;41:3769–80. <https://doi.org/10.1007/s10792-021-01944-5>
- Brar S, Shah ML, Sute SS, Pereira S, Ganesh S. Rotational stability of Eyecryl toric intraocular lens: 12-month prospective study. *Indian J Ophthalmol.* 2021;69:1775–80. <https://doi.org/10.4103/ijo.ijo.3463.20>
- Leng L, Bai H, Li H, et al. Effect of anterior capsule polishing on Nd:YAG capsulotomy rate. *Front Med.* 2022;9:815966. <https://doi.org/10.3389/fmed.2022.815966>
- Thom H, Ender F, Samavedam S, et al. Effect of intraocular lens properties on risk of Nd:YAG capsulotomy: systematic review and meta-analysis. *PLoS One.* 2019;14:e0220498. <https://doi.org/10.1371/journal.pone.0220498>
- Zhao Y, Yang K, Li J, Huang Y, Zhu S. Hydrophobic vs hydrophilic intraocular lenses in preventing posterior capsule opacification: meta-analysis. *Medicine (Baltimore).* 2017;96:e8301. <https://doi.org/10.1097/md.00000000000008301>