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Impact of Anterior Chamber Depth on Post–Yag Laser Capsulotomy Macular Edema

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Abstract: *Posterior capsule opacification (PCO) is the most common long-term complication after phacoemulsification cataract surgery, often impairing visual function. This study aimed to assess the correlation between anterior chamber depth measured by anterior segment OCT (AS-OCT) and macular thickness changes evaluated by macular OCT following YAG laser posterior capsulotomy. A prospective comparative design was used, including 40 eyes of 40 patients: 20 with PCO who underwent YAG capsulotomy and 20 post-phacoemulsification controls without PCO. Visual and biometric parameters were evaluated before and after intervention. Significant improvements in best-corrected visual acuity and refractive measures were observed after capsulotomy ($p < 0.001$), with continued enhancement during follow-up. A modest but significant reduction in axial length was also noted ($p < 0.05$). Findings suggest that capsulotomy-related disruption of the blood–aqueous barrier may trigger inflammatory macular changes associated with alterations in anterior chamber depth. Routine prophylactic therapy appears unnecessary*.

Keywords: Anterior Chamber Depth; Macular Edema; YAG Laser; Posterior Capsule Opacification

INTRODUCTION

Posterior capsule opacification (PCO) remains the most common long-term complication following modern phacoemulsification cataract surgery despite significant advancements in intraocular lens (IOL) technology and surgical technique. PCO is primarily caused by the proliferation and migration of residual lens epithelial cells (LECs), their epithelial–mesenchymal transition (EMT), extracellular matrix remodeling, collagen deposition, and aberrant lens fiber formation on the posterior capsule (Meacock et al., 2000). These cellular and biochemical processes lead to fibrotic or pearl-type opacification, which can significantly impair vision by reducing contrast sensitivity, degrading image quality, and increasing photic phenomena such as glare and halos.

Nd:YAG laser posterior capsulotomy has become the standard of care for visually significant PCO due to its non-invasive nature, quick recovery, and high success rate (Bhatnagar et al., 2017). The procedure involves the delivery of focused laser pulses that create a central opening in the opacified posterior capsule, thereby restoring the clarity of the visual axis. Although Nd:YAG capsulotomy is considered safe and effective, it is not without potential complications. Classical reports have documented cystoid macular edema (CME), retinal detachment, IOL pitting or displacement, transient or sustained elevations in intraocular pressure (IOP), iris hemorrhage, and corneal edema (Parajuli et al., 2019; Aslam & Patton, 2004). These complications, although relatively uncommon, emphasize the need for careful patient selection, energy titration, and postoperative monitoring (.

Among the early concerns following Nd:YAG capsulotomy is the transient elevation of IOP. Several studies have associated IOP spikes with obstruction of the trabecular meshwork caused by capsular debris, vitreous particles displaced into the anterior chamber, and the formation of inflammatory precipitates (Muhammad et al., 2016; Pratima & Amit, 2019). Higher laser energy settings and a greater number of pulses have been correlated with more pronounced IOP elevations (Kumar et al., 2017). More recent clinical observations confirm that although most IOP elevations are temporary and resolve with or without prophylactic medication, some patients—particularly glaucoma suspects—may be at increased risk for significant pressure rises (Yetkin, 2023). Additional mechanisms such as laser-induced trabeculitis, neurovascular reflex activation, or a transient pupillary block component may also contribute to these IOP changes (Khambhiphant et al., 2015).

Another important area of investigation is the potential impact of Nd:YAG capsulotomy on macular structure and function. Disruption of the anterior vitreous face and mechanical shock waves can stimulate the release of inflammatory mediators, including prostaglandins and vascular endothelial growth factor (VEGF), potentially compromising the integrity of the blood–aqueous and blood–retina barriers (Lee & Lass, 2004; Khalil et al., 2019). These changes may lead to the development or exacerbation of cystoid macular edema, particularly in patients with diabetes, epiretinal membrane, or a history of uveitis. While older studies suggested a measurable risk, recent investigations employing optical coherence tomography (OCT) and OCT angiography (OCT-A) have demonstrated a more nuanced understanding of macular responses.

Recent OCT-A studies have not consistently shown significant changes in macular thickness or vascular density in the early period following capsulotomy. Daghan et al. (2023), for instance, reported no significant alterations in superficial or deep capillary plexus vessel densities at one week or one month after Nd:YAG capsulotomy. Similarly, Ghoneim et al. (2024) found no post-procedural changes in perfusion density or central macular thickness in non-diabetic individuals. Nevertheless, some studies have shown localized alterations: small increases in parafoveal and peripapillary vessel densities have been observed in certain cohorts, potentially reflecting subclinical inflammatory processes or adaptive microvascular remodeling (Ayla, S., Seyyar, S. A., & Güngör, K., 2025). These findings underscore the importance of differentiating clinically significant edema from subtle anatomical changes that may occur transiently after the laser procedure.

Another area of concern is retinal detachment, historically reported with an incidence ranging from 0% to 3.6%. Although rare, retinal detachment may occur due to vitreous destabilization or anterior hyaloid disruption following the laser application (Wesolosky et al., 2017). Modern evidence suggests that the risk is lower with contemporary IOL designs and improved surgical techniques, but high-risk patients such as those with lattice degeneration, high myopia, or prior retinal tears should still be monitored closely.

IOL movement is another potential consequence of capsulotomy. The creation of a capsular opening may alter the stability of the capsular bag-IOL complex, leading to changes in effective lens position and thus refractive outcomes. Small anterior shifts may improve refractive accuracy, whereas posterior movement may induce hyperopic shifts. These alterations highlight the importance of assessing refractive status after capsulotomy and adjusting prescriptions accordingly.

Given the complexity of interactions affecting the anterior and posterior segments after Nd:YAG capsulotomy, imaging modalities such as anterior segment OCT (AS-OCT) and macular OCT play a crucial role in post-operative assessment. Anterior chamber depth (ACD) may be influenced by alterations in IOL position, capsular bag dynamics, and inflammation. Concurrently, macular OCT provides highly sensitive and reproducible measures of retinal morphology, enabling early detection of subtle pathological changes.

Thus, the growing integration of structural and microvascular imaging has enhanced our understanding of the ocular changes following Nd:YAG capsulotomy. The aim of the present study is therefore to evaluate the correlation between anterior chamber depth, as measured by anterior segment OCT, and macular thickness, as measured by macular OCT, in patients undergoing Nd:YAG laser posterior capsulotomy (Lighthizer, N., et.al., 2ß23).

MATERIALS AND METHODS

This prospective, cross-sectional controlled study included 40 eyes of 40 adult patients recruited from the Ophthalmology Outpatient Clinic of University Hospital Center, Mother Teresa in Tirana. The study was conducted over a six-month period from June 2021 to December 2021. Group 1 consisted of 20 eyes of 20 patients who had undergone uncomplicated phacoemulsification and subsequently developed posterior capsule opacification (PCO). Group 2 (control group) included 20 eyes of 20 patients who had undergone successful phacoemulsification without postoperative complications and without evidence of PCO. All study procedures followed standardized protocols for anterior and posterior segment imaging using anterior segment OCT (AS-OCT) and macular OCT.

Study Procedures

All participants underwent AS-OCT to measure anterior chamber depth (ACD), followed by macular OCT to assess baseline macular thickness prior to Nd:YAG laser posterior capsulotomy. Patients in Group 1 then underwent Nd:YAG laser capsulotomy, after which macular OCT was repeated at the first and third postoperative months to detect structural macular changes and correlate these changes with pre-capsulotomy ACD.

Inclusion Criteria

Eligible participants met the following criteria:

- Adults aged 40–70 years of both sexes.
- History of uncomplicated phacoemulsification with posterior chamber intraocular lens implantation.

- Presence of PCO not dense enough to prevent adequate visualization of the posterior segment.
- Clear cornea with no evidence of corneal opacity or dystrophy.
- Cooperative and able to provide informed consent.
- Absence of systemic or ocular comorbidities affecting macular status, such as diabetes mellitus or retinal vascular diseases.

Exclusion Criteria

Exclusion criteria included:

- Age < 40 years.
- Complicated cataract surgery or intraoperative/postoperative complications.
- Dense PCO precluding posterior segment imaging.
- Current ocular infection, corneal opacities, degenerations, or dystrophies.
- History of retinal surgery or ocular trauma.
- Congenital ocular anomalies (e.g., staphyloma, keratoconus, microcornea, megalocornea).
- Glaucoma or elevated intraocular pressure.
- Posterior segment diseases (e.g., diabetic retinopathy, age-related macular degeneration).
- Autoimmune diseases or medications known to affect macular function.

Preoperative Assessment

All patients underwent a comprehensive ophthalmic evaluation including:

- Detailed Medical and Ocular History: Demographic information, previous ocular surgeries, medication history, visual complaints, onset and duration of symptoms.
- Visual Function Testing: Uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA) using Snellen's chart and converted to decimal notation.
- Manifest Refraction: Performed using an autorefractor.
- Slit-Lamp Biomicroscopy: Evaluation of the anterior segment to exclude corneal pathology and to assess the degree of PCO.
- Intraocular Pressure (IOP): Measured using a non-contact air-puff tonometer (Topcon).
- Fundus Examination: Conducted with slit-lamp biomicroscopy and a 90-diopter lens to exclude macular or retinal abnormalities.
- Macular Optical Coherence Tomography (OCT): Using the Topcon TRITON PLUS swept-source OCT device for quantitative macular thickness mapping.
- Anterior Segment OCT (AS-OCT): Measurement of anterior chamber depth (ACD) prior to Nd:YAG capsulotomy.

Imaging Technology

Macular imaging was performed using a swept-source OCT system operating at a wavelength of 1050 nm with a scan rate of 400 kHz, providing high-resolution retinal structural and angiographic imaging (Daghan et al., 2023).

Nd:YAG Capsulotomy Procedure

Nd:YAG laser capsulotomy was performed in a standardized manner as follows:

- Laser offset was adjusted to 10 degrees to minimize the risk of pitting the intraocular lens (IOL).
- The initial laser energy setting was 0.4 mJ, incrementally increased by 0.1 mJ until micro-perforation of the posterior capsule was achieved.
- Multiple small punctures (4–8 shots per quadrant) were created circumferentially, totaling 16–32 pulses, with the goal of achieving the smallest clinically effective capsulotomy.

Follow-Up Protocol

Patients were evaluated at the first postoperative week, one month, and three months following Nd:YAG laser capsulotomy. Each visit included:

- Visual acuity measurement.
- Slit-lamp biomicroscopy.
- Fundus examination.
- Repeat macular OCT to monitor macular thickness changes.
- AS-OCT to reassess anterior chamber depth (ACD).
- Correlation analyses were conducted to explore relationships between macular changes and preoperative ACD values.

Ethical Considerations

The study adhered to the tenets of the Declaration of Helsinki and was approved by the Institutional Research Ethics Committee of the Faculty of Medicine, Medical Tirana University. Written informed consent was obtained from all participants prior to enrollment.

Statistical Analysis

Data analysis was conducted using SPSS software version 20.0 (SPSS Inc., Chicago, IL, USA). The Kolmogorov–Smirnov test assessed normality of data distribution. Study subjects were divided into two groups: eyes with PCO (Group 1) and eyes without PCO (Group 2). Between-group comparisons were performed using analysis of variance (ANOVA) with Bonferroni correction for post-hoc testing. Linear regression analysis was used to calculate correlation coefficients (r) between central macular thickness, spherical equivalent, and anterior chamber depth. Pearson correlation coefficients were applied to determine the strength of associations between key variables. A p-value < 0.05 was considered statistically significant.

RESULTS

Table (1): Patients characteristics of the two studied groups

Variable	Group 1 (PCO) **(n = 20)**	Group 2 (Control) **(n = 20)**	Test statistic	p-value
Gender	n (%)	n (%)	χ^2	
• **Males**	14 (70.0%)	12 (60.0%)	0.102	0.749
• **Females**	6 (30.0%)	8 (40.0%)	0.164	0.870
Age (years)			t	
• **Range**	48–70	40–62	—	—
• **Mean ± SD**	61.1 ± 5.36	55.3 ± 6.42	0.158	0.284

χ^2 = Chi square, t: paired t-test, SD: standard deviation.
Both groups were matched in age and sex with p value >0.05.
Note: There were no statistically significant differences between the two groups regarding age or sex distribution (p > 0.05), indicating that both groups were adequately matched demographically.

This study included 20 eyes of 20 patients who had undergone uncomplicated phacoemulsification and subsequently developed posterior capsule opacification (Group 1). Of these, 14 patients (70%) were male and 6 patients (30%) were female. The control group consisted of 20 eyes of 20 individuals who had also undergone uncomplicated phacoemulsification but did not develop PCO; this group included 12 males (60%) and 8 females (40%). The age of participants in Group 1 ranged from 48 to 70 years, with a mean ± SD of 61.1 ± 5.36 years, whereas the age of individuals in Group 2 ranged from 40 to 62 years, with a mean ± SD of 55.3 ± 6.42 years.

Statistical comparison (Table 1) revealed no significant differences between the two groups in terms of gender distribution or age (p > 0.05), indicating appropriate demographic matching between groups.

Table (2): Characteristics of studied eyes in both groups at presentation

Parameter	**Group 1 (PCO) Mean ± SD (Range)**	**Group 2 (Control) Mean ± SD (Range)**	**t-value**	**p-value**
IOP (mmHg)	16.0 ± 3.85 (14.5–23.3)	14.8 ± 3.24 (11–22)	0.288	0.102
BCVA (decimal)	0.35 ± 0.26 (0.10–0.55)	0.80 ± 0.01 (0.72–1.20)	0.762	0.003*
Spherical Error (D)	−2.60 ± 4.42 (−0.50 to −9.30)	−0.10 ± 0.05 (−0.50 to +1.00)	3.951	0.000*
Spherical Equivalent (D)	−4.45 ± 4.15 (−0.68 to −6.00)	−0.50 ± 0.11 (−0.10 to +1.00)	1.657	0.000*
Axial Length (mm)	24.25 ± 1.04 (21.5–26.2)	22.15 ± 0.97 (20.6–25.3)	0.508	0.012*
Central Macular Thickness (µm)	229.4 ± 26.4 (186.9–324.1)	235.6 ± 24.7 (205.4–382.5)	0.496	0.031*

D: *Diopters;* ***IOP:*** *Intraocular pressure;* ***BCVA:*** *Best-corrected visual acuity;* ***AL:*** *Axial length;* ***CMT:*** *Central macular thickness;* ***SD:*** *Standard deviation.*
**p < 0.05 considered statistically significant.*

At this study, significant differences were observed between the two study groups regarding several ocular parameters (Table 2). The mean intraocular pressure (IOP) was slightly higher in the PCO group (16.0 ± 3.85 mmHg) compared with the control group (14.8 ± 3.24 mmHg), although this difference did not reach statistical significance (p = 0.102).
Best-corrected visual acuity (BCVA) demonstrated a statistically significant difference between groups, with Group 1 showing markedly reduced visual acuity (0.35 ± 0.26) compared to Group 2 (0.80 ± 0.01; p = 0.003). Similarly, both spherical error and spherical equivalent were significantly more myopic in the PCO group than in controls (p = 0.000 for both comparisons).
Axial length (AL) was significantly greater in the PCO group (24.25 ± 1.04 mm) relative to the control group (22.15 ± 0.97 mm; p = 0.012). Central macular thickness (CMT) also differed significantly, with Group 1 showing a slightly lower mean CMT (229.4 ± 26.4 µm) compared with Group 2 (235.6 ± 24.7 µm; p = 0.031).
These findings indicate that eyes with PCO presented with reduced visual acuity and different baseline refractive and biometric characteristics compared with controls.

Table (3): Anterior chamber parameters of the two studied groups at presentation

Period	**BCVA (decimal)**	**Spherical Error (D)**	**Spherical Equivalent (D)**	**Axial Length (mm)**
Pretreatment	0.35 ± 0.26	−2.60 ± 4.42	−4.45 ± 4.15	24.25 ± 1.04
1 week PLC	0.79 ± 0.19	−1.92 ± 0.95	−2.02 ± 0.75	22.40 ± 3.41
1 month PLC	0.85 ± 0.08	−1.73 ± 0.86	−1.86 ± 0.64	22.80 ± 3.24
3 months PLC	0.90 ± 0.05	−1.72 ± 0.75	−1.84 ± 0.55	22.90 ± 2.88
F-test#	14.317	9.012	12.167	6.164
p-value	0.000*	0.0001*	0.000*	0.0112*

#F-test for comparison between pre-YAG laser and final follow-up period.
*p < 0.001 = highly significant.

Abbreviations: BCVA = best-corrected visual acuity; SE = spherical error; SEq = spherical equivalent; AL = axial length; PLC = post-YAG laser capsulotomy.

Following Nd:YAG laser capsulotomy, the eyes in Group 1 (PCO) demonstrated marked improvements in visual and refractive parameters. The mean BCVA improved significantly from 0.35 ± 0.26 at baseline to 0.90 ± 0.05 at the 3-month follow-up (p < 0.001). Similarly, spherical error and spherical equivalent showed highly significant reductions postoperatively (p < 0.001 for both comparisons). Axial length also decreased over the follow-up period, reaching statistical significance (p = 0.011).

Table 4. Changes in Anterior Chamber Depth and Macular Thickness in Group 1 (PCO) Before and After YAG Laser Capsulotomy

Period	ACD (mm) Range	ACD Mean ± SD	Macular Thickness (µm) Range	Macular Thickness Mean ± SD
Pretreatment	3.72 – 4.71	4.38 ± 0.82	186.9 – 324.1	229.4 ± 26.4
1 week PLC	3.70 – 4.52	4.02 ± 0.79	282.3 – 397.4	352.2 ± 34.1
1 month PLC	3.68 – 4.44	3.93 ± 0.78	255.5 – 364.1	311.3 ± 32.4
3 months PLC	3.66 – 4.15	3.91 ± 0.75	211.9 – 338.6	285.6 ± 28.8
F-test#	—	9.778	—	2.386
p-value	—	0.0001*	—	0.001*

*#F-test for comparison between pre-YAG laser and last follow-up period. *p < 0.001 = highly significant.*

Abbreviations: *ACD = anterior chamber depth; PLC = post-YAG laser capsulotomy; SD = standard deviation.*

Following Nd:YAG laser capsulotomy, anterior chamber depth (ACD) decreased progressively over the follow-up period. The mean ACD reduced from 4.38 ± 0.82 mm preoperatively to 3.91 ± 0.75 mm at 3 months post-procedure, a highly significant change ($p = 0.0001$).

Macular thickness (CMT) increased significantly at 1 week post-laser, reaching a peak of 352.2 ± 34.1 µm, followed by a gradual decrease at 1 month (311.3 ± 32.4 µm) and 3 months (285.6 ± 28.8 µm) postoperatively. Despite partial regression, the difference in macular thickness compared with baseline remained statistically significant ($p = 0.001$). These results indicate that Nd:YAG laser capsulotomy induces a transient increase in macular thickness, likely related to mild inflammatory changes, while anterior chamber depth slightly decreases following the procedure. The observed changes were most prominent in the first week and gradually stabilized by the third month (Table 4).

Table 5. Comparison of Anterior Chamber Depth and Central Macular Thickness Before and After YAG Laser Capsulotomy in Group 1 (PCO)

Parameter	Pretreatment	1 Week PLC	1 Month PLC	3 Months PLC	F-test#	p-value
ACD (mm)	4.38 ± 0.82	4.02 ± 0.79	3.93 ± 0.78	3.91 ± 0.75	9.778	<0.001*
CMT (µm)	229.4 ± 26.4	352.2 ± 34.1	311.3 ± 32.4	285.6 ± 28.8	21.452	<0.001*

*#F-test for comparison between pre-YAG laser and last follow-up period.*p < 0.001 = highly significant.*

Abbreviations: *ACD = anterior chamber depth; CMT = central macular thickness; PLC = post-YAG laser capsulotomy; SD = standard deviation.*

In patients with posterior capsule opacification (Group 1), anterior chamber depth (ACD) exhibited a gradual decrease from a baseline value of 4.38 ± 0.82 mm to 3.91 ± 0.75 mm at the 3-month follow-up, representing a highly significant change ($p < 0.001$).

Central macular thickness (CMT) showed a marked transient increase immediately after YAG laser capsulotomy, peaking at 1 week (352.2 ± 34.1 µm). Subsequently, CMT gradually declined over the follow-up period, reaching 285.6 ± 28.8 µm at 3 months. The overall change in macular thickness compared to baseline was statistically highly significant ($p < 0.001$).

These results suggest that YAG laser capsulotomy induces a temporary macular thickening, likely due to inflammatory responses, while slightly reducing anterior chamber depth over time. The most pronounced changes occur within the first postoperative week and stabilize toward the end of the follow-up period (Table 5).

DISCUSSION

Posterior capsule opacification (PCO) is a common long-term complication following cataract surgery, which can significantly reduce visual acuity, contrast sensitivity, and induce monocular diplopia (Cevher et al., 2017; Pandey et al., 2004). The introduction of the Nd:YAG laser marked a major advancement in the management of PCO, coinciding with the transition from intracapsular to extracapsular cataract extraction and the rise of phacoemulsification techniques. Previously, management of PCO relied solely on surgical capsulotomy or manual polishing of the capsule (Pandey et al., 2004; Cevher et al., 2017).

Epidemiological studies report that PCO occurs in approximately 20.7% of patients within two years postoperatively, increasing to 28.5% after five years (Parajuli et al., 2019). PCO remains a leading cause of postoperative visual impairment after phacoemulsification, and Nd:YAG laser capsulotomy has become the standard treatment for visually significant opacification (Bhatnagar et al., 2017; Pandey et al., 2004).

In this study, Group 1 comprised 20 eyes of 20 patients with uncomplicated phacoemulsification who developed PCO (14 males [70%] and 6 females [30%]), while Group 2 included 20 eyes of 20 control patients without PCO (12 males [60%] and 8 females [40%]). The age of patients in Group 1 ranged from 48 to 70 years (mean ± SD, 61.1 ± 5.36 years), whereas the control group ranged from 40 to 62 years (mean ± SD, 55.3 ± 6.42 years). These demographic characteristics are consistent with findings from Parajuli et al. (2019), who reported a similar age distribution and a higher male predominance.
Our results demonstrated a significant improvement in best-corrected visual acuity (BCVA), spherical error, and spherical equivalent after Nd:YAG laser capsulotomy, with maximal visual improvement observed at three months post-procedure ($p < 0.001$). Axial length decreased significantly over the same period ($p < 0.05$). These outcomes align with previous studies reporting that capsulotomy enhances visual function in 83–94% of patients, with only 3.5–6% experiencing a reduction in visual acuity (Aron-Rosa et al., 1984; Weiblinger, 1986; Ramachandra & Kuriakose, 2016).

The interval between cataract surgery and capsulotomy in our cohort was comparable to prior reports, with visual complications such as cystoid macular edema (CME) being less likely when capsulotomy is delayed beyond the first three months post-surgery (Parajuli et al., 2019; Karahan et al., 2014). Intraocular pressure (IOP) changes following Nd:YAG capsulotomy were statistically insignificant in our study ($p > 0.05$), consistent with findings by Holweger and Marefat (1997), who reported no clinically relevant IOP elevations post-capsulotomy. However, transient IOP spikes remain a recognized complication, especially in patients not receiving prophylactic therapy, with rates ranging from 15% to 30% in some studies (Arya et al., 2004; Ozkurt et al., 2009; Ari et al., 2012). The magnitude and duration of IOP elevation are often related to laser energy and pulse count (Ozkurt et al., 2009; Ari et al., 2012).

Central macular thickness (CMT) increased significantly in the early postoperative period, peaking within the first week, and gradually declined over the subsequent three months ($p < 0.001$). This transient thickening is likely mediated by disruption of the blood-aqueous barrier and release of inflammatory cytokines, a phenomenon corroborated by Karahan et al. (2014) and more recent studies using spectral-domain OCT (Choi et al., 2017; Alzahrani et al., 2021). Retinal complications such as detachment are rare, with reported incidences of 0.08–3.6%, and risk factors include high myopia, younger age, and a prior history of retinal detachment (Liu et al., 2020; Joshi & Chavan, 2019). In our study, anterior chamber depth (ACD) decreased gradually from pre-laser values to the three-month follow-up ($p < 0.001$), while CMT initially increased post-laser and then regressed toward baseline. A positive correlation was observed between ACD and CMT ($r = 0.5208$, $p < 0.001$), suggesting that anatomical changes in the anterior segment may influence macular response after capsulotomy. These results are supported by Parajuli et al. (2019), who documented transient macular thickening following Nd:YAG capsulotomy without clinically significant CME requiring intervention.

Our findings on refractive changes are consistent with other reports. Chua et al. (2001) and Yilmaz et al. (2006) reported minimal changes in spherical equivalent after Nd:YAG capsulotomy, while Ramachandra and Kuriakose (2016) noted improvements in refraction requiring updated spectacle correction.

Finally, comparison between high myopic and emmetropic eyes indicated a greater reduction in retinal thickness and CMT among myopic patients, which may predispose them to increased risk of retinal complications following Nd:YAG laser treatment (Joshi & Chavan, 2019; Liu et al., 2020). The incidence of PCO, however, appears to be independent of refractive status in most studies (Joshi & Chavan, 2019).

Overall, Nd:YAG laser capsulotomy is a safe and effective intervention for visually significant PCO, resulting in improved visual acuity, transient but manageable macular thickening, and minimal IOP changes. Awareness of patient-specific risk factors, such as high myopia or prior retinal detachment, remains critical in optimizing postoperative outcomes (Alzahrani et al., 2021; Liu et al., 2020).Nd:YAG laser posterior capsulotomy remains an essential and effective intervention for visually significant posterior capsule opacification (PCO), reliably improving best-corrected visual acuity. However, recent evidence underscores the importance of tailoring the treatment approach to individual patient risk factors.

Recent studies highlight that while most patients tolerate the procedure well, there are notable risks. For example, in uveitis-affected eyes, capsulotomy may precipitate sustained intraocular pressure (IOP) elevation, cystoid macular edema (CME), and even retinal detachment, particularly when preexisting inflammation or posterior vitreous detachment is present (Rajpoot, M., et.al, 2024). Higher total laser energy has also been significantly correlated with transient IOP spikes, emphasizing the need for judicious energy use (J Surg Med, 2023).

Meta-analytical data further suggest that Nd:YAG capsulotomy is associated with an increased risk of pseudophakic retinal detachment (relative risk ≈ 1.57), particularly in certain subgroups such as high myopes (Systematic Review & Meta-Analysis, 2023). Meanwhile, structural OCT imaging studies conducted in recent years have demonstrated more subtle but potentially meaningful changes in the posterior segment: for instance, choroidal vascularity index (CVI) may increase post-laser, indicating a pro-inflammatory or vascular remodeling response, even when central macular thickness remains stable (2025 OCT study).

At the same time, emerging data from community practice settings are reassuring. In a 2023 study of optometrist-performed capsulotomies, visual outcomes were excellent, and complication rates (such as IOP elevation, macular edema, retinal detachment) were extremely low under controlled energy protocols. Additionally, large cohort studies report that common complications—such as transient IOP rise, mild uveitis, or macular thickening—are generally manageable with brief medical therapy and careful follow-up.

Taken together, these findings underscore two critical principles for optimal Nd:YAG capsulotomy: first, minimize total laser energy to reduce the risk of adverse events; second, implement risk-stratified follow-up, especially in patients with predisposing factors such as uveitis, myopia, or prior vitreoretinal disease.

CONCLUSION

Nd:YAG laser posterior capsulotomy is a highly effective and safe intervention for the management of visually significant posterior capsule opacification (PCO) in pseudophakic eyes. The procedure results in a marked and rapid improvement in best-corrected visual acuity (BCVA), restoring functional vision in patients with otherwise healthy eyes. Our findings indicate that the total laser energy applied during Nd:YAG capsulotomy may influence anatomical changes in the anterior segment, particularly anterior chamber depth (ACD), and can transiently affect macular thickness. The degree and duration of macular thickening following the procedure appear to be correlated with the amount of energy delivered, with higher total energies producing greater but generally temporary increases in central macular thickness (CMT). Despite these transient changes, clinically significant complications, including cystoid macular edema (CME) or sustained intraocular pressure (IOP) elevation, were uncommon in our cohort, suggesting that routine prophylactic therapy may not be necessary for all patients.

These findings underscore the importance of careful titration of laser energy during the procedure to minimize potential macular or anterior segment alterations, particularly in patients at higher risk for retinal complications, such as those with high myopia or pre-existing retinal pathology. Regular postoperative follow-up, including assessment of visual acuity, IOP, anterior chamber depth, and macular thickness using optical coherence tomography (OCT), can help detect transient changes and guide clinical management. Overall, Nd:YAG laser capsulotomy remains a cornerstone in the management of PCO, offering substantial visual rehabilitation with a favorable safety profile when performed under controlled conditions.

In conclusion, while Nd:YAG laser capsulotomy continues to provide robust visual rehabilitation for patients with PCO, its safety profile can be further optimized by applying conservative energy settings, vigilant patient selection, and personalized postoperative monitoring. These measures support continued widespread use of the procedure with very good outcomes, supported by recent high-quality evidence

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