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Clinical Outcomes of Nd: YAG Laser Posterior Capsulotomy: Impact on Intraocular Pressure, Refraction, Anterior Chamber Depth, and Macular Thickness

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Abstract

Background: Nd: YAG laser posterior capsulotomy is a commonly performed procedure to treat posterior capsular opacification following cataract surgery. While the procedure is known to effectively improve visual acuity, its potential impact on intraocular pressure (IOP), refraction, anterior chamber depth (ACD), and macular thickness remains a subject of debate. This study aims to investigate the effects of Nd: YAG laser posterior capsulotomy on these ocular parameters.

Methods: This study was designed as a prospective analysis conducted at a tertiary eye care center on patients who underwent Nd: YAG laser posterior capsulotomy at a tertiary eye care center between January 2020 and December 2020. Preoperative and postoperative measurements of IOP, refraction, ACD, and macular thickness were collected and compared. Statistical analyses were performed using paired t-tests, and p-values <0.05 were considered statistically significant.

Results: A total of 30 eyes from 25 patients (mean age, 65.4 ± 8.2 years) were included in the analysis. Following Nd: YAG laser posterior capsulotomy, the mean intraocular pressure (IOP) increased from 15.2 ± 2.3 mmHg to 17.0 ± 2.7 mmHg ($p < 0.001$). The refractive status showed a mean myopic shift of -0.35 ± 0.16 diopters ($p < 0.001$,). Additionally, there was a statistically significant reduction in anterior chamber depth (ACD) from 3.15 ± 0.42 mm to 2.90 ± 0.37 mm ($p = 0.003$,). However, there was no significant change in macular thickness after the procedure ($p = 0.287$).

Conclusion: Nd: YAG laser posterior capsulotomy leads to a mild but statistically significant increase in IOP and a small myopic shift in refraction. Additionally, the procedure results in a decrease in ACD but does not significantly affect macular thickness. Ophthalmologists should consider these effects when performing Nd: YAG laser posterior capsulotomy and carefully monitor patients postoperatively.

Keywords: Nd:YAG Laser; Posterior Capsulotomy; Intraocular Pressure; Refraction; Anterior Chamber Depth; Macular Thickness

Abbreviations: PCO: Posterior Capsule Opacification; CME: Cystoid Macular Edema; IOP: Increased Intraocular Pressure; ACD: Anterior Chamber Depth; PCIOL: Posterior Chamber Intraocular Lens.

Introduction

Posterior capsule opacification (PCO), commonly referred to as "secondary cataract," is a frequent complication

following cataract surgery. It occurs when residual lens epithelial cells proliferate and migrate onto the posterior capsule, leading to visual impairment [1,2]. PCO results in reduced visual acuity, compromised contrast sensitivity, glare disability, and monocular diplopia, necessitating additional intervention [3,4]. Nd: YAG laser posterior capsulotomy has become the standard treatment for PCO, with a success rate exceeding 95% [4-6]. Despite its effectiveness, the procedure carries potential complications such as retinal detachment, cystoid macular edema (CME), and C (IOP) [2,3]. Of these complications, elevated IOP is particularly concerning as it may contribute to the development or progression of glaucoma [2,3].

The effect of Nd:YAG laser posterior capsulotomy on IOP, as well as other ocular parameters such as best-corrected visual acuity (BCVA), anterior chamber depth (ACD), and macular thickness, remains a subject of debate [2,3]. While some studies suggest an increase in IOP following the procedure [1,7], others report no significant change or even a decrease in IOP. Furthermore, the impact of Nd: YAG laser capsulotomy on BCVA, ACD, and macular thickness is still inconclusive [1,7]

Therefore, the present study aims to investigate the effects of Nd:YAG laser posterior capsulotomy on IOP, BCVA, ACD, and macular thickness. By evaluating these outcomes, we aim to contribute to the existing knowledge and provide insights into the risks and benefits associated with this widely performed procedure.

Materials and Methods

Study Design

This study was designed as a prospective analysis conducted at a tertiary eye care center. The study aimed to investigate the effects of Nd: YAG laser posterior capsulotomy on intraocular pressure (IOP), refraction, anterior chamber depth (ACD), and macular thickness in patients who developed posterior capsular opacification following cataract surgery.

Participants

A total of 25 patients were recruited for the study, contributing a total of 30 eyes for analysis. The patients had undergone uncomplicated manual small incision cataract surgery or phacoemulsification with posterior chamber intraocular lens (PCIOL) implantation were consecutively enrolled and patients having any retinal disease, glaucoma, uveitis, optic neuropathy, or opacities were excluded from the study.

Procedure

Nd: YAG laser posterior capsulotomy was performed on all included patients using a standardized technique. The procedure involved creating an opening in the posterior capsule of the lens using a Nd: YAG laser. The laser parameters, such as power and shots, were carefully selected based on the individual patient's characteristics and the surgeon's discretion.

Data Collection

Baseline measurements of IOP, refraction, ACD, and macular thickness were recorded prior to the Nd: YAG laser posterior capsulotomy procedure. Follow-up assessments were scheduled at specific time points, including 1 hour, 1 week, and 1 month postoperatively. At each visit, the same measurements were repeated using standardized techniques and equipment.

Statistical Analysis

Statistical analyses were performed to compare the preoperative and postoperative measurements of IOP, refraction, ACD, and macular thickness. Paired t-tests were used to assess the statistical significance of the changes observed. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki and obtained approval from

Results

In our study, a total of 30 eyes from 25 patients with a mean age of 65.4 ± 8.2 years were included for analysis. After Nd: YAG laser posterior capsulotomy, we observed a significant increase in mean intraocular pressure (IOP) from 15.2 ± 2.3 mmHg to 17.0 ± 2.7 mmHg ($p < 0.001$) . This finding is consistent with the study by Smith, et al. [8], indicating that the procedure can lead to a mild but statistically significant rise in IOP.

Refraction measurements showed a mean myopic shift of -0.35 ± 0.16 diopters ($p < 0.001$). This myopic shift aligns with the results reported by Brown and Bron [9], suggesting that Nd: YAG laser posterior capsulotomy can induce a small change in refractive status.

Furthermore, our study demonstrated a statistically significant reduction in anterior chamber depth (ACD) from

3.15 ± 0.42 mm to 2.90 ± 0.37 mm (p = 0.003). Karabatsas, et al. [10] also reported a decrease in ACD after Nd: YAG laser posterior capsulotomy, supporting our findings. The decrease in ACD observed in our study suggests potential alterations in the lens-iris diaphragm position or changes in aqueous humor dynamics.

However, we did not observe a significant change in macular thickness following the procedure (p = 0.287). This finding is consistent with the study by Meyer, et al. [11]. Indicating that Nd: YAG laser posterior capsulotomy does not have a notable impact on macular thickness.

Discussion

Our study contributes to the understanding of the effects of Nd: YAG laser posterior capsulotomy on various ocular parameters. The increase in intraocular pressure (IOP) observed after the procedure aligns with previous findings [8]. This rise in IOP emphasizes the importance of vigilant monitoring and appropriate management of IOP in patients undergoing capsulotomy.

The myopic shift in refraction following Nd: YAG laser posterior capsulotomy is consistent with previous studies [9]. This finding suggests that the procedure may induce changes in corneal curvature or the effective lens position. Ophthalmologists should consider the potential refractive changes when planning the intervention and discussing postoperative expectations with patients.

The reduction in anterior chamber depth (ACD) observed in our study, similar to the findings by Karabatsas, et al. [10], indicates potential alterations in the anatomical relationships within the anterior segment of the eye. The decrease in ACD may have implications for intraocular lens stability and postoperative visual outcomes. Surgeons should be mindful of these changes and their impact on the overall visual system.

In contrast, we did not find a significant change in macular thickness after Nd: YAG laser posterior capsulotomy, which is consistent with the study by Meyer, et al. [11]. This suggests that the procedure may have limited impact on macular health. However, it is important to note that our study had a relatively short follow-up period, and long-term effects on macular thickness were not evaluated. Further investigations with longer-term follow-up are needed to fully assess the impact on macular health.

Our study's comprehensive analysis tries to provides valuable insights into the effects of Nd: YAG laser posterior capsulotomy on various ocular parameters. The observed increase in IOP aligns with previous findings, indicating that this effect is consistent across different patient populations [8]. The implications of this finding are critical, as elevated IOP is associated with glaucoma development and progression [2]. Understanding the underlying mechanisms driving this increase can lead to better management strategies and improved patient outcomes.

Regarding the myopic shift in refraction, its consistency with previous research further strengthens the validity of our findings [9]. However, the precise mechanisms responsible for this refractive change require further investigation. The changes in corneal curvature or the effective lens position may result from biomechanical alterations induced by the laser procedure [9]. Analyzing corneal topography and examining the relationship between preoperative biometric parameters and refractive changes could provide valuable insights into the nature of these shifts.

The observed reduction in ACD post-capsulotomy suggests potential alterations in the anterior segment anatomy [10]. However, the exact mechanisms causing this change remain unclear. Investigating anterior segment optical coherence tomography (AS-OCT) images and evaluating aqueous humor dynamics may shed light on the underlying anatomical changes [10]. Understanding these alterations can help improve surgical planning, optimize intraocular lens selection, and refine postoperative care to achieve better visual outcomes.

While our study did not find a significant change in macular thickness after capsulotomy, this finding must be interpreted with caution due to the relatively short follow-up period [11]. Macular thickness changes may develop over time and become more evident in long-term follow-up assessments. Future studies with extended follow-up periods are necessary to assess the long-term effects on macular health. Evaluating macular thickness changes alongside visual function and patient-reported outcomes will enhance our understanding of the clinical significance of these findings.

Limitations

Our study has several limitations that should be acknowledged. Firstly, its retrospective nature introduces inherent biases associated with data collection. The relatively small sample size and single-center design may limit the generalizability of the findings. Additionally, the study focused on short-term outcomes, and the long-term effects of Nd:YAG laser posterior capsulotomy were not evaluated. Future studies with larger sample sizes, longer follow-up periods, and multi-center designs are necessary to provide a more comprehensive understanding of the effects of this procedure.

Conclusion

In conclusion, our study demonstrates that Nd:YAG laser posterior capsulotomy leads to a mild but statistically significant increase in intraocular pressure (IOP) and a small myopic shift in refraction. Additionally, the procedure results in a decrease in anterior chamber depth (ACD) without significantly affecting macular thickness. Ophthalmologists should consider these effects and monitor patients postoperatively to optimize outcomes and minimize potential complications.

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