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THE EFFECT OF ND: YAG LASER TREATMENT OF POSTERIOR CAPSULAR OPACIFICATION ON ANTERIOR CHAMBER DEPTH AND REFRACTION IN PSEUDOPHAKIC EYES

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Abstract

Objective: *The purpose of this study was to look into possible changes in intraocular pressure and refraction brought on by modifications in anterior segment properties after Nd: YAG laser capsulotomy for opacification of the posterior capsule.*

Study type: *cross-sectional study.*

Settings: *Armed Forces Institute of Ophthalmology, Rawalpindi.*

Duration: *January 2025 to June 2025.*

Subjects and Methods: *Thirty-six randomly selected eyes from 22 individuals with clearly severe PCO, ranging in age from 20 to 70 years, were used in this study. During phacoemulsification surgery, patients received single-piece, foldable, hydrophobic acrylic intraocular lenses inserted inside bags. The eyes were thoroughly examined both before and after the capsulotomy. IOP and refractive variations were assessed. Pentacam was used both prior to and after the capsulotomy.*

Results: *The mean VA (logMAR) rose statistically substantially from 0.53 ± 0.086 prior to the Nd:YAG laser-capsulotomy to 0.77 ± 0.074 one month after the procedure (P < 0.001). After one month, the mean spherical and cylindrical powers were 0.19 ± 1.35 DS and − 0.86 ± 0.71 DC, respectively, compared to 0.50 ± 1.85 DS and 1.45 ± 0.97 DC before to the treatment. The method resulted in a considerable decrease in both cylindrical (P = 0.0001) and spherical (P = 0.003) errors. Prior to the Nd:YAG laser capsulotomy, the mean ACD was 4.55 ± 0.77 mm, and one month later, it was 3.98 ± 0.77 mm. Significant decreases in ACD were seen (P = 0.0025).*

Conclusion: *The anterior chamber actually shrank after capsulotomy; spherical equivalents did not alter, but spherical and cylindrical errors did. As a result, the best corrected VA improved. The following variables did not differ statistically significantly: anterior chamber angle, anterior chamber volume, central corneal thickness, pupil size, or intraocular pressure.*

INTRODUCTION

Blindness is a worldwide health issue. Worldwide, cataracts cause half of all blindness.[1] A cataract is characterized as opacification of the lens that can result in hazy and blurred vision. Cataracts can harm one or both eyes and grow slowly.[2] The most common late consequence of cataract surgery is visually significant posterior capsular opacification (PCO), which occurs in 25% of patients within five years after extra-capsular cataract surgery.[3] Proliferation, transformation, and migration of lens epithelial cells that remain on the anterior capsule margin and form plaques on the central part of the posterior capsule are characteristics of PCO. The migrating epithelium from the lens's equator gradually opacifies the posterior capsule, lowering the patient's visual acuity. In adults, the period between cataract surgery and visually noticeable posterior capsular opacification can range from months to years. In younger age groups, nearly all opacification happens within two years following surgery. As age increases, the rate of opacification decreases.[4]

With a success rate of over 95%, ND-YAG laser surgery is the preferred treatment for PCO cases.[5] A pseudophakic eye's opacified capsule can be removed with a quick technique called ND-YAG posterior capsulotomy.[6] However, there have also been reports of certain side effects from this treatment, including retinal injury, vitreous prolapse, corneal injuries, pupillary block, iritis, intraocular pressure increases, IOL movement, and IOL dislocation.[7]

With a success rate of over 95%, Nd:YAG laser posterior capsulotomy is currently the accepted treatment for PCO.[8] With a wavelength of 1064 nm, the solid-state (Nd: YAG) laser can harm eye tissues by triggering optical breakdown with a brief, high-power pulse.[9] Nd: Although the YAG laser posterior capsulotomy procedure is usually uneventful, some complications have been reported, including IOL dislocation, corneal damage, iritis, elevated intraocular pressure (IOP) and increased risk of retinal detachment.[8]

In contrast, a number of studies discovered that after Nd:YAG laser capsulotomy, eyes with PCO showed either no IOL movement at all or a decrease in ACD. Unwanted refractive errors or other related issues could be indicated by this shift in ACD.[10]

The purpose of this study was to look into possible changes in intraocular pressure (IOP) and refraction brought on by modifications in anterior segment properties after Nd: YAG laser capsulotomy for opacification of the posterior capsule.

METHODOLOGY:

This cross-sectional study was carried out in the Armed Forces Institute of Ophthalmology in Rawalpindi, Punjab, Pakistan, between January and June 2025. The ethical review board of the hospital approved it. From among the attendants, the patients who met the following inclusion requirements were chosen. 36 randomly chosen eyes from 22 patients with substantial PCO were used for that procedure. Patients who were between the ages of 18 and 70, had a round, regular reactive pupil, had significant visual loss from PCO following phacoemulsification cataract extraction (two lines less than postoperative VA on the Snellen chart), and had received in-the-bag IOLs following cataract surgery—particularly monofocal single-piece hydrophobic acrylic, which was the type used for all patients—were included. Patients with significant uveitis or macular edema, corneal pathology, severe corneal edema, scarring, glaucoma, or a history of using contact lenses (either cosmetic or refractive) within two days of cataract surgery were not included in the study.

All patients gave their written informed consent to participate and have the results published for scholarly purposes. Each patient received the following treatment: A thorough medical history, both general and ocular, Ocular examination: slit-lamp biomicroscopy, VA, and fundoscopy were performed prior to and 1 month after Nd:YAG laser capsulotomy. Snellen system was used to measure VA in logMAR units for the statistical analysis. Prior to surgery and one month after the procedure, autorefraction with an autorefractometer in conjunction with subjective refraction were used to assess refractive modifications. The IOP was measured using a Goldmann applanation tonometer and a Pentacam spinning Scheimpflug camera: The researcher performed all Pentacam analyses, all measurements were performed under conventional dim light conditions, and all measurements were collected in nondilated settings. Pentacam software is used to calculate the anterior chamber characteristics (ACD, ACV, anterior angle width, CCT, and pupil size) both before and 1 month after YAG laser capsulotomy. Following the use of a conventional contact lens to increase power density at the posterior capsule level, a circular region of the central posterior capsule with a diameter of roughly 4.0 to 4.5 mm was cleaned by applying laser energy to the capsule. The capsule received energy in increments of 1 mJ and up to 2 mJ. For one week after the procedure, 0.1 mg/5.0 mL dexamethasone eye drops were applied four times a day to control inflammation. There were no indications of procedure-related issues.

After the data were transferred onto the computer, analysis was conducted using SPSS software package version 25.0. Numbers and percentages were used to describe the qualitative data. The terms mean ± SD were used to describe quantitative data. Quantitative data from two regularly dispersed periods were compared using the paired t-test. The findings were subjected to the 5% threshold of significance.

RESULTS:

The study comprised the eyes of 22 patients, whose ages ranged from 19 to 69 years old, with a mean age of 56.89 ± 12.66. There were 16 (45%) male patients and 20 (55%) female patients. According to Table 1, P = 0.55 is statistically insignificant for P > 0.05.

As indicated in Table 2, the ACA ranged from 31.7° to 56.7° with a mean of 44.29° ± 6.8° prior to the treatment and from 32.9° to 55.9° with a mean of 43.91 ± 6.48 following the procedure, with a negligible difference (P = 0.8). As indicated in Table 2, the ACV varied from 102 mm3 to 231 mm3 prior to the procedure, with a mean of 163.22 ± 31.38, and from 100 mm3 to 229 mm3 following the procedure, with a mean of 162.08 ± 31.48, with an insignificant difference (P = 0.87). With a highly significant difference (P = 0.0025), the ACD ranged from 3.18 mm to 5.76 mm preprocedure with a mean of 4.55 ± 0.77 and from 2.66 mm to 5.18 mm postprocedure with a mean of 3.98 ± 0.77.

Before and after the surgery, the IOP ranged from 11 mmHg to 16 mmHg, with a mean of 13 ± 1.31 and 13.33 ± 1.31, respectively. According to Table 3, P = 0.64 is statistically insignificant at P > 0.05.

The preprocedure pupil diameter ranged from 1.73 mm to 4.44 mm with a mean of 2.59 ± 0.56, and the postprocedure pupil diameter ranged from 1.92 mm to 4.15 mm with a mean of 2.63 ± 0.54. According to Table 3, P = 0.27 is statistically insignificant at P < 0.05.

The preprocedure CCT varied from 476 µm to 590 µm with a mean of 523.61 ± 36.59, while the postprocedure CCT ranged from 472 µm to 582 µm with a mean of 516.58 ± 35.9. According to Table 3, P = 0.413 is statistically insignificant at P < 0.05.

With a highly significant difference, the BCVA varied from 0.3 to 0.7 logMAR preprocedure with a mean of 0.53 ± 0.086 and from 0.6 to 0.8 logMAR postprocedure with a mean of 0.77 ± 0.074. Table 4 displays the extremely significant difference (P = 0.003) between the spherical errors, which ranged from − 4.00 to + 4.500 preprocedure with a mean of 0.50 ± 1.85 and from − 3.50 to 3.50 postprocedure with a mean of 0.19 ± 1.35. Table 4 displays the cylindrical errors, which ranged from − 4.00 to − 0.25 preprocedure with a mean − 1.45 ± 0.97 and from − 3.00 to 0 postprocedure with a mean − 0.86 ± 0.71. With an insignificant difference (P = 0.59), the spherical equivalent varied from − 5.25 to 3.25 preprocedure with a mean of − 0.33 ± 1.87 and from − 4.50 to 2.25 postprocedure with a mean of − 0.27 ± 1.34.

Table 1: Descriptive statistics (n=36)

		Frequency	%age
Age (years)	20-45	13	36.11
	46-70	23	63.89
Gender	Male	16	45.0

	Female	20	55.0
Side	OD OS	18 18	50.0 50.0

Table-2: Comparison of the anterior chamber parameters before and after procedure.

	Before Procedure	**Post-therapy**	**p-value**
	Mean ± SD	Mean ± SD	
Anterior chamber angle (ACA)	44.29 ± 6.8	43.91 ± 6.48	**0.8**
Anterior chamber volume (ACV)	163.22 ± 31.38	162.08 ± 31.48	**0.87**
Anterior chamber depth (ACD)	4.55 ± 0.77	3.98 ± 0.77	**0.0025**

Table-3: Comparison of the IOP, pupil diameter and CCT before and after procedure.

	Before Procedure	**Post-therapy**	**p-value**
	Mean ± SD	Mean ± SD	
IOP	13 ± 1.31	13.33 ± 1.31	**0.64**
Pupil diameter	2.59 ± 0.56	2.63 ± 0.54	**0.27**
CCT	523.61 ± 36.59	516.58 ± 35.9	**0.413**

Table-3: Comparison of refraction before and after procedure.

	Before Procedure	**Post-therapy**	**p-value**
	Mean ± SD	Mean ± SD	
BCVA	0.53 ± 0.086	0.77 ± 0.074	**0.0001**
Sphere	0.50 ± 1.85	0.19 ± 1.35	**0.003**
Cylinder	−1.45 ± 0.97	−0.86 ± 0.71	**0.0001**
Standard error	−0.33 ± 1.87	−0.27 ± 1.34	**0.59**

DISCUSSION:

In line with other research findings, the current study found a considerable improvement in VA. According to Panezai et al.[11], postlaser VA was attained between 6/18 and 6/6 in 91% of cases, whereas prelaser VA varied from hand motions to 6/36 in 80% of cases. Following YAG laser capsulotomy, patients' VA on the Snellen chart significantly improved; 60.2% of patients had a VA of 6/18 or better, according to Khan et al.[12] Additionally, 51 (88%) of the 58 patients had a VA improvement to one or more Snellen lines.

Both the spherical and cylindrical errors showed a statistically significant decrease. However, after capsulotomy, spherical equivalents remained unchanged. The real refractive shifts brought on by variations in cylindrical power may be obscured by stability in spherical counterparts.

Similar to our investigation, Ozkurt et al.[13] and Moshirfar et al.[14] observed no changes in spherical equivalent. Following Nd:YAG capsulotomy, they did not separately analyze refractive powers as spherical and cylindrical errors. Unlike our investigation, Oztas et al.[15] did not change the sphere error or the spherical equivalent. Cylinder error also significantly decreased one month after YAG laser capsulotomy.

Bozukova et al.[16] claim that the hydrophobic IOL's optic tilting is responsible for this improvement in refractive errors because its short haptics have trouble bending during capsule contraction. This reduces the contracting force after capsulotomy, which in turn reduces wavefront aberrations and ocular tilt.

In line with our findings, Oztas et al.[15] used Pentacam and A-scan ultrasonography, respectively, to show a substantial decrease in mean ACD after Nd:YAG capsulotomy. Assessments of ACD after Nd:YAG capsulotomy revealed no alterations, according to Ozkurt et al.[13] This may be due to the study's small sample size (26 eyes from 23 participants). In contrast to our findings, Monteiro et al.[17] demonstrated a correlation between modest IOL backward motions and the size of the capsulotomy. In our investigation, we did not discover any further links between alterations in anterior segment features and capsulotomy size.

Among the side effects of Nd:YAG laser posterior capsulotomy are higher intraocular pressure, unwanted refractive errors, changes in IOL location, and acute glaucoma. A change in ACD is a significant problem.[17-19] The mean IOP levels did not differ significantly after a month, and IOP increases were kept at 1-3 mmHg.

Long-term IOP after Nd:YAG capsulotomy is often higher than precapsulotomy baselines, especially in individuals with glaucoma or those whose IOP significantly increases in the hours after the capsulotomy, according to Ge et al.[20] This cannot be shown in our study because glaucoma patients were initially excluded and there was no short-term IOP test. Histopathological studies performed during the Nd:YAG capsulotomy suggest that blockage of the trabecular meshwork causes increased intraoperative pressure and reduced drainage capacity. The accumulation of pigment, erythrocytes, fibrin, inflammatory cells, and lens debris in the anterior chamber's trabecular meshwork is what causes this occlusion.[21]

Other theorized explanations of the increase in IOP that also affect the anterior angle include direct effects on the trabecular cells, pupillary block brought on by the vitreous moving forward owing to shockwaves, damage to the trabecular endothelial cells, and the release of inflammatory mediators.[22] A month after Nd:YAG laser capsulotomy, the anterior angle measured with Pentacam in this study did not change, despite Eliaçık et al.[23] reporting that anterior segment optical coherence tomography, a reliable noncontact method for measuring anterior ocular structures, demonstrated a significant increase in the depth and width of the ACA in pseudophakic eyes with PCO. This is because Pentacam's measurements of anterior angle and pupil size are the least accurate anterior segment variables.[24]

A 7 µm drop in the CCT was not statistically significant. Oztas et al.[15] discovered the same thing with YAG capsulotomy after Nd., but they were unable to determine the reason for the drop. Nonetheless, recent studies on the effects of antiglaucoma drugs, including prostaglandin analogs and alpha agonists like apraclonidine, on CCT might explain this decrease.[25] Following Nd:YAG capsulotomy, there were no statistically significant changes in pupil size or ACV. The identical results were reported by Oztas et al.[15] in three sections for IOL.

Based on the discussion above, we identified the following study limitations: 1. No further associations between the alterations in anterior segment features, the size of the capsulotomy, and the powers employed have been discovered. 2. Only one-month intervals are used for the short-term assessment of anterior segment characteristics.

CONCLUSION:

The anterior chamber actually shrank after capsulotomy; spherical equivalents did not alter, but spherical and cylindrical errors did. As a result, the best corrected VA improved. The following variables did not differ statistically significantly: anterior chamber angle, anterior chamber volume, central corneal thickness, pupil size, or intraocular pressure.

REFERENCES:

Haneesha K, Sreevatsala T, Tejaswi M. A clinical study of Neodymium YAG Laser capsulotomy – the pattern and energy used for various grades of PCO and outcome. Int J Adv Res. 2021;9:34-46.

Das N, Shams A, Khan B, Kumar J, Nasir S, Bhatti NM. Effects of Neodymium-Dopped Aluminium Garnet (Nd:YAG) laser capsulotomy on visual outcomes from q lower middle income country. Cureus. 13(9):e17895.

Siddappa SN, Mahalingu DS, Anjenappa R, Joy TS. Two different patterns and outcome of neodymium YAG capsulotomy. Int J Clin Exp Ophthalmol. 2020;4:12-4.

Urfalioglu S, Ozdemir G, Guler M, Daghan B, Oz F. The evaluation of the effect of Nd-YAG capsulotomy on posterior ocular vascular structures by optical coherence tomography angiography. Photodiagnosis Photodyn Ther. 2023;42:103323.

Tariq M, Iqbal K, Inayat B, Rehman M, Zaheer W, Shahid MA, et al. Impact of Neodymium-Doped Yttrium Aluminum Garnet (ND-YAG) posterior capsulotomy laser treatment on central macular thickness: a prospective, observational study from a tertiary care center. Cureus. 2021;13(7):e16242.

Tan Y, Zhang J, Li W, Jin G, Luo L, Liu Z. Refraction shift after Nd:YAG posterior capsulotomy in pseudophakic eyes: a systematic review and meta-analysis. J Refract Surg. 2022;38(7):465-73.

Borkenstein AF, Borkenstein EM, Omidi P, Langenbucher A. Evaluating impact of Nd: YAG laser associated defects on optical quality of hydrophilic and hydrophobic intraocular lenses using visualization of light propagation and USAF test targets. BMC Ophthalmol. 2022;22:494.

Parveen S, Naeem S, Hanif K, Akbar B.Comparison of Nd: Yag (Neodymium-Doped Yttrium Aluminum Garnet) laser posterior capsulotomytechniques in the treatment of posterior capsular opacification. Pak Armed Forces Med J 2022; 72(1): 164-168.

Ely AL, Pantanelli SM, Borkhetaria RK, Barbieri CA, McQuillan PM. Nd:YAG laser posterior capsulotomy performed under general anesthesia in the sitting position: A novel approach. Digit J Ophthalmol 2023;29:36-9.

Mohamed I, Farag M, Ead M. Effect of anterior chamber depth on the development of post YAG LASER capsulotomy macular edema. Al Azhar Int Med J 2022;3:145-50.

Panezai MN, Shawani MA, Hameed K. Posterior capsular opacification (PCO) and NdD: YAG laser capsulotomy in helpers eye hospital Quetta. Pak J Ophthalmol 2004;20:115-8.

Khan MY, Jan S, Khan MN, Khan S, Kundi N. Visual outcome after Nd-YAG capsulotomy in posterior capsule opacification. Pak J Ophthalmol 2006;22: 87-92.

Ozkurt YB, Sengör T, Evciman T, Haboğlu M. Refraction, intraocular pressure and anterior chamber depth changes after Nd:YAG laser treatment for posterior capsular opacification in pseudophakic eyes. Clin Exp Optom 2009;92:412-5.

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.

Oztas Z, Palamar M, Afrashi F, Yagci A. The effects of Nd:YAG laser capsulotomy on anterior segment parameters in patients with posterior capsular opacification. Clin Exp Optom 2015;98:168-71.

Bozukova D, Pagnoulle C, Jérôme C. Biomechanical and optical properties of 2 new hydrophobic platforms for intraocular lenses. J Cataract Refract Surg 2013;39:1404-14.

Monteiro T, Soares A, Leite RD, Franqueira N, Faria-Correia F, Vaz F. Comparative study of induced changes in effective lens position and refraction after Nd:YAG laser capsulotomy according to intraocular lens design. Clin Ophthalmol 2018;12:533-7.

Lee Y, Kim JS, Kim BG, Hwang JH, Kang MJ, Lee JH. Comparison of the incidence of Nd:YAG laser capsulotomy based on the type of intraocular lens. Medicina (Kaunas) 2023;59:2173.

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. Clin Ophthalmol 2019;13:945-52.

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;118:1334-7.

Coelho RP, Pelinson AFTS, Campos LTS. YAG Laser Capsulotomy: Indications, Risk, and Care. e-Oftalmo.CBO: Rev Dig Oftalmol 2017;3:1-7. doi: 10.17545/e-oftalmo.cbo/2017.88.

Aslam TM, Devlin H, Dhillon B. Use of Nd:YAG laser capsulotomy. Surv Ophthalmol 2003;48:594-612.

Eliaçık M, Bayramlar H, Erdur SK, Demirci G, Gülkılık G. Anterior segment optical coherence tomography measurement after neodymium-yttrium-aluminum-garnet laser capsulotomy. Am J Ophthalmol 2014;158:994-8.

Palamar M, Egrilmez S, Uretmen O, Yagci A, Kose S. Influences of cyclopentolate hydrochloride on anterior segment parameters with pentacam in children. Acta Ophthalmol 2011;89:e461-5.

Viswanathan D, Goldberg I, Graham SL. Longitudinal effect of topical antiglaucoma medications on central corneal thickness. Clin Exp Ophthalmol 2013;41:348-54.