The Impact of YAG Laser Capsulotomy on Intraocular Pressure

■ Dr. MAISOON MOHAMED * ■ Dr. Rania Abdullah Ali Alkhoja **
■ Dr. Algharib Albaghdadi Alshraa * * * ■ Dr. Amal Nouri Elthabet ****

● Received:21/09/2025 ● Accepted: 03/11/2025

■ **Abstract:**

Background: Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser capsulotomy is the gold standard for treating posterior capsule opacification (PCO). While effective, it is associated with complications, most commonly a rise in intraocular pressure (IOP). This study investigates the relationship between procedural parameters (capsulotomy size and total laser energy) and the incidence of complications.

Methods: A longitudinal study was conducted to follow up forty-eight pseudophakic patients with visually significant PCO underwent Nd:YAG laser capsulotomy at Tripoli Eye Hospital. Patients were monitored for IOP changes, cystoid macular edema (CME), and other complications at 1-hour, 1-week, and 1-month post-procedure. Statistical analysis assessed correlations between laser parameters and outcomes.

Results: A significant IOP spike was observed in treated eyes compared to untreated fellow eyes at 1-hour post-procedure ($p < 0.05$). This elevation was more pronounced and persistent in eyes with larger capsulotomy sizes (>3.9 mm) and higher total laser energy (>40 shots). Transient macular thickening

*DALOUB Lecturer Department of Ophthalmology Faculty of Human Medicine Tripoli University, E-maiI:Misadaloub@yahoo.com

* *DALOUB Lecturer Department of Ophthalmology Faculty of Human Medicine Tripoli University,E-maiI:dr.raniaelkhoja@gmail.com

* * *DALOUB Assistant Professor Department of Ophthalmology Faculty of Human Medicine Tripoli University E-maiI:alshraa@uot.edu.ly.

* * * *DALOUB Lecturer Department of Ophthalmology Faculty of Human Medicine Tripoli UniversityE-maiI:Amalelthabet@gmail.com

was noted but resolved by one month, with no significant correlation to laser parameters. No cases of retinal detachment or severe inflammation occurred. Pre-existing glaucoma was a risk factor for sustained IOP elevation.

Conclusion: Nd:YAG laser capsulotomy is a safe and effective procedure. However, IOP elevation is a common complication, strongly correlated with larger capsulotomy size and higher total energy. Using the minimal effective energy and a conservative capsulotomy size, particularly in glaucoma patients, is recommended to minimize complications.

Keywords: Nd:YAG Laser, Posterior Capsulotomy, Posterior Capsule Opacification, Intraocular Pressure, Cystoid Macular Edema, Cataract Surgery Complications

■ **المستخلص:**

الخلفية: يُعد استئصال المحفظة باستخدام ليزر YAG المشوب بالنيوديميوم (Nd:YAG) المعيار الذهبي لعلاج تعتيم المحفظة الخلفية (PCO). وعلى الرغم من فعاليته، إلا إنه يرتبط بمضاعفات، وأكثرها شيوعًا ارتفاع ضغط العين (IOP). تبحث هذه الدراسة في العلاقة بين المعايير الإجرائية (حجم استئصال المحفظة وإجمالي طاقة الليزر) ومعدل حدوث المضاعفات

الطريقة: أُجريت دراسة طولية لمتابعة ثمانية وأربعين مريضًا مصابين بضمور عدسة كاذب مع PCO ذو دلالة بصرية، خضعوا لاستئصال المحفظة بالليزر Nd:YAG في مستشفى طرابلس للعيون. تمت مراقبة المرضى بحثًا عن تغيرات ضغط العين، والوذمة البقعية الكيسية (CME)، ومضاعفات أخرى بعد ساعة واحدة، وأسبوع واحد، وشهر واحد من العملية. قيّم التحليل الإحصائي الارتباطات بين معايير الليزر والنتائج.

النتائج: لوحظ ارتفاع كبير في ضغط العين في العيون المعالجة مقارنةً بالعيون غير المعالجة بعد ساعة واحدة من العملية ($p < 0.05$). كان هذا الارتفاع أكثر وضوحًا واستمرارًا في العيون ذات أحجام استئصال المحفظة الأكبر (>3.9 مم) وطاقة الليزر الكلية الأعلى (>40 طلقة). لوحظ سماكة بقعية عابرة ولكنها اختفت بعد شهر واحد، دون وجود ارتباط كبير بمعايير الليزر. لم تحدث أي حالات انفصال شبكي أو التهاب شديد. كان الجلوكوما الموجود مسبقًا عامل خطر لارتفاع ضغط العين المستمر

الخلاصة: يُعد استئصال المحفظة باستخدام ليزر Nd:YAG إجراءً آمنًا وفعالًا. ومع ذلك، يُعد ارتفاع ضغط العين من المضاعفات الشائعة، ويرتبط ارتباطًا وثيقًا بحجم المحفظة الأكبر والطاقة الكلية الأعلى. يُنصح باستخدام الحد الأدنى من الطاقة الفعالة وحجم المحفظة المحافظ، خاصةً لدى مرضى الجلوكوما، لتقليل المضاعفات

● **الكلمات المفتاحية:** ليزر Nd:YAG، استئصال المحفظة الخلفية، تعتيم المحفظة الخلفية، ضغط العين، الوذمة البقعية الكيسية، مضاعفات جراحة إعتام عدسة العين

■ Introduction

Posterior capsule opacification (PCO) is the most frequent long-term complication of cataract surgery, causing visual degradation similar to the original cataract. The Nd:YAG laser posterior capsulotomy, introduced in the 1980s, provides a non-invasive and immediate solution by creating an opening in the opacified posterior capsule.

Despite its widespread use and efficacy, the procedure is not without risks. Documented complications include a rise in intraocular pressure (IOP), cystoid macular edema (CME), retinal detachment, and damage to the intraocular lens (IOL). The rise in IOP is the most common adverse event, with its severity potentially linked to technical parameters of the procedure.

This study aims to evaluate the complications associated with Nd:YAG laser capsulotomy, with a specific focus on the relationship between capsulotomy size, total laser energy delivered, and the incidence and severity of postoperative IOP elevation.

Methodology and Study Design

*S*tudy Design and Setting: This research was conducted at Tripoli Eye Hospital between January 2023 and January 2024 as a longitudinal to follow up patients with PCO underwent Nd:YAG laser capsulotomy.

Patient Selection: A total of 48 pseudophakic patients with visually significant PCO were enrolled. The inclusion criteria were bilateral pseudophakia, with only one eye scheduled for capsulotomy (the fellow eye served as a control). Patients with active ocular inflammation, retinal disease, or prior vitrectomy were excluded.

Intervention and Data Collection: All procedures were performed using a Zeiss Visulas III Nd:YAG laser system. Preoperative assessment included Best Corrected Visual Acuity (BCVA), IOP measurement via applanation tonometry, slit-lamp biomicroscopy, and dilated fundus examination. Data collected during the procedure included the number of laser shots, total energy used, and capsulotomy size and shape. Patients were followed up at 1 hour, 1 week, and 1-month post-procedure, with IOP measurement and complication

assessment at each visit.

Statistical Analysis: The Wilcoxon Rank-Sum Test was used to compare IOP between treated and control eyes. Regression analysis was employed to identify variables associated with IOP elevation. Subgroup analysis was performed based on capsulotomy size and total energy used.

■ Results

Intraocular Pressure (IOP) Changes

- A statistically significant rise in IOP was observed in treated eyes compared to control eyes at the 1-hour post-operative mark ($p < 0.05$).
- At one-week, mild IOP elevation persisted in 9.3% of patients with larger capsulotomy sizes (>3.9 mm), compared to only 2.7% in the small-size group.
- By one month, IOP had returned to baseline in most patients. However, all patients with a known diagnosis of glaucoma required sustained IOP-lowering medication.
- A positive correlation was found between larger capsulotomy size, higher total laser energy (>40 shots), and the magnitude of the immediate IOP spike.

Macular Thickness and Cystoid Macular Edema (CME)

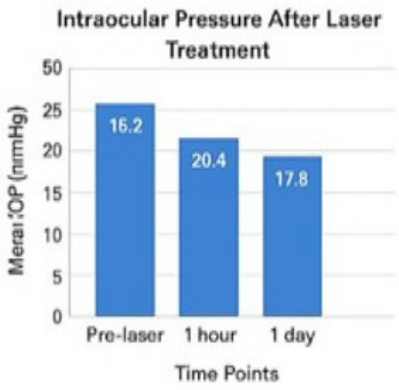
- Optical coherence tomography (OCT) revealed transient increases in macular thickness in both groups at one week, which resolved to preoperative levels by week 4. There was no statistically significant difference in macular thickening between the small and large capsulotomy groups.
- No clinical CME was diagnosed in the study cohort during the follow-up period.

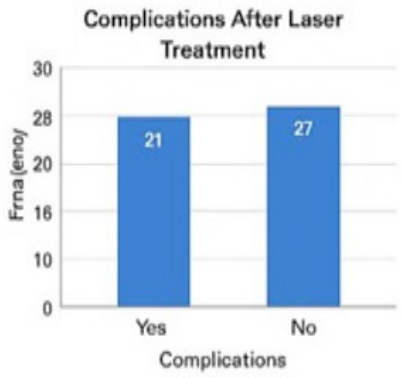
■ Other Complications

- IOL pitting was noted in two cases, but neither patient reported visual complaints.
- No instances of retinal detachment, pupillary block, or significant vitritis were observed.

Table 1 Characteristics of Study Population (n=48)

Variable	Frequency (n)	Percent (%)	p-value
Gender	27	56.3	0.84
Age	21	43.8	0.77
Complications	19	39.6	0.92
Prior Surgery on Eye	20	41.7	0.43
Ocular Hypertension	16	33.3	0.32
Need for Eye Drops	22	45.8	0.55
Post-Laser Surgery	5	10.4	0.72





Variable	Frequency (n)	Percent (%)	p-value
Gender	27	56.3	0.84
Age	28	79.2	0.77
Complications	19	39.6	0.92
Prior Surgery on Eye	20	41.7	0.43
Ocular Hypertension	16	33.3	0.52
Need for Eye Drops	22	45.8	0.85
Post-Laser Surgery	5	10.4	0.72

■ Discussion

This study confirms that Nd:YAG laser posterior capsulotomy is a highly effective procedure, but underscores the importance of technique in preventing complications. The most consistent finding was a transient IOP elevation, which was directly influenced by procedural aggressiveness—namely, larger capsulotomy size and higher total laser energy.

The correlation between energy/size and IOP spike highlights the need for a conservative approach. Using the minimum number of shots and the smallest effective capsulotomy diameter can significantly mitigate this risk, a consideration of paramount importance for glaucoma patients who demonstrated a propensity for sustained IOP elevation.

The transient nature of macular thickening in our study, with no cases progressing to clinical CME, suggests that while the procedure incites a mild inflammatory response, it is typically self-limiting. The absence of serious complications like retinal detachment in our cohort aligns with literature indicating it is a rare, multifactorial event.

Conclusion and Recommendations

Nd:YAG laser capsulotomy is a safe and vital procedure for managing PCO. To minimize complications, particularly IOP elevation, a conservative technique is recommended.

Clinical Recommendations:

1. **Utilize Minimal Energy:** *Employ the lowest effective energy per pulse and the fewest number of shots required to create an adequate opening.*
2. **Optimize Capsulotomy Size:** *Create a capsulotomy that is functional but conservative in size, ideally not exceeding the IOL optic diameter.*
3. **Pre-Treat High-Risk Patients:** *Administer prophylactic IOP-lowering medications to patients with pre-existing glaucoma or ocular hypertension.*
4. **Schedule Appropriate Follow-up:** *Monitor IOP closely within the first few hours and weeks after the procedure, especially in high-risk individuals.*
5. **Delay Refractive Correction:** *Advise patients to wait 2-4 weeks before updating spectacle prescriptions to allow for refractive stabilization.*

■ References

1. Wormstone IM. Posterior capsule opacification: a cell biological perspective. Exp Eye Res. 2002;74:337–347. [PubMed] [Google Scholar]

2. Nakazawa M, Ohtsuki K. Apparent accommodation in pseudophakic eyes after implantation of posterior chamber intraocular lenses. Am J Ophthalmol. 1983 Oct;96(4):435–8. PMID: 6624824. [PubMed] [Google Scholar]

3. Aron-Rosa D, Aron JJ, Griesemann M, Thyzel R. Use of the neodymium- YAG laser to open the posterior capsule after lens implant surgery: a preliminary report. J Am Intraocul Implant Soc. 1980 Oct;6(4):352–

4. PMID: 7440377. [PubMed] [Google Scholar] 4. Fankhauser F, Roussel P, Steffen J. Clinical studies on the efficiency of high power laser radiation upon some structures of the anterior segment of the eye. First experiences of the treatment of some pathological conditions of the anterior segment of the human eye by means of a Qswitched. Int Ophthalmol. 1981 May;3(3):129–39. PMID: 7196390. [PubMed] [Google Scholar]

5. Shah GR, Gills JP, Durham DG, Ausmus WH. Three thousand YAG lasers in posterior capsulotomies: an analysis of complications and comparison to polishing and surgical discission. Ophthalmic Surg. 1986 Aug;17(8):473–7. PMID: 3748538. [PubMed] [Google Scholar]

6. Chambless WS. Neodymium: YAG laser posterior capsulotomy results and complications. J Am Intraocul Implant Soc. 1985 Jan;11(1):31–2. PMID: 3838167. [PubMed] [Google Scholar]

7. Gardner KM, Straatsma BR, Pettit TH. Neodymium:YAG laser posterior capsulotomy: the first 100 cases at UCLA. Ophthalmic Surg. 1985 Jan;16(1):24–8. PMID: 3838376. [PubMed] [Google Scholar]

8. Stark WJ, Worthen D, Holladay JT, Murray G. Neodymium:YAG lasers An FDA report. Ophthalmology. 1985 Feb;92(2):209–12. PMID: 3982799. [PubMed] [Google Scholar]

9. Wasserman EL, Axt JC, Sheets JH. Neodymium:YAG laser posterior capsulotomy. J Am Intraocul Implant Soc. 1985 May;11(3):245–8. PMID: 4008310. [PubMed] [Google Scholar]

10. Magno BV, Datiles MB, Lasa MS, Fajardo MR, Caruso RC, Kaiser- Kupfer MI. Evaluation of visualfunction following neodymium:YAG laser posterior capsulotomy. Ophthalmology. 1997 Aug;104(8):1287–93. PMID: 9261315. [PubMed] [Google Scholar]

11. Sunderraj P, Villada JR, Joyce PW, Watson A. Glare testing in pseudophakes with posterior capsule opacification. Eye (Lond) 1992;6(Pt 4):411–3. PMID: 1478316. [PubMed] [Google

Scholar]

12. Tan JC, Spalton DJ, Arden GB. The effect of neodymium: YAG capsulotomy on contrast sensitivity and the evaluation of methods for its assessment. Ophthalmology. 1999 Apr;106(4):703–9. PMID: 10201590. [PubMed] [Google Scholar]

13. Keates RH, Steinert RF, Puliafito CA, Maxwell SK. Long-term follow-up of Nd:YAG laser posterior capsulotomy. J Am Intraocul Implant Soc. 1984 Spring;10(2):164–8. PMID: 6547424. [PubMed] [Google Scholar]

14. Ambler JS, Constable IJ. Retinal detachment following capsulotomy. Aust N Z J Ophthalmol. 1988 Nov;16(4):337–41. PMID: 3248183. [PubMed] [Google Scholar]

15. Bath PE, Fankhauser F. Long-term results of Nd:YAG laser posterior capsulotomy with the Swiss laser. J Cataract Refract Surg. 1986 Mar;12(2):150–3. PMID: 3754577. [PubMed] [Google Scholar]

16. Billotte C, Berdeaux G. Adverse clinical consequences of neodymium:YAG laser treatment of posterior capsule opacification. J Cataract Refract Surg. 2004 Oct;30(10):2064–71. PMID: 15474815. [PubMed] [Google Scholar]

17. Karahan E, Tuncer I, Zengin MO. The Effect of ND:YAG Laser Posterior Capsulotomy Size on Refraction, Intraocular Pressure, and Macular Thickness. J Ophthalmol. 2014;2014:846385. doi: 10.1155/2014/846385. PMID: 24724016. [PMC free article] [PubMed] [Google Scholar]

18. Ari S, Cingu AK, Sahin A, inar YC, Caca I. The effects of Nd:YAG laser posterior capsulotomy on macular thickness, intraocular pressure, and visual acuity. Ophthalmic Surg Lasers Imaging. 2012 Sep-Oct;43(5):395– 400. doi: 10.3928/15428877-20120705-03. PMID: 22785102. [PubMed] [Google Scholar]

19. Steinert RF, Puliafito CA, Kumar SR, Dudak SD, Patel S. Cystoid macular edema, retinal detachment, and glaucoma after Nd:YAG laser posterior capsulotomy. Am J Ophthalmol. 1991 Oct;112(4):373–80. PMID: 1928237. [PubMed] [Google Scholar]

20. Framme C, Hoerauf H, Roider J, Laqua H. Delayed intraocular lens dislocation after neodymium:YAG capsulotomy. J Cataract Refract Surg. 1998 Nov;24(11):1541–3. PMID: 9818350. [PubMed] [Google Scholar]

21. Levy JH, Pisacano AM, Anello RD. Displacement of bagplaced hydrogel lenses into the vitreous following neodymium: YAG laser capsulotomy. J Cataract Refract Surg. 1990 Sep;16(5):563–6. PMID: 2231370. [PubMed] [Google Scholar]

22. Maguire AM, Blumenkranz MS, Ward TG, Winkelman JZ. Scleral loop fixation for posteriorly

dislocated intraocular lenses. Arch Ophthalmol. 1991 Dec;109(12):1754–8. PMID: 1841589. [PubMed] [Google Scholar]

23. Schneiderman TE, Johnson MW, Smiddy WE. Surgical management of posteriorly dislocated silicone plate haptic intraocular lenses. Am J Ophthalmol. 1997 May;123(5):629–35. PMID: 9152068. [PubMed] [Google Scholar]

24. Shakin EP, Carty JB Jr. Clinical management of posterior chamber intraocular lens implants dislocated in the vitreous cavity. Ophthalmic Surg Lasers. 1995 Nov-Dec;26(6):529–34. PMID: 8746574. [PubMed] [Google Scholar]

25. Findl O, Drexler W, Menapace R, et al. Changes in intraocular lens position after neodynamium: YAG capsulotomy. Ophthalmic Surg Lasers. 1995 Nov-Dec;26(6):529–34. PMID: 8746574. [Google Scholar]

26. Thornval P, Naeser K. Refraction and anterior chamber depth before and after neodymium:YAG laser treatment for posterior capsule opacification in pseudophakic eyes: a prospective study. J Cataract Refract Surg. 1995 Jul;21(4):457–60. PMID: 8523294. [PubMed] [Google Scholar]

27. Zaidi M, Askari NS. Effect of Nd:YAG laser posterior capsulotomy on anterior chamber depth, Intraocular pressure, and refractive status. J Cataract Refract Surg. 2000 Aug;26(8):1183–9. PMID: 11008046. [PubMed] [Google Scholar]

28. Hasan KS, Adhi MI, Aziz M, et al. Nd:YAG Laser Posterior Capsulotomy. Pak J Ophthalmol. 1996;12:3–7. [Google Scholar] 29. Harris WS, Herman WK, Fagadau WR. Management of the posterior capsule before and after the YAG laser. Trans Ophthalmol Soc U K. 1985;104(Pt 5):533–5. [PubMed] [Google Scholar]