Cataract extraction after inadvertent Nd:YAG laser capsulotomy in a phakic eye

Majid Moshirfar1,2,3, Alyson N Tukan4 and Nour Bundogji4

Abstract
Inadvertent neodymium: yttrium–aluminum–garnet (Nd:YAG) capsulotomies are rare, with only one incident reported in the literature prior to the present case. We discuss the management of a phakic patient with a dense posterior subcapsular cataract who underwent yttrium–aluminum–garnet (YAG) capsulotomy for presumed posterior capsular opacification. Operative course involved cataract surgery with anterior vitrectomy for prolapsed lens fragments due to the disrupted posterior capsule. This patient experienced excellent visual outcomes postoperatively, with ultimate best-corrected visual acuity of 20/20. This case underscores the importance of thorough preoperative time out, including confirmation of patient's understanding of the intended procedure.

Keywords
Capsulotomy, neodymium: yttrium-aluminum-garnet, posterior subcapsular cataract, posterior capsular opacification

Date received: 14 September 2022; accepted: 13 April 2022

Introduction
Development of posterior capsular opacification (PCO) is one of the most common complications after phacoemulsification cataract extraction and is easily rectified with a posterior capsulotomy using the neodymium:yttrium–aluminum–garnet (Nd:YAG) laser.1 YAG capsulotomy can be performed in the office and spares the patient an additional incisional procedure, thus simplifying the management of PCO. Visual outcomes are excellent, with improved functional visual acuity, greater low-contrast visual acuity, and fewer higher-order aberrations.2 Although it is a relatively simple procedure, YAG capsulotomy is not without risks. A review article reports that the most prevalent complications after YAG capsulotomy include intraocular lens (IOL) movement, hyperopic shift, IOL pitting, anterior chamber flare/iritis, elevated intraocular pressure, cystoid macular edema, and retinal tear/detachment.1

Though rates of these outcomes are variable across studies, the potential for adverse effects after YAG capsulotomy underscores the importance of deliberate patient selection to maximize the procedural risk/benefit ratio. Given careful preoperative evaluation and grading of PCO prior to YAG capsulotomy, it is rare to encounter YAG capsulotomies performed in error. In fact, to our knowledge, only one case in the literature reports an inadvertent YAG capsulotomy for a misdiagnosis of PCO.3 The present case contributes another incident of a phakic patient undergoing YAG capsulotomy, followed by cataract extraction with an open posterior capsule.

Case presentation
An 81-year-old phakic female patient with an ocular history of macular degeneration presented to her ophthalmologist with symptoms of worsening glare and progressive difficulty reading over the past year. The details regarding the patient's history obtained at this first visit are not available. During the initial examination, the patient was deemed to have visually significant PCO in the left eye, for which she was scheduled...
to undergo YAG capsulotomy. After firing several shots with the YAG laser, the ophthalmologist realized that the patient was phakic, and her dense posterior subcapsular cataract (PSC) had been mistaken for PCO. The patient was referred to our office for evaluation of cataract surgery in the setting of a disrupted posterior capsule secondary to the inadvertent YAG capsulotomy.

On presentation to our office, the patient noted worsened blurry vision in her left eye with best-corrected visual acuity (BCVA) of 20/400. Slit-lamp examination of the left eye revealed a clear cornea, flat iris, 2 + nuclear sclerotic cataract, 4 + PSC, and a 4 x 2 mm opening in the posterior capsule (Figure 1) with radialized, scrolled edges (Figure 2). The vitreous had few cells, and macula was notable for retinal pigment epithelium changes. Cataract surgery was discussed in detail with the patient, with emphasis on the complexity of her case and guarded visual prognosis.

**Operative management**

On the day of surgery, the patient was prepared and draped in the usual sterile ophthalmic fashion after receiving retrobulbar block. Surgery proceeded with modifications of the standard protocol. The pre-existing posterior capsular opening was observed, and the red reflex was noted to be dull due to the cataract and the hydrated cortex. Vision blue was introduced, and only a minimal amount of Viscoat was used to prevent deepening the anterior chamber and further extension of the existing posterior capsular tear. A 5.5 mm capsulorhexis was created. Hydrodissection and hydrodelineation were not performed due to the possibility of dislocating the entire nucleus into the vitreous cavity. After an initial groove of 50% depth of the nucleus using minimal energy, the bottle height was lowered to approximately 55 mmHg. While maintaining a shallow chamber and using low irrigation with low aspiration flow rate, the nucleus was bisected into two hemispheres and then prolapsed into the shallow anterior chamber similar to a Brown maneuver. This maneuver decreased the risk of the cataract falling into the vitreous with phacoemulsification. Subsequently, the two hemi-nucleus were removed with minimal phacoemulsification energy. Remnants of the cortical material were removed using a manual Simcoe-style irrigation/aspiration system. Anterior vitrectomy was performed. It was noted that approximately one-fifth of the cortex fell into the vitreous chamber during phacoemulsification. It was confirmed that no vitreous remained in the anterior chamber and anterior capsule was intact. Upon completion of the vitrectomy, a 3-piece acrylic IOL, 21.5D AR40e lens (Johnson & Johnson Vision Care, Inc, USA), was inserted into the sulcus with the optic of the IOL captured into the capsulorhexis. Miochol was injected into the anterior chamber, and the pupil was confirmed to be round without peaking. A single interrupted 10-0 nylon suture was used to close the main incision. The lens was well-centered, and the patient was taken to recovery in good condition.

**Postoperative course**

Postoperatively, the patient was treated with a regimen of PredForte, ofloxacin, and ketorolac. Uncorrected visual acuity (UDVA) improved from 20/125 on Day one to 20/40 at 3 weeks, with BCVA 20/25 and manifest refraction of +0.75−1.25 x 180. The IOL was observed to be stable and in good position with optic capture. A 1.5 mm fragment was noted in the vitreous, with vitreous heme that was almost completely resorbed by three weeks postoperatively. The final UDVA was 20/30, with BCVA 20/20.

**Discussion**

The present case reports the rare event of a YAG capsulotomy in a phakic eye. Fortunately, the patient did not experience...
any direct iatrogenic consequences of the YAG capsulotomy, such as retinal tear/detachment and intraocular pressure elevation. However, her subsequent cataract surgery was more complex given the existing opening in her posterior capsule, which allowed a large fragment of her cataract to prolapse into the vitreous chamber. Although not unexpected, this required a vitrectomy and posed further risks to the patient than a standard cataract extraction. Sulcus implantation of the IOL was successful, and this patient has experienced good visual outcomes postoperatively. From a surgical standpoint, this case presents similar challenges to the extraction of a polar cataract with compromised integrity of the posterior capsule. Various surgical techniques have been employed to minimize the risk of posterior capsular rupture, though phacoemulsification can successfully be employed with caution as was used in the present case. Special considerations include minimizing rapid pressure changes in the capsular bag, mechanically cushioning the posterior defect with the epinucleus, using low aspiration and flow settings, and maintaining a closed environment to preserve the iridocapsular-diaphragm.

Only one other similar case has been reported in the literature. Ibrahim et al. describe a patient who unexpectedly had lens dislocation during phacoemulsification and was later discovered to have already undergone a YAG capsulotomy preoperatively. The patient had been diagnosed with PCO by two separate practitioners, when in fact she had a dense PSC and was already scheduled to undergo cataract surgery at the time of the YAG capsulotomy. We have no information on the exact pre-YAG capsulotomy evaluation by the referring clinician. We advise the preoperative evaluation to include a complete history, any cataract or ocular surgery, a fully dilated eye examination, and documentation of all the findings.

These two cases highlight the alarming scenario in which a misdiagnosis of PCO in a phakic patient is perpetuated to the level of treatment with YAG capsulotomy. The patients in these cases were at risk from both the YAG capsulotomy and subsequent complex cataract extraction. The Joint Commission established the Universal Protocol in 2004 to prevent wrong site, wrong procedure, and wrong person surgeries by introducing a preoperative time out, and these time outs have been shown to improve team communication without sacrificing efficiency. Thorough time-outs could have prevented events such as the cases described above. A detailed root-cause analysis should be performed to identify where the breakdown in the Universal Protocol occurred and prevent future repetition of this error. A disruption in the continuity of care introduces the opportunity for an initial misdiagnosis of PCO (instead of PSC) to be overlooked if the ophthalmologist performing the YAG procedure assumes that the preoperative diagnosis is correct. As Ibrahim et al. mention, incomplete mydriasis may play a role in the misdiagnosis of PCO, which is compounded by the lack of continuity between providers. A deliberate and thorough preoperative time-out, as defined by the Universal Protocol, should also be conducted in the laser room to verify that the patient’s name, date of birth, procedure, and intended eye are correct. It is of paramount importance that the ophthalmologist performing the procedure confirms the diagnosis and procedure. Other factors to consider are inadequate preoperative evaluation, incomplete or inaccurate documentation, misinterpretation of the records, and incorrect terminology for the diagnosis or procedure.

The preoperative consent process likely needs modification, as well. Whether it is a language barrier or diminished hearing acuity from advanced age, patients may arrive in the laser room without a clear understanding of the planned procedure or why it is indicated for them. Furthermore, shame surrounding feelings of illiteracy and lack of comprehension may prevent patients from asking questions or advocating for themselves if they have doubts about the relevance of the procedure. Thus, patient understanding of any given procedure or treatment should always be confirmed. Evidence suggests that the teach-back method is effective by allowing patients to reiterate the basics of the procedure, including the intention, risks, and alternatives, in order to confirm comprehension.

**Conclusion**

With a patient’s vision and safety at stake, entirely preventable errors such as performing YAG capsulotomy in a phakic eye are unacceptable. Preoperative time-outs should be considered an essential component of any procedure and performed with diligence. Importantly, verifying patient understanding of the intended procedure is paramount to this process. Fortunately, the present case demonstrates that good visual outcomes are still possible after cataract extraction despite a more complex case requiring vitrectomy for prolapsed lens fragments in the setting of an inadvertent capsulotomy.

**Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Ethical approval**

The study conforms with the Helsinki Declaration of 1964, as revised in 2013, concerning human and animal rights. The Hoopes Vision Ethical Review Board approved this case report.

**Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

**Informed consent**

Written informed consent was obtained from the patient for their anonymized information to be published in this article.
Publication originality statement
We confirm this publication is original.

ORCID iD
Alyson N Tukan https://orcid.org/0000-0002-1126-1594

References
1. Karahan E, Er D and Kaynak S. An overview of Nd:YAG laser capsulotomy. Med Hypothesis Discov Innov Ophthalmol 2014; 3(2): 45–50.
2. Wakamatsu TH, Yamaguchi T, Negishi K, et al. Functional visual acuity after neodymium:YAG laser capsulotomy in patients with posterior capsule opacification and good visual acuity preoperatively. J Cataract Refract Surg 2011; 37(2): 258–264.
3. Ibrahim AA, Carrim ZI and Mahomed I. Phakic YAG capsulotomy: the penny dropped after the nucleus. Clin Exp Ophthalmol 2013; 41(8): 809–810.
4. Vasavada AR and Vasavada VA. Managing the posterior polar cataract: an update. Indian J Ophthalmol 2017; 65(12): 1350–1358.
5. The Joint Commission. Universal Protocol, https://www.jointcommission.org/standards/universal-protocol/ (accessed 13 July 2021).
6. Lee SL. The extended surgical time-out: does it improve quality and prevent wrong-site surgery. Perm J 2010; 14(1): 19–23.
7. Miller MJ, Abrams MA, Earles B, et al. Improving patient-provider communication for patients having surgery: patient perceptions of a revised health literacy-based consent process. J Patient Saf 2011; 7(1): 30–38.