

# Nd: YAG capsulotomy for posterior capsule opacification after combined clear corneal phacoemulsification and vitrectomy

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**Purpose:** To evaluate the efficacy and safety of Neodymium:YAG (Nd:YAG) laser capsulotomy for posterior capsule opacification (PCO) following combined phacoemulsification and vitrectomy for the treatment of cataract in association with macular hole (MH) or epiretinal membrane (ERM).

**Methods:** Retrospective clinical study of 34 eyes of 34 patients who underwent combined cataract surgery and vitrectomy, developed PCO, and subsequently underwent Nd:YAG laser capsulotomy. Follow-up examinations included visual acuity measurement, evaluation of intraocular lens (IOL) centration, intraocular pressure (IOP) measurement, and dilated fundus examination.

**Results:** Nd:YAG laser capsulotomy was performed in all 34 eyes. The mean age of the patients was 65.08 years (range 45–87) and the mean follow up period was 11.05 months (range 4–23). The mean time elapsed between the last intraocular operation and the development of PCO was 10.00 months for patients with previous ERM and 15.33 for those with MH ( $P = 0.001$ , t-test for equality of means). None of our patients developed recurrence of MH, retinal detachment, IOL dislocation, or permanent IOP elevation.

**Conclusion:** In our study, the most remarkable observation is that no complication occurred after the YAG capsulotomy, possibly because the eyes were vitrectomized and vitreous seems to play an important role in the occurrence of post-Nd:YAG complications. In addition we noted that PCO seems to occur earlier in the eyes undergoing combined surgery for cataract and ERM when compared with those where combined phacoemulsification and vitrectomy are performed for cataract and MH.

**Keywords:** Nd:YAG capsulotomy, phacoemulsification, vitrectomy

## Introduction

Cataract, epiretinal membranes (ERM), and macular holes (MH) are distinct clinical entities frequently coexisting in the same patient.

Robert Machemer, who was the first to establish an experimental model of retinal detachment, is best known for his development of pars plana vitrectomy for the treatment of vitreous hemorrhages in proliferative diabetic retinopathy.<sup>1</sup> Nowadays, almost four decades since Machemer's revolutionary work, performance of combined vitrectomy and phacoemulsification is common when both cataract and vitreoretinal disease are present. This approach is necessary to enable adequate visualization of the posterior pole during vitreoretinal procedures and even if the opaque lens does not reduce visual function prior to surgery, it often progresses postoperatively as a result of vitreoretinal operation and the use of intraocular gas or silicone oil. Additionally, combined surgery has been considered to reduce intraoperative complication rates and allows immediate visual rehabilitation with only one operation.<sup>2–4</sup>

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Posterior capsular opacification (PCO) is the most common complication of cataract extraction, occurring in up to 33% of patients after five years.<sup>5,6</sup> PCO, apart from visual impairment, can obscure fundus view and potentially compromise follow-up ability of patients with posterior segment pathology such as diabetic retinopathy and macular edema. Neodymium: YAG (Nd:YAG) laser capsulotomy, the treatment of choice, is not without complications, some of which might be sight-threatening such as macular edema and retinal detachment.<sup>7</sup>

Prognosis and complication rate of Nd:YAG laser capsulotomy in patients having undergone combined vitreoretinal surgery and phacoemulsification has been inadequately described in the literature.<sup>8-10</sup> We reviewed a series of 34 eyes that developed PCO and required Nd:YAG laser capsulotomy after combined cataract and vitreoretinal surgery.

## Patients and methods

We retrospectively reviewed the medical records of 34 patients (34 eyes) with PCO who had previously undergone combined pars plana vitrectomy with phacoemulsification and intraocular lens (IOL) implantation. All patients had surgery at the Department of Ophthalmology, Athens General Hospital 'G. Genimatas' by a single surgeon.

All patients presented with decreased visual acuity which was attributed to PCO during their follow up in our clinic. Nd:YAG laser capsulotomy was performed if it was clinically indicated by a decrease in visual acuity of two lines at least since previous examination or in the presence of a clinically opaque capsule. Nd:YAG laser capsulotomy was eventually performed in all 34 eyes. The procedure was performed under topical anesthesia (tetracaine drops), and pupil dilatation was achieved with the use of tropicamide 1% and phenylephrine 10%. The procedure was interrupted if more than five IOL pits were observed. Postoperative use of dexamethasone 0.1% and iopidine drops were prescribed for one week. Follow up examinations included visual acuity measurement, evaluation of IOL centration, intraocular pressure (IOP) measurement using Goldman applanation tonometry, and dilated fundus examination. The mean follow-up period (after Nd:YAG capsulotomy was performed) was 11 months.

## Results

The demographic and clinical features of the patients are listed in Table 1. The mean age of the patients was 65.08 years (range 45-87) and the mean follow up period was 11.05 months (range 4-23).

All eyes had clinically significant lens opacification at the time of vitreoretinal surgery. The indications for vitreoretinal surgery included: vitreomacular traction syndrome (VMT) (four eyes), MH (12 eyes) and the presence of an ERM (18 eyes).

In all eyes after uncomplicated phacoemulsification, the IOL (foldable three-piece hydrophobic acrylic PC IOL Acrysof MA60BM; Alcon Laboratories, Fort Worth, TX) with 5.5 mm optic diameter was implanted in the capsular bag through a 4.5 to 5 mm capsulorhexis. Subsequently in eyes with MH (12 eyes) and with VMT (4 eyes) a 20-gauge-vitrectomy was performed with induction of PVD using the vitreous cutter to engage and pull on the peripapillary vitreous. A volume of 0.3 ml of Trypan blue was injected in the vitreous cavity over the posterior pole and removed two minutes later; Internal limiting membrane (ILM) was peeled off from the macular area. Perfluoropropane C<sub>3</sub>F<sub>8</sub> gas 14% was used in the cases with MHs and the patient was instructed to adopt prone positioning for seven days. In eyes with ERMs, a 20-gauge-vitrectomy was performed, ERM peeling and subsequently the ILM was peeled of the macula with the aid of Trypan blue. No tamponade was used in any case with ERM or VMT.

Posterior capsule opacification was observed in all 34 eyes and required an Nd:YAG capsulotomy because of deterioration in postoperative best-corrected visual acuity. None of the eyes had persistent endotamponade when they underwent Nd:YAG capsulotomy.

Postcapsulotomy, four eyes developed moderate anterior chamber reaction that resolved with topical corticosteroids. In seven eyes IOP increased temporarily for a few days post-op, but it was well controlled with topical antiglaucoma agents. None of our patients developed retinal detachment or recurrence of MH. IOL decentration or dislocation did not occur in any of the studied eyes. Cystoid macular edema was observed in two eyes that had undergone combined vitrectomy and phacoemulsification for ERM removal, however, the edema was also evident before the YAG-capsulotomy and did not augment after the procedure.

The visual acuity pre- and post-YAG capsulotomy, as well as the time elapsed until the appearance of PCO are listed in Table 1 and vary according to the nature of the disease. It seems that PCO appears earlier (Table 2;  $P = 0.001$ , t-test for equality of means) in the eyes suffering an ERM (mean 10.00 months) compared to patients with MH disease (mean 15.33 months). No difference between the two groups was observed in age ( $P = 0.491$ , t-test for equality of means) or

**Table I** Data for patients treated with Nd:YAG capsulotomy

Case	Age (yr)	Sex	Condition	Follow-up (M)	VA pre-YAG	VA post-YAG
1	56	Male	ERM	6	20/63	20/40
2	77	Male	ERM	8	20/80	20/40
3	78	Female	ERM	17	20/50	20/25
4	67	Female	ERM	18	20/50	20/40
5	64	Female	ERM	13	20/40	20/25
6	65	Female	ERM	12	20/80	20/40
7	53	Male	ERM	7	20/63	20/40
8	62	Female	MH	7	20/100	20/63
9	54	Male	MH	4	20/40	20/40
10	58	Male	ERM	5	20/50	20/25
11	78	Male	MH	19	20/100	20/63
12	83	Male	VTS	15	20/60	20/40
13	45	Male	ERM	8	20/40	20/25
14	56	Male	MH	5	20/40	20/40
15	67	Male	VTS	7	20/100	20/40
16	65	Male	ERM	10	20/50	20/40
17	54	Male	MH	14	20/32	20/25
18	87	Male	MH	12	20/100	20/63
19	76	Male	ERM	15	20/63	20/40
20	65	Female	ERM	10	20/50	20/32
21	66	Male	ERM	5	20/80	20/32
22	51	Female	ERM	5	20/80	20/40
23	59	Female	ERM	4	20/80	20/32
24	72	Female	VTS	19	20/100	20/40
25	77	Female	MH	21	20/40	20/32
26	69	Male	ERM	23	20/63	20/40
27	61	Female	MH	19	20/100	20/80
28	59	Male	ERM	10	20/80	20/40
29	55	Female	ERM	5	20/100	20/63
30	67	Female	MH	18	20/40	20/32
31	78	Male	MH	12	20/100	20/40
32	59	Male	MH	8	20/63	20/40
33	51	Female	MH	9	20/40	20/25
34	79	Female	VTS	6	20/100	20/40

**Abbreviations:** ERM, epiretinal membrane; MH, macular hole; VA, visual acuity; VTS, vitreomacular traction syndrome.

**Note:** Follow-up is measured in months, age is measured in years.

in sex ( $P = 0.465$ , chi-square test). None of the eyes had any complication after the Nd:YAG capsulotomy.

## Discussion

Posterior capsule opacification remains the most common long-term complication after cataract surgery. It can be treated by Nd:YAG laser capsulotomy, however, this may lead to other complications. It has been suggested that PCO may be significantly more extensive after combined vitrectomy and phacoemulsification than after cataract

surgery alone.<sup>11</sup> Toda and colleagues,<sup>11</sup> in a study evaluating the degree of PCO in patients undergoing combined cataract and vitreoretinal surgery, concluded that the PCO rate was significantly higher after combined surgery especially in patients with diabetes mellitus. After combined surgery eyes could also develop severe postoperative inflammation, which probably leads to more extensive PCO.<sup>12,13</sup> Lens epithelial cells (LECs) proliferate in response to many factors, one of which is inflammation. It has been suggested that surgical trauma stimulates residual LECs to produce cytokines such

**Table 2** Table demonstrating the time elapsed between combined vitrectomy–phacoemulsification and posterior capsule opacification

Time until PCO		
Case	ERM	MH
1	10	12
2	5	18
3	6	17
4	9	10
5	11	19
6	12	9
7	5	19
8	8	14
9	11	16
10	8	15
11	14	18
12	18	17
13	6	
14	9	
15	11	
16	12	
17	19	
18	6	

**Abbreviations:** ERM, epiretinal membrane; MH, macular hole; PCO, posterior capsule opacification.

**Note:** Time until PCO is measured in months.

as interleukin-1 (IL-1), IL-6, IL-8, basic fibroblast growth factor and transforming growth factor. These cytokines may play an important role in fibrous proliferation of LECs via an autocrine pathway, paracrine pathway, or both.<sup>14,15</sup> The degree of postoperative inflammation appears to be related to PCO development after combined surgery even in patients without diabetes mellitus.<sup>11</sup>

Silicone IOLs have been considered to provoke PCO.<sup>16</sup> Other factors that are considered to contribute to the formation of PCO include IOL decentration, capsulorhexis decentration, capsule tears, and insufficient zonules, but in our cases we had none of these complications.

In our study, where we chose an acrylic IOL, the capsular fibrosis in the cases dealt with combined vitrectomy and phacoemulsification was probably enhanced by accumulation of fibrin and proliferation of stimulating factors in the space between IOL and the posterior capsule. In cases treated with combined surgery the posterior capsule is “supported” by fluid or gas and not from the vitreous, as it happens in eyes undergoing cataract surgery alone; this may have a role in the induction of posterior capsular fibrosis in the early postoperative period, and this finding is in accordance with the findings of other authors.<sup>17,18</sup> Another contributing factor to

early occurrence of PCO after combined surgery, could be the inflammation which is induced by the prolonged surgery time and the combination of cataract with vitrectomy surgery.

In addition, the appearance of significant PCO seemed to have occurred earlier in the eyes that underwent combined surgery due to ERM (mean 10.0 months) compared to the patients having a MH preoperatively (15.33 months). Although it is difficult to draw an accurate conclusion due to the small number of patients, it seems that the use of intravitreal gas which is used in all eyes undergoing MH surgery—but usually not in uncomplicated vitrectomy for ERM—does not enhance the occurrence of PCO. It is not unlikely that in cases with intravitreal gas use (MH cases), the gas “supports” the posterior capsule against the IOL and narrows the space between IOL and capsule forming a barrier to cell migration. On the other hand in cases with ERM the posterior capsule is loosely “supported” by the fluid filling the vitreous cavity giving more space for cell migration between the IOL and the capsule. Additionally, the underlying condition responsible for the occurrence of the ERM such as branch retinal vein occlusion, uveitis, or previous cryotherapy or laser may have played an additional role in the earlier occurrence of PCO in eyes with ERMs.

Neodymium:YAG laser capsulotomy can cause short- and long-term IOP elevations that could possibly induce subsequent glaucoma and damage to the optic nerve.<sup>19</sup> The underlying mechanism to this IOP rise after Nd:YAG laser capsulotomy remains unclear. Proposed mechanisms include effects to the ciliary body caused by the laser shock waves, a neurohumoral increase in the IOP, structural effects of laser energy on sodium hyaluronate, and finally mechanical blockage of the trabeculum with various debris such as fragments from the disrupted posterior capsule or vitreous. Other well established complications of Nd:YAG laser capsulotomy are retinal detachment and macular edema.<sup>20,21</sup> Proposed mechanisms for the above complications include liquefaction of the vitreous and interruption of the anterior hyaloid face.

In our study, no major complication was observed after the YAG capsulotomy apart from transient mild IOP spikes that were easily controlled with antiglaucoma drops. The absence of complications of YAG laser in the vitrectomized eyes of our study could be attributed to the absence of vitreous, alterations of which have been considered to play an important role in the development of IOP elevation, retinal detachment, and cystoid macular edema. Interestingly, IOL decentration or dislocation did not occur in any eye after YAG laser capsulotomy and the post-Nd:YAG capsulotomy visual acuity was restored in all 34 eyes.

## Conclusion

Nd:YAG capsulotomy seems to be a safe and effective procedure for eyes that have previously undergone combined phacoemulsification and vitrectomy surgery.

## Disclosure

The authors report no conflicts of interest in this work.

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