Incidence, Indications, and Outcomes of Yag Capsulotomy In Eyes Implanted with an Accommodating Intraocular Lens

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ABSTRACT

Objectives: To report the incidence of capsular changes in Crystalens-implanted eyes and analyze the indications and outcomes of yag capsulotomy.

Methods: We reviewed the records of 411 eyes of 258 patients implanted with the Crystalens IOL. Capsular change indications for yag capsulotomy were posterior capsular opacification (PCO), lens tilt, and capsular striae. Eyes in each indication were further subdivided into therapeutic yag (TY) and prophylactic yag (PY) groups. Outcomes before and after yag capsulotomy were analyzed.

Results: Ninety of 411 crystalens-implanted eyes (22%) had undergone yag capsulotomy. Sixty-one eyes had PCO, 12 had lens tilt, and 17 had striae. Twenty-seven eyes belonged to the therapeutic (TY) and 63 eyes to the prophylactic (PY) yag subgroups. The mean interval between phacoemulsification and yag capsulotomy was 10 months. In the TY PCO subgroup, uncorrected distance visual acuity (UDVA) changed from 20/40 pre-yag to 20/25 post-yag, uncorrected near visual acuity (UNVA) from J3 to J2, manifest refraction spherical equivalent (MRSE) from -0.43D to -0.2D. In the TY tilt subgroup, UDVA changed from 20/50 to 20/30, UNVA was unchanged at J2, and MRSE from -1.21D to -0.89D. In the TY striae group, UDVA changed from 20/50 to 20/30, UNVA from J3 to J2, and MRSE from 0.62D to -0.4D. In the PY PCO subgroup, UDVA was unchanged at 20/25, UNVA unchanged at J2, and MRSE changed from -0.52D to -0.47D. In the PY tilt subgroup, UDVA changed from 20/25 to 20/20, UNVA unchanged at J2, and MRSE changed from -0.87D to -0.45D. In the PY striae subgroup, UDVA was unchanged at 20/30, UNVA changed from J3 to J2, and MRSE changed from -0.62D to -0.7D.

Conclusion: Capsular changes occurred after Crystalens implantation that necessitated yag capsulotomy. Once vision has deteriorated, a therapeutic yag treatment can help improve vision. If capsular changes have occurred but vision has not deteriorated, a prophylactic yag capsulotomy can stabilize visual and refractive outcomes.

Keywords: Crystalens, accommodating IOL, YAG capsulotomy, posterior capsular opacity, lens tilt, striae, Z syndrome

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There is an increasing trend towards cataract surgeries using presbyopia-correcting intraocular lenses (IOL) that provide good unaided distance, intermediate, and near vision, thus decreasing a patient's dependence on eyeglasses.[1]

The Crystalens (Bausch & Lomb, Rochester, NY, USA) is the only accommodating IOL approved by the US Food and Drug Administration (FDA) with an indication for presbyopia correction. When a Crystalens-implanted eye tries to accommodate, the ciliary muscle contracts, increasing the pressure gradient from the vitreous cavity. The hinges that connect the two haptic plates to the optic allow the lens to move or vault forward. When the vitreous pressure dissipates, the lens optic moves backward.Another proposed mechanism of action is the arching of the center of the Crystalens optic as the eye accommodates, increasing its radius of curvature and consequently increasing the eye's effective positive power.[2]

The Crystalens requires an ideal resting position in the posterior capsular bag for maximum efficiency and stability of refractive outcomes. Though surgeries may be unremarkable, changes in capsular bag dynamics can arise postoperatively causing vision to deteriorate.

Several important events related to the capsular bag occur during and after cataract surgery. The cataract or natural lens, which is invariably larger and occupies the entire capsular bag, is replaced by a smaller and thinner IOL. The capsular bag inevitably shrinks and encapsulates the IOL. In some eyes, because of the length of the Crystalens, tension is formed along the long axis of the IOL, creating wrinkles or stretch marks called posterior capsular striae (PCS) that are visible under the Crystalens optic.

In the later postoperative period, retained lens epithelial cells within the capsular bag re-populate and migrate along the inner lining of the bag, making its way towards the posterior capsule. These cells can coalesce into a thick cloudy layer resulting in posterior capsular opacification (PCO).[3,4] Some cases of PCO can progress and form thick fibrous bands that contract creating tense wrinkles usually seen under the haptic plates.[3] These dense fibrous wrinkles may extend toward the central capsular area of the Crystalens creating another mechanism for PC striae formation. Other IOLs with C-loop haptics absorb the force of capsular contraction and rarely causes striae.

As capsular tension progresses, the hinges can bend symmetrically towards the same direction causing lens vaulting with a resultant refractive shift: a myopic shift if vaulting is anterior, a hyperopic shift if vaulting is posterior.[5] Tension on the two haptic plates can be uneven. If the hinges asymmetrically bend towards the same direction and lens position is altered, this is called lens tilt. If the hinges asymmetrically bend towards opposite directions (one forward and one backward), this IOL configuration in the capsular bag resembles the letter Z, with the tilted optic in the middle.[6] This variant of lens tilt is called Z syndrome. Posterior capsule striae, lens tilt, and Z syndrome are unique forms of capsular change observed in the Crystalens IOL.

With PCO and other capsular changes, the standard procedure for treatment is use of the Neodymium: Yttrium, Argon, Garnet laser posterior capsulotomy (yag capsulotomy).[7] It has been shown to be effective in opening posterior capsules, with improvement or maintenance in visual acuity in 96% of cases.

At present, there were only two case reports but no published literature regarding yag capsulotomy in a large cohort of Crystalens-implanted eyes.[6,12] The objectives of our study were to report the incidence and indications for yag capsulotomy in Crystalens-implanted eyes and to compare the visual and refractive outcomes before and after yag capsulotomy.

METHODOLOGY

This was a case series of 90 eyes that underwent Nd: YAG laser posterior capsulotomy (yag capsulotomy) after phacoemulsification with implantation of a monofocal accommodating intraocular lens (IOL). Both the surgeries and the laser procedures were done in a single private institution by a single surgeon. All eyes with other pathologies prior, during, and postsurgery, as well as those needing combined procedures for retina or glaucoma were excluded. Eyes that underwent previous refractive surgery were, likewise, excluded.

We reviewed the records of 411 eyes of 258 patients that were implanted with a Crystalens IOL after phacoemulsification. A total of 90 eyes of 58 patients underwent yag capsulotomy and were included in this study. Indications for yag capsulotomy were classified as posterior capsule opacification (PCO), posterior capsule striae (PCS), and lens tilt.

Each indication for yag capsulotomy was further subdivided into therapeutic yag (TY) and prophylactic yag subgroups. TY was performed on eyes wherein the uncorrected distance vision had worsened by 2 lines or more between one month postcataract surgery and preyag capsulotomy examination. PY was performed on eyes with the same indications of PCO, striae, and lens tilt but vision had not deteriorated yet by 2 lines or more of uncorrected distance vision for the same time points. Each subgroup was analyzed in terms of uncorrected distance (UDVA), intermediate (UIVA), and near vision (UNVA), and manifest refractive spherical equivalent (MRSE) before yag capsulotomy and on the last follow up documented after yag capsulotomy. UDVA was measured using a Snellen chart at a distance of 6 meters. UIVA and UNVA was measured using a reading card (Bausch & Lomb, Rochester, New York, USA) held at 32 inches (80 cm) for the UIVA, and 16 inches (40 cm) for the UNVA.The time points between cataract surgery and yag capsulotomy, as well as between yag capsulotomy and the last follow up, were reported.

After cataract surgery, majority of patients complied with the recommended follow-up schedule of day 1, 1 week, 1, 3, 6, 9, 12 months, then every 6 months thereafter. In addition to refraction, vision testing and slitlamp examination on each visit, the pupils were dilated and the posterior capsule checked on the slitlamp starting at 3 months postoperatively and every visit thereafter. Capsular findings were documented in the medical records. If capsular changes had occurred, patients were informed and advised to undergo yag capsulotomy.

The severity of the patients' PCO was classified according to the Madurai PCO grading scale[9] (Table 1). Patients with cells reaching the central posterior capsule area (PCO grade 2 or higher) were advised to undergo yag capsulotomy. Striae and lens tilt have no standard grading system but were reported as present or absent.

Nd:YAG Laser Posterior Capsulotomy

Yag capsulotomy was performed by a single surgeon (RTA) using the Visulas YAG II+ system (Carl Zeiss Meditec, AG, Germany). Eyes were dilated with tropicamide phenylephrine hydrochloride (SanMyd-P, Santen, Osaka, Japan). For posterior capsular opacity (PCO), laser shots were fired beginning centrally and extending outward in a spiral pattern. A round capsulotomy measuring 2 -2.5 mm was accomplished.

Table 1. Madurai PCO grading scale.

Level of Severity	Description
No PCO	No evidence of posterior capsule opacification (PCO) seen before and after pupillary dilation to a minimum of 6 mm. With a direct ophthalmoscope, a clear view of the optic disc, blood vessels, and the nerve fiber layer is obtained.
Grade I	No central PCO is seen. PCO is seen only with the pupil dilated to a minimum of 6 mm. With a direct ophthalmoscope, a clear view of the optic disc, blood vessels, and the nerve fiber layer is obtained.
Grade II	PCO is present in the central visual axis, detectable in an undilated pupil. With a direct ophthalmoscope, there is a mild obscuration of fundus detail, in that the optic nerve head is clearly seen but the retinal nerve fiber layer and the blood vessels are not clearly seen.
Grade III	PCO is present in the central visual axis with an undilated pupil. With direct ophthalmoscopy, there is a marked obscuration of fundus detail, in that even the margins of the optic nerve head are not clearly defined because of the PCO.

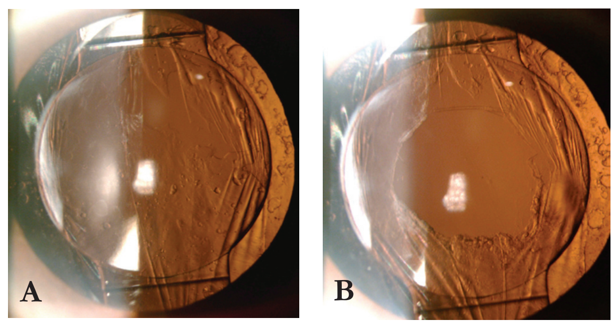

Figure 1. Posterior capsular opacity (A) and after yag capsulotomy (B).

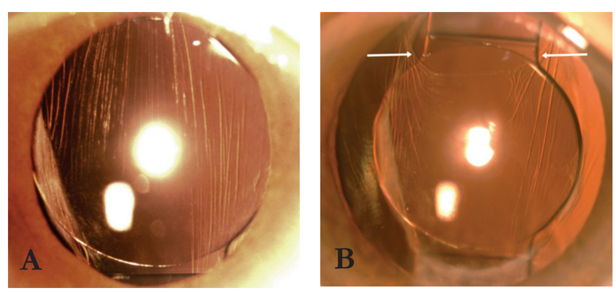

Figure 2. Posterior capsule striae and lens tilt (A) and after yag capsulotomy (B).

(Figure 1). For striae and lens tilt, a linear capsulotomy was created under the plate haptic where capsular tension was greatest. Laser shots were fired from the center of the haptic plate and extending to the lateral edges of the haptic plate (Figure 2). There were instances when a yag capsulotomy at the opposite haptic plate and/or the central capsular area was, likewise, performed in the same session or at a later session to relax the capsular tension. In some cases of

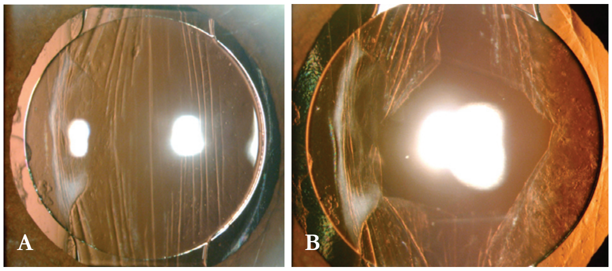

Figure 3. Multiple striae (A) and after yag capsulotomy (B).

striae, a yag treatment in the central capsular area was enough to relax the capsular tension (Figure 3). Laser power was between 0.7-1.0 mJ, taking note to use the least power to accomplish capsular rupture with minimal tear extensions. The patients were advised to instill one drop of tobramycin-dexamethasone (Tobradex, Alcon Laboratories Inc, Fort Worth, Texas, USA) four times a day for seven days.

Statistical Analysis

The demographic and clinical data were collated and analyzed. Differences between baseline and follow-up findings were noted. A paired t-test was used, with a *p* value equal to or less than 0.05 considered statistically significant.

RESULTS

Demographics

A Crystalens IOL was implanted in 411 eyes or 258 patients after phacoemulsification from January 2009 to August 2012. Out of this population, 90 eyes of 58 patients (22%) had undergone Nd:YAG laser posterior capsulotomy (yag capsulotomy). Forty-four eyes had the Crystalens HD model and 46 eyes had the AO model. Thirty-six patients were female and 22 were male. The mean age at the time of the yag capsulotomy was 65 years old (range: 32 – 82 years old) (Table 2).

Table 2. Demographics of the study population.

# of Crystalens-implanted eyes	411 eyes (258 patients)
# of Yag Capsulotomies	90 eyes (58 patients), 22% of Crystalens implants
Male: Female Ratio of Yag Capsulotomies	22:36
Mean Age at Time of Yag Capsulotomy	65 years old (range: 32 – 82)
Yag Capsulotomy Complications	0

Indications for Yag Capsulotomy

The three indications for yag capsulotomy were identified as posterior capsule opacification (PCO), posterior capsule striae (PCS), and lens tilt. Out of the 90 eyes that underwent yag capsulotomy, these main indications were further subdivided into therapeutic yag (TY) (27 eyes) and prophylactic yag (PY) (63 eyes) subgroups. Three eyes had Z syndrome and were included in the analysis of the lens tilt TY subgroup (Table 3).

Table 3. Indications for yag capsulotomy.

	Therapeutic Yag	Prophylactic Yag	Subtotal
PCO	15	46	61 (68%)
Striae	5	12	17 (19%)
Lens Tilt	7	5	12 (14%)
TOTAL	**27 (30%)**	**63 (70%)**	**N = 90 eyes**

Posterior Capsule Opacification (PCO)

The mean interval from the time of cataract surgery to yag capsulotomy was 11 months for both the TY and the PY groups. The mean interval from the time of the yag capsulotomy to the time of the last follow-up was 6.5 months for the TY and 9.5 months for the PY groups (Table 4).

Table 4. Mean intervals from cataract surgery to yag capsulotomy and last follow-up.

	THERAPEUTIC YAG		PROPHYLACTIC YAG	
	Phaco to yag	Yag to last follow-up	Phaco to Yag	Yag to last follow-up
PCO	11	6.5	11	9.5
Striae	11	12	12	9
Lens Tilt	8.5	12	7	8.5
MEAN	**10 months**	**10 months**	**10 months**	**6 months**

In the PCO TY group, the mean improvement was 2 lines of UDVA, 1 line of UIVA, and 1 line of UNVA after yag capsulotomy. The differences between the pre- and postyag UDVA and the UNVA were statistically significant (p=0.000 and p=0.04, respectively). The mean manifest refraction spherical equivalent (MRSE) improved after yag capsulotomy but was not statistically significant (p=0.13) (Table 5).

In the PCO PY group, there was no change in mean UDVA and UNVA. There was an improvement of 1 line of UIVA, which was statistically significant (p=0.002). The mean MRSE improved after yag capsulotomy but was not statistically significant (p=0.59) (Table 5).

Table 5. Visual parameters before and after yag capsulotomy in posterior capsule opacity (PCO).

	THERAPEUTIC YAG		PROPHYLACTIC YAG	
	Before Yag	Last Follow-up	Before Yag	Last Follow-up
Mean Visual Acuity				
UDVA	20/40	20/25	20/25	20/25
UIVA	20/30	20/25	20/25	20/20
UNVA	J3	J2	J2	J2
Mean Manifest Refraction				
Sphere	-0.09	-0.15	-0.18	-0.17
Cylinder	-0.68	-0.50	-0.71	-0.76
MRSE	-0.43	-0.20	-0.53	-0.47

Posterior Capsule Striae (PCS)

The mean interval from the time of cataract surgery to yag capsulotomy was 11 months for the TY and 12 months for the PY groups. The mean interval from the time of yag capsulotomy to the last follow-up was 12 months for the TY and 9 months for the PY groups (Table 4).

In the PCS TY group, the mean improvement was 2 lines of UDVA and UIVA, and 1 line of UNVA. The improvements in UIVA and UNVA were statistically significant (p=0.002 and p=0.006, respectively). There was an improvement towards emmetropia in the MRSE after the yag capsulotomy; however, it was not statistically significant (p=0.76) (Table 6).

Table 6. Visual parameters before and after yag capsulotomy in posterior capsular striae (PCS).

	THERAPEUTIC YAG		PROPHYLACTIC YAG	
	Before Yag	Last Follow-up	Before Yag	Last Follow-up
Mean Visual Acuity				
UDVA	20/50	20/30	20/30	20/30
UIVA	20/32	20/20	20/30	20/25
UNVA	J3	J2	J3	J2
Mean Manifest Refraction				
Sphere	-0.10	0	-0.10	-0.40
Cylinder	-1.05	-0.80	-1.05	-0.80
MRSE	-0.62	-0.40	-0.73	-0.69

For the PCS PY group, there was no change in the mean UDVA. There was an improvement of 1 line of UIVA (p=0.05) and UNVA (p=0.12). The mean MRSE improved with a notable decrease in the average cylinder. However, this was not statistically significant (p=0.64) (Table 6).

Lens Tilt (LT)

The mean interval from the time of cataract surgery to the yag capsulotomy was 8.5 months for the TY and 7 months for the PY groups. The mean interval from the time of yag capsulotomy to the last follow-up was 12 months for the TY and 8.5 months for the PY groups (Table 4).

In the LT TY group, the mean improvement was 3 lines of UDVA, 1 line of UIVA, and no change for the UNVA. The improvement in the UDVA was found to be statistically significant (p=0.004). There was also a general lessening of the myopic error. However, this was not statistically significant (p=0.23) (Table 7).

For the LT PY group, there was an improvement of 1 line of UDVA, and no change of UIVA and UNVA. These changes were not statistically significant (p=0.08, p=0.16, p=0.37, respectively). The improvement in the MRSE after the yag capsulotomy was found to be statistically significant (p=0.03) (Table 7).

Table 7. Visual parameters before and after yag capsulotomy in lens tilt (LT).

	THERAPEUTIC YAG		PROPHYLACTIC YAG	
	Before Yag	Last Follow-up	Before Yag	Last Follow-up
Mean Visual Acuity				
UDVA	20/50	20/25	20/25	20/20
UIVA	20/30	20/25	20/20	20/20
UNVA	J2	J2	J2	J2
Mean Manifest Refraction				
Sphere	-0.64	+0.57	-0.60	-0.20
Cylinder	-1.14	-0.89	-0.55	-0.50
MRSE	-1.21	-1.02	-0.87	-0.45

Z Syndrome

Three eyes had Z syndrome out of the 90 eyes that underwent yag capsulotomy. They were analyzed under the lens tilt indication.

For the first case of Z syndrome, the interval from cataract surgery to yag capsulotomy was 11.5 months. From one month after cataract surgery to before the yag capsulotomy, the patient lost 4 lines of UDVA with a notable myopic shift. At his last follow-up 26 months after yag capsulotomy, he gained 3 lines of UDVA and UIVA, and 1 line of UNVA. The manifest refraction remained unchanged. Compared to the immediate postoperative period, there was no loss of best corrected distance visual acuity and distance-corrected near vision (Table 8).

Table 8. Visual parameters in Z syndrome case 1.

	1 Month Postsurgery	Before Yag	Last Follow-up
Visual Acuity			
UDVA	20/25	20/60	20/30
UIVA	20/32	20/32	20/16
UNVA	J5	J3	J2
Manifest Refraction			
Sphere	+0.75	-1.25	-1.25
Cylinder	-0.25	0	0
MRSE	+0.63	-1.25	-1.25
Best Corrected Visual Acuity			
BDVA	20/20	20/25	20/20
DCNVA at 40 cm	J5	J6	J5

For the second case of Z syndrome, the interval from cataract surgery to yag capsulotomy was 3 months. Prior to yag capsulotomy, the patient lost 4 lines of UDVA and one line of UIVA and UNVA, with a myopic shift and an increase in cylinder. At her last follow-up 16 months after yag capsulotomy, she gained 2 lines of UDVA, UIVA was unchanged, and gained 1 line of UNVA. Although the cylinder increased, there was a notable decrease in the spherical error resulting in a lower spherical equivalent. Her best corrected distance visual acuity and distance-corrected near vision were unchanged (Table 9).

Table 9. Visual parameters in Z syndrome case 2.

	1 Month Postsurgery	Before Yag	Last Follow-up
Visual Acuity			
UDVA	20/20	20/50	20/30
UIVA	20/25	20/32	20/32
UNVA	J3	J2	J3
Manifest Refraction			
Sphere	-1.00	-2.00	-0.75
Cylinder	-0.25	-0.50	-1.00
MRSE	-1.13	-2.25	-1.25
Best Corrected Visual Acuity			
BDVA	20/20	20/20	20/20
DCNVA at 40 cm	J3	J3	J3

For the third case of Z syndrome, the interval from cataract surgery to the yag capsulotomy was 3 months. From one month after cataract surgery to before yag capsulotomy, the patient lost 3 lines of UDVA and 1 line of UIVA, with a myopic shift of -0.75D and a notable increase in cylinder of -1.50D. At his last follow-up 3 months after yag capsulotomy, he gained 1 line of UDVA and 2 lines of UIVA. Although there was a further myopic shift, the cylinder decreased by -1.25D (Table 10).

Table 10. Visual parameters in Z syndrome case 3.

	1 Month Postsurgery	Before Yag	Last Follow-up
Visual Acuity			
UDVA	20/25	20/50	20/40
UIVA	20/25	20/32	20/20
UNVA	J2	J1	J1
Manifest Refraction			
Sphere	0	-0.75	-1.75
Cylinder	-0.50	-2.00	-0.75
MRSE	-0.25	-1.75	-2.13
Best Corrected Visual Acuity			
BDVA	20/20	20/20	20/20
DCNVA at 40 cm	J1	J1	J3

Combined Outcomes (PCO, PCS, LT)

The mean interval from cataract surgery to yag capsulotomy was 10 months in both the TY and the PY groups for all the indications. For all indications wherein TY was done, there was an improvement of 2 lines of UDVA and 1 line of UIVA and UNVA. These were all statistically significant (p=0.000, p=0.007, and p=0.000, respectively). The improvement in mean spherical equivalent was, likewise, statistically significant (p=0.01). For all indications wherein PY was performed, the vision remained unchanged for the UDVA, UIVA, and UNVA. The mean spherical equivalent improved on the last follow-up, but was not statistically significant (p=0.94) (Table 11).

Table 11. Visual parameters before and after yag capsulotomy in combined outcomes (PCO, PCS, LT).

	THERAPEUTIC YAG		PROPHYLACTIC YAG	
	Before Yag	Last Follow-up	Before Yag	Last Follow-up
Mean Visual Acuity				
UDVA	20/50	20/30	20/25	20/25
UIVA	20/30	20/25	20/25	20/25
UNVA	J3	J2	J2	J2
Mean Manifest Refraction				
Sphere	-0.27	-0.27	-0.27	-0.22
Cylinder	-0.87	-0.70	-0.69	-0.74
MRSE	-0.70	-0.43	-0.62	-0.52

DISCUSSION

Conventionally, surgeons waited till vision has significantly deteriorated from posterior capsular opacification (PCO) before performing yag capsulotomy. An analysis of pooled multiple reports found that the overall rate of visually significant PCO was approximately 28% at 5 years. The incidence at 3 years of quantitatively measured PCO has been reported at 56% for polymethylmethacrylate (PMMA), 40% for silicone, and 10% for acrylic material, although the yag capsulotomy rates may be lower. In a large postmortem review, the prevalence of yag capsulotomy was 0.9% for acrylic, 12-21% for various silicone, and 27-33% for PMMA IOLs.[10]

In other studies that documented PCO in different IOL configurations, the multifocal spherical group (Acrysof ReSTOR SN60D3) had a PCO rate of 42.7% and a yag capsulotomy rate of 25.3%, with a mean time from surgery to yag capsulotomy of 13.8 ± 7.9 months. In the monofocal spherical group (Acrysof Natural SN60AT), the PCO rate was 28.0% and the yag capsulotomy rate was 17.3%, with a mean time from surgery to yag capsulotomy of 13.0 ± 9.3 months. In the monofocal aspheric group (Acrysof IQ SN60WF), the PCO rate was 14.7% and the yag capsulotomy rate was 4%, with a mean time from surgery to yag capsulotomy of 9.3 ± 6.4 months. The authors believed that the high yag capsulotomy rate for the multifocal spherical group was due to the increased patients' expectations and the reduced contract sensitivity caused by the physical properties of a diffractive IOL, with a higher awareness of any media opacity such as PCO.[11]

In our study, 61 of 411 Crystalens-implanted eyes (14.8%) underwent yag capsulotomy because of PCO with a mean time after cataract surgery of 11 months.The Crystalens is an IOL made of silicone material with a square-edged posterior surface. It has been postulated that silicone material induces a higher PCO rate while a square-edge design induces less. There has been no evidence suggesting that the hinged two-plate haptic design is detrimental or not against PCO. Our rate of yag treatment for PCO was comparable to other published studies.[10,11]

Our literature search revealed two case reports of asymmetric vaulting and yag capsulotomy.[6,12] This paper was the first to report on the incidence and indications of yag capsulotomy in a large population of Crystalens-implanted eyes, and the first to analyze the striae and lens tilt that occurred with the Crystalens. Since we started using the Crystalens, we realized that the hinged haptic plates were an advantage, allowing flexibility of forward movement of the lens and contributing to its presbyopia-correcting capability. However, they could also be a disadvantage because tension in the capsular bag could cause striae, and worse, cause lens tilt and Z syndrome.

Z syndrome or asymmetric tilt occurred as a result of uneven capsular contraction exerted on one or both haptic plates. (Figure 4). There was no warning that Z syndrome was about to occur although we believed that striae and lens tilt were signs that capsular tension was increasing and preceded Z syndrome. We could only diagnose it after it has occurred by visualizing it through a dilated pupil. From our previous experience, once Z syndrome has resulted, it was difficult to resolve it, notably for the lens optic to return to its proper vaulting. The outcomes of our 3 cases of Z syndrome even after yag capsulotomy were below par; all 3 eyes had significant myopia with astigmatism and compromised distance vision. This was also the case in a report by Yuen.[12]

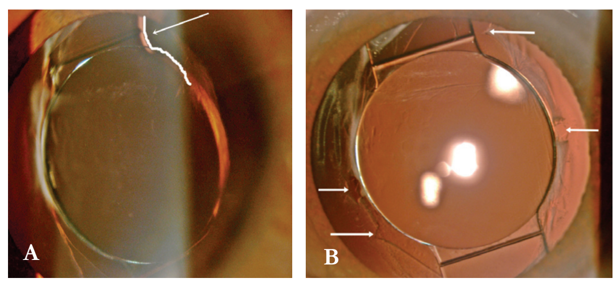

Figure 4. Z syndrome or asymetric tilt (A) and after yag capsulotomy (B).

Our practice pattern has evolved to anticipating Z syndrome and preventing its occurrence. Once we observed capsular changes, such as grade 2 PCO, PCS, and lens tilt, even if uncorrected distance vision has not deteriorated by more than 2 lines of vision, we proceeded with yag capsulotomy. This has provided our justification for performing what we termed in this paper as prophylactic yag capsulotomy and would explain the higher prophylactic yag rate (70%) compared to the therapeutic yag rate (30%). We believed that our Z syndrome rate was low (0.73%, 3 out of 411 eyes) most likely because we had a low tolerance for capsular change and performed prophylactic yag capsulotomy.

We do not recommend indiscriminate yag capsulotomy on clear posterior capsules with good vision because we recognize that yag capsulotomy is not without its own set of risks. In its FDA report in 1985, the major intraoperative complication of yag capsulotomy was damage to the IOL (20%). The second was rupture of the anterior hyaloid face (19%). Other less frequently encountered operative complications included: corneal edema in 0.3%, bleeding in 1%, and iris damage in 0.4% of the cases. The major postoperative complication was elevation of intraocular pressure (39%). Cystoid macular edema (1.2%) was detected at sometime during the six months following yag capsulotomy.Other postoperative complications included retinal detachment in 0.5%, pupillary block in 0.1%, retinal hemorrhage in 0.4%, iritis in 0.6%, and vitritis in 0.3% of cases.[8] So far, we did not encounter any of these complications in our case series possibly because we used low energy settings and we only perform yag treatment in small areas such as in the central 2.5 mm of the posterior capsule or underneath the haptic plate.

We separated the analysis to prophylactic and therapeutic yag to find out the effects on vision. Eyes wherein therapeutic yag capsulotomy was performed showed significant improvement in distance, intermediate, and near vision with lessening of the refractive error. This included the 3 eyes with Z syndrome, although their uncorrected distance vision remained compromised compared to those without Z syndrome. Eyes that underwent prophylactic yag treatment maintained uncorrected distance, intermediate, and near vision with no worsening noted.

IOL innovations and improvements in surgical techniques tried to control or lessen the incidence of capsular changes; but we still could not reliably predict in which eyes capsular change would occur, when it would occur, and how much it could eventually affect visual acuity. Once capsular change has occurred, the remedy still remained to be yag capsulotomy.

Our study data suggested that in Crystalens-implanted eyes that have grade 2 PCO, striae and lens tilt, yag capsulotomy could improve or stabilize visual outcomes. We recommend prompt yag capsulotomy once capsular changes are encountered to lessen the incidence of Z syndrome.

The limitations of our study were the absence of grading systems for striae and lens tilt, arbitrary selection of a decrease of two lines of uncorrected distance vision as the criterion for therapeutic yag capsulotomy, unstandardized follow-up times after yag capsulotomy, and no separate analysis for the Crystalens HD and AO-implanted eyes. However, we believed that the lens characteristics and architecture that were affected by capsular forces would be similar in the two models of the Crystalens.

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