American Academy of Ophthalmology
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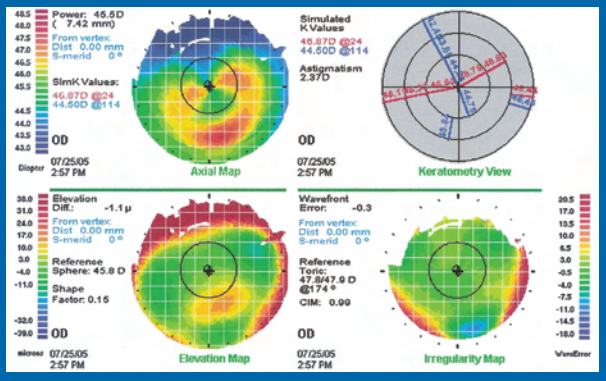
# FocalPoints

Clinical Modules for Ophthalmologists

VOLUME XXIX NUMBER 8
SEPTEMBER 2011 (MODULE 2 OF 3)




# The Dissatisfied Presbyopia-Correcting IOL Patient

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*Focal Points* (ISSN 0891-8260) is published quarterly by the American Academy of Ophthalmology at 655 Beach St., San Francisco, CA 94109-1336. For domestic subscribers, print with online 1-year subscription is $187 for Academy members (2 years, $337; 3 years, $477) and $252 for nonmembers (2 years, $455; 3 years, $642). International subscribers, please visit www.aao.org/focalpoints for more information. Online-only 1-year subscription is $155 for Academy members (2 years, $277; 3 years, $395) and $209 for nonmembers (2 years, $375; 3 years, $535). Periodicals postage paid at San Francisco, CA, and additional mailing offices. POSTMASTER: Send address changes to *Focal Points*, P.O. Box 7424, San Francisco, CA 94120-7424.

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# Learning Objectives

## Upon completion of this module, the reader should be able to:

- Demonstrate understanding of the optics of the current presbyopia-correcting intraocular lens implant (PrCIOL) designs
- Recognize the potential side effects and complications associated with implantation of PrCIOLs
- Use various testing modalities to clinically evaluate the signs and symptoms accompanying side effects of PrCIOLs
- Review the treatment options for the potential side effects and complications of PrCIOLs
- Formulate a list of exclusionary criteria for potential PrCIOL candidates

***Financial Disclosures***

The authors, reviewers, and consultants disclose the following financial relationships. **William S. Clifford, MD:** (S) Transcend Medical. **D. Michael Colvard, MD, FACS:** (C) Abbott Medical Optics, Bausch & Lomb; (P) OASIS Medical. **M. Bowes Hamill, MD:** (S) Alcon Laboratories, OPHTEC, Vision Care. **Alan M. Kozarsky, MD:** (C) Bausch & Lomb Surgical. **Terrence P. O'Brien, MD:** (C) Alcon Laboratories, Allergan, AMO/VISX (Abbott), Bausch & Lomb Surgical, Inspire Pharmaceuticals, Ista Pharmaceuticals. **Steven I. Rosenfeld, MD, FACS:** (C) Inspire Pharmaceuticals; (L) Allergan. **Jonathan B. Rubenstein, MD:** (L) Alcon Laboratories, Allergan, Bausch & Lomb Surgical. **Roger F. Steinert, MD:** (C) Abbott Medical Optics, LenSx, ReVision Optics; (P) Rhein Medical; (S) Abbott Medical Optics. **C. Gail Summers, MD:** (L) BioMarin Pharmaceutical.

The following contributors state that they have no significant financial interest or other relationship with the manufacturer of any commercial product discussed in their contributions to this module or with the manufacturer of any competing commercial product: Bradley S. Foster, MD; Syndee J. Givre, MD, PhD; Edward K. Isbey III, MD, Susan R. Keller; Ramana S. Moorthy, MD; Daniel Mummert, Eric P. Purdy, MD; George A. Stern, MD; Kim Torgerson.

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# Introduction

As the population steadily ages, an increasing number of individuals will develop presbyopia and cataracts. In addition to seeking cosmetic surgery in an effort to remain youthful in their physical appearance, many patients are similarly attracted to refractive cataract surgery to correct their presbyopia and regain their youthful ability to simultaneously focus clearly at distance vision and near vision without glasses.

The optical advantages of presbyopia-correcting IOLs (PrCIOLs) are sometimes outweighed by visual side effects in a minority of patients. Unfortunately, as our surgical techniques and technology advance, patient expectations correspondingly increase as well. Patients often have a strong desire for excellent quality of vision

at all distances. The disappointment when PrCIOLs do not meet these high expectations is compounded when a patient has to pay a premium above the insurance coverage for a standard monofocal IOL. As with all surgical procedures, it is important to identify which patients are reasonable candidates for PrCIOLs in advance of the surgery. Equally important is the ability to diagnose and manage postoperative problems that are encountered with PrCIOL technology. Therefore, all refractive and cataract surgeons must become expert in the evaluation and management of the dissatisfied PrCIOL patient.

# Optics of Presbyopia-Correcting IOLs

The types of PrCIOLs currently available in the United States are accommodating lenses and multifocal lenses (MFIOLs). Within the multifocal group, there are 2 basic types: refractive and diffractive. All MFIOLs have multiple optical zones comprised of concentric rings on the optic. By definition, these MFIOLs simultaneously present more than one image to the retina. The distribution of incoming light to more than one focal plane decreases contrast sensitivity and increases glare because the clearly focused image is always overlapped by out-of-focus images generated by the multiple optical zones. On average, MFIOLs reduce contrast sensitivity approximately 25% compared to monofocal IOLs. In addition, these degraded images can cause problems seeing in dimly lit environments and other night vision complaints such as glare and halos (Table 1). Recently introduced aspheric monofocal IOLs achieve better contrast sensitivity and less spherical aberration than standard spherical IOLs; it remains to be seen if newer aspheric versions of the MFIOLs will also gain this benefit.

## Refractive Multifocal IOLs

The ReZoom multizone refractive acrylic IOL (Abbott Medical Optics, Santa Ana, California) is a second-generation lens based upon the Array lens platform. The ReZoom lens has 5 concentric refractive zones that alternate distance and near focus and is distance dominant because the central, third, and fifth zones are for distance. Aspheric transitions between the zones allow for some intermediate vision and reduce the incidence of glare and halos compared to the original Array lens. The IOL uses 100% of the incoming light with one-half used for distance vision, one-third for near vision, and the remainder for intermediate vision. With a small pupil, less than 3 mm, the IOL is distance dominant due to the distance-focused central zone. Unfortunately, when reading, both the synkinetic near reflex and ambient light contribute to a miotic pupil, making reading more difficult. Larger pupils enhance the near function of the ReZoom lens, making it better for reading in dim light, but making driving at night more difficult. The

Table 1. Comparison of Multifocal Intraocular Lens Characteristics

| CHARACTERISTIC | RESTOR | REZOOM | CRYSTALENS | TECNIS |
|---|---|---|---|---|
| Description | Pupil-dependent optic | Pupil-dependent optic | Ciliary muscle–dependent focusing | Pupil-independent optic |
| Near vision | Excellent | Good | Adequate and variable | Excellent |
| Intermediate vision | Good | Excellent | Excellent | Good |
| Distance vision | Good | Excellent | Excellent | Good |
| Benefits | Most reliable for reading | Good for distance | Best intermediate vision<br>Best distance vision<br>Best clarity of vision<br>Best for night vision | Most reliable for reading |
| Drawbacks | Glare and halos<br>Reduced contrast sensitivity | Glare and halos<br>Reduced contrast sensitivity | Unpredictable near vision<br>May still need readers | Glare and halos<br>Reduced contrast sensitivity |
| Small pupil (sunny day) | Distance vision reduced<br>Near vision excellent | Distance vision good<br>Near vision poor | Distance vision excellent<br>Near vision good | Distance vision good<br>Near vision excellent |
| Large pupil (night time) | Distance vision good<br>Near vision fair<br>Glare and halos | Distance vision fair<br>Near vision good<br>Glare and halos | Distance vision excellent<br>Near vision good | Distance vision good<br>Near vision good<br>Glare and halos |

3.5 diopter difference between the distant and near focal point corresponds to approximately 2.5 diopters of addition in the spectacle plane, creating an optimal reading distance of 40 cm (Table 1).

## Diffractive Multifocal IOLs

The AcrySof ReSTOR SA60D3 lens (Alcon Laboratories, Fort Worth, Texas) is a multifocal diffractive acrylic IOL with a central apodized diffractive zone surrounded by a purely refractive outer zone. Unlike the ReZoom lens with a dedicated central zone for distance, the ReSTOR lens has 12 concentric diffractive zones in the central 3.6 mm of its anterior surface, dividing the incoming light into simultaneous distant and near focal points. Apodization entails a gradual centrifugal decrease in step height of the 12 diffractive concentric rings, creating a smoother transition of light between the distance and near focal points and theoretically reducing the visual phenomena of glare, halos, and other night vision complaints. The outer refractive region is strictly for distance. This MFIOL is increasingly distance dominant with larger pupil size as the outer refractive zone comes into play. When the pupil size decreases, as in reading, the focal dominance of the IOL shifts from distance to equal parts distance and near. With a 3 mm pupil, incoming light is split 40% for distance and 40% for near, and 20% is lost due to destructive interference. The loss of light requires that a bright light be used for reading. Night driving, associated with a larger pupil, is improved by the distance dominance. The +4.0 reading add translates to a +3.2 D add at the spectacle plane (Table 1).

Recent innovations for the ReSTOR IOL include aspheric optics in the SN6AD3 lens, which has 12 concentric rings that theoretically reduce some dysphotopsias, and the newest-version SN6AD1 lens, which has 9 concentric rings and a reduced add of +3.00, thereby increasing the focal length for reading (approximately 2.25 diopters at the spectacle plane).

The 3-piece silicone Tecnis multifocal lens, model ZMA00 (Abbott Medical Optics), was approved in January 2009. This lens combines a modified prolate aspheric anterior surface with multizone diffractive optics on the posterior surface. The 32 diffractive rings cover the entire posterior surface of the optic, making the multifocal effect of the lens less dependent on ambient light and associated pupil size. The aspheric optics are intended to improve visual acuity and contrast sensitivity. Similar to the ReSTOR IOL, a portion of the incoming light is lost due to the diffractive optics. The latest Tecnis MFIOL, model ZMB00, is a one-piece acrylic lens.

## Accommodating IOLs

The Crystalens accommodating IOL (Bausch & Lomb, Rochester, New York) models, listed in order of FDA approval, include the AT-45, AT-50SE, AT-500 HD, and, most recently, the Crystalens AO. This nonreflective silicone IOL is comprised of a monofocal, square-edged optic with hinged, modified plate haptics. The monofocal optic provides only one focus at a time. Image sharpness and contrast sensitivity are better than with the refractive and diffractive MFIOLs because there is no out-of-focus image to contend with (Table 1). Theoretically, ciliary muscle contraction allows for forward movement of the hinged optic, providing a variable amount of accommodation, but averaging approximately +1.25 diopters. Another possible explanation for the accommodative effect is that ciliary muscle contraction allows for arching of the optic, resulting in an increased radius of curvature. Whichever explanation is true, the near vision is variable and at times unpredictable, causing many surgeons to utilize a modified monovision in one eye targeted for residual low myopia to ensure that there will be adequate uncorrected reading vision.

In 2008, the Crystalens HD500 was approved, with the theoretical benefit being improved near vision due to a proprietary optic design consisting of an increased radius of curvature for the central 1.8 mm of the optic, resulting in an increased depth of focus. This optic design is a form of multifocal lens and may create similar optical issues. Preliminary results have shown increased contrast sensitivity compared to previous models, but a small percentage of patients experience myopic shifts in the first few weeks after surgery in the –0.50 to –2.50 D range. Possible explanations for this finding include small pupils forcing the image through the central 1.8 mm zone, or mild anterior displacement of the IOL within the capsular bag presumably due to capsular contractile forces (Table 1). The Crystalens AO with an aspheric optic appears to have reduced the incidence of myopic shifts and dysphotopsias.

# Neural Adaptation

MFIOLs produce multiple in-focus and out-of-focus images simultaneously on the retina, thereby creating problems with edge sharpness and glare. *Neural adaptation* is the term given to the attempt by the visual cortex to improve edge definition over a 6- to 12-month postoperative period. In general, the brain adapts better to

interocular disparity (differences between the eyes such as anisometropia) compared to intraocular disparity (different images within the same eye, such as multifocality).

## Potential Visual Complaints

There are a host of potential visual complaints in PrCIOL patients, many of which are also observed in patients who have undergone cataract surgery with traditional monofocal IOLs. Visual symptoms include glare, halos, night vision complaints, reduced contrast sensitivity, problems driving at dusk or in dim light, diplopia, smudgy "Vaseline-like" vision, fluctuating vision, metamorphopsia, problems reading both without and with correction, problems with distance vision, loss of intermediate vision, and a generalized lack of clarity even with glasses. Unfortunately, the visual symptoms are usually not specific enough to allow the ophthalmologist to pinpoint a single diagnosis. Thus, it is important to consider multiple possible etiologies for a patient's complaints after PrCIOL implantation and to consider the different levels of potential involvement (Table 2).

**Table 2. Sources of Dissatisfaction with Presbyopia-Correcting Intraocular Lenses**

- Incorrect postoperative refractive error: residual spherical refractive error, residual astigmatism
- Problems with ocular surface: dry eye syndrome, blepharitis and lid margin disease
- Corneal abnormalities: epithelial basement membrane dystrophy, corneal scars and opacities, abnormal corneal curvature (keratoconus, forme fruste keratoconus, pellucid marginal degeneration), Fuchs corneal dystrophy
- Pupillary abnormalities: pupil too large, pupil too small, eccentric pupil
- Problems with IOL: IOL decentration, Z syndrome
- Problems with capsular bag: anterior capsular phimosis, posterior capsular opacification
- Retinal abnormalities: cystoid macular edema, macular epiretinal membrane, age-related macular retinal degeneration, background diabetic retinopathy
- Inadequate neural adaptation
- Unmet expectations
- Personality disorders

## Differential Diagnosis for Visual Disturbances

When confronted with a dissatisfied PrCIOL patient, the ophthalmologist should employ a systematic approach to considering multiple possible abnormalities that can affect the quality of vision. All PrCIOLs, and in particular the MFIOLs, are very unforgiving lenses. They work best in healthy eyes with normal tear films, healthy lid margins, clear and healthy corneas, and normal retinas. They also work best when the IOLs are perfectly centered. Figures 1 and 3 provide flowcharts that help guide the clinician in a systematic stepwise approach to evaluating and managing the dissatisfied PCIOL patient.

In making a differential diagnosis, one should first consider a residual refractive error. Residual sphere, cylinder, or both, can cause glare, blurry vision, and ghosting of images. The residual error can affect both distance and near vision. Unaided vision that improves when viewing through a pinhole suggests residual refractive error. A careful refraction will uncover this abnormality, and patients will often report resolution of their symptoms while seated behind the phoropter or wearing a trial frame.

Glare and halos can be experienced after cataract surgery with conventional monofocal IOLs, and they occur with greater frequency after implantation of PrCIOLs. Glare and halos may be due to decentered IOLs, the internal reflectivity of synthetic lenses, and edge glare from the optic (especially in patients with large pupils). These findings are a common side effect of refractive and diffractive optics in MFIOLs. A trial of brimonidine (0.15% or 0.2%) or dilute pilocarpine drops (0.5% to 1%) to reduce or prevent mydriasis under mesopic or scotopic conditions may reduce the symptoms and help make this diagnosis.

Irregular astigmatism causes lack of clarity at distance and near and is not fully correctable with spectacles. Irregular astigmatism may be present before the surgery, or it may develop postoperatively. Subclinical corneal ectatic disorders, such as keratoconus and pellucid marginal degeneration, may exist undiagnosed until preoperative or postoperative corneal topography is performed (Figure 2). The unpredictable dynamics of wound healing, involving both the corneal incision and any limbal relaxing incisions (LRIs), may create irregular astigmatism. Computed corneal topography can confirm this diagnosis, as well as a trial with a rigid gas-permeable contact lens (Figure 3).

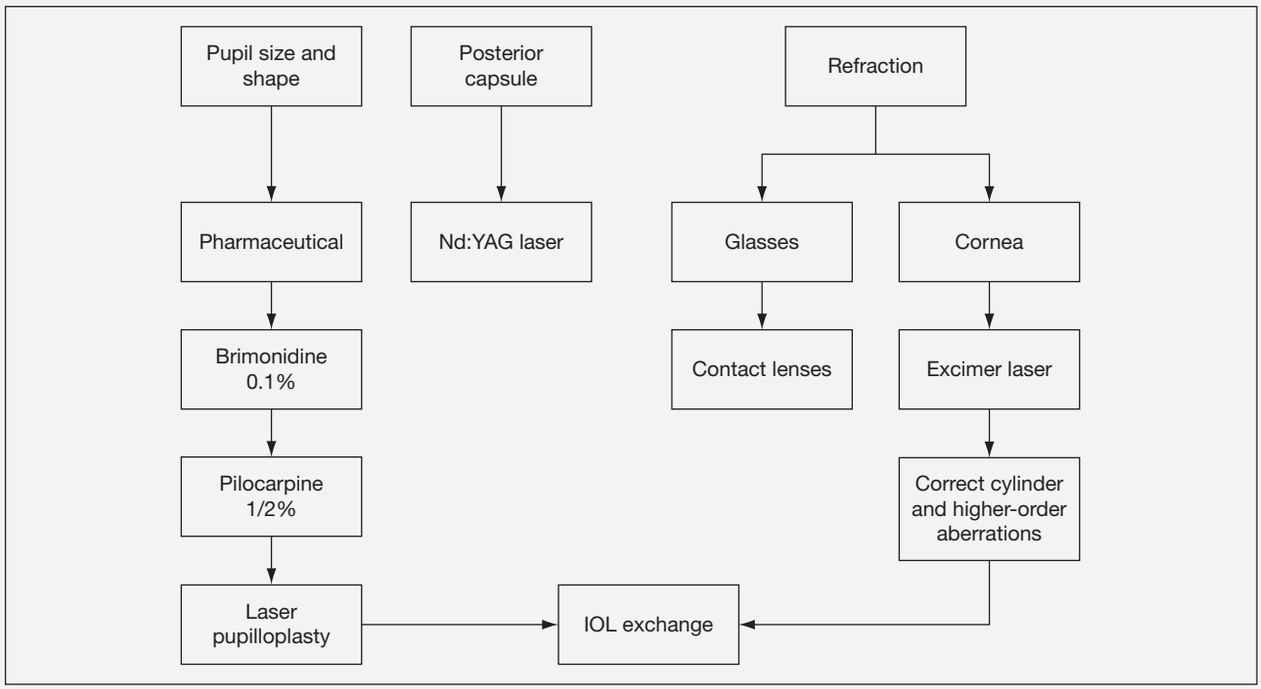


Figure 1 Flowchart for evaluation of multifocal intraocular lens patient with OK acuity, bad glare. (Reproduced with permission from Roger Steinert, MD.)

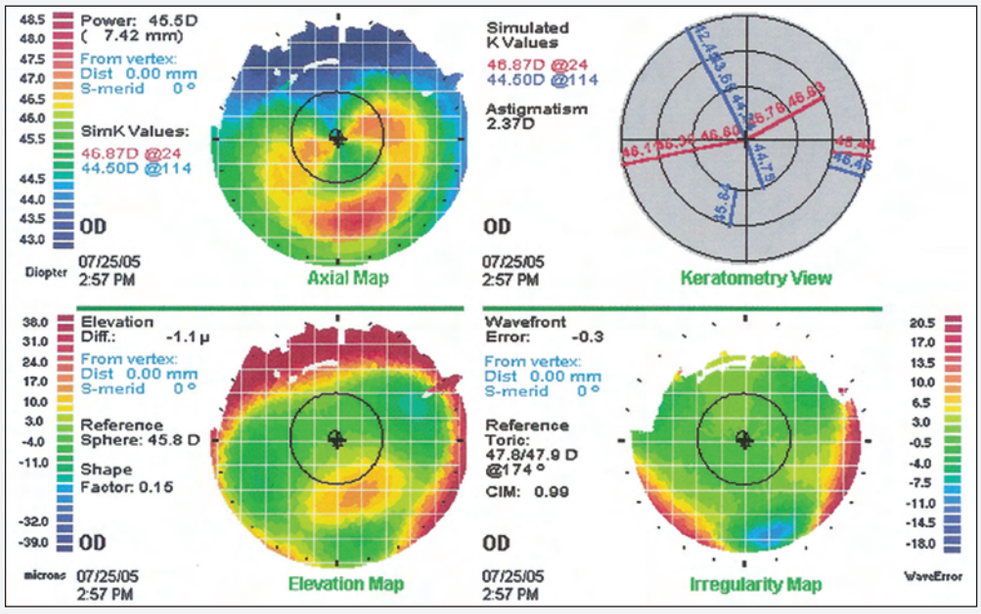


Figure 2 Irregular corneal topography demonstrating keratoconus which can distort vision with monofocal and MFIOLs.

Less commonly, irregular corneal healing and MFIOLs can induce or increase pre-existing higher-order aberrations (HOAs). Wavefront analysis can delineate and quantify the amount of HOAs in most patients, but they can sometimes be difficult to capture with Hartmann-Shack aberrometry through a MFIOL (Figure 4).

Problems reading after PrCIOL surgery may be due to inadequate accommodation, seen with the accommodating Crystalens IOL, or inadequate near power, as seen

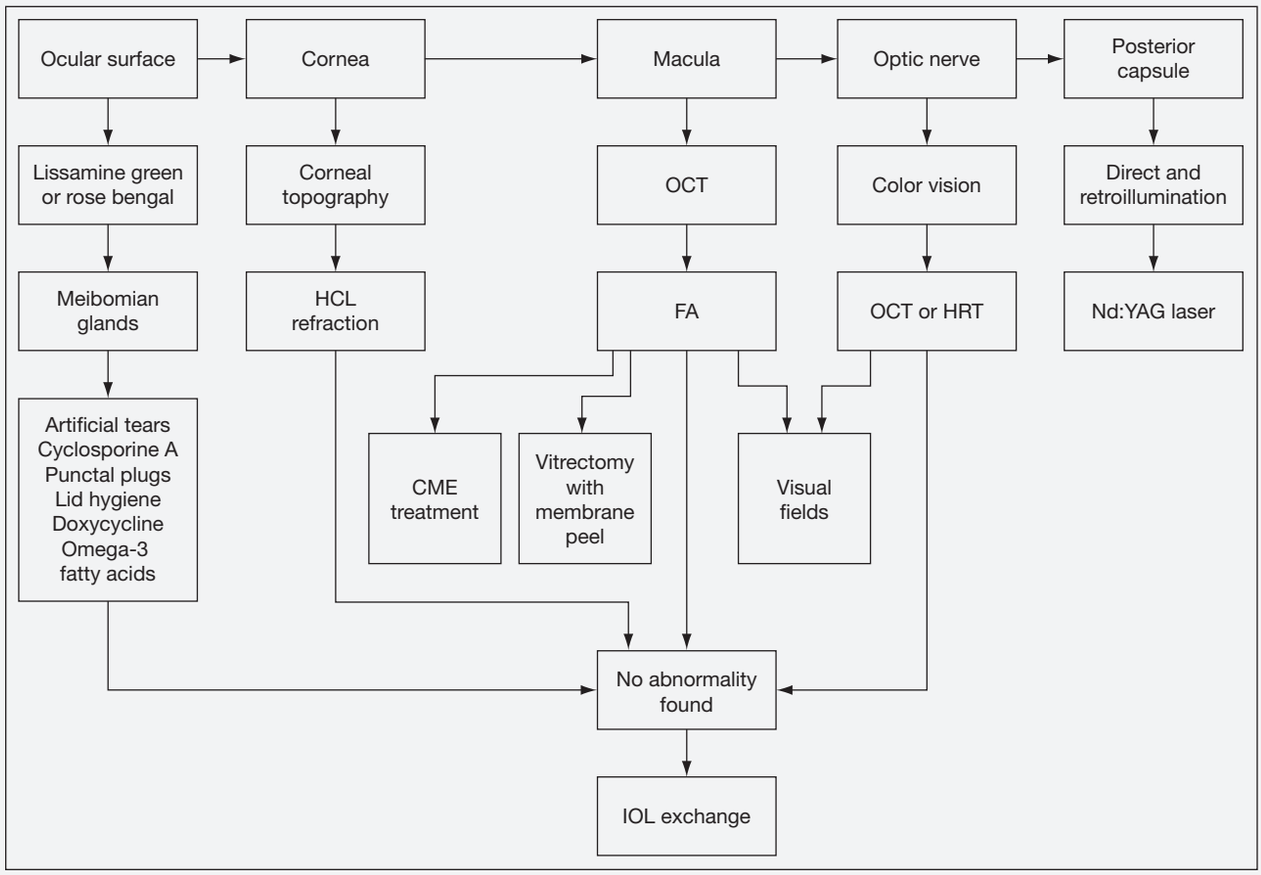


**Figure 3** Flowchart for evaluation of multifocal intraocular lens patient with bad clarity, distance and near. (Reproduced with permission from Roger Steinert, MD.)

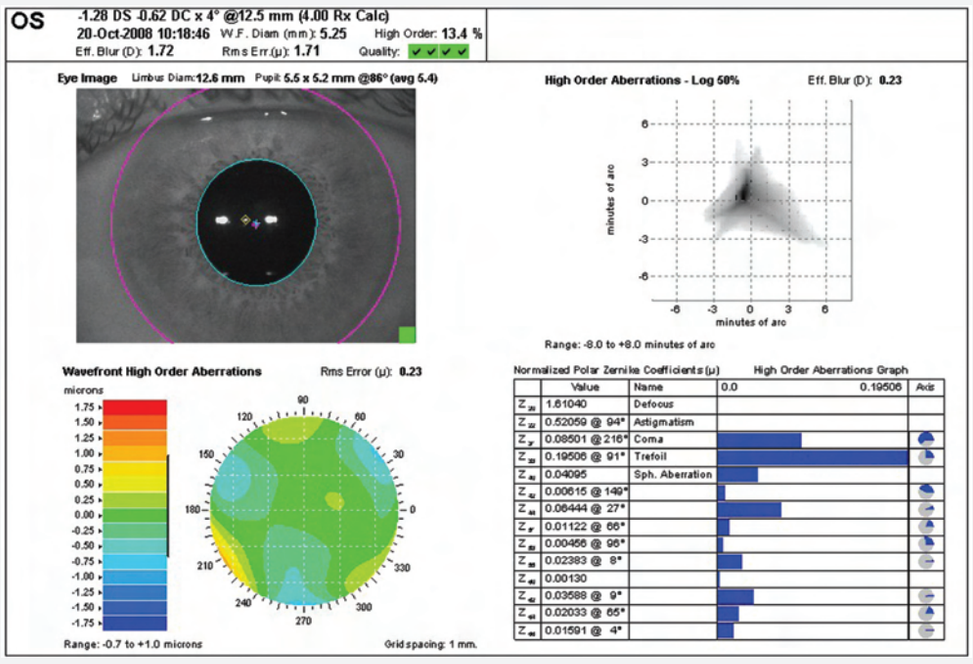


**Figure 4** Wavefront analysis demonstrates higher-order aberrations.

with the ReZoom IOL that is more effective at intermediate than near distances. Patients have to hold their reading material much further away than they were used to doing preoperatively. Other patients with PrCIOLs may find the need to hold their reading material much closer than they were accustomed to, as can be seen with the +4.0 D ReSTOR IOL with its effective near add at the corneal plane of about +3.2 D. Patients should be counseled preoperatively about anticipated changes in their near focal points after surgery. In addition, the loss of light from a diffractive optic may require the patient to use a brighter reading light.

Complaints of binocular diplopia or blurry vision may be an indication of an ocular motility disorder, rather than a problem with the PrCIOL. A thorough motility exam and examination of the old spectacles for evidence of prism may be very helpful. Unmasking of a latent phoria can occur following cataract surgery with any type of IOL. Divergence or convergence insufficiency may also occur as a result of the refractive shift with the PrCIOLs.

A thorough slit-lamp examination can reveal several possible explanations for inadequate vision in the PrCIOL patient. Dry eye syndrome can significantly affect the quality of one's vision by an abnormal tear film alone, or in association with keratitis sicca. Patients with dry eye syndrome often complain of fluctuating vision, improved temporarily with blinking or instillation of artificial tears. Slit-lamp examination reveals tear debris, a reduced tear meniscus, a punctate keratitis (Figure 5), and/or an abnormal tear break-up time. Vital staining with rose bengal or lissamine green may demonstrate devitalized epithelial cells on the corneal surface. Schirmer's testing may also be of benefit. Lid abnormalities such as ectropion or punctal eversion may contribute to a dry eye syndrome and exposure keratitis.

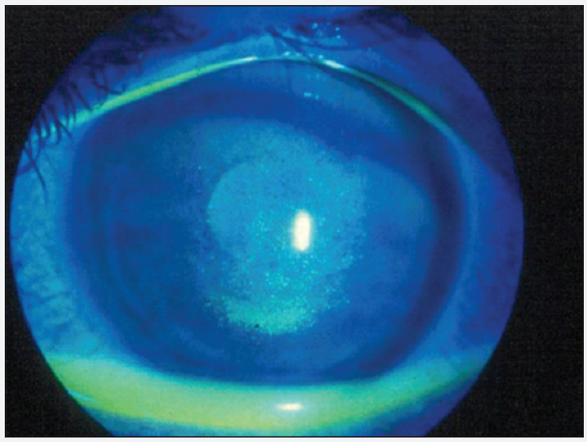

Figure 5 Dry eye syndrome with punctate keratitis and irregular ocular surface.

Blepharitis can also affect vision by contributing to an unstable tear film and associated punctate keratitis (Figure 6). Abnormal tear dynamics are more likely to affect the vision in MFIOL patients compared to monofocal IOL patients. Meibomian gland dysfunction causes an abnormal lipid layer and results in more rapid tear film break-up and greater evaporative tear loss, leading to a secondary aqueous tear deficiency. Identifying these conditions preoperatively and instituting appropriate lid hygiene before surgery can often help avoid the resulting postoperative visual symptoms.

IOL decentration is another cause of both subjective and objective loss of vision in MFIOL patients. A decentered IOL may cause a residual refractive error, induced astigmatism, or glare from an exposed edge of the IOL optic. The patient should be examined with an undilated

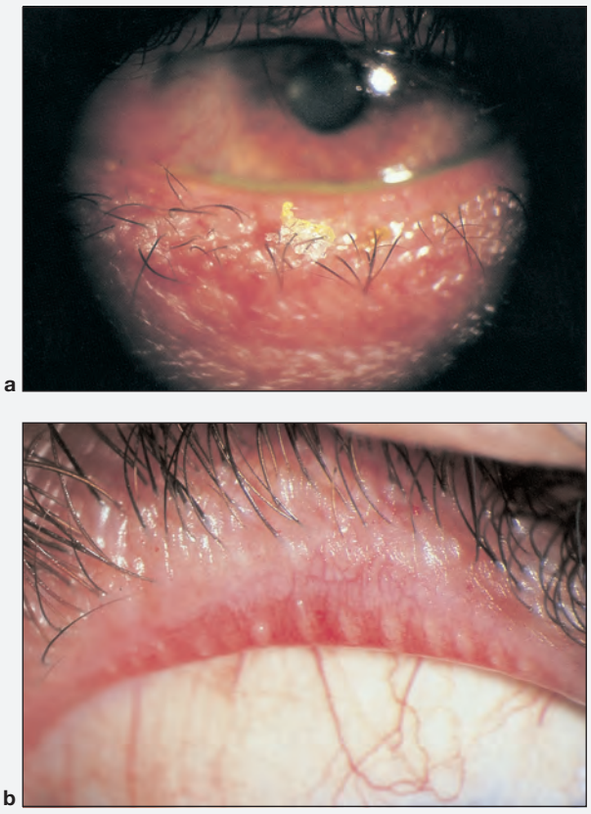


Figure 6 Conditions contributing to an unstable tear film with increased evaporation and dry eyes. **a.** Staphylococcal blepharitis with collarettes surrounding eyelashes. **b.** Meibomian gland dysfunction. (Both parts reprinted with permission from Reidy JJ, *Basic and Clinical Science Course,* Section 8, American Academy of Ophthalmology, 2011.)

pupil for evidence of a decentered IOL, such as a visible optic edge or obvious decentration of the concentric rings of the optic within the pupillary space (Figure 7). Avoiding MFIOLs in patients with irregular anterior capsulotomies, compromised zonular fibers, or compromised posterior capsules will reduce the incidence of this condition.

In MFIOL patients, an eccentric pupil is another possible explanation for inadequate distance or near vision, glare and halos, and waxy vision. It may have been present preoperatively or may develop postoperatively. The etiology of the symptoms may be very similar to a decentered IOL.

After dilation, anterior capsular phimosis may be observed (Figure 8). The opacified anterior capsular rim may be so contracted that it impinges upon the visual axis, either in a miotic pupil (as seen in photopic conditions) or in the dilated pupil (as may be seen in mesopic conditions such as night driving). It can also cause IOL decentration. Patients with this condition may report a film or haze around objects, despite having a clear central visual axis and good Snellen acuity. Their symptoms may be worsened at night or in dimly lit rooms as the induced mydriasis exposes more of the opacified anterior capsular rim.

Anterior capsular phimosis and lens dislocation were not uncommon complications with the first-generation Crystalens, AT-45. An eccentric capsulorrhexis or asymmetric contractile forces in the capsular bag can cause an anterior displacement of one plate haptic and an anterior tilt to the adjacent half of the IOL optic (Figure 9), an effect known as the Z syndrome. The tilted IOL optic induces a sphero-cylindrical refractive error and affects the uncorrected near and distance vision. The incidence of this complication has dramatically decreased with the introduction of the newer-generation Crystalens models with broader rectangular haptics.

Posterior capsular opacification is a very common cause of reduced distance or near vision not correctible by refraction or a contact lens. Refractive and diffractive IOLs are particularly sensitive to posterior capsular opacification, and even mild changes in the posterior capsule can have profound effects on the objective and subjective vision (Figure 10). This is believed to be due to the loss of contrast sensitivity inherent with these types of MFIOLs that is exacerbated by the posterior capsular opacification.

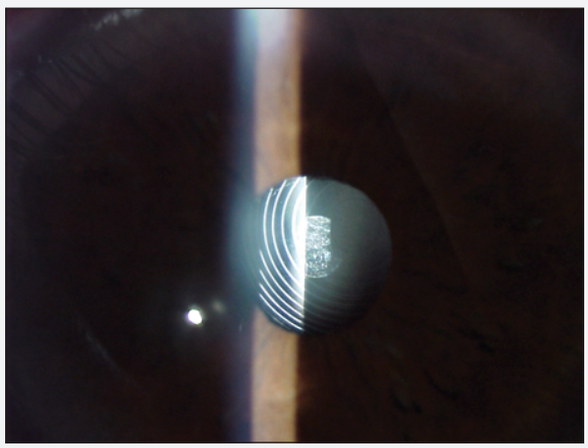

Figure 7 Dislocated ReSTOR multifocal IOL no longer centered in the undilated pupil. (Image courtesy of Eric D. Donnenfeld, MD.)

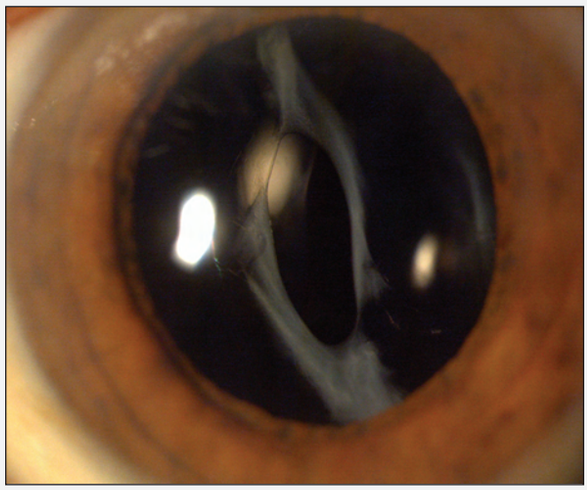

Figure 8 Anterior capsular phimosis with Crystalens IOL.

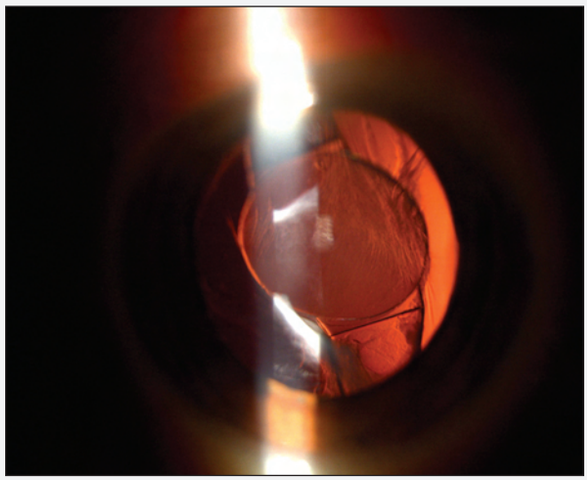

Figure 9 Z syndrome with early Crystalens model, with superior haptic and upper portion of optic vaulting anteriorly

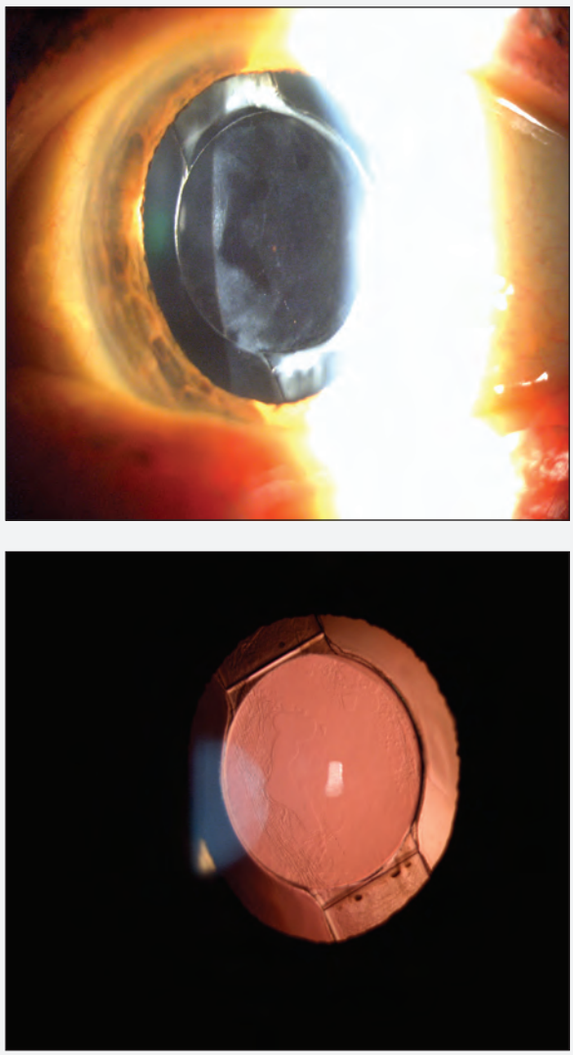

Figure 10 Posterior capsular opacification. **a.** Direct slit beam demonstrates posterior capsular opacification behind a Crystalens intraocular lens. **b.** Retroillumination better demonstrates posterior capsular opacification.

Macular problems, including cystoid macular edema (CME), epiretinal membrane (ERM), and age-related macular degeneration (AMD), can cause reduced vision and cause dissatisfaction in the PrCIOL patient. All forms of macular disease have a more profound effect in PrCIOL patients because of the reduction in contrast sensitivity. CME can occur in otherwise uncomplicated cases, although it is more common in patients with underlying diabetes, macular ERMs, a history of uveitis, concurrent treatment with topical prostaglandin inhibitors, or following complicated surgery such as a torn posterior capsule or vitreous loss. ERMs can cause waxy vision, blurry vision at both distance and near, and metamorphopsia. Macular ERMs can be present preoperatively, may also develop postoperatively, and may sometimes be associated with vitreomacular traction causing additional visual distortion. Subtle macular abnormalities can be difficult to identify on examination, particularly in patients with significant cataracts. Fluorescein angiography (FA) is diagnostic in patients with CME (Figure 11), and optical coherence tomography (OCT) is a sensitive, noninvasive method to identify all of these macular diseases (Figures 12 and 13). Preoperative OCT screening of potential PCIOL candidates is advisable. As a general rule, PrCIOLs should not be used in patients at high risk for CME or with evidence of other macular diseases.

Diabetic retinopathy can limit the best-corrected vision in any patient pre- or postoperatively. Dissatisfied PrCIOL patients with underlying diabetes should be evaluated for retinopathy and CME. Both FA and OCT can be employed to make this diagnosis. Patients with preoperative diabetic retinopathy or a history of previous diabetic macular edema are not good candidates for MFIOLs.

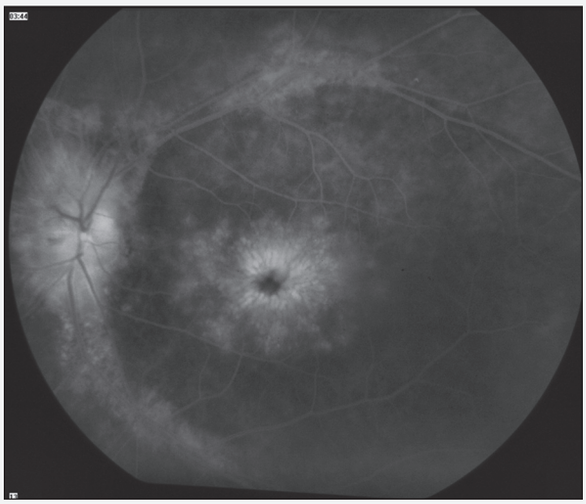

Figure 11 Fluorescein angiogram demonstrating florid cystoid macular edema.

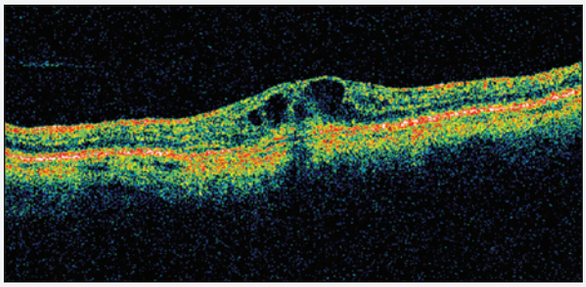

Figure 12 Optical coherence tomography image demonstrating significant cystoid macular edema.

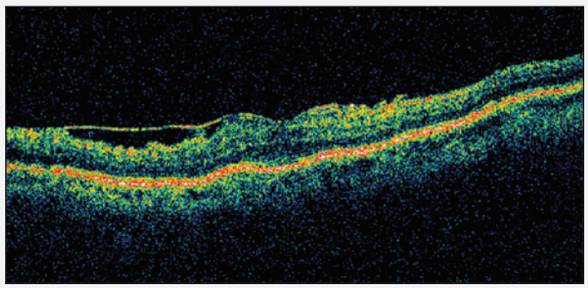

Figure 13 Optical coherence tomography image demonstrating a macular epiretinal membrane with loss of the foveal depression.

Some patients with complaints of glare, halos, waxy vision, or blurry vision are fully evaluated and not found to have any easily recognized explanation. They usually have excellent best spectacle-corrected vision. Their MFIOLs are centered in the capsular bag with a clear posterior capsule. They have normal optic nerves, normal maculae, insignificant refractive errors, and normal corneal topographies. These patients are believed to have inadequate neural adaptation. They have not yet learned to deal with the simultaneous images presented to the retina, one in focus and the other blurred. Most, but not all patients do experience at least some degree of neural adaptation, but it may take 6 to 12 months. There is no reliable way to predict preoperatively which patients will experience problems with neural adaptation, and there is no way to treat or promote neural adaptation postoperatively in these unhappy MFIOL patients.

Some dissatisfied PrCIOL patients have excellent visual and functional surgical results, but they have unmet or unrealistic expectations. The surgeon's promise of "decreased reliance on glasses" or "increased independence from glasses" is misinterpreted by the patient to mean perfect, crisp 20/20 vision at distance, intermediate, and near. These patients are best served by empathetic discussions in the office, and demonstrations of the vision they might have had with standard monofocal IOLs. Placing a pair of –3.0 D spectacles on the patient will demonstrate the limited near vision they would have had with standard monofocal IOLs.

# Management of the Dissatisfied PrCIOL Patient

Refer again to Figures 1 and 3 for a systematic stepwise approach to the dissatisfied PCIOL patient. Table 3 summarizes indications for multifocal IOL exchange.

Dry eye syndrome should be treated, depending upon clinical severity, with a stepwise approach using frequent artificial tears, night-time lubricating ointments, punctal plugs or permanent punctal occlusion, topical cyclosporine drops, oral doxycycline or minocycline, topical corticosteroids, and oral omega-3 fatty acids. Ideally, identifying these patients and instituting treatment prior to surgery would be extremely helpful and would also improve preoperative biometry and videokeratography for more precise IOL calculations. Patients need to be counseled that dry eye syndrome is a chronic condition, and that treatment must be carried out indefinitely.

Lid margin disease, including blepharitis and meibomian gland dysfunction, needs to be aggressively treated. The usual regimen of warm compresses, lid scrubs, topical antibiotics or combination antibiotic–steroid ointments, topical cyclosporine, oral doxycycline or minocycline, and oral omega-3 fatty acids, can all be of benefit. As with dry eyes, identifying and treating these patients preoperatively can be of immense benefit and may help avoid the unhappiness postoperatively. It is important to remember than an unstable tear film from lid margin disease exacerbates the dry eye syndrome.

Residual refractive errors can be managed with spectacles, either permanently or temporarily in the immediate postoperative period, or with contact lenses.

## Table 3. Indications for Multifocal Intraocular Lens Exchange

| |
|---|
| Dysphotopsias: glare. halos, night vision complaints |
| Dislocated IOL |
| Poor quality of vision |
| Persistent punctate epithelial keratitis |
| Large postoperative refractive error |
| Macular epiretinal membrane |
| Age-related macular degeneration |
| Background diabetic retinopathy |
| Irregular astigmatism |
| Corneal ectatic disorders: keratoconus, pellucid marginal degeneration |
| Significant higher-order aberrations |

Significant refractive errors are best managed more definitively with laser vision correction (photorefractive keratectomy or LASIK), IOL exchange, or piggy-back IOLs. It is important to wait until the refraction has stabilized, which may take 3 to 6 months. Laser vision correction is best for mild-to-moderate refractive errors, while IOL exchange is better for moderate-to-large errors. Limbal relaxing incisions can be considered for residual astigmatism. LRIs work best for lower amounts of astigmatism, ≤2 diopters, while laser vision correction can correct up to 6 diopters. Conventional rather than customized wavefront-guided excimer laser ablations may be preferred to avoid eliminating negative spherical aberration induced by the MFIOL in order to preserve multifocality.

Because even mild posterior capsular opacification can have a profound effect on the quality of vision in MFIOL patients, YAG laser posterior capsulotomy should be performed earlier in these cases. An important caveat is the patient with posterior capsular opacification in whom IOL exchange is being considered. Opening the posterior capsule can make an IOL exchange technically more difficult and increase the risk of postoperative complications. Thus, this procedure should be delayed until one is certain that IOL repositioning or replacement is not going to be needed.

CME is best prevented rather than treated after the fact. Many refractive cataract surgeons recommend preoperative CME prophylaxis with topical nonsteroidal anti-inflammatory drug (NSAIDs) eyedrops starting 3 days preoperatively and continuing treatment for 2 to 4 weeks postoperatively, along with topical corticosteroids. High-risk patients, such as patients with diabetes or macular ERMs, need even longer treatment postoperatively, around 6 to 8 weeks. When CME develops postoperatively, we recommend an aggressive approach consisting of topical corticosteroids, topical NSAIDs, and a posterior sub-Tenon's injection of a long-acting corticosteroid, such as triamcinolone acetonide (Kenalog). If the CME fails to respond to this regimen, consideration can be given to intravitreal VEGF inhibitors, such as bevacizumab (Avastin), or intravitreal steroids. CME treatment with steroid and anti-VEGF injections are currently off-label uses of these products.

Macular ERMs can cause permanent distortion of vision and metamorphopsia by themselves, but it is important to also look for associated CME or macular holes, as this may alter treatment. CME associated with a macular ERM is more recalcitrant to medical treatment. Visually significant macular ERMs sometimes need to be surgically removed with a pars plana vitrectomy and membrane peel. Consultation with a vitreoretinal surgeon is very helpful in deciding if and when surgical intervention is indicated.

A displaced pupil, despite a centered posterior chamber MFIOL in the bag, can cause visual symptoms at distance and near. Argon laser pupilloplasty to retract the pupillary border can be helpful. The quadrant to be treated is 180° away from the area of displacement. For example, if the pupil is superonasally displaced, treating the inferotemporal quadrant will retract the iris in this quadrant and expose the center of the MFIOL. The "Rule of 500" is an excellent starting point: 500 µm spots, with 500 mJ power, for a duration of 500 milliseconds.

Decentered IOLs are more challenging to treat. Topical brimonidine or dilute pilocarpine (0.5% to 1%) drops to keep the pupil from dilating under mesopic and scotopic conditions may solve the problem and be a possible long-term solution. IOL repositioning can be very effective, especially if there is an intact capsular bag. If the capsular bag is not intact, either from surgical trauma or a YAG laser capsulotomy, repositioning an IOL is much more difficult, and replacement with a monofocal IOL is often the best option. Standard monofocal IOLs and 3-piece versions of the MFIOLs can be dialed out of the bag into the ciliary sulcus. The Crystalens and the 1-piece acrylic MFIOLs are not indicated for sulcus fixation, and consideration should be given to IOL exchange. Removal of the Crystalens and the one piece acrylic MFIOLs can be difficult, especially more than 4 to 6 months after surgery, due to capsular adhesion around the haptics and the inability to dial these lenses out of the capsular bag without causing zonular stress and weakening.

Capsular phimosis can be treated with the YAG laser by making several small radial incisions around the anterior capsular edge. This will often enlarge the opacified opening, and prevent further contraction.

The Z syndrome, unique to the Crystalens IOL, and seen almost exclusively in the original model AT45, can be remedied in 2 ways. If detected early, the optic can be pushed posteriorly, thereby restoring the desired posterior vaulting of the optic. If it is longstanding, and associated with capsular phimosis or asymmetric capsular contraction, an attempt should be made to open the capsular bag (usually with viscoelastics) and rotate the IOL into a meridian where it can more easily span the full extent of the capsular bag and vault posteriorly.

In cases of unexplained visual loss or suspected inability to neural adapt, it can be helpful to obtain a second opinion, either from a vitreoretinal specialist, neuro-ophthalmologist or another experienced refractive/cataract surgeon. Reassurance and empathy will also go a long way toward allaying the fears and concerns of the PrCIOL patient.

# Exclusionary Criteria

Although there are varying opinions about exclusionary criteria for PrCIOLs, suggested guidelines are listed in Table 4. These personal opinions of the authors may be modified based upon the clinical experience of each individual PrCIOL surgeon.

## Difficult Personality

The ideal surgical candidate is an upbeat, optimistic person who is not overly compulsive or too exacting to deal with the variable outcomes of PrCIOL surgery, and the possibility of adjustments or enhancements. Surgeons should avoid the difficult personalities who are depressed, angry, unforgiving, obsessive compulsive, or don't seem to fully understand the risks of surgery.

## Dry Eye Syndrome

Patients with pre-existing dry eye syndrome, including punctate keratitis that does not resolve with a 1-month trial of ocular surface treatment, should probably not have a PrCIOL. Even if the ocular surface improves, these patients require long-term and intensive treatment postoperatively, that may be objectionable to the patient or be difficult to maintain. Patients with symptoms of dry eye syndrome, but who have a smooth, moist corneal surface can probably have a PrCIOL, but should be counseled preoperatively about the risk of worsening of their condition postoperatively.

## Lid Margin Disease

Patients with significant and symptomatic blepharitis and/or meibomian gland dysfunction are also not ideal candidates for a PrCIOL, especially if associated with punctate keratitis. These conditions often worsen with time, and it is difficult for patients to commit to long term lid hygiene. PrCIOLs may be considered in these patients if they respond to a preoperative regimen of lid hygiene.

## Irregular Astigmatism and Corneal Ectatic Disorders

We recommend preoperative screening with corneal topography to look for irregular astigmatism or signs of ectasia, as these patients should not have PrCIOLs.

## Maculopathy

Patients with most forms of pre-existent maculopathy including ERM, macular cysts, CME, AMD, and background diabetic retinopathy should not have a PrCIOL. All of these conditions can reduce contrast sensitivity and limit best-corrected vision, and they may progress or worsen after surgery. We personally recommend a screening OCT in all PrCIOL patients. We have occasionally encountered occult macular ERMs and vitreomacular traction and been thankful we did not implant a PrCIOL (Figure 14).

## Pseudoexfoliation Syndrome

Pseudoexfoliation is often associated with compromised zonular support, thereby increasing the risk of capsular phimosis, dislocated IOL, and poor support for the movement of an accommodating IOL. Pseudoexfoliation is also associated with late dislocation of the IOL or capsular bag/IOL complex. Since all types of PrCIOLs require precise IOL centration and support, patients with pseudoexfoliation are not good candidates.

**Table 4. Suggested Exclusionary Criteria for Multifocal Intraocular Lenses**

| |
|---|
| Significant keratitis sicca |
| Significant lid margin disease: anterior blepharitis, meibomian gland dysfunction |
| Irregular astigmatism |
| Corneal ectatic disorders: forme fruste keratoconus, pellucid marginal degeneration |
| Fuchs corneal dystrophy |
| Macular epiretinal membranes |
| Age-related macular degeneration |
| Background diabetic retinopathy |
| Pseudoexfoliation syndrome |
| Unrealistic expectations |

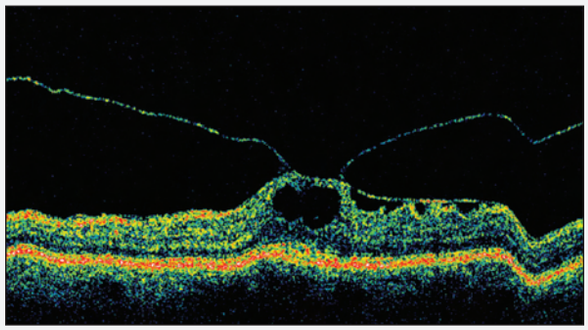

Figure 14 Optical coherence tomography image demonstrating macular epiretinal membrane with vitreomacular traction with a stage 1 macular hole in a patient with a normal OCT image preoperatively.

# Conclusion

Dealing with unhappy patients is unpleasant for the surgeon as well as the patient. Selling anything as "premium" inevitably raises expectation levels. Careful and candid preoperative counseling and setting realistic expectations is critical to successful outcomes and satisfied patients. This same commitment is necessary in the early postoperative period, when negative symptoms are most apparent.

PrCIOLs offer an alternative to standard monofocal IOLs and the possibility of a broad range of unaided vision. PrCIOL designs have steadily improved, but they are not yet perfected. Each particular IOL has certain advantages and potential shortcomings. PrCIOLs offer a useful compromise in pursuit of uncorrected near vision, and spectacle independence in a carefully selected, motivated individual, but are not for everyone. Patients must be made aware of the potential trade-offs and compromises. With careful patient selection, comprehensive evaluation of problems, and thoughtful approach to treatment, many problems can be alleviated.

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# Clinicians' **Corner**

Clinicians' Corner provides additional viewpoints on the subject covered in this issue of *Focal Points*. Consultants have been invited by the Editorial Review Board to respond to questions posed by the Academy's Practicing Ophthalmologists Advisory Committee for Education. While the advisory committee reviews the modules, consultants respond without reading the module or one another's responses. –*Ed.*

**1. What routine preoperative testing do you perform on your patients who request a presbyopia-correcting IOL (PrCIOL)?**

**Dr. Kozarsky:** I employ the IOLMaster optical device (Carl Zeiss Meditec, Dublin, California) for biometry data, and the Orbscan system (Bausch & Lomb, Rochester, New York) for corneal topography. I obtain macular optical coherence topography data if I have any suspicion of a non-cataract cause of decreased visual acuity.

**Dr. Rubenstein:** For PrCIOL patients, I routinely do the following preoperative workup:

- full ophthalmologic exam with manifest refraction and careful attention to the ocular surface, tear film, cornea, and macula
- fluorescein and lissamine green staining of the cornea and conjunctiva if there is a question of ocular surface abnormality
- IOLMaster biometry and/or immersion ultrasound for IOL calculations
- manual keratometry that I personally perform
- corneal topography
- macular OCT—not routinely, but only if there is a clinical suspicion of macular disease
- visual field—only if there is a history of glaucoma or abnormal optic nerve

**2. What retinal conditions would lead you to advise a patient not to have a PrCIOL?**

**Dr. Kozarsky:** Essentially any macular condition is, in my mind, a contraindication to having a PrCIOL. Common specific contraindications include macular pucker, age-related macular degeneration with the exception of perhaps barely detectable drusen, or any diabetic retinopathy.

**Dr. Rubenstein:** I avoid PrCIOLs in patients with clinically significant macular degeneration as evidenced by confluent macular drusen or disruption of the retinal pigment epithelium (RPE) that has an expected negative effect on visual acuity. I also avoid patients with a history of previous retinal detachment repair or vitrectomy because these patients often have compromised macular function.

### 3. What is your preferred PrCIOL and why?

**Dr. Kozarsky:** I prefer the Tecnis multifocal lens (Abbott Medical Optics, Santa Ana, California) and the AcrySof ReSTOR lens (Alcon Laboratories, Fort Worth, Texas). The Tecnis lens is similar to the ReSTOR lens, both being acrylic diffractive optic IOLs, except the lens material is not prone to glistenings. Both lenses essentially guarantee uncorrected reading capability, which is the gold standard of premium lens success for most patients. In my experience, freedom from reading glasses is far less certain with the Crystalens (Bausch & Lomb), which I reserve for patients who report that sharp intermediate and arms' length vision is more important than reading small print. If the distance refractive target is met, the difference between 3 and 4 diopters of add in multifocal implants seems far less important than hitting the refractive target (plano distance) and giving the patient uncorrected reading capability.

**Dr. Rubenstein:** My preferred PrCIOL is the AcrySof IQ ReSTOR SN6AD1 (Alcon Laboratories). With proper patient selection and education, this lens has been very successful in our practice. I find that the postoperative refractive error and uncorrected distance visual acuity is very predictable with a very low need for refractive enhancements. The reading add with the newer +3 add lens allows for a comfortable reading distance and improves intermediate vision. Centration on the visual axis is very important, and patients need to be warned that they may see halos around street lights and automobile headlights and that near vision in a dark room may be compromised.

### 4. Would you ever mix IOLs and use different types of PrCIOLs in the same patient?

**Dr. Kozarsky:** I have used combinations of PrCIOLs in the past to mix intermediate and close reading distances with many successes. Occasionally, unhappy patients have strongly preferred either the multifocal or the zonal/pseudoaccommodative lens to the extent they wanted an exchange of the less preferred lens. Consequently, I have not mixed implants for a few years.

**Dr. Rubenstein:** No. The risks for cortical adaptation are high enough when using 2 of the same lenses, and I would worry about creating adaptation problems with different lenses. With bilateral AcrySof SN6AD1 lens implants, I have found that the vast majority of my patients can see well at all distances and function without glasses.

### 5. How do you respond to a patient with a monofocal IOL in one eye and requests a PrCIOL in the other eye?

**Dr. Kozarsky:** This approach has worked out well for a number of my patients with a monofocal IOL in the first eye and a near plano refraction. They must understand that the reading capability will come at the cost of some decreased distance quality and increased aberration when compared to the monofocal eye. This approach works out especially well when the second cataract is fairly advanced. Trading an advanced cataract for minimal PrCIOL aberration is always a good subjective trade.

**Dr. Rubenstein:** With lengthy and proper consent, these patients can do very well. These patients must understand that their reading vision will not be as good as bilateral implantation; however, they gain considerably more near vision than bilateral monofocal IOL patients. I have done this in a few physicians who can read their charts and function well in their offices without reading glasses.

### 6. How do you handle an unhappy patient with a PrCIOL in one eye and needing cataract surgery in the other eye?

**Dr. Kozarsky:** This is a very unusual situation if I have done my job to educate the patient on advantages and limitations of a PrCIOL, achieved the plano distance refractive target in the first eye with a healthy ocular surface, a clear posterior capsule, and there is no residual astigmatism or other limiting ocular pathology. Commonly these patients are uncertain, but not unhappy, in the week or two between the first and second implant and need encouragement to have the "matching" surgery in the fellow eye. If a patient has gone many weeks or months after a perfect first eye PrCIOL and is becoming progressively more miserable for any reason about the PrCIOL, there may be no choice but to do an exchange for a monofocal lens in the first eye before monofocal cataract surgery in the fellow eye. The latter situation is not a rare one with referred postoperative PrCIOL patients.

**Dr. Rubenstein:** The first step is to accurately diagnose the source of the patient's complaints. The regularity of the cornea, state of the ocular surface, clarity of the posterior capsule, and health of the macula all need to be assessed. If all of these are normal, then the IOL may be the culprit. Testing for internal wavefront abnormalities from the IOL needs to be assessed. If the IOL is really the problem, I would put a monofocal IOL in the second eye knowing that I may need to do an IOL exchange in the first eye at a later date.

### 7. How do you respond to a 70-year-old patient who requests a PrCIOL and has bilateral cataracts and a few hard macular drusen in each eye?

**Dr. Kozarsky:** If it appears that there is any likely progression to visually significant age-related macular degeneration (wet or dry), I will not use a multifocal or pseudoaccommodative IOL. Obvious drusen or the temptation to start the protocol recommended in the Age-Related Eye Disease Study contraindicates the use of multifocal or pseudoaccommodative implants.

**Dr. Rubenstein:** This is a tough call. If the drusen are few and not coalesced, if the RPE around the fovea looks normal and if the drusen have not progressed significantly over time, I would consider a PrCIOL with proper consent. However, it is always safer to use a monofocal IOL in these cases.

### 8. How do you handle the financial considerations for a dissatisfied PrCIOL patient?

**Dr. Kozarsky:** Assuming that this is my surgical patient, I will provide all remedial services at no additional cost to the patient. This would include office visits after the 90-day global period, excimer laser treatment, punctal plugs, and IOL exchange. I cannot recall any patient who has even broached the topic of a refund of the PrCIOL upcharge; instead, this type of patient typically realizes all the extra time and effort that has been spent in making the PrCIOL work and is generally more appreciative than demanding. This assumes that the patient chose the premium IOL service without pressure from the doctor or practice. Again, this is a very unusual situation if the surgery has been performed in a suitable patient, the patient was educated about the benefits and limitations of PrCIOLs, and all objective targets have been achieved.

**Dr. Rubenstein:** We generally do not offer patients a refund unless they bring up the idea. Because I operate in a hospital setting, the patient gets charged separately from the hospital and from our practice. If a dissatisfied patient demands a refund, our office would refund the physician's portion.

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