EXTRACT THE LENS

Why I prefer refractive lens exchange for dysfunctional lens syndrome.

BY DANIEL S. DURRIE, MD

Dysfunctional lens syndrome as a term has been around for more than 15 years. It was first introduced by Harvey Carter, MD, as a way to talk to patients about using IOLs to improve their vision before they developed cataracts. When patients older than 48 years of age desire better vision, more and more surgeons are recommending refractive lens exchange (RLE) as a way to address issues that refractive surgery alone cannot.

THE STAGES OF DYSFUNCTIONAL LENS SYNDROME

Surgeons are beginning to divide dysfunctional lens syndrome into three stages, each with its own potential surgical treatment.

Stage 1 occurs when patients are in their 40s and becoming presbyopic. The crystalline lens loses its focusing power but is still clear and colorless. Patients' dislike of reading glasses and bifocals prompts them to seek an eye examination. At Durrie Vision, this is usually when my colleagues and I begin having discussions with our patients about their overall vision goals—not just for the present but also what they want in 15 or 20 years.

In stage 2, nuclear sclerosis begins, and patients start complaining that their night vision is deteriorating and they need more light to read. Typically, they are in their 50s and 60s.

Stage 3 occurs when the patient has a visually significant cataract. Treatment for this condition is well understood and will not be addressed in this article.

AT A GLANCE

- Surgeons are beginning to divide dysfunctional lens syndrome into three stages.
- Most patients are unaware of refractive lens exchange as a treatment for stage 2 dysfunctional lens syndrome.
- The author argues that refractive lens exchange is often the best option for treating stage 2 dysfunctional lens syndrome.

TREATMENT CONSIDERATIONS

Stage 1 now has several treatment options, most of which are familiar to patients. They include blended vision, monovision, and LASIK or PRK. Plus, the FDA recently approved the first corneal inlay (Kamra; AcuFocus), which I find has made patients more interested in looking for solutions to stage 1 dysfunctional lens syndrome.

In my experience, the treatment of stage 2 dysfunctional lens syndrome requires a longer conversation with patients (see *Why Multiple Tests Are Necessary*). Most of them are unaware of RLE. It is therefore my goal to ensure that patients understand their lens and its anatomy (my practice uses eye models and Eyemaginations software to this end). Once they fully understand the natural course of vision as

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WHY MULTIPLE TESTS ARE NECESSARY

No single test will provide a comprehensive look at a patient's crystalline lens. At Durrie Vision, we run a battery of tests, including ocular scatter and topography. These tests can be accomplished with tools most clinics already have such as an Orbscan (Bausch + Lomb), Galilei Dual Scheimpflug Analyzer (Ziemer Ophthalmic Systems), or Pentacam Comprehensive Eye Scanner (Oculus Surgical). We begin by using the side Scheimpflug image that shows the lens density. Clinics can use the OPD-Scan (Nidek or Marco) to help differentiate between corneal and lenticular distortion, but I would say that measurements with these devices are not as sophisticated as those of devices that are being designed specifically for dysfunctional lens syndrome. Our practice also uses the iTrace (Tracey Technologies) and AcuTarget HD (AcuFocus).

Combined, these tests provide a detailed overview of the patient's lens, its density, optical scatter, and whether the distortions are in the lens or on the cornea.

Finally, we use Eyemaginations software and model eyes to educate patients about our findings.

MONOVISION'S ROLE IN CATARACT SURGERY

Many factors contribute to success with this common and effective strategy for presbyopic correction.

BY DIVYA M. VARU, MD

Monovision creates artificial anisometropia in order to correct presbyopia. Westsmith first proposed this technique in 1958 as a method of prescribing optical aids for presbyopic contact lens wearers.[1] Monovision continues to be effectively used to manage presbyopia, with studies reporting a mean success rate of 73% using contact lenses[2] and 86% to 96% after refractive surgery.[3-5]

Monovision in pseudophakic patients was first described in 1984.[6] Owing to advances in surgical technique and IOL technology, patients pursuing cataract or refractive lens exchange surgery are increasingly demanding about their postoperative visual function and spectacle independence. Overall, patients report an 80% or higher rate of satisfaction with pseudophakic monovision.[7-10] Success with this approach can be achieved with monofocal, toric, or accommodating IOLs, and it has become a vital skill for today's ophthalmic surgeons.

PREVALENCE

Monovision correction during cataract surgery is popular among ophthalmologists. In a 2003 survey of American Society of Cataract and Refractive Surgery (ASCRS) members, 86% of US surgeons preferred monovision or modified monovision, whereas only 13% preferred multifocal IOLs.[11]

AT A GLANCE

- Pseudophakic monovision creates artificial anisometropia in order to correct presbyopia.
- The approach can use monofocal, toric, or accommodating IOLs.
- Careful preoperative planning, knowledge of the technique's limitations, sufficient patient counseling, and excellent surgical technique are essential.

Even as IOL technology improved, a 2014 survey of physician attendees at the ASCRS annual meeting found that monovision correction during cataract surgery was used three times more commonly than all presbyopia-correcting IOLs (22.3% vs 7.2%). Cost to the patient, concern over nighttime quality of vision, and concern about inadequate unaided near and intermediate vision were cited as the most common barriers to converting patients to presbyopia-correcting IOLs.[12]

Achieving success with pseudophakic monovision requires careful preoperative planning, knowledge of the technique's limitations, sufficient patient counseling, and excellent surgical technique.

PREOPERATIVE ASSESSMENT

In order to assess a patient's goals, lifestyle needs, preference for glasses after surgery, and financial considerations, I use a questionnaire designed by Steven J. Dell, MD (Figure). Ideal candidates for pseudophakic monovision correction not only have a strong desire to be less dependent on glasses, but they also understand the strategy's limitations.

A deciding factor between a presbyopia-correcting IOL and pseudophakic monovision is the patient's level of motivation for achieving spectacle independence. The bilateral implantation of multifocal IOLs achieves higher rates of spectacle independence than does pseudophakic monovision: 78% and 81% with the AcrySof IQ Restor models SN6AD1 and SN6AD3 (Alcon), respectively, and 85% with the Tecnis ZM900 (Abbott Medical Optics).[13,14] In comparison, the rate of spectacle independence after cataract surgery varies from 26% with 1.00 to 1.16 D of monovision to 81% with 2.27 D of monovision.[8,9,15] Historically, patients with pseudophakic monovision have reported difficulty reading fine print and driving in dim light or hazardous conditions, but having backup glasses for these situations typically resolves the problem. Any patient considering pseudophakic monovision should have realistic expectations regarding his or her need for glasses based on the planned amount of anisometropia.

Of note, multifocal IOLs reduce contrast sensitivity and increase the prevalence of dysphotopsia, particularly glare and halos, compared with monofocal IOLs.[14,16] In a direct

comparison to patients with approximately 1.25 D of pseudophakic monovision, individuals who underwent bilateral multifocal IOL implantation had an increased rate of dysphotopsias and IOL exchange surgery.[15]

Deciding between pseudophakic monovision and multifocal IOL implantation to address presbyopia also requires a financial discussion with patients and counseling on the shortcomings of each option.

FACTORS INFLUENCING SUCCESS WITH PSEUDOPHAKIC MONOVISION

How Much Anisometropia?

In conventional monovision, surgeons historically aimed for 2.00 to 2.50 D of anisometropia, but in a 2003 survey, 46% of surgeons preferred a modified monovision approach, which targets a refraction of -0.50 to -1.00 D in the nondominant eye.[11,17] Modified monovision provides patients with excellent binocular vision at far and intermediate distances, but their near vision is limited compared to after conventional monovision.[18] Modified monovision is likely gaining popularity, because intermediate vision tasks such as using a mobile phone, tablet, and computer are becoming increasingly important.

Date_____ Name_____

Cataract and Refractive Lens Exchange Questionnaire

The term "cataract" refers to a cloudy lens within the eye. When a cataract is removed, an artificial lens is placed inside the eye to take the place of the human lens that has become the cataract. Occasionally, clear lenses that have not yet developed cataracts are also removed to reduce or eliminate the need for glasses or contacts. If it is determined that surgery is appropriate for you, this questionnaire will help us provide the best treatment for your visual needs. It is important that you understand that many patients still need to wear glasses for some activities after surgery. Please fill this form out completely and give it to the doctor. If you have questions, please let us know and we will assist you with this form.

1. After surgery, would you be interested in seeing well **without glasses** in the following situations?
   Distance vision (driving, golf, tennis, other sports, watching TV)
   ___Prefer no **Distance** glasses. ___ I wouldn't mind wearing **Distance** glasses.

   Mid-range vision. **(computer, menus, price tags, cooking, board games, items on a shelf)**
   ___Prefer no **Mid-range** glasses. ___ I wouldn't mind wearing **Mid-range** glasses.

   Near vision (reading books, newspapers, magazines, detailed handwork)
   ___Prefer no **Near** glasses. ___ I wouldn't mind wearing **Near** glasses.

2. Please check the **single** statement that best describes you in terms of **night vision:**
   ___ a. Night vision is extremely important to me, and I require the best possible quality night vision.
   ___ b. I want to be able to drive comfortably at night, but I would tolerate some slight imperfections.
   ___ c. Night vision is not particularly important to me.

3. If you **had** to wear glasses after surgery for one activity, for which activity would you be **most** willing to use glasses? ____**Distance Vision.** ____**Mid-range Vision.** ____**Near Vision.**

4. If you could have good **Distance Vision during the day without glasses**, and good **Near Vision for reading without glasses**, but the compromise was that you might see some **halos or rings** around lights at night, would you like that option? ____Yes ____No

5. If you could have good **Distance vision during the day and night** without glasses, and good **Mid-range Vision** without glasses, but the compromise was that you might need glasses for reading the finest print at near, would you like that option? ____Yes ____No

6. Surgery to reduce or eliminate your dependence upon glasses for **Distance, Mid-range and Near Vision** may be partially covered by insurance if you have a cataract that is covered by insurance. Would you be interested in learning more about this option?
   ____Yes ____No ____Maybe, it depends on how much is covered by insurance.

7. Please place an "X" on the following scale to describe your personality as best you can:
   [----------I----------]
   Easy going Perfectionist

Please Sign Here_____

Figure. The Dell index.

Stereopsis and contrast sensitivity are reduced in proportion to the amount of anisometropia.[18] A monovision threshold test can help surgeons to determine what degree of anisometropia a given patient can tolerate (see *Monovision Threshold Test*).[19]

Of note, monofocal IOLs have pseudoaccommodative properties because of the depth of focus, miosis upon convergence, lid squeezing, the implants' spherical aberration, corneal multimodality, or postoperative refraction.[20] This additional 1.00 D of accommodative effect usually means that the myopic defocus in pseudophakic monovision can be limited to 1.50 to 1.75 D yet still provide a greater range of vision.[21]

Although recommended for patients undergoing keratorefractive surgery, a contact lens trial with monovision may be of limited utility in cataract surgery patients owing to their poor BCVA.[22] I have found it beneficial to place a +1.25 D trial lens in front of the planned near eye when I am explaining the expected outcome to one of these patients.

The Role of Ocular Dominance

Because patients with strong ocular dominance will not be able to suppress blur, lower levels of anisometropia should be considered for these individuals.[19]

Oftentimes, the dominant eye is corrected for distance based on the assumption that the nondominant eye will more easily suppress blur. There are reports of success with

MONOVISION THRESHOLD TEST

1. Determine the dominant eye.
2. Give the full distance correction in the phoropter or trial frame.
3. Occlude the nondominant eye (typically, the planned near eye).
4. Add -0.25 D increments to the dominant eye (typically, the planned distance eye) until the patient reports sustained blur.
5. Occlude the distance eye.
6. Add +0.25 D increments to the near eye until the patient reports sustained blur.
7. Note this interocular difference.
8. Instruct the patient to open both eyes.
9. Alternatively, add -0.25 D increments to the near eye and +0.25 D increments to the distance eye until the patient cannot tolerate the difference.
10. Note this interocular difference.
11. The patient's interocular threshold will lie between the initial monocular interocular difference and the final binocular difference.[1]

1. Maloney WF. Presbyopia success depends on comprehensive preop evaluation. *Ocular Surgery News US Edition*. August 1, 2005. http://bit.ly/1LhqMxJ. Accessed July 1, 2015.

crossed monovision, however, so perhaps the magnitude of ocular dominance is more significant in determining patients' satisfaction.[4,7]

Other Considerations

Success with pseudophakic monovision demands an emmetropic result in the patient's distance eye. For that reason, surgeons must correct astigmatism via astigmatic keratotomy, limbal relaxing incisions, laser vision correction, and/or toric IOLs.

A patient's age matters. In one study of pseudophakic monovision, the highest percentage of satisfied patients were 70 years of age or older.[8]

Pseudophakic monovision may compromise vision in low light such as when patients are driving at night. The procedure can also decrease depth perception. It is therefore important for surgeons to consider the patient's occupation and hobbies preoperatively.

Further studies of pupillary size are needed. Generally speaking, surgeons should be conservative about the amount of myopic defocus in patients with large scotopic pupils.[19]

Monovision should be avoided in patients at risk of developing postoperative diplopia such as those with a history of strabismus surgery, phoria, or intermittent tropias.[22]

When a patient is not a candidate for a multifocal IOL but is highly motivated to achieve spectacle independence, surgeons can consider using a myopic defocus with an accommodating IOL such as the Crystalens or Trulign (Bausch + Lomb). Because of the limited accommodating ability of these IOLs, pseudophakic monovision is necessary to achieve high rates of spectacle independence.[23] In my experience, when implanting accommodating lenses bilaterally, targeting the near eye for -0.75 to -1.00 D will achieve reading vision without correction. Alternatively, patients may benefit from the placement of a monofocal IOL in their distance eye and an accommodating IOL with myopic defocus for intermediate and near vision in their contralateral eye.

FINANCIAL CONCERNS

In 2004, an estimated 1.04 billion people had presbyopia, but nearly half of them did not wear presbyopic correction, primarily in developing countries. Cataract surgery using pseudophakic monovision with monofocal IOLs is a cost-effective option to alleviate the burden of presbyopia.[22]

For patients with high cylindrical errors, a long-term cost analysis showed that toric IOLs were more cost-effective than conventional IOLs, because the former reduced patients' postoperative need for spectacles and contact lenses.[24] When implanting toric IOLs or toric accommodating IOLs, it therefore makes sense for surgeons to consider a monovision approach so as to reduce patients' dependence on glasses and contact lenses.

In a 2008 study, 80% of all patients were willing to pay at least $5 per day, or $1,825 or more annually, to be free of spectacles.[25] Nevertheless, the 2014 ASCRS survey found that presbyopia-correcting IOLs were being used in only 7% of cataract surgeries.[12] Pseudophakic monovision can help to bridge the gap between patients' desires, their finances, and the limitations of technology.

The economic gain of using presbyopia-correcting IOLs compensates the surgeon for the increased pre- and postoperative planning, testing, and counseling. Similar perioperative management and excellent surgical technique are required for success with presbyopia-correcting IOLs and for pseudophakic monovision. Although surgeons cannot bill for monovision itself, the use of noncovered services such as limbal relaxing incisions and adjunctive laser vision correction has allowed many surgeons to offer monovision as an effective part of their refractive packages or in conjunction with toric or accommodating IOLs.

CONCLUSION

Cataract and refractive lens exchange surgery offers patients an opportunity for improved visual function and decreased dependence on spectacles and contact lenses. Pseudophakic monovision is a common and effective strategy. Low levels of anisometropia can correct presbyopia without markedly impairing binocular function. Patients should be educated about the benefits and limitations of this approach, which is easily reversible with a pair of glasses or contact lenses. ■

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people age, many of my patients choose to have their lenses replaced in stage 2 rather than wait for a cataract.

In my experience, patients with stage 2 dysfunctional lens syndrome are often best treated with RLE rather than other options. A corneal inlay is not going to perform to its best capability in an eye with nuclear sclerosis and a lot of ocular scatter. LASIK monovision will only work for a couple of years before the patient returns with vision complaints. In contrast, RLE prevents cataracts and stabilizes the vision system. (Obviously, the patient has to be vetted as a viable candidate first.)

> **"The RLE conversation and education are a long-term commitment that ... will grow a practice but not immediately."**

A LONG-TERM COMMITMENT

For the surgeon, the RLE conversation and education are a long-term commitment that, in my experience, will grow a practice but not immediately. Patients frequently go home and mull over RLE for a few months or even years. As a reminder, they came to my office expecting LASIK, not something that would address their vision problems for years to come. I would say that approximately 20% to 25% of people opt for RLE during their first discussion.

Offering RLE to patients with stage 2 dysfunctional lens syndrome makes good sense, but it requires a practice to invest time and effort into educating people. ■

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