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Update on Mastering Refractive IOLs
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Approaching astigmatism in presbyopia IOL patients

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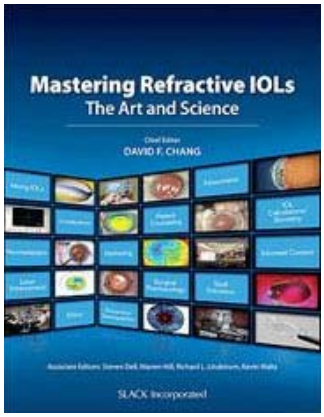

Chapter excerpt: Presbyopia-correcting IOLs are a wonderful technology that we can provide to our patients. Whether used during refractive lens exchange or cataract surgery, presbyopia-correcting IOLs require extreme precision as they treat both ametropia and presbyopia. Patients requesting presbyopia-correcting IOLs have high expectations that require the surgeon to achieve emmetropia (ie, ±0.25 D) every time. This need for precision has renewed our attention to preoperative biometry to maximize the accuracy of IOL power calculations.

Presbyopia-correcting IOLs also require surgeons to have a strategy for astigmatism correction. In my experience, as little as 0.75 D of astigmatism degrades visual quality and may leave a patient symptomatic with visual blur, ghosting and halos. Surgical correction of astigmatism is now a necessity if one is to employ these IOLs. Because a toric presbyopia-correcting IOL platform is not yet available, surgeons must combine corneal refractive procedures (ie, limbal relaxing incisions, LASIK and PRK) with presbyopia-correcting IOLs to achieve the desired outcome.

Limbal relaxing incisions

Limbal relaxing incisions (LRIs) provide a safe, effective and practical approach for reducing 3.5 D or less of pre-existing astigmatism. Paired 600-µm-deep arcuate incisions are placed in the cornea approximately 0.5 mm to 1 mm anterior to the limbus — on the steep meridian — at the time of lens replacement surgery. LRIs have several advantages over more centrally placed astigmatic keratotomy: They are easier to perform and more forgiving than astigmatic keratotomy; they have less tendency to induce irregular astigmatism; and there is a less likelihood of shifting in the resultant axis of cylinder. When paired LRIs are kept at 90° or less of arc length, they exhibit a consistent 1:1 coupling ratio (ie, the amount of flattening that occurs in the incised meridian, relative to the amount of steepening that results 90° away) that elicits little change in spherical equivalence. Therefore, no alteration in the calculated lens power is needed.

Corneal topography is best used to determine the pattern, amount and location of astigmatism. Additionally, topography can detect subtle corneal pathology that would contraindicate the use of LRIs (eg, forme fruste keratoconus). Refractive cylinder can be influenced by lenticular astigmatism, which is eliminated after removal of the crystalline lens, so surgeons should utilize topography and keratometry when treating astigmatism.

When planning the incisions, consult a nomogram that includes age modifiers to determine the appropriate arc length of the LRIs. Review the cylinder axis location on the corneal topography map; if there is a significant disparity between the keratometry and corneal topography (ie, 30° or more), you may elect to defer the LRIs

until the refraction stabilizes after lens replacement surgery. It is critical to properly center the LRIs over the steep corneal meridian because an axis deviation will result in a reduction in desired effect. Our clinic reported significant cyclotorsion when patients move from an upright to supine position. Therefore, while the patient is upright, I recommend placing an orientation ink-mark at the limbus (ie, 6 o'clock or 12 o'clock position) to help identify the steep axis more accurately.

Laser vision enhancements

When planning presbyopia-correcting IOL surgery in a patient with a high level of pre-existing astigmatism (ie, more than 3 D), a bioptics approach (ie, IOL followed by laser vision enhancement) may be needed. LRIs alone are unlikely to correct the astigmatism completely. Significant residual astigmatism in patients with presbyopia-correcting IOLs will result in suboptimal uncorrected vision. For this reason, patients will want the shortest possible interval before laser enhancement is performed.

There are several different strategies for these planned laser vision enhancements. The first is to perform the presbyopia-correcting IOL surgery followed by LASIK or PRK. LASIK surgery requires placing a suction ring on the eye that significantly increases IOP during the flap creation. Allowing phacoemulsification incisions 12 weeks to heal ensures that these incisions will not rupture during LASIK enhancement. Because PRK surgery does not use a suction ring, the PRK enhancement can be performed when the refraction has stabilized, which is usually 4 to 6 weeks after IOL surgery. The second approach is to create the LASIK flap 1 to 2 weeks before presbyopia-correcting IOL surgery, followed by lift flap LASIK enhancement 4 to 6 weeks later. This approach allows for an earlier enhancement, when the refraction stabilizes similar to the PRK option, because the LASIK flap has already been created and can simply be lifted to perform laser ablation. I prefer the third and final approach, which is to perform LASIK or PRK to reduce the astigmatism before presbyopia-correcting IOL surgery. The latter provides the patient with the best functional vision immediately after presbyopia-correcting IOL implantation. Because the preoperative data for IOL calculations is available, determining the IOL power after LASIK or PRK is not difficult. If needed, additional laser treatment could still be used to further enhance the patient's vision.

A perfect time to use the third approach, laser vision correction followed by presbyopia-correcting IOL surgery, is when the patient has a high level of hyperopic astigmatism. A mixed astigmatism laser ablation is performed first to reduce the astigmatism without significantly changing the average keratometry. Minimal to no change in IOL power is needed when compared with pre-LASIK/PRK calculations. For example, a 64-year-old man presented with a manifest refraction in the left eye of +5.50−5.00 × 167 = 20/20 with average keratometry of 43.63 D. Conventional LASIK was performed treating +2.50−5.00 × 167. One month postoperatively, the refraction was +2.50−0.50 × 10 = 20/20, with average keratometry unchanged a t 43.63 D. Refractive lens exchange was performed with insertion of a +21 D ReSTOR IOL (Alcon), which was the same power calculated before LASIK. One month after refractive lens exchange with ReSTOR, the patient's uncorrected distance visual acuity was 20/20 and uncorrected near visual acuity was 20/20, with refraction of +0.25−0.25 × 164.

Conclusion

Presbyopia-correcting IOLs are currently the most exciting advancement in cataract and refractive surgery. Patients demand and expect great results with presbyopia-correcting IOLs. The challenges that surgeons face in meeting these expectations require extreme precision, not only when performing IOL power calculations but also when dealing with pre-existing or residual astigmatism. Developing a strategy for astigmatism correction will help surgeons meet or even exceed presbyopia-correcting IOL patient expectations.

Update: Pearls for astigmatism management

In a recent interview with *Premier Surgeon*, **Jason E. Stahl, MD,** spoke about his approach to astigmatism and the importance of being a cataract surgeon with refractive correction skills.


Jason E. Stahl

PS: Have there been any major changes since this chapter was written?

Dr. Stahl: There has not been much change in how we approach patients with astigmatism. For a lower-level correction (2 D or less), we will do limbal relaxing incisions (LRIs) at the time of cataract or refractive lens exchange surgery. For a higher-level correction (greater than 2 D), you have to decide whether to do the implant first followed by a keratorefractive procedure (ie, LASIK or PRK) about 3 months later to correct the astigmatism. Or another approach is to create a LASIK flap prior to IOL surgery that can be lifted for laser enhancement once the refraction has stabilized. Sometimes I will do a mixed astigmatism LASIK treatment in patients with high hyperopia and astigmatism prior to IOL surgery. In my experience, this will correct the astigmatism and not change the corneal power significantly, so it is not challenging to pick a lens power and get them seeing very well right after their IOL implantation.

PS: Are there any new technologies you are using to help patients achieve the best possible outcome?

Dr. Stahl: In some patients, I now integrate the ORange intraoperative wavefront aberrometer from WaveTec to help guide the LRI treatments. An ORange measurement is taken after the patient's crystalline lens is removed, and based on this measurement, the LRIs are performed. We can then take another measurement and see how well we have done correcting the astigmatism and then actually do an enhancement of the LRI right there on the table before finishing the case, if needed. This new technology can help improve your outcomes with LRIs.

Another new technology that I have used to help with LRIs is the TrueVision 3-D visualization system. This 3-D high-definition system converts the optical image from the surgical microscope to a digital 3-D high-definition image on a "heads-up" flat panel display during cataract surgery. Software applications allow a preoperative 3-D image taken in clinic to be registered with the live surgical image, permitting overlay metric data on 3-D display to help guide the placement of LRIs. I participated in a recent multicenter clinical trial using the TrueVision LRI application in 46 eyes that resulted in 80% of eyes with astigmatism of 0.5 D or less.

Toric multifocal lenses are now available internationally. Alcon has the ReSTOR multifocal toric, and there are other manufacturers outside the U.S. that have a toric multifocal lens that can be used in these situations, but unfortunately, we do not have those here in the U.S. yet.

PS: How might the approach to astigmatism be different if a toric multifocal IOL was available in the U.S.?

Dr. Stahl: It would most likely make some surgeons more comfortable using the multifocal lenses. However, I still think that if we just look at what is holding back the adoption of these presbyopia-correcting IOL technologies, it is because your traditional cataract surgeons are not refractive surgeons. They are worried they are not going to hit the refractive endpoint — close to plano — which these lenses require to have the best outcome. That may be not as challenging on the spherical side, but you have to control astigmatism, too. If you are not comfortable doing the LRIs or do not have the ability to do a LASIK or a PRK enhancement, you would probably just decide not to add these lenses to the practice, because you do not want to have an unhappy patient.

I think there would be a huge adoption of toric presbyopia-correcting lenses. As we saw with the adoption of the toric implants that are now available, there were many surgeons who were not comfortable doing LRIs, but when the toric implant came out, they said, "This is something that I know I can use to consistently correct

astigmatism, and I'm going to be comfortable using this in my patients." So, I believe there will be an increase in the number of surgeons who are using presbyopia-correcting lenses once the toric multifocal and/or accommodating IOLs are available.

PS: How do you see the continuing progression of technology helping surgeons approach and deal with pre-existing astigmatism?

Dr. Stahl: What it comes down to is that we have to be both cataract and refractive surgeons. If a surgeon is going to use presbyopia-correcting IOLs, the patient expects to see well at distance and near without glasses. The only way to achieve this goal is to correct the refractive error, including astigmatism. As little as 0.75 D of astigmatism is likely to result in a suboptimal visual result. That means you have to have all the tools, and not all of it can be done just by doing a refractive lens exchange or cataract surgery.

Toric presbyopia-correcting lenses will help, as well as IOLs that are being developed that allow their power to be adjusted postoperatively; however, there is always going to be the need for possible fine-tuning the refractive outcome on the cornea with, most likely, an excimer laser. You have to approach these patients as a refractive surgeon. There will be a significant number of patients who will need a keratorefractive enhancement, and so becoming comfortable with LRIs, LASIK and PRK is necessary if you are going to start using these lenses now or in the future.

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