Presbyopia & Toric IOL Correction:
Keys to Success with Multifocal & EDOF IOLs
The fourth annual ESCRS Clinical Survey revealed some interesting trends about the use of multifocal, toric, and extended depth of focus (EDOF) intraocular lenses (IOLs) for the correction of presbyopia. For instance, while only 11% of current cataract procedures among responding surgeons included presbyopia-correcting IOLs, almost three times as many – 30% – use monovision or mini-monovision as an alternative.

When asked how satisfied their patients are with monovision vs presbyopia-correcting IOLs one year postoperatively, surgeons reported that patient satisfaction for near, intermediate and distance vision is higher in presbyopia-correcting IOL patients – especially for intermediate, but even more so for near vision.

Participants were asked to identify the lowest amount of postoperative residual cylinder error they consider to be visually significant in patients implanted with bifocal/trifocal or EDOF IOLs. The responses suggest that EDOF IOLs are believed to accept higher levels of cylinder error, especially for higher amounts of astigmatism in the range of 0.75D to more than 1.0D (Figure 1).

Over time the number of ESCRS delegates finding 10 degrees or more of rotational error acceptable has significantly decreased

The cost to patients and concerns over contrast visual acuity and nighttime quality of vision are the main reasons for not performing more presbyopia-correcting IOL procedures. Trifocal and EDOF IOL patients are believed to have over three times the chance of having significant aberrations at night even if the patient has no residual refractive error and a healthy ocular surface. Respondents said they believed just 5% of monovision patients would have significant aberrations at night, while

In patients implanted with a bifocal/trifocal or an EDOF IOL, what is the lowest amount of postoperative residual CYLINDER error that is considered to be visually significant in DIOPTRES?

Figure 1: EDOF IOLs are believed to accept higher levels of cylinder error

EDOF IOLs are believed to accept higher levels of cylinder error

After implanting a toric IOL, how many DEGREES of postoperative rotational error is acceptable before visual quality and degradation of visual acuity are significantly affected? ANSWER: 10 OR MORE DEGREES

19% of trifocal and 16% of EDOF IOL patients would have these visual disturbances.

Toric IOL cost considerations play a significant role in IOL choice. Just 13% of respondents’ current cataract procedures involve toric IOLs, but if cost were not an issue, they would choose toric IOLs for 61% of cataract patients who have significant astigmatism.

ESCRS delegates were asked what their most common procedure to manage astigmatism in monofocal cataract patients with 0.75D, 1.25D and 1.75D of cylinder, and their responses indicate that for higher astigmatism, toric lenses are the top choice, but for lower amounts of astigmatism, on-axis incision seems to be an alternative.

The survey revealed that a third of delegates believe that 10 or more degrees of rotational error is acceptable in patients who receive a toric IOL, before visual quality and degradation of visual acuity are

The chart shows the percentage of ESCRS delegates finding 10 degrees or more of rotational error acceptable over time from 2014 to 2018.

Refractive IOLs: Importance of Patient Selection and Realistic Expectations

By Béatrice Cochener-Lamard MD, PhD

Thanks to surgical progress and better understanding and control of optics that make toric, multifocal and extended depth of focus (EDOF) intraocular lenses (IOLs) possible, ammetropia and spectacle independence can be targeted in select cataract patients. Careful patient selection and clear communication regarding realistic expectations are the keys to success with refractive IOLs (RIOLs).

There are two scenarios in which RIOLs are indicated. The first one is refractive lens exchange, where presbyopia patients seek an intraocular solution to spectacle independence. The benefit-to-risk ratio is best in the case of patients who are over 55 years old when LASIK and monovision are inadequate solutions because of insufficient results for near vision and early loss of crystalline transparency, which can be graded nowadays by densitometry or scatter light diffusion changes evaluation.

The second scenario in which RIOLs are indicated is in the case of true cataract patients. Traditional monofocal cataract surgery would simply enable these patients to recover lost visual acuity. With RIOLs, we can do better, especially with the use of toric IOLs that correct corneal astigmatism as spectacles do. We can even achieve complete spectacle independence with the use of EDOF or multifocal IOLs, if there are no ocular or systemic contraindications.

When patients are amenable to this option, it is vital to educate them about the surgery and what they can expect from it, and it is critical to obtain their informed consent. This process is time consuming: You must explain what presbyopia is, manage expectations, perform the surgery, including astigmatism correction, and ensure that they fully comprehend the advantages and limitations of all steps throughout the process, including the risk of not being able to use the selected IOL in case of surgical complication.

PATIENT SELECTION

When choosing candidates for RIOLs, it is important to rule out those who have unreasonable expectations. These patients must understand that they should not expect perfect vision at all distances in all conditions because of the potential impact on quality of vision. It is also important to rule out candidates whose profession entails specific vision requirements, such as a nightshift ambulance driver.

Furthermore, we must eliminate any candidates who have ocular progressive diseases, such as glaucoma, maculopathy, or corneal disturbances. We must also take into consideration any disturbances in binocular vision, as well as any progressive systemic disease, such as diabetes or auto-immune disease.

Other factors that should raise a red flag include a personal or family history of keratoconus and age-related macular degeneration. It is also recommended to exclude patients who are younger than 55 and have a lens longer than 24mm, except in the case of traumatic or unilateral congenital cataract, because their risk of retinal complications is higher.

KEY VALUATION PARAMETERS

When evaluating a patient for RIOL surgery, consider their visual function, near and far visual acuities, as well as intermediate vision from 60-to-80cm. Also factor in refraction and binocular vision and oculomotoricity, especially in case of amblyopia and hyperopia.

It is particularly important to examine the ocular surface for potential dry eye disease (DED), which is present in 50% of cataract cases (Figure 3). The prevalence of DED increases with age, so it is particularly critical in this patient population to evaluate the lipid layer for blepharitis and meibomian gland dysfunction. A successful surgical outcome is dependent on identifying and treating DED prior to surgery.

Patients must understand that no RIOL will enable them to return to the vision that they had in their 20s: There is a neuroadaptation process that takes anywhere from two weeks up to a few months; there is an impact on quality of vision, especially at night; and visual performance will depend on light conditions.

With respect to RIOL choice, I recommend this decision tree (Figure 4). When the patient is below age 55, I lean toward a corneal correction approach with presbyLASIK, and monovision is still efficient in myopia. Above that age, there is a place for refractive lens exchange with presbyopic IOLs, if inclusion criteria are respected. EDOF IOLs may best serve true cataract patients, over 70 years of age, who are interested in reduced spectacle dependence because they are more forgiving on remaining refractive error and less demanding in vision quality.
Incorrect candidate selection, imperfect measurements and insufficient patient information can result in RIOL surgery failure. Even if intracorneal solutions for presbyopic correction appear to be a more predictable, more stable, and faster way than any corneal approach to correction, it is important not to offer this option too early. It is vital to select patients who are motivated and have reasonable expectations, who understand the compromises involved in RIOLs and who aren’t looking for vision perfection. It is important to discuss with them issues such as neuroadaptation and visual function issues related to light conditions.

CONCLUSION

Incorrect candidate selection, imperfect measurements and insufficient patient information can result in RIOL surgery failure. Even if intracorneal solutions for presbyopic correction appear to be a more predictable, more stable, and faster way than any corneal approach to correction, it is important not to offer this option too early. It is vital to select patients who are motivated and have reasonable expectations, who understand the compromises involved in RIOLs and who aren’t looking for vision perfection. It is important to discuss with them issues such as neuroadaptation and visual function issues related to light conditions.

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Keys to Success with Toric IOLs

By Douglas D. Koch MD

Toric IOLs are clearly underutilized, with only 13% of participants in last year’s ESCRS Clinical Survey acknowledging use of them for surgical presbyopia correction. If you keep the following tips in mind, you can optimize outcomes with premium IOLs and help your patients achieve the spectacle independence and clear vision they want.

First, keep in mind that the threshold for correcting astigmatism is very low. My target is less than 0.5D of total corneal astigmatism, so precision in all steps is critical. One study by Hayashi looked at subjects implanted with a +3.0D add multifocal IOL and then introduced 0.5D of astigmatism. Uncorrected distance vision dropped from 20/20 to 20/30, which is significant.1

Next, let’s consider use of technology. I use biometers that have light-emitting diodes for identifying power and meridian. Topography is also essential. Refraction sometimes provides a clue about the magnitude and meridian of astigmatism. If the refraction differs significantly from your other measurements, it may indicate something about the posterior cornea or lens tilt. Most importantly, you must validate your data.

Another key to successful use of toric IOLs is understanding your surgically induced astigmatism (SIA). It will likely be minimal with a temporal 2.2-to-2.4mm incision, but it is often higher with superior or larger incisions. SIA with a temporal incision is low, but the scatter is large and that will play into postoperative results. If you are uncertain about your SIA or use superior incisions, I recommend that you determine it using a calculator, such as the one Warren Hill MD has on his website: http://www.doctor-hill.com.

It is important to rule out irregular astigmatism (Figures 5 and 6). This is where topography becomes so important. I prefer Placido imaging; it is reliable and given that irregular astigmatism causes poor outcomes, I consider this technology a must-have in my practice. Placido mires are a great way to validate surface quality and rule out conditions such as anterior basement membrane disease, subepithelial scarring and visually significant dry eye. All of these can be treated, but be sure to validate surface quality post-treatment. I often find that, even with complete removal of surface pathology such as Salzmann’s or anterior basement membrane dystrophy, the cornea is no longer pristine, and these patients may no longer qualify for a multifocal IOL. In addition, topography is required to rule out ectatic disorders that would disqualify these corneas for postoperative enhancement.

It is essential to validate your biometric data, especially corneal measurements. I always take more than one measurement, either with two different devices or the same device. You can validate your data qualitatively. We look at the LED mires of every patient and remeasure and treat as necessary to get perfect mires, which will give optimal measurements.
is improving, reported outcomes with posterior corneal measurement are at best only marginally superior to regression approaches. So, using lens manufacturer formulas, such as the Barrett, or the Abulafia-Koch, is just as good as direct measurement at this time.

Another key element is recognising that correct alignment is more critical in multifocal eyes. Just 10 degrees of misalignment equates to greater than 33% under correction. I try to target alignment within 5 degrees, but certainly less than 10 degrees.

When it comes to post-LASIK/PRK eyes, toric IOLs are reasonable if these criteria are met: 1) regular bow-tie astigmatism within the central 3mm zone; 2) the difference in astigmatism magnitude between the two biometers we use, IOLMaster and Lenstar, is ≤0.75D; and 3) the alignment of the steep meridian of the two devices is within 15 degrees. (Presumably, one could substitute other devices for the two biometers we use.) When these criteria are met, we have found accuracy within 0.5D of a target of 80% or greater.

Toric IOLs in keratoconic and post-RK eyes are even more challenging due to the greater amount of irregular astigmatism. We use toric IOLs in these patients if the cornea is demonstrably stable, the astigmatism in a central 3mm is fairly regular, the patient has indicated that he or she does not want to wear contact lenses postoperatively and the astigmatic correction in their glasses pre-cataract surgery is similar to the corneal astigmatism and gave them good vision.

Finally, be aware of the potential for astigmatism due to IOL tilt. Given all of these possible sources of error, you must listen to your patient’s visual complaints postoperatively and respond proactively. Don’t be satisfied with subpar vision. Be ready to address postoperative spherical and astigmatic errors as necessary to maximise your patients’ vision and enjoyment of their pseudophakic vision.

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REFERENCE
Preoperative evaluations are more important than ever with toric presbyopia IOLs

Maximising Outcomes with Trifocal IOLs

By Thomas Kohnen, MD, PhD, FEBO

Trifocal IOLs offer high patient satisfaction and a better chance of spectacle independence than is likely with other types of refractive lenses. In order to optimise our outcomes with these lenses, we must optimise the ocular surface, achieve emmetropia, centre the lens and avoid intraoperative complications.

With trifocal IOLs, light is distributed to multiple foci to achieve far, intermediate and near vision (Figure 9). The newest trifocal IOL on the market in Europe is the Acriva Trinova (VSY Biotechnology), which utilises Sinusoidal Vision Technology to achieve outstanding visual outcomes in mesopic conditions, with 92% effective light transmission. It is designed with 12 stepless diffractive zones, which offers better contrast sensitivity. The aim of the design is to reduce halos and scattered light. Overlapping diffractive pattern trifocal IOLs cause significant light loss. Every single percentage of light loss affects patients’ overall visual performance exponentially. The Acriva Trinova lens ensures maximum light transfer as a result of its stepless diffractive zones. The higher the light transmission, the better the contrast sensitivity.
The trifocal IOLs that preceded the Acriva include the FineVision (PhysIOL), AT LISA tri (ZEISS), PanOptix (Alcon) and RayOne Trifocal (Rayner). The RayOne trifocal IOL, which is actually derived from bifocal technology, has 16 diffractive steps and a 4.5mm diffractive zone. It was developed to be less dependent on pupil size or lighting conditions, and it improves distance vision in mesopic conditions. This can also be used as an add-on to a monofocal lens in a procedure similar to the piggyback IOL paradigm, where you put the trifocal lens into the sulcus where an IOL has already been implanted. This way we can use trifocality – and maybe even in the future EDOF technology – on top of our older monofocal lenses.

CLINICAL STUDIES
We have done several studies of the available trifocal IOLs. For instance, a prospective, non-randomised, non-comparative case series of 27 patients undergoing implantation of AT LISA trifocal or toric, revealed that patients were very happy with their outcomes overall. Contrast sensitivity was within normal range in photopic, mesopic and mesopic with glare conditions. Despite some optical phenomena, patients had high spectacle independence three months postoperatively; 92% of patients said they would choose the same IOL again.

With trifocal IOLs, light is distributed to multiple foci to achieve far, intermediate and near vision

In a study of the PanOptix trifocal with a quadrifocal design, where 27 patients received bilateral implantation, we had similar results. Visual performance of this IOL showed good visual acuity at all distances, with best VA at 60cm, and high patient satisfaction and spectacle independence three months postoperatively. We also found some optical disturbances, but overall the patients were happy.

We compared the AT LISA trifocal and the PanOptix panfocal IOLs in a recently published study. The prospective, non-randomised comparative case series of 20 subjects undergoing bilateral implantation of PanOptix panfocal or AT LISA trifocal revealed that with respect to monocular visual performance, there was no significant difference between the IOLs at far, intermediate or near distance. However, there was better visual acuity at 50cm and 66cm with the panfocal IOL. The main difference was in the defocus curve, with a bit of an advantage at 60cm for the panfocal lens.

IDEAL CANDIDATES AND PEARLS
The ideal trifocal IOL candidate is a patient who wants spectacle independence and good vision at all distances; someone with no pathology on the cornea, no pathology on the retina, no irregular astigmatism. Patients who are contraindicated to this technology are those who have severe dry eye disease, pseudoexfoliation, glaucoma, and/or severe retinal disease.

Preoperative evaluations are more important than ever with toric presbyopia IOLs. Topography, endothelial cell counts, macular function, exclusion of keratitis sicca are all critical to successful outcomes and satisfied patients. With respect to postoperative refraction, in most of these eyes we need to achieve emmetropia. With so many new IOL calculation formulas available, you must be sure that the one you use with these IOLs is up to date. Equally important is the need for precise IOL centration, and a carefully created capsulorhexis or capsulotomy. These lenses will not function appropriately if they are centered upon placement or if they center over time. Some of my key pearls are summarised in Figure 10.

Preoperative optimisation of the ocular surface is also critical. An expansive literature review of 16 papers confirms that an impaired ocular surface affects preoperative planning for cataract surgery, including IOL calculations, toric IOL axis and magnitude estimates, keratometry and topography measurements; and also increases surgical difficulty. Surgeons should recognise and aggressively pre-treat cataract patients who have pre-existing dry eye disease.

One of the final points that must be made is that the effect of astigmatism is often underestimated. Make sure you don’t leave patients with 1.5D of astigmatism – particularly multifocal IOL patients. We think 0.5D should be the highest amount of astigmatism that can remain and still leave a patient enjoying the benefits of multifocality.

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Keys for Maximising Outcomes with Trifocal IOLs

- Preoperative optimisation of ocular surface
- Achieving emmetropia
- Correction of astigmatism
- Correction of misaligned or dislocated toric IOL
- Effect of manual capsulorhexis size and IOL position
- Intraocular complications (posterior capsular rupture)

Figure 10: Essential considerations for maximizing patient outcomes with trifocal IOLs