

## Keys to selecting the best IOL for your patient



Kumar Doctor, MD

**W**hen selecting the best IOL for a cataract patient, physicians must focus on a few key factors that are critical to maximizing results. Below are some of the most important factors to consider during this process.

### Spherical aberration and chromatic aberration

The minimizing of spherical aberration is critical as multiple studies have shown that peak visual performance in the young eye has 0.0 microns of spherical aberration on average.<sup>1</sup> Other studies have shown that as spherical aberration increases with age, contrast sensitivity decreases, further supporting the importance of minimizing this in patients.<sup>2</sup>

By fully correcting spherical aberration, a Tecnis monofocal IOL (Abbott Medical Optics, Santa Ana, Calif.) provides a 13% increase in contrast sensitivity over an IOL that leaves +0.1 microns of residual spherical aberration.<sup>3</sup> This testing was performed in an optical bench setting by putting various IOLs in front of a camera and measuring the sharpness of light focus with 3 mm and 5 mm pupils.

Another evolving concept is the correction of chromatic aberration, which is expressed through the Abbe number. The amount of chromatic aberration is impacted by both the optic material and design. A recent study has shown that the Tecnis Multifocal IOL provides effective chromatic aberration correction not only because of the optic material but also due to its full diffractive surface and +4.0 add.<sup>4</sup>

When correction of spherical and chromatic aberration is combined, the synergistic effect is much greater than correcting either one individually.<sup>5,6</sup>

### Transmission of blue light

Another key element of an IOL is the full transmission of blue light, which is essential for optimal scotopic vision.<sup>7</sup> Blue light provides 35% of scotopic sensitivity.

Blue light regulates melanopsin expression, providing 53% of melanopsin sensitivity and melatonin

formation and is the main zeitgeber for circadian rhythmicity. Light exposure from sources richest in blue wavelengths mediate important effects including photoentrainment, thermoregulation, improved nocturnal sleep quality, heart rate variability, treatment of non-seasonal or seasonal depression, and vitality.<sup>7</sup>

### Incidence of glistenings

Glistenings, or microvacuoles, in the IOL material has long been debated with regard to their significance. However, studies have shown that these glistenings can cause a loss in contrast sensitivity,<sup>8</sup> decreased visual acuity,<sup>9</sup> and increased light scatter.<sup>10</sup>

Tecnis IOLs do not develop glistenings in my experience. The reason is largely due to Abbott Medical Optics' proprietary cryolathing method for limiting microvoid formation and high temperature fluctuations that can cause these glistenings.<sup>11</sup> Other IOLs have

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## Incidence of glistenings

Glistenings can cause:

- A loss in contrast sensitivity
- Decreased visual acuity
- Increased light scatter
- Tecnis IOLs are not associated with glistenings
- AMO's proprietary cryolathing method limits microvoid formation and high temperature fluctuations that can cause glistening

Glistenings in a competitive acrylic IOL

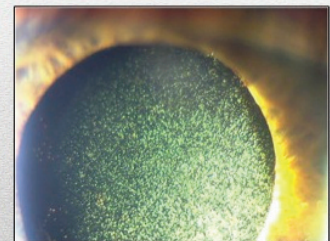


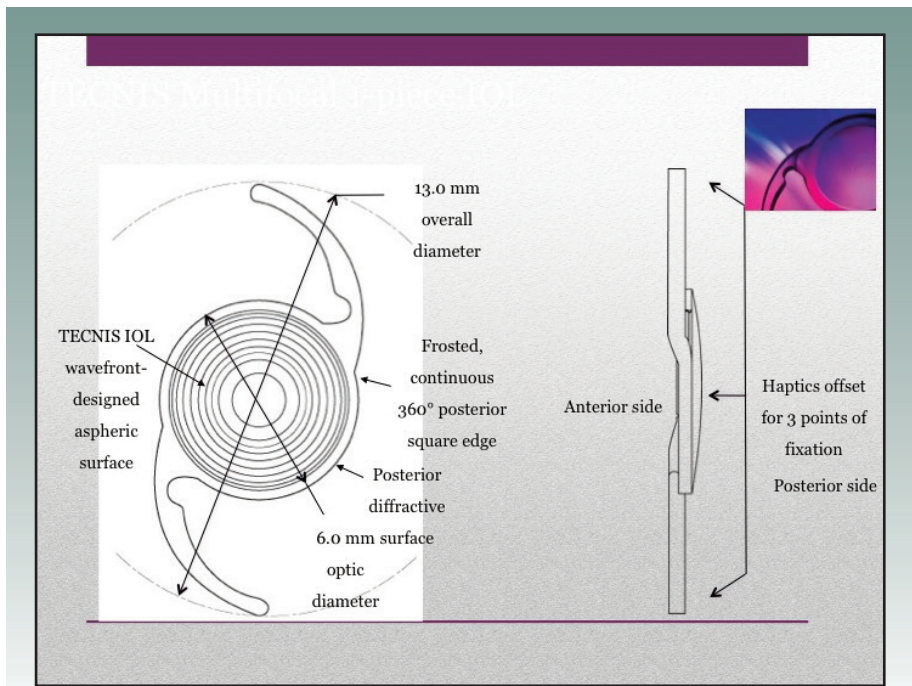
Image courtesy of Randall J. Olson, MD

The impact of glistenings to an IOL when implanted in the eye can be significant.

Source: Kumar Doctor, MD

# Peace of mind: Predictable, successful IOL surgery

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**Optical profile and design of the Tecnis Multifocal 1-piece IOL**

Source: Kumar Doctor, MD

been shown to have a high incidence of glistenings, with one study showing an incidence of up to 60%, with almost half of these being graded as moderate to severe glistenings.<sup>12</sup>

## IOL design

Perhaps one of the most important considerations when selecting an IOL is its design. The Tecnis IOL family has many design advantages. One of these is ease of implantation. Tecnis lenses have a bag-friendly coplanar delivery, reduced thickness for a slim lens profile, and polished haptic loops to reduce friction and enable controlled gentle unfolding of the lens in the capsular bag.

Another design benefit is the ProTEC 360-degree edge design of Tecnis IOLs. This square edge is designed to limit LEC migration and provide uninterrupted contact with the posterior capsular bag at the haptic-optic junctions. Unlike traditional single-piece

designs, it prevents cell migration along the haptic.

A third major design benefit is the Tecnis Tri-Fix three-point fixation. This is an offset haptic design, providing three points of contact with the capsular bag and additional stability. This further limits LEC migration and helps rapid, long-term stabilization of the optic and refraction.

## Personal experience

In my experience, the Tecnis Multifocal IOL has allowed patients to see 20/20 or better at distance, intermediate, and near visual acuity at 6 months. Overall my Tecnis Multifocal IOL patients have reported statistically greater levels of satisfaction than other IOL patients. My rate of enhancement for Tecnis patients has been extremely minimal.

In fact, visual quality outcomes of the Tecnis Multifocal IOL are so good that I have even implanted this lens bilaterally in my mother with excellent results.

## References

1. Artal P, Alcon E, Villegas E. Spherical aberration in young subjects with high visual acuity. Presented at ESCRS 2006, Paper 558.
2. Kershner RM. Retinal image contrast and functional visual performance with aspheric, silicone, and acrylic intraocular lenses. Prospective evaluation. *J Cataract Refract Surg.* 2003 Sep;29(9):1684–94.
3. Zhao H, et al. The additive effects of different optical design elements contributing to contrast loss in pseudophakic eyes implanted with different aspheric IOLs. Presented at ESCRS 2009.
4. Zhao H., Mainster M. The effect of chromatic dispersion on pseudophakic optical performance. *Br J Ophthalmol.* 2007 Sep;91(9):1225–9.
5. Yoon GY, Williams DR. Visual performance after correcting the monochromatic and chromatic aberrations of the eye. *J Opt Soc Am A Opt Image Sci Vis.* 2002;19:266–275.
6. Manzanera S, et al. Visual benefit of the combined correction of spherical and chromatic aberrations. *Ophthalmol Vis Sci.* 2007;48: E-Abstract 1513.
7. Mainster M. Violet and blue light blocking intraocular lenses: photoprotection versus photoreception. *Br J Ophthalmol.* 2006 Jun; 90(6):784–92.
8. Gunenc U, et al. Effects on visual function of glistenings and folding marks in AcrySof intraocular lenses. *J Cataract Refract Surg.* 2001 Oct;27(10):1611–4.
9. Christiansen G, et al. Glistenings in the AcrySof intraocular lens: pilot study. *J Cataract Refract Surg.* 2001 May;27(5):728–33.
10. van der Mooren M, et al. Combining in vitro test methods for measuring light scatter in intraocular lenses. *Biomed Opt Express.* 2011 Mar; 2(3):505–510.
11. Miyata A. Equilibrium water content and glistenings in acrylic intraocular lenses. *J Cataract Refract Surg.* 2004 Aug;30(8):1768–72.
12. Colin J, Orignac I. Glistenings on intraocular lenses in healthy eyes: effects and associations. *J Refract Surg.* 2011;27(12):869–875.

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## Learning a few new things



Con Moshegov, MD

### *A new level of outcomes with toric IOLs requires reconsidering some previously held standards*

I have to admit that I am “depressed” that some of the concepts I thought were previously resolved are being questioned today. In 2008, I easily calculated my surgically induced astigmatism (SIA), but now I understand that SIA varies significantly from eye to eye and is hard to predict.

In 2008, we concerned ourselves only with anterior keratometry for IOL selection, used topography to rule out irregular astigmatism, and attributed disparity between keratometry and spectacle prescription to “lenticular” astigmatism. However, new information published by **Doug Koch, MD**, shows the posterior cornea contributes significantly to outcomes, and we will need to account much more for this moving forward.

Two other things we see differently now are the role of LRIs and marking for toric IOLs. In 2008 I didn’t think there was much of a future with manual LRIs; however, since the development of femtosecond arcuate incisions, I have reconsidered the value of corneal incisional surgery to correct astigmatism. In the past I was comfortable with corneal marking to align the preoperative and intraoperative axis for toric IOLs;

however, now I’m being told that intraoperative aberrometry is needed for optical alignment.

The effects of these developments have increased my appreciation for the ability to perform a VISX excimer laser (Abbott Medical Optics, Santa Ana, Calif.) enhancement for cases that wind up with a level of residual refractive error due to these inherent elements of variability. I have also developed greater humility in expressing my current beliefs and trust most what works in my own hands.

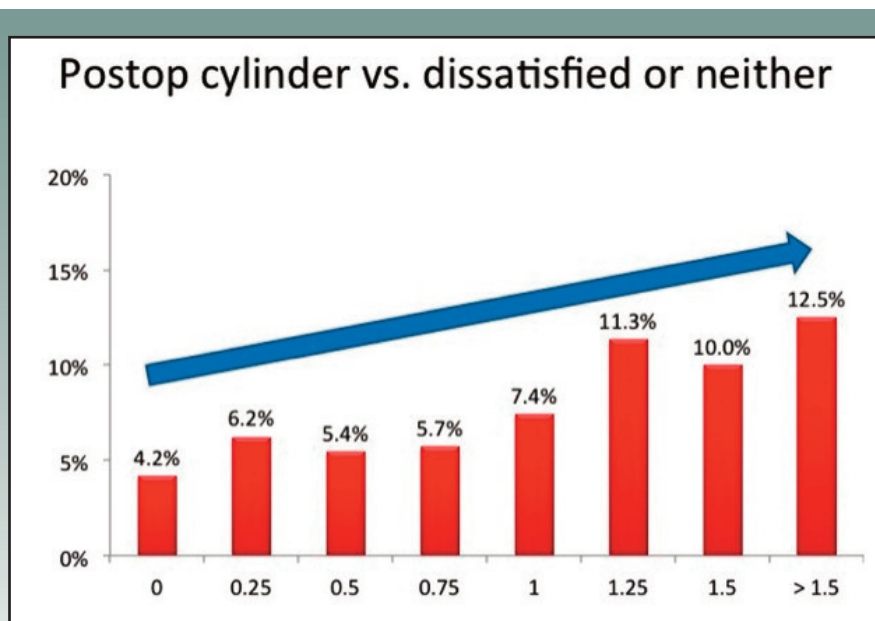
Data from Optical Express shows that even low levels of residual cylinder can result in significant visual quality impact to a patient. Recent information from an analysis of **Steve Schallhorn, MD**, of more than 30,000 LASIK procedures shows that the number of dissatisfied patients grows exponentially with each quarter diopter of residual astigmatism. Overall, 76% of LASIK patients were satisfied when they had no astigmatism, but this level decreased to 35% when 1.0 D of astigmatism was present.

The good news is that the Tecnis Toric IOL (Abbott Medical Optics) helps reduce astigmatism to very low levels. This lens displays excellent rotational stability, with recent data from the FDA showing less than 3 degrees of rotation six months postoperatively and 72% of patients having  $\leq 0.50$  D of residual refractive cylinder postop. Similar data was shown in a study performed in Europe by **Oliver Findl, MD**.

In my experience the Tecnis Toric IOL displays excellent rotational stability. It’s part of the Tecnis family with monofocal, toric, multifocal, and multifocal toric variants on the same platform and has a solid new injector system. I encourage my colleagues to consider trialing these lenses.

When implanting toric IOLs, it is important to focus on a few key pearls to maximize results:

- Mark the axis preoperatively. Cyclorotation does occur when the patient goes from a sitting to a lying position, and it is easy to get disoriented under the patient drape.
- Aim for the lowest level of residual toric error when selecting a lens power and



Data on the impact of residual error in patient satisfaction rates from 4,970 eyes implanted with multifocal IOLs in Optical Express

Source: Steve Schallhorn, MD

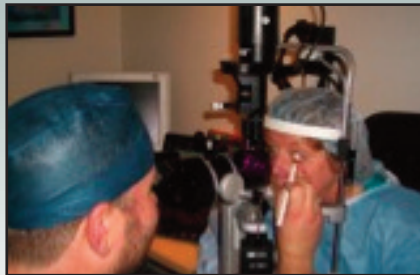
don't be overly concerned with flipping the axis of the astigmatism. Meridional aniseikonia and spatial distortion only occur when flipping the axis with glasses where vertex distance comes into play.

- Pay attention to the details of your toric IOL calculator. The Tecnis Toric Calculator takes several unique elements into account, including axial length to estimate the lens that will leave the lowest level of residual error postoperatively.
- Aim for the lowest level of postop misalignment from intended axis as possible. Every degree of error from intended axis has a visual quality consequence, and when you get close to 10 degrees of error, the amount of visual quality degradation can be very significant.

According to **Eric Donnenfeld, MD**, "Limbal relaxing incisions and femtosecond laser arcuate incisions are gaining favor as methods to correct residual astigmatism after cataract surgery. We are now undergoing a renaissance of LRIs and astigmatic keratotomies, and these are becoming more and more important in our armamentarium."

I'm not sure that is the case outside the U.S. Toric IOLs have revolutionized the way we deal with preoperative astigmatism and have taken us a long way in achieving good refractive outcomes with lens-based surgery. For the cases that require minor enhancement afterward, I think either LASIK or PRK is significantly more predictable than LRIs even with femtosecond lasers. In any case, LASIK and PRK give us the opportunity to refine spherical outcomes as well as cylindrical ones.

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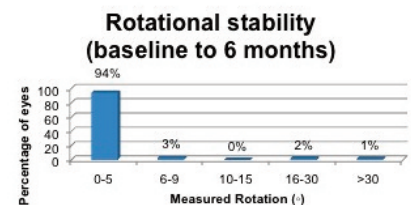
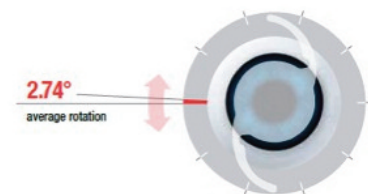


**Marking the eye preoperatively is critical to success with toric IOLs**

Source: Con Moshegov, MD

## TECNIS Toric IOL – FDA IDE Study: Rotational stability

- Mean rotation between baseline and 6 months
  - Absolute: 2.74°



**The average amount of rotational error between intended and actual axis in the U.S. FDA study of the Tecnis Toric IOL was 2.74 degrees.**

Source: Con Moshegov, MD

## Keys to choosing between IOLs in your practice



Han Bor Fam, MD

**T**he importance of the optical design, materials, and ease of implantation cannot be understated when choosing an IOL. These are the three keys to success with an IOL in cataract surgery, and all are important to the peace of mind, economy, and high technology that is critical for the best outcomes.

### Design

One key element of lens design is to have solid IOL centration and stability. In my experience, the Tecnis lenses (Abbott Medical Optics) with the three-point fixation, called TriFix, permit constant capsular contact, greater stability, and rapid, long-term stability of the optic and refraction. TriFix also provides better contact of the sharp optic edge against the posterior capsule, reducing the migration of LECs that cause PCO.

### Optics

Spherical aberration is a key element to appropriately compensate for in cataract patients. It is important that the IOL you implant has a similar spherical aberration compensation to what is present in the cornea. Studies by **George H.H. Beiko, BM, BCh, FRCS(C)**, and others have shown that the average corneal spherical aberration level is  $0.27 \mu$ , and a personal study by myself of 70 Asian eyes has confirmed this, showing that the average level of spherical aberration is  $0.31 \text{ D}$ .<sup>1</sup>

Even low levels of residual spherical aberration have been shown to severely impact visual quality postoperatively, so I have chosen to use the Tecnis IOL

platform, which has the most appropriate level of spherical aberration compensation of any of the major IOLs, at  $-0.27 \mu$ .

Chromatic aberration is another factor that contributes to blurriness for patients. The material used in the Tecnis platform has proven to have the lowest level of chromatic aberration among hydrophobic acrylic IOL materials.<sup>2,3</sup>

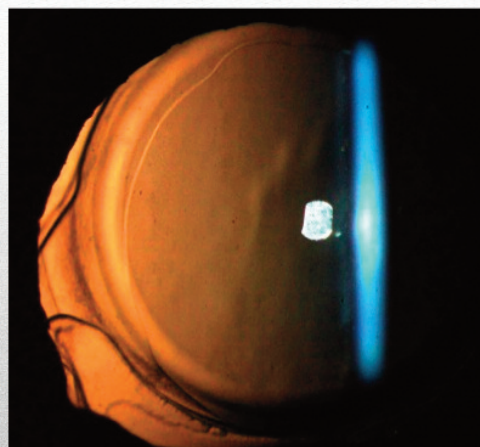
### Clarity

In order to have clear IOLs postoperatively, it is key to work with an IOL platform that has minimal glistenings. A study by Dr. Beiko has shown that when glistening is present, stray light scatter increases between 300 and 3,000 times the levels of that when glistening is absent.

The Tecnis lenses also contain UV-blocking clear media that does not block important blue light from entering the visual system.

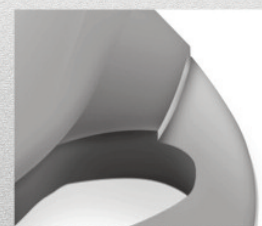
### Ease of implantation

Most recently, the introduction of the new iTec preloaded system further enhances the platform. The preloaded system reduces the risk of contamination as no contact is involved during the IOL loading



### • Posterior capsular opacity barrier

- Constant capsular contact
- Squarer contact of sharp optic edge against the posterior capsule



Tecnis IOL platform exhibits material clarity (left) and a strong PCO barrier (right)

Source: Han Bor Fam, MD

process, and it is a single-use disposable system. There is also a reduced risk of mismatch between the cartridge and IOL model.

A preloaded system reduces other unwanted incidences with loading the injector, and has reliability and efficiency benefits. The possible loss of the IOL is avoided with a preloaded system, and there is no mechanical damage to the IOL from manipulation or upside down confusion.

The iTec platform has greater reliability by permitting more consistency in incision size (2.2–2.4 mm) with the Tecnis IOLs and enhanced control of planar delivery. Efficiency is another benefit with iTec by saving loading time, minimal staff training, and faster surgical turnover.

When a patient desires spectacle independence and is a suitable candidate, I am in favor of implanting a Tecnis Multifocal IOL in eyes with minimal corneal astigmatism or a Tecnis Toric Multifocal when significant corneal astigmatism is present. For those who do not mind wearing readers or who are not suitable for a multifocal, a Tecnis Monofocal IOL or a Tecnis Toric should be considered for minimal corneal astigmatism or significant corneal astigmatism, respectively.

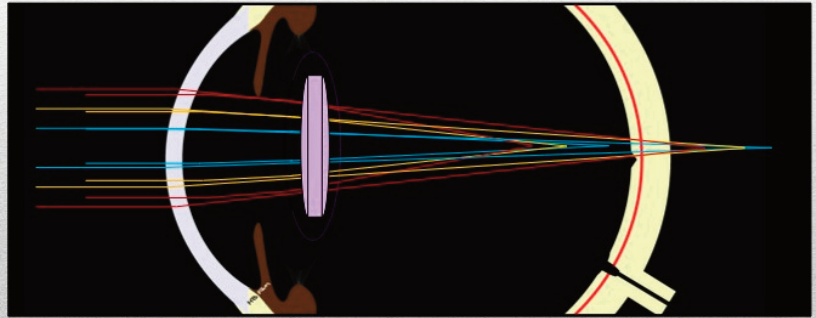
#### References

1. Lim KL, Fam HB. Ethnic differences in higher-order aberrations: Spherical aberration in the South East Asian Chinese eye. *J Cataract Refract Surg.* 2009 Dec;35(12):2144–8.
2. Zhao H., Mainster M. The effect of chromatic dispersion on pseudophakic optical performance. *Br J Ophthalmol.* 2007 Sep;91(9):1225–9
3. Negishi K, et al. Effect of chromatic aberration on contrast sensitivity in pseudophakic eyes. *Arch Ophthalmol.* 2001 Aug;119(8):1154–8.

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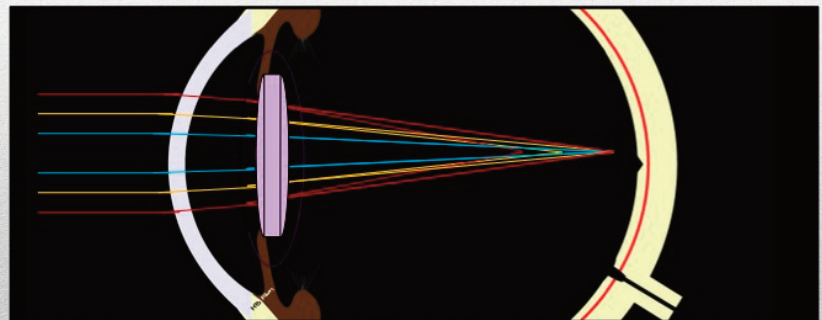
## Normal IOL

$$\text{Cornea (+SA)} + \text{IOL (+SA)} = \text{Total (++)SA}$$



## Tecnis

$$\text{Cornea (+SA)} + \text{Tecnis (-SA)} = \text{Total (Aspheric)}$$



**Spherical IOLs add to the cornea's spherical aberration resulting in a highly aberrated visual system. The aspheric Tecnis IOL compensates for corneal aberration aiming at postoperative zero spherical aberration.**

Source: Han Bor Fam, MD

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