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## Rayner<sup>®</sup> Toric IOLs: A Roadmap to Success

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Oliver Findl

# Treatment options for the correction of astigmatism

Correcting astigmatism in cataract surgery is gaining importance for a couple of reasons, says Oliver Findl MD, who holds dual appointments at Hanusch Hospital, Vienna, and Moorfields Eye

Hospital, London. First, astigmatism is prevalent in older populations, with about one-third having more than 1.0 dioptre of cylinder and about one in five exceeding 1.5 dioptres.

Second, as better IOLs and surgery have improved vision outcomes, patient expectations have risen dramatically. Many expect to see well without glasses at distance, and often up close as well. "Cataract surgery has become much more of a refractive procedure," Dr Findl says.

Meeting these higher outcome expectations requires precise correction of astigmatism, Dr Findl notes. Astigmatism can be treated in a variety of ways, including on-axis cataract incisions, opposite clear corneal incisions, limbal relaxing incisions, toric IOLs and laser surgery after lens implants. Leaving small amounts of astigmatism may even be desirable in some cases. Each has its own advantages and drawbacks, Dr Findl says. But whatever the approach, a good outcome requires high precision in diagnosis, defining of the axis, marking the axis and treatment.

## Defining the axis

Determining the type, degree and axis of astigmatism are the first steps. Because correcting eyes with irregular astigmatism is more complicated, it is important to identify it. Dr Findl recommends using both keratometry from the IOLMaster (Carl Zeiss Meditec, Jena, Germany) and either Placido topography or Scheimpflug tomography, and comparing the readings. If there are significant differences in magnitude or axis between the two methods, say 15 degrees or more, you may want to refrain from implanting a toric IOL because it won't be clear on which axis it should be implanted, he added. "At the very least we need to inform the patient of the problem and that we may need to re-correct for astigmatism after surgery."

## Treatment options

On-axis cataract incisions and opposite clear corneal incisions can be used to correct small amounts of astigmatism without using additional equipment or surgical steps, Dr Findl says. However, the degree of correction is limited and results are variable. According to the literature, an on-axis incision can induce anywhere from 0.1 to 0.9 dioptres of astigmatism, but typically it is within 0.3 to 0.5 dioptres. The same keratome can be used to make an opposite clear corneal incision, yielding 1.3 to 2.1 dioptres of correction. But the results are variable and difficult to predict. Long-term regression may also be an issue.

Limbal relaxing incisions – or more correctly, peripheral corneal relaxing incisions as they are typically made 0.5mm to 1.0mm inside the limbus – may also be effective for corrections of up to about 3.0 dioptres, Dr Findl says. But even when using adjustable knives to control incision depth and individualised nomograms, results are variable, likely due to differences in elasticity of the cornea and scarring reactions between patients.

Toric lenses hold promise as a more predictable and reliable astigmatism solution, Dr Findl says. While some early models were difficult to implant or prone to rotation, they have

undergone significant development and improvement in the past few years. Recent designs offer greater ease of use and stability, Dr Findl says. These include the Rayner T-flex®, which offers corrections of 1.0 up to 11.0 dioptres, the Acritec/Zeiss toric designs, which offer 1.0 to 12.0 dioptres, and the Alcon Acrysof Toric, which initially was available in 1.0 to 3.0 dioptres, with a wider range of correction recently added. In addition, the Rayner Sulcoflex® offers cylinder corrections of 1.0 to 6.0 dioptres cylinder in a sulcus-implanted lens that can be used with other IOLs in the bag.

## Aligning the axis

Precise alignment of the toric lens with the axis of astigmatism is the key to success, Dr Findl emphasises. "If you are on axis, everything is fine. But for every degree you are off, you have a three per cent loss of correction. Ten degrees is about 1/3 loss. Does that make a happy patient? Thirty degrees off means no correction and an axis change and an unhappy patient. Greater than 30 degrees off and you are worse off with a toric lens, and the patient is very unhappy."

Dr Findl notes that supine cyclotorsion rotates patients' eyes on average from 2.0 to 4.1 degrees to as much as 17.5 degrees when they lie down compared with sitting or standing. Therefore, it is essential to mark the axis when the patient is sitting.

Dr Findl finds some of the commercial marker tools, which rely on a pendulum to show the vertical axis, clumsy and even unreliable. He prefers to mark the axis with a needle from a diabetic syringe at the slit lamp, preferably on an undilated eye. The slit-beam is oriented in the horizontal and vertical meridians and used to guide the marks at the limbus. A fine mark is important because a mark from a 1mm marking pen covers about 10 degrees at the limbus, making an imprecise alignment almost certain. However, a methylene-blue marker can be used to highlight the scratch.

## Avoiding overcorrection

While toric lenses offer the most predictable and stable astigmatism correction, Dr Findl uses both incisional and lenses in his practice. "My strategy is to reduce astigmatism. Beware of overcorrection because it will cause an axis flip."

Dr Findl counsels patients about spectacle independence and listens closely for clues as to how patients will respond to toric correction. "Patients who are happy to wear spectacles and hesitate may be poor candidates." He also manages expectations. "Under-promise and over-deliver," he adds.

For up to 0.5mm cylinder, Dr Findl usually relies on a temporal or on-axis incision, depending on how much residual astigmatism is desired. For patients receiving multifocal lenses, toric lenses may be considered at 0.5 to 1.0 dioptres astigmatism, but he generally goes with on-axis incisions. Above 1.0 dioptre, he uses an opposite clear corneal incision or LRI up to 2.0 dioptres astigmatism. Above 3.0 dioptres cylinder, he relies exclusively on toric IOLs.

Leaving some residual astigmatism also can be beneficial, taking advantage of Sturm's conoid, Dr Findl says. "Myopic astigmatism can give you good intermediate or reading vision. Combined with a little monovision it often can be quite helpful and results in good patient satisfaction."

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Charles Claoué

# The Rayner IOL platform and Raytrace®



Achieving great clinical outcomes with toric IOLs requires a robust lens platform that provides long-term stability and resistance to opacification that supports customised optics that meet individual patient needs. Effectively managing your surgical schedule and in-house intraocular lens inventory requires that toric lenses in a wide range of axes, and cylindrical and spherical powers be available on demand. The Rayner T-flex® toric IOL provided through the Raytrace® online ordering system provides both, says Charles Claoué MD, DO, FRCS, FRCOphth, Queen's Hospital, London, UK.

But getting an IOL quickly is only valuable if the lens itself is easy for surgeons to use and meets patients' needs over years of service. Based on the proven C-flex®, the T-flex® platform materials, construction and design ensure this, Dr Claoué says.

The Rayacryl® hydrophilic acrylic co-polymer material of which the T-flex® is made offers many clinical advantages, Dr Claoué says. Because hydrophilic acrylic is rigid in its dehydrated state, it can be precisely machined with diamond-tipped lathes to produce highly complex customised optics on demand, which is not possible with molded materials. In its hydrated state, hydrophilic acrylic is easily folded and unfolded in the eye for quick and confident implantation at surgery.

In the eye, hydrophobic acrylic offers superior optical qualities Dr Claoué notes. Unlike hydrophobic materials, it will not develop vacuoles or glistenings over time. Studies also show that hydrophilic acrylic materials are far less adherent to silicone oil. "It coats at about five per cent compared with about 35 per cent for hydrophobic acrylic and 100 per cent for silicone, so for vitreoretinal surgeons, this would be the preferred material."

Hydrophilic materials also have the potential to deliver intraocular drugs. "It is like a sponge. You can soak it in antibiotics or anti PCO drugs or perhaps other drugs in the future. Only hydrophilic acrylic can do this," Dr Claoué says.

IOL platform design is also crucial to long-term success. For a toric IOL, stability of centration, tilt, and above all, rotation are even more important than with standard lenses because every degree of rotation off axis reduces cylinder correction by three per cent. The closed-loop anti-vaulting haptics used in the T-flex® show exceptional stability, Dr Claoué says.

Dr Claoué cited research by Zhenping Zhang MD, PhD that showed decentration of 0.191 +/- 0.140mm in the x-axis and 0.189 +/- 0.117mm in the y-axis; and tilts of 1.084 +/- 1.214 degrees in the x-axis and 1.052 +/- 0.896 degrees in the y-axis for Rayner anti-vaulting haptic lenses implanted in 37 eyes of 32 patients. More important, rotation was minimal, averaging 0.45 degrees ranging from 0.12 and 0.93 degrees one week after surgery, and 0.47 degrees ranging from 0.0 to 0.98 degrees one month after surgery. "This is a very stable platform for complex optics."

The T-flex® design also incorporates the enhanced square edge proven to slow PCO. "Unless the square edge crosses the optic-haptic junction of a single-piece IOL, there is an 'Achilles heel' for PCO to migrate to the visual axis," Dr Claoué says. He cited animal studies by

Nishi and colleagues in the 2004 JCRS and human studies by Hayashi & Hayashi in the 2007 *American Journal of Ophthalmology* that found the square edge design more important than lens material for PCO prevention.

Some toric lenses on the market do not have square edges, he notes. These have been shown to have YAG capsulotomy rates as high as 5.9 per cent at 12 months, and 7.5 per cent at 24 months compared to 1.8 per cent at 30 months for the Rayner C-flex®, which shares the enhanced square edge design with the T-flex®. "Forgetting the square edge doubles the PCO rate."

Dr Claoué points out that the T-flex®, with an optic diameter of 5.75mm and an overall diameter of 12.50mm, is available fully customised up to at least 11 dioptres cylindrical correction through the Rayner Raytrace® online ordering service. Both standard and premium lenses are offered. Surgeons may go online and enter patient data, including axial length and keratometry values and axes, as well as preoperative and target refraction, to order a customised lens with rapid delivery and a backup lens in some markets.

To Dr Claoué, custom ordering makes great sense and doesn't interfere with patient scheduling. "If your patient needs a toric IOL, you will calculate the IOL before the day of surgery. If you calculate in advance you can order in advance." This allows you to order a customised lens instead of the standard powers offered by other manufacturers. It also helps keep down the number of IOLs you need to keep on hand at the clinic, reducing complexity, clutter and cost.

"We are being true to what ophthalmologists want – a standard platform that is very stable, but a custom optic that is different for each patient," Dr Claoué says.

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Gerd U Auffarth

## Pearls for the successful implantation of toric IOLs

A clear understanding of optical measurement definitions, accurate patient biometry and careful lens ordering all contribute to successful implantation of toric IOLs, says Gerd U Auffarth MD, University

of Heidelberg, Germany. Over time, he has come up with several preoperative pearls that help ensure accurate lens power and placement.

### Understand corneal power measurement variables

Current corneal measurement technology does not measure refractive power directly, but rather transforms corneal radii measurements in millimetres into refractive powers using a formula that incorporates a refractive index. A smaller radius translates into a steeper meridian and a higher refractive power. The problem is that different instruments use different refractive indexes, Dr Auffarth notes. For example, the Orbscan corneal topographer (Bausch & Lomb, Rochester, US) uses an index of 1.3375 while the IOLMaster uses 1.332. This can easily produce a one-dioptre or more difference in translating corneal radii to refractive power. When using online IOL calculators, "it is always important to tell the manufacturer what device you are using to give the K value or refractive power," he adds.

### Take contacts out for at least two weeks

Accurate lens power depends on accurate corneal measurement, and contact lenses distort corneas. If a patient wears contact lenses, ask them to remove them and leave them out for two weeks, and then return for biometry, Dr Auffarth says.

### Take keratometry and topographic measurements

Detecting irregular astigmatism or keratoconus is important to a good outcome.

### Conduct biometry measurements at the beginning of pre-op exams

Routine tests such as Goldmann tonometry can interfere significantly with corneal measurements. In a prospective study of 30 eyes, Dr Auffarth found that about seven per cent exhibited high corneal irregularities 10 minutes after tonometry. Using an IOLMaster, significantly more

keratometry measurements were needed to obtain three error-free results, and the reliability of consecutive K-measurements was significantly lower when measured 10 minutes after applanation tonometry than before tonometry. "The message is, always do the biometry at the beginning of the preoperative set-up, before you touch the cornea with anything."

### Check lens calculations when ordering online

When ordering a lens online, look at the sphere and cylinder values as well as the target refraction of the lens offered by the online calculator. "Even if the spherical equivalent is zero there might be a substantial residual astigmatism."

### Mark the axis with the patient awake and sitting

As Dr Findl suggests, mark the axis with the patient awake and in a sitting position. While Dr Findl prefers a needle at the slit lamp, Dr Auffarth recommends horizontal axis marker (Geuder, Germany), or the measuring ring (Asico, US) to mark the horizontal plane or cylinder axis. Microscopes that incorporate axis markers are on the way, with one recently introduced by Carl Zeiss Meditec.

### Use toric IOLs in patients with high astigmatism from penetrating keratoplasty

Dr Auffarth has had good results using toric lenses in this special patient population. "They get really high astigmatism up to 10 dioptres or even more." In a study of 24 eyes in 21 patients with a mean preoperative subjective astigmatism of  $-6.98 \pm 3.50$  dioptres, he obtained  $-1.43 \pm 1.74$  one day post-op and  $-2.55 \pm 1.77$  at three months. "You can get so high astigmatism that even 11 dioptres [cylindrical correction] is not enough. But this is an excellent result and these patients are extremely happy."

Toric IOLs also can be used in patients with previous refractive surgery, and in custom match applications. The Sulcoflex sulcus-fixated toric lens can be used to correct residual astigmatism with multifocal or other lenses. "We can apply this technology in a huge range of situations," Dr Auffarth concludes.

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Ashok Vyas

## Study finds Rayner's T-flex<sup>®</sup> toric IOL rotating about 3 degrees on average at 2 years

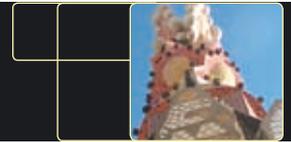
Maintaining rotational stability is critical for toric IOLs to function over time. A continuing study by Ashok Vyas FRCS, Scarborough Hospital, UK, finds that the mean rotation of

Rayner's T-flex<sup>®</sup> toric lens was less than three degrees at two years, and no rotation over five degrees among all study subjects. Visual acuity and patient satisfaction was also high. These results suggest that on average at two years, the

lens maintains 90 per cent or better of intended astigmatic correction in most eyes, and well meets patient needs.

"Axis management is the key word in correcting astigmatism," Dr Vyas says. He took care to precisely determine, mark, align and maintain the axis throughout.

In this prospective study of 12 eyes, Dr Vyas implanted T-flex<sup>®</sup> lenses using axis as determined by keratometry with computerised videokeratography as a guideline. Historic axis and power of cylinder correction in spectacles was also used to determine an intended axis of implantation.



Patients' vertical and horizontal axes were marked before surgery in a sitting position with a slit lamp. During surgery, an axis marker was used to align the toric axis using these reference points. Dr Vyas noted that a 360 overlap of the curvilinear capsulorhexis is best to help maintain centration. Axis alignment and cylinder power were sometimes confirmed using retinoscopy at the end of surgery.

Torus corrections ranged from 1.5 to 6.5 dioptres cylinder, with 10 of the 12 cases ranging from 2.5 to 4.0 dioptres. Retro-illumination photos were taken at one week, six months and 24 months after surgery. Using Adobe acrobat images, the angle of axis with the horizontal/vertical line was observed and calculated. Unaided visual acuity and patient satisfaction levels were also assessed.

Provided the lens is implanted properly and there are no problems with capsular tears or other structural damage at surgery, the major factor in maintaining stability is lens design. The T-flex® uses Rayner's anti-vaulting haptic technology to resist both asymmetric capsular contraction and rotation. A bag that starts out 10.5mm in diameter remains stable at 10 or even 9.5mm. "The haptics absorb all the contractile forces, keeping the optic well centred. The optic remains stable – at least that is the theory," Dr Vyas says.

In practice, the results were good. At six months, mean rotation from the axis marked at operation for the 12 cases was 2.32 degrees, ranging from 0.31 to 4.96 degrees. At 24 months the mean was 3.17 degrees, ranging from 0.17 to 4.86 degrees. "This is a very slight movement that one can see sometimes with this lens. This is a very small movement from six months to 24 months."

Unaided and best corrected visual acuity were also measured. At 24 months, 11 of 12 eyes saw 20/30 or better uncorrected, with two better than 20/20 and one at 20/40. Best corrected vision was 20/20 or better in 11 eyes with five better than 20/20 and one at 20/30. Eleven patients were very satisfied with their vision and one was neutral. One patient underwent a YAG capsulotomy at 15 months.

"We saw minimal rotation with excellent visual acuity at six and 24 months. Patient satisfaction level was very high, and I think this is the most important measure of all," Dr Vyas says.

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Miltos Balidis

## Correction of post-keratoplasty astigmatism with T-flex® toric IOL

Post-keratoplasty corneas are among the most challenging astigmatism cases. Not only is the degree of astigmatism typically high, it is often irregular – and can even change radically during

surgery, says Miltos Balidis PhD, AHEPA University Hospital, Thessaloniki, Greece. Yet his early results in an ongoing retrospective study suggest that toric lenses can greatly improve vision in these patients.

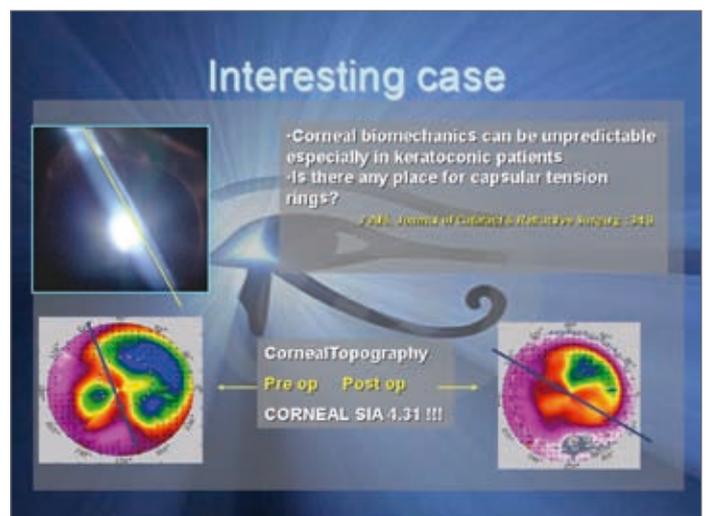
Dr Balidis reported on six-month results for five patients, four male, one female, with a mean age of 53.5 years. Three patients had penetrating keratoplasty after keratoconus, one to treat desmetocele and one to treat trauma. IOL power calculations were obtained based on standard corneal topography, and laser interferometry biometry with Biograph (Wavelight, Alcon, Ft Worth, US). All patients were implanted with T-flex® toric lenses. Uncorrected visual acuity, best corrected VA, cylinder and keratometry, and corneal and total surgically induced astigmatic cylinder were assessed preoperatively and postoperatively.

Overall, mean pre-op cylinder was reduced from 6.5 to 2.74 dioptres. Mean corneal surgically induced astigmatic correction was 4.1 dioptres sphere and total surgically induced correction 6.0 dioptres. In the case of one patient with 11 dioptres of astigmatism, the correction achieved was 80 per cent of the attempted, but in the other four patients the corrections were within 0.5 dioptres of the intended value.

Defocus, which Dr Balidis considers the best overall indicator of refractive result, was less than 1.0 dioptre for 60 per cent, or three of the patients after surgery. Similarly,

post-op uncorrected visual acuity was better than pre-op best corrected visual acuity. After surgery, all patients tested 20/100 or better uncorrected and 40 per cent achieved 20/40. That compares with one patient at 20/50 best corrected and 80 per cent or four patients at 20/80 or better and one patient at 20/400 best corrected before surgery. All eyes gained at least three lines of spectacle corrected vision, with 60 per cent gaining five or more and one gaining nine lines. "Uncorrected most of our patients get very well, and with spectacle correction it is sometimes up to 100 per cent."

However, corneal biomechanics can be unpredictable, especially in keratoconic patients, Dr Balidis notes. "You will





find a lot of interesting cases when you start dealing with sick corneas." In one interesting case, he saw the axis shift 20 degrees with a corneal surgically induced astigmatism of 4.31 dioptres. "This is something you have to consider. We have an ectatic peripheral, thin cornea and we get three dioptres induced with a 3mm incision just because we did the cataract incision." He offers some tips for planning and managing treatment of post-keratoplasty astigmatism:

#### **Try to keep the cataract incision as astigmatically neutral as possible**

Suturing the incision or going in through a scleral tunnel will help, especially in keratoconus. "Remember, you are dealing with a sick cornea," Dr Balidis says.

#### **Make sure the IOL is right side up**

Because the axis marks on the toric IOL are close to the host-graft interface, they can be difficult to see. Nonetheless, if the toric marks are not easily seen, there is a good chance the

lens is upside down, Dr Balidis says, altering the toric effect of the implant. If it is upside down you may be able to reposition it inside the eye if there is sufficient anterior chamber depth (over 3mm preoperatively measured).

"My first impression is that toric IOLs can address keratoplasty astigmatism, and very effectively. We may need an IOL modification as far as the marking is considered," Dr Balidis concludes.

However, he notes that visual acuity depends on corneal symmetry. If the patient has a regular, bow-tie astigmatism you can expect good results with the toric lens. But in cases of irregular or asymmetric astigmatism, consider using a topography-guided excimer laser astigmatism correction and a standard IOL.

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**Tanja M Rabsilber**

## M-flex T<sup>®</sup>: the benefits of a multifocal toric IOL

**T**oric multifocal IOLs hold the promise of bringing the predictability and stability of toric astigmatic correction to patients with astigmatism of more than 1.5 dioptres looking for spectacle independence. A three-

month study by Tanja M Rabsilber MD, University Hospital, Heidelberg, Germany, suggests that the Rayner M-flex T<sup>®</sup> can deliver on this promise.

The M-flex<sup>®</sup> multifocal IOLs are based on a multi-zone refractive aspheric optic technology with either four or five annular zones, depending on the IOL base power. Like the monofocal T-flex<sup>®</sup>, it is composed of hydrophilic acrylic and features 360 degree sharp optic edge on the posterior to discourage PCO. The lens is available in two sizes, 5.75mm optic with 12.0mm total diameter, and 6.25mm optic with 12.5mm diameter. The standard M-flex T<sup>®</sup> comes in spherical powers of +14.0 to +32.0 in 0.5 dioptre increments with 2.0 dioptres cylinder and a +3.0 or +4.0 dioptre add. The special power range offers cylinder from 1.0 to 1.5 dioptres and 2.5 to 6.0 dioptres in 0.5 dioptre steps.

Dr Rabsilber tested the lenses on 10 eyes in six patients with spherical errors ranging from -10.0 to +9.0 and a mean cylinder of -2.65 +/-0.97 dioptres, ranging from -1.5 to -4.75 dioptres. "When you look at the range you see this lens is good for high levels of combined refractive errors," Dr Rabsilber says.

Mean sphere value of the implanted lenses was 20.95 +/-10.61 dioptres, mean cylinder was 2.95 +/-0.93, and mean near add 3.20 +/-0.42 dioptres. Two patients underwent a mix-and-match procedure to treat anisometropia and amblyopia. Preoperative mean best corrected distance visual acuity was 0.19 +/-0.15 logMAR, due to the

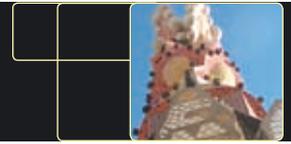
patients with amblyopia, Dr Rabsilber notes. Six eyes were refractive lens exchange and four were cataracts. Mean age was 47.4 years +/-16.6 years, ranging from 17 to 60. Patients were tested for uncorrected and corrected distance and near visual acuity at one day, one month and three months after surgery.

The refractive results were good. Spherical equivalent was stable over time, with a median of -0.13 dioptres at one day, and a median of -0.06 dioptres at three months. A mean residual cylinder of 0.88 dioptres was measured at three months. In looking at IOL power calculations, the median difference between target and achieved spherical equivalent was 0.00 dioptres, with a median cylinder difference of -0.70 dioptres. "These are reliable results," Dr Rabsilber says.

Postoperative median uncorrected distance visual acuity nearly matched preoperative best corrected values at about 0.2 logMAR. This improvement held for the amblyopic patients as well, Dr Rabsilber notes. Best corrected distance visual acuity reached a median value of 0.1 logMAR at three months.

Near uncorrected visual acuity medians reached 0.35 logMAR, with best corrected visual acuity reaching 0.21 logMAR. Median near add accepted was 1.0 dioptre.

The mix-and-match patients also did well. One 53-year-old female received a Tecnis multifocal with a 4.0 dioptre add in her right eye, which had 0.75 dioptre sphere and 20/30 vision uncorrected distance vision before surgery, and a M-flex T<sup>®</sup> in the left eye, which had 6.0 dioptres sphere and -4.74 dioptres cylinder and uncorrected vision of 20/100 and anisometric amblyopia before surgery. This patient achieved uncorrected 20/20 distance and near vision in the right eye, and 20/30 distance and 20/60 near vision in the left, corrected to 20/25 and 20/40 six months after surgery.



"We found the M-flex T® lens to be reliable in IOL calculations. The functional results are good, especially in patients with high refractive errors. One dioptre of near add was still accepted, but keep in mind we implanted more 3.0 dioptre adds than 4.00 dioptres. We are also seeing a benefit for patients presenting with anisometropia

and moderate amblyopia with a mix-and-match approach, and these patients are very satisfied after surgery," Dr Rabsilber concludes.

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Michael Amon

## Enhancing refractive outcomes with Rayner's Sulcoflex® Toric IOL

Patients expect an exact refractive result with cataract or refractive surgery these days. But it doesn't always happen. The Sulcoflex® Toric IOL offers a stable and predictable option for correcting

residual spherical and cylindrical error that is less traumatic than an IOL exchange, according to studies by Prof Michael Amon, Academic Teaching Hospital of St John, Vienna, Austria. And because the lens can be rotated or removed, it is adjustable and reversible.

"I am talking about a new concept, a lens that can be implanted in the ciliary sulcus," Prof Amon says.

Sulcoflex® is a sulcus-fixated pseudophakic supplementary lens with an undulated haptic and an angulation of 10 degrees that can be implanted with another IOL, including multifocal lenses. This design results in high lens stability and the concave posterior optic minimises the chance of contact with an in-the-bag IOL. As this IOL is implanted in the sulcus the risk of lens epithelial cell ingrowth between the lenses is reduced. The optic is 6.5mm in diameter and the overall length is 13.5mm.

The standard toric version comes in spherical equivalents of -3.0 to +3.0 dioptres with cylinders from +1.0 to +3.0 dioptres in 1.0 dioptre steps and spheres ranging from -4.5 to +2.5 dioptres depending on cylinder power. The premium range extends from spherical equivalent of -6.0 to +6.0 dioptres with cylinders ranging from 1.0 to 6.0 dioptres in 0.5 dioptre steps, and spheres from -9.0 to +5.5 dioptres. Sulcoflex® is also offered in multifocal and monofocal aspheric form.

Prof Amon has followed 27 eyes implanted with various Sulcoflex® lenses for two years, including four with the Sulcoflex® Toric. His report focused on rotational stability, which is essential for a toric lens to function.

Like the phakic T-flex® toric IOL, precise identification and marking of the axis is essential, Prof Amon notes. He typically implants the lens through a 2.5mm temporal clear corneal incision with viscoelastic to maintain chamber depth. The lens haptics are very soft to avoid harming the ciliary tissues. After lens placement, aspiration of the viscoelastic and hydration and antibiotic injection, he makes the final alignment of the lens to ensure it is not dislodged due to the stresses of the surgical process. "Final alignment after complete removal of OVD and air-bubbles is essential," he says.

At 24 months follow-up for two cases, the rotation has been very stable. At all follow-up periods a distance between the Sulcoflex® and the primary IOL, and between the Sulcoflex® and the iris, has been maintained, Prof Amon says.

The Sulcoflex® Toric is a supplementary lens that can be used primarily during the first cataract surgery (Duet-implantation) or in a second surgery, Prof Amon says. It can be implanted with a multifocal lens (in the bag) to provide astigmatic correction. Or it can be implanted after surgery to enhance the results of patients who have already been operated. "One day you may want to keep on hand a stock of Sulcoflex® lenses to put in on top of the standard IOL in the same procedure".

"There are also specific indications for cases I like to call 'dynamic refraction,'" Prof Amon says, "conditions where the cylinder or sphere is likely to change over time, including keratoplasty, keratoconus/globus, and paediatric cataract. "You can adjust by rotating or removing the lens. For keratoplasty if you need to do another transplant you can just take out the lens and put in another one at a later stage," he notes.

The surgery is safe and easy and it is reversible. The lens has high rotational stability and is a biocompatible, injectable IOL. "Sulcoflex® represents a promising new concept for the enhancement of postsurgical results or primary application," Prof Amon concludes.

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