Toric IOL implantation in cataract surgery with high regular corneal astigmatism after penetrating keratoplasty

By Wolfgang J. Mayer, MD, PhD, FEBO,
Professor and Senior Surgeon at the Eye Clinic of the Ludwig-Maximilians-University (LMU) Hospital, Munich, Germany

INTRODUCTION

Post-penetrating keratoplasty (post-PK) is frequently associated with substantial postoperative refractive error due to high regular or irregular graft astigmatism. Options such as spectacles, contact lenses, limbal relaxing incisions, intracorneal ring segments, and ablative refractive surgery, or a combination of these techniques, may be utilised depending on the type and severity of the astigmatism present. For post-PK patients with concomitant cataract, another viable option may be to implant a toric intraocular lens. With advances in diagnostic and surgical technologies over recent years, both PK-induced astigmatism and cataract can be successfully treated at the same time with phacoemulsification and implantation of a toric IOL. Here we present one such challenging case which highlights the benefits of such an approach for post-PK patients with cataract.

PATIENT HISTORY

A 68-year-old female presented at our clinic for cataract surgery having undergone penetrating keratoplasty for keratoconus scarring in her right eye eight years earlier. The patient had a long history of suffering after her keratoplasty surgery. While the surgery itself was successful, the patient was plagued by high postoperative astigmatism, which could not be corrected with glasses. Several contact lens adjustments were also unsuccessful due to the poor fit of the contact lens (steep corneal radii). In the course of time, she also developed a cataract. The patient was finally referred to our clinic with a question about surgical optimization.

The eye had a transparent donor graft with a satisfactory endothelial cell count of 1850 cells/mm2 but high residual astigmatism of -12.25 D at 105°. The spherical equivalent was -11.75 D. The patient had a central corneal thickness of 528 microns, age-related cataract formation, corneal against-the-rule (ATR) astigmatism in the optical zone and normal optical nerve head and retina status. Her uncorrected visual acuity was +1.3 logMAR and attained +0.5 logMAR after correction. After discussing the treatment options with the patient, it was decided to perform phacoemulsification followed by implantation of a ZEISS AT TORBI 709M toric intraocular lens.

Patient details:	Female, 68 years of age
Presentation:	Right eye post-keratoplasty, age-related cataract, corneal against-the-rule astigmatism. Normal optical nerve head and retina status
Endothelial cell count:	1850 cells/mm2
Preoperative visual acuity:	0.25 D BCVA and 0.05 D UCVA
Preoperative refraction:	-11.75 D sphere/ - 12.25 D cylinder / 105°
IOL Master 700 measurements:	**K-Values front:** R1 41.1 D (101°), R2 50.5 D (10.9°) Astigmatism: 9.4 D. **TK-Values:** R1 41.3 D (104°), R2 51.0 D (14°), Astigmatism: 9.7 D. **Axial length:** 27.91 mm **Anterior chamber depth:** 4.69 mm
Lens selection:	ZEISS AT TORBI 709M
Postoperative refraction (3 months):	+0.50 D sphere/ - 1.25 D cylinder / 94°

Table 1: Patient preoperative assessment data and postoperative refraction

PREOPERATIVE ASSESSMENT

Precise and reliable biometric measurements are vital in obtaining predictable outcomes with toric lenses, and even more so in complex cases or eyes with unusual geometry.

For this post-PK patient, swept-source OCT (IOLMaster 700) enabled us to obtain more precise images of the entire cornea, the anterior chamber depth and the lens thickness. Furthermore, additional biometric information was provided by the fact that the device measures both the anterior and posterior surface of the cornea. The IOLMaster 700 also indicates whether the patient was fixating at the right point and whether there was a tilt or decentration of the crystalline lens. This is very important to avoid postoperative refractive surprises with toric IOLs.

The workup from the IOLMaster 700 gave the following measurements: K-Values front: R1 41.1 D (101°), R2 50.5 D (10.9°), Astigmatism of 9.4 D. TK-Values: R1 41.3 D (104°), R2 51.0 D (14°), Astigmatism of 9.7 D. The axial length was relatively long with 27.91 mm, and anterior chamber depth was 4.69 mm. Surgical planning was carried out using EQ Workplace, a cataract surgery planning tool which is part of the ZEISS Cataract Suite. After accessing the patient's biometry and diagnostic data remotely, I could then calculate and select the appropriate toric model with data being automatically transferred and pre-populated from the IOLMaster.

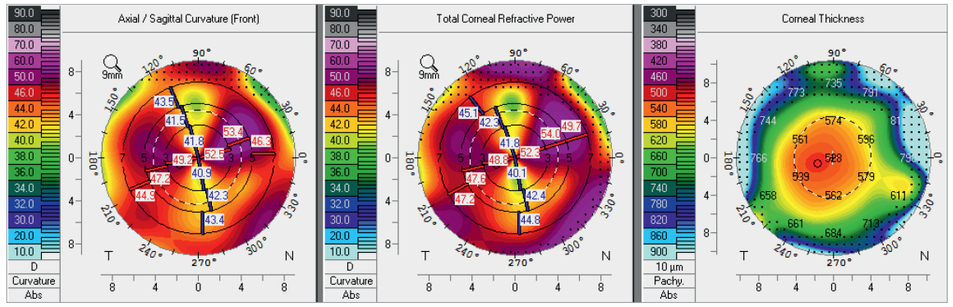

Fig 1: Topography of cornea after corneal transplantation and before cataract surgery with toric IOL implantation

We opted to implant a ZEISS AT TORBI 709M lens with -1.0 D and +11.50 D cylinder for correction of ATR astigmatism based on TK-values with a targeted spherical equivalent undercorrection using the Barrett TK Toric Formula. We chose this monofocal, bitoric lens as it offers a larger cylinder range up to 12 D and comes in smaller 0.5 D increments than other toric IOLs on the market, allowing for enhanced fine-tuning of the refractive outcome and higher precision. The bitoric optic design aims to optimize the visual outcomes for patients with a higher degree of astigmatism such as this particular patient, resulting in better imaging quality thanks to a larger usable optic.

SURGERY

The surgery was performed using a temporal corneal incision and a calculated surgical induced astigmatism (SIA) of 0.2 D. After phacoemulsification cataract extraction and IOL implantation, toric IOL axis alignment was obtained using the CALLISTO eye system, a markerless digital system which allows for precision by avoiding errors during manual marking and horizontal axis misalignment. CALLISTO eye markerless uses eye-tracking technology that overlays assistance templates to the live image of the microscope, based on a match with a previously captured reference image from the IOLMaster. The assistance overlays are then continuously tracked and also projected into the eye piece of the OPMI LUMERA 700 microscope.

DISCUSSION & CONCLUSION

Our strategy to implant a toric IOL in this post-PK cataract patient proved to be a successful one. After three months, the patient's refractive outcome was very good, with a spherical equivalent of +0.50 D and a greatly improved cylinder of -1.25 D at 94-degrees. The AT TORBI 709M lens was shown to be stable in the capsular bag and there was no evidence of any postoperative rotation. The patient was very happy with the outcome. The surgery effectively reduced the optical phenomena and double vision frequently encountered in high astigmatism after keratoplasty. The patient was able to dispense with her contact lenses and was spectacle independent for distance vision. With complex cases such as this one, it is vital to carefully monitor the status of the transplanted graft and to be alert to the risk of corneal decompensation and potential need for repeat keratoplasty surgery. If the endothelial cells are depleted beyond a safe margin, a better strategy may be to implant a monofocal IOL in the capsular bag combined with an add-on toric lens into the sulcus. This will make IOL exchange easier in the event of graft failure and repeat keratoplasty surgery. Another pearl for such complex eyes is to measure the total corneal refractive power in the optical 4 mm zone (Total Keratometry) to obtain total astigmatism values. In our clinical experience, taking due account of both the posterior and anterior cornea for IOL power calculation can have a notable positive effect on the final refractive outcome. It is also advisable to aim for slight under-correction which will compensate for the higher risk of axis rotation after surgery in these post-keratoplasty cases.

Precision throughout the complete workflow is the key: successful patient outcomes with toric IOLs require a combination of careful preoperative assessment and biometry, rigorous surgical technique, and lens technology that delivers excellent refractive outcomes while remaining stable in the capsular bag. For a busy surgeon, the ZEISS Cataract Suite with its seamless integration of advanced technologies, helps to ensure that quality and efficiency are present at all key stages of the procedure. The combination of precise biometry, precise axis alignment, smooth workflow planning and a wide range of toric IOL models with small increments support us to satisfy patients needs without significant changes to our standard cataract techniques.

Wolfgang J. Mayer, MD, PhD, FEBO,
is a Professor and Senior Ophthalmic Surgeon at the Ludwig-Maximilians-University (LMU) Hospital, Munich, Germany. He is a specialist in refractive laser/lens and corneal transplant surgery and has published over 90 peer-reviewed journal articles including original articles, case reports, reviews, and book contributions.

Media placement sponsored by Carl Zeiss Meditec AG