Outcomes of post-SMILE Cataract Surgery with Multifocal IOL Implantation:

The Benefit of Total Keratometry for Power Calculation

Sri Ganesh, MBBS, MS, DNB and Sheetal Brar, MBBS, MS, FPRS, FC

CASE HISTORY

A 54-year-old man presented in January, 2018 with complaints of diminished vision and poor night vision 5 years after undergoing SMILE for correction of myopia. Prior to SMILE, his refraction was -9.5 -0.50 @45 OD and -10.0 -0.50 @115 OS, and his best spectacle corrected visual acuity (BSCVA) was 6/6 OU. Uncorrected distance visual acuity (UDVA) after SMILE was 6/6 OU.

On examination, he had a grade 2 nuclear sclerotic cataract OD and grade 1 nuclear sclerotic cataract OS. Refraction was -2.75 -0.75 @30 OD and-2.0 -0.75 @140 OS; UDVA was 6/24 OD and 6/12 OS; BSCVA was 6/9 OD and 6/7.5 OS. The patient stated that he wanted a multifocal IOL implant to reduce his dependence on glasses after cataract surgery.

Preoperative diagnostic assessments included Scheimpflug imaging with the Pentacam (Oculus) for topography and corneal aberrometry along with the IOLMaster 700 (Carl Zeiss Meditec) for biometry. Zernike analysis showed positive spherical aberration of 0.677 microns OD and 0.532 microns OS.

Surgery was planned for implantation of the AT LISA tri 839MP IOL (Carl Zeiss Meditec) and a plano target OU. IOL calculations were performed using multiple methods, and the results are summarized in Table 1.

We calculated the prediction errors for formulae incorporated in the IOL Master 700 and Barrett's True K post refractive surgery formula and we found that the prediction error with the Barrett Universal II and Total Keratometry (TK) was lowest amongst the three (Table 2). Hence, this formula was chosen with this lens. The patient underwent surgery with implantation of a +19.0 D IOL OD and +18.0 D IOL OS.

Calculation method	Recommended IOL power (D)	
	OD	OS
Barrett Universal II with EKR[1]	+18.54	+18.15
Barrett Universal II with TK	+18.88	+18.03
ASCRS IOL calculator results		
Masket formula	+19.91	+19.63
Modified-Masket	+20.48	+20.32
Barrett True-K post refractive surgery formula with clinical history	+19.70	+19.49
Shammas	+20.66	+20.11
Haigis-L	+19.49	+18.95
Potvin-Hill Pentacam	+20.01	+19.45

1 EKR = equivalent-K reading (Pentacam)

Table 1. IOL calculations

FORMULA	OD		OS	
	IOL Power (D)	Residual refraction (D)	IOL Power (D)	Residual refraction (D)
Barrett True-K post refractive surgery formula with clinical history	+19.5	+0.18	+19.0	+0.14
Barrett Universal II with TK	+19.0	+0.02	+18.0	+0.11
Holladay EKR WITH BARRETT II	+19.0	-0.09	+18.0	-0.08

Table 2. Predicted residual refractions for implantation of the AT LISA tri 839MP

Postoperatively, manifest refraction was 0.00 +0.62 @130 OD and +0.50 -0.50 @160 OS. In binocular testing, UDVA was 6/6p and uncorrected near visual acuity was N6. Intermediate vision was checked at 60 cm with ETDRS charts and was - 0.1 LogMAR , which is excellent. The patient was extremely satisfied with the outcome and reported minimal halos at 2 weeks, which are expected to get better with neuroadaptation.

DISCUSSION

When patients with a history of corneal refractive surgery to treat myopia need cataract surgery, they often want to maintain reduced spectacle dependence, but there have been challenges to meeting this goal. Both LASIK and PRK induce higher order aberrations (HOAs) and may create a multifocal cornea with subsequent loss of contrast and reduction in visual quality.[1] Thus, there has been concern about further reduction in image contrast with implantation of a diffractive multifocal IOL.[1]

SMILE has been shown to induce less HOAs than the excimer laser procedures.[2,3] Therefore, patients who have a history of myopic SMILE may be more suitable candidates for a multifocal IOL compared to patients with prior LASIK or PRK. Furthermore, newer optic designs for presbyopia-correcting IOLs, including trifocal and extended-depth-of-focus IOLs, provide better contrast sensitivity than earlier generation bifocal implants along with a fuller range of functional uncorrected vision. The AT LISA tri 839MP IOL chosen for this patient is a diffractive trifocal IOL. Studies show that patients implanted with the AT LISA tri 839MP have good image quality, functional uncorrected vision at all distances, and contrast sensitivity under photopic and mesopic conditions that is within the normal range.[4-7]

Visual outcomes with any IOL, however, are sensitive to residual refractive error. Achieving a good refractive outcome is particularly important with a multifocal IOL, and in fact, blurred vision associated with residual ametropia has been identified as a leading cause for patient dissatisfaction after multifocal IOL surgery.[8,9] Achieving the refractive target after cataract surgery in eyes with a history of corneal refractive surgery is challenging using standard keratometers or corneal topographers because these devices measure only anterior corneal curvature and extrapolate the posterior corneal curvature based on normal relationship between anterior and posterior corneal curvatures. This relationship, however, is changed after refractive procedures that remove corneal tissue (PRK, LASIK, SMILE), thus creating errors in estimating the true corneal power.[10]

Various methods have been introduced for estimating the true corneal power in eyes that have undergone myopic PRK and LASIK, and formulas with demonstrated effectiveness are included in the American Society of Cataract & Refractive Surgery IOL calculator [http://iolcalc.ascrs.org/]. No single formula, however, has been found to outperform the others, and as seen in this case, their use generates a range of suggested IOL powers that leaves surgeons with the dilemma of deciding which to choose.

Use of the IOLMaster 700 to determine Total Keratometry is a new method for direct assessment of total corneal power coming with the next software release (Figure 1). Using telecentric 3-zone keratometry and swept-source OCT technology, the IOLMaster 700 considers corneal thickness and actual values for the radius of the posterior cornea to give a reading of total corneal power. By replacing assumptions and modeling with actual measurements, the first data indicates, that IOLMaster 700 may provide reliable data on corneal power in the challenging cases of surgically modified corneas.

Total Keratometry can be used in classic IOL power calculation formulas and with existing IOL constants because it was designed to be compatible with standard keratometry in normal eyes. It can also be used to calculate post myopic LASIK eyes with standard formulas, that include direct anterior chamber depths values, such as the Haigis or the Holladay II formula.

In order to optimize the benefit of having this new total corneal power reading, however, Graham Barrett, MD, developed two new formulas – the Barrett TK Universal II formula for non-toric IOLs and the Barrett TK Toric formula for toric IOLs – and they will be integrated into the IOLMaster 700 with the latest software revision. Using the IOLMaster 700, surgeons can therefore obtain all of their preoperative biometry measurements and perform the IOL power calculation with a single device, avoiding any need for using third-party software or online calculators.

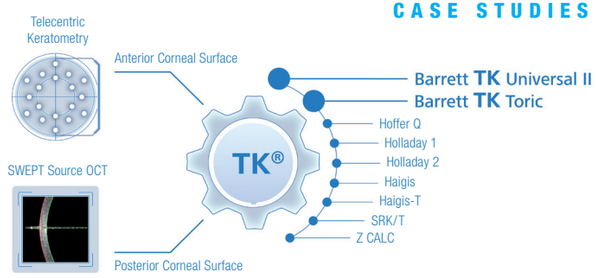

Figure 1. IOLMaster 700 with Total Keratometry - a new method for direct assessment of total corneal power

CONCLUSION

This case describes our first experience performing cataract surgery in a post-SMILE patient. Using the IOLMaster 700 for biometric measurements, including Total Keratometry, and IOL calculation, and by choosing the AT LISA tri 839MP IOL, we were able to achieve excellent refractive and functional outcomes. Despite these very encouraging results, thorough counseling to establish realistic expectations about the potential for a less than perfect outcome remains a critical component of the preoperative discussion for all cataract surgery patients.

Dr. Ganesh is Chairman and Managing Director at the Nethradhama Super Specialty Eye Hospital, Bangalore, India. He is a consultant for Carl Zeiss Meditec.
Dr. Brar is a senior consultant at the Nethradhama Super Specialty Eye Hospital.

This content is based on our own professional opinion or on our study results. It is not necessarily a reflection of the point of view of Carl Zeiss Meditec AG and may not be in line with the clinical evaluation or the intended use of their medical devices.

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