

# TABLE: PHILOSOPHIES OF ASTIGMATISM MANAGEMENT



QUESTIONS	DANIEL H. CHANG, MD	DAVID F. CHANG, MD	UDAY DEVGAN, MD, FACS, FRCS	DETLEF HOLLAND, MD	MARK A. KONTOS, MD	RUTH LAPID-GORTZAK, MD, PHD
<b>My basic preoperative workup consists of</b>	history, lifestyle questionnaire, visual acuity, manifest refraction and glare testing, eye dominance, slit-lamp examination, and dilated fundus examination	IOLMaster 700 with TK (Carl Zeiss Meditec); iTrace topography and wavefront aberrometry (Tracey Technologies); automated K  	simple biometry (keratometry and axial length), which are all that is required if the patient does not desire a refractive correction at the time of cataract surgery; I tell patients that cataract surgery is to correct the cataract, and refractive surgery is to address the refractive issues	gathering information about patient expectations regarding spectacle independence	refraction, keratometry, A-scan ultrasound, and topography	a standardized procedure consisting of tear-film assessment, refraction, slit-lamp biomicroscopy, topography, and biometry
<b>Additional diagnostics that I find helpful during the preoperative workup include</b>	biometry performed prior to examination	(no answer)	for patients desiring a refractive outcome at the time of cataract surgery (ie, most of my patients), corneal topography, corneal tomography (dual Scheimpflug imaging), corneal OCT, optical coherence biometry, refraction, and measurement of old glasses	tear film examination, leading to dry eye treatment if necessary	OCT of the macula and tear-film diagnostics	testing geared toward the use of premium IOLs as the standard of care
<b>To me, the best way to measure corneal astigmatism is</b>	biometry with the IOLMaster 700  	combining IOLMaster with TK, autokeratometry, and topography; I look for a consensus and best fit for the three methods	finding congruence between different devices (ie, topography, tomography, and keratometry all give similar measurements)	using multiple topography devices, corneal aberrometry, and IOLMaster 700; I believe that comparison of the results from this mixture of devices generates the best information about total corneal astigmatism	using topography and TK measurements	using three methods of keratometry routinely and comparing the results before deciding what to use; if all are congruent, we use the K from the biometer for power calculation and have a standardized operating procedure
<b>My pricing and packaging for astigmatism correction is</b>	US\$1,995 for astigmatism correction only, US\$2,995 when bundled with presbyopia correction	least expensive with manual astigmatic keratotomy; next most expensive with a toric IOL; most expensive with RxLAL (RxSight)	US\$2,150 per eye for refractive services, which includes laser vision correction enhancement if needed	a copayment of about €1,000 for a toric monofocal IOL; in laser cataract surgery, there is no additional cost for relaxing incisions	US\$1,750 for a monofocal IOL with laser cataract surgery and US\$2,900 for a presbyopia-correcting IOL with laser cataract surgery	to offer astigmatism correction if it is indicated and feasible; there is a copayment, and the patient decides whether to accept the service



**GILLES LESIEUR, MD**

K readings, corneal diameter, Pentacam (Oculus Optikgeräte), and, most important, TK on the IOLMaster 700 and corneal diameter



treating ocular surface disease and meibomian gland dysfunction, checking the retina with OCT, and checking the cornea with endothelial cell count and Pentacam to identify and avoid irregular astigmatism

TK with IOLMaster 700

€150



**EHSAN SADRI, MD, FACS, FAO**

ruling out untreated dry eye and obtaining corneal tomography with Pentacam or Cassini (Cassini Technologies) and biometry with IOLMaster; we compare results among machines to ensure that they are consistent

assessments of overall ocular health; OCT and thorough retinal examination are needed to rule out other potential causes of poor visual outcome after cataract surgery

to measure total corneal astigmatism, for which I believe the Cassini is the best option



uniform, no matter what means I use to achieve the goal; package price of around US\$2,000 will include a toric lens and/or laser, as needed



**GIACOMO SAVINI, MD**

optical biometry with three devices (Aladdin [Topcon], OA-2000 [Tomey], and Pentacam AXL, with formula constants optimized for each); for multifocal IOL candidates, we add ultrasound immersion biometry, again with optimized constants; astigmatism measurement with Pentacam AXL and Sirius (CSO), and, for research purposes only, total corneal astigmatism with anterior segment OCT (MS-39, CSO) and TK with IOLMaster 700

macular OCT and endothelial cell count

using a Scheimpflug camera or anterior segment OCT to determine total corneal astigmatism

not different for toric and nontoric IOLs, as all eyes are potential candidates for astigmatism correction and, therefore, undergo the same preoperative procedures; all patients pay the same price for preoperative examinations



**ABHAY R. VASAVADA, MS, FRCS; AND VAISHALI VASAVADA, MS**

manual K, automated K (Lenstar, Haag-Streit), optical biometry, corneal tomography (Pentacam), iTrace aberrometry, visual acuity, and refraction status—all done before instillation of any drops; after dilation: slit-lamp examination, retinal evaluation, and retinal OCT

dry eye assessment, anterior segment OCT evaluation, aberrometry (for assessment of alpha angle), assessment of mesopic pupil size

with a combination of manual K and corneal topography

for toric IOL correction (our choice almost exclusively), which is 1.5 times the price of our aspheric monofocal IOL package



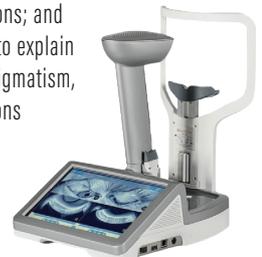
**ELIZABETH YEU, MD**

the SPEED questionnaire; Placido-disc topography; LED topography (Cassini); biometry with Lenstar; LipiScan meibomian imaging (Johnson & Johnson Vision); a patient video on surgery options; and a counselor to explain cataract, astigmatism, and IOL options

tear osmolarity measurement if the patient complains of symptoms suggestive of DED (fluctuating vision, redness, foreign body sensation)

establishing consistency among images from the Lenstar, Atlas 9000 (Carl Zeiss Meditec), or OPD-Scan III (Nidek) Placido-disc topography and the Cassini

US\$1,695 for laser cataract surgery only for low cylinder and US\$2,195 for a toric IOL; in September, we started trialing a simplified package at US\$1,995 to fix vision for clarity at a single focus (eg, far vision)



◆ TABLE: PHILOSOPHIES OF ASTIGMATISM MANAGEMENT, CONTINUED... ◆

						
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<b>The minimum amount of astigmatism that I treat is</b>	0.50 D ATR	as little as a 0.50 D touch-up with an LRI on the OR table when I measure pseudophakic astigmatism with the ORA System (Alcon)	0.50 D	0.75 D	0.50 D ATR, 0.75 D WTR	any astigmatism worth correcting according to the IOL calculator, usually starting at 1.10 D WTR and 0.75 D ATR
<b>In my hands, the best way to manage low astigmatism is</b>	with a toric IOL	for less than 1.00 D, LRI guided with ORA	placement of phaco incision with an LRI	with a toric IOL, if the patient desires astigmatism treatment; in general, with multifocal IOLs, we use toric models starting at 0.75 D, and with monofocal IOLs we use torics starting at 1.00 D; if no toric IOL is desired, in laser cataract surgery we perform astigmatic incisions for cylinder of less than 2.00 D	with laser astigmatic keratometry or LASIK	for patients willing to pay for the service, a toric IOL; otherwise, relaxing incisions
<b>In my hands, the best way to manage high astigmatism is</b>	with a toric IOL	with a toric IOL for 1.00 D or more of corneal astigmatism	with a toric IOL for 1.00 D or greater of corneal astigmatism	with a toric IOL	with a toric IOL or LASIK	with a toric IOL; the patient must demonstrate good visual acuity with the toric correction in the spectacle plane
<b>My go-to toric IOLs are</b>	Tecnis Toric and Tecnis Symfony Toric (both by Johnson & Johnson Vision)	AcrySof IQ Toric (Alcon) monofocal because it has better rotational stability than the Tecnis monofocal	AcrySof IQ Toric; AcrySof Restor Toric (Alcon); Tecnis Toric IOL; enVista Toric IOL (Bausch + Lomb)	Lentis Mplus Toric or Lentis Comfort Toric plate-haptic IOLs (both from Oculentis) and the Precizon Toric (Ophtec)	Tecnis Toric models ZCT and ZXT	dependent on the wishes of the patient; if a trifocal IOL is chosen, tall patients usually get an IOL with an intermediate distance of 80 cm, and patients of medium height get an IOL intermediate distance of 60 cm; our procedures are standardized, and IOL choice is tailored to the patient's needs
<b>My preferred IOL calculations and/or IOL calculation software are</b>	the Barrett II formula on the IOLMaster 700	the Barrett formula using TK	IOLcalc.com (Advanced Euclidean Solutions) using artificial intelligence	the Barrett formula	the Barrett Universal formula on the IOLMaster 700	usually the manufacturer's software





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when it is needed and possible to correct with an IOL; if this is not possible, I perform a LRI or no correction	0.75 D	0.60 D for multifocal IOL candidates, on condition that this measurement is repeatable and is provided by both Scheimpflug cameras; for patients with monofocal IOLs, sometimes I correct as little as 0.75 or 1.00 D, depending on the patient's expectations and requirements	0.50 D of regular corneal astigmatism	any corneal astigmatism, especially if it is > 0.25 D
to be accurate	a corneal or LRI; this is the method I use for less than 1.00 D of astigmatism	with toric IOLs	with a toric IOL	for anterior corneal astigmatism WTR 1.00 D or ATR 0.50 D, a toric IOL; for lower amounts, laser cataract surgery
much the same	with a toric IOL; this is the method I use for 1.00 D of astigmatism and above	with toric IOLs	with a toric IOL, sometimes combined with femtosecond laser astigmatic keratotomy if the astigmatism is outside the range of available toric IOLs	with a toric IOL
AT Torbi (Carl Zeiss Meditec) and Ankoris (PhysIOL), depending on corneal diameter	Tecnis Toric and the enVista toric	AcrySof IQ Toric SNGATx	AcrySof IQ Toric	AcrySof IQ Toric IOLs for naive corneas; for those with previous refractive surgery, I use the enVista toric IOL, and I look forward to availability of the toric IOL from Johnson & Johnson Vision
SRK T, Hoffer Q, and Barrett formulas for spherical equivalent and my own nomogram for astigmatism correction with TK double-checked with the chosen IOL company's calculator	different depending on the size and shape of the eye and the presence of previous refractive surgery; I have used the formulas on the ASCRS portal in recent years	a formula developed with Kristian Næser, MD, published in 2017 and available <a href="http://atsoiweb.com/toric-calculator/">atsoiweb.com/toric-calculator/</a> (see details in my accompanying article on page 60)	the Barrett Universal II Formula and Barrett Toric Calculator	the Barrett Toric Calculator through the Veracity Surgical system (Carl Zeiss Meditec), which offers an updated version of the formula; I also compare with the Barrett integrated toric IOL calculator online



## TABLE: PHILOSOPHIES OF ASTIGMATISM MANAGEMENT, CONTINUED...



### QUESTIONS

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**My method for IOL alignment is**

cardinal Nd:YAG laser marks registered to preoperative topographic and pupil images; ink marks are made manually intraoperatively on the steep axis

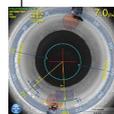
Callisto eye (Carl Zeiss Meditec) digital alignment, refined with ORA intraoperative aberrometry

using my chopper and then verifying on the OR table

in laser cataract surgery, alignment with the IntelliAxis-L system (Lensar), and otherwise the RoboMarker (Surgilum) for corneal axis marking

the Callisto eye with manual marking as backup

the Verion Image Guided System (Alcon) for intraoperative IOL alignment



**I measure astigmatism intraoperatively: Yes or No?**

no

yes

yes, as needed on a case-by-case basis (we have all of the toys)

no

no

no

**If I measure astigmatism intraoperatively, I use**

N/A

ORA

multiple devices

N/A

N/A

N/A

**When I encounter unhappy toric IOL patients, the best way to treat them is**

to treat based on the cause of their unhappiness—but toric IOL patients are rarely unhappy

to rotate any misaligned toric IOL; usually, however, the error is residual sphere rather than astigmatism

assessing each patient individually; maybe I will reposition the toric IOL, maybe exchange the IOL, maybe use laser vision correction

if the toric IOL is in the wrong axis, by repositioning in the correct axis after repeating measurements including biometry and topography

with rotation or exchange of the IOL or with LASIK

to make a correct diagnosis and, if the unhappiness is related to IOL misalignment, correct it

**If I need to address residual postoperative astigmatism, I use**

PRK (typically)

LRI at the same time the second eye is operated on, unless rotating the toric IOL would help

individual assessment; maybe I will reposition the toric IOL, maybe exchange the IOL, maybe use laser vision correction

an add-on IOL or touch-up with LASIK, in the rare instance when IOL rotation is not useful and if the amount of error is reasonable for retreatment

LASIK

whatever the correct diagnosis indicates; if the Toric Results Analyzer (astigmatismfix.com) of Berdahl and Hardten shows that IOL rotation will solve the problem, I do that; otherwise, I would do a laser touch-up

**I perform peripheral corneal relaxing incisions: Yes or No?**

yes, but very rarely

yes

yes, of course

yes

yes

yes, when indicated

**Peripheral corneal relaxing incisions: Manual or femtosecond?**

manual

manual

both—and we have multiple femtosecond lasers available

femtosecond

femtosecond

manual

**In my opinion, the biggest roadblock to more widespread use of toric IOLs is**

financial

patients' lack of understanding of both the value proposition and astigmatism itself

the cost to the patient; if you have astigmatism and you can afford the toric IOL, then it is the best choice

misinformation among our colleagues about the good results and easy handling of modern toric IOLs; pricing is also still a problem

cost

the reluctance of eye surgeons to use a technology that patients have to pay for; if the patient understands that success is not guaranteed, one should and can proceed with premium technology



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Callisto eye image-guided system	marking the 6- and 12-o'clock positions preoperatively at the slit lamp; we also have an ORA System to perform intraoperative measurements	with the Verion Image-Guided System	image-guided	streaming information through Lensar Streamline (Lensar) from the Cassini and/or OPD-Scan
no	yes	no	no	no
N/A	the ORA System	N/A	intraoperative aberrometry with the ORA System with VeriEye Technology	N/A
to check for IOL rotation	depending on the timing; in the early postoperative period, IOL rotation; after a year, a laser enhancement is probably a better option	to determine why the astigmatism correction was not complete and base the treatment on the cause: Was it IOL rotation? Wrong preoperative measurements? Unexpected amount of surgically induced astigmatism from the main incision?	by finding out the reason for their dissatisfaction and addressing it: for example, rotation of a misaligned toric IOL, IOL exchange in case of a gross error, or, rarely, a corneal refractive procedure	depending on the patient and the etiology of the residual cylinder; see my main article on page 64 for details
a laser enhancement; depending on the amount of residual astigmatism, and if there is no IOL rotation, I use either PRK or LASIK	the same strategy as above	IOL rotation if surgery is recent and the spherical equivalent equals the preoperative target; otherwise femtosecond LASIK; in many cases, however, a simple eyeglass prescription is sufficient, especially with monofocal IOLs	iTrace aberrometry toric planning software, the Barrett formula, and astigmatismfix.com	a variety of tactics, depending on the patient and the etiology of the residual cylinder; for malrotation, I check against astigmatismfix.com to see if re-rotation of IOL is warranted; otherwise, it depends on how much residual cylinder (< 1.00 D, IOL exchange, LRI, or PRK/LASIK; > 1.00 D IOL exchange); see main article on page 64 for details
yes	yes	no, I stopped in 2011 when I started using toric IOLs	yes, rarely	yes
manual	both	N/A	femtosecond	at time of cataract surgery, always femtosecond; for postoperative residual cylinder, either manual or laser
price (for patients) and the difficulty of power calculation (for surgeons)	the surgeon's mindset, especially among older surgeons	in the public national system, mainly cost; in private practices like mine, I don't see any roadblock	the added out-of-pocket cost to the patient of opting for the IOL	physicians' lack of understanding of real astigmatism versus induced astigmatism (from dry eye, etc) and not being able to correct postoperative surprises

