

How Much Astigmatism Do I Fix With Cataract Surgery?

BY ELIZABETH YEU, MD

Ophthalmologists managed astigmatism surgically long before the invention of toric IOLs. The combination of patients' rising expectations, postoperative toric IOL surprises, and a rediscovered interest among cataract surgeons in the contribution of the posterior cornea to astigmatism has increased my attention to detail during the preoperative planning stage. A basic tenet is that most people (about 84%) have a steep with-the-rule (WTR) posterior corneal curvature, which effectively adds to the total corneal against-the-rule (ATR) astigmatism.¹ This rule clinically results in a miscalculation of the toric correction with my presumed posterior corneal fudge factor for one or two toric IOL patients out of every 10 whom I am treating surgically. Moreover, this basic tenet does not include eyes with obliquely oriented anterior corneal astigmatism. To date, information on the accuracy of corneal tomography for assessing posterior corneal astigmatism is scarce. It is my understanding, however, that at least one ophthalmic company is developing software to fine-tune the assessment of posterior corneal astigmatism magnitude and meridian. There is evidence to support that intraoperative aberrometry can improve outcomes with ocular toricity management during refractive cataract surgery,² but no head-to-head studies have been performed that compare the accuracy of astigmatic correction using the Baylor toric nomogram (Figure) versus intraoperative aberrometry or tomography.

My approach to managing corneal astigmatism is a relaxed variation on the Baylor toric nomogram,

Effective IOL cylinder power at corneal plane (D)	WTR (D)	ATR (D)
0	≤ 1.69 (>1.0: PCRI)	≤ 0.39
1.00	1.70 – 2.19	0.40* – 0.79
1.50	2.20 – 2.69	0.80 – 1.29
2.00	2.70 – 3.19	1.30 – 1.79
2.50	3.20 – 3.79	1.80 – 2.29
3.00	3.80 – 4.39	2.30 – 2.79
3.50	4.40 – 4.99	2.80 – 3.29
4.00	5.00 –	3.30 – 3.79

* Especially if specs have more ATR

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Figure. The Baylor toric nomogram.

which has mitigated but (as noted earlier) not eliminated postoperative surprises in my patients. Hayashi et al demonstrated that anterior corneal astigmatism drifts approximately 0.34 D from WTR to ATR over time,³ which I take into consideration, especially for patients 65 years of age or younger. The corneas of older patients have likely completed most of the "drifting," so my goal is to leave them with minimal or neutralized WTR astigmatism.

Posterior corneal astigmatism is approximately 0.30 to 0.40 D WTR in most patients with anterior WTR astigmatism and approximately 0.20 D WTR in most patients with anterior ATR astigmatism.⁴ Because I have been so concerned about flipping

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How do you measure corneal astigmatism to determine a toric IOL calculation?

- I use a toric IOL calculator.
- I use the Baylor toric IOL nomogram.
- I use intraoperative aberrometry.
- I perform at least two of the methods mentioned above and compare the information.

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the axis in my WTR patients because of the posterior corneal astigmatism, I have often grossly undercorrected the WTR astigmatism in these cases. This may occur for any number of reasons. First, the actual amount of the posterior corneal astigmatism is unclear, and there is the 16% possibility that the patient may be part of the minority who actually have ATR posterior corneal astigmatism to begin with, which would increase the amount of total WTR astigmatism that the patient has. Also, I purposely tried to leave the patient with residual WTR astigmatism of approximately 0.30 D to account for the natural corneal drift. Last, any little malrotation can further reduce my intended astigmatic correction. Thus, I now use toric IOLs in eyes that have at least 1.40 D of WTR astigmatism (instead of 1.70 D per the Baylor nomogram), and as mentioned earlier, I aim to neutralize the astigmatism fully rather than leave them with WTR cylinder (especially in older eyes). One other optical property that I take into consideration, which is still an unclear science, is the contribution of the effective lens position. In shorter eyes (< 22 mm), the IOL often sits more anteriorly, resulting in a stronger toric correction, and thus I will choose the lower toric power. Conversely, I will choose the higher toric power in eyes that have a longer axial length (> 26 mm), especially if the amount of astigmatism is between two toric powers.

Online Survey Results May 2014

How do you account for the contribution of the posterior cornea in toric IOL cases?

A nomogram	50.00%
The ORA system	35.71%
A nomogram and the ORA system	14.29%

How do you treat unanticipated residual astigmatism in cases in which the preoperative measurements indicated astigmatic treatment would not be needed?

Limbal relaxing incisions	21.43%
Arcuate incisions with the femtosecond laser	35.71%
PRK or LASIK	42.86%

All of the subtle differences I described make it challenging at times to choose the correct toric IOL power. I use various tools to help with my decision. To determine the toric correction, I start with at least two similar anterior corneal keratometry readings (topography, optical biometry, manual keratometry), review the cylindrical magnitude and axis in the patient's spectacles, and account for the patient's age and axial length. Ultimately, I look forward to software updates and new devices that will ascertain total corneal astigmatism more accurately.

The question I pose is this: how do you measure corneal astigmatism to determine a toric IOL power calculation? ■

Elizabeth Yeu, MD, is in private practice at Virginia Eye Consultants and an assistant professor of ophthalmology at Eastern Virginia Medical School in Norfolk, Virginia. Dr. Yeu may be reached at (757) 622-2200; eyeu@vec2020.com.



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2. Krueger RR, Shea W, Zhou Y, et al. Intraoperative, real-time aberrometry during refractive cataract surgery with a sequentially shifting wavefront device. *J Refract Surg.* 2013 Sep;29(9):630-635.
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4. Koch DD, Ali SF, Weikert MP, et al. Contribution of posterior corneal astigmatism to total corneal astigmatism. *J Cataract Refract Surg.* 2012 Dec;38(12):2080-2087.