Toric IOLs and Refractive Surprises

An online calculator assists surgeons with planning for toric IOL implantation and analyzing refractive surprises postoperatively.

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With patients' high expectations for spectacle independence after cataract surgery, the analysis of and planning for astigmatic correction has become a priority for ophthalmologists. The ASSORT (Alpins Statistical System for Ophthalmic Refractive Surgery Techniques) Toric IOL calculator is an essential tool for surgeons considering toric IOL implantation and postoperative analysis. ASSORT is available as a free online service (www.assort.com) that analyzes all measurable ophthalmic parameters such as surgically induced astigmatism from the phaco incision, axial length, and personalized IOL constants (SRK/T, Hoffer Q, Holladay 1, and Haigis formulas). Users select any toric IOL manufactured worldwide, and the program calculates the expected remaining refractions (Figure 1).

PREOPERATIVE ANALYSIS

Accurate preoperative measurement of corneal astigmatism is the first important step for optimizing refractive outcomes with toric IOLs. We consider several measurements in our planning process: manual keratometry and simulated keratometry from topography and the IOLMaster (Carl Zeiss Meditec). The placement of the phaco incision requires careful consideration to allow for any change in the preexisting corneal astigmatism. Placing the phaco incision away from the steepest corneal meridian will result in a change in magnitude and orientation of the corneal astigmatism, whereas placing it on the steepest corneal meridian will most effectively reduce and not change its orientation.

The ASSORT calculator can be used to select a toric IOL when planning for monovision or a nonzero refractive target. To accurately predict the effective lens position and the IOL's power, personalized IOL constants are incorporated in the calculations (Figure 2). Once the surgeon inputs all of the required parameters, he or she can e-mail a summary display to the local IOL representative for ordering.

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POSTOPERATIVE ANALYSIS

Refractive surprises can occur after toric IOL implantation. The causes include incorrect magnitude of the IOL due to nonoptimized lens constants, misalignment of the IOL, unexpected surgically induced astigmatism from the phaco incision, and inaccurate preoperative measurements. Even when the lens has the correct power and orientation, refractive surprises can occur as a result of preexisting ocular residual astigmatism whereby, even before a cataract developed, there was a mismatch between the corneal astigmatism and the refractive cylinder in magnitude and/or orientation. An objective measurement of the corneal astigmatism for planning toric IOL implantation has not and cannot factor in the subjective cortical-driven preferences of the patient.

The ASSORT's postoperative analysis enables surgeons to determine the best course of action in cases of a refractive surprise. Once the surgeon enters the patient's postoperative manifest refraction, corneal astigmatism, and the orientation of the toric IOL, the easy-to-follow module graphically displays the effect of rotating the toric IOL and calculates the resulting minimum possible manifest refraction (Figure 3). The direction and degree of rotation for the most favorable refractive outcome is displayed.

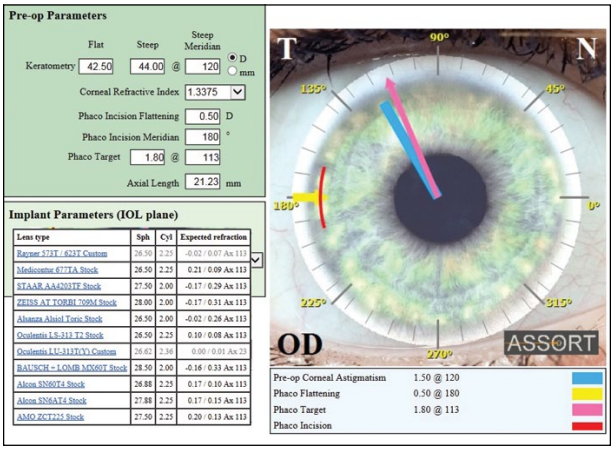

Figure 1. The ASSORT Toric IOL Calculator allows for selection of any commercially available toric IOL and displays the expected spherocylindrical refraction for each.

In cases where the amount of refractive cylinder reduction is not significant (eg, -1.75 D cylinder to -1.25 D cylinder) despite optimally rotating the IOL, ASSORT determines if the correct toric IOL power has been selected by the magnitude of error and correction index using the Alpins Method (Figure 4), therefore indicating when an IOL exchange may be required. LASIK may also be considered to correct a refractive surprise. ASSORT provides a systematic process for the surgeon to optimize visual outcomes using either the least invasive or preferred procedure.

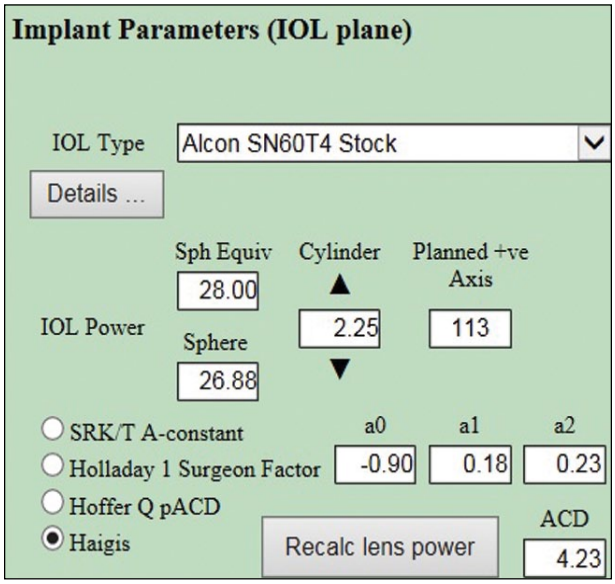

Figure 2. Personalized IOL constants can be used when planning toric IOL procedures for accurate effective lens position and toric IOL power calculations.

Our preference is to rotate the IOL if we expect the correction will significantly reduce the manifest refractive cylinder, and we know how much and in which direction to rotate the lens. It is important to note the effect of a misaligned toric IOL. For example, a 15° misalignment will reduce the effectiveness of the corneal astigmatic correction by approximately 15% (Figure 5), not the 45% that is

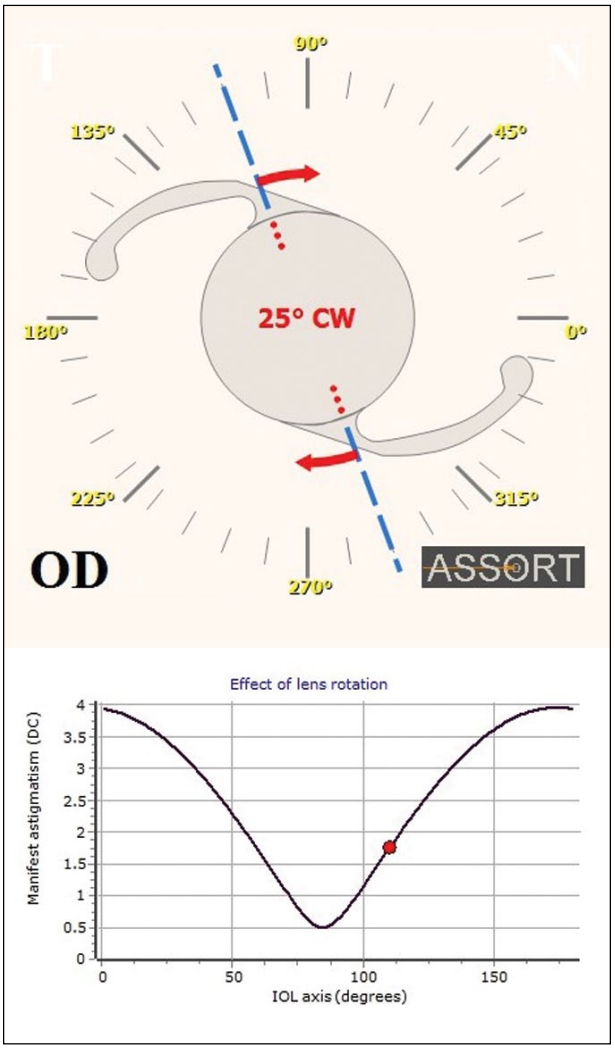

Figure 3. Calculation of toric IOL rotation to minimize cylindrical refractive surprise. Abbreviation: CW, clockwise.

Alpins Method

SIA	4.14	Ax	34
TIA	2.25	Ax	30
Difference Vector	1.94	Ax	129
Correction Index	1.84		
Index of Success	0.86		
Magnitude of Error	1.89		
Angle of Error	4 (CCW)		

Figure 4. Display of the Alpins Method of vectorial analyses. Abbreviations: SIA, surgically induced astigmatism; TIA, target induced astigmatism; Ax, direction of the vector; CCW, counterclockwise.

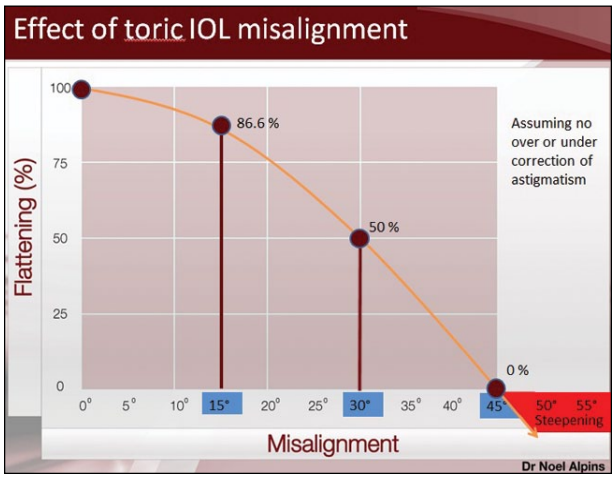

Figure 5. Reduction in effective astigmatic correction with toric IOL misalignment.

commonly quoted but overstates the loss of effect.[1] This becomes more significant for toric power IOLs greater than 4.00 D.

CONCLUSION

ASSORT provides a comprehensive and accurate tool for surgeons for preoperative planning, ordering the appropriate toric IOL for individual patients, and analyzing toric IOL procedures. The program's analytical capabilities helps surgeons manage refractive surprises and improve overall visual outcomes for their patients. ■

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1. Alpins NA. Vector analysis of astigmatism changes by flattening, steepening and torque. *J Cataract Refract Surg*. 1997;23:1503–1514.