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Comment on: Rethinking the optimal methods for vector analysis of astigmatism

Ophthalmologists have adopted the ASSORT (Alpins Statistical System for Ophthalmic Refractive surgery Techniques) calculators as their preferred method of astigmatism analyses as demonstrated by their frequency of use and the prevalence of citations in the literature. The calculators' ability to import unlimited amounts of data and graphically display analyses in a style recommended by journals' Instructions for Authors is a key reason for their acceptance. I commend Koch et al. for highlighting such an important subject.[1]

The Alpins method has been recognized as the comprehensive process of astigmatism analysis for some time now. As with many approaches, a single component will not provide the whole picture; all elements should be considered. The ASSORT Group Analysis Calculators not only display the basic analyses of Koch et al. but also include the true vectorial (univariate and bivariate) analyses required to guide the surgeon in correcting for any postoperative astigmatism to improve future visual outcomes.

We have verified the ASSORT calculations and found them to be accurate for the cases given. We thank the authors for their observation that total corneal astigmatism is not currently used for toric intraocular lens (IOL) analyses and have already updated the calculator to account for this.

Double-angle diagrams are inherently displays of double axes and, thus, should not be labeled with misplaced single axes. The way to avoid confusion is to label such diagrams clearly as double-angle diagrams with the axes doubled to their mathematically correct value and to accompany them with the corresponding polar diagram (single-angle diagram).

The Alpins method guides the surgeon on how to improve astigmatism outcomes and, hence, is clinically useful. The basic analyses of means and standard deviations display only a summated astigmatism (centroid) and no vectorial analysis of change.

Plots of surgically induced astigmatism vector (SIA) vs target induced astigmatism vector (TIA) are one view of the data that highlight obvious overcorrections and undercorrections of a treatment in the absence of gross misalignment of the achieved and intended treatments. Angle of error (AE) plots are another view of the data, which reveal any misalignment of the achieved and intended treatments.[2] Both examples in this article have unusual values revealed on one or both of the SIA vs TIA plots and the AE plot. Such cases would always need to be examined comprehensively to determine the underlying cause.

The polar plot of the correction index (CI) places the CI at the axis of the treatment which is the TIA axis (that is 180 degrees in both the 2 cases provided).[3] This is useful to detect possible variations in treatment efficacy according to treatment orientation. A quick glance then allows the surgeon to see whether there are differences in effect between with-the-rule, against-the-rule, and oblique treatments.

Regarding the toric IOL analysis, the (incomplete) example given by the authors uses the Barrett formula to select the IOL; this formula is known to add a correction to the measured anterior corneal power to account for back-surface corneal astigmatism. Thus, the authors' observation that an SIA based on anterior keratometry differs from the SIA calculated by the Barrett formula is correct but not unexpected. Using the anterior keratometry values, the selected IOL does not target zero refractive cylinder, so it is not surprising that the Difference Vector (DV—displaying magnitude and axis as one value, combining both AE and Magnitude of Error [ME]) is nonzero and the CI indicates an overcorrection of the treatment.

Concerning terminology, the relatively new term of ocular residual astigmatism originated with Duke-Elder in his *System of Ophthalmology*, volume 5, published in the 1950s, who used the term residual astigmatism. Ocular was added to avoid confusion with this commonly used term for surgical residual astigmatism.[3] Neither internal nor external astigmatism considers the significant perceptual astigmatism introduced by the visual cortex.

I agree with the authors that double-angle diagrams have an important role to play in the reporting of astigmatism analysis. Easily understood (0 to 360 degrees) diagrams are the fundamentally important basis for all calculations used by the Alpins method. However, this does not negate the fact that other views of data are important to help ophthalmologists understand the complexity that can occur in astigmatism analysis. The ASSORT Group Analysis Calculator provides both polar and double-angle plots, which highlight important features of the data being analyzed. By providing the ophthalmologist with various displays, we can aid understanding of this complicated subject.

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Disclosures: *N. Alpins has a financial interest in the ASSORT Surgical Management Systems used to support the planning and analysis of astigmatic correction. ASSORT holds trademarks and patents in vector planning.*

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