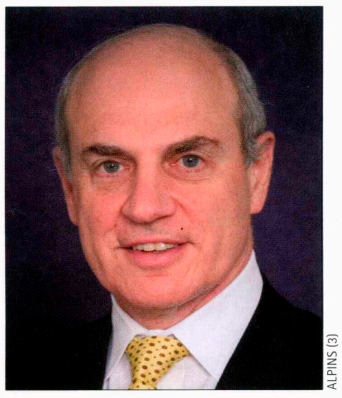
Refractive and Corneal Parameters Should be Used

Refractive Laser Surgery

Astigmatism Measurement and Analysis


ALPINS (3)

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MELBOURNE – There are a multitude of means of measuring astigmatism, all of which vary in some way from the other resulting in variability in the quantity and orientation estimated. These measurement techniques, whether they are manual or automated, fall into one of two fundamentally different modes – corneal or refractive, both of which currently have separate roles in planning treatment.

In simple terms, these amounts of astigmatism are defined by the dioptric difference between the orthogonal steep and flat meridian or the manifest cylindrical error. In the majority of corneas there is not exactly 90° separation between the adjacent principal meridia, so some irregularity exists in healthy astigmatic corneas, the result being this measured value becomes less precise. Irregular astigmatism can be divided into physiological and pathological types depending on the degree and nature of irregularity. An effective measure of corneal irregularity is topographic disparity (TD), which is defined as the vectorial difference between the superior and inferior bow-tie astigmatism values of the cornea.

To achieve an astigmatic analysis a comparison needs to be made. In cases when this is preoperative and only one corneal topographic map needs to be considered, then the ORA (ocular residual astigmatism), which is the vectorial difference between corneal (K) and refraction (R) measurements, is the key parameter. In an ideal world the K and R measurements would be identical in magnitude and axis and the ORA would be zero. However, this is rarely the case and largely expected due to the variability created by the steep and flat meridian not being extremely orthogonal, and the bow-tie pattern in topography being skewed. Higher ORA's appear to coexist with higher amounts of irregularity (TD's). When the ORA exceeds 1.00 D the risk of an adverse visual outcome increases to a significant level with conventional, refractive based treatments. This will result in excessive corneal astigmatism remaining and reduces the quality of vision, particularly under low lighting conditions. However, poor outcomes such as the one above mentioned could be avoided with vector planning techniques.

After surgery, the key analysis is that of the change in successive maps on keratometry readings from preoperative to postoperative values including change in astigmatism orientation. The vital element here is to use the same device for successive measurements to avoid artefactual results. Comparing the actual astigmatism amounts before and after a procedure will only tell us whether the astigmatism has decreased or increased, and by how much. This gives little insight into how the astigmatism surgery performed in regards to the level of success, the amount of correction or the angular accuracy of application.

To remedy this, three principal vectors; TIA (target induced astigmatism vector), SIA (surgically induced astigmatism vector) and DV (difference vector) provide the necessary information in absolute terms. Their various relationships to each other give indicators to over or under correction, angle of error of surgery and the astigmatic success achieved (fig. 1). These factors when properly applied allow nomogram adjustments with a scientific basis.

Astigmatism analysis should be performed using both refractive and corneal parameters. It is important to understand what has happened to the corneal astigmatism after refractive laser surgery – particularly as most surgeons would treat based upon spectacle refraction alone. The corneal astigmatism tracking and analysis of refractive surgery outcomes is an objective and independent means of assessing treatments commonly based completely on refractive parameters. In cases where patients complain of visual symptoms where unaided visual acuity is 20/20 with no spherical or astigmatic correction required – further investigation may reveal that the corneal astigmatism remaining postoperatively is significant enough to cause patient dissatisfaction. This has become an important issue since the FDA alert reported by 140 patients prior to 2008 now being studied prospectively by the joint taskforce of FDA, ASCRS, AAO for LASIK outcomes.

The information we gain from corneal topographers is underutilised in a number of areas. Keratorefractive comparisons as well as a vectorial analysis between pre op and post op maps beyond what is currently available are important considerations where the amount of astigmatism present, as quantified by the simulated keratometry (Sim K) values, is evident. Also, many topographers have their own individual modes for quantifying irregularity so that topographic disparity can now provide a gauge of irregularity, potentially enabling the standardisation of data obtained from all topographers.

A new software program (iAssort) will be presented which addresses all of these points. The ORA performs pre operative astigmatism analyses using corneal and refractive data to red flag any potential for an adverse visual outcome due to astigmatism. This analytical information is now obtainable as an output of topographers and will also be available with dual systems that are capable of measuring both corneal and ocular wavefront parameters. The software program is interfaced and resides in the majority of commonly used topographers, with more devices including those with aberrometers, being interfaced in coming months. ■

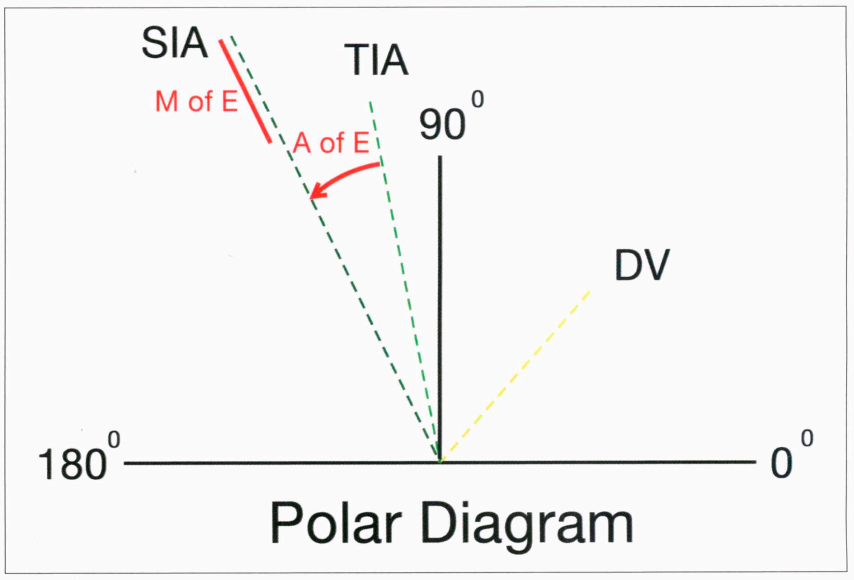

Fig. 1b: Polar diagram. The TIA, SIA and DV calculated vectors as they would appear on the eye.

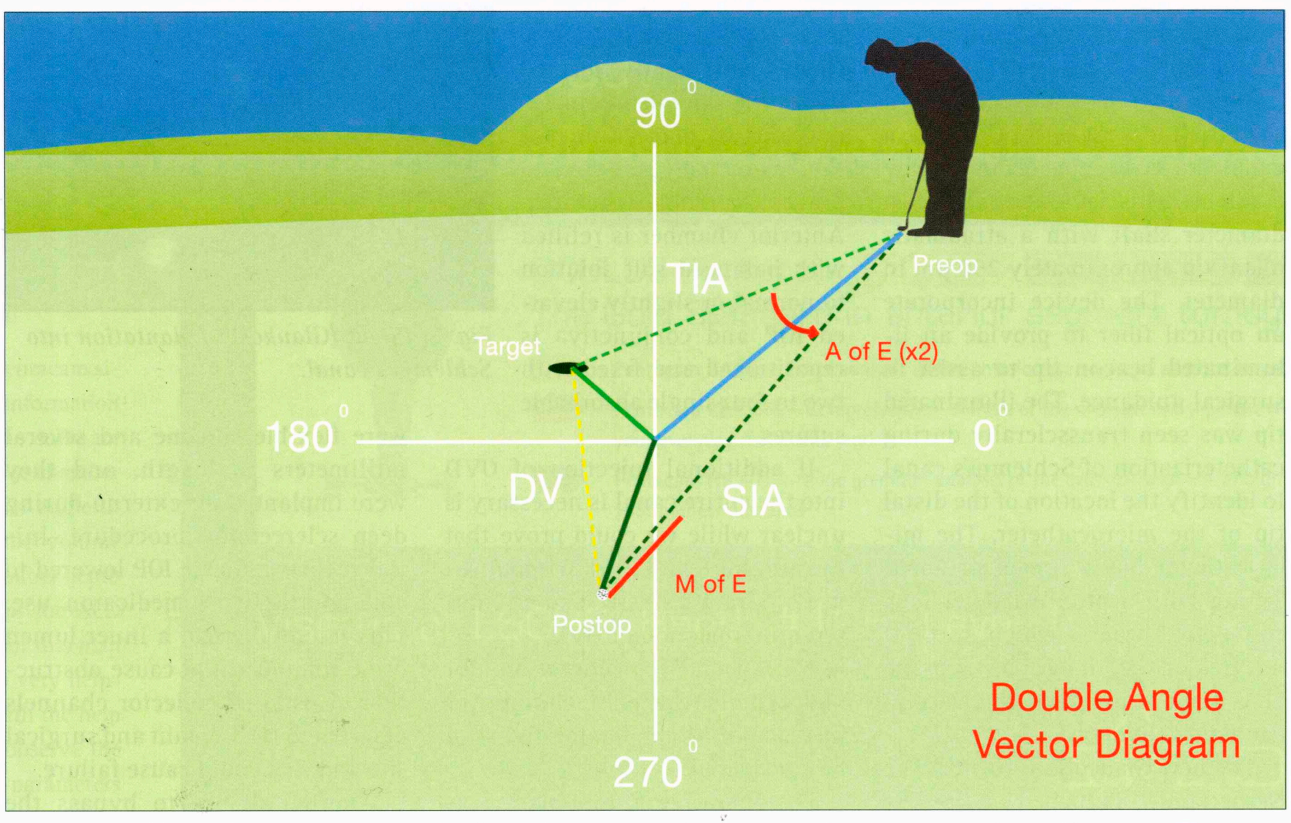

Fig. 1a: Double angle vector diagram displays the pre op and post op astigmatism together with target. The dashed lines are the calculated vectors (TIA, SIA and DV).

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Noel Alpins declares to have a financial interest in the Assort software..