iAssort and Pentacam for an Alpins Astigmatism Analysis

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The parameters obtained from topography systems are currently underutilised when managing patients. The data derived from the simulated keratometry (Sim K) values can be used to perform an objective corneal analysis of surgical outcomes when treating astigmatism. Analyses by subjective refractive parameters alone are subject to bias as the testing clinician is aware of the targeted end point. Hence a parallel astigmatism analysis by both corneal and refractive parameters is recommended.

Furthermore standardised measures of corneal irregularity and any corneal/refractive astigmatism discrepancy can be calculated to determine suitability for surgery and its likely success, prior to it being performed.

The iAssort software for astigmatism analysis which interfaces with several topography systems, is designed as a simple calculator to inform the surgeon of all the above including whether the astigmatism treated was over or under corrected, whether it was "on" or "off" axis and to quantify success achieved and assist with nomogram development.

When selecting the topography map from any review visit, iAssort will import the Sim Ks, the 3, 5 and 7mm zone flat and steep parameters. This is displayed for the Oculus Pentacam topographer in (**Figure 1**). The Alpins analysis is displayed numerically and graphically to quantify surgical, success, errors and refine nomograms.

Figure 2 displays the numerical Alpins analyses using an example

with preoperative Sim Ks of 4.60D at a steep meridian of 10 degrees and postoperative Sim Ks of 0.78D @ 86 which are imported from the Oculus Pentacam topographer. Multiple visits can be analysed by scrolling through the imported data.

The user has the option of entering a manifest refraction – this will allow the ocular residual astigmatism (ORA) to be calculated and displayed. This vector value quantifies the corneal/refractive difference and is a good prognostic guide to the likely success of astigmatism correction with any eye. It is necessary of course that the user enters an astigmatic treatment in dioptres and an intended meridian to be flattened for the analyses to appear, as this is not known to the topographer.

An eye's Alpins astigmatism analysis in the most essential form requires a calculation of the 4 following parameters:
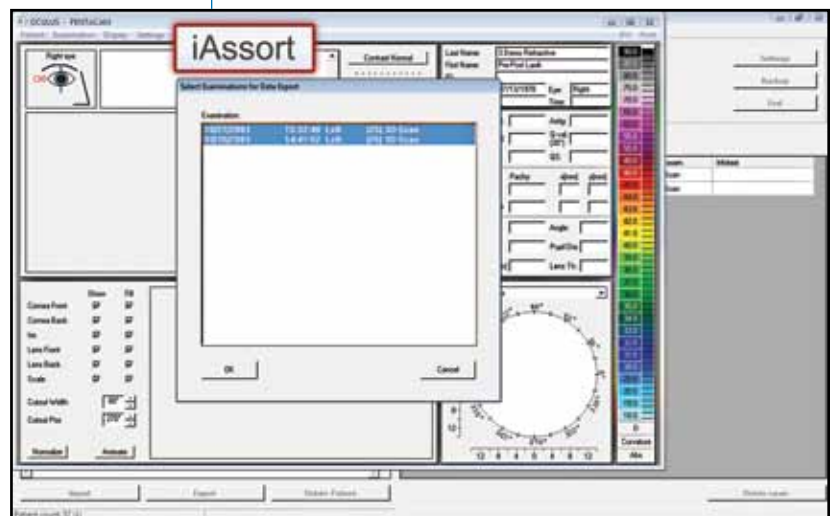

Figure 1: The iAssort icon as it appears in the Oculus Pentacam tool bar and the associated review visits that have been selected by the user for export to the iAssort software.

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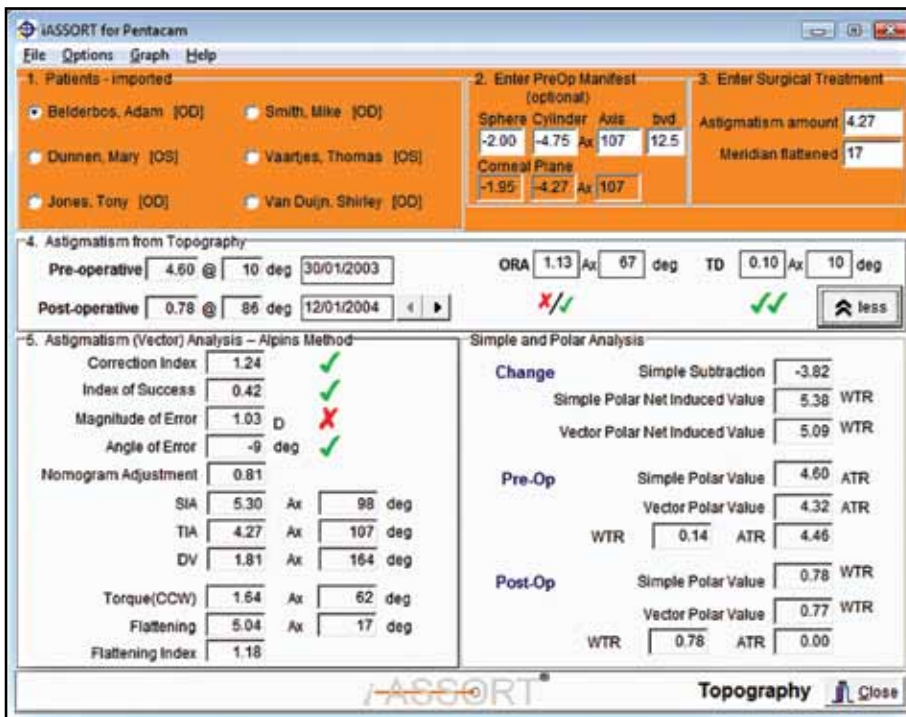*web: www.assort.com*

Figure 2: A numerical Alpins analysis performed using iAssort software installed on the Oculus Pentacam.

1. The Correction Index (CI) is a ratio of the surgically induced astigmatism vector (SIA) versus the target induced astigmatism vector (TIA) and ideally would be unity. A CI greater than 1.0 indicates an overcorrection of the astigmatism and a CI less than 1.0 indicates an undercorrection of the astigmatism treatment. In the example shown in **Figure 2**, the CI is 1.24 indicating a 24% overcorrection of the intended astigmatism treatment.

2. The Index of Success (IOS) is a relative measure of success and is the ratio of the difference vector (DV) divided by the TIA. The DV is the change that would enable the result of the initial surgery to achieve its intended calculated target. The perfect result for the IOS would be zero (as no astigmatism remains) indicating that 100% of the intended astigmatic treatment was achieved. **Figure 2** displays an IOS of 0.42 meaning 58% success in treating the intended astigmatism.

3. The Magnitude of Error (M of E) indicates the difference in magnitudes between the SIA versus the TIA and is positive for over corrections and negative for under corrections. In the example, the M of E is + 1.03D quantifying the overcorrection in dioptric terms.

4. The Angle of Error (A of E) displays whether the astigmatism treatment was "on" or "off" axis and is quantified in degrees by the angle that subtends the SIA and TIA. It has a negative magnitude if it is in a clockwise direction and a positive one if it is in a counterclockwise direction. The outcome in Figure 2 displays the astigmatic treatment functionally applied 9 degrees clockwise to that intended.

When examining patient suitability for laser vision correction, a very useful parameter is the ORA which is calculated as the vectorial difference between the corneal and refractive (corneal plane) astigmatism. A significant amount of ORA (>0.75D) may adversely affect the an-

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ticipated visual outcome – if, for example, a patient presented with a spectacle prescription of +0.25/-2.50 Ax 5 and the ORA was in the order of 1.50D, then a full correction would not be possible when assessing both the cornea and refractive astigmatism. The surgeon can advise the patient accordingly ahead of time that there would be some residual astigmatism postoperatively and the procedure may not be suitable if treated solely by refractive parameters alone, as excess astigmatism will remain on the cornea as it fully neutralises the internal ORA.

The topographic disparity (TD) can be used as a standardised measure of corneal irregularity using computer assisted videokeratography (CAVK) parameters. It is defined as the vectorial difference between the superior and inferior topographical values (measured at the 5mm zone in the numerical display), calculated in dioptres on a double angle vector diagram (DAVD).

A graphical representation of the parameters is useful for those surgeons that would like to investigate the calculation of the vectors in more detail. The polar diagram displays the parameters as they would appear on an eye **(Figure 3)**.

It is important to note that the corneal astigmatic 'Target' may not be zero and is 1.13D in the example shown in Figure 3. This is explained as the surgical treatment entered here is not based on the preoperative Sim Ks but on the manifest astigmatic component of the refraction = -4.27 Ax 107 (corneal plane). In cases at the other end of the spectrum where the treatment is based on these corneal parameters to sphericise the cornea, then the corneal 'Target' will be zero.

To calculate the three principal surgical vectors SIA, TIA and DV, a DAVD must be used. After the calculation, a polar diagram is required so they can be displayed as they would appear on the eye rather than on a
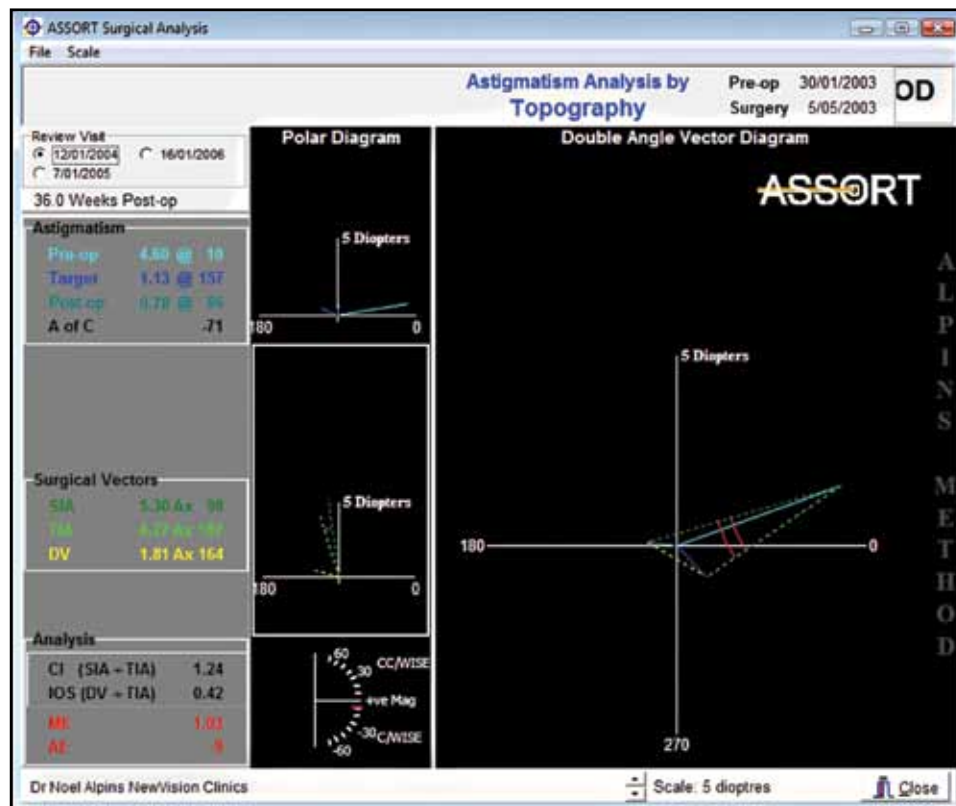

Figure 3: A graphical Alpins analysis of corneal astigmatism displaying the double angle vector diagram (DAVD) used to calculate the analysis. Polar diagrams also separately showing astigmatism parameters and surgical vectors.

mathematical construct of a double angle plot. Figure 3 displays the TIA or the actual treatment originating at the preoperative astigmatism of 4.60D @ 20 (double angle) and terminating at the non-zero target of 1.13D @ 314 on the DAVD.

The SIA again originates at the preoperative astigmatism on the DAVD but ends at the postoperative astigmatism of 0.78D @ 172. The DV = 1.81D Ax 328 is the line that connects the achieved astigmatism to the targeted on a DAVD.

Note that the axes of these vectors must be halved from the calculation on the DAVD to be displayed on a polar diagram and simulate how they appear on an eye. However, it is important to note that the magnitudes remain the same in this process.

In addition, helpful visual symbols (ticks and crosses) are displayed in the numerical analyses of the iAssort software to assist the surgeon as to whether each of the Alpins analysis parameters falls within or outside expected satisfactory ranges. The benefits of the iAssort software include:

- A better understanding of topography changes after surgery providing more utility to this valuable device.

- Calculation of astigmatism outcomes using the Alpins method of astigmatism analysis to quantify errors, gauge success and adjust nomograms.

- Assessment of ORA and TD as useful preoperative standardised parameters for assessing surgery suitability and patient expectations.

- Increasing diagnostic value to the Pentacam and other topographers for a quantitative analysis of the changing corneal astigmatism parameters.

Reference

1. Alpins NA. Astigmatism Analysis by the alpins method. J Cataract Refract Surg 2001; 27:31-49