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Short Communication

Perfecting Astigmatism Treatment - Reduction and Regularisation

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With so many advances in devices that can measure the corneal shape, the treatment of astigmatism can be further refined to improve visual outcomes with refractive laser surgery.

The ability to accurately measure both the front and back of the cornea together with the astigmatism at different zones of the cornea allows for perfecting current treatments of astigmatism.

The method of vector planning which incorporates both the corneal as well as the refractive parameters in the treatment plan has been well documented in its superior astigmatic outcomes compared to treatments planned using refractive parameters alone [1-4]. By calculating the ocular residual astigmatism (ORA) [5] routinely preoperatively the surgeon is able to establish how much astigmatism can be corrected at the time of laser eye surgery and advise the patient accordingly.

Vector planning places emphasis on the ORA to distribute this untreatable amount of astigmatism to both the cornea and manifest refraction postoperatively while at the same time targeting a spherical equivalent of zero. The benefits shown by the vector planning studies are a significant reduction in postoperative corneal astigmatism as well as refractive cylinder compared to treatment paradigms based on refractive parameters alone [1-4].

The surgeon can base the vector planning treatment plan on the corneal and refractive measures they believe to be the most accurate. For example, using corneal topographic astigmatism (CorT) [6,7] as a measure of corneal astigmatism uses all the captured data on tomography to calculate the corneal astigmatism rather than the limited data used to calculate simulated keratometry (Figure 1). The CorT can be calculated using the iAssort software (www.assort.com) available for all leading tomographers for both anterior astigmatism and total corneal astigmatism, which includes the posterior cornea. On the refractive side, using manifest, cycloplegic or wavefront refraction can be decided by the ophthalmologist.

Applying this vector planning paradigm to different sections of the cornea has the ability to further improve the targeted corneal shape and potentially improve best corrected visual acuity as a result.

Dividing and conquering

The cornea can conceptually be divided into two based on the flat meridian of the total corneal astigmatism measure. Applying vector planning with a specific emphasis on the ORA for each half of the cornea can maximally reduce the corneal astigmatism. A corneal

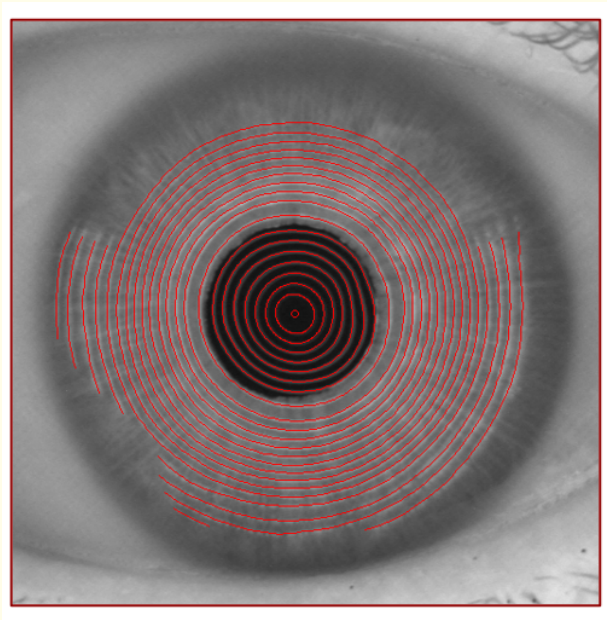

Figure 1: *The corneal topographic astigmatism (CorT) parameter incorporates all the measured data from topography to calculate an accurate measure of corneal astigmatism.*

astigmatism measure can be obtained from tomography for the one half of the cornea and another for the other half of the cornea using the 5 mm zone. There is one common refraction across the entire cornea so this is used for each of the two halves of the cornea for the treatment parameters. The next step can then target regularising any remaining corneal astigmatism to potentially improve best corrected visual acuity. The overall total astigmatism of the cornea should equal the average of the corneal astigmatisms for each half of the cornea. The regularisation process then aims to target this average total astigmatism for each half of the cornea. The regularisation process aims to leave the minimised corneal astigmatism in the typical bow-tie topography pattern of astigmatism in an ideal symmetrical and orthogonal orientation (Figure 2) [8].

Smoothing

To avoid a discontinuity in the two treatment profiles (one for each half of the cornea) across the hemi-division, it is necessary to smooth the profile as determined in a recent study [8].

The more asymmetric and/or non-orthogonal the corneal shape, the more likely that there will be differing emphases on the ORA for each half of the cornea when using vector planning. If one half of the cornea has more corneal astigmatism than refractive cylinder, or if the target hemi meridional orientation is more favourable, it makes sense to emphasis more corneal treatment and vice versa. In this way this hemi-divisional treatment is a further customisation than astigmatic treatments which use the same parameter across the entire cornea.

Reduction and regularisation of astigmatism

Let's consider an example (Figure 3).

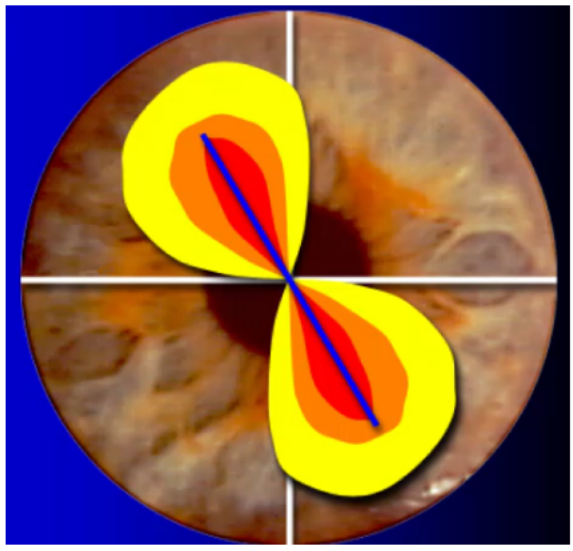

Figure 2: *A typical topography map showing a symmetrical and orthogonal bow-tie shape of corneal astigmatism.*

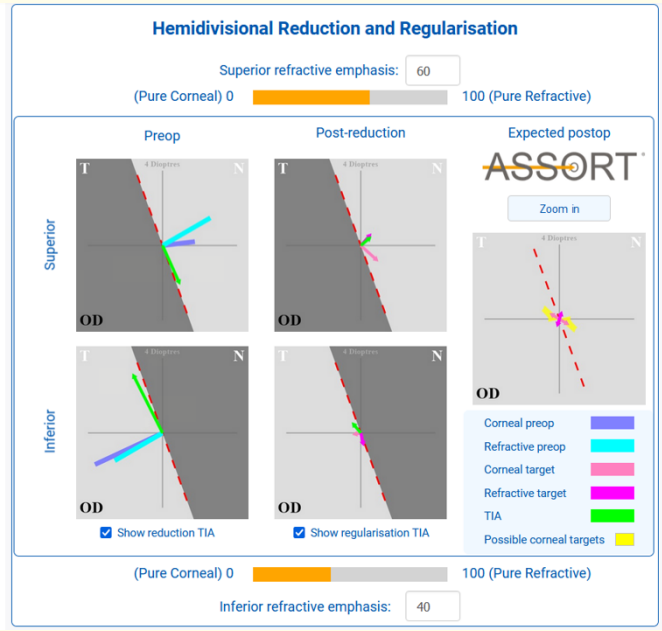

Figure 3: *The Designer Cornea® ASSORT software calculates a single treatment to both reduce and regularise astigmatism.*

Preoperative parameters measured (OD) as follows:

Manifest refraction -2.50/-3.25 x 120.

Corneal topographic astigmatism (CorT total) 42.00/45.75 @ 21.

The delineation of the two halves of the cornea is at a meridian of 111 degrees which is the flat meridian of the CorT.

Figure 2 displays the preoperative status of the eye with the 'Superior' referring to one half of the cornea and the 'Inferior' to the other half. The 'Superior' preop diagram displays the refractive cylinder of 3.25D at a positive axis of 30 degrees, the corneal astigmatism of 1.75D @ 7 degrees measured by tomography at the 5 mm zone as well as the astigmatism reduction treatment known as the target induced astigmatism vector (TIA) in green.

The 'Inferior' diagram displays the common refractive cylinder of the two halves of the cornea of 3.25D at a positive axis of 210 degrees, the corneal astigmatism of 4.00D @ 205 and the TIA in green.

The theoretical astigmatism targets (refractive and corneal) are displayed on the 'Post-reduction' figures together with the TIA for each half to then regularise the remaining astigmatism, targeting an orthogonal, symmetrical cornea as shown by the corneal targets displayed in a straight line and of even length in the far right display of figure 3.

It is important to note in figure 3 that the emphasis placed on the ORA for the 'Superior' half of the cornea is 60% by refraction and 40% by Corneal parameters as there is much more refractive cylinder than corneal astigmatism. The opposite is the case for the 'Inferior' half of the cornea where a greater emphasis is now placed to reduce the corneal astigmatism as there is more corneal astigmatism than refractive cylinder.

There are 99 different emphasis settings that the surgeon can select from for each half of the cornea to target the desired corneal and refractive astigmatism postoperatively.

This approach of reducing and regularising astigmatism using vector planning can be performed as a single treatment on any magnitude and orientation of astigmatism as well as any refractive laser procedure including LASIK, PRK, LASEK and lenticule extraction. This astigmatism treatment also corrects for any associated myopia or hyperopia. The Designer Cornea® software enabling calculation of these laser treatment parameters is freely available online at www.assort.com and www.isrs.org. Together with leading laser manufacturers the surgeon can establish a protocol for the prefect astigmatic treatment.

Bibliography

1. Alpins NA and Stamatelatos G. "Customized photoastigmatic refractive keratectomy using combined topographic and refractive data for myopia and astigmatism in eyes with forme fruste and mild keratoconus". *Journal of Cataract and Refractive Surgery* 33 (2007): 591-602.

2. Alpins NA and Stamatelatos G. "Clinical Outcomes for laser *in situ* keratomileusis using combined topography and refractive wavefront treatments for myopic astigmatism". *Journal of Cataract and Refractive Surgery* 34 (2008): 1250-1259.

3. Arbelaez MC., *et al*. "Clinical outcomes of laser *in situ* keratomileusis with an aberration-neutral profile centered on the corneal vertex comparing vector planning with manifest refraction planning for the treatment of myopic astigmatism". *Journal of Cataract and Refractive Surgery* 43 (2017): 1504-1514.

4. Jun I., *et al*. "Comparison of clinical outcomes between vector planning and manifest refraction planning in SMILE for myopic astigmatism". *Journal of Cataract and Refractive Surgery* 46.8 (2020): 1149-1158.

5. Alpins NA. "New method of targeting vectors to treat astigmatism". *Journal of Cataract and Refractive Surgery* 23 (1997): 65-75.

6. Alpins NA and Stamatelatos G. "New method of quantifying corneal topographic astigmatism that corresponds with manifest refractive cylinder". *Journal of Cataract and Refractive Surgery* 38 (2012): 1978-1988.

7. Alpins NA., *et al*. "Corneal Topographic Astigmatism (CorT) to Quantify Total Corneal Astigmatism". *Journal of Refractive Surgery* 31.3 (2015): 182-186.

8. Hemidivisional Vector Planning to Reduce and Regularize Irregular Astigmatism by Laser Treatment. *Graefe's Archive for Clinical and Experimental Ophthalmology* (2022).

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