



Noel Alpíns

Topography and wavefront linkage improves visual outcomes

Sean Henahan

COMBINING wavefront refraction and topography values via vector analysis when planning refractive laser surgery for myopia and astigmatism produces improvements in visual outcomes, recent clinical studies suggest.

Noel Alpíns FRACS, FRCOphth, FACS, has been using vector planning and analysis as a regular part of his refractive laser surgery practice for more than a decade. He developed a commercial form of software that accounts for ocular residual astigmatism (ORA) during the planning phase.

Ocular residual astigmatism is the vectorial difference between refractive and corneal astigmatism. Treatment based on refraction alone leaves all ORA to be corrected on the cornea. However including topographical parameters with wavefront refraction values produces reduced amounts of corneal astigmatism, according to Dr Alpíns, who has recently completed a series of clinical studies.

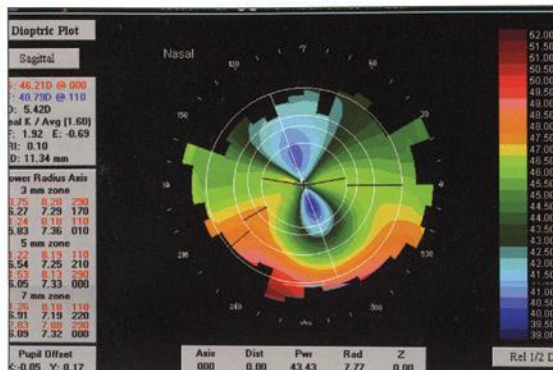
"Laser vision correction has shown incremental improvements over the past decade and is producing good visual outcomes. However, I think we can treat astigmatism better. Our studies indicate that including vector analysis in the planning stage helps us accomplish this. Indeed, the higher the amount of pre-operative corneal refractive astigmatism differences, the greater the benefit appears to be," he told *EuroTimes*.

ORA is a vectorial measure that analyses both the magnitude and orientation differences between the topography and the refractive cylinder. In the ideal world, the ORA would be zero. However, as the differences between manifest refraction and topography increase, either in the magnitude or the axis of astigmatism or both, these increase the impact on treatment.

"In the ideal world you would have identical amounts and orientation of astigmatism on the cornea and then as a secondary result in the manifest refraction. In the real world these are prevalent differences. If you disregard the corneal shape and treat totally by either the manifest refraction or the wavefront refraction, you are leaving all that corneal data out when you actually sculpt a spherocylindrical lens onto the cornea. The result is excess corneal astigmatism remains. If you bring ORA into the treatment plan and quantify it, you end up with less astigmatism on the cornea, by locating the treatment closer to the principal corneal meridian," he explained.

Prospective study results

Dr Alpíns conducted a randomised prospective study comparing the clinical outcomes obtained with LASIK by wavefront aberrometry guidance alone versus



Topography map displaying keratoconic cornea

wavefront aberrometry combined with vector planning that incorporated topographic data. The 21 eyes in the pilot study were all treated with the S4 Visx (AMO) laser. Vector planning was done using the ASSORT® program developed by Dr Alpíns.

Postoperatively, the eyes in the vector-planning group had both a greater reduction in corneal astigmatism magnitude and a greater proportional reduction of corneal astigmatism, 51 per cent compared to 31 per cent for eyes treated using wavefront refraction alone at three months and 45 per cent compared to 37 per cent for the wavefront alone group at six months. Both treatment groups produced reductions in refractive astigmatism. As would be expected the wavefront alone eyes achieved slightly greater reduction in refractive astigmatism.

Higher order aberrations, measured in terms of total RMS, coma, and trefoil, were lower for the vector-based treatments at three months, and at six months. This correlated with lower corneal and overall astigmatism postoperatively. The vector-based treatment also produced better results in low contrast acuity under photopic conditions at three months and better low and high contrast acuity under mesopic conditions at six months, he said.

"These outcomes have remained stable through six months of follow-up. I realise that to demonstrate statistical significance in more than the two parameters achieved, we would need to conduct a much larger study; perhaps up to a calculated 300 eyes using statistical t-test to capture all these possible parameters. However, this was a small prospective, randomised study that showed trends in favour of the vector planning study group and I am confident in the data. As more doctors use the technique they will realise its value. This is a scientific structured paradigm of treatment that produces very good outcomes superior to what is currently being achieved with wavefront alone parameters."

Keratoconus patients may be candidates

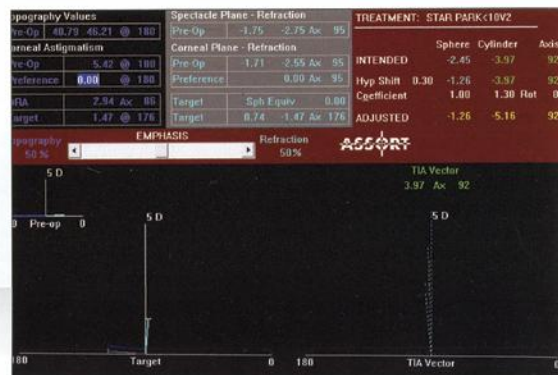
Vector planning might also benefit selected patients with mild and forme fruste keratoconus. Dr Alpíns said he had treated 45 keratoconic eyes with PARK using combined topographic and refractive data for planning with "extremely positive" results some with more than 10 years' follow-up. This experience demonstrates the potential for improved visual results in astigmatic eyes with keratoconus by also more closely aligning treatment to the principal corneal meridia, he emphasised. The study will be published in the April issue of the *Journal of Cataract and Refractive Surgery*.

He explained that keratoconic eyes are really extreme in terms of these corneal refractive differences. Studies looking at ORA in normal astigmatic eyes have shown average levels of 0.73 D to 0.81 D. In keratoconic eyes, by contrast, the average ORA is 1.34 D. This is more than a 50 per cent increased difference, he noted.

In one example the patient presented with 5.42 D @180 of corneal astigmatism, with refractive astigmatism at the corneal plane of 2.55 DC x5 (plus cylinder). After vector-based treatment, the corneal astigmatism was reduced to 1.50 D, with a better than expected refractive astigmatic outcome of 0.50 DC. The patient had uncorrected post-operative visual acuity of 6/5.

"Until recently this has been a taboo subject. One of the reasons keratoconus has got a bad name with laser treatment was that it was mostly treated purely by refractive means. This resulted in leaving much more astigmatism after surgery. This increased adverse visual outcomes and was not tolerated well by a significant proportion of patients suffering from these symptoms. Contrary to conventional thinking, it is possible to treat these eyes safely with PARK in selected patients," he told *EuroTimes*.

The clinical successes reported by Dr Alpíns using vector planning are the



ASSORT Treatment Planning - shows how the ORA of 2.94D Ax 86 is apportioned 50 per cent to eliminating the topography astigmatism and 50 per cent to the refractive cylinder

culmination of more than a decade of research. In the early 1990s he began to think of how better to analyse and measure astigmatism, coming eventually to the idea of vector analysis.

"I soon realised that the calculations required could not be done in your head. With the advent of computers I was able to use the ASSORT® outcomes analysis programme to do the numerics, and compare potential and actual outcomes. It became obvious that just comparing pre- and postop astigmatism amounts was inadequate because it doesn't really tell you what's gone wrong with the process. The vectorial analysis tells you whether the treatment was under- or overcorrected, and whether you were on or off axis and what adjustments need to be made."

What began as an outcomes analysis tool evolved into a treatment-planning tool. Dr Alpíns said it then became clear that surgeons would want more than an analysis programme for astigmatism, they would want software that tracked visual acuity, ocular tension, and all aspects of changes induced by eye surgery. The result was the ASSORT® program, which gives refractive surgeons a dynamic planning tool with which they can include ORA in planning refractive surgery.

"I use the software for all my cases now. It can be used with all laser platforms if integrated and is applicable to every patient with astigmatism. There is no downside and no trade-off. It is easy to learn and adds almost no time to the procedure. The combining of topography parameters is an exciting development in laser vision correction that represents a whole new treatment paradigm."

Dr Alpíns teaches a course on vector planning at many of the major ophthalmology conferences. He will be teaching the course at the upcoming ASCRS conference in San Diego, and again at the annual ESCRS Congress in Stockholm.

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