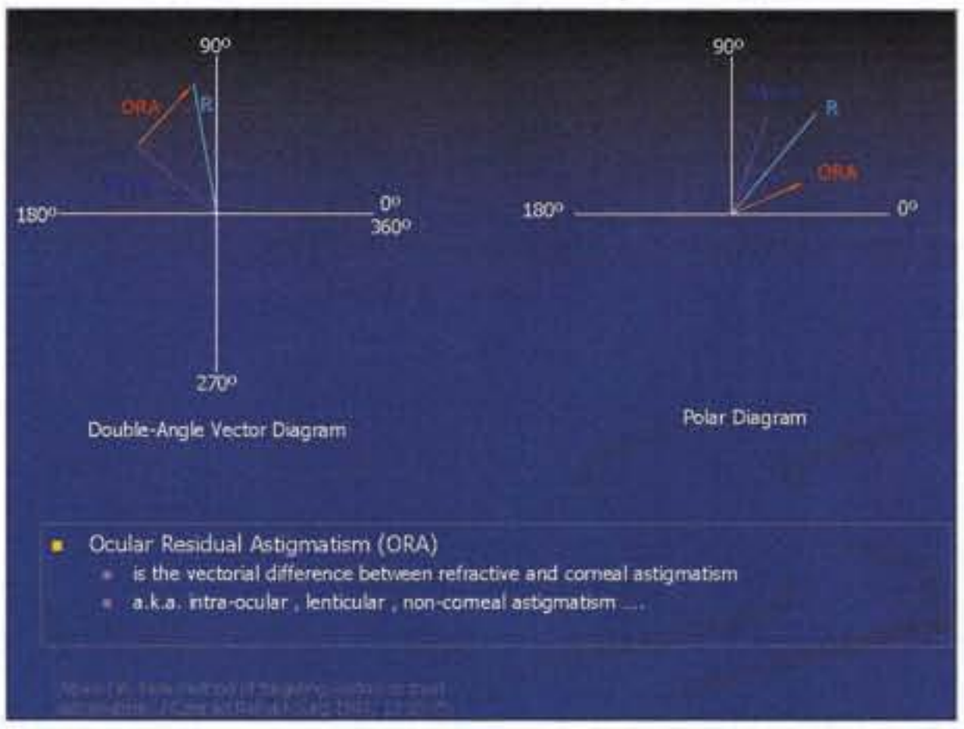
Innovation Spotlight

Angles on using customized vector analysis to treat refractive patients

by Maxine Lipner Senior Contributing Editor

Even with wavefront analysis, many patients still aren't achieving "super vision." Is there a missing link?



In cases where the corneal and refractive astigmatism differ in magnitude and/or axis, the Ocular Residual Astigmatism (ORA) can be calculated using a Double-Angle Vector Diagram (DAVD). Note that the astigmatic meridia on the polar diagram are doubled to obtain the vector diagram display but the magnitudes remain unchanged.

Source: Noel Alpins, M.D.

The treatment in this eye's example incorporates the topography as well as the refraction due to a difference in astigmatic magnitudes and orientations. The corneal astigmatism is 5.42 D at 180 and the refractive astigmatism at the corneal plane is 2.55 Ax 5 (plus cylinder). The calculated vectorial difference between these two values, the ORA, is 2.94 D x 86. This is the calculated minimum amount of astigmatism that will remain in this eye and its optical correction after laser treatment.

Source: Noel Alpins, M.D.

Currently, there's a missing element in refractive treatment that continues to limit results — incorporation of topography data.

"Topographic values are completely overlooked in treatment," said **Noel Alpins, M.D.**, director, New Vision Clinics, Melbourne, Australia. "If you want to take laser vision correction to its next level of achievement, we have to include this in the treatment plan, and as a result we're going to end up with a lot less astigmatism remaining behind on the cornea."

Dr. Alpins has developed a vector planning method, using the Assort software program (Assort, Victoria, Australia) that takes this key element into account, with an eye to ultimately achieving "supervision" in some.

Available wavefront and conventional treatments home in completely on refractive results, neglecting the simulated keratometry readings of the topography map, Dr. Alpins said. As a result, too much astigmatism is left in the corneal plane.

Dr. Alpins' technique assesses the difference between the corneal and refractive astigmatism, using a specially devised mathematical construct. He has dubbed this difference, which measures the non-corneal astigmatism, 'the ocular residual astigmatism (ORA) value.' The vector planning technique, which quantifies this ORA, attempts to optimize results by integrating the corneal shape into the treatment plan.

Treating high-risk keratoconic patients

While this technique can aid any astigmatic patient, Dr. Alpins has put the technique to use in a group of keratoconic patients that have been considered at significant risk for adverse outcomes when undergoing refractive surgery.

Keratoconic patients differ to a much greater degree between the corneal and refractive shape being around 50% more than average patients.

"If you treat by conventional means, which is using manifest refraction or wavefront aberrometry alone, then you are going to leave too much astigmatism on the cornea," Dr. Alpins said. "Whereas, what we do differently is that the principal meridia of treatment are much more closely aligned to the corneal parameters than if you were treating by spectacle or aberrometry refraction alone."

As a result, the patient ends up with less astigmatism remaining on the cornea because the treatment is more closely aligned to the principal corneal meridia.

While maximum ablation occurs close to the flattest meridian when practitioners treat by spectacle refraction or aberrometry alone, the maximum ablation doesn't coincide with this flat meridia.

Instead, using the vector planning method, the practitioner chooses a point that takes both topography and refraction into account and optimizes the alignment and magnitude even closer, Dr. Alpins said.

"We take on average for that group, a point giving 40% of the emphasis of eliminating astigmatism from the cornea and 60% to the refractive element," Dr. Alpins said. "It's kind of taking an optimized view of both and incorporating them in the treatment." This point can be customized to suit the particular patient.

Dr. Alpins sees this technique, which incorporates the ORA, as the best practitioners can effectively do in eliminating astigmatism in an eye.

"In an ideal world you can eliminate all of the astigmatism out of the system and everyone is going to be astigmatism free—but you can only do that when the topography value and the refractive value are exactly the same," Dr. Alpins said. "When they differ it's an imperfect system, you can't eliminate all of the astigmatism out of the system—you have to leave some behind somewhere."

This is the key element as to why practitioners don't achieve the much heralded "super vision as frequently as they might," Dr. Alpins said.

"We're still falling short of the perfect treatment in wavefront," he said. "The missing element is we're not taking care of the cornea—we're just leaving too much astigmatism there."

A vector patient

Using the example of one keratoconic patient, Dr. Alpins shows how the technique works to help practitioners devise the optimum treatment plan. The patient had an ORA of 2.94 D. "If you treat by refraction alone or wavefront refraction, you're going to end up with a target T or corneal astigmatism of 2.94 D," he said.

However, using the vector planning method, Dr. Alpins placed 50% of the emphasis on eliminating refractive astigmatism and the other 50% on eliminating corneal astigmatism.

As a result, both the target topography and target refraction were 1.47 D. This means that just 1.47 D of residual astigmatism was left on the cornea. Had the patient been treated by refraction alone, 100% of the 2.94 D astigmatic value would have been left on the cornea.

"To neutralize all the internal aberrations of the eye, you have to put the equal and opposite on the corneal surface," Dr. Alpins said. "If this keratoconic patient was treated like that they would be really

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unhappy because they would have way too much astigmatism on the cornea and you would have distorted the cornea too much."

In this case, practitioners were able to optimize the patient's vision. Pre-op, the patient had a best uncorrected acuity of 20/120 and a best spectacle-corrected acuity of 20/15; post-op, the best uncorrected acuity was 20/15 and the BCVA was 20/12, with an improvement in their BCVA of one line. Most importantly this is reflected in only 0.50 D of refractive astigmatism present three months after surgery – 1.00 D less than targeted.

Studying the technique

In a study published by Dr. Alpins in the *Journal of Cataract and Refractive Surgery* of 33 keratoconic patients, with a mean ORA was 1.22 D, using surface ablation, one out of four had an improvement in BCVA of up to two lines. The specific results of this study have not been published.

Using the technique, investigators were able to halve the amount of corneal astigmatism without creating additional refractive astigmatism – frequently less than targeted.

"You're actually getting something for nothing—you're getting improvement in their BCVA," he said. "We halved the amount of corneal astigmatism, but we didn't actually penalize the patient by having them suffer from any additional refractive astigmatism, in fact less than expected."

As a result, these patients ended up with a lot fewer second-order aberrations. In addition, no patients lost any lines of best spectacle-corrected visual acuity and patients' corneal shape also remained very stable, some over an eight-year period.

The problem with refractive surgery today is that with too much astigmatism left on the cornea, patients are ending up with an excess amount of second- and third-order aberrations such as coma remaining, he said.

"The patients who are at risk are those with the high ORA," Dr. Alpins said. "Those differences can easily be calculated by a simple vectorial calculation, which gives the ORA."

A high ORA can spell trouble. "Any patient is at risk if this value is greater than 1.0 D, which occurs in one in four astigmatic patients" Dr. Alpins said.

Ultimately, patients with high ORAs can be left out of the treatment mix altogether or, practitioners can treat them using the vector planning technique, as they can with more typical patients.

With this technique, they can optimize results by taking the topography side of the treatment into account and allow patients to maximize their vision and in some cases even achieve "supervision," Dr. Alpins said.

Editors' note: Dr. Alpins has a financial interest in the Assort program.

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