

# Resultant astigmatism can be minimized with inclusion of topography data, surgeon says

Vector planning can help surgeons find the optimal balance between corneal and refractive measurements.

by Nicole Nader

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The amount of resultant astigmatism after wavefront-guided LASIK can be reduced by

incorporating topography measurements into the surgical treatment plan, according to one surgeon.

"Wavefront-guided treatments leave too much astigmatism on the cornea by

not accounting for the difference between refractive astigmatism – whole eye astigmatism – and topographic astigmatism," said Noel A. Alpines, MD.

He called the lack of correction of astigmatic aberrations in wavefront-guided LASIK the "missing link" of the treatment. "Wavefront is an excellent technology, which

addresses the problem of spherical aberrations very well. However, it does not address the problem of astigmatic aberrations as effectively as it might," Dr. Alpines told OCULAR SURGERY NEWS.

Because corneal topography measure-



**"Once you've done the treatment that's closer to ideal refractive**

**parameters, you're left with less corneal astigmatism and fewer aberrations. This increases the level of satisfaction that patients attain."**

— Noel A. Alpines, MD

ments are not factored into wavefront-guided treatments, patients are often left with too much astigmatism on the cornea as a result of a higher overall ocular residual astigmatism (ORA) present prior to performing the surgery, Dr. Alpines said. The ORA quantifies errors stemming from the cornea separately from all other components, including the lens and the vitreous, and a perceptual element, he said.

Dr. Alpines estimated that by incorporating corneal topography measurements into wavefront treatment plans, surgeons can reduce the amount of total astigmatism remaining after wavefront-guided LASIK by 50%.

"You can leave a lot less astigmatism on the cornea, about half as much, by bringing the corneal shape into the surgical treatment plan," Dr. Alpines said.

## 'Missing link'

Traditional wavefront aberrometry analysis derives a refractive value from a patient's lower- and higher-order aberrations but includes no compensation for keratometric measurements, he pointed out.

"You get a refractive value of the second-order aberrations, comprising sphere and cylinder, a spherical value of defocus, a refractive astigmatic value and a root mean square value gauging all of these," Dr. Alpines explained. Values are also attained for the third- and fourth-order aberrations of coma, trefoil and quatrefoil, he said.

Topography, traditionally used for ascertaining a patient's eligibility for LASIK, provides multiple readings of keratometric values of the cornea, including average astigmatic values. Patients who show a high degree of corneal astigmatism suggesting keratoconus, as documented by topography maps, or who have thin corneas, are



The ASSORT computer program provides vector planning for optimized treatment (top). Also shown are results of a patient showing minimized astigmatism (bottom). Source: Alpina NA

contraindicated for LASIK, he said.

"After checking for eligibility, most surgeons slip the topography maps out of consideration. They don't look at the astigmatic values again. But, if you take those values and enter them into a software program, you will be able to numerically compare both the topographic and wavefront values," Dr. Alpina said.

"You find that the topographic values are commonly significantly different from the wavefront refractive cylinder values derived from the aberrometer," he added.

### Inducing astigmatism

According to Dr. Alpina, the discrepancy in values is often highest for patients with significant corneal ectasia, such as in keratoconus with significant astigmatism. A study Dr. Alpina conducted found that 33 patients with keratoconus had greater irregularities on the corneal surface and larger differences between keratometric and refractive values than patients with normal corneas.

"The average ORA of patients with keratoconus was 1.25 D, about 50% greater than normal astigmatic eyes," Dr. Alpina explained.

Patients with normal eyes and astigmatism can also have greater ORA. Dr. Alpina said that between 10% and 15% percent of healthy eyes have "very significant" astigmatism and, subsequently, significant differences between wavefront and topography values.

Surgeons who disregard the discrepancy in values and perform wavefront-guided LASIK based just on refractive values, as is currently done with traditional wavefront ablation, usually induce additional astigmatism that is unavoidable, Dr. Alpina said.

"Current treatments tend to reproduce all of the eye's internal aberrations onto the surface of the cornea and, ultimately, induce more corneal astigmatism," Dr. Alpina said. He noted a published study of 100 eyes, all of which

were astigmatic, that underwent correction based on refractive values alone; 33 patients had 1 D or more of astigmatism than expected following surgery, and seven patients had higher postoperative corneal astigmatism than existed preoperatively.

### Vector planning

By recognizing and compensating for the differences between refractive and topographic values, surgeons can induce less astigmatism after surgery and produce better visual outcomes, Dr. Alpina said. He said he compensates for the differences in astigmatic values by finding an intermediate value between the two differing measurements.

"There are 98 points between the extremes of the refractive astigmatic value and topographic astigmatic value which surgeons can choose. Choose any one of those intermediate points, and your treatment will be optimized. You will have an optimized customized treatment for your patient," Dr. Alpina explained.

Dr. Alpina designed and uses a computer program called ASSORT that provides vector planning to simplify the calculation. "Vector planning provides the means for inclusion of corneal values in the wavefront treatment plan. In a calculated manner, it determines the optimized balance between corneal and refractive parameters," Dr. Alpina said.

He said surgeons cannot "eyeball" or estimate the optimized values; they must be calculated through a nomogram using vectorial calculations. Currently, there are no wavefront analyzers that offer the ASSORT program, but Dr. Alpina said he hopes that laser companies will incorporate similar programs into the lasers of the future. The two current wavefront analyzers that include wavefront and topography components in their wavefront sensors, the Nidek OPD-Scan ARK-10000 and the Bausch & Lomb Orbscan, do not include vector

planning to reduce resultant astigmatism, he said.

### Better outcomes

Topography-modified wavefront treatment plans created through vector planning reduce astigmatism by approximating the treatment closer to the principal corneal meridian during treatment, Dr. Alpina said.

"By moving the treatment closer (less off-axis) to the corneal curvature, you are correcting more corneal astigmatism and will produce a better visual outcome," Dr. Alpina said. "Vector planning moves the treatment closer to the corneal shape,

the principal corneal meridian, and leaves less astigmatism remaining."

Calculations derived from vector planning position the maximum laser treatment 40% to 50% closer to the corneal meridian than traditional wavefront, which performs ablation on the negative refractive axis and refractive meridian as determined by aberrometry, he said.

"Once you've done the treatment that's closer to ideal refractive parameters, you're left with less corneal astigmatism, and fewer aberrations will be present or detectable on aberrometry.

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# Astigmatism

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This increases the level of satisfaction that patients attain," Dr. Alpins said.

He called the increased benefit in outcomes "an incremental improvement" in wavefront treatment techniques.

"If 90% of patients were extremely happy after wavefront-guided LASIK, 8% were satisfied and 2% were less than satisfied, we are hoping that after incorporating the corneal curvature into the treatment plan we can lower the threshold for happiness," Dr. Alpins said.

"While trying to make 100% of patients extremely happy is probably an

unrealistic goal, maybe we can improve that threshold of happiness to 98% of patients being extremely happy, 2% of patients being happy, and no patients left unhappy with their outcomes," he said.

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## For Your Information:

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### ■ Reference:

Alpins NA. New method of targeting vectors to treat astigmatism. *J Cataract Refract Surg*. 1997;23:65-75.

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