

Complications of refractive surgery suggest needed improvements

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in Lisbon

WAVEFRONT-guided treatments, active trackers, and optimised treatment nomograms have all helped to improve visual outcomes with refractive surgery. However, many patients still develop visual problems post-operatively, suggesting there is a need for further improvement, according to Vikentia Katsanevaki MD PhD, University of Crete, Greece.

“The problem is that, although there is good theory behind the aberration-free procedures, they have not achieved their potential yet in the clinical setting,” she told a special workshop on visual optics at the XXIII Congress of the ESCRS.



Vikentia Katsanevaki

A second problem occurring from refractive surgery is that corneal healing may cause corneal scattering.

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While the virgin eye is affected by refractive error, aberrations, scattering and diffraction, refractive surgery changes the eye's optics, and this can create new problems with visual performance. Alteration of the corneal shape, light scattering produced by corneal healing, eccentric ablations, and iatrogenic corneal ectasia are some of the problems resulting from refractive surgery.

Changes in corneal asphericity from a prolate to an oblate shape are common after myopic correction and can create higher order aberrations, which will affect contrast sensitivity. In a small study, Dr Katsanevaki and her colleagues measured a 1.44 RMS increase in total higher order aberrations with a statistically significant increase of coma and spherical aberrations in 43 eyes that had refractive surgery.

“I would say it's well proven that conventional treatments multiply higher order aberrations, and this has a definite effect on contrast sensitivity. In addition, severe aberrations can decrease visual acuity and cause optical phenomena of mesopic and scotopic vision particularly in larger pupils,” said Dr Katsanevaki.

“It's not only something we may see at the slit-lamp, or the interface in a LASIK case. Objective evaluation such as confocal microscopy shows that even clear corneas have some increased scattering because of the treatment,” she noted.

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In addition to small-angle scattering, wide-angle scattering caused by newly synthesised collagen and haze can also occur. When an ablation is not completely smooth, it can activate keratocytes, which then lead to small irregularities that trigger small angle scattering.

Epithelial smoothing

Surface-treated patients tend to perform better in terms of contrast sensitivity, lines gained, and long-term visual performance because the epithelium compensates for any small irregularities on the surface, said Dr Katsanevaki.

That idea is supported by animal research demonstrating that rabbit eye epithelia become hypertrophic and create a whole new surface after ablations that had created irregularities intentionally.

“Given the fact that the refraction indices between the epithelium and the stroma are quite the same, this may cause a smoothing of the image,” she said.

Eccentric ablations were one of the biggest problems in the early days of refractive surgery. Spontaneous eye movements and lasers with small treatment zones and poor beams without active trackers caused the complication.

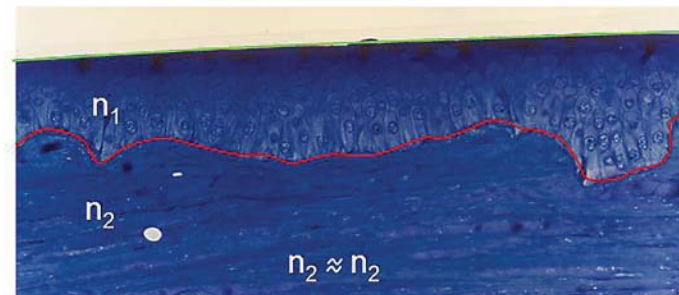
“We now have many of the best refractive tools, and many of the problems we used to have are no longer an issue because we are using better microkeratomes, better laser platforms, optimised nomograms, and aspherical procedures and ablation profiles,” said Dr Katsanevaki.

Old eccentrics

However, there are still patients who were treated with the old technology needing retreatment for their eccentric ablations. The complication can affect optics severely by inducing astigmatism or creating subjective symptoms like glare, starburst, blurred vision, and monocular diplopia. And, if the eccentric ablation is more than 1.0 or 2.0 millimetres in a small zone, it can also cause line loss.

Corneal topography has helped with the problem because it offers an objective measure of each patient's individual optics. This approach provides data on the corneal homogeneity in terms of optics, and the clinician can pinpoint a severely de-centred ablation. The systems can also predict corneal visual acuity according to the optics of the measured eye. For example, an eccentric ablation of more than 1.0 mm in a patient with a pupil size of more than 4.0 mm can still lead to 20/25 high contrast visual acuity, but when the pupil

The role of epithelium



Courtesy of Vikentia Katsanevaki MD

size is bigger, the device estimates that the visual acuity would drop down to 20/63.

“Even today with the evolution of wavefront aberrometers, I still feel that being able to have good corneal topography and a way to analyse it can give us enough information on the visual performance of the patient,” she said.

provide reliable data on very irregular corneas.

“Most of the topographers and wavefront analysers are calibrated for a model eye, if you go very far beyond that, the errors of the device are quite high, so you don't have a reliable measurement,” said Dr Katsanevaki.

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Theory vs practice

She emphasised that while there is a good theoretical background behind linking the topography or wavefront map to the laser system and then performing a customised ablation, in clinical practice it does not produce great results for every patient.

“Once we thought the topography-guided ablation could be the solution to our problems, but it's not always working because there are certain problems,” Dr Katsanevaki said.

For example, there is no direct link between the topography map and the centration of the ablation, which decreases the success of the topography-guided improvement and can cause astigmatism undercorrection.

“If you do not define the same centres between the laser ablation and the corneal topography, you can even create more irregularities onto the cornea. This may explain why sometimes we have worse results than intended,” she said.

In addition, topographic systems have a limited ability to