

Iris Coloboma

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CASE PRESENTATION

A 28-year-old female presents for a routine refractive surgery evaluation. Her manifest refractions are $-5.50 +1.25 \times 80$ OD and $-2.25 +1.75 \times 80$ OS. Her wavefront refractions are $-5.08 +1.22 \times 78$ OD and $-2.61 +1.83 \times 77$ OS. The higher-order aberrations measure $0.38\mu\text{m}$ OD and $0.75\mu\text{m}$ OS (Figure 1).

The keratometry readings are $43.0@089/41.5@179$ OD and $43.5@081/41/4@171$ OS, confirming corneal astigmatism consistent with the patient's manifest and wavefront refrac-

tions. Corneal topography confirms regular symmetric astigmatism consistent with the aforementioned findings. Iris registration was not obtainable in the patient's left eye. The rest of the examination is unremarkable except for the iris coloboma in her left eye (Figure 2).

How would you proceed, and is your excimer laser platform's tracking system capable of appropriate alignment in this case?

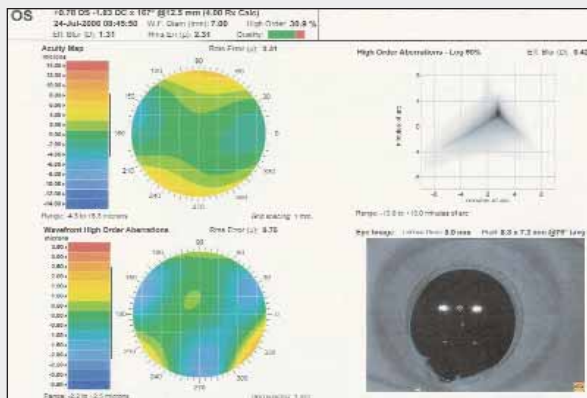


Figure 1. A Visx Customvue scan (Advanced Medical Optics, Inc., Santa Ana, CA) of the patient's left eye showed an RMS error of $0.78\mu\text{m}$ with notable increases in coma, trefoil, and spherical aberration.

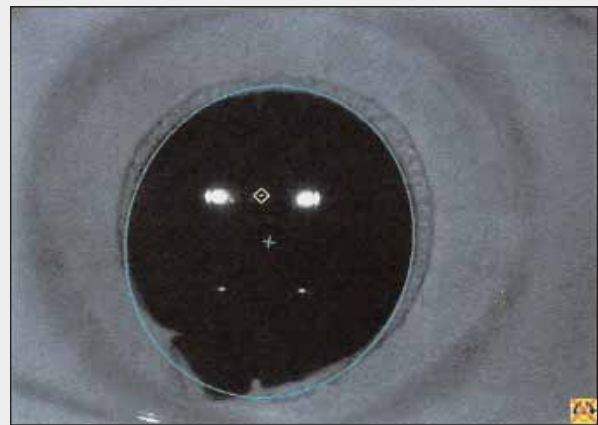


Figure 2. The patient's left eye had an iris coloboma from the 6:30- to the 7:30-o'clock position. Iris registration could not be obtained despite multiple tries.

STEVEN J. DELL, MD

With an iris coloboma, it may be difficult to define the geometric center of the irregular pupil, let alone track the pupil. The centroid of this irregular pupil may be in quite a different location than the visual axis. The Visx Star S4 laser (Advanced Medical Optics, Inc.) uses the pupil centroid as the basis for aligning the wavefront-guided treatment. I am thus concerned that the coloboma could result in a misaligned ablation. Additionally, the defect extends nearly to the limbus in this young patient, and even an ideally centered treatment would expose a portion of untreated cornea to the entrance pupil in the inferonasal part of the eye.

In the noncustomized mode, the alignment of the LASIK treatment can be manually offset to the visual axis, but concerns related to the iris defect and night vision complaints still apply. I have seen similar cases in which surgeons manually centered noncustomized treatments on the visual axis

with a very poor result. As a safety precaution, the Visx Star S4 laser requires that a pupil be within 20% of round to permit tracking, which may not be possible in this eye.

Eyes with a refraction of $-2.25 +1.75 \times 080$ can have surprisingly sharp uncorrected near acuities. Because this patient currently has significant anisometropia, one might consider treating only her right eye if a contact lens trial yielded positive results. In theory, this approach would leave the patient with just over 1.30D of anisometropia, which would benefit her in 10 years or so.

Another option might be a topography-driven customized treatment. This approach is still complicated by the presence of an iris defect outside the treatment zone, and it is unclear exactly how to center such a treatment. In my opinion, treating the patient's left eye carries a high risk of visual complaints, and she might be better advised to concentrate on her significantly more nearsighted right eye.

DANIEL S. DURRIE, MD

An iris coloboma need not prevent LASIK treatment. The Ladar 6000 laser (Alcon Laboratories, Inc., Fort Worth, TX) aligns to the limbus and not the iris for both conventional and wavefront-guided surgery. Customcornea (Alcon Laboratories, Inc.) compensates for cyclorotation by rotating the treatment to match the ink marks placed near the limbus before the wavefront reading.

I would perform the workup on the day of surgery for both a conventional and a wavefront-guided LASIK treatment. That is generally my approach to complicated cases. I take a centration photograph on both the Ladar 6000 laser and the Ladarwave (Alcon Laboratories, Inc.). Next, I dilate the pupil, mark the limbal registration, and perform a wavefront measurement. I then assess all of the data and use the treatment option I think will produce the optimal result.

PAUL J. DOUGHERTY, MD

The relatively high degree of higher-order aberrations in this myopic astigmat's left eye may be due to the asymmetric pupil. Assuming normal topographies and corneal thicknesses, I would offer the patient an Optimized Aspheric LASIK treatment (described later) in her right eye and corneal wavefront LASIK in her left eye with the Nidek EC-5000 CXII excimer laser system (Nidek, Inc., Fremont, CA). Wavefront-guided ablations are unnecessary and are sometimes less helpful than wavefront-optimized ablations in cases where the degree of higher-order aberrations is low (J. Venter, unpublished data, 2006).

For the patient's right eye, I would use the Optimized Aspheric Treatment Zone (OATz) program (Nidek, Inc.), which creates a large effective optical zone that has been shown to increase visual quality.¹ One caveat regarding the wavefront measurement of her left eye is that the Zernike polynomials are twice those of her right eye, but her eyes are considered normal in all other clinical aspects. Perhaps the wrong pupillary center was denoted during wavefront acquisition, thus leading to artificial coma as a result of calculating the Zernikes on the wrong axis. I would therefore repeat the aberrometric measurement with the Nidek OPD Scan (Nidek, Inc.), which measures on the visual axis and does not depend on a circular pupil.

Only if the magnitude of the higher-order aberrations in the patient's left eye are not an artifact would I instead use the Customized Aspheric Treatment Zone (CATz) software (Nidek, Inc.; P. J. Dougherty, unpublished data, 2006) instead of OATz. CATz is a topography-guided, corneal wavefront treatment that would address the high level of higher-order aberrations in her left eye. Both OATz and CATz are in phase 3 FDA trials but are readily available internationally.

I would use the 200-Hz eye tracker and torsional error de-

tor for both eyes. The programs rely on the pattern of iris crypts as orientation landmarks. Despite the iris coloboma in the patient's left eye, there are enough iris details for both the eye tracker and torsional error detector to be effective. The Nidek OPD Scan presents wavefront data at an axis other than the pupil's center and notes various axes of the eye. The Nidek system's eye tracker allows the surgeon to center the treatment over the line of sight (pupil's center), the visual axis, or anywhere in between.² For the left eye, I would center the treatment over the visual axis, because the line of sight would be difficult to determine, given the iris' abnormal architecture.

STEPHEN G. SLADE, MD

I would likely use the Technolas 217z (Bausch & Lomb, Rochester, NY) with the tracker turned off, because the eye tracker centers on the pupil's midpoint. The pupillary and optical centers of this patient's left eye do not match. I would therefore align the center of the treatment with the Purkinje images and perform the ablation. This approach is fairly easy with the Technolas 217z. I would have the patient look up at the helium/neon fixation beam. I would then align the Purkinje images to achieve "pupil glow" to demonstrate alignment. The next step would be to mark the optical axis at the limbus and align the central marking in the horizontal and vertical meridians. During the ablation, I would ensure that the limbal markings stayed in alignment with the reticle of the microscope. For PRK, one could likely follow the helium/neon fixation beam on the cornea throughout the treatment.

It would be helpful to know the patient's BCVA. If it is good and the amount of aberrations is low, then treating the higher-order aberrations might not be a necessity, and a conventional treatment might be appropriate.

JOACHIM LOEFFLER, DIPL-ING

I would recommend a wavefront-guided treatment using the Allegretto Wave excimer laser system (Wavelight, Inc., Sterling, VA) for the patient's left eye. The RMS higher-order aberrations are high, but the other parameters are normal. In FDA clinical trials, such aberrations could be reduced by wavefront-guided treatments using the Allegretto Wave. Also, because the visual axis in that eye is unknown, both the automatically centered wavefront-optimized treatment (Wavelight, Inc., Sterling, VA) around the center of the pupillary ellipse and a treatment with manual centration (eye tracker off) would pose a high risk of incorrect centration and a resultant increase in coma and tilt.

If the iris coloboma is unstable, however, I would advise against any LASIK treatment, because the visual axis, refractions, and aberrations might change.

In general, obtaining the same iris registration and definition of the pupil centroid on both the wavefront analyzer and laser would be crucial. The Allegretto Wave sys-

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REFRACTIVE SURGERY COMPLICATIONS MANAGEMENT

tem uses the same algorithms for detecting the pupil and centroid in its laser and wavefront analyzer. That feature would enhance safety in this case. With the iris coloboma, however, the size of the pupil will be critical. The Allegretto Wave system will only be able to reliably find the same central points if the pupil is nearly the same size during wavefront imaging and treatment.

The "decentered" pupillary area, the high RMS higher-order aberrations, and the cylinder in the patient's left eye may result in a rather deep ablation at 7 o'clock. Only complete planning of a treatment with the Allegretto Wave system can give a numerical answer on the expected residual stromal thickness in this area.

Either a wavefront-optimized or a wavefront-guided treatment could be performed on the patient's right eye. ■

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1. Hori-Komai Y, Toda I, Asano-kato N, et al. Comparison of LASIK using the NIDEK EC-5000 Optimized Aspheric Transition zone (OATZ) and conventional ablation profile. *J Refract Surg.* 2006;22:546-555.
2. Kermani O. Automated visual axis alignment for refractive excimer laser ablation. *J Refract Surg.* 2006;22(suppl):1089-1092.