

# Aberrations After the Treatment of a Corneal Scar

BY JAY BANSAL, MD; EMIL WILLIAM CHYNN, MD, MBA; AND ROY S. RUBINFELD, MD

## CASE PRESENTATION

A 30-year-old male engineer presents with a complaint that he has seen “images stacked right on top of each other” through his right eye for several years. He has a history of a metallic foreign body in his right eye at age 15. Several years later, he underwent excimer laser treatment in that eye to remove the resultant corneal scar. Since then, he has used no correction for his right eye but has worn a soft contact lens in his left eye.

The patient expresses a desire to be free of the contact lens in his left eye. His UCVA is 20/30 OD, which improves to 20/20 with a hard contact lens overrefraction of +0.75 -0.75 X 180. His UCVA is 20/400 OS, which corrects to 20/20 with a spherical equivalent of -4.25 D. The slit-lamp examination is normal in both eyes, with no evidence of scarring in his right eye. Central pachymetry readings with the Orbscan topographer (Bausch & Lomb, Rochester, NY) are 557  $\mu$ m OD, with no

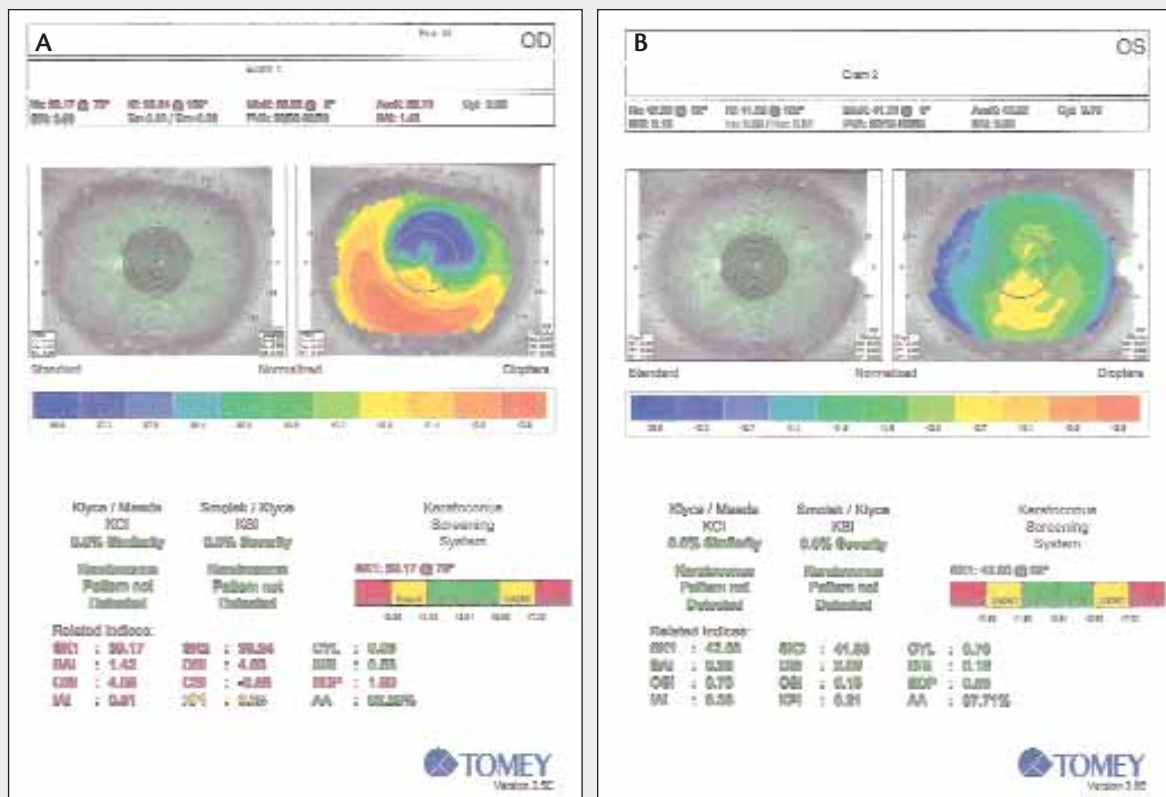


Figure 1. Preoperative measurements of the patient's right (A) and left (B) eyes with the TMS-4 (CBD Ophthalmic/Tomey, Phoenix, AZ).

## CASE PRESENTATION (CONTINUED)

peripheral areas of thinning, and 593  $\mu\text{m}$  OS. In the patient's right eye, the Visx WaveScan Wavefront System (Advanced Medical Optics, Inc., Santa Ana, CA) shows a refraction of +0.20 -1.41 X 142 (4.00 Rx calc) with 55.8% higher-order aberrations and a root mean square error of 1.19 (Figures 1 to 3).

How would you proceed?

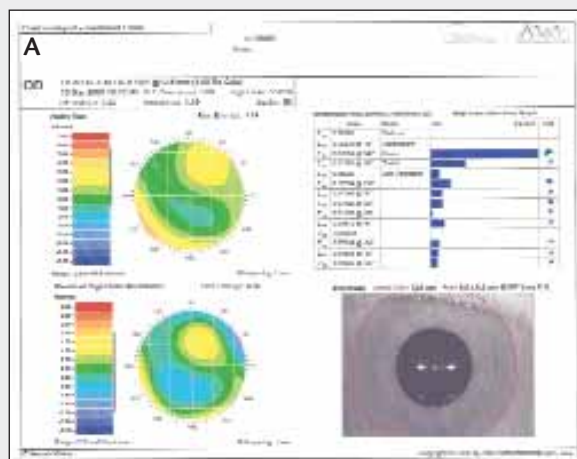


Figure 2. Preoperative measurements of the patient's right (A) and left (B) eyes with the Visx WaveScan Wavefront System.

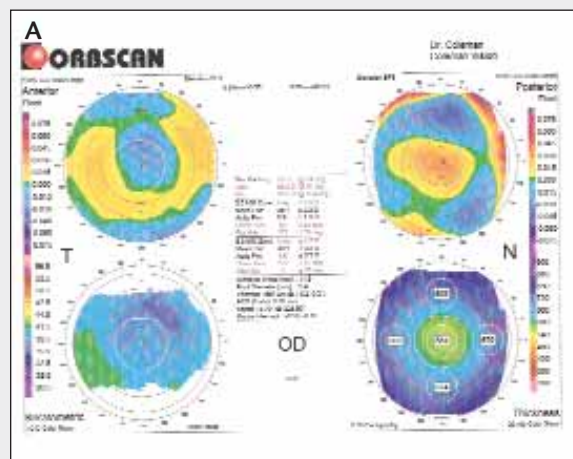


Figure 3. Preoperative measurements of the patient's right (A) and left (B) eyes with the Orbscan topographer.

### JAY BANSAL, MD

The visual distortion in this patient's right eye is related to the high amount of coma and other higher-order aberrations. The decentered ablation visible on the topography of his right eye could cause these higher-order distortions. The patient would benefit from either a topography-guided ablation, which is not yet available in the US, or a wavefront-guided enhancement. Because he has had previous laser treatment with induced higher-order aberrations, I would consider the possibility of a hyperopic outcome following his customized enhancement. I would therefore

explain to him that he might require additional surgery following the enhancement.

Assuming I used a Visx Star excimer laser platform (Advanced Medical Optics, Inc.) for the enhancement procedure, I would first perform a trial with the Visx PreVue lens (Advanced Medical Optics, Inc.) and confirm there was a subjective improvement in vision for the patient. With a normal corneal thickness, the patient can undergo a LASIK enhancement in his right eye. I would prefer to use a femtosecond laser for the LASIK enhancement, and I would be sure to make the flap thicker than normal (130  $\mu\text{m}$  or

more) because of possible epithelial hyperplasia following the patient's previous PRK procedure. I would recommend customized IntraLASIK (Intralase FS laser; Advanced Medical Optics, Inc.) for his left eye.

The important aspect of this case is the patient's education so that his expectations are realistic and he understands the possibility of additional laser vision correction.

### EMIL WILLIAM CHYNN, MD, MBA

This case is interesting both for its complexity and its realism. It demonstrates a common experience of refractive surgeons—namely, the presentation of a patient with incomplete records who underwent surgery elsewhere and desires further surgery, but only if it is “safe.”

The patient reports ghosting or monocular diplopia in his right eye, which is most likely due to his superiorly decentered ablation with respect to the optical zone, as evident on topography. It is uncertain whether the original surgeon intentionally decentered the phototherapeutic keratectomy (PTK) to remove the scar or if the PRK was unintentionally decentered to remove the patient's scar and simultaneously address his refractive error. I would guess the former. In my hands, the final refractive result is more predictable with PRK, and patients tend to be more satisfied than after experiencing a (uncontrolled) hyperopic shift after PTK.

The cornea of the patient's right eye is clear. Although the chance of scarring with surface ablation is always higher in retreatments, I do not think the risk is significant. Nevertheless, I always try to minimize the possibility by prescribing oral steroids, Pred Forte (Allergan, Inc., Irvine, CA), and intraoperative mitomycin C. In this case, Orbscan topography shows sufficient corneal thickness, both centrally and peripherally, for the rather minor intended refractive treatment, and there are no signs of keratoconus in either eye.

The question is whether I can successfully treat the patient with standard wavefront algorithms or whether the decentered ablations are best treated with a specialized retreatment algorithm or a topographically guided ablation. According to the Visx CustomVue map (Advanced Medical Optics, Inc.) of the patient's right eye, the higher-order aberrations compose 56% of the total error. This measurement does not concern me, because the underlying refractive error is quite minor, with a spherical equivalent of only -0.51 D. This points to one disadvantage of reporting higher-order aberrations as a percentage of the total: namely, the resultant percentage is highly dependent on the size of the denominator, so one may get 56% higher-order aberrations in an eye with a low total refractive error. More importantly, the Visx WaveScan refraction of +0.20 -1.41 X 142 is similar to the hard lens overrefraction of +0.75 -0.75 X 180. I am therefore reassured that the Visx WaveScan objectively measured a global refractive error similar to what the patient is experiencing subjectively.

In complicated cases, I cut a Visx PreVue lens and have the patient hold it up in order to document both his objective improvement in visual acuity and his subjective improvement in symptomatology. For this patient, I would want to see at least a one-line improvement in acuity to 20/25 as well as a significant subjective improvement in the ghosting/diplopia in his right eye. In my experience, a Visx PreVue lens that demonstrates both objective and subjective improvement will usually lead to a visual outcome that is satisfactory to the patient.

In Visx CustomVue retreatments, I hesitate to adjust the treatment parameters, particularly the physician adjustment, because I feel that the results of doing so are more unpredictable than in primary treatments. Adjustments also make using the Visx PreVue lens difficult. For example, placing a trial lens of -0.50 D over a Visx PreVue lens makes the already tiny optical zone almost impossible for the patient to look through. If I do not obtain a Visx PreVue lens that demonstrates both subjective and objective visual improvement, then I prefer to recapture another Visx PreVue lens that demonstrates both and agrees with my gestalt of what the “correct” refractive correction should be.

I would allow the patient to decide on which eye I operated first, as either choice seems reasonable medically. LASEK on his left eye could achieve a visual acuity of 20/20 or better, eliminate his anisometropia, and thus reduce his symptomatology. My choice of LASEK versus epi-LASIK is based on my observation of a slightly higher risk of an intrastromal incursion by the epi-LASIK separator in retreatments and cases with prior foreign bodies. If the patient requested surgery on his right eye first, I would counsel him about his heightened chance of scarring from a second surface procedure as well as steps we would take to reduce this risk. I would not promise that the final result in his reoperated eye would be perfect or as good as in his fellow eye, because the goal is to fix a damaged eye. Given positive results from the Visx PreVue lens, I would tell the patient that his visual acuity should improve and that his subjective symptoms should diminish somewhat.

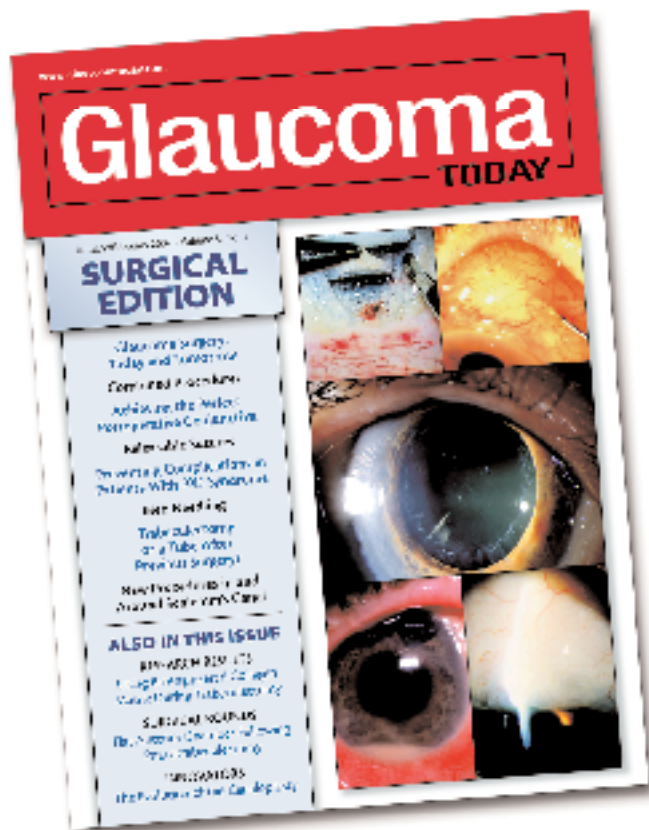
### ROY S. RUBINFELD, MD

It might be helpful to obtain this patient's old records to determine specifically what excimer laser treatment was performed on his right eye to correct the corneal scar. Most likely, the original surgeon applied PTK inferiorly only, without an attempt to spread the corneal flattening effect toward the superior cornea. This would explain the currently high levels of coma visible on aberrometry and also on Placido disk topography of his right eye. It would also be interesting to know the BSCVA for his right eye, as it might have a bearing on the optimal management of this patient.



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Essentially, this is a case of inferior flattening, high levels of coma, and irregular astigmatism in a right eye and an essentially normal myopic left eye with no evidence of topographic or other abnormalities.

I would cut several Visx PreVue lenses using the Visx WaveScan measurement of his right eye with multiple plus and minus physician adjustment settings. I would carefully determine which lens provided optimal postoperative correction and consider treating the patient's right eye with wavefront-guided PRK followed by a brief intraoperative application of a low dose of mitomycin C. If the PreVue lenses did not seem able to correct the coma effectively, then I would consider a topography-guided ablation as a one- or two-staged procedure, most likely with the Allegretto Wave excimer laser (WaveLight, Inc., Sterling, VA), because I have seen excellent results with this system in similar patients.

After I had corrected the visual acuity of the patient's right eye to his and my satisfaction, then his left eye could undergo LASIK at a later date. One could argue for treating both eyes on the same day. This case is somewhat complex, however, and the decision should be made after an extensive informed consent discussion with the patient. ■

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