

# Q

## Can CustomVue cope with highly aberrated eyes?

by David R. Shapiro, MD

# A

In my experience, CustomVue is quite capable of measuring and treating most highly aberrated, post-surgical eyes. I've operated on a number of post-RK, post-PRK, and post-LASIK patients using the Visx CustomVue system and have been impressed with the results in these therapeutic cases, especially after the Fourier software upgrades.

Fortunately, I don't have too many "skeletons in the closet." However, every surgeon knows that one of our great hopes for wavefront was that it would allow us to "fix" unhappy patients whose previous refractive surgery (in our own centers or elsewhere) has left them with less than optimal outcomes.

There are two elements to a custom treatment, of course. You have to have an aberrometer that is robust enough to measure the aberrations in a complicated eye and come up with a treatment plan, and you have to have a laser sophisticated enough to lay down that complex treatment pattern on the eye. With CustomVue, we have the ability to do both.

### Measuring accurately

I believe the shift to Fourier analysis in the CustomVue system is going to be very important for therapeutic ablations.

Certainly, Zernike polynomials have provided us with adequate wavefront reconstruction in normal eyes, and sometimes even in post-surgical eyes. Even before the Fourier upgrade, I had never encountered a post-laser eye that I was unable to capture or design a treatment for using the WaveScan aberrometer, although I feel that the treatment algorithms will offer a better fit and be of greater accuracy with the Fourier math.

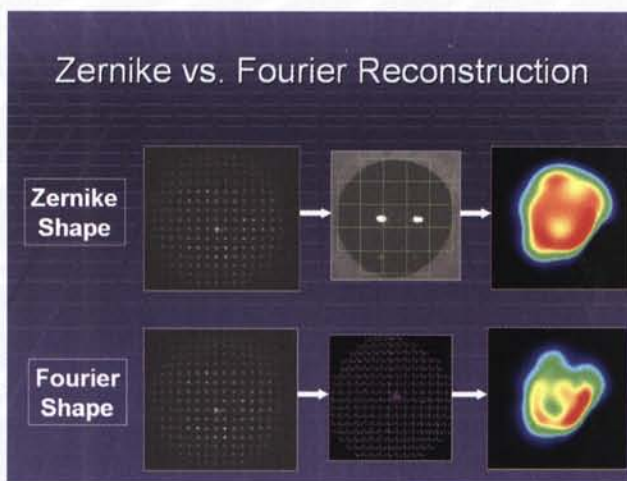
to 7 mm (rather than 6 mm) and can capture data from an elliptical pupil is also very important to obtaining key peripheral detail for reconstruction of complex wavefronts.

### Ablating complex shapes

Of course, the best treatment pattern in the world is useless if the laser can't ablate it. Some people mistakenly believe that the Visx laser is a "broad beam" laser that can't lay down the intricate patterns required for complex post-surgical corrections. I would argue that CustomVue is actually the best suited to address complex eyes of any system on the market, due to new laser technologies, specifically, Variable Spot Scanning (VSS).

VSS allows the spot size with CustomVue to vary from 0.65-6.50 mm—a much greater range of possibilities than other systems, which offer only one or two smaller spot

sizes. The ability of the laser to infinitely vary spot size as well as spot placement mathematically creates two "degrees of freedom" instead of the single degree of freedom afforded by systems that can only vary spot placement (Fig 3). I believe this gives CustomVue an unparalleled capacity for intricate detail, essential for the complex shapes required by customized ablations.



*Fourier utilizes all the Hartmann-Shack data points to create a wavefront shape, where Zernike utilizes on a sampling of data points.*

Fourier avoids the smoothing effects of Zernike that become more problematic as the ablation shape increases in complexity. It is able to utilize all of the Hartmann-Shack data points, rather than a best-fit sampling (Fig 1). The result is a much more detailed shape than is possible with Zernikes (Fig 2).

Furthermore, the fact that the new Fourier software captures data out

	Intended Shape	Achieved Shape	Pulse Count	Original Wavefront RMS ( $\mu\text{m}$ )	Residual Wavefront RMS ( $\mu\text{m}$ )	Aberration Reduction
Z6 ( $Z_3^{-3}$ )			211	1.05	0.04	97%
Z8 ( $Z_3^1$ )			259	1.00	0.04	96%
Z11 ( $Z_4^2$ )			327	1.00	0.04	96%

**Variable Spot Scanning is able to reduce complex aberrations well beyond 10th order zernikes. The limiting factor is the reconstruction algorithm.**

### Case example

The following case is representative of therapeutic CustomVue cases I've performed.

The patient was a 45-year-old man who came to me with complaints of poor uncorrected visual acuity nine years after PRK surgery elsewhere with a Summit Apex laser. Originally a  $-3.50\text{D}$  myope, he achieved a good result initially from the PRK procedure, but said the vision in his right eye had deteriorated in recent years.

Upon examination, his acuity in that eye was  $20/30^{-2}$  (J1 at near). Manifest refraction was  $-1.00 +0.75 \times 68$ . His cornea was healthy, with no PRK-related haze or scarring. The PRK treatment was slightly decentered superiorly. The wavefront exam showed significant higher order aberrations, with an RMS of 0.25, dominated by coma and trefoil.

One month following CustomVue, his uncorrected visual acuity in the treated eye was  $20/10$ . Topography revealed a much larger and more centered ablation zone. The surface regularity index (SRI) measurements had improved from 0.32 preoperatively to 0.10 following CustomVue. Similarly, the surface asymmetry index (SAI) had improved from 0.25 to 0.09.

It is very encouraging that some of these patients who had PRK in an era of poorer precision can enjoy an improvement in optical quality through CustomVue.

### Not just for the tough cases

Even in primary cases in normal eyes, I believe it's always better to do a CustomVue procedure than a conventional, provided the patient is otherwise a CustomVue candidate. In my practice, 99% of candidates choose to have CustomVue even though they have to pay a higher fee for it. There are three reasons I strongly recommend the custom procedure, no matter how "simple" the case. First, wavefront imaging is inherently a more accurate assessment of the optical system than one can achieve with a phoropter. Second, conventional treatments, even in eyes with low RMS scores, tend to induce new higher order aberrations. Third, the latest laser technology (VSS, VRR) makes for a better ablation pattern than you get with a conventional laser treatment.

*Dr. Shapiro is in private practice, specializing exclusively in refractive surgery. Contact him [dshapiro1@cox.net](mailto:dshapiro1@cox.net). He has no financial relationship with any company mentioned in this article.*

### Tips for taking on therapeutic cases

*Based on my experience in these and similar cases, I am much more comfortable with the "leap of faith" customized ablation requires us to make. We measure carefully, pay attention to detail, but ultimately, we have to trust that the reconstructed wavefront the software comes up with will benefit the patient. There are several precautions I would recommend in treating these complicated cases:*

- *Capture good images. Best practices and attention to detail are even more important in a therapeutic case. Be sure that your best technician captures images and be very careful to rule out dry eye problems or other confounding factors.*
- *Make sure you have multiple wavefront images that form a tight cluster. Without assurance of good reproducibility of the wavefront images, I'm much less willing to make that leap of faith.*
- *A tight correlation between WaveScan and manifest refractions, however, sometimes is less important with highly aberrated eyes.*
- *Ablate a PreVue lens. Although I never do this in a regular case, I find it gives both me and the patient added confidence in the treatment.*
- *Consider treating the two eyes on separate days.*
- *With myopic therapeutic customized ablations, pay careful attention to the amount of tissue to be removed in order to avoid overcorrection, especially in cases with large amounts of spherical aberration.*
- *Be conservative in using hyperopic therapeutic customized ablations—it may be necessary to reduce the amount of hyperopic treatment (i.e. add more minus with the physician adjustment function).*