We have been impressed by the CustomCornea procedure with the LADARVision wavefront-guided LASIK system (Alcon Laboratories, Inc., Fort Worth, TX) because of its ability to address higher-order aberrations induced by previous conventional refractive surgery. Many patients suffering from glare, halos, and night-driving problems are interested in the off-label use of this laser system for retreatments. In our first 15 wavefront retreatments, the mean total root mean square decreased by 53% from 2.67 to 1.25 µm, and the mean wavefront magnitude root mean square shrank from 1.04 to 0.85 µm. Mean spherical aberration decreased from 0.66 to 0.53 µm, and the amount of coma decreased from 0.62 to 0.46 µm. Most importantly, adverse visual symptoms decreased in all patients.

THE SYSTEM

CustomCornea software allows us to make target offset adjustments for nomogram purposes of up to ±0.75 D. We recently received the new CustomCornea surgery planning software upgrade, which allows us to preview the ablation profile. By moving the cursor over different areas of the ablation profile, the software reveals specific planned depths of ablation. This type of accuracy in surgical planning can be especially valuable in cases of previous LASIK.

Although all of these software features are helpful in retreatments, a very precise and robust laser platform is required to provide precise customized treatments. With the LADARVision system, a closed-loop, laser radar eye-tracking system follows ocular movements with a sampling rate of 4,000 times per second. Compensations for movements are made at a rate of 10 milliseconds. The tracking system’s speed and proper treatment alignment ensure that laser pulses are delivered at the appropriate location on the cornea.

In addition, a 0.8-mm Gaussian beam ablates the cornea in a complex pattern of overlapping spots. The combination of size, shape, and overlap of laser spot application produces a smooth overall ablation and allows the laser system to accurately treat higher-order aberrations because of the small beam size. Moreover, the wide diameter of the wavefront-guided ablation zone (6.5-mm optical zone with a blend zone to 9.0 mm) allows the CustomCornea platform to treat a greater number of aberrations in the periphery (where they are so bothersome to patients at night) than other laser platforms treat.

Figure 1. The authors used the standard 3-D Wave system (Marco Technologies, Jacksonville, FL) to measure topography preoperatively (bottom left) and at 4 months postoperatively (top left). The difference map appears at right.
The FDA recently expanded the approved range of CustomCornea treatments to ≤ -8.00 D of sphere and ≤ -4.00 D of astigmatism. In the past, we sometimes performed conventional ablation so that an eye would be within the approved range for wavefront treatment. With the expanded range, we anticipate that only retreatment patients who are currently hyperopic may need this two-stage approach.

CASE REPORT

One of our patients, a 46-year-old male, elected to undergo a flap-lift retreatment after previous LASIK (Figures 1 and 2). Preoperatively, he had difficulty driving at night. Topography revealed a small laser optical zone (area of central flattening) from previous LASIK surgery and a large pupil OD. The laser optical zone after conventional LASIK was also slightly decentered superiorly, causing vertical coma. In addition, the functional optical zone was significantly smaller than the pupil size, a difference that caused spherical aberration-related symptoms. Nighttime pupil dilation revealed induced aberrations by allowing light to enter from areas peripheral to the functional optical zone.

The topographic difference map (Figure 1) illustrates the effects of wavefront-guided ablation by mapping the net differences between the patient’s pre- and postoperative topographies. On the scale for the difference map, green represents no net change in corneal power, red represents net steepening, and blue represents net flattening. The net effect of retreatment with CustomCornea was 1.00 D of diffuse peripheral flattening to correct spherical aberration with a blend to 3.50 D of inferior flattening to treat vertical coma. The amount of spherical aberration decreased from 0.77 to 0.64 µm. Retreatment lessened the total amount of coma (nearly all vertical) from 0.90 to 0.63 µm. It is important to note that the inferior flattening was asymmetrical in this case; conventional LASIK could only have treated the eye symmetrically and would not have been able to address coma.

TIPS FOR SUCCESS

We follow the protocol for the LADARWave wavefront measurement device. After obtaining centration photos, we use 1% tropicamide with 2.5% phenylephrine to dilate the patient’s pupils and diminish accommodation. The LADARWave optically adjusts beyond the far point of the eye to further minimize residual accommodation, and it measures the eye’s wavefront profile to the 4th Zernike order. We are meticulous in our wavefront acquisition; we place reference marks just peripheral to the limbus at the 3- and 9-o’clock positions to ensure that the measured...
wavefront is registered with the system-derived treatment at the laser.

Although the high accuracy and objectivity of wavefront-guided data acquisition in laser planning is advantageous, this objectivity may need to be balanced against the subjective refraction. Patients who have worn spectacles or contact lenses for most of their lives may be accustomed to and can prefer their subjectively determined refractions. To compensate for preferences, we compare patients’ manifest refractions to their wavefront-derived refractions. We routinely adjust the target offset of the wavefront spherical equivalent refraction to be 0.30 D less than the manifest spherical equivalent. This nomogram adjustment, based on our first 53 primary CustomCornea LASIK procedures, has improved our treatment outcomes.

CONCLUSION

Our patients prefer wavefront-guided to conventional LASIK, a choice supported by our results to date. We expect that the CustomCornea platform’s expanded treatment parameters will lead to a greater role for wavefront technology in primary laser vision correction procedures. This system also allows us to visually rehabilitate patients who have suffered from higher-order aberrations created by previous conventional ablations.

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