Two common forms of customized refractive surgery are wavefront-guided and wavefront-optimized treatments. Theo Seiler, MD, PhD, of Zürich, Switzerland, and I are the co-developers of the two approaches.1,2 Today, the wavefront-optimized approach is the standard treatment used with the WaveLight Allegro Eye Q excimer laser (Alcon Laboratories, Inc., Fort Worth, Texas; Figure 1).

Wavefront-guided treatments use a wavefront sensor such as the Hartmann-Shack sensor3 or the Tscherning aberrometer4 to measure the eye’s complete refractive status. These sensors generate the wavefront measurement, and this objectively measured optical information is then translated into an ablation profile for LASIK or PRK (Figure 2). Thus, such technologies allow us to use the optics of the individual eye to program the laser.

Wavefront-optimized treatments, on the other hand, are based on the eye’s subjective refraction—not on objective wavefront measurements. The major difference from wavefront-guided treatments is that the physiological condition of the eye’s optical errors is maintained while the sphere and cylinder are corrected, thus altering the refraction. Conversely, wavefront-guided treatments aim to correct higher-order aberrations (HOAs). With wavefront-optimized treatments, we use subjective measurements to assess the patient’s refraction, and the laser then provides a customized treatment based on this refraction. Wavefront-optimized treatments treat only the HOAs that would be induced by the alteration of the refraction, and therefore these treatments aim to not induce additional aberrations in the process of correcting the patient’s refraction.

**The Birth of Wavefront-Optimized Treatments**

I started working with Professor Seiler about 16 years ago. At that time, the correction of moderate or high myopic errors with LASIK produced postoperative visual disturbances (ie, glare and halos) that significantly affected patients’ visual performance. When we meas-

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**Take-Home Message**

- Wavefront-guided technologies take the objective wavefront measurements of the individual eye and apply them to the laser ablation profile.
- Wavefront-optimized treatments, based on the eye’s subjective refraction, maintain existing optical aberrations and correct sphere and cylinder.
- The choice of treatment is dependent on the size and amount of optical aberrations. Below 0.3 μm RMS, either treatment is effective. Above 0.6 or 0.7 μm, wavefront-guided is best.
ured the optical performance of those eye using wavefront sensors, we discovered that specific aberrations, or optical wavefront errors, such as spherical aberration, were induced by the classic ablation profile used at that time. Once we had the ability to measure these optical errors before and after the procedure, we could apply this information to the ablation profile to compensate for the induction of these errors.

Using this knowledge, we began modifying ablation profiles to prevent the induction of aberrations. This is the general concept of wavefront-optimized treatments. We started using wavefront-optimized in 1998 with the WaveLight Allegretto platform. With these treatments, wavefront data and other information is used in a general way to adjust the overall ablation profile, but we do not measure the wavefront of every patient. That is done in wavefront-guided treatments.

WHY MAINTAIN OPTICAL ERRORS?

In the case of normal physiological aberrations that are typical for most of the population, the differences between wavefront-guided and wavefront-optimized treatments are minor. Studies have shown that below a certain level (approximately 0.3 µm root mean square [RMS] HOA for a 6-mm treatment zone), there is practically no difference between the two techniques. However, if the optical errors are larger, in the range of 0.6 or 0.7 µm for a 6-mm treatment zone, outcomes are better after wavefront-guided treatment. Therefore, wavefront-guided is preferable when a significant amount of HOAs are present, but for the majority of the population with less severe visual disturbances, wavefront-optimized treatments are the better choice. (See Patient Selection for Wavefront-Guided Treatments, page 40.) We see excellent outcomes with wavefront-optimized treatment of myopia up to 12.00 D and hyperopia up to 6.00 D, and for RMS of HOAs of less than 0.3 µm for a 6-mm pupil.

In the international market, wavefront-optimized treatments predominate over wavefront-guided treatments by approximately 9:1 (personal communication, WaveLight beta site group). In fact, the postoperative aberration profiles of wavefront-optimized and wavefront-guided treatments are similar unless there are visual symptoms. There is no real benefit to wavefront-guided treatment in patients without visual symptoms, and, from a practical standpoint, wavefront-optimized treatment is easier and more reliable in terms of predictability in these eyes.

PATIENT WORK-UP

Preoperative examinations for wavefront-optimized treatments, like those for any standard refractive procedure, include manifest refraction, cycloplegic refraction, and visual acuity. There are no special diagnostic requirements for wavefront-optimized treatments, whereas wavefront-guided treatments require repeated measurements (four or five times) on a dilated pupil. There is no need or benefit to doing extensive measurements if the patient does not have visual symptoms.

Although wavefront-optimized treatments have not changed since we first used them in the late 1990s, today’s nomograms improve the predictability of the procedure. General nomograms are available from Alcon, but many surgeons formulate their own based on experience. My recommendation to my colleagues (Continued on page 60)
In the case of normal physiological aberrations that are typical for most of the population, the differences between wavefront-guided and wavefront-optimized treatments are minor.

and friends is that it is worth the effort to create your own personal nomogram because it improves the predictability of the refractive outcome.

**CONCLUSION**

Every surgeon has his or her own style of doing things, from the refraction to the surgical procedure to the follow-up. Some surgeons prefer to perform the objective measurements that are used for wavefront-guided refractive surgery, while others rely on subjective refraction for use with wavefront-optimized treatments. As one of the developers of wavefront optimization, I must admit I am partial to its use; however, I also admit that in certain situations it pays to use wavefront-guided refractive surgery.

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