# Customized Refractive Treatments

## Glossary

- Aberration-free treatment

With this treatment, existing high-order aberrations are not changed. Only visual defects such as nearsightedness (myopia) farsightedness (hyperopia) and astigmatism are corrected
The patient will retain the normal visual impression provided by the spectacles or contact lenses and the brain requires no learning phase for compensating new, possibly disturbing changes. No additional aberrations are created that could impair visual acuity and contrast vision

- Aberrometry

A method of capturing the wavefront of an ocular system. Typically a light beam is projected into the eye and the aberrometer captures the existing rays as they are reflected off of the retina. The wavefront profile of the eye is then displayed on a map. Wavefront maps are displayed in terms of Zernike polynomials and measured in microns.
Aberrometer
Diagnostic device for ascertainment of objective and quantitative imaging errors of the eye. The device can detect visual errors in the eye with much more detail (high order aberrations) than the classical spectacle prescription (low order aberrations).

- Ablation

Removal of corneal tissue carried out surgically. The word ablation is derived from the Latin “ablation” meaning “to carry away”.

- Aspheric

Not spherical. Designation for the surface of a lens whose curvature changes from the centre to the periphery. An aspheric surface enables the correction of aberrations, especially the spherical aberration, by freely shaping the optical surface.

- Corneal wavefront

The corneal wavefront documents the type and size of all existing higher order aberrations on the cornea (about 80 percent of aberrations in the human eye occur in the corneal area and the rest 20 percent are found in the lens and in the vitreous body).
The corneal wavefront is calculated from the corneal topography using algorithms.

- Customized Refractive Surgery

Wavefront-driven excimer laser photoablation. In addition to treating lower-order aberrations (sphere and cylinder), custom refractive surgery, theoretically, treats higher-order aberrations ($6^{th}$+ order). Wavefront-guided ablations create treatment profiles based on wavefront maps and the treatment may be asymmetrical and is customized for the individual patient. The treatment parameters vary according to the system utilized. This term stands for “tailor-made” corneal surgery. Thereby selected findings from the corneal wavefront analysis and the ocular wavefront analysis may influence the treatment scheme. The eye is examined for the finest anatomical deviations.

- Ocular wavefront

The ocular wavefront aberration documents the type and size of higher order imaging errors in the entire optical system of the eye (cornea, lens and vitreous body).
Typically, a defined light wave is sent into the eye and the reflected wavefront is measured with an optical sensor. The deviation in the optical path is described mathematically (through Zernike polynomials) and called "ocular wavefront aberration".

- Higher order visual defects

Higher order aberrations that cause imaging errors of the eye other than near- and farsightedness or astigmatism. They are mainly due to slight irregularities on the corneal surface. In most eyes, these cause no disturbance during the day, but are only noticeable in twilight or at night. In bright daylight, our pupil is small and the light enters the eye mainly along the optical axis. In twilight or darkness, the pupil becomes larger. Then higher order errors lead to strong interferences because the light now also enters the eye through edge areas laying aside the optical axis. Therefore, the visual acuity of an otherwise normal seeing patient may decrease as soon as light conditions become worse.

- Wavefronts

Wavefront capture by an aberrometer is the measurement of lower- and higher-order aberrations. As a wavefront passes through multiple refractive surfaces, ocular aberrations are induced that prevent individual light beams from focusing at the same point on the macula. Ocular aberrations increase as a function of pupil size and become visually significant with pupil dilation. In a perfect optical system, the wavefront would be flat. Optical aberrations are as unique as a person's fingerprint, with each eye producing its own unique wavefront. Once a patient's wavefront is captured, it can be incorporated into the refractive surgical procedure for a customized treatment.
Wavefront technology, or aberration measurement, is based on the principle that the light entering the eye would not be distorted if the eye did not have small errors. However, as no eye is perfect, the light is spread into very specific and unique patterns designated as wavefront. Wavefront technology measures the individual light ray errors of every eye, called wavefront aberration (low and higher order aberrations). Wavefront analysis of the entire eye (ocular wavefront) and the wavefront analysis of the cornea (corneal wavefront) are available. The higher order aberrations are very dependent on the pupil diameter. The smaller the pupil is, the less influence the higher order aberrations have and vice-versa.