

CUSTOM LASIK

Glossary of terms

Aberrometer - an optical instrument that measures the total wave aberrations of the eye, beyond the conventional spherocylindrical refractive correction.

Actuator - active repositioning elements that perform surface displacement or deformation in a deformable mirror.

Adaptive Optics - optical assemblies or components whose performance is monitored with a wavefront sensor and controlled so as to compensate for the aberrations by a wavefront compensator.

Astigmatism - blurry vision produced by football-shaped corneas, which are too steep in one place and too flat in another. Astigmatic corneas focus light in two different places in the eye, making both near and distance vision a problem.

Best corrected visual acuity (BCVA) - the best possible vision a person can achieve with corrective lenses measured in terms of Snellen lines on an eye chart.

Coma - third order aberration - this abnormality is characterized by an asymmetric up and down undulation from one side of the wave to the other. It is not uncommon to have a significant amount of coma in pre-operative refractive errors, especially among hyperopes. Off-centered ablations can feature large amounts of coma post-operatively.

Conventional LASIK - LASIK surgery that uses an eyeglass prescription to plan the surgery.

Cornea - the transparent front segment of the eye that covers the iris, pupil and anterior chamber, providing most of the eye's optical power. This is the part of the eye reshaped by laser vision correction.

Custom LASIK - LASIK surgery that uses the wavefront to plan the surgery. Light is projected into your eye and focused on the retina. Part of this light is reflected back out of your eye to form the wavefront.

Deformable Mirror - mirror that has an actively controlled reflective surface.

Diopter - measurement of the degree to which light converges or diverges; also a measurement of lens refractive power.

Effective Blur (Eff Blur) - is the amount of spherical error (in diopters) it would take to create a Root Mean Square (RMS) error equal to the RMS error created by all the aberrations. This is provided as an aid to assessing the qualitative impact of the higher order aberrations.

Eye's Optics - the refraction system of the eye, consisting of cornea, aqueous humor, crystalline lens and vitreous humor.

Fixation Target - a visual target that helps patients maintain the view direction and the accommodation of the eye in ophthalmic instruments.

Hartmann-Shack Sensor - measures an outgoing wavefront from the eye. The sensor uses 217 small lenses called lenslets arranged in a hexagonal array to measure the wavefront emerging across the pupil.

High Order Aberration Index - represents the percentage of high order aberrations as a fraction of the RMS total of aberrations measured.

Hyperopia (Farsightedness) - Also known as farsightedness, is a refractive error in which you see better from a distance than close up. Hyperopia is caused by an eyeball that is too short to focus light on the retina. Light strikes the retina before it can come to a sharp focus.

Modulation Transfer Function - the ratio of the modulation in the image to that in the original object as a function of spatial frequency (cycles per degree) of the sine wave pattern.

Myopia (Nearsightedness) - also known as nearsightedness, is a refractive error in which you see better close up than from a distance. Myopia is caused by an eyeball that is too long to focus light on the retina or a cornea which is too steeply curved. In these cases light focuses instead in front of the retina.

Optical Aberration Index (OAI) - shows us what percentage of the total WavePrint errors are High Order Aberrations (HOAs) that aren't just spherical and cylindrical and therefore may give a better indication of which patients would be good candidates for having today's Conventional LASIK (which treats only lower order aberrations).

Photon Lag - the relative delay of photons as they exit the eye.

Point-Spread Function (PSF) - what one point of light looks like to the patient measured in minutes of arc.

Polynomial - mathematical explanation for the aberrations created.

Presbyopia - the normal aging process of the eye, in which its natural lens loses some of the flexibility that allows it to fine tune the focusing of light. This usually occurs between the ages of 40 and 50. Everyone experiences presbyopia at some point as they get older, resulting in nearsighted people requiring bifocals in their forties, and those who never needed glasses before may require now reading glasses. The one advantage to mild myopia (nearsightedness) is that once someone begins to be presbyopic, they may be able to remove their glasses to read (myopia effectively counteracts presbyopia). Those who choose to have laser vision correction will lose this ability. The cornea will focus light correctly, which will force people to need reading glasses for small print, like every other normally sighted person with presbyopia.

Because laser vision correction is designed to reshape the cornea and does not effect the lens of the eye, it can not correct presbyopia. However, there are currently many procedures being tested to correct presbyopia. More information about these procedures is available by consulting an eye care provider.

Retina - the thin lining at the back of the eye that converts images from the eye's optical system into electronic impulses sent along the optic nerve for transmission to the brain.

Root Mean Square - the integrated root mean square of the differences between the wavefront surface and the mean value of the surface.

RMS Error - the (Root Mean Square Error) is the error between the exam's measured wavefront and that of an ideal plane wavefront. It is expressed in microns. Note: A typical RMS value for an emmetropic eye is around 0.2 μm over a 6-mm pupil.

Skew Ray - any ray through an optical system that is not a meridional ray; the plane created by a refracted skew ray does not contain the optical axis.

Snellen Chart - the chart used to test visual acuity with black letters of various sizes against a white background.

Spherical Aberration - is commonly seen after refractive surgery, resulting from the dramatic change in corneal contour at the junction of the ablation zone and peripheral untreated cornea. Spherical aberration is a common cause of nighttime halos and may play a significant role in the loss of contrast sensitivity under low conditions that some patients experience post-operatively.

Treatment table - a treatment protocol containing sequence, location and description of the treatment beam.

Trefoil - wavefront shape with threefold symmetry.

Uncorrected Visual Acuity (UCVA) - the best possible vision a person can achieve without corrective lenses measured in terms of Snellen lines on an eye chart.

Wavefront - describes rays of light emanating from a source and represents the surface made up of those points along the rays that are in the same temporal phase. Wavefront also describes a surface shape of the imperfections of an optical system.

Wavefront Decomposition - expansion of a general wavefront function in terms of a function set of polynomials.

Wavefront Technology - originally developed for use in high-powered telescopes to reduce distortions in space, now adapted for eyecare. A single beam of infrared laser light is passed into the eye and focused on the retina. The light is then reflected off the retina, passed back through the eye, through a lenslet array to a sensor, and then analyzed from 200 different aspects to create a map of the eye - or fingerprint of vision. This technology uncovers unique characteristics of the eye never measured before using standard methods for glasses and contact lenses.

Zernike polynomial - a complete set of polynomials, introduced by F. Zernike, that are orthogonal over the interior of a unit circle; conventional aberrations such as defocus, astigmatism, coma, and spherical aberration correlate to a subset of the Zernike polynomials.

Maps

Refractive Map - displays the refractive error of the eye over the entire entrance pupil.

Wavefront Error Map - shows the deviation of light from that of a perfect optical system. This is a pseudo color map that provides a quantitative representation of the aberrations of the measured eye.

Hartmann - Shack Pattern - the clarity of focus of the grid of spots indicates the quality of the measurement.

Wavefront Error/Refractive Correction Difference Maps - illustrates the point-by-point differences between two exams of the same eye taken at different times and are referred to as Ex 1 and Ex 2. Ex 1 is always the first exam selected.

Wavefront Error/Rx Correction Difference Maps - can be either, depending on what is selected in the Map Type control. The upper map always includes all aberrations, including sphere and cylinder. The lower maps include higher order aberrations only, excluding sphere and cylinder.

Wavefront Error/Rx Correction Maps - shows, in the same view, either the Acuity Map and the Wavefront High Order Aberration Map or Refractive Acuity and High Order Map for both exams chosen.

Zernike Coefficients Table and Difference Table Views - Zernike coefficients up to the sixth order are displayed in the Zernike Coefficients Table and may be displayed in standard or polar coordinates. Standard Zernike coordinates express the exam data using classical mathematical terms, while polar Zernike coordinates combine similar Zernike terms to represent the optical properties obtained from the exam data.

Colors -

Red represents areas in which light is advanced - meaning there is a shorter distance or less media for light to travel. Red in the periphery indicates a more myopic eye.

Blue represents areas in which light is lagging - meaning there is a longer distance or more media for light to travel through. Blue in the periphery indicates a more hyperopic eye.