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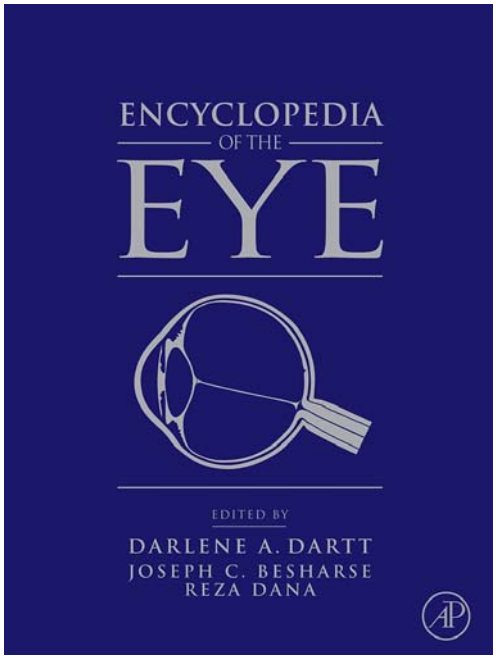

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Refractive Surgery

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Glossary

Aberrations – Phase deviations from the ideal wave front measured at the pupil plane. Aberrometers measure local ray deviations, which are fitted to the derivatives of the wave aberration, usually expressed as a Zernike polynomial expansion. A relevant aberration in the human eye (and particularly after standard refractive surgery) is spherical aberration (which results in peripheral rays converging on a different plane than central rays). A common optical quality metric derived from the wave aberration is the root mean square (RMS) wave-front error.

Ablation profile – Corneal tissue that needs to be removed at each location to produce the desired change in corneal power. Generally, the ablation-profile equation is converted into the number of laser pulses to be applied at each location.

Asphericity – Parameter used to describe the deviation of the anterior corneal surface from a sphere. The corneal surface can be fitted to a conic section using the apical radius of curvature and the eccentricity e (variation of this curve with distance from the apex). Asphericity Q is defined as $-e^2$, with the surface represented by the following equation: $(X^2+Y^2)+(1+Q)Z^2-2ZR=0$. For a sphere $Q=0$, a typical cornea shows an asphericity $Q=-0.26$; a surface with zero spherical aberration should have an asphericity $Q=-0.52$; an oblate surface (exhibiting positive spherical aberration) will have $Q>0$; and a prolate surface (exhibiting low positive spherical aberration or negative) will have $Q<0$.

Beer–Lambert law – Law governing the photoablation of the corneal tissue by excimer laser. The depth of ablated material is proportional to the logarithm of the laser fluence (relative to the ablation threshold).

Contrast-sensitivity function (CSF) – The contrast-sensitivity function represents the minimum subjectively discernible contrast as a function of spatial frequency. It typically has an inverted-U shape, peaking at around 4 cycles per degree (c/deg), with sensitivity decreasing on either side of the peak. The shape of the CSF is determined by the properties of the visual neurons and the optical aberrations of the eye. Other factors affecting the CSF are pupil diameter and luminance. CSF is a more sensitive measure of changes in visual quality following a change in the optics (such as that produced by refractive surgery) than visual acuity.

Excimer laser – Laser producing stimulated emission after electrical discharge forming dimers or complexes, emitting typically ultraviolet (UV) light. Lasers applied in refractive surgery use a combination of Argon (as inert compound) and fluorine (reactive gas) and emit at 193 nm. The excimer lasers are well suited to remove exceptionally fine layers of surface material (particularly, biological matter and organic compounds) by disrupting the molecular bonds of the tissue, through ablation rather than burning, leaving the remainder of the material almost intact. Lasers used in refractive surgery have fluences typically ranging between 120 and 400 mJ cm^{-2}.

Laser-assisted *in situ* keratomileusis (LASIK) – Corneal refractive surgery technique which involves the creation of a thin flap on the cornea, folding it to enable remodeling of the tissue underneath with laser and repositioning the flap back after the corneal ablation has been performed.

Modulation-transfer function (MTF) – Optical function representing the contrast degradation by an optical system as a function of spatial frequency. Factors affecting the MTF are diffraction (pupil size),

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