Investigative Ophthalmology & Visual Science

Invest Ophthalmol Vis Sci 2007;48: E-Abstract 3136.

3136—B999

Predicting Depth of Focus in Pseudophakic Eyes With Aspheric IOLs Using a Customized Polychromatic Modeling

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Support: Advanced Medical Optics, Groningen, The Netherlands & MEC_FIS2004-2153 (Spain).

Abstract

Purpose: To extend the monochromatic customized modeling of pseudophakic eyes recently reported (Tabernero et al., IOVS, 47, 4651, 2006) including chromatic aberrations. This modeling will be used to predict the depth of focus of real eyes with different types of aspheric IOLs correcting various amounts of spherical aberration.

Methods: We applied the customized model in a group of pseudophakic eyes. IOLs alignment was measured using a research-prototype instrument and corneal topographies were measured with a topographer. The actual data from the patients together with the geometry and optical properties (refractive index, dispersion) of the IOLs were imported into a ray tracing modeling. A monochromatic point-spread function (PSF) for each wavelength in the visible spectrum was calculated and then the averaged white-light PSF (weighted by the visual sensitivity function). From PSF data, the polychromatic MTFs for each subject and for different amounts of defocus (between -1 and 1 D) were calculated. Three different IOLs designs were tested: a design that balances the average value of corneal SA (Tecnis, AMO, Santa Ana, CA) a design that induces zero value of SA, and a conventional spherical IOL that adds positive SA with values depending on its power.

Results: The average value of depth of focus obtained from the real data in all patients was not compromised by the level of corneal SA corrected by the IOLs. The differences found among the lenses were less when polychromatic light was used in place of monochromatic light. This suggests that the

highest benefit could arise from the combined correction of both spherical and chromatic aberrations in IOLs.

Conclusions: We developed a realistic "virtual surgery" modeling to predict the polychromatic optical performance after IOL implantation. This approach was applied in a group of pseudophakic patients to predict depth of focus with different IOL designs. In real eyes depth of focus was similar with or without correction of spherical aberration. We also predicted that the best performance would be achieved by correcting simultaneously both chromatic and spherical aberrations in future IOL designs.

Keywords: intraocular lens • optical properties