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Polarization and Aberrations in Normal and Post-LASIK Eyes Assessed with an Aberro-Polariscope

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Abstract

Purpose: To evaluate the properties of polarization and aberrations of corneas in normal and post-refractive surgery eyes. These data could be of use to detect corneal mechanical stress induced by the surgery, potentially causing lower visual outcomes.
Methods: We have developed an aberro-polariscope to measure both ocular aberrations and spatially-resolved polarization properties of the cornea. The apparatus is a modified version of a Hartmann-Shack wave-front sensor incorporating a polariscope. This consists of a linear polarizer in the illumination path and a quarter-wave retarder and another linear polarizer in the registration path. Series of four Hartmann-Shack spot images, corresponding to different appropriate orientations of the retarder, are recorded. From these images, the wave-aberration and parameters of polarization related to the corneal birefringence (retardation and azimuthal angle) are computed. Retardation is mainly related to corneal thickness and azimuth informs about stress directions, tensions and arrangement distribution of stromal lamellae.
Results: Wave-front aberrations and spatially-resolved maps of the polarization parameters across the pupil were obtained for both normal and post-LASIK eyes. Aberrations in post-LASIK eyes were significantly larger than in normal eyes, in agreement with previous findings. Retardation for normal subjects increases from the center to the peripheral cornea, but in post-LASIK subjects seems to be more uniform in the analyzed area. We found a dominant value of the azimuth across the central cornea in both normal and post-LASIK corneas. A combined analysis of these aberration and polarization results will permit a better understanding of the changes of the cornea after LASIK.
Conclusion: We developed a new instrument: aberro-polariscope, that allows simultaneous measurements of the ocular wave-front aberration and polarization properties of the living eye. This instrument can be of use in a clinical environment to follow the biomechanical and optical changes of the cornea after refractive surgery.

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