Investigative Ophthalmology & Visual Science

Invest Ophthalmol Vis Sci 2004;45: E-Abstract 2844.

2844—B479

OBJECTIVE MESUREMENTS OF OCULAR SCATTERING AS A FUNCTION OF AGE

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Commercial Relationships: J.M. Bueno, None; **E. Berrio**, None; **P. Artal**, None.

Grant Identification: MCyT_BFM2001–0391 (Spain)

Abstract

Purpose: It is well established that both ocular aberrations and scattering increase with age. However, while aberrations can be objectively measured, methods for assessing scattering are mostly subjective. We developed a polarimetric technique to objectively evaluate how ocular scattering changes with age.

Methods: An instrument based on a double–pass (DP) imaging polarimeter was implemented to measure the degree of polarization (DOP) of the light emerging from the eye. The DOP is the fraction of light that remains polarized after passing the ocular media. Since de–polarization and scattering are two physical phenomena intrinsically related, our technique provides an objective parameter to quantify changes in ocular scattering: a larger DOP value indicates a smaller amount of scattered light. In the incoming pathway of the DP system a linearly polarized infrared diode laser illuminates the eye. The recording pathway includes a fixed linear polarizer together with a movable quarter–wave plate. Series of four DP images for the appropriate orientations of the retarder are recorded to estimate the DOP. This procedure was first tested in a scattering–variable artificial eye and we found high correlation between the level of scattering and DOP variations. Measurements were then carried out in 32 healthy eyes with normal vision, corresponding to 23 normal adult subjects with ages ranging from 18 to 70 years.

Results: The DOP ranged from 0.94 to 0.49 and decreased significantly with age ($R=0.83$, $p<0.0001$). A value 1 means complete absence of scattering, while 0 means a perfect scattering media. Averaged DOP values were 0.79 ± 0.10, 0.70 ± 0.07 and 0.60 ± 0.06 for young [18–45 yrs], middle–aged [45–60 yrs] and elderly subjects [60–70 yrs], respectively.

Conclusions: We implemented an objective method to measure the amount of ocular scattering. The system is sensitive enough to discriminate the increase of scattered light in the eye with age, regardless the natural variability of the in–vivo measurements. This increase of scattering contributes to explain the decay of visual outcomes with aging, beyond the impact of larger aberrations. This instrument may serve as an objective test of different levels of ocular scattering in a clinical environment.

Keywords: optical properties • aging