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Purkinje Imaging System to Objectively Measure Corneal Haze and Lenticular Scattering

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Abstract

Purpose: Ocular scattering increases with age, surgery and some pathology. Although physical changes in the cornea, the lens, the retina and the humors might contribute to alter the amount of ocular scattering, most techniques estimate the total ocular scatter without discriminating the different contributions. Here we describe a Purkinje imaging instrument that permits to objectively measure the amount of scattering associated with the cornea and the lens, avoiding the contribution from the retina.

Methods: An experimental system to record the 4rd Purkinje image (reflection from the back lens surface) in vivo was developed. The eye was illuminated by a 633-nm He-Ne laser. In the registration pathway an objective optically conjugated the 4rd Purkinje image with the CCD plane of a video camera. The subjects stared directly at the camera, which made the illumination and the recording pathways being at 40 degrees. For each measurement, two consecutive images were acquired with (non-saturated) and without (saturated) a neutral density filter. In the first case, the directional light of the Purkinje image was captured. The saturated case allowed detecting the halo of scattered light. A composed image was finally reconstructed using both images with increased dynamic range. The relative intensities of both scattered and directional light in the composed image were calculated. In order to test the performance of our instrument, we used a set of experimental contact lenses producing controlled amounts of scatter to simulate corneal haze. Measurements were carried in young subjects wearing these lenses.

Results: The central part and the skirts of the 4th Purkinje image were independently analyzed in eyes

wearing contact lenses with different scatter levels and compared to the image recorded in the control young eyes. As expected, the core of the Purkinje image hardly changes when increasing scattering, but the intensity at the halos increased with the amount of induced scattering.

Conclusions: We have implemented an objective method to measure the contribution of the ocular scattering coming from the cornea and the lens. The system is sensitive enough to discriminate different induced levels of corneal scattering. This instrument may be useful in a clinical environment to objectively estimate the levels of corneal haze after refractive surgery or/and scattering within the lens.

Keywords: refractive surgery • refractive surgery: optical quality • optical properties