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Improved autofluorescence lifetime ophthalmoscopy image quality based on suppression of the crystalline lens fluorescence

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Abstract

Purpose : The detection of metabolic changes in the retina is the goal of autofluorescence lifetime ophthalmoscopy (FLIO). The confocal principle of modern scanning laser ophthalmoscopes alone is not able to suppress the fluorescence of the crystalline lens sufficiently because of its large volume and strong autofluorescence, which causes artifacts in FLIO data. We propose a combination of confocal principle with an additional annular aperture stop and performed experimental measurements in an eye model to determine the best suppression of the crystalline lens fluorescence while maintaining most of the retina fluorescence.

Methods : The experimental setup consists of a 445nm Laser (12mW), coupled into the light path by a dichroic mirror (edge wavelength 495nm). The model eye consists of a 20 mm lens, a fluorescent layer directly after the lens to model the crystalline lens fluorescence (sodium fluorescein, peak emission 515nm) and a 100µm thin fluorescent layer to model the retina fluorescence (rhodamine B, peak emission 575nm). An array spectrometer detects the fluorescence (500-700nm). To apply the confocal principle, the illumination pinhole and the field stop are 100µm in diameter each. The annular stops have an outer diameter of 7 mm and inner diameters of 1, 2, 3 and 4mm. The annular stops were made by a 3D printer and thus required a small supporting structure to keep the inner part of the stop in place, which was corrected for mathematically.

Results : In comparison to the confocal principle alone, the fluorescence of the modelled crystalline lens is decreased to 26%, 9%, 5% and 2%, while the modelled retina fluorescence was 96%, 71%, 31% and 13% for the annular stop with inner diameters of 1, 2, 3 and 4mm. The

Michelson contrast between lens and retina fluorescence is 0.08 for the confocal principle alone and 0.57, 0.75, 0.70 and 0.71 for the annular stops.

Conclusions : The best compromise to suppress the crystalline lens fluorescence and preserve the retina fluorescence delivers an annual aperture stop with an inner diameter of 2mm in combination with the confocal principle. A similar annual aperture should be incorporated into fundus autofluorescence scanning laser ophthalmoscopes, such as the FLIO instrument, to minimize artifacts caused by the crystalline lens fluorescence and improve image quality.

This is an abstract that was submitted for the 2016 ARVO Annual Meeting, held in Seattle, Wash., May 1-5, 2016.