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Dark-adapted versus bleached state in fluorescence lifetime imaging ophthalmoscopy

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Footnotes

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Abstract

Purpose : The (early) detection of diseases based on metabolic changes in the retina is the goal of the novel autofluorescence lifetime ophthalmoscopy (FLIO) technique. These metabolic changes can be detected as alterations in the fundus autofluorescence (FAF) lifetimes. The influences of the photopigment bleaching and photobleaching on the FAF lifetimes are unknown. Thus, we performed a volunteer study to investigate these influences.

Methods : In 21 healthy volunteers (23.6±3.8 years) time-resolved FAF was measured with a FLIO device (30° of fundus, excitation at 473nm, detection in two spectral channels: 500-560nm (ch_1) and 560-720nm (ch_2), time-correlated single photon counting method). All subjects had a crystalline lens. The pupil was dilated with 0.5% Tropicamid. After volunteers adapted to the dark using a custom-made lightproof eyewear over a period of 30 min, the first FLIO measurement was recorded (dark-adapted state). Subsequently, one eye was bleached for 1 min using a luminance of 3200cd/m^2, followed by a FLIO measurement (bleached state). The fluorescence lifetimes were estimated from the FAF decays, based on three exponential functions, using the software FLIMX (www.flimx.de). Average values from the central region, and the inner and outer rings of the ETDRS grid were utilized to compare both bleaching states using analysis of variance, Friedman, and post hoc tests.

Results : Only ch_2 yielded significant changes ($p<0.05$) for the fluorescence lifetime τ_2 from all ETDRS regions (+19-28ps), for the fluorescence lifetime τ_1 (+6ps) and the mean fluorescence lifetime (+6ps) in the central area that were less than 10% in magnitude. Additionally, the acquisition time in the bleached state was significantly reduced by approximately 20% on average,

compared to the dark-adapted state. The fluorescence lifetime differences caused by bleaching were much smaller than pathological states known from literature.

Conclusions : We conclude that bleaching is not relevant for current clinical FLIO applications because of the small magnitude of the elicited fluorescence lifetime changes. Thus, it is advisable to instruct patients to wait in a bright room before FLIO measurements. If the expected changes in the fluorescence lifetime in a specific experimental paradigm are small, FLIO users should follow a strict acquisition protocol in terms of the photopigment bleaching state of the patients to obtain the most reliable results.

This is an abstract that was submitted for the 2018 ARVO Annual Meeting, held in Honolulu, Hawaii, April 29 - May 3, 2018.