

Autofluorescence Imaging

Clinical application with SD OCT imaging.

BY FRANK G. HOLZ, MD

New technologies, such as spectral domain optical coherence tomography (SD OCT) and autofluorescence, are being used to better understand the pathophysiology of retinal diseases, to identify those patients most at risk, and to measure specific response to therapeutics. Fundus autofluorescence (FAF) imaging, one of the modes available in the Spectralis HRA+OCT (Heidelberg Engineering, Vista, CA), enhances the instrument's utility as a diagnostic device and a tool for monitoring therapy of patients with retinal and macular diseases.

The Spectralis system allows simultaneous capture of confocal scanning laser ophthalmoscopy (cSLO) fundus images and high-resolution SD OCT scans. Additionally, it offers several different fundus-imaging modes. These include a novel method known as fundus autofluorescence (FAF) imaging, which detects autofluorescent material, ie, lipofuscin, in the retinal pigment epithelium (RPE). Fluorophores detectable with this imaging method may also occur anterior or posterior to the RPE cell monolayer.

Excessive lipofuscin accumulation in the RPE is a com-

mon downstream pathogenic pathway in various monogenetic and complex retinal diseases including age-related macular degeneration. The accumulated lipofuscin produces a signal that is captured in the FAF image allowing in vivo mapping of metabolic changes in the RPE. This information surpasses that available with conventional imaging techniques.

The detailed images also allow an FAF classification system, which can be used to identify risk factors for disease progression, to design and monitor interventional trials, and to identify genetic causes associated with certain disease manifestations.

RECENT STUDY

In a study published in *American Journal of Ophthalmology*, my colleagues and I evaluated the relationship between autofluorescence patterns, geographic atrophy and disease progression, ie spread of atrophic patches, in 195 eyes of 129 patients with AMD.¹

Results showed that the topographic distribution of abnormal lipofuscin accumulations in the RPE relates to

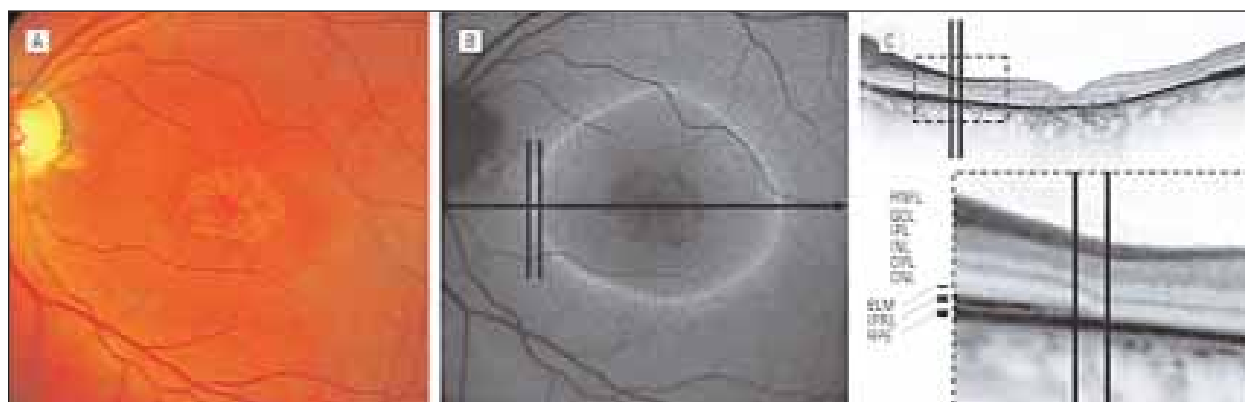


Figure 1. Simultaneous fundus autofluorescence (FAF) and spectral domain—optical coherence tomography imaging. The line of increased FAF corresponds to a junctional zone (B and C, within black lines). RPE indicates presumed correspondence of the retinal pigment epithelium; IPRL, interface of the inner/outer segments of photoreceptors; ELM, external limiting membrane; ONL, outer nuclear layer; OPL, outer plexiform layer; INL, inner nuclear layer; IPL, inner plexiform layer; GCL, ganglion cell layer; and RNFL, retinal nerve fiber layer.

the progression of the disease. The areas of high lipofuscin accumulation correlate with areas of high biochemical activity associated with potential cell death. The GA progresses in the direction of these areas.

With the simultaneous recordings of high-resolution OCT, it is now possible to evaluate corresponding morphologic substrates, ie, underlying microstructural changes in the retina and RPE in areas of high lipofuscin accumulation.

CASE IN POINT

Application of the new combined imaging technology is illustrated in the case of a 47-year-old man with bilateral bull's eye maculopathy (Figure 1).² He exhibited a ring of increased FAF that sharply demarcated a central area of severely impaired light sensitivity that had been demonstrated by fundus-controlled microperimetry. Simultaneous cSLO and SD OCT imaging revealed that the area of increased FAF corresponded to the junction between two zones. Outside the ring, OCT scans showed preserved retinal layers; within the ring, the interface of the inner and outer segments of photoreceptor layer was absent, and the hyperreflective band that is assumed to represent the external limiting membrane appeared to rest directly on the preserved RPE layer. The outer nuclear layer and the more inner retinal layers appeared unaffected. Fundus autofluorescence and the RPE layer appeared normal on either side of the ring, independent of the presence of the interface of the inner/outer segments of photoreceptors.

Ultimately, the FAF classification system could be used to identify risk factors for progression as well as to design and monitor interventional trials and identify genes associated with certain AMD manifestations. Research is also under way on the FAF alterations in pigment epithelial detachments, central serous chorioretinopathy, chorioretinal inflammatory disorders, vitelliform macular dystrophy type 2 (Best disease), and pseudoxanthoma elasticum. ■

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