suture track created from tantalum marker placement. There are no reports of scleral perforation during tantalum marker or plaque placement. However, it is known that scleral perforation can occur during strabismus (0.8% to 1.8%) and scleral buckle surgery (2.5%).\(^4,5\) Presumably, a needle pass penetrated the tumor to provide an avenue for tumor cells to spread beyond the highly localized treatment area of the proton beam. This case demonstrates the vigilance that must be taken in tantalum marker placement, tumor delineation, and timely delivery of an adequate dose of radiotherapy.

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**Increased Fundus Autofluorescence Related to Outer Retinal Disruption**

Fundus autofluorescence (FAF) imaging is able to map metabolic changes at the level of the retinal pigment epithelium (RPE) noninvasively in vivo. However, the observed autofluorescence signal is a summation of not only the autofluorescence originating from the RPE but also that from more anterior ocular structures including the overlying neuroretina.\(^1\)

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**Figure 1. Multimodal Imaging of a 30-Year-Old Man With Multifocal Choroiditis and a 50-Year-Old Woman With Multiple Evanescent White Dot Syndrome**

A-D, Multimodal imaging of a 30-year-old man with multifocal choroiditis in the left eye. A fundus autofluorescence (FAF) image at presentation using the Optos system showed multiple hypoautofluorescent spots and a peripapillary zonal hyperautofluorescent area (A), colocalizing with an area of disruption of both the ellipsoid and retinal pigment epithelium–photoreceptor interdigitation zones in the corresponding spectral-domain optical coherence tomographic (SD-OCT) image (B). A FAF image 7 months later (C) showed resolution of the peripapillary zonal hyperautofluorescent area concomitant with near-complete restoration of both the ellipsoid and the digitation zones in the corresponding SD-OCT image (D). E-H, Multimodal imaging of a 50-year-old woman with multiple evanescent white dot syndrome. A 30° FAF image using the confocal scanning laser ophthalmoscope system showed multiple hyperautofluorescent spots (white arrow) (E), which corresponded to areas of focal disruption (arrow) of both the ellipsoid and retinal pigment epithelium–photoreceptor interdigitation zones on a horizontal SD-OCT scan (F). After bleaching, the FAF signal of the surrounding retinal areas increased more than the FAF signal of the spots, resulting in a markedly decreased difference in autofluorescence level between the pathological spots and the relatively normal-appearing surrounding retinal tissue (G). However, on the corresponding SD-OCT images before (F) and after (H) bleaching, the retinal structure looked identical. One hour later, the hyperautofluorescent spots reappeared just as in E (image not shown). The green arrows in A, C, E, and G indicate the levels of the SD-OCT scans in B, D, F, and H, respectively.
Retinal photopigments within the photoreceptor outer segments have absorption properties, and illumination with blue light decreases the optical pigment density by photobleaching. After blue light irradiation, there is photoisomerization of the opsin proteins from the 11-cis to all-trans conformation in the photoreceptor outer segments. This photoisomerization to the all-trans configuration causes a decrease in the optical density of the photopigment in the outer segments of the photoreceptors, resulting in a temporary loss of light absorption properties. Theelen et al have shown that in healthy and diseased
Multimodal imaging of the left eye of a 50-year-old man with resolved central serous chorioretinopathy. The infrared reflectance image (same in A-C), the fundus autofluorescence (FAF) image (same in D-F), and the spectral-domain optical coherence tomographic (OCT) transverse sections (G-I) and B scans (J-L) were acquired with the confocal scanning laser ophthalmoscope (Heidelberg Retina Angiograph; Heidelberg Engineering). The segmentation for the transverse OCT was between the superior border of the ellipsoid zone and the superior border of the retinal pigment epithelial band. The level of segmentation is shown by the red lines in the OCT B scans in M-O. E and H, Note that there were 2 autofluorescent patterns within the previously detached retinal area (dotted lines). A-I, First, there are focal granular hyperautofluorescent spots (arrows) appearing bright in the infrared image, hyperautofluorescent in the FAF image, and bright in the transverse OCT image. J-O, These granular hyperautofluorescent spots correspond to hyperreflective deposits at the level of the retinal pigment epithelium in the corresponding OCT B scans (white lines). Second, there is a diffuse hyperautofluorescent area in the FAF image (E, dotted line) colocalizing precisely with a hyporeflective area in the transverse OCT image (H, dotted line). This demonstrates that the diffuse hyperautofluorescence in the FAF image colocalizes precisely with the disruption of both the ellipsoid and interdigitation zones in the corresponding OCT B scans.
eyes, the illumination of a retinal area with blue light produces a relative hyperautofluorescence as compared with the surrounding nonilluminated area. The mechanism involved is a window defect due to the relative loss of photopigment density in the outer segments of the photoreceptors after bleaching of these photopigments.

When the outer retinal structure is damaged, the photopigment density will be reduced. There is a quantitative deficiency in visual pigment in both rods and cones in areas of both active and resolved serous retinal detachments in central serous chorioretinopathy, with rhodopsin levels reduced to 20% to 30% of normal.4 We investigated whether outer retinal structural damage with photopigment loss in various retinal diseases may also lead to an increased autofluorescence signal through a window defect that increases the excitation of and unmasks the autofluorescence emitted from the underlying relatively preserved RPE.

**Methods**

Patients with various retinal diseases with focal outer retinal structural loss, an underlying RPE that appeared intact as detected by focal disruption of the ellipsoid zone, and an intact RPE band on corresponding spectral-domain optical coherence tomographic (SD-OCT) images were evaluated with FAF imaging. The FAF imaging was performed with the confocal scanning laser ophthalmoscope (Heidelberg Engineering). One patient was imaged with the Ultra-Widefield (200°) Retinal Imaging System (Optos). Two patients were evaluated before and after bleaching. For the bleaching condition, the patients were dark adapted for 20 minutes. Following this, a 55° confocal short (blue) wavelength-autofluorescent image was acquired. A retinal area of 30° × 30° adjacent to the hyperautofluorescent region of interest was then illuminated with the excitation light source for 60 seconds to achieve light adaptation of this area. Subsequently, another 55° image was acquired. Transverse SD-OCT images segmented between the superior border of the ellipsoid zone and the superior border of the RPE band were acquired and correlated with the FAF images.

**Results**

Six patients were included: 2 patients with multiple evanescent white dot syndrome, 1 with multifocal choroiditis, and 3 with resolved central serous chorioretinopathy. The retinal areas with a disruption of both the ellipsoid and interdigitation zones and intact RPE band on SD-OCT imaging corresponded to areas of hyperautofluorescence. After bleaching, the qualitative analysis showed that the FAF signal of the background increased more than the FAF signal of the outer retinal diseased areas, therefore decreasing the contrast and making the originally hyperautofluorescent lesions almost disappear (Figure 1 and Figure 2). In the patient with multifocal choroiditis, a zonal peripapillary hyperautofluorescent area corresponded precisely to a disruption of the ellipsoid zone in the corresponding SD-OCT image (Figure 1). Over time, the resolution of this zonal hyperautofluorescent retinal area was concomitant with the restoration of the ellipsoid zone in the corresponding SD-OCT image (Figure 1). The diffuse hyperautofluorescent areas in the FAF images colocalized precisely with a hyporeflective area in the transverse SD-OCT images, demonstrating that the diffuse hyperautofluorescence in the FAF image colocalizes with the disruption of both the ellipsoid and interdigitation zones in the corresponding SD-OCT B scans (Figure 3).

**Discussion**

Outer retinal disruption may result in increased autofluorescence due to a window defect as a result of photopigment loss. This mechanism could help explain hyperautofluorescence in a variety of settings including inflammatory entities such as multiple evanescent white dot syndrome and multifocal choroiditis, the active margin of acute zonal occult outer retinopathy, both acute and resolved central serous chorioretinopathy, rhegmatogenous retinal detachment after repair, the hyperautofluorescent ring in retinitis pigmentosa and autoimmune retinopathy, and at the edge of geographic atrophy where there is loss of photoreceptors over an intact RPE. Recognizing that increased FAF can occur in the absence of increased fundus fluorophores may help clinicians detect and more precisely monitor early photoreceptor damage. In some patients, these findings may provide an anatomical correlate of persistent suboptimal visual function despite relatively normal retina-RPE structure.

There may be other causes of hyperautofluorescent signals in these eyes with various diseases and complex pathophysiological mechanisms, but we believe that optical pigment density reduction as a result of outer retinal disruption should be considered as a possible explanation for the presence of a hyperautofluorescent signal in cases of retinal diseases that tend to affect the photoreceptors prior to RPE involvement.

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OBSERVATION

Iris Microhemangiomatosis With Videographically Documented Active Bleeding and Vision Loss

Iris microhemangiomatosis is an unusual, benign vascular abnormality that can cause spontaneous and recurrent hyphema with transient vision loss. Active bleeding is rarely documented and usually presumed, based retrospectively on nontraumatic layered hyphema. We report a case of iris microhemangiomatosis with videographically documented active bleeding.

Figure 1. Slitlamp Photographs of Pupillary Margin Microhemangiomatosis in Both Eyes

A, Pupillary margin microhemangiomatosis in the right eye with active bleeding at the 11-o’clock position. B, Tiny asymptomatic pupillary margin microhemangiomatosis in the left eye. Close-up view of active bleeding in the right eye before (C) and after (D) argon laser photocoagulation.

Report of a Case | A 62-year-old man was referred for nontraumatic hyphema in the right eye. He noted sudden blurred vision over 1 day while painting his house. There were no previous episodes in either eye. There was a history of controlled hypertension, cerebral aneurysms managed surgically, and aspirin use. There was no history of bleeding disorders.

On examination, the patient was afebrile with a heart rate of 59 beats/min and blood pressure of 150/92 mm Hg. Visual acuity was 20/80 OD and 20/50 OS. Intraocular pressure was 19 mm Hg OU. By slitlamp examination, anterior chamber hyphema with a height of 3 mm was noted in the right eye. There were pupillary margin vascular tufts of microaneurysms in the right eye at the 11-, 12-, 5-, and 8-o’clock positions. Active bleeding from the tuft at the 11-o’clock position was documented (Figure 1 and Video). Similarly, microaneurysmal tufts were found in the left eye at the 10-, 12-, and 7-o’clock positions without bleeding. Gonioscopy revealed normal anterior chamber angle without neovascularization bilaterally. Compression gonioscopy in the right eye temporarily decreased bleeding. Dilated fundus examination results were unremarkable in each eye.

Owing to progressive bleeding in the right eye, the patient was treated with photocoagulation of the iris vascular lesion using single-spot argon laser (200-μm spot size, 200-mW power, 0.1-second duration, 1 spot). The anterior lens capsule was avoided. After a single session, the bleeding immediately stopped and atropine sulfate and prednisolone acetate drops were prescribed for 1 week. On follow-up, the vascular tuft remained closed and best-corrected visual acuity was 20/40 OD.