

Applying SD OCT for Diagnosis and Management of Exudative AMD

The RTVue SD OCT system utilizes summated en-face (C-scan) subanalysis.

BY NALIN J. MEHTA, MD

Spectral-domain (SD) optical coherence tomography (OCT) technology, with its superior data density and speed, has the ability to better differentiate between the various components and subtypes of age-related macular degeneration (AMD) than time-domain OCT. To date, however, there has been only limited development in the clinical relevance of the vast amounts of 3-D data acquired with this technology.^{1,2} In most commercial systems, the software has only a restricted ability to explore the characteristics of reconstructed en-face (C-scan) images to allow segmentation of the various retinal layers.

The software algorithms of the RTVue SD OCT (Optovue, Inc., Fremont, CA), however, have advanced 3-D data analysis capabilities, which not only create reconstructed C-scan (en-face) images, but also subsequently collapse and summate an arbitrary number of these images in the anteroposterior axis at any given horizontal plane with respect to the retinal pigment epithelium (RPE) layer. This allows for improved isolation and identification of distinct retinal tissue planes.

Analysis of the outer segment of the retina (the area bounded by the RPE apices and the outer limiting membrane, both identifiable on SD OCT) can be performed using this summated en-face imaging technique, an optical pattern that can be used to track subtle structural alterations in otherwise uniform-appearing retinal tissue on B-scan images. Novel clinical applications of this optical phenomenon are described in this article.

CASE REPORT

A woman, 88 years of age, with a diagnosis of nonexudative AMD in her left eye for several years, presented in July 2008 for follow-up examination; she has been asymptomatic in that eye to date. Examination that day was significant for a Snellen acuity of 20/30 -2 with an intraocular pressure of 16 mm Hg. Amsler-grid testing revealed new, paracentral metamorphopsia. Biomicroscopic examination was significant for pseudophakia, as well as drusen and pigmentary mottling in the left macula, without hemorrhage or hard exudate.

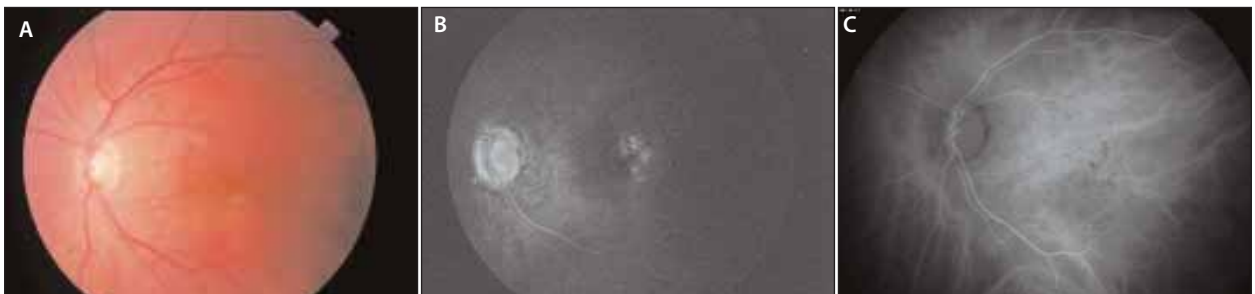


Figure 1. Fundus photo (A), fluorescein angiography (B), and indocyanine green angiography (C).

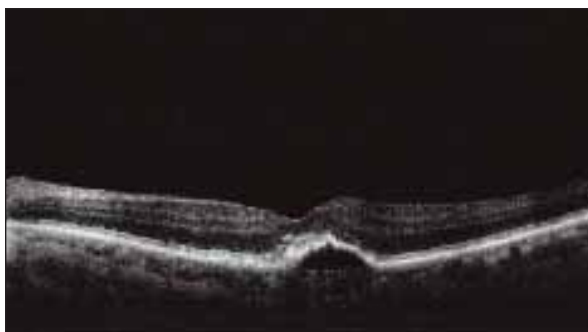


Figure 2. SD OCT B-Scan showing RPE detachment and retinal tissue blurring nasal to the RPED.

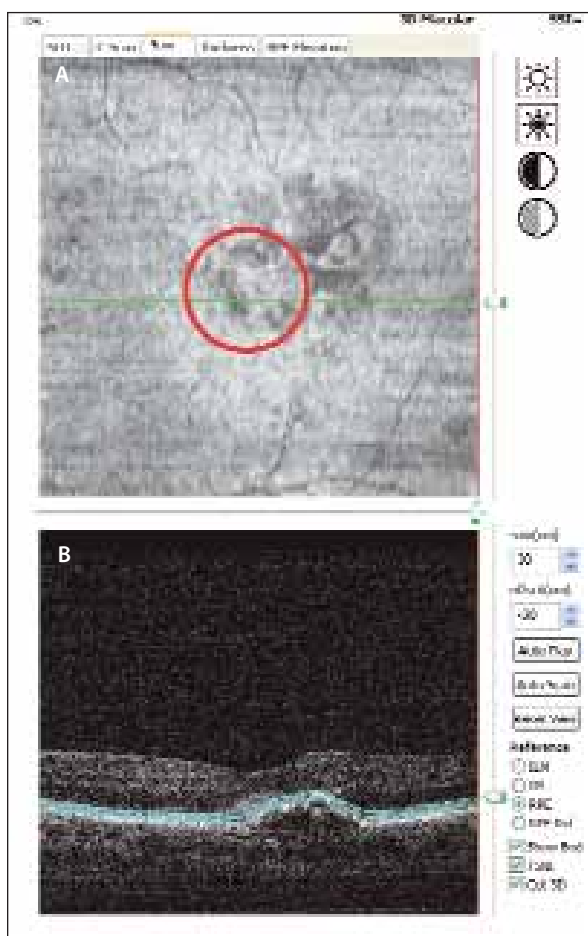


Figure 3. SD OCT en face (C-scan) image (A) and corresponding B-scan (B) of RPED and adjacent area July 2008.

Fluorescein angiography (FA) and fundus photography were subsequently obtained for her left eye (Figure 1). There was no identifiable subretinal neovascular membranes (SRNVM), with gradual hyperfluorescence consistent with a combination of temporal window defect, as well as nonspecific RPE dysfunction vs serous RPE detachment (RPED).

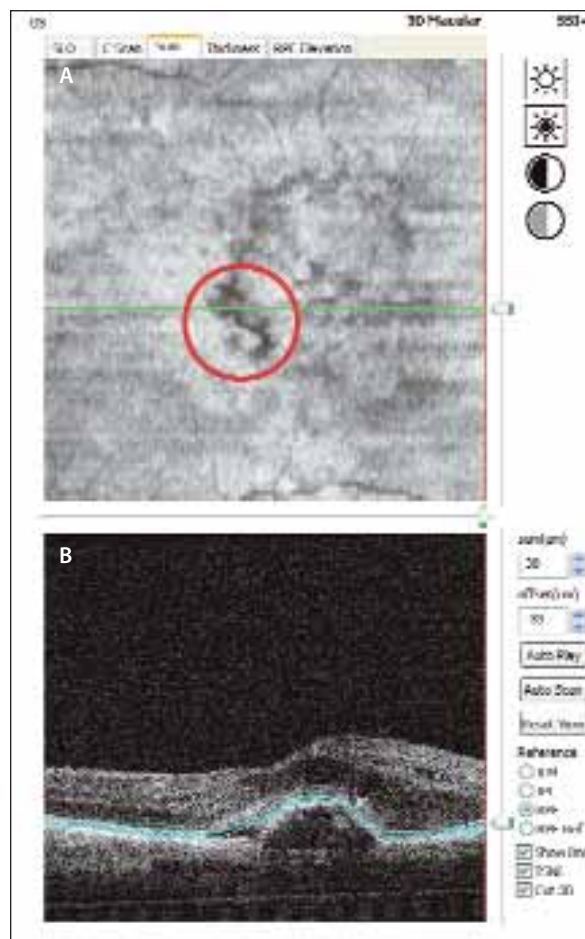


Figure 4. SD OCT en face (C-scan) image (A) and corresponding B-scan (B) of RPED, subretinal fluid and cystic edema October 2008.

Subsequent SD OCT (Figures 2 and 3) was consistent with a subfoveal serous RPED with some low reflective irregularities within, with no subretinal fluid or cystic edema noted. There was, however, a subtle blurring of the outer retina with moderate reflectivity at the subfoveal edge of the RPED. Summated en-face imaging of the outer segment subsequently revealed focal hypo-reflective darkening adjacent to the RPED, correlating with this blurring (Figure 3, circled area). The retinal thickness was within normal limits. This RPED was not present on OCT acquired several years ago.

Given the inconclusive data, indocyanine green angiography was obtained (Figure 1), which revealed no SRNVM activity. At this point, observation was recommended and a 3-month follow-up was planned.

The patient returned in October 2008. However, earlier examination by her general eye care practitioner had revealed a new hemorrhage in the left macula and a visual

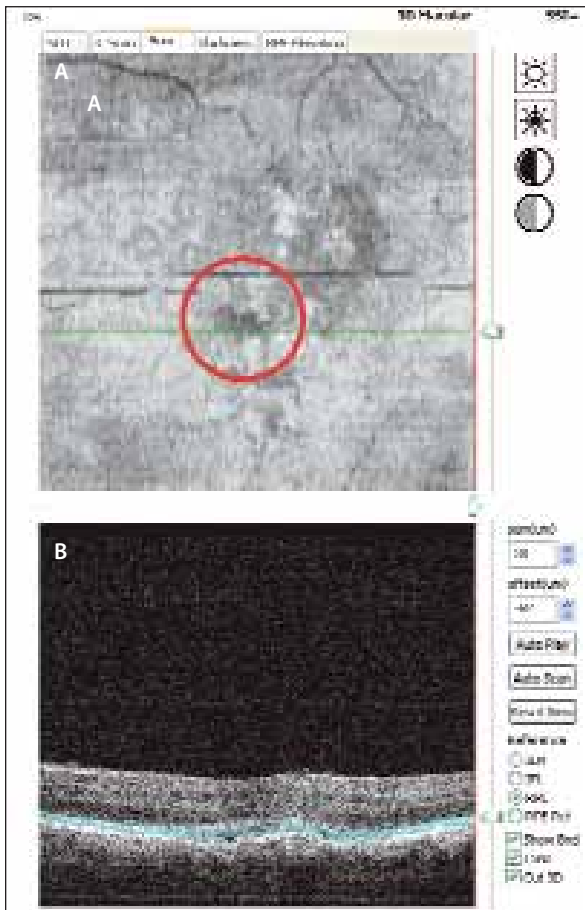


Figure 5. SD OCT en face (C-scan) image (A) and corresponding B-scan (B) posttreatment demonstrating significant resolution of RPED, edema, and subretinal fluid November 2008.

acuity of 20/30 +2. Snellen visual acuity was reduced to 20/50, although the patient reported no subjective changes. Amsler-grid testing continued to demonstrate paracentral metamorphopsia. Macular exam at this time demonstrated a definite RPED with subretinal hemorrhagic blots. Fluorescein angiography demonstrated a more intense staining pattern than her previous fluorescein angiography, and was consistent with predominantly occult subfoveal SRNVM associated with the RPED. OCT at this time revealed definite subretinal fluid and cystic macular edema (Figure 4). Summated en-face imaging of the outer segment, moreover, revealed a significantly increased hyporeflectivity in the dark area identified previously, corresponding to the subretinal fluid pocket on B-scan.

At this point, a combination of intravitreal ranibizumab followed by photodynamic therapy was initiated. The patient returned in November 2008 with Snellen acuity of 20/50 +2 with continuing Amsler-grid abnormality and a stable posterior pole exam. Subsequent SD OCT (Figure 5)

revealed resolution of cystic edema and subretinal fluid, with only a subtle pocket of subretinal fluid remaining in the initially suspicious area; outer-segment en-face imaging revealed significant reduction of the hyporeflexive focus, though still more prominent than the initial SD OCT.

DISCUSSION

For the past several years, we have quickly evolved from goals of damage control in AMD to expectations of visual stability and even improvement. Although physicians intuitively know that treating any type of disease in its earliest stages leads to better outcomes, our efforts continue to be limited by the size, location, and severity of the exudative process upon diagnosis.³

This case demonstrates a novel imaging method that potentially enhances the diagnostic capabilities of SD OCT in exudative AMD by observing changes in the reflectivity pattern of the outer segment, where fluid from underlying choroidal neovascularization (CNV) is most likely to accumulate first. Although SRNVM could not be confirmed using conventional testing at the time of initial presentation, subtle changes in outer-segment reflectivity consistent with early fluid accumulation were, in retrospect, noticeable in the area of retinal blurring adjacent to the RPED at that time.

It is notable that investigators have observed changes on SD OCT B-scans in the outer segment with RPE-level deformities in AMD.⁴ Studies have, moreover, demonstrated microstructural changes in preexisting choroidal capillaries not only in normal aging, but also with early CNV.⁵

En-face summation algorithms for SD OCT data may, therefore, be able to detect precursors to CNV in the choriocapillaris, in addition to being able to monitor the effects of treatments upon the same. Future improvements in SD OCT resolution (ie, ultrahigh-resolution OCT), moreover, may enhance the sensitivity of en-face imaging, thereby improving diagnostic accuracy of conversion to exudative AMD in its earliest stages. This technology may, furthermore, be applied to other retinal layers such as the choroid and the RPE. ■

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