SS-OCTA Negates Need for FA in CNV Management

SS-OCTA plays a key role in clinical decisions for the management of wet AMD patients based on multimodal imaging without dye injection.

BY LUIS ARIAS BARQUET, MD

In the past, fluorescein angiography (FA) was the gold standard for the classification of choroidal neovascularization (CNV) secondary to age-related macular degeneration (AMD). The CNV pattern or lesion composition was determined by FA findings and classified as classic or occult, and the CNV location and size were also assessed with the assistance of FA.

Currently, state-of-the-art optical coherence tomography (OCT) technology, such as Topcon’s Swept Source (SS) with OCT angiography (OCTA), allows a new and accurate CNV classification, without the need of dye injection. Likewise, choroidal polyps can even be detected with OCTA without the need of a complex indocyanine green angiography (ICGA).

Topcon’s OCTA is built on the DRI OCT Triton platform and powered by OCTARA, a proprietary image processing algorithm that provides highly sensitive angiographic detection. As a result, exceptional visualization of vascular structures, even in the choroid and deeper retinal layers is realized. This technology allows the deeper structures to be visualized with less depth-dependent signal roll off, and it detects even low microvascular flow with high sensitivity. Furthermore, the 1 um wavelength makes OCT imaging possible for patients with media opacities.
OCTARA image processing technology extracts the signal changes derived from vascular flow using multiple B-scans acquired at the same position. It demonstrates high sensitivity for the detection of low blood flow in microvasculature.

With structural B-scans, we can classify CNV into three types:
- Type 1: Below retinal pigment epithelium (RPE); equivalent to occult CNV.
- Type 2: Above RPE; equivalent to classic CNV.
- Type 3: Intraretinal CNV; equivalent to retinal angiomaticous proliferation (RAP) lesions (Figure 1, page 1).

With OCTA we can determine the size of the CNV and its location in relation to the fovea (Figure 2). Moreover, OCTA provides a composite image to highlight the presence of the CNV among the different retinal layers and a density map helpful to study the blood flow in the vascular plexus (Figure 3).

It’s important to make our clinical decisions based on a multimodal imaging approach using the totality of the information provided by the structural B-scans, the fundus photograph, the OCTA, and the En Face mode. The En Face mode provides a coronal view of the choroid and retina at different depths, which supplies additional information to conventional cross-sectional imaging.

CASE STUDY

This case study shows multimodal imaging of a 70-year-old male with CNV at baseline and then again at follow-up visits after intravitreal injections at 6 and 12 months. SS-OCTA shows reduction of macular fluid and the CNV activity at 12 months (Figure 4). However, enlargement of the CNV was observed at 6 months on the OCTA with an increase in blood flow on the structural B-scan that improved at 12 months with further treatment (Figure 5).
SS-OCTA should be considered more of a new way to examine, diagnose, and monitor our wet AMD patients rather than a substitute for conventional angiographies requiring dye injection.

In conclusion, clinical management of wet AMD patients is currently based on multimodal imaging including OCT, OCTA, En Face, fundus photography, and fundus autofluorescence. Angiographic examinations requiring dye injection are no longer needed in most patients. SS-OCT is helpful in the diagnosis of wet AMD patients.

OCTA is an effective aid in monitoring flow reduction following anti-VEGF therapy, and En Face is excellent for monitoring intraretinal cyst reduction.

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SS-OCTA Proves Beneficial to Posterior Uveitis Management

The diagnosis of retinal vasculitis and posterior uveitis is based on multimodal imaging. OCTA is a non-invasive diagnostic tool that can play an important role in the diagnosis of and management of uveitic conditions such as retinal vasculitis, white-dot syndromes, and inflammatory choroidal neovascular membranes.

BY ALFREDO ADÁN, PHD, MD

RETINAL VASCULITIS
Vasculitis is considered a specific disorder, in which components of the blood vessel are the center of the inflammatory focus. Fluorescein angiography (FA) has poor resolution of the deep retinal capillary plexus; optical coherence tomography angiography (OCTA) is not limited by leakage. OCTA provides microvascular morphological detail and information regarding capillary perfusion (Figure 1). In this case of Susac Syndrome, OCTA illustrated that areas of retinal capillary nonperfusion/hypoperfusion were more frequently observed in the deep than in the superficial capillary plexus (Figure 2). Capillary dropout is easily identified in FA, as are changes in macular capillary density in OCTA (Figure 3, page 4).

Figure 1. OCTA provides microvascular morphological detail and information regarding capillary perfusion.

Figure 2. In a case of Susac Syndrome, areas of retinal capillary nonperfusion/hypoperfusion are observed more frequently in the deep than in the superficial capillary plexus.
Topcon’s En Face Swept Source (SS)-OCT and OCTA enables the diagnosis of white dot syndromes. This, in turn, provides the information necessary to identify whether the primary inflammation is in the choriocapillary, choroid, or ellipsoids layer. In cases of retinal vasculitis, OCTA shows that the ischemic changes, in the majority of cases, are in the deep capilar plexus. OCTA is also useful in cases of choroidal new vessels secondary to posterior uveitis.

White dot syndromes include several disorders such as acute posterior multifocal placoid pigment epitheliopathy (APMPPE), multiple evanescent white dot syndrome (MEWDS), and punctate inner choroidopathy (PIC).

In this example of APMPPE, ophthalmoscopy showed multiple hypopigmented yellow subretinal lesions in the
posterior pole, whereas SS-OCT revealed ellipsoid zone disruptions in the macula with overlying hyperreflectivity in the outer retina (Figure 4, page 4).

In the acute stage of the disease, these dark areas may result from decreased signal transmission or loss of blood flow — or sluggish blood flow — that may be below the limits of detection (Figure 5, page 4).

OCTA provides new imaging evidence of the site and area of choriocapillary vascular pathology during the acute and later phases of APMPPE, including primary inflammatory choriocapillaropathy and progressive evidence of reduction in extent of sluggish flow areas. In APMPPE, changes in the outer retina are reversible.

In this example of MEWDS, OCTA imaging data localizes the pathologic process to the outer retina and the photoreceptors. OCTA imaging shows that choriocapillary circulation appears normal in the acute phase and suggests that MEWDS is an injury of the photoreceptors. En Face imaging illustrates the pathology as a pattern of hyperreflective dots (Figure 6, page 4).

In cases of serpiginous-like choroiditis, OCTA effectively documents progressive or recurrent choriocapillaris hypoperfusion via monitoring and follow-up of these patients.

In conclusion, our findings suggest that OCTA is an important imaging modality for managing posterior uveitis and retinal vasculitis together with other diagnostic tools.

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SS-OCT Presents Advances in Ocular Tumor Treatment

Deep range imaging with SS-OCT opens up new possibilities for diagnosis, follow-up, and treatment of ocular tumors.

BY GERASIMOS ANASTASSIOU MD, PHD

Topcon’s Swept Source (SS)-optical coherence tomography (OCT) has important physical properties that make it a more advanced and superior tool, in comparison to Spectral Domain (SD)-OCT, for visualisation of choroidal or retinal tumors. These properties include a wavelength of 1050 nm for SS-OCT versus 840 nm for SD-OCT, as well as an improved signal to noise ratio. While it’s possible to obtain a scan in the deep choroid of almost equal quality by using modifications of an SD-OCT, such as the EDI module, there are still two major differences between taking a scan with SS-OCT and SD-OCT. First, with EDI the signal on the retinal surface and in the vitreous is not as clear; second, and perhaps even more importantly, the acquisition time has been found to be 83-fold shorter with the SS-OCT. This speed equates to efficiency that represents a clear benefit in daily practice.

SS-OCT offers advantages that can be demonstrated in numerous applications. For instance, this technology is effective for precise measurement and monitoring of choroidal nevi. SS-OCT is superior compared to the conventional ultrasonography especially in lesions less than 1.5 mm thick. Nevi may grow towards vitreous or

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Swept Source OCT & Angiography: Clinical Advances and Applications

Figure 1. SS-OCT showing exudative detachment after radiotherapy of choroidal melanomas.

Figure 2. SS-OCT showing scleral ectasia/necrosis after radiotherapy of choroidal melanomas.

Figure 3. SS-OCT showing a case of posterior uveitis.

Even sclera. Though different morphological features are seen in melanomas and nevi, there is no clear criterion based on OCT helping to differentiate between these two entities.

**IMAGE SERIES**

Exophytic Papillary Angioma

This imaging represents the diagnosis of exophytic papillary angioma (Figure 5A through 5G). We performed a 9x9 mm SS-OCTA scan using the central fixation to get both macula and optic disc visualized in one scan. The SS-OCTA of the superficial capillaries (5A) was normal, but in the deeper layer (5B), a vascular structure was detected at the temporal margin of the optic disc. On B-Scan a solid intraretinal mass with confined vascular flow (5C, arrow) was shown. There was no contact to retinal pigment epithelium (RPE), and the SS-OCTA of the sub-RPE layers was normal so that a juxtapapillary CNV could be excluded. The diagnosis of an exophytic papillary angioma was made. The dimension of the angioma (BxLxH 640x1028x276 µm) was measured by vertical and horizontal B-Scans (5D, 5E). The En Face mode (5F) demonstrated much more detailed information about the two-dimensional extend of the angioma and the surrounding exudation compared to the fundus photo (5G).

Figure 4. SS-OCT showing progress 1 week after oral steroids and 3 months after no medication in a case of posterior uveitis.
SS-OCT helps in the detection of secondary effects after radiotherapy of choroidal melanomas, such as exudative detachment (Figure 1, page 6) or scleral ectasia/necrosis (Figure 2, page 6). SS-OCT with a clear signal in vitreous, retina, and choroid is an ideal tool for monitoring treatment response in posterior uveitis via detection of the inflammatory response in the vitreous, the retina deposits, and exudative changes, as well the choroidal infiltrates in just one scan. In this example of posterior uveitis, SS-OCT imaging compares progress 1 week after oral steroids and 3 months after no medication (Figures 3 and 4, page 6).

Choroidal hemangiomas can be well visualized by SS-OCT and have a typical pattern with the blood-filled cavernous, and retinal angiomas can be diagnosed and monitored by OCT angiography (OCTA), which also enables a clear differential diagnosis to juxtapapillary choroidal neovascularization (CNV) (Figure 5A, see Image Series, page 6).

Our use of SS-OCT indicates that its limitations are minor. For instance, the signal is limited by heavy pigmentation of the tumor; tumors with a maximum thickness of up to 1.8 mm to 2.0 mm may be visualized in toto, and, of course, it does not detect lesions outside of the central 30° to 40° of the fundus.

In conclusion, SS-OCT is the best available OCT technology for visualising tumors within the eye. It’s useful in differential diagnosis of flat melanocytic lesion, in measuring and monitoring lesion over time, in monitoring treatment, such as that of melanoma, angioma, and posterior uveitis; and OCTA adds valuable information especially in vascular tumors.

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New Software Study: GA-AMD Quantification

GA associated to AMD is an advanced form of AMD that affects more than 5 million people worldwide.¹ It is a common cause of vision impairment worldwide and a leading cause of impaired visual function in the elderly people.²

BY JOSÉ M. RUIZ-MORENO, MD, PHD

Assessing BCVA alone does not capture the effect of geographic atrophy (GA) on visual function. With GA, patients often have sparing of central visual acuity, but they still experience profound deficits in visual acuity. With GA, poor low-light vision is a major patient complaint, and low luminance dysfunction predicts subsequent visual acuity loss in GA. The speed with which patients can read is another major complaint of GA patients, and it has substantial impact. The speed with which patients are able to read has an inverse correlation with GA lesion size. Microperimetry is another barometer of GA extent; it correlates GA progression with scotomatous points in the macular area.

IMAGING METHODS
There are several imaging methods available to quantify GA age-related macular degeneration (AMD), such as color fundus photography, autofluorescence, Spectral Domain (SD)-optical coherence tomography (OCT) and Swept Source (SS)-OCT. GA-AMD is a progressive disease; the assessment of GA from OCT images is an important clinical and research task as it provides valuable information regarding the evolution of the disease. OCT is one procedure that can verify progression of GA-AMD. Using SS-OCT, the device provides us a high-resolution study of the atrophic area, as this example shows (Figure 1, page 8). Hotlz et al. have published that fundus autofluorescence (FAF) imaging can identify GA subtypes that may predict the rate of lesion enlargement, as seen in this example (Figure 2, page 8).

AUTOMATED GA-AMD QUANTIFICATION
Due to the time consuming and subjective nature of manual image analysis, there is a need for reliable objective automated methods of image segmentation to obtain GA measures of both lesion perimeter and lesion area.
The vast majority of previous studies examining GA, with imaging methods, have utilized manual measurement procedures, which have several limitations. They require subjective judgments; they can be too time consuming to be practical in a clinical setting; they can potentially be prone to bias; and they presented great difficulty because of the numerous data sets needed for statistical analysis.

For all of these reasons, new software was developed by Topcon (Japan) to reduce the complexity of compiling imaging data. In order to determine the accuracy and repeatability of the new software, we carried out a cross sectional, non-interventional study. The aim of the study was to evaluate this software’s ability to automate and simplify quantification of GA-AMD using SS-OCT.

**PATIENTS AND METHODS**

- This cross-sectional, non-interventional study included 60 eyes from AMD patients, with GA and without previous choroidal neovascularization (CNV). They were scanned using a Triton SS-OCT (Topcon, Japan).
- The study of every eye included color fundus photography, autofluorescence imaging, OCT study with a 7x7 cube area with eye tracking, repeated three consecutive times, and five-line cross of 12 mm.
- Three observers independently determined the area and the perimeter at the FAF image as ‘gold standard’ measurement of the size of the GA area.
- They independently performed the corrections at the automatic segmentation of the atrophic area.
- All tasks were performed in a masked fashion.
- Inclusion criteria were GA-area associated to AMD without previous CNV, enough capacity to fixate the OCT test, the entire atrophic area must be included in 7x7 cube, and no opacities of the media.
- At the time of this presentation we had 42 eyes from 32 AMD patients (10 bilateral cases).
- There was 61% female (26/16); all were Caucasian.
- Median BCVA was 20/160, with a range of 20/40 to 20/400.

**STUDY AIMS:**

- To study the reproducibility of the software by comparing the automatic area and the automatic perimeter between the three consecutive explorations.
- To determine the accuracy of the software by comparing the data obtained with manual measurements versus automatic measurements.
- To study the real efficacy of the software by comparing the corrected automatic measurements versus manual measurements.

**STUDY OUTCOMES AND CONCLUSION**

- The new software allows us to automatically do the quantification of the GA area and perimeter associated to AMD.
- The image analysis is fast, objective, with a smaller coefficient of variation than manual procedures.
- The accuracy of the new software is better in regular atrophic lesions. It’s necessary to improve its segmentation in irregular cases.

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