Optimizing OCT Imaging

By Jose Antonio Mendoza, MD, MSc

Imaging technologies play an important role in our profession. The ability to visualize tissue and evidence of disease in detail is one of the cornerstones of our jobs, and it's important that our diagnostic technology gives us the highest quality information. High-quality images contribute to a more confident diagnosis, and ultimately better patient outcomes through more informed disease management. Advancements in Optical Coherence Tomography (OCT) imaging devices yielding such optimized images were the topic of a workshop featured at the **virtual eyeRISE 2021 conference**.

When considering OCT imaging devices, the quality can be affected by three parameters: 1) the scan area (field of view); 2) the scan density (resolution); and 3) the scan time. If we hold any one of these parameters constant, the other two factors can be inversely affected. Inherently, there has always been a need to make some tradeoff when selecting the scan pattern on our OCTs—until now.

In an effort to eliminate the need for eye care providers to have to choose between scan area and scan quality, Topcon Healthcare (Tokyo, Japan) developed PixelSmart™ technology for the Triton, Topcon's Swept Source OCT (SS-OCT) platform. At its core, PixelSmart is designed to deliver the best of both worlds—the image quality of a high-density line scan and the wide coverage of a dense cube scan—without sacrificing scan speed.

PixelSmart's new image processing algorithm is elevating visualization of the retina by delivering the clarity of averaged images throughout the entire volume scan—reducing speckle noise and improving contrast. The technology is a post-processing technique, meaning scan time is not affected and existing Triton scans previously captured on the device can be reprocessed to further enhance their scan quality.

This step forward in OCT imaging aims to provide clinicians with the highest possible image quality to help them better identify and differentiate between pathologies, with the goal of improving patient care and outcomes.

The following discussion reveals the positive first impressions from Jose Mendoza, MD (Lima, Peru), an ophthalmologist who spent several months evaluating PixelSmart technology on his patient population.

OCT in Clinical Practice

What is your typical imaging protocol in clinic?
Dr. Mendoza: The protocol that I use the most on every patient is the 12x9mm 3D Wide scan, which gives me a lot of information about the macula and optic disc so I can pinpoint retinal and glaucomatous defects. If I need to focus on a smaller lesion, then I do an averaged line scan to get even more detail.

What percentage of your patients have cataracts and how is SS-OCT technology impacting your care of these patients?
Dr. Mendoza: Fifty percent or more of our patients have dense cataracts. These patients frequently also have glaucoma, AMD, or other retinal diseases in addition to their cataracts. Due to the longer wavelength and deeper penetration of SS-OCT technology, we can significantly improve our workflow because we can visualize the retina through opaque media and avoid surprises after surgery. For us, it's been a game changer.

How do you think improvements to B-scan image quality, with regard to en face and 3D structural visualization, help in the evaluation of retinal pathologies?
Dr. Mendoza: Sometimes rare diseases mimic other diseases and can be very difficult to differentiate. En face imaging can help the clinician decide between, for example, choroidal polyps and CNV, because it reveals a number of biomarkers that can't be seen on a single B-scan. 3D reconstruction is a great weapon to show the patient what is going on in their eye. Patients don't necessarily know what an RPE or CNV is, but seeing a 3D visualization can help them to better understand their condition.

By introducing PixelSmart have you been able to create a standardized scan protocol that covers most, if not all, of your imaging needs in clinic?
Dr. Mendoza: Yes, we have. We were using a lot of 3D imaging processing with en face visualization, but it was too time consuming to look through all of these patient findings and take advantage of all that the technology offers. By introducing a standardized screening protocol that incorporates a PixelSmart scan, we have been able to improve our clinical workflow. We've found that PixelSmart not only improves the quality of the scans but the time that it takes us to interpret the images.

Applying PixelSmart to Patient Cases

CASE STUDY 1: Vitreomacular Traction: Improving Upon 2D Imaging With PixelSmart

This vitreomacular traction case demonstrates how PixelSmart technology has greatly improved on 2D imaging. This 80-year old female, pseudophakic in both eyes since 2010, presented with complaints of blurred vision OU for two weeks. BCVA was 20/100 OD and 20/80 OS, and no other relevant pathologies were found on the physical exam. We performed simultaneous, pinpoint registered OCT and color fundus photography with the Triton SS-OCT.

In Figure 1, the fundus photograph for both eyes is unaffected by media opacities because the patient is pseudophakic, OU.

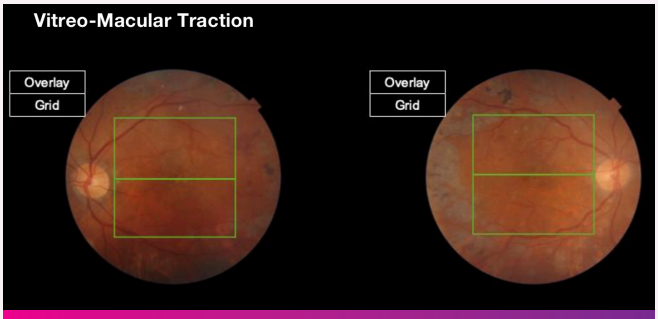

Figure 1.

Figure 2 shows vitreomacular traction with PixelSmart off. The surface of the retina reveals small hyperreflective bands that suggest an epiretinal membrane, but could be a reflection or an artifact.

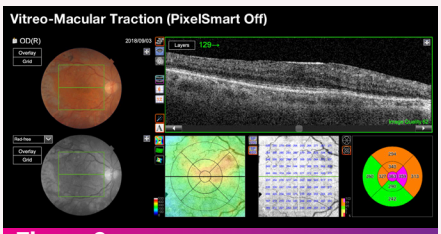

Figure 2.

In Figure 3, with PixelSmart on, the hyperreflective band can be seen clearly in the center of the fovea. It's also possible to see the extent of the vitreomacular traction—extending superiorly and nasally to the fovea.

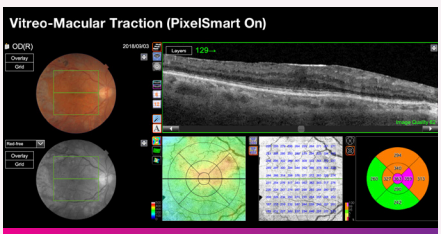

Figure 3.

In Figure 4, switching to en face imaging with PixelSmart off (left Panel A), the extent of the macular traction and the epiretinal membrane is apparent, but details are hard to see. When PixelSmart is turned on (right Panel B), details become clear across the epiretinal membrane, and some of the bands of traction and their locations in the surface irregularities can be visualized.

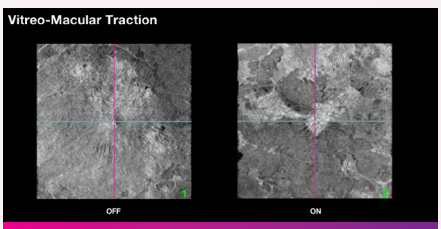

Figure 4.

Figure 5 depicts a 3D reconstruction using PixelSmart technology. The software not only corrects motion artifacts that frequently confound OCT images, but it also improves the 3D reconstruction of the image.

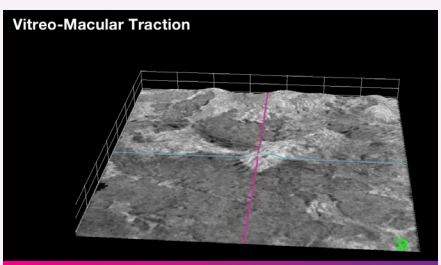

Figure 5.

In addition to high-resolution B-scans, the Triton can also create a movie of several different B-scans overlapping in full resolution. This type of visualization is very valuable when evaluating difficult cases.

CASE STUDY 2: Differentiating AMD from PCV: Cutting Through Opacities with PixelSmart

In this case, there is a need to differentiate between a neovascular membrane and polypoidal choroidal vasculopathy (PCV)—a pathology that can be the cause of exudative maculopathy, especially in Asian populations. PCV often gets misdiagnosed as macular degeneration due to similarities in the pathologies, which consequently impacts the effectiveness of the treatment. PCV can exhibit characteristic features on OCT that we can look for to distinguish its presence.

This 86-year old male, pseudophakic in the right eye with a previous diagnosis of bilateral AMD, presented with complaints of blurred vision in the left eye prior to cataract surgery. His BCVA was 20/40 OD and 20/100 OS, and no other relevant pathologies were reported. Using the Triton SS-OCT, the patient had OCT imaging and color fundus photography simultaneously captured, and ICGA was performed on another device.

In Figure 1, the patient's initial imaging revealed a dense cataract in the left eye, so SS-OCT technology was needed to image through the opacities.

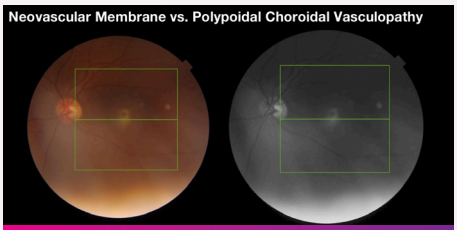

Figure 1.

In Figure 2, the patient's OCT image without PixelSmart is depicted. Usually with PCV, some polypoidal lesions and pigmented epithelium detachments are present, and the choroid appears thickened. The condition, in the spectrum of pachychoroid diseases, commonly exhibits a double layer sign which can be hard to visualize with a 3D volumetric scan, especially if the scan is not densely sampled.

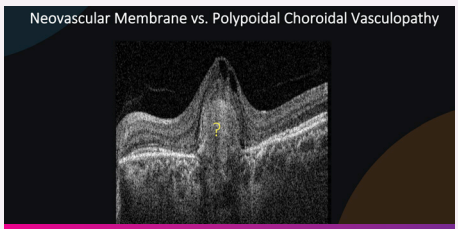

Figure 2.

Figure 3 is the resulting patient image after PixelSmart technology was applied, which enhanced the visibility of the lesions leading to the ability to make a more confident diagnosis.

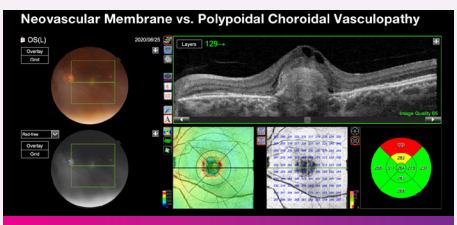

Figure 3.

In Figure 4, the B-scan illuminates hyperreflective foci, neovascular lesions, subretinal hyperreflective material, and pachychoroid. This is suggestive of classic AMD with neovascular membrane, rather than PCV.

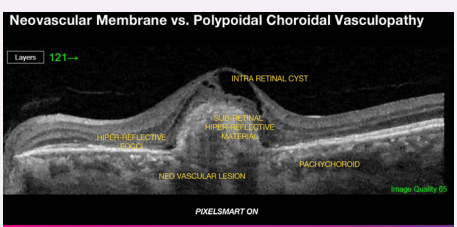

Figure 4.

As a clinician who depends on high image quality to make accurate diagnoses and treatment plans, the Triton SS-OCT with PixelSmart is invaluable technology that I've incorporated in my daily clinical practice. ●

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