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Using Fourier Domain OCT to Improve Clinical Outcomes

Learn about features that enable us to see the fine details of the posterior segment more clearly than ever before.

By Yasuo Tano, M.D.

As a retina specialist, I believe the RTVue-100 Fourier domain optical coherence tomography (OCT) system is an incredibly powerful tool in ophthalmic practice. It's one of the fastest scanning machines available, providing very precise resolution of fundus images. The instrument also produces various microscan modes that are very useful in patient care.

In this article, I'll discuss the capabilities of the RTVue-100 and how we can use it in a wide variety of clinical cases.

Higher Definition

The faster speed and higher resolution of Fourier domain OCT allows for higher definition, which is facilitated by more pixels per image. As anyone familiar with high-definition television knows, more pixels make a picture sharper. Details, such as small blood vessels and the photoreceptors in the inner and outer segments, become crystal clear.

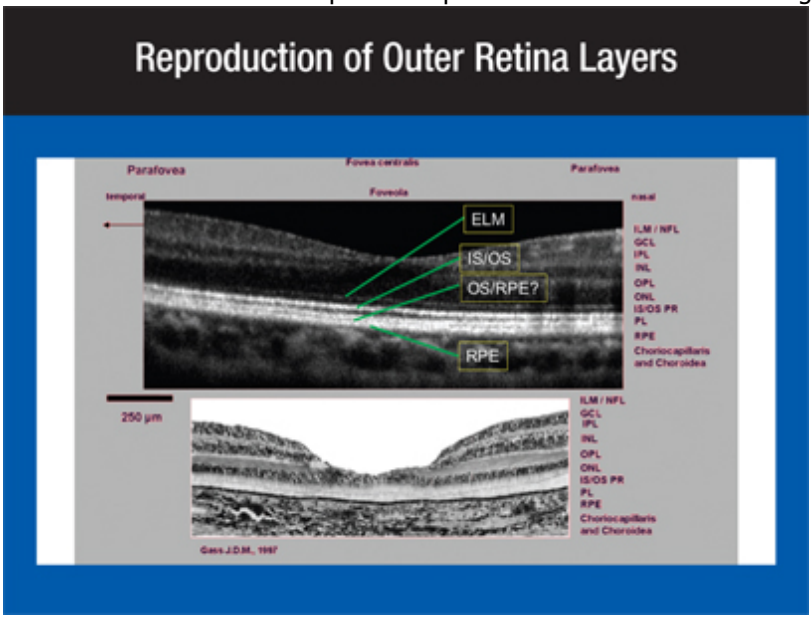

Figure 1. The RTVue-100 allows us to delineate the four outer layers of the retina.

Because the Fourier domain OCT image is captured in a fraction of a second, we don't see the motion artifact that's commonly seen in conventional OCT images. Finally, because of the efficiency of simultaneous signal acquisition, Fourier domain OCT has a higher signal. It appears brighter and cleaner than time domain OCT. Even deep choroidal vessels are visible in normal eyes.

The RTVue-100 also provides excellent resolution in the vitreoretinal mode, helping us examine the inner part of the retina, or in the chorioretinal mode, enabling us to examine the outer part of the retina. Crisp images can be obtained for most cases.

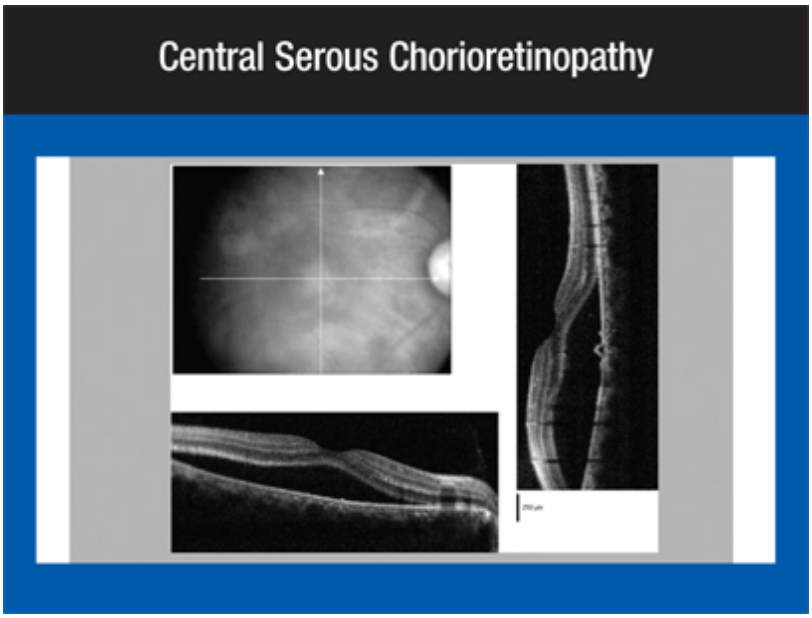

Figure 2. Significant bulging of the retinal pigment epithelium (RPE) is seen in this case of central serous chorioretinopathy.

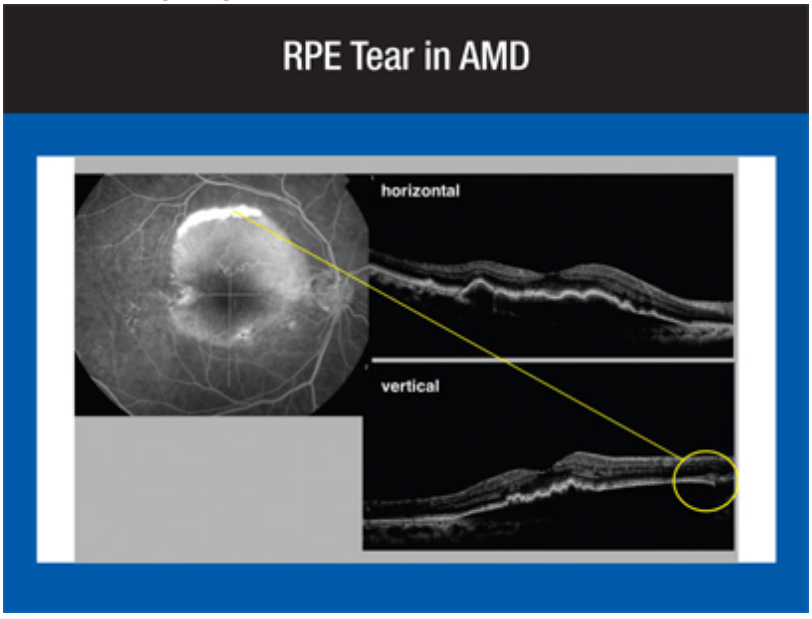

Figure 3. This image shows a retinal pigment epithelium (RPE) tear in a patient with age-related macular degeneration.

The RTVue-100 Difference

You may wonder what difference these features make in daily clinical care. One example can be found in **Figure 1,** where the RTVue-100 provides a view of the four outer layers of the retina. In addition, we can obtain a 12-mm wide scan image. This provides enough length to scan the entire posterior pole.

In central serous chorioretinopathy (CSC), for instance, we can see significant bulging of the retinal pigment epithelium (RPE), as shown in **Figure 2**. Or, as presented in **Figure 3,** we can see an RPE tear in a patient with age-related macular

degeneration (AMD).

The RTVue-100 also allows us to focus clearly on a total epiretinal membrane. This device can provide a clear image of vitreomacular traction syndrome with disruption of the outer part of the retina as seen in **Figure 4** and can reveal a microhole (**Figure 5**) that wouldn't be clearly visible with time domain OCT.

Cystoid Macular Edema and Other Conditions

Figure 6 shows cystoid macular edema (CME) associated with branch retinal vein occlusion. Layers in the outer retina appear to be more or less within the normal range. The appearance of these structures tells us that this patient will make a good visual recovery after appropriate treatment.

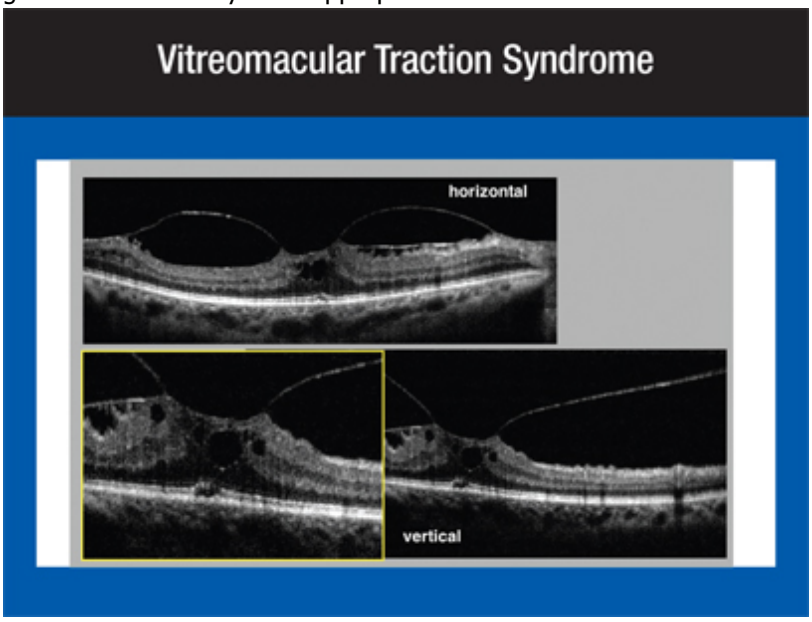

Figure 4. Vitreomacular traction syndrome is visualized using the RTVue-100.

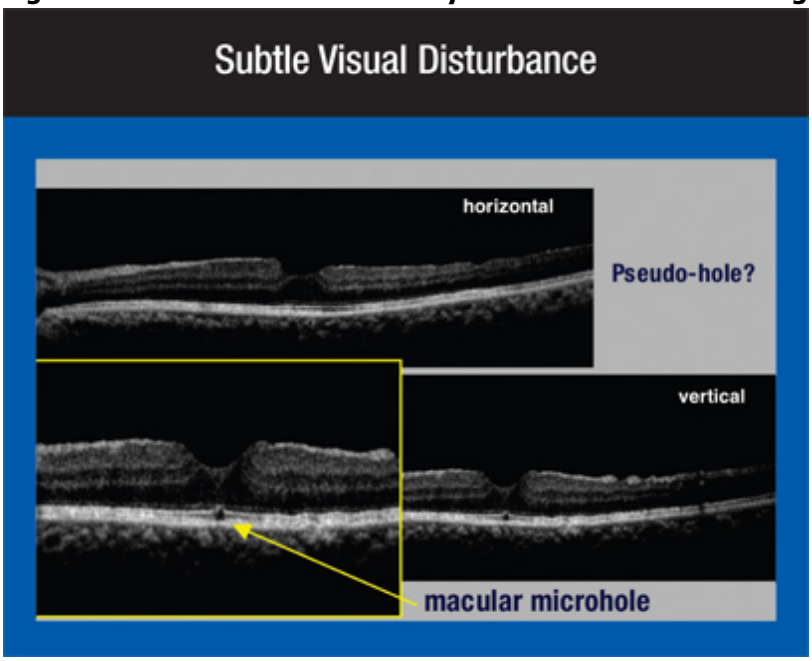

Figure 5. A small area of the perifoveal scotoma looks like a pseudo-hole, but a closer look with the RTVue-100 reveals the micro-hole and disruption of the outer part of the retina.

Retinitis pigmentosa is shown in **Figure 7**. The RTVue-100 clearly shows the outer part of the retina, revealing that most of the outer retina is gone.

In a case of CSC, the RTVue-100 enables us to see exudation and, with the use of a B-scan, the translucent area as well. These cases almost always present with a translucent region. One case of CSC involved a patient who had the disease more than 5 years and presented with visual acuity of 20/200. The detached retina was somewhat thin. The lack of structure in the outer retinal layer suggested a poor visual prognosis.

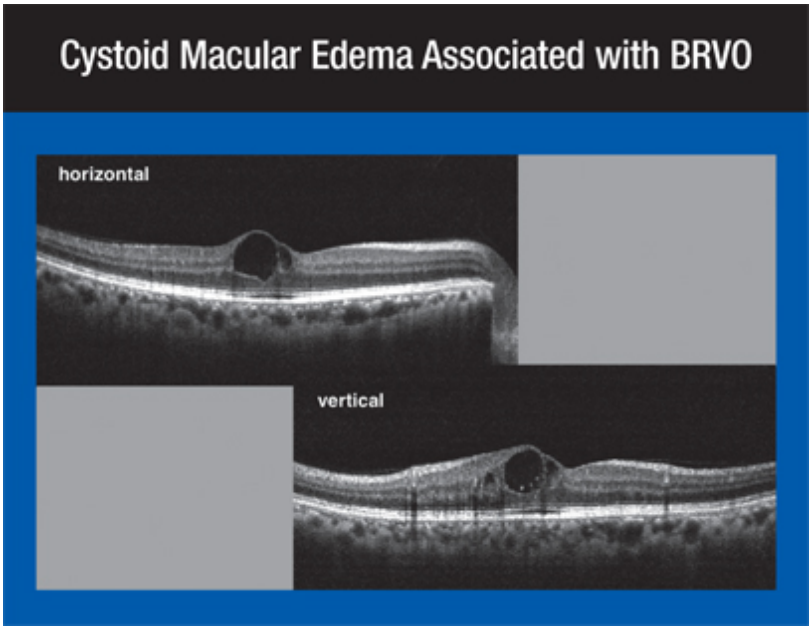

Figure 6. The outer retina appears to be more or less within the normal range in this case of cystoid macular edema associated with branch retinal vein occlusion.

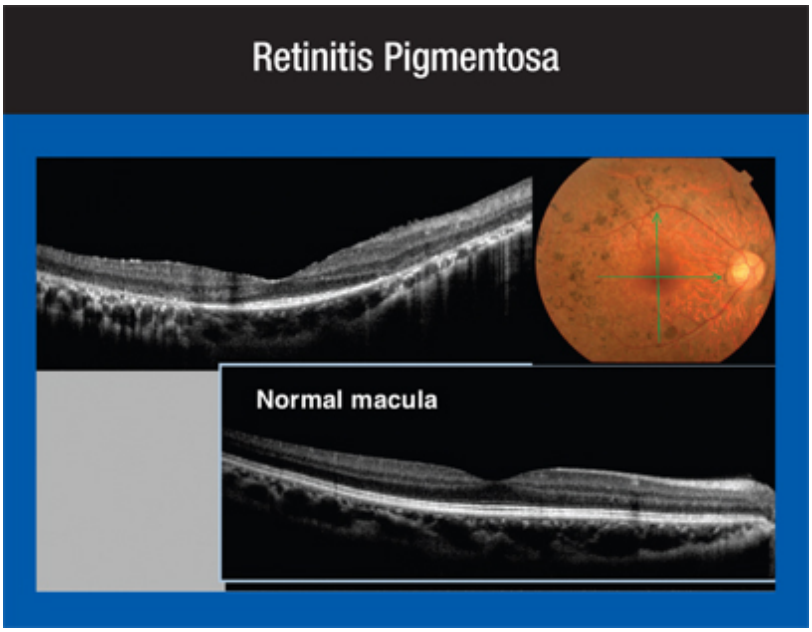

Figure 7. Most of the outer retina is gone in this case of retinitis pigmentosa.

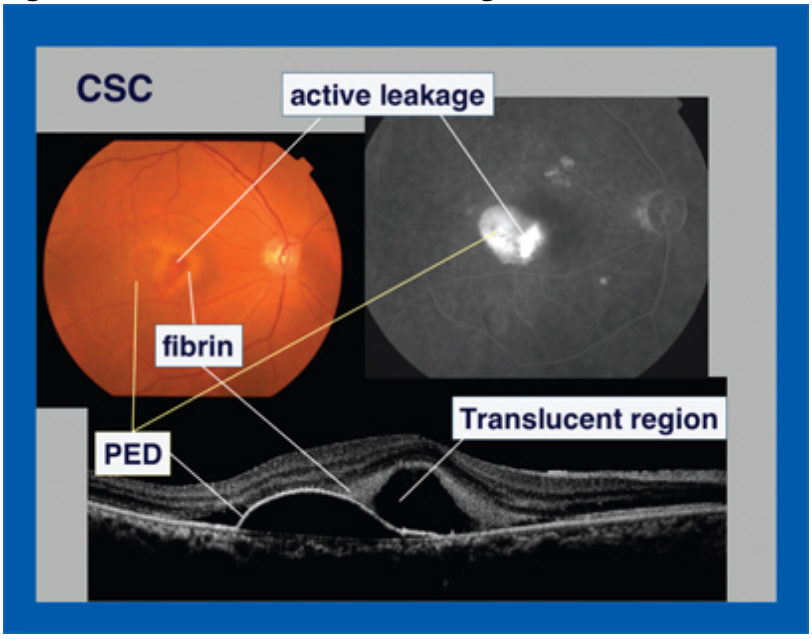

Figure 8. Central serous pigment epithelial detachment (PED) and fibrin exudation are seen in this case of central serous chorioretinopathy (CSC).

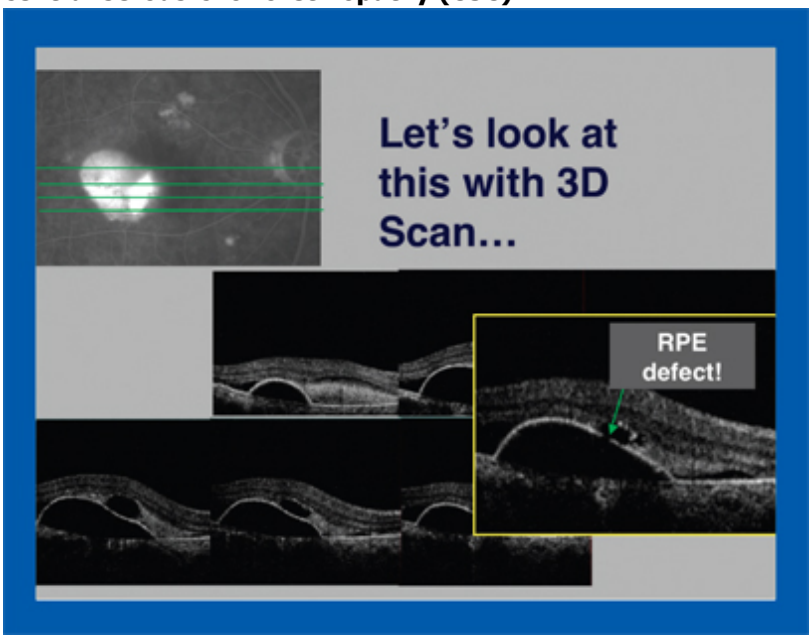

Figure 9. The RTVue's 3-D scan of the same patient shown in Figure 8 reveals fibrin exudation and a translucent area.

VKH Disease and PCV

The RTVue-100 allows us to see subretinal fluid in horizontal and vertical views in a case of Vogt-Koyanagi-Harada (VKH) disease. We may be able to avoid performing a more invasive fluores-cein angiography to identify the pathology in some of these cases.

In polypoidal choroidal vasculopathy, we have even less reason to turn to fluorescein angiography. We can see polypoidal lesions much better with the RTVue-100 technology than with fluorescein angiography in some cases. For instance, an image of a polypoidal lesion plus the fibrin isn't obvious on an angiogram, which provides a flatter presentation.

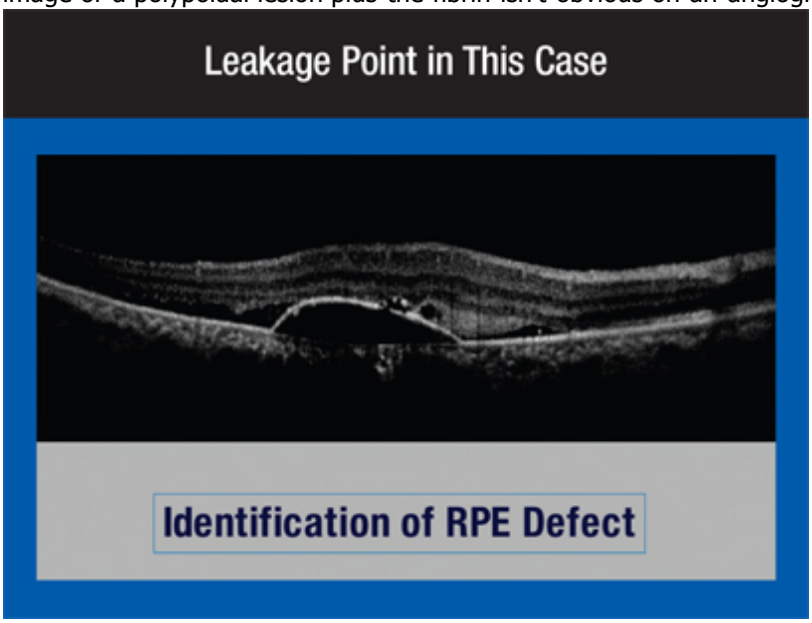

Figure 10. The RTVue-100 identifies a retinal pigment epithelium (RPE) defect.

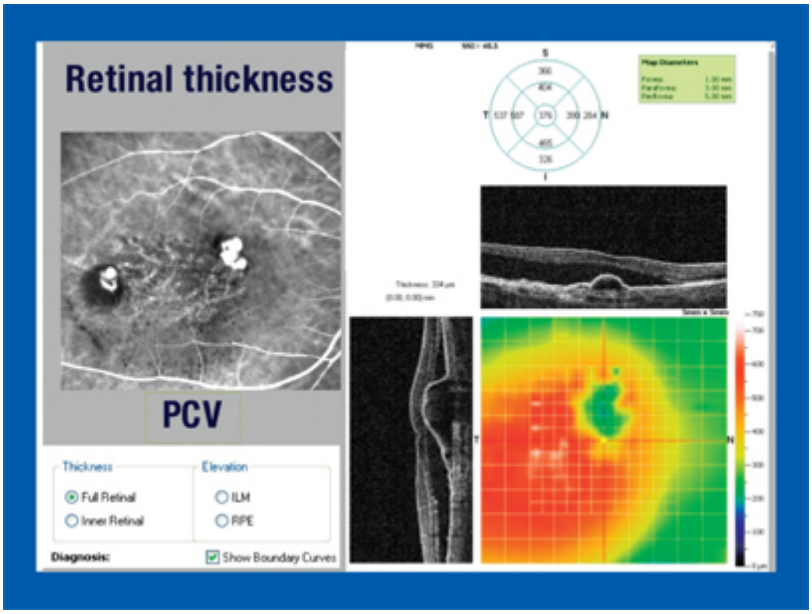

Figure 11. The RTVue-100 precisely presents a map of sensory retina thickness.

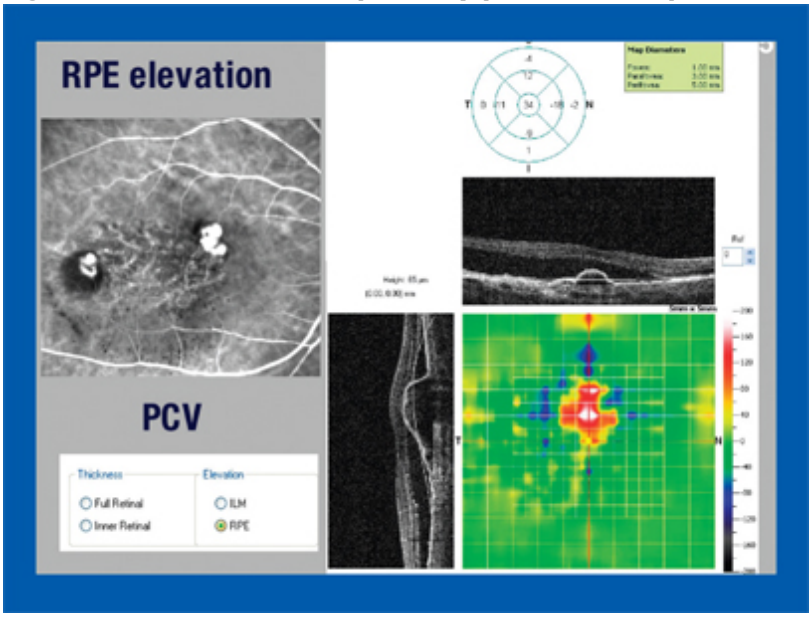

Figure 12. The retinal pigment epithelium (RPE) is shown by the RTVue-100, delineating the inner limiting membrane (ILM) and the RPE layer.

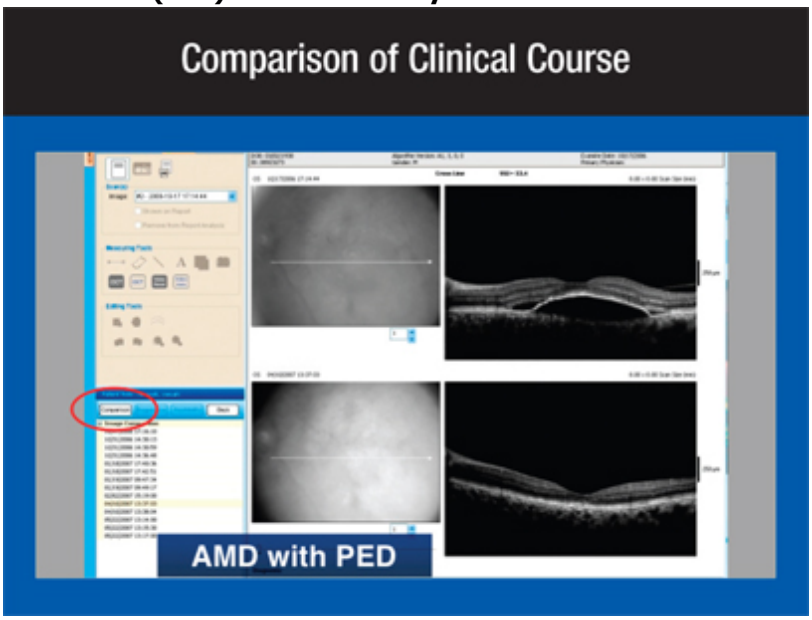

Figure 13. The RTVue-100 enables us to effectively track a patient with AMD and pigment epithelium detachment (PED).

Using 3-D Analysis

The 4-mm × 4-mm 3-D macula scan from the RTVue-100 enables us to see a coronal scan image very easily, and that image can be reproduced with one scan during an examination.

For example, in a case of myopic foveoschisis, when using time domain OCT, which takes long axial eye scans, we struggle to see the fine detail. With the RTVue-100, however, the process of obtaining a clear image is much easier. In this case, we can identify the microfolds very well, even with the long axial link.

In cases of CSC, we've always spent a good deal of time locating the bulging of the lesion. Now, we can locate it easily by moving a cursor. Using the 3-D mode, we can view the bulging, the small lesion and the leakage. We can see what we need to see even after several weeks, as the lesion becomes more diffuse.

In **Figure 8,** we can see the central serous pigment epithelium detachment and the presence of fibrin exudation.

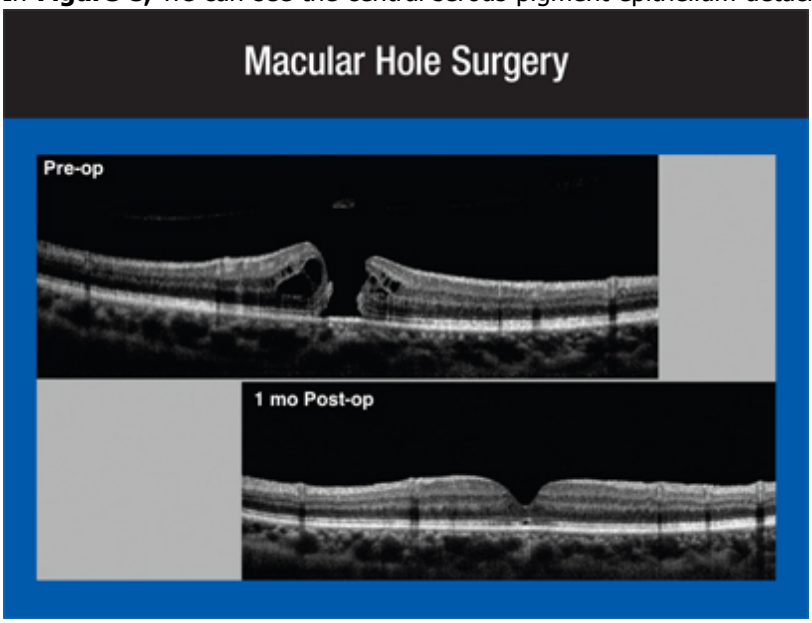

Figure 14. The RTVue-100 shows preoperative and postoperative macular hole size, which may help us predict the treatment outcome for this patient.

Figure 9 shows the same patient using the 3-D scan of the RTVue-100. As expected, there's fibrin exudation and a translucent area.

In **Figure 10,** we can find the RPE defect right at the point where we see the translucent region. Only this dynamic machine can identify the RPE defect in such cases.

Biometric and Chronological Analysis

We also can perform biometric and chronological analyses with the RTVue-100, as well as measure the RPE elevation using a convenient algorithm. In contrast, measuring the RPE elevation with time domain OCT is likely to produce erroneous results.

Figure 11 shows a map of sensory retinal thickness. We can see the RPE elevation in **Figure 12,** delineating the inner limiting membrane and the RPE layer. Retinal thickness is shown again in the posterior vitreous cortex, where the elevation is clearly seen.

In addition, we can obtain measurements manually. We can draw a line around fibrin-enriched subretinal fluid, for example, to remeasure it. We can perform biometry in the case of an RPE tear and measure retinal thickness automatically.

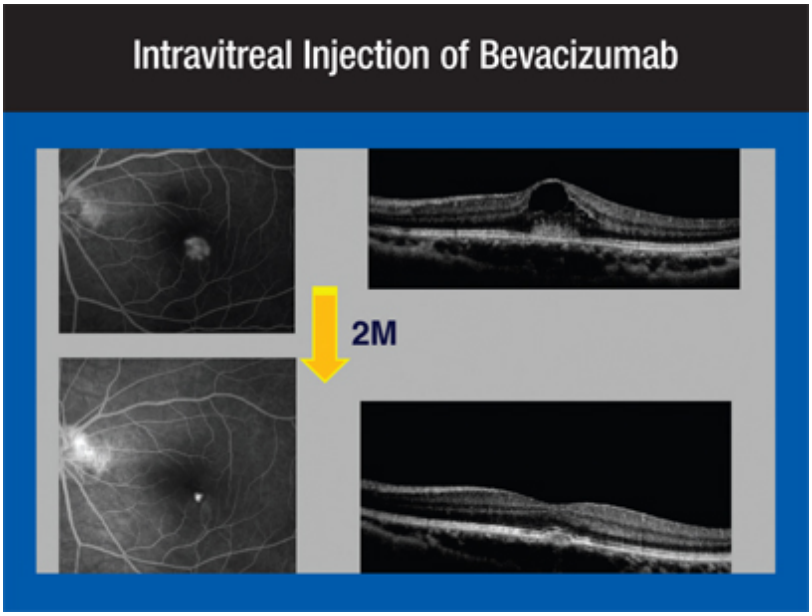

Figure 15. An age-related macular degeneration case is shown before and 2 months after bevacizumab (Avastin, Genentech) treatment.

Tracking Clinical Care

Using comparison images to track the clinical course of a disease is key to optimizing treatment choices. The RTVue-100 enables us to effectively track a patient with AMD and pigment epithelium detachment (PED). We can clearly see the findings before and after treatment **(Figure 13)**.

Figure 14 shows the size of a macular hole preoperatively and postoperatively. The images can help us predict visual performance after surgery. **Figure 15** shows an AMD case before the use of bevacizumab (Avastin, Genentech) and 2 months after treatment. We can see clearly how the choroidal neovascularization has changed.

New Horizons

Fourier domain OCT with the RTVue-100 significantly broadens our diagnostic capabilities. It provides us with precise biometry and detailed analysis through the use of 3-D and chronological imaging. Even more encouraging is the fact that further development of sophisticated vitreoretinal imaging analysis is expected in the future. I believe we're obtaining the best available imaging because of the introduction of this technology.

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