Part one of a three-part series on the important role of the CIRRUS HD-OCT and how it may ultimately allow practitioners to provide a higher standard of care to their patients.

The development of optical coherence tomography (OCT) stands as one of the most significant medical breakthroughs in all of eye care. Initially thought to be a technology geared mainly for ophthalmology, optometrists have quickly embraced it and are in a perfect position to take their place as the primary eye-care provider. And just in time, as the demand for medical eye care is expected to increase over the next two decades as the population ages. An aging population means more patients with ocular disease than ever before—and consequently, more patients with macular degeneration, diabetic retinopathy, glaucoma and a host of other diseases. The CIRRUS HD-OCT by Carl Zeiss Meditec enables practitioners to visualize disease that is invisible to ophthalmoscopy and helps to diagnose disease earlier and more effectively.

At this year’s SECO International meeting in Atlanta, a panel of highly respected optometrists gathered to discuss the use of OCT in the modern optometric practice. A condensed version of this discussion will be presented in a three-part series that offers clinically relevant and practical information on the role of OCT in the diagnosis and management of retinal disease and glaucoma, as well as its practice management applications. Part one, which focuses on retina, begins here.

Mark T. Dunbar, OD: Spectral-domain optical coherence tomography (SD-OCT), specifically with the CIRRUS HD-OCT (Carl Zeiss Meditec), has revolutionized how we look at the retina. Not since Helmholtz invented the ophthalmoscope in the late 1800s has a technology completely changed the landscape of viewing and examining the retina and optic nerve.

Diana L. Shechtman, OD: I agree, Dr. Dunbar. It’s one way for me to dissect the retina and evaluate it layer by layer to better understand the pathogenesis behind retinal disease.

Dr. Dunbar: Whenever I look at the macula of an age-related macular degeneration (AMD) patient, I try to establish the presence of subretinal fluid, hemorrhage or exudate. Sometimes this can be relatively easy to determine on clinical exam and quite often, you need to rely on the OCT to provide that information. Even in cases when it’s clear that there is no fluid, Dr. Shechtman, I have heard you say that you are a big proponent of using OCT to establish a baseline when managing patients just as you do your glaucoma patients. Can you provide us some detail as to how you do that?

Dr. Shechtman: Quantitatively, especially now using CIRRUS HD-OCT, we can truly identify subtle progression over time. Qualitatively, we can observe secondary associated complications such as retinal thinning or disruption of the photoreceptor involvement. In addition, enhanced evaluation of the choroid is now possible with enhanced depth imaging (EDI). In the past, we used to view things in 2-D, but now, assessment is in 3-D.
Using the CIRRUS Advanced retinal pigment epithelium (RPE) analysis, we can measure the area and height, the actual numerical values and the number of drusen in a particular site, which is known as volumetry.

**Dr. Dunbar:** For all patients, we typically do the five-raster line scan to examine the macula in high-resolution. We also always perform the “macular cube,” which contains a lot of the essential information for generating macular thickness maps and 3-D imaging, as well as doing segmentation. Additionally, the macular cube's software program allows you to analyze drusen and geographic atrophy on your patients, so as you follow AMD patients over time, you can objectively measure whether the drusen or geographic atrophy is progressing. That’s why it’s important to scan these patients early in the course of their disease to establish the baseline.

**Kirk L. Smick, OD:** It’s increasingly important to track patients and identify those with this condition earlier.

**Dr. Shechtman:** If we’re talking about progression and you want to analyze macular change, you have to use the cube because you can manipulate the information and conduct more advanced visualization. I also use the raster scan to expand resolution and often conduct my analysis on gray scale images.

**Dr. Gaddie:** A break in the RPE/Bruch’s membrane junction of a non-wet, dry AMD-type patient is a causative factor for the development of wet AMD. Fortunately, the macular cube can help us determine whether there is such a tear or breach of the RPE/Bruch’s membrane junction.

**Dr. Shechtman:** Similarly, if I see any signs of fluid in the presence of drusen, I have a high suspicion that the patient’s dry AMD has converted to wet. The CIRRUS HD-OCT helps me identify the presence of subtle fluid.

**Dr. Smick:** For me, that’s the point (and not until then) at which we refer the patient. Retinal surgeons aren’t going to do anything more for these patients than we would, so this is a great opportunity to keep them in our practices and follow them ourselves.

**Dr. Dunbar:** Great point, Dr. Smick. I think that’s one of the main advantages of the CIRRUS HD-OCT: that it gives us the ability to continue to follow our AMD patients and reaffirms the presence or absence of any fluid. Adding to the comments by Drs. Gaddie and Shechtman about the progression of AMD, the presence of retinal or subretinal fluid is a sure sign that a patient has converted from the dry form of the disease to the wet form.

More than any other SD-OCT technology, I have really been impressed with the evolution of software for the CIRRUS HD-OCT, particularly in being able to more closely follow my AMD patients. But that’s not all; the CIRRUS HD-OCT also has applications in the management of diabetic retinopathy.

**OCT AND DIABETIC RETINOPATHY**

**Dr. Dunbar:** Between 40% and 45% of Americans diagnosed with diabetes have some stage of diabetic retinopathy. Interestingly, one report suggests that at least 90% of new cases could be reduced with proper and vigilant treatment and monitoring of eyes. What is your threshold for ordering OCT in a diabetic patient?

**Dr. Gaddie:** Using the macular cube scans, five-line rasters and progression analysis, we can tell whether a patient’s retinopathy is progressing. Or, if a patient has macular edema and his surgeon injects him with an anti-vascular endothelial growth factor (anti-VEGF) agent or performs a laser procedure, we can use the CIRRUS HD-OCT to follow him in our office to see the resolution of that edema.

How I manage these patients depends on the severity of their retinopathy. The closer to the macula I see hemorrhaging and exudates, the more I’m concerned about macular edema. And, the closer to the posterior pole I see activity, the more likely I am to want to follow that patient using the CIRRUS HD-OCT.

**Dr. Shechtman:** I agree with you 100%. Many diabetic retinopathy patients get anti-VEGF injections, but edema doesn’t just subside after a single injection. Patients need to be re-evaluated for the need to re-treat, even after the initiation of treatment.

I believe a good baseline is individualized for each patient. So at the very least, I would want to establish a baseline so that I can follow that particular patient’s scan over time for any changes, including those in macular thickness.

**“More than any other SD-OCT technology, I have really been impressed with the evolution of software for the CIRRUS HD-OCT, particularly in being able to more closely follow my AMD patients.”**

**Dr. Dunbar:** The main indications for performing an OCT really have not changed since the first commercially available OCT became available in the early 2000s. We all would agree that when looking at a macula, we’re not really sure what we’re seeing—whether there’s fluid or vitreomacular traction (VMT)—but the CIRRUS HD-OCT invariably provides that key piece of information to help determine the diagnosis. That’s why it’s invaluable when dealing with retinal diseases other than AMD and diabetic retinopathy.

**APPLICATIONS IN OTHER RETINAL DISEASES**

**Dr. Gaddie:** In addition to VMT, we
should also discuss macular holes and how the CIRRUS HD-OCT has revolutionized the way we manage these conditions.

**Dr. Shechtman:** CIRRUS HD-OCT is invaluable when it comes to macular evaluation, particularly for entities such as macular hole and VMT. VMT can progress into a macular hole. Interestingly, 50% of early macular holes will progress and 50% will resolve on their own.1 Yet, once a patient has a stage II macular hole (which is now a full thickness macular hole), regardless of his visual acuity, there’s a 70% chance of further progression with associated decreased visual acuity. Thus, at this stage, a referral is necessary.

**Dr. Dunbar:** I also utilize EDI in patients who have idiopathic central serous chorioretinopathy (ICSC). Patients who tend to have recurrent central serous also tend to have thicker choroids, so this is another great application.

**Dr. Gaddie:** Those patients reportedly in the literature have a higher rate of having a choroidal neovascular membrane, so when they’re recurrent like that, I definitely want to watch the state of the RPE to see what’s going on.

**Dr. Dunbar:** That’s a good policy, Dr. Gaddie. On another note, while the CIRRUS HD-OCT can perform segmentation, not all SD-OCTs have the technology to do so. Dr. Shechtman, can you provide an example of when you might do segmentation?

**Dr. Shechtman:** I would perform segmentation in cases where there is a lot of drusen and consequently, also a good amount of disruption. OCT can help to both qualify and quantify this associated disruption. Using the CIRRUS HD-OCT, I can fillet the retina at the level of the true abnormality. We are used to seeing the retina from a bird’s eye view. Using C-scans, which segment the retina from top to bottom, we can compare retinal images with spectacular localized OCT images, side by side.

**Dr. Dunbar:** That’s great. Thank you, Dr. Shechtman.

Before we conclude this part of the series on the CIRRUS HD-OCT, there is one final topic I would like to discuss: Plaquenil (hydroxychloroquine, Sanofi-Aventis) toxicity. When dealing with patients who present with this problem, one challenge that clinicians have faced in the past is the early detection of retinal changes. Fortunately, SD-OCT and other specialized ancillary tests have made this task easier.

**Monitoring Patients on Plaquenil**

**Dr. Dunbar:** In February 2011, we saw a shift in the recommendations for managing Plaquenil patients to SD-OCT or FAF or multifocal electroretinograms.4 How have these revised guidelines changed how you manage and treat your Plaquenil patients?

**Dr. Shechtman:** We perform CIRRUS HD-OCT on every Plaquenil patient who presents to our office for screening (within a year of starting the medication). If we determine that they are a high-risk patient (those who have...
kidney and/or liver dysfunction, high BMI, retinal disease, elderly patients, those who take a dosage higher than the standard 200 mg or 400 mg per day, and those who have been on the medication for longer than five years), we will repeat OCT once every six months to a year, but those who are not high risk will have an OCT performed again five years after baseline and then six months to a year thereafter.

In the past, 1% to 2% of patients taking the standard Plaquenil dose developed fundoscopic apparent Plaquenil maculopathy. Even if the medication was discontinued, many patients continued to experience visual loss. Now, intentionally waiting for fundoscopic apparent maculopathy is too late. It’s imperative to determine early toxicity to initiate prompt management. The CIRRUS HD-OCT can help to further assess the photoreceptor integrity, which may be one of the first areas affected by Plaquenil.

Dr. Dunbar: Where we start to see Plaquenil toxicity is in the outer retinal layers, particularly in that inner/outer photoreceptor segment (IS/OS) junction, which some refer to as the photoreceptor integrity line. But you really need the high resolution of the CIRRUS HD-OCT when looking at the outer retinal layers, particularly at that IS/OS junction, to see some of the earliest changes associated with Plaquenil use.

That wraps up our discussion on the use of the CIRRUS HD-OCT for retinal diseases. Drs. Gaddie, Shectman and Smick, thank you for your valuable input.

Watch for the second part of this three-part series, which will focus on the CIRRUS HD-OCT in the diagnosis and management of glaucoma, next month.

Dr. Dunbar: E.O. is an elderly patient who lost central vision in one eye due to macular degeneration. She also has a large area of geographic atrophy, as well as some retinal pigment epithelium (RPE) abnormality in her macula. Remarkably, her vision continues to be around 20/25. We followed her mostly using CIRRUS HD-OCT. A spectral-domain OCT done in January 2013 shows no sub-retinal fluid or choroidal vascular membrane, but some irregularity is visible at the level of the RPE as well as some loss of the inner/outer photoreceptor segment junction. The images at right compare RPE profile and the sub-RPE slab image from February 2010 (left) and January 2013 (right).

Diana L. Shechtman, OD: This patient’s visual acuity was about 20/30 and she had a history of epiretinal membrane, diabetic retinopathy and dry age-related macular degeneration (AMD). The OCT revealed the presence of fluid. She had both a neurosensory and RPE detachment. Given that we had her baseline data, we compared a previous RPE elevation map to today’s RPE elevation map. The sub-RPE analysis showed evidence of increased RPE thickness. The patient was in fact diagnosed with an early choroidal neovascular membrane. She has improved and maintains excellent visual acuity after prompt treatment of anti-vascular endothelial growth factor therapy.

Case 1

Mark T. Dunbar, OD:

Case 2

Diana L. Shechtman, OD:

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