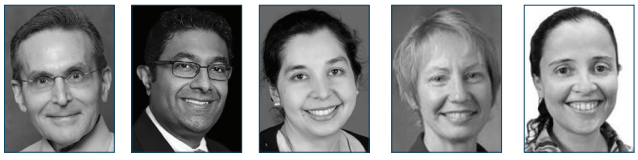
USING OCTA IN YOUR CLINIC

Experts discuss the benefits of this new imaging modality, as well as pitfalls to avoid.

A conversation with Philip J. Rosenfeld, MD, PhD; SriniVas Sadda, MD; and Nadia K. Waheed, MD, MPH
Moderated by Cynthia A. Toth, MD, and Amani A. Fawzi, MD



OCT angiography (OCTA), invented in the mid 2000s, has made its way to the clinic already, yet much debate exists on whether it provides reproducible standardized imaging. For example, if a vessel isn't visible on OCTA, is it a problem with the imaging system or is it indeed missing? To address some of these concerns and help parse out where OCTA fits into our retina imaging armamentarium, we sat down with experts in the field. Here's what they had to say.

– Cynthia A. Toth, MD, and Amani A. Fawzi, MD

DR. TOTH: HOW DOES OCTA FIT INTO THE OVERALL IMAGING PICTURE IN THE RETINA CLINIC?

Philip J. Rosenfeld, MD, PhD: I think of OCTA in two different realms: clinical care and research. The research realm is exciting, but we need to focus more on how the clinician benefits from using this technology. I used to think of it as purely an angiographic tool, but now I think of it as one-stop shopping because an OCTA scan combines both structural and angiographic information.

For angiographic assessment of a patient with AMD, diabetic retinopathy, or a retinal vein occlusion, I use OCTA scans. I can't remember the last time I performed fluorescein angiography (FA) or ICG angiography (ICGA) on a patient with a macular or retinal vascular disease. That's where wide-field swept-source and spectral-domain OCTA imaging are so valuable. I think of OCTA as a single imaging modality from which we can extract multimodal images. While I may not look at the angiographic component right away, I often go back and look at it later.

DR. FAWZI: ARE THERE SPECIFIC PATIENTS FOR WHOM YOU GET AN OCTA?

SriniVas Sadda, MD: I almost never get an OCTA for a patient with a posterior vitreous detachment, but just

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AT A GLANCE

- OCT angiography (OCTA) may not be multimodal imaging per se, but it does provide different modes of visualization—an angiogram, a structural image, and en face imaging with boundary specific segmentation—from one scan.
- OCTA can help clinicians explain the need for frequent follow-up to patients with geographic atrophy who are at risk for developing exudation.
- By assessing the OCTA cross-section with flow overlay, clinicians can rule out artifacts. If the flow is in the wrong location for the disease, it is most likely an artifact.

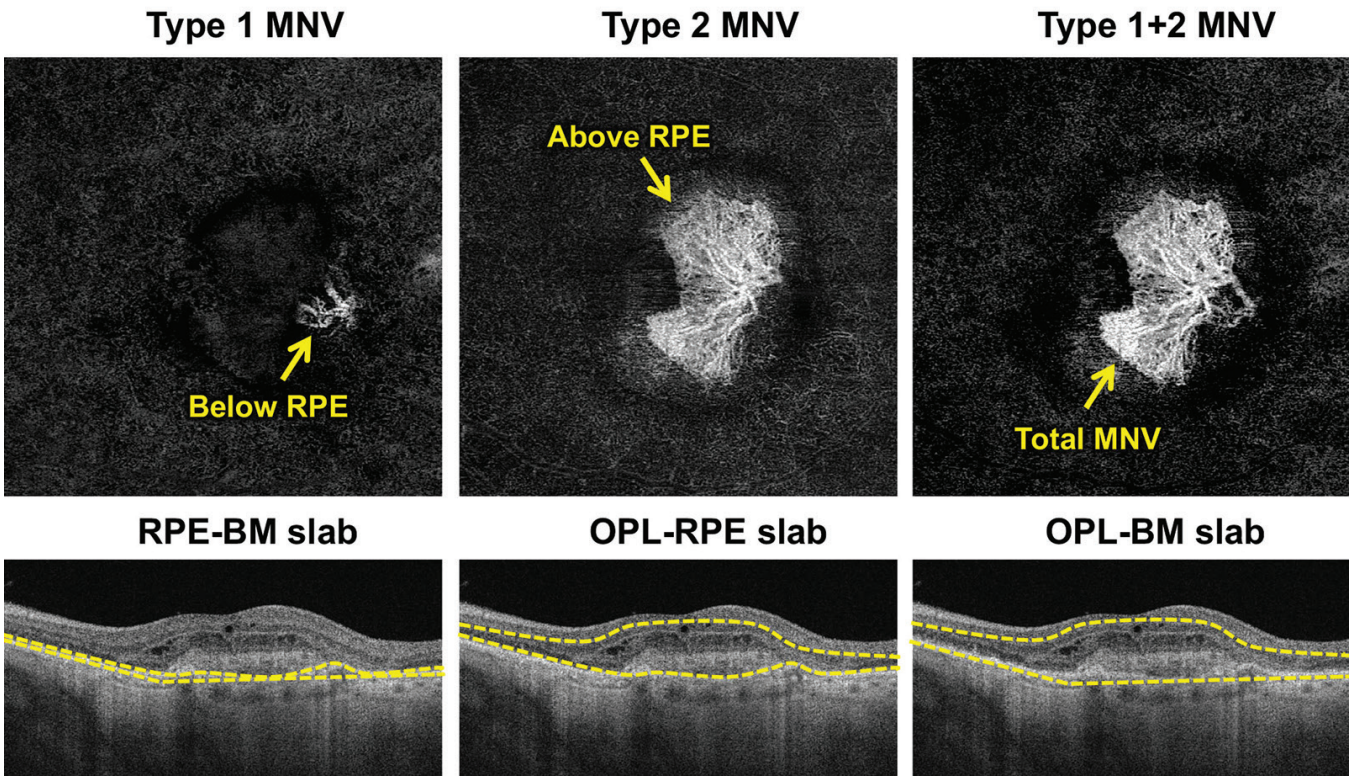

Figure. The use of boundary specific segmentation in OCTA imaging allows for the detection of different components of a macular neovascular lesion. The outer plexiform layer (OPL) to Bruch membrane (BM) slab detects the entire lesion, while the RPE to BM slab detects the type 1 component and the OPL to RPE slab detects the type 2 component.

about everyone else could benefit from OCTA. Still, there are certain patients for whom we get one every time. This really is a clinical tool now, and its utility extends beyond AMD. I use it for any patient who may have macular neovascularization (MNV), and not just high-risk drusen and pigment epithelial detachments (PEDs) with double-layer signs of AMD; it's also useful for other diseases such as myopia and pachychoroid spectrum disorders. In some of those conditions, dye-based angiography is challenging to interpret, and OCTA has been a transformative addition.

I also use it routinely for patients with retinal vascular diseases, such as diabetic retinopathy, to assess macular perfusion. OCTA is clearly better than FA for assessing macular ischemia. It's also a great tool for identifying and monitoring neovascularization, and it can help to distinguish intraretinal microvascular abnormalities from areas of flat neovascularization. In the context of anti-VEGF therapy, especially with montage OCTA scans, I can monitor for the response to treatment.

Another condition for which I obtain OCTA routinely is suspected macular telangiectasia. The structural OCT and OCTA images are really all you need to make this diagnosis.

Lastly, I use it routinely in inflammatory diseases. In placoid chorioretinopathies, for example, OCTA can show significant choriocapillaris abnormalities, a finding that can be helpful with patient management because you can observe some recovery of the choriocapillaris during the course of treatment. In one of our offices, almost every patient gets an OCTA because we anticipate that it might be useful later. Since I can capture OCTA at the same time as a structural OCT, it fits nicely into the workflow.

DR. TOTH: GEOGRAPHIC ATROPHY (GA) IS A HOT TOPIC BECAUSE OF THE NEWLY FDA-APPROVED THERAPY. DO YOU USE OCTA IN THE SETTING OF GA?

Nadia K. Waheed, MD, MPH: We know that patients with dry AMD may have nonexudative MNV on OCTA but may not necessarily have fluid. Their OCT may show low-lying PEDs, and OCTA can help us visualize the network of vasculature that underlies these low-lying detachments. This is a very important feature in patients who phenotypically appear dry because they are at a much higher risk of developing exudation.

I like to do an OCTA scan for my dry AMD patients. While looking for a low-lying PED on the OCT can help, it can be challenging to tell if a patient has MNV at the margins of the lesions, particularly in patients with GA who have basal laminar deposits that often mimic a low-lying PED. It is useful to obtain an OCTA to definitively ascertain if there is neovascularization because it helps me determine how frequently I need to follow these patients.

All of this, of course, will become even more important

as we start using anticomplement therapies for GA. Many of the upcoming new therapies have been associated with a higher risk of conversion to exudation. Now we must question whether this already high risk is even higher in patients who have pre-existing nonexudative lesions. I anticipate using OCTA to look for these lesions and track if they are growing and, eventually, watch for exudation more carefully over time. Additionally, OCTA will be important to either diagnose or rule out conversion to exudation in these patients.

Dr. Rosenfeld: In nonexudative AMD, I really depend on en face OCTA images for the detection of soft drusen, reticular pseudodrusen, calcified drusen, hyperpigmentation, and, most importantly, persistent hypertransmission defects, also known as complete retinal pigment epithelium (RPE) and outer retinal atrophy, or cRORA. These are bright areas on the sub-RPE slab. I can see where the light is beginning to penetrate through the attenuated or absent RPE. The appearance and growth of these persistent hypertransmission defects are synonymous in my mind with the appearance and growth of GA. That's how I'm going to diagnose and follow patients who are candidates for treatment with a complement inhibitor.

Using the same scan pattern but with a different boundary specific slab, I can see a thin double-layer sign or basal laminar deposits around the atrophy, which is a good indication that the lesion is going to grow quickly. Looking at a slab above the RPE, I can identify the reticular pseudodrusen, and with the choriocapillaris slab, I can see flow deficits around the lesion.

Sometimes this double-layer sign in nonexudative AMD corresponds to MNV, and this is where OCTA is so valuable. OCTA can distinguish between basal laminar deposits and MNV. I also make the distinction between macular atrophy that is adjacent to, versus within, the neovascularization. I interpret the prognosis of these cases differently because the atrophy tends to grow slowly when it forms within the lesion. But, when the atrophy is adjacent to the lesion, the GA tends to grow at the same pace as other atrophic lesions.

DR. FAWZI: HOW MUCH TIME DOES THIS TAKE, AND HOW MUCH INFORMATION ABOUT OCTA DO CLINICIANS NEED TO USE IT PROPERLY?

Dr. Rosenfeld: Clinicians can spend a lot of time slicing and dicing these OCTA scans, but in clinic, you just need the basic information, which can be obtained with a retinal thickness map and the sub-RPE slab. The sub-RPE slab is important for detecting the areas of atrophy. Initially, I want to know the answer to two important questions: Is there atrophy, and is there exudation? Everything else can be analyzed later.

Dr. Sadda: The most critical application for most clinicians is identifying neovascularization and patients who may be at high risk for the development of neovascularization.

The beauty of OCTA is that you know for sure because you can see the vasculature. If you are going to treat a patient with a complement inhibitor who already has an area of nonexudative neovascularization, the OCTA is a good discussion point for that patient to help explain why you need to monitor them more frequently for the development of exudation.

Dr. Fawzi: The biggest question that we always face is what about the artifact and how do you deal with them? Some of my colleagues use OCTA and they're sure a patient has MNV, but because the signal strength is weak or the patient has a cataract, they can't find that neovascularization, and they end up throwing the baby out with the bath water, so to speak.

DR. FAWZI: WHAT ADVICE CAN YOU OFFER TO HELP CLINICIANS AVOID ARTIFACTS WHEN STARTING WITH OCTA IMAGING?

Dr. Waheed: There are a few critical pieces to integrating OCTA into clinic. The first is having well-trained photographers. There is a steep learning curve to OCTA, and much of that is photographer dependent. A good OCTA image depends on proper image acquisition much more than a structural OCT alone, and you need people who know how to acquire good images. It does take a little longer than your standard OCT, and standard OCTs tend to be very forgiving of operators.

The second is choosing the right patients. The more I use OCTA, and the better the technology, software, and tracking gets, the easier it is to apply to a broader swath of patients.

The third piece is understanding that the structural information always comes cross-registered with the vascular information. Perhaps the most useful scans are the structural B scans with the flow overlay because they help you correlate the structure and function. For example, if you see an area that has vessels on the OCTA and you think that it might be neovascularization, you can correlate the structure and the function to tell if it is a projection artifact from overlying blood vessels or if it's an area that has a PED or subretinal hyperreflective material associated with the vessels.

OCTA is not multimodal imaging per se, but it does provide multiple different modes of visualization—an angiogram, a structural image, and an en face image—from one scan.

Dr. Fawzi: The cross-section with flow overlay is the most useful scan because you can rule out the artifacts. You can see where that flow is happening and if it's in the wrong location for your disease, it is most likely an artifact.

Dr. Rosenfeld: Artifacts are an issue, but it's rare that they prevent you from appropriately interpreting the data. Artifacts on OCTA, and motion artifacts in particular, tend to arise with the more difficult cases, and dye-based angiography isn't going to provide you any more information anyway. For example, you can't always see the lesion well in patients who have large PEDs associated with type 1 MNV, but these are the same types of lesions that FA and ICGA imaging would yield ambiguous results as well. The more clinicians use OCTA, the more comfortable they will become with processing the images. If you really want to learn as much as possible, these more difficult cases do take time.

Dr. Fawzi: The worst offenders are patients for whom the signal strength is very low; then, you start to see many artifacts, and people are unfortunately misinterpreting them as flow in the wrong places. I usually teach my fellows that if the signal strength is below a certain level, they should ignore that scan because it's full of artifacts and they shouldn't try to extract information that isn't there.

Dr. Rosenfeld: I always teach my fellows to look at the flow but also look at the structural image, particularly the en face image. If you don't have a good structural image, you're never going to be able to extract a useful flow image. Always look at the structure and the flow together.

DR. TOTH: WHAT TYPE OF PATIENTS SHOULD CLINICIANS CHOOSE TO IMAGE WITH OCTA WHEN THEY ARE FIRST LEARNING TO USE THE DEVICE?

Dr. Sadda: Choosing patients with clear media, and maybe patients with good vision and good fixation, can give you a positive experience. You're just asking for problems with signal attenuation and motion artifacts with patients who have substantial media opacity and can't fixate. You want to get off to a good start so that you don't give up because you are frustrated.

OCTA is an incredibly powerful tool, but with great power comes great responsibility. You really must understand the technology to use it wisely. As with all our ophthalmic imaging technology, you must get into the weeds a bit as a responsible clinician to understand how the information from OCTA is actually generated. That can help you make sense of some of the limitations and pitfalls.

We should all look at the en face OCTA imaging with its companion structural image (the same is true of the OCT B scans) to help us recognize various problems, such as motion artifacts.

Similarly, when things disappear in and out of the en face image, be wary of segmentation artifacts. We are used to looking for segmentation artifacts in OCT thickness maps, and we can apply those same lessons to OCTA.

Finally, it is important to recognize projection artifacts. All OCTA devices come with projection removal software, but it's not perfect. Again, using the structural OCT is helpful because the more hyperreflective an object is on the structural OCT, the more likely that it's a projection artifact from an overlying vascular structure.

Dr. Waheed: As you're starting out, some of the interesting cases to look at are either patients who have conditions like central serous chorioretinopathy or those along the pachychoroid spectrum where you're wondering if its neovascularization or fluid in the absence of neovascularization. I'm not a great fluorescein interpreter and always questioned whether something was neovascularization or leakage from a hotspot or small RPE punctures. I've always liked ICG in these ambiguous cases. Now with OCTA, I can tell right away whether there is neovascularization.

OCTA is also useful to image patients with retinal vascular disease, such as diabetic eye disease, especially if you have widefield OCTA. Looking for areas of peripheral ischemia can help you risk stratify these patients. In addition, looking at patients with branch retinal vein occlusions can give you a good idea of how ischemic the retina is and can help you think forward.

For example, if a patient has a branch retinal vein occlusion and macular edema, assessing the level of ischemia can tell you how responsive these patients may be to anti-VEGF therapy. Similarly, for patients with diabetes and macular ischemia, OCTA can help you understand what kind of vision these patients will have after treatment. I find it really gratifying to use OCTA in my retinal vascular disease patients because the images are beautiful, and they tell a story beyond what you can see with structural OCT scans.

Dr. Rosenfeld: A good imaging technician who can acquire OCTA images is worth their weight in gold. They are so valuable because you get good images time and time again.

The more time you spend with OCTA, the better your ability to interpret structural OCT gets. Once you challenge yourself looking at structural OCTs, you can identify the location of both exudative and nonexudative neovascular lesions, polypoidal choroidal vasculopathy lesions, and RPE tears. You will improve your structural OCT interpretations by learning how to interpret the OCTA scan (Figure).

Dr. Fawzi: Know your OCTA machine and get as many OCTAs as you can during the day. But you must sit down at the end of the day with your fellows and go through them. You will get more out of it if you do it after hours. Don't throw the baby out with the bath water when it comes to interpreting OCTA in your clinic; instead, wait until

(Continued on page 30)