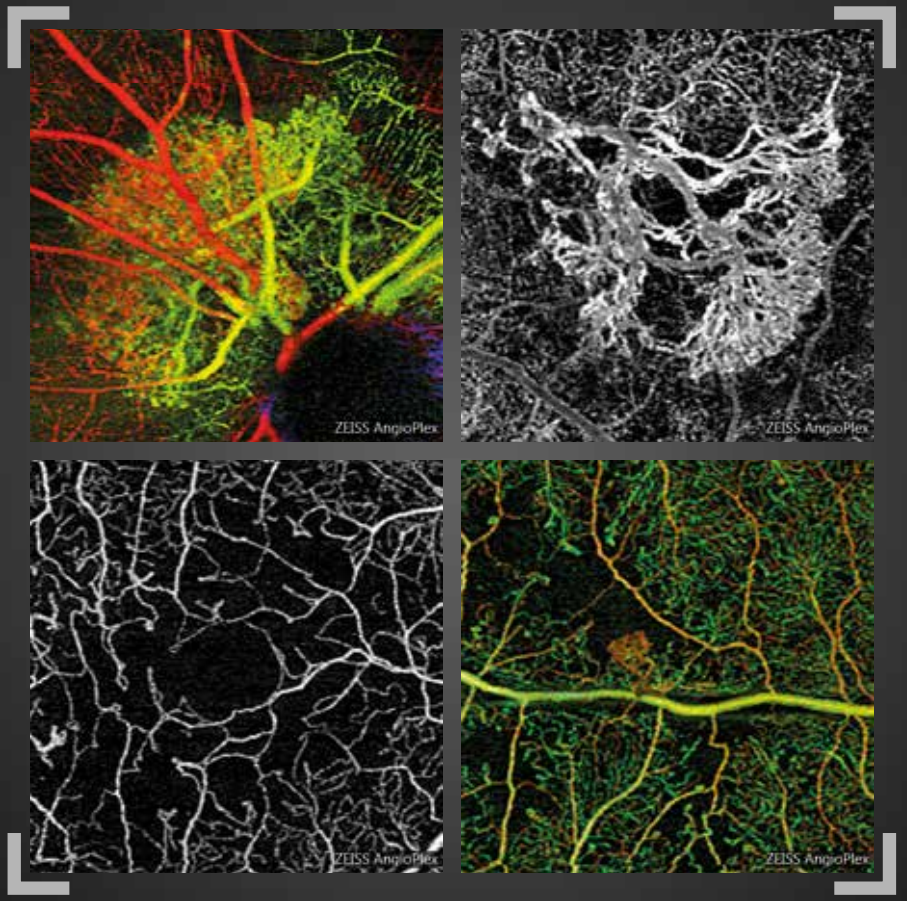
# PRACTICAL

# OCT-ANGIOGRAPHY

## Neovascularization, edema, ischemia and degeneration

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# CHAPTER 1
# OCT-ANGIOGRAPHY TECHNIQUE & OVERVIEW

The capacity of OCT (optical coherence tomography) to non-invasively provide high-resolution, high-sensitivity and in-depth visualization of retinal and eye microstructures without contact, has been a key factor in its success since its emergence in the 1990s. Undoubtedly, OCT has proved to be a technological breakthrough in ophthalmology because it provides unprecedented clinically relevant information to assist with the diagnosis and treatment of eye diseases.

Over the last 15 years, the OCT technology has made substantial advances with a continuous improvement in instruments, ease of use, functionality, and data analysis capabilities, providing assistance in patient diagnosis and monitoring. The Spectral Domain OCT (SD-OCT) technology has rapidly been adopted in ophthalmologic imaging applications, both for clinical and research purposes. Unlike clinical imaging techniques, such as fluorescein angiography (FA) and indocyanine green angiography (ICGA), the clinical use of OCT, which offers a non-invasive approach allowing a rapid high-resolution assessment of retinal microstructures, has steadily increased.

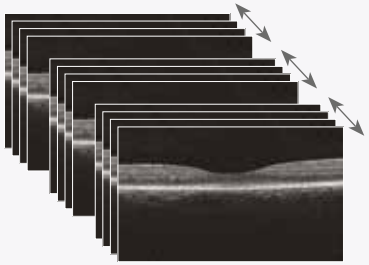
OCT-Angiography is a new, non-invasive diagnostic method through which the vascular structures of the retina and choroid may be visualized in three dimensions without the need for contrast agent injection. Through acquisition software and more advanced hardware, OCT-Angiography enables imaging of the retinal vascular flow.

OCT-Angiography is based on the principle of diffractive particle movement detection, such as red blood cells, on sequential OCT B-scans performed repeatedly at the same retina location, therefore showing the presence of blood vessels. OCT-Angiography requires higher imaging speeds than most currently available devices are able to provide for a sufficiently dense volume.

The method is based on differences between the B-scans to generate a movement-related contrast, especially a contrast related to erythrocyte movement in the vascular system.

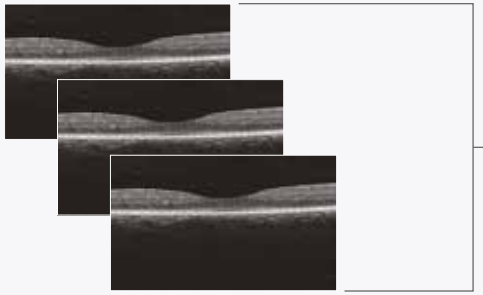
To generate the image of the retinal microvascularization, each B-scan of the examination pattern is consecutively repeated several times. The contrast comparisons on consecutive B-scans at the same location reveal some areas with a contrast change over time and some areas with a constant contrast. The temporal change in contrast in a specific location is attributed to the movement of erythrocytes, which therefore indicates the location of the vessels.

Acquisition

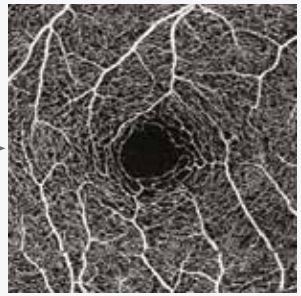


**Sequential OCT B-scans**
The sequential examinations by OCT are acquired up to four times at the same location during a single examination.

Data processing

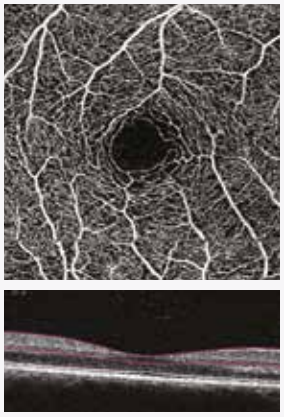


**OCT B-scan of the blood circulation**
Each group of OCT B-scan generates an image of the blood flow.



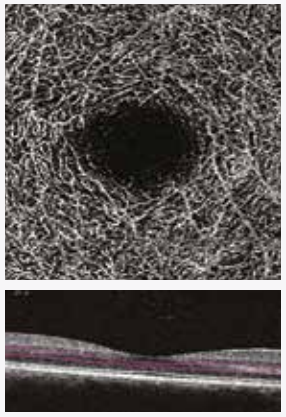
**OCT-Angiography map**
These maps are a reconstruction of the microvasculature of the retina and choroid.

Superficial retina



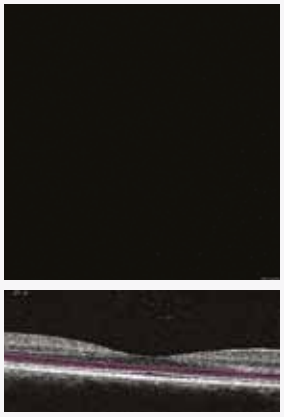
Superficial retinal layer (pre-established map of the vasculature between the ILM [1] and the IPL [2]).

Deep retina



Deep retinal layer (pre-established map of the vasculature between the IPL [2] and the OPL [3]).

Avascular zone



Avascular zone of the retina (pre-established map of the vasculature between the OPL [3] and the RPE [4]).

OCT-angiographic maps are a 2D representation of the retinal vasculature over a particular area of interest.
The analysis interface provides 2D maps of the representation of the microvasculature, according to different anatomically interesting segmentation profiles.

1) ILM: inner limiting membrane
2) IPL: Inner plexiform layer
3) OPL: Outer plexiform layer
4) RPE: Retinal pigment epithelium

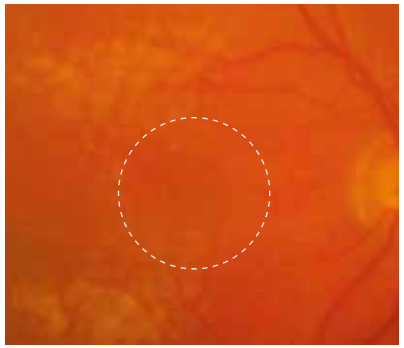
# CHAPTER 2
# CHOROIDAL NEOVASCULARIZATION

OCT-Angiography is an extraordinary tool for visualizing abnormal choroidal vasculature. In addition, the examination provides information on the plane in which these new vessels develop. In age-related macular degeneration, type 1 and type 2 new vessels give rise to much more spectacular images than type 3 new vessels (retinal angiomatous proliferation). Remember that these anastomoses often develop in a plane perpendicular to that of the retinal pigment epithelium, which may explain their poorer visualization in an en-face representation.

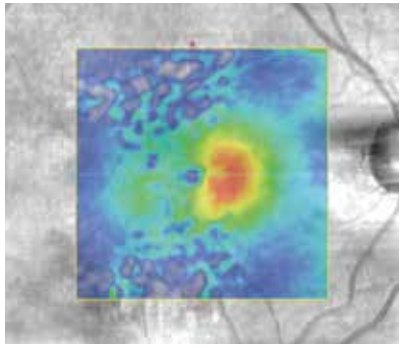
However, the ophthalmologist should remember that visualizing a neovascular network does not systematically mean neovascular activity. Indeed, new vessels may be present but inactive either spontaneously (quiescent occult neovascularization) or after suitable treatment. Thus, the analysis of OCT-Angiography should always include a more conventional OCT analysis with B-scans. Comparing both examinations allows an assessment of the anatomical location of new vessels and their activity, evidenced by exudative manifestations.

The evolution after treatment is still the subject of intense studies. Indeed, if the new vessel morphology seems to change after anti-VEGF treatment, it appears difficult to propose re-treatments based on anatomical changes in neovascular structure, in the absence of exudative manifestation. Only future prospective studies comparing the evolution of OCT-Angiography images to conventional imaging will really clarify the place of this new instrument in the therapeutic management of choroidal neovascularization.

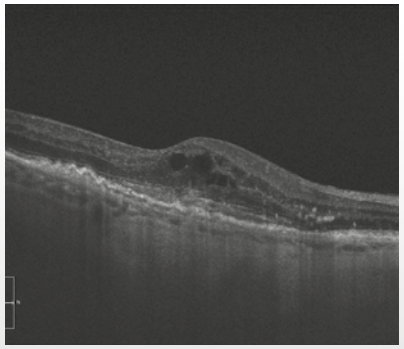
# CLASSIC OR TYPE 2 CHOROIDAL NEOVASCULARIZATION OBSERVED IN A 91-YEAR OLD PATIENT



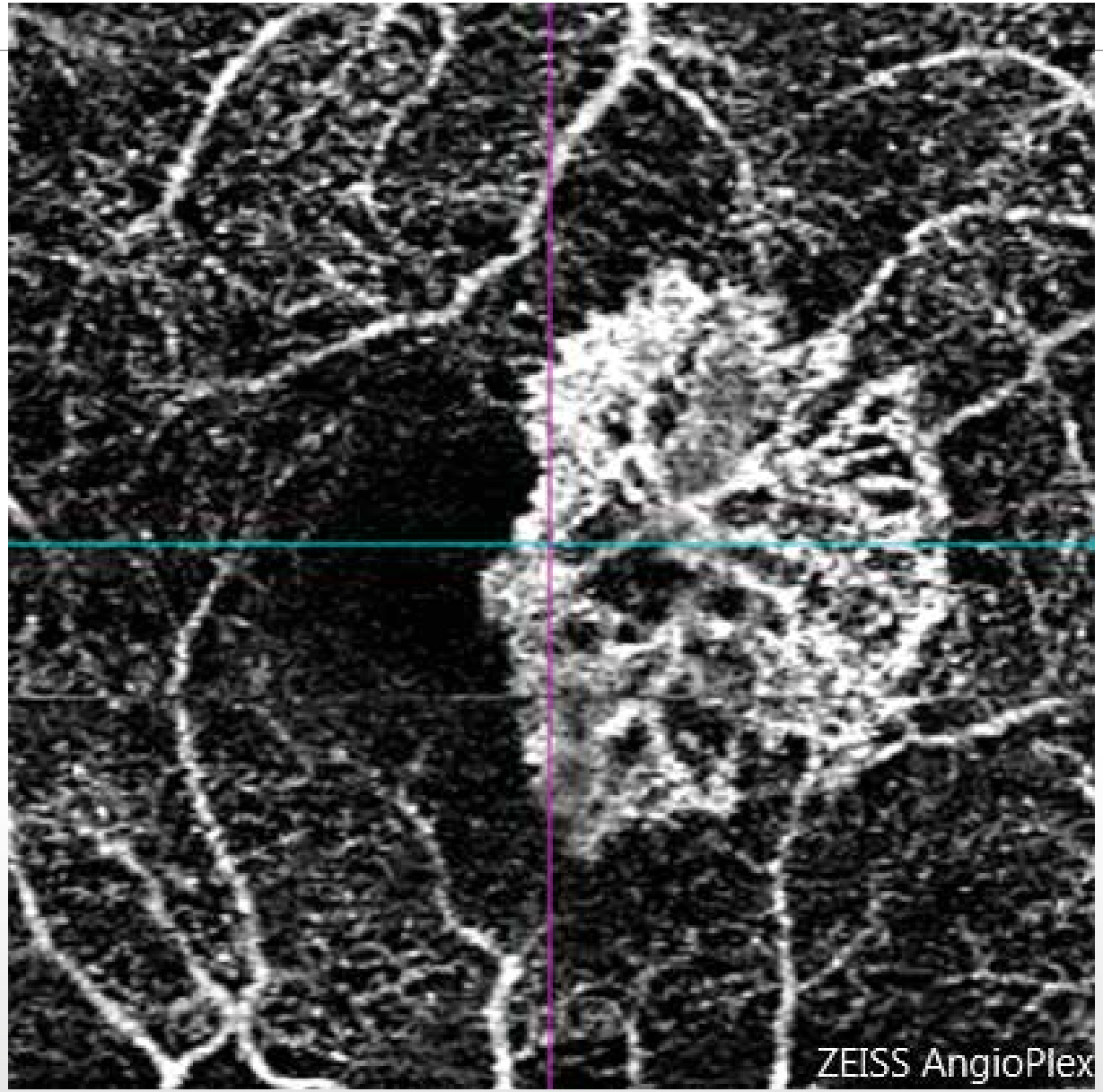
**Color photo showing drusen at the posterior pole.**
There is no hemorrhage. A small greyish lesion is seen off center nasal to the foveola.



**The OCT mapping confirms the presence of an abnormal retinal thickening.**
Note the great heterogeneity of the pseudo color image corresponding to the presence of drusen.



**Horizontal OCT B-Scan passing through the lesion:**
Intraretinal edema associated with a hyper-reflective subretinal lesion.




**OCT-Angiography performed above the plane of the retinal pigment epithelium:**

The neovascular network is perfectly visualized.
There are peripheral anastomoses corresponding to the outer edge of the lesion.

In this case, OCT-Angiography prmitted visualization of the neovascularization without use of fluorescein angiography.