OCT/OCTA: The What, When and How

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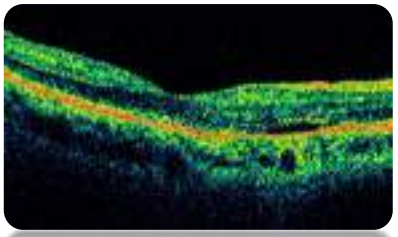
Rodman Disclosures:

- Visionix
- iCare
- Apellis
- Iveric Bio
- LKC technologies

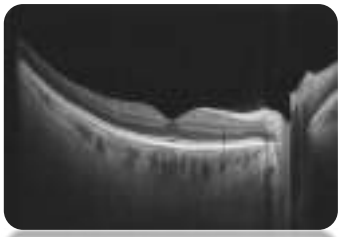
NSU Florida

OCT Angiography: *The Next Chapter in Posterior Imaging*

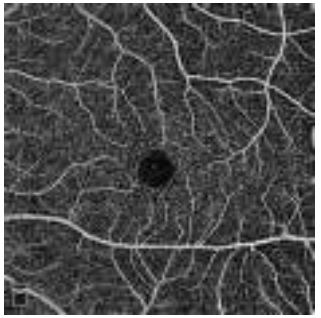
- Time Domain
- Spectral Domain
- OCT Angiography (OCTA)…THE NEXT CHAPTER!!



2002: Time Domain OCT



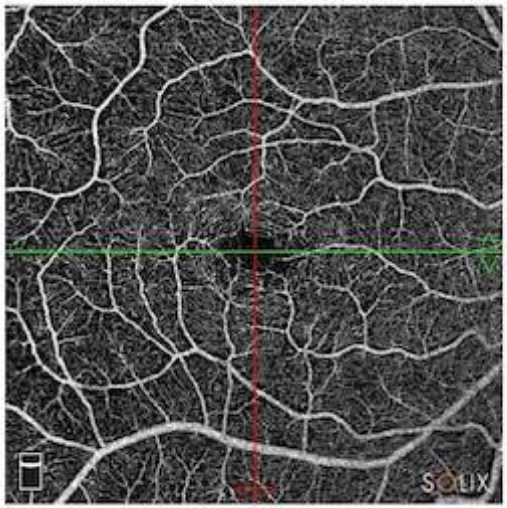
2006: Spectral Domain OCT



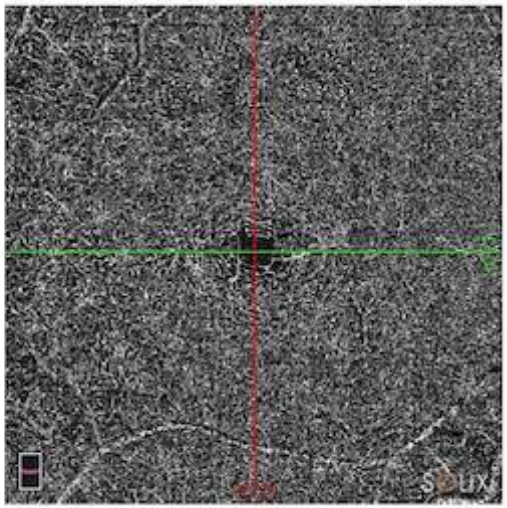
2014: OCTA

OCT Angiography

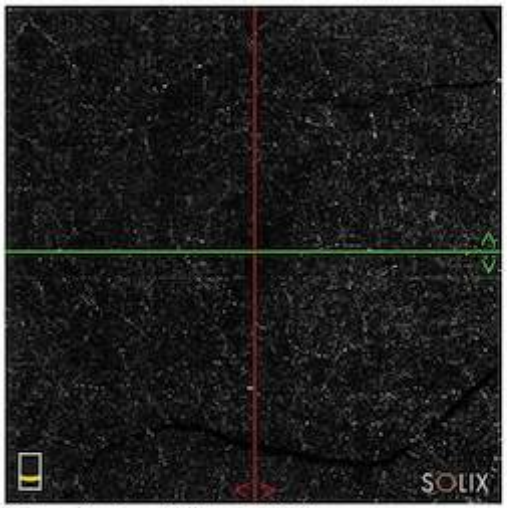
- See retinal vasculature without referring patients out of the practice
- Visualize signs of disease earlier and make more intelligent referrals
- Manage more pathology
- Elevate the practice with state-of-the art imaging technology



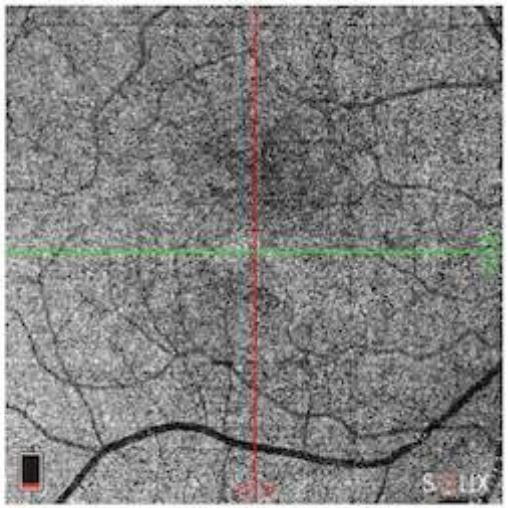
Superficial (ILM - IPL)



Deep (IPL - OPL)

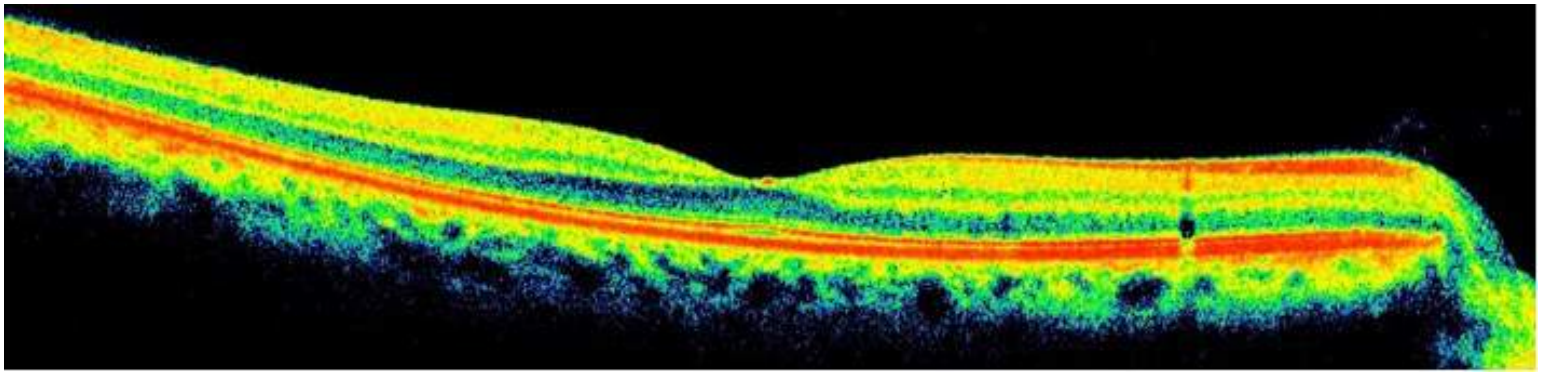


Outer Retina (OPL - BRM)



Choriocapillaris (BRM - BRM+30µm)

Optical Coherence Tomography

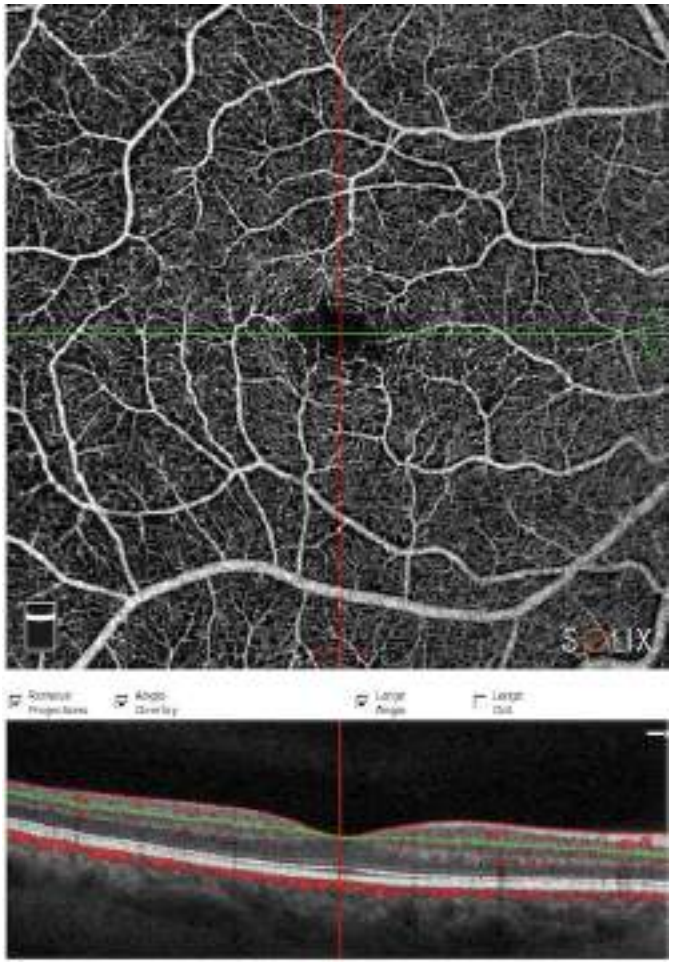


PROS:

- Excellent visualization of macular architecture
- Non-invasive
- Easy to perform

BUT.... UNABLE TO VISUALIZE VASCULATURE/ FLOW!!!

OCT with OCTA: *A Match Made in Heaven*



- **Conventional SD-OCT**
  - Stationary tissue (**structure)**
- **OCT Angiography**
  - Moving red blood cells **(function)**

OCT angiograms co-registered with OCT B-scans from the same area allows simultaneous viewing of structure and function.

OCT & OCTA Provide Different – but Complementary – Information

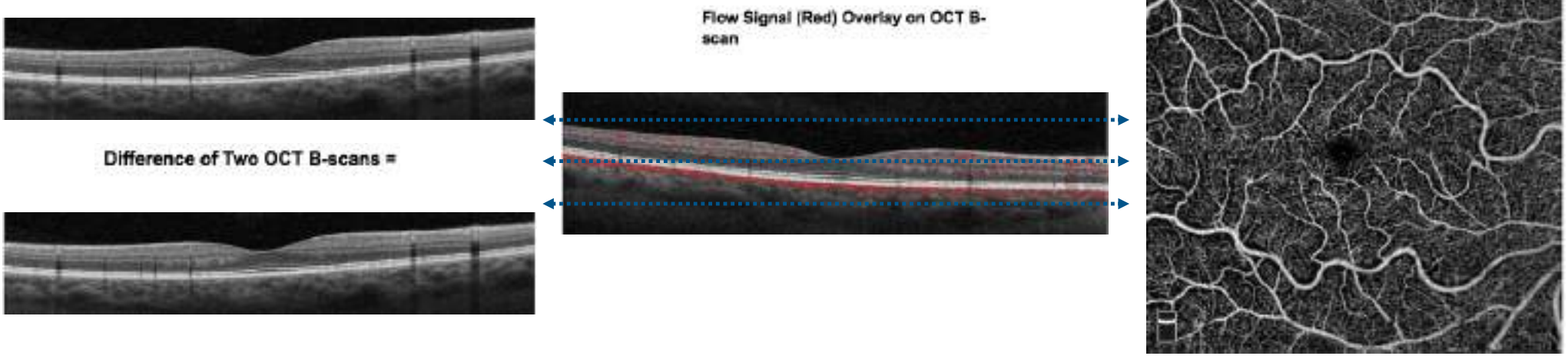
OCT: Structure	OCTA: Function
Visualize STRUCTURAL changes • Drusen • Fluid • Elevations/disruptions in retinal layers	**Visualize blood flow in the vessels** • CNVM
	Visualize ischemia/poor perfusion • Diabetic retinopathy • Vascular occlusion

OCTA vs FA

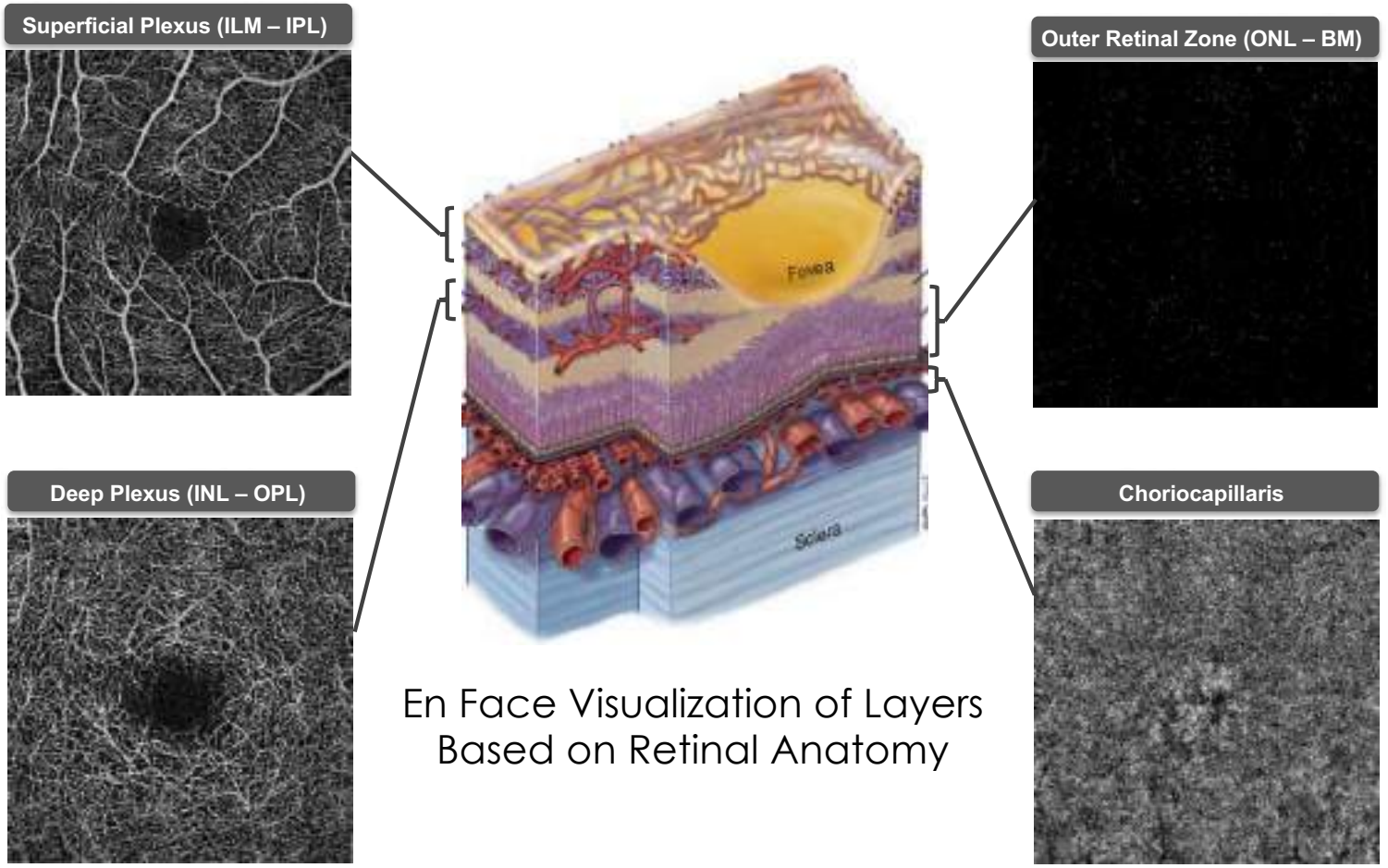
Fluorescein Angiography	OCTA
Wide field capabilities	Limited field of view
Invasive	Non-invasive
Dye Based	No dye used
Lower resolution	Higher resolution
Less affected by motion	More affected by motion
Two dimensional, no segmentation	Three-dimension, segmentation
Images superficial retina	Images sup, deep, outer retina and choroid
Dynamic blood flow information	Static blood flow information
Blood flow information	Structural and blood flow information
5-30 minutes of imaging time	5 minutes of imaging time

How does OCTA work?

- OCTA uses motion contrast to detect flow from OCT data



En-face OCTA Slabs: Based on Retinal Anatomy



En Face Visualization of Layers
Based on Retinal Anatomy

Various scan sizes available!

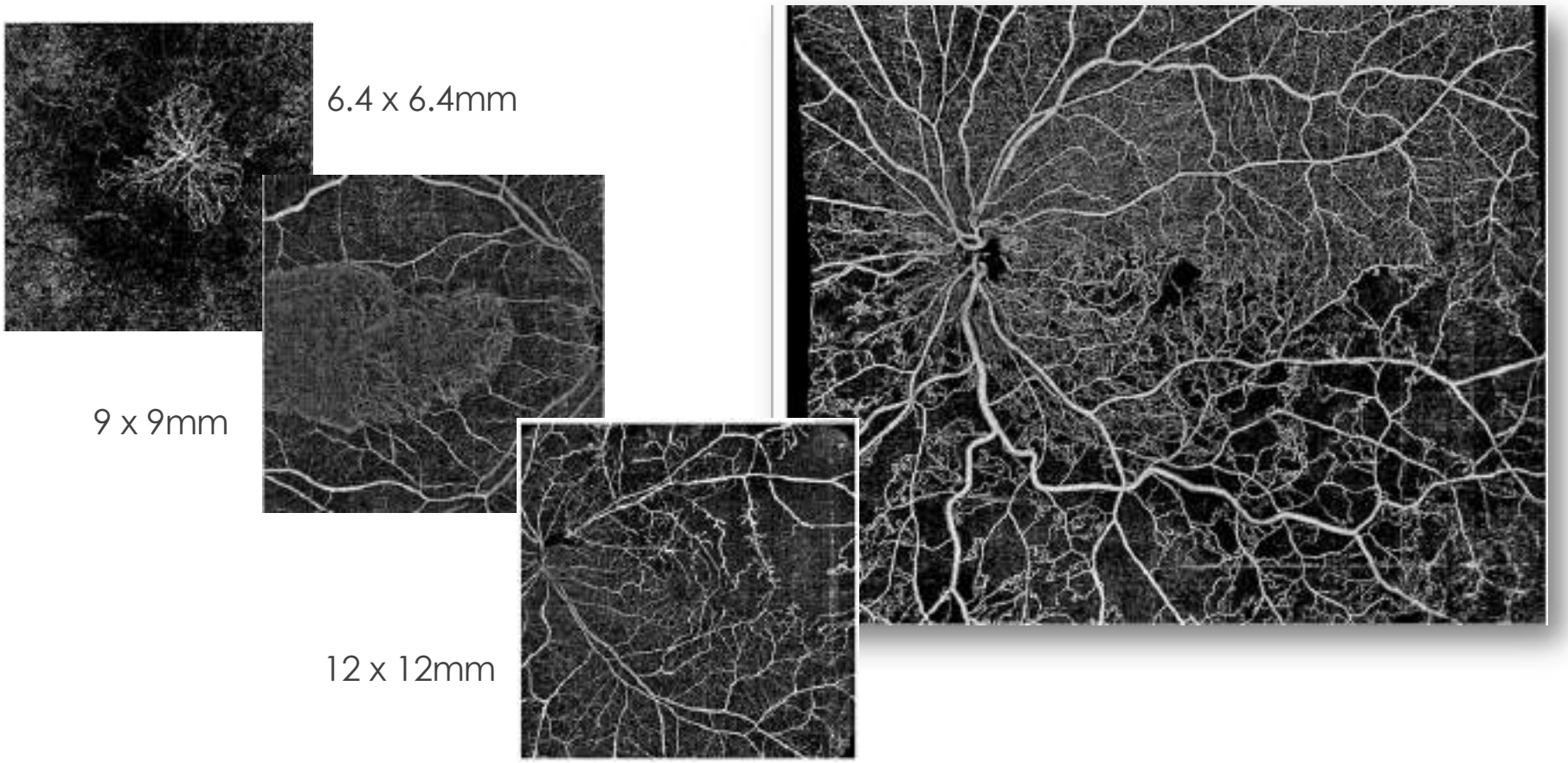
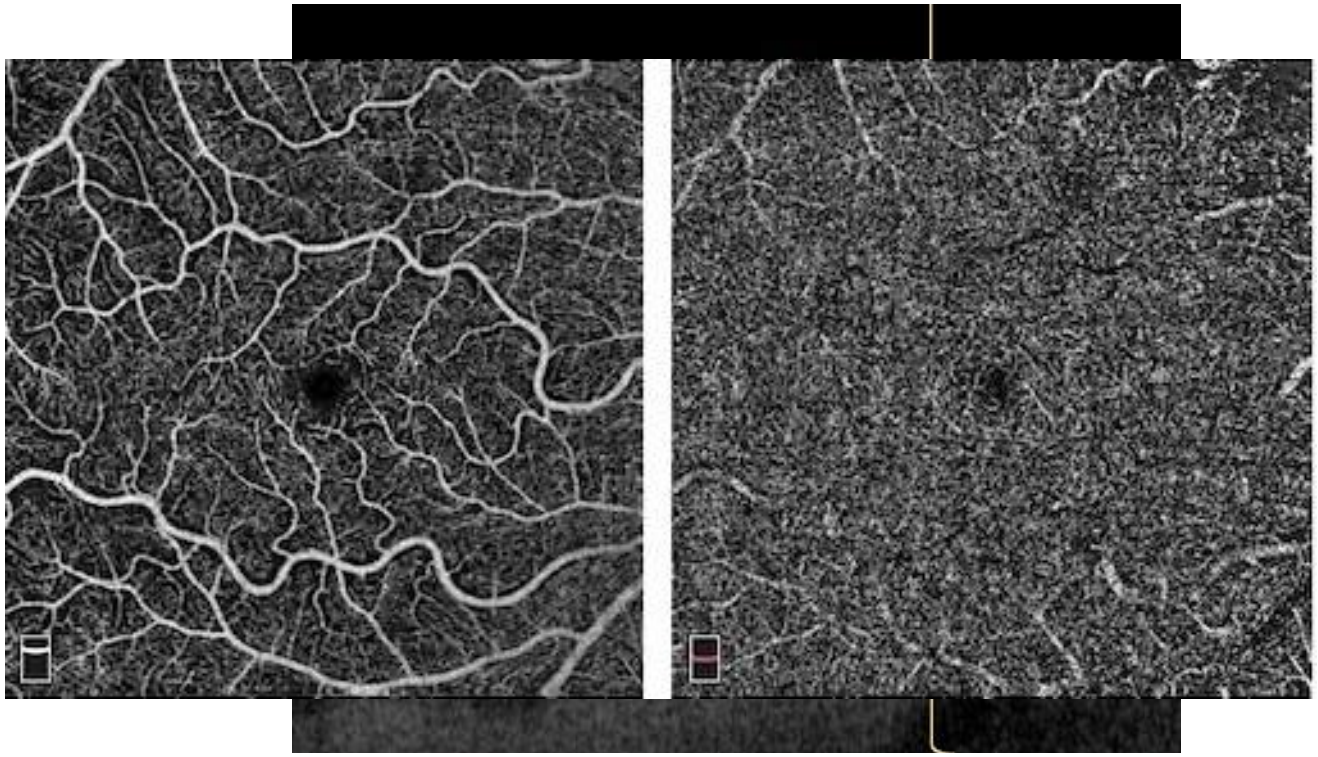


Image courtesy of Adil El Maftouhi, Centre Rabelais, Lyon, France

Apply This Clinically

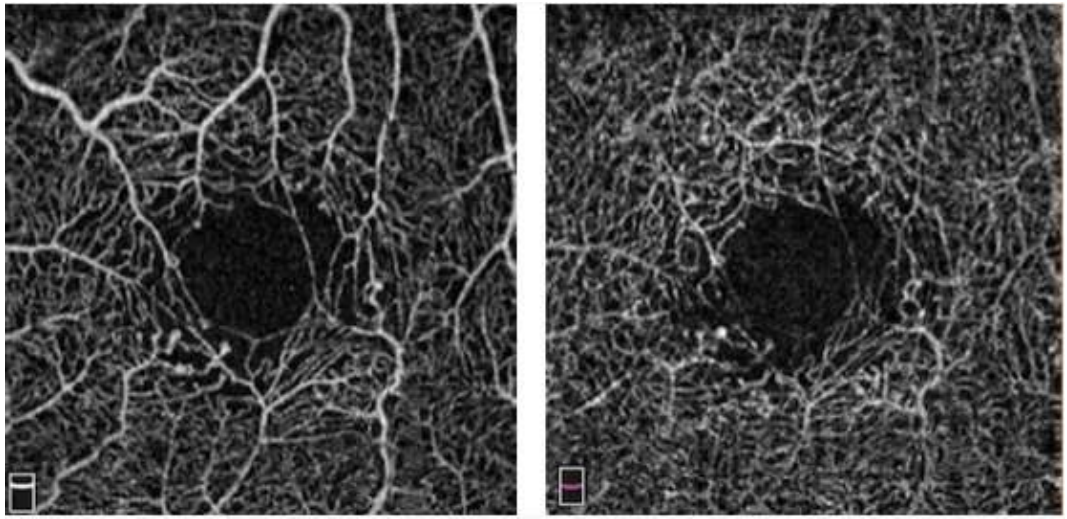
Inner Retinal Disease

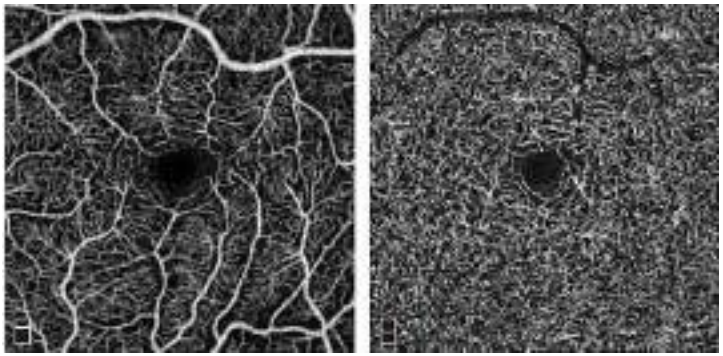
Inner Retinal Disease



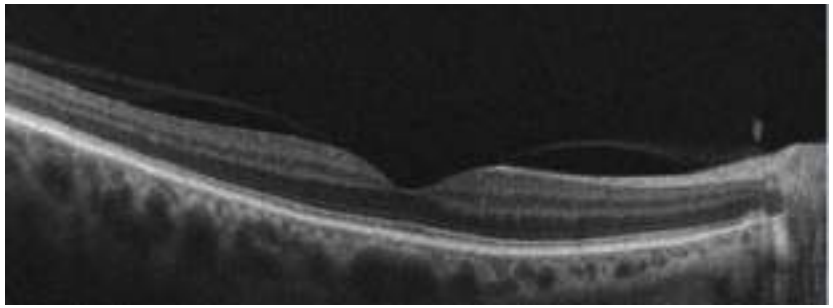
Diabetic Retinopathy

- **Positive Indicators**
  - Retinal capillary non-perfusion – seen as blackened area without blood flow outside FAZ
  - Microaneurysms
  - Enlarged FAZ

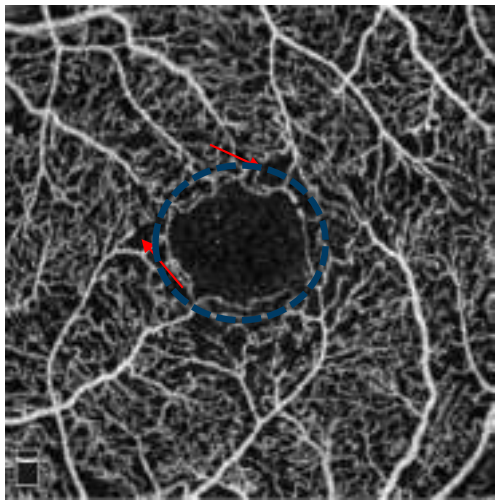




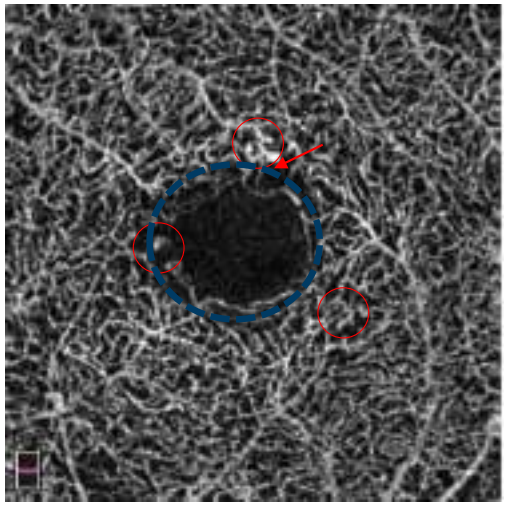
Meet Carla: *A 45-year-old African American female*



"My BS is excellent…. Can't remember the number …. But my A1C is 7!!! I'm so proud of myself"

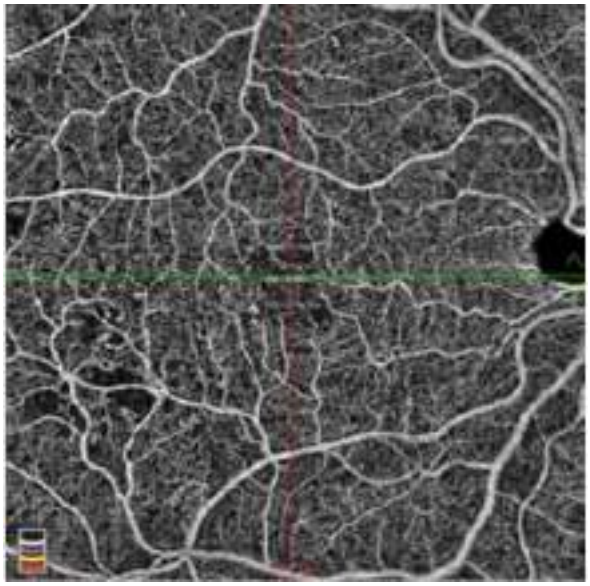


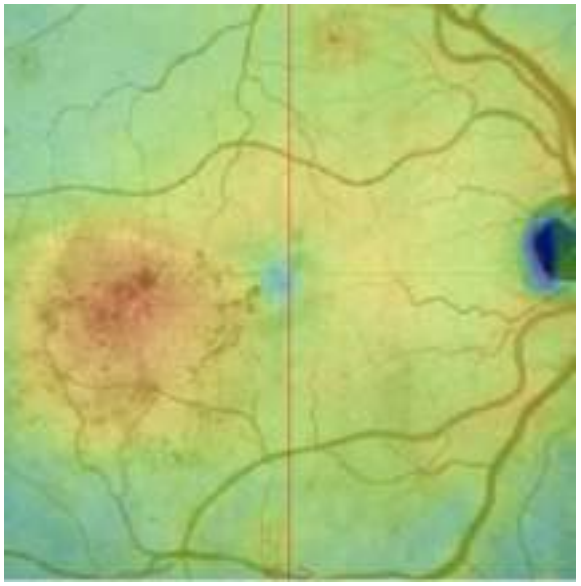
Superficial Capillary Plexus

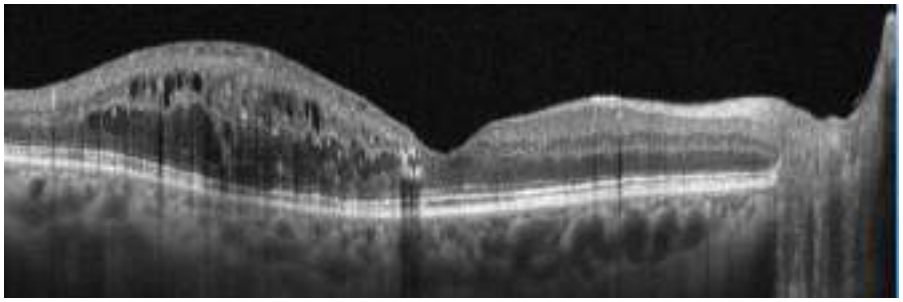


Deep Capillary Plexus

OCT Angiography: Taking the BEST care of our patients!



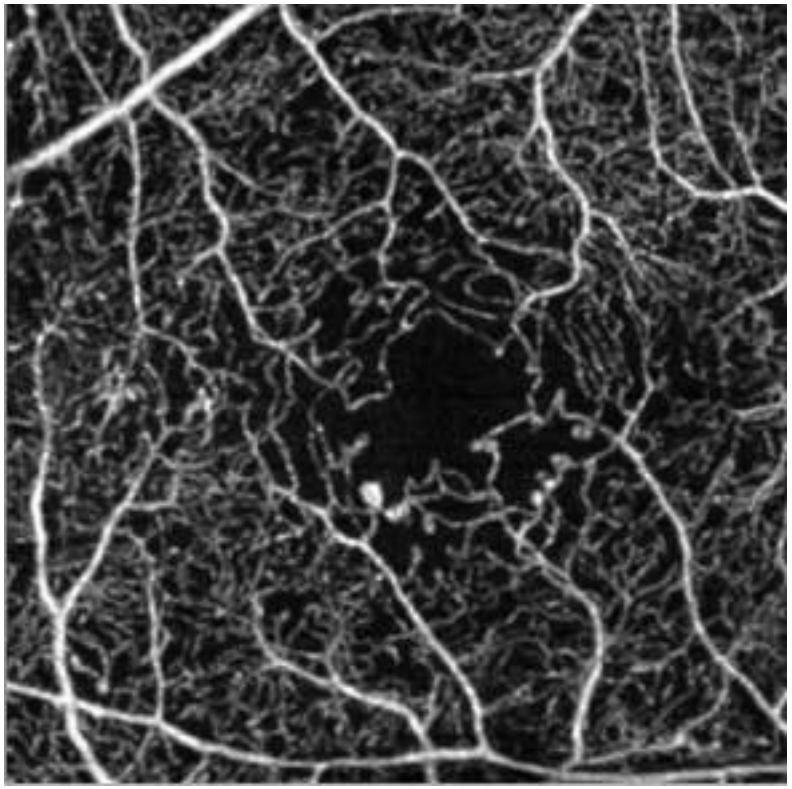




Diabetic macular edema… but what else???

Images courtesy of Explore Vision Clinic, Paris, France

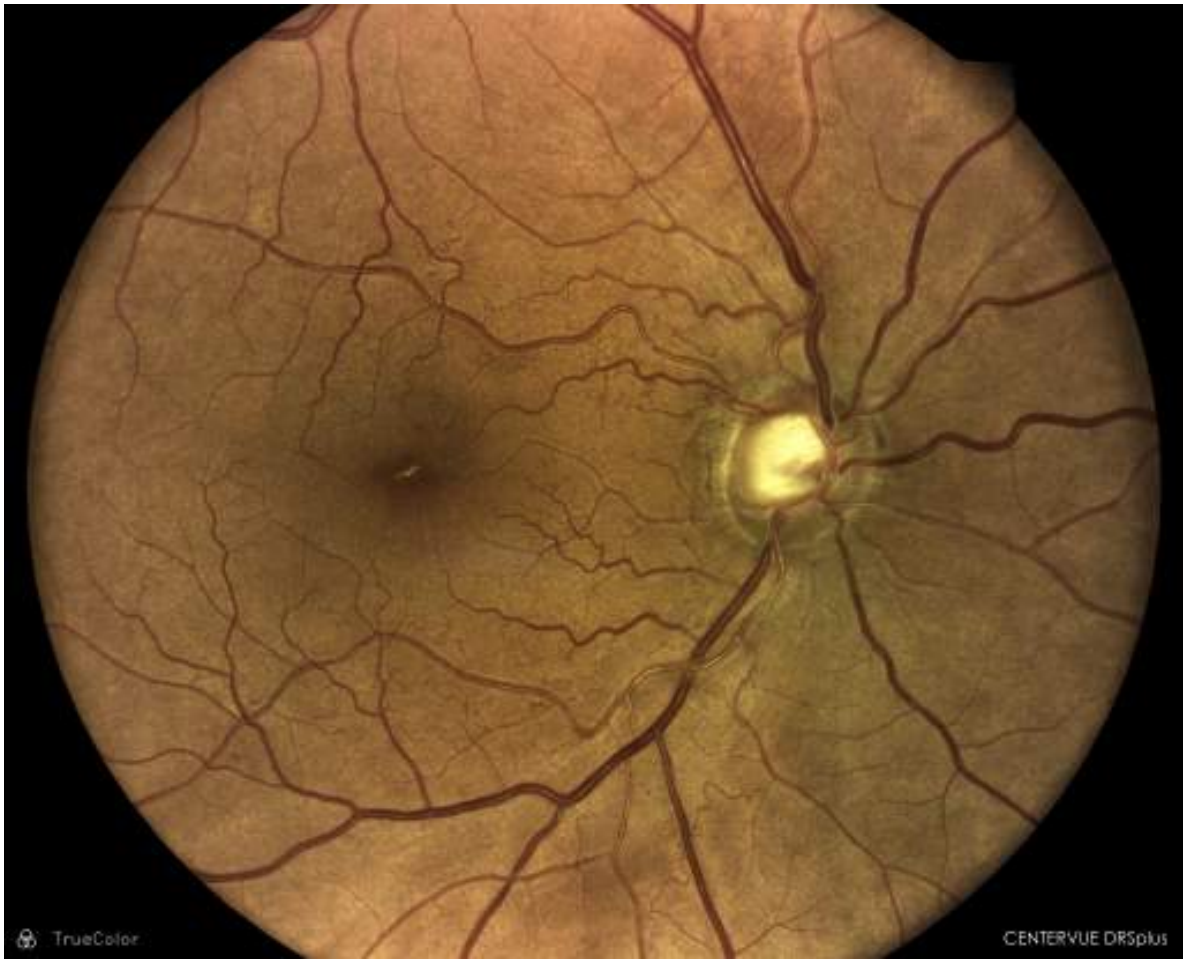
Meet James: *55-year-old African American male*



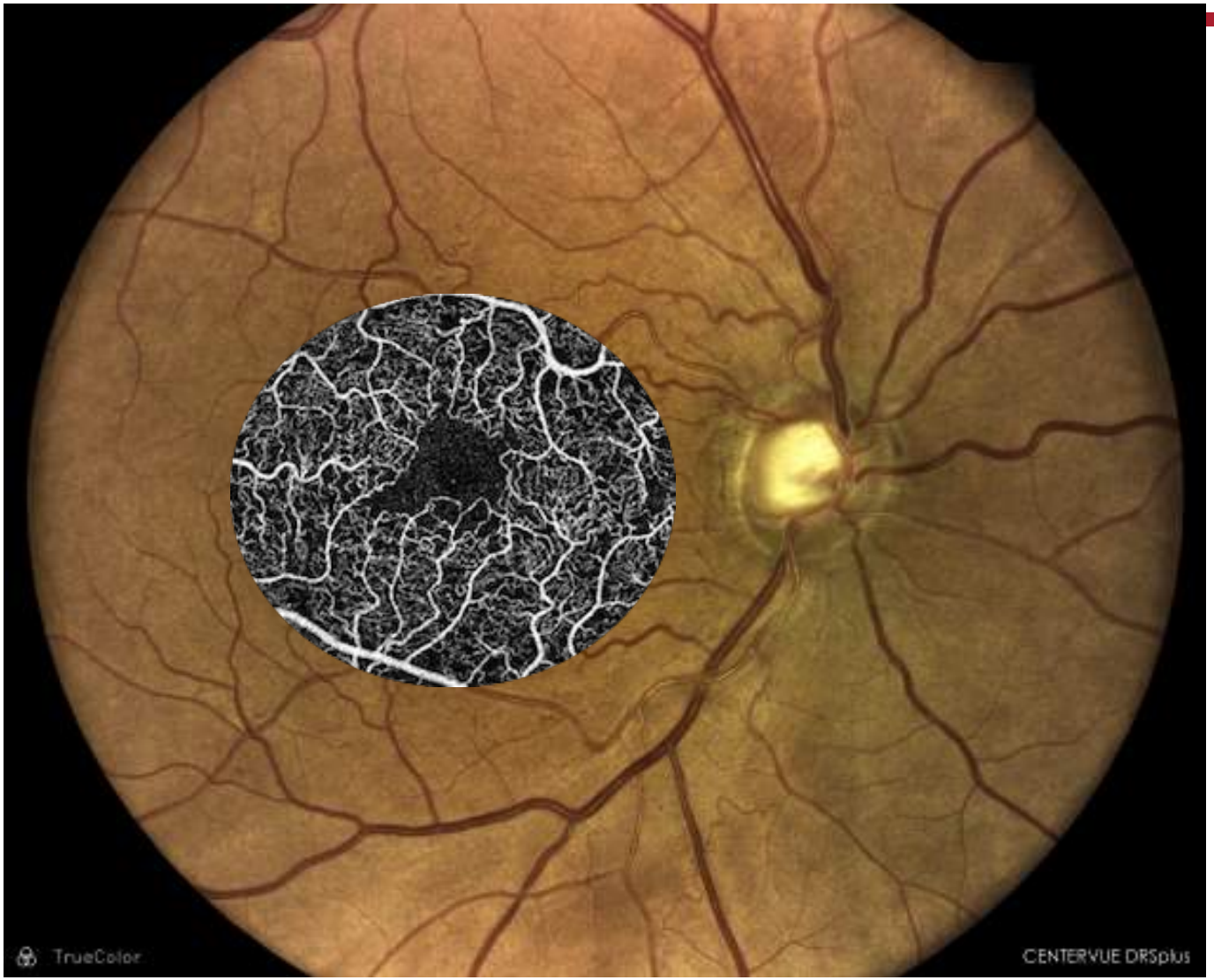
No diabetic retinopathy on fundus exam; **Decreased BCVA… 20/50!!**

OCT Angiography provides the answer!!!

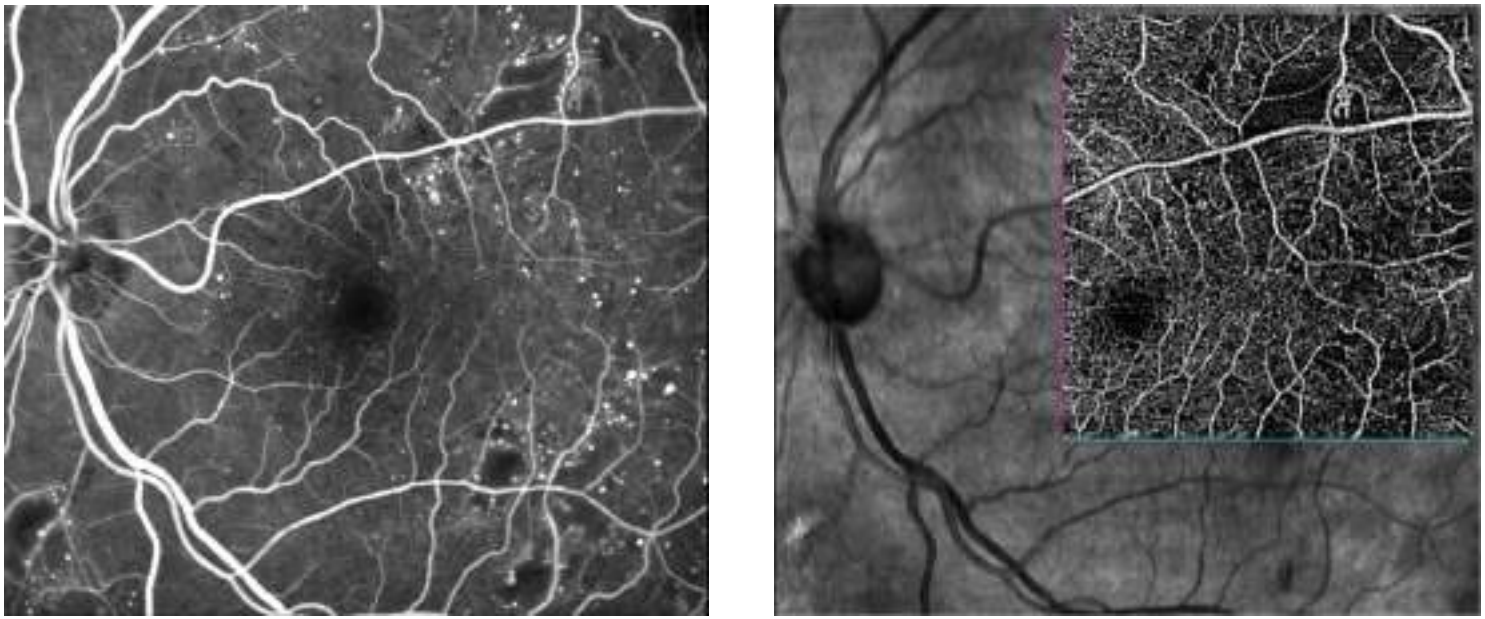
45-year-old glaucoma suspect; DM x 5 years



"Poorly controlled BS; trouble with every medication that his PCP has put him on"

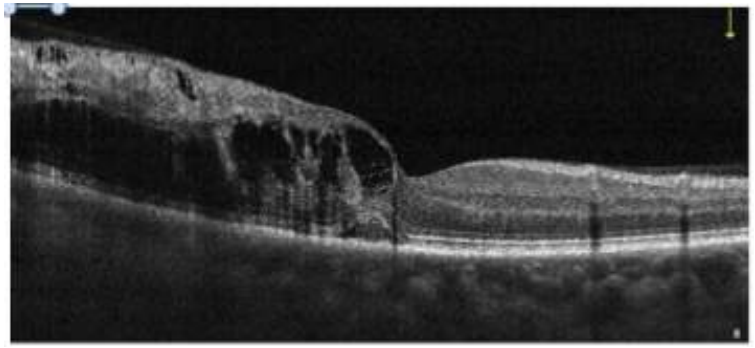

TrueColor
CENTERVUE DRSplus

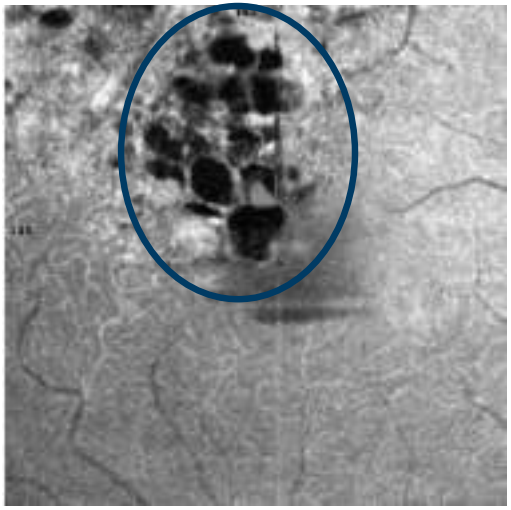
Non-proliferative diabetic retinopathy

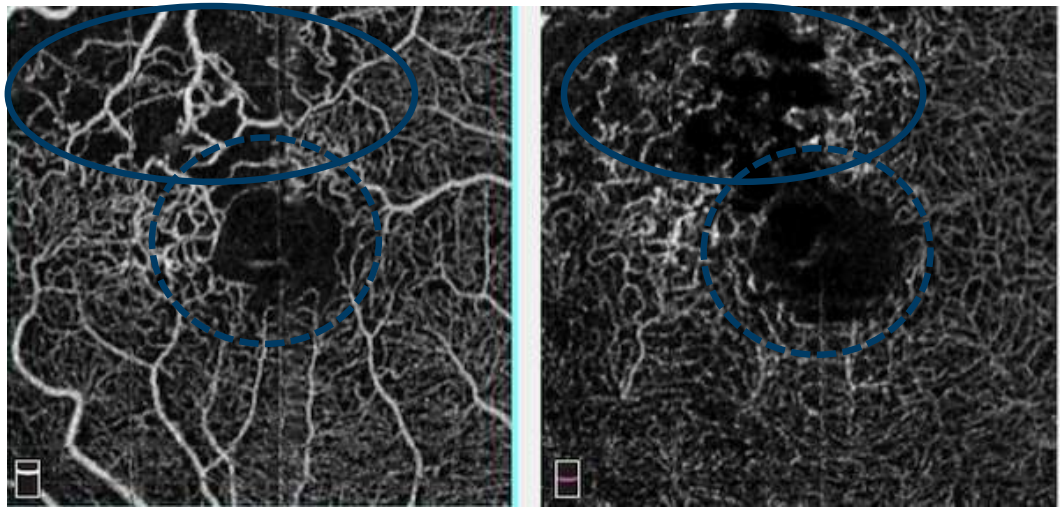


OCTA Comparison to Fluorescein Angiography

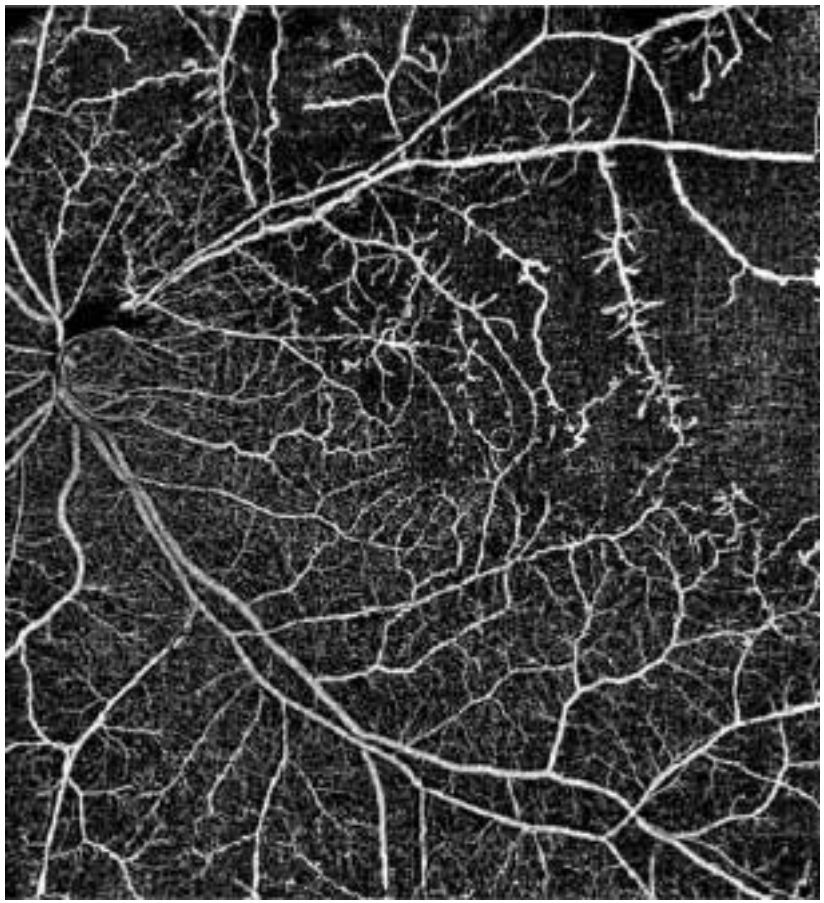
Branch Retinal Vein Occlusion



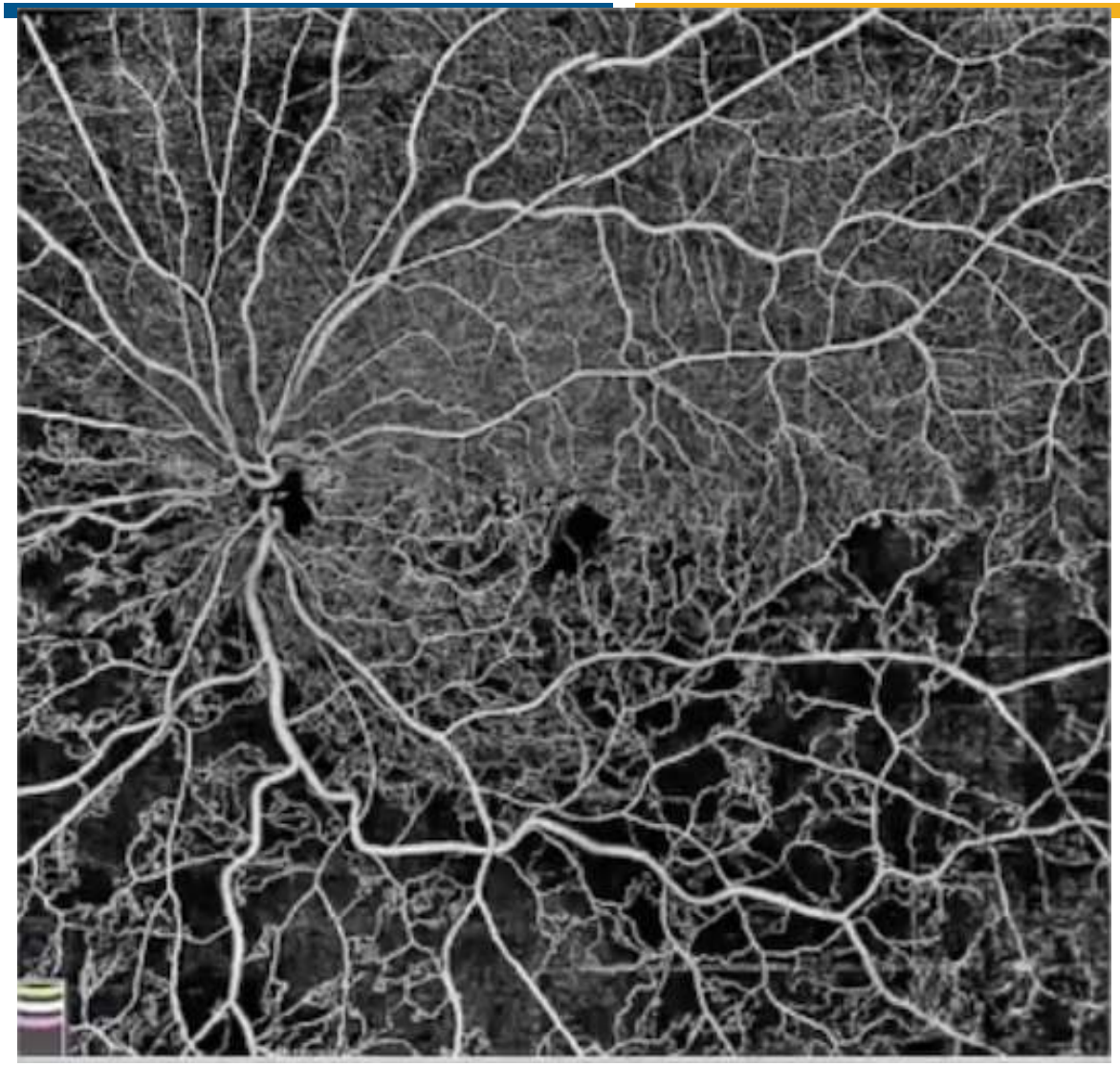




FAZ area in DCP positively correlated with a decrease in visual acuity; may be an indicator of visual prognosis



12x12 Scan: Increase image size; see the full extent of the occlusion

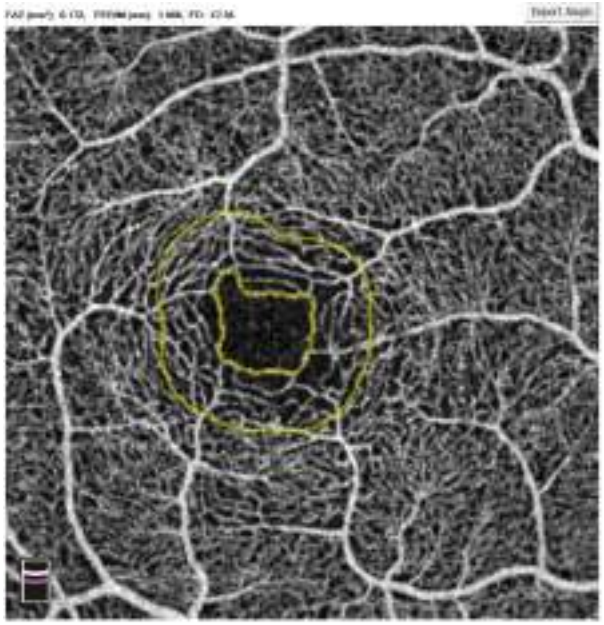


…and another!

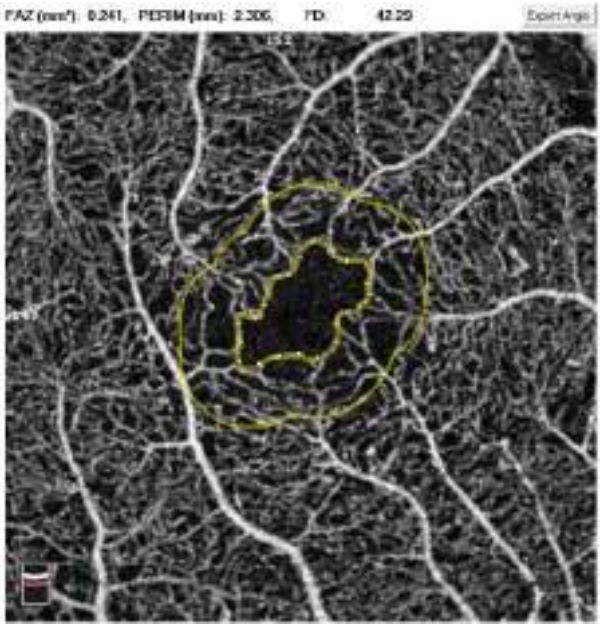
AngioAnalytics

Diabetic Eye Disease

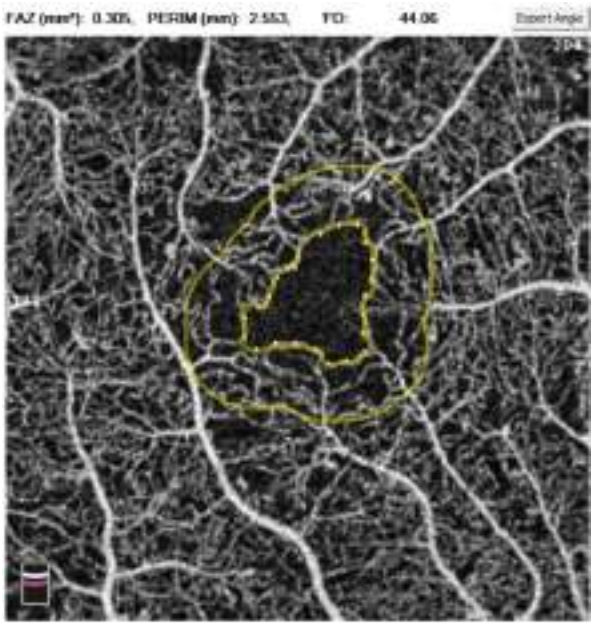
Foveal Avascular Zone in Normal & Diabetic Eyes



Normal Eye



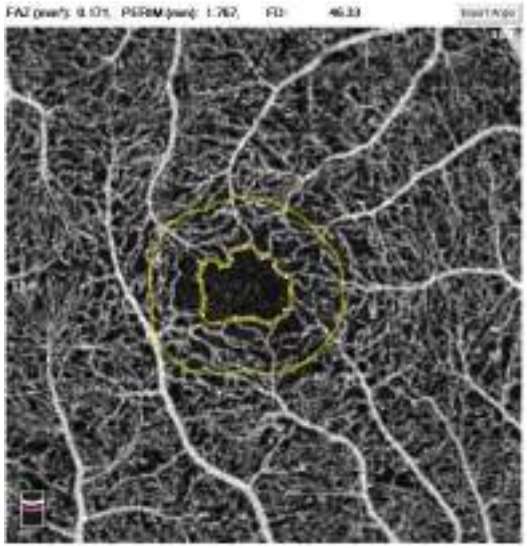
Diabetic Eye



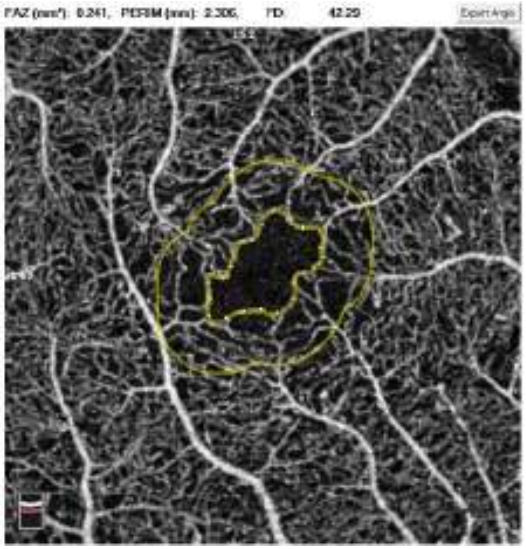
More Advanced Diabetic Eye

Images courtesy of Bernard C. Szirth, OD, Rutgers New Jersey Medical School Department of Ophthalmology and Visual Science

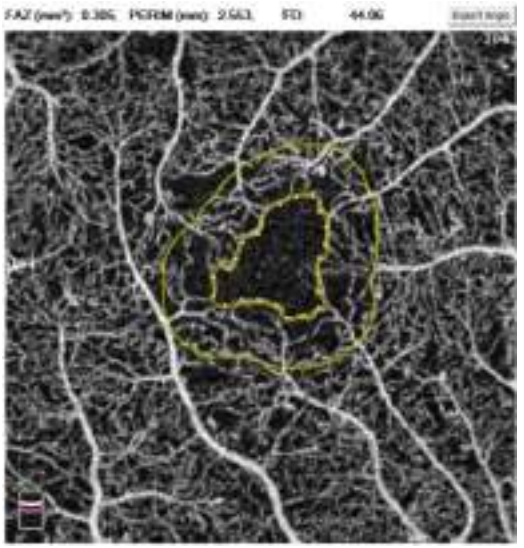
FAZ Change Analysis



2015



2016

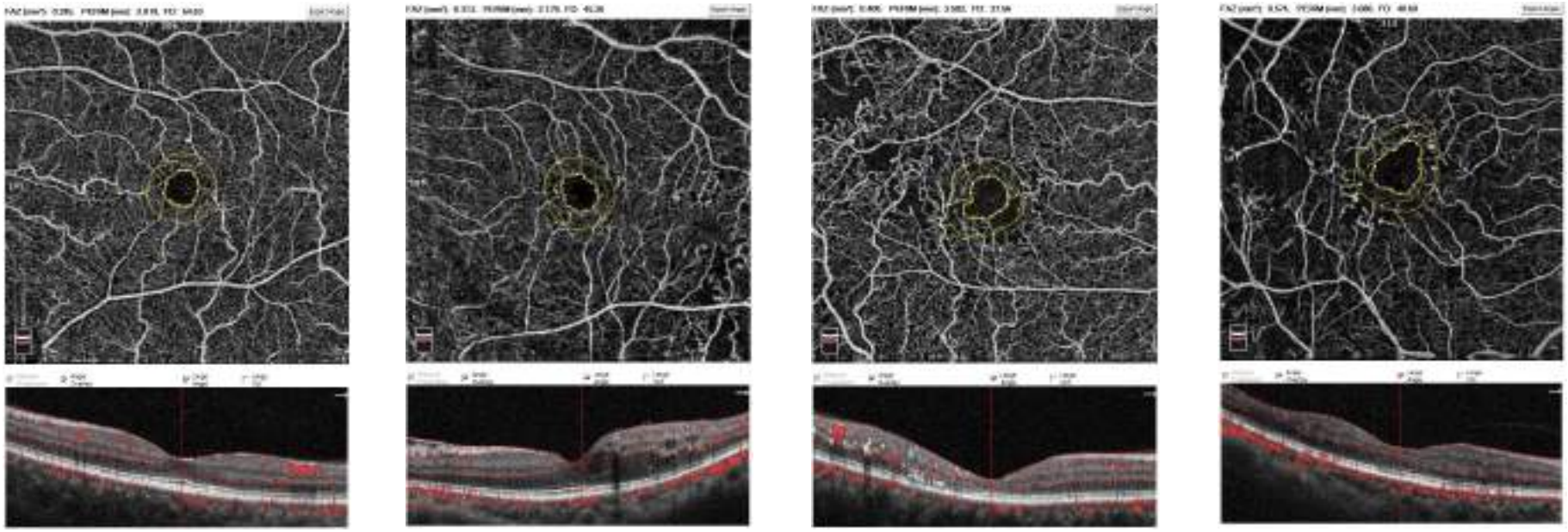


2017

Image courtesy of Bernard C. Szirth, OD, Rutgers New Jersey Medical School Department of Ophthalmology and Visual Science

Aid in Disease Severity Assessment with FAZ Measurements

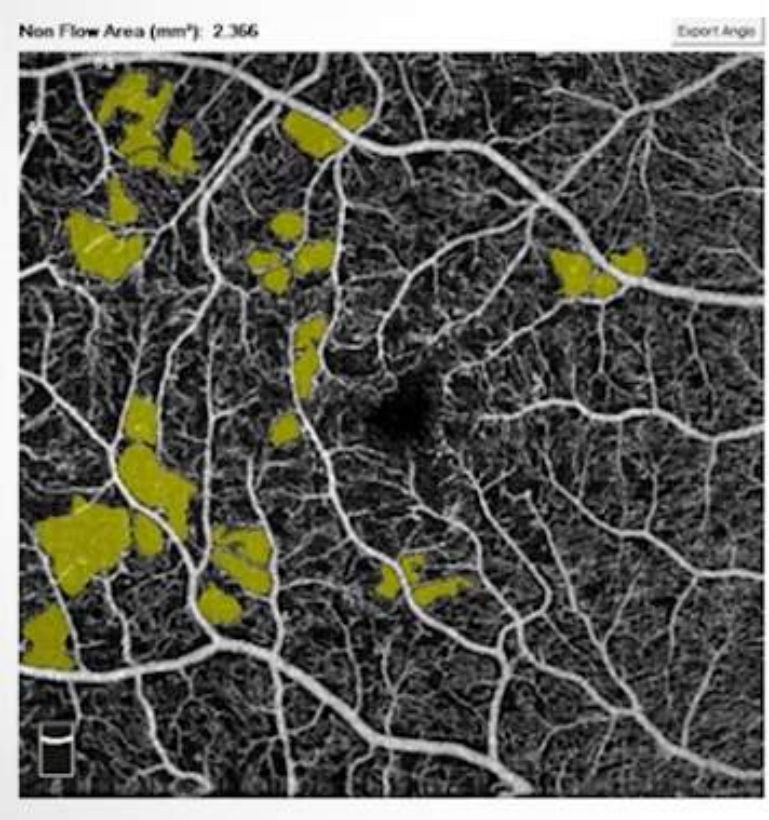
FAZ size and FAZ vessel density are correlated significantly with disease severity in DR.[1]



Mild NPDR | Moderate NPDR | Severe NPDR | PDR

1. Nesper PL, Roberts PK, Onishi AC, et al. Quantifying Microvascular Abnormalities With Increasing Severity of Diabetic Retinopathy Using Optical Coherence Tomography Angiography. Investigative Ophthalmology & Visual Science. 2017;58(6):BIO307-BIO315. doi:10.1167/iovs.17-21787.

Non-Flow Area

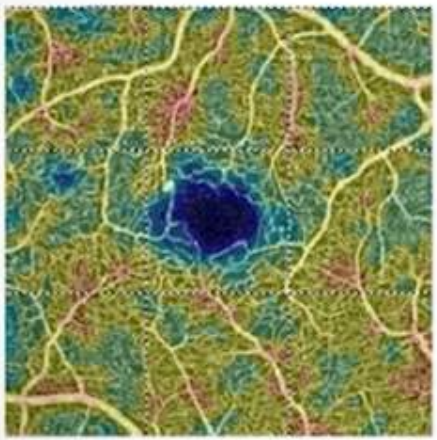


- Based on Superficial Capillary Plexus
- Click on area of interest

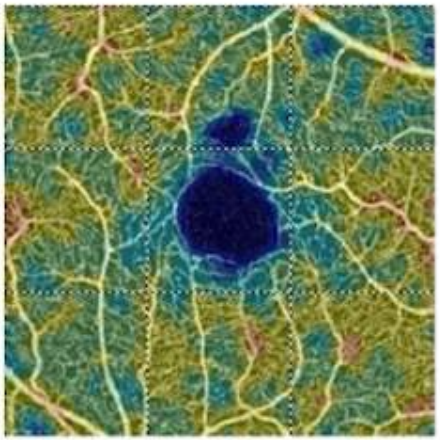
Measurement:

- Non-Flow Area: Total area of selected non-flow areas

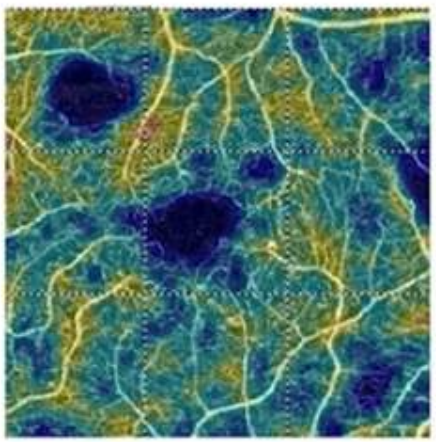
Vessel Density



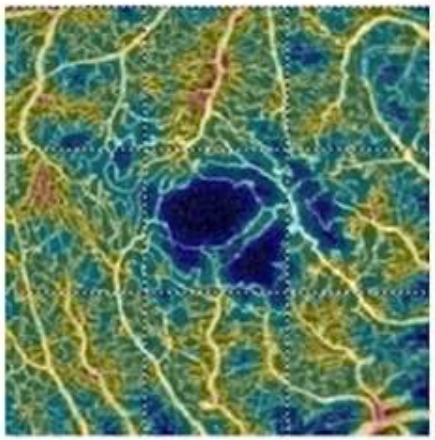
Mild NPDR
56.2%



Moderate NPDR
51.7%



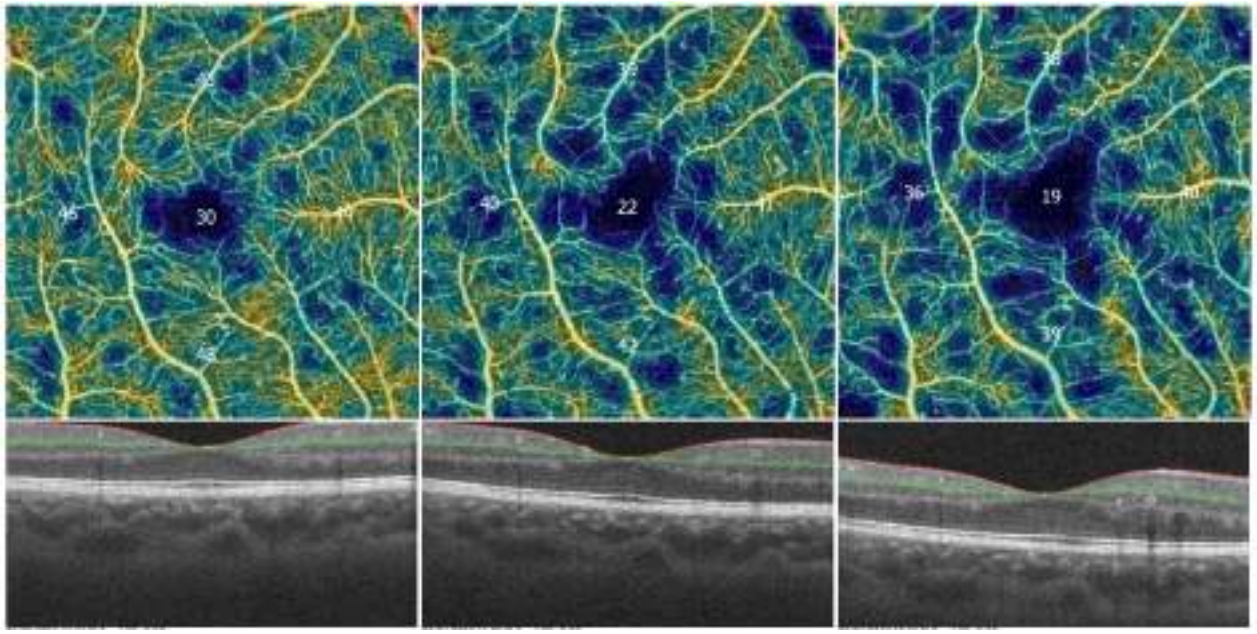
Severe NPDR
41.6%



PDR
47.2%

Assess Disease Progression with Multi-scan View

Vessel Density Decreases Significantly with Disease Severity[4]



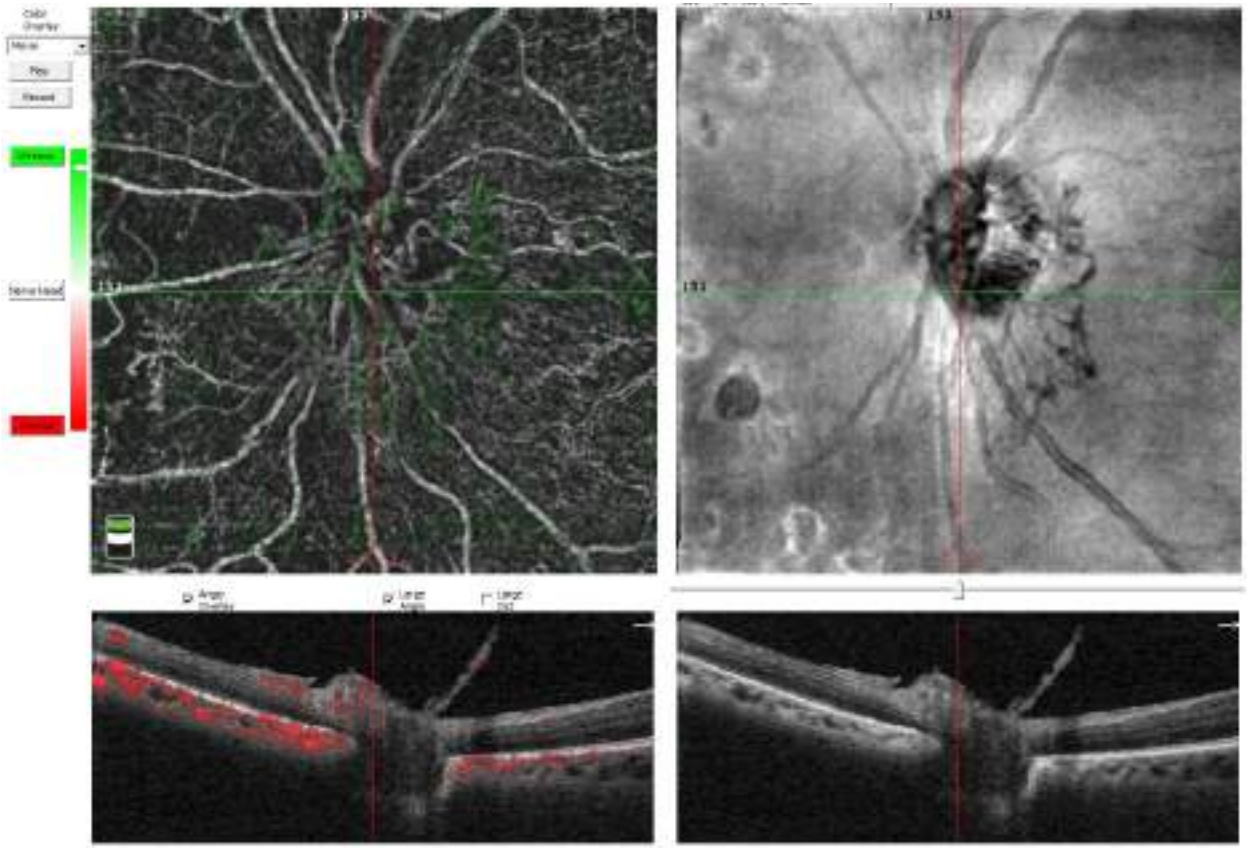
4. Nesper PL, Roberts PK, Onishi AC, et al. Quantifying Microvascular Abnormalities With Increasing Severity of Diabetic Retinopathy Using Optical Coherence Tomography Angiography. Investigative Ophthalmology & Visual Science. 2017;58(6):BIO307-BIO315. doi:10.1167/iovs.17-21787.

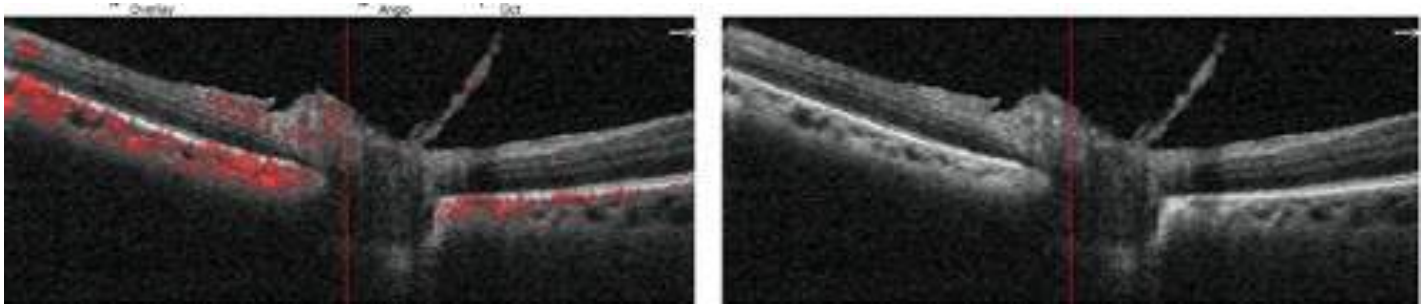
Meet Juan: *A 67-year-old Hispanic male (14 years DM)*

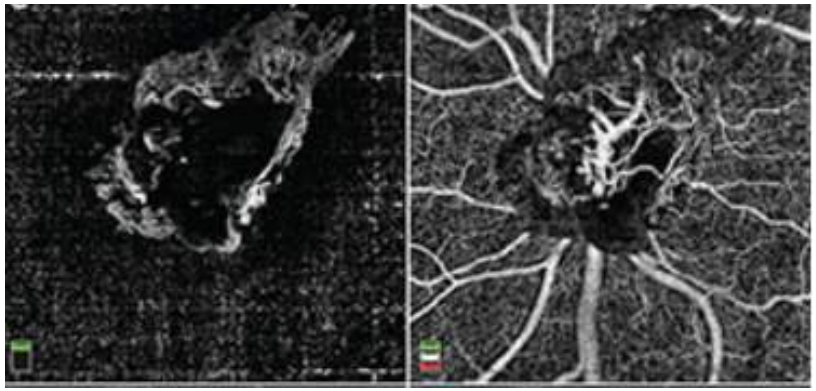
"The vision in my left eye is "weird" x 2 months!!

Missed last 3 annual exams

https://imagebank.asrs.org/file/27528/neovascularization-of-the-disc

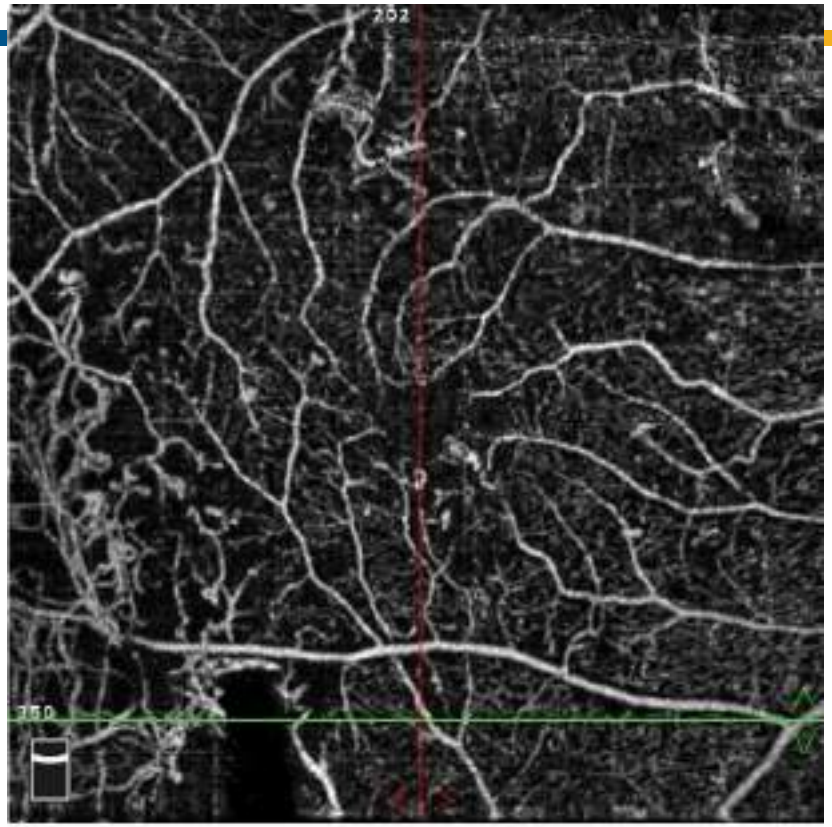


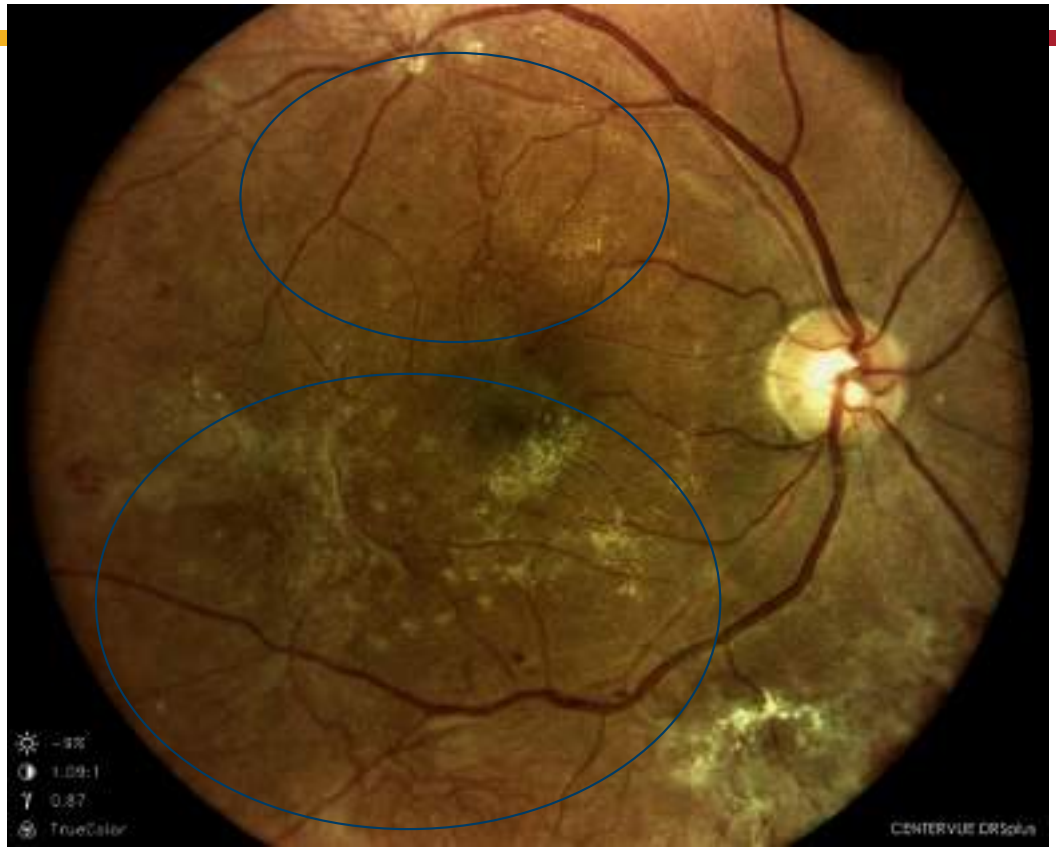


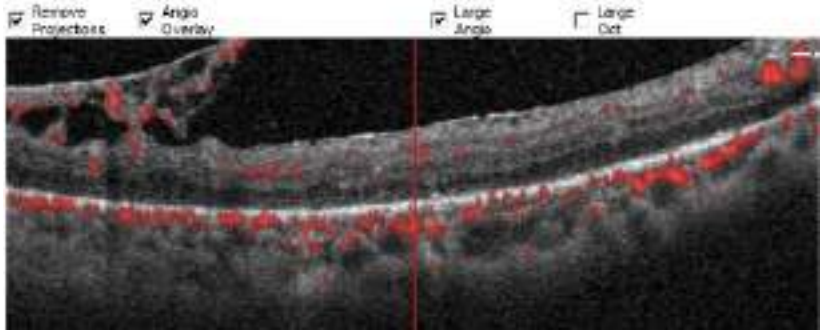


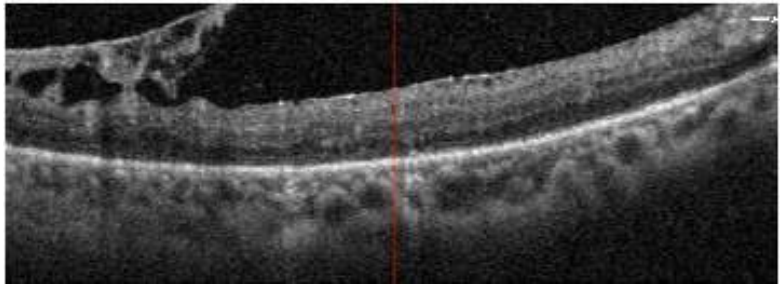
Position the scan at the vitreoretinal interface

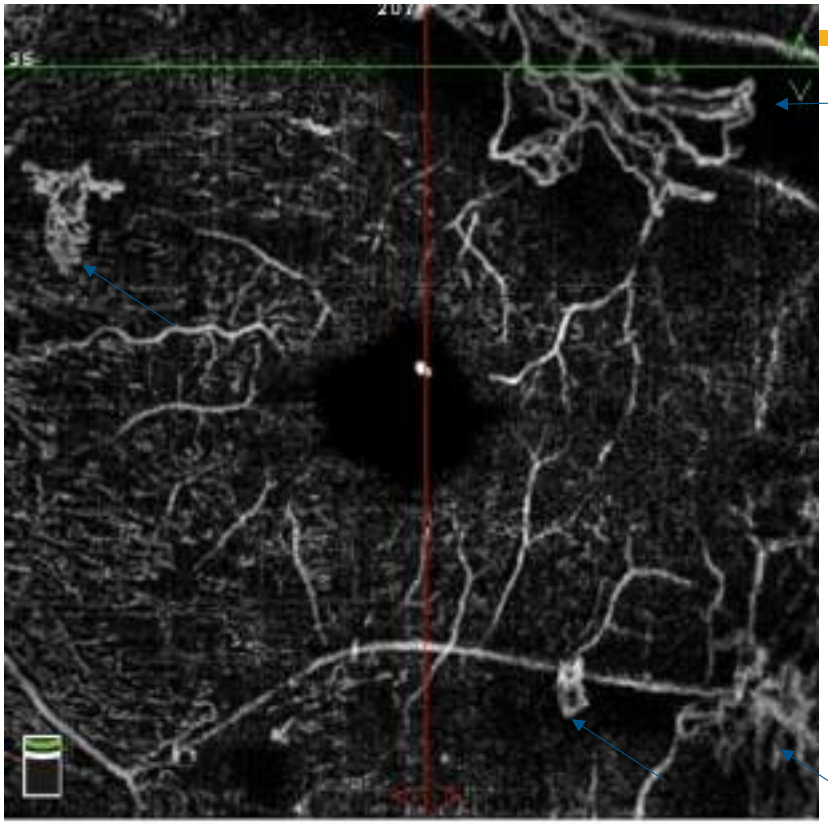
62-year-old Indian Male; DM2 x 20 years; “High BS levels”


202
250


-9%
1.09:1
0.87
TrueColor
CENTERVUE DRSplus

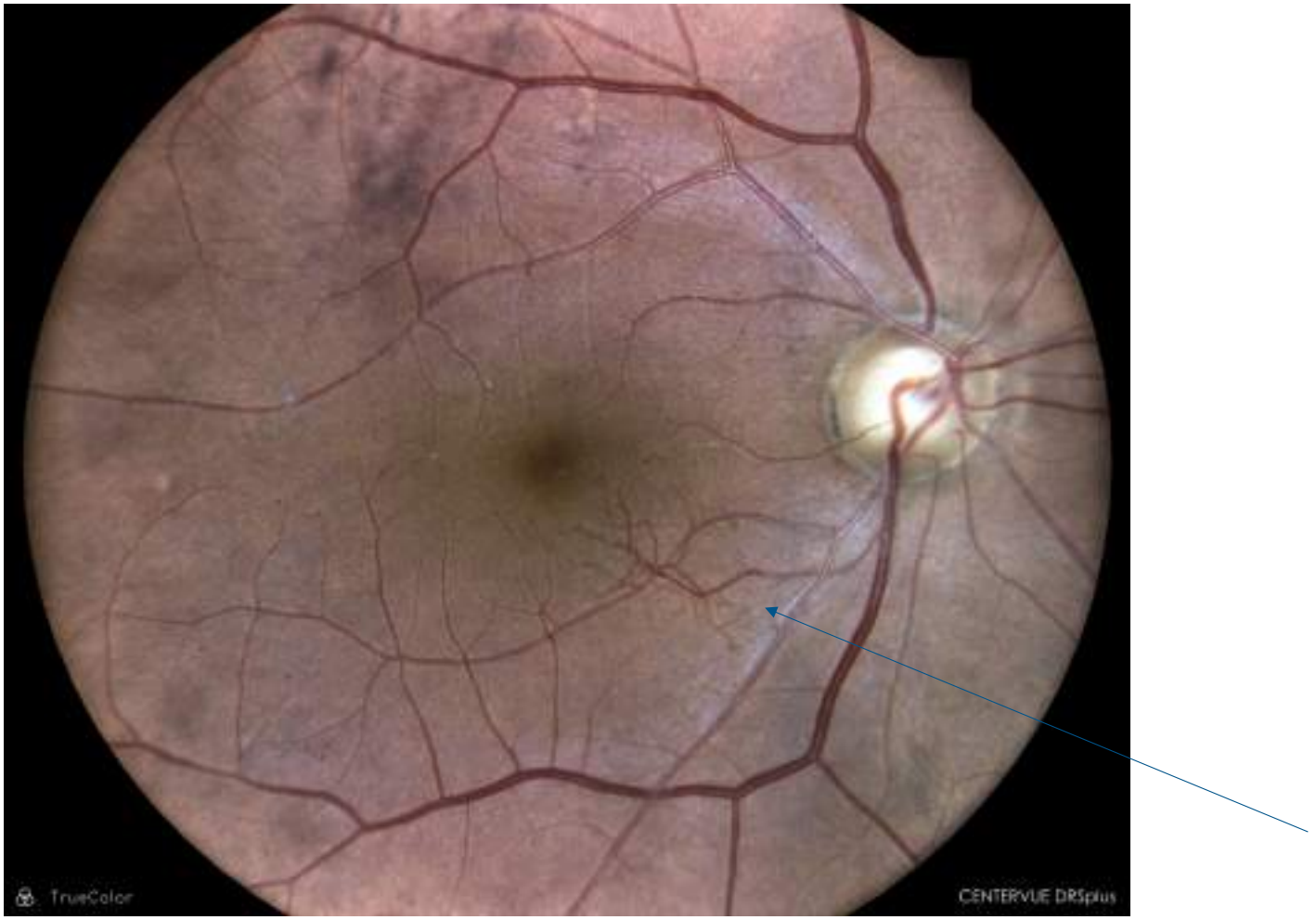

Remove Projections
Angio Overlay
Large Angio
Large Oct

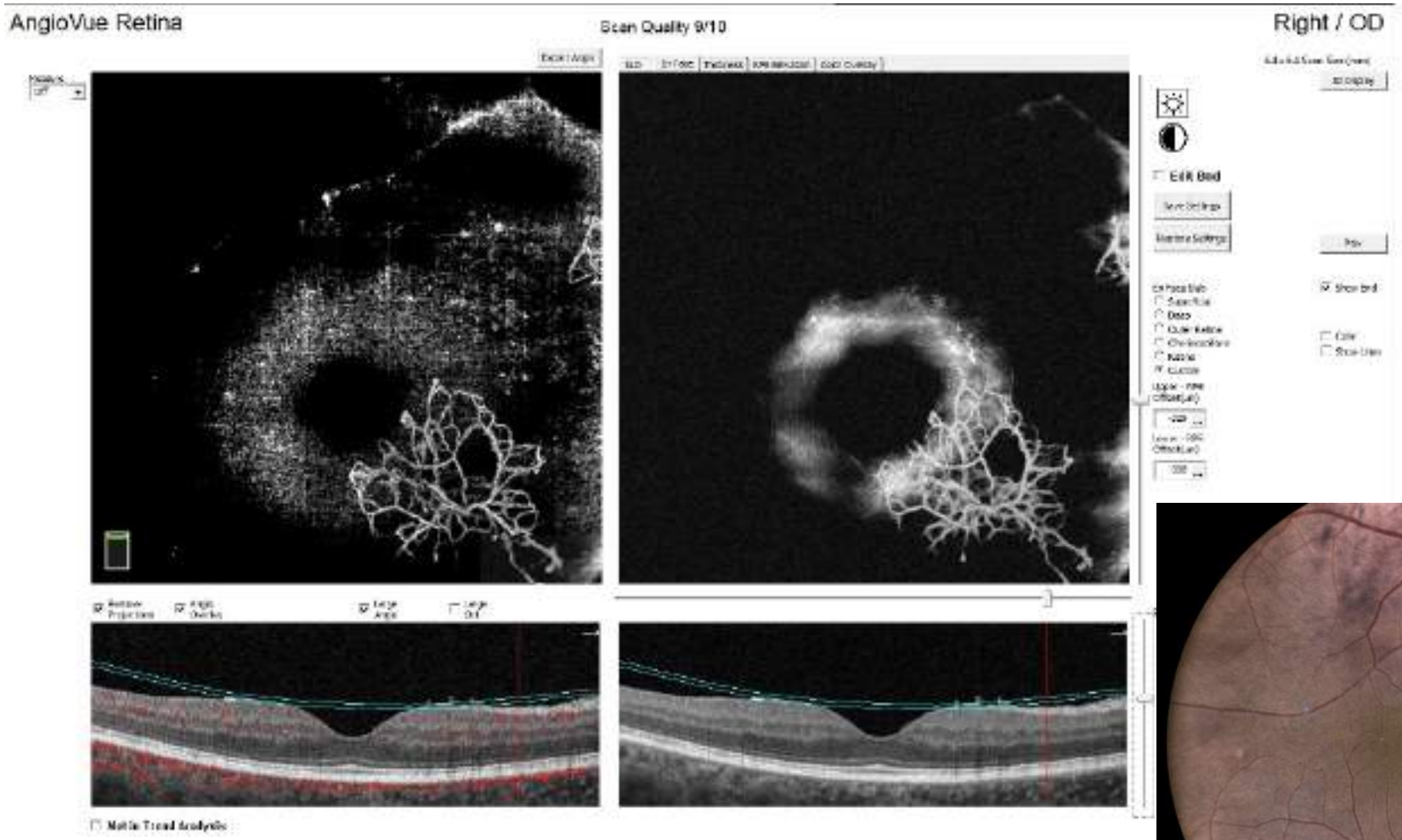


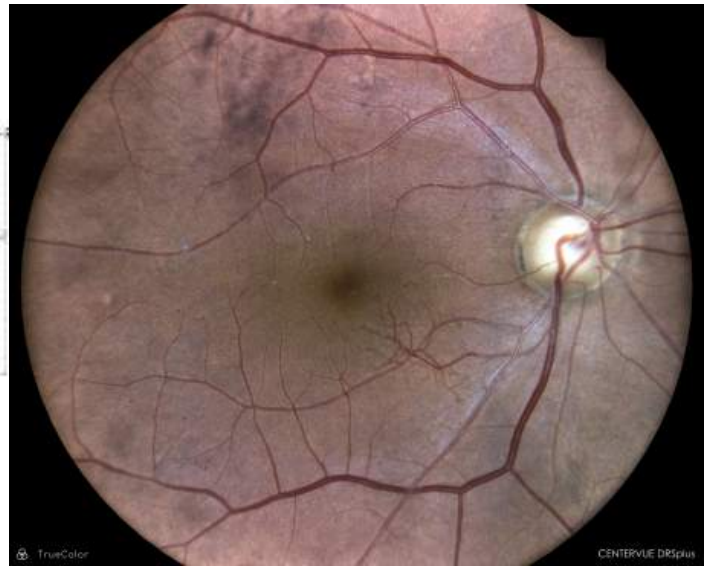

Remove Projections
Angio Overlay
Large Angio
Large Oct


-9%
1.09:1
0.87
TrueColor
CENTERVUE DRSplus

And yet another…. At fast glance, doesn't look too bad!! But does it???



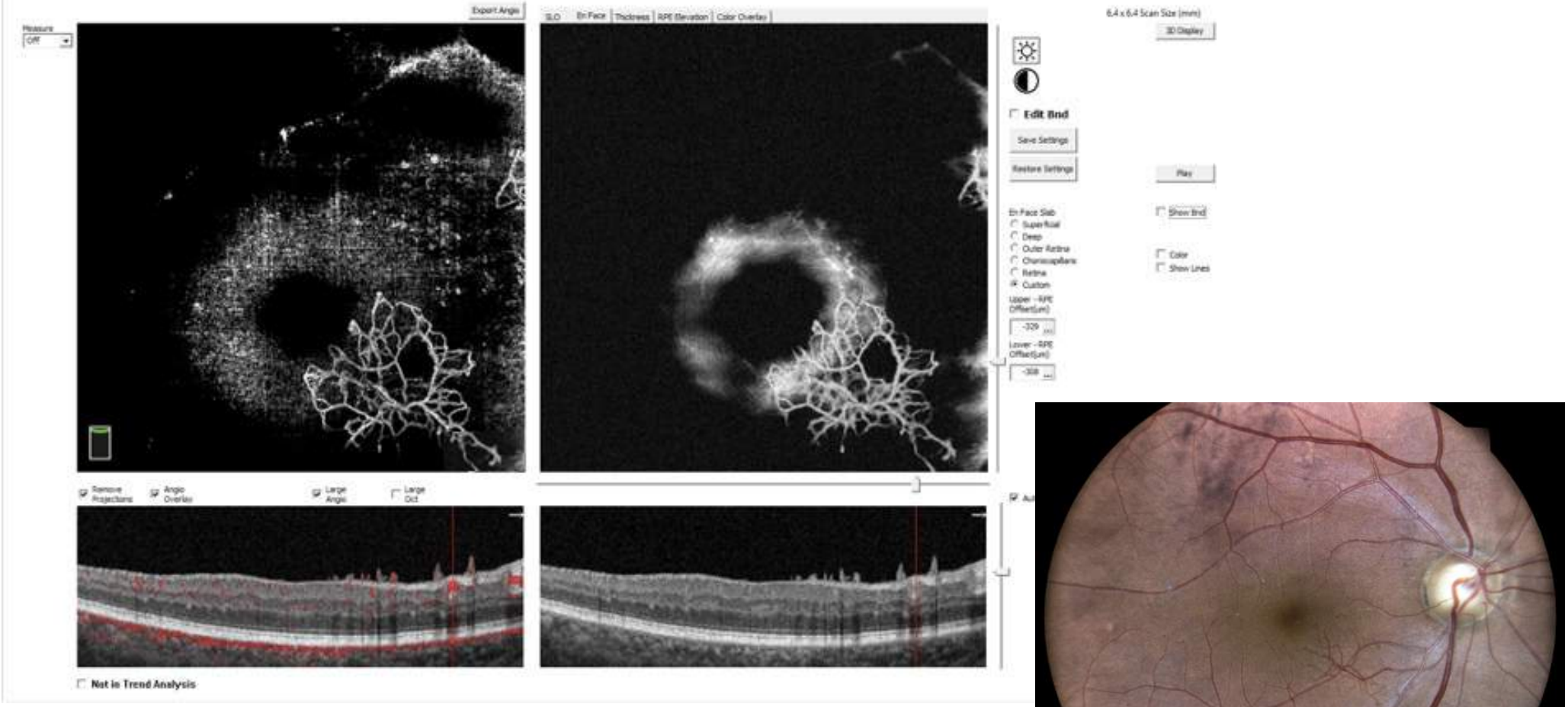

AngioVue Retina
Scan Quality 9/10
Right / OD
Edit Bscl
Show Grid
Multiple Visual Analysis

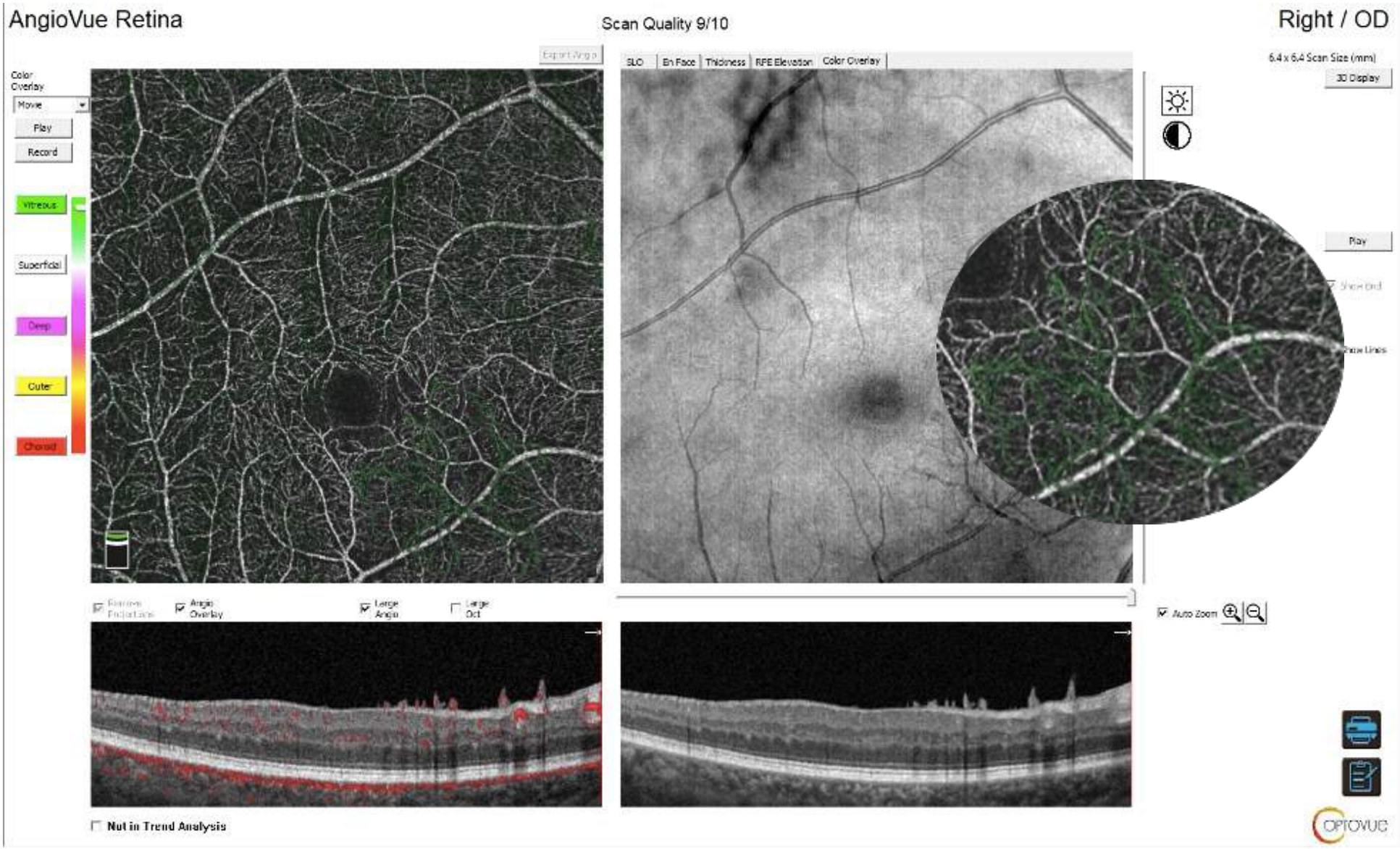

TrueColor
CENTERVUE DRSplus

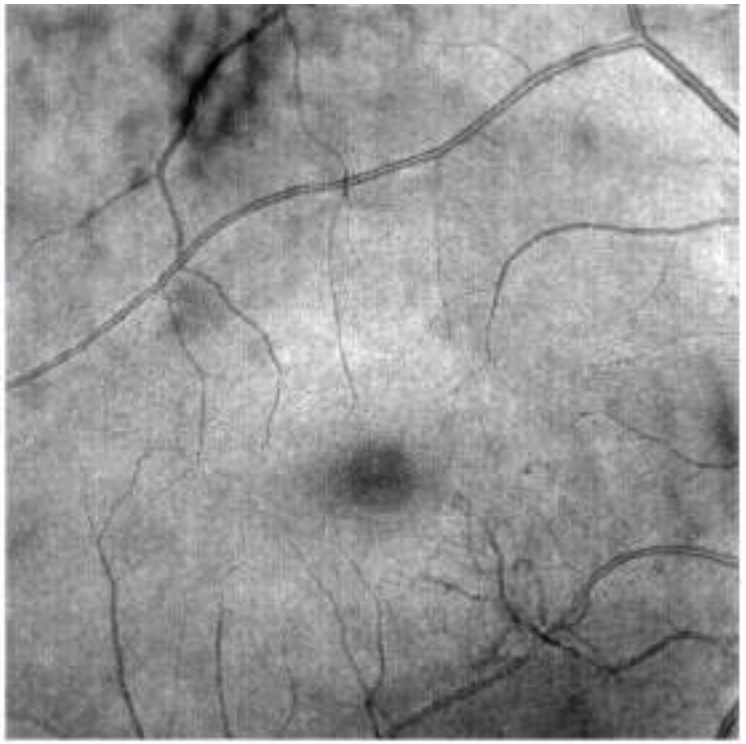
AngioVue Retina

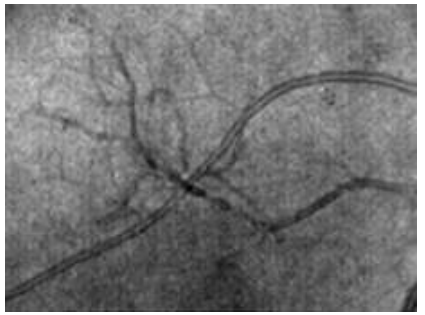
Scan Quality 9/10

Right / OD




AngioVue Retina
Scan Quality 9/10
Right / OD
Color Overlay
Movie
Play
Record
Vitreous
Superficial
Deep
Outer
Choroid
SLO
En Face
Thickness
RPE Elevation
Color Overlay
6.4 x 6.4 Scan Size (mm)
3D Display
Play
Auto Zoom
Not in Trend Analysis
OPTOVUE

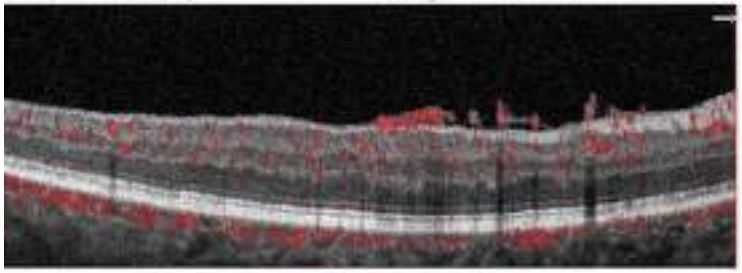


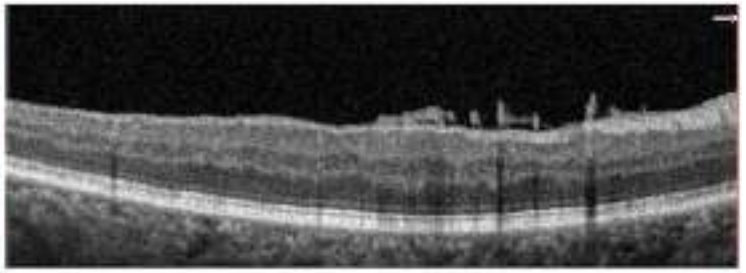


Angio Overlay

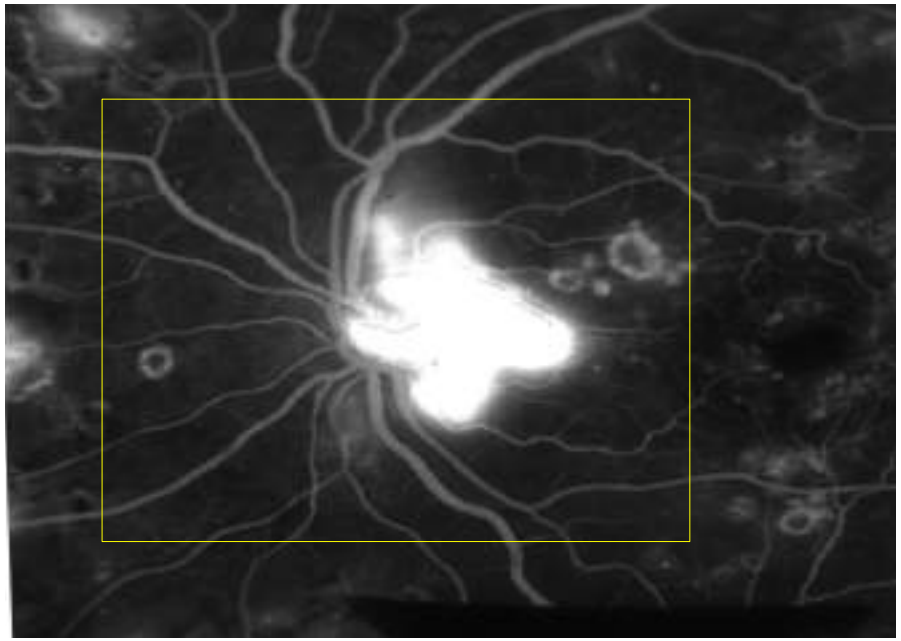
Large Angio

Large OCT

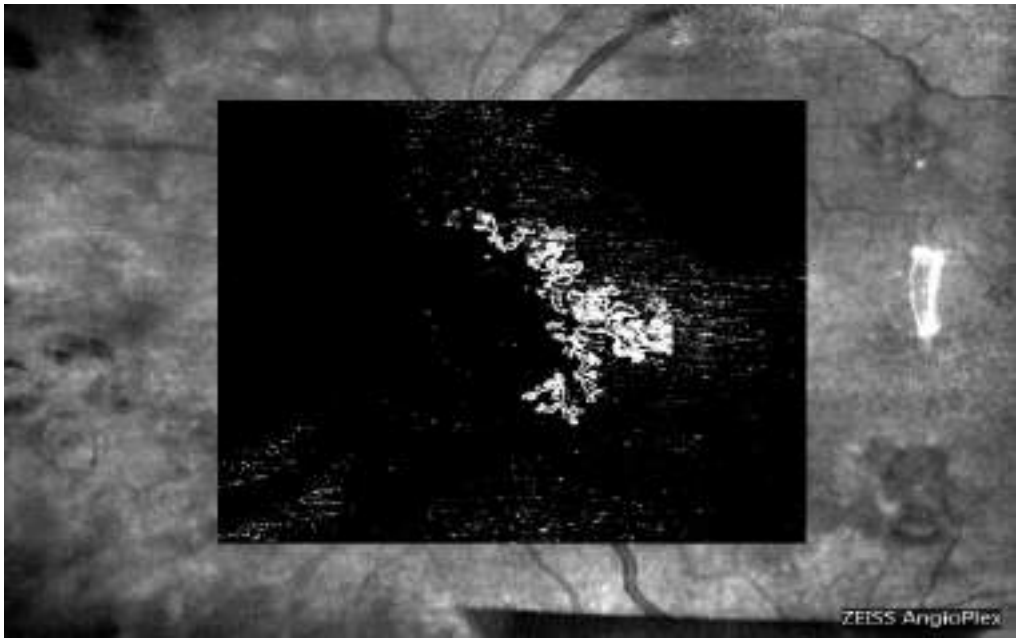




PDR



1:48 FA

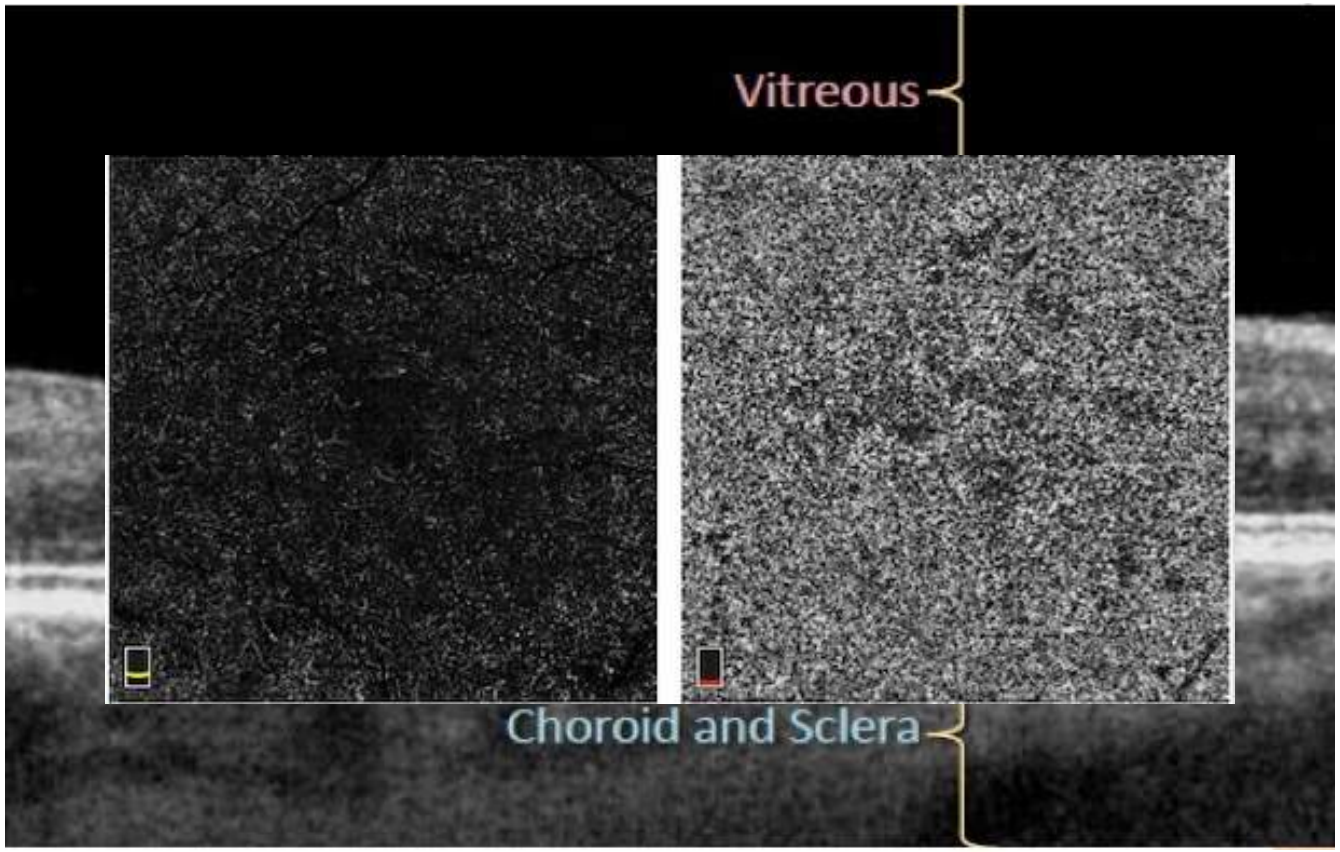


OCTA

Courtesy of S. Lee, East Bay Retina Consultants, Oakland, California, USA

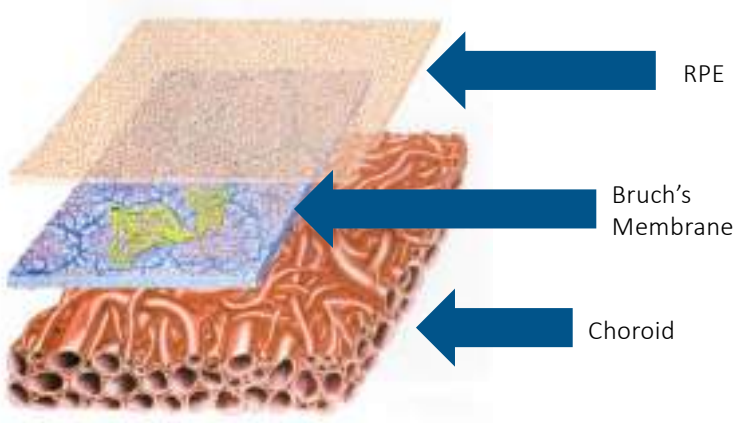
Apply This Clinically

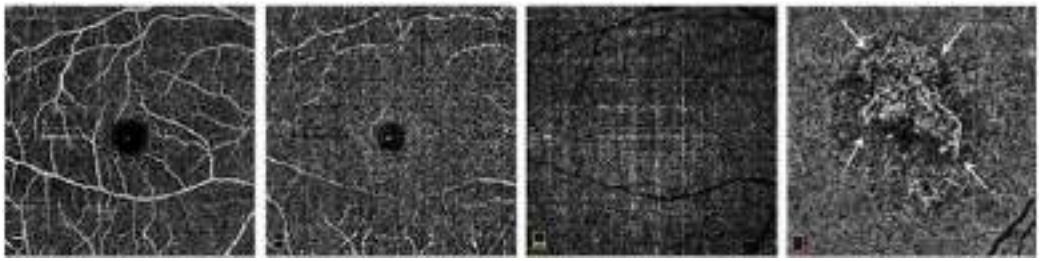
Outer Retinal Disease: Choroidal Neovascular Membrane

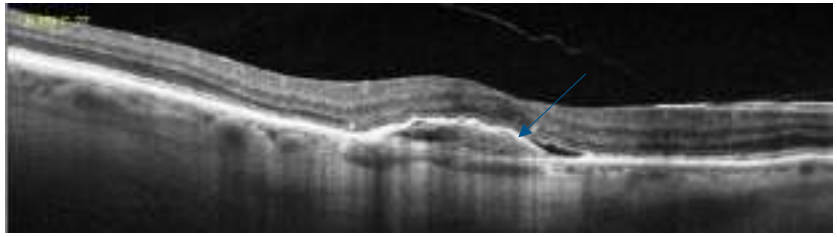

Vitreous
Choroid and Sclera

Type 1 "Occult" CNV

- New vessels develop in the choroid
- New vessels located **BELOW RPE** and ABOVE Bruch's membrane







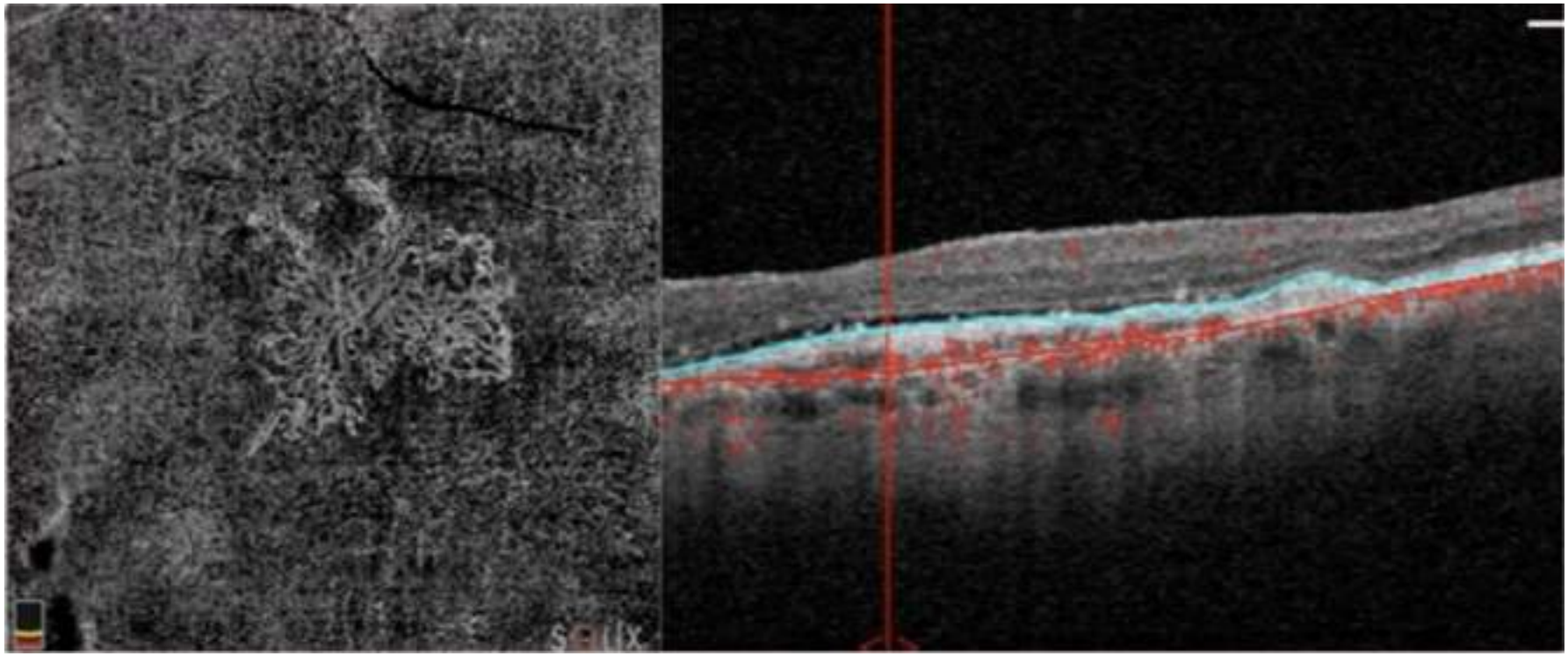
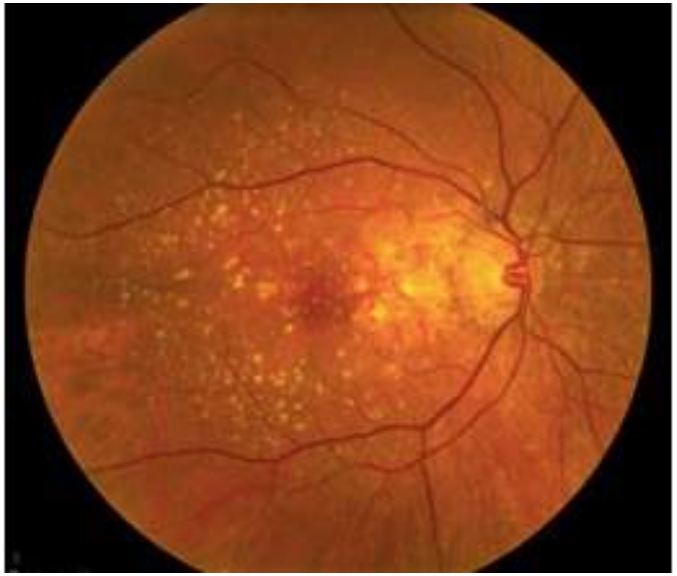


Image courtesy of Adil El Maftouhi, Centre Rabelais, Lyon, France

65 y/o Caucasian Male

- History of Dry AMD, Recent decrease in vision OS

https://eyerounds.org/cases/118-AMD-progression.htm

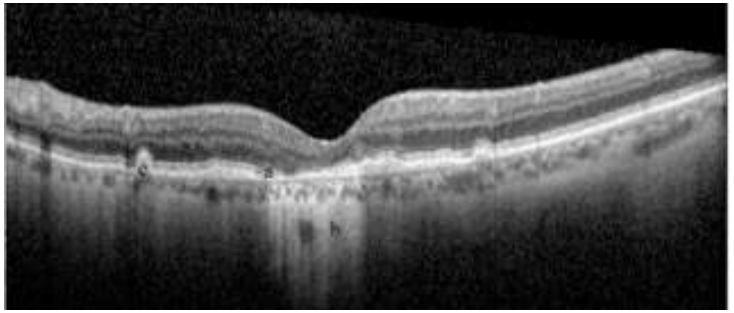


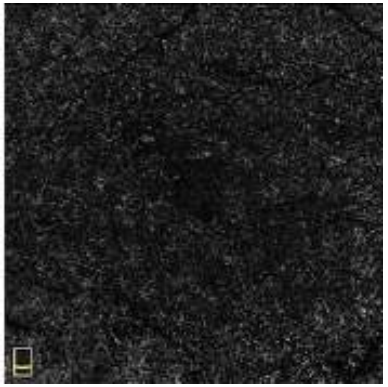
OD

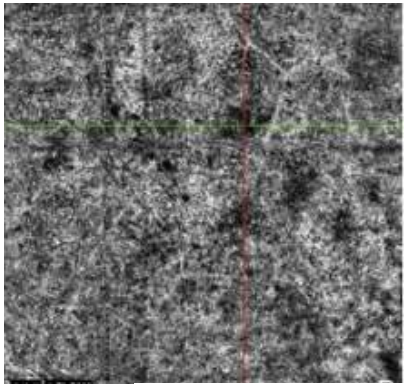
Multiple, large drusen

Geographic atrophy

But.... NO signs of CNVM







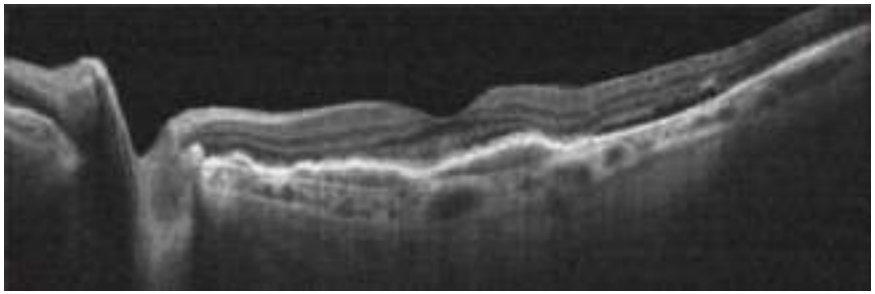
https://eyerounds.org/cases/118-AMD-progression.htm

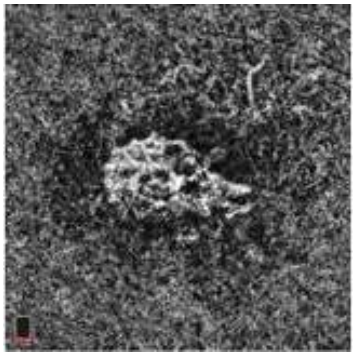
OS

Multiple, large drusen

Geographic atrophy

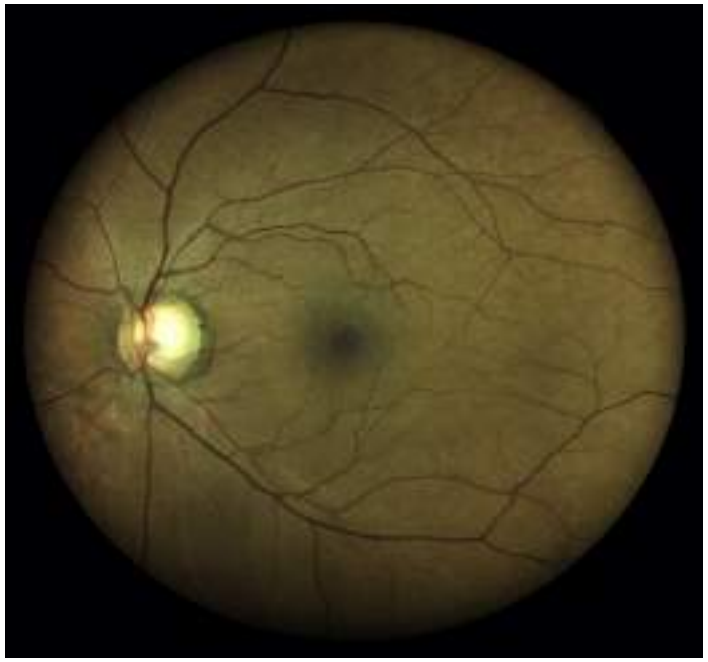
But…. Larger area of atrophy and subretinal hemorrhage

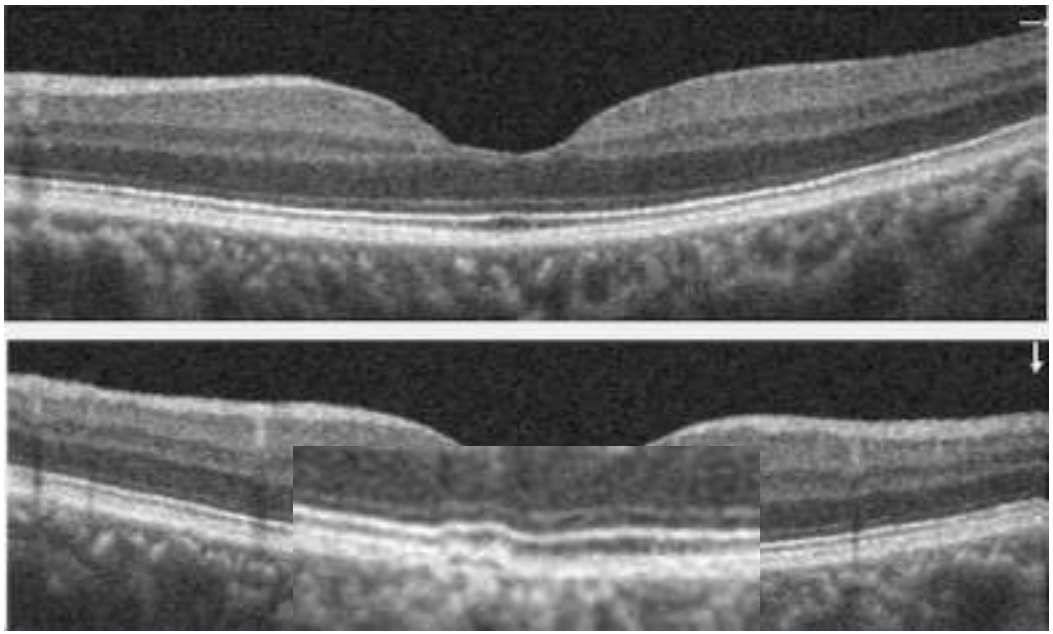


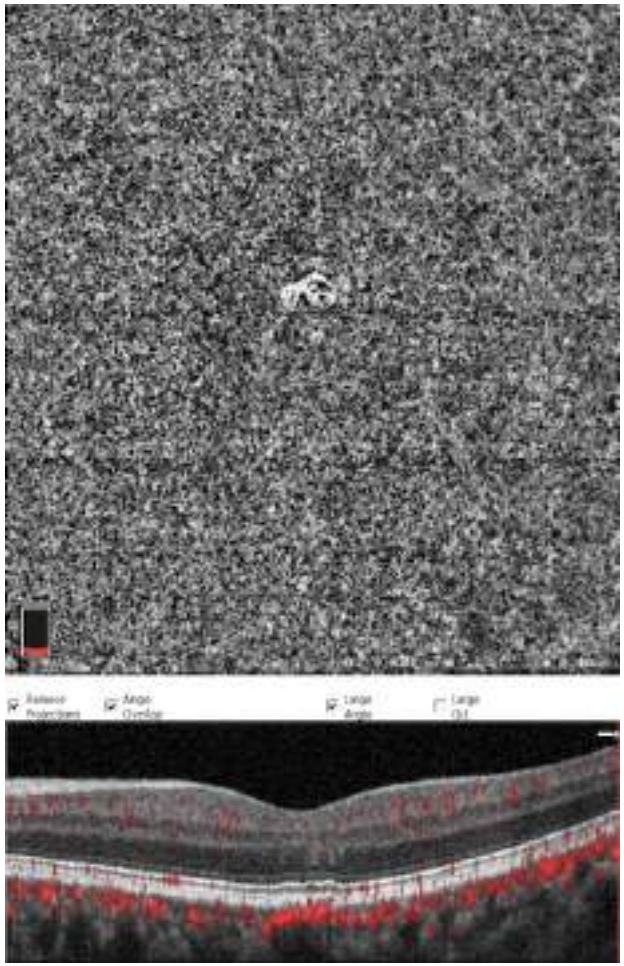


https://eyerounds.org/cases/118-AMD-progression.htm

63 y/o African American Male







…And Another!!

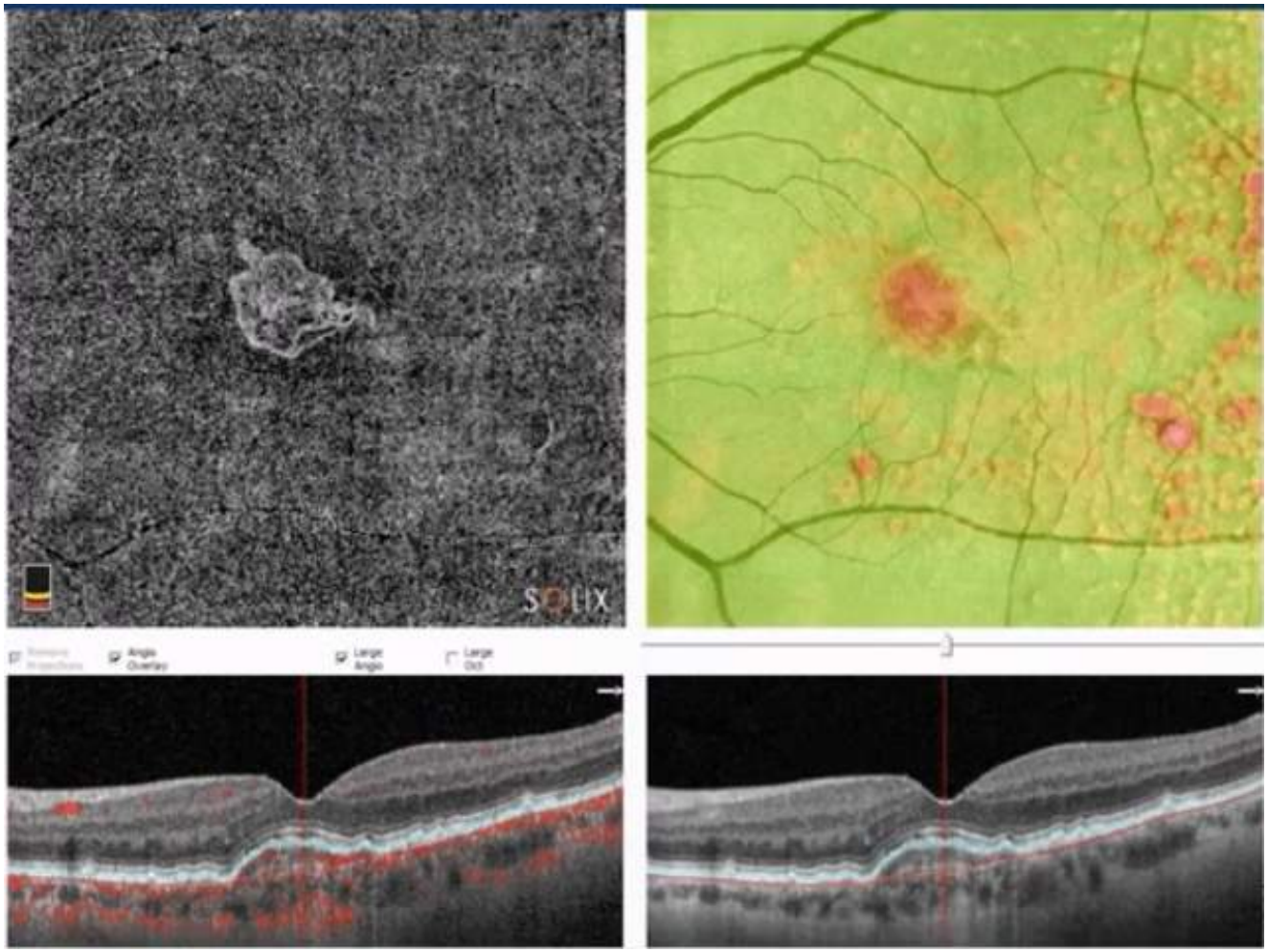
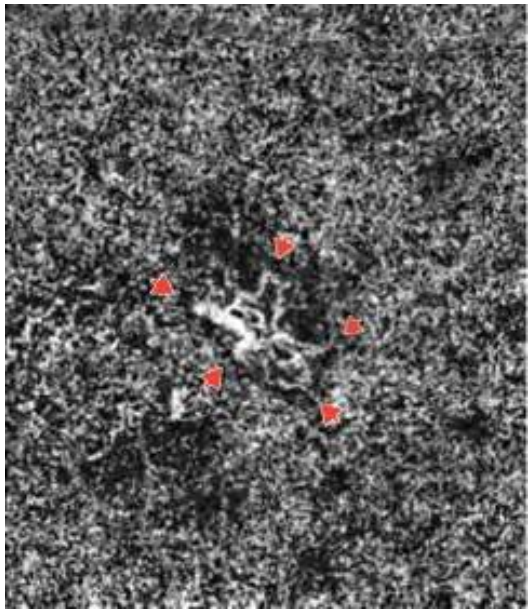
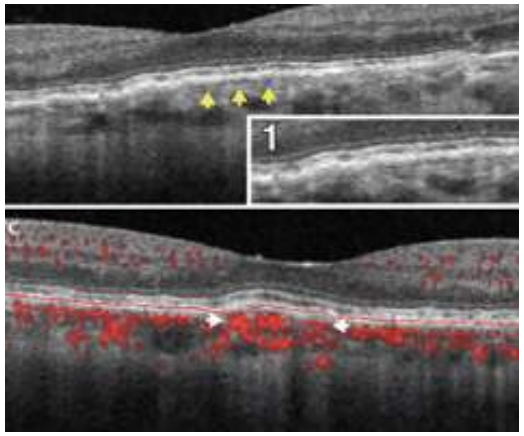


Image courtesy of Adil El Maftouhi, Centre Rabelais, Lyon, France

How do we define non-exudative occult CNV?

- No leakage on OCT (blood/fluid etc.)
- No visible exudation on OCT
- Distinct neovascular frond on OCTA
- No leakage on FA





https://retinatoday.com/articles/2020-may-june/oct-angiography-in-nonexudative-age-related-macular-degeneration

Non-exudative Occult CNVM: Clinical Pearls

In eyes with NEON, progression to frank CNVM is more common than progression to intermediate AMD, and therefore this risk warrants closer follow-up.

> Ophthalmol Retina. 2019 Aug;3(8):629-636. doi: 10.1016/j.oret.2019.03.008. Epub 2019 Mar 21.

Detection of Nonexudative Choroidal Neovascularization and Progression to Exudative Choroidal Neovascularization Using OCT Angiography

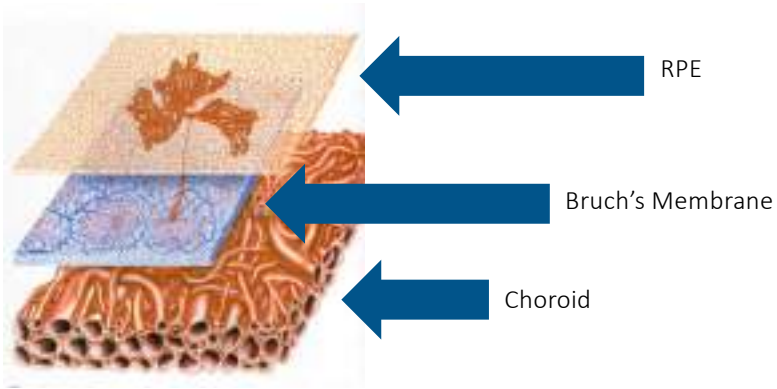
Steven T Bailey [1], Omkar Thaware [2], Jie Wang [2], Ahmed M Hagag [2], Xinbo Zhang [2], Christina J Flaxel [2], Andreas K Lauer [3], Thomas S Hwang [2], Phoebe Lin [2], David Huang [3], Yali Jia [2]

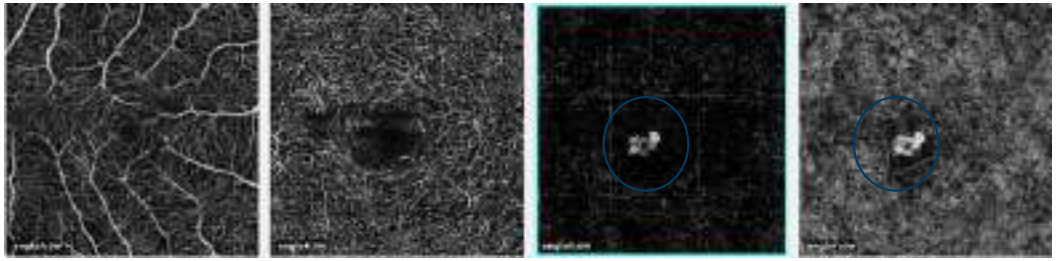
Non-exudative Occult CNVM: Clinical Pearls

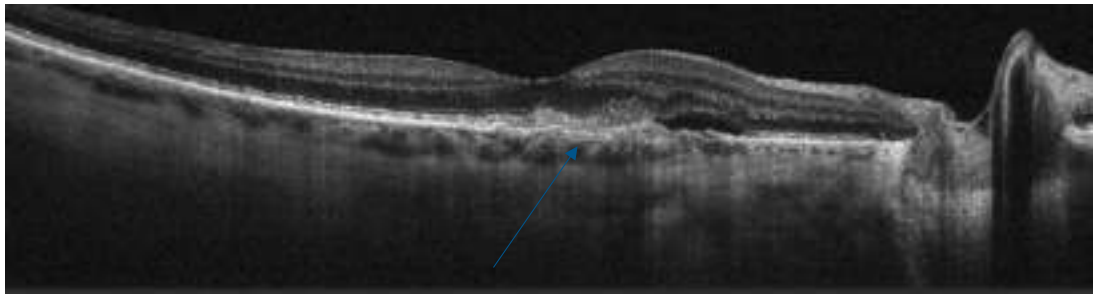
Nonexudative CNV frequently is detected by OCTA in the fellow eyes of those with exudative CNV. These lesions carry a high risk of exudation developing within the first year after detection and could benefit from close monitoring. The high risk of progression may justify prophylactic treatment; further studies are needed.

Type 2 "Classic" CNV

- New vessels develop in choroid
- New vessels located **ABOVE the RPE** and ABOVE Bruch's membrane





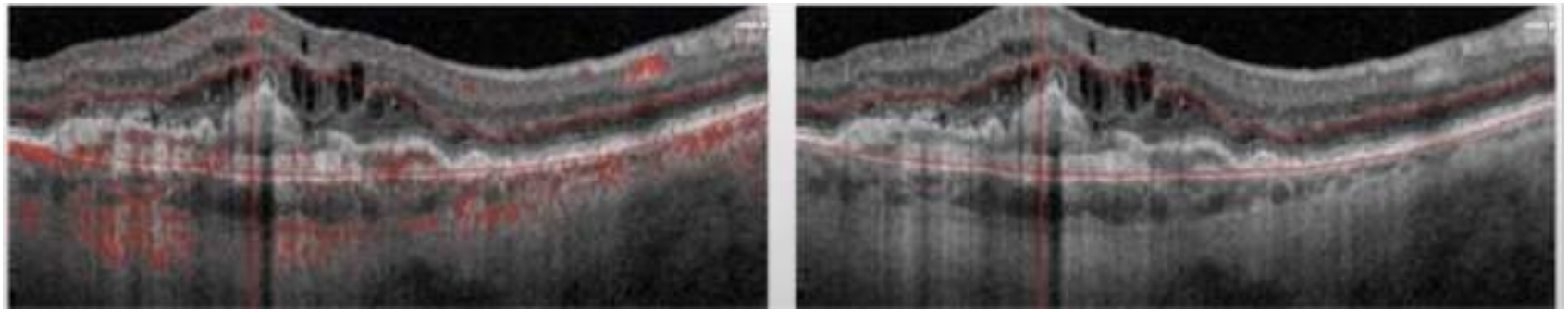


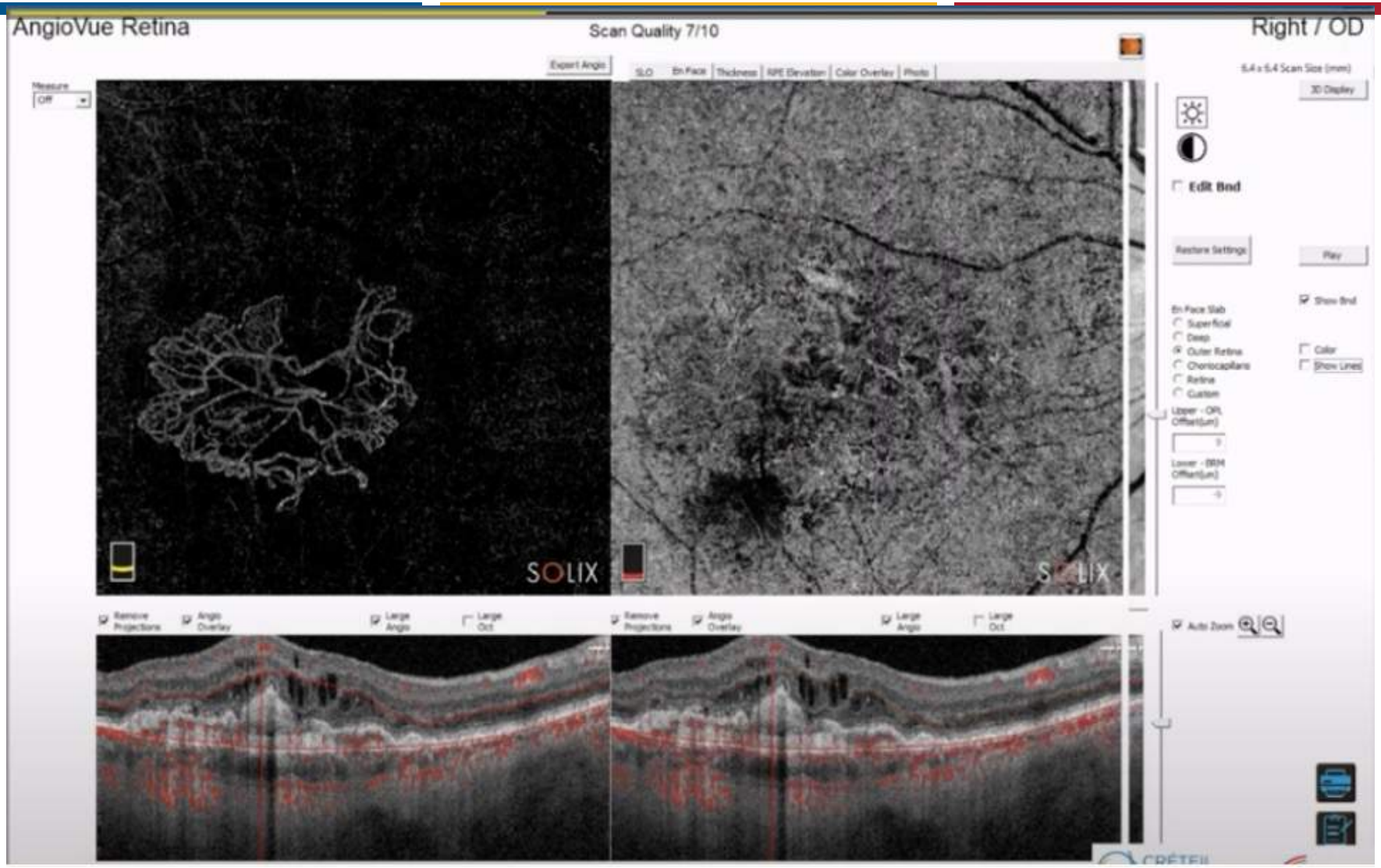
Meet Wendy: *A 66-year-old Caucasian female*

"I have a long-standing history of Macular Degeneration…. BUT…. My vision has gotten really bad in my right eye…."

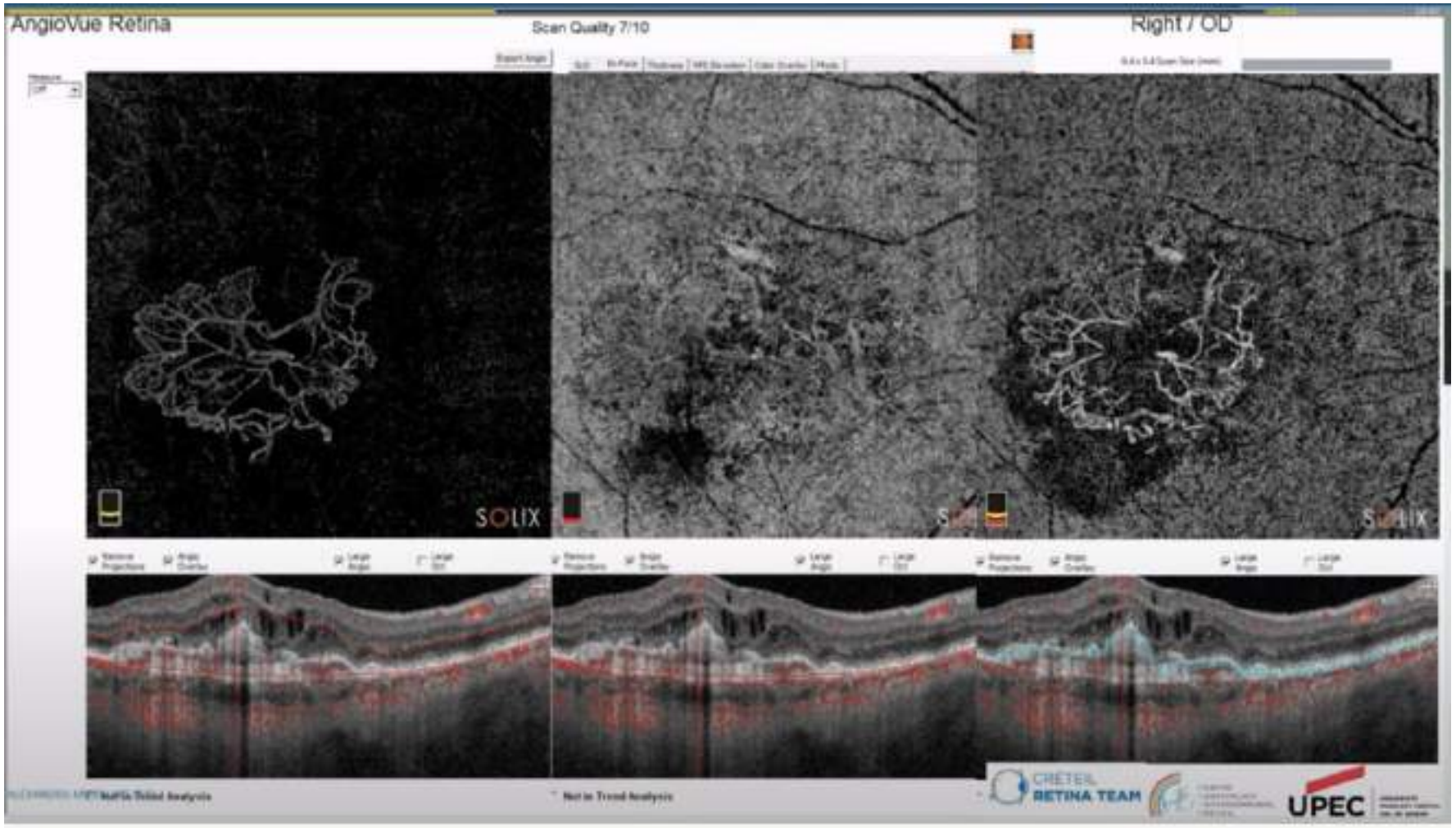
https://www.eurekalert.org/pub_releases/2013-04/nei-tcb040213.php

OCT B-scans





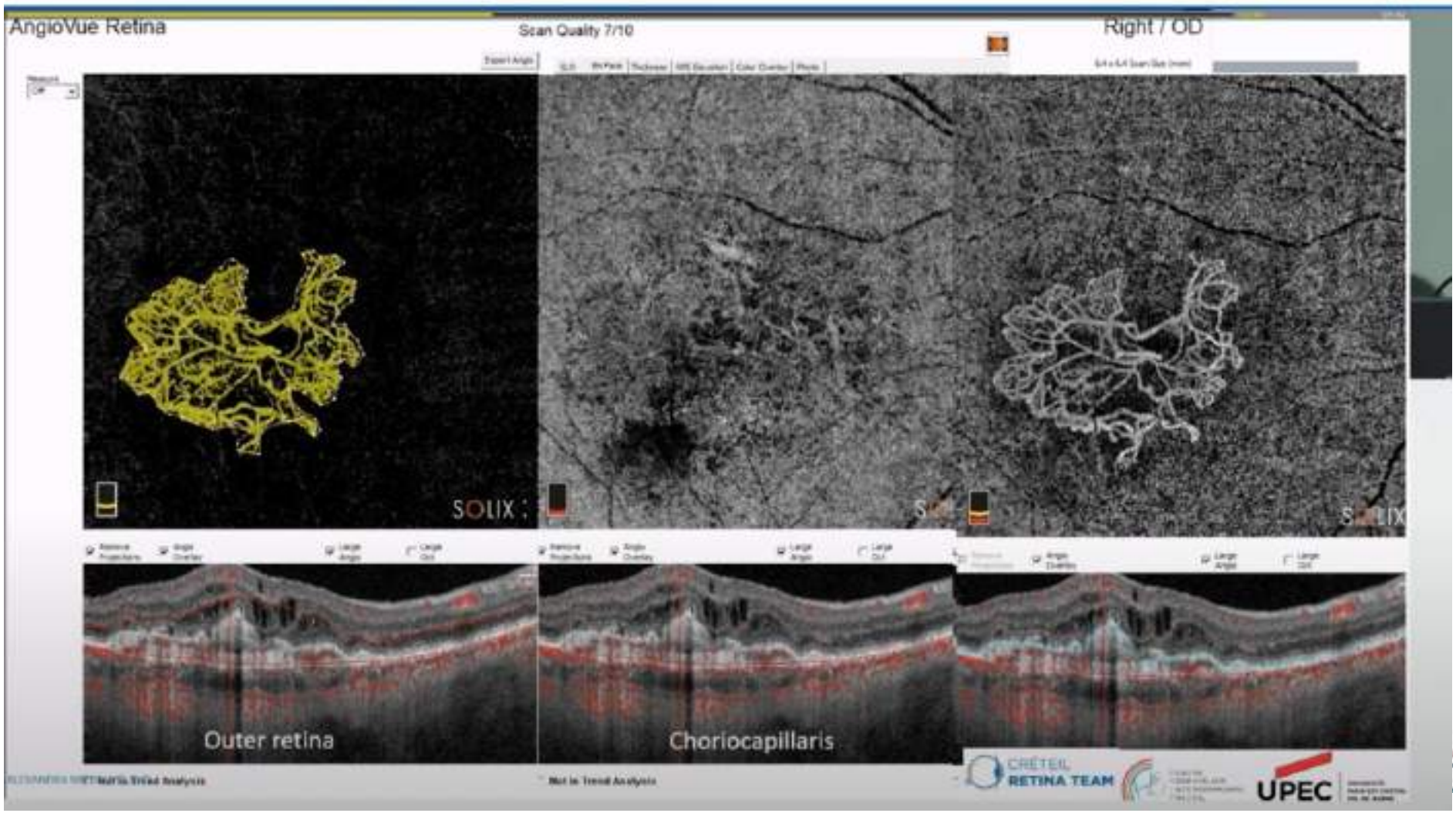
Alexandra Miere


AngioVue Retina
Scan Quality 7/10
Right / OD
SOLIX
SOLIX
SOLIX
CRETEIL
RETINA TEAM
UPEC

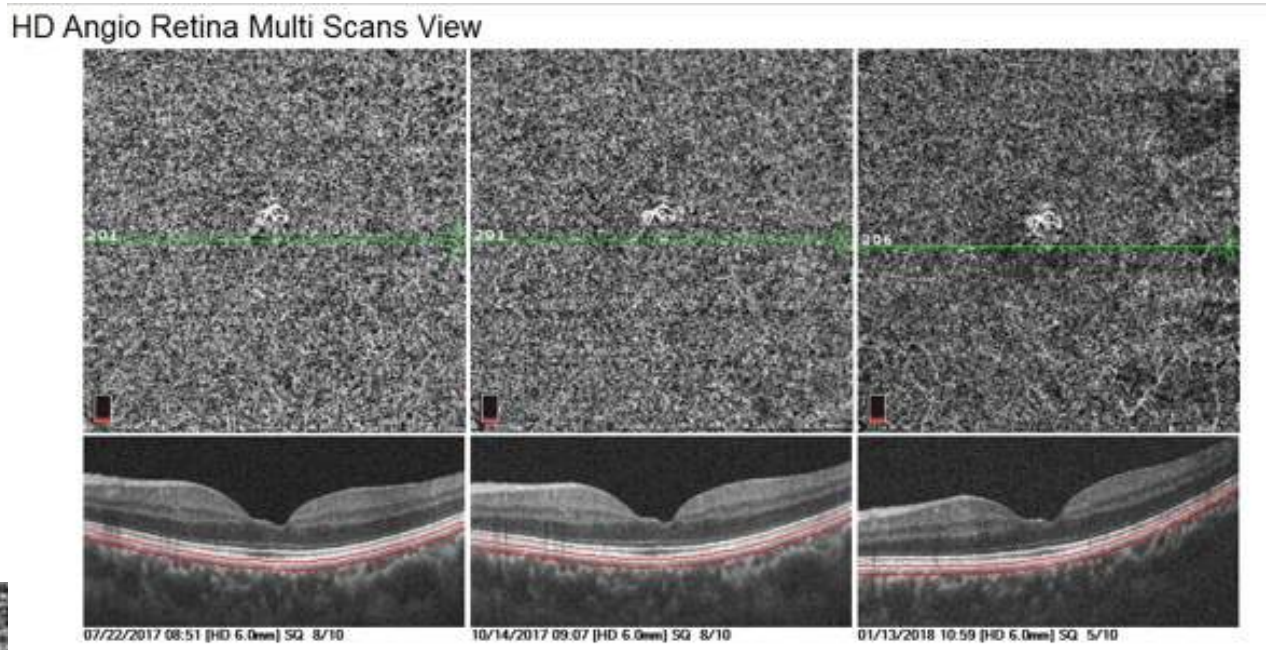
AngioAnalytics

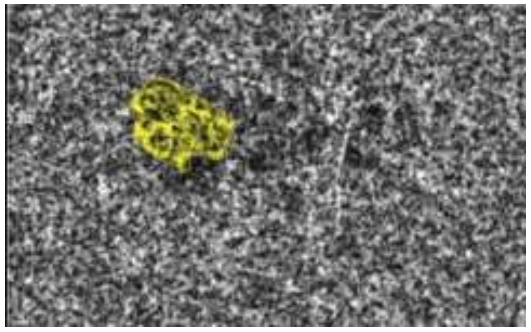
Choroidal Neovascular Membranes

"Flow Area"


AngioVue Retina
Scan Quality 7/10
Right / OD
SOLIX
Outer retina
Choriocapillaris
CRETEIL
RETINA TEAM
UPEC

AngioAnalytics: Trend Analysis





AngioAnalytics: CNV Multi Scan View for Follow-Up

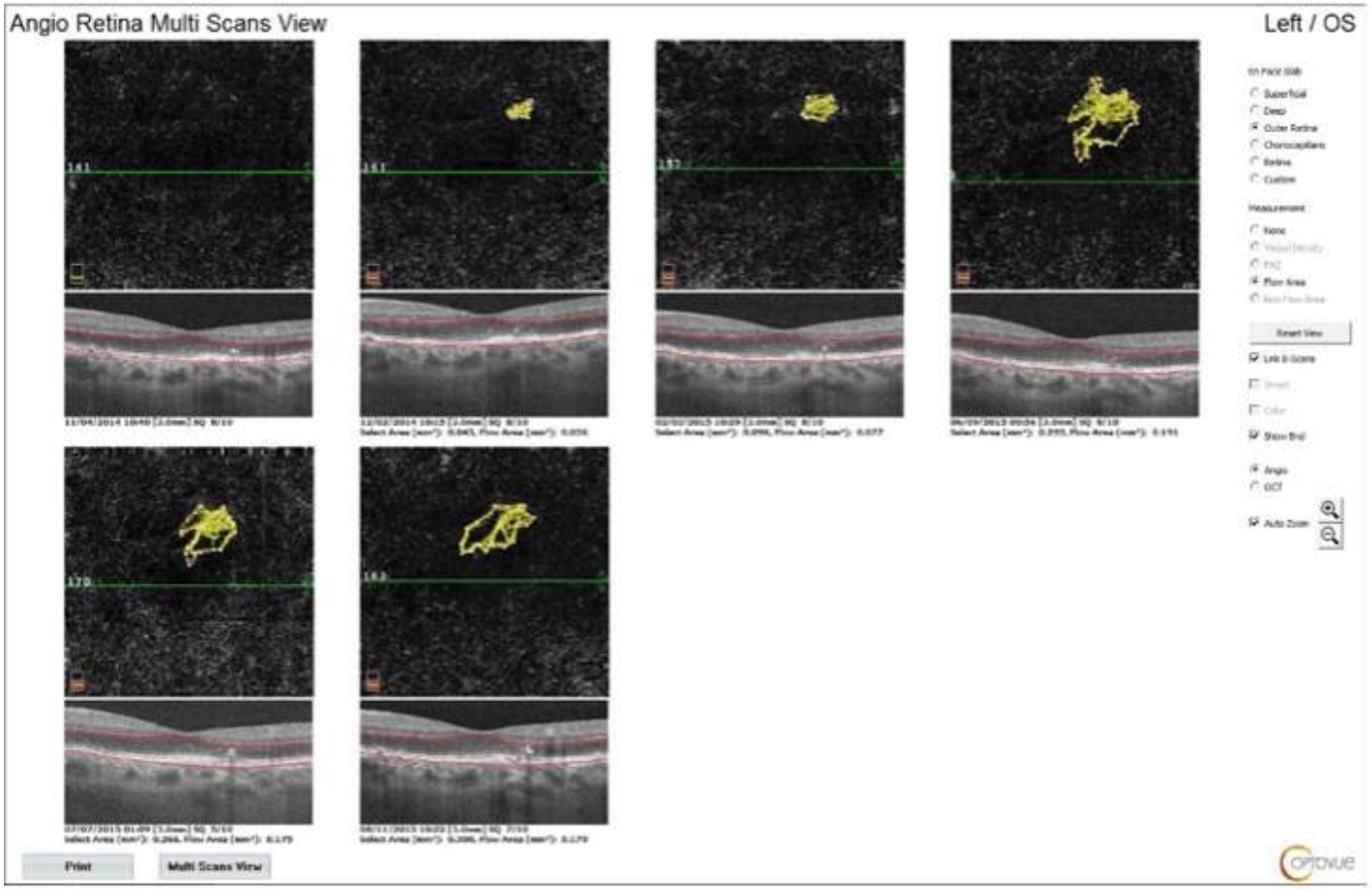
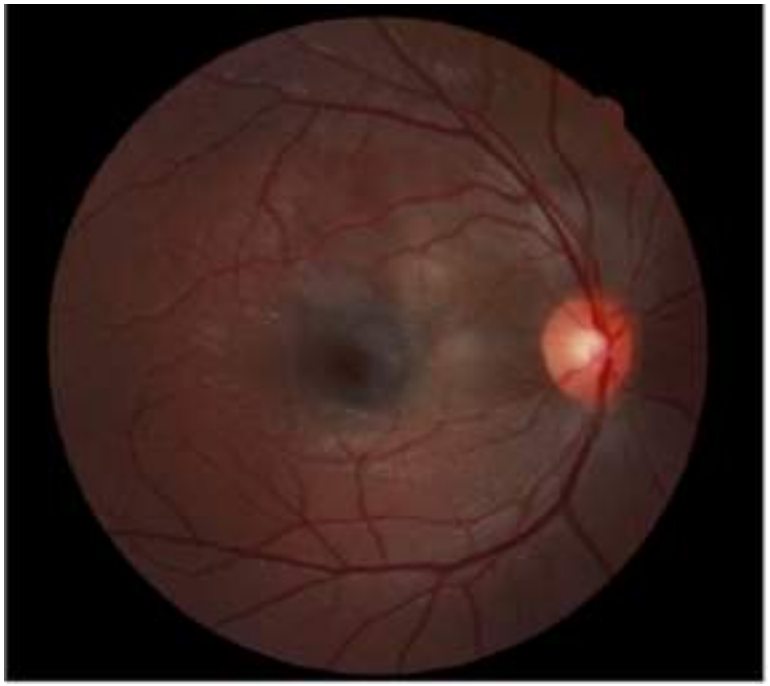


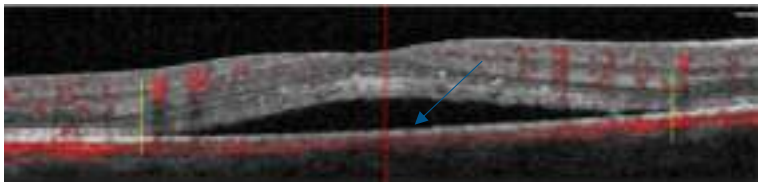
Image courtesy of Paul Tornambe, MD, FACS, Retina Consultants San Diego, La Jolla, California

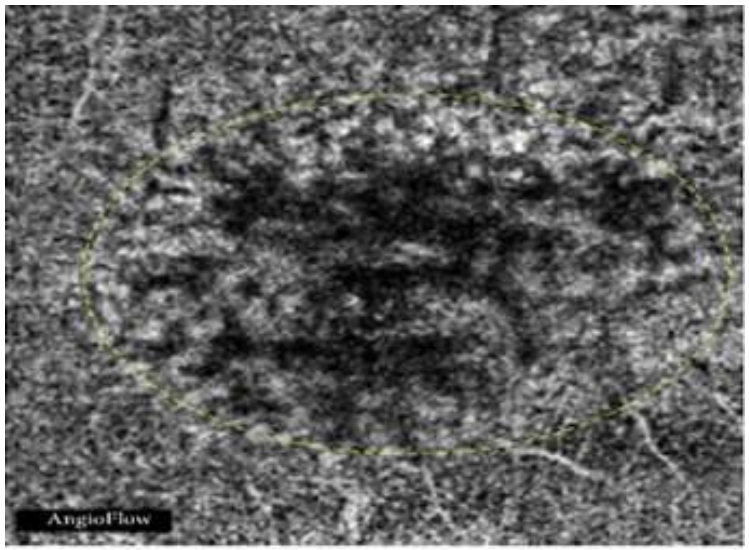
Apply This Clinically

Outer Retinal Disease: Central Serous Chorioretinopathy

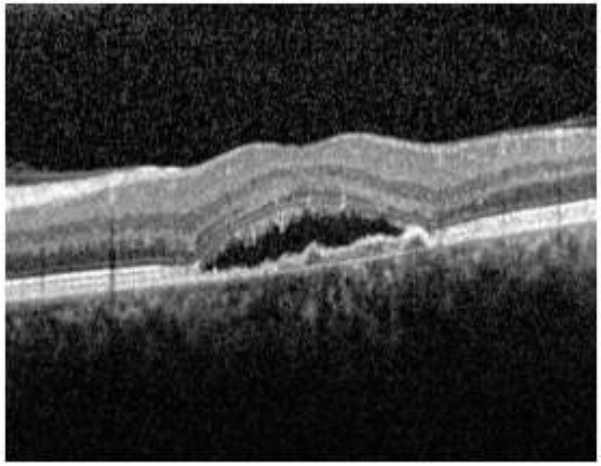
CSR: The easy one…

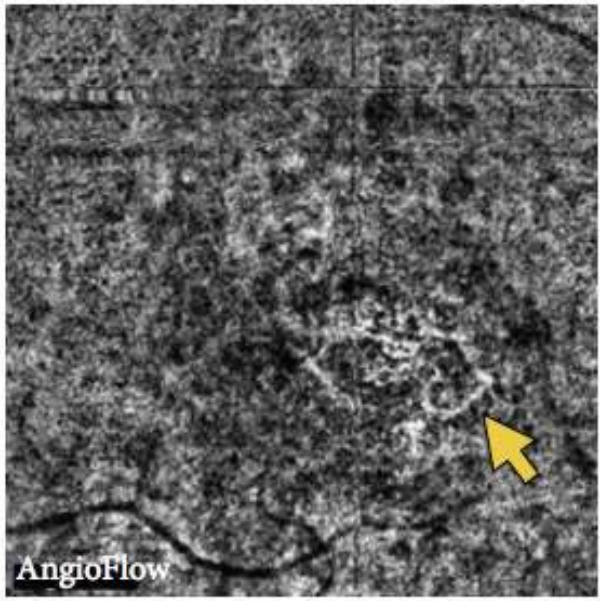




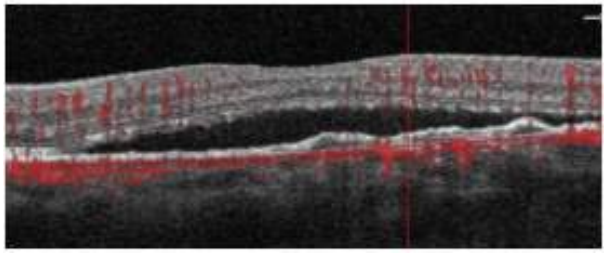


Choriocapillaris slab: Shadowing





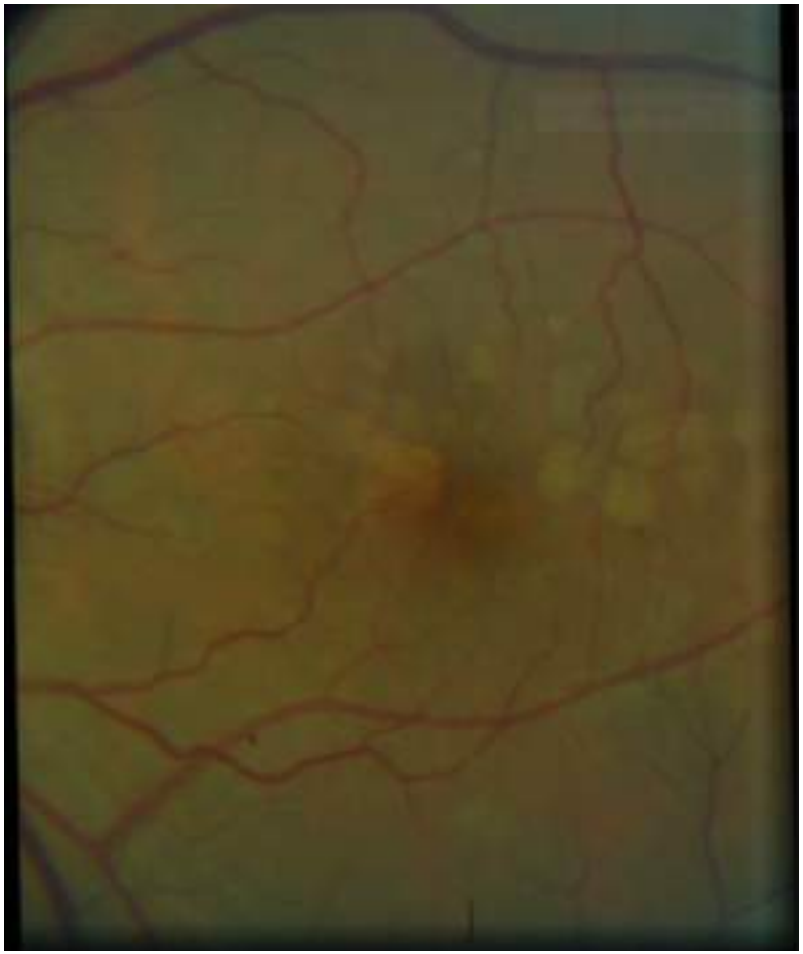
CSR: The chronic one!



Apply This Clinically

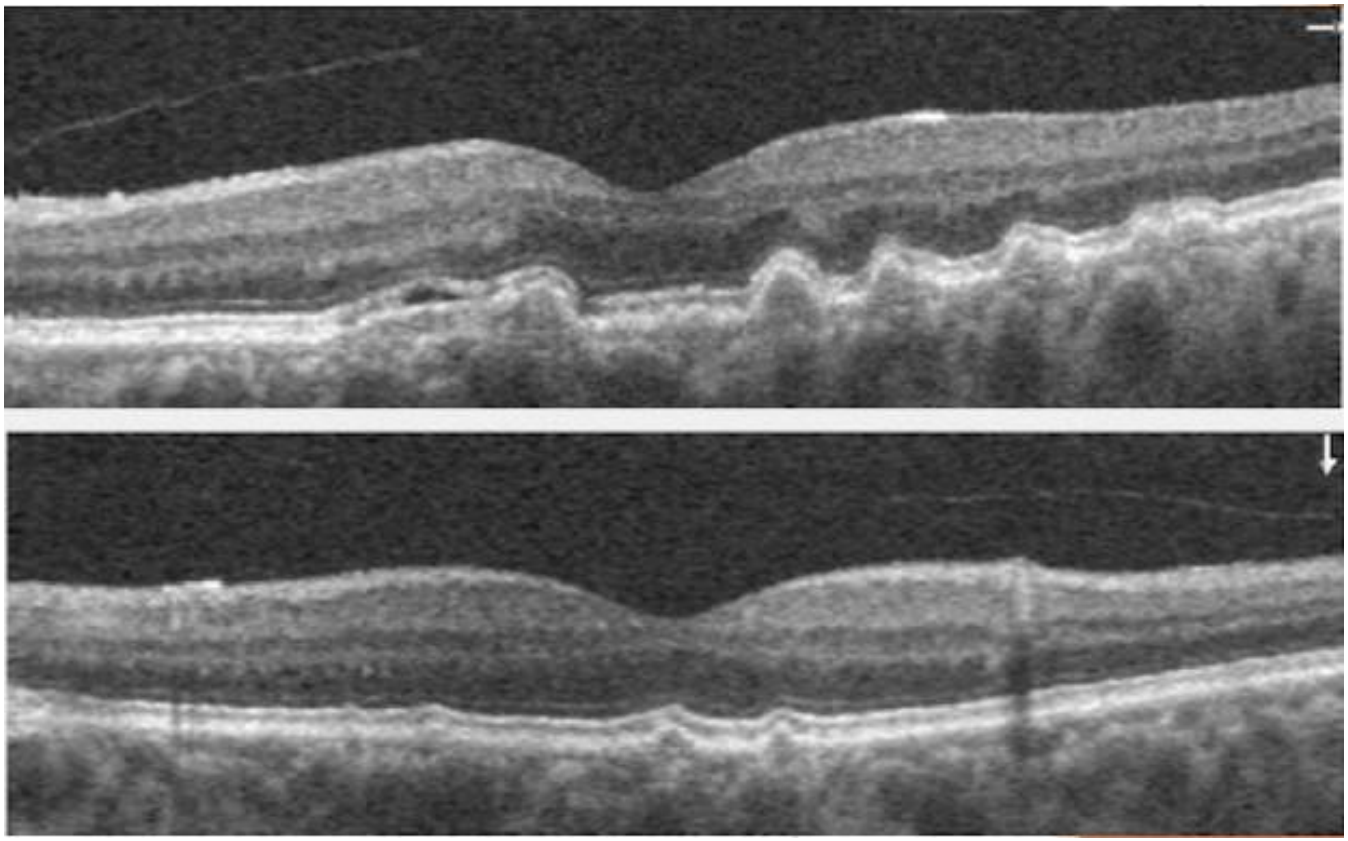
Outer Retinal Disease: Pigment Epithelial Detachment

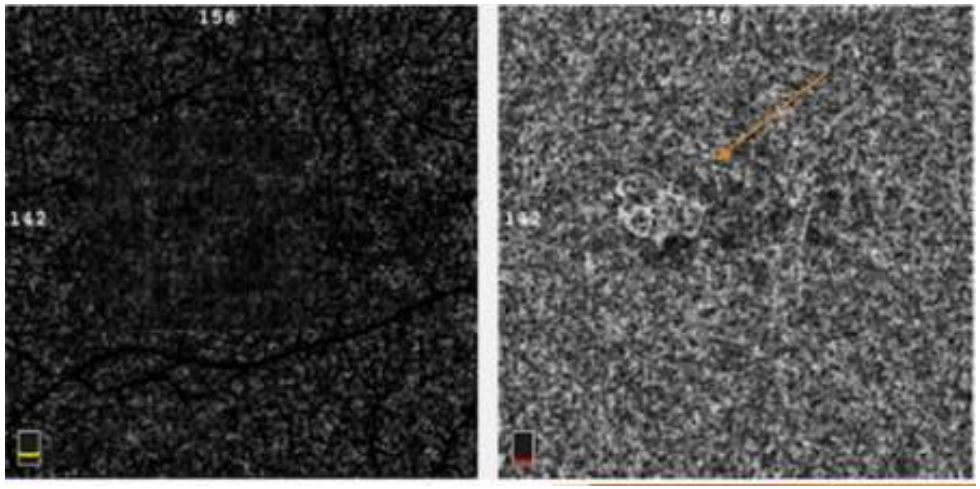
72-year-old Hispanic Male

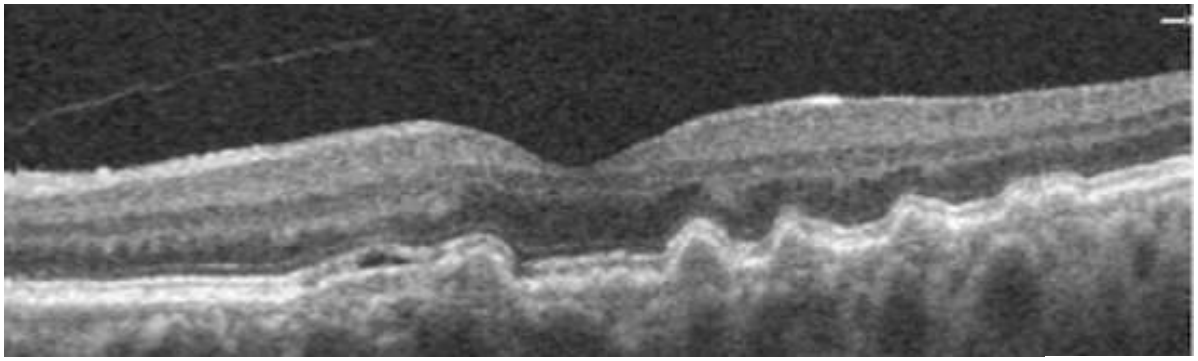


No new visual complaints

Stable vision

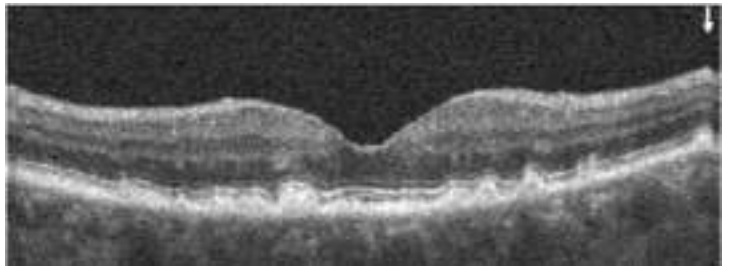



156
142
156
142

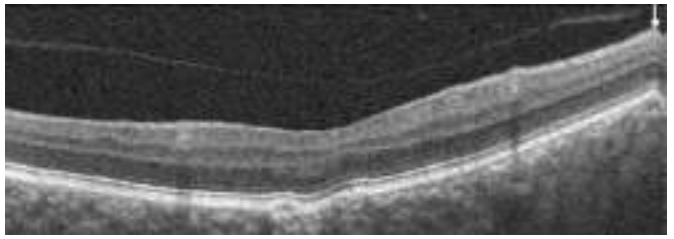


What about these scans?

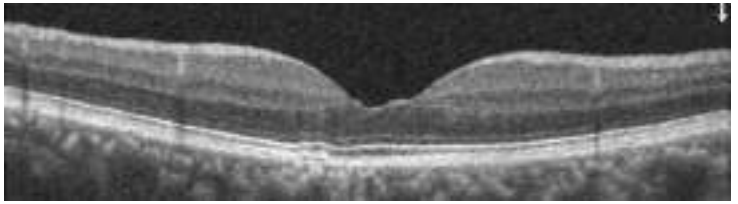
All 20/20!!!!



A



B



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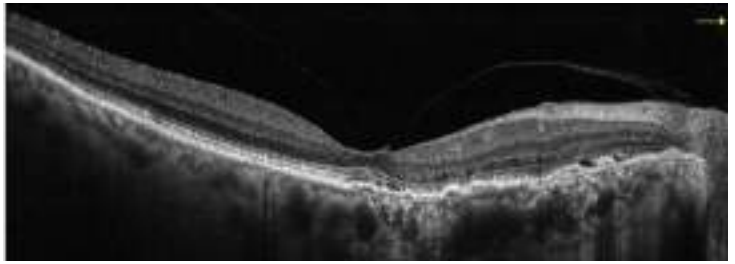

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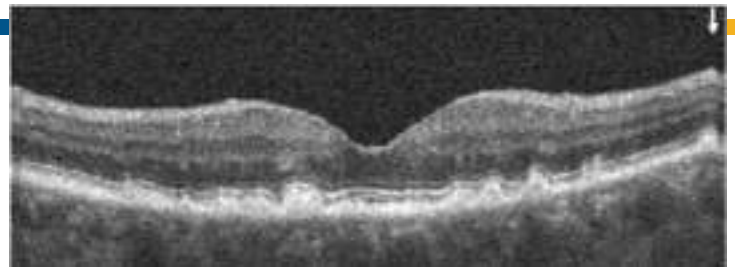

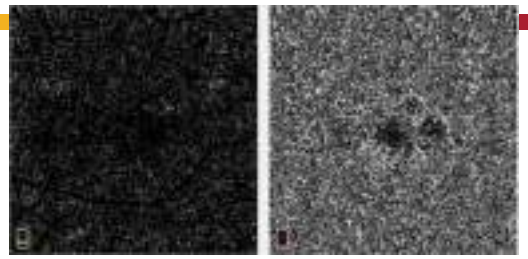

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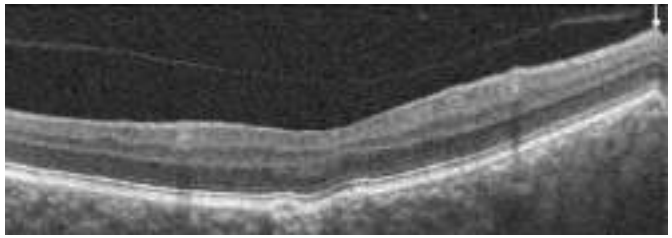

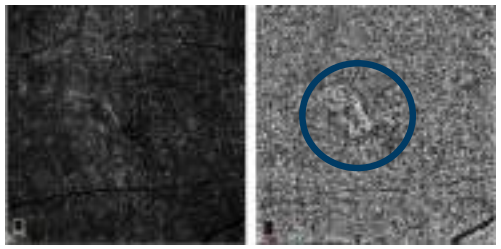

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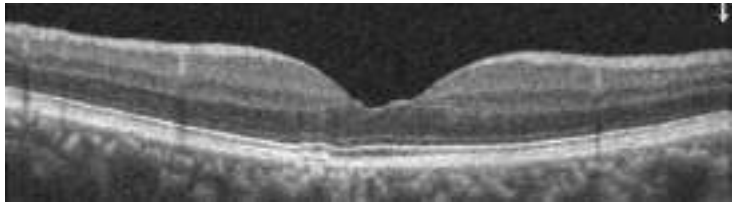

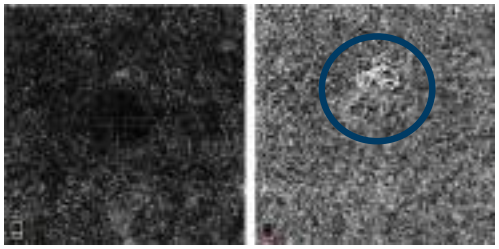

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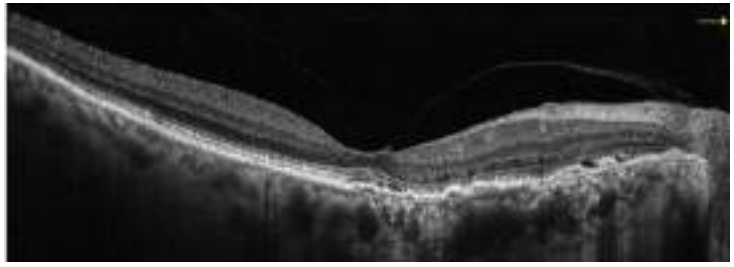

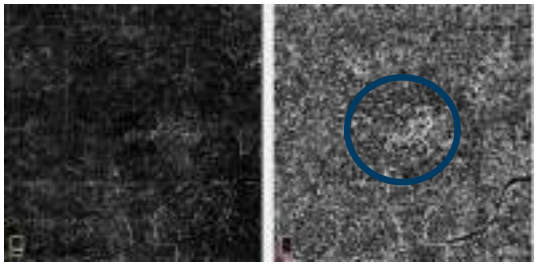

D

Questions??

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