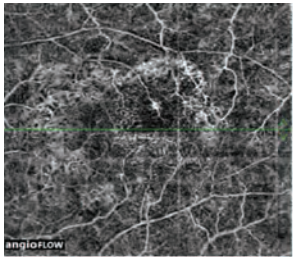
# OCT Angiography




**OAO 2017 Annual Symposium**

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*SPECIAL THANKS TO DR. DAVID CHOW*

TRI TORONTO RETINA INSTITUTE

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MISSISSAUGA RETINA INSTITUTE

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Financial disclosures:

Advisory board: Alcon, Novartis, Bayer

Research grant: Bayer

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## OCT ANGIOGRAPHY

NON-INVASIVE MICROVASCULAR ENHANCED IMAGING TECHNOLOGY


**Intrinsic motion of RBC's in the vessels imaged in space over time**

**Functional assessment of vasculature**

**En Face projections used to view**

**NO CONTRAST MEDIUM injected**

**3D depth resolved images**

*Motion Contrast used to image the flow in retinal vasculature*

**SSADA (Split Spectrum Amplitude Decorrelation Angiography) algorithm**

**Spectral Domain OCT system**

**En Face 3d Visualization**

**Motion Correction technology**

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## OCT ANGIOGRAPHY

### PRINCIPLES OF OCT ANGIOGRAPHY

VISUALIZING FLOW THROUGH MOTION CONTRAST

FLOWING WATER CAN BE DISTINGUISHED FROM A STATIC BACKGROUND BY COMPARING SEQUENTIAL VIDEO FRAMES TO HIGHLIGHT MOTION

MOTION CONTRAST IS SIMILARLY USED IN OCT ANGIOGRAPHY TO DISTINGUISH BLOOD FLOW IN THE VESSEL FROM STATIC TISSUE

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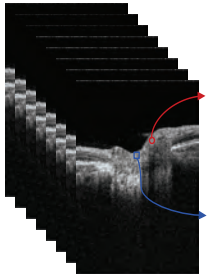
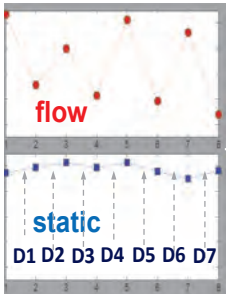
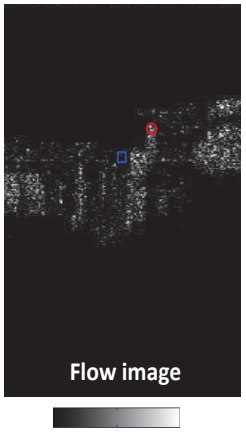
# OCT Angiography






$$\frac{1}{N-1}\sum_{n=1}^{N-1} D_n$$

$$D_n(x,z) = 1 - \frac{A_n(x,z)A_{n+1}(x,z)}{[\frac{1}{2}A_n(x,z)^2 + \frac{1}{2}A_{n+1}(x,z)^2]}$$
$$(n = 1 \rightarrow N-1)$$




Jia Y, Tan O, Tokayer J, et. al., Split-spectrum amplitude-decorrelation angiography with optical coherence tomography. *Optics Express* 2012; 20:4710

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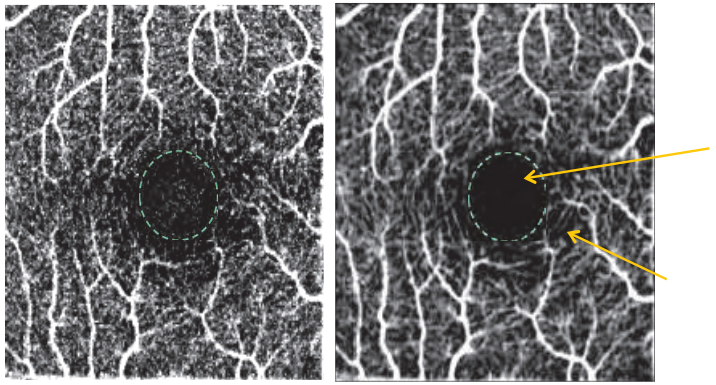
# OCT Angiography

## SSADA technology improves image quality



Jia Y, Tan O, Tokayer J, et. al., Split-spectrum amplitude-decorrelation angiography with optical coherence tomography. *Optics Express* 2012; 20:4710

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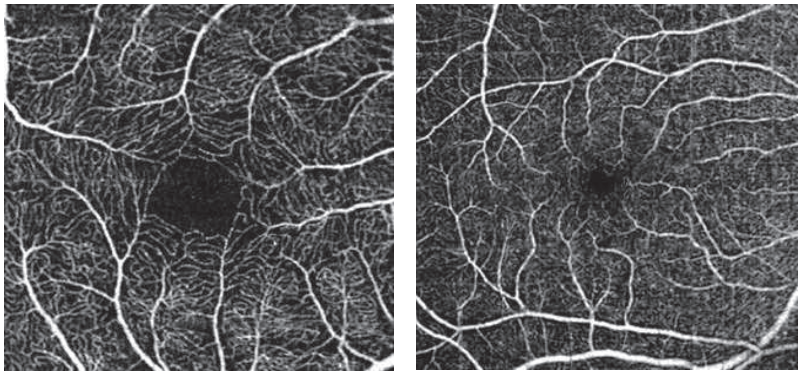
# OCT Angiography

## Normal macula

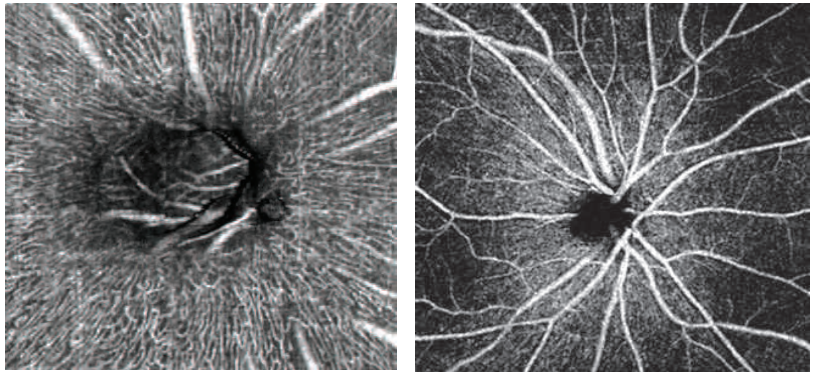


304 x 304 x 640 image volume scanned in ~3s

7

# OCT Angiography

## Normal optic disk



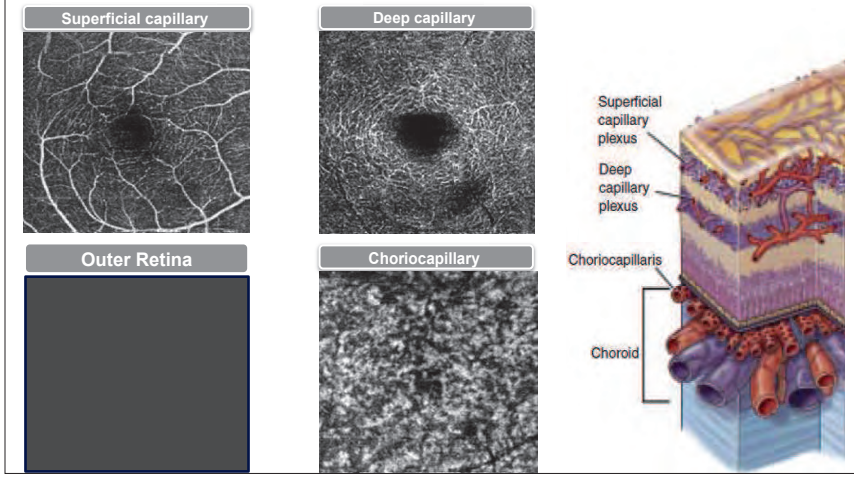
304 x 304 x 640 image volume scanned in ~3s

8

# OCT Angiography

## En face visualization - Segmentation of Cube

Can be automated or manual adjusted!





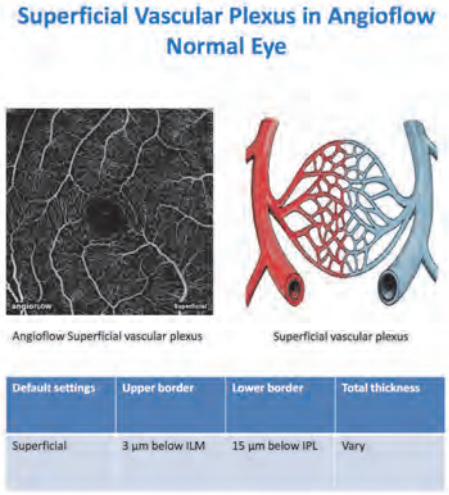

# OCT Angiography

## En face visualization - auto segmentation settings

**SUPERFICIAL RETINAL VASCULAR PLEXUS**

Consistent with our typical view on fluorescein angiography

Diabetic Retinopathy, Retinal artery and vein occlusions




| Default settings | Upper border | Lower border | Total thickness |
|---|---|---|---|
| Superficial | 3 µm below ILM | 15 µm below IPL | Vary |



# OCT Angiography

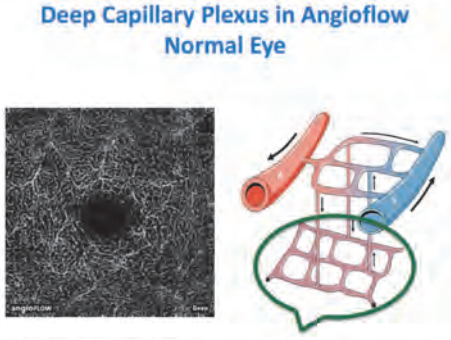
## En face visualization - auto segmentation settings

**DEEP RETINAL VASCULAR PLEXUS**

Brand new area of imaging

Traditional FA showed smudgy leakage but no details

Affected in many conditions but may be primary site of pathology in MacTel or RAP




| Default settings | Upper border | Lower border | Total thickness |
|---|---|---|---|
| Deep | 15 µm below IPL | 70 µm below IPL | 55 µm |



# OCT Angiography

## En face visualization - auto segmentation settings

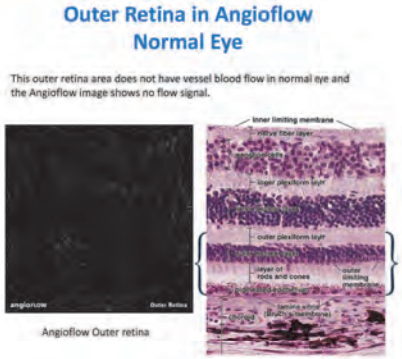
**OUTER RETINA**

Brand new area of imaging

Chosen to look at specifically as it is avascular in normal humans

Vascularization is always pathology!

Will be useful to specifically look for CNVM above the RPE, RAP lesions, etc



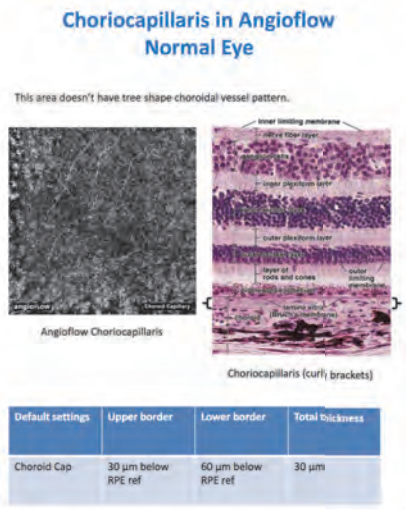

| Default settings | Upper border | Lower border | Totalthickness |
|---|---|---|---|
| Outer Retina | 70 µm below IPL | 30 µm below RPE ref | Vary |

# OCT Angiography

## En face visualization - auto segmentation settings

**CHORIOCAPILLARIS**

PRIMARY SITE OF PATHOLOGY IN ARMD, MCNV






# OCT Angiography

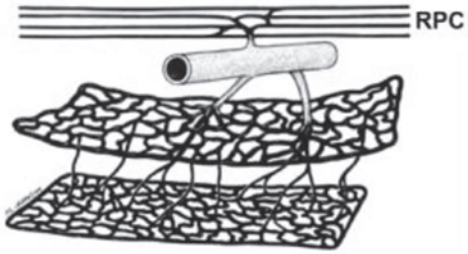
## En face visualization - auto segmentation settings
## Optic disk

**VITREOUS**

**RADIAL PERIPAPILLARY CAPILLARIES**

**SUPERFICIAL RETINAL VASCULAR PLEXUS**

**DEEP RETINAL VASCULAR PLEXUS**

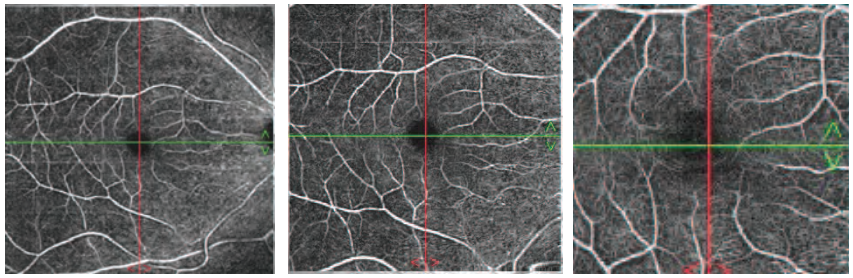





# OCT Angiography

## Angioflow Image: Field size 8-6-3 mm with ANGIOVUE

8×8 6×6 3×3



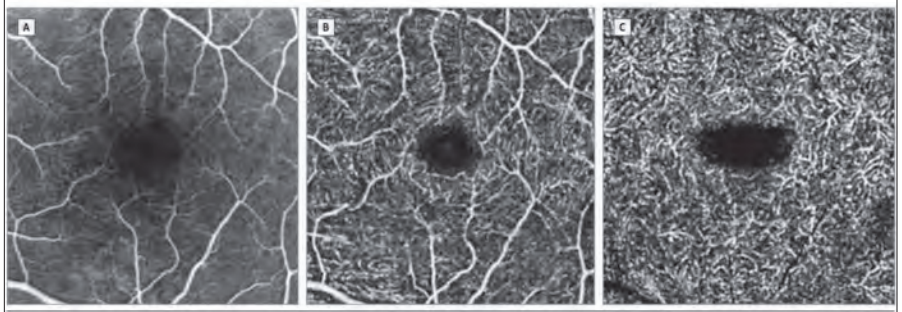


Original Investigation

## Retinal Vascular Layers Imaged by Fluorescein Angiography and Optical Coherence Tomography Angiography

Richard F. Spaide, MD; James M. Klancnik Jr, MD; Michael J. Cooney, MD

JAMA 2015




A, Fluorescein angiographic image of the central macular region. B, Optical coherence tomography angiography image of the inner retinal vascular plexus. C, Optical coherence tomography angiography image of the outer plexus. The capillaries around the foveal avascular zone are included in the segmentation of the inner layer.

WHAT % OF OUR TRADITIONAL FA VASCULATURE IS REPRESENTED BY THE INNER RETINAL PLEXUS?

95%

Original Investigation

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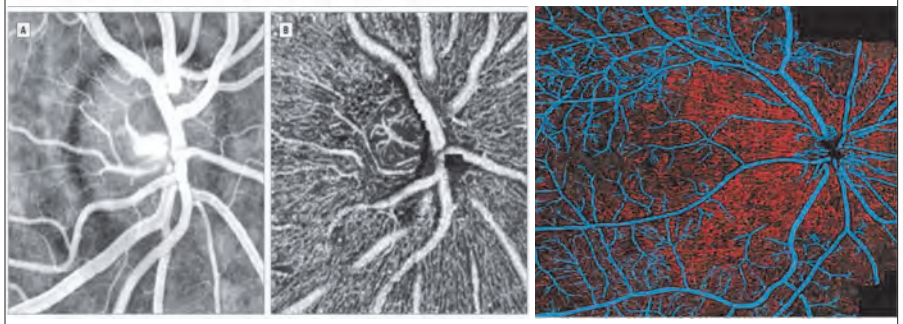

RADIAL PERIPAPILLARY CAPILLARIES WELL APPRECIATED WITH OCTA NOT FA

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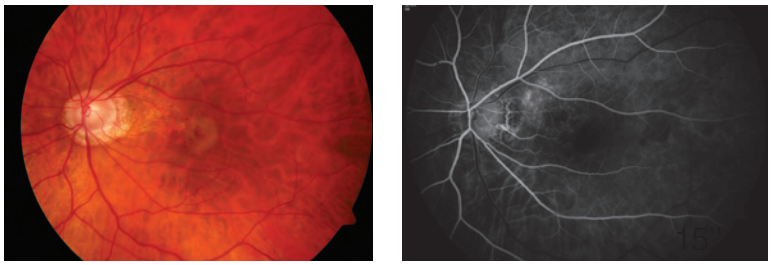
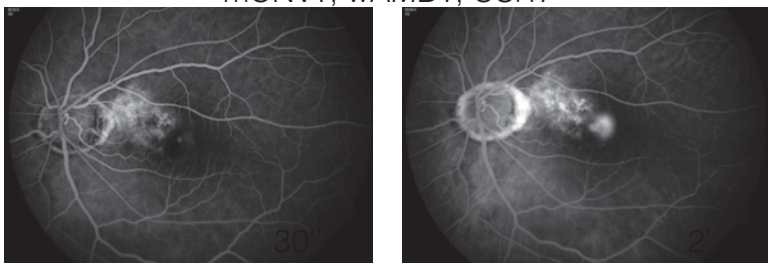


mCNV?, wAMD?, CSR?



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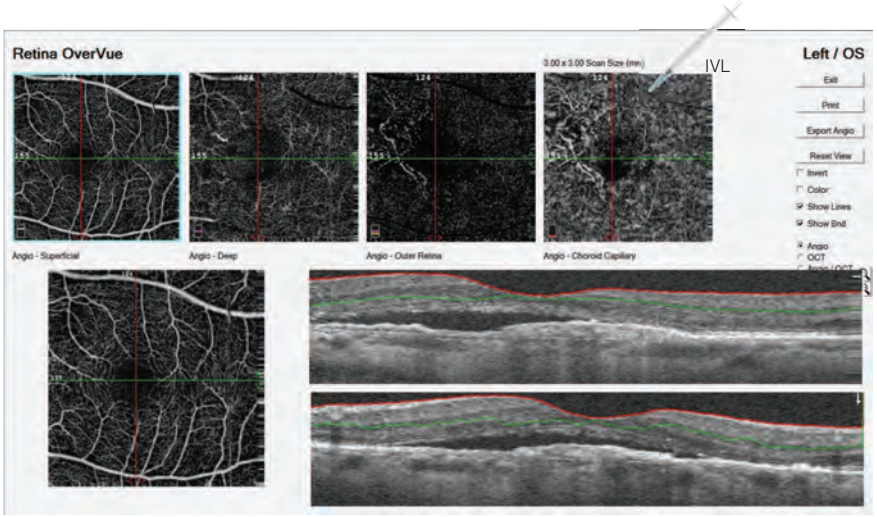


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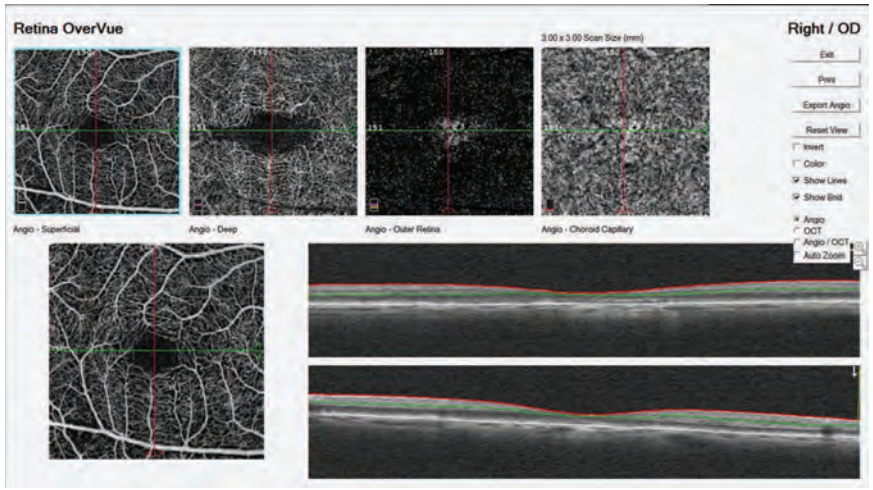


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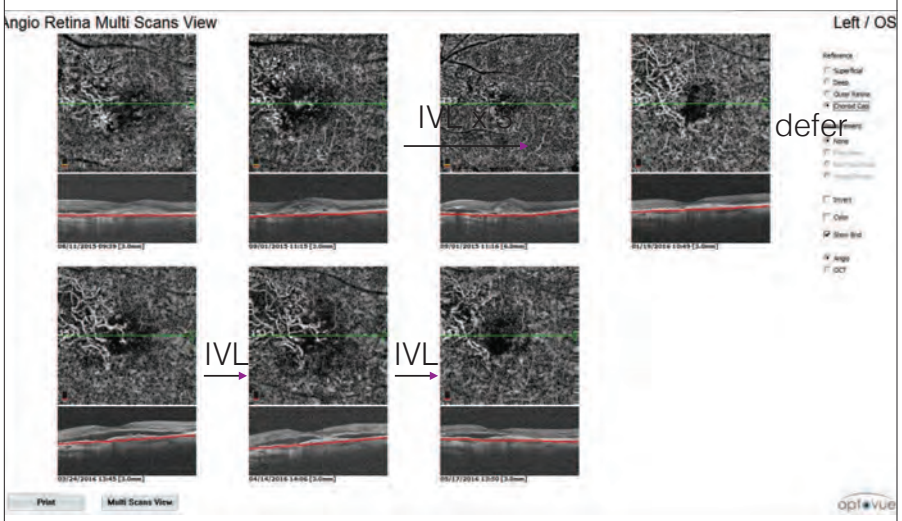


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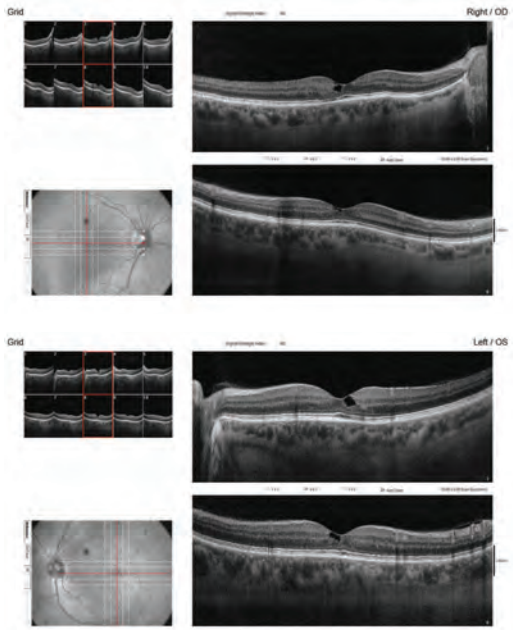
61 F slightly blurred OU
20/40 OU
Borderline DM
telangiectatic vessels temporal to fovea OU

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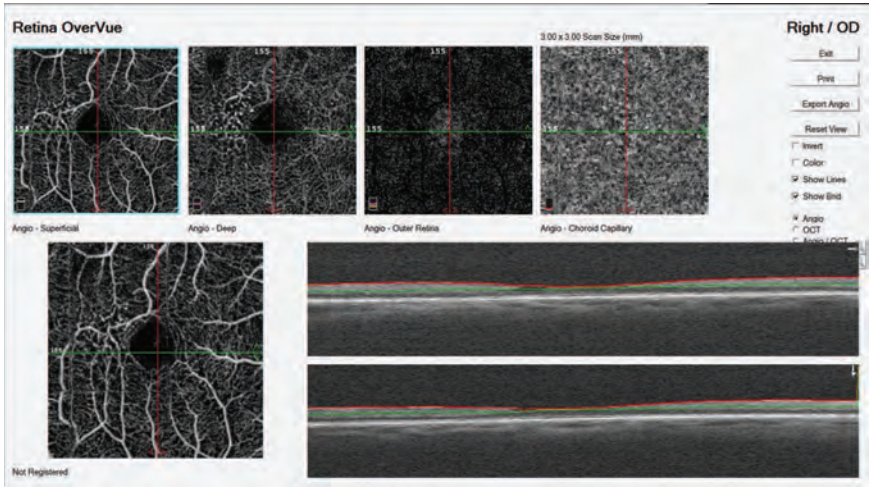
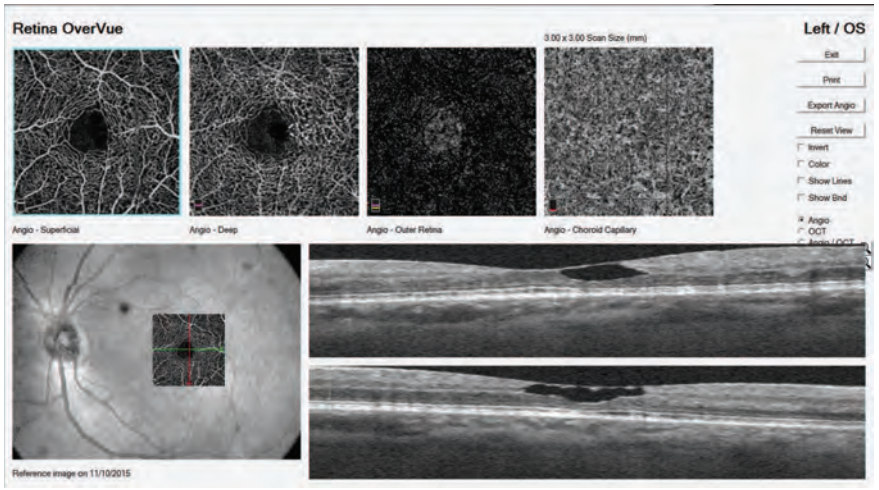



24

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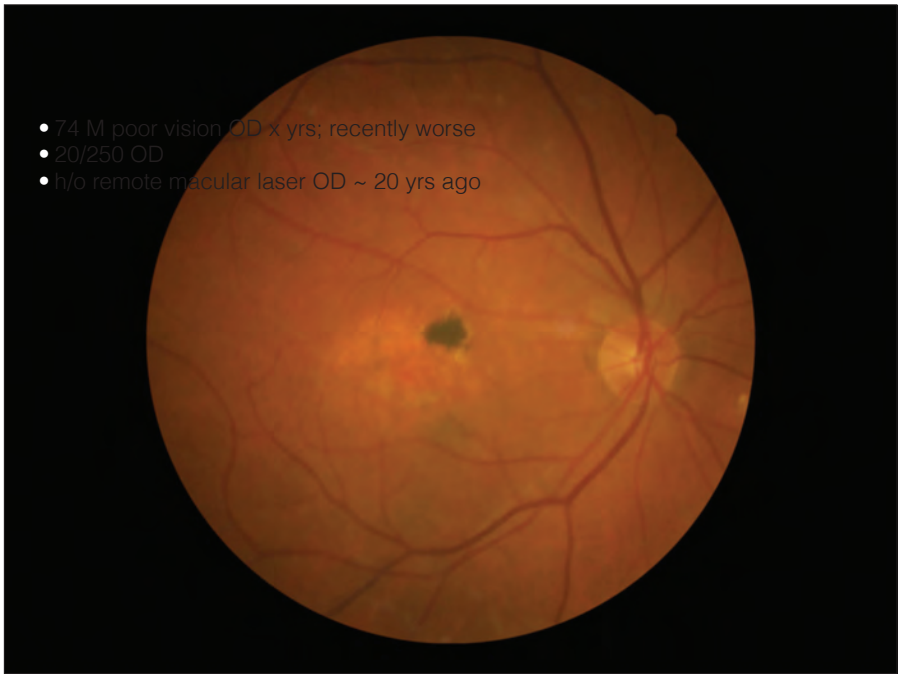
- 74 M poor vision OD x yrs; recently worse
- 20/250 OD
- h/o remote macular laser OD ~ 20 yrs ago



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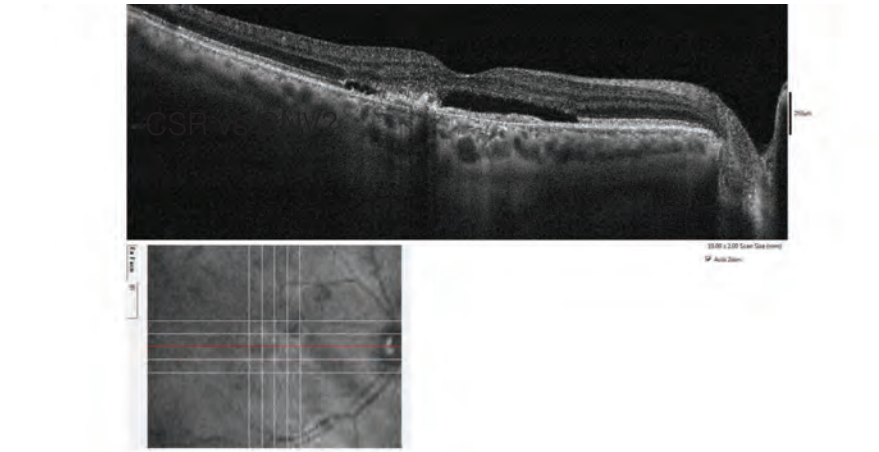


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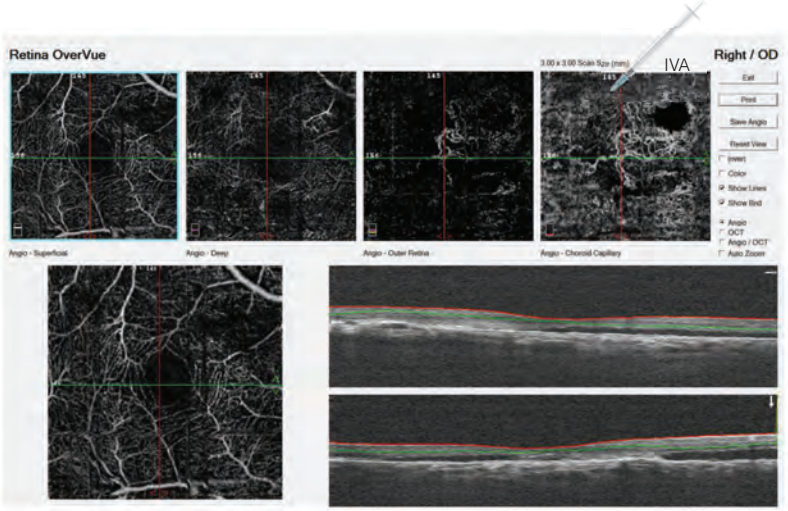


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# Summary

OCTA uses multiple OCT B scans to deduce movement of RBCs in blood vessels.

Algorithms such as SSADA improve image quality.

en face technology allows segmentation of superficial retinal vessels, deep retinal vessels, outer retina, and choriocapillaris.

OCTA allows visualization of PP vessels: implications for glaucoma management?

Strengths: detection of CNV, mac ischemia, telangiectasia

Drawbacks: prone to errors, lack of leakage info, limited to poster pole