

OCT-A(nd) You

Leo Semes, OD
Professor Emeritus, UAB
"Fall Fest 2022"

1

Objectives

- Review the capability of OCT for retinal diseases
- Distinguish between OCT-A and fundus fluorescein angiography
- Understand the imaging of capillary presence/absence via OCT-A
- Appreciate the imaging capacity of the retinal and choroidal vascular systems as they relate to diagnosis and management of retinal vascular and degenerative diseases and glaucoma.

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Disclosures

Leo Semes, OD, FAAO
Speaker Bureau, Consultant - Maculogix
Speaker Bureau - Regeneron
Scientific Advisory Board - EyePromise
Stock options - Eye Promise (< 0.01% ownership), HPO (< 0.01% ownership)

3

What is OCT-Angiography?

How does OCT-A differ from OCT and Fluorescein Angiography (FA)

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OCT Case

- J Rodman, OD, FAAO

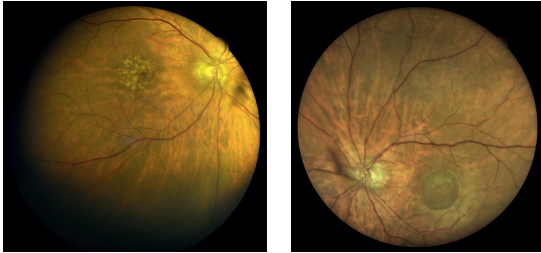
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Meet Curtis: An 87-year-old Caucasian Male

- Reports blurry vision OS>OD
 - "But only when my glasses are off!!"
- H/O Non-Exudative Intermediate Dry AMD OU
- PMH: (+)Hypertension, Arteriosclerosis
- BCVA: OD 20/20 **OS 20/50**

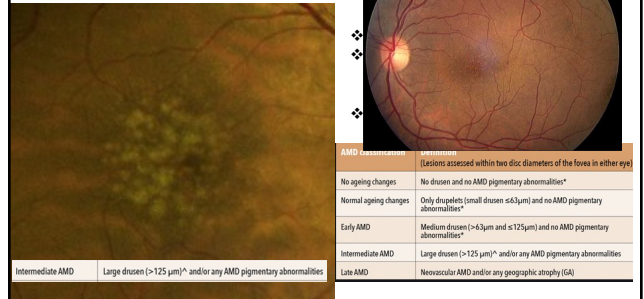
6

Fundoscopic Evaluation: Let's break it down!



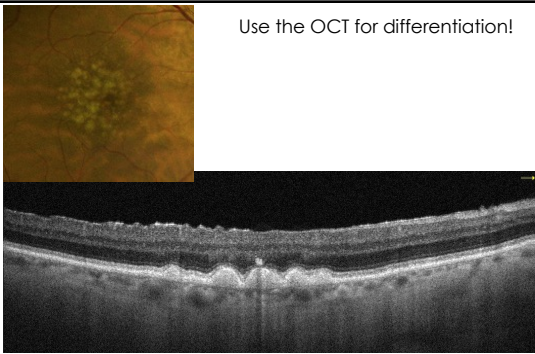
7

Fundoscopic Evaluation OD



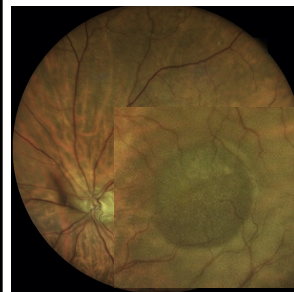
8

Use the OCT for differentiation!



9

Fundoscopic Evaluation OS: Let's unpack!



What is this??

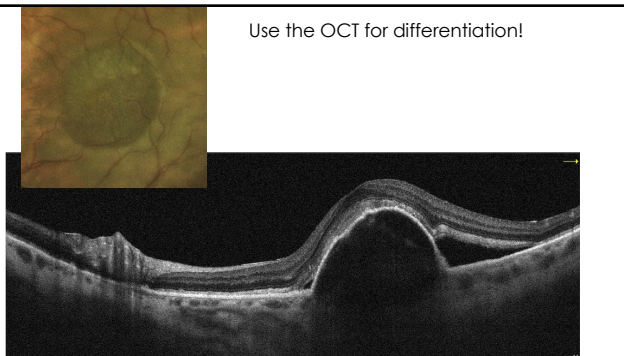
❖ Is this AMD?

❖ What do we know?

- ❖ Elevated lesion
- ❖ Greyish-green in color
- ❖ Yellow deposition above lesion

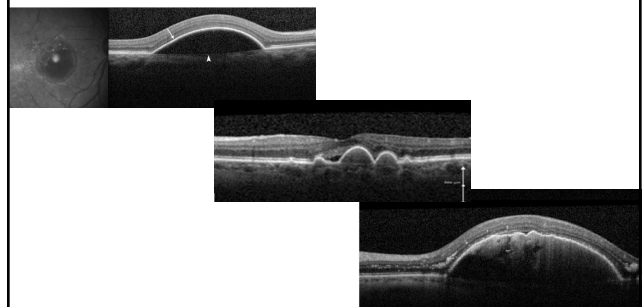
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Use the OCT for differentiation!



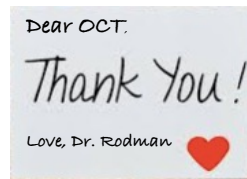
11

Recall the various types of Pigment Epithelial Detachments!!



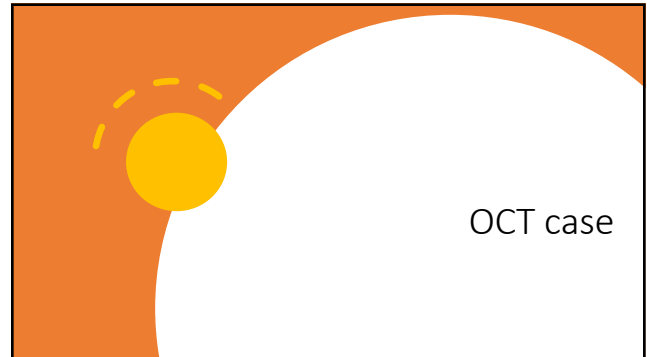
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Importance of Multi-Modal Imaging (OCT!!) in this Case!!



- OD: Helped classify the stage of AMD
- OS: Assisted in diagnosis and management decisions

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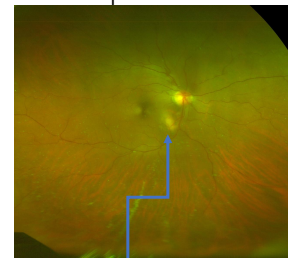
14

55 BF
referred for
imaging of
Choroidal
Nevus

- Healthy
- No medications
- Histories non contributory
- VA 20/20 OD, OS; wears full-time monovision CL correction
- IOP = 15/16 mm Hg (10 AM)
- Anterior segments unremarkable by slit-lamp microscopy

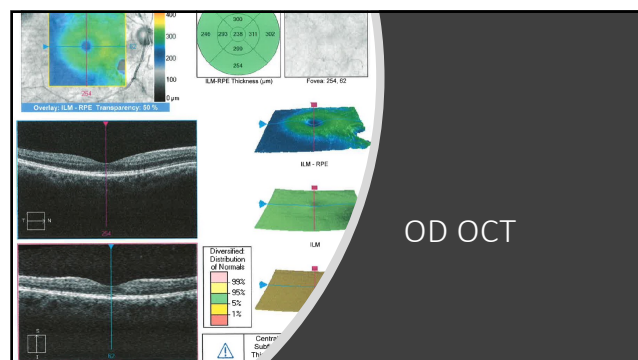
15

Wide-angle fundus photo

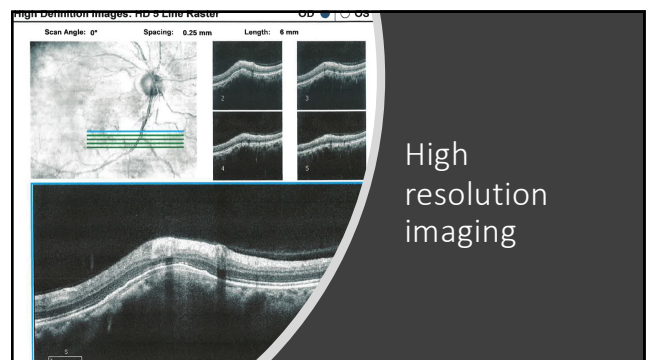


Note the alteration of color, and stereoscopically, contour.

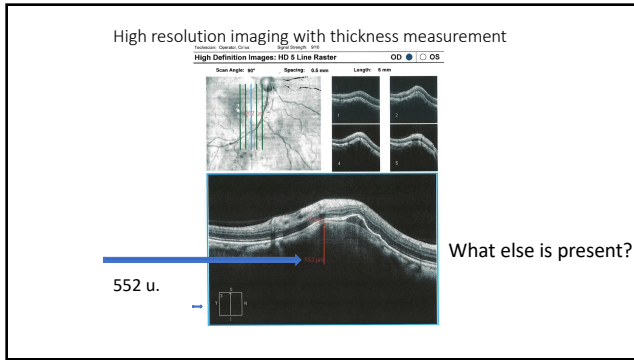
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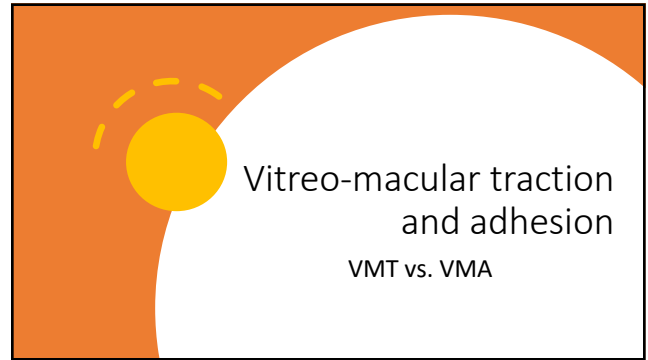
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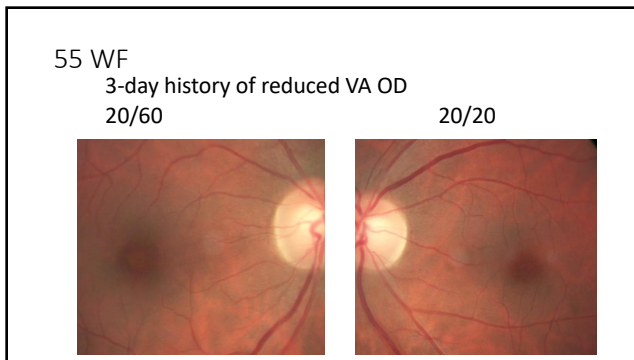
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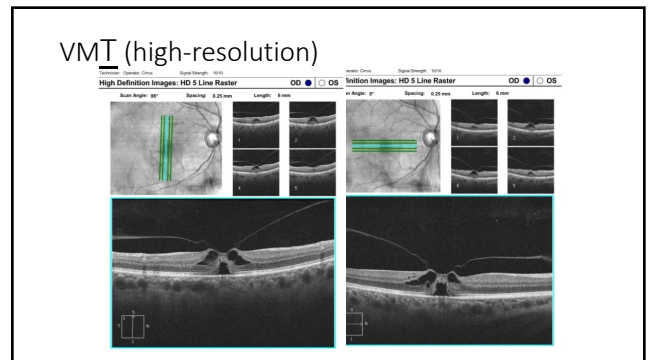
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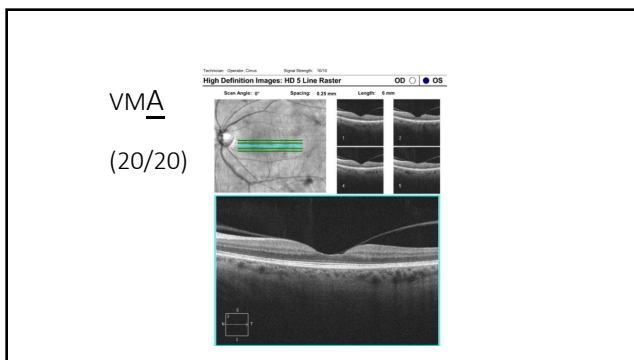
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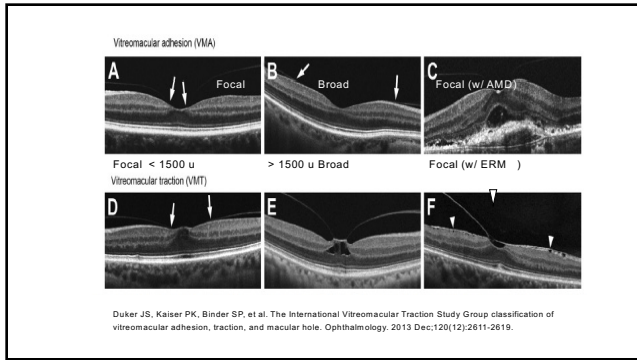
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International Vitreomacular Traction Study group Classification

Classification	Subclassification
Vitreomacular adhesion	Size: focal ($\leq 1500 \mu\text{m}$) or broad ($> 1500 \mu\text{m}$)
VMT	Isolated or concurrent
Full-thickness macular hole	Size: focal ($\leq 1500 \mu\text{m}$) or broad ($> 1500 \mu\text{m}$)
	Isolated or concurrent
	Size: small ($\leq 250 \mu\text{m}$), medium ($> 250 - \leq 400 \mu\text{m}$), or large ($> 400 \mu\text{m}$)
	Status of vitreous: with or without VMT
	Cause: primary or secondary

Duker JS, Kaiser PK, Binder SP, et al. The International Vitreomacular Traction Study Group classification of vitreomacular adhesion, traction, and macular hole. Ophthalmology. 2013 Dec;120(12):2611-2619.

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Table 2. Correlation between Commonly Used Clinical Macular Hole Stages and the International Vitreomacular Traction Study Classification System for Vitreomacular Adhesion, Traction, and Macular Hole

Full-Thickness Macular Hole Stages in Common Use	International Vitreomacular Traction Study Classification System
Stage 0	VMA
Stage 1: impending macular hole	VMT
Stage 2: small hole	Small or medium FTMH with VMT
Stage 3: large hole	Medium or large FTMH with VMT
Stage 4: FTMH with PVD	Small, medium, or large FTMH without VMT

FTMH = full-thickness macular hole; PVD = posterior vitreous detachment; VMA = vitreomacular adhesion; VMT = vitreomacular traction.

Duker JS, Kaiser PK, Binder SP, et al. The International Vitreomacular Traction Study Group classification of vitreomacular adhesion, traction, and macular hole. *Ophthalmology*. 2013 Dec;120(12):2611-2619.

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Natural course of VMT

- 11% of 53 patients developed spontaneous PVD (& release of traction) at 60 months F/U

Hikichi T, Yoshida A, Akiba J, Trempe CL. Natural outcomes of stage 1, 2, 3, and 4 idiopathic macular holes. *Br J Ophthalmol*. 1995;79(6):517-520.

- 32% of 106 symptomatic patients had spontaneous PVD at 23 months F/U

John VJ, Flynn HW Jr, Smiddy WE, et al. Clinical course of vitreomacular adhesion managed by initial observation. *Retina*. 2014 March;34(3):442-446.

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VAST Study

PREVALENCE OF VITREOMACULAR ADHESION IN PATIENTS WITHOUT MACULOPATHY OLDER THAN 40 YEARS

JULIE A. RODMAN, OD, MS,* DIANA SHECHTMAN, OD,* BRAD M. SUTTON, OD,† JOSEPH J. PIZZIMENTI, OD,‡ AVA K. BITTNER, OD, PhD* VAST STUDY GROUP

Purpose: To determine the prevalence and factors influencing vitreomacular adhesion (VMA) or vitreomacular traction (VMT) in subjects without maculopathy older than age 40 years.

Retina 2018 Oct;38(10):2056-2063.

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VAST Study

- Prospective
- 14 centers across US
- CEE, SD-OCT
- Independent, masked-readers classified SD-OCT findings
 - Using IVTS rubric

Appendix 1. The VAST Study Group

Ken Walls, MD, Azan Eye Associates; Mike Tolentino, MD, Center for Retina and Macular Diseases; Charlie Fico, OD and Kirk Smith, OD, Clayton Eye Center; Marisa Perez, OD, Front Range Eye Associates; Jeffrey Gerson, OD, Grn Eye Care; Aaron Gold, OD and Tim Murray, MD, Murray Ocular Oncology and Retina; William Jones, OD, New Mexico EyeCare; Melanie Grindall, OD, Marlon Demeritt, OD, May Jarkas, OD, Kim Makhoul, OD, Sherrell Reynolds, OD, Julie Tyler, OD, and Lori Vollmer, OD, Nova Southeastern University, College of Optometry; Larry Alexander, OD, Optover; Blair Lounsbury, OD, Pacific University College of Optometry; Jay Haynie, OD, Retina and Macula Specialists; Gary Steintham, MD, Jay Levy, MD, and Wilfredo Lara, MD, Retina Macula Specialists of Miami; Jack Schaeffer, OD and Mark Schaeffer, OD, Schaeffer Eye Center; Marc Bloomstein, OD, Schwartz Laser Eye Center; Steven Fernex, OD, Sepúlveda VAMC; Paul Chous, OD, Sofgarban Opticians; and Leo Semes, OD, University of Alabama Birmingham, College of Optometry.

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VAST Study

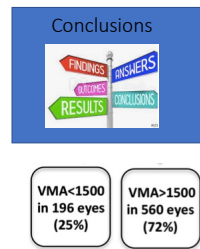
- 1950 Eyes
- Aged 40-89
- Phakic
- No pre-existing maculopathy
- No history of injection or Jetrea

Study Criteria

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VAST Study

- VMA prevalence of 39%
 - Broad VMA (>1500 μm) more prevalent than focal (< 1500 μm)
 - Younger
 - Hyperopes
 - Primary vs tertiary sites
- VMT prevalence of 1%



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VAST Study

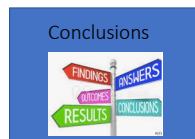
- VMA prevalence of 39%
- VMT prevalence of 1%
- Most common in 40s and 50s
 - Then decreases with age:
 - 25% VMA over age 63
 - 2% VMT over age 63



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VAST Study

- Not significantly associated with:
 - Sex
 - Refractive error
 - VA status
- AA 55% less than Caucasians



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OCT-Angiography

The main event

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Some basics . . .

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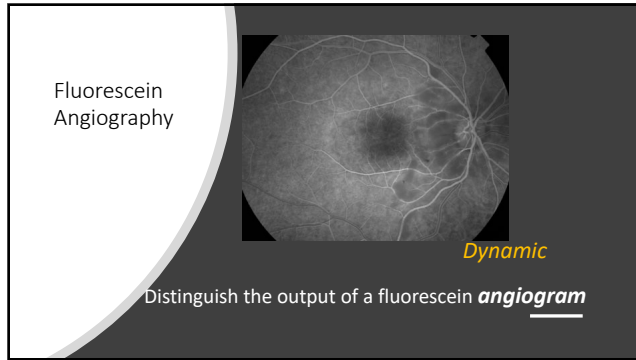
OCT-Angiography

- OCT-Angiography IS
- "Non-invasive"
 - Imaging of RBC *motion* to define capillaries
 - Presents information regarding capillary density

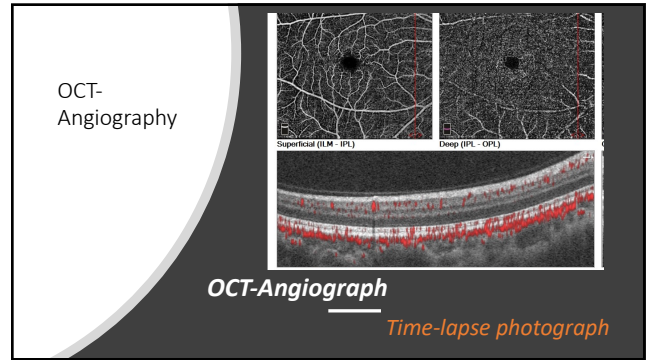
- OCT-Angiography IS NOT
- A substitute for fluorescein angiography
 - A means to assess integrity of the circulatory systems of the eye

Distinguish the output of a fluorescein **angiogram**
Dynamic
 and an **OCT-Angiograph** *Time-lapse photograph*

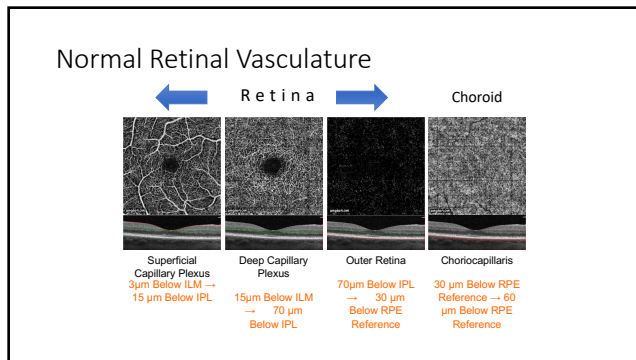
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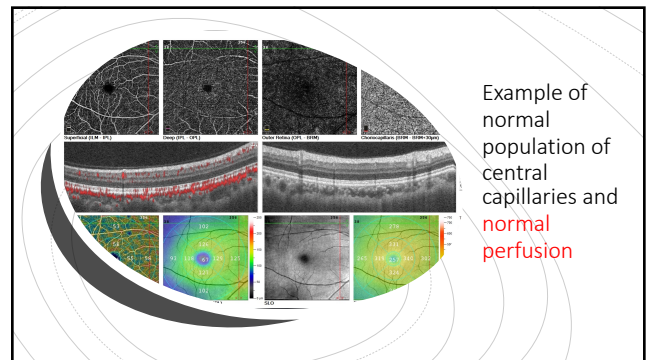
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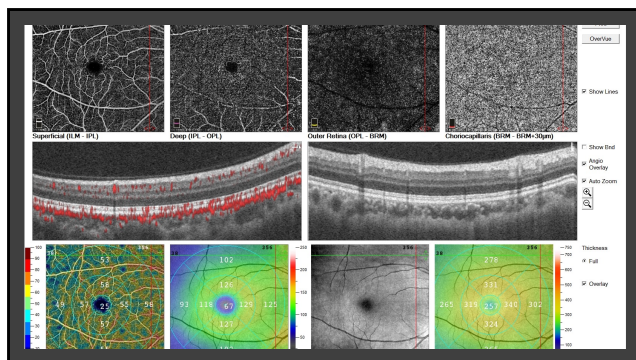
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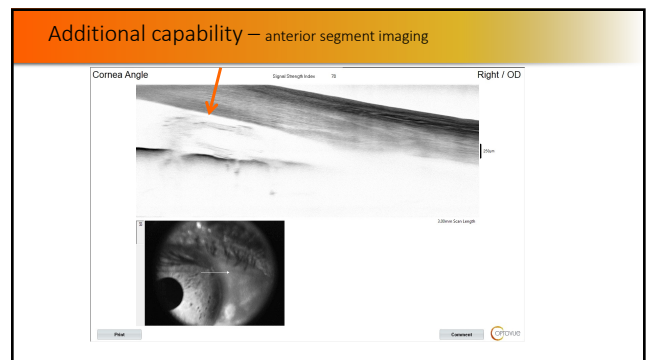
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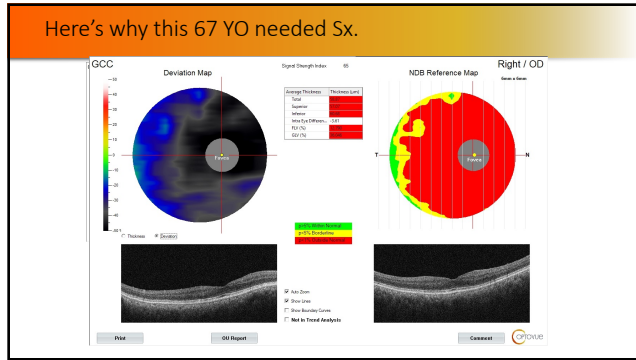
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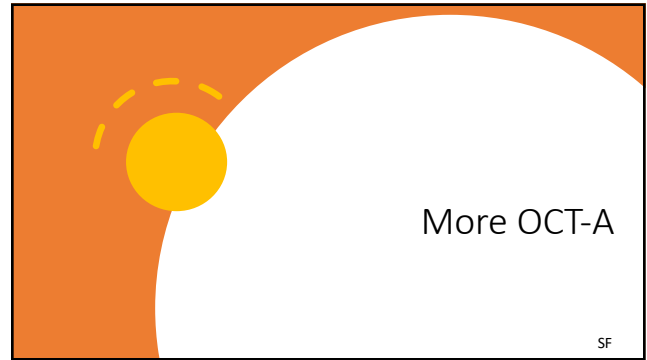
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45

73 yo white male

- Presents as urgent walk-in
- Reports decreased VA OS x 2 weeks
 - No pain, flashes/floaters etc.
- Pertinent Med Hx
 - DM type 2 x6 years: last A1c 6.3
 - HTN: last 121/76
 - Meds: metformin, prazosin, HCTZ, vardenafil

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73 yo white male

20/20



20/50

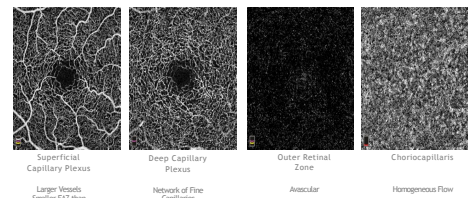


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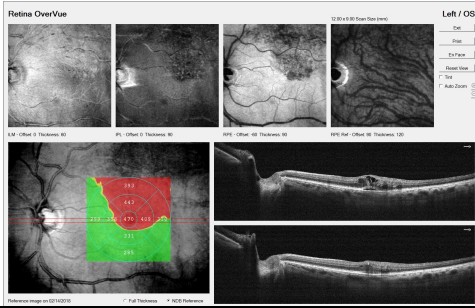
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Remember what Normal should look like

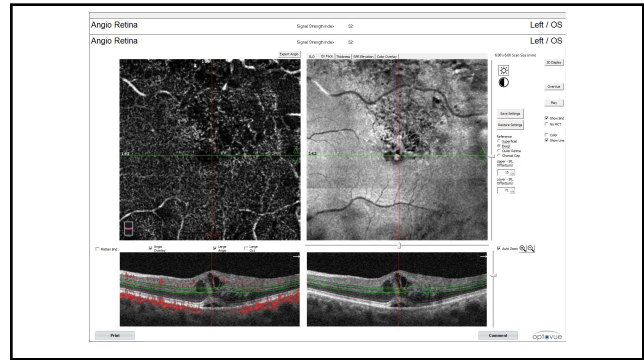


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Widefield



50

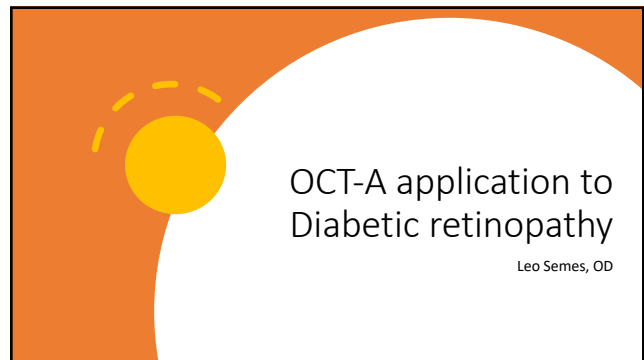


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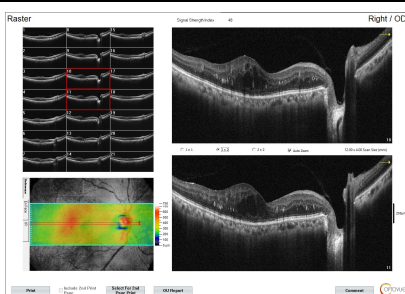
73 yo white male

- Assessment
 - Ischemic BRVO OS with macular edema
- Plan
 - Avastin injection x 3 OS
 - Repeat OCT/OCTA after third injection
 - Optimize BP/BS control

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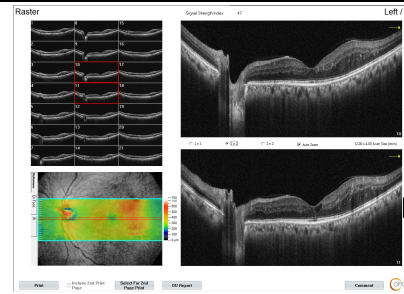


53



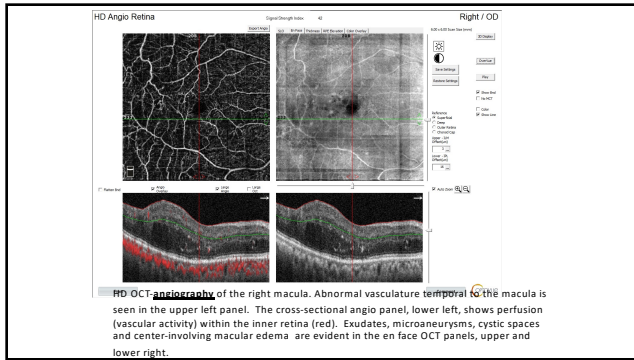
Cross-section OCT through the center of the macula, OD. Note the exudates, cystic spaces and center-involving macular edema.
Retinal thickening is represented by the color topography (lower left panel)

54

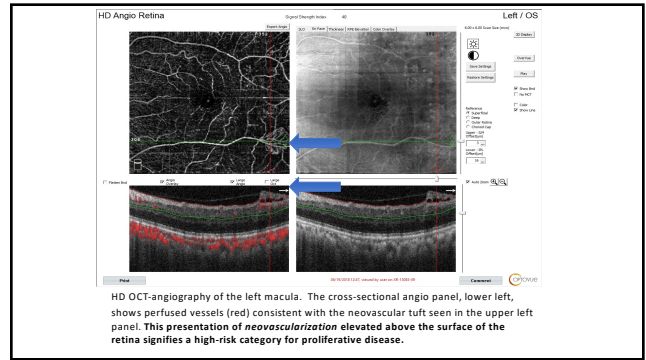


Cross-section OCT through the center of the macula, OS. Note the exudates, cystic spaces, retinal thickening and macular edema. On the color topographic representation, note temporal to the macula the elevation represented by hotter colors and corresponding thickness that is seen as neovascularization.

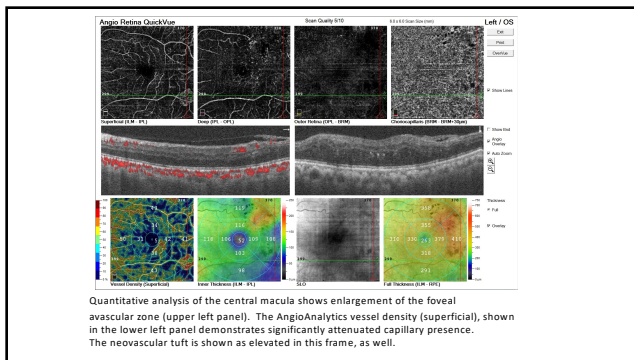
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56



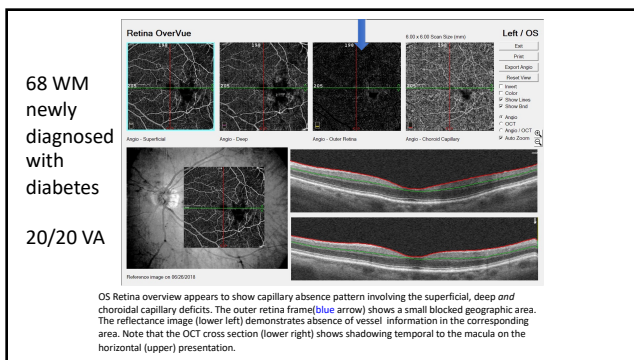
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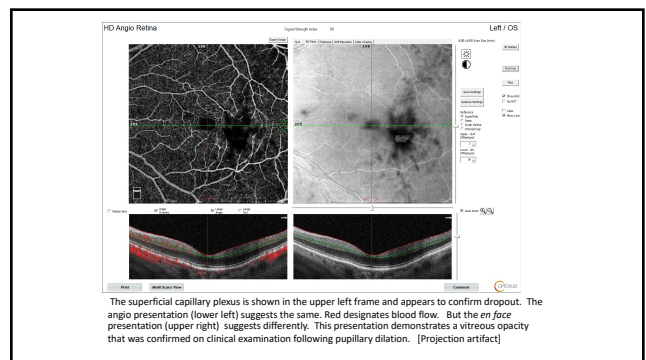
58

Another patient with diabetes. . .

59



60



61

West-coast diabetes . . .

Dr. Ferrucci

63

50 year old male

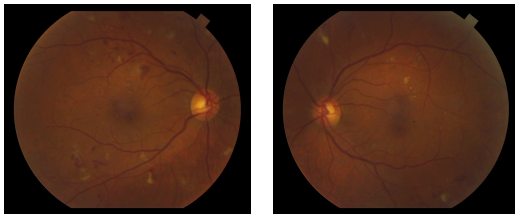
- Type 2 DM x 20 years
 - Last A1c 8.7
 - Insulin and liraglutide (Victoza)
- Reduced VA OD x 9 mos
- h/o injections OD last year
- Told earlier this year no more injections needed.

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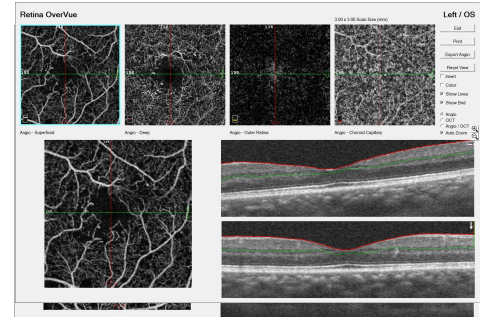
50 year old male

20/50

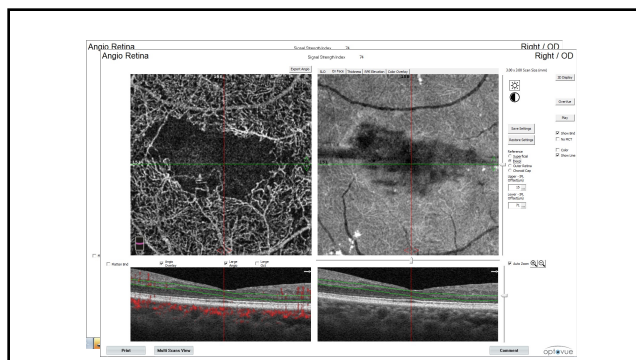
20/20



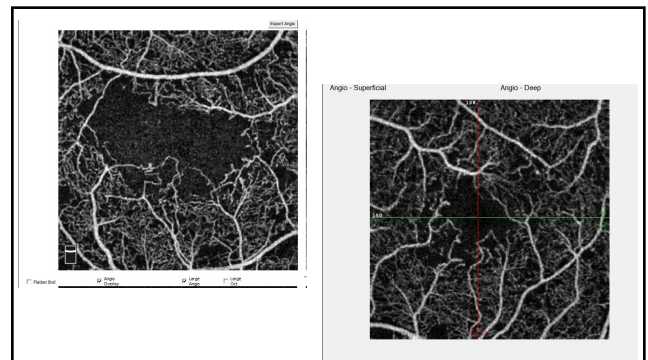
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67



68

50 year old male

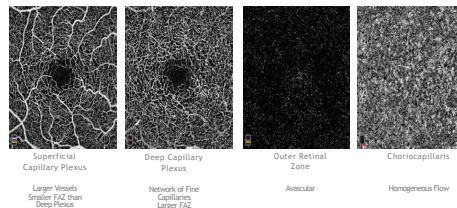
- Moderate NPDR OU
- No center involved DME OD
- Macular ischemia OD>>OS on OCTA
 - No need to do FA
 - No treatment available
- Optimize acuity
- Optimize BP/BS control
- RTC 3 mos. Repeat OCT/ OCTA

KEY POINTS:

- WITHOUT OCT-A OR FA WOULD NOT BE ABLE TO DIAGNOSE ISCHEMIA
- WITH OCT-A, ABLE TO AVOID INVASIVE FA AND ABLE TO DO IN ODS OFFICES

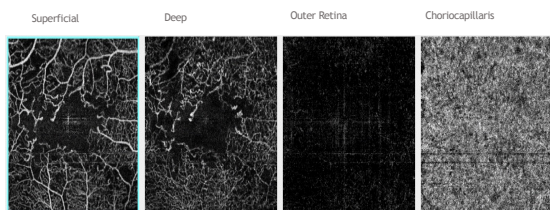
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Normal



70

Capillary disorganization examples (DR)



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54 yo male

- New pt, LEE 3 years ago. No complaints. Glasses scratched
- Oc hx: none
- Med hx:
 - HLD
 - Mild HTN
 - Statin, atenolol

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54 yo male

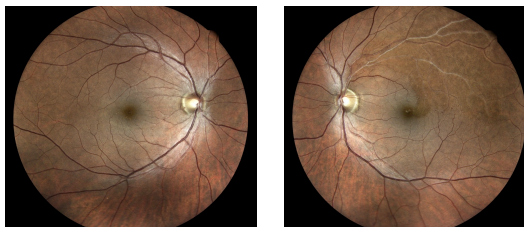
- VAcc 20/20 OD, OS
- BCVA: 20/20 OD, OS
- FCF: full OD; inferior nasal restriction OS

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Old BRVO

20/20

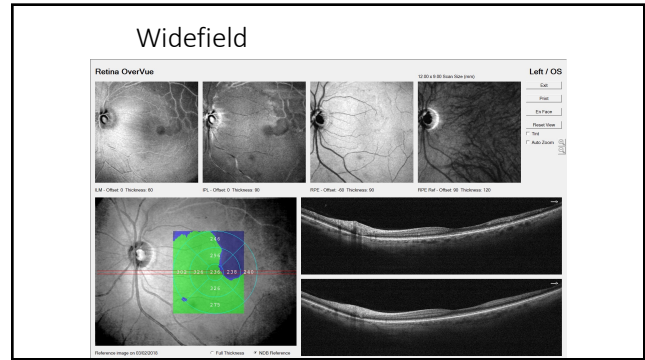
20/20



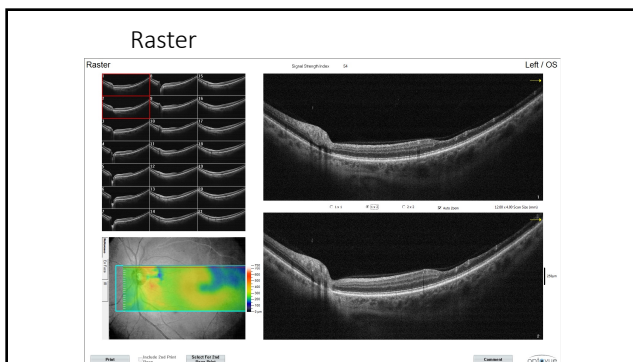
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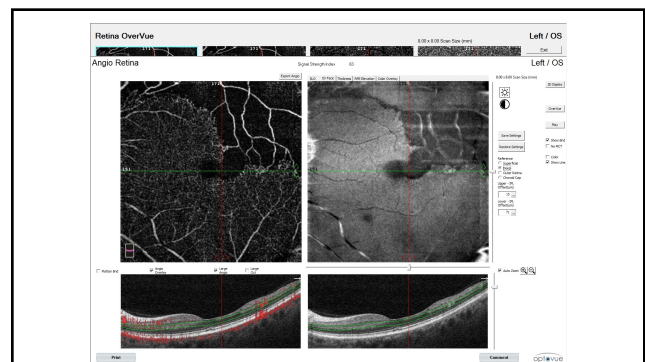
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84



85

Old BRVO

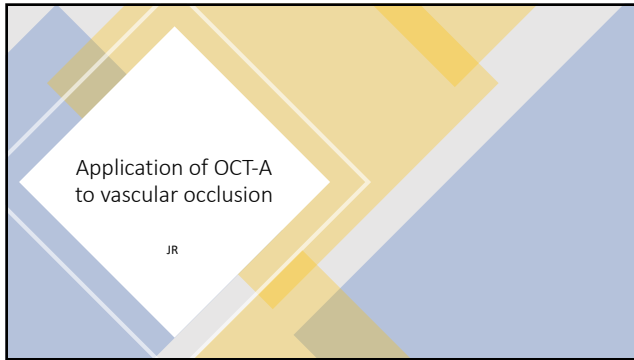
- BP 130/91 (slightly high)
 - PCP will recheck in 2-3 weeks
 - May alter meds if still high
- HgA1c: 5.6
- Lipids; all normal
 - Total chol: 189
 - Triglycerides: 145
 - HDL: 45
 - LDL: 115
- Carotid ordered

86

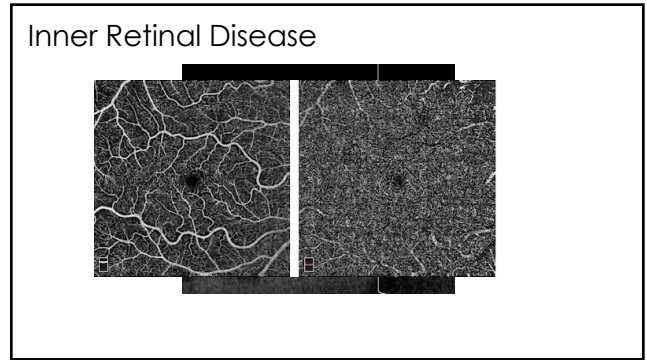
Old BRVO

- Assessment:
 - Old ischemic BRVO OS without NV mac edema
- Plan
 - Optimize BP/BS control
 - Order carotid
 - RTC 6 mos
 - No FA needed!

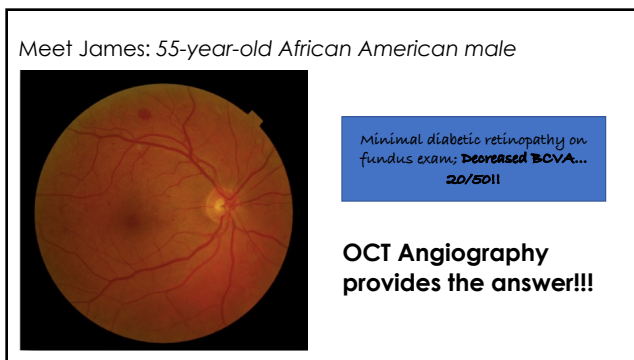
87



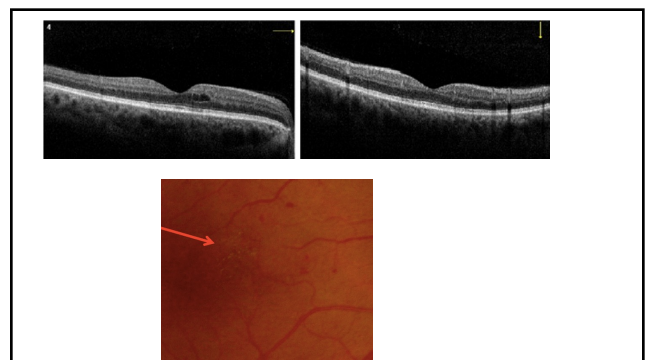
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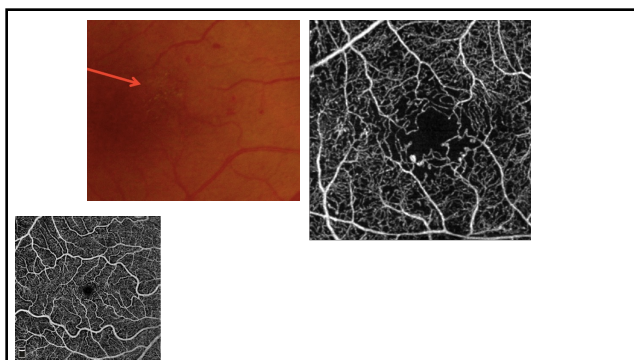
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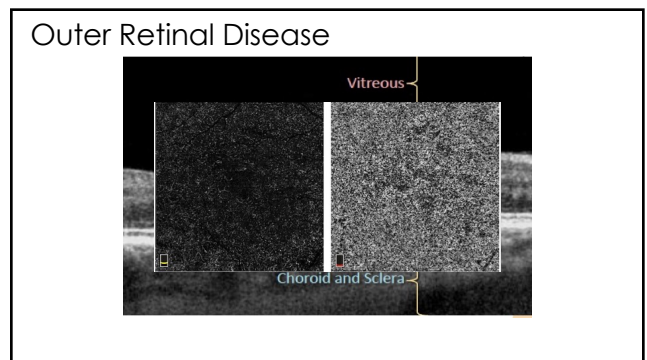
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91



92



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Meet Antonio: A 74-year-old Hispanic Male

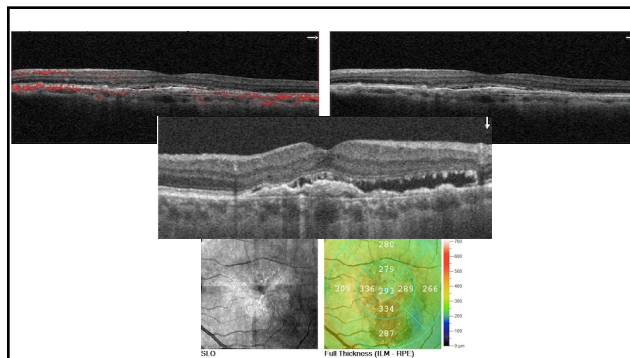


20/70

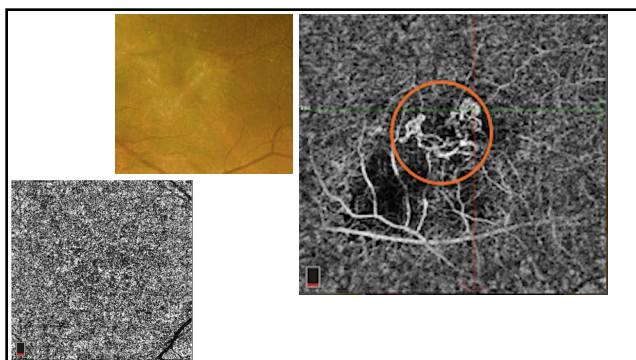
"I had an eye exam three months ago, but I do not think the doctor got my prescription right. Especially my left eye..."

Could it be lenticular... after all, the patient is 74??

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Importance of Multi-Modal Imaging (OCT!!) in these Cases!!

Dear OCTA

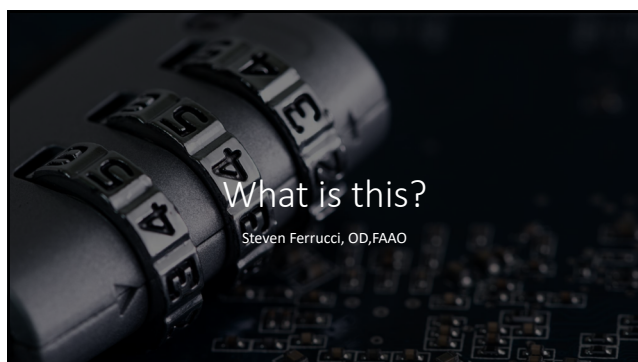
Thank You!

Love, Dr. Rodman



- James: Explained decreased vision
- Antonio: Illustrated CNV in vague fundus image

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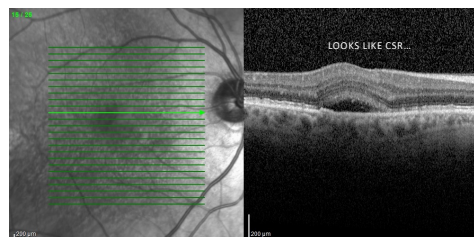


What is this?

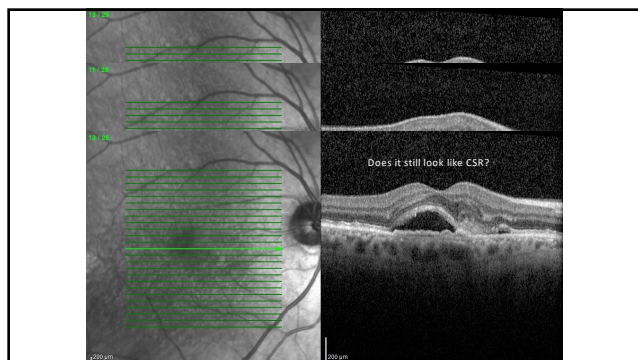
Steven Ferrucci, OD,FAAO

98

What is this?



99

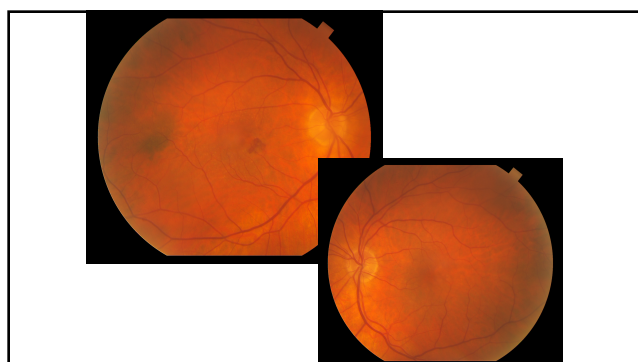


100

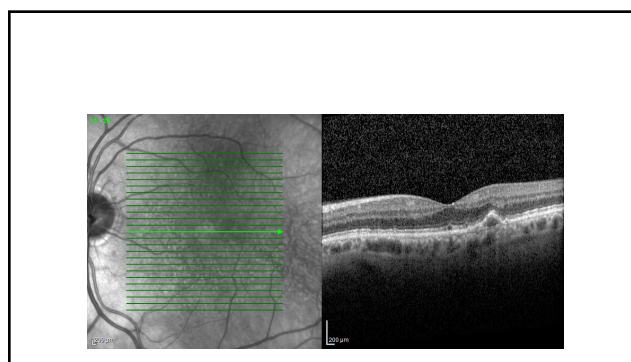
Rest of story

- 2 week h/o decreased VA OD
- + metamorphopsia
- Oc hx: unremarkable , but last exam almost 7 years ago
- Med hx: no diabetes, no HTN
- **75 years old!!**

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AMD!!

- WET AMD OD!!
- Avastin Series OD x 3
- Be careful making diagnosis without all the information!
- Don't use OCT in a vacuum!

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Retina Clinic

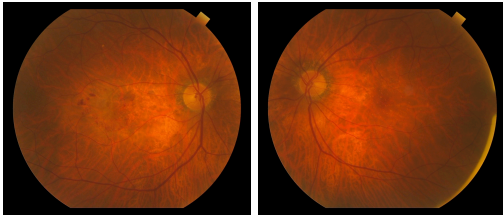
- Stage 2 CNVM
- Avastin series x 3 OS.
- Repeat OCT/OCT-A after 3rd injection

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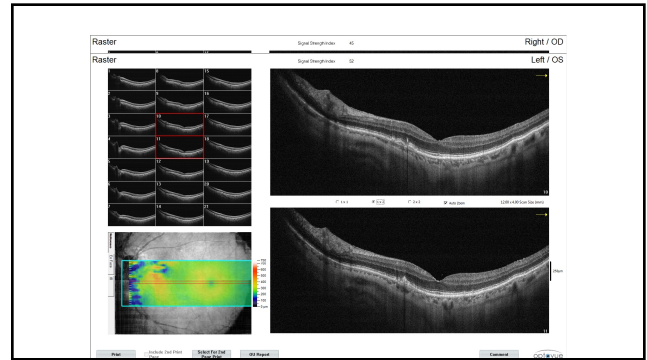
Another example

20/100

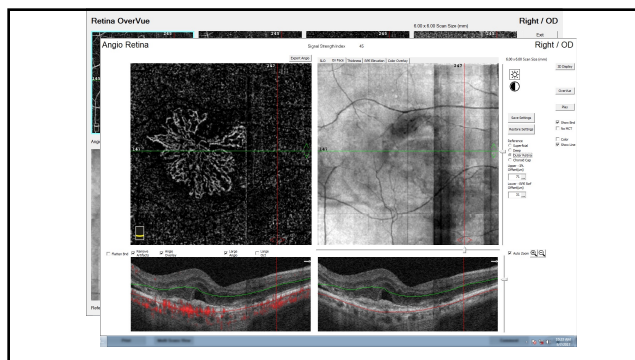
20/20



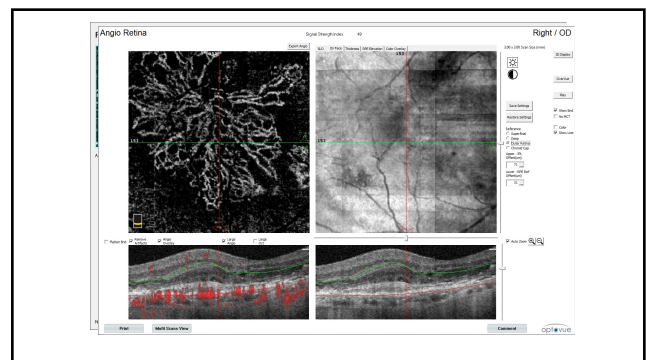
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80 yo male

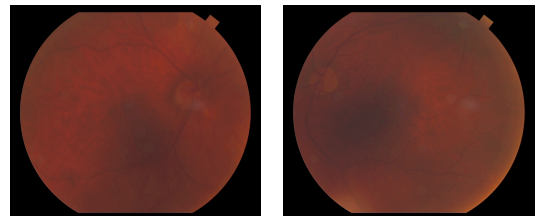
- Annual exam
- Pt states VA OD has decreased slowly since last exam
- 20/80 OD, 20/25+2 OS
- Probably cataracts....
- 3-4+ OD, 3+ OS
- Query small heme in macula, but poor view....

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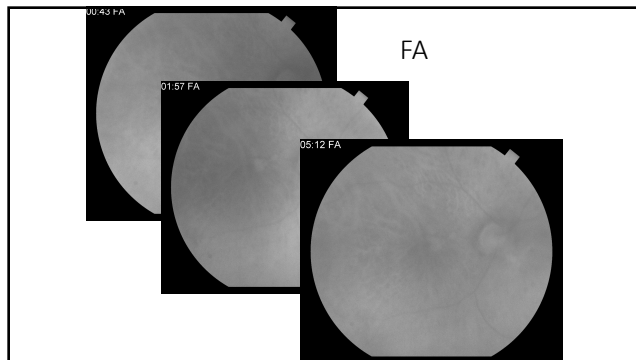
80 yo male

20/80

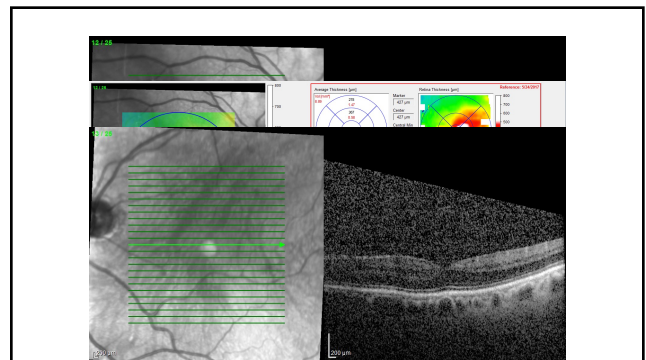
20/25+2



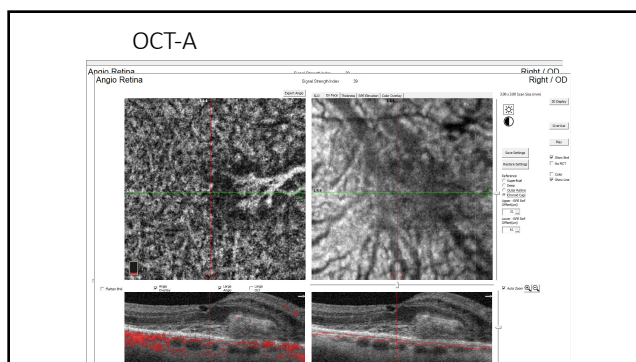
112



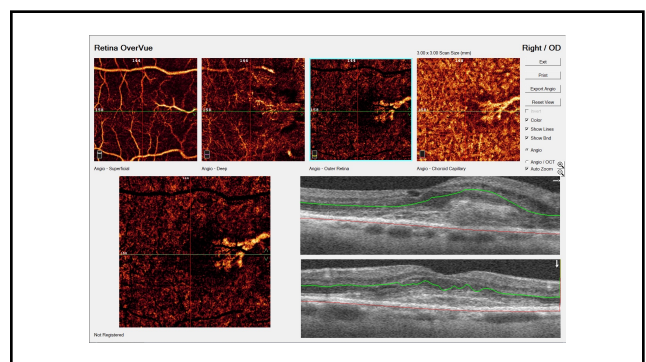
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80 yo male

- CNVM OD on OCTA
- Refer for 3 anti-VEGF injections OD.
- Repeat OCTA after 3rd injection
- Pt agrees with plan
- 1st injection within 1 week

KEY POINT: WITHOUT OCTA MAY HAVE MISSED CNVM AND ATTRIBUTED LOSS TO CATRACT AND DELAYED TREATMENT

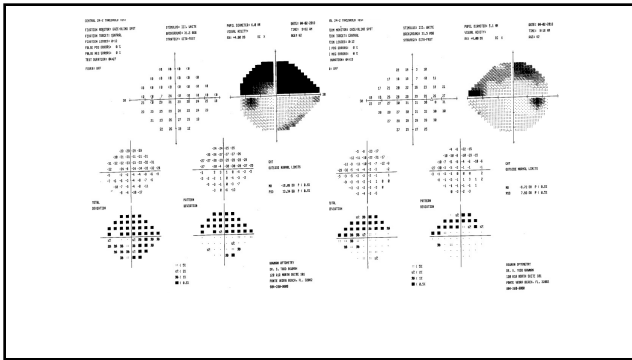
117

62 WM

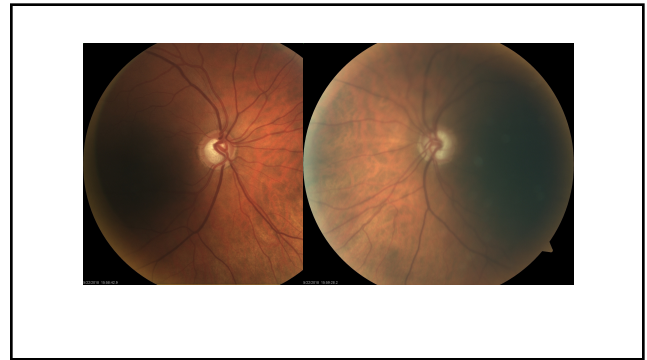
- Complained of vision loss superiorly in the left eye (May, 2018)
- VA 20/20 OD, OS; (L)RAPD 2+; IOP 11,9 mmHg.
- Seen by primary-care OD - Dx = NTG, initiated on latanoprost qhs.

Sent for consultation/SLT due to significant VF depressions. (June 2018)

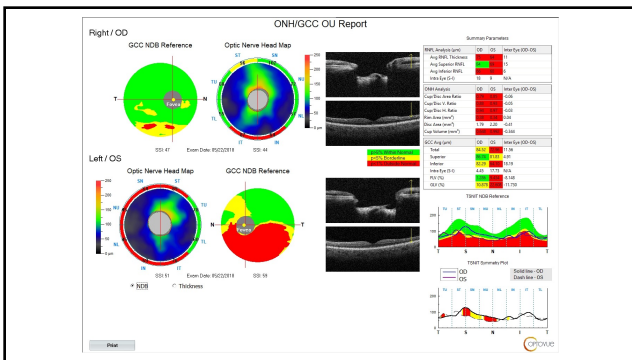
118



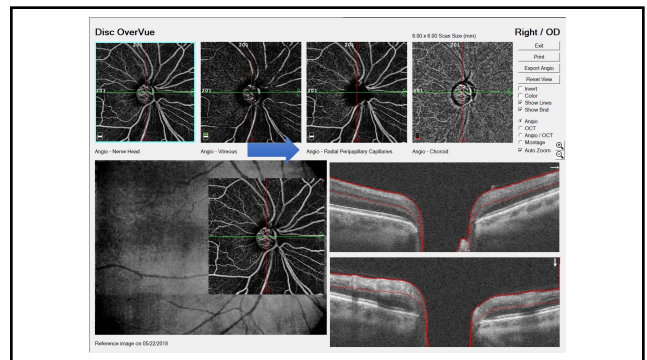
119



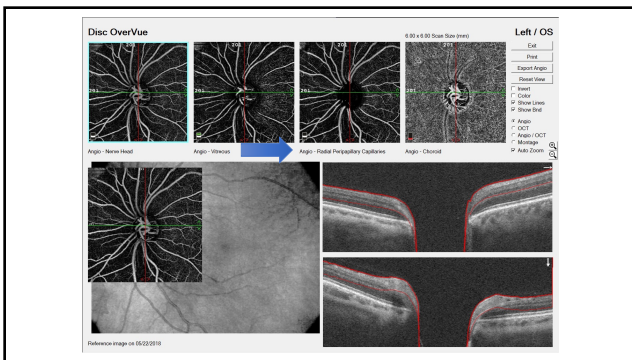
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Additional information

- Patient reveals in social conversation the he suffers from Reynauds syndrome

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Additional information

- Patient reveals in social conversation the he suffers from Reynauds syndrome
- Patient further reveals in casual conversation that he takes a prescription medication for ED, and that it makes his vision blurry!

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SCIENCE ADVANCES | RESEARCH ARTICLE

BIOCHEMISTRY

Cryo-EM structure of phosphodiesterase 6 reveals insights into the allosteric regulation of type I phosphodiesterases

Sahil Gulati^{1,2,3}, Krzysztof Palczewski^{1,3,4,5}, Andreas Engel⁶,
Henning Stahlberg^{7*}, Lubomir Kovack⁸

Cyclic nucleotide phosphodiesterases (PDEs) work in conjunction with adenylylate/guanylate cyclases to regulate the key second messengers of G protein-coupled receptor signaling. Previous attempts to determine the full-length structure of PDE family members at high resolution have been hindered by structural flexibility, especially in their linker regions and N- and C-terminal ends. Therefore, most structural activity relationship studies have so far focused on truncated and conserved catalytic domains rather than the regulatory domains that allosterically govern the activity of most PDEs. Here, we used single-particle cryo-electron microscopy to determine the structure of the full-length PDE6 α 2 β complex. The final density map resolved at 3.4 Å reveals several previously unseen structural features, including a conserved N-terminal domain and the interface of PDE α subunits with the PDE β heterodimer. Comparison of the PDE6 α 2 β complex with the closed state of PDE5A sheds light on the conformational changes associated with the allosteric activation of type I PDEs.

Gulati et al., *Sci Adv* 2019;5:eaa4322 27 February 2019

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SCIENCE ADVANCES | RESEARCH ARTICLE

BIOCHEMISTRY

the PDE family (4, 5) and other related enzymes (6). In particular, inhibitors of PDE5, including sildenafil and vardenafil, are widely used for the treatment of erectile dysfunction and pulmonary hypertension (7). However, PDE5 inhibitors have been associated with several ocular side effects, including blurred vision, changes in color vision, transient alterations in the electroretinogram, conjunctival hyperemia, ocular pain, photophobia, and, in extreme cases, damage to the optic nerve (8). These secondary effects are mediated

Gulati et al., *Sci Adv* 2019;5:eaa4322 27 February 2019

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But not all data support the risk for AION

- Analysis included reports from MEDLINE, EMBASE, Toxline and VigBase for NAION and PDE-5 inhibitors
 - Four observational studies, (3 had good methodological protocols)
 - 50 case reports, 12 of which **did not have risk factors** for NAION, but regular administration was observed in 24/50 (48%) & 39 (78%) were treated for ED
 - 608 spontaneous reports

Conclusion: According to the available evidence, the treatment with phosphodiesterase - 5 inhibitors was not found to be associated with NAION.

Penedones A, Alves C, Batel Marques F. Risk of nonarteritic ischaemic optic neuropathy with phosphodiesterase type 5 inhibitors: a systematic review and meta-analysis. *Acta Ophthalmol*. 2020 Feb;98(1):22-31. doi: 10.1111/aos.14233. Epub 2019 Sep 27.

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Thank you



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