OCT and OCT Angiography in Retinal Disease

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Indiana Optometric Association
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Disclosure Statement
(next slide)

Disclosures- Greg Caldwell, OD, FAAO

- Will mention many products, instruments and companies during our discussion
  - ★ I don't have any financial interest in any of these products, instruments or companies
- Pennsylvania Optometric Association –President 2010
  - POA Board of Directors 2006-2011
- American Optometric Association, Trustee 2013-2016
- I never used or will use my volunteer positions to further my lecturing career
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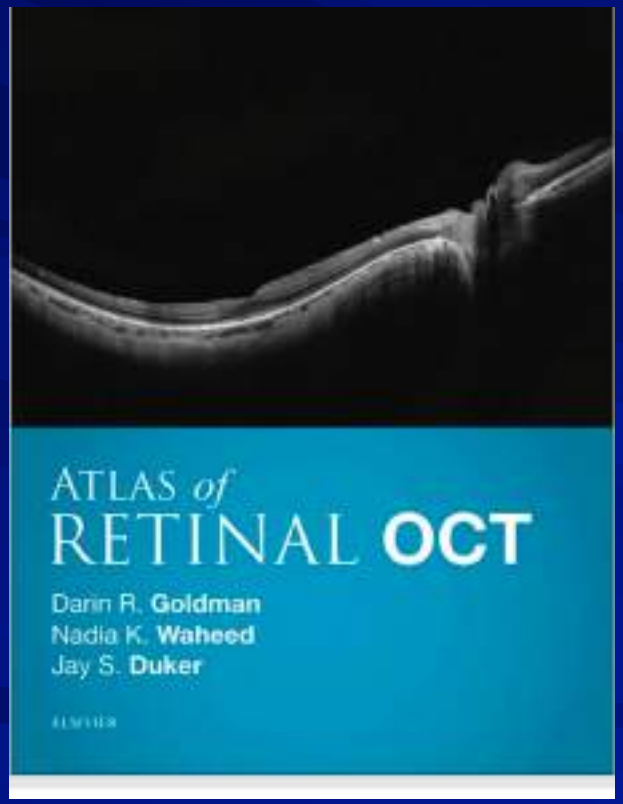
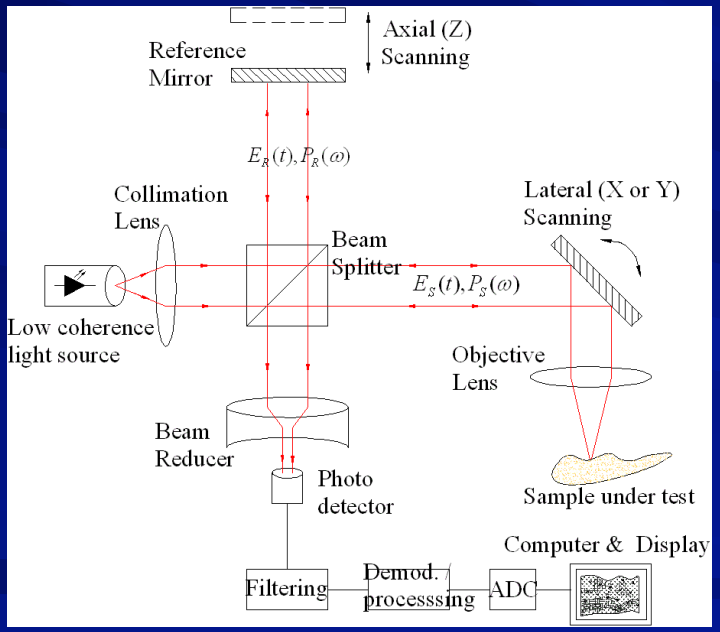
Resource: OCT Community for OCT and OCT-A

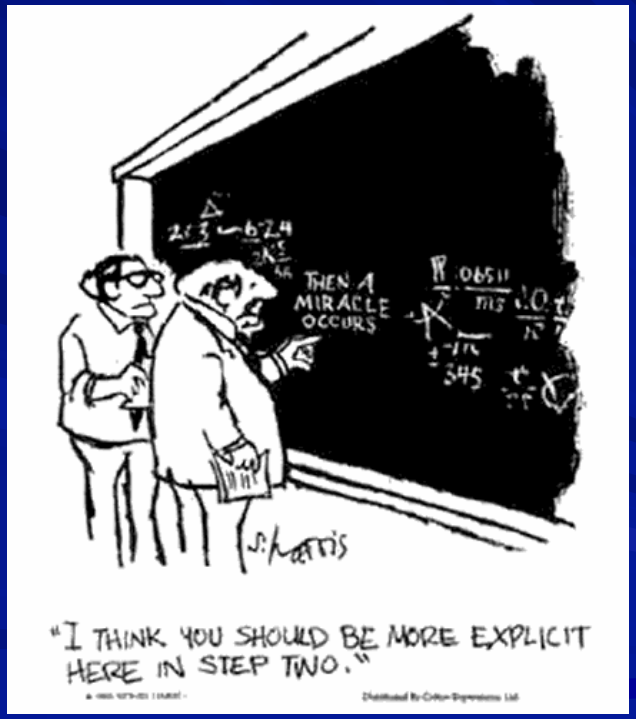
Book Resources



Optical Coherence Tomography

Course Design





OCT and OCT Angiography

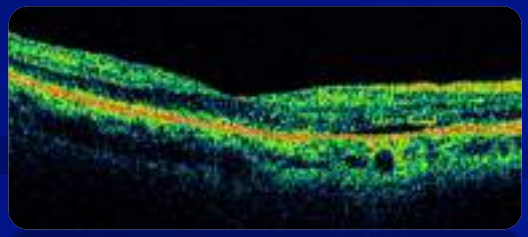
Both are Becoming Equally Important in Diagnosis, Management, and Treatment

Optical Coherence Tomography

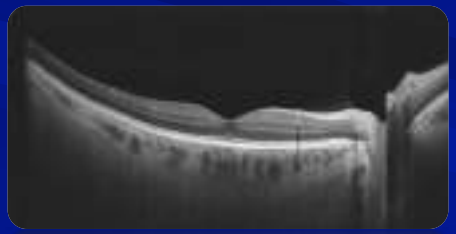
- OCT is an optical signal acquisition and processing method
- Time domain OCT
  - 15-16 microns of resolution
  - Stratus (Zeiss)
- Spectral domain (SD-OCT) or Fourier domain OCT
  - Spatially encoded frequency domain OCT (SEFD-OCT)
  - 5-6 microns of resolution
    - Able to see photoreceptor morphology (inner/outer segments)
  - 50 times faster than time domain
- Swept source OCT
  - Time encoded frequency domain OCT
  - 1 micron of resolution
- Future of OCT- intraoperative imaging, blood flow and oxygenation measurements
- May have the possibility to assess retinal pathology like a pathologist

OCT Angiography: the Next Chapter in Posterior Imaging

- Images retinal microvasculature without dye injection
- Displays structure and function from a single imaging system



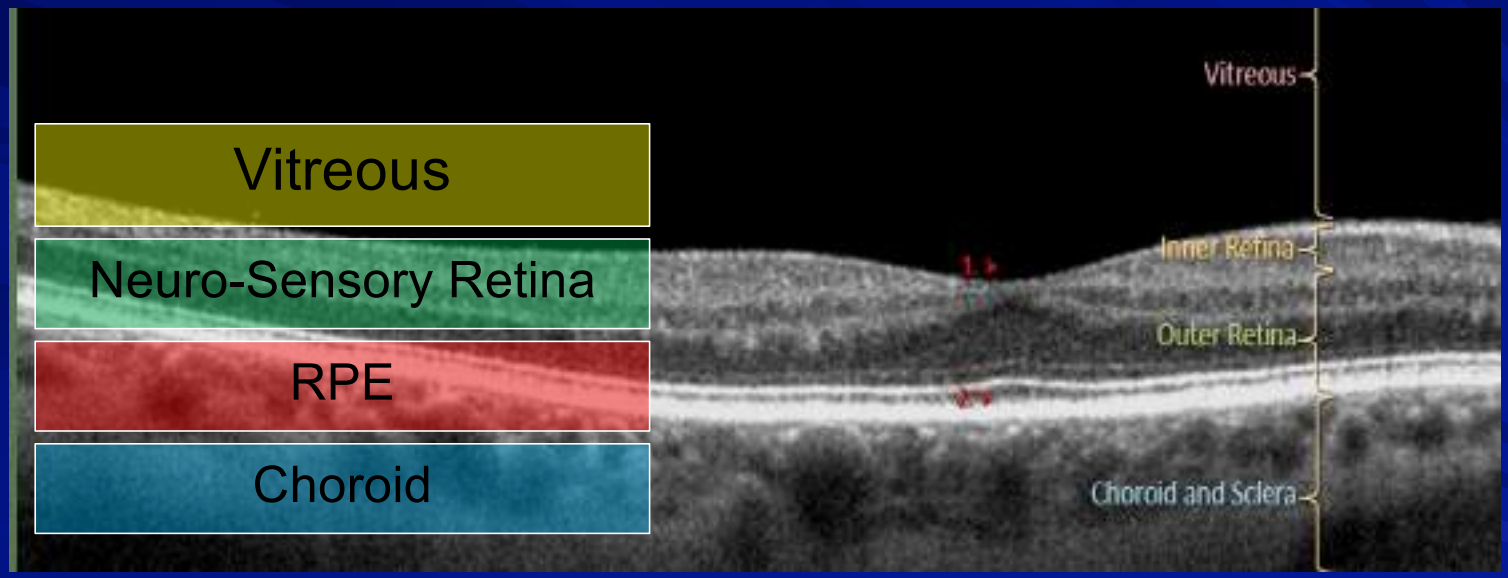
2002: Time Domain OCT

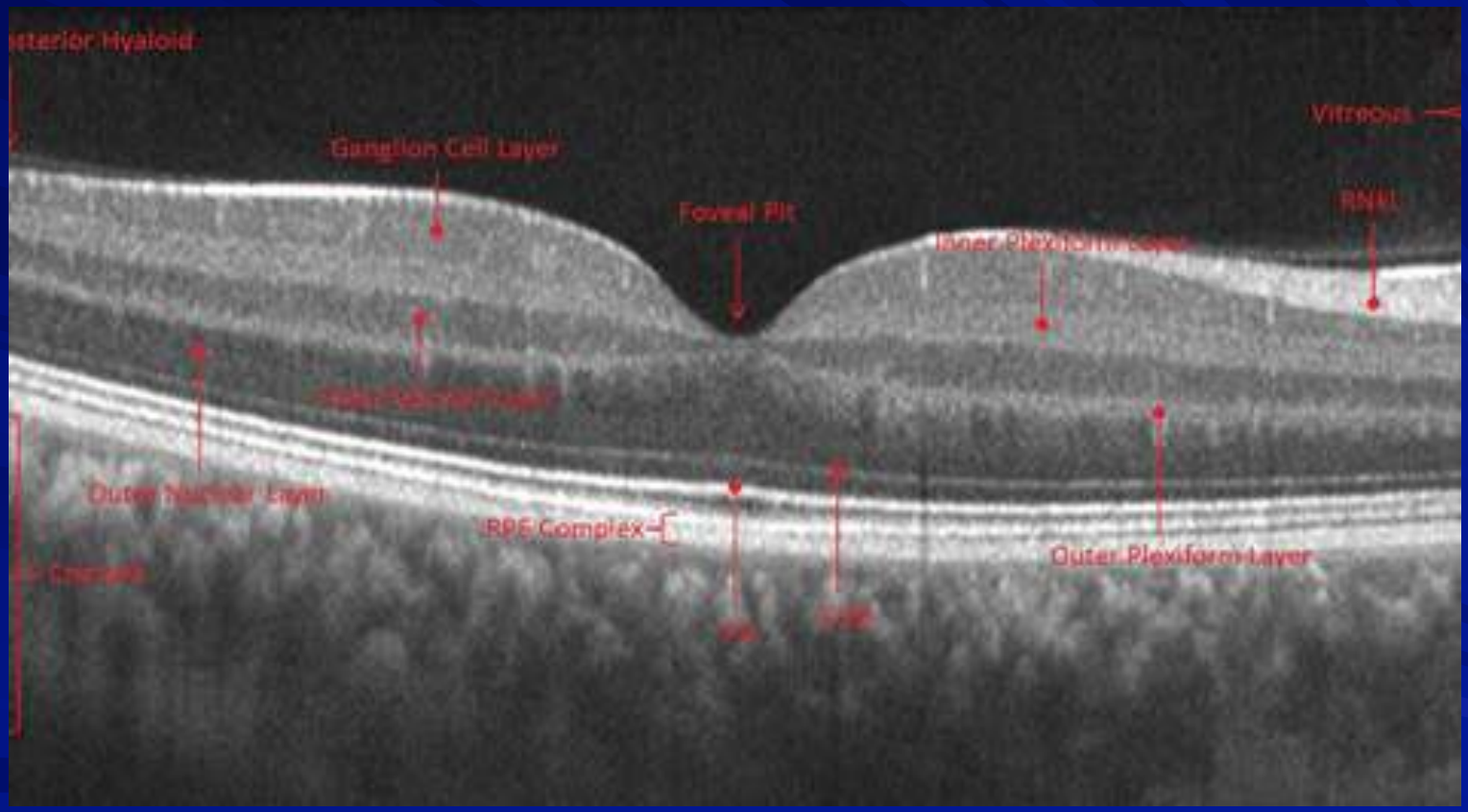


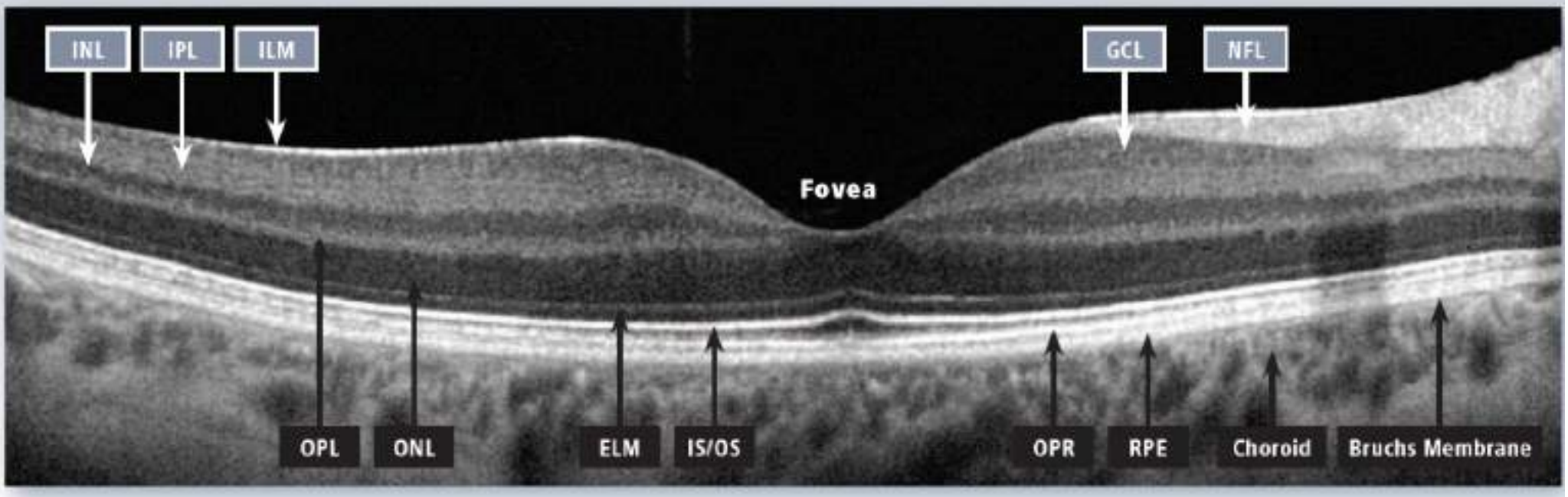
2006: Spectral Domain OCT

2014: OCTA

4 Basic Categories: Diseases of the….




Ganglion Cell Layer
Foveal Pit
Vitreous
RNFL
Outer Plexiform Layer
RPE Complex

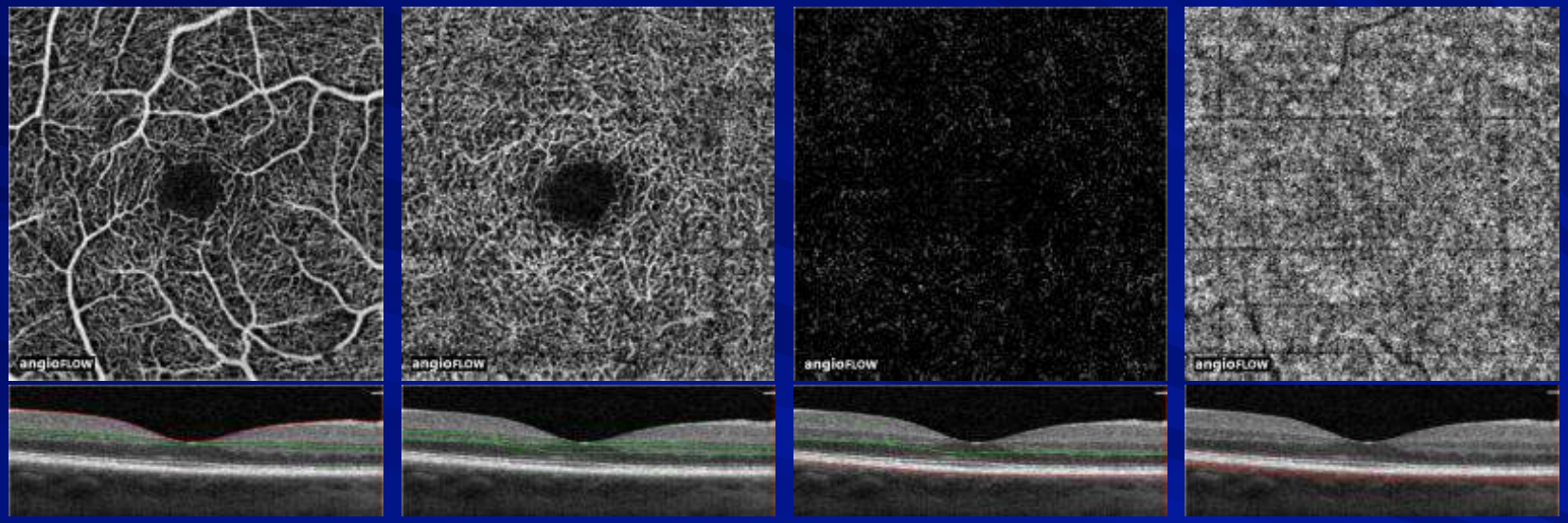


ILM: *Inner limiting membrane*
IPL: *Inner plexiform layer*
INL: *Inner nuclear layer*
OPL: *Outer plexiform layer*
ONL: *Outer nuclear layer*

ELM: *External limiting membrane*
IS/OS: *Junction of inner and outer photoreceptor segments*
OPR: *Outer segment PR/RPE complex*

NFL: *Nerve fiber layer*
GCL: *Ganglion cell layer*
RPE: *Retinal pigment epithelium + Bruch's Membrane*

Normal Retinal Vasculature



Superficial Capillary Plexus

3μm Below ILM → 15 μm Below IPL

Deep Capillary Plexus

15μm Below ILM → 70 μm Below IPL

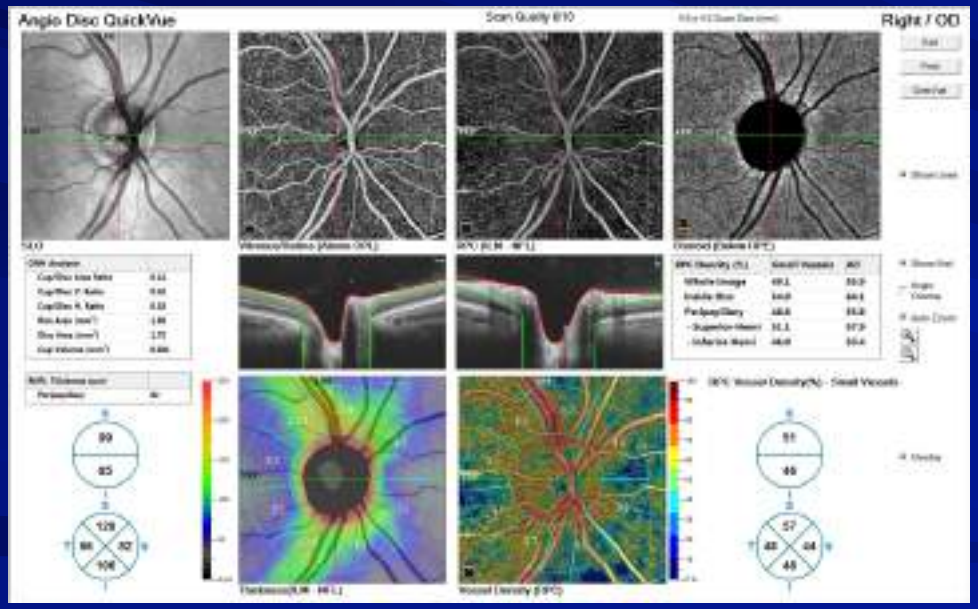
Outer Retina

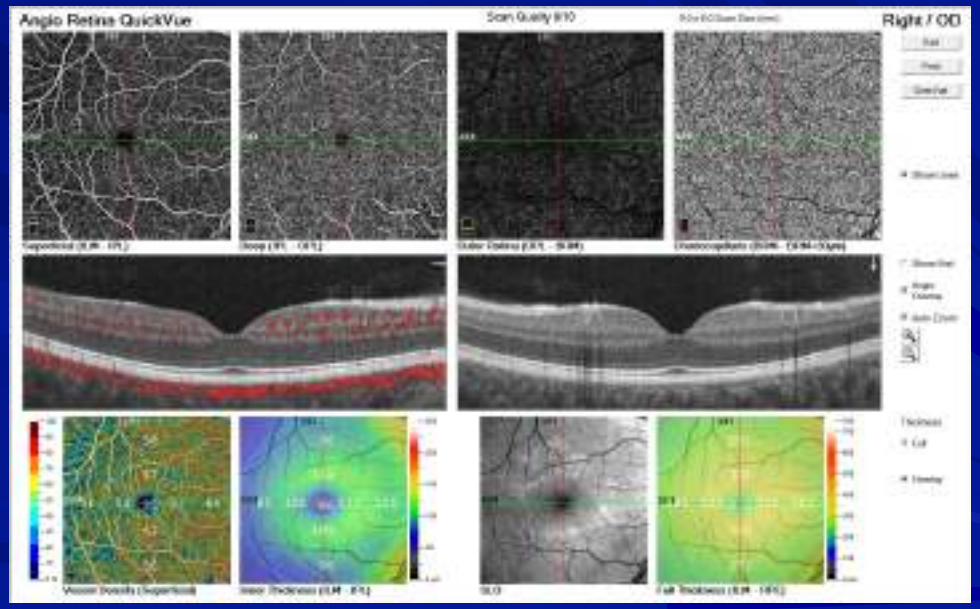
70μm Below IPL → 30 μm Below RPE Reference

Choriocapillaris

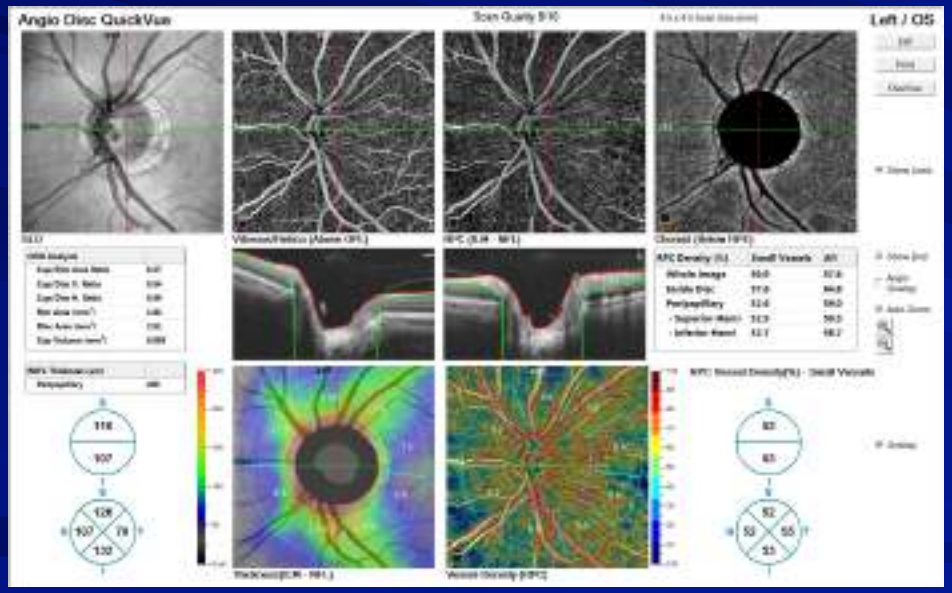
30 μm Below RPE Reference → 60 μm Below RPE Reference

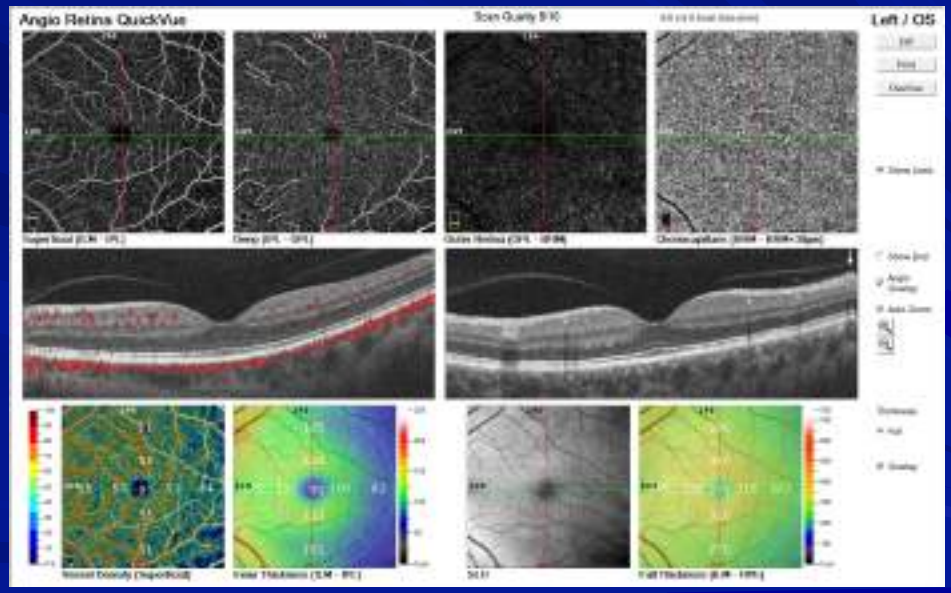
Review of Normal
25 year old man



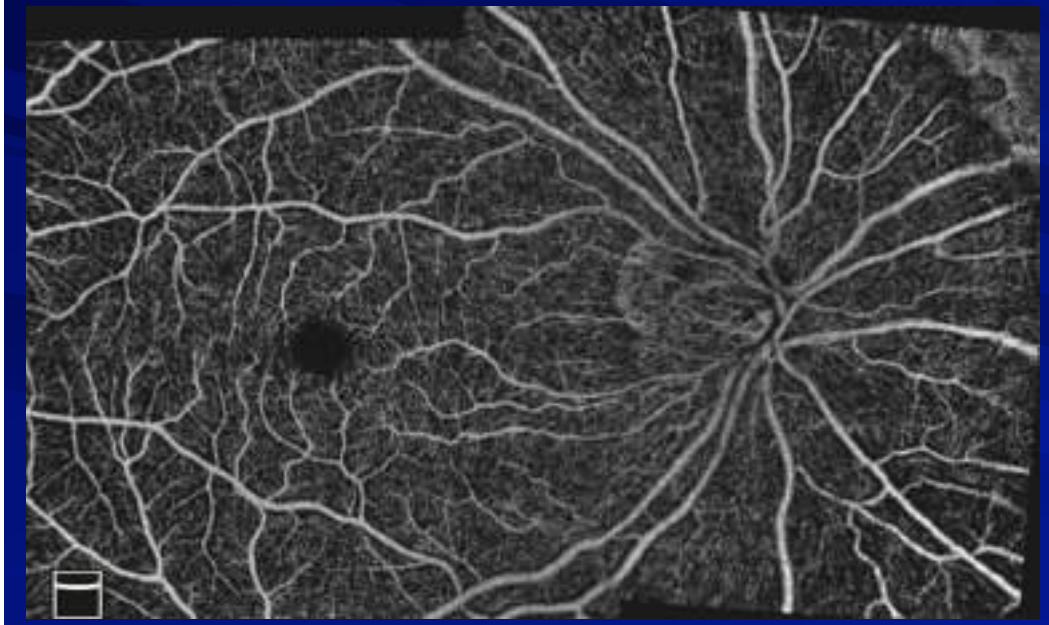


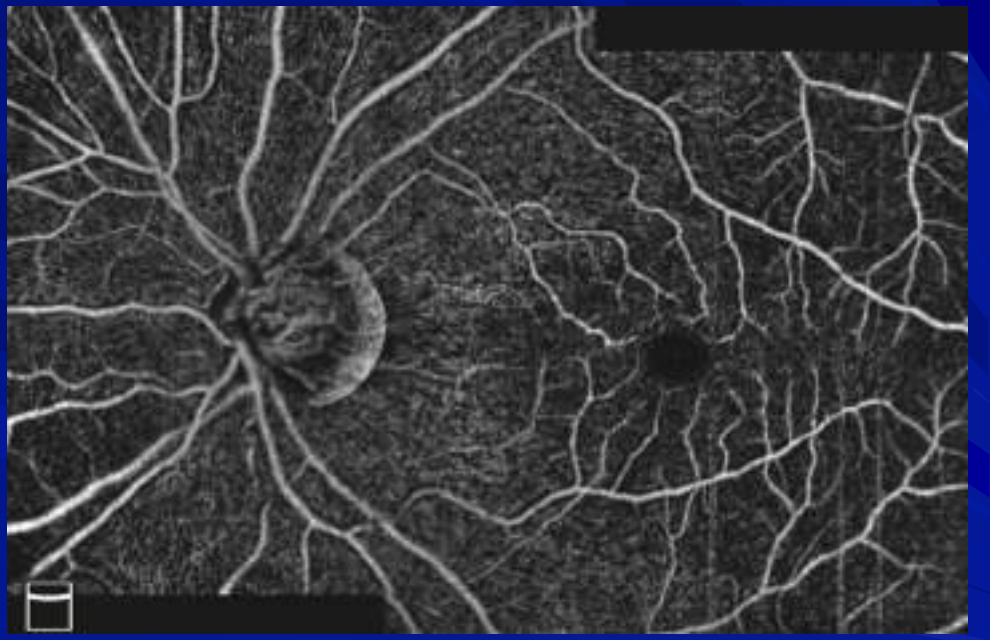
Review of Normal
60 year old man

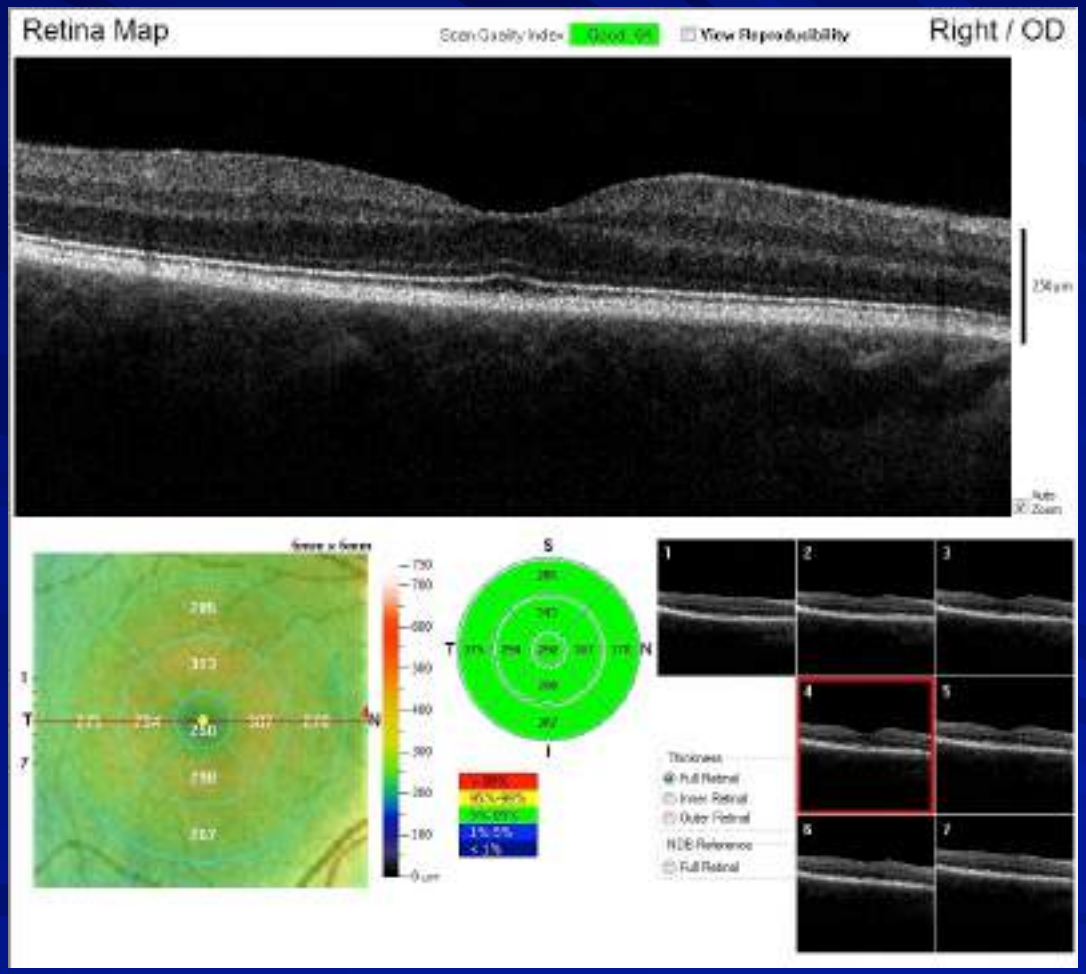




60 Year Old Montage OU







Learn to predict visual acuities

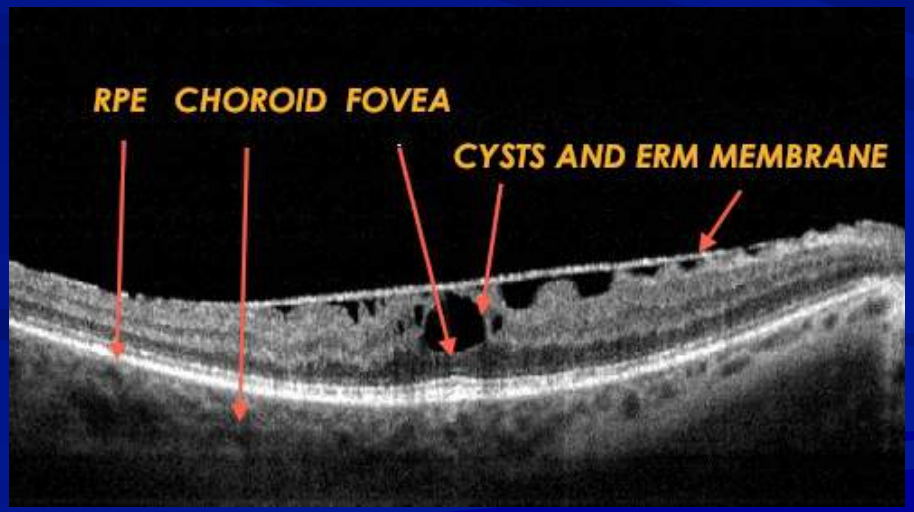
OCT of Vitreoretinal Interface Disorders

OCT of Vitreoretinal Interface Disorders

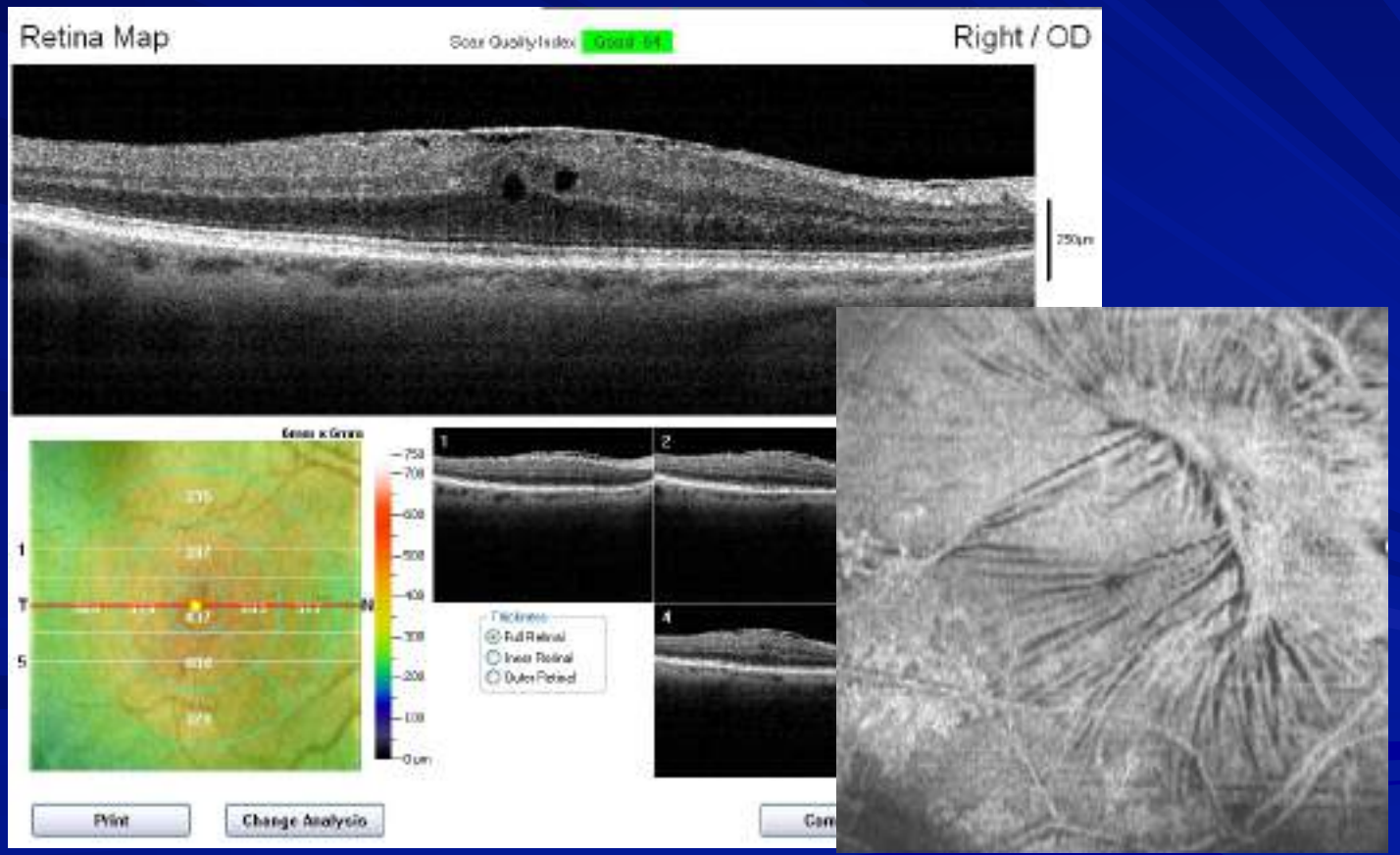
- Epiretinal membrane
- Vitreomacular adhesion
  - Complete VMA at birth
  - OCT reveals specific stage of vitreous separation
- Vitreomacular traction
- Pseudohole
- Lamellar hole
- Full Thickness Macular Hole

Epiretinal Membrane

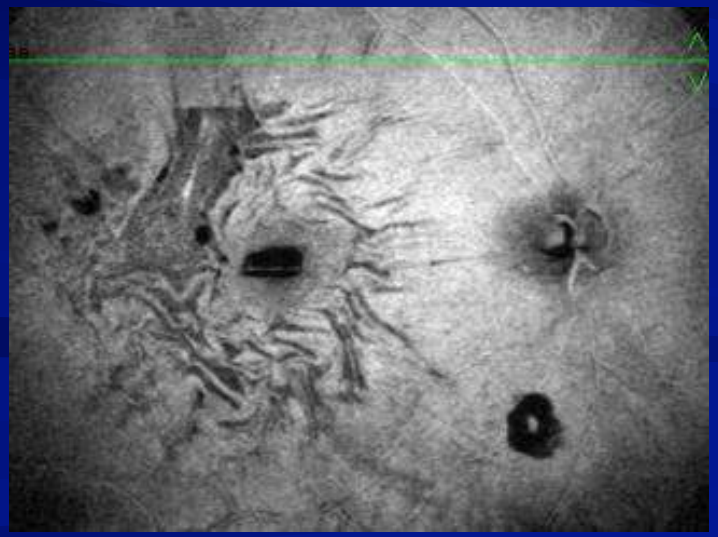
- Other names: premacular fibroplasia, preretinal glosis, macular pucker, surface wrinkling retinopathy
- Believed to be the result of proliferation of retinal glial cells on the internal limiting membrane that escaped through breaks in the internal limiting membrane
- May create macular edema
- Amsler grid may elicit metamorphosia from surface wrinkling or macular edema
- Treatment: Monitor until severe then retinal consult, possible vitrectomy with membrane peeling



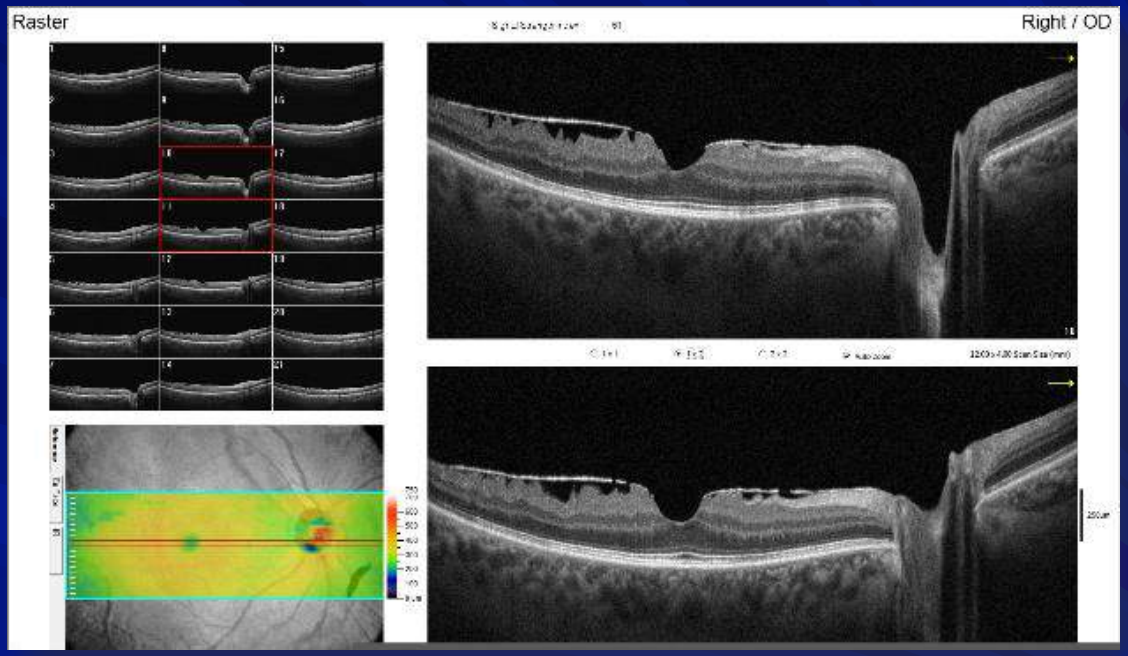
Epiretinal Membrame (ERM)



Epiretinal Membrane (ERM)

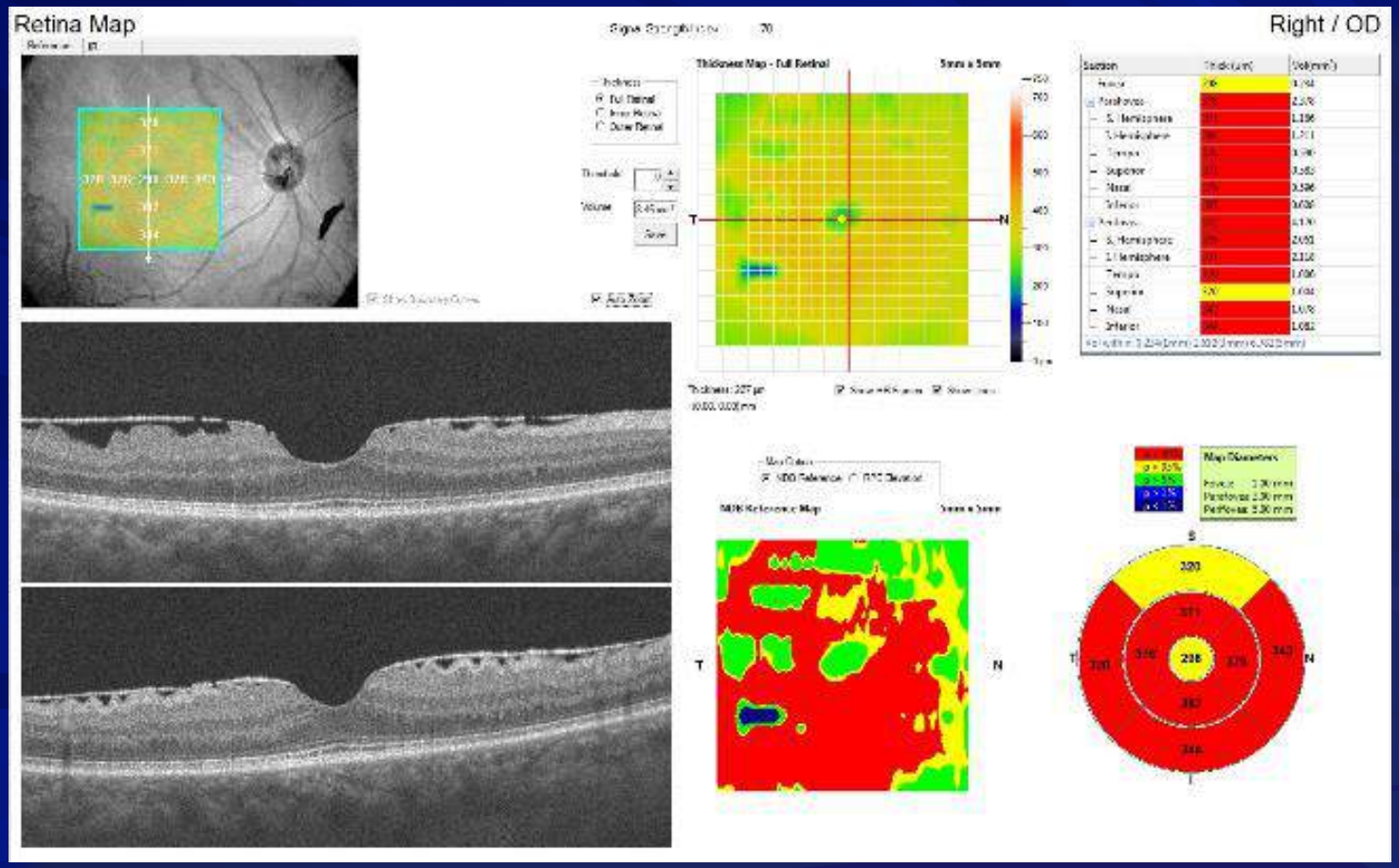


En Face OCT of ILM



Raster Scan

Epiretinal Membrane (ERM)



Retina Map

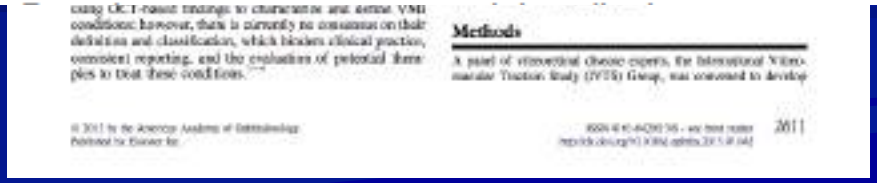
The International Vitreomacular Traction Study Group Classification of Vitreomacular Adhesion, Traction, and Macular Hole

Jay S. Duker, MD,[1] Peter K. Kaiser, MD,[2] Suzanne Binder, MD,[3,4] Marc D. de Smet, MD,[5] Alain Gaudric, MD,[6]

Main Outcome Measures: Optical coherence tomography-based anatomic definitions and classification of vitreomacular adhesion, vitreomacular traction (VMT), and macular hole.

Results: Vitreomacular adhesion is defined as perifoveal vitreous separation with remaining vitreomacular attachment and unperturbed foveal morphologic features. It is an OCT finding that is almost always the result of normal vitreous aging, which may lead to pathologic conditions. Vitreomacular traction is characterized by anomalous posterior vitreous detachment accompanied by anatomic distortion of the fovea, which may include pseudocysts, macular schisis, cystoid macular edema, and subretinal fluid. Vitreomacular traction can be subclassified by the diameter of vitreous attachment to the macular surface as measured by OCT, with attachment of 1500 μm or less defined as focal and attachment of more than 1500 μm as broad. When associated with other macular disease, VMT is classified as concurrent. Full-thickness macular hole (FTMH) is defined as a foveal lesion with interruption of all retinal layers from the internal limiting membrane to the retinal pigment epithelium. Full-thickness macular hole is primary if caused by vitreous traction or secondary if directly the result of pathologic characteristics other than VMT. Full-thickness macular hole is subclassified by size of the hole as determined by OCT and the presence or absence of VMT.

Conclusions: This classification system will support systematic diagnosis and management by creating a clinically applicable system that is predictive of therapeutic outcomes and is useful for the execution and analysis of clinical studies.



Methods

A panel of vitreoretinal disease experts, the International Vitreomacular Traction Study (IVTS) Group, was convened to develop

VMA versus VMT
Focal or Broad Attachment

Table 4. The IVTS Classification System for Vitreomacular Adhesion, Traction, and Macular Hole

Anatomic State	IVTS Classification System for Vitreomacular Adhesion, Traction, and Macular Hole
VMA	Definition
	Evidence of perifoveal vitreous cortex detachment from the retinal surface
	Macular attachment of the vitreous cortex within a 3-mm radius of the fovea
	No detectable change in foveal contour or underlying retinal tissues
	Classification
	By size of attachment area
	Focal (≤1500 μm)
	Broad (>1500 μm, parallel to RPE and may include areas of dehiscence)
	By presence of concurrent retinal conditions
	Isolated
	Concurrent
VMT	Definition
	Evidence of perifoveal vitreous cortex detachment from the retinal surface
	Macular attachment of the vitreous cortex within a 3-mm radius of the fovea
	Association of attachment with distortion of the foveal surface, intraretinal structural changes, and/or elevation of the fovea above the RPE, but no full-thickness interruption of all retinal layers
	Classification
	By size of attachment area
	Focal (≤1500 μm)
	Broad (>1500 μm, parallel to RPE and may include areas of dehiscence)
	By presence of concurrent retinal conditions
	Isolated
	Concurrent

Vitreomacular Adhesion (VMA)

Optical Coherence Tomography–Based Definition and Classification of Vitreomacular Adhesion

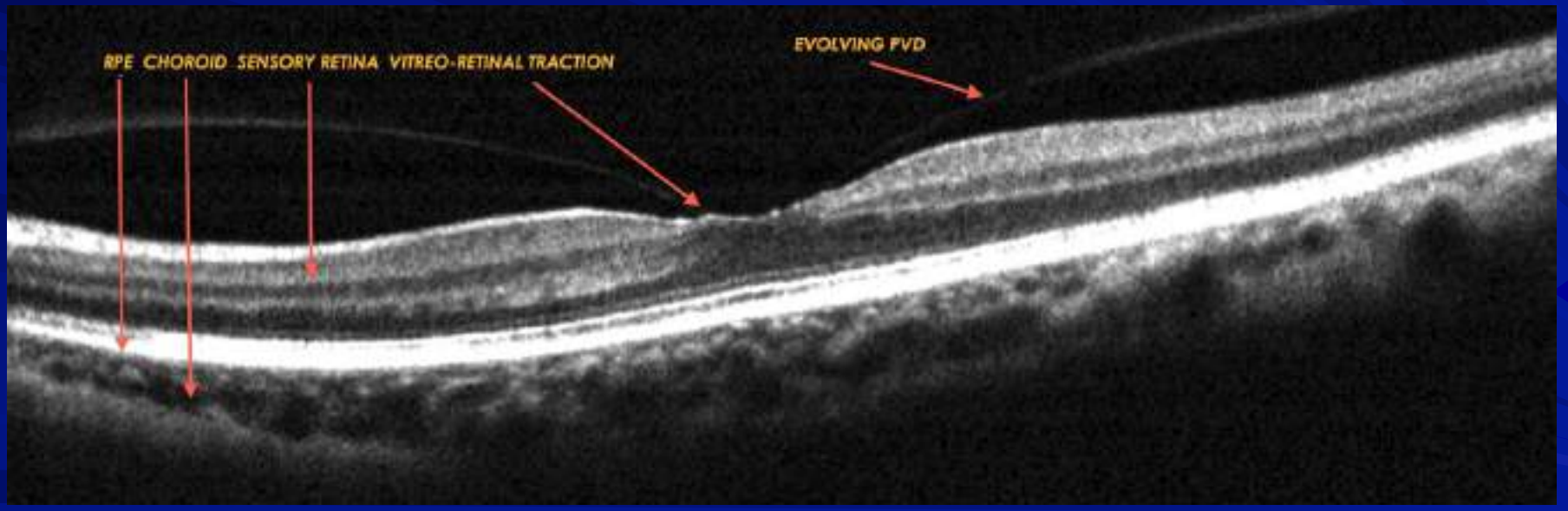
Vitreomacular adhesion is a perifoveal vitreous detachment and is defined, as with other terms in this report, by anatomic features detected with OCT. In Uchino's, Gaudric's, and Johnson's classification schemes, VMA is the equivalent of a stage 1 PVD.[1,2,13,15] Most eyes have complete vitreoretinal adhesion at birth, so the concept of vitreoretinal adhesion and VMA is a normal state. In this OCT-based classification scheme, however, VMA represents a specific stage of vitreous separation wherein partial detachment of the vitreous in the perifoveal area has occurred,

Focal versus Broad in VMA and VMT

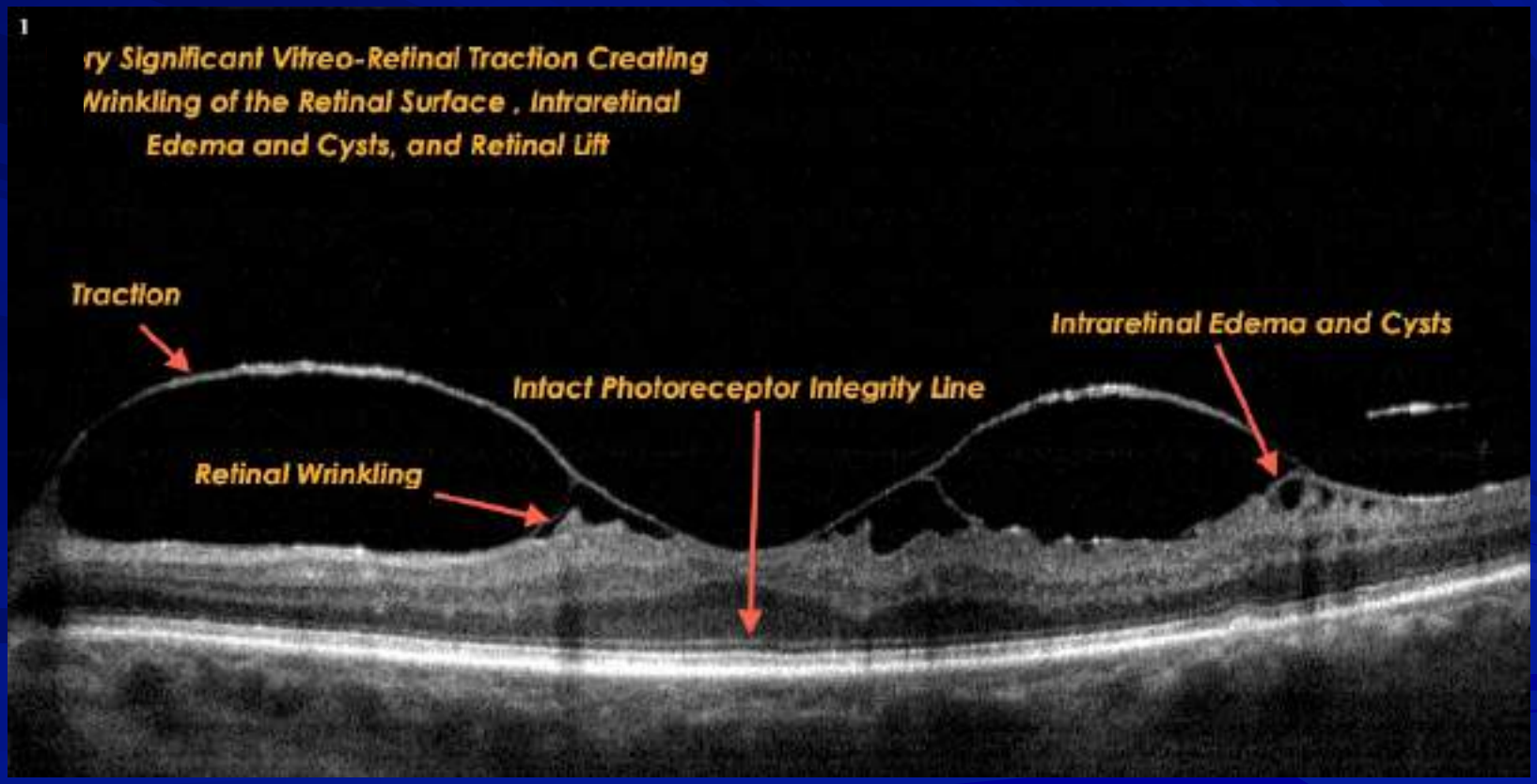
Certain key points are worth noting when considering the definition of VMA. First, this anatomic definition of VMA has been dissociated from symptomatology, because specific visual symptoms are subjective and may be caused by unrelated disease. Second, eyes with VMA may be subclassified by size of the adhesion into either: (1) focal (≤1500 μm) or (2) broad (>1500 μm; Fig 1A, B). The 1500-μm cutoff has been selected for several reasons. This 1500-μm diameter is a known area of increased vitreous adhesion to the fovea. In addition, this figure has been used routinely to distinguish focal from broad VMA in the published vitreoretinal literature and at most OCT reading centers.[4,16] It remains unclear whether there is any prognostic difference between focal and broad VMA. When ascertaining the expanse of vitreous attachment, one measures areas in which the adhesion is roughly parallel to the retinal pigment epithelium (RPE). Small regions of dehiscence (<1 mm) between the vitreous and neurosensory retina may be present within zones of broad VMA and should be disregarded when classifying VMA as either focal or broad. Eyes with VMA also may have other associated macular abnormalities, including age-related macular degeneration (Fig 1C), retinal vein occlusion, or diabetic macular edema.[17,18] In these eyes, VMA should be termed *concurrent*, and the term *isolated* should be reserved for cases where no ocular disease is present (Table 1).

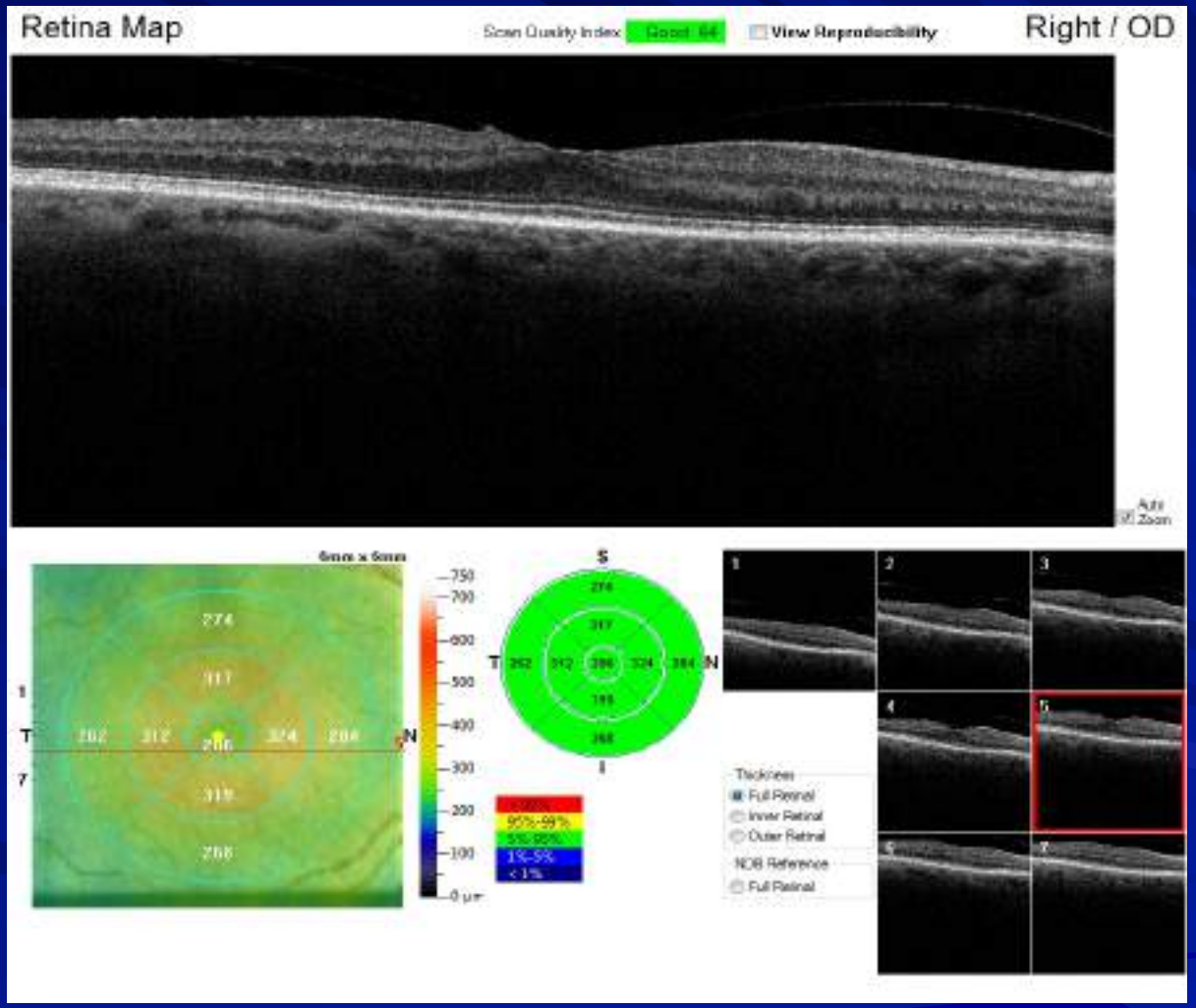
Like VMA, VMT can be subclassified into either focal or broad, depending on the width of vitreous attachment (Table 1). Broad areas of attachment with traction can cause generalized thickening of the macula, vascular leakage on fluorescein angiography, macular schisis, and cystoid macular edema. Focal areas of vitreous attachment with traction tend to distort the foveal surface, elevate the foveal floor, form pseudocysts within the central macula, or result in a combination thereof (Fig 1D–F). The presence of pseudocysts usually is associated with diminished visual acuity and visual distortion. After release of traction, pseudocysts generally resolve over time with little remaining visual deficit.[20]

Vitreomacular Traction
Focal



Vitreo-Macular Traction (VMT)
Focal

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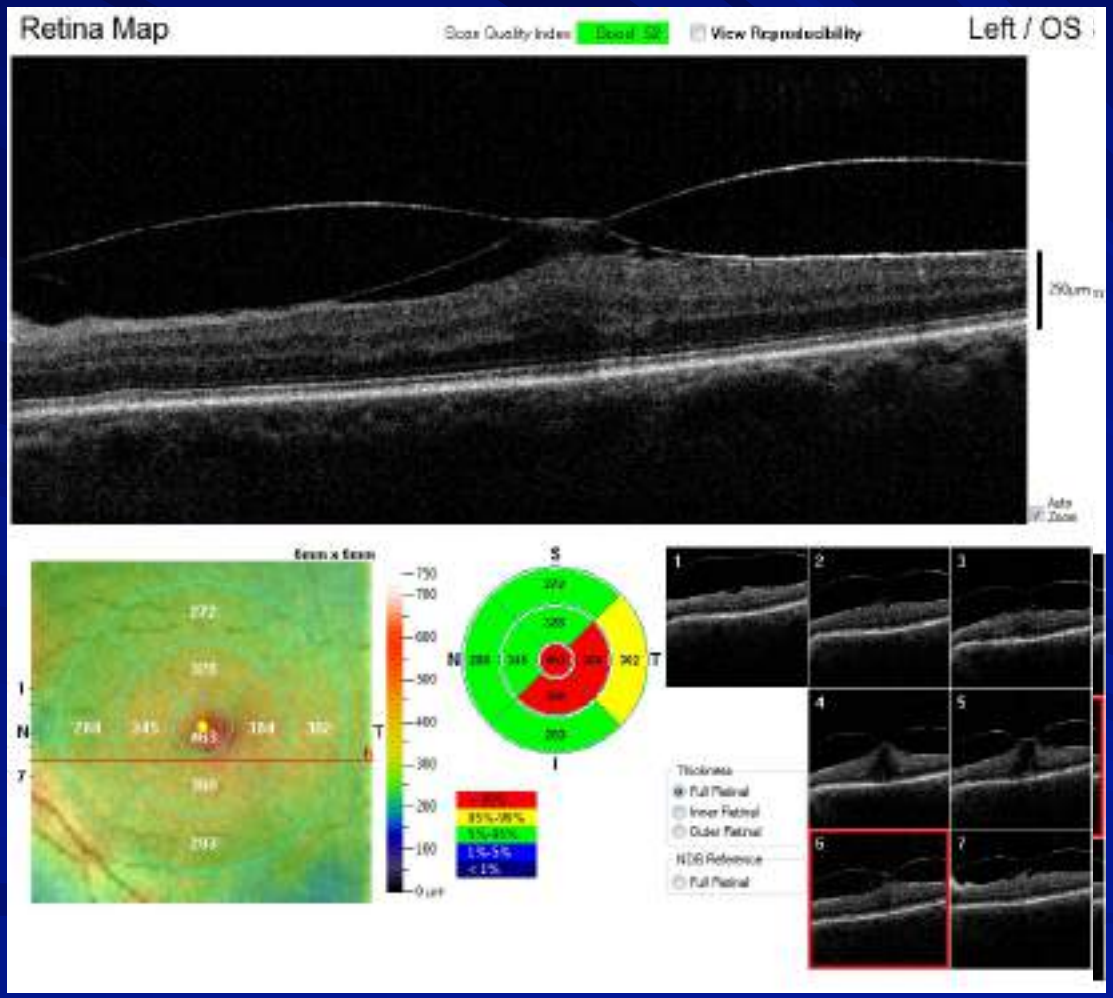
Full Retinal


Retina Map
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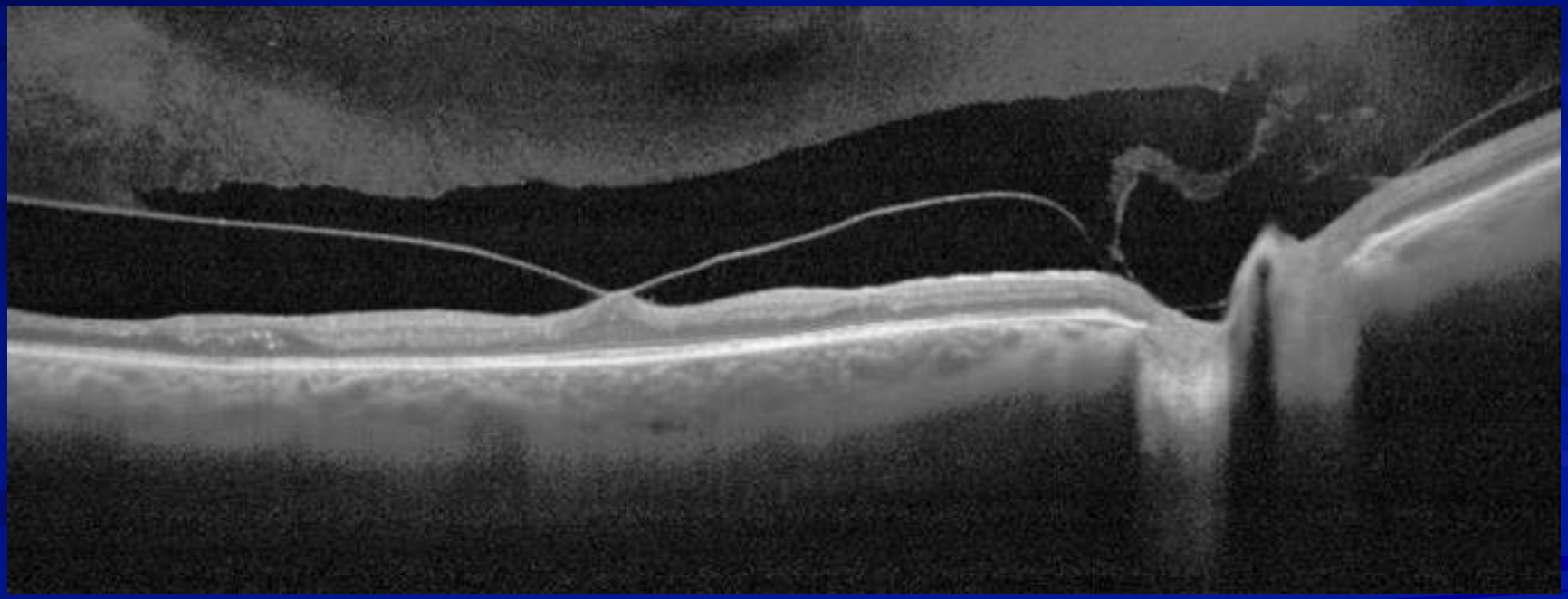
Focal Vitreomacular Traction



Full Thickness Macular Hole

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Conclusions: This classification system will support systematic diagnosis and management by creating a clinically applicable system that is predictive of therapeutic outcomes and is useful for the execution and analysis of clinical studies.

Stage 1-4 Macular Holes

Ophthalmology *Volume 120, Number 12, December 2013*

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

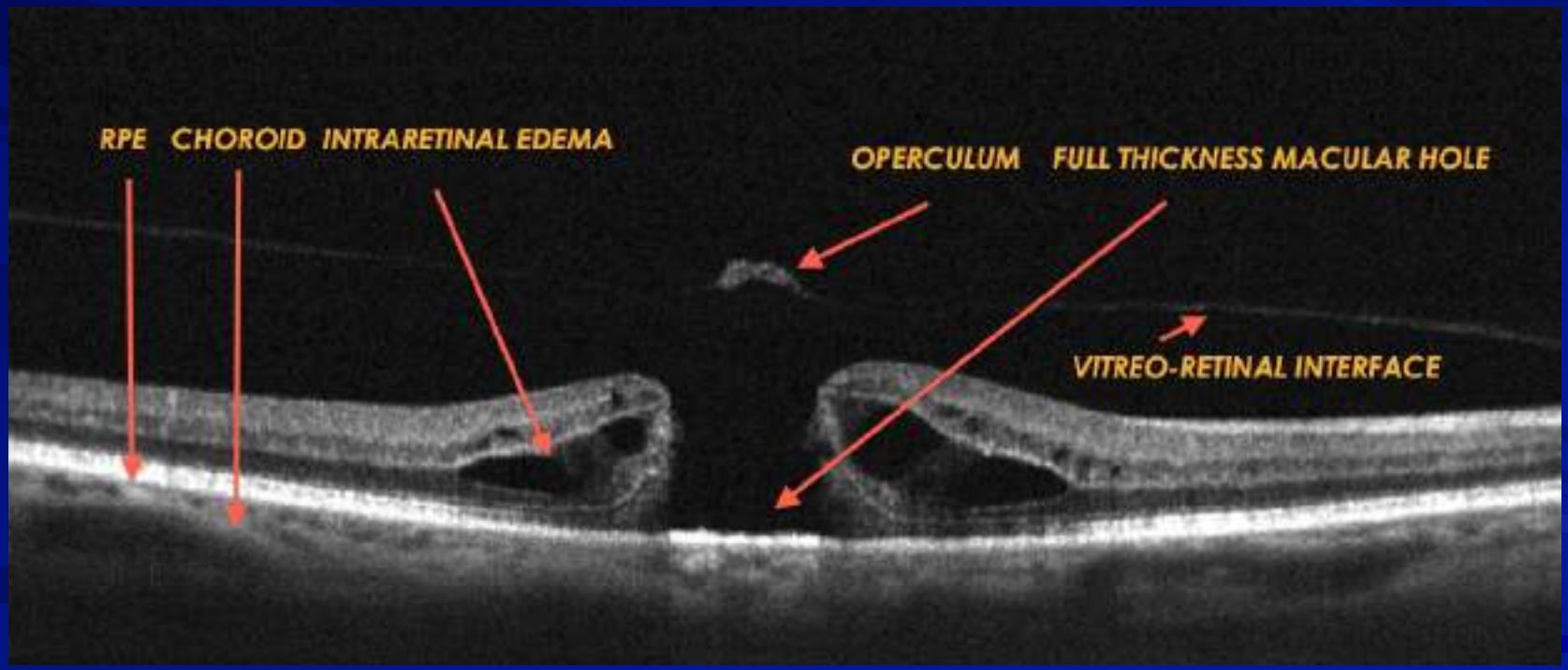
Full-Thickness Macular Hole Stages in Common Use	International Vitreomacular Traction Study Classification System
Stage 0	VMA
Stage 1: impending macular hole	VMT
Stage 2: small hole	Small or medium FTMH with VMT
Stage 3: large hole	Medium or large FTMH with VMT
Stage 4: FTMH with PVD	Small, medium, or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

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

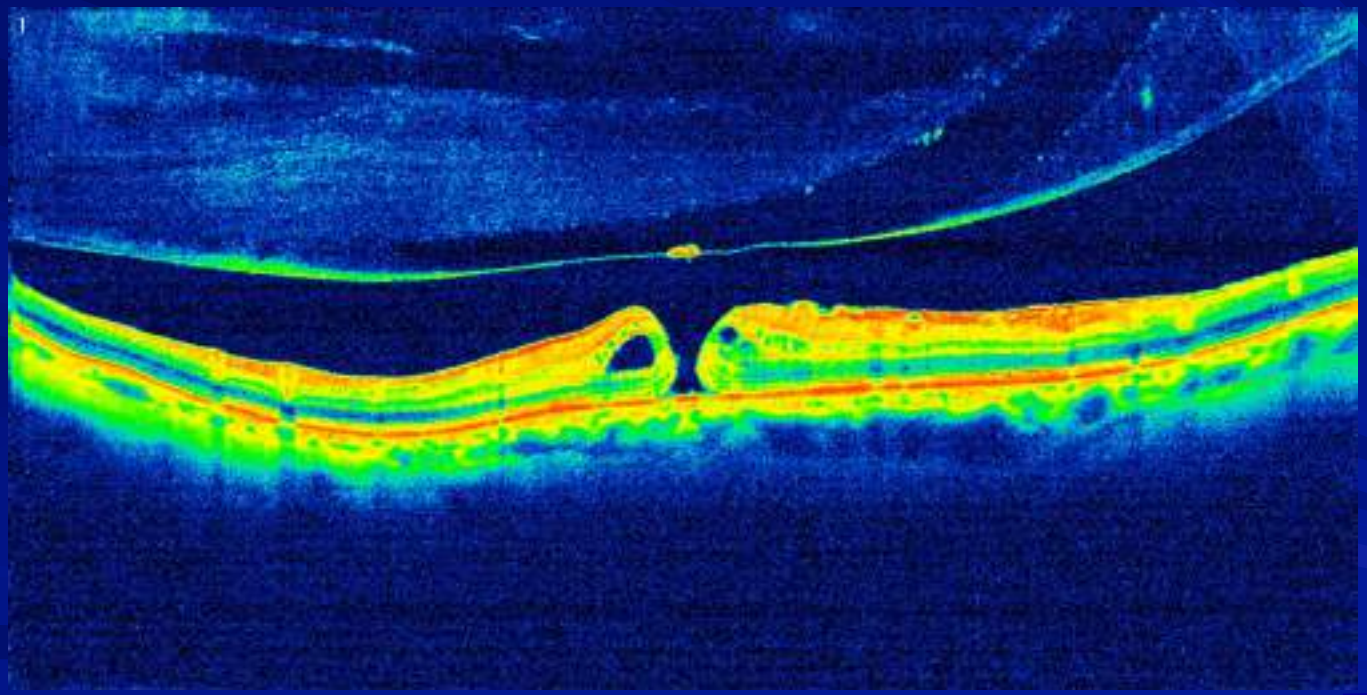
Full Thickness Macular Hole

	Concurrent
FTMH	Definition
	Full-thickness foveal lesion that interrupts all macular layers from the ILM to the RPE
	Classification
	By size (horizontally measured linear width across hole at narrowest point, not ILM)
	Small (≤250 µm)
	Medium (>250 µm and ≤400 µm)
	Large (>400 µm)
	By presence or absence of VMT
	By cause
	Primary (initiated by VMT)
	Secondary (directly due to associated disease or trauma known to cause macular hole in the absence of prior VMT)

Full Thickness Macular Hole Large and Without VMT



Small Full Thickness Macular Hole without VMT



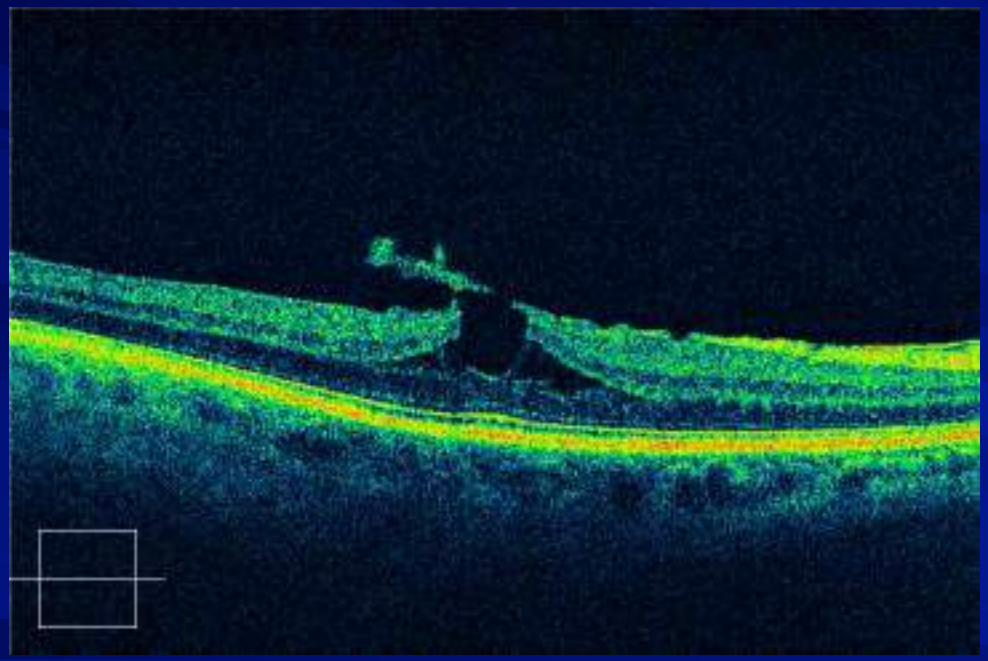
What About the Other Eye?

- One eye has a full thickness macular hole
- Stage 0 macular hole
  - VMA
- Impending macular hole
  - VMT
  - Despite the name
    - Can spontaneously resolve

Impending Macular Hole

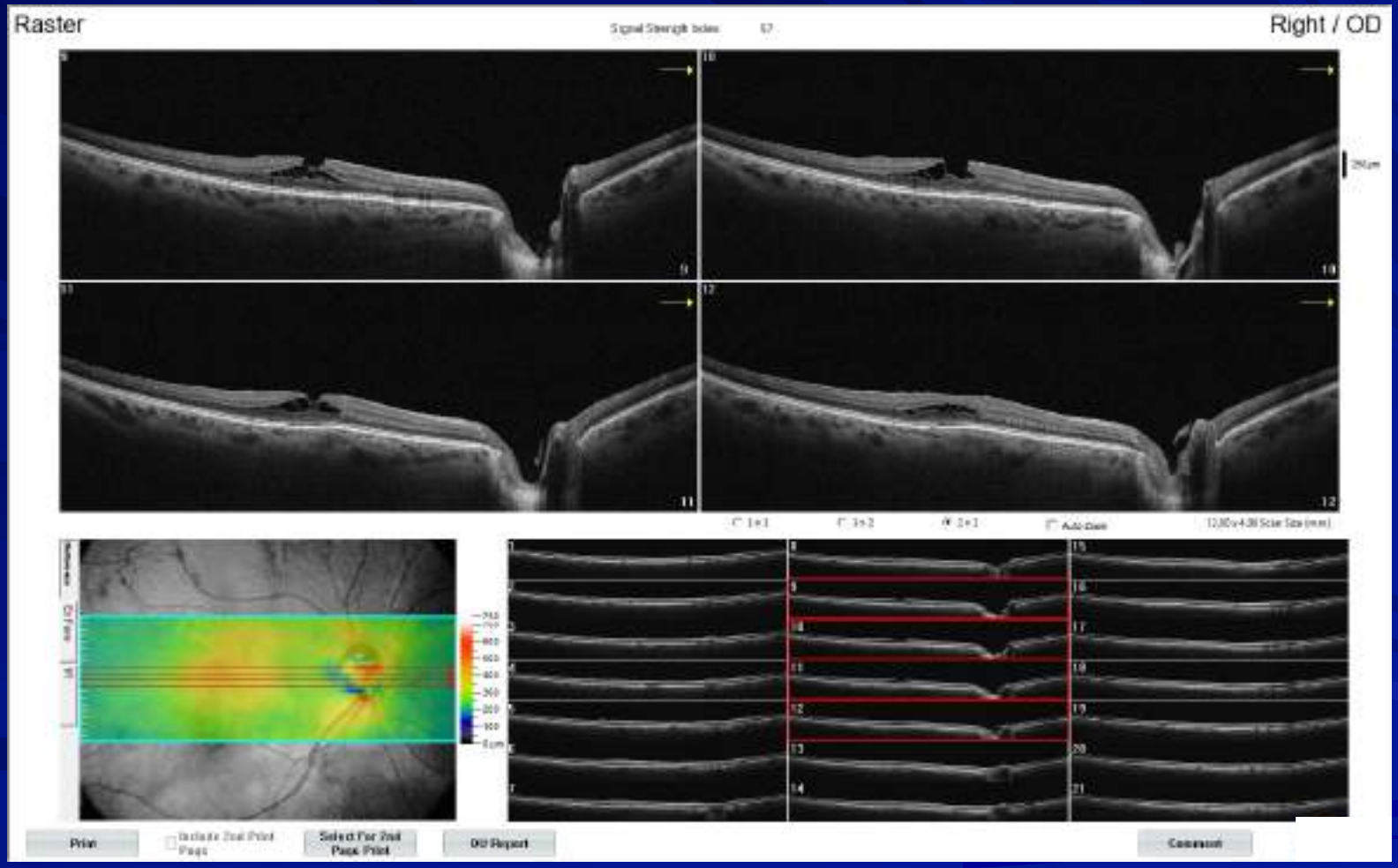
A special circumstance exists when an individual develops FTMH in one eye and OCT reveals VMA or VMT in the fellow eye. Studies show that these fellow eyes are at increased risk for development of FTMH.[48] In the past, the finding of VMA in a fellow eye has been referred to as a stage 0 macular hole, but the term *impending macular hole* should be used instead to describe a case in which FTMH is observed in one eye and VMT is observed on OCT in the fellow eye (Tables 2 and 3). The term *impending macular hole*, despite the connotation of inevitability, does not exclude the possibility of spontaneous resolution.

Macula Hole?



Lamellar Macular Hole

Lamellar macular hole (LMH) is a partial-thickness foveal defect that typically appears on biomicroscopy as a round or oval, well-circumscribed, reddish lesion. Clinical detection of early LMH may be difficult using biomicroscopy alone. Anatomic OCT-based features of LMH include the following: (1) an irregular foveal contour; (2) a defect in the inner fovea (may not have actual loss of tissue); (3) intraretinal splitting (schisis), typically between the outer plexiform and outer nuclear layers; and (4) maintenance of an intact photoreceptor layer. Lamellar macular hole can be distinguished from FTMH on OCT best by the presence of intact photoreceptors at the base (Fig 2E).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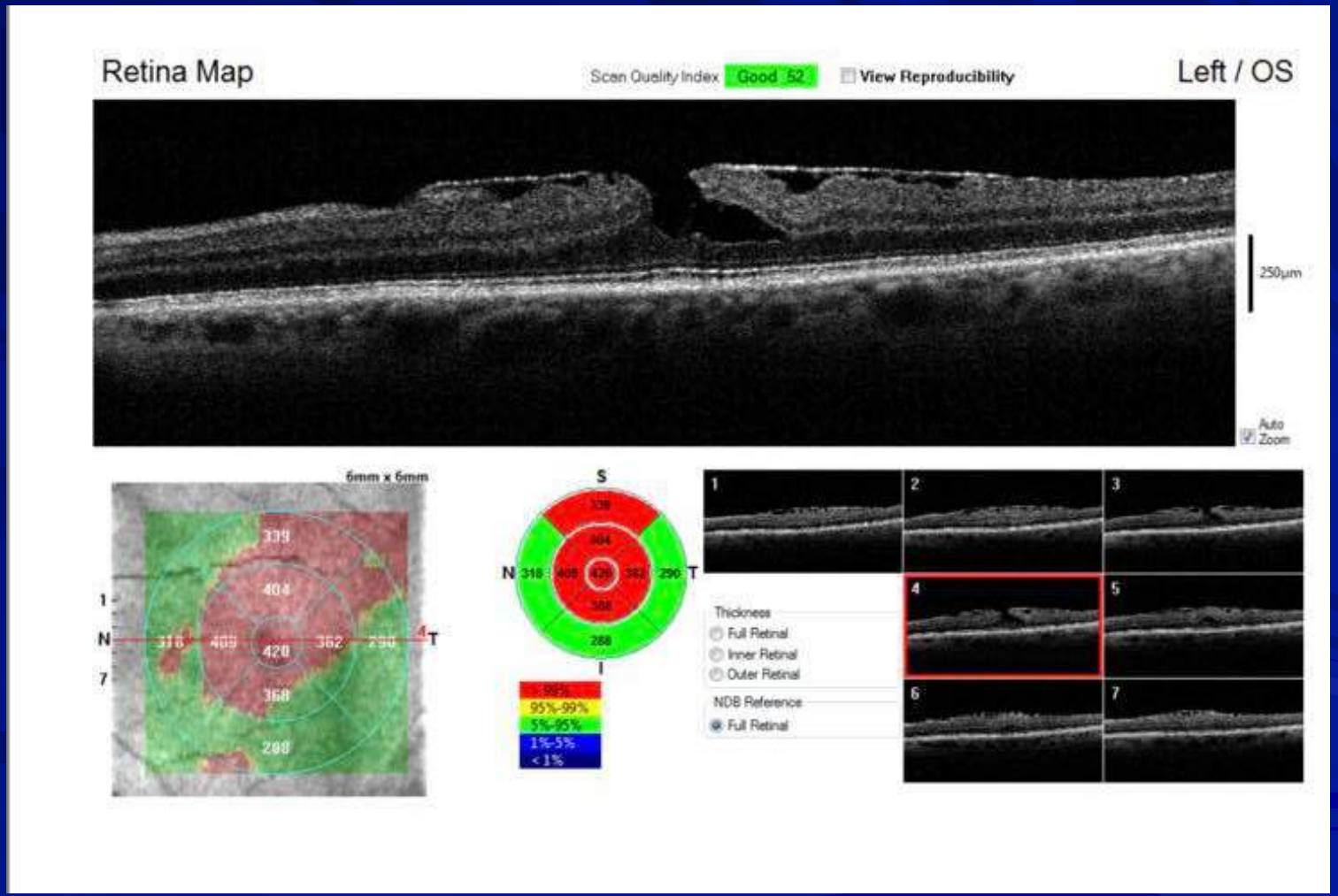
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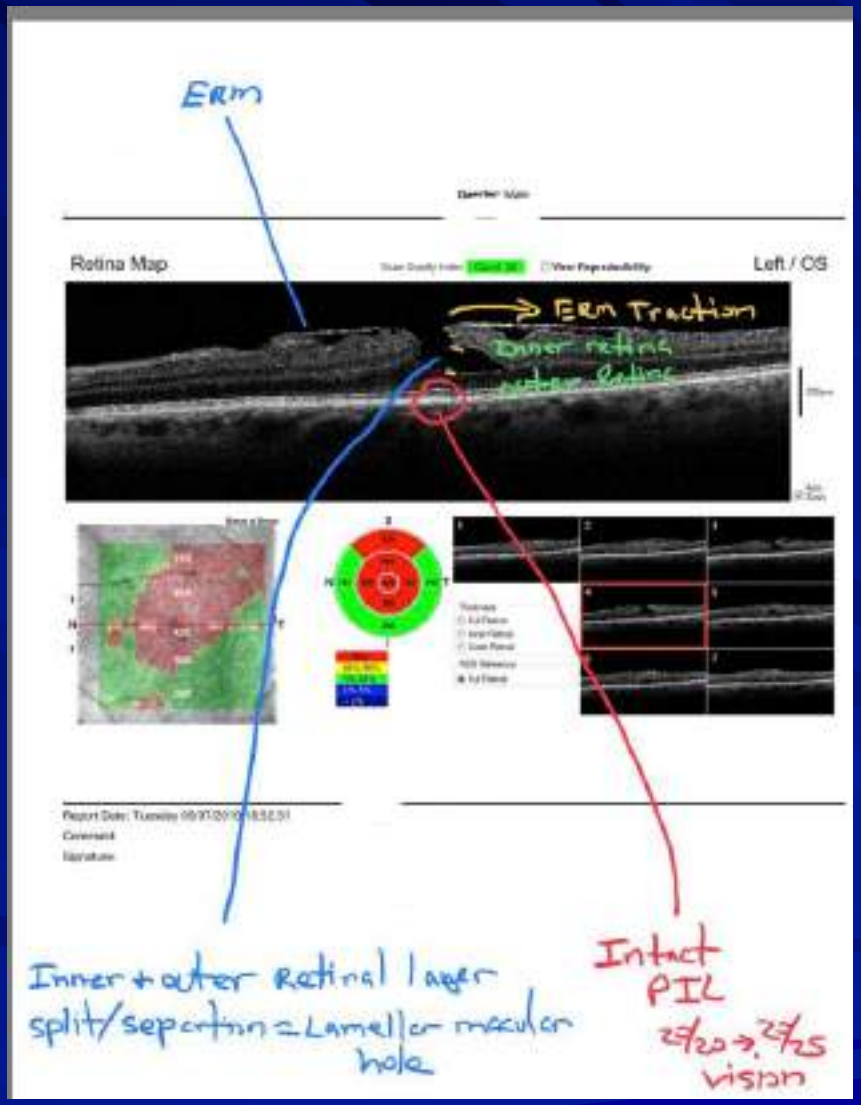
339
404
316
409
420
362
290
368
288
1
4
7
N
T
S
I
N 318 409 420 362 290 T
339
404
368
288
< 99%
95%-99%
5%-95%
1%-5%
< 1%
Thickness
Full Retinal
Inner Retinal
Outer Retinal
NDB Reference
Full Retinal
1
2
3
4
5
6
7


ERM
Retina Map
Left / OS
ERM Traction
Inner retina
outer Retina
Inner + outer retinal layer
split/separtion = Lamellar macular
hole
Intact
PIL
27/20 → 27/25
vision

Pseudohole

	Maintenance of an intact photoreceptor layer
Macular Pseudohole	Definition
	Invaginated or heaped foveal edges
	Concomitant ERM with central opening
	Steep macular contour to the central fovea with near-normal central foveal thickness
	No loss of retinal tissue

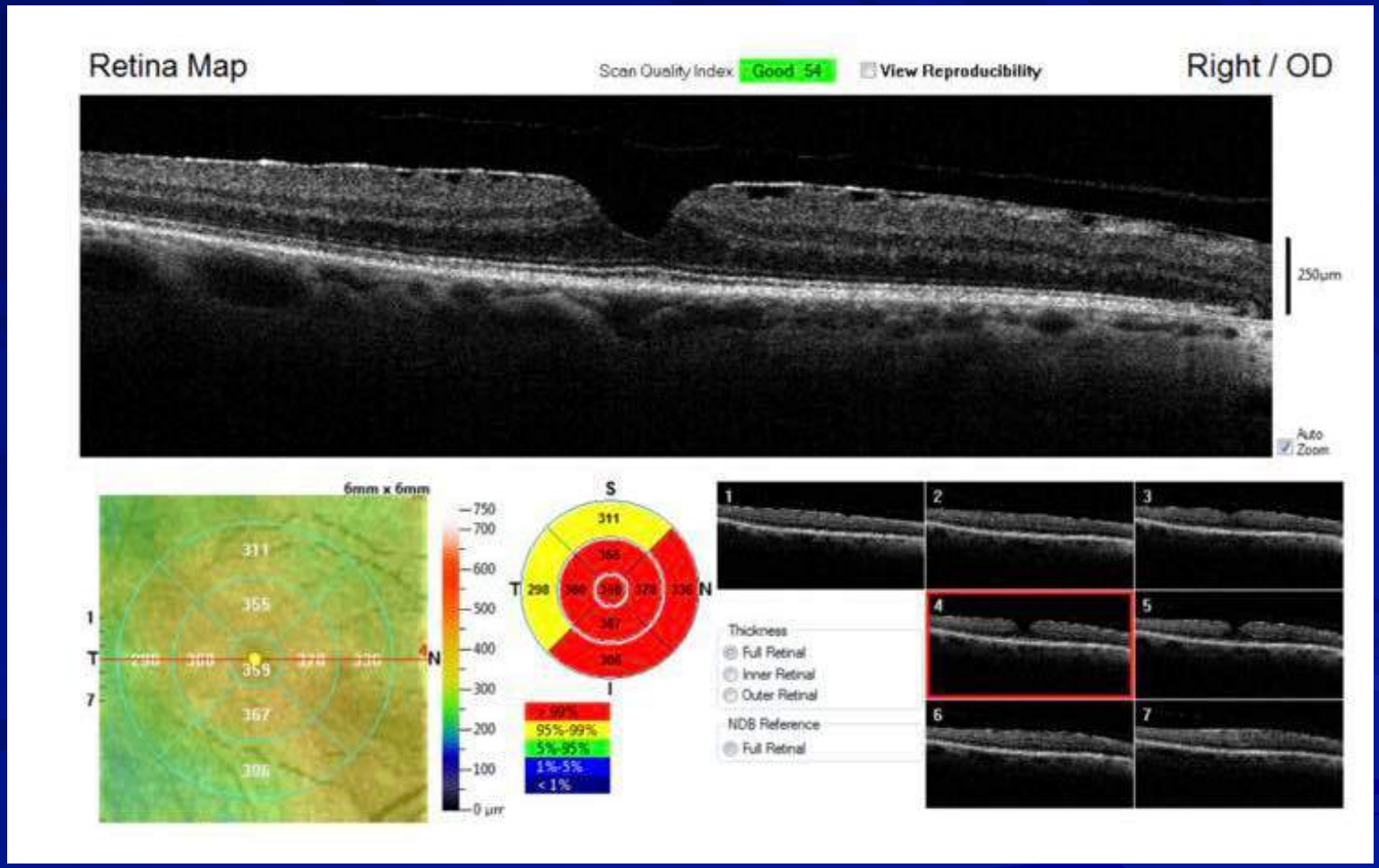
Abbreviations: ERM = epiretinal membrane; FTMH = full-thickness macular hole; ILM = internal limiting memb
omacular Traction Study; LMH = lamellar macular hole; RPE = retinal pigment epithelium; VMA = vitreomacul
traction.

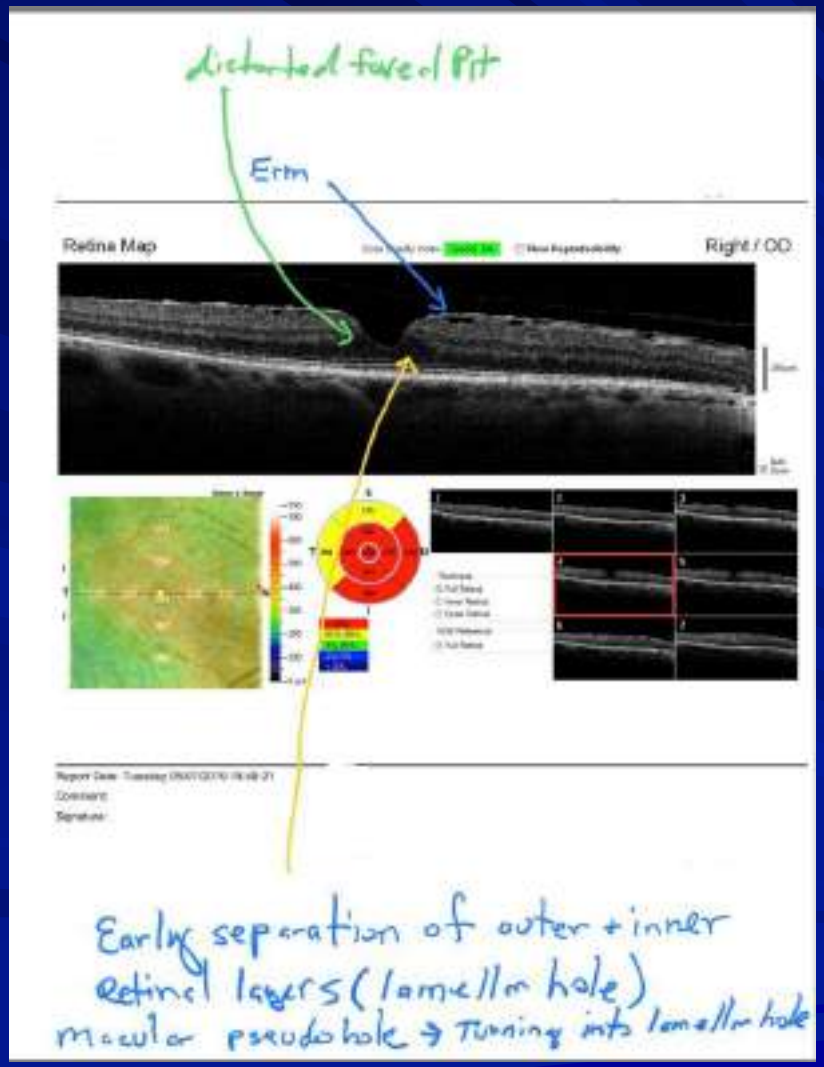
pseudohole.[50] Importantly, there is no loss of foveal tissue, as is observed typically with LMH or FTMH. Central foveal thickness usually is normal or slightly thin.[50] Thus, OCT confirms the diagnosis on the basis of the following 4 characteristics (Fig 2F): (1) invaginated or heaped foveal edges, (2) concomitant ERM with central opening, (3) steep macular contour to the central fovea with near-normal central foveal thickness, and (4) no loss of retinal tissue.

a shape that mimics a hole but c
tissue.

Management of macular pseudo
the ERM is associated with a sig
plana vitrectomy with membran
Successful ERM removal often le
foveal contour and some improve

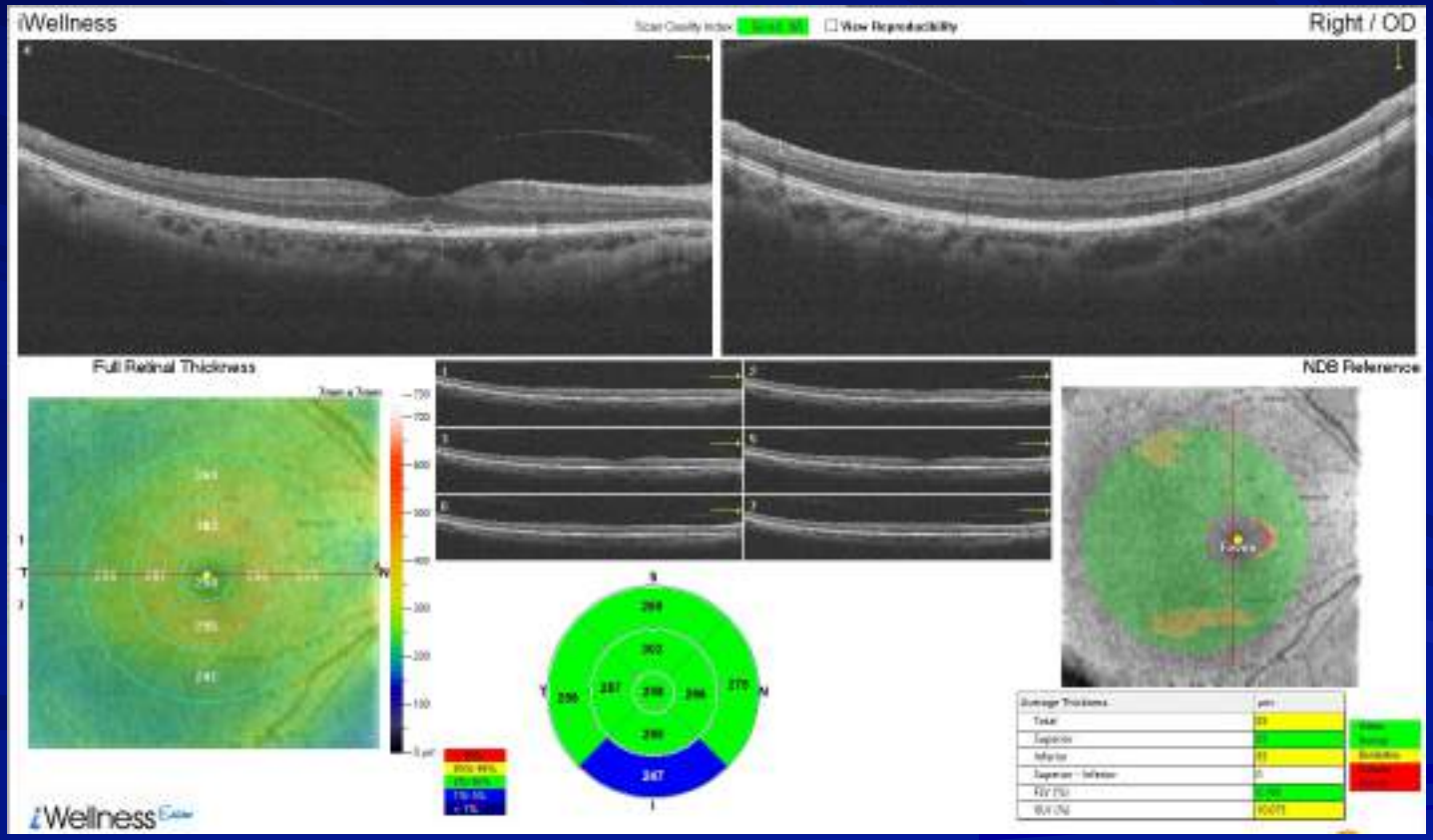
The new OCT-based anaton


Retina Map
Scan Quality Index Good 54
View Reproducibility
Right / OD
250µm
Auto Zoom
6mm x 6mm
311
355
T
N
359
367
306
750
700
600
500
400
300
200
100
0 µm
S
311
T
298
N
I
< 99%
95%-99%
5%-95%
1%-5%
< 1%
Thickness
Full Retinal
Inner Retinal
Outer Retinal
NDB Reference
Full Retinal
1
2
3
4
5
6
7

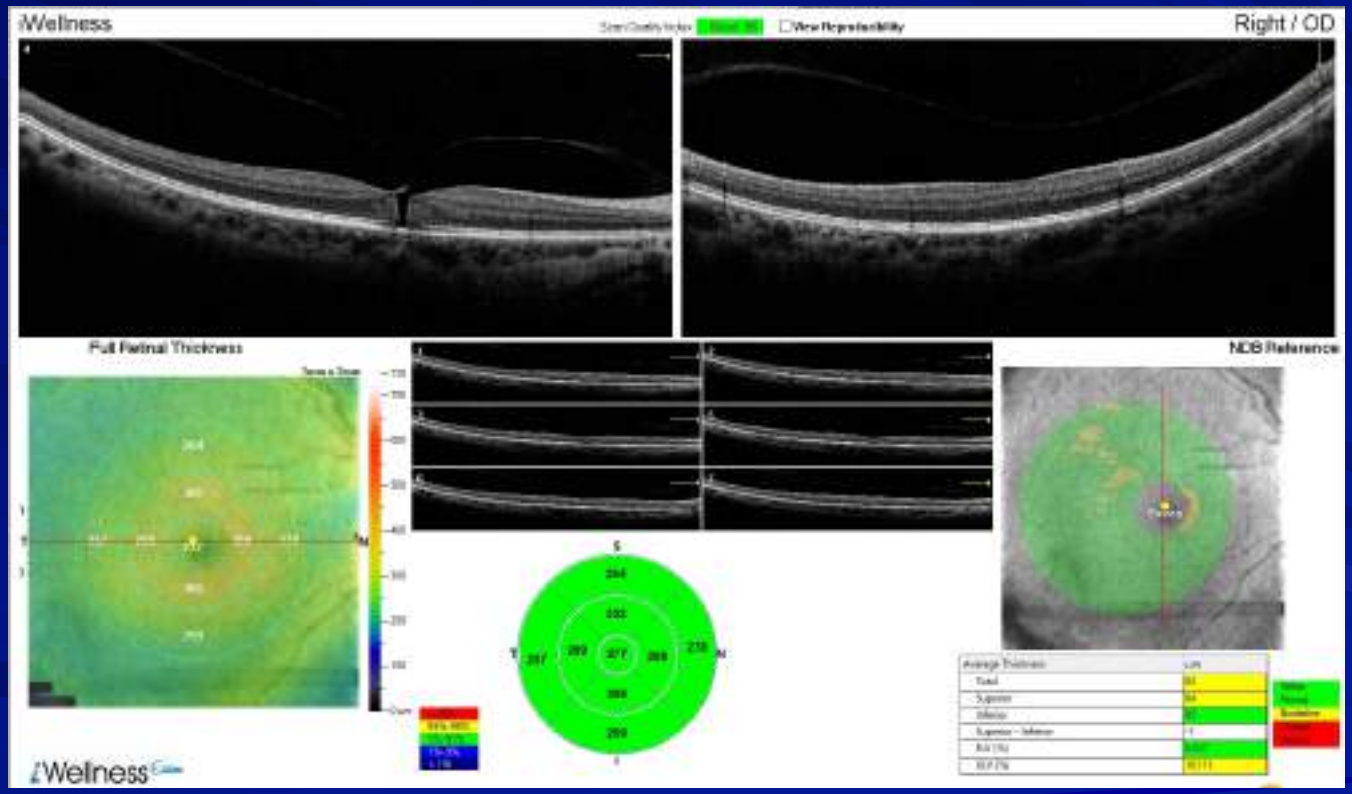

distorted foveal Pit
Erm
Retina Map
Right / OD
Early separation of outer + inner
retinal layers (lamellar hole)
macular pseudohole → Turning into lamellar hole

Let's See How We Are Doing

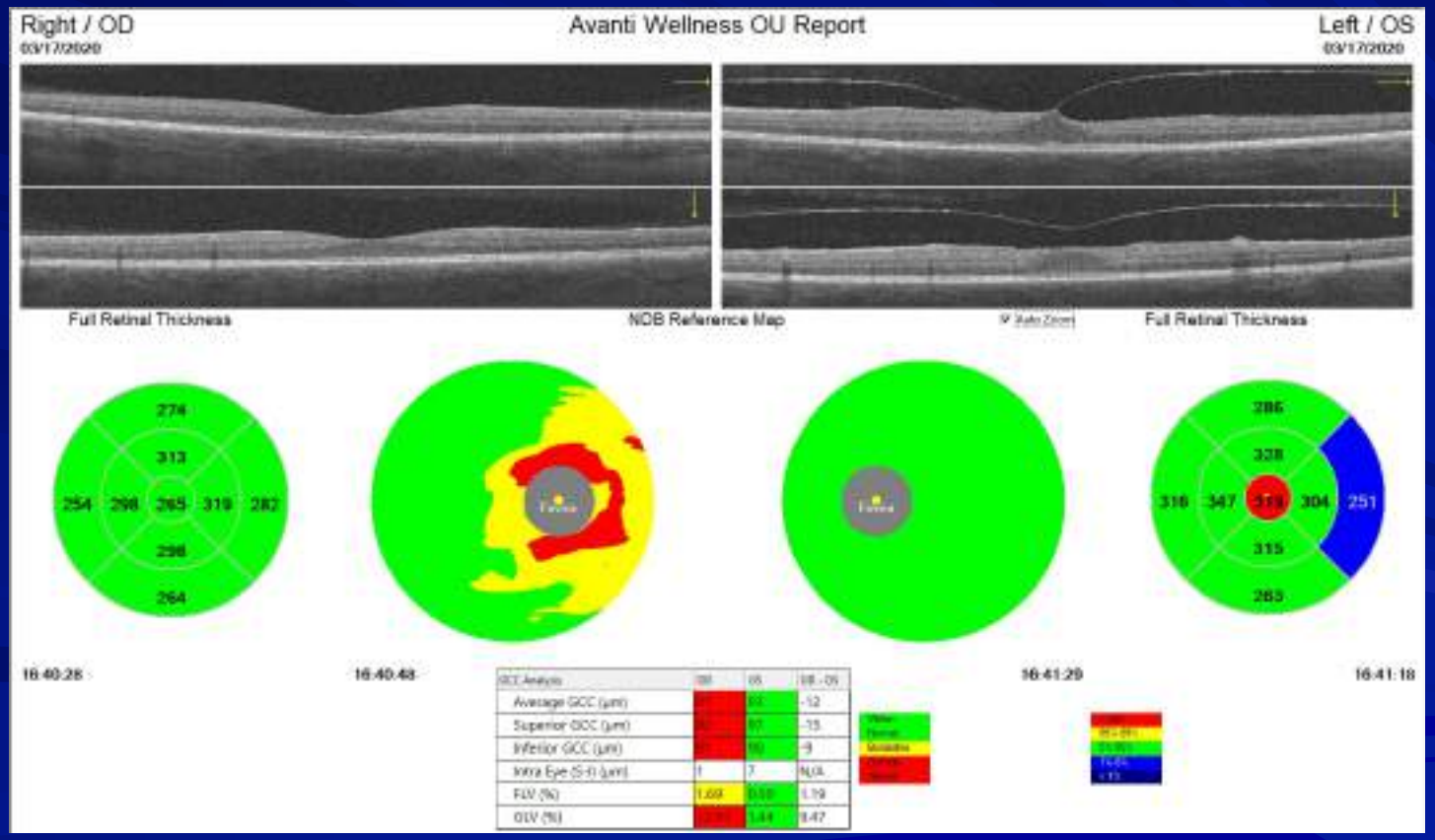
Diagnosis?


iWellness
Right / OD
Full Retinal Thickness
NDB Reference
iWellness

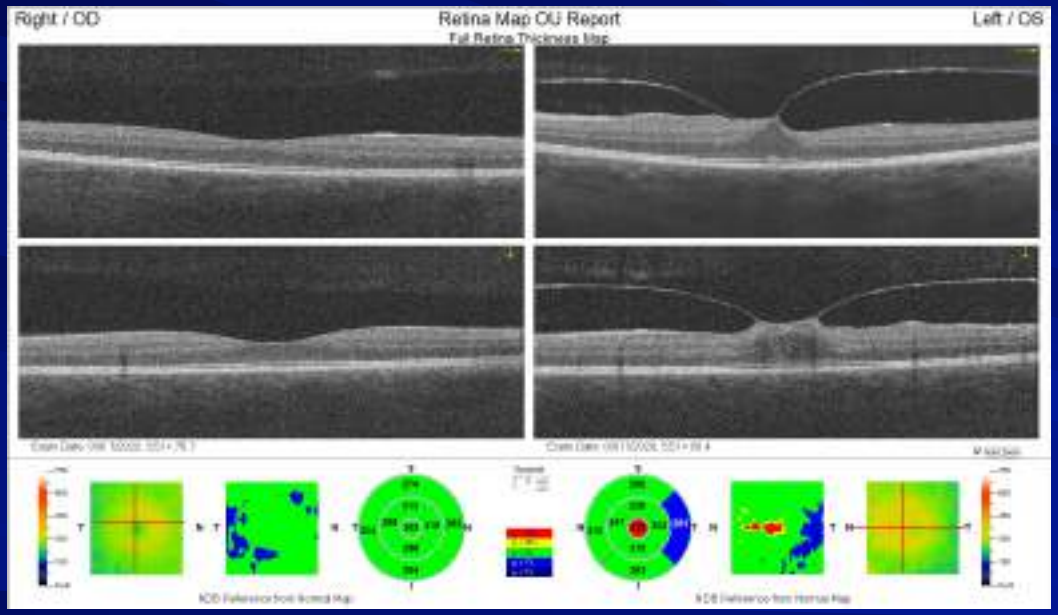
8 Weeks Later - Diagnosis?

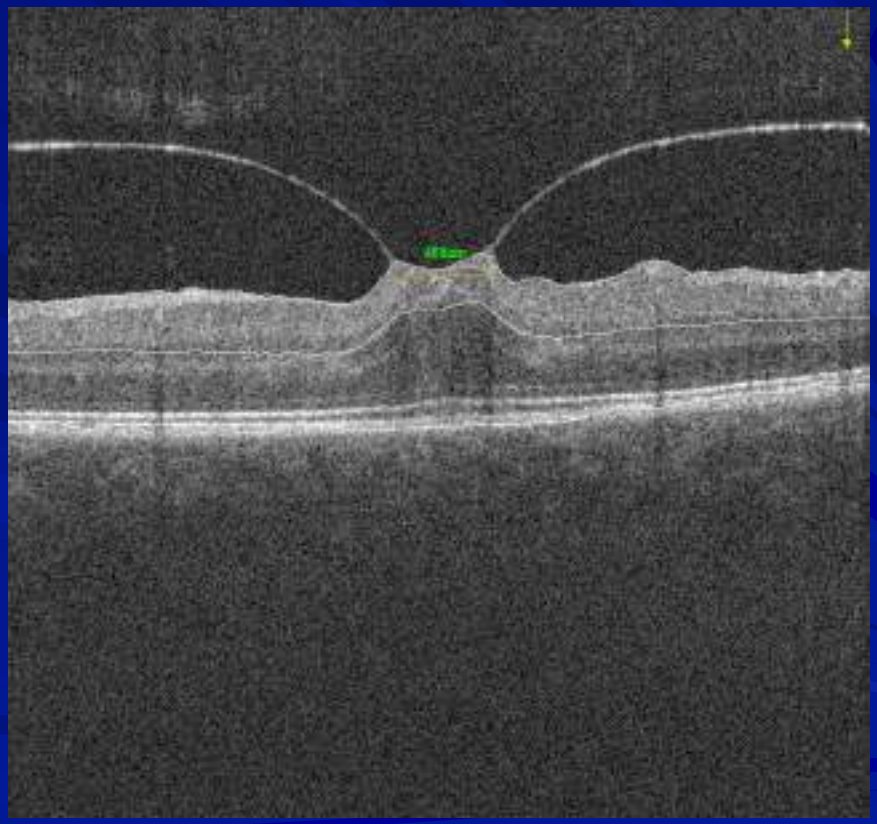


30-year-old woman - Diagnosis?
March 17, 2020

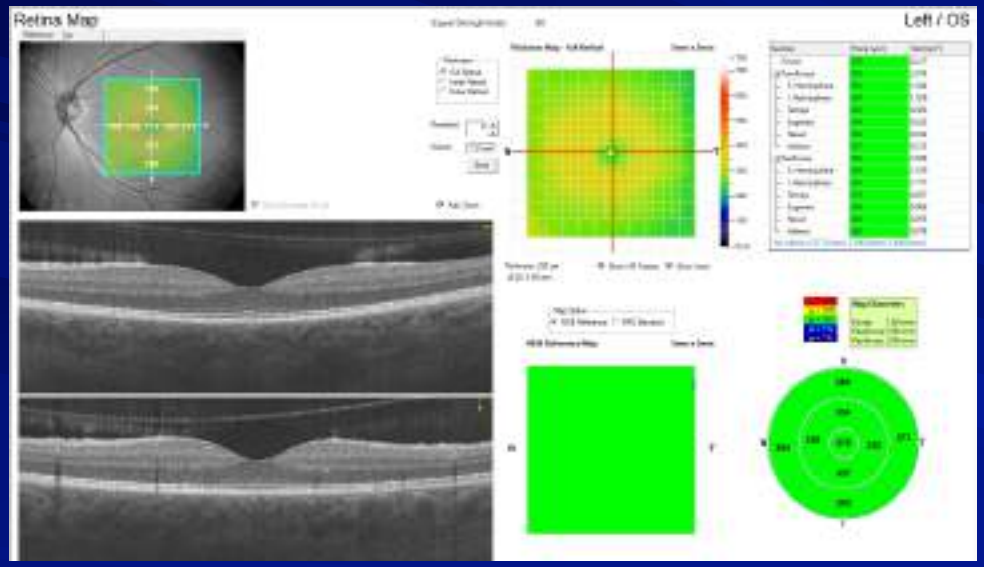


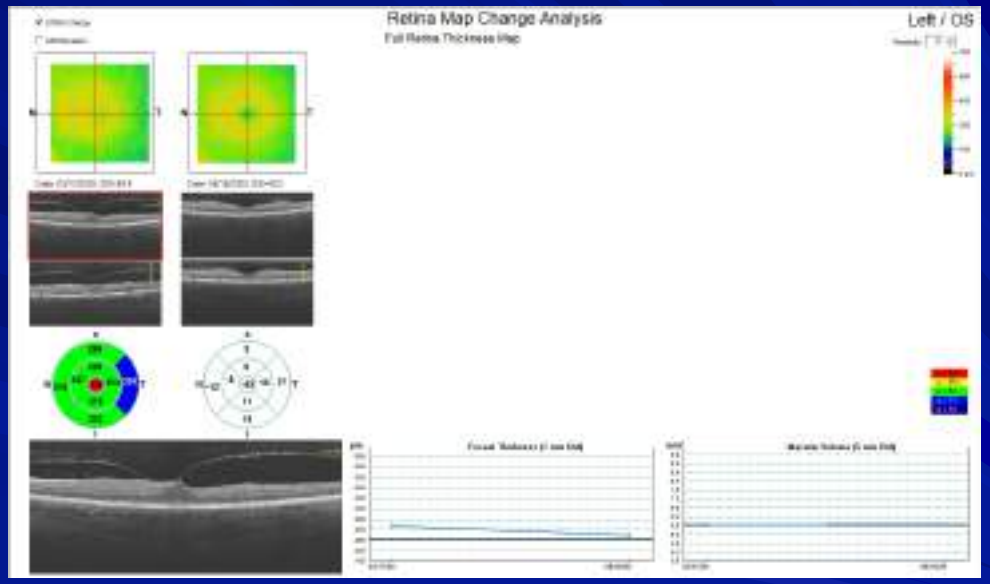
A Closer Look – Oh no!





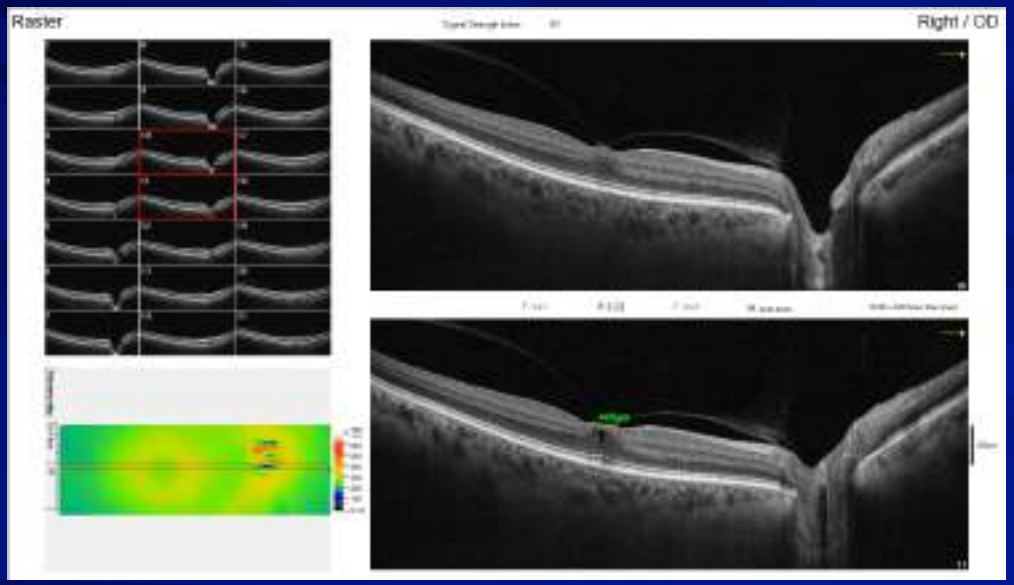
Phew – Lucky! June 16, 2020

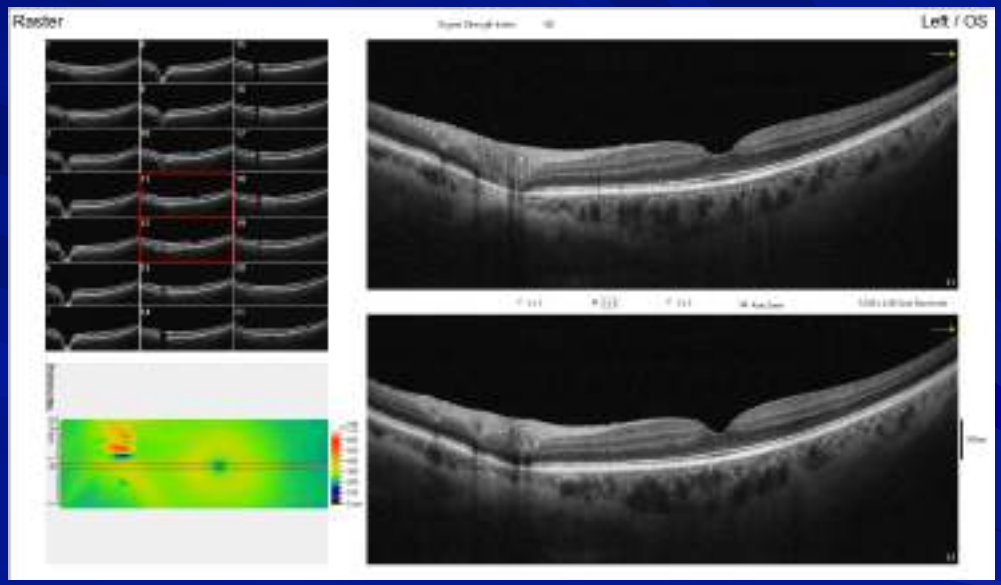




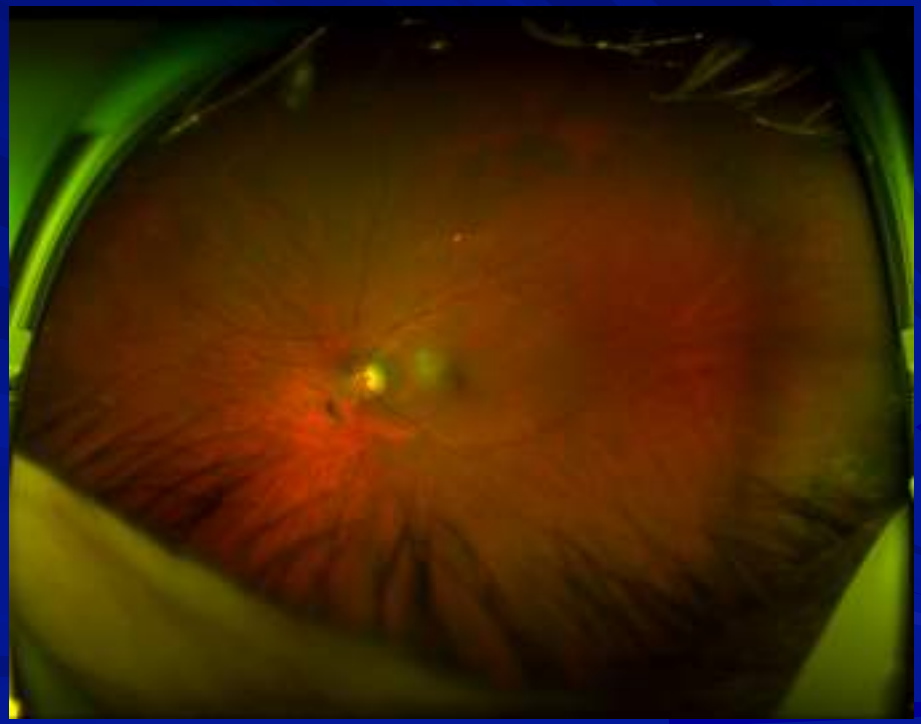
Next Case

February 15, 2020

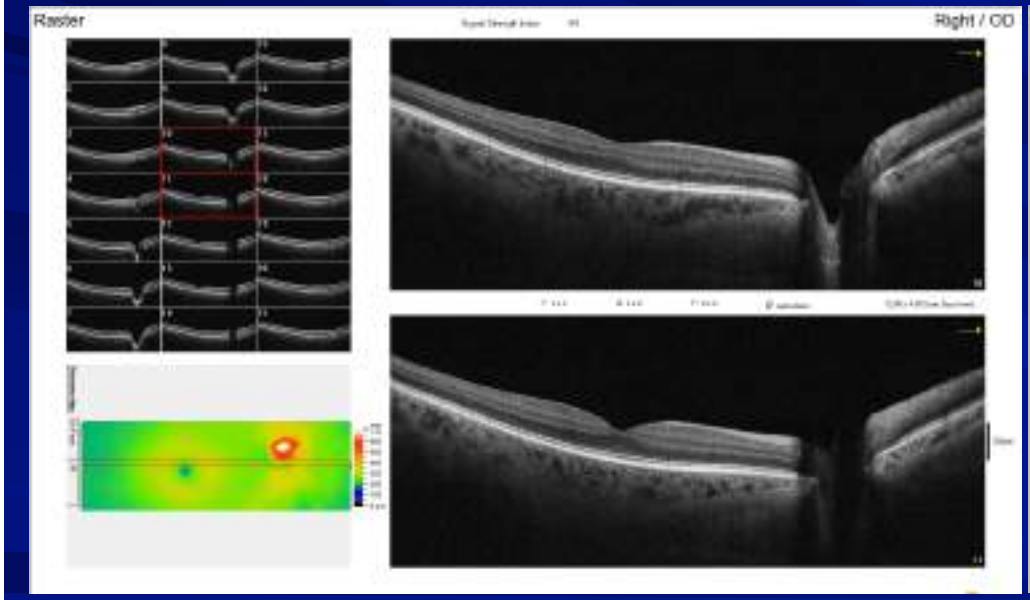


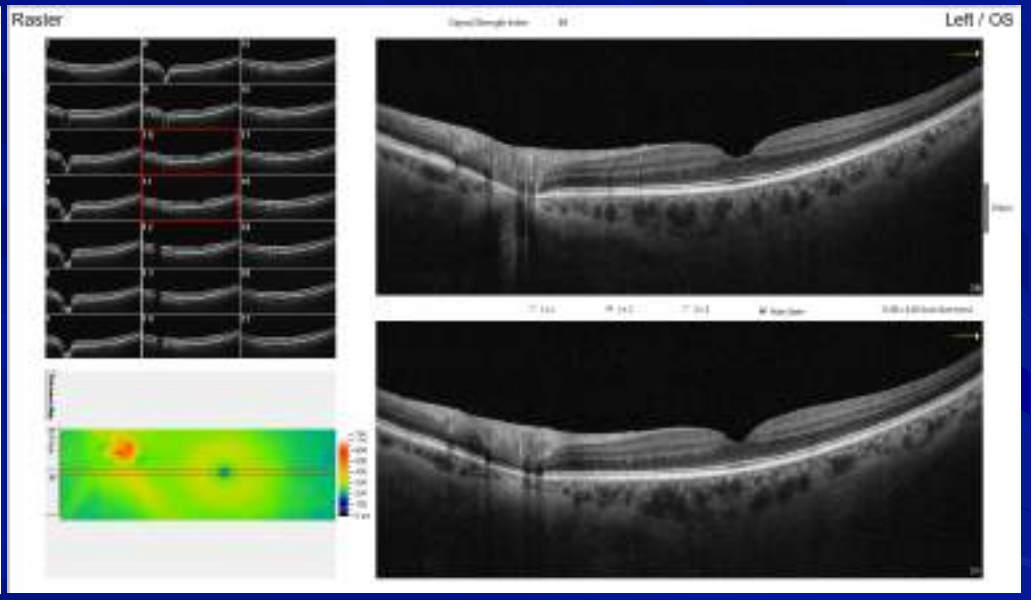


8-24-2020
Widefield Imaging

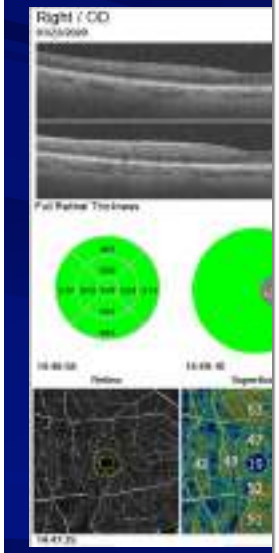


8-24-2020 Phew!

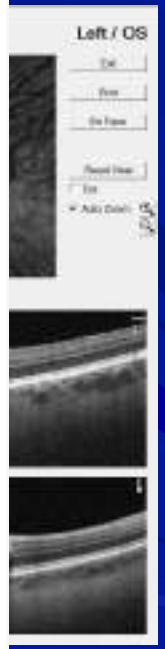




Diagnosis?


Right / OD

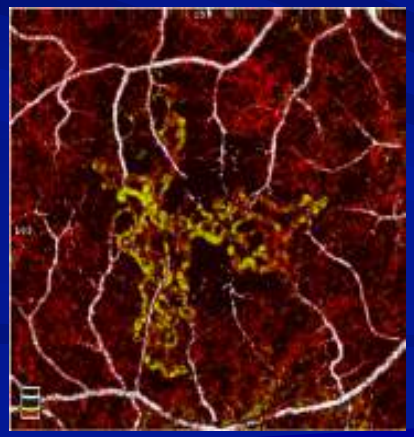

3D Widefield MCT
Signal Strength Index: 47
Left / OS
En Face
Overlay
Play
Rewind
Edit Bad
Auto Zoom


Left / OS

OCT Angiography
A New Approach to Protecting Vision

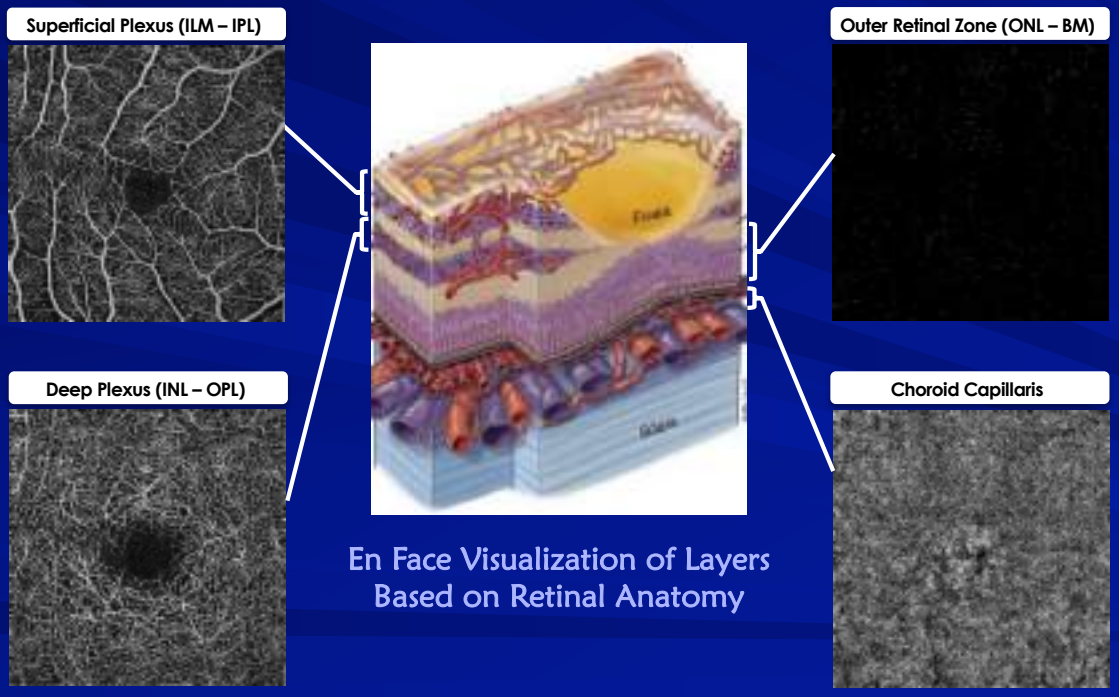
- Non-invasive visualization of individual layers of retinal vasculature
- Pathology not obscured by fluorescein staining or pooling
- Image acquisition requires less time than a dye-based procedure
- Reduced patient burden allows more frequent imaging to better follow disease progression and treatment response

FA of CNV



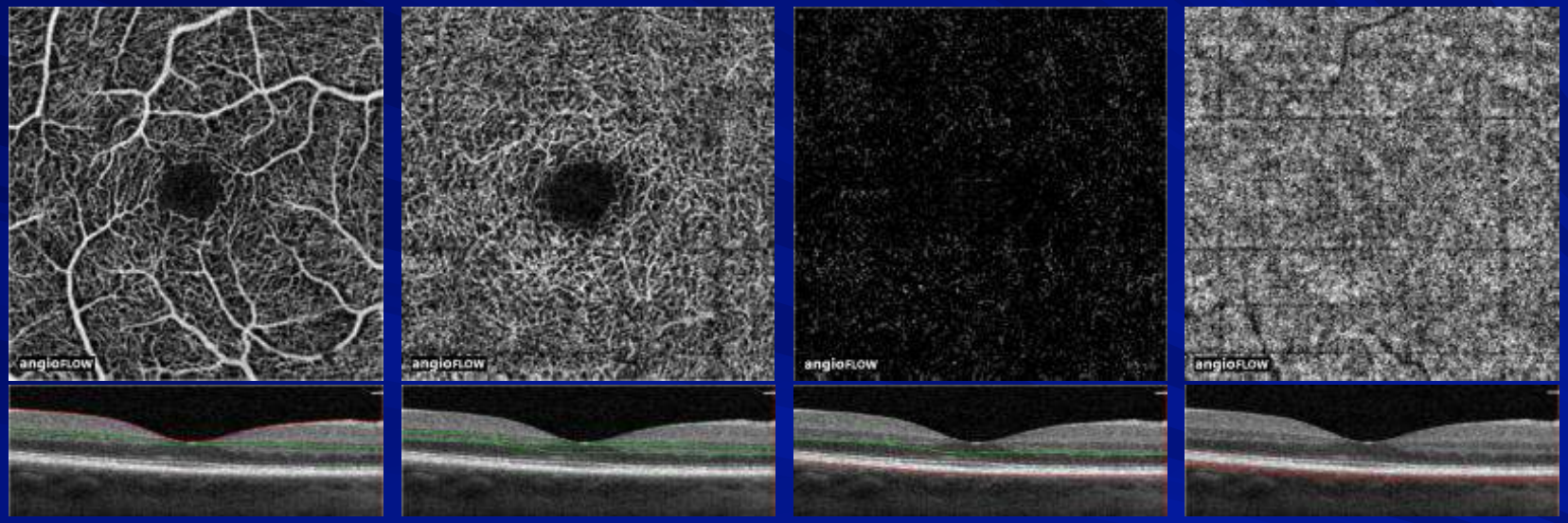
OCTA of CNV

Enface OCT-A Slabs Based on Retinal Anatomy



En Face Visualization of Layers Based on Retinal Anatomy

Normal Retinal Vasculature



Superficial Capillary Plexus

3μm Below ILM → 15 μm Below IPL

Deep Capillary Plexus

15μm Below ILM → 70 μm Below IPL

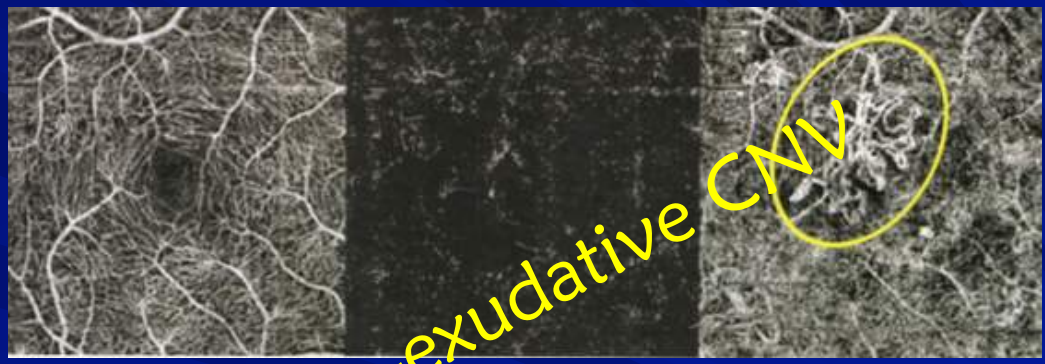
Outer Retina

70μm Below IPL → 30 μm Below RPE Reference

Choriocapillaris

30 μm Below RPE Reference → 60 μm Below RPE Reference

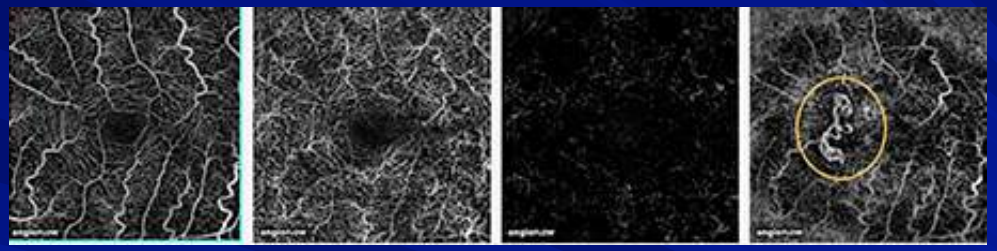
Type 1 "Occult" CNV

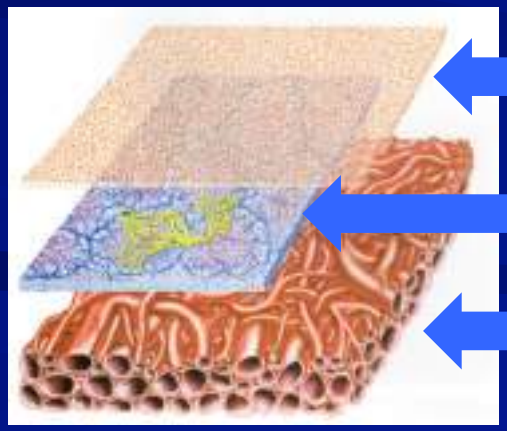


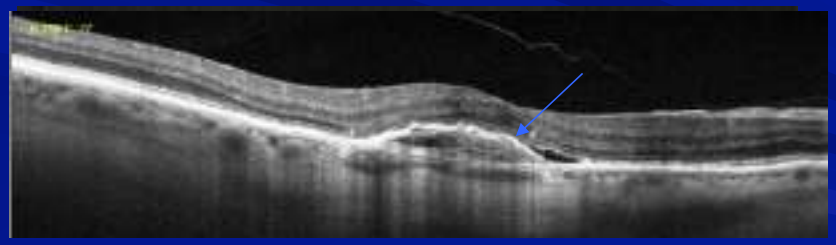
- New vessels develop in the choroid
- New vessels located below RPE and above Bruch's membrane

Type 1 "Occult" CNV

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

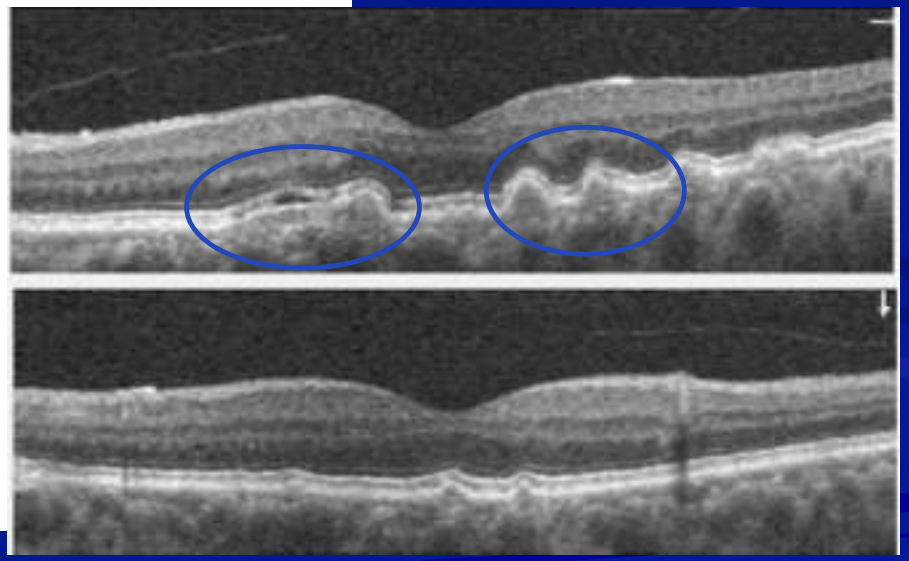




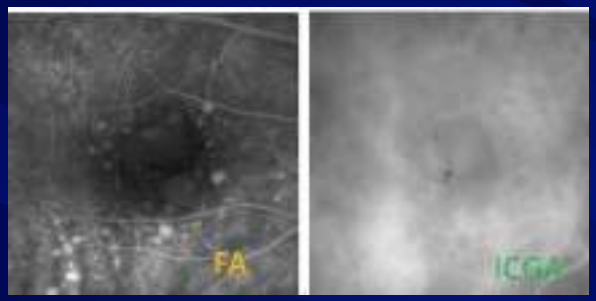


CNV?

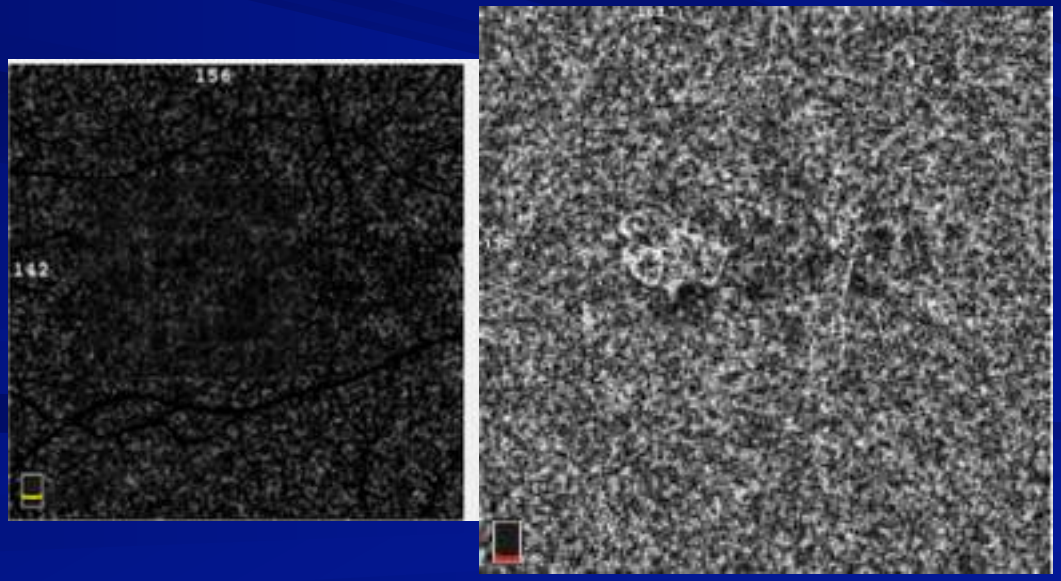
72 y/o Hispanic male
20/30
History of "Dry AMD"

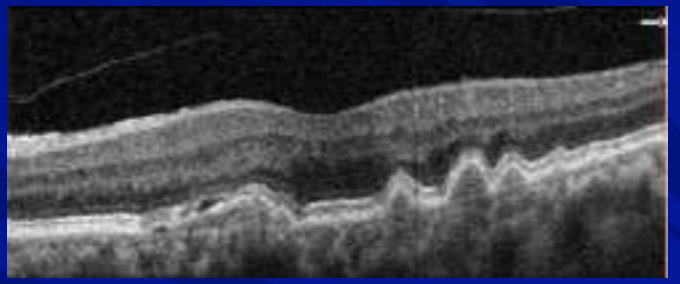


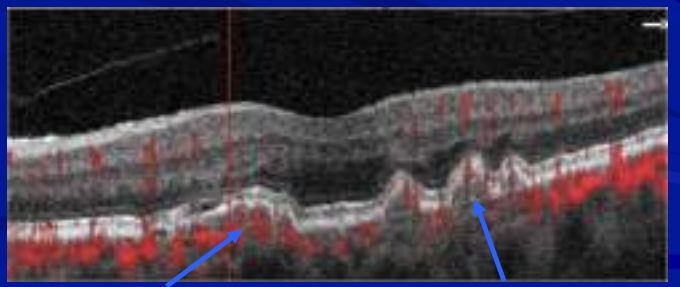
Multimodal imaging and OCTA



VAGUE???



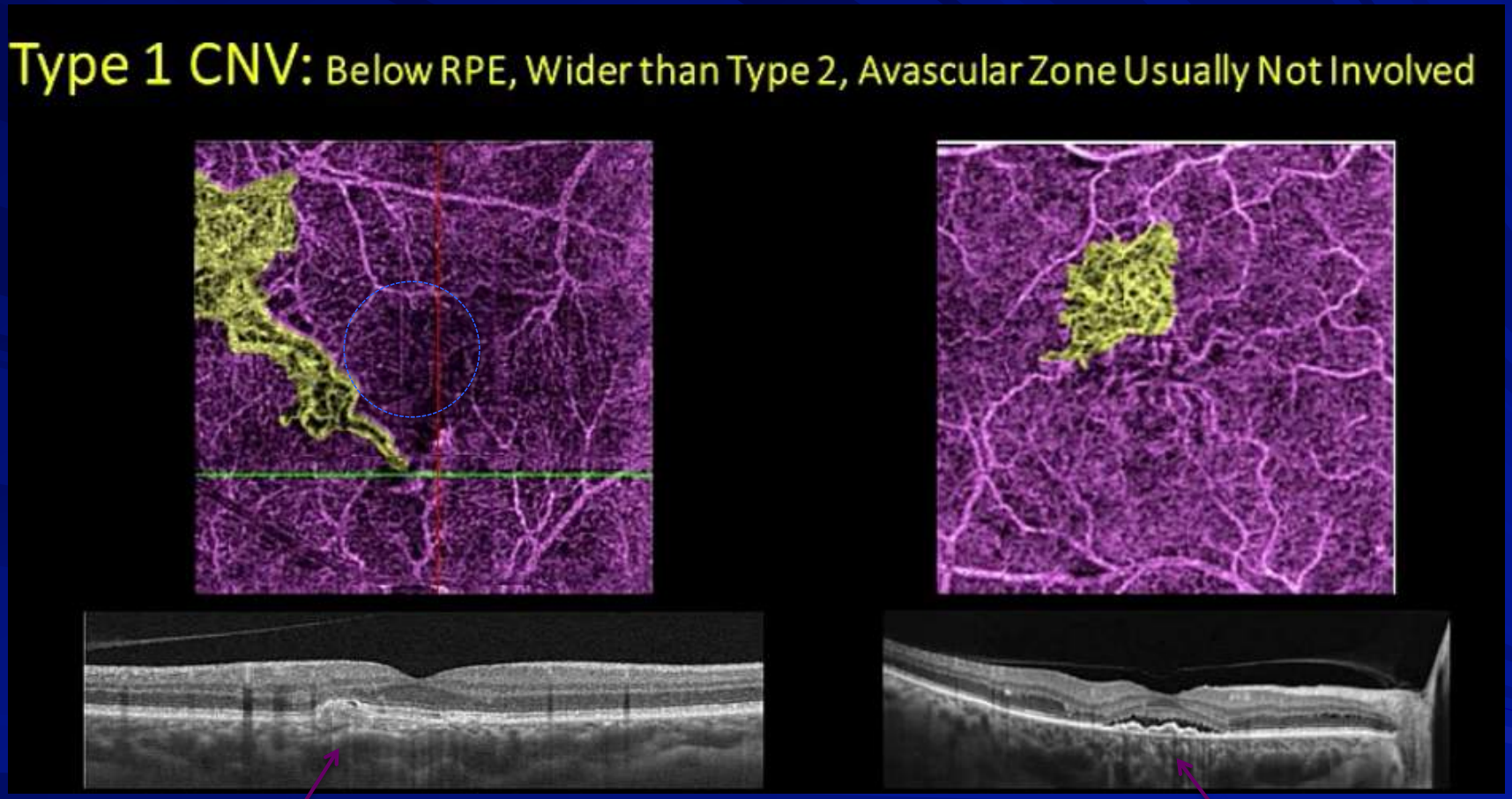




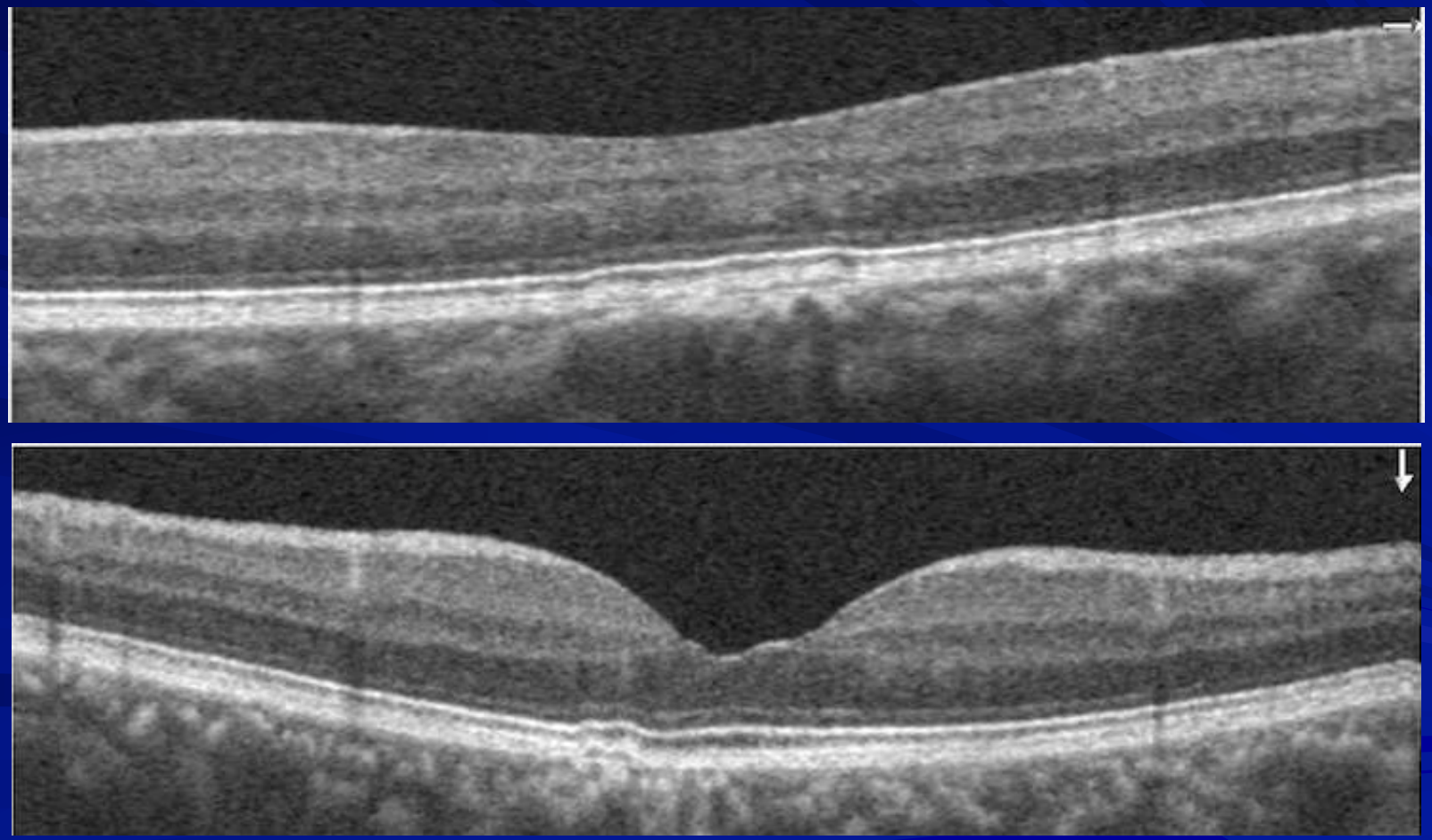
Vascularized

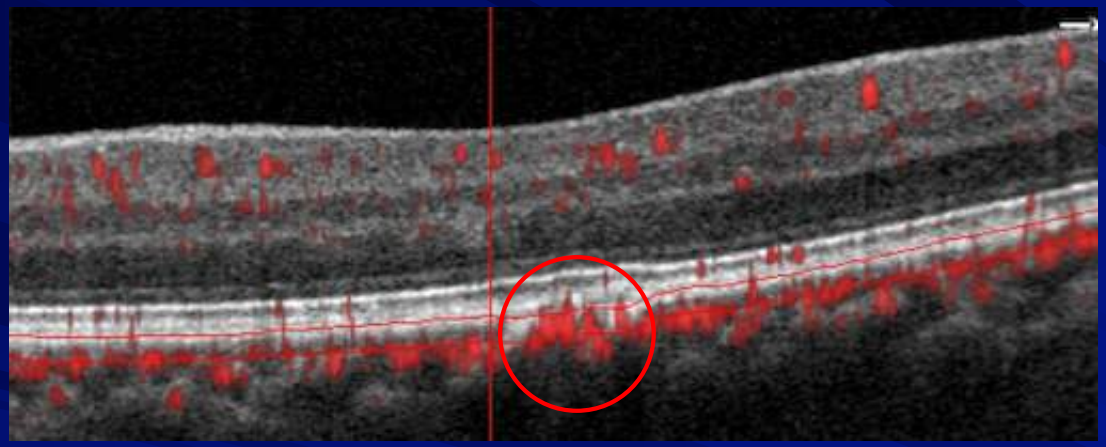
Non-vascularized

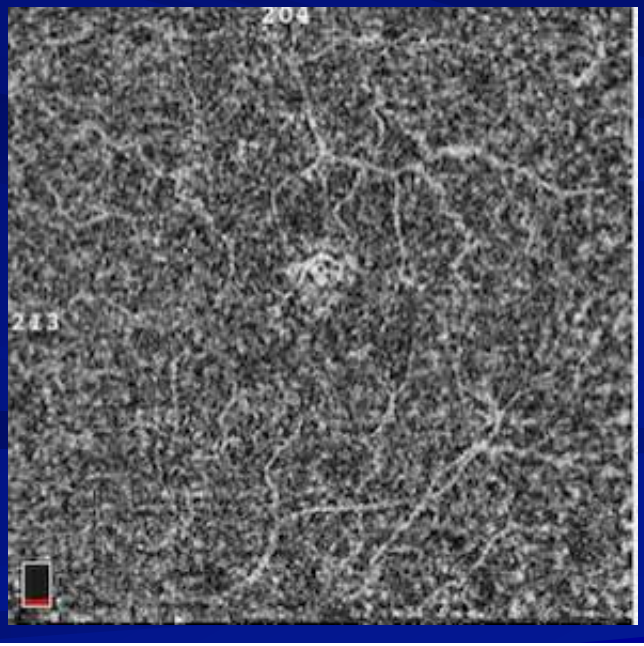
Type 1 CNV: Below RPE, Wider than Type 2, Avascular Zone Usually Not Involved



And the not so obvious ones…

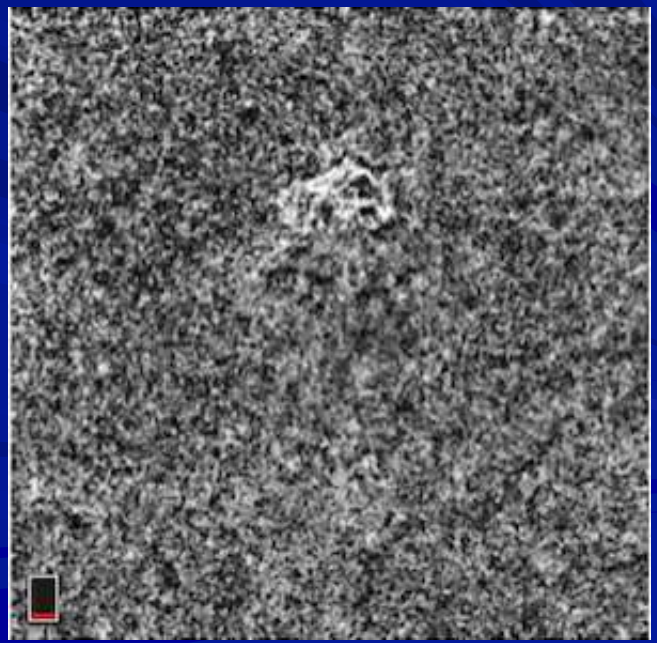




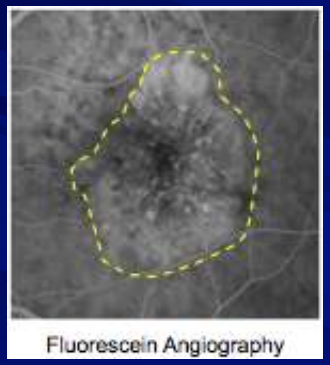


6x6

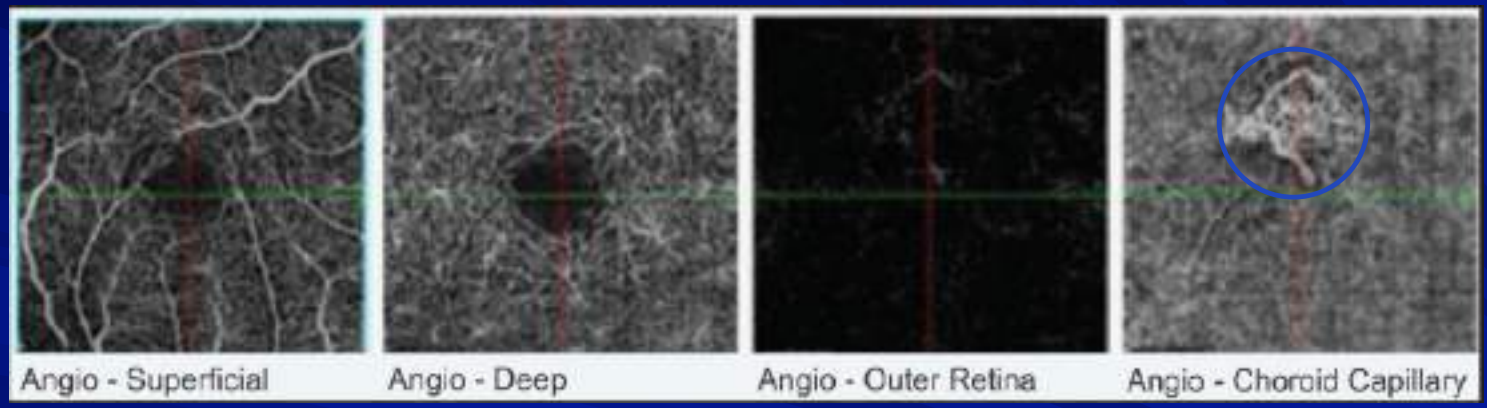
3x3

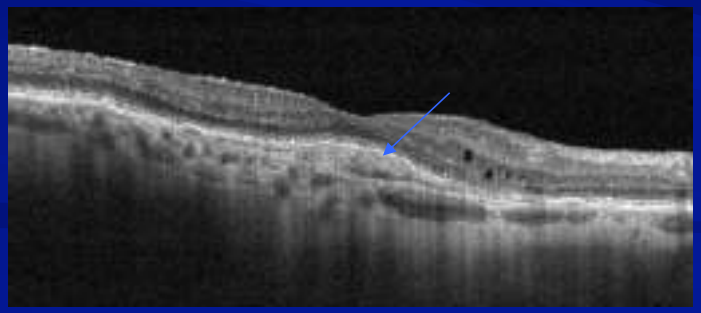


Case example: 70 y/o WM, AMD



Fluorescein Angiography



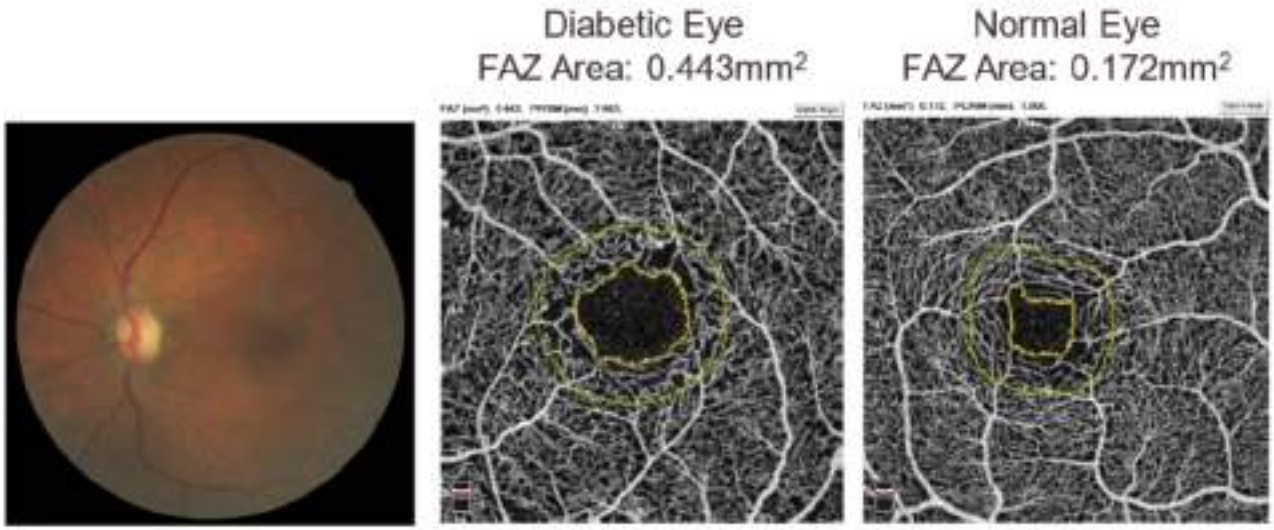


Below the RPE

Diabetes

Identify Early Vascular Changes in Diabetic Eyes

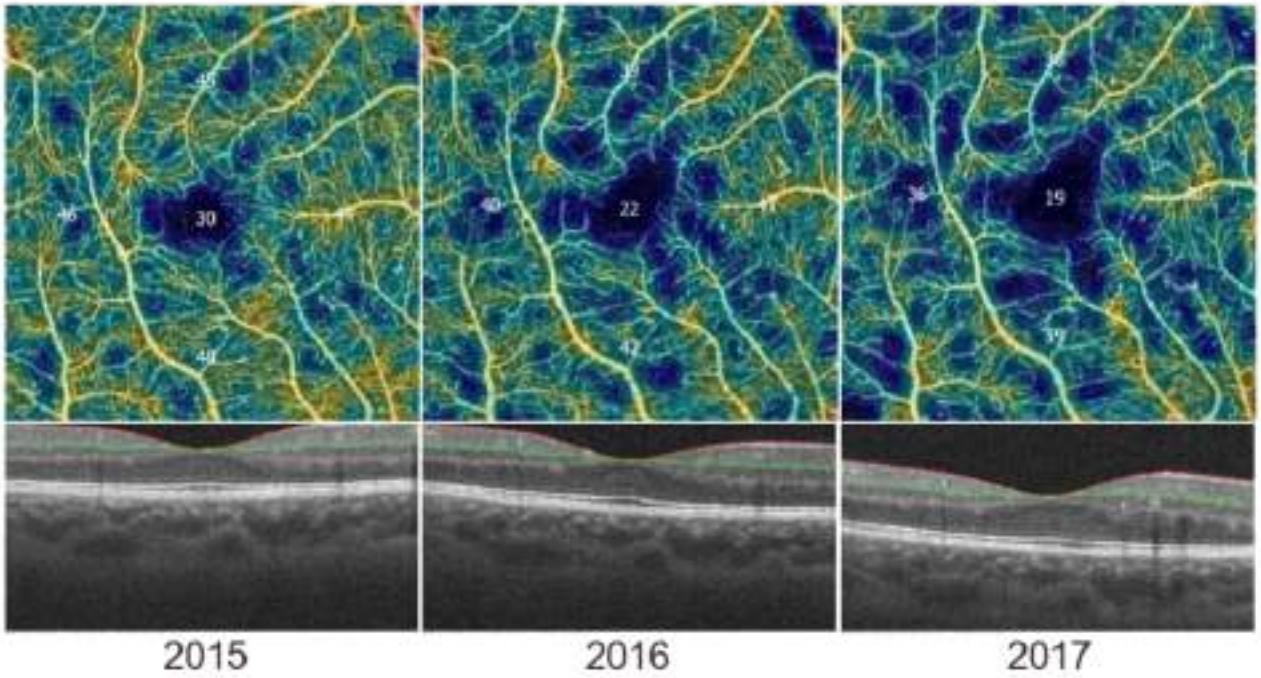
Patients with DM have a larger FAZ than healthy eyes.[3]



3. Di, G., Weihong, Y., Xiao, Z. et al. Graefes Arch Clin Exp Ophthalmology (2016) 254: 873. https://doi.org/10.1007/s00417-015-3143-7
Images courtesy of Julie Rodman, OD, FAAO

Assess Disease Progression with Multiscan View

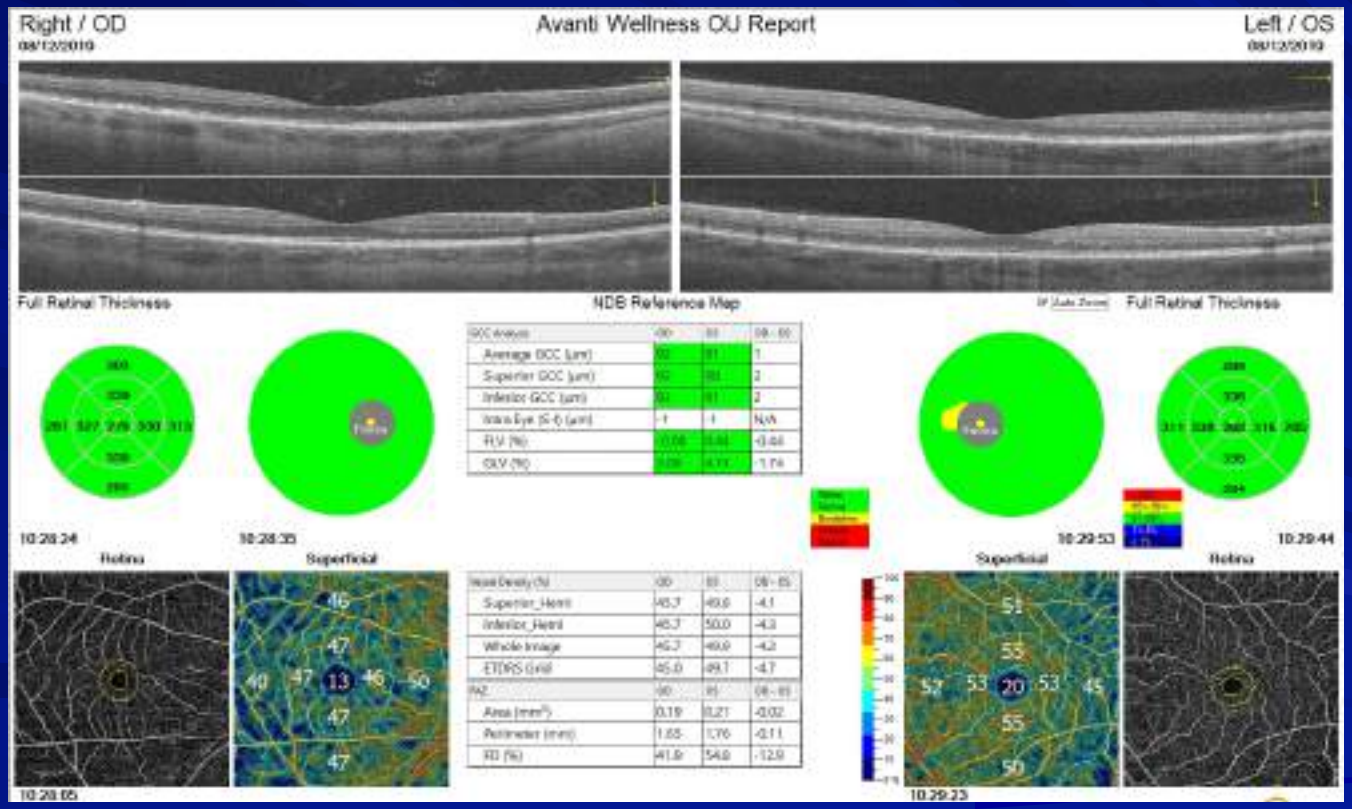
Vessel Density Decreases Significantly with Disease Severity[4]



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

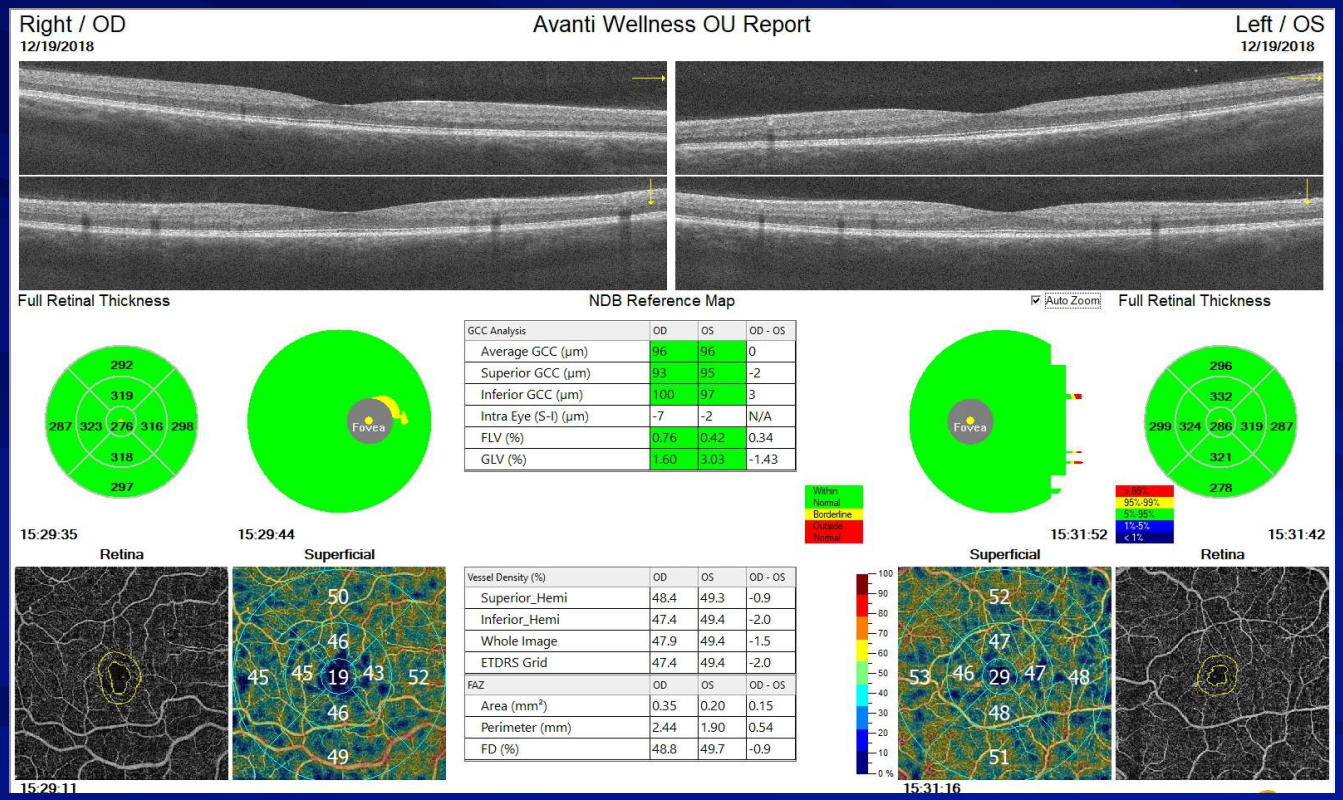
AngioWellness Report

Comprehensive Eye Exam - Healthy



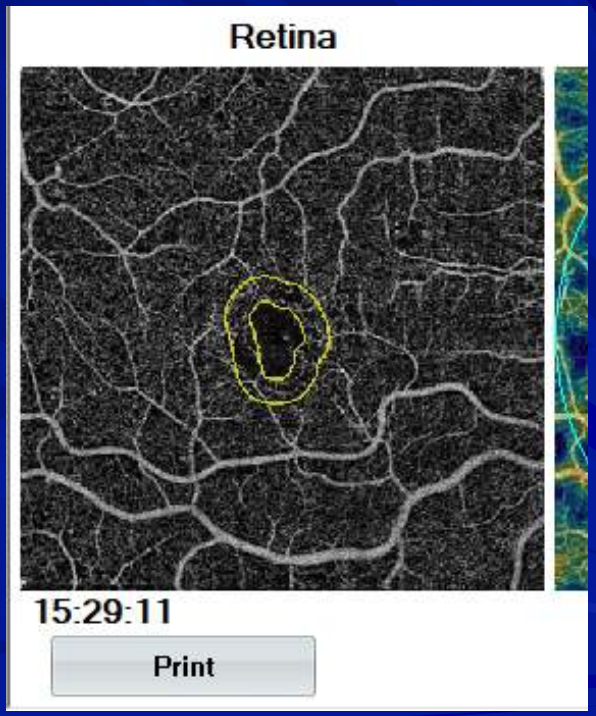
AngioWellness Report

Patient 1 with Diabetes



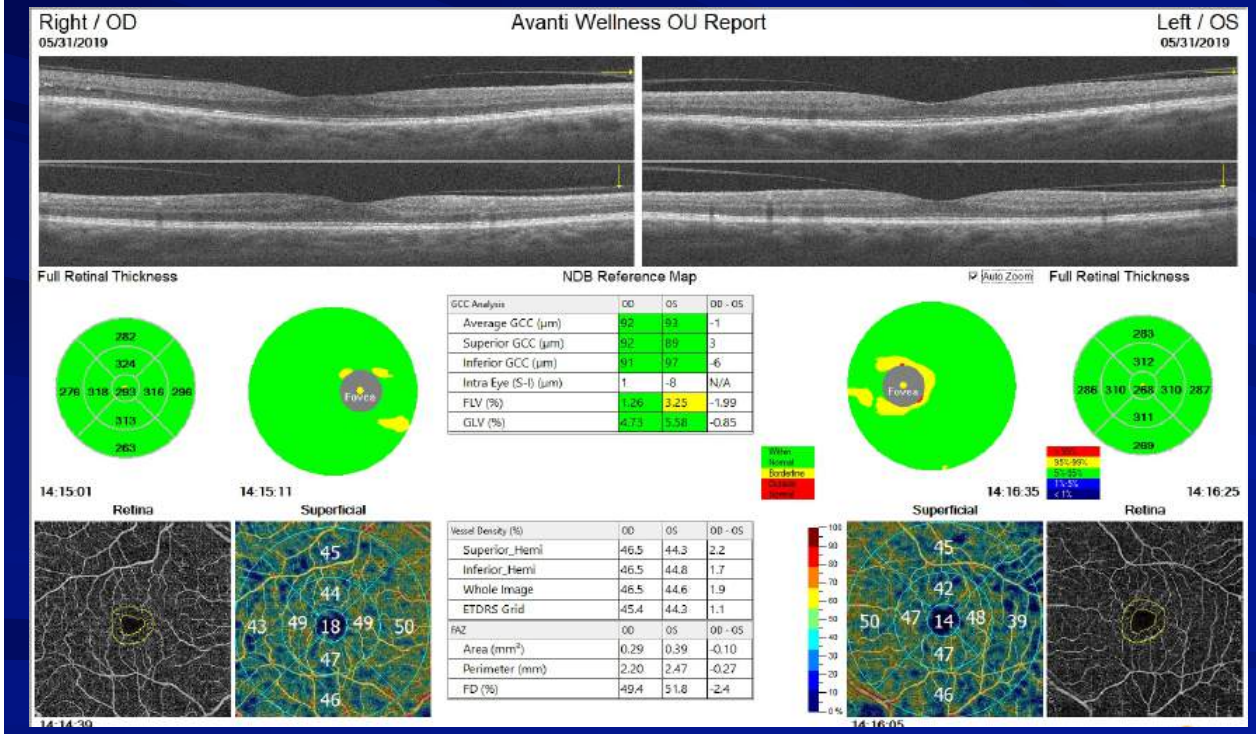
GCC Analysis	OD	OS	OD - OS
Average GCC (µm)	96	96	0
Superior GCC (µm)	93	95	-2
Inferior GCC (µm)	100	97	3
Intra Eye (S-I) (µm)	-7	-2	N/A
FLV (%)	0.76	0.42	0.34
GLV (%)	1.60	3.03	-1.43

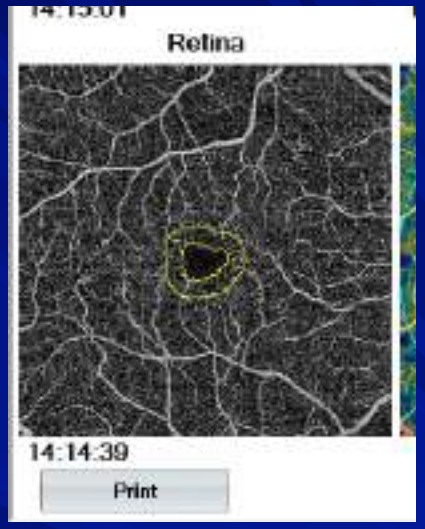
Vessel Density (%)	OD	OS	OD - OS
Superior_Hemi	48.4	49.3	-0.9
Inferior_Hemi	47.4	49.4	-2.0
Whole Image	47.9	49.4	-1.5
ETDRS Grid	47.4	49.4	-2.0
FAZ	OD	OS	OD - OS
Area (mm²)	0.35	0.20	0.15
Perimeter (mm)	2.44	1.90	0.54
FD (%)	48.8	49.7	-0.9

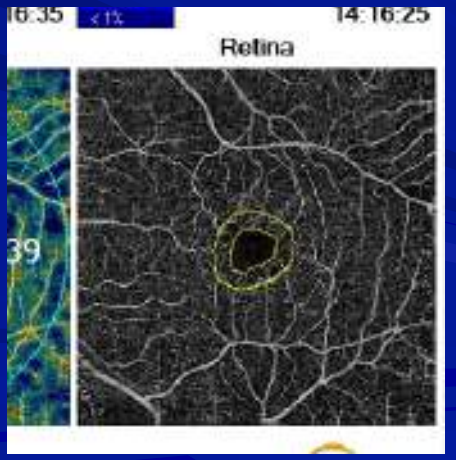


AngioWellness Report

Patient 2 with Diabetes

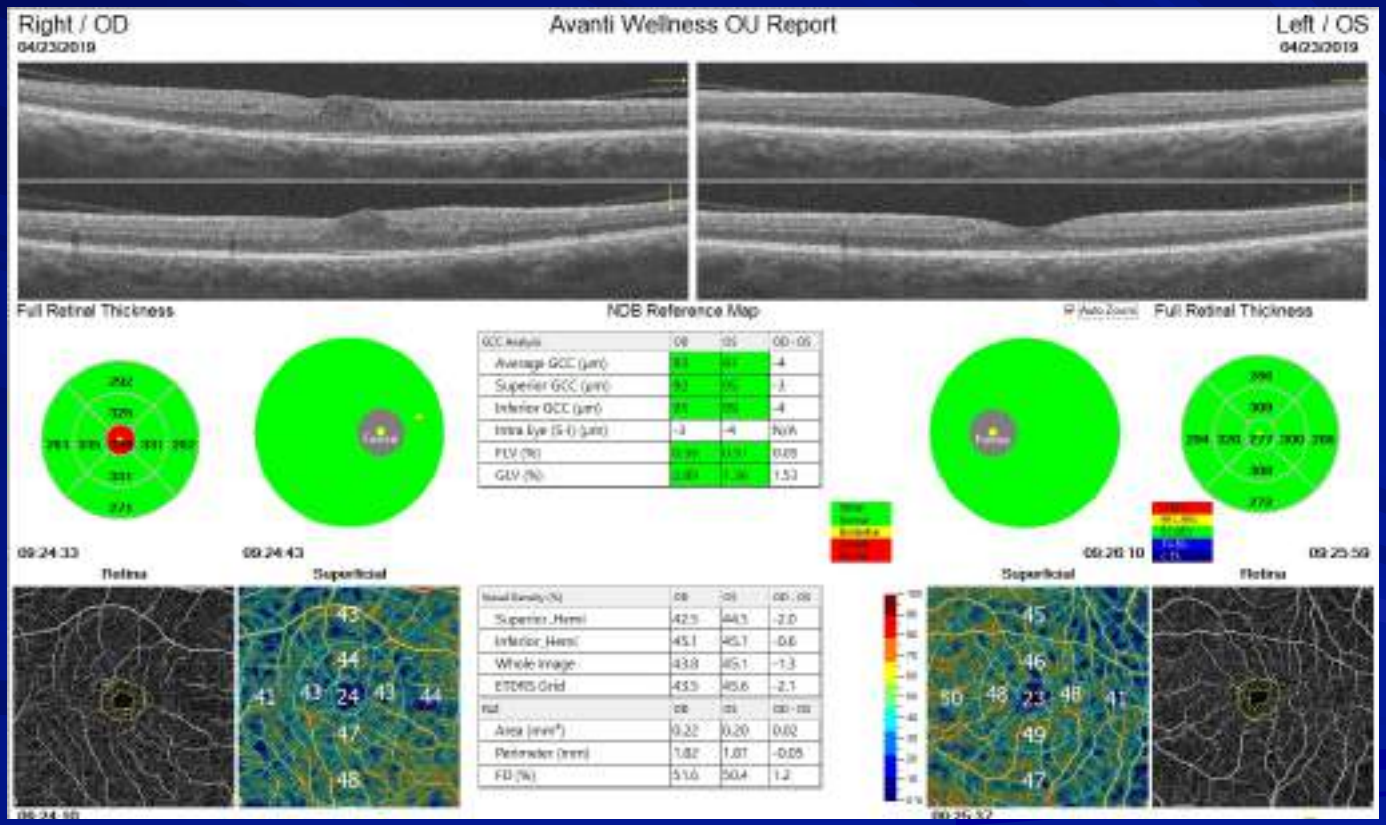






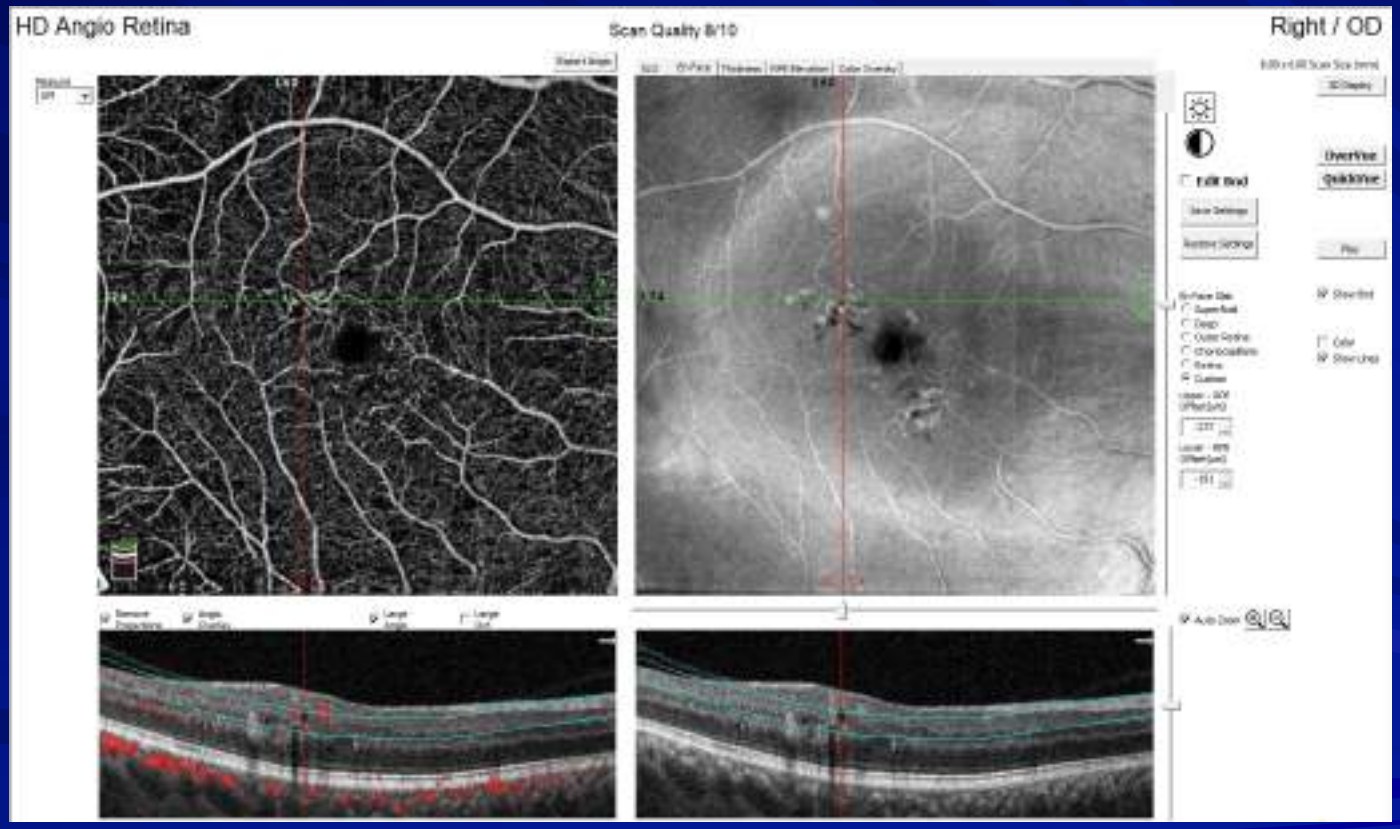
AngioWellness Report

Patient 3 with Diabetes



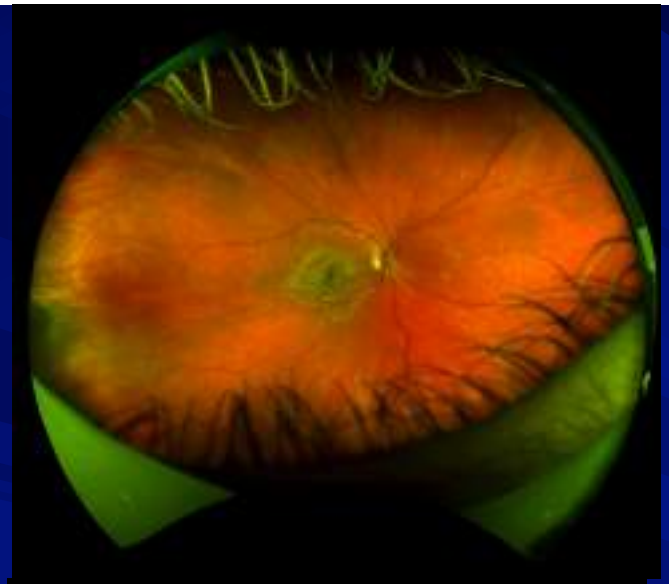
AngioWellness Report

Patient 3 with Diabetes

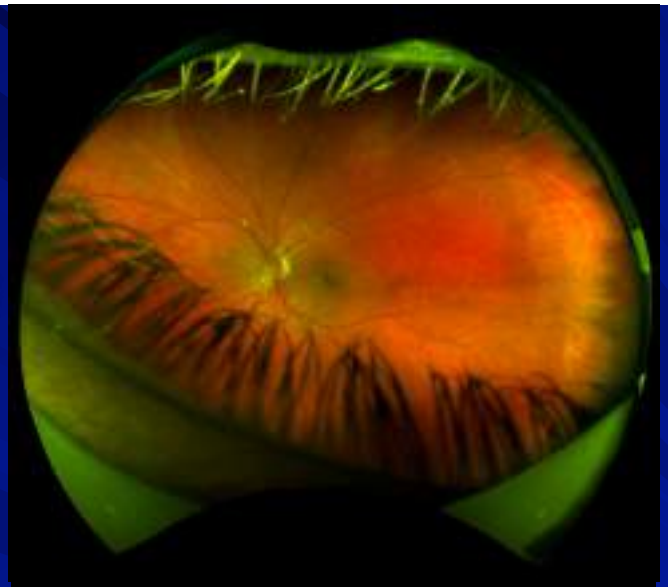


29 year old man with diabetes

- Yearly diabetic exam, reports no changes to vision
  - Type 1 DM
- BS: 190 this AM, last HbA1c 8.6
- Vision 20/20
- Anterior segment: normal
- Posterior segment:
  - Non-proliferative DR
    - Hemes and exudates
  - No CSME
- Billed for:
  - Exam- 99214
  - Optomap, OCT-Wellness, and OCT-A (Angiography)



10-31-2017

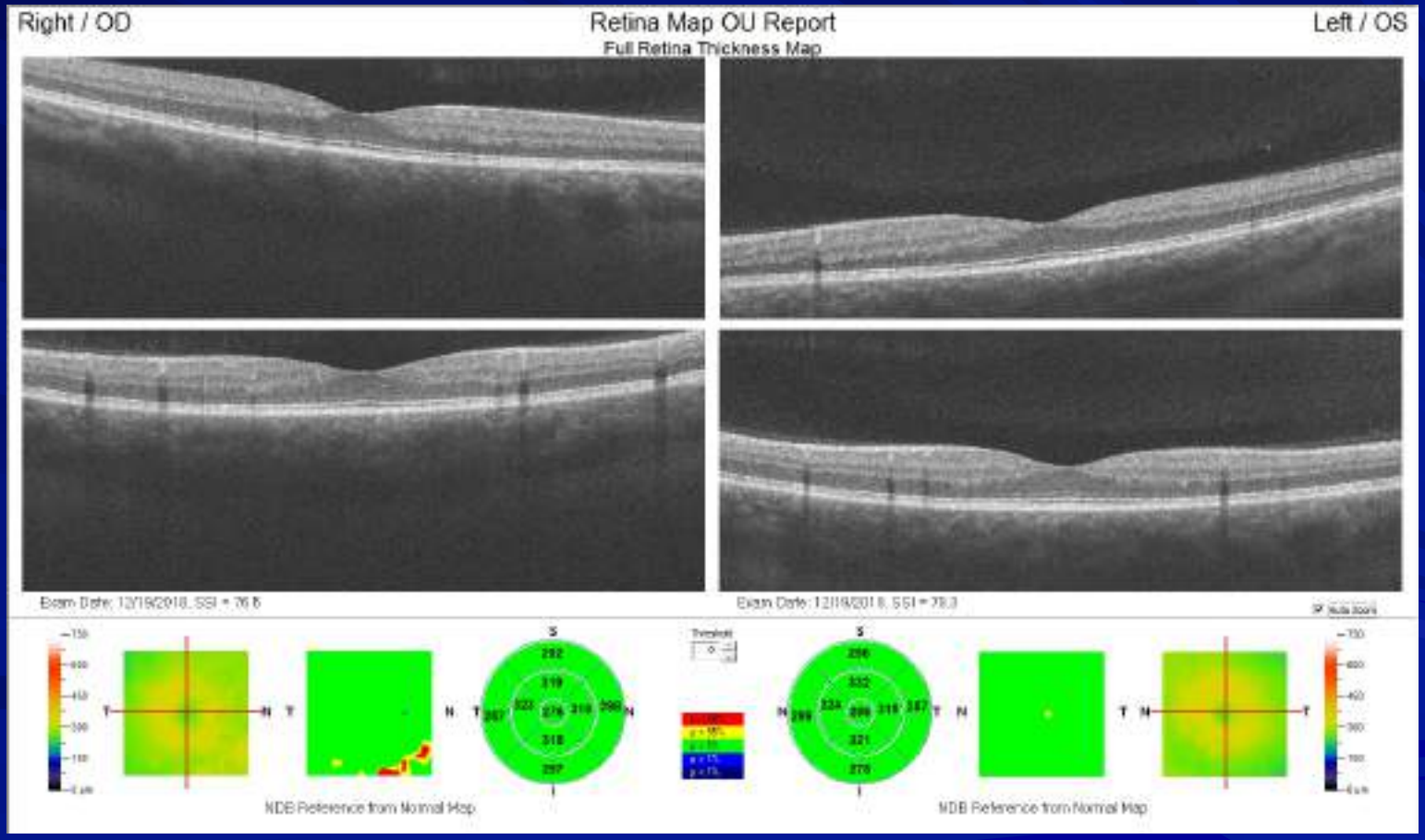


12-19-2018

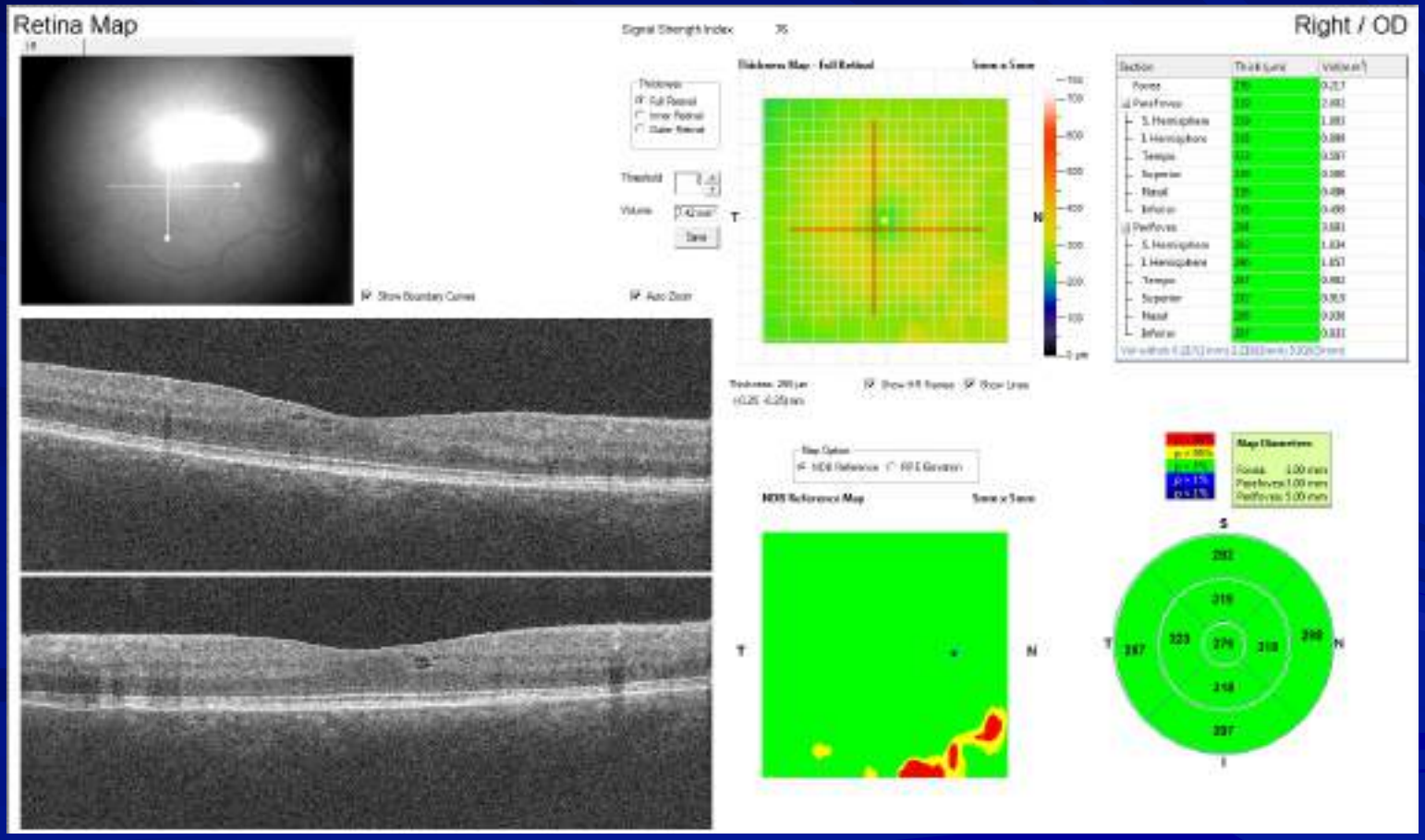

12-19-2018


12-19-2018

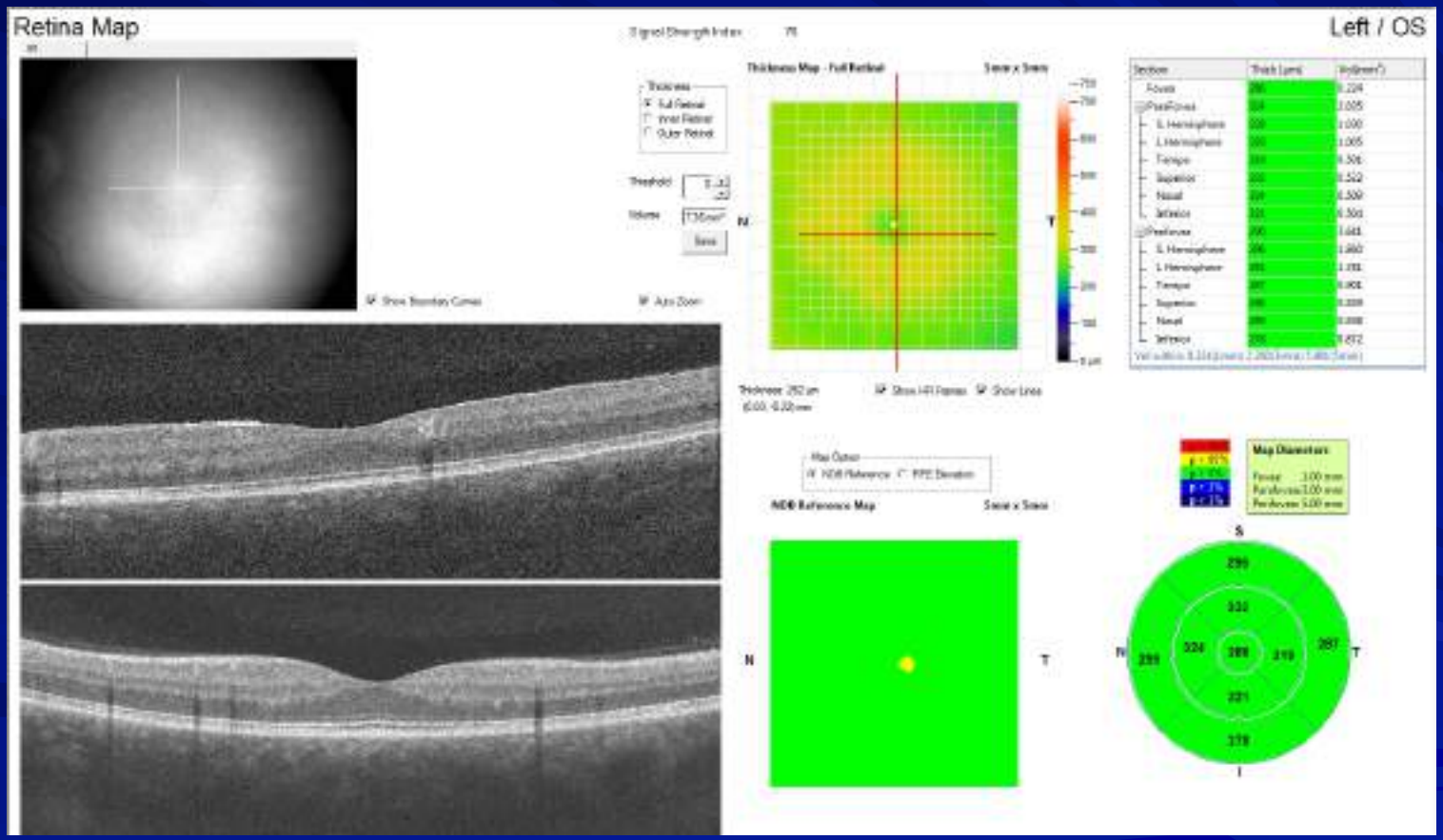
12-19-18


Right / OD
Retina Map OU Report
Full Retina Thickness Map
Left / OS
NDB Reference from Normal Map
NDB Reference from Normal Map

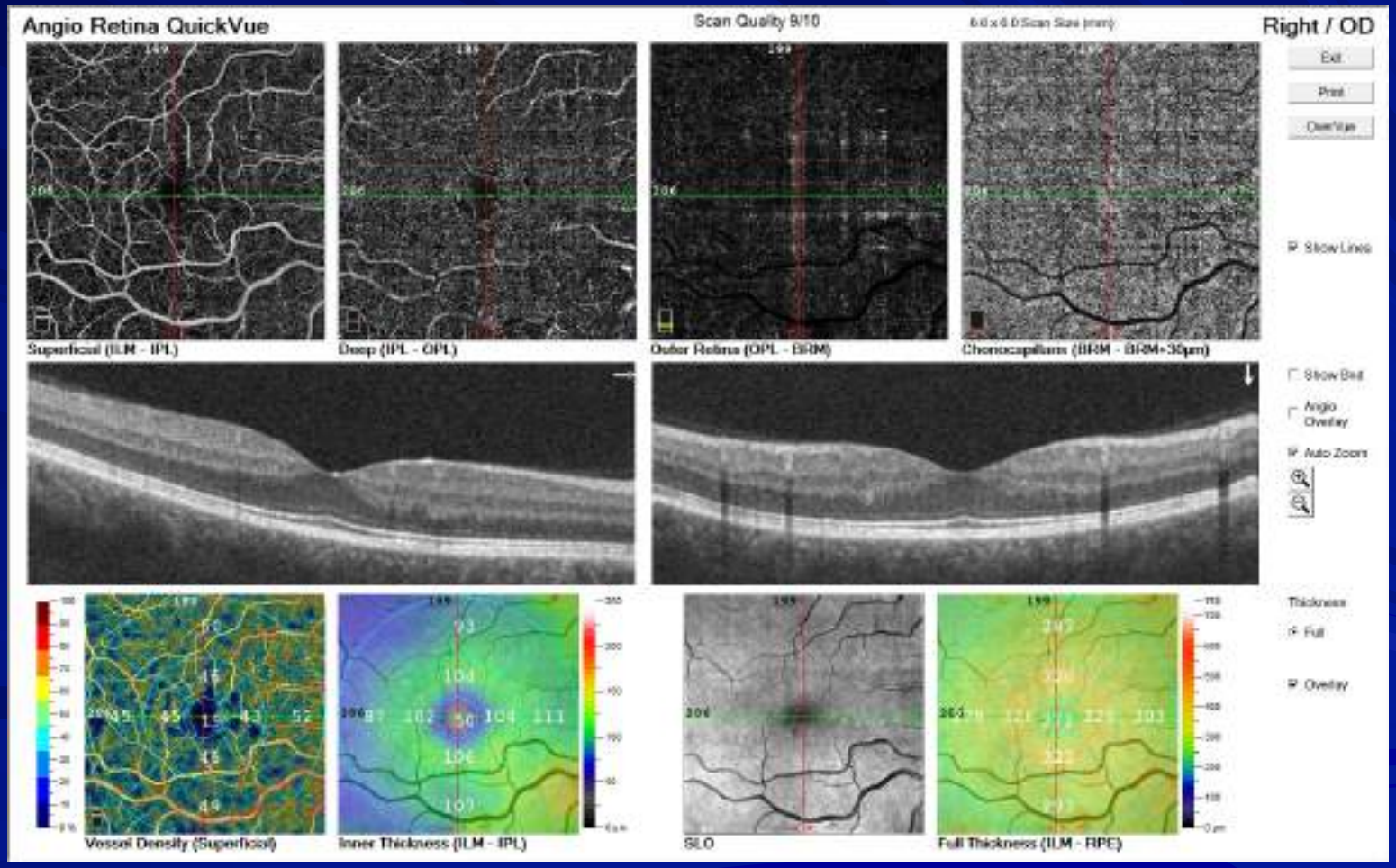
12-19-18 what do you see?



12-19-18 what do you see?



12-19-2018


Angio Retina QuickVue
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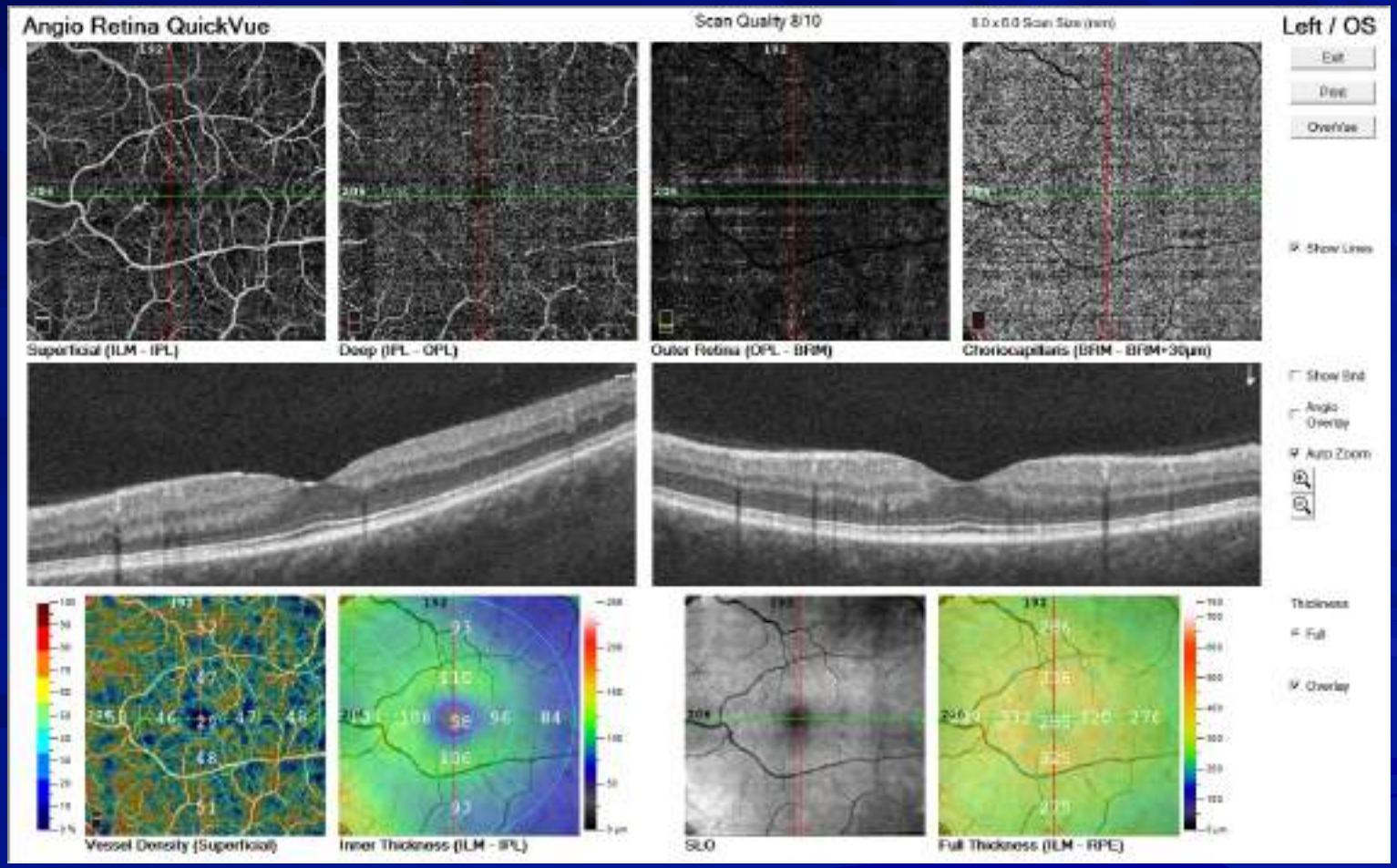
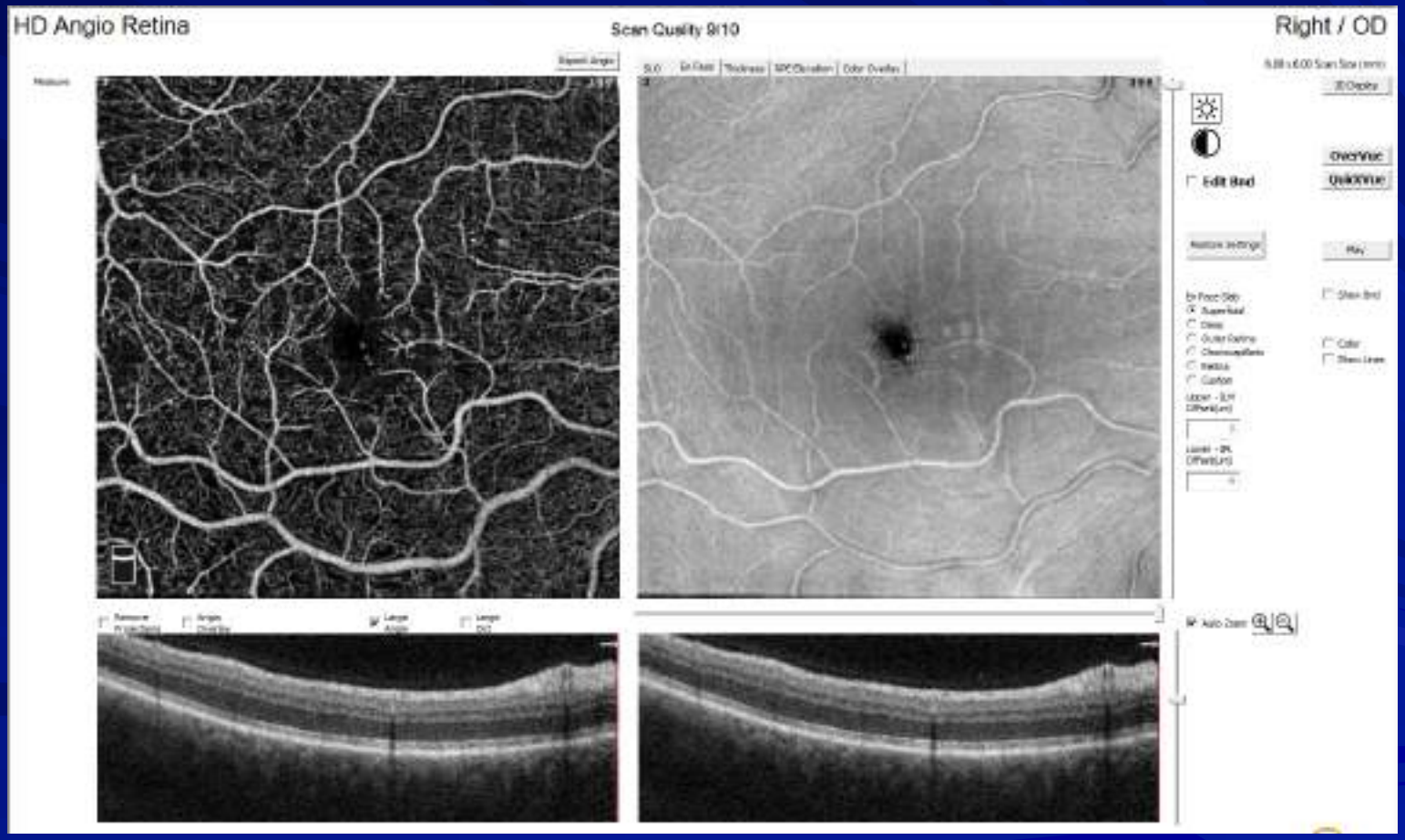
Right / OD
Exit
Print
Show Lines
Superficial (ILM - IPL)
Deep (IPL - OPL)
Outer Retina (OPL - BRM)
Choriocapillaris (BRM - BRM+30µm)
Show Bscan
Angio Overlay
Auto Zoom
Thickness
Full
Overlay
Vessel Density (Superficial)
Inner Thickness (ILM - IPL)
SLO
Full Thickness (ILM - RPE)

12-19-18


Angio Retina QuickVue
Scan Quality 8/10
Left / OS
Exit
Print
Overlay
Show Lines
Superficial (ILM - IPL)
Deep (IPL - OPL)
Outer Retina (OPL - BRM)
Choriocapillaris (BRM - BRM+30µm)
Show Grid
Angio Overlay
Auto Zoom
Thickness
Full
Overlay
Vessel Density (Superficial)
Inner Thickness (ILM - IPL)
SLO
Full Thickness (ILM - RPE)

12-19-2018



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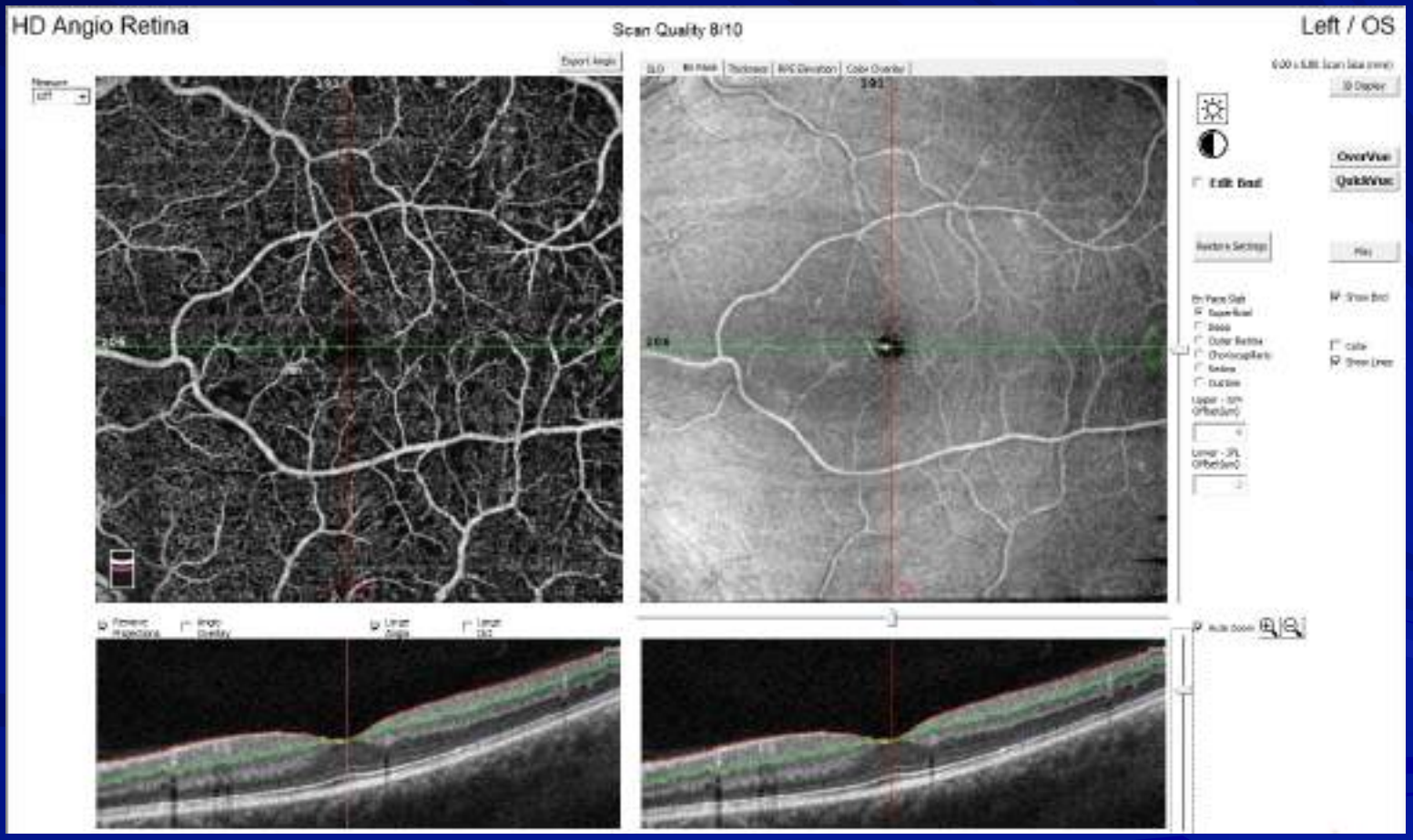

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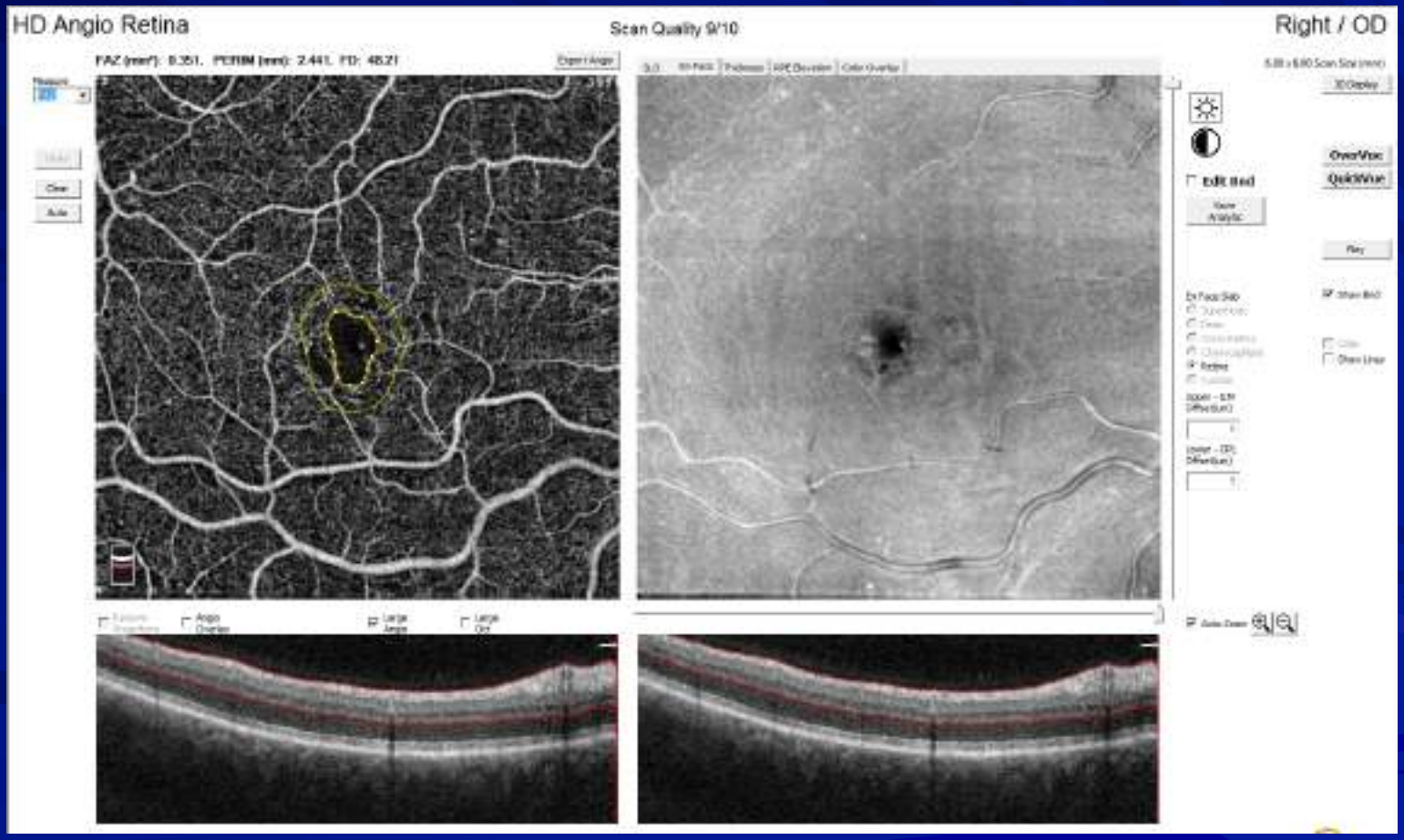

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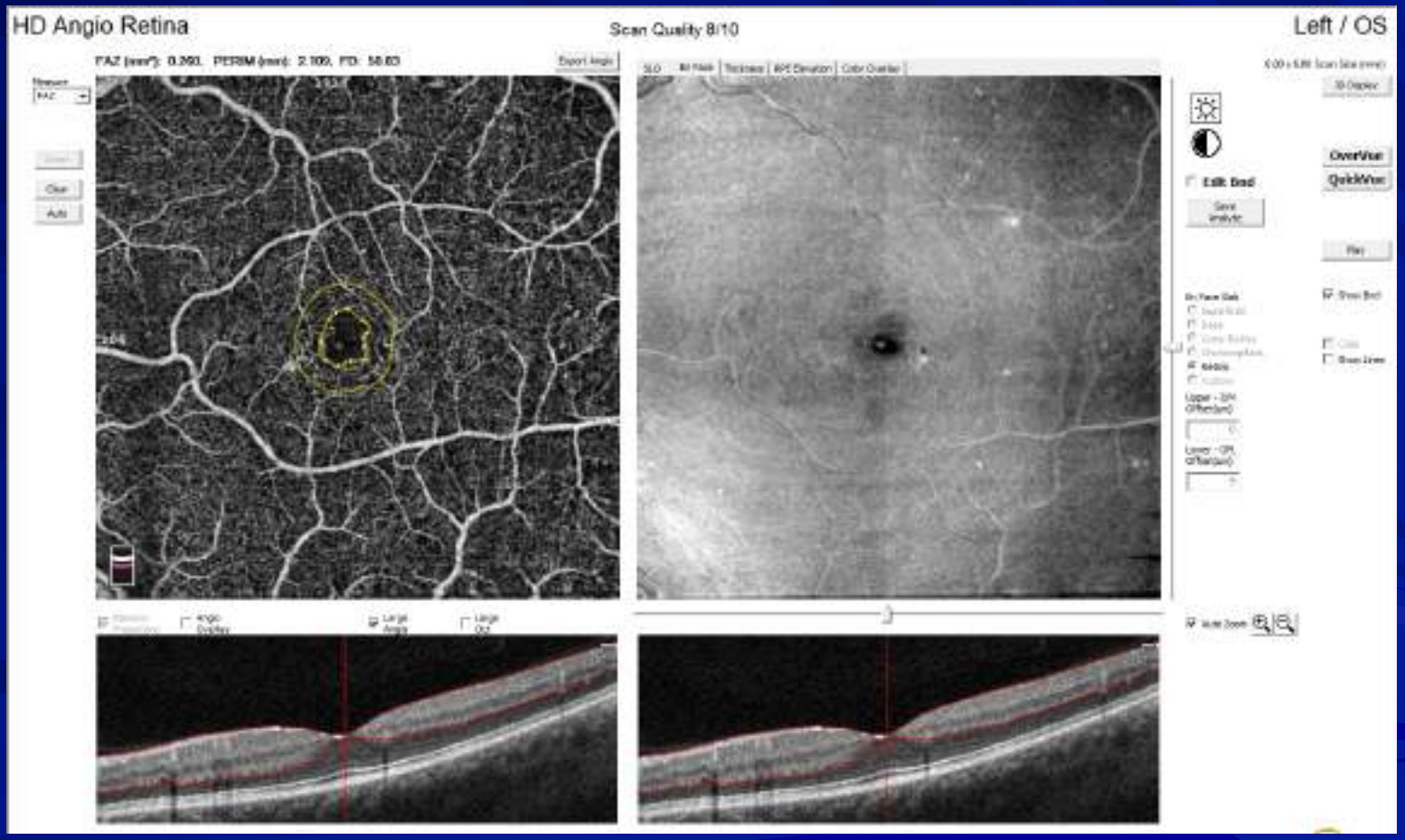


58-year-old man with diabetes

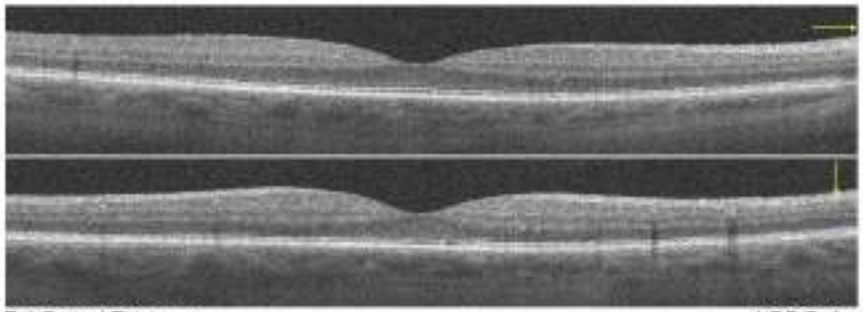
- New patient to the practice
- BS: unsure, last HbA1c unsure
- DM meds: metformin, glyburide, Invokana
- Vision 20/20
- Anterior segment: normal

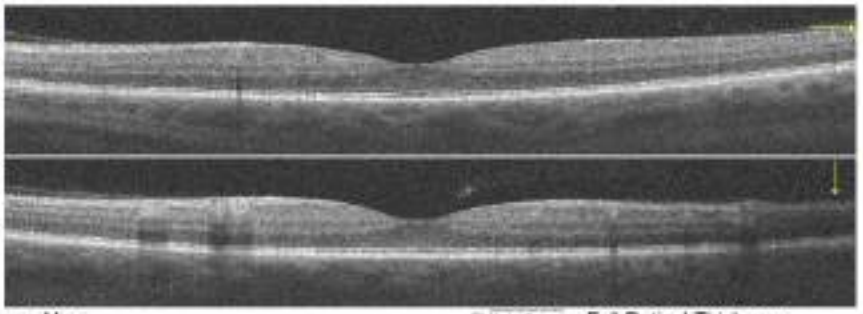
Widefield Imaging

Right / OD
08/18/2020

Avanti Wellness OU Report

Left / OS
08/18/2020





Full Retinal Thickness

NDB Reference Map

Full Retinal Thickness

GCC Analysis	OD	OS	OD - OS
Average GCC (µm)	107	110	-3
Superior GCC (µm)	105	107	-2
Inferior GCC (µm)	110	113	-3
Intra Eye (S-I) (µm)	-5	-6	N/A
FLV (%)	0.02	0.00	0.02
GLV (%)	0.02	0.00	0.02

10:06:26

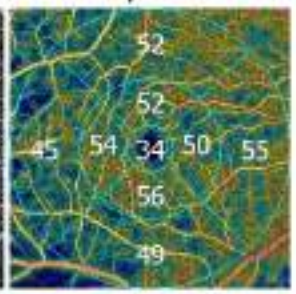
10:06:35

10:08:03

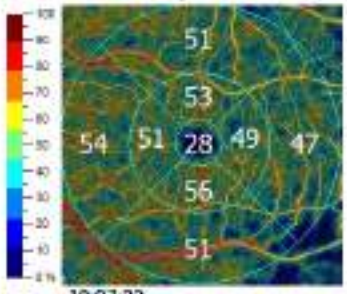
10:07:54

Retina

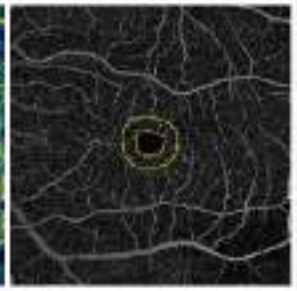
Superficial



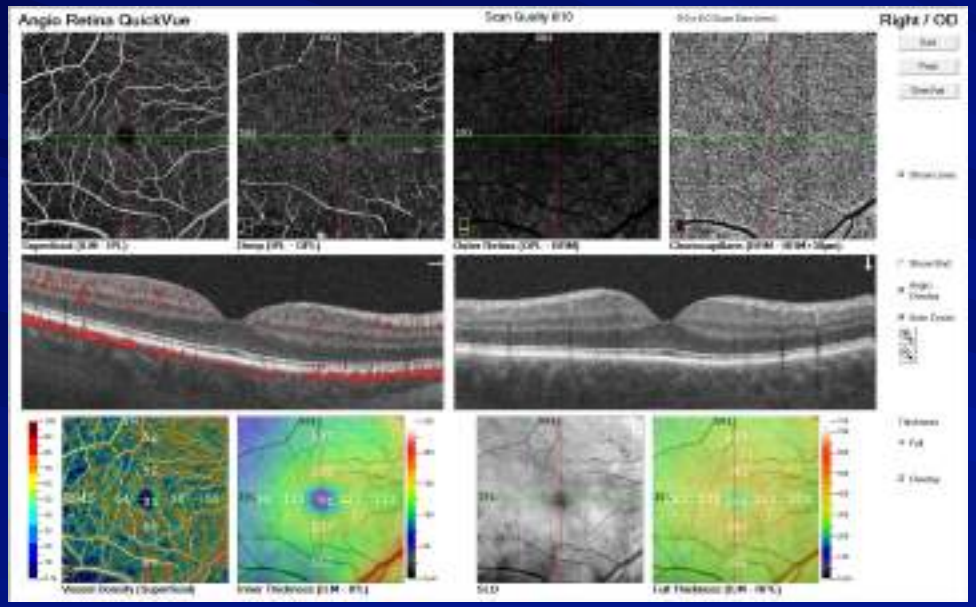
Vessel Density (%)	OD	OS	OD - OS
Superior_Hemi	50.7	50.0	0.7
Inferior_Hemi	49.5	49.1	0.4
Whole Image	50.1	49.5	0.6
ETDRS Grid	50.3	50.4	-0.1
FAZ	OD	OS	OD - OS
Area (mm²)	0.15	0.24	-0.09
Perimeter (mm)	1.49	1.92	-0.43
FD (%)	55.5	55.0	0.5

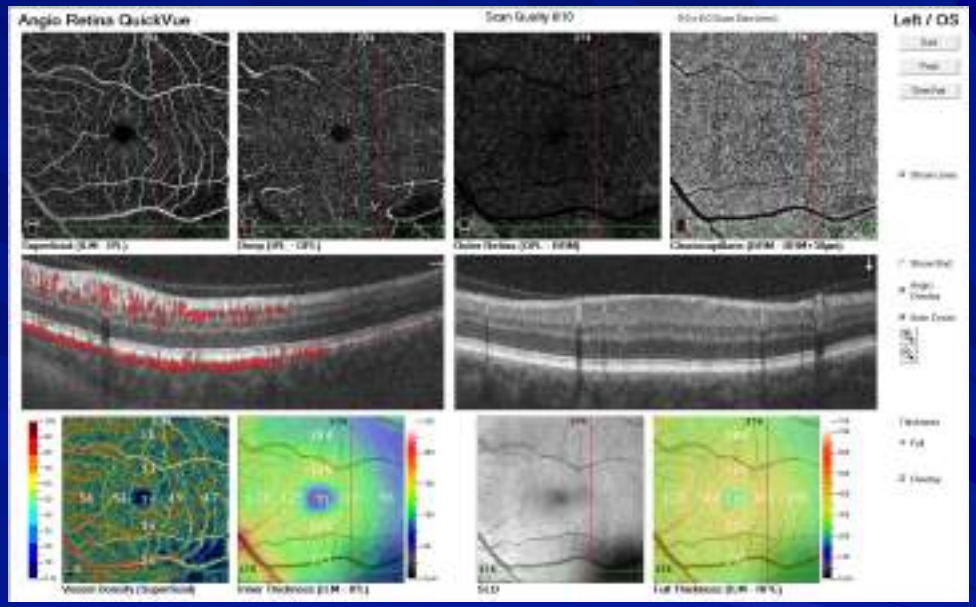


Superficial



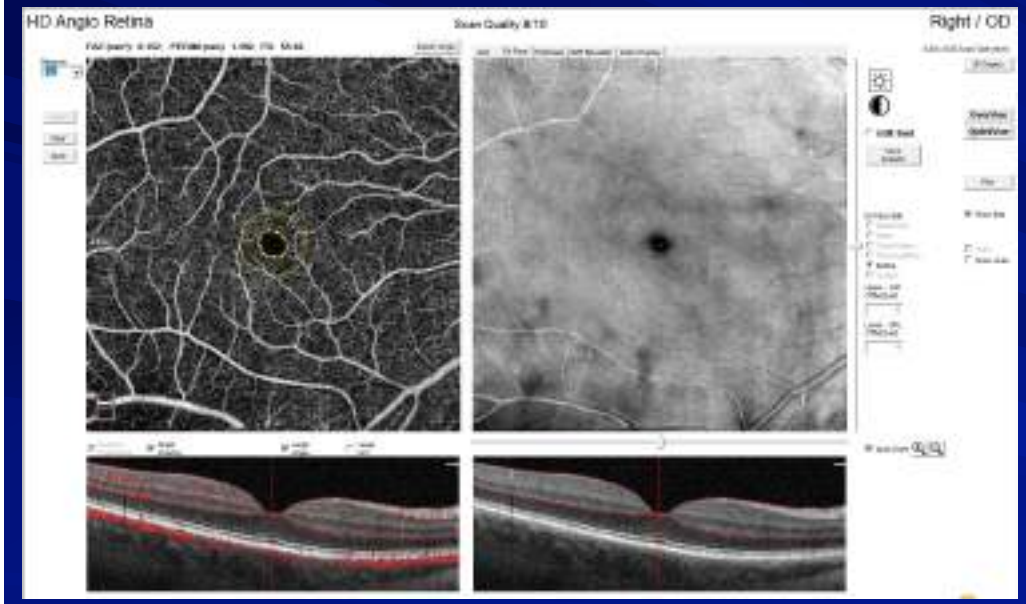
Retina

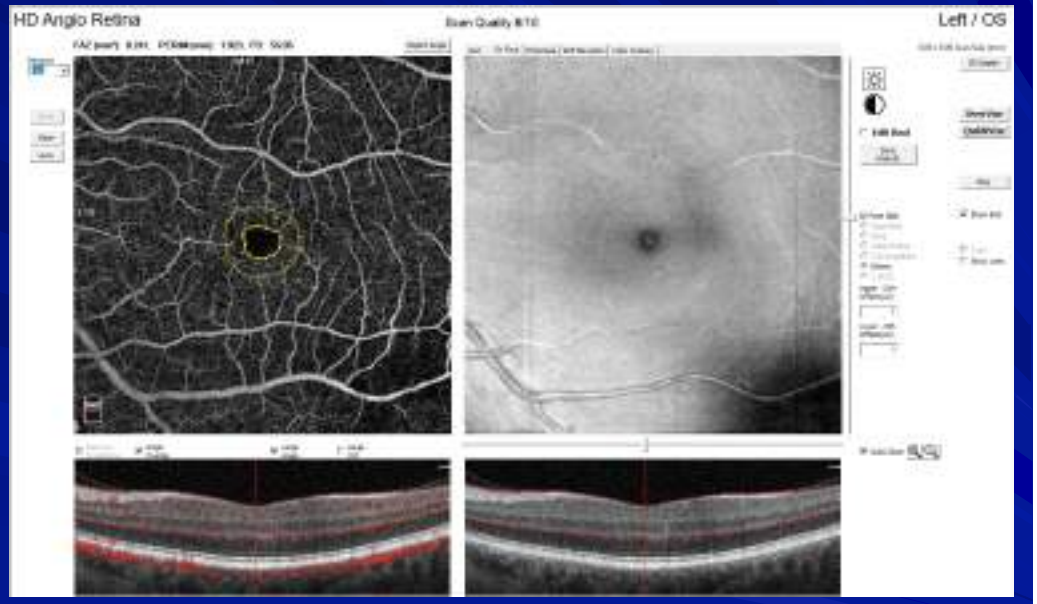

Angio Retina QuickVue
Scan Quality 8/10
Right / OD


Angio Retina QuickVue
Scan Quality 8/10
Left / OS

FAZ Damage – This is DR

Time to get to know your BS and HBA1c

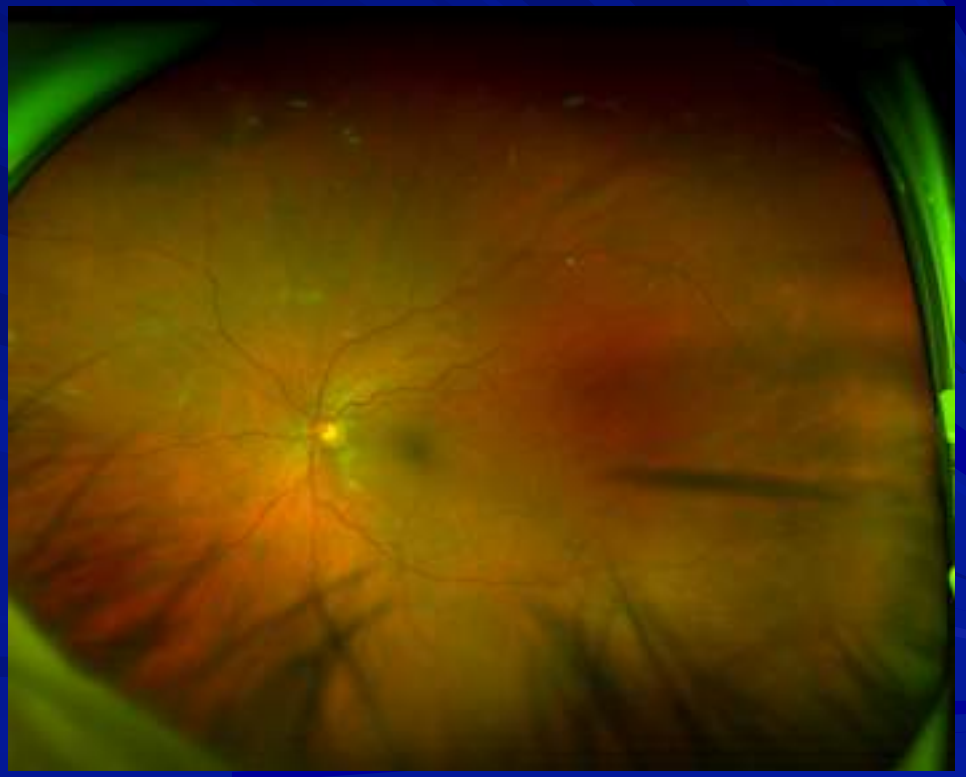




64-year-old man with diabetes

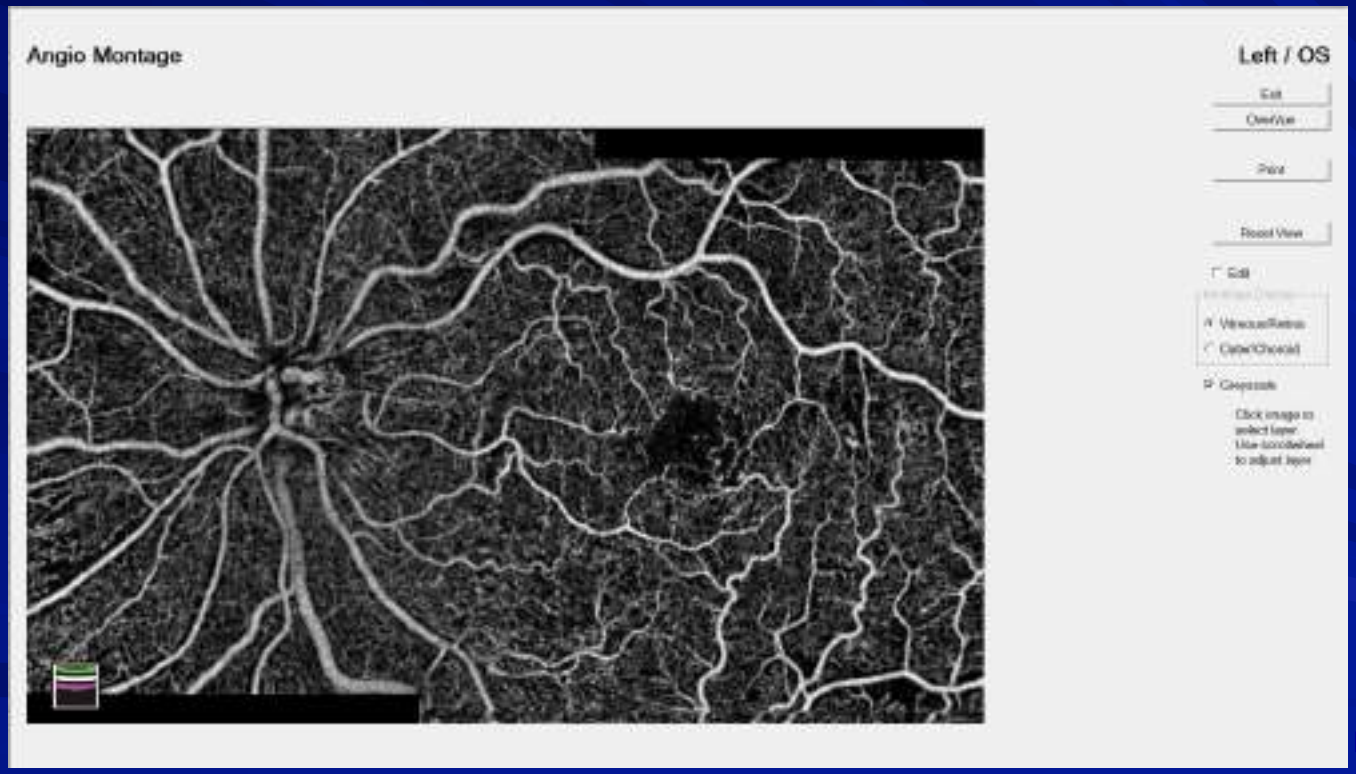
- BS: 134 this AM, last HbA1c 8.0
- DM meds: Novolog and Amaryl
- Vision 20/20
- Anterior segment: normal

Widefield Imaging

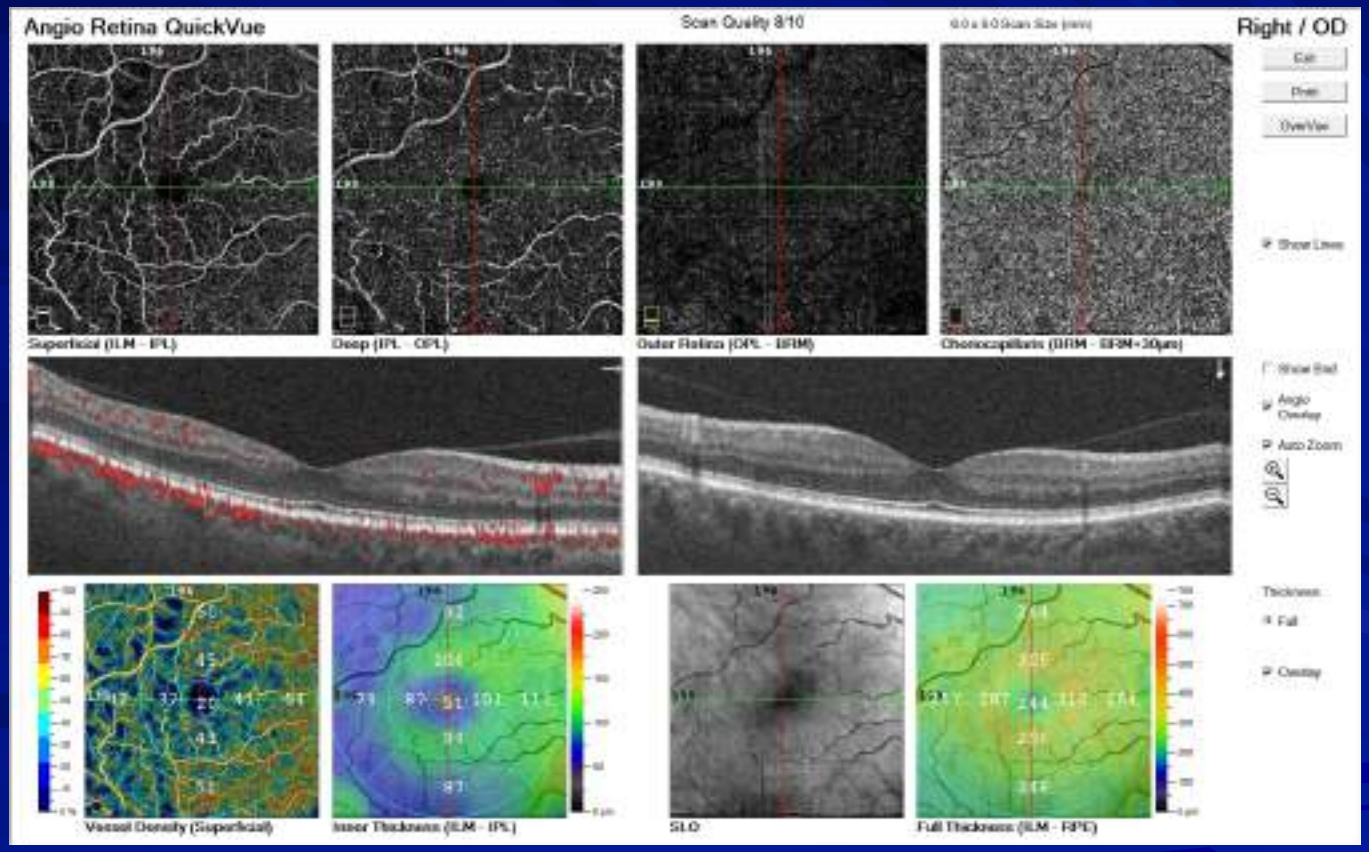


64-year-old man with diabetes

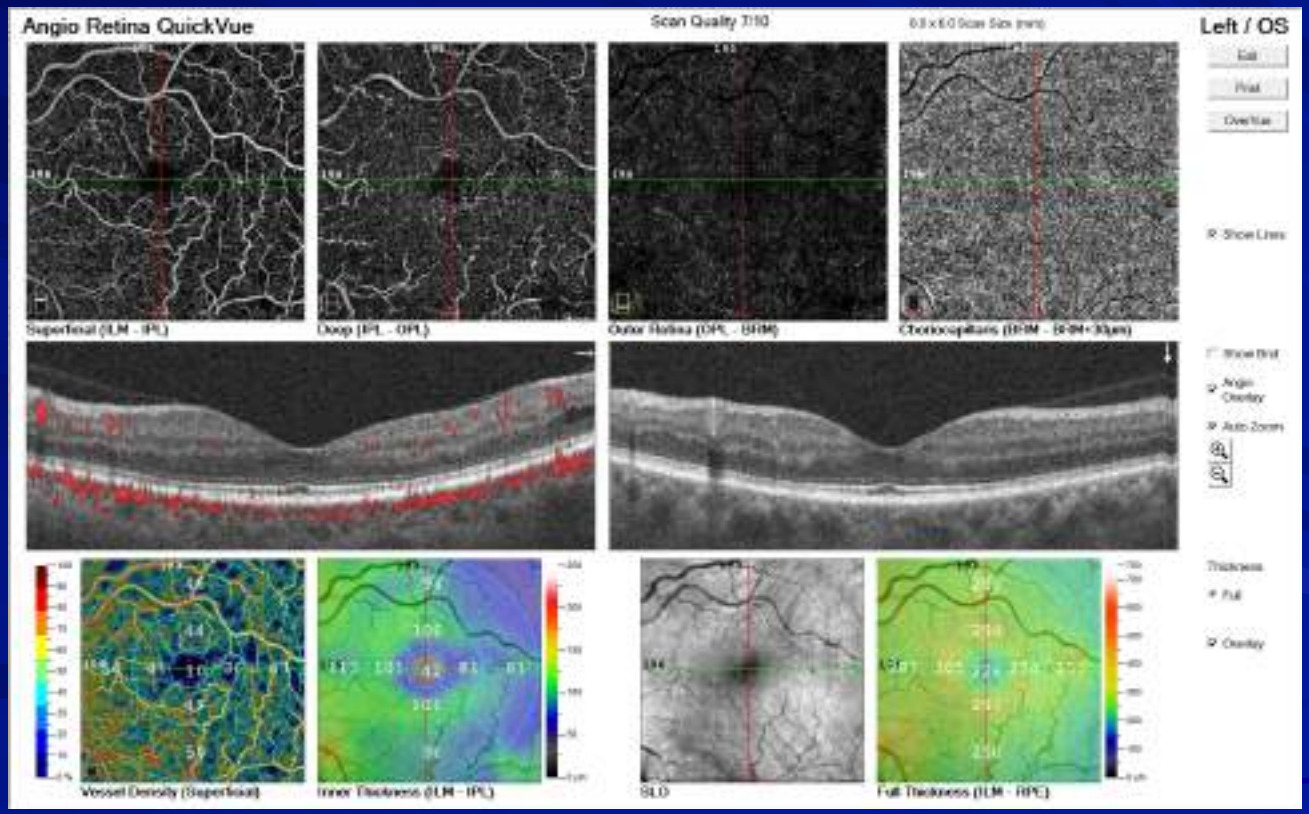
64-year-old man with diabetes



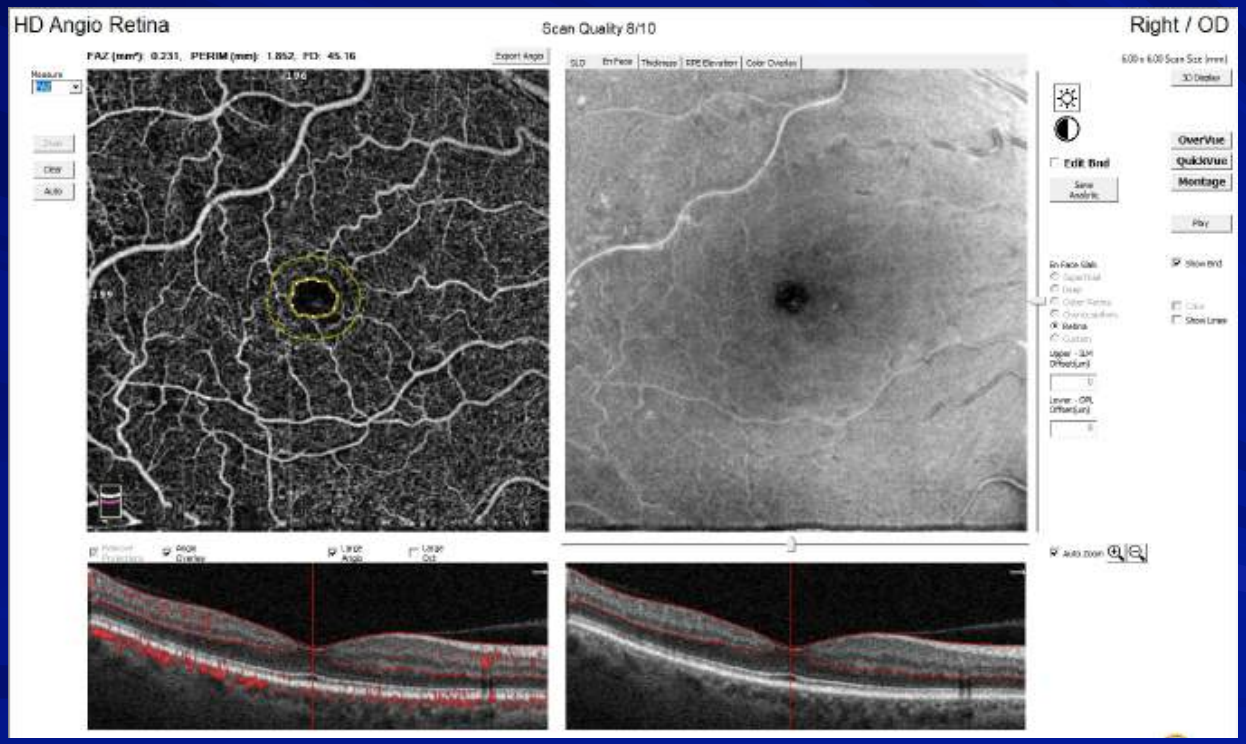
64-year-old man with diabetes



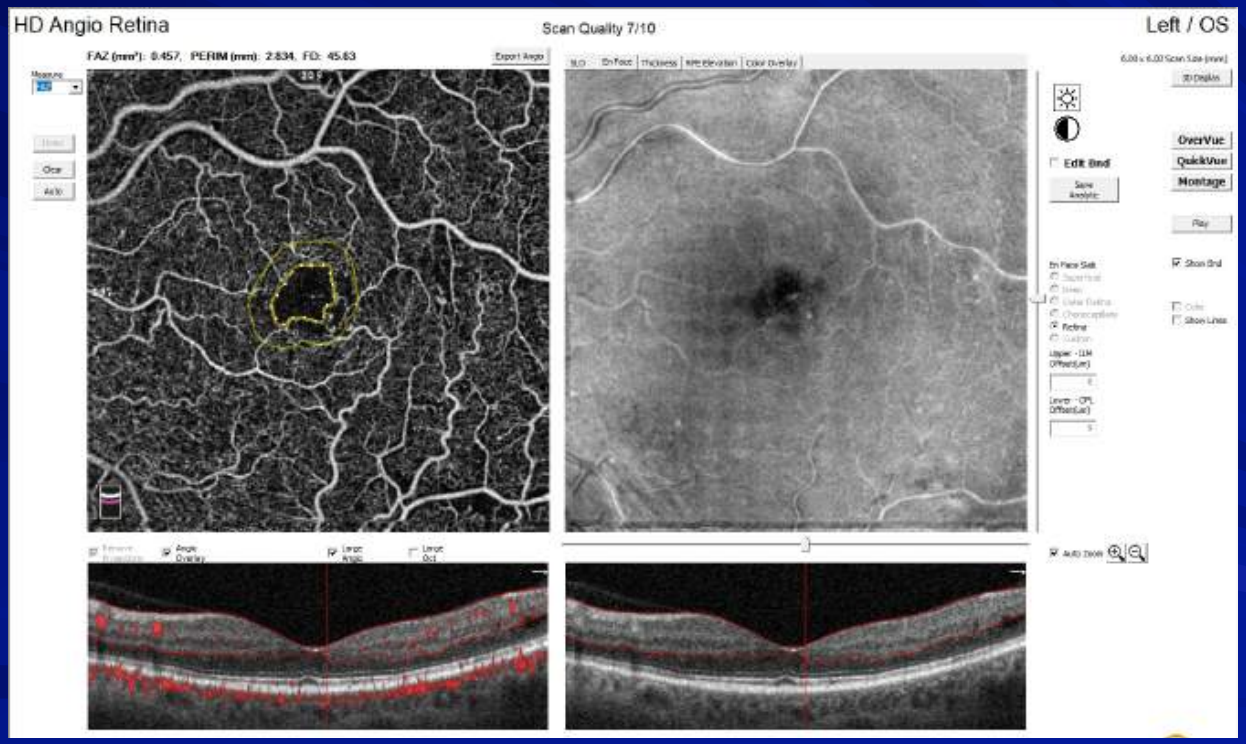
64-year-old man with diabetes



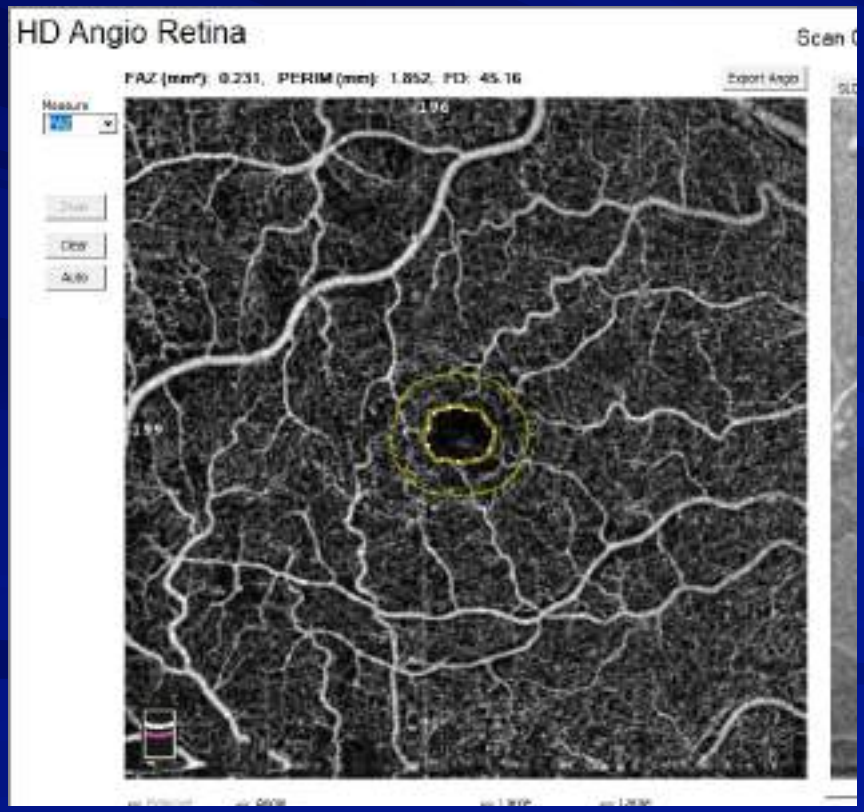
64-year-old man with diabetes

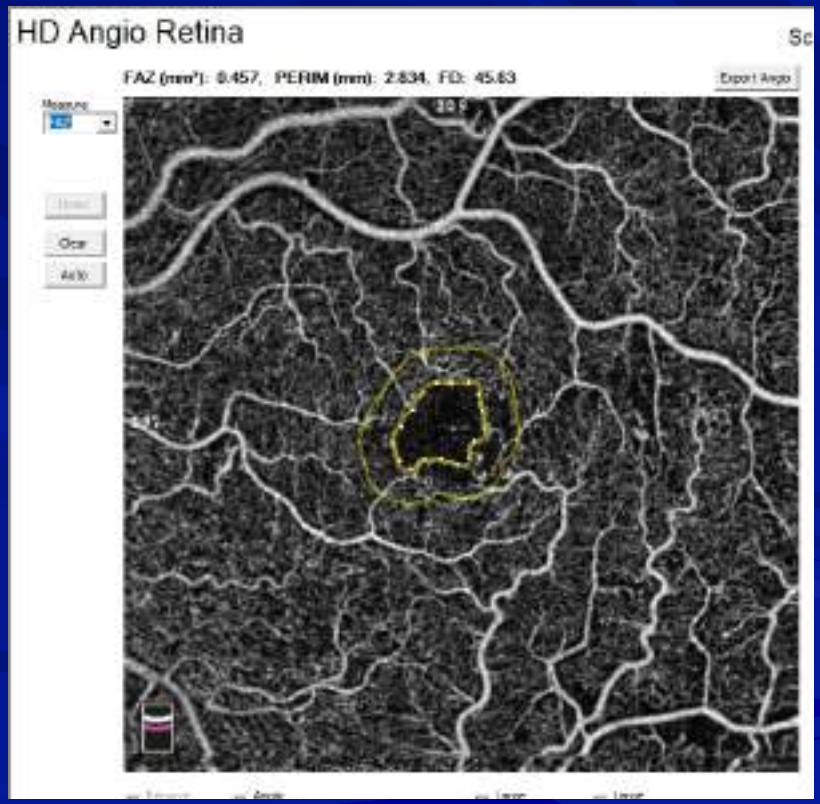


64-year-old man with diabetes



64-year-old man with diabetes



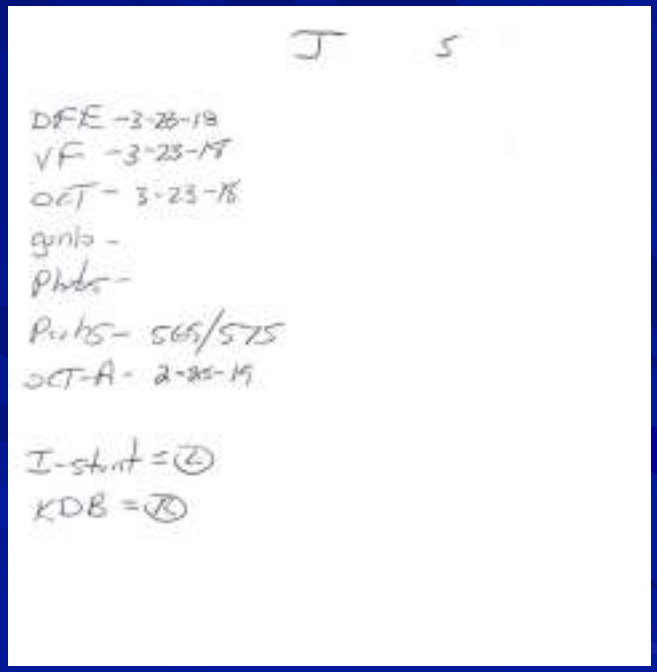


OCT and OCT-A

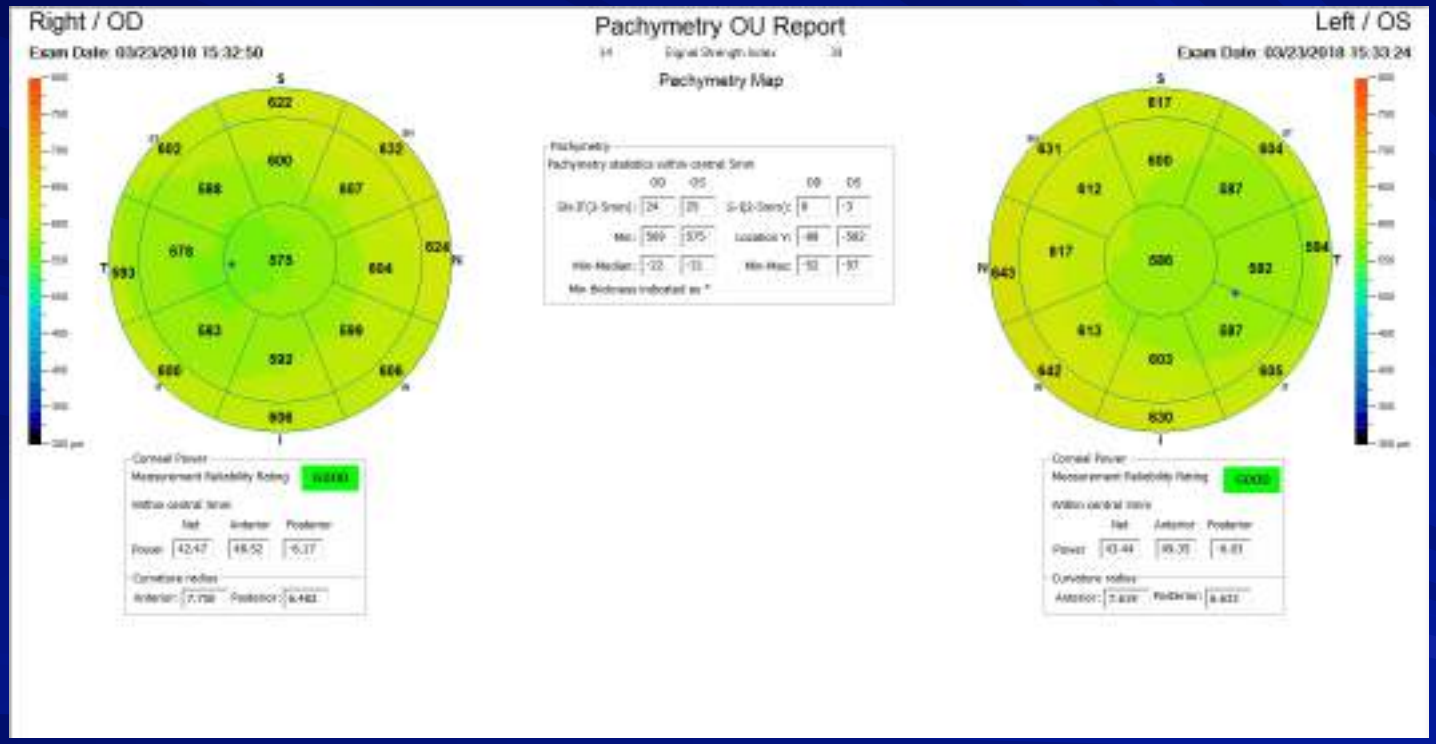
- Treatment?
- Certainly useful, beneficial, essential, and important in following the patient with diabetes
- Improved HbA1c

68-year-old woman with glaucoma

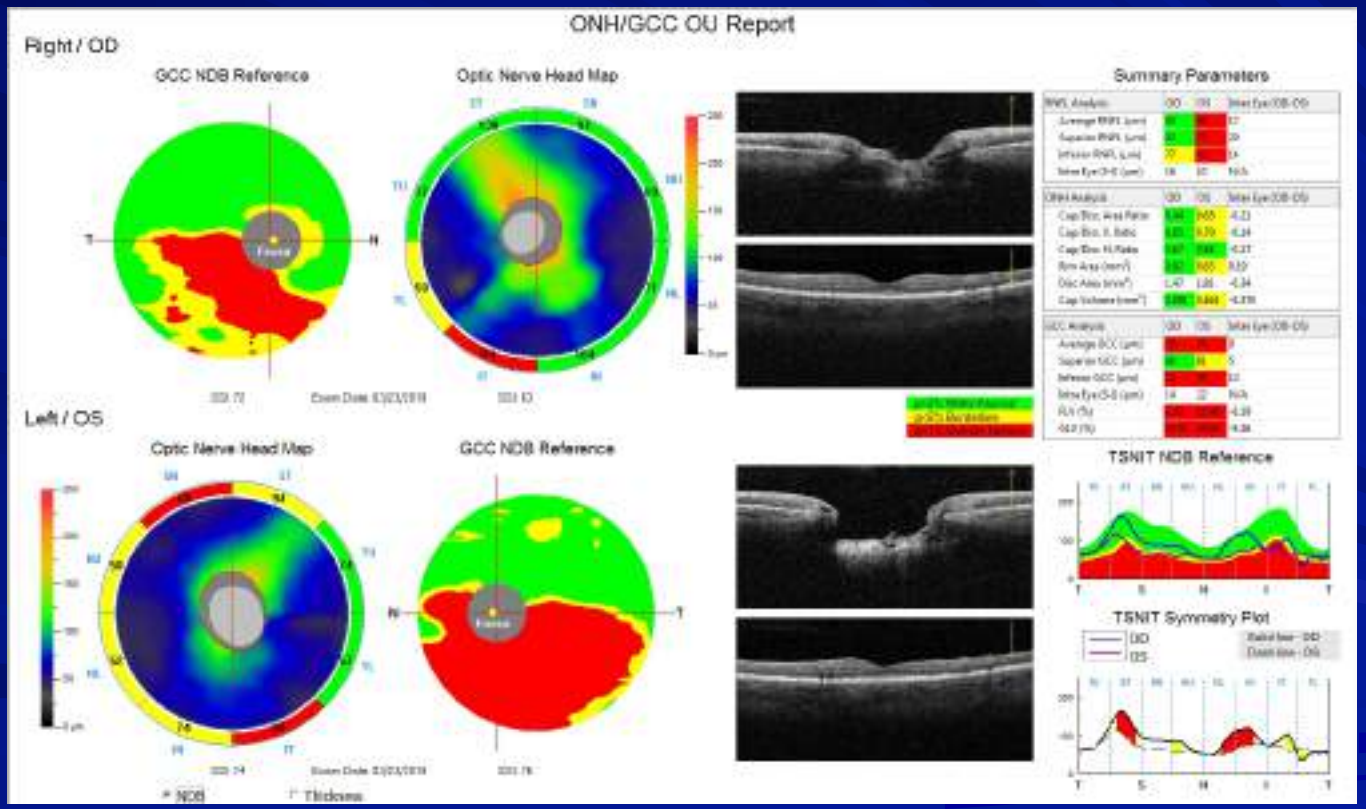
- Wants second opinion for glaucoma management
- Recently had cataract surgery OS with iStent
  - ★ September 25, 2017
  - ★ Dorzolamide 2% BID OS, Lumigan 0.01% QD OS
- Our practice recently performed cataract surgery and Kahook dual blade (KDB) MIGS
  - ★ July 24, 2018
- IOP_{GAT}: 12 and 16 at 11:27 am



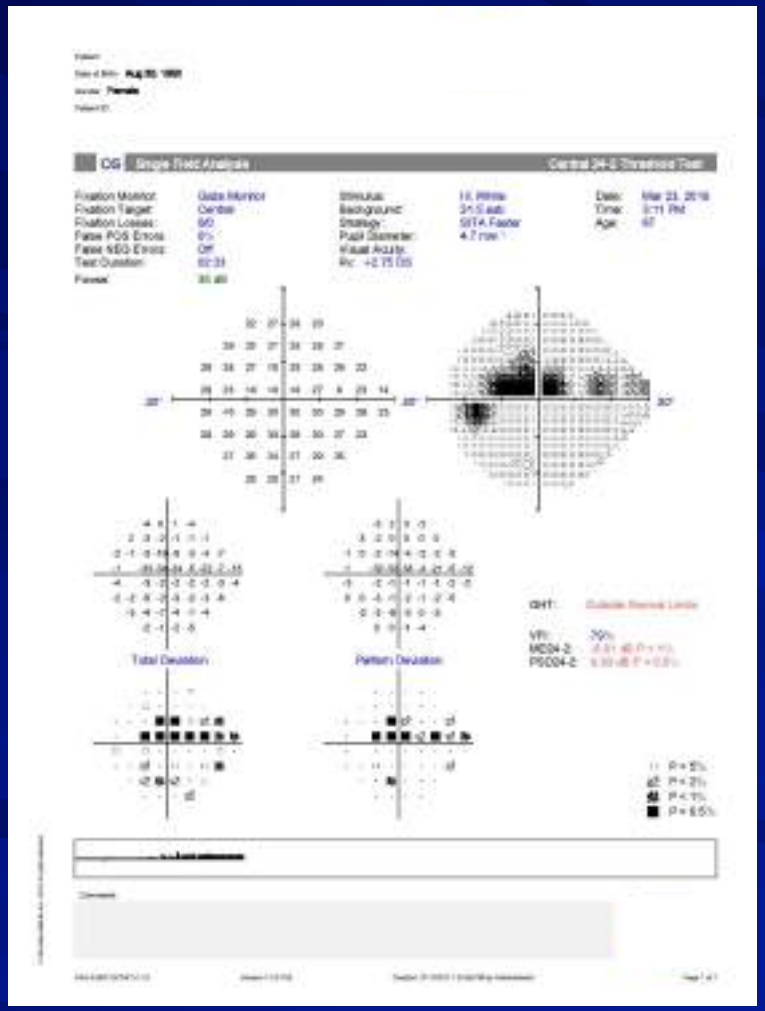
OCT for Pachymetry in Glaucoma

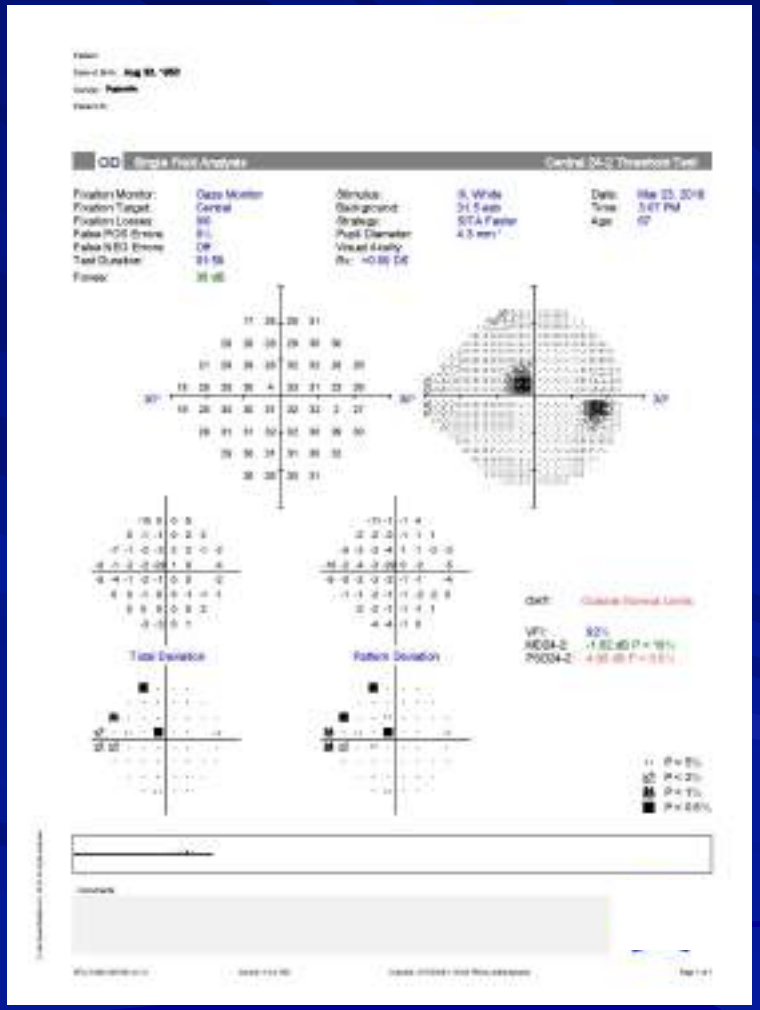


OCT GCC and NFL

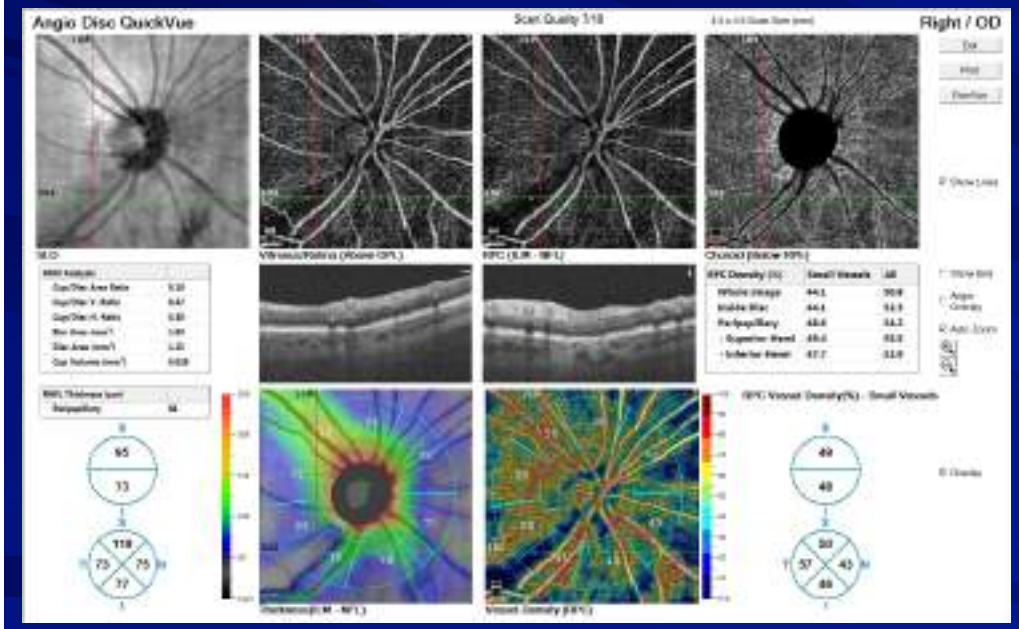


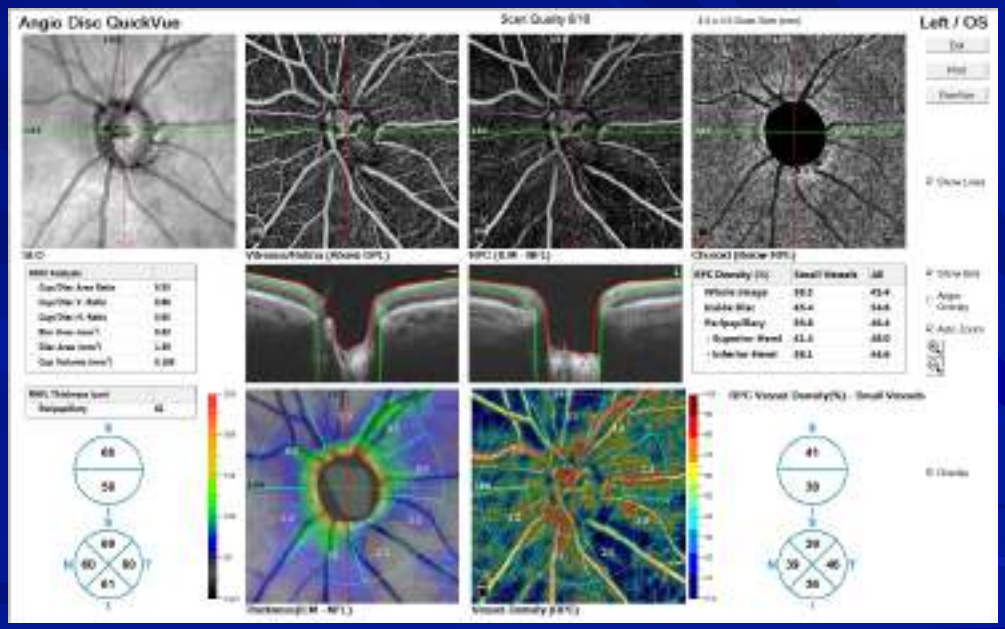
Visual Fields



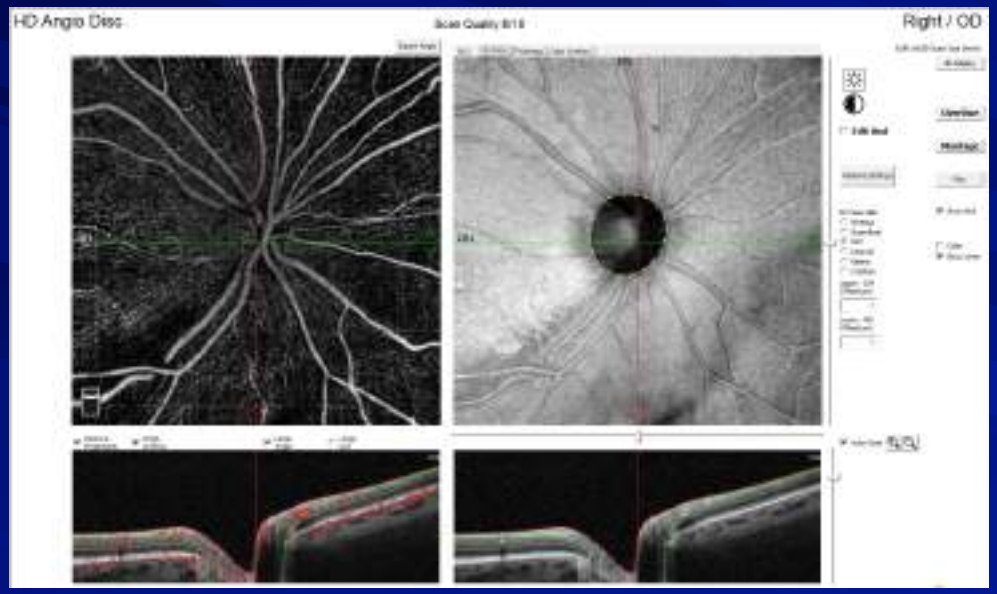


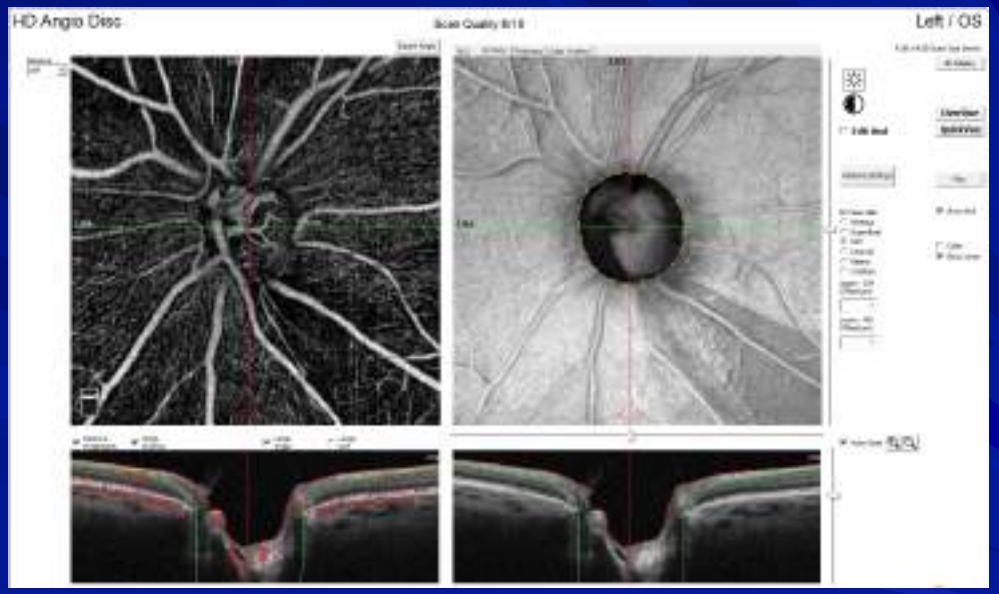
Angiography and AngioAnalytics of Disc



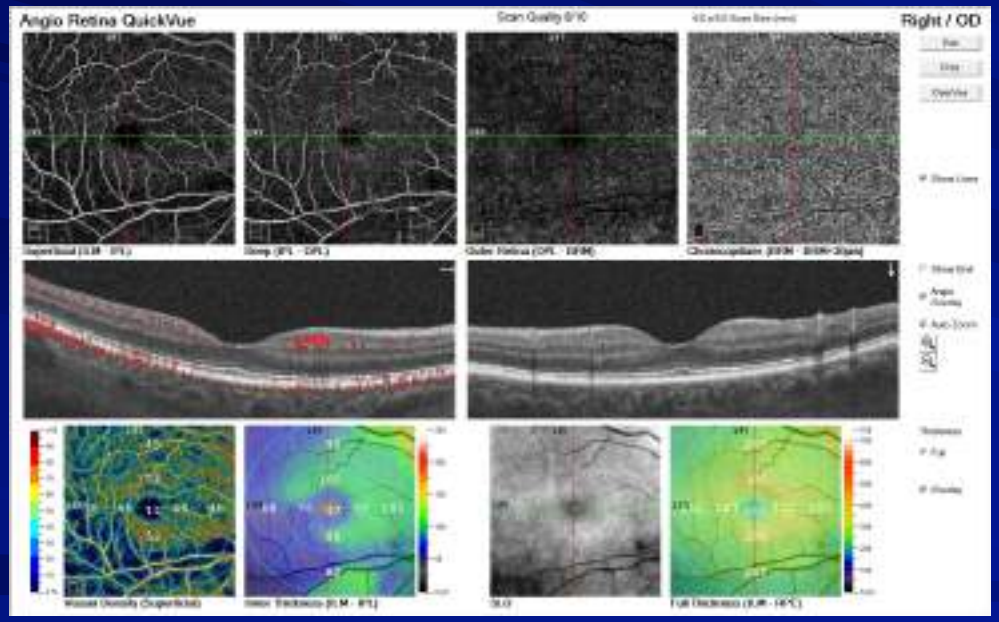


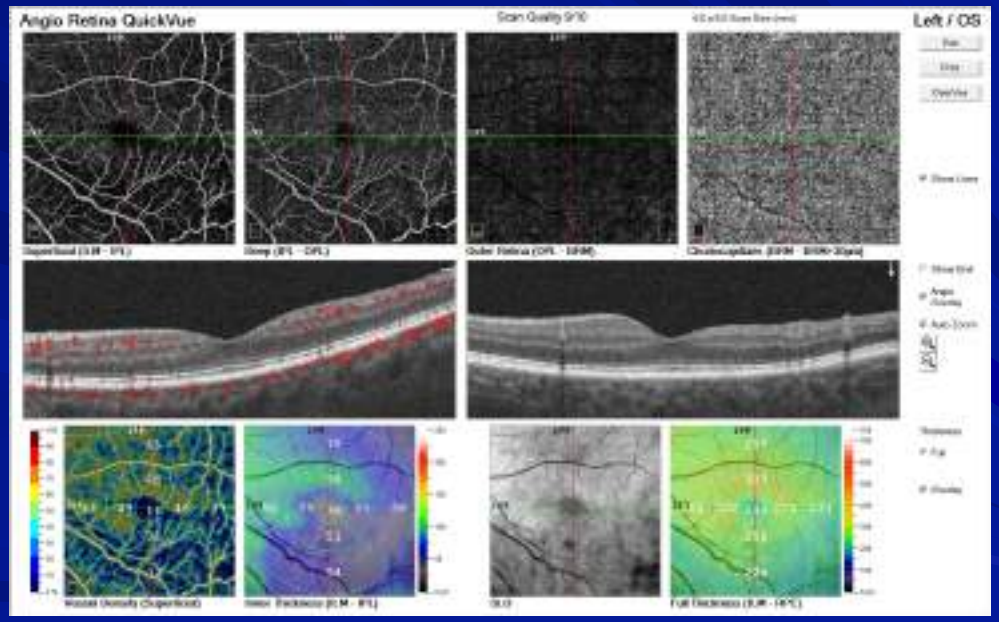
En Face Radial Peripapillary Capillaries (RPC)



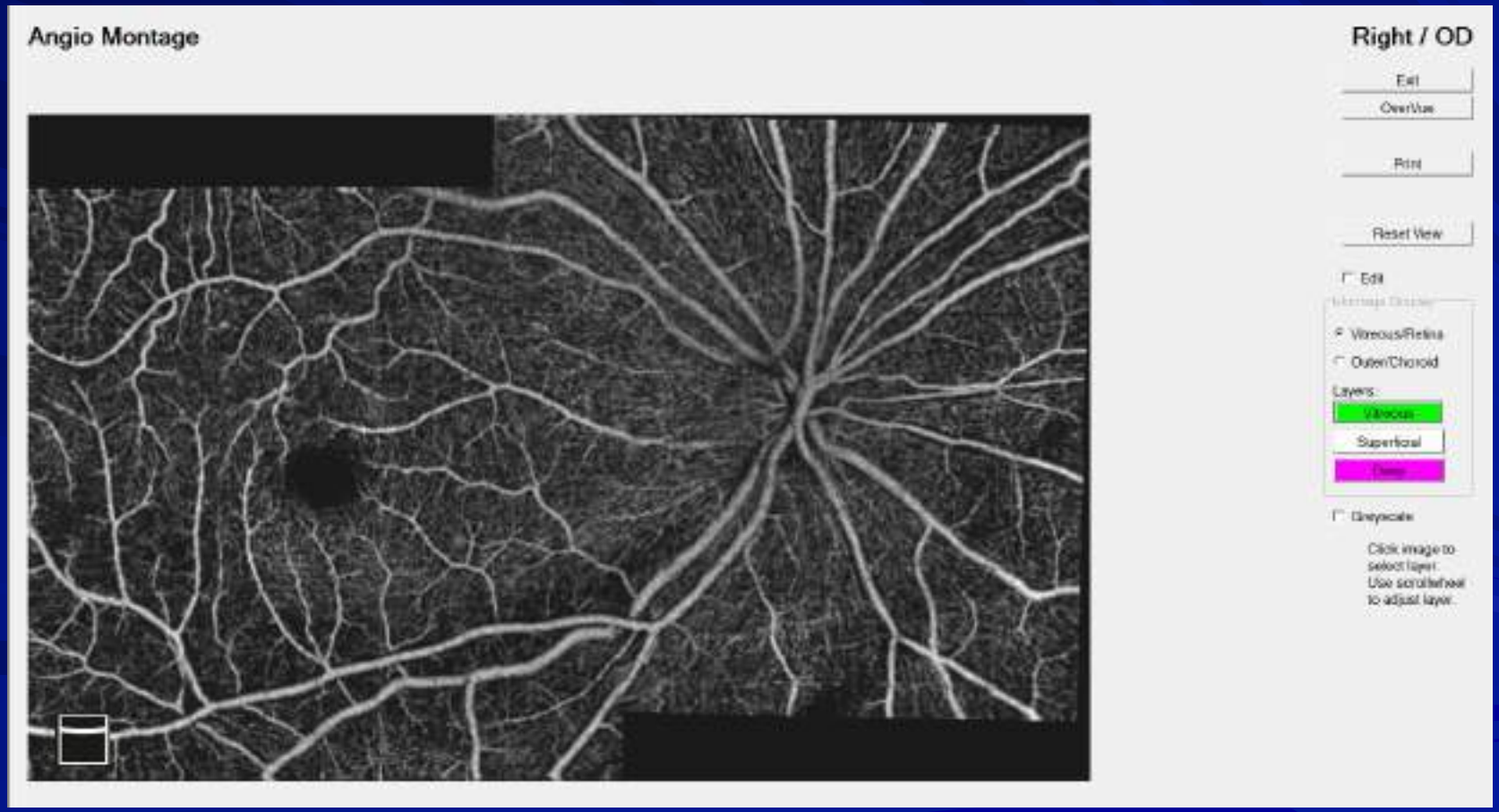


Angiography and AngioAnalytics of Retina





Montage OD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Right / OD
Exit
Print
Reset View
Edit
Superficial
Click image to
select layer.
Use scrollwheel
to adjust layer.

Montage OS


Angio Montage
Left / OS
Exit
OverVue
QuickVue
Print
Reset View
Edit
Vitreous/Retina
Outer/Choroid
Layers:
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Superficial
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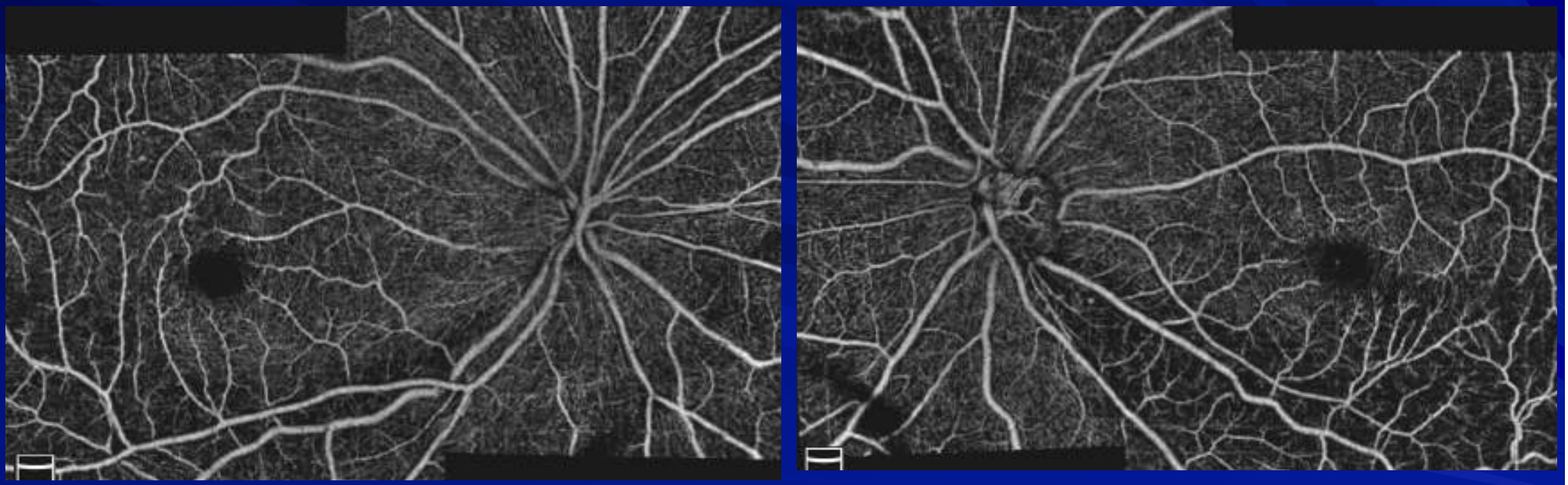
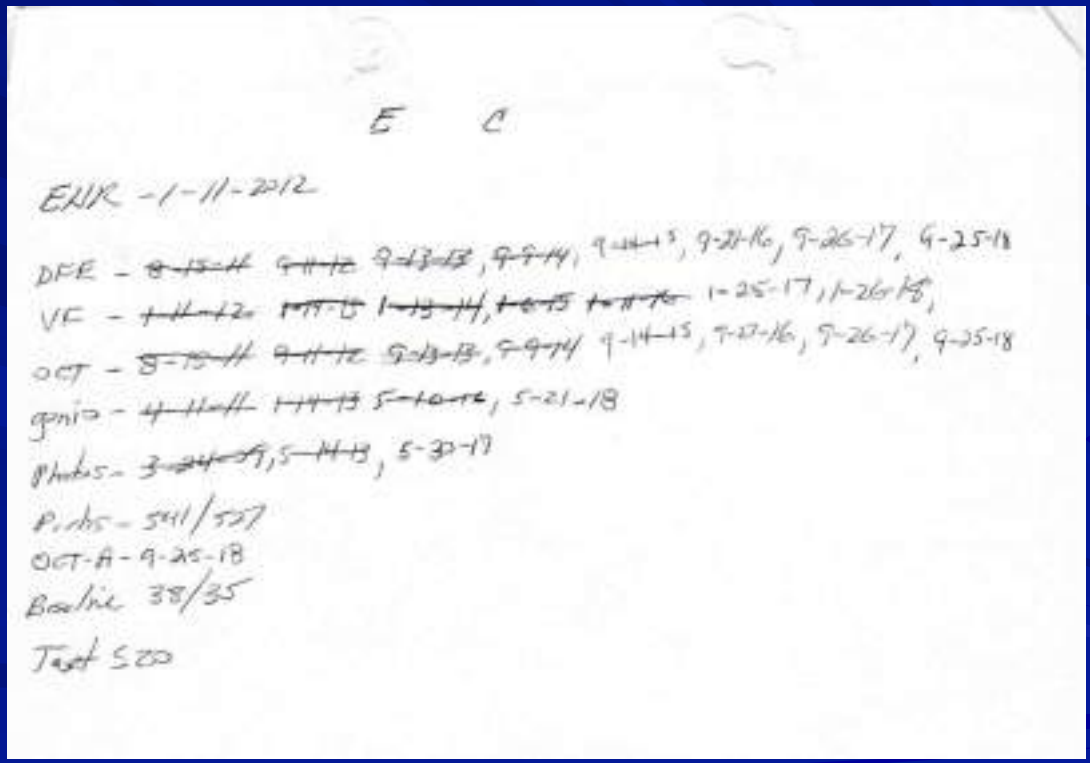
Greyscale
Click image to select layer
Use scrollwheel to adjust layer

Montage OU

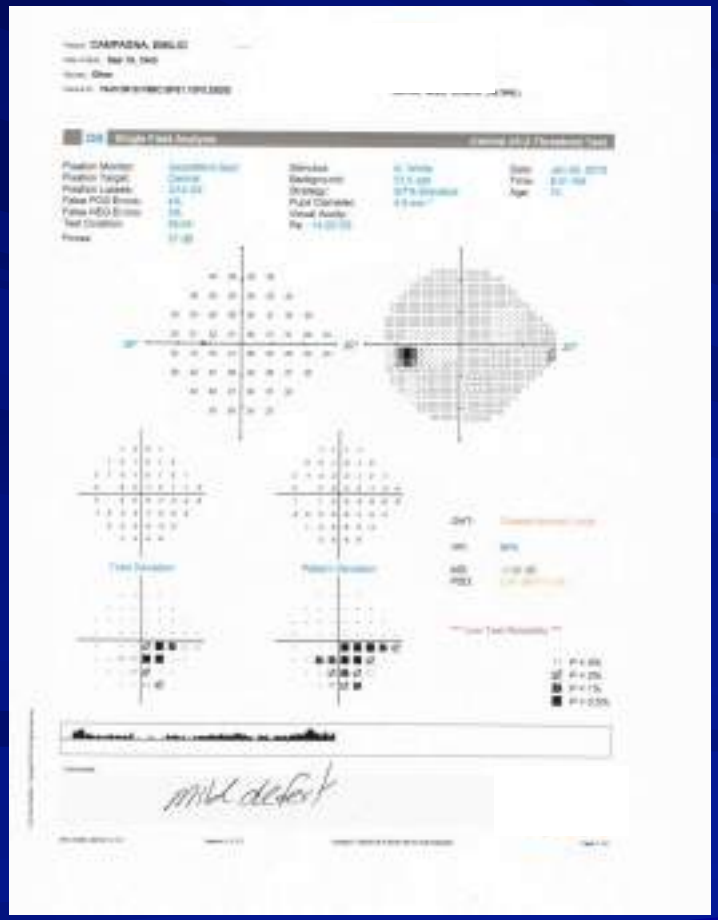


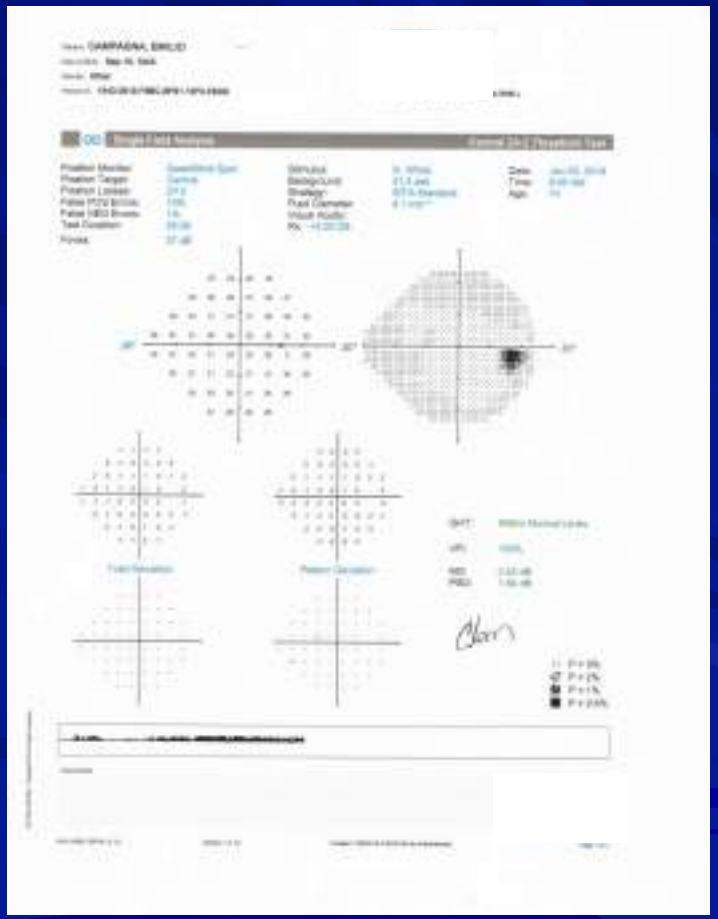
74-year-old man

- POAG, OS > OD
- Lumigan 0.01% QD OU
- Combigan BID OU

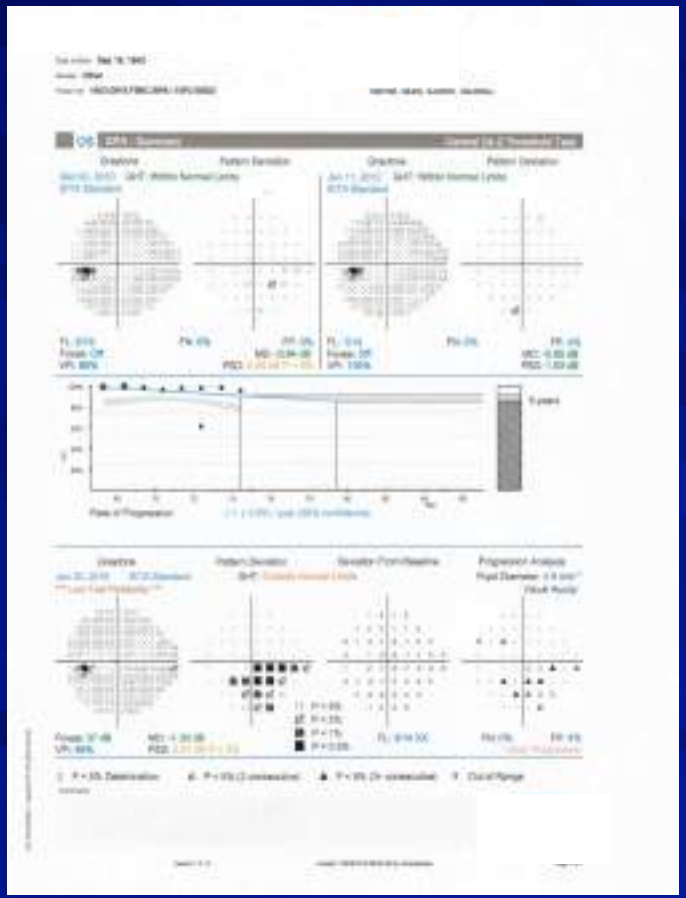


VF OD and OS 1-26-2018

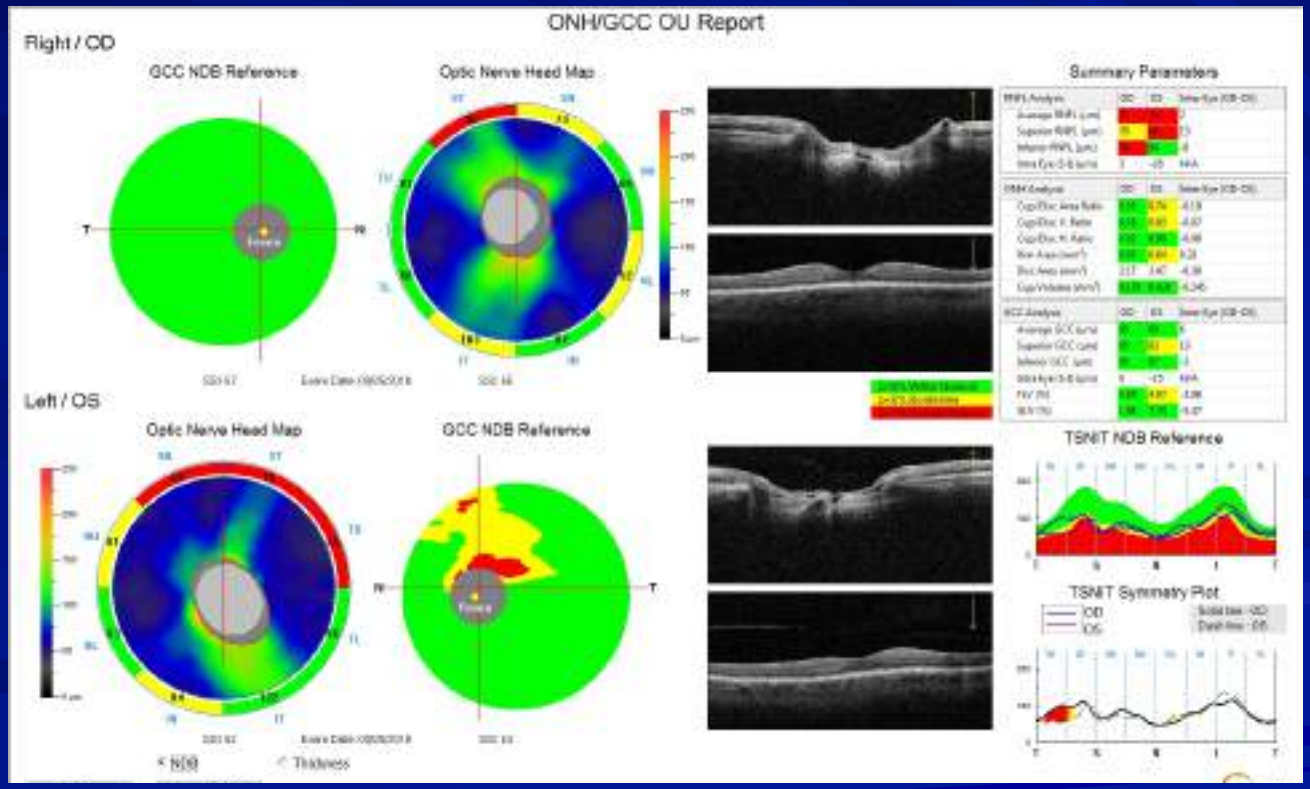




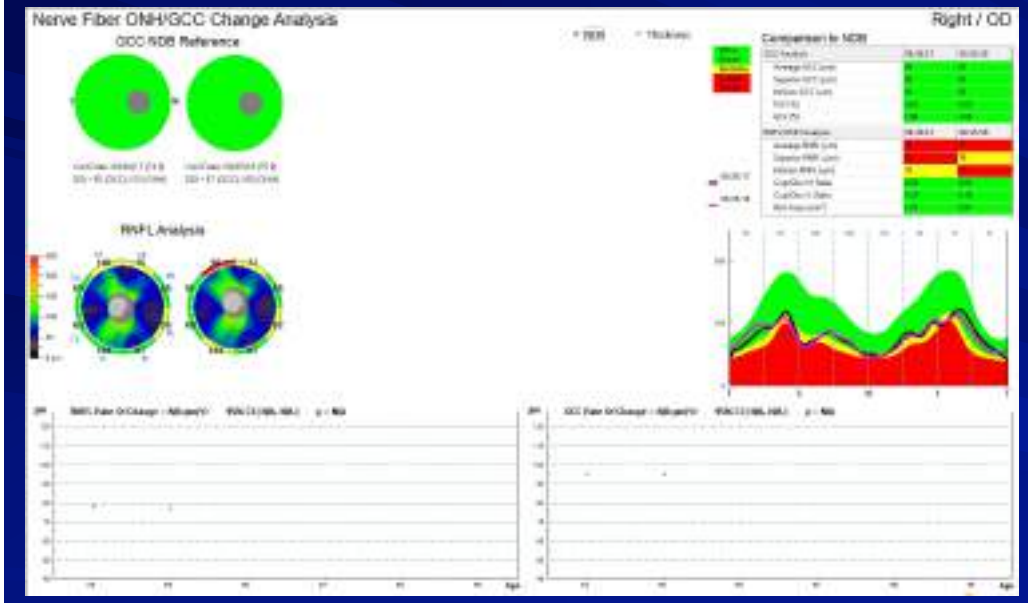
VF OD and OS GPA 1-26-2018

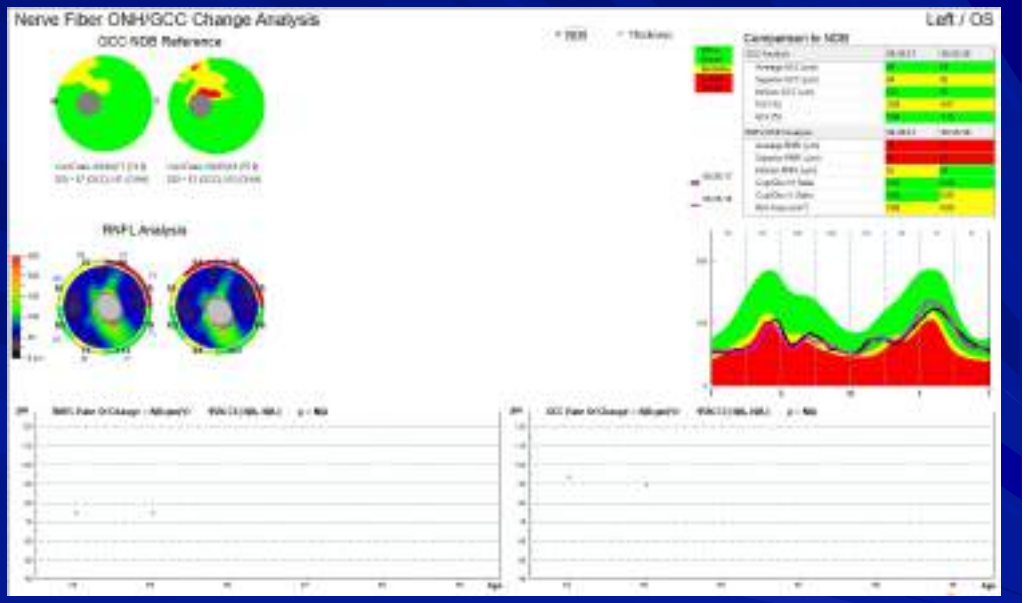


OCT NFL and GCC 9-25-2018

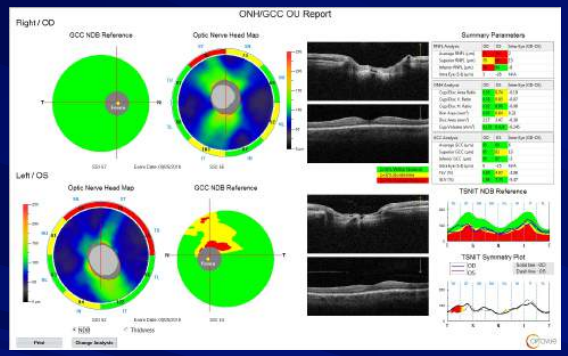


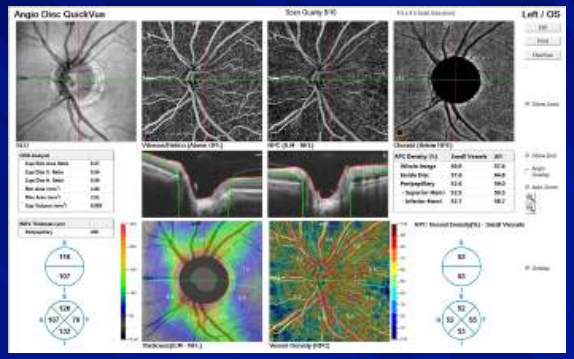
Change Analysis NFL-GCC

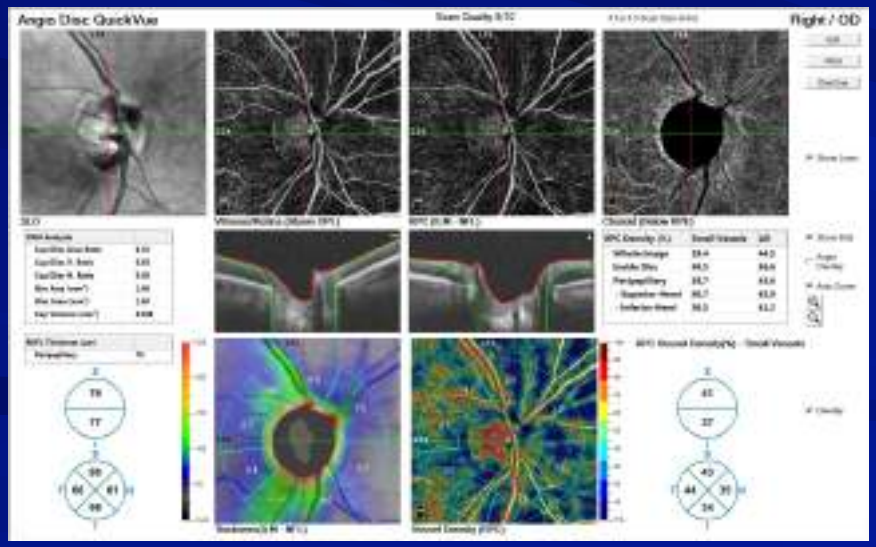


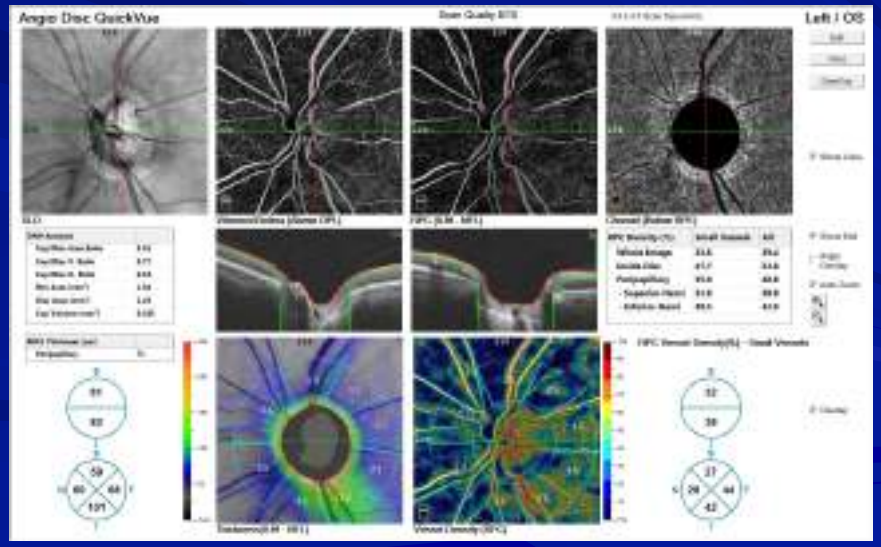


OCT-A 9-25-2018
POAG OS > OD

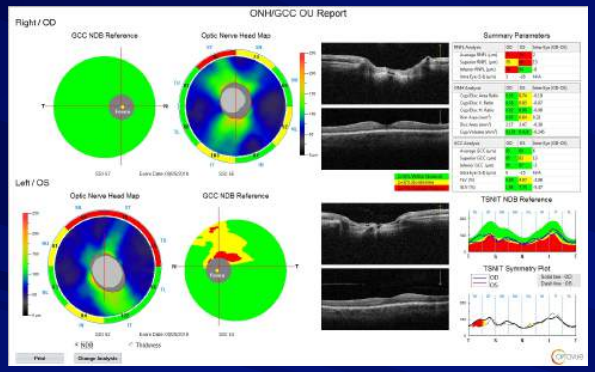


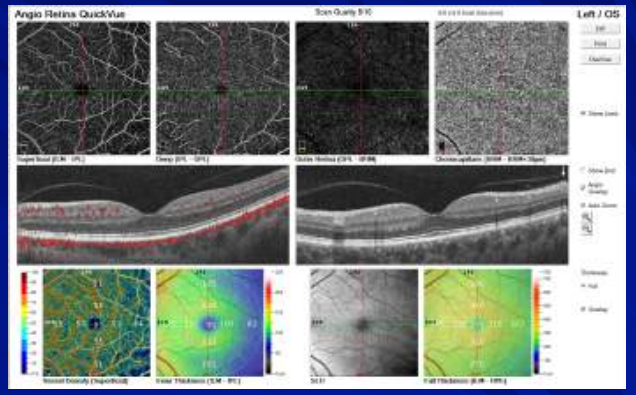


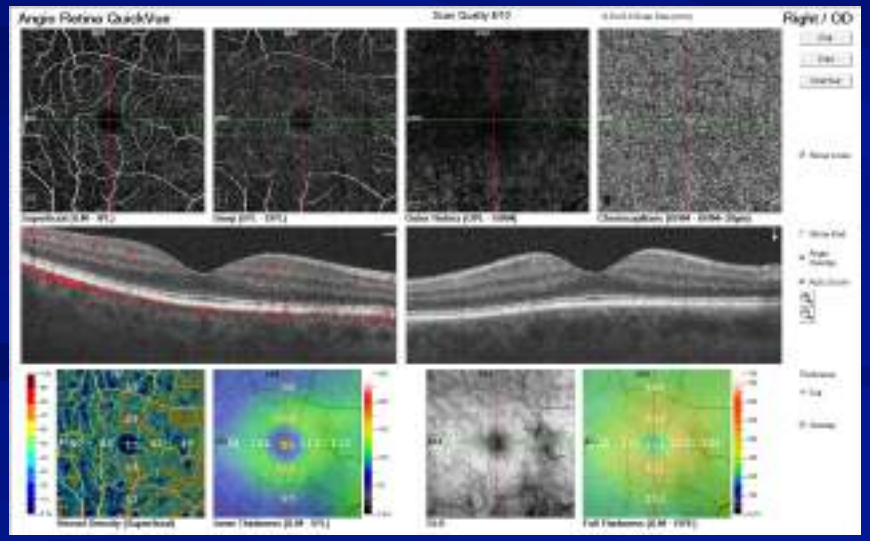


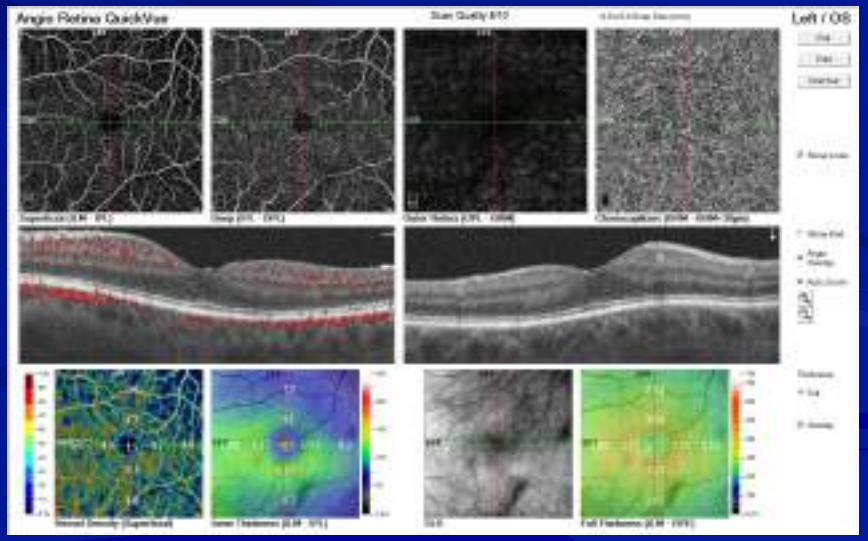


OCT-A 9-25-2018
POAG OS > OD





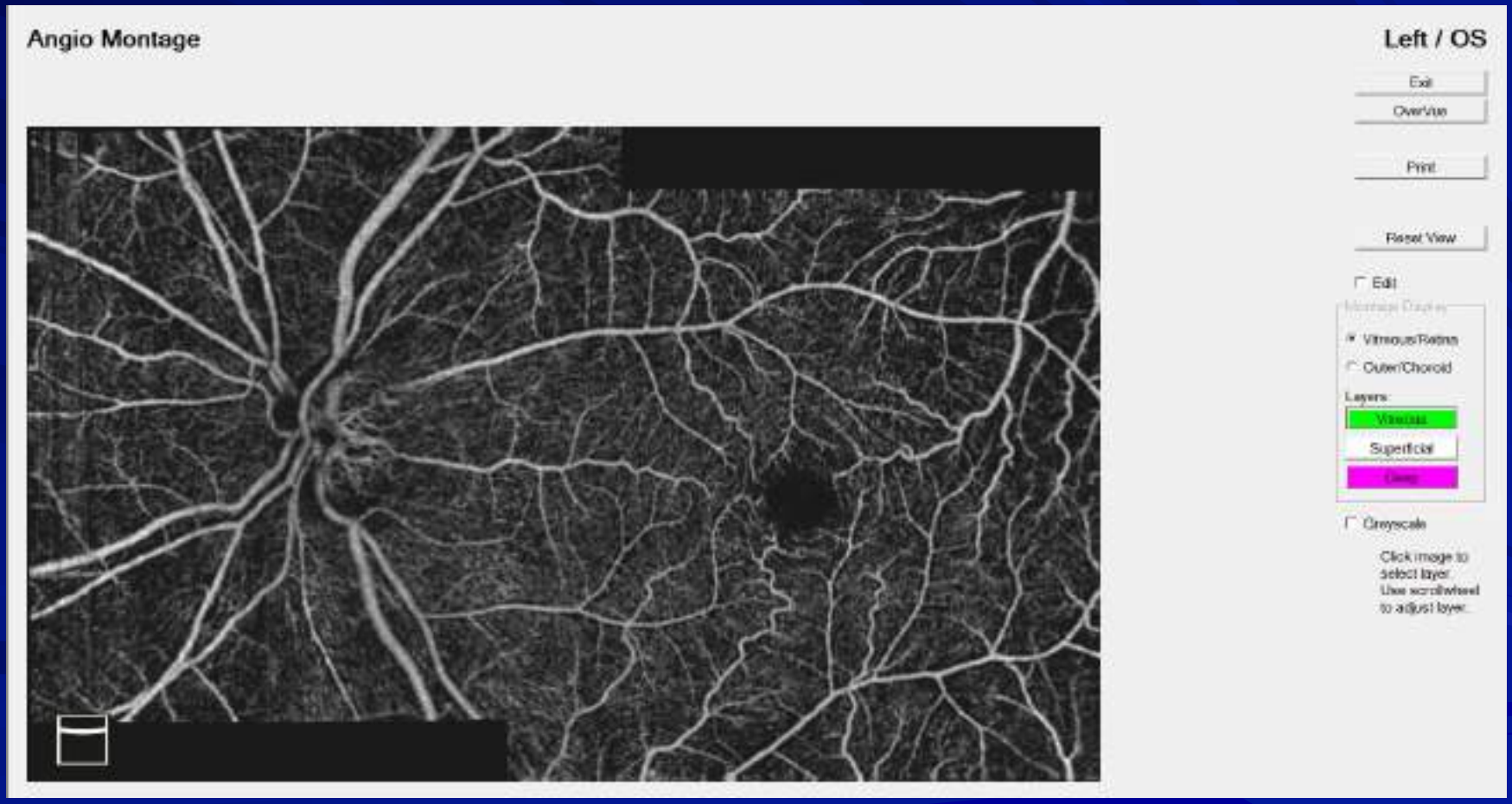




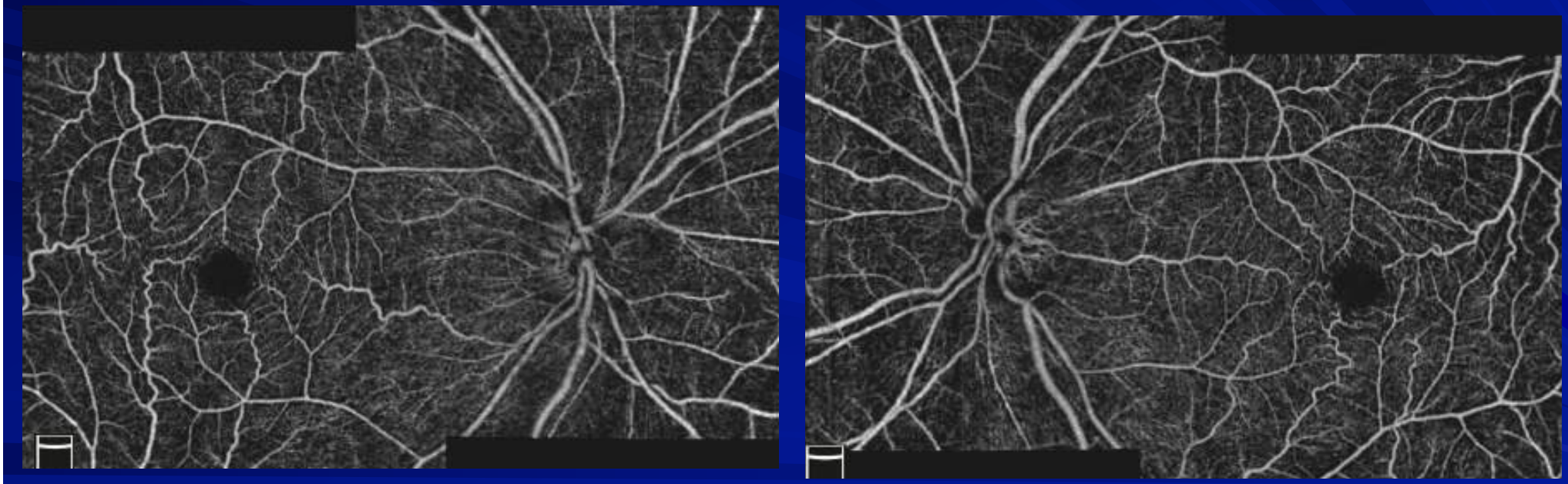
Montage OD


Angio Montage
Right / OD
Exit
OverVue
Print
Reset View
Edit
Vitreous/Retina
Outer/Choroid
Layers:
Vitreous
Superficial
Deep
Grayscale
Click image to select layer. Use scrollwheel to adjust layer

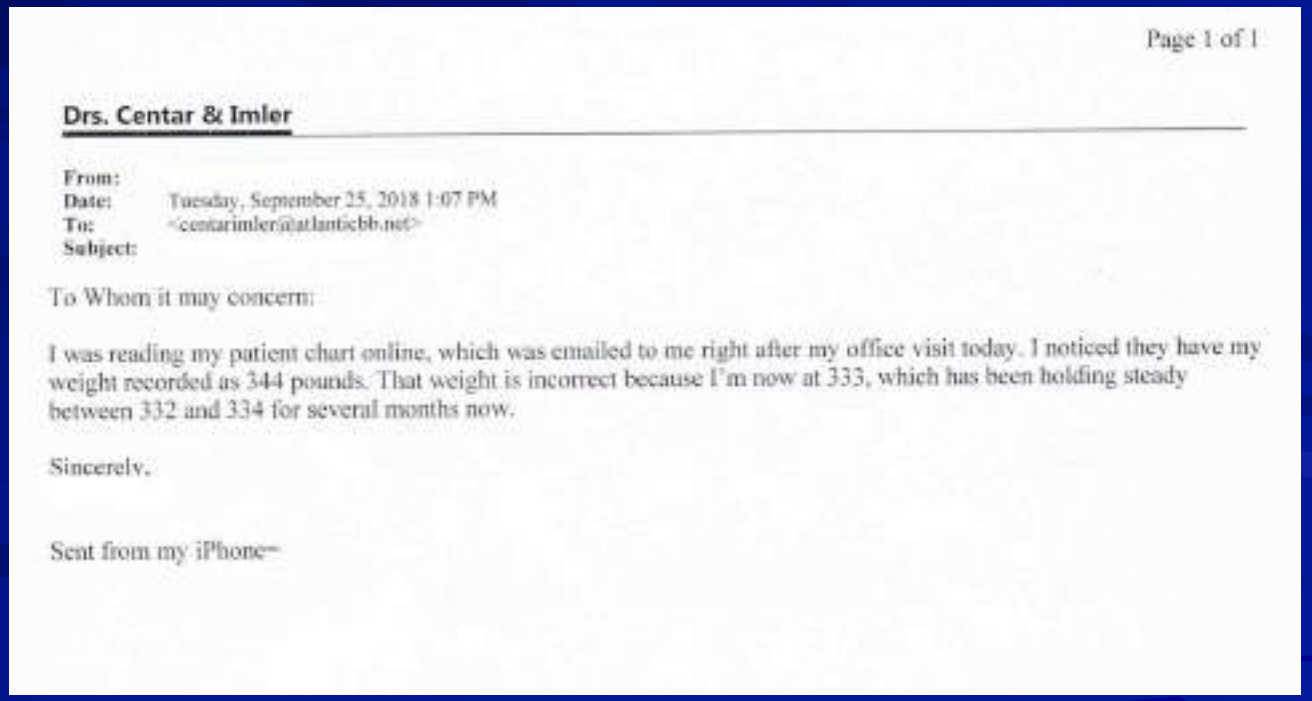
Montage OS


Angio Montage
Left / OS
Exit
Overview
Print
Reset View
Edit
Vitreous/Retina
Outer/Choroid
Layers:
Vitreous
Superficial
Deep
Greyscale
Click image to select layer. Use scrollwheel to adjust layer.

Montage OU



They do read their EHR communication



Page 1 of 1

Drs. Centar & Imler

From:
Date: Tuesday, September 25, 2018 1:07 PM
To: <centarimler@atlanticbb.net>
Subject:

To Whom it may concern:

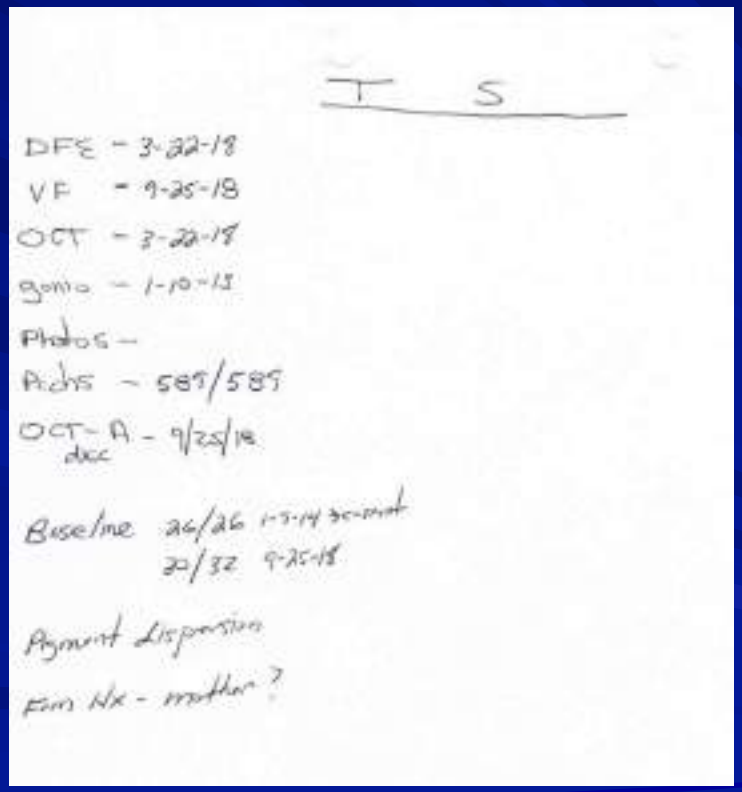
I was reading my patient chart online, which was emailed to me right after my office visit today. I noticed they have my weight recorded as 344 pounds. That weight is incorrect because I'm now at 333, which has been holding steady between 332 and 334 for several months now.

Sincerely,

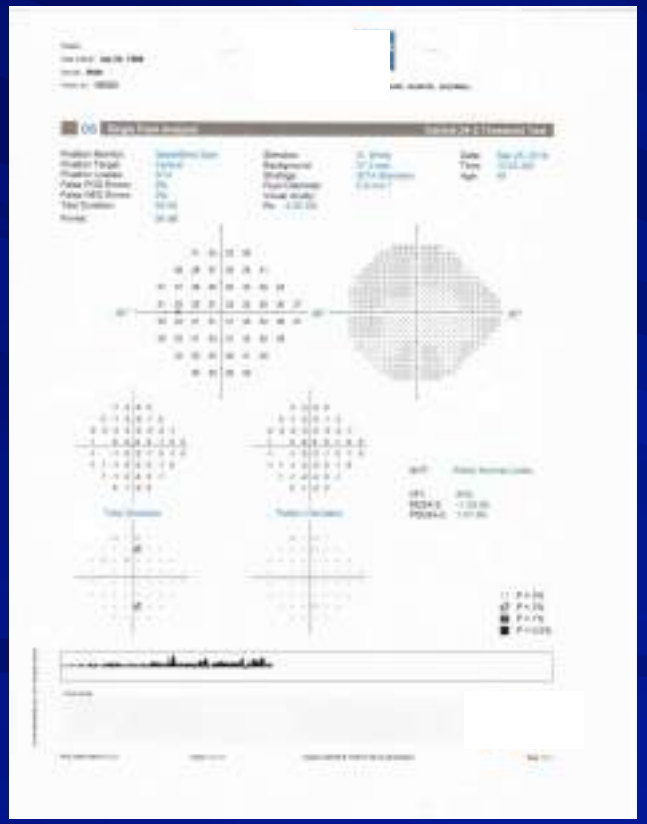
Sent from my iPhone

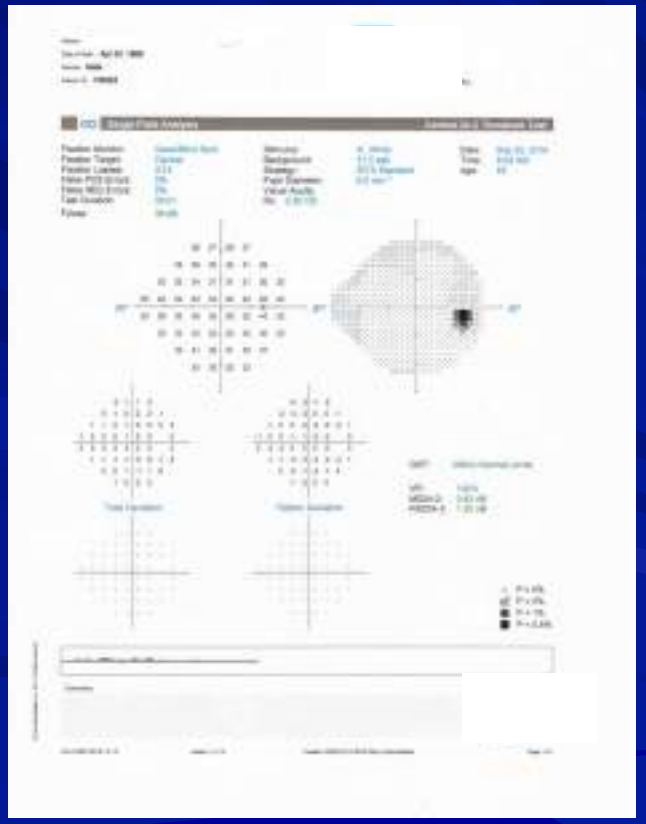
49 year old man

- Ocular Hypertension since 2014
  - No treatment
- Pigment Dispersion
- Baseline IOP or Tmax 26/26
  - 2014— March 2018
- Today 30/32, new Tmax 9-25-18

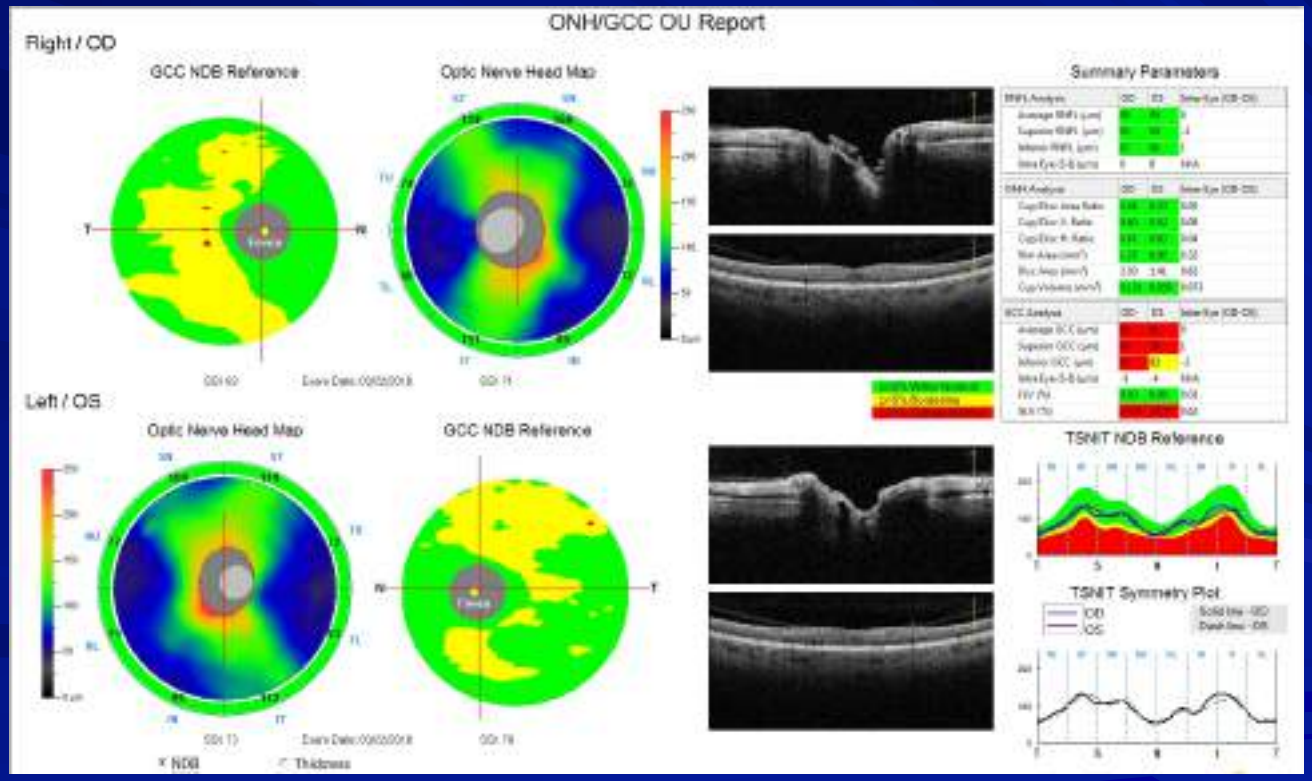


VF 24-2 Sita-Faster
9-25-2018

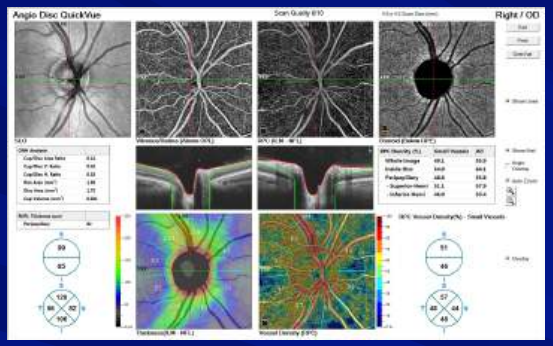


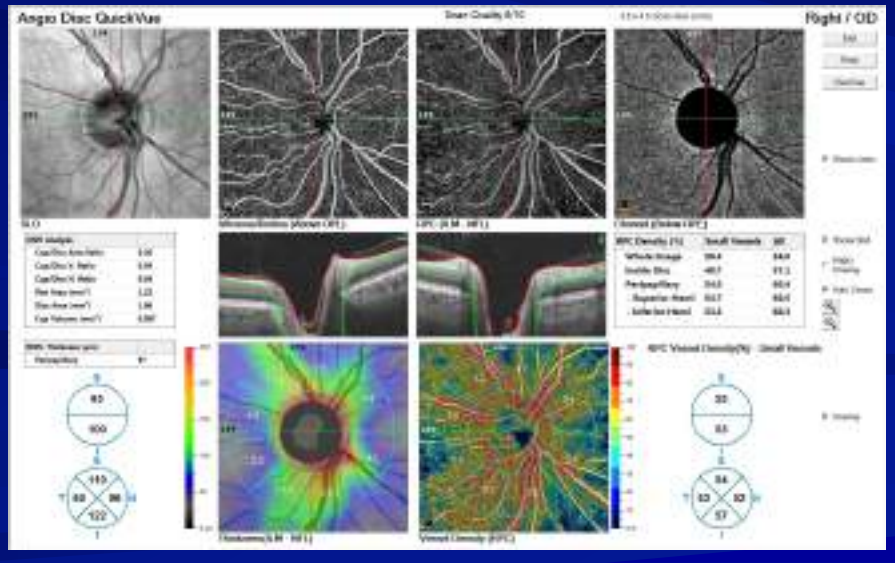


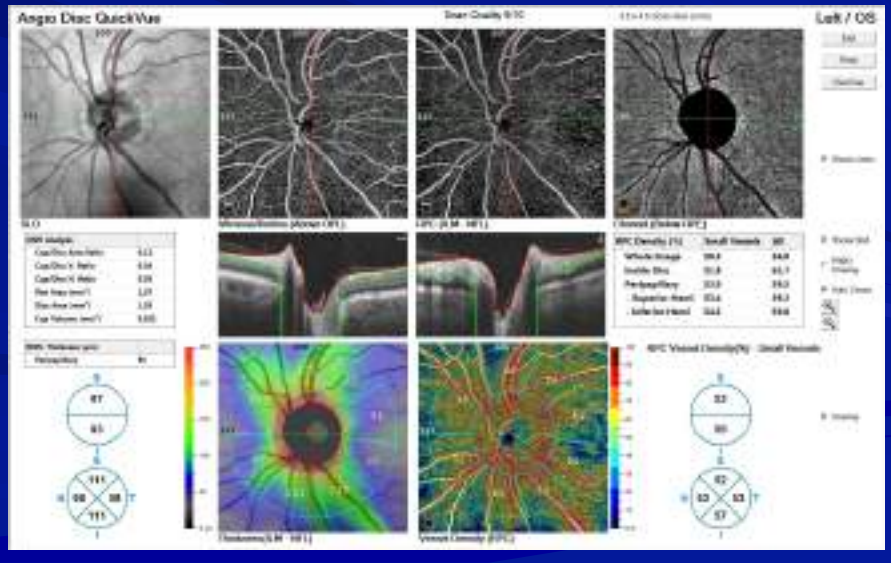
OCT NFL and GCC
3-22-18



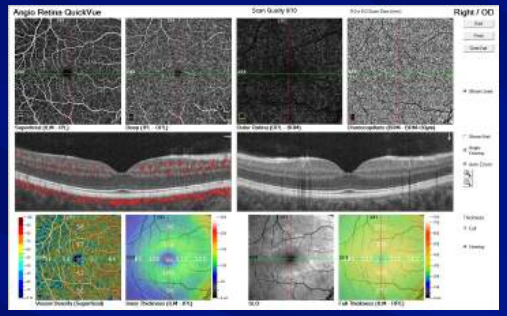
OCT-A 9-25-2018

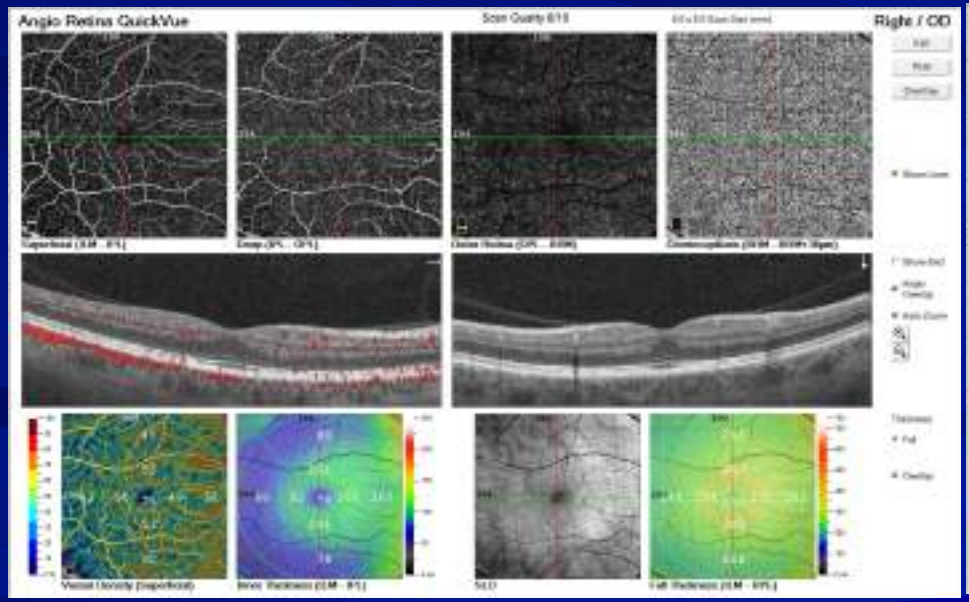


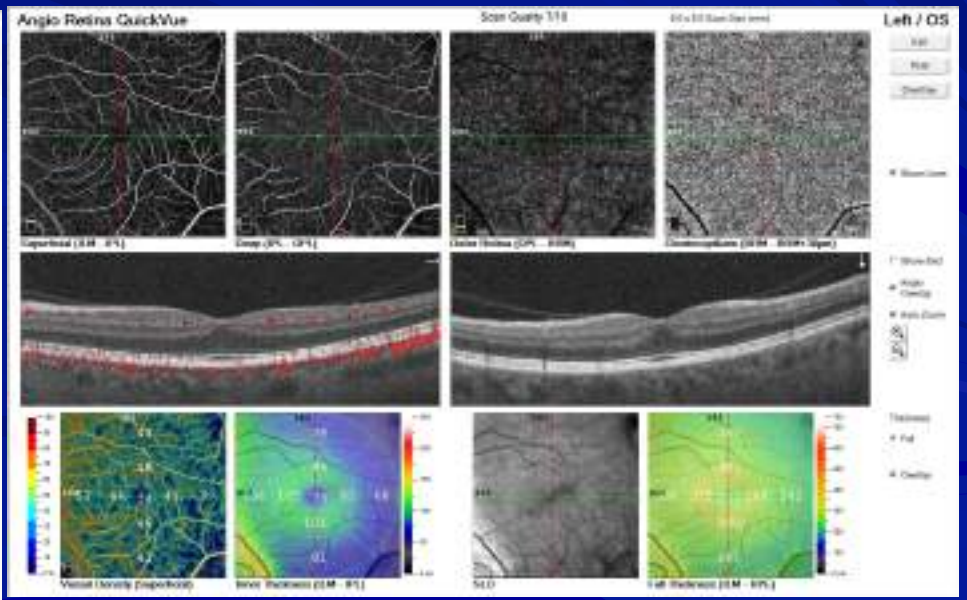




OCT-A 9-25-2018







Montage OD


Angio Montage
Right / OD
Exit
Overlue
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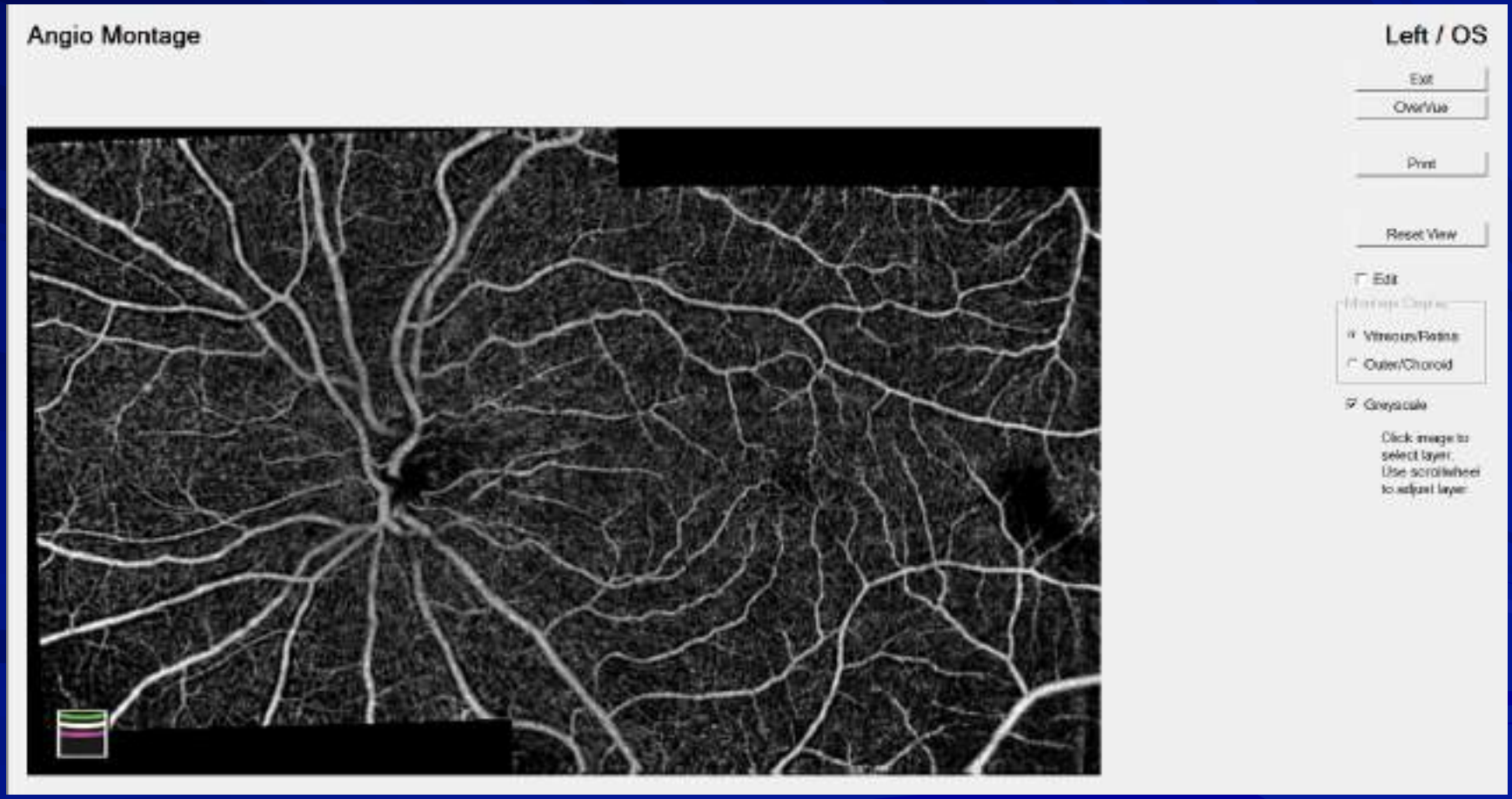
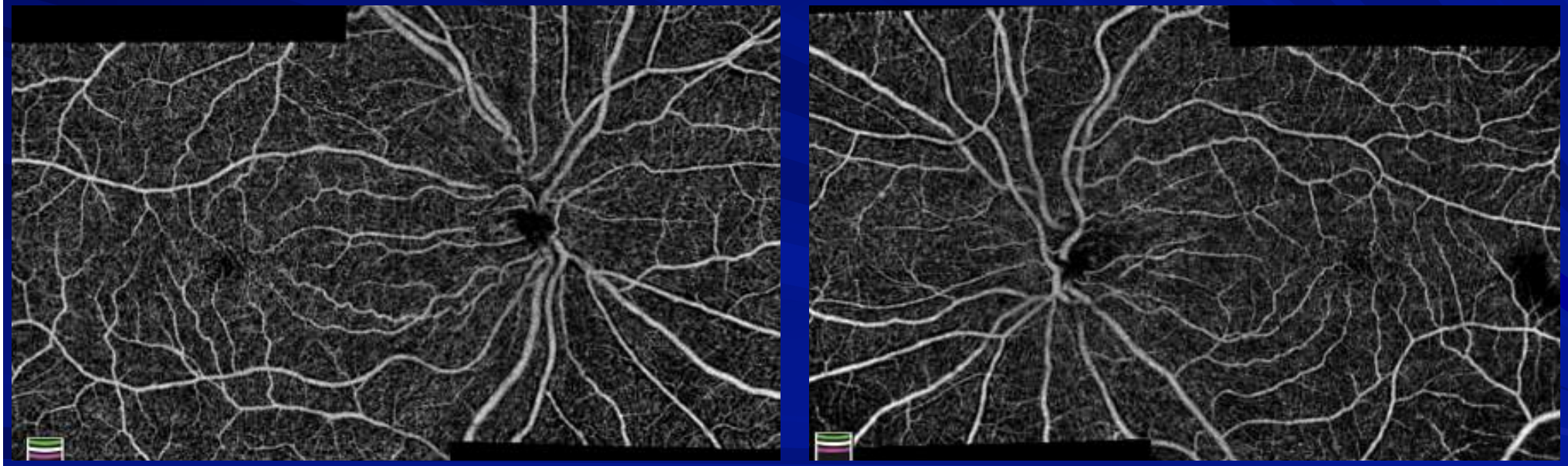
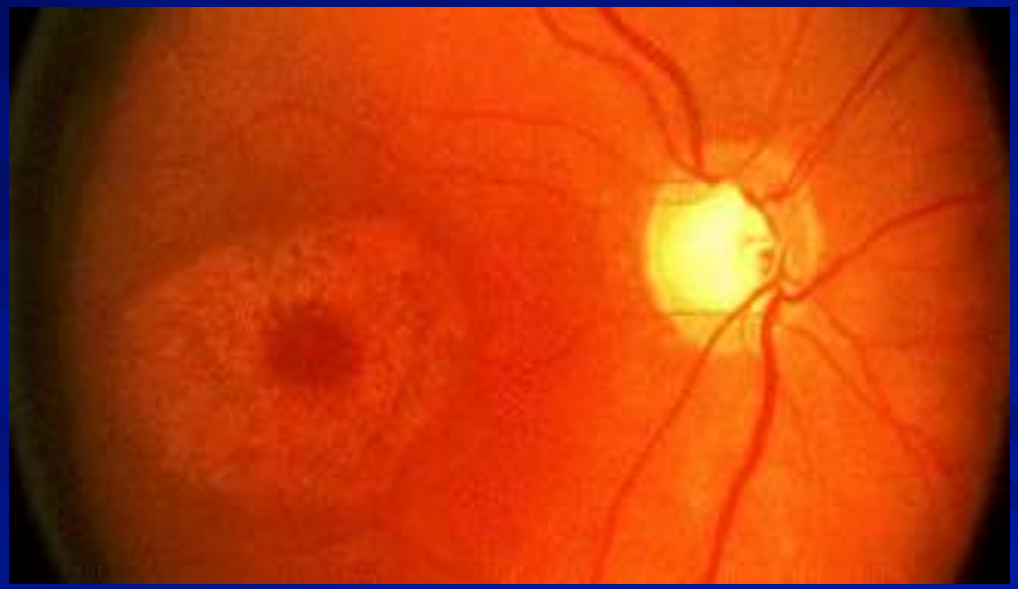
Reset View
Edit
Vitreous/Retina
Outer/Choroid
Grayscale
Click image to
select layer
Use scrollwheel
to adjust layer

Montage OS


Angio Montage
Left / OS
Exit
Overlay
Print
Reset View
Edit
Vitreous/Retina
Outer/Choroid
Greyscale
Click image to
select layer.
Use scrollwheel
to adjust layer.

Montage OU





Revised Recommendations on Screening for Chloroquine and Hydroxychloroquine Retinopathy

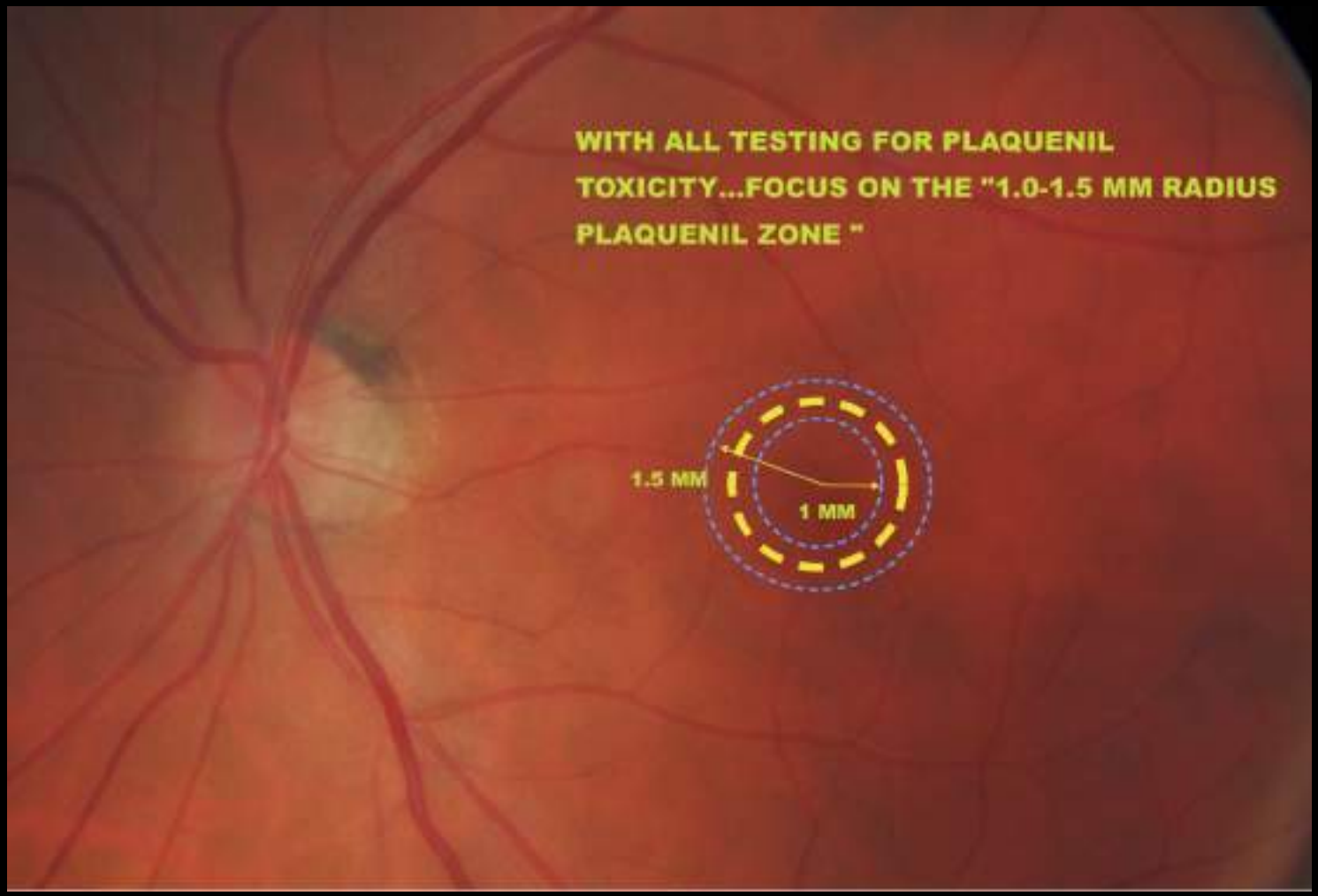
- Last recommendations were 2002 by the American Academy of Ophthalmology
- Improved screening tools and new knowledge about prevalence of toxicity have prompt the change
  - 1% after 5-7 years of use or a cumulative dose of 1000 grams (Plaquenil)
- There is no treatment for this condition
  - Therefore must be caught early
- Screening for the earliest hints of functional or anatomic change
- Plaquenil toxicity is not well understood

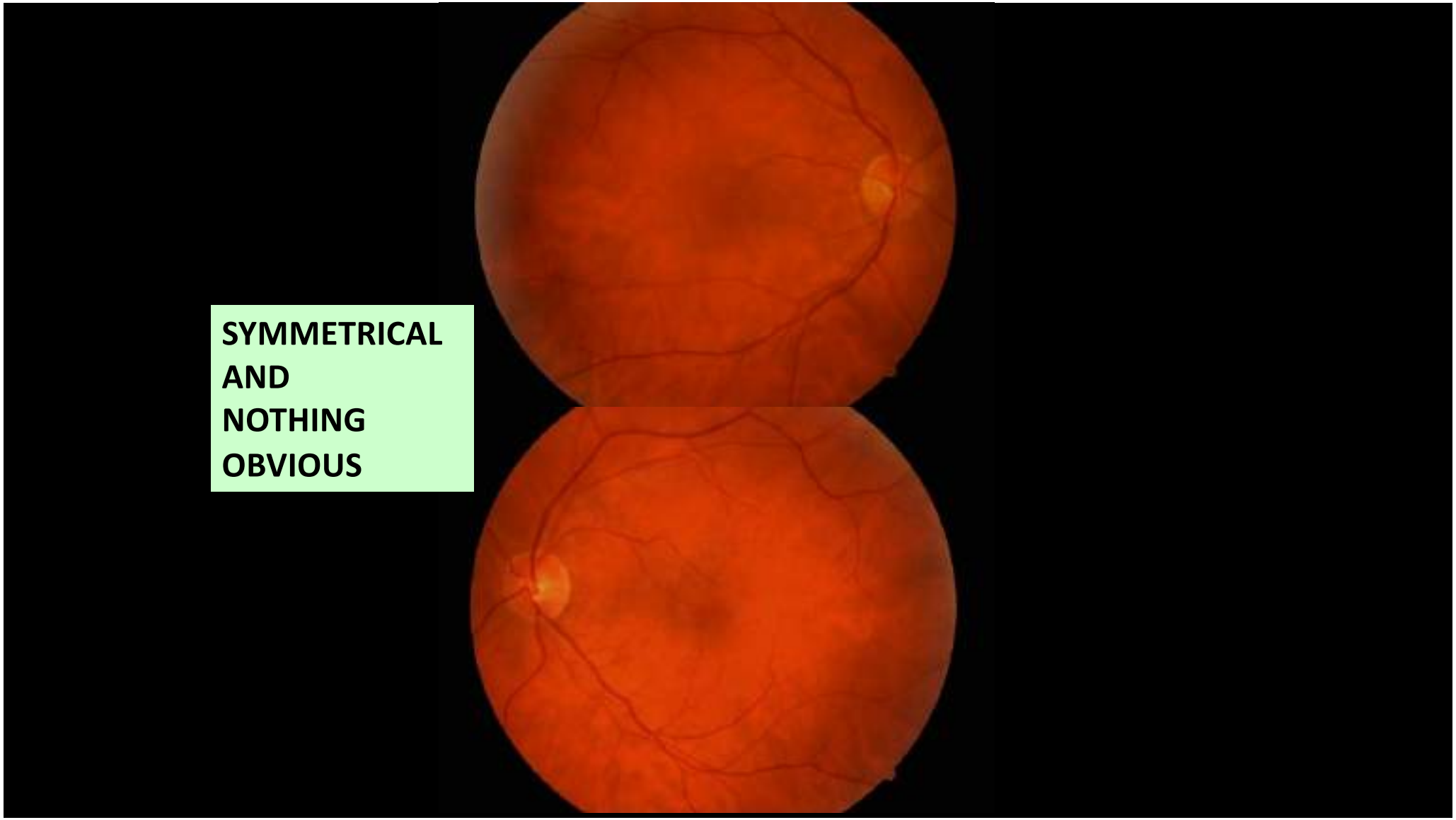
American Academy of Ophthalmology Update

Revised Recommendations on Screening for Chloroquine and Hydroxychloroquine Retinopathy

Ophthalmology Volume 118, Number 2, February 2011

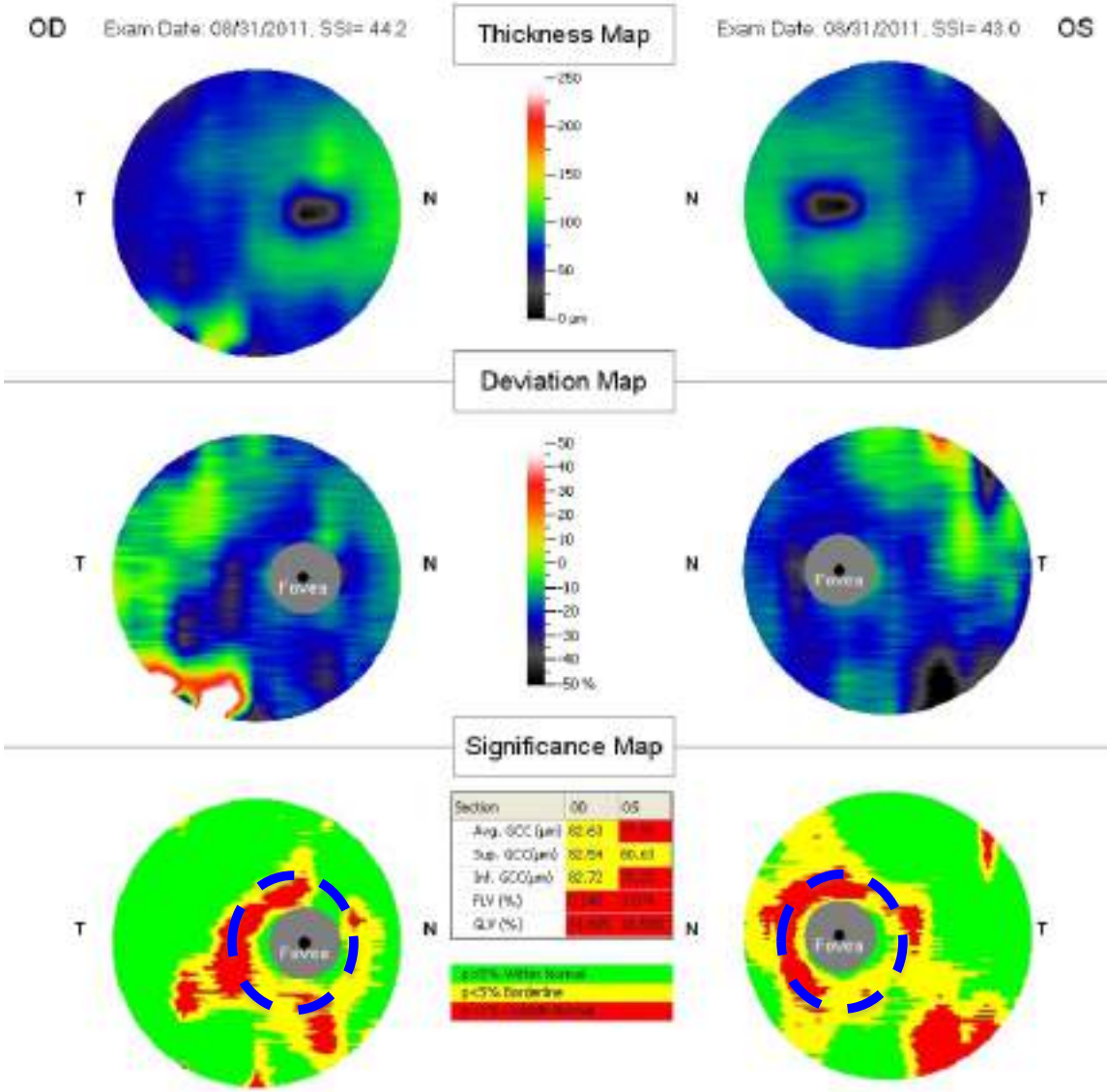
PLAQUENIL ZONE




SYMMETRICAL
AND
NOTHING
OBVIOUS

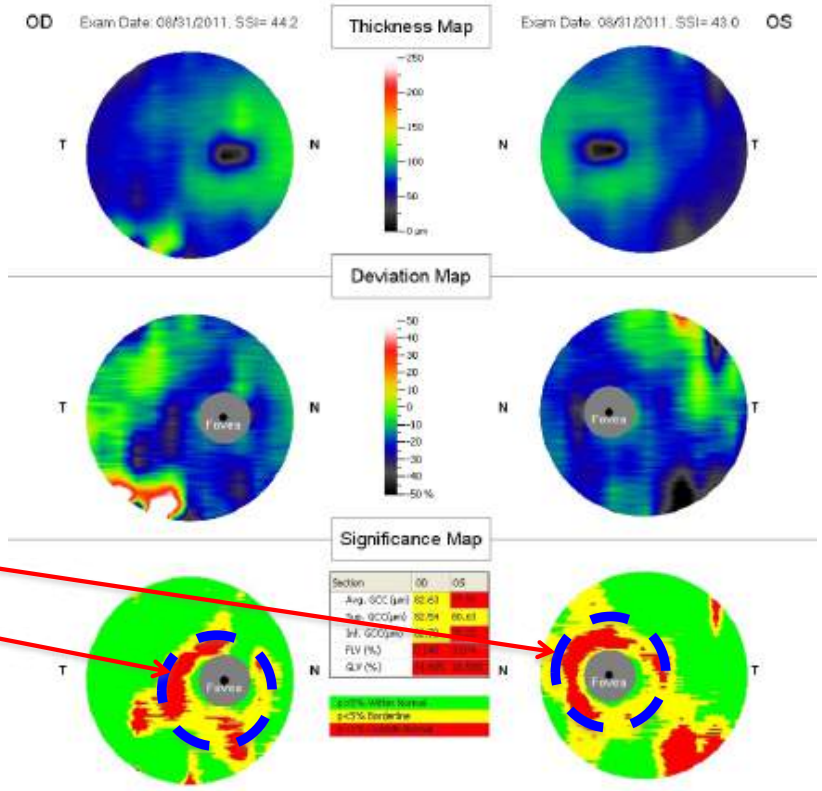
1-1.5 MM PERIMACULAR GCC THINNING THE FIRST SIGN OF PLAQUENIL TOXICITY

WHY? THICKEST LAYER OF GANGLION CELLS AND SMALLEST GANGLION CELLS AT THAT LOCATION. VERY SENSITIVE TO TOXICITY


OD
Exam Date: 08/31/2011, SSI= 44.2
Thickness Map
Exam Date: 08/31/2011, SSI= 43.0
OS
T
N
N
T
250
200
150
100
50
0 µm
Deviation Map
T
N
N
T
Fovea
50
40
30
20
10
0
-10
-20
-30
-40
-50 %
Significance Map
T
N
N
T
Fovea
Section
OD
OS
Avg. GCC (µm)
Sup. GCC(µm)
Inf. GCC(µm)
FLV (%)
GLV (%)
82.63
82.84
82.72
p<5% Borderline

WHAT DO YOU SEE ON THE SCANS?

A. THINNING OF THE GCC IN THE PLAQUENIL ZONE
B. MACULAR EDEMA
C. COMPROMISED PIL
D. NOTHING OF IMPORT



DO YOU SEE ANY PROBLEM IN THE PLAQUENIL ZONE?

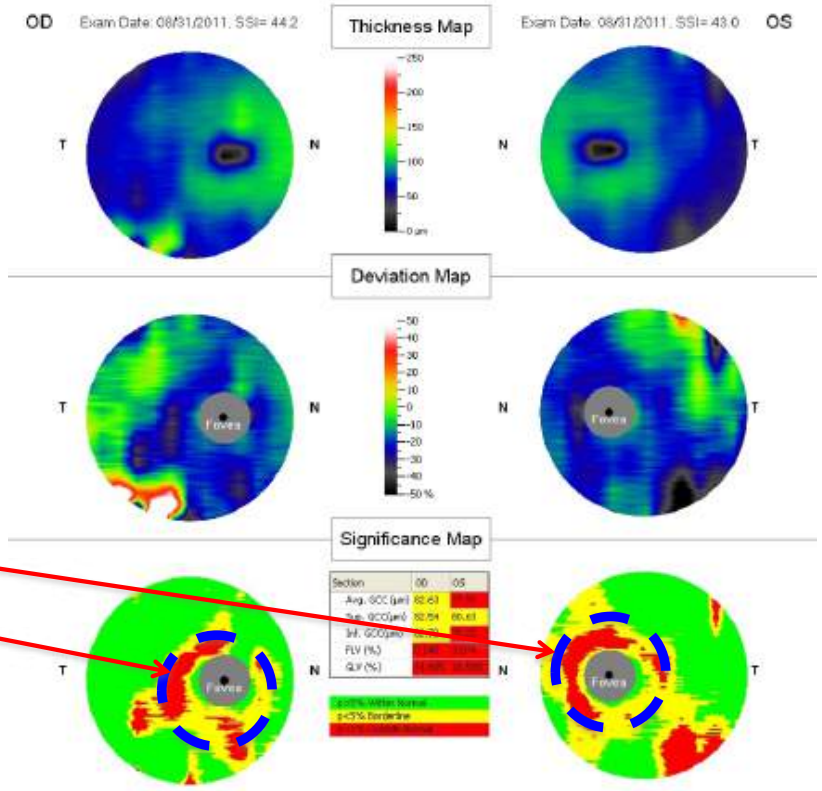
WHAT DO YOU SEE ON THE SCANS?

A. THINNING OF THE GCC IN THE PLAQUENIL ZONE

B. MACULAR EDEMA

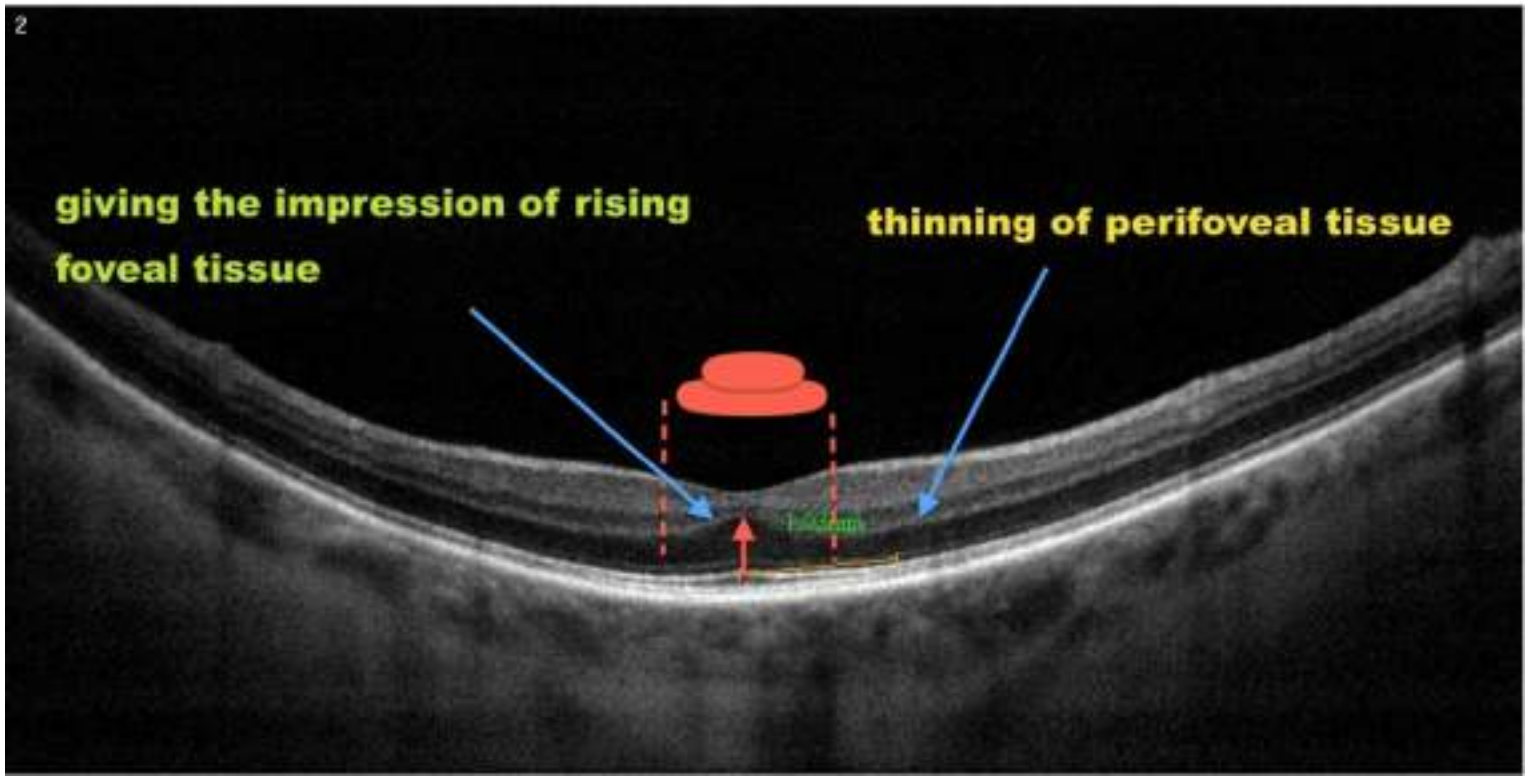
C. COMPROMISED PIL

D. NOTHING OF IMPORT

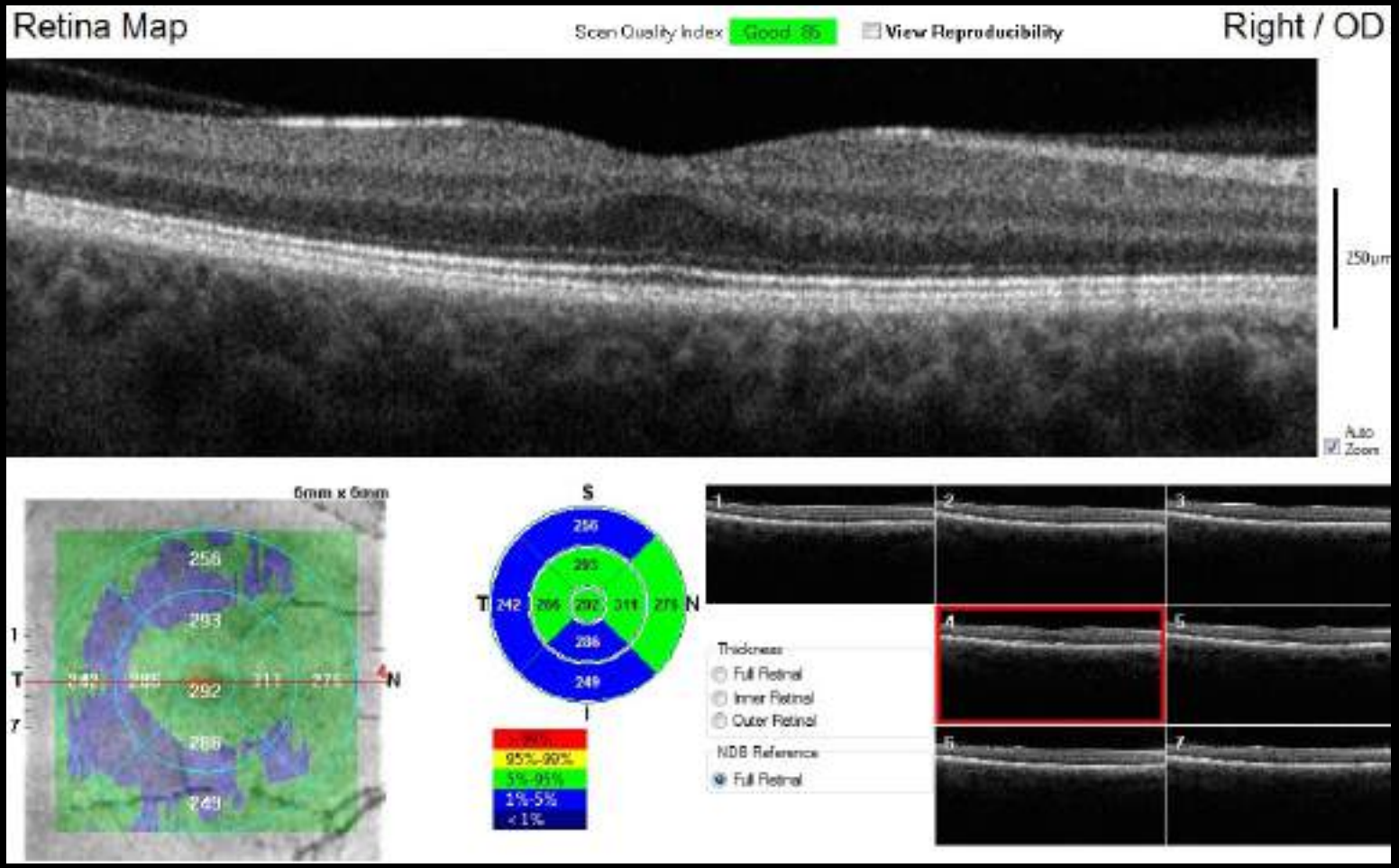


DO YOU SEE ANY PROBLEM IN THE PLAQUENIL ZONE?

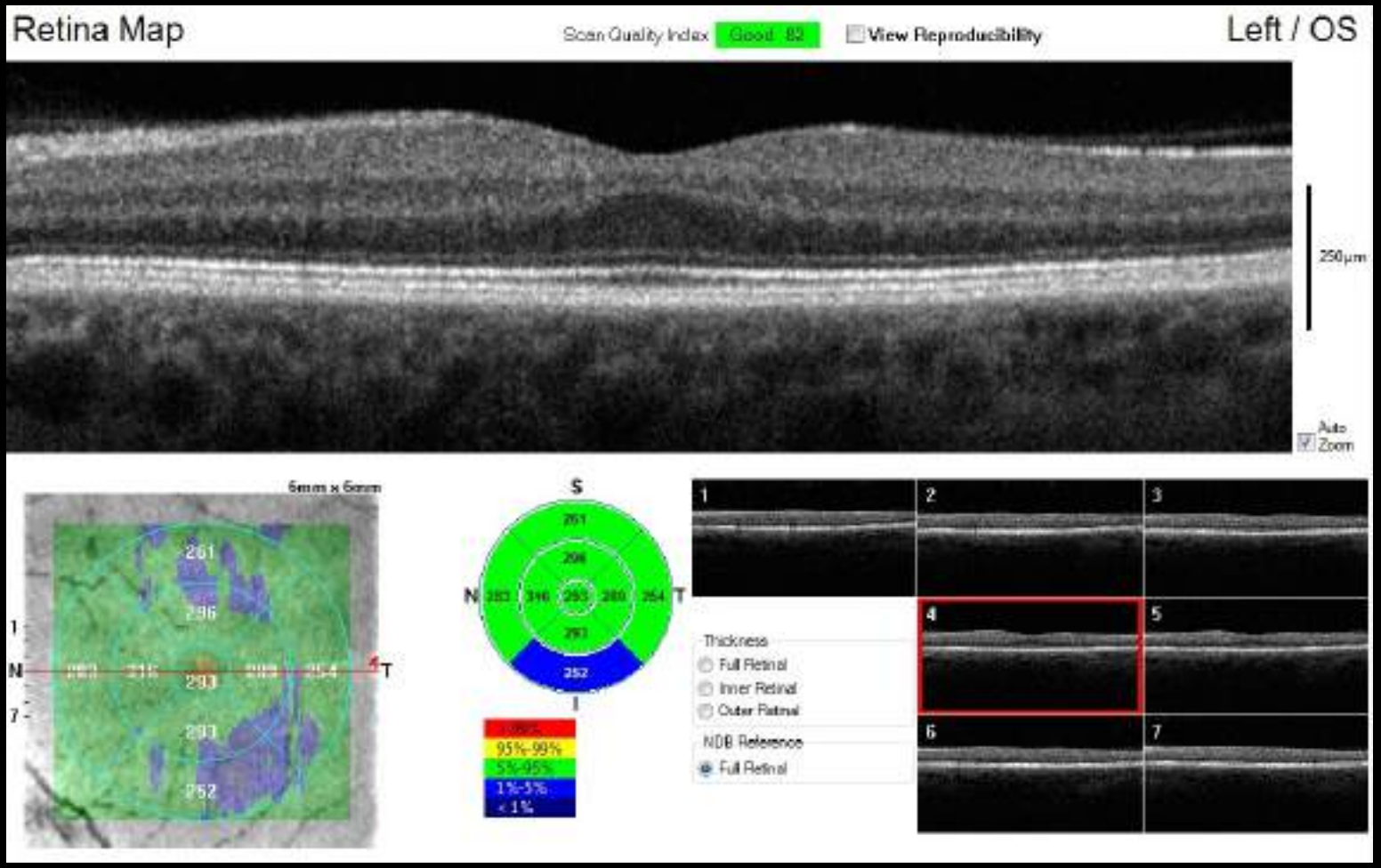
Figure 1 The flying saucer sign representing compromise of the perifoveal retinal tissue with maintenance of the foveal retinal tissue. From Chen E, Brown DM, Benz MS, et al. Spectral domain optical coherence tomography as an effective screening test for hydroxychloroquine retinopathy (the "flying saucer" sign). Clin Ophthalmol. 2010; 4: 1151–1158. Published online 2010 October 21.
doi: 10.2147/OPTH.S14257



AUGUST 2014

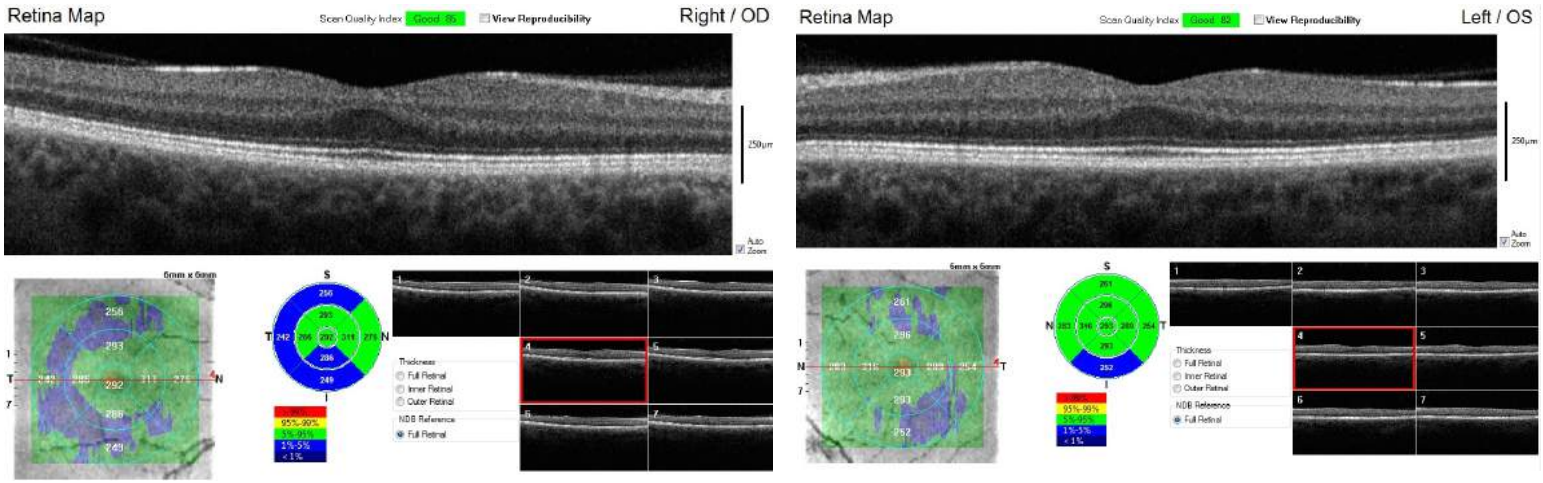

Retina Map
Scan Quality Index Good 85
View Reproducibility
Right / OD
250µm
Auto Zoom
6mm x 6mm
256
293
T
292
N
I
S
T 242 286 292 311 N
I
Thickness
Full Retinal
Inner Retinal
Outer Retinal
NDB Reference
Full Retinal
1
2
3
4
5
6
7

AUGUST 2014


Retina Map
Scan Quality Index Good 82
View Reproducibility
Left / OS
250 µm
Auto Zoom
6mm x 6mm
261
296
293
252
S
N
T
I
95%-99%
5%-95%
1%-5%
< 1%
Thickness
Full Retinal
Inner Retinal
Outer Retinal
NDB Reference
Full Retinal
1
2
3
4
5
6
7

WHAT DO YOU SEE ON THE SCANS?

A. THE FLYING SAUCER SIGN
B. MACULAR EDEMA
C. INCREASED PERIMACULAR RETINAL THINNING
D. A AND C



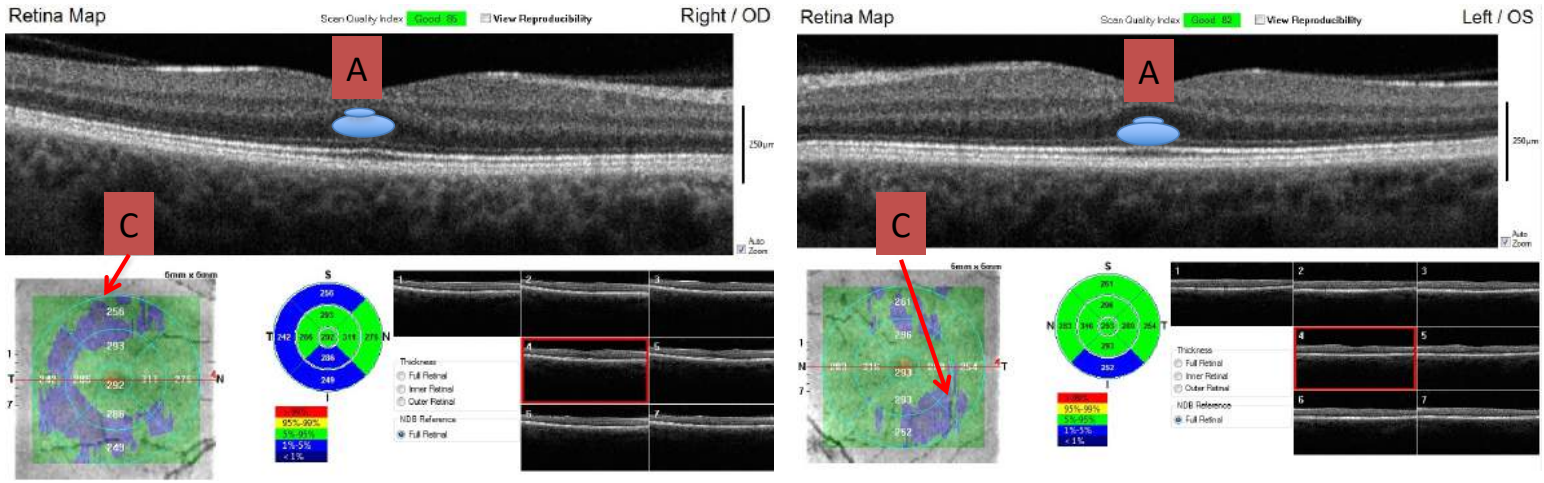
WHAT DO YOU SEE ON THE SCANS?

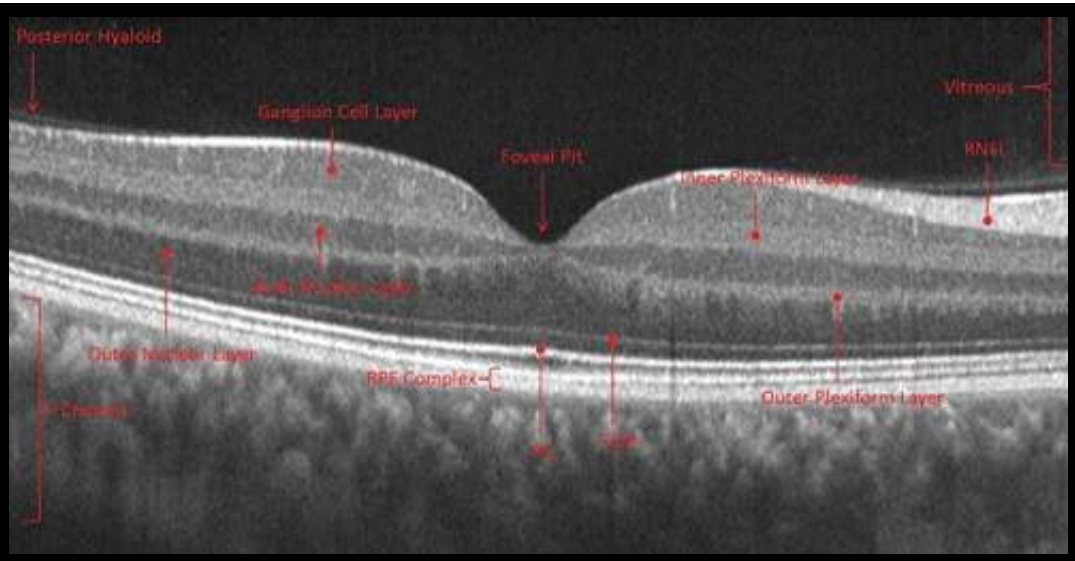
A. THE FLYING SAUCER SIGN

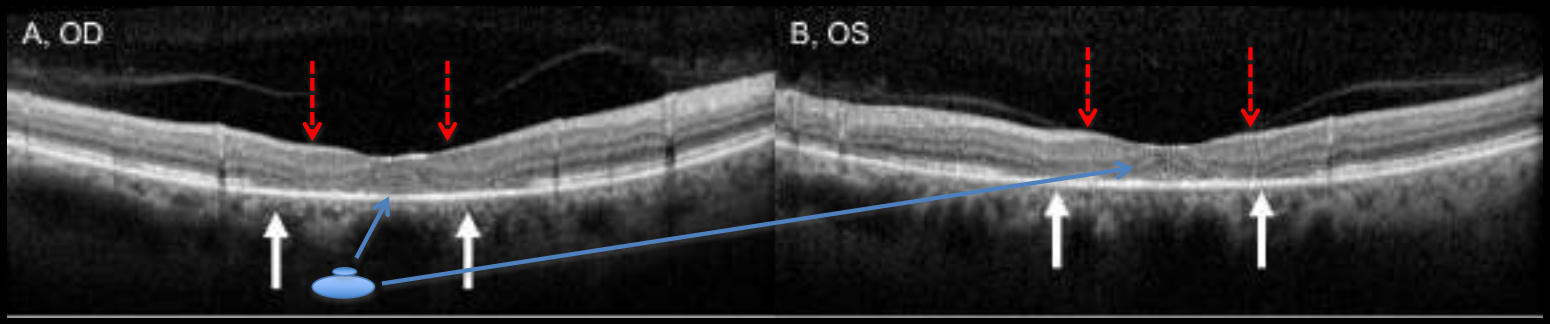
B. MACULAR EDEMA

C. INCREASED PERIMACULAR RETINAL THINNING

D. A AND C







BILATERAL COMPROMISE OF THE PIL (WHITE ARROWS) AFTER COLLAPSE OF PERIFOVEAL RETINA (RED DASHED ARROWS) WITH FLYING SAUCER ATTACK (BLUE ARROWS)

THE END GAME…ONCE YOU DISCONTINUE PLAQUENIL IT STAYS AROUND A WHILE TO CREATE DAMAGE..LONG ½ LIFE

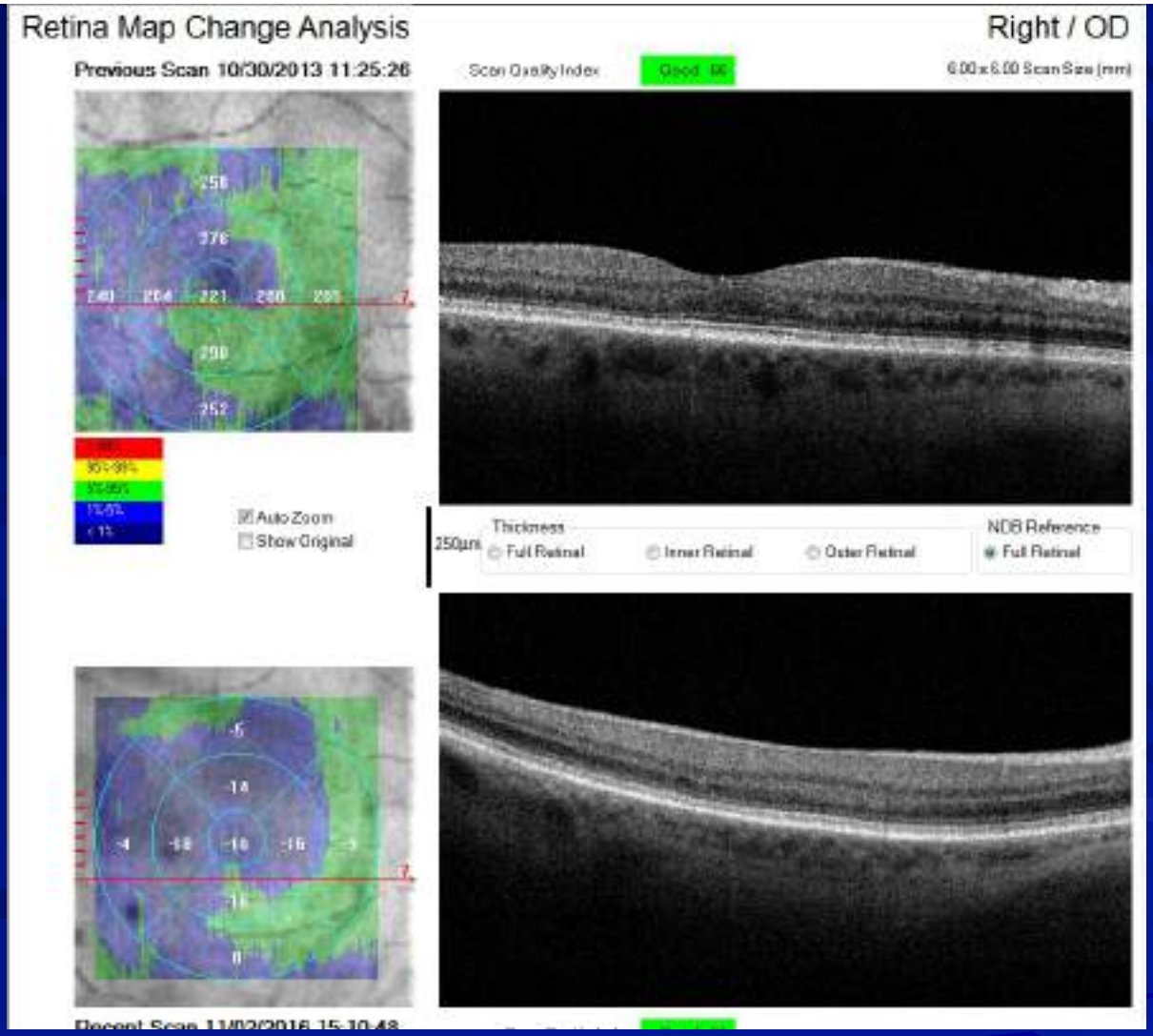
WAY OUTTA THE BARN

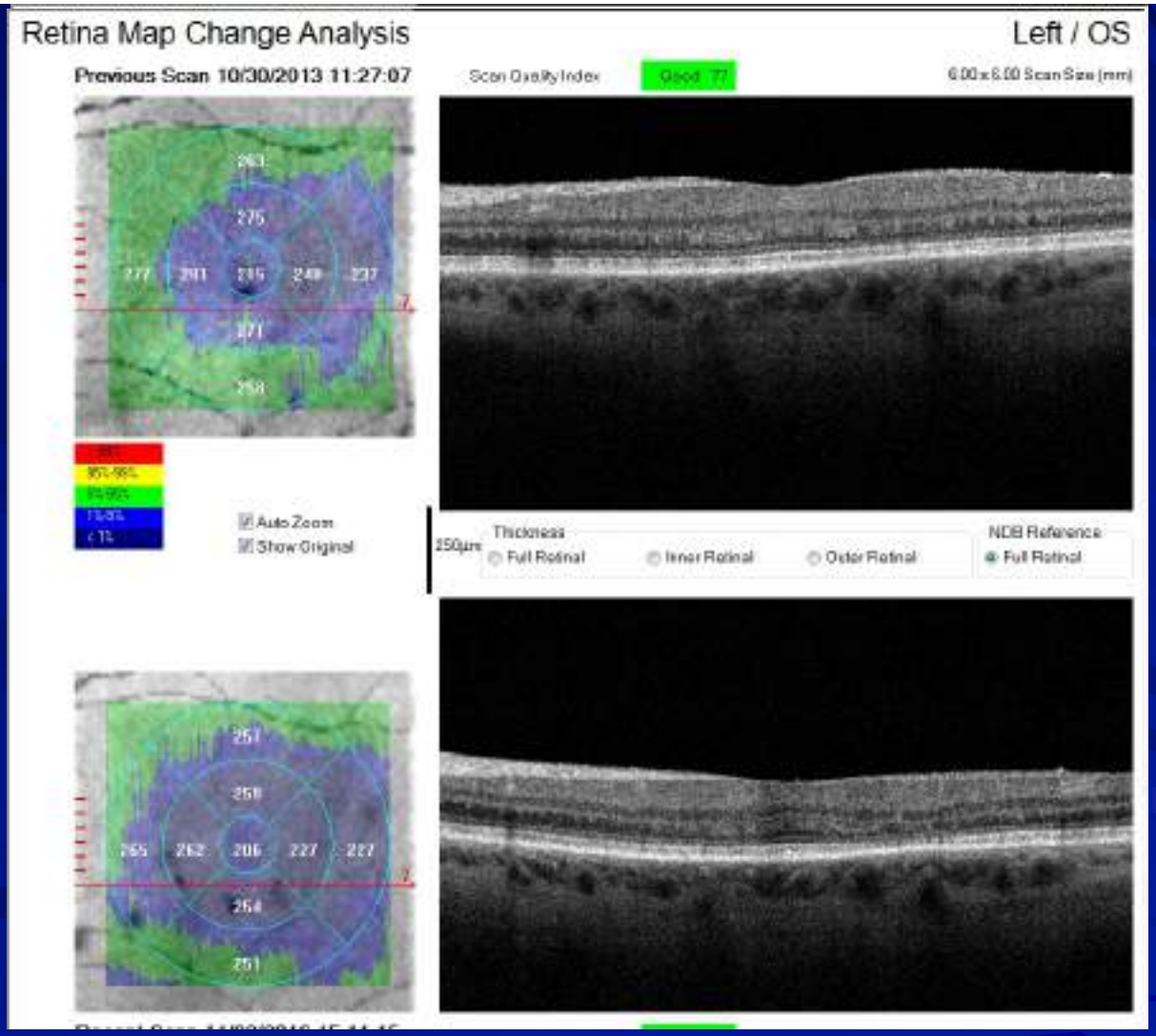
71 yo woman

- With Lupus and hypertension
- Medications:
  - Colazapam
  - Plaquenil 200 mg BID, 15 years
  - 81 mg ASA
  - Prednisone
  - Losartin
- VA 20/25 OD/OS (mild cataracts)
- Patient was told to see an ophthalmologist in 2013

2016

2016


Retina Map Change Analysis
Right / OD
Previous Scan 10/30/2013 11:25:26
Scan Quality Index
Good 96
6.00 x 6.00 Scan Size (mm)
258
376
240
284
321
280
283
299
252
Auto Zoom
Show Original
250µm
Thickness
Full Retinal
Inner Retinal
Outer Retinal
NDB Reference
Full Retinal
-5
-14
-4
-18
-16
-16
-3
-16
8


Retina Map Change Analysis
Left / OS
Previous Scan 10/30/2013 11:27:07
Scan Quality Index
Good 77
6.00 x 6.00 Scan Size (mm)
263
275
277
261
245
249
237
271
258
Auto Zoom
Show Original
250µm
Thickness
Full Retinal
Inner Retinal
Outer Retinal
NDB Reference
Full Retinal
251
258
255
262
206
227
227
254
251

Questions?

Thank You!

grubod@gmail.com

814-931-2030