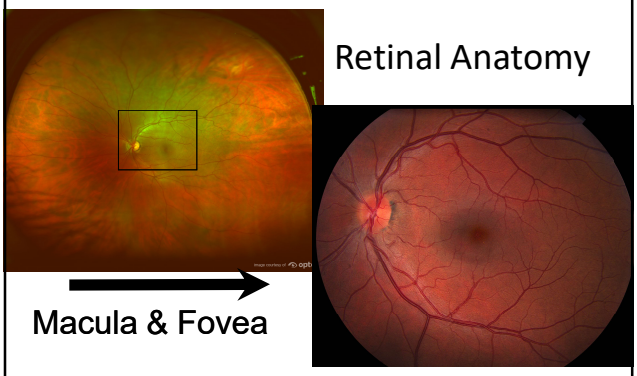
Optical Coherence Tomography:
Indications and Interpretation

- Mid-Atlantic Retina
- Wills Eye Hospital
- Carl H. Park, MD

Retinal Anatomy



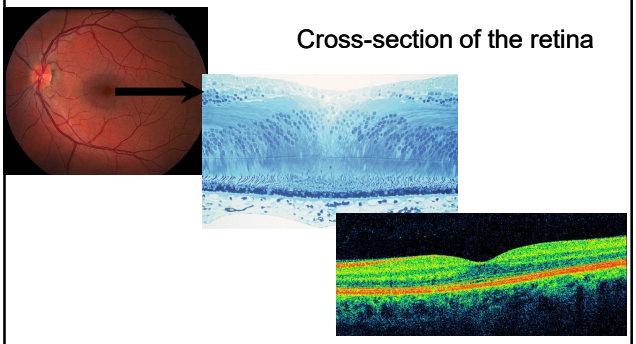
Objectives

- Understand principles of OCT
- Develop a strategy for reviewing OCT images
- Be able to integrate OCT interpretation into the diagnosis and management of common retinal diseases

What is OCT?

Optical Coherence Tomography

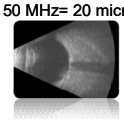
- Introduced by Huang, et al. in 1991 as a high-resolution, noninvasive, in vivo ophthalmic imaging technique



Cross-section of the retina

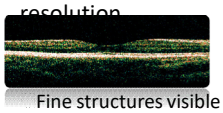
Ultrasound vs OCT

- Sound Waves
- Reflection from intraocular structures
- Requires direct contact
- Resolution
  - Depends on frequency
  - 10 MHz= 150 microns
  - 50 MHz= 20 microns

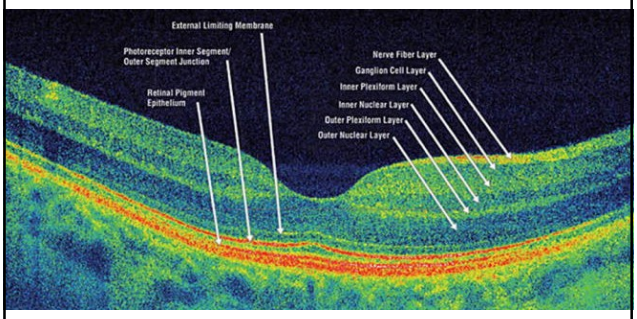


Light

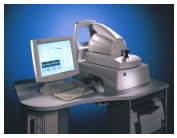
- Reflection from intraocular structures
- No physical contact
- Higher spatial resolution



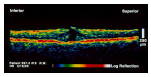
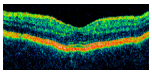
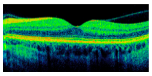
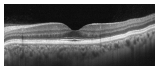
- Fine structures visible

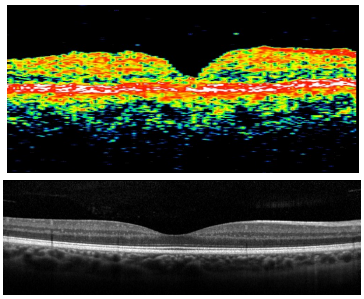


Different types of OCT





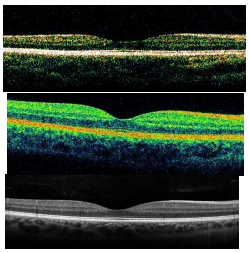
		Single line scan	Scans/ second	Resolution (microns)	
	OCT 1995	100 A-scans x 500 points	100	20	
	OCT3 Stratus OCT 2002	512 A-scans x1024 points	500	10	
	Cirrus HD-OCT 2007	4096 A-scans x 1024 points	27,000	5	
	Advanti RT-Vue XR 2014	10,000 A-scans x >100 million points	70,000	3	



TD-OCT vs. SD-OCT

Time domain OCT
- 400 A-scans per second
- 10 microns resolution

Spectral domain OCT
- 40,000 A-scans per second
  - Less motion artifact
- 3-4 micron resolution



Benefits of Spectral Domain

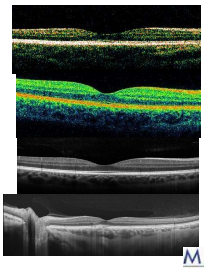
- Images more area
- Cube- 3D analysis
- Higher resolution, better visualization
- Faster scan acquisition
- Eye tracking
- Correlation of fundus images with OCT placement

Mid Atlantic RETINA

SD-OCT vs. SS-OCT (Swept Source)

Spectral domain OCT (SD-OCT)
- 40,000 A-scans per second
- 3-4 micron resolution
- Less motion artifact
- Eye tracking
- Correlation of fundus images with OCT placement

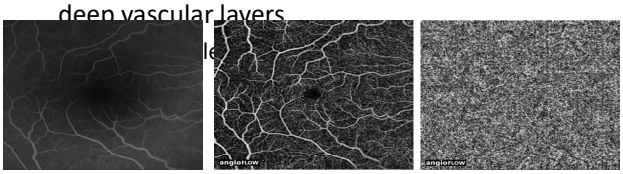
Swept Source OCT (SS-OCT)
- 100,000 to 400,000 A-scans per second
- 5.3 micron resolution
- Imaging down to individual photoreceptors
- Even less motion artifact
- Better penetration through ocular opacities

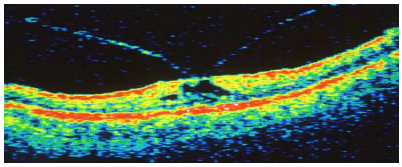


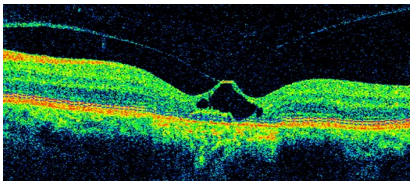
Mid Atlantic RETINA

What is OCT angiography?

- Fast, non-invasive OCT-based imaging technique to visualize vasculature
- Depth resolved: separates superficial and deep vascular layers







OCT Angiography

- Fast, non-invasive OCT-based imaging technique to visualize vasculature
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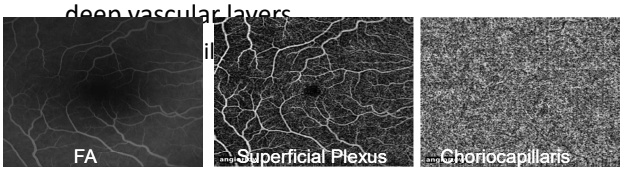
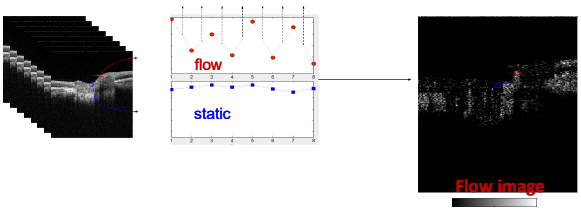


How does OCTA Work?



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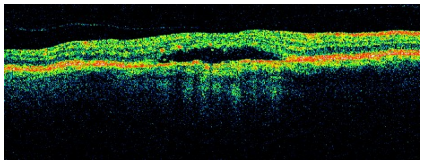
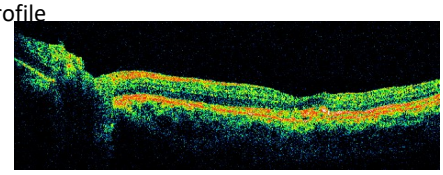
OCT Images

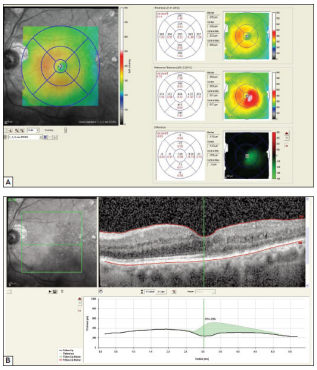
- Highly reflective red layer
  - delineates the posterior boundary of the retina
  - corresponds to the RPE and choriocapillaris

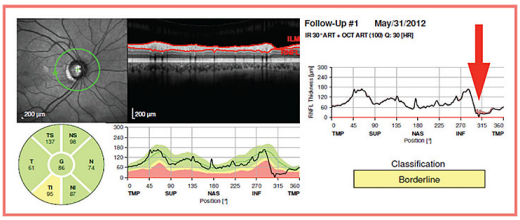


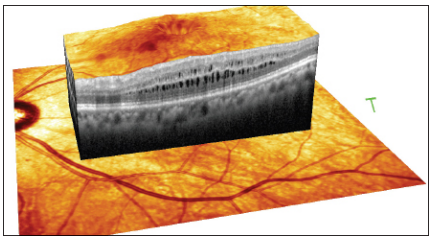
OCT Images

- Large scale anatomic features
  - fovea
  - optic disc
  - retinal profile



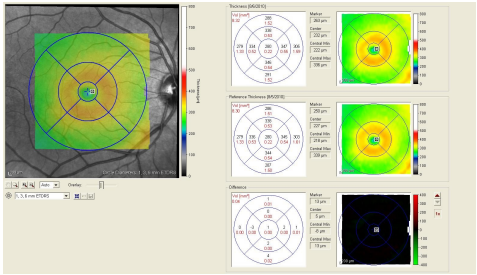




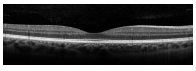


Mid Atlantic RETINA

Retinal Thickness: SD-OCT

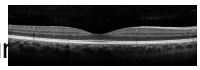


Interpreting OCT's



- Ensure you have the correct patient's scan
- Look at the signal strength index or equivalent
- Look at horizontal and vertical B-scans, determine if there is motion artifact or multiple B-scan averaging
- Analyze it from anterior to posterior
- Look at all scans (radials, volumes)

Interpreting OCT's



Vitreous: Partial PVD, PVD, u
comment on PVD status; is it clear?

Inner macular and foveolar contour: is it normal or not? How is it abnormal?

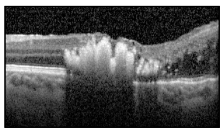
Retinal thickness: Too thick, too thin? Which layers are abnormally thick or thin?

N.B.: Try to find normal retina and then trace it into areas of pathology

Reflectivity

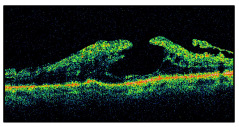
Increased due to:

- Subretinal fibrosis
- Hard Exudates
- Hemorrhage



Decreased due to:

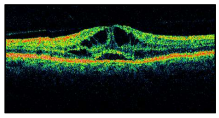
- Increased fluid/ edema



Retinal Thickness

Retinal Thickness

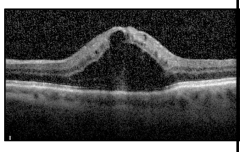
- Important in assessment of macular disease
- Following patients
  - diabetic retinopathy
  - cystoid macular edema



- Thickness increased in edema

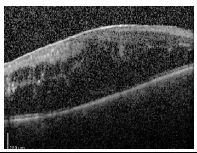
Note presence or absence of cystic spaces

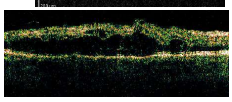
Decreased thickness in atrophy or scarring



Interference

- Decreased signal from
  - Reduction in the incident light
    - Dense cataract
    - Cloudy media
    - Poorly centered IOL
    - Small capsulotomy





Results in hypo reflectivity

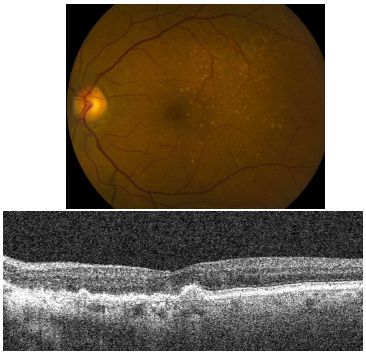
Dry AMD

83 yo male returns for annual ophthalmic exam, no complaints

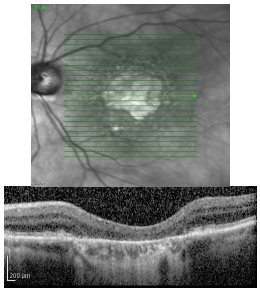
Va 20/30 OU

Exam reveals large drusen

AREDS vitamins



Dry AMD: Geographic Atrophy

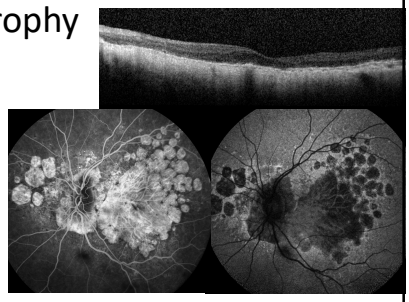


Dry AMD: Geographic Atrophy

87 yo female with longstanding central scotoma, no visual changes

Va 20/200

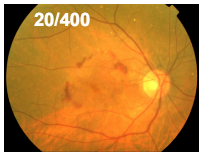
Exam and OCT reveal

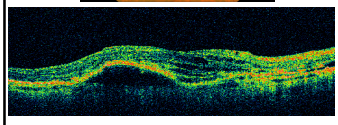


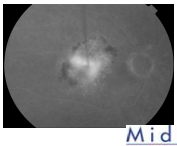
Treat and Extend for Wet AMD

- Treat patient until dry
  - Initial evaluation obtain FA and OCT
  - Document on OCT when dry
- Extend follow-up by 1-2 weeks when dry
- If exudation recurs, shorten follow-up to previous interval
- This treatment algorithm minimizes patient follow-ups and injections with maximizes visual outcome

Treat & Extend Case-Baseline







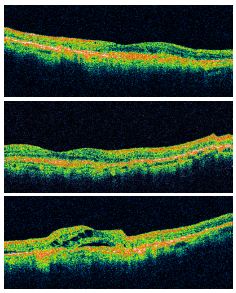
Mid Atlantic RETINA

Treat and Extend Case

LUCENTIS F/U 8 weeks

LUCENTIS F/U 10 weeks

LUCENTIS F/U 8 weeks

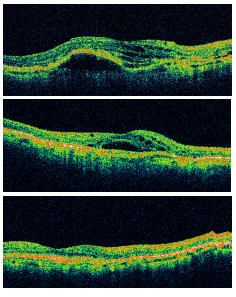


Treat and Extend Case

LUCENTIS F/U 4 weeks

LUCENTIS F/U 4 weeks

LUCENTIS F/u 6 weeks

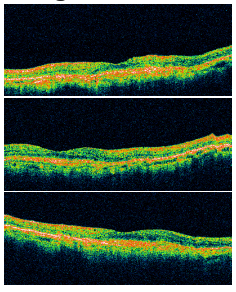


Treat and Extend Case

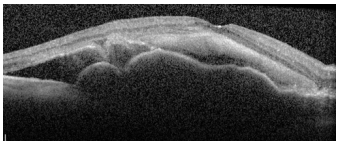
LUCENTIS F/U 8 weeks

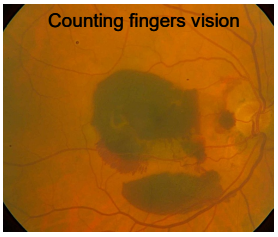
LUCENTIS F/U 10 weeks

LUCENTIS F/U 12 weeks

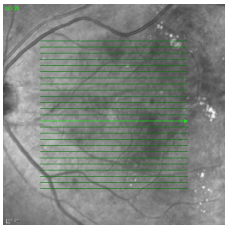


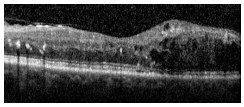
92 yo male with acute visual loss OD
Wet AMD: sub-retinal and sub-RPE hemorrhage





Diabetic Macular Edema





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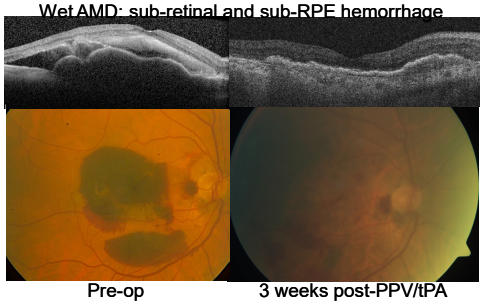
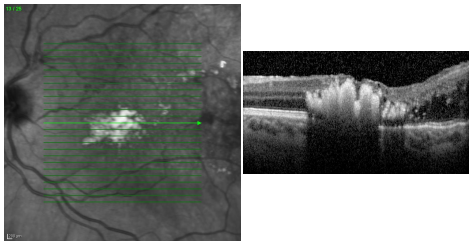


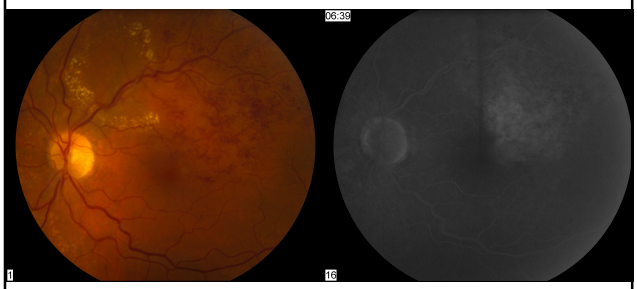
Pre-op
CF

3 weeks post-PPV/tPA
20/60 cc

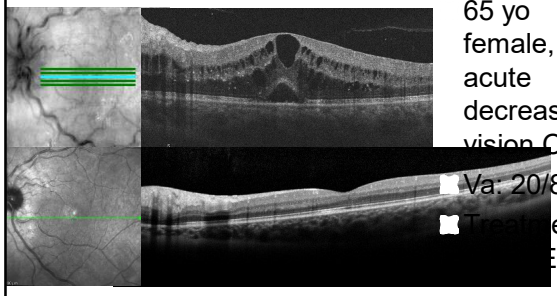
DME: Hard Exudates



BRVO

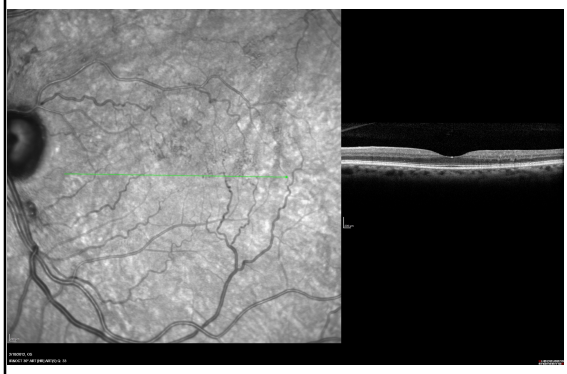


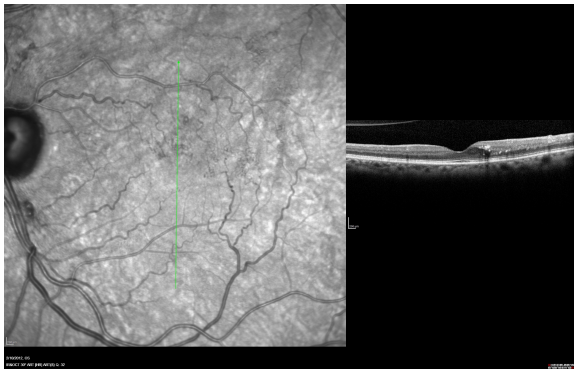
Central retinal vein occlusion



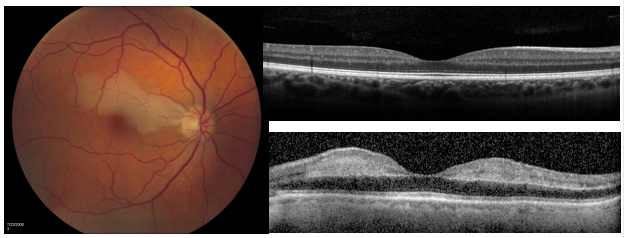
65 yo female, acute decrease vision OS

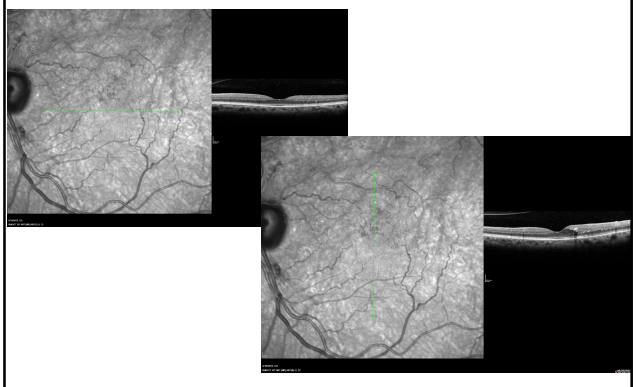
- Va: 20/80
- Treatment: EGF





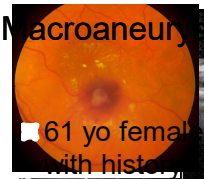
Retinal Artery Occlusion

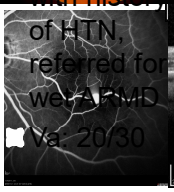


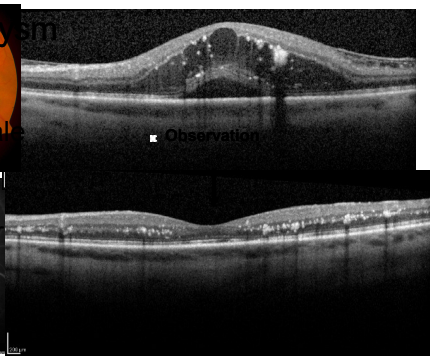


Macroaneurysm

- 61 yo female with history of HTN, referred for wet AMD
- Va: 20/30

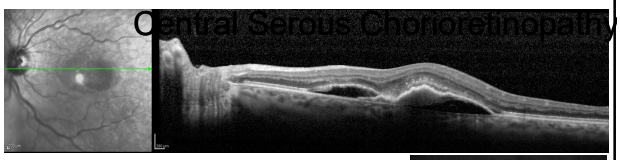




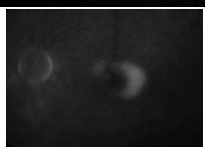


- Observation

Central Serous Chorioretinopathy



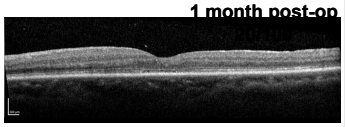
- 40 yo "type A" male with distortion OS
- Va: 20/25
- Fluorescein shows pooling
- OCT shows sub-retinal fluid and pigment epithelium detachment
- Treatment: observation, photodynamic therapy, anti-VEGF treatment



Vitreomacular Traction (VMT)

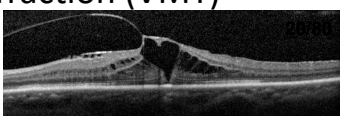
s/p vitrectomy, membrane peel, gas

Va improved to 20/60 at 8 months

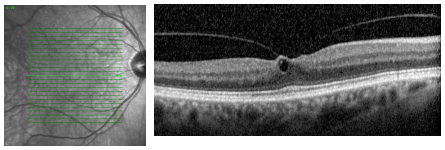


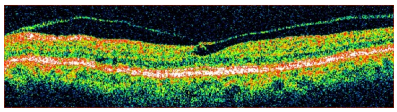
Vitreomacular Traction (VMT)

- 81 yo woman with progressive distortion and decreased Va OS to 20/80
- OCT shows posterior hyaloid causing traction on fovea
- Observation vs. vitrectomy

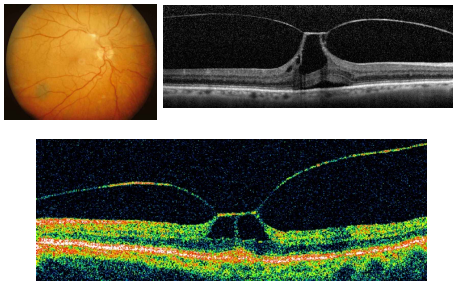


Vitreo-macular Traction

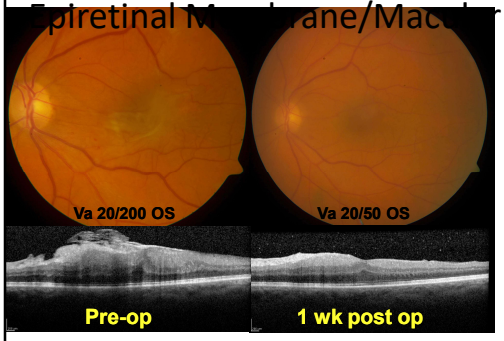




Vitreo-macular Traction



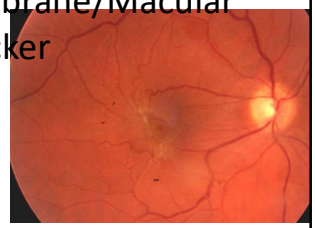
Epiretinal Membrane/Macular Pucker

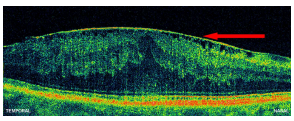


- 66 yo male with decreased vision for months left eye

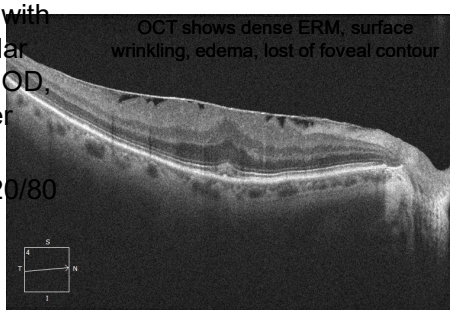
Epiretinal Membrane/Macular Pucker

- 64 yo female s/p recent cataract surgery is unhappy with vision
- Va 20/60 OD with distortion
- Exam reveals macular pucker with surface

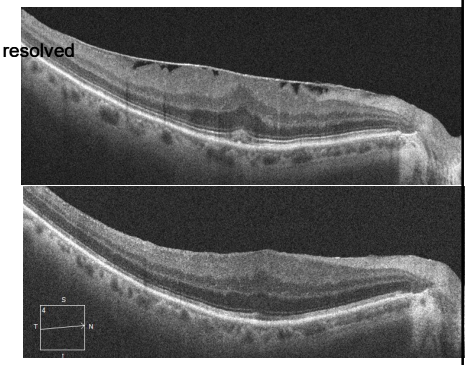




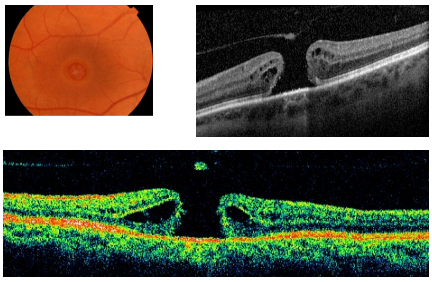
- 70 year old diabetic with monocular diplopia OD, no longer drives
- VA OD 20/80



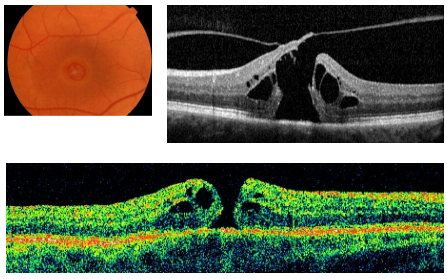
1 week post-op
monocular diplopia resolved
VA 20/25



Macular Hole



Macular Hole



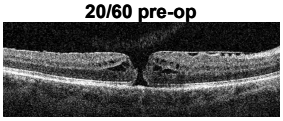
Macular Hole

59 yo female presents with progressive distortion and gray scotoma OD

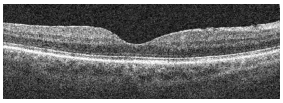
Exam and OCT reveal macular pucker, macular hole, edema

Treatment: vitrectomy,

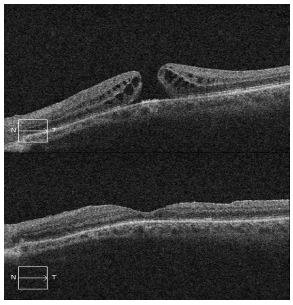
20/60 pre-op



20/25 post-op

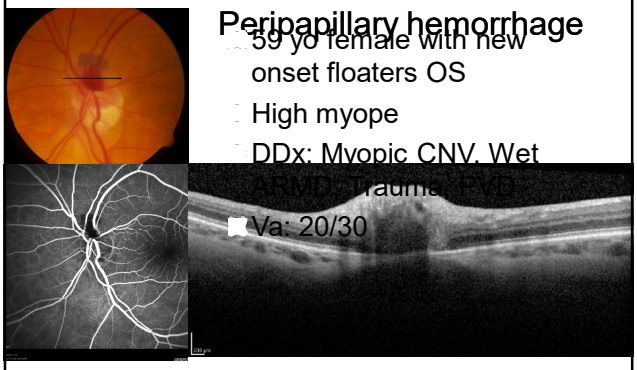


Macular Hole



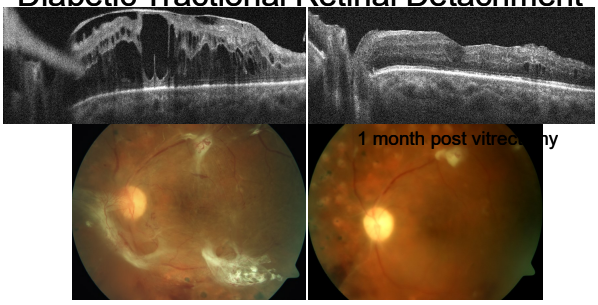
- 60 yo female without improvement in central visual acuity after macula on rhegmatogenous retinal detachment repair
- “Shadow is gone, but I can’t read”
- Va 20/100

Peripapillary hemorrhage



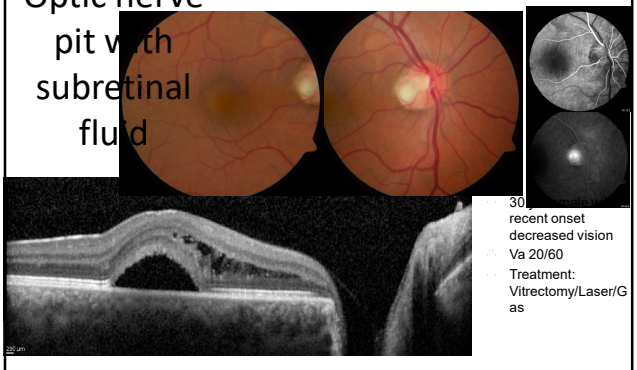
- 59 yo female with new onset floaters OS
- High myope
- DDx: Myopic CNV, Wet ARMD, Trauma, PVD
- Va: 20/30

Diabetic Tractional Retinal Detachment



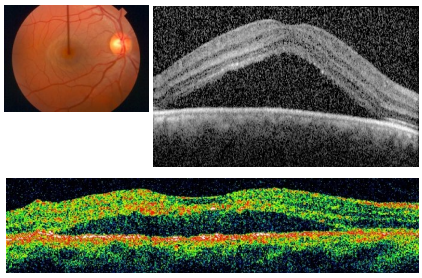
1 month post vitrectomy

Optic nerve pit with subretinal fluid



- recent onset decreased vision
- Va 20/60
- Treatment: Vitrectomy/Laser/Gas

Central Serous Choioretinopathy



Conclusions

- OCT is a useful way to diagnose and follow macular disease
- Careful interpretation of OCT can yield significant information
- It is important to complete the history and examination w