

INTERPRETING RETINAL OCT'S & INTRODUCING OCT-ANGIOGRAPHY

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Overview

- ▣ Beyond (Retina) First
 - History/principles of the OCT
 - What does the normal retinal OCT look like
 - Vitreal disorders
 - Retinal/RPE disorders
 - Choroidal disorders
- ▣ Glaucoma
 - What does the normal ONH OCT look like
 - ▣ rNFL
 - ▣ CCA
 - ONH disorders

History of OCT

- ▣ 1991: 1st scientific description of the OCT
 - Huang et al, Science. 1991; 254 (5035): 1178-1181.
- ▣ Original Founders:
 - David Huang, M.D., PhD
 - Dr. James Fujimoto, PhD
 - Eric Swanson, MS
 - Carmen Puliafito, M.D.
 - Joel Schulman, M.D.
- ▣ Introduced commercially in the mid-1990's

The Beginning OCT

- ▣ 1995 OCT1 debuted at 100 axial scans per second with a resolution of 20 microns

Evolving the OCT

- ▣ Stratus OCT - 2002
 - "Time domain"
 - 500 axial scans/second
 - 10 micron resolution

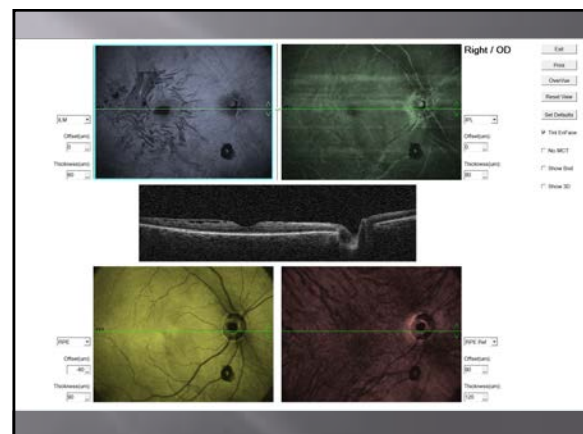
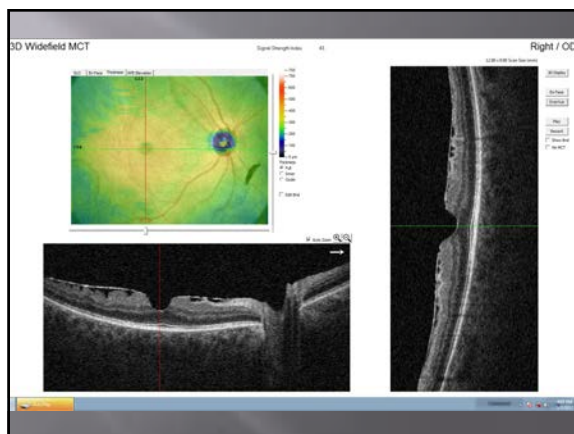
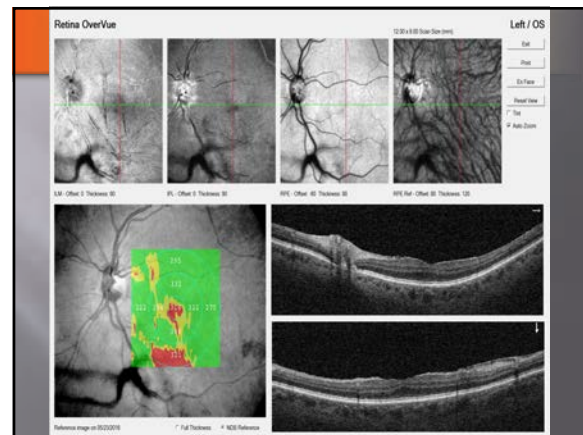
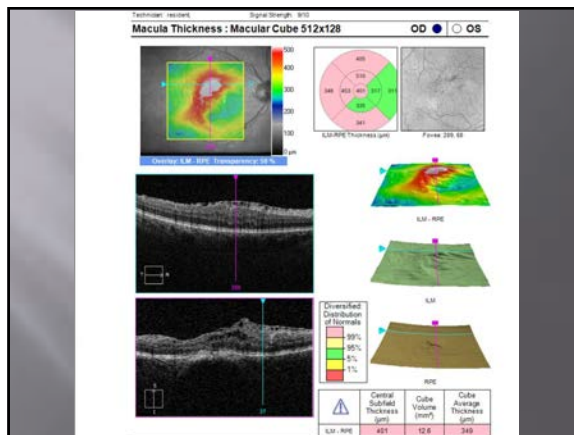
Evolving the OCT

- ▣ "Spectral-Domain" OCT - 2007
 - "Fourier-Domain"
 - 27,000 - 40,000 axial scans/second
 - ▣ Analyzes data using a spectrometer
 - ▣ Does not use a moving mirror
 - ▣ Very fast acquisition speed
 - 65x greater acquisition speed
 - ▣ 3-D imaging
 - *** 3.5 - 6 micron resolution ***

Understanding and Interpreting the Retina OCT

- Choroid
- 10 layers of the retina
 - RPE
 - Photoreceptors
 - ELM
 - Outer nuclear layer
 - Outer plexiform layer
 - Inner nuclear layer
 - Inner plexiform layer
 - Ganglion cell layer
 - Nerve fiber layer
 - ILM
- Vitreous

4 Basic Categories: Diseases of the...



Posterior Vitreous Detachment (PVD)

Vitreo-macular adhesion/traction (VMT)

Vitreomacular traction

Vitreomacular traction

Macular hole

- ▣ Unilateral, decreased vision
 - Often in 60-80 year old women
 - Anyone w/ a history of trauma
- ▣ Symptoms:
 - Decreased vision, metamorphopsia
 - ▣ 20/200 for full thickness holes
- ▣ Signs:
 - Red hole in the macula
 - (+) Watzke-Allen sign

Macular hole

- ▣ Stages
 - Stage 1a -> impending hole. Normal foveal depression with yellow spot/dot in fovea.
 - Stage 1b -> Abnormal foveal depression with yellow ring.

Stage 1b macular hole

Macular hole

- Stages
 - Stage 2 -> Small full-thickness hole. 20/80 - 20/400.
 - Stage 3 -> Full-thickness hole w/ cuff of SRF. No PVD
 - Stage 4 -> Full-thickness hole with cuff of SRF, with complete PVD.

Stage 2 macular hole

Macular hole

- Stages
 - Stage 2 -> Small full-thickness hole. 20/80 - 20/400.
 - Stage 3 -> Full-thickness hole w/ cuff of SRF. No PVD
 - Stage 4 -> Full-thickness hole with cuff of SRF, with complete PVD.

Stage 3
Macular
hole

Stage 4 macular hole ->

New Macular Hole Staging

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	VMH
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

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Small FTMH w/o traction

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Medium FTMH w/o traction

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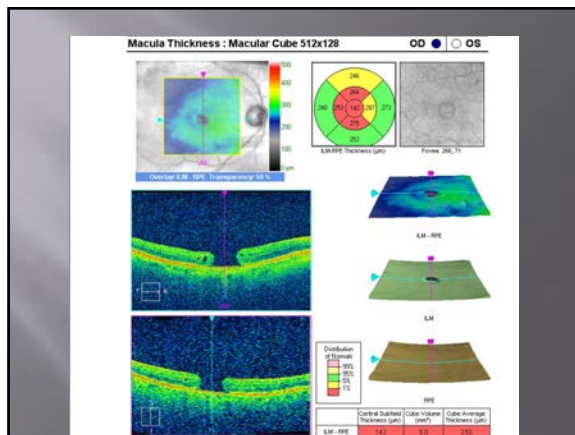
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Stage 4: FTMH with PVD	Small, medium, or large FTMH without VMT

Large FTMH with traction

> 400 microns

Macular Hole

- Treatment:
 - Stage 2 holes or beyond (full thickness macular holes)
 - Vision 20/40 or worse
 - How long has the hole been there???
 - Vitrectomy & membrane peel
 - Face down???
- Prognosis:
 - 20/40 or better in up to 65% of cases



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Lamellar Macular hole

- "Partial thickness macular holes"
- Aborted macular holes
- "Upside down anvil" "anvil-like"
- VA -> usually 20/40 or better
- 4 characteristics
 1. Irregular foveal contour
 2. Break in inner fovea
 3. Intraretinal split
 4. Intact foveal photoreceptors

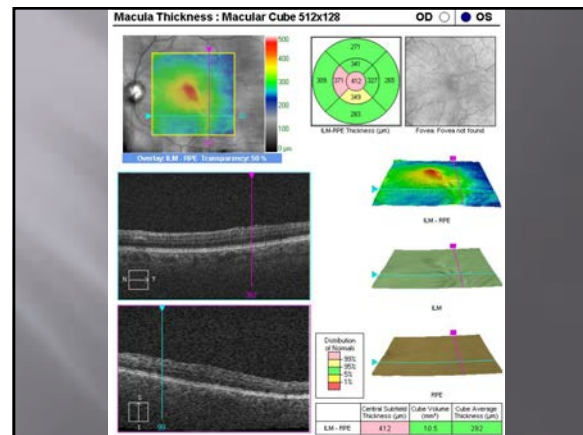
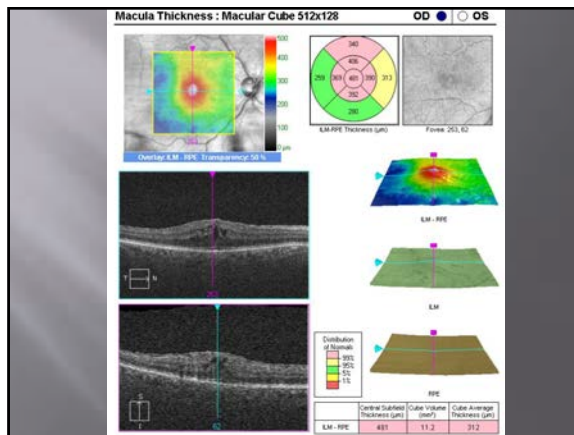
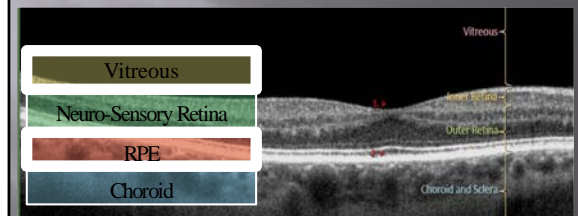
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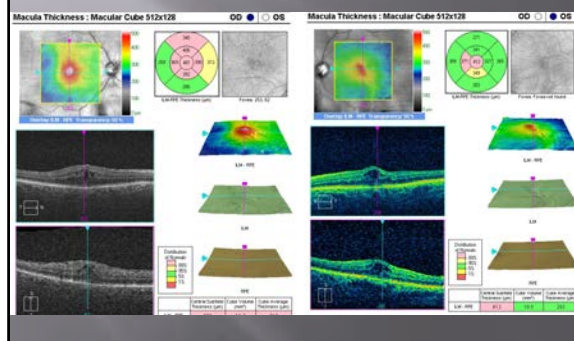
Pseudohole

- ❑ “False hole”
- ❑ Simulates macular hole w/o actual tissue dehiscence
- ❑ Full thickness retinal tissue is still present
 - Not an anvil
- ❑ VA
 - Usually 20/20 – 20/30 unless significant ERM is present

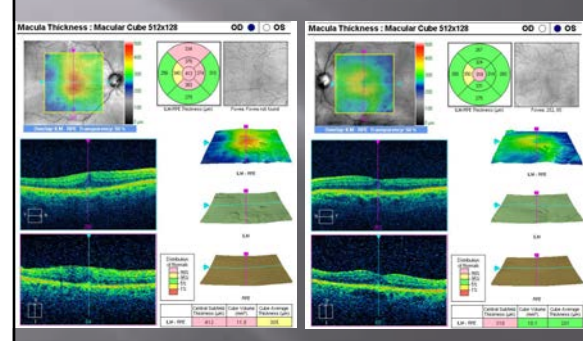
4 Basic Categories: Diseases of the...



Before Tx



3 weeks after Tx

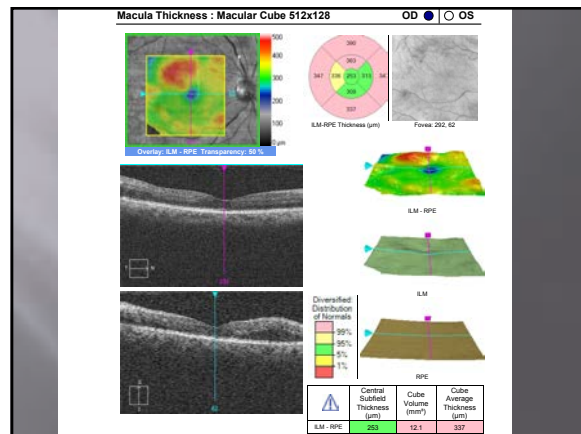
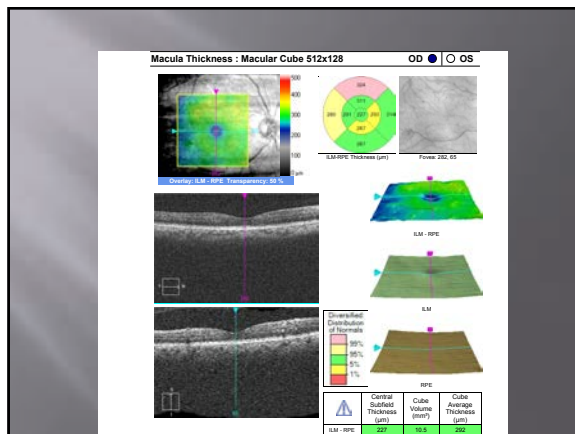


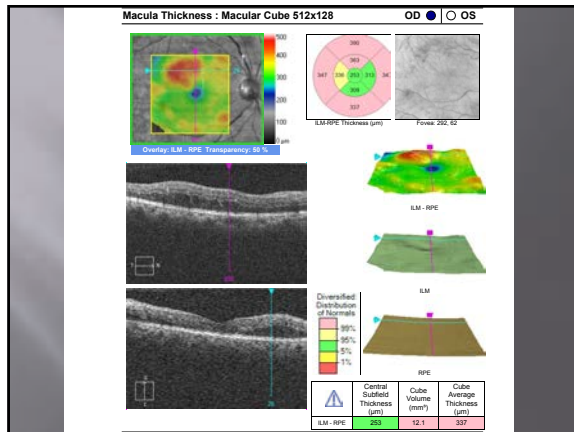
Cystoid Macular Edema (CME)

Cystoid Macular Edema (CME)

Diabetic macular edema (DME)

CSME vs. CME???





Central Serous Chorioretinopathy (CSR)

- Demographics
 - 25-50 year old men, stressed/Type A personalities
- Symptoms
 - Unilateral, blurred vision
 - VA → usually 20/20 – 20/80
 - Metamorphopsia
- Signs
 - Localized serous detachment of the neurosensory retina in the macula

Central Serous Chorioretinopathy

- DDx:
 - Optic disc pit
 - CNVM

Central Serous Chorioretinopathy

- Med associations:
 - Steroids
 - Nasal sprays, steroid creams, oral, injectable
 - Ephedra
 - Ephedrine & pseudoephedrine
- Treatment:
 - Observation/lifestyle change
 - D/C steroid if possible
 - Possible laser therapy

Spirolactone versus observation in the treatment of acute central serous chorioretinopathy.

Rui X, et al. Br J Ophthalmol. 2017.
(Show full citation)

Abstract

PURPOSE: To evaluate the efficacy of oral spirolactone in patients with acute central serous chorioretinopathy (CSR).

METHODS: This is a prospective, randomised controlled clinical study. Thirty patients with acute CSR were the participants, including 10 patients who were treated with spirolactone 500 mg orally, twice daily for 2 months in the experimental group and 12 patients who received observation in the control group. Main outcome measures included the proportion of eyes achieving complete resolution of subretinal fluid (SRF), changes in central macular thickness (CMT), the height of SRF (SRFH), best-corrected visual acuity (BCVA) and subfoveal choroidal thickness (SFCT). The follow-up period was 2 months.

RESULTS: Complete resolution of SRF was achieved in 10.0% (1/10) and 8.3% (1/12) of the eyes in the treatment group and the control group, respectively, at 2 months (p=0.18). The mean CMT and SRFH decreased significantly at each visit in both groups (p<0.05), and there was significant difference between the two groups at 2 months (p=0.05 and p=0.05, respectively). BCVA (in logMAR) of the minimum angle of resolution (mean) improved in both groups at 2 months (p=0.05). In the treatment group, the mean baseline SFCT significantly decreased from 302.58±87.38 μm to 427.44±74.37 μm at 2 months (p=0.07), while the change from baseline from 460.55±152.38 μm to 463.75±100.65 μm was not significant in the control group (p=0.19). But the difference between the two groups in BCVA and SFCT were not significant.

CONCLUSIONS: Oral spirolactone is more effective with a faster absorption of SRF than observation. It is a promising treatment for acute CSR.

Central Serous Chorioretinopathy

- Med associations:
 - Steroids
 - Nasal sprays, steroid creams, oral, injectable
 - Ephedra
 - Ephedrine & pseudoephedrine
- Treatment:
 - Observation/lifestyle change
 - D/C steroid if possible
 - Possible laser therapy

Plaquenil Toxicity

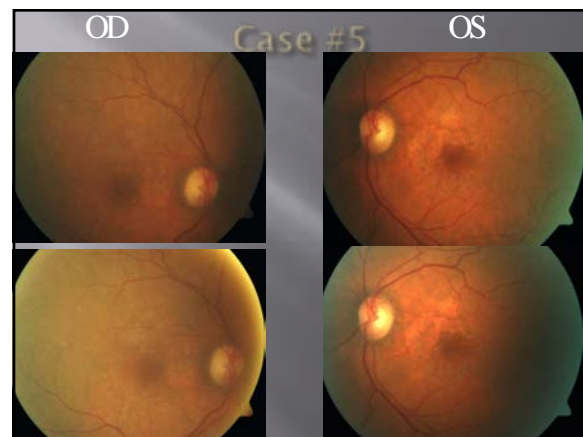
- ▣ Antimalarials:
 - Chloroquine
 - Hydroxychloroquine (Plaquenil)
- ▣ Now used for RA, SLE, Sjogren's, etc.
- ▣ Toxicity risk is low, but....
- ▣ Lots of different screening recommendations have been proposed

Plaquenil Toxicity

- ▣ Risk Factors:
 - Cumulative dose**
 - ▣ 1000 gram cumulative dose for Plaquenil
 - ▣ 6.85 years to reach that
 - Daily dose
 - Age
 - Liver or kidney dysfunction
 - Pre-existing retinal disease or maculopathy

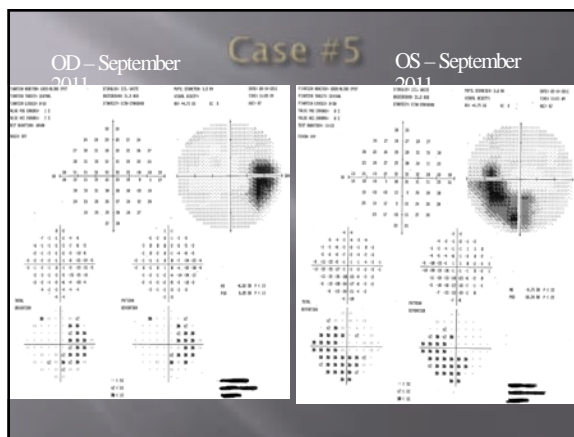
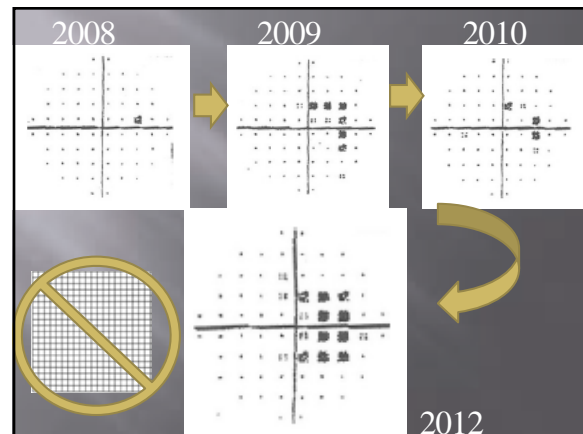
Plaquenil Toxicity

- ▣ Symptoms:
 - Asymptomatic early
 - Paracentral visual field defects affecting reading
 - Color vision changes
- ▣ Signs:



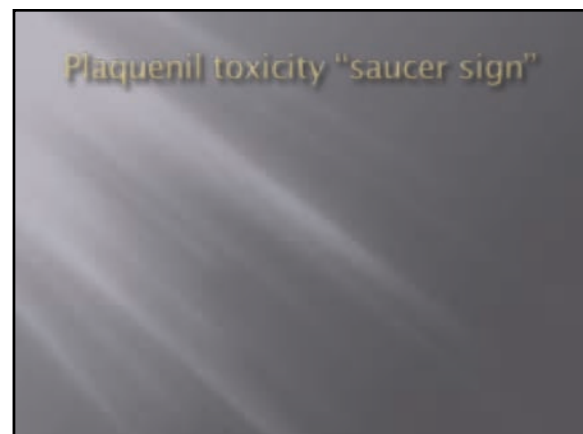
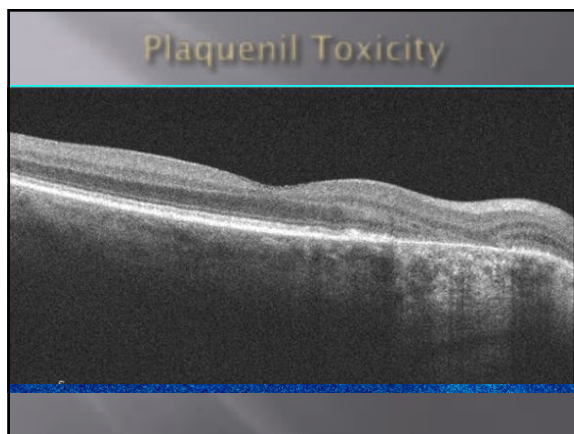
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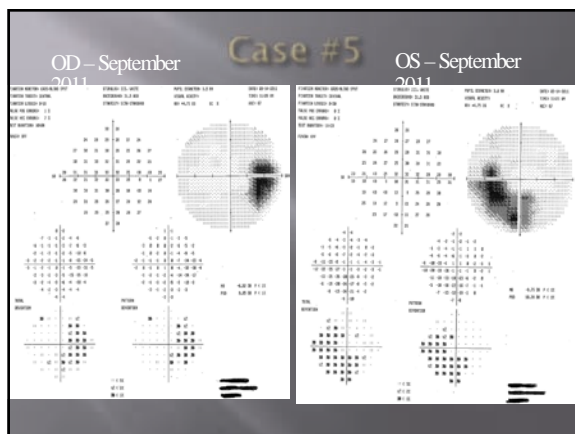
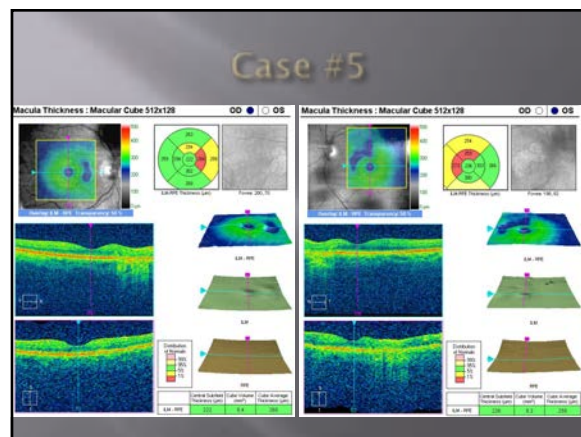
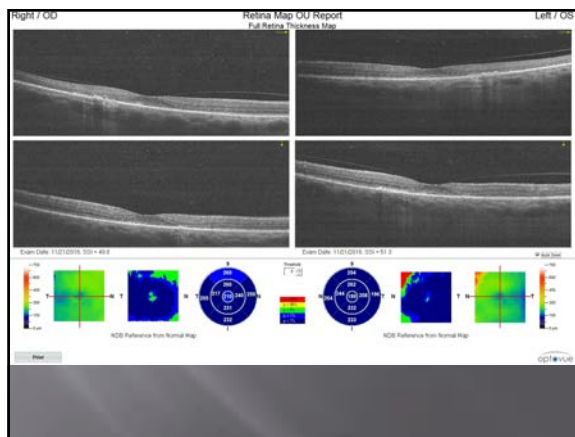
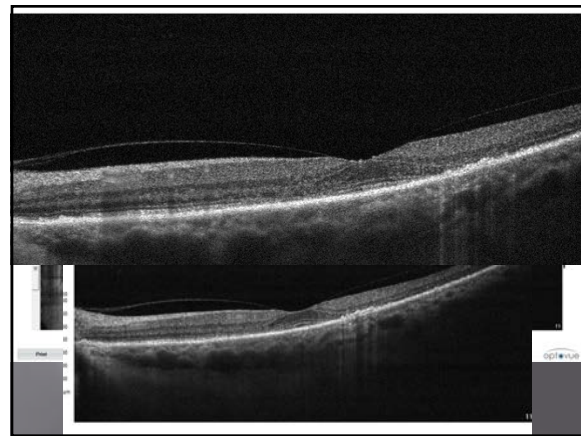
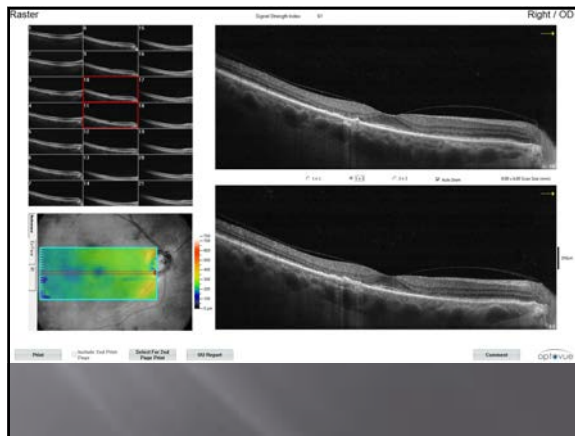
- ▣ Recommended Screening Guidelines:
 1. Baseline exam within the first year of starting Plaquenil
 - ▣ Biomicroscopy exam, 10-2 VF, Fundus photos, OCT
 - After 5 years, annual screening exams
 - ▣ SD-OCT or
 - ▣ mfERG or
 - ▣ Fundus autofluorescence



Plaquenil Toxicity

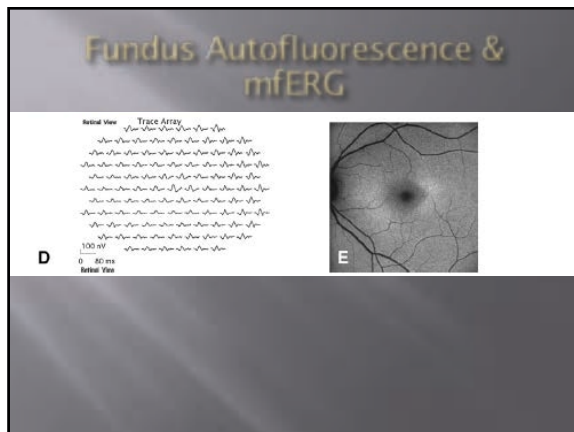
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 - After 5 years, annual screening exams
 - ▣ Biomicroscopy exam along with 10-2 VF and
 - ▣ ~~SD-OCT~~ or
 - ▣ ~~mfERG~~ or
 - ▣ ~~Fundus autofluorescence~~





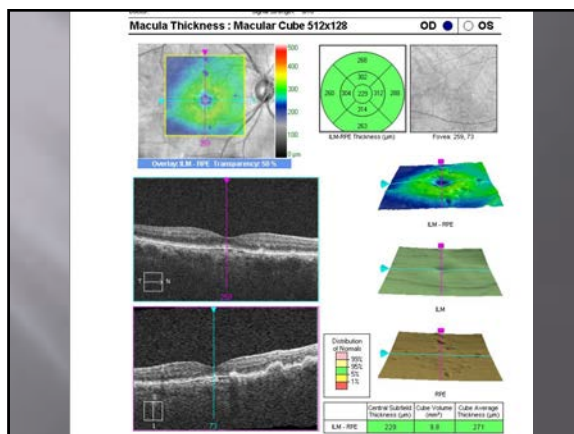
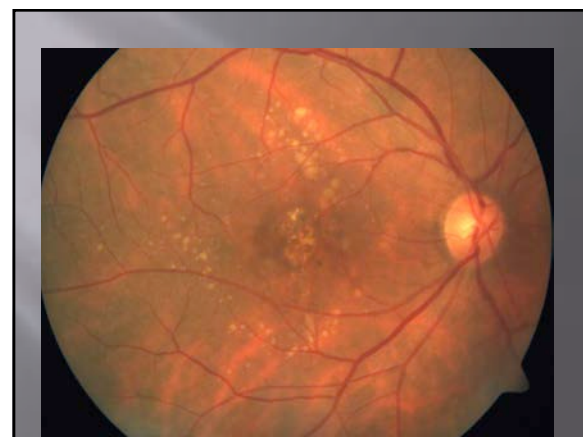
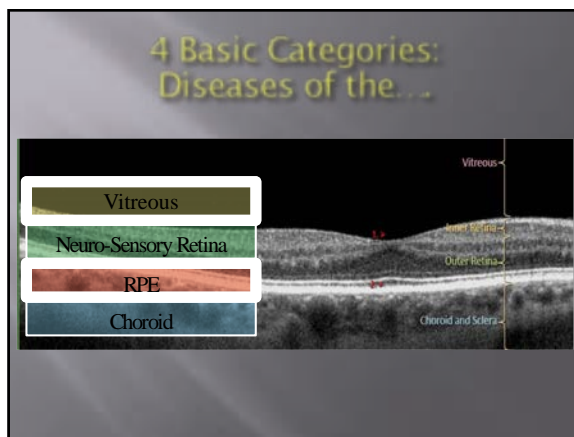
Plaquenil Toxicity

- Tests not recommended for screening
 - Fundus photography
 - Time-domain OCT
 - FA
 - Full-field ERG
- EOG
- Color vision testing
- Amsler grid

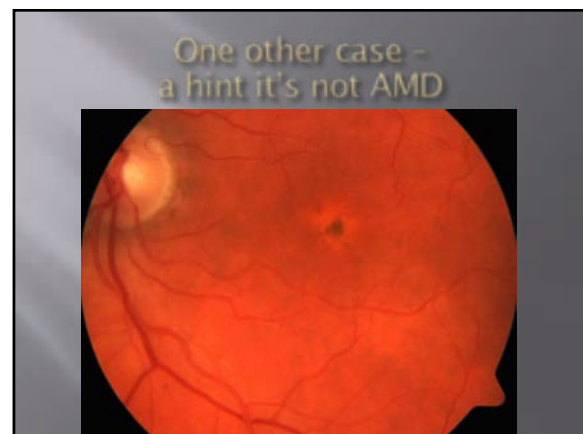
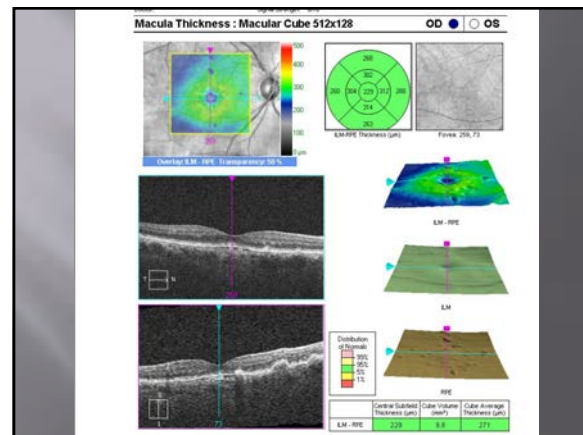
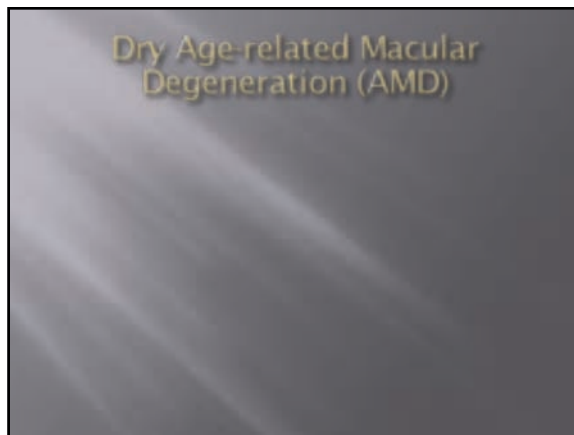
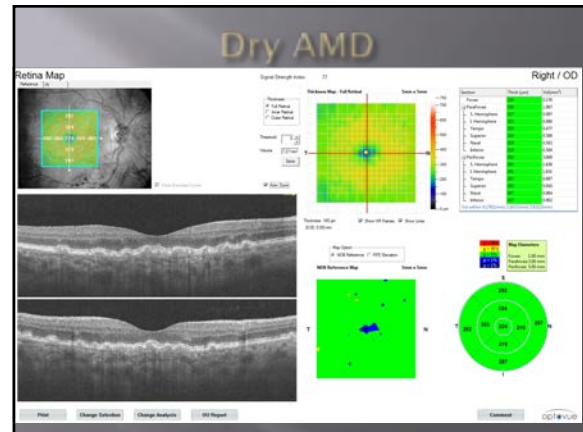
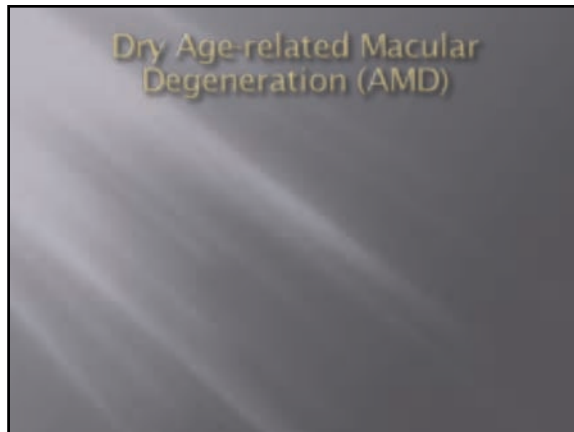


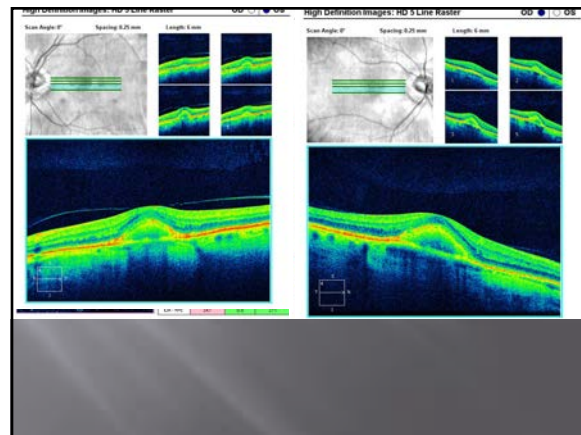
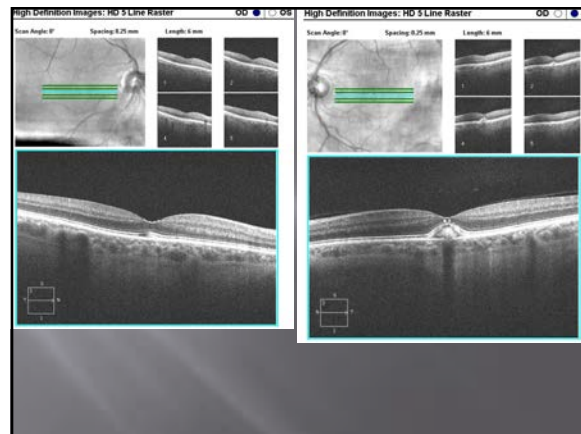
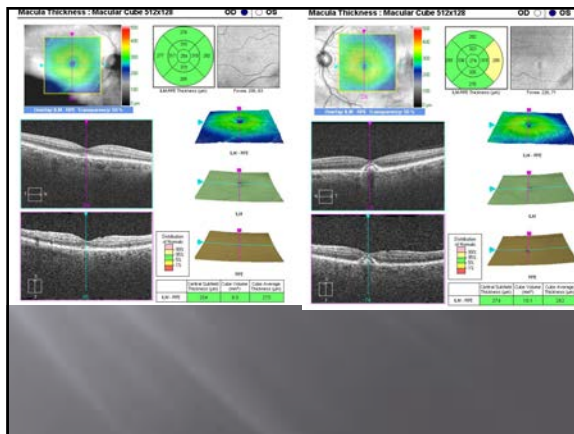
Plaquenil Toxicity

- Treatment:
 - No medical therapy is available to treat/cure the toxicity
 - D/C the med if possible
 - Work with the PCP



Dry Age-related Macular Degeneration (AMD)



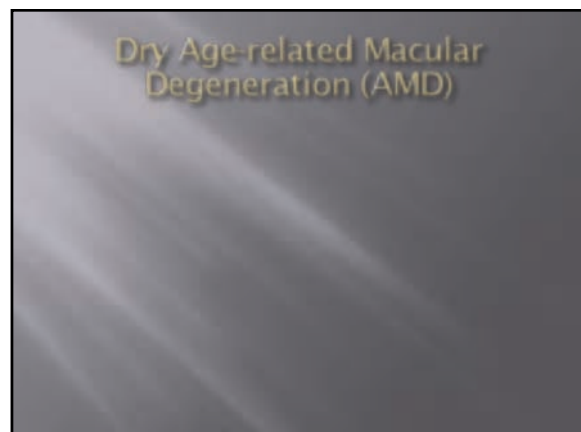


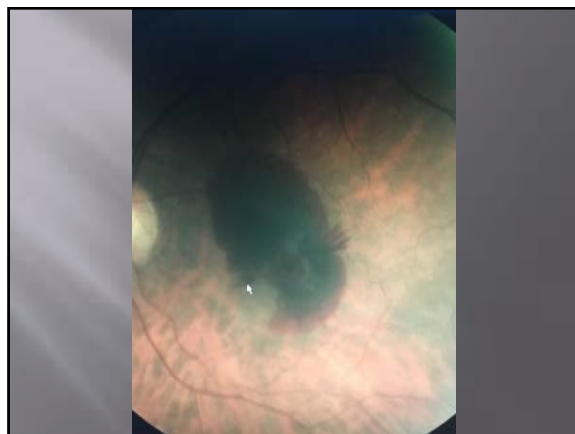
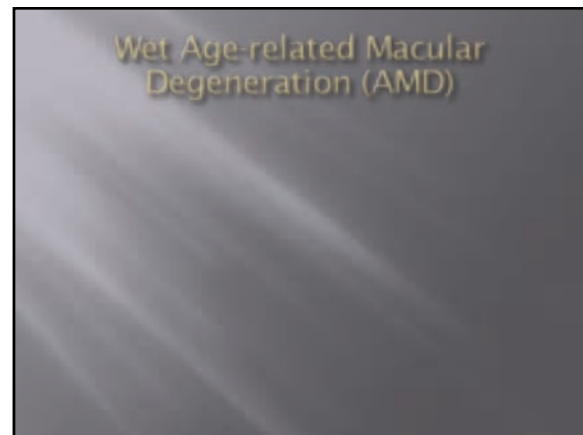
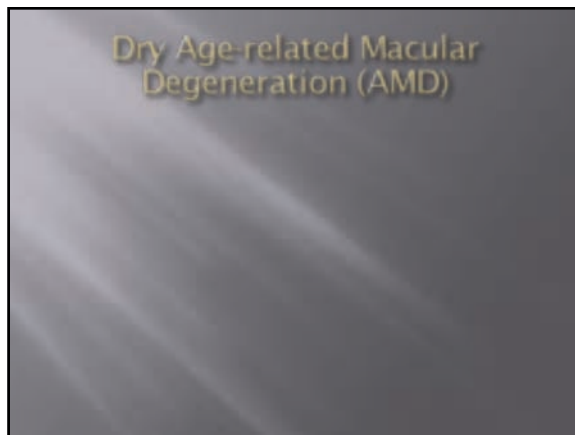
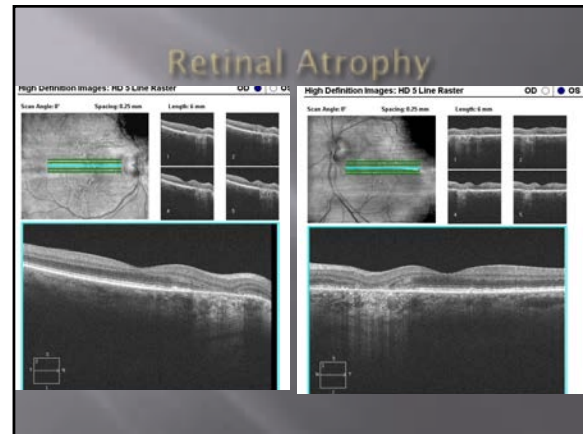
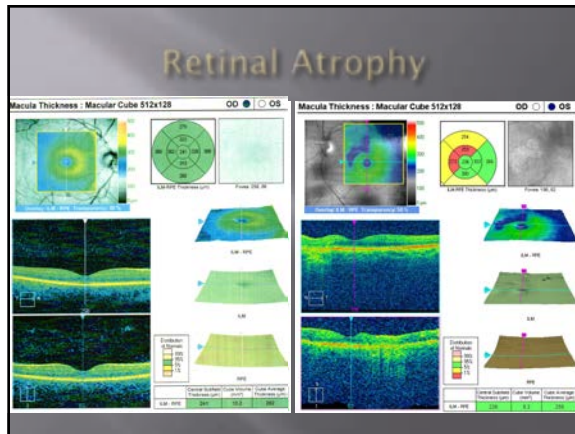
The left eye shows a normal appearing optic nerve. Here we have an area of central hyperpigmentation with a surrounding haze of hyperpigmentation that looks like regressed drusen. The vessels are unremarkable and the retinal periphery is unremarkable.

IMPRESSION:

1. Mild adult vitelliform disease, possibly a small pattern dystrophy, possibly a very early onset of age-related macular degeneration. At the current level no treatment is needed besides routine observation and monitoring.

I have discussed with him that he should check the left and right eyes separately at least, if possible, three to four times a week for a few seconds and see us or you with any new or sudden changes. Beyond this, we have given him information about vitamin supplementation and have not set him up for an immediate follow up with us here, but of course we would be happy to visit back with him if new or sudden changes were to arise.



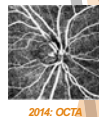
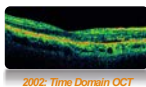


Wet Age-related Macular Degeneration (AMD)

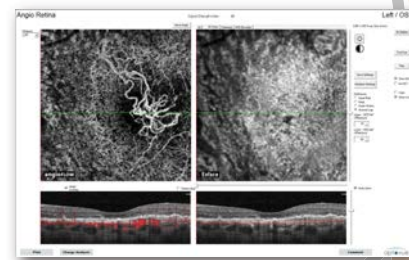
OCT ANGIOGRAPHY

OCT Angiography: the Next Chapter in Posterior Imaging

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

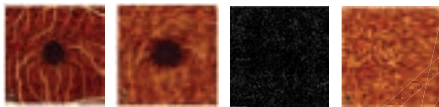


Structure & Function from One System



A New Approach to Visualizing Blood Flow

- Patient Benefits
 - Reduces patient burden to allow more frequent imaging
 - Avoid potential side-effects of fluorescein injection
- Clinical Benefits
 - Faster than a dye-based procedure
 - Ultra-high resolution imaging of retinal microvasculature
 - 3D visualization: segments retinal vasculature into individual layers



OCT-Angiography

How Does it Work?

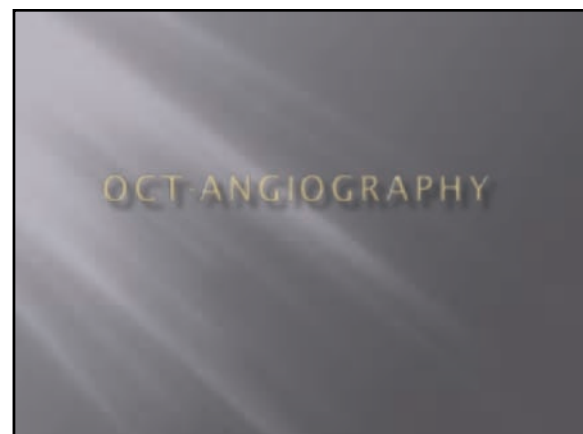
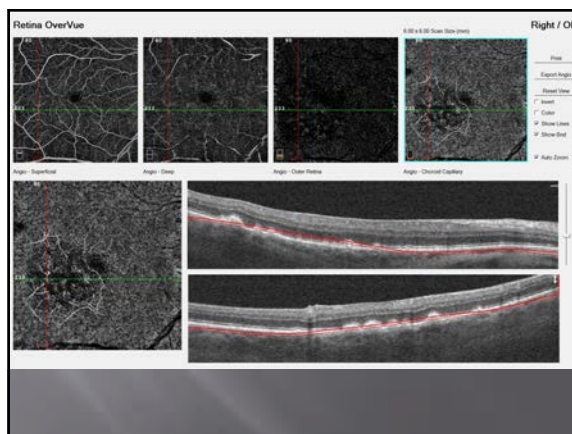
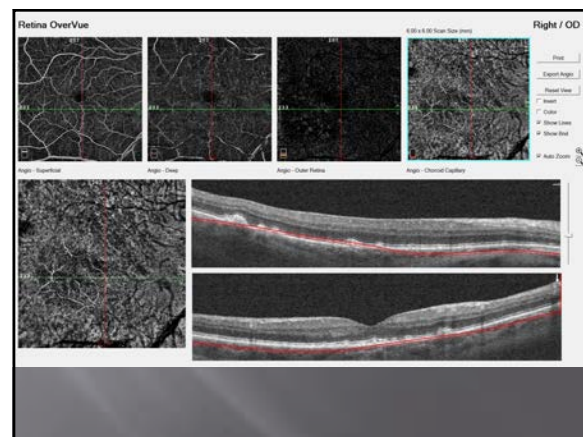
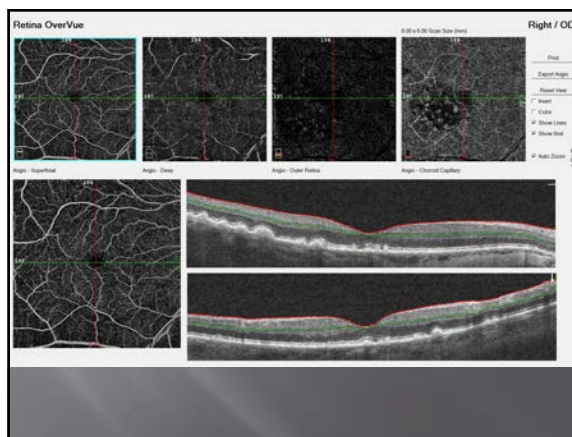
Principles of OCTA

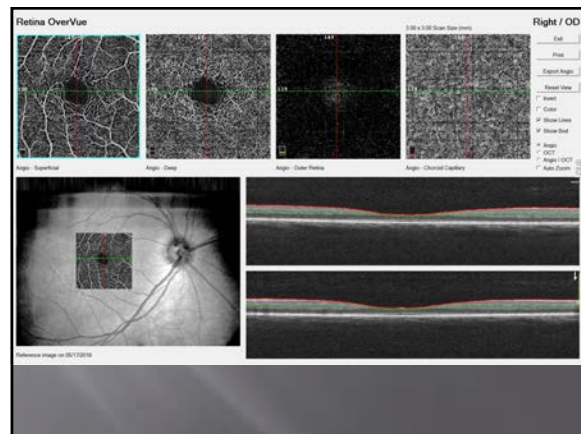
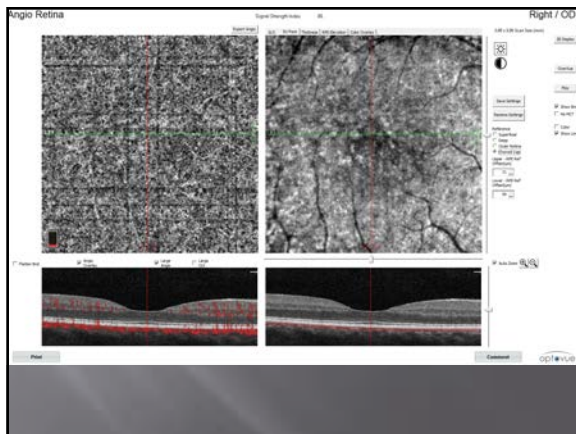
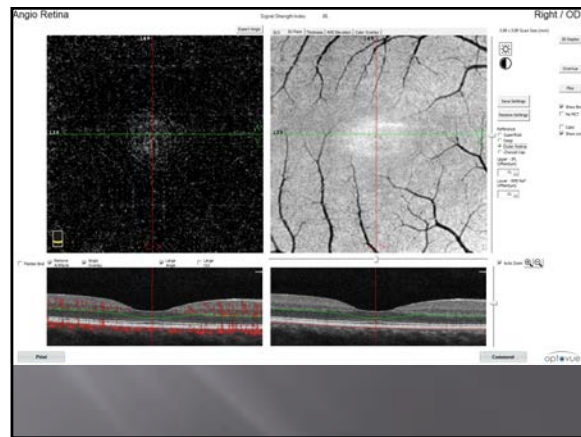
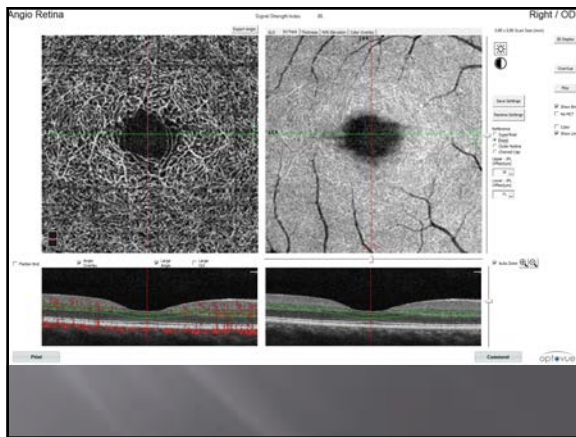
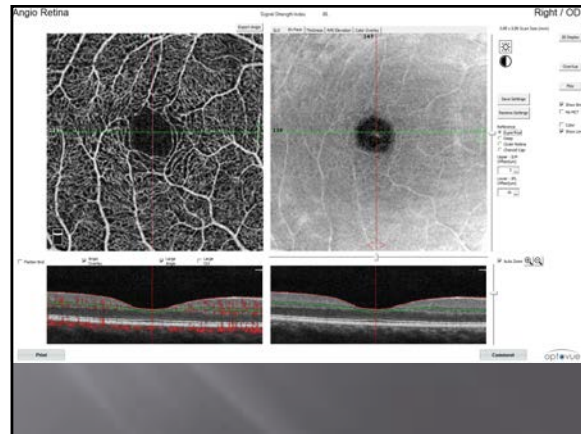
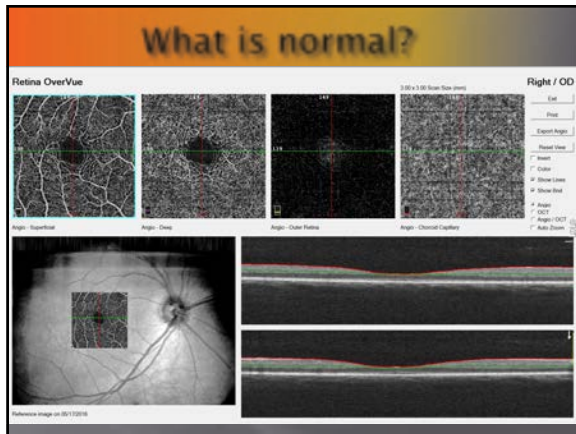
OCTA uses motion contrast to detect flow from OCT data

- Rapidly acquires multiple cross-sectional images from a single location on the retina
- Flow is the difference in signal between two sequential B-scans

Enface OCTA Generated from OCTA Volume Data

- Multiple motion-contrast frames create 3D OCTA volume
- Enface visualization of layers obtained by slicing and projecting slabs from 3D OCTA data





OCT-A in our clinic

Indications:

- AMD - dry vs. wet
- Diabetics -
is there neo?
is their non-perfusion (capillary dropout)?
- Vein Occlusions
- Glaucoma patients
nerve perfusion?

INTERPRETING RETINAL OCT'S & INTRODUCING OCT-ANGIOGRAPHY

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