OCT & OCT Angiography - Something Old and New in Interpretation and Everyday Usage

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Texas Optometric Association
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Resource: OCT Community for OCT and OCTA

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Book Resources

Optical Coherence Tomography
- A technology that allows high resolution cross sectional imaging of the retina
- Aids and assists in the diagnosis of glaucoma and retinal disease
- Helpful in neuro-ophthalmic disease and as well as anterior segment pathologies
- Provides objective quantitative assessment of tissue structure
- Facilitating in a more accurate and earlier diagnosis and treatment

Optical Coherence Tomography
Course Design
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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 (SD-OCT)
  - 5-6 microns of resolution
  - Able to see photoreceptor morphology

- Spatially encoded frequency domain OCT (SEFD-OCT)
  - 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

4 Basic Categories: Diseases of the...

Vitreous
RPE
Choroid
...
Green, Red, Yellow, and Blue Disease

Hints to this Disease

- If the disease is a bilateral disease
  - Glaucoma

- If the scans are symmetric
  - Then it most likely not disease
  - Anatomical variation
  - Normal for that patient

- Another hint is the GCC
  - > 100 microns
  - < 95 microns
28 yo woman with yellow disease

- OD +6.25 -0.75 x 005 20/20
- OS +6.50 -0.75 x 170 20/20
- No medications
- Systemic hx: unremarkable
- IOPs 17-20 mm Hg OU 2011-2016

46 yo woman with red-yellow disease

- OD 0.75 20/20
- OS 1.25 20/20
- Systemic hx: thyroid dysfunction, high cholesterol
- Medications for the above
- IOPs 15 mm Hg OU 8:30 am

63 yo woman with red, yellow, blue, and green disease

- OD plano/ +2.00 20/20
- OS -0.50/ +2.00 20/20
- IOPs 15-18 mm Hg OU 2011-2015
58 yo with yellow disease

- OD +1.00  20/20
- OS +1.25  20/20
- IOPs:  13/15 mm Hg at 11:24 am
- [pay attention to FLV and GLV]

40 yo man with red, blue, green disease

- OD -7.50 - 0.75 x 110  20/20
- OS -7.50 - 0.75 x 105  20/20
- IOPs:  15/13 mm Hg at 6:30 pm
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22 months apart

27 yo woman with blue disease IOPs 13/13

OCT of Vitreoretinal Interface Disorders

- Early PVD
- Epiretinal membrane
- Vitreomacular traction syndrome
- Pseudohole
- Lamellar hole
- Macular hole

Epiretinal Membrane

- Other names: preretinal fibroplasia, preretinal gliosis, 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 cause macular edema
- Anam grid may elicit metamorphopsia from surface wrinkling or macular edema
- Treatment: Monitor until severe then retinal consult, possible vitrectomy with membrane peeling

Epiretinal Membrane (ERM)

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Epiretinal Membrane (ERM)
- Ex. Face OCT of ILM
- Raster Scan

Vitreomacular Traction Syndrome
- Peripheral posterior vitreous detachment (PVD)
- Persistent adherence with traction to macula and/or disc
- Macular edema or disc edema
- "Double" epiretinal membrane

Posterior Vitreous Detachment (PVD) with Vitreo-Macular Traction

Vitreo-Macular Traction (VMT)

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OCT of Vitreoretinal Interface Disorders

Posterior Vitreous Detachment (PVD) with Vitreous Traction

Full Thickness Macular Hole

More on Macula Holes...
- Stage 1
- Stage 2 (refer/consult)
- Stage 3
- Stage 4 – full thickness

Stage 3 Macular Hole
Make Sure You Carefully Review the Other Eye

Why?

- Looking for a Stage 0 macular hole
- Some studies say that finding a Stage 0 has a 42% risk of going to a full thickness macular hole
- If no Stage 0 then 0-3% risk
- OCT can identify eye at risk
  - Only visible on OCT
  - Not visible via clinical exam

Stage 0 macular hole observations by optical coherence tomography.

Chan A, Duker JS, Schuman JS, Fujimoto JG. New England Eye Center, Tufts University School of Medicine, Boston, Massachusetts 02111-1533, USA.

OBJECTIVE: To introduce the concept of a stage 0 macular hole based on optical coherence tomographic observations of the vitreoretinal interface in fellow eyes of patients with unilateral idiopathic macular holes, and to evaluate the subsequent risk of progression to a full-thickness macula.

DESIGN: Retrospective observational case series.

PARTICIPANTS: Ninety-four patients with a unilateral stage 2, 3, or 4 full-thickness macular hole.

METHODS: The medical records of patients with a unilateral macular hole diagnosed between 1994 and 2000 at the New England Eye Center were reviewed.

MAIN OUTCOME MEASURE: Development of a full-thickness macular hole in the fellow eye on biomicroscopic fundoscopy or optical coherence tomography (OCT).

RESULTS: In 27 (28.7%) of 94 clinically normal fellow eyes, OCT detected an abnormality of the vitreoretinal interface but no macular anatomy. The vitreoretinal abnormalities were further subclassified into severe (4 eyes), moderate (8 eyes), and mild (15 eyes) based on the intensity and morphology of the OCT signal. One of the 4 (25%) severe cases progressed to a full-thickness macular hole, 4 of the 8 (50%) moderate cases became full-thickness macular holes, and no (0%) mild cases progressed to a full-thickness macular hole. Severe and moderate eyes seemed to share characteristic features on OCT that increased their risk of macular hole development (stage 0 macular hole). The macular hole-free survival at 48 months was 94% for stage 0-negative patients, versus 54% for stage 0-positive patients.

CONCLUSIONS: A stage 0 macular hole has a normal biomicroscopic appearance clinically, but has salient features on OCT as a result of oblique vitreous traction. Optical coherence tomographic findings consist of a normal foveal contour and normal retinal thickness and must include the presence of a preretinal, minimally reflective, thin band inserting obliquely on at least one side of the fovea. The presence of a stage 0 macular hole in the fellow eye is a significant risk factor for the development of a second macular hole.

OCT in AMD

- Need spectral domain to follow intermediate or worse AMD
- Able to identify OCT predictors of progression
- Especially in identifying OCT predictors of progression
  - Hyper-reflective foci
  - Reticular pseudodrusen
  - Nascent geographic atrophy
  - Sub-RPE hyper-reflective columns
  - Drusen substructures
  - Drusen load and regression

Hypo versus Hyper Reflectance

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Hypo versus Hyper Reflectance
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Case 3 - OCT Predictors of Progression

Case 4 - OCT Predictors of Progression

Case 5 - OCT Predictors of Progression

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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
- Relaxed patient burden allows more frequent imaging to better follow disease progression and treatment response

Enface OCT-A Slabs
Based on Retinal Anatomy

Normal Retinal Vasculature

Type 1 "Occult" CNV
- New vessels develop in the choroid
- New vessels located below RPE and above Bruch’s membrane

CNV?
22 y/o Hispanic male
2666/66
History of "Dry AMD"
Clinically Significant Macular Edema

48 yo man
- DM with insulin pump, Humalog
- Insulin pump for 10 years
- On second insulin pump
- First seen on our office 12/28/16
- HbA1c 9.2 6 months ago

52 yo man
- DM for 10 years
- Reports poor control
- 20/20 OU
- HbA1c 13.1

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Central Serous Retinopathy
(Neurosensory Detachment)

46 year old man
- Complains of a perfect yellow circle in the center of his OS
- The circle stays in the center of his vision even when he moves his eye
- VA 20/20 OU
- Refraction OD Plano OS +1.00 D
  - Prior visit Plano OU
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Photos

RPE Detachment With Clear Fluid

Central Serous Chorioretinopathy

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Central Serous Chorioretinopathy

Glaucma

Overlay of the RNFL and GCC

 GCC Thinning in Glaucoma

NFL and GCC
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POAG

Glaucoma Suspect strong family history

Not Just for the Posterior Segment

Cornea – you don’t need a second instrument

Fuch’s Dystrophy

Corneal Failure of PC-IOL
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Post-LASIK

Keratic Precipitates "KP" Secondary to Iritis Secondary Sarcoidosis

Less Than 15 Degrees Get Consult
Closed Angle

Plaquenil Toxicity

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 visual loss prompt the change

- Screen every 6 months
- Adjust interval based on serologic result
- Prescribed to maintain only
- Screening for the earliest signs of macular or systemic change
- Plaquenil toxicity is not well understood

Closed Angle

Plaquenil Zone

With all testing for Plaquenil toxicity, focus on the 1.0-1.5 mm radius Plaquenil Zone.
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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

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

BILATERAL COMPROMISE OF THE NFL (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

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Join the group to browse past and new OCT Connect cases!