Understanding and Interpreting OCT

The Swiss Army Pocket Knife of Eye Care

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Mark Dunbar: Disclosure

- Consultant for Allergan
- Optometry Advisory Board and Speaker bureau for:
  - Allergan
  - Carl Zeiss Meditec
  - Artic Dx
  - Sucampo

Mark Dunbar does not own stock in any of the above companies

Optical Coherence Tomography (OCT)

- Non-contact, non-invasive imaging device
- Produces high-resolution images of the posterior segment
  - Optical biopsy
- Quickly emerged as the standard of care for imaging in retina and glaucoma
- Revolutionized ocular disease management in all of eye care
Advances in SD-OCT

- Improving software
- Noise reduction/over sampling technology that provides higher resolution imaging
- Wider and deeper scans
- Greater density in the scans
- Improvements in 3D imaging
- Enhanced depth imaging – imaging choroid
- Progression analysis software

Main Clinical Utilities of OCT

- High resolution evaluation of retinal anatomy
- Diagnosis of macular conditions difficult to establish with biomicroscopy
- Quantitative assessment of retinal and vitreoretinal anatomic alterations
- Objective means for monitoring disease progression and/or therapeutic response

Spectral Domain OCT
The Competition

- Carl Zeiss: Cirrus
- OptiVue: Avantis and the iVue
- Heidelberg: Spectralis
- Topcon – Maestro coming out
- Optos
- SOCT Copernicus (Reichert)
  - Now owned by Cannon
The Anatomy

General Principles

- Don’t make it more complicated than it needs to be
- Don’t get caught up in the minutia!
- Pay attention to the IS/OS junction
  - Aka – PIL (photoreceptor integrity line)
- Provides great anatomic perspective – but it won’t “tell” you the diagnosis

Central Serous and Neurosensory Retinal Detachment
Full Thickness Macular Hole
When is a hole...a hole?

Lamellar Macular Hole in the Era of OCT

- Witkin et al reported on 19 eyes of 18 patients with lamellar holes imaged with ultra-high resolution OCT
- All the lamellar holes shared some common features
  - An irregular foveal contour
  - A break in the inner fovea
  - Separation of the inner from the outer foveal layers, leading to an intraretinal split
  - Absence of a full thickness defect with intact photoreceptors posterior to the area of foveal dehiscence.

Macular Edema

Outer Retinal Tubules
Plaquenil Screening: Traditionally

- Baseline macula photos
- Color vision testing
- Amsler grid
- 10-2 Visual fields
- Yearly exams

Revised Recommendations on Screening for Chloroquine and Hydroxychloroquine Retinopathy

Michael F. Marcus, MD,1 Chad Kline, MD,1 Troy A. Liu, MD,2 Jason E. Eysen, MD,2 William F. Moral, MD,3 for the American Academy of Ophthalmology

Background: The American Academy of Ophthalmology’s recommendations for screening of chloroquine and hydroxychloroquine retinopathy (CHORE) were based on a 2010 American Academy of Ophthalmology (AAO) practice parameter. As the timeframe for examination of visual field (VF) changes in CHORE is unknown, we sought to improve our understanding of the clinical course of CHORE.

Revised Recommendations on Screening for Plaquenil Toxicity

- Amsler grid testing removed as an acceptable screening technique
  - NOT equivalent to threshold VF testing
- Strongly advised that 10-2 VF screening be supplemented with sensitive objective tests such as:
  - Multifocal ERG
  - Spectral domain OCT
  - Fundus autofluorescence
Revised Recommendations on Screening for Plaquenil Toxicity

- Tests Not Recommended for Screening:
  - Fundus photography
  - Time domain OCT
  - Fluorescein angiography
  - Full-field ERG
  - Amsler grid
  - Color vision screening
  - EOG

Leonardo
57 y/o Hispanic Male

- “Routine” exam
- Has had poor vision for ~ 25 yrs or so
- VA: 20/70 RE; 20/60 LE
- CVF: FTFC OU
- Pupils: ERRL – No APD
- SLE – Tr NS

Advanced RPE Analysis

- RPE Elevations: If the RPE is raised, a new proprietary algorithm for Cirrus maps and measures the area and volume of the elevations.
- Sub-RPE Illumination: If the RPE is absent or has lost integrity, a new proprietary algorithm for Cirrus can map and measure the affected area.
OCT in Glaucoma

Traditional Methods of Assessing Glaucoma

- IOP monitoring
  - Major risk factor
- Subjective evaluation of the optic nerve
- Visual field testing

SD OCT
Stop Light Display of RNFL Normative Range

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- 95% of normal population falls in or below green band; 90% falls within green band
- 5% of normal population falls within or below yellow band; 4% falls within the yellow band
- 1% falls within red band; considered outside normal limits
73 eyes with glaucoma vs. 146 age-matched normals

Peripapillary ONH parameters and RNFL thickness measured

**Optic Nerve Head Calculations**

- The disc edge is determined by the termination of Bruch’s membrane
- The rim width around the circumference of the optic disc is then determined by measuring the amount of neuro-retinal tissue in the optic nerve
- In this method, the disc and rim area measurements correspond to the anatomy in the same plane as the optic disc.
Tania: 44 y/o Hispanic Female

- Has been seen several times over the yrs for routine eye care
- 1998: TA 20/22
- 09/05: TA 18/20
- 12/07: 19/20

Tania

- Ocular HTN
  - No treatment
  - Is there a reason to justify treating her?
- What is her risk for developing glaucoma?
  - 5 yrs vs. lifetime?
Vesta: 61 y/o Hatian Female

- Has been followed with NTG since 2006
  - GL suspect 2001 – always with suspicious ON’s
- Meds: Alphagan bid OU, Latanoprost q hs OU
- Medical Hx: HTN, HIV (+) for > 15 yrs
- VA: 20/20
- TA for the past 3 or 4 yrs: 9-13 mmHg OU
  - Last 2 visits 9 mmHg – today 13
Ganglion Cell Analysis

- Measures thickness for the sum of the ganglion cell layer and IPL using data from the Macular 200 x 200 or 512 x 128 cube scan patterns

- RNFL distribution in the macula depends on individual anatomy, while the GCL+IPL appears regular and elliptical for most normals. Thus, deviations from normal are more easily appreciated in the thickness map, and arcuate defects seen in the deviation map may be less likely to be due to anatomical variations.

The analysis contains:

- Data for both eyes (OU)
- Thickness Map - shows thickness measurements of the GCL + IPL in the 6mm X 6mm cube, contains an elliptical annulus centered about the fovea.
- Deviation Maps - shows a comparison of GCL + IPL thickness to normative data.
- Thickness table - shows average and minimum thickness within the elliptical annulus.
- Sector maps - divides the elliptical annulus of the Thickness Map into 6 regions: 3 equally sized sectors in the superior region and 3 equally sized sectors in the inferior region. Values are compared to normative data.
- Horizontal and Vertical B-scans.

51 y/o Hispanic Female

- Reports shadow peripherally in her LE
- VA: 20/20 OU
- CVF: FTFC; Pupils: NO APD
- TA: 16-17 on 3 visits
Summary: OCT and Glaucoma

- OCT is able to accurately detect early glaucoma with good reliability
- Also very good with already established glaucoma
- Determining same day reliability is critical
  - Corroborate your findings
  - To be able to accurately utilize serial analysis in future scans
- OCT is as good as other ON imaging devices