Abstract
Optical Coherence Tomography has revolutionized our understanding of retinal disease. Today Spectral domain technology has taken us to even greater heights. This lecture will provide a nuts and bolts approach using cases to understand and interpret the OCT as well as provide an update on the latest in spectral domain technology, as well as OCTA.

Objectives
1. Have an understanding on OCT interpretation 
2. Have an understanding how and when to use advance OCT visualization & OCTA 
3. Familiarize yourself with distinct scans & findings associated with diseases discussed

OCT
I. Introduction
OCT is a non-invasive procedure that uses low coherence interferometry to give a high-resolution cross sectional image of the retina. It is an invaluable tool in the diagnosis and management of ocular diseases.
   a. Principles
   b. Cases
   c. Quantitative measurements
   d. Qualitative measurements
      1. Hypo-reflectivity
      2. Hyper-reflectivity
      3. Factors affecting reflectivity
      4. Attenuation vs shadowing
   e. Variation in line scan
      a. Radial: use in Macular hole
      b. HD 21: typical use
      c. HD 1: highest resolution
      d. Cross sections
   f. Enface (C-scan): separation of retina layer by layer
   g. Looking at each retinal layer
      a. PIL (photoreceptor integrity line) aka IS/OS and EZ line(ellipsoid zone): anatomic landmark on a macular OCT provides the most useful information about visual function

II. How OCT revolutionizes retinal evaluation
A. Non-invasive high-resolution optical biopsy of the retina
B. Aids in the diagnosis of retinal pathology & supplements other diagnostic tests
C. Monitors retinal disease process
D. Evaluates therapeutic benefits

III. Quantitative measurements
   A. Retinal map
      1. Normative data
      2. Topographical image using spectral domain OCT (SDOCT)
      3. SDOCT vs time domain

IV. Retinal evaluation using OCT
   A. Epi-retinal membrane (ERM): Fibrotic membrane on the retinal surface
1. OCT findings
   (a) highly reflective tugging membrane on retinal surface
   (b) increase retinal thickness and associated retinal distortion
   (c) loss of normal foveal contour

2. The value of OCT
   (a) may help to evaluate presence of associated complications
   (b) helps evaluate thickness, location, density and type of ERM
   (c) quantitative measurements are used for monitoring
   (d) aids in differential diagnosis (DDx)

B. Vitreomacular traction (VMT) syndrome: Partial vitreal detachment with attachment on the macula
   1. OCT findings
      (a) partial adherence of the posterior hyaloid on the macula
      (b) loss of foveal depression
      (c) associated retinal edema
      (d) 90-degree separation of the posterior vitreous cortex from the ILM with associated with structural retinal changes
   2. The value of OCT
      (a) VMT may be hard to distinguish with biomicroscopic evaluation alone
      (b) monitoring for progression or spontaneous resolution
      (c) helps evaluated associated complications

B. Choroidal neovascular membrane (CNM)
   1. OCT findings
      (a) RPE/retinal detachment may be present with associated cellular debris
      (b) RPE disruption or isolated lesion with moderate to high reflectivity
      (c) may observe classic CNM protruding through the RPE
   2. The value of OCT
      (a) helps in the diagnosis & adjunct to FA
      (b) helps determine associated findings
      (c) Pronto study
      (d) Spectralis SDOCT

C. Central Serous Detachment (CSC): Serous detachment of the neurosensory retina
   1. OCT findings
      (a) elevated retina with shallow margins
      (b) optically clear center
   2. The value of OCT
      (a) may help in DDx
      (b) monitoring the course of the disease

D. Macula Hole (MH)
   1. Staging using OCT
   2. OCT findings differ depending on staging
   3. OCT value
      (a) DDx:
         Lamellar hole: contour change, outer retina present, inner split pseudo hole: ERM present or outer retina present
         Solar: small defect of just outer retina (PIL) with inner retinal layers intact
      (b) monitoring
E. **Clinical significant macular edema (CSME):** resulting from microvascular changes in DM

1. OCT findings
   - (a) increase retinal thickness
   - (b) hyporeflective "spongy-like" retinal appearance; resulting in irregular hollow spaces
   - (c) retinal cystic changes
   - (d) loss of foveal depression

2. The value of OCT
   - (a) precise location of edema may be observed using the retinal map
   - (b) monitor post-surgical progress or complications
   - (c) may help to validate particular treatment options

F. **Cystoid macular edema (CME):** Leaking perifoveal capillaries leads to fluid accumulation within the macular area, resulting in formation of cystic space(s)

1. OCT findings
   - (a) loss of foveal pit of associated with cetal foeval edema
   - (b) cystic black space(s) within the macular area with minimal reflectivity
   - (c) increased macular thickening
   - (d) may be noted in entities like retinal vein occlusion, DR, RP, uveitis, cataract extraction, etc.

2. The value of OCT
   - (a) assists in diagnosis
   - (b) monitor benefits of treatment

G. **Idiopathic macular hole (MH):** Full thickness reduction of the retinal layers within the macular area

1. OCT findings
   - (a) full thickness defect with opening of the neurosensory retina associated with anterior/posterior traction
   - (b) may be associated with retinal edema and thickening of the margins
   - (c) central thinning is noted on the macular map analysis

2. The value of OCT
   - (a) may help to identify early changes that may be indistinguishable in fundoscopic evaluation (helps in determining stages)
   - (b) may determine benefits of therapeutic intervention
   - (c) helps in the understanding of the pathophysiology of the disease
   - (d) helps in staging

V. **Using it for diagnosis criteria**
   a. Choroidal neovascular membrane
      i. Characteristics: fluid
   b. Plaquenil toxicity
      i. Previous monitoring guidelines
      ii. Today’s monitoring guidelines: OCT & VF are standard of care
         1. OCT findings include perifoveal defect of PIL, saucer like appearance & others
   c. Age related choroidal atrophy
      i. New Dx criteria
ii. How to measure choroidal thickness using the OCT
d. Idiopathic Macular Telangiectasia (IMT)
i. Characteristics of Type 1 vs 2: type 2 has a draping of ILM
ii. OCT findings associated with type 2
e. Lamellar hole
   i. Fundus characteristics
   ii. OCT findings
f. Myopic fovealschisis
   i. Characteristics
   ii. OCT findings

VI. OCT uses beyond the macula
a. OCT findings of a peripheral retinal conditions
   i. value in retinal hole
      1. representation of traction
      2. representation of fluid cuff
   ii. Distinguishing RD vs retinoschisis
      1. RD undulates and see clear separation between retina and RPE
      2. Schisis will show muller's stretching with inner and outer retinal separation
b. Optic nerve
   i. Papilledema vs Optic nerve head (ONH) (similar to typical modulation associated with macular drusen)
      1. Clinical findings: lumpy bumpy
      2. OCT findings
   ii. MS & optic neuritis
      1. New data shows GCC thinning may correlate to MS relapse
      2. Optic neuritis is associated with NFLD
   iii. Optic pit
      1. Clinical findings
      2. OCT findings
   iv. Vitreopapillary traction
      1. Spectrum of VR traction
      2. OCT findings
c. OCT findings of vascular entities
   i. Polypoidal choroidal vasculopathy
   ii. Superficial vs intraretinal hemorrhages
   iii. Vitreous hemorrhage
   iv. Retinal macroaneurysm
d. MS & OCT
   i. Note GCC thinning
e. Strokes & OCT
   i. GCC defects correlate with visual field defects
f. Peripheral vitreoretinal disease
1. Retinoschisis: splitting of inner and outer layer with stretching of the Muller cell

Retinal detachment: separation of neurosensory retina from RPE

g. Lesions

i. How OCT can help in the evaluation of a small ocular melanoma
   1. TFSOM (Shield et al 2009):
      2. Evaluation of overlaying fluid using OCT: fluid & thickness increase likelihood of a melanoma

ii. OCT findings associated with CHRPE

iii. OCT findings associated with a nevus

iv. Use of EDI (enhance depth imaging) may be helpful for lesions within the choroid and choroidal thickness measurements

V. Spectral Domain

a. Available instruments & their benefits
b. Higher resolution & speed
c. 3D measurements
d. Software capabilities
   1. Video capabilities
   2. Segmentation
   3. Point-by-point registration
   4. Advanced visualization

E. Comparing companies

VI OCTA: microvascular evaluation

a. Principles: newest OCT able to look at microvascular changes
b. Uses: DR, IMT, AMD, occlusive disease, others
c. Case samples
d. Slabs
   vitreoretinal interface (VRI): superficial neo
   superficial
   deep: MAs
   avascular:
   choroicapilaries: CNV
   choroid