Optical Coherence Tomography (OCT): Posterior Segment Applications

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I. Principles of optical coherence tomography (OCT)
   a. Analogous to orbital ultra-sonography which assesses the time delay response to the transmission of sound waves
   b. Provides non-invasive in situ cross-sectional imaging of tissue via low coherence interferometry
   c. Ultra-structural visualization is achieved through the assessment of echo time delay and intensity of back-scattered / back-reflected light from ocular tissues

II. Optical coherence tomography imaging
   a. Temporal vs. spectral domain (spectral domain layer segmentation & 3D visualization)
   b. Tomography (transverse tomograph and longitudinal tomograph)
   c. Scans (line scan, circular scan, en face scan)

III. Interpretation of OCT
   a. Optical reflectivity of incident light
      i. Normal ocular structures demonstrating increased optical reflectively
         1. Retinal pigment epithelium
         2. Photoreceptor junction
         3. Nerve fiber layer
b. Optical scatter

i. High scattering

1. Enhanced reflectivity

2. Increased attenuation of incident light – shadowing of deeper retinal structures

3. Causes of high backscattering include hyper-reflective entities
   a. Hard exudates
   b. Hemorrhages
   c. Detached retinal pigment epithelium
      i. Drusenoid
      ii. Serous
      iii. Hemorrhagic
      iv. Serosanguinous

ii. Moderate scattering

1. Intermediate appearance of OCT images

2. Causes of moderate backscattering
   a. Retinal edema
   b. Alterations in cellular structure

iii. Optically transparent

1. Devoid of backscatter

2. Causes
   a. Normal vitreous body / vitreo-retinal interface
   b. Serous fluid
   c. Subretinal fluid
c. Fundus Auto-Fluorescence (FAF)

IV. Morphologic approach for the methodological analysis and characterization of abnormal OCT imaging studies

a. Vitreous
   i. Vitreous
   ii. Asteroid hyalosis

b. Vitreo-retinal interface
   i. Posterior vitreous detachment (complete vs. partial)
   ii. Vitreo-macular adhesion vs. vitreo-macular tractional syndrome
   iii. Epi-retinal membrane (ERM)
      1. Macular pseudo-hole
      2. Characterization of membranes
         a. Globally adherent membranes
         b. Locally adherent membranes
      3. OCT - surgical outcome predictor
   iv. Macular cyst
   v. Lamellar hole
   vi. Macular hole (OCT characterization of macula in order to stage disease according to the Gass classification scheme)

c. Retina and macula
   i. Macular degeneration
      1. Drusen
2. Non-neovascular
   a. Geographic atrophy (OCT tomograph & autofluorescence)
   b. Macular atrophy

3. Neovascular macular degeneration
   a. Posterior to anterior originating membranes
      i. Classical choroidal neovascular membranes (CNVM)
      ii. Occult CNVM
   b. Anterior to posterior membranes
      i. Retinal Angiomatous Proliferation (RAP)
      ii. Plaquenil® maculopathy
         1. AOA 2002 management guidelines
         2. AOA 2011 management guidelines
   iii. Intra-retinal edema
      1. Macular edema
         a. Disease etiology (retinal vascular occlusive disease, DM, post-surgical)
      2. Qualitative and quantitative analysis of treatment
         a. Medical therapy
         b. Intra-vitreal intervention
   iv. Intra-cellular edema
   v. Neurosensory retinal detachment
   vi. Retinoschisis

d. Optic nerve
   i. Drusen
ii. Optic nerve edema

iii. Peri-papillary atrophy

e. Choroidal

i. Choroidal nevus

   1. Amelanotic
   2. Pigmented

ii. Choroidal tumors

   1. Choroidal melanoma
   2. Choroidal osteoma

iii. Polypoidal Choroidal Vasculopathy (PCV)

iv. Central serous choroidopathy

v. Focal choroidal excavation

V. Emerging advances in optical coherence tomography

   a. Handheld OCT
   b. Intra-operative OCT
   c. Functional OCT