Glaucoma Masqueraders – Conditions That Mimic OCT Findings in Glaucoma

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We have no actual or potential conflict of interest in relation to this presentation
Objectives

- Interpret OCT printouts
- OCT findings in glaucoma
- Glaucoma masqueraders
Interpreting OCT Printouts

ONH/RNFL SCANS
MACULAR SCANS/GANGLION CELL ANALYSIS
LINE SCANS
OCT – RNFL/Optic Cube Scans

<table>
<thead>
<tr>
<th>OD</th>
<th>OS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average RNFL Thickness</strong></td>
<td>95 µm</td>
</tr>
<tr>
<td><strong>RNFL Symmetry</strong></td>
<td>78%</td>
</tr>
<tr>
<td><strong>Disk Area</strong></td>
<td>2.68 mm²</td>
</tr>
<tr>
<td><strong>Cup Volume</strong></td>
<td>0.019 mm³</td>
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</tbody>
</table>

**OD** and **OS**

**RNFL and ONH: Optic Disc Cube 200x200**

**RNFL Thickness Map**

**Disc Center (0.06,0.21)** mm

**Exverted Horizontal Tomogram**

**Distribution of Normals**

**RNFL Quadrants**

**RNFL Clock Hours**

**RNFL Circular Tomogram**

**Classifiation OD**

Within Normal Limits

**Classification OS**

Borderline
OCT – Macular Cube Scans/GCA
OCT Findings in Glaucoma

ONH/RNFL SCANS
LINE SCANS
GANGLION CELL ANALYSIS
OCT in Glaucoma

- RNFL deviation map
- RNFL thickness map
- RNFL distribution
  - Quadrants
  - Sectors/clock hours
- RNFL tomograms
- Macular ganglion cell
  - GCL, IPL, RNFL- GCC
  - GCIPL- GCA
- Line scans
OCT GCA/GCC - Glaucoma

Ganglion Cell OU Analysis: Macular Cube 512x128

ONH and RNFL OU Analysis: Optic Disc Cube 200x200
Glaucoma Case
56 year old Caucasian female

- **POHx**
  - Glaucoma suspect
  - Meibomian gland dysfunction

- **PMHx**
  - Migraine w/ visual auras
  - Depressive disorder

- **BCVA**
  - OD: -1.00+0.75 x 135  20/20
  - OS: -0.50+0.50 x 030  20/20
56 year old White female

- Pupils: PERRL, (-)RAPD
- Confrontation testing: unremarkable

- Gonioscopy:
  OD: \ CB /  OS: \ CB /  
  CB * CB  CB * CB  
  / CB \  / CB \  
  - Pigment: grade 1+ OU
  - Approach: flat OU
  - PAS/NV/AR: none OU

- Pachymetry: OD: 615um, OS: 597um

- IOP: 16/16 @0836
ONH and RNFL OU Analysis: Optic Disc Cube 200x200

<table>
<thead>
<tr>
<th></th>
<th>OD</th>
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<tbody>
<tr>
<td>Average RNFL Thickness</td>
<td>87 µm</td>
<td>78 µm</td>
</tr>
<tr>
<td>RNFL Symmetry</td>
<td>79%</td>
<td></td>
</tr>
<tr>
<td>Rim Area</td>
<td>1.02 mm²</td>
<td>0.94 mm²</td>
</tr>
<tr>
<td>Disc Area</td>
<td>1.48 mm²</td>
<td>1.79 mm²</td>
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<tr>
<td>Average CD Ratio</td>
<td>0.56</td>
<td>0.59</td>
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<td>Vertical CD Ratio</td>
<td>0.53</td>
<td>0.73</td>
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<tr>
<td>Cup Volume</td>
<td>0.163 mm³</td>
<td>0.364 mm³</td>
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</table>

RNFL Deviation Map

Neuro-retinal Rim Thickness

RNFL Thicknes

RNFL Circular Tomogram
Glaucoma Masqueraders
Case #1
42 year old Asian male - 2008

- **CC:** none, monitor eye condition

- **POHx**
  - No ocular diseases, injuries, or surgeries

- **PMHx**
  - HTN x 9 years
  - SLE with nephritis
    - HCQ 400mg/day since 2004
  - Hyperlipidemia
  - EtOH dependence in remission
42 year old Asian male

- **BCVA**
  - OD: -0.25  20/20
  - OS:  -0.25  20/20

- **Pupils:** PERRL, (−)RAPD

- **Confrontation testing:** unremarkable
42 year old Asian male

- Color vision (Ishihara): OD: 14/14, OS: 14/14

- Amsler grid: OD: no scotoma, no metamorphopsia
  OS: no scotoma, no metamorphopsia

- Anterior segment: unremarkable OU

- IOP: 17/17 @0905
42 year old Asian male

- **Assessment:**
  - Low risk glaucoma suspect
  - No retinopathy associated with HCQ

- **Plan:**
  - RTC 4 months, HVF 30-2, gonioscopy, pachymetry
42 year old Asian male

- **IOP:** 16/17 @0920

- **Gonioscopy:**
  - OD: \ CB /  OS: \ CB /
  - CB * CB  CB * CB
  - / CB \  / CB \
  - Pigment: grade 1+ OU
  - Approach: flat OU
  - PAS/NV/AR: none OU

- **Pachymetry:** OD: 615um, OS: 597um
42 year old Asian male

- **Assessment:**
  - Low risk glaucoma suspect

- **Plan:**
  - RTC 4 month, HVF 10-2
Baseline RNFL
OCT 01/2012
50 year old Asian male - 2016

- **POHx**
  - Moderate risk glc suspect
  - HCQ use without maculopathy
  - Mild cataracts
  - Dry eyes

- **PMHx**
  - HTN x 17 years
  - SLE with nephritis
    - HCQ 400mg/day since 2004
  - Hyperlipidemia
  - EtOH dependence in remission
50 year old Asian male

- **BCVA**
  - OD: sc 20/20
  - OS: sc 20/20

- Pupils: PERRL, (-)RAPD

- Confrontation testing: unremarkable
06/2016, 08/2016, 02/2017
Macular Change Analysis
10/2014 to 05/2017
Table 4. Earliest or Most Affected Quadrant of the Retina

<table>
<thead>
<tr>
<th>Patient</th>
<th>Quadrant</th>
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<tbody>
<tr>
<td>E1</td>
<td>Temporal</td>
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<tr>
<td>E2</td>
<td>Inferonasal</td>
</tr>
<tr>
<td>E3</td>
<td>Temporal</td>
</tr>
<tr>
<td>M1</td>
<td>Inferotemporal</td>
</tr>
<tr>
<td>M2</td>
<td>Inferonasal</td>
</tr>
<tr>
<td>M3</td>
<td>Inferotemporal</td>
</tr>
<tr>
<td>M4</td>
<td>Inferotemporal</td>
</tr>
<tr>
<td>S1</td>
<td>Inferotemporal</td>
</tr>
<tr>
<td>S2</td>
<td>Unclear</td>
</tr>
<tr>
<td>S3</td>
<td>Inferotemporal</td>
</tr>
</tbody>
</table>
Parafoveal vs Pericentral

Pericentral Retinopathy and Racial Differences in Hydroxychloroquine Toxicity

Ronald B. Melles, MD, Michael F. Marmor, MD

- 201 patients with HCQ ret
  - 76% parafoveal
  - 12% mixed
  - 12% pericentral

- 26 Asians
  - 50% pericentral
Ganglion Cell Layer

- GC-IPL in chronic HCQ therapy

  Macular ganglion cell–inner plexiform layer thickness for detection of early retinal toxicity of hydroxychloroquine

  Emrah Kan · Konuralp Yakar · Mehmet Derya Demirag · Mustafa Gok

- Median tx time 80 months (range 60-120 mo)

- Avg, minimum, sectorial macular GC-IPL significantly thinner

- Could occur in absence of VFD and clinically evident HCQ ret
Ganglion Cell Layer

Macular Retinal Ganglion Cell–Inner Plexiform Layer Thickness in Patients on Hydroxychloroquine Therapy

Min Gyu Lee,¹ Sang Jin Kim,¹ Don-Il Ham,¹ Se Woong Kang,¹ Changwon Kee,¹ Jaejoon Lee,² Hoon-Suk Cha,² and Eun-Mi Koh²

- GC-IPL thickness not definitively correlated with HCQ use in early HCQ management

- Avg and minimum GC-IPL thinning associated with:
  - HCQ retinopathy
  - Cumulative dose (>1000g)
• SD-OCT is a primary screening test
  
  o Screen beyond central macula in Asians (to arcades)
  
  o Focal interruption of photoreceptor outer segment lines
    ▷ Obtain star scan through fovea
51 year old Asian male

**Assessment:**
- Moderate pericentral HCQ retinopathy
  - Associated VFD on 24-2
  - Associated pericentral thinning on GCA on macular cube
  - Structural location confirmed with line scans
- Risk factors
  - High cumulative dose
  - Renal disease
- RNFL stable
  - RNFL defect location did not correlate with VFD or GCA
- ONH appearance stable
Plan:
- Latanoprost was discontinued 2/2017
- ERG was obtained
  - No parafoveal damage
  - Mildly reduced amplitude inferior pericentral
- Recommend d/c HCQ
- RTC 3 months follow-up
Case #2
74 year old Pacific Islander male

- **CC:** blur, gradual onset, x 6 months

- **POHx**
  - Mild cataracts
  - Diabetes without retinopathy
  - H/o thyroid orbitopathy OD 1990’s, resolved
    - h/o mild proptosis OD; conjunctival injection OU
  - POAG suspect

- **PMHx**
  - HTN x 25 years
  - DM x 12 years
  - H/o Graves’ Dz, s/p thyroidectomy 1994
  - CKD
  - Hypercholesterolemia
74 year old Pacific Islander male

- **BCVA**
  - OD: +1.25 +0.50 x 025  20/25
  - OS: +1.25 DS          20/60, PH NI

- Anterior segment: mild cataracts, otherwise unremarkable OU

- **IOP: 11/11 @0830**
## IOP Flow Sheet:

<table>
<thead>
<tr>
<th>Date and Time</th>
<th>IOP</th>
<th>OD (H/V)</th>
<th>OS (H/V)</th>
<th>Meds</th>
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<tbody>
<tr>
<td>12/22/97</td>
<td>--</td>
<td>16/16</td>
<td>0.3</td>
<td>0.3</td>
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<tr>
<td>07/26/99</td>
<td>--</td>
<td>14/14</td>
<td>0.4</td>
<td>0.55</td>
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<tr>
<td>06/19/00</td>
<td>--</td>
<td>12/11</td>
<td>0.4</td>
<td>0.5</td>
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<tr>
<td>12/18/01</td>
<td>0840</td>
<td>15/15</td>
<td>0.45</td>
<td>0.45</td>
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<tr>
<td>12/10/02</td>
<td>1305</td>
<td>15/14</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>02/10/04</td>
<td>1310</td>
<td>14/14</td>
<td>0.4</td>
<td>0.45</td>
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<tr>
<td>11/14/05</td>
<td>1513</td>
<td>12/12</td>
<td>0.4</td>
<td>0.55</td>
</tr>
<tr>
<td>01/09/07</td>
<td>1304</td>
<td>12/13</td>
<td>0.4</td>
<td>0.55</td>
</tr>
<tr>
<td>03/03/08</td>
<td>0850</td>
<td>13/13</td>
<td>0.45</td>
<td>0.55</td>
</tr>
<tr>
<td>07/30/14</td>
<td>0830</td>
<td>11/11</td>
<td>0.55/0.6</td>
<td>0.6/0.7</td>
</tr>
</tbody>
</table>
74 year old Pacific Islander male

- **Assessment:**
  - Likely NTG
  - DM without DR
  - Mild cataracts

- **Plan:**
  - RTC 2 weeks, HVF 24-2, gonioscopy, pachymetry
74 year old Pacific Islander male

- **Gonioscopy:**
  
  OD: \ SS /  
  SS * SS  
  / CB \  
  OS: \ SS /  
  SS * SS  
  / SS \  
  
  - Pigment: grade 1+ OU
  - Approach: flat OU
  - PAS/NV/AR: none OU

- **Pachymetry:** OD: 547um, OS: 554um
74 year old Pacific Islander male

- **BCVA**
  - OD: 20/25-
  - OS: 20/60

- **Pupils:** 6/3mm OD, 5/3mm OS, (+) grade 1+ APD OS

- **IOP:** 12/12 @1158
Exam Findings

- Decreased BCVA OS
- Relative APD OS
- Severely depressed VF OS
- RNFL thin nasally OD, temporally OS
  - Avg RNFL thickness symmetrical
74 year old Pacific Islander male

- MRI brain with and without contrast
  - 2.4 x 1.8 x 2.0 cm enhancing sellar mass with suprasellar extension favored to be a **pituitary macroadenoma**
  - mass effect on the optic chiasm and optic nerves
  - mass abuts the cavernous internal carotid arteries bilaterally, without narrowing of the arteries which have preserved flow voids.
Central 30-2 Threshold Test

Fixation Monitor: Gaze/Blind Spot
Fixation Target: Central
Fixation Location: 2/21
False Pos Errors: 3%
False Neg Errors: 14%
Test Duration: 09:11

Pupil Diameter: 6.6 mm
Date: 09-23-2014
Visual Acuity: 6/60 DS + 1.80 DC X 35
Age: 74
RX: +3.60 DS + 1.80 DC X 35

SITA-Standard
Stimulus: Ill White

Pattern Deviation

Total Deviation

GHT
Outside Normal Limits

Pattern Deviation not shown for severely depressed fields. Refer to Total Deviation.

VFI 61.1%

MD -7.25 dB P < 0.5%
PSD 6.52 dB P < 0.5%

Pattern Deviation

Total Deviation

GHT
Outside Normal Limits

Pattern Deviation not shown for severely depressed fields. Refer to Total Deviation.

VFI 10%

MD -26.25 dB P < 0.5%
PSD 7.25 dB P < 0.5%

Pattern Deviation

Total Deviation

GHT
Outside Normal Limits

Pattern Deviation not shown for severely depressed fields. Refer to Total Deviation.

VFI 10%

MD -26.25 dB P < 0.5%
PSD 7.25 dB P < 0.5%
Compressive Optic Neuropathy

- **OCT findings**
  - OCT RNFL vs GCC/GCA

- **OCT pRNFL**
  - CON: temporal and nasal (chiasm)
    - Crossing fibers, nasal hemiretina
  - GON: superior and inferior
    - Lamina cribrosa

- **OCT mGCL**
  - CON: nasal fibers
  - GON: inferior and temporal
  - Superior to pRNFL in discriminating between CON and GON

GON vs CON mGCLIPL

GON

CON
ONH and RNFL OU Analysis: Optic Disc Cube 200x200

**OD**  |  **OS**
---|---
**Average RNFL Thickness**  | 71 μm  | 71 μm
**RNFL Symmetry**  | 88%  | 88%
**Rim Area**  | 0.97 mm²  | 0.95 mm²
**Disc Area**  | 2.18 mm²  | 2.20 mm²
**Average C/D Ratio**  | 0.74  | 0.74
**Vertical C/D Ratio**  | 0.57  | 0.68
**Cup Volume**  | 0.356 mm³  | 0.352 mm³

**2014 vs 2016**
Case #3
56 year old Caucasian male

- **CC:** no complaints; transferring care to VA

- **POHx**
  - NTG x 1.5 years
    - Cosopt bid OU
  - High myopia

- **PMHx**
  - HTN
  - OSA
  - Hyperlipidemia
56 year old Caucasian male

- BCVA
  - OD: -9.00 +0.50 x 115, 20/20
  - OS: -10.25 +2.00 x 015, 20/20

- CVF: full OU

- Pupils: ERRLA, no RAPD
56 year old Caucasian male

- Anterior segment: unremarkable OU
- IOP: 13/15
56 year old Caucasian male

- **Assessment:**
  - NTG dx in private sector
  - High myope

- **Plan:**
  - RTC 4 months, HVF 24-2, gonioscopy, pachymetry
  - Continue Cosopt bid OU
56 year old Caucasian male

- **IOP:** 14/16

- **Gonioscopy:**
  - OD: \ CB /  
  - OS: \ CB /  
  - CB * CB  
  - CB * CB  
  - / CB \  
  - / CB \  
  - Pigment: grade 1 both eyes
  - Approach: flat both eyes
  - PAS/NV/AR: none both eyes

- **Pachymetry:** OD: 544um, OS: 550um
Assessment:
- High myope
- Treated NTG suspect

Plan:
- Continue Cosopt bid OU
- RTC 6 months IOP check
OCT/RNFL Confounding Factors

- Anatomical
- Peripapillary atrophy
- Normative database
- Location of bundles
Tilted Disc
Peripapillary Retinoschisis
Peripapillary Atrophy

- Thinner RNFL
- Extension of PPA to the radius of the RNFL scan
Peripapillary Atrophy
Baseline: Jan/10/2012
Classification: Outside Normal Limits

Follow-Up #3: Feb/19/2015
Classification: Borderline

Follow-Up #4: May/28/2015
Classification: Outside Normal Limits
Central 24-2 Threshold Test

Fixation Monitor: Gaze/Blind Spot
Fixation Target: Central
Fixation Losses: 2/16
False POS Errors: 11%
False NEG Errors: 3%
Test Duration: 05:10

Fovea: OFF

Stimulus: Ill. White
Background: 31.5 ASB
Strategy: SiTA Standard
Pupil Diameter: 4.9 mm
Visual Acuity:RX: -5.50 DS DC X
Date: 02-19-2015
Time: 9:32 AM
Age: 61

GHT
Outside Normal Limits
VFI 98%
MD +0.18 dB
PSD 2.93 dB P < 2%

Total Deviation

Pattern Deviation

VAMC Livermore
4951 Arroyo Road Bldg 62
Livermore, CA 94550
284 healthy individuals
18-84 yo
Racially diverse
- 43% Caucasian, 24% Asian, 18% African American, 12% Hispanic
Refractive error: -12.00D to +8.00D
Asian database?
Spectralis Normative Database

- 201 healthy individuals
- 18-78 yo
- Racially homogenous
  - Caucasian
- Refractive error: -7.00D to +5.00D
Optovue RTVue Normative Database

- **861 subjects**
  - Version 4.0
  - largest of any OCT device at this time
- **15 clinical sites**
  - International (England, China, Japan, India)
- **19-82 yrs of age**
  - Average 50 yrs
- **Ethnic specific**
  - African Descended, Asian, Caucasian, Chinese, Hispanic, Indian, Japanese, and a combination of all ethnicities
- **Refractive error: +/- 8 D sph, +/- 2 D cyl**
Topcon 3D OCT-2000

- 137 subjects for disc scans
  - female>male
- 164 subjects for macula scans
  - female>male
- 20-70+ (average age 42 yrs old)
- 6 clinical sites in the US
- Refractive error
  - +3.00 D to -6.00 D
Nidek RS-3000

- Non-highly myopic normative database
  - 220 healthy individuals
    - 130 Asians, 90 Caucasians
  - Refractive error: -6.00D to +3.00D
  - Avg axial length
    - 24.0 mm Asians
    - 23.4 mm Caucasians

- Highly myopic normative database
  - 112 healthy Asians
  - Avg refractive error: -8.1 D
  - Avg axial length: 27.1 mm

RNFL Maps

- RNFL distribution angle decreases with increase myopia and leads to abnormal RNFL thickness deviation map

- Evaluate the RNFL thickness map with reference to the RNFL deviation map

RNFL defects detected on red-free photographs better correlated with RNFL thickness map than RNFL deviation map.

GCC/GCA

- Ganglion cell complex (GCC)
  - RNFL + GCL + IPL

- Ganglion cell analysis (GCA)/GCIPL
  - GCL + IPL
Mild to Moderate Myopia

- pRNFL vs GCIPL

58 year old Caucasian male

**Assessment:**
- High myopia
  - RNFL
    - Thicker temporal RNFL
    - Thinner superior and inferior RNFL, borderline nasal RNFL
    - Stable RNFL x 2 years
  - Line scans indicate robust RNFL
  - Stable nasal defect OD, clear HVF OS
  - Stable ONH appearance
- Treated NTG suspect
58 year old Caucasian male

Plan:
- Continue Cosopt bid OU
- RTC 6 months IOP check
Case #4
80 year old Caucasian male

- CC: none

- POHx
  - Low risk glaucoma suspect secondary to ONH appearance
  - Mild cataracts OU
  - Mild ERM OD

- PMHx
  - HTN
  - Osteoarthritis
80 year old Caucasian male

- OD  +2.00 +1.25 x 005  20/20
- OS  +2.75 +1.00 x 180  20/20

- Pupils: PERRL, (-)RAPD

- Confrontation testing: unremarkable
80 year old Caucasian male

- Anterior segment: unremarkable OU
- IOP: 14/13 @0914
ONH and RNFL OU Analysis: Optic Disc Cube 200x200

<table>
<thead>
<tr>
<th>Parameter</th>
<th>OD</th>
<th>OS</th>
</tr>
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<tbody>
<tr>
<td>Average RNFL Thickness</td>
<td>94 μm</td>
<td>93 μm</td>
</tr>
<tr>
<td>RNFL Symmetry</td>
<td>74%</td>
<td></td>
</tr>
<tr>
<td>Rim Area</td>
<td>1.14 mm²</td>
<td>1.05 mm²</td>
</tr>
<tr>
<td>Disc Area</td>
<td>1.82 mm²</td>
<td>1.44 mm²</td>
</tr>
<tr>
<td>Average C/D Ratio</td>
<td>0.60</td>
<td>0.52</td>
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<tr>
<td>Vertical C/D Ratio</td>
<td>0.61</td>
<td>0.53</td>
</tr>
<tr>
<td>Cup Volume</td>
<td>0.173 mm³</td>
<td>0.147 mm³</td>
</tr>
</tbody>
</table>

Neuro-retinal Rim Thickness

Disc Center (0.03, 0.30) mm
Extracted Horizontal Tomogram

Disc Center (-0.09, -0.48) mm
Extracted Horizontal Tomogram

Extracted Vertical Tomogram

RNFL Circular Tomogram

RNFL Quadrants

RNFL Clock Hours
Situs Inversus

- Situs inversus of the optic disc is a congenital abnormality
- Anomalous insertion of the optic stalk into the optic vesicle, resulting in dysversion of the ONH

- OCT findings:
  - Thicker nasal RNFL
  - Thinner superior-temporal
  - Thinner temporal
  - Thinner inferior-temporal
  - Nasally located superior and inferior RNFL bundles
  - RNFL thickness profile is associated with the degree of optic disc tilt

Case #5
72 year old Caucasian male

- **CC:** developed blurry vision in right peripheral field x 1 month

- **POHx**
  - Mild cataracts
  - Actinic keratosis on eyelids OU

- **PMHx**
  - s/p left occipital CVA 08/2007
  - HTN x 30 years
  - Atrial fibrillation
  - Hyperlipidemia
72 year old Caucasian male

- **BCVA**
  - OD: +0.75 +0.50 x 020  20/40
  - OS: +1.25 +0.75 x 175  20/30

- **Pupils:** PERRL, (-)RAPD

- **Confrontation testing:** right homonymous hemianopia
72 year old Caucasian male

- **Anterior segment:**
  - Lens: NS grade 1+, PSC OU
  - blepharitis OU

- **IOP:** 18/18 @0850

- **Posterior segment:**
  - c/d 0.6/0.6 OU
  - Macula: flat, homogenous OU
  - Posterior Pole: clear OU
  - Periphery: no holes/tears OU
Stable left occipital encephalomalacia.
72 year old Caucasian male

**Assessment:**
- s/p occipital lobe CVA with right congruous homonymous hemianopia
- Mild/moderate cataracts with decreased BCVA

**Plan:**
- RTC 1 year for comprehensive eye exam
76 year old Caucasian male

**POHx**
- Low risk glaucoma suspect
- s/p occipital lobe CVA with right congruous homonymous hemianopia
- Mild/moderate cataracts with decreased BCVA

**PMHx**
- s/p left occipital CVA 08/2007
- HTN
- Atrial fibrillation
- Hyperlipidemia
- h/o herpes zoster
76 year old Caucasian male

- **BCVA**
  - OD: -1.75 +0.75 x 026  20/50
  - OS: +0.50 +1.00 x 168  20/30

- **Pupils:** PERRL, (-)RAPD

- **Confrontation testing:** right homonymous hemianopia
76 year old Caucasian male

- Anterior segment:
  - Cataracts OD>OS
  - Blepharitis OU

- IOP: 14/13 @0845
76 year old Caucasian male

- Prior exam data:
  - Gonioscopy:
    - OD: \ CB /   OS: \ CB /
    - CB * CB      CB * CB
    - / CB \       / CB \\
    - Pigment: grade 2+ OU
    - Approach: flat OU
    - PAS/NV/AR: none OU

  - Pachymetry: OD: 560, OS: 569
76 year old Caucasian male

- **Assessment:**
  - POAG OD > OS
    - Suspicious OCT findings, ONH appearance, new VF defects OD
  - s/p occipital lobe CVA with right congruous homonymous hemianopia
  - Moderate cataracts with decreased BCVA
  - h/o herpes zoster without ocular manifestations

- **Plan:**
  - Start latanoprost 1 gtt qhs OU
  - RTC 6 weeks IOP check
78 year old Caucasian male

**POHx**
- POAG OU – latanoprost qhs OU
- s/p occipital lobe CVA with right congruous homonymous hemianopia
- Moderate cataracts with decreased BCVA
- h/o herpes zoster without ocular manifestations

**PMHx**
- s/p left occipital CVA 08/2007
- HTN x 30 years
- Atrial fibrillation
- Hyperlipidemia
- h/o herpes zoster
78 year old Caucasian male

- **BCVA**
  - OD: -4.00 +0.75 x 026  20/60
  - OS: -1.50 +1.00 x 168  20/50

- **Pupils: PERRL, (-)RAPD**

- **Confrontation testing: right homonymous hemianopia**
78 year old Caucasian male

- Anterior segment:
  - Cataracts OD>OS
  - Blepharitis OU

- IOP: 11/12 @1549
Macula Thickness: Macular Cube 512x128

Overlay: ILM - RPE Transparency: 50%

ILM - RPE

ILM

RPE

Diversified: Distribution of Normals
- 99%
- 95%
- 5%
- 1%

Central Subfield Thickness (µm) | Cube Volume (mm³) | Cube Average Thickness (µm)
--- | --- | ---
ILM - RPE | 268 | 8.9 | 248
78 year old Caucasian male

- **Assessment:**
  - POAG OD > OS vs glaucoma suspect OU
    - OCT findings and ONH appearance
  - s/p occipital lobe CVA with right congruous homonymous hemianopia
  - Moderate cataracts with decreased BCVA
  - Stable superior nasal central VFD likely due to prior BRAO

- **Plan:**
  - Continue latanoprost 1 gtt qhs OU
82 year old Caucasian male

- POHx
  - Treated high risk glaucoma suspect
    - OCT findings and ONH appearance
  - s/p occipital lobe CVA with right congruous homonymous hemianopia
  - Stable superior nasal central VFD likely due to prior BRAO
  - Pseudophake OD
  - Moderate cataract OS
Hemianopia with corresponding topographic GCIPL
Trans-synaptic Retrograde Degeneration

- **Axonal degeneration**
  - Central and peripheral nervous system
  - Anterograde (Wallerian) toward the post-synaptic end
  - Retrograde toward the presynaptic cell body

- **Trans-neuronal degeneration**
  - Occurs after damage to the CNS
  - Degeneration crosses a synapse
  - Neurons in the LGN and RGCs degenerate following occipital lobe lesions
Trans-synaptic Retrograde Degeneration

- **History**
  - Animal models
    - Rat, cat, monkey
  - 20th century

- Clinical fundus changes seen only in those with damage to the post-geniculate pathway occurred prenatally – Miller et al. 1995

- Reduction in signal on the pattern ERG- Stoerig et al. 1989

- RNFL changes with OCT – Jindahra et al. 2009

- Shrinkage of optic tract can be demonstrated by MRI – Bridge et al. 2011; Cowey et al. 2011
OCT has the ability to measure pRNFL and GCL

- **pRNFL**
  - Indirectly measures TRD
  - Issues with post-chiasmatic lesions that respect the vertical midline
    - Divided in quadrants/sectors
    - Temporal quadrant
      - Both retinal fibers from the temporal retina as well as the papillomacular bundle nasal to the fovea
TRD OCT

Nasal Retinal Fibers
Temporal Retinal Fibers

RNFL Thickness Map

OD Thickness Map

OD Sectors
TRD OCT
TRD OCT

PanoMap Analysis: Right Eye

OD ○ ○ OS

- Dec Area: 1.75 mm²
- Rim Area: 0.77 mm²
- Average C/D Ratio: 0.76
- Vertical C/D Ratio: 0.73
- Cup Volume: 0.548 mm³
- Average RNFL Thickness: 78 μm
- Superior RNFL Thickness: 94 μm
- Inferior RNFL Thickness: 104 μm

- Diversified Distribution of Normals
  - NA 95% 5% 1%

- Combined GCA and RNFL Deviation Map

- RNFL Thickness

- GCL + IPL

- Average GCL + IPL Thickness: 65
- Minimum GCL + IPL Thickness: 43

PanoMap Analysis: Left Eye

OD ○ ○ OS

- Dec Area: 1.86 mm²
- Rim Area: 0.85 mm²
- Average C/D Ratio: 0.75
- Vertical C/D Ratio: 0.74
- Cup Volume: 0.586 mm³
- Average RNFL Thickness: 68 μm
- Superior RNFL Thickness: 80 μm
- Inferior RNFL Thickness: 72 μm

- Diversified Distribution of Normals
  - NA 95% 5% 1%

- Combined GCA and RNFL Deviation Map

- RNFL Thickness

- GCL + IPL

- Average GCL + IPL Thickness: 68
- Minimum GCL + IPL Thickness: 80

- Diversified Distribution of Normals
  - NA 99% 95% 5% 1%
Incomplete HH/Quadrantanopia

- **Blue**
  - ST and S GCIPL
  - Clock hrs 10 to 1
- **Red**
  - SN and S GCIPL
  - Clock hrs 2, 3, 9, 10
TRD: OCT RNFL vs Macula GCL

- **Mitchell et al.**
  - 22 pts with HH due to occipital cortical disease
  - TRD of the GCL in 15 pts, some whom showed no RNFL thinning at all
  - GCL changes onset by 1 yr post-injury and extended out as far as 10 yrs
  - TRD was not observed in 2 pts

- **Herro and Lam**
  - 9 pts with ischemic CVA
  - GCL thinning but not RNFL

- **Shin et al.**
  - 11 pts with quadrantanopia
  - GCL thinning in 20 of 22 eyes
  - RNFL thinning in 15 eyes only

- GCL more sensitive and offer a clearer demonstration of the phenomenon
Location

46 pts with CVA

Areas included:
- Anterior cerebral artery (ACA) 8
- Middle cerebral artery (MCA) 21
- Posterior cerebral artery (PCA) 17

- OCT RNFL changes in all 3 groups
- PCA had the most significant changes; followed by MCA and then ACA
- Pattern of RNFL loss was similar among all infarction territories
- Correlation between time after infarction and degree of RNFL thinning

- Location (PCA) and time were related to the extent of TRD

- True TRD vs retrograde
  - Optic tract (anterior choroidal artery – MCA)
Transneuronal Retrograde Degeneration of the Retinal Ganglion Cells in Patients with Cerebral Infarction

Hae-Young Lopilly Park, MD, PhD,1 Young Gun Park, MD,2 A-Hyun Cho, MD, PhD,3 Chan Kee Park, MD, PhD1

Time Course of TRD

- Occipital lobe lesions
- OCT reduction in RNFL (TD-OCT)
- Longitudinal study
- 38 pts with CVA involving the occipital lobe/tract
  - 6 days to 67 yrs
  - 9.8 microns per log year

- Speed of the TRD was highest in the first few years, after which it slowed down and reduced to slightly higher than age-related thinning after 10 yrs.
- Formula to predict RNFL thickness:
  - Mean RNFL (microns) = 110.3 – (9.08)*(elapsed time in log yrs)-(0.4)*(age at time of measurement)

- Patients with less TRD on OCT in the first few years after CVA were observed to demonstrate a greater degree of visual field recovery
- Size of the lesion did not correlate with the magnitude of the TRD
Lesion Size – Acquired vs Congenital

- Best predictors of RGC degeneration after lesions of striate cortex in monkeys were the size of the lesion - Cowey et al.

- Size of the lesion did not correlate with the magnitude of the TRD - Jindahra et al.

- Acquired lesions - the larger the initial lesion, the greater is the resulting TRD

- Congenital lesions tend to be smaller compared to acquired lesions with comparable visual field deficits

- A better predictor of TRD was the size of the visual field deficit - Millington et al.
Progression of transynaptic retinal degeneration with spectral-domain optical coherence tomography

Schwartz et al.

- 60 y/o WM with CVA
- Left homonymous hemianopia
- Baseline OCT was 3 months after CVA

- 3 months post-CVA
  - OCT and GCC normal
- 13 months post-CVA
  - OCT and GCC thinning
- 17 months post-CVA
3 months post-CVA

13 months post-CVA

17 months post-CVA
Summary

- **OCT**
  - RNFL
  - GCA/GCC
  - Macular cube
  - Line/raster scans

- Correlate clinical findings
  - VA’s, pupils,
  - Imaging: OCT, VFs, photos
Glaucoma Masqueraders – Conditions That Mimic OCT Findings in Glaucoma

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