10 Hacks for Understanding and Interpreting OCT in Retina and Glaucoma

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Mark Dunbar: Disclosure

- Optometry Consultant
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  - Allergan
  - Carl Zeiss
  - Regeneron
  - Genentech

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

Why Do You Need an SDOCT

- Increased demands for eye care due to rapidly growing aging population
- An “aging” population means more patients with disease
- The responsibility on the doctor to accurately diagnose and manage is too great
- If you are going to practice medical eye care OCT is essential

The Evolution of OCT Imaging

- OCT has changed how clinicians look at the retina
- OCT has changed how we manage glaucoma
- The assessment of retinal abnormalities and glaucoma based on OCT imaging has advanced eye care
- OCT in Optometry practices ~ what %
- As the technology has evolved -> prices continue to come down

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**Advances in SD-OCT**

- Improving software
- Faster – virtual angiography
- Noise reduction/over sampling technology
- Wider and deeper scans
- Greater density in the scans
- Improvements in 3D imaging
- Enhanced depth imaging – imaging choroid
- Progression analysis software

**10 Hacks for OCT Interpretation: Retina**

1. Don’t make it more complicated than it needs to be: keep it simple and don’t get caught up in the minutia!
2. Many macular disease conditions have a “signature” OCT feature
   - Learn what those are and the diagnosis and interpretation becomes easier
3. Correlate what you see on clinical exam with anatomy on OCT
4. Is there fluid?
5. What is the status of the IS/OS line
6. Pay attention to the vitreoretinal interface
7. Is it full thickness?
8. OCT findings in dry AMD can be a predictor for progression to GA or CNV
9. Make sure you are scanning all your high myopes
10. Look for change over time

**OCT Angiography (OCTA)** is a great non-invasive tool to view the microvascular

**Hack/Tip #1**

1. Don’t make it more complicated than it needs to be
   - Keep it simple
   - Don’t get caught up in the minutia!

**Simple Tip**

Print/View B Scan Images in Black and White -> not color: you lose resolution with color

**Remember: Many different Options for Visualization of Macular Detail**

- HD 1 Line 1x11
  - 1x11 averaged
  - HD Foveal Assessment
  - HD Enhanced
  - Foveal center important
  - Centering helps with reproducibility

- HD 21 Line
  - 21 lines
  - 4/8x averaged
  - Ideal for anti-VEGF therapy monitoring

- HD Cross
  - 5 horizontal
  - 5 vertical
  - 8x averaged
  - Ideal for macular hole assessment & surgical planning

**Hack #2**

Many macular disease conditions have a “signature” OCT feature

Learn what those are and the diagnosis and interpretation becomes easier
What does this “signature” OCT represent?

Hack/Tip #3
Correlate what you see clinically with what is happening anatomically
(The OCT does not exist in a vacuum)

Where is the Fluid?

Diabetic Macular Edema (DME)
Hack/Tip # 4: Is there Fluid?

ICSC

Poor Vision Following Cataract Surgery

AC IOL
Never Saw Well
VH: 20/200
Hack/Tip #5: What is the Status of the IS/OS Junction?
…but why are the letters moving…?

Conditions Affecting IS/OS Junction
AKA: PIL, Ellipsoid Line

57 y/o Hispanic Male:

Hack/Tip # 6:
Pay Attention to the Vitreomacular Interface?

VA: 20/40
Central Vision Loss Fellow Eye Due to CNV
65 y/o Hispanic Female
VA: 20/40

7/27/14
20/40
20/50
10/6/14

VMT evolving into a Macular Hole

Hack/Tip # 7:
Is it Full Thickness?

65 y/o White Female
↓ VA RE X 6 Wks, ↓ VALE X > 1 Yr

20/100 20/400
Pseudoholes vs. Full Thickness Holes

Hack # 8
OCT findings in dry AMD can be a predictor for progression to GA or CNV
Risk Factors for Progression to Wet AMD

- Traditionally based on clinical appearance
- Intermediate AMD
  - Large drusen > 125 microns
  - RPE mottling/pigmentary abnormalities
- Risk of conversion to wet AMD over 5 years > 50%

OCT Biomarkers May Help Predict Conversion to GA or Wet AMD

Hyper-Reflective Foci (HRF)
- Extracellular pigment granules and outer segment debris (outer HRF)
- May also represent displacement and clumping of degenerated RPE cells or
- AREDS2 study: Patients with HRF had 5X increased risk of progression to GA at 2 years vs. controls

AMD Is the Leading Cause of Blindness for Caucasians in the US

OCT Biomarkers May Help Predict Conversion to GA or Wet AMD

- Hyper-Reflective Foci (HRF)
- Reticular pseudo drusen
- Incomplete Retinal Pigment Epithelial and Outer Retinal Atrophy (iRORA)
  - Without RPE loss
  - Replaces "Nascent GA"
- Hyper-transmission defects
- OCT-Reflective Drusen Substructures

OCT Biomarkers May Help Predict Conversion to GA or Wet AMD

- OCT Biomarkers in Neovascular Age-Related Macular Degeneration: A Narrative Review
  - Chronic Retinal Hypoperfusion, Acute Retinal Necrosis, Outer Retinal Necrosis, Central Venous Occlusion
  - A review article: "OCT Biomarkers in Neovascular Age-Related Macular Degeneration: A Narrative Review"

Reticular Pseudo Drusen

- Subretinal collections of granular, interlacing, hyper-reflective material located above RPE
- Commonly found in the superior macula or close to superotemporal arcade
- Undergo a characteristic lifecycle of growth, invasion into the ellipsoid zone, and finally regression
- Reticular pseudodrusen is associated with an additional 2-6-fold increased risk of progression to nAMD or central GA.
  - Risk of progression higher for reticular pseudodrusen located outside the macula

Hyper-reflective Columns

- Narrow strips of light transmission
- Overlying RPE appears intact
  - May represent micro-cracks
- Increased risk of progression to GA
  - Present in 27% of eyes that progressed to GA nAMD
Jeff: mid-50’s Attorney, High Myopia
Hx of RD Repair in both eyes: RE: 1985 LE 1989

- Never recovers vision in the RE
- He is followed through the 90’s with a progressive NS and declining VA ~ 20/70
  - 1 eyed patient and reluctant to have CE
- Eventually has CE/IOL 90’s-early 2000’s and does well
  - VA 20/25 low refractive error
Jeff: High Myopia and VMT

3/11/19
• Feels Vision is slightly worse, increase in distortion

Myopic Macular Retinoschisis
- Seen in 9% of highly myopic eyes with posterior staphyloma
- 50% progress to macular hole formation or macular detachment within 2 yrs
- Caused by rigidity of ILM that induces traction

Initial Visit 1 year later
20/200

2 years after initial presentation

Pars Plana Vitrectomy

Pseudophakia – was myopic all her life

Had a Vitrectomy – 1 year later 20/40
2/4/22

1 year later 2 years after last OCT 1 year later

RE

79

2009

Blurred vision and metamorphopsia LE

High Myopia

80

Diagnosis

• CNV – related to pathologic myopia
• Tx: Avastin injection

81

82

2 months after injection

83

84
OCT Angiography (OCTA) is a great non-invasive tool to view the microvascular structures. The basic idea of how it works:

- Capturing motion in the retina
- Scans at 68,000 A-scans per second
- Traditional SD OCT scan at 28,000 to 40,000 A-scans per second
- Compares repeat scans acquired at the same position in the retina to look for changes - motion
97

Ischemia near the FAZ

98

What’s Next in OCT?

99

Notal Home-OCT vs. Heidelberg Spectralis

100

10 Hacks/Tricks for OCT Interpretation in Glaucoma

1. Make sure it is a reliable scan
2. Do 3 RNFL scans at a time
3. GCC is valuable and often correlates with RNFL
4. Can the RNFL/optic nerve of your patient be applied to the normative data base?
5. Does the OCT findings fit with the clinical presentation?
6. Watch out for “Red Disease!”
7. There is a large range of normal before the RNFL reaches a tipping point
8. The OCT can show glaucomatous change BEFORE it is seen on visual fields
9. A change of > 10 microns from previous measurements is significant
10. The SDOCT is not as sensitive with more severe glaucoma

101

Hack/Tip #1
Make Sure it is a Reliable Scan
- Make sure you have a good single strength:
  - Cirrus: signal strength ≥ 7
  - 6 is borderline
  - OptoVue: 40 and above
- Make sure there is no algorithm failure

102

Hack/Tip #2
Do 3 RNFL scans at a time
- Ensures consistency/reliability
- On follow up, 2 of the scans can be used as the baseline for guided progression analysis GPA
What is the Reproducibility of RNFL OCT Clock Hour Measurements

A. 0-3 microns
B. About 4-5 microns
C. About 10 microns
D. > 10 microns

How much change needs to occur on an OCT RNFL for it to be significant?

RNFL Quadrants and Clock Hours

Inter-visit Tolerance:
Clock Hours: ~ 4-5 microns
Quadrant: 8-10 microns
Using 2 of the initial scans as the baseline for GPA

Hack/Tip # 3
GCC is valuable and often correlates well with the RNFL (but not always)
Hack/Tip # 4
Can the RNFL/optic nerve of your patient be applied to the normative data base?

- Pathologic myopia
- Tilted disc
- Extremely large cups (and small)
- Patients less then 18 yo

99% probability that the area is abnormal – compared to the normal population
95% probability the area is normal
Hack/Tip #5
Does the OCT findings fit with the clinical presentation?

51 y/o Hispanic Female
- Reports shadow peripherally in her LE
- TA: 16-17 on 3 visits
Watch Out for *Red* Disease!

TA: 12 to 14 on T5 bid, ~ 16 off T5
Hack/Tip #7
Be on the lookout for Green Disease

There is a large range of “normal” before the RNFL reaches the “tipping point”

Tipping Point = 75 microns
Average RNFL Thickness Ranges ~ 75 - 110 microns

There is a Large “Range” of Normal

- Just like perimeter, the average patient can lose a third of her/his RNFL or neuro-retinal rim and still be inside the normal range.
- We can measure multiple steps of statistically significant change while a glaucoma suspect still is in the green normal range.
- It is possible to view SD-OCT change from baseline as an early detection strategy in glaucoma suspects.

What This Means For Everyday Clinical Care

- We can measure multiple steps of statistically significant change while a glaucoma suspect still is in the green normal range.
- It is possible to view SD-OCT change from baseline as an early detection strategy in glaucoma suspects.

Values shown are for a 69 year old normal.
Large Range of Normal Before Tipping Point

Hacks/Tips #8
The OCT can show glaucomatous change **BEFORE** it is seen on visual fields

Estimating the Lead Time Gained by Optical Coherence Tomography in Detecting Glaucoma before Development of Visual Field Defects

- At 95% specificity, up to 35% of eyes had abnormal average RNFL thickness 4 years before development of visual field loss and 19% of eyes had abnormal results 8 years before field loss.
- Conclusions: Assessment of RNFL thickness with OCT was able to detect glaucomatous damage before the appearance of VF defects on SAP. In many subjects, significantly large lead times were seen when applying OCT as an ancillary diagnostic tool.

Hacks/Tips #8
The OCT can show glaucomatous change **BEFORE** it is seen on visual fields

Hacks/Tips #9
A change of ≥ 10 microns from previous measurements is significant

Case MC
- 73 yo female presents for follow up: GL Suspect
- Past history single elevated IOP
- BCVA 20/25 and 20/20
- IOP 21 RE 19 LE;
  - CCT 560u R 565u L
- Anterior segment normal
- Mild NS and cortical cataracts

The ON
- Small optic discs OU
- RE c/d ~ 0.6 but
  - Appeared saucerized infero temporally
- LE c/d .35
This was her 15 months earlier

Is this significant?

See what happens the next year
Case MC progression

- Clinical suspicion proved true
- Initial progression in normal range and continued
  - Rate is important consideration
- Treatment initiated
- Subtle corresponding VF defect evolved
- Currently stable in short term on well tolerated meds

Detecting Glaucoma Progression Using OCT - RNFL

- RNFL Thinning on OCT
- Patient able to do a reliable VF?
- Is thinning > 10 microns?
  - Yes: Glaucoma has progressed
  - No
- Is there VF worsening and disc hemorrhage that corresponds to the area of thinning?
  - Yes: Progression not confirmed
  - No: Repeat studies at appropriate intervals

Hack/Tip # 10

The SDOCT is not a sensitive with more severe glaucoma

- Floor Affect in Advanced Glaucoma ~40-50 microns
- Difficult to use the OCT to measure progression

Visual Fields become more important... particularly 10-2 VF
Summary OCT in Glaucoma

- OCT provides another piece information for the "glaucoma puzzle"
  - Along with IOP, visual fields and clinical appearance of the nerve
- It provides an objective means of comparing "glaucomatous" nerves from normal or physiologic optic nerve
- It provides an objectives means of determining progression

Summary: OCT in Retina

- SD OCT has emerged as a critical tool in the diagnosis and treatment of retinal disease
- It has changed how we evaluate the macula
- Helps establish a diagnosis that is difficult to determine with only standard ophthalmology
- Advancing software has provided expanded uses of OCT
- OCT Angiography has taken OCT to the next level