OCT Applications in Optometry

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**OCT**

Get the right one for the right reason!

**Which OCT?**

- Time Domain
- Fourier (Spectral) Domain

**Time Domain vs. Spectral**

“Cirrus OCT has better scan quality than Stratus OCT, especially in glaucomatous eyes. In cases with good-quality scans, the sensitivity and specificity, and AUCs were similar. The best agreement was in the global average RNFL classification. The widths of limits of agreements exceed the limits of resolution of the OCTs.”

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Mandatory Slide

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**FOURIER DOMAIN OCT ADVANTAGE**

- FD OCT has twice the depth resolution as TD OCT (5 microns vs 10 microns)
- Allows imaging and segmentation of ganglion cell layers
- Faster speed also allows for greater density of sampling points and reduces artifacts from eye-movements (FD OCT has 26,000 A scans/sec vs Stratus TD OCT with 400 A scans/sec)
Evaluation of the Cornea and Anterior Chamber

Pachymetry Maps

Keratoconus Analysis
Thickness Parameters
B-Scans

Power Calculations

6 mm diameter average thickness values by region
Central circle 0-2 mm
Middle circle 2-5 mm
Outer circle 5-6 mm

Thickness Map color coded

Keratoconus

IMAGING AND MEASUREMENT OF THE CORNEA

Angle Calculations

MEASURED OCCCLUDABLE ANGLE
How Do They Compare?

FDT, SWAP, flicker perimetry, and OCT are all useful methods for discriminating between healthy eyes and eyes with early glaucoma. Among all 10 OCT parameters, NFLT has the highest sensitivity for detecting early glaucomatous changes in GS patients.

Nomoto, Hiroki; Matsumoto, Chota; Takada, Sonoko; Hashimoto, Shigeki; Arimura, Eiko; Okuyama, Sachiko; Shimomura, Yoshikaz. Detectability of Glaucomatous Changes Using SAP, FDT, Flicker Perimetry, and OCT. Journal of Glaucoma. 18(2):165-71, Feb 2009.

DENDRITIC SHRINKAGE

- The first structural change from glaucoma was a shrinkage of the ganglion cell dendritic fields


GANGLION CELL LOSS IN THE MACULA

- Histologic studies have shown ganglion cell loss in the macula
- Desatnik et al. (1996) found macular ganglion cells are lost in early glaucoma
- Yucel et al. (2003) showed loss of cells in the parvocellular layers of the LGN implicating central ganglion cell loss

TD OCT STUDY LIMITATIONS

• Major disadvantage in these studies is that TD OCT typically measures full retinal thickness only (does not isolate ganglion cells)

• TD OCT does not have enough depth resolution to image and segment the ganglion cells accurately and reliably

IMAGING THE GCC WITH THE FD OCT

GCC is inner retinal layers

• Nerve Fiber Layer – Ganglion cell axons
• Ganglion cell layer – Cell bodies
• Inner-Plexiform Layer – Dendrites

DIAGNOSTIC ACCURACY: GCC VS TD OCT FULL RETINA THICKNESS IN MACULA

• Tan et al. (2009) found the GCC (FD OCT) was significantly more accurate for detecting glaucoma compared to fovea thickness (full macula thickness) with Stratus TD OCT

• Mori et al. (2010) also showed GCC was significantly more accurate than full macula thickness with TD OCT


DIAGNOSTIC ACCURACY: GCC VS MACULA VF SENSITIVITY IN MACULA

• GCCT determined by SD-OCT (RTVue-100) showed a statistically significant structure-function association with macular VF, and the strength of the association was greater than that of the mpRNFL with macular VF in the superior central VF area.


DIAGNOSTIC ACCURACY: GCC VS FD OCT RNFL

• Rao et al. (2010) found GCC had similar accuracy levels as RTVue FD RNFL

• Seong et al. (2010) found similar results

• Kim et al. (2010) found AROC values were higher for RNFL vs GCC in a group of advanced glaucoma patients, but GCC values were higher than RNFL in a group of early glaucoma patients

FD OCT: GCC VS DISC VS RNFL

- Huang et al. (2010) compared the diagnostic accuracy for GCC, optic disc, and RNFL from the RTVue
- AROC for RNFL was highest (AROC = 0.92), with GCC second (AROC = 0.86), and vertical C/D ratio a close third (AROC = 0.854)
- They found the accuracy improved when they combined all three structures in an LDF (AROC = 0.97)

GCC SUMMARY

- GCC thickness correlates well with visual fields
- Highly reproducible
- More reproducible and more accurate for detecting glaucoma than macula thickness with TD OCT
- Similar accuracy for detecting glaucoma as FD OCT RNFL thickness

GCC:

Arrive at the scene of the crime before the crime

In addition to ppRNFL thickness, the mGCC thickness could be a structural parameter for detecting preperimetric glaucoma

“Proof in the Pudding”

Case Studies

Case History (2005)

- 57 YOM
- Struggles with diabetic control
- Has had some laser tx in prior 2-3 years
- CD always larger; but some? change
- Matrix screening field has new finding
- IOP always been in upper teens (17-19)
- Initiate glaucoma evaluation for NTG
- Side note: Approximately 2009 patient started CPAP

Optic Nerve Evaluation

(Also some background diabetic retinopathy)

Some exudates

Moderate Cupping
Matrix Screening Field
March 2005

Matrix Comprehensive Field
March 2005

Inferior defects (superior OCT?)
Superior defects (inferior OCT?)

OS (OD worse than OS)
OD

OCT Scan
April 2005

OS - Superior Damage (Consistent with Inferior Field Defect)
OD - Inferior damage (Consistent with Superior Field Defect)
OD worse than OS (Consistent with VF)

OD - Inferior damage (Consistent with Superior Field Defect)

RNFL Progression Evaluation (OD)
02/09-04/12
Stable

RNFL Progression Evaluation (OS)
02/09-04/12
Stable

Starting to drop? (Repeat OCT sooner)

GCC Progression Evaluation (OD)
02/09-04/12
Stable
Caveat

- RNFL changes occur earlier than field changes
- GCC changes occur earlier than RNFL
- Early progressive change in GCC is **EARLY!**
- Repeat OCT sooner to verify

OCT and Retinal Stuff

Patient Data

- 74 yo wf
- C/O vision stress
- Non contributory history
- Baby aspirin + vitamins
- VA With Contact Lenses OD 20/30 OS 20/40
- CCT 510/516 IOP 14/15
- Long standing VM traction OS and ERM OU with a Hx of refusing intervention
And the problem is....

- Examination 12.14.11 (29 YOF)
  - BCVA: OD: PL -0.50x082  20/20
    OS: -0.25-1.00x097  20/20
  - IOP: 13, 13
  - EOM’s, CF, Pupils WNL OU
  - C/D: OD .3/.3 R OS .3/.3 R
  - Posterior Segment WNL OU

And the problem is....

- 29 y/o caucasian female (6 months later)
- Reports “black spot in center of vision in both eyes for one week”
- POH: unremarkable
- PMH: unremarkable
- Social History: Cigarettes 1 pack/day x 10 years

And the problem is...

  - BCVA: OD BCVA: OD: PL -0.50x082  20/40*
    OS: -0.25-1.00x097  20/40*
  - IOP: 15, 15
  - EOM’s, CF WNL, Pupils Round Reactive, OD>OS with OD reaction more sluggish than OS
  - C/D: OD .3/.3 R OS .3/.3 R
  - Posterior Segment:


What's Going on Here?

It's Here Too!

DIAGNOSIS?

• SOLAR MACULOPATHY
• PATIENT WATCHED THE ECLIPSE FOR ABOUT 30 MINUTES!

“Routine Exam”

• BVA 20/20 OD and 20/25 OS (69 YOF)
• Posterior IOL OU with clear capsules
• BVA 20/20 OU 1 year prior
• PERRLA
• Hypertensive, BP 118/79
• Fundus – unremarkable
• Brother had a macula hole
• Unexplained acuity decrease OS????
OS Retina

Matrix Screening VF

VF at visit today
VF done 1.5 years prior

Macula intact?

What is this?
Normal Macula?

OS with Cirrus

A look with Cirrus

FA of OS

• FA shows delayed return inferotemporal
• Enough time that any edema and hem resolved on BIO
• No central “window defect” related to macula hole

DIAGNOSIS?

• Old BRVO in OS
• OS- posterior hyaloid face pulled away from fovea. Demonstrates a small remnant of hyaloid. May have a bit of retina showing on OCT (possibly with some NFL), but NO hole
• Need to monitor OD now

Blurry Vision Case

Left their previous doctor because “blurry vision” not getting better
Saw another OD app. 1 yr. ago
• “blurry at distance and near about 6 months”
• 39 YOF
• BVA 20/20 OD and 20/30 OS
• Ta 11/10 @ 2:45 pm
• Trace guttata OU
• Fundus- unremarkable
• Gave artificial tear and scheduled to re-refract with binocular testing

One Year Later
• “Got recall from prior doc, but vision still blurry and wanted another opinion”
• BVA 20/20 OD and 20/50 OS
• CD .35/.35
• PERRLA
• AC - unremarkable

Re-Refraction (1 month later)
• BVA 20/20- OD and 20/40 OS
• Plan: Prescribe Rx with Base-in prism

Fundus Evaluation
OD OS
A little disc pallor?

Matrix Fields

OD RNFL OS RNFL
A Little Thin Here Too? RNFL dropout 360
OD GCC		OS GCC

Don’t Look Good

What da heck is going on?

- Neuro Referral: MRI done
- 2.1 x 1.6 cm planum sphenoidale meningioma w/meningeal involvement of inferior orbital gyrus, deformation of olfactory nerves, encasement of ant. cerebral artery, A1/A2 segments, on the left, right, invasion of left cavernous sinus, and stenosis of left optic canal

Surgery Performed

- Compression of left optic nerve needed
- BVA 20/40 OD and NLP OS

Grow Your Contact Lens
Practice with OCT

Mini-Scleral become “mainstream”

- Scleral design – useful for “sick eyes”. Have a lot of vault (fluid layer), reduced O2
- Mini-scleral -
  1. Similar size and comfort to soft CL
  2. Minimal fluid layer, great O2
  3. Great for dry eye patients, toric and multifocals
  4. Use of OCT “takes the art right out of it” with respect to fitting

MINI-SCLERAL CONTACTS

Use the measure tool to accurately determine vault ±88 microns
MINI-SCLERAL CONTACTS

MINI-SCLERAL CONTACTS

MINI-SCLERAL CONTACTS

THANK YOU!