Optic Nerve Head and Retinal Nerve Fiber Layer Imaging in Glaucoma Diagnosis

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Optic nerve imaging

- Topography
  - Confocal Scanning Laser Ophthalmoscope (CSLO)
  - HRT: Heidelberg Retinal Tomograph
  - TopSS: Topographic Scanning System
- RNFL thickness
  - Scanning Laser Polarimetry (SLP)
  - GDx NFA: Nerve Fiber Analyzer
  - Optical Coherence Tomography (OCT)
  - Retinal Thickness Analyzer: macula

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TSNIT Plot and Overlay Graph of RNFL
Useful for detecting asymmetry
Shifting of scan

Best Predictor of Glaucoma
- Where does RNFL have best diagnostic accuracy?
  - Overall
  - Inferior
  - Superior

Ganglion Cell Complex
- Glaucoma leads to thinning of macular NFL and inner retinal layer
- Glaucomatous macular thinning occurs in primarily 3 innermost retinal layers
  - NFL +
  - Ganglion Cell Layer +
  - Inner Plexiform Layer =
  - Ganglion Cell Complex, GCC
Ganglion Cell Complex

- Mapping of GCC by SD-OCT has good diagnostic power
- Macular GCC thickness and RNFL thickness showed similar diagnostic performance for detecting early, moderate, and severe glaucoma
- GCC can be used alone or with RNFL to assess glaucoma

Mild Glaucoma - Example
Significant cpNFL defects
Significant GCC defects

Detecting Progression
- Limited information for longitudinal glaucoma assessment and detection of progression.
- Early progression software available with serial overlay scanning
Detecting Progression

- True change can be difficult to define.
- Test-retest variability inherent to OCT
- Scan series of different quality may affect comparison
- Same tissue may not be measured on follow up exams
- Age-related loss of RNFL
- RNFL measurements not comparable to data on other OCT machine, need to be on a single instrument
- OCT can be used in synergy with HVF
- Look for focal areas of thinning on the OCT scan and then corresponding structural change in clinical evaluation or slight VF progression to help confirm change in RNFL.

Case 1

- 76 y.o. Asian male
- IOP: OD 24-25, OS 20
- CCT: OD 514 um, OS 505 um
- Travatan OU @HS
- IOP treated OU: 17 mm Hg
Should we treat OU and is current treatment enough?

Relevance

- High IOP OD, upper normal OS
- Thin corneas OU
- C/D ratio OD>OS
- Normal VF OU
- RNFL thinning OU
- Pre-perimetric glaucoma
Case 2

- 70 y.o. Caucasian male
- IOP: OD 23, OS 26
- CCT: OD 521 um
  OS 515 um
- On Travatan OU 1 year ago
- Then taken off meds...

Repeated with similar scotomas and possible progression.
Relevance

- OHTN, glaucoma suspect
- Normal RNFL: may consider observation
- Treatment may be considered to reduce risk of progression to glaucoma

Case 3

- 61 y.o. Caucasian female
- Previous diagnosis of POAG
- IOP 12 OD, 12 OS
- Abnormal optic nerve OD with asymmetry
- No history of treatments
Relevance

- Optic nerve abnormality picked up by OCT
- Optic pit: stable
- Acquired optic pit: glaucomatous damage
- RNFL imaging may help differentiate
- VF helps differentiate

Case 4

- 57 year-old African-American female who was referred for glaucoma evaluation due to having C/D asymmetry and abnormal nerve fiber analysis.
- Past Ocular history: Anisometropic amblyopia
- BCVA: OD 20/25 OS 20/60
- OD: Hyperopia OS: Myopia
- CCT: OD 583/ OS 585 microns
- Ta: OD 14 mm Hg OS 14 mm Hg
Relevance
• View the entire clinical picture
• Glaucoma suspect vs POAG ?
• C/D asymmetry due to anisometropia (high myopia OS > OD)
• Abnormal but stable OCT
• Stable VF, optic nerve
• Follow every 6 months

Case 5
• Poor childhood vision
• CE/IOL OU 10 years ago in Mexico with total RD OS, mild improvement OD
• Diagnosed with glaucoma, intermittently compliant
• Several months of slowly worsening vision OD
• BCVA 20/60 OD, NLP OS
• IOP 16 OD, 40 OS
• Pupils: Round, reactive to light OD with 4 + APD OS by reverse
• EOM Full
• B – scan OS closed funnel RD
Case 5
Fundus/Disc photos

Case 5
HVF

Case 5
OCT
Case 5

Initial assessment and plan –
- Advanced POAG OD with baseline IOP of 16.
  - Initially started on XLT with some improvement
  - High fluctuation
  - Eventually placed on XLT, Cosopt, and Alphagan
  - IOP remained between 9 and 10 on all subsequent visits.

Follow up –
- Pt was seen every 3 months and remained stable until 1 year later when vision dropped to 20/400 (patient did not notice subjective change in vision) and possible worsening of visual field.
- Referred to glaucoma clinic for evaluation, IOP still 9 to 10 OD

HVF
Case 5

- Follow up –
  - IOP 10 vision now 20/400, probable progression of HVF, exam of optic nerve unchanged

- What would your course of action be for this patient?
Relevance

- Imaging is not always helpful
- For that matter, neither are visual fields or optic nerve exam
- When things don’t fit, look further!
Conclusion

- Imaging provides complementary indicators of glaucomatous optic nerve damage
- Make sure scan is of sufficient quality
- Useful in earlier detection of GOND in glaucoma suspects
- Useful in patients with poor VF testing
- Useful in following glaucoma suspects and mild to moderate glaucoma
- Information must always be taken in context with clinical exam and vision / VF testing

References

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- Kim et al. Structure-Function Relationship and Diagnostic Value of Retinal Ganglion Cell Complex Measurements using Fourier domain OCT in glaucoma. IOVS 2010 Apr 1