OCT in Glaucoma Diagnosis

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Disclosure

- Michael Chaglasian, O.D. is a paid advisor, consultant or researcher for the following commercial/industry groups:
  - Allergan, Alcon Labs, Carl Zeiss Meditec

Spectral Domain: Many Options

Cirrus SD OCT

- Glaucoma Applications:
  - RNFL
  - Optic Disc
  - Ganglion Cell Analysis

- Retinal Application:
  - Not Covered here
How to “Read” a Printout

- **FIRST!**: **Signal Strength**
  - A KEY indicator of image quality
  - Should be 7/10 or higher on Cirrus
  - **DO NOT** interpret poor quality scan as “red” disease
- Well centered image
- No evidence of movement artifact
- Review Plots and Displays
  - Thickness Map and Deviation Map
  - Quadrant and Sector Plots
  - TSNIT and Optic Nerve B-Scan Tomograms

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Cirrus RNFL Analysis

**OPTIC DISC CUBE SCAN**
The 6mm x 6mm cube is captured with
200 A-scans per B-scan, 200 B-scans.

**CALCULATION CIRCLE**
AutoCenter™ function automatically centers
the 1.73mm radius peripapillary calculation circle
around the disc for precise placement and
repeatable registration.

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Glaucoma – RNFL Thickness Analysis

- The **RNFL thickness map** shows
  the patterns and thickness of the
  nerve fiber layer within the 6mm x
  6mm cube

- The **RNFL deviation map** is
  overlaid on the OCT fundus image to
  illustrate precisely where RNFL
  thickness deviates from a normal range

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Glaucoma – RNFL Thickness Analysis

- A **TSNIT** (temporal-superior-nasal-inferior-temporal) circle,
  with a radius of 1.73mm, is established around the disc
- The LSO fundus image is shown with an OCT fundus
  overlay. The red circle indicates the location of the RNFL
  TNSIT circle
Glaucoma – RNFL Thickness Analysis

RNFL thickness is displayed in graphic format and compared to age-matched normative data.

RNFL OU Analysis

RNFL thickness and comparison to normative data is shown in graphic format and compared to age-matched normative data.

Comprehensive ONH and RNFL Analysis

RNFL thickness map with cup and disc mask

- **En face OCT fundus image** shows boundaries of the cup and disc and RNFL calculation circle integrated with the RNFL thickness deviation map
- The deviation map indicates variance from normal

Normative Data: Glaucoma

- Average RNFL Thickness
- RNFL Symmetry
- Rim Area
- Disc Area
- Average C/D Ratio
- Vertical C/D Ratio
- Cup Volume

**Distribution of Normals:**
Color coded indication of normative data comparison for RNFL and ONH.
- The thickest 5% fall in the white area.
- 90% of measurements fall in the green area.
- The thinnest 5% fall in the yellow area or below.
- The thinnest 1% of fall in the red area.
- Measurements in red are considered outside normal limits.
- ONH values will be shown in gray when the disc area does not match with normative data.

Example Normative Data:
Example Normative Data:

- Diffuse Loss OS
- Focal Loss OD

Optic Nerve Head Analysis

Optic Nerve Head Calculations

- The disc edge is determined by the termination of Bruch's membrane. This is validated in the literature. The rim width around the circumference of the optic disc is then determined by measuring the amount of neuroretinal tissue in the optic nerve. This differs from other methods that determine the cup margin based on its intersection with a plane at a fixed distance above the disc.

- In this method, the disc and rim area measurements correspond to the anatomy in the same plane as the optic disc.

Comprehensive ONH and RNFL Analysis

RNFL and Neuroretinal Rim Displays

Neuroretinal Rim Thickness profile demonstrates symmetry between the two eyes

Peripapillary RNFL Thickness profile shows symmetry and anomalies in RNFL structure

RNFL thickness values are compared to normative data

RNFL thickness is compared to normative data in quadrant and clock hour displays

Quadrants may reveal diffuse thinning. Clock Hours may show localized thinning
Use of Diagnostic Imaging in Glaucoma

Cirrus RNFL and ONH Analysis Elements

OCT en face fundus image shows boundaries of the cup and disc and the RNFL calculation circle.

The integrated RNFL thickness deviation map shows deviation from normal

RNFL thickness map also displays cup and disc mask

Optic Nerve Head calculations are presented in a combined report with RNFL thickness data. Key parameters are compared to normative data and displayed in table format

Cirrus RNFL and ONH Analysis Elements

RNFL Peripapillary Thickness profile, OU - compared to normative data

Neuro-retinal Rim Thickness profile, OU - compared to normative data

RNFL Quadrant and Clock Hour average thickness, OD and OS - compared to normative data

Zeiss: Cirrus OCT Printouts

What are practitioners' most common misunderstandings of imaging technology?

“The thought that these devices can diagnose glaucoma in the absence of corroborating clinical evidence is, in my opinion, the most common (and potentially dangerous) misunderstanding.

The limited normative databases against which scans are compared can never cover the remarkably varied appearance and structure of the optic nerve we encounter in normal individuals.”

James Brandt, MD

Red Disease!

Glucoma versus red disease: imaging and glaucoma diagnosis

Hannah T. Cheung and Michael K. Lin

Purpose of this study: Imaging for documentation and diagnosis of ocular disease is increasing exponentially. Optical coherence tomography (OCT) without using any biomarkers (OCT), neither using biomarkers (OCT), or using biomarkers (OCT) for detecting and diagnosing disease can be helpful in the management of ocular disease. This study aimed to determine the correlation between OCT imaging and disease activity in the management of ocular disease.

Methods: The study was a prospective, multicenter, observational study of 125 eyes of 125 patients with glaucoma. The OCT images were evaluated for the presence of glaucomatous optic nerve abnormalities and the correlation between OCT imaging and disease activity was determined.

Results: Of the 125 eyes, 75 eyes had mild or moderate glaucomatous optic nerve abnormalities, and 50 eyes had severe glaucomatous optic nerve abnormalities. The OCT images showed that OCT imaging was highly correlated with disease activity in the management of ocular disease. The sensitivity, specificity, and accuracy of OCT imaging for detecting glaucomatous optic nerve abnormalities were 0.85, 0.90, and 0.88, respectively.

Conclusions: OCT imaging is valuable for the management of ocular disease and can be used to determine the extent of disease activity. OCT imaging is an important tool for the management of ocular disease and can be used to determine the extent of disease activity.
Use of Diagnostic Imaging in Glaucoma

Red Disease

Read a Printout Summary
- Image Quality
- Step by step to review most plots.
- RNFL and Optic Nerve
- Localized vs. Diffuse
- Normative Data
- Red Disease

Segmentation Retina/Macula

Manuela / Ganglion Cell Scans for Glaucoma
- First noted with older Time Domain OCT (Stratus)
- Now all 3 Major OCTs, but with different approaches

Ganglion Cell Analysis - Zeiss
- Ganglion Cell Layer
- Inner Plexiform Layer
- Theory that the RNFL is too variable and not important in macular assessment

CIRRUS: Ganglion Cell Analysis
- Measures thickness for the sum of the ganglion cell layer and inner plexiform layer (GCL + IPL layers) using data from the Macular 200 x 200 or 512 x 128 cube scan patterns.

Anatomy: Ganglion Cell Layer and IPL
Cirrus: Ganglion Cell Analysis

The analysis contains:
- Data for both eyes (OU)
- Thickness Map —
  - Shows thickness measurements of the GCL + IPL in the 6mm by 6mm cube and contains an elliptical annulus centered about the fovea.
- Deviation Maps —
  - Shows a comparison of GCL + IPL thickness to normative data.
- Thickness table —
  - Shows average and minimum thickness within the elliptical annulus.

NEW: PanoMap Analysis

Integration of RNFL, ONH, GCA, and Macular Thickness analyses

Macular/Ganglion Cell Analysis for Glaucoma: Key Points

- Is a “complement” to traditional RNFL scans
- Has a large number of false positives.
- Should **NOT** be used as the sole basis of a diagnosis for glaucoma.
- Not proven to make an earlier diagnosis.