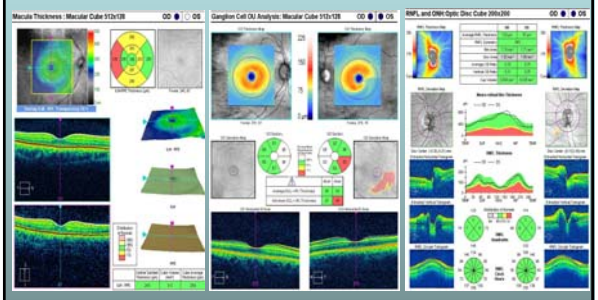
Analyzing OCT Data



Marcus Gonzales, OD, FAAO

Financial Disclosures

- No financial disclosures.
- Marcus Gonzales OD, FAAO, Diplomate, American Board of Optometry
- Clinical Associate Professor at the University of Houston College of Optometry

Outline

- Macular Cube
  - Macular Thickness Analysis
  - Ganglion Cell Analysis
- Optic Disc Cube
  - Glaucoma Analysis
- Pitfalls

OCT Basics

- Light passes into eye and reflects off the retina to provide a histological-type image of the retinal architecture
- Retinal layers hyper/hypo-reflect based on specific tissue type
- Changes to the retinal reflectivity indicates a defect
- If defect strongly reflects light, creates pseudo-hypo defect (shadow)

OCT Basics

- Requires decent pupil size to allow enough light into the eye
- Requires clear media (cornea to retina) to provide high quality images
- Higher signal strength = easier for instrument to delineate the different retinal layers

OCT Basics - Normal

Hyper-Reflective Layers:

- Nerve Fiber Layer, Photoreceptor Integrity Line (PIL) or Ellipsoid Zone (EZ), RPE/Bruch's Membrane Complex

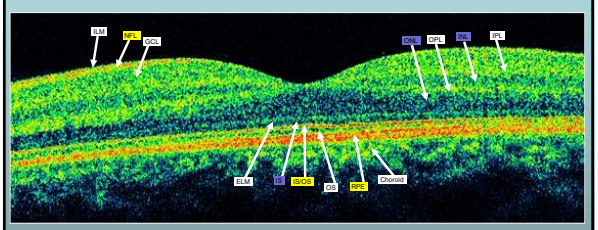
Hypo-Reflective Layers:

- Inner and Outer Nuclear Layers, Inner segments of photoreceptors

Pseudo Hypo-Reflective (Shadow) Findings:

- Underneath superficial blood vessels

NORMAL HD-OCT



NFL: Nerve Fiber Layer
ILM: Inner Limiting Membrane
GCL: Ganglion Cell Layer
IPL: Inner Plexiform Layer
INL: Inner Nuclear Layer

OPL: Outer Plexiform Layer
ONL: Outer Nuclear Layer
ELM: External limiting membrane
IS: Photoreceptor Inner Segment

IS/OS: Junction of inner and outer photoreceptor segments (AKA: PIL, EZ)
OS: Photoreceptor Outer Segment
RPE: Retinal Pigment Epithelium/Bruch's

OCT Basics – Defects

Hyper-Reflective Defects:

- Abnormal glial tissue, blood, exudates, cotton wool spots, RPE hyperplasia/atrophy

Hypo-Reflective Defects:

- Fluid, tissue atrophy, tissue separation, sub-RPE blood/fluid/mass

Pseudo Hypo-Reflective (Shadow) Defects:

- Vitreous opacity, dense retinal blood/exudates/cotton wool spots

OCT Basics – Analysis

Abnormal Retinal Thickening:

- Retinal traction, large superficial hemes, cotton wool spots, fluid (ex: edema, choroidal neovascularization), schisis

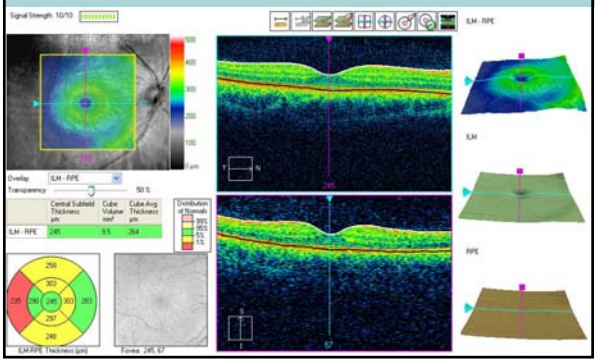
Abnormal Retinal Thinning:

- Tissue atrophy (ex: ischemic, glaucomatous), RPE scarring

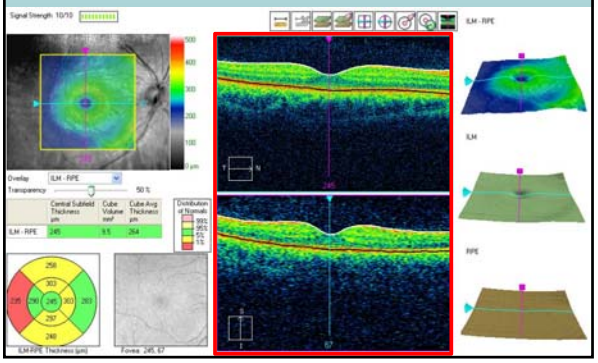
Pearls for Analyzing Data

- Understand what layer is being affected
- Understand how the data is being collected and what the analysis means
- Look at the reliability before interpreting

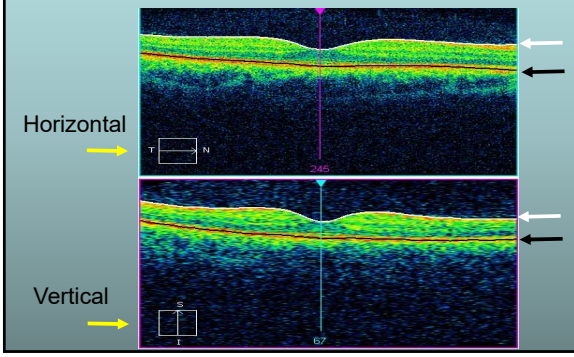
Macular Thickness Analysis



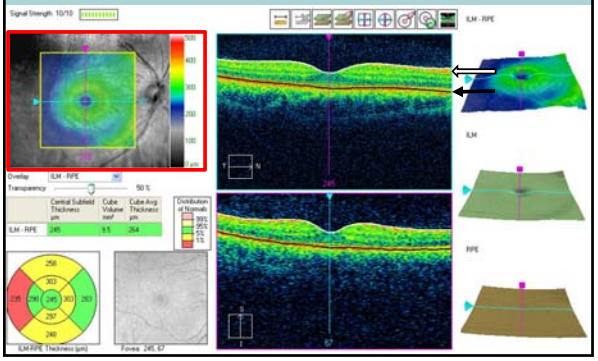
B-Scans



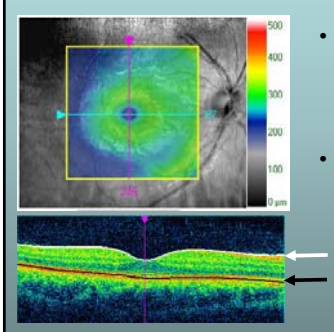
B-Scans



Thickness Map

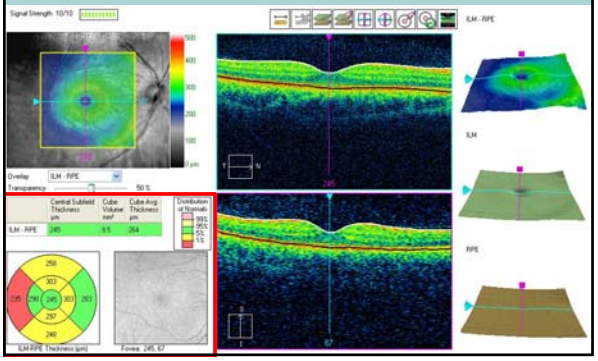


Thickness Scale

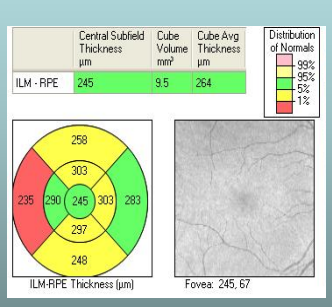


- Straight color scale
  - Red = Thicker
  - Blue = Thinner
- Look for trends and asymmetry
  - Not all thickening is edema
  - Not all thinning is retinal loss

Normative Database

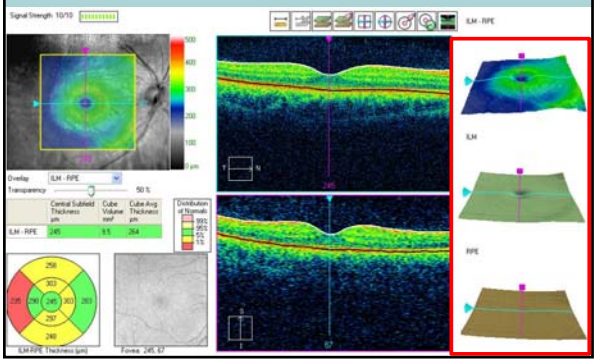


Normative Database

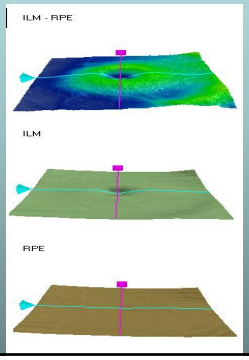


- Auto Fovea Identification
- Concentric Circles
  - 1mm, 3mm, 6mm
- Odd color scale

3-D Surface Maps

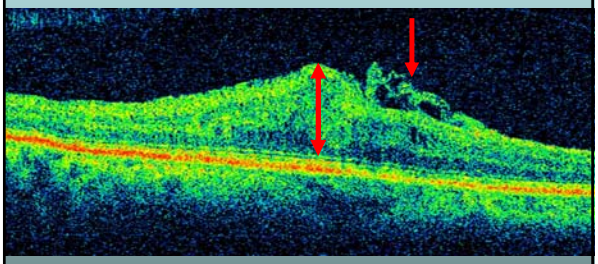


3-D Surface Maps

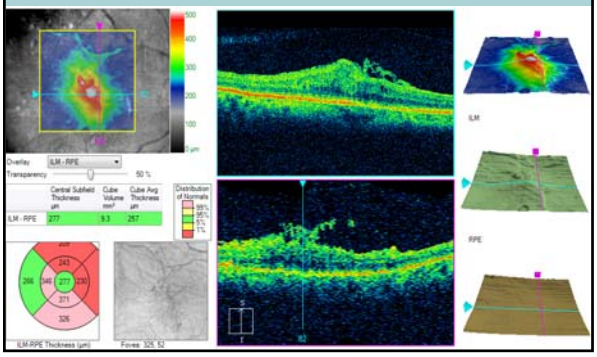


Contracted ERM

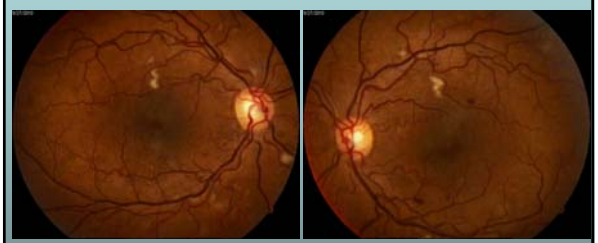
Contracted ERM OCT



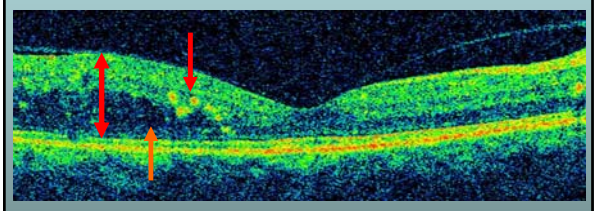
Macular Thickness Report

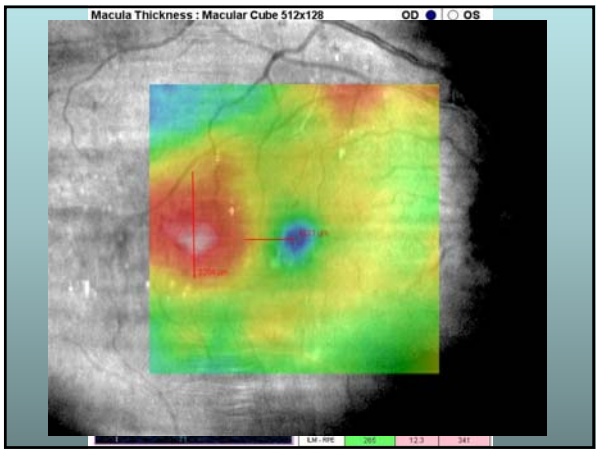


Diabetic Retinopathy



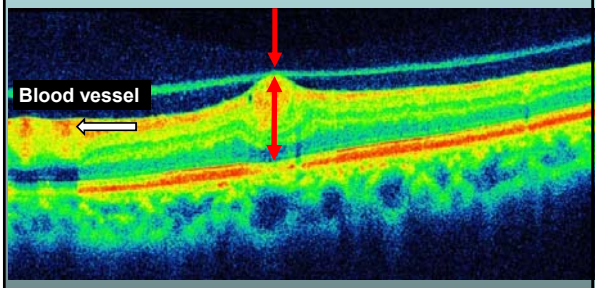
Dot/Blot Hemorrhage and/or Exudate with Diffuse Edema





Cotton Wool Spot

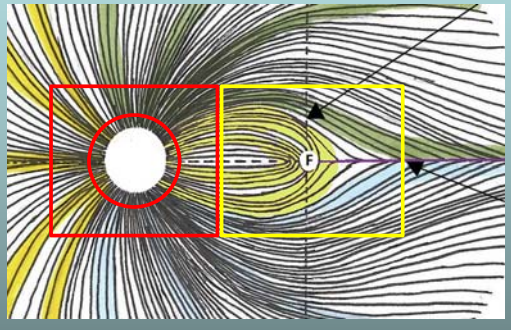
Cotton Wool Spot



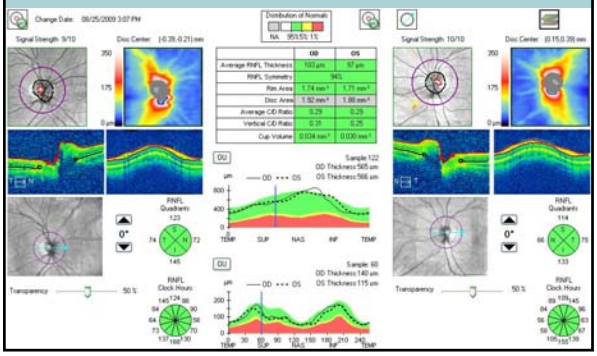
Why do an OCT for Glaucoma?

- Objective determination of the C/D ratio
- Measures the amount of NFL/GCC
  - Compares to normative database
  - Compares intereye symmetry
- Baseline measurements to track change

Nerve Fiber Distribution

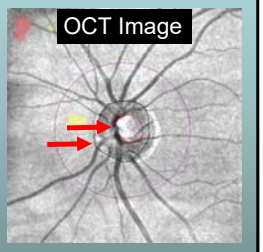


ONH/RNFL Analysis

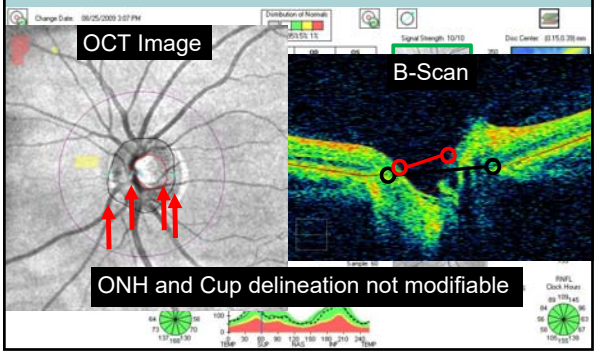


ONH Analysis

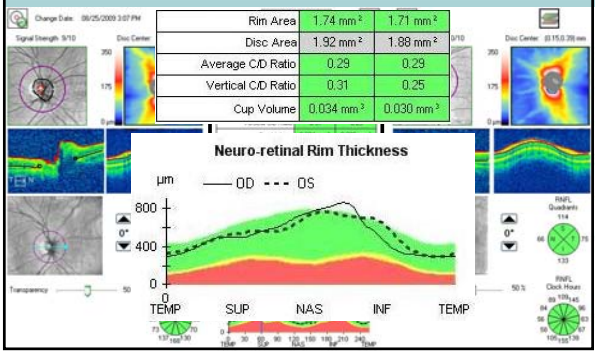
- Cup/Disc Ratio
  - Average and Vertical
- Rim Area
- Cup Volume
- Rim Thickness Profile



ONH Analysis



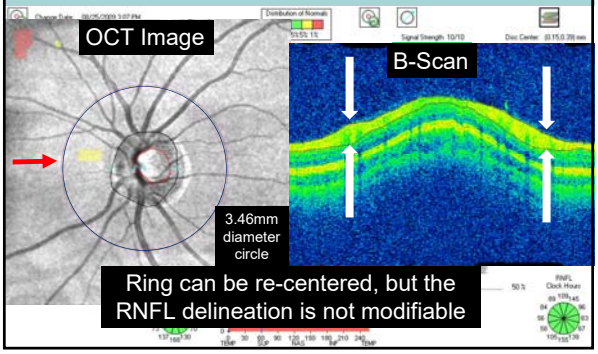
ONH Calculations



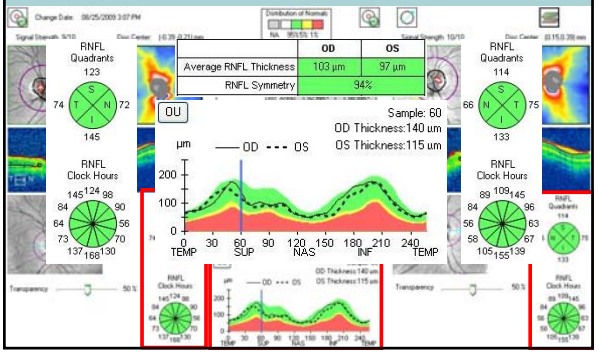
RNFL Analysis

- Extracted RNFL Circle
  - Thickness Profile (TSNIT)
  - Quadrants/Clock Hours
  - Average Thickness/Asymmetry
- Cube
  - RNFL Thickness Map
  - RNFL Deviation Map

Extracted RNFL Circle



Data from Extracted RNFL Circle



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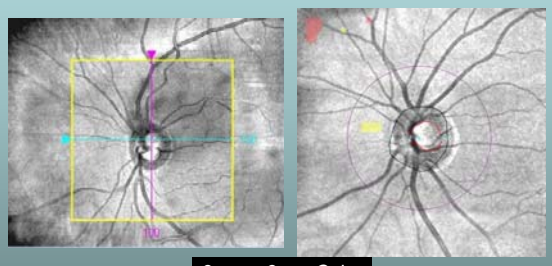
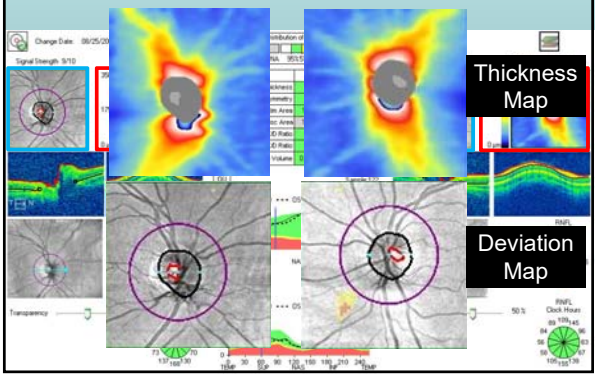
Cube



6mm x 6mm Cube

RNFL Data from Cube



Interpretation

Reliability

General Overview:

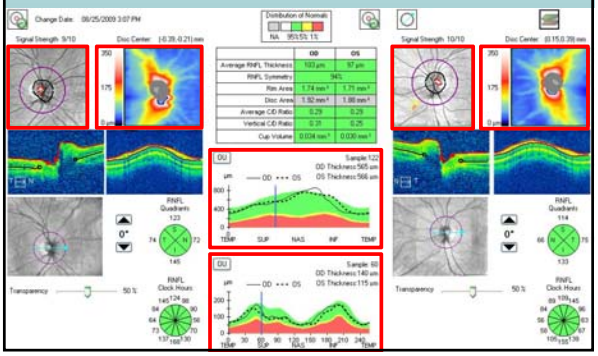
- Rim Thickness Profiles
- TSNIT
- RNFL Thickness and Deviation Maps

Specific Numbers:

- Pie Graphs and Tables
- ONH Calculations

➢ Normative Database
➢ Inter-eye Symmetry

General Overview



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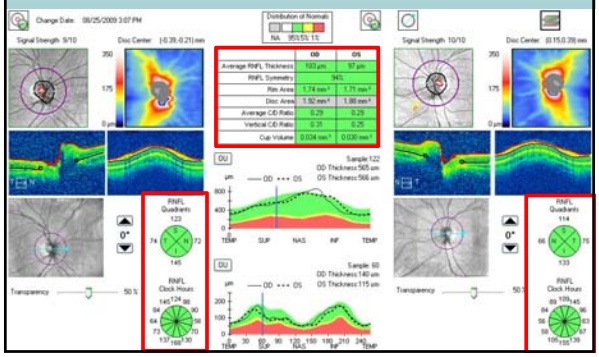


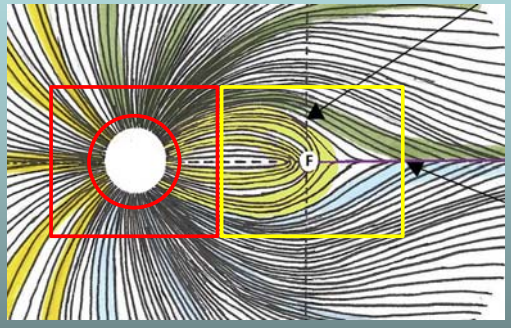
Specific Numbers

Measurement	Matched to Normal Based On	Gray	White	Green	Yellow	Red
RNFL						
Average RNFL Thickness, RNFL Symmetry, RNFL Clock Hours, RNFL Quadrants, RNFL Thickness (graph)	Age	Gray shading does not apply to RNFL measurements	The thickest 5% of measurements fall in the white area (white > 95%).	90% of measurements fall in the green area (5%<green<95%).	The thinnest 5% of measurements fall in the yellow area or below (1%<yellow<5%, suspect).	The thinnest 1% of measurements: Measurements in red are considered outside normal limits (red < 1%, outside normal limits).
Optic Nerve Head						
Rim Area and Neuroretinal Rim Thickness (graph)	Disc Area and Age	ONH Normative Database is not applicable if: 1) The disc area is larger than 2.5mm² or smaller than 1.33mm², or 2) The Average or Vertical C/D Ratio is below 0.25, or 3) The ONH Normative Database license has not been activated.	The largest 5% of measurements fall in the white area (white > 95%).	90% of measurements fall in the green area (5%<green<95%).	The smallest 5% of measurements fall in the yellow area or below (1%<yellow<5%, suspect).	The smallest 1% of measurements: Measurements in red are considered outside normal limits (red < 1%, outside normal limits).
Average C/D Ratio, Vertical C/D Ratio, Cup Volume			The smallest 5% of measurements fall in the white area (white > 95%).	90% of measurements fall in the green area (5%<green<95%).	The largest 5% of measurements fall in the yellow area or below (1%<yellow<5%, suspect).	The largest 1% of measurements: Measurements in red are considered outside normal limits (red < 1%, outside normal limits).

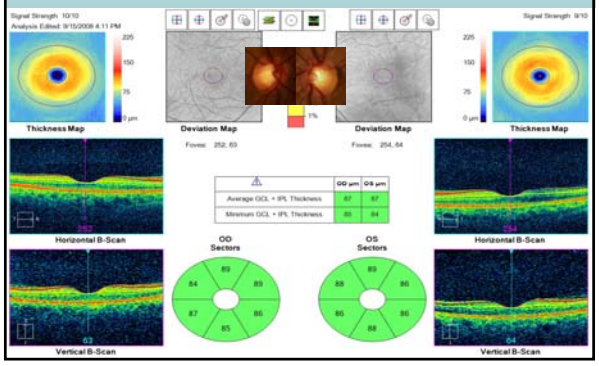
Specific Numbers

- Vertical Rim Thickness
- Rim Area
- NFL @ 7/5 o'clock (inferior-temporal)
- NFL Inferior Quadrant
- Vertical C/D Ratio
- Average NFL Thickness
  - Greater than 9-12um may be significant

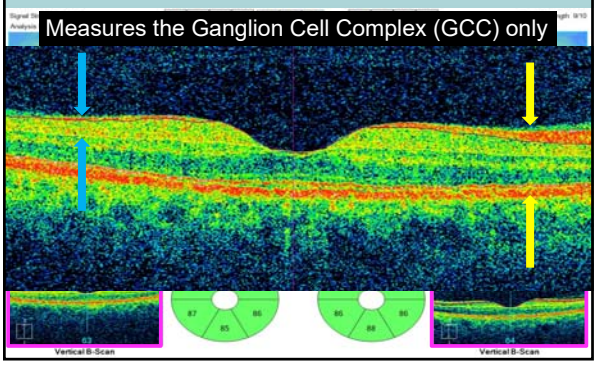
Nerve Fiber Distribution



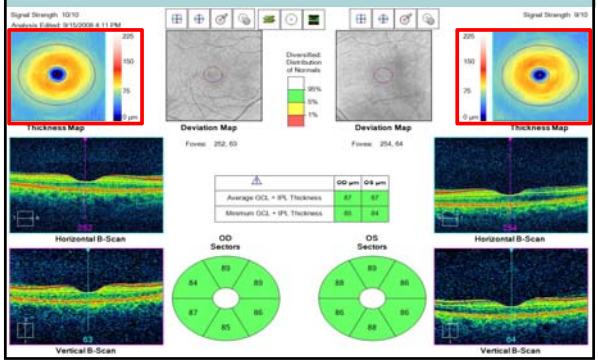
Ganglion Cell Analysis



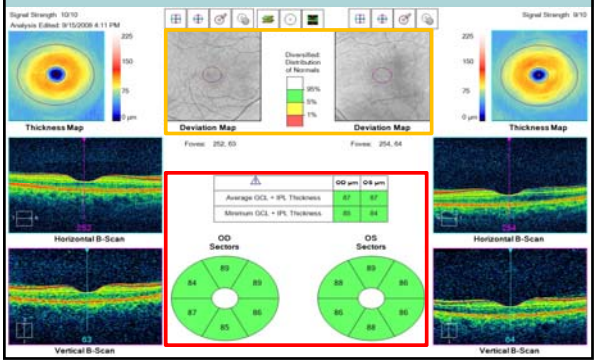
B-Scans



Thickness Maps



Normative Database

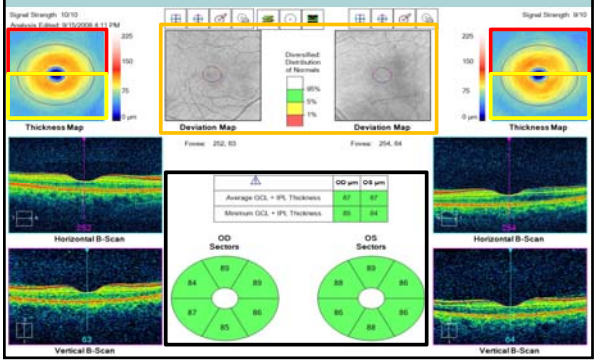


Interpretation

- Reliability
- General Overview:
  - Ganglion Cell Complex Thickness
    - Superior-Inferior Intra-eye Symmetry
    - Inter-eye Symmetry
  - Deviation Maps
- Specific Numbers:
  - Sector Maps
  - Average/Minimum GPL+IPL Thickness

➢ Normative Database
➢ Inter-eye Symmetry

General Overview

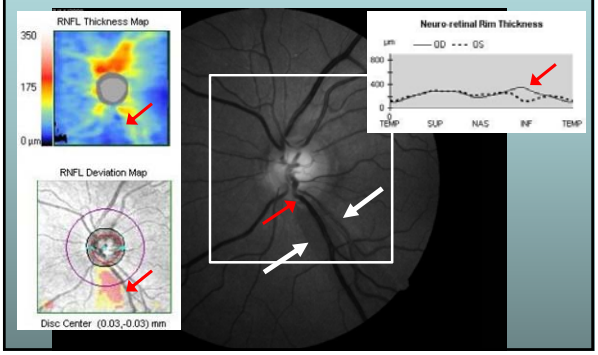


Specific Numbers

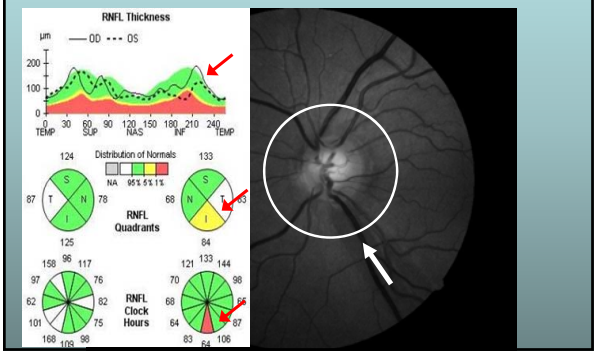
- Average GPL + IPL Thickness
  - Whole area
- Minimum GPL + IPL Thickness
  - Thinnest area among 360 radial spokes
- Sector Maps
  - Inferior-temporal sector

Case Example

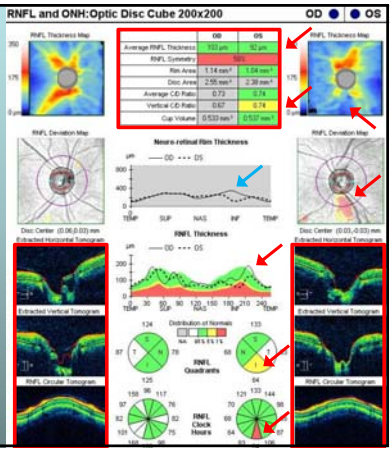
Defect on ONH/Cube Scan



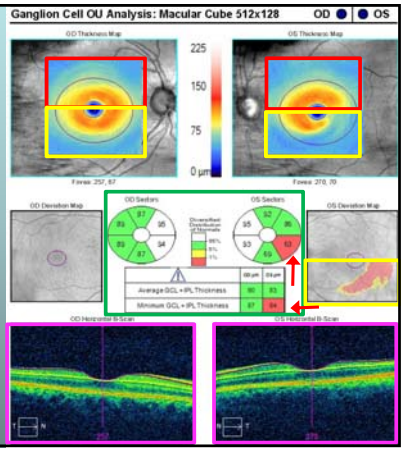
Defect on RNFL Calculation Ring



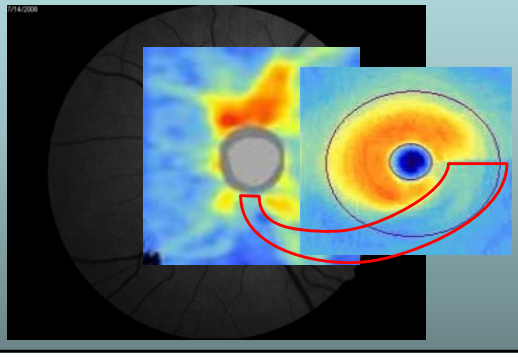
Interpretation



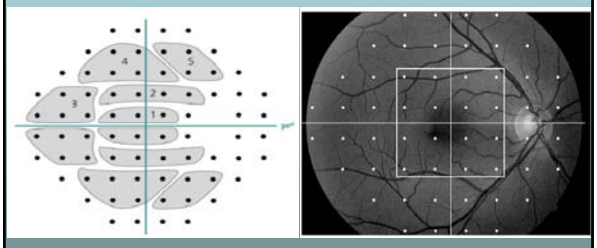
Interpretation



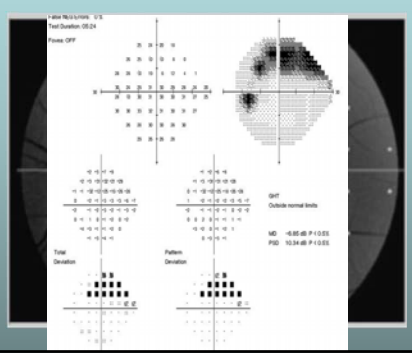
OCT Overlay



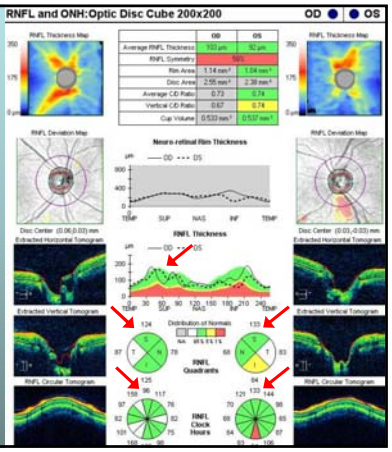
Structure-Function Correlation



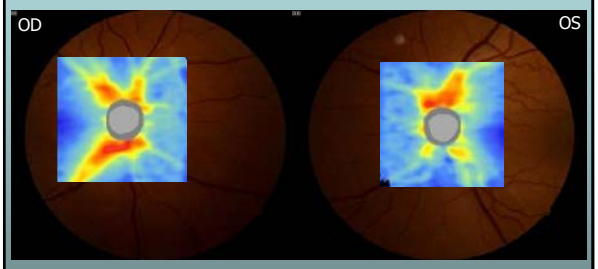
Structure-Function Correlation



What about superior asymmetry?



Normal Anatomical Variance

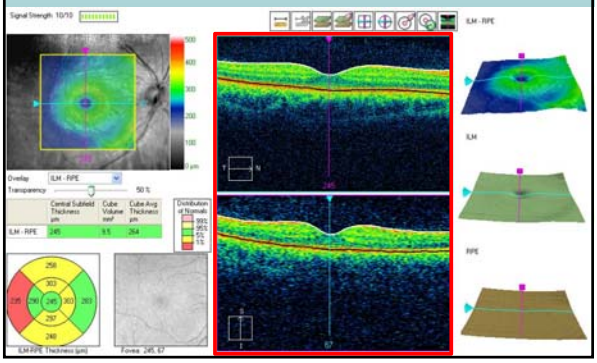


Thank you for your attention

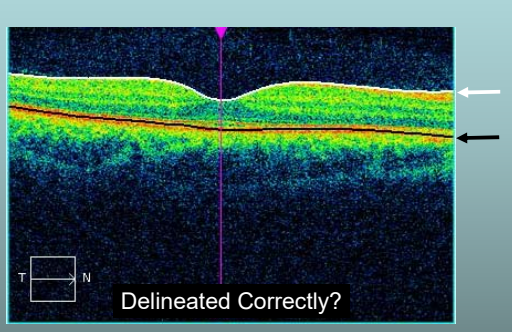
Questions?

Email: doctorgonzales@gmail.com

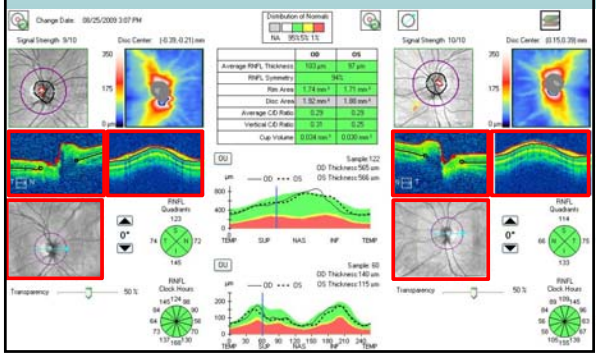
Reliability



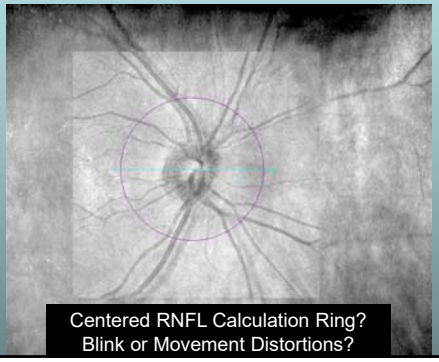
B-Scans



Reliability

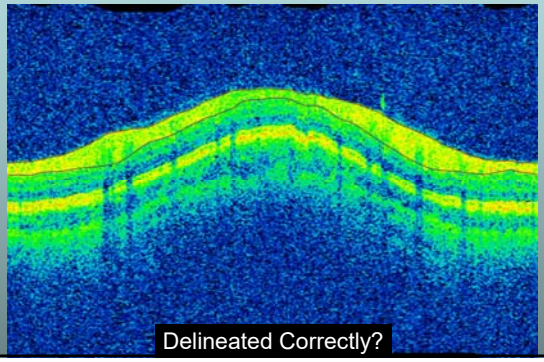


En Face Image



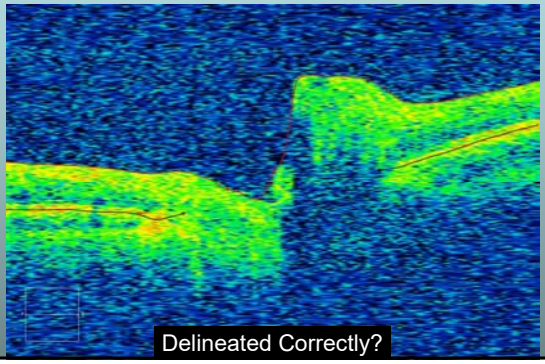
Centered RNFL Calculation Ring?
Blink or Movement Distortions?

Extracted RNFL Circle B-Scan



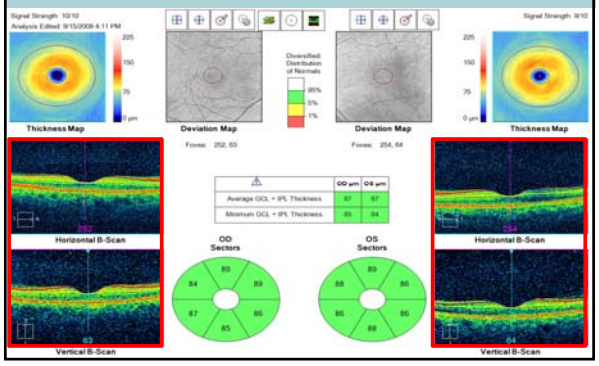
Delineated Correctly?

ONH Tomogram B-Scan

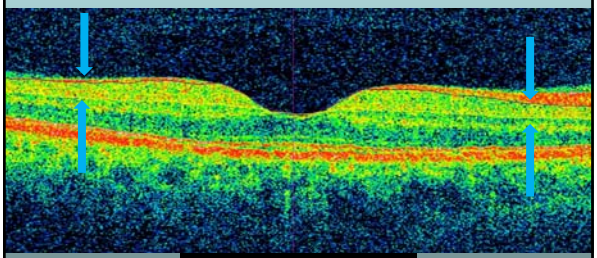


Delineated Correctly?

Reliability



B-Scans

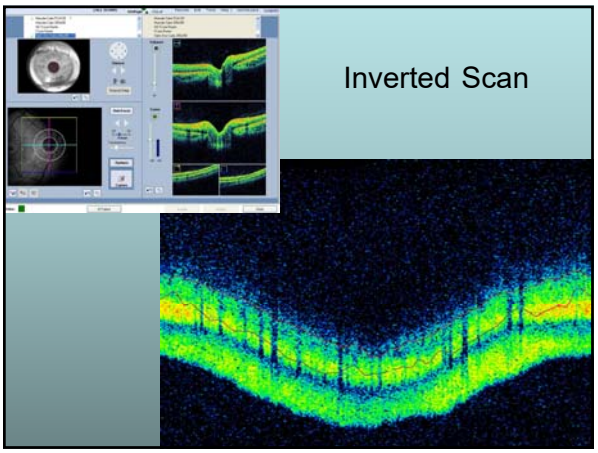


Delineated Correctly?

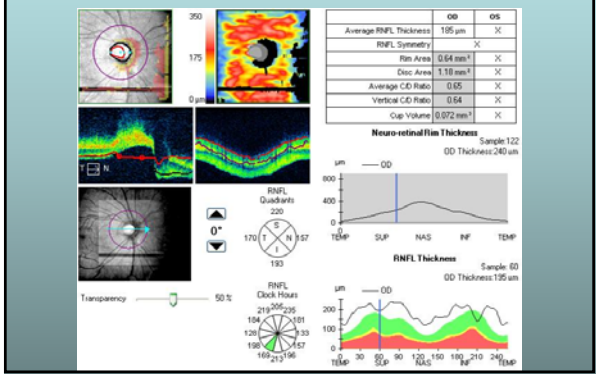
Pitfalls

- Inverted Scan
- Scan Too High
- Movement Defect
- Blink Defect
- Poor Signal Strength

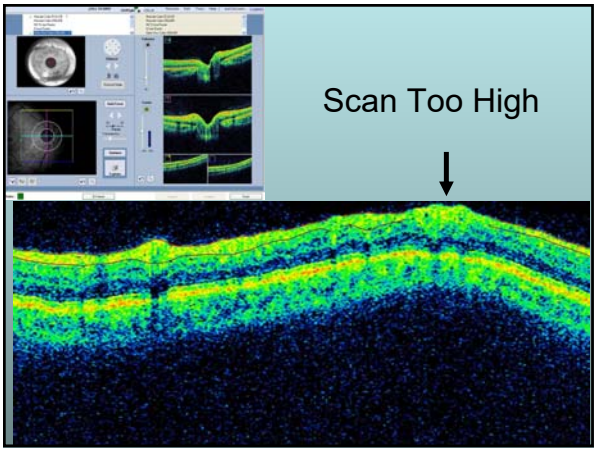
Inverted Scan



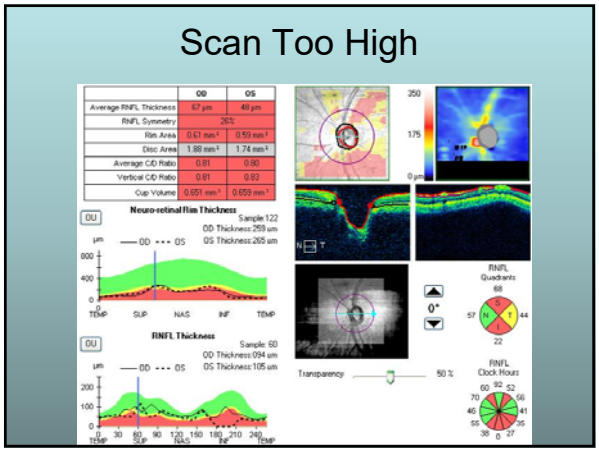
Inverted Scan



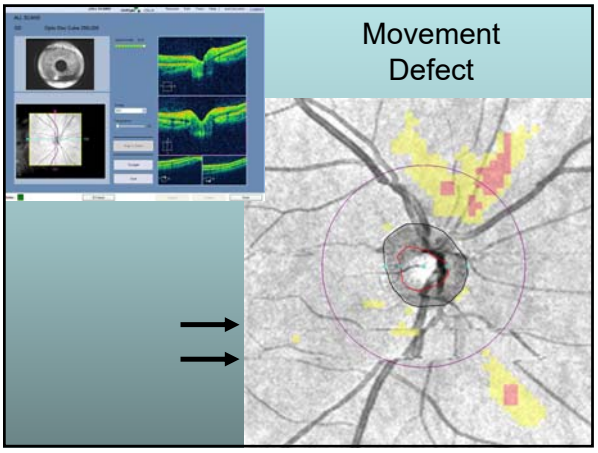
Scan Too High



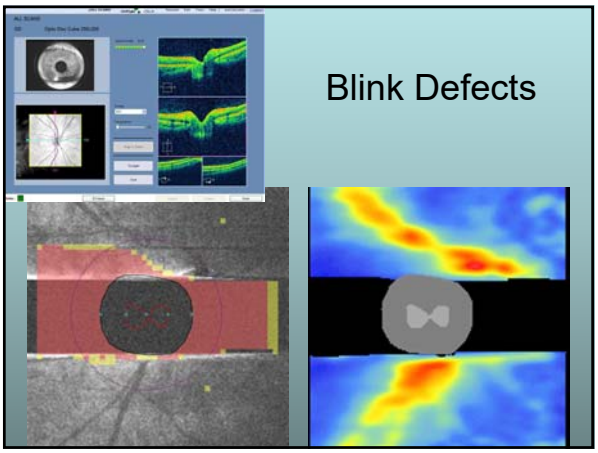
Scan Too High



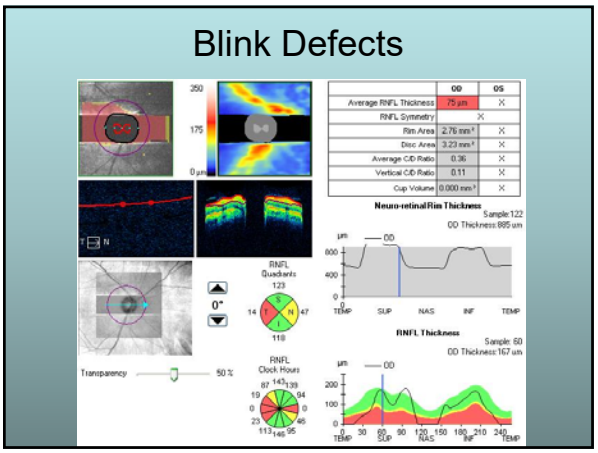
Movement Defect



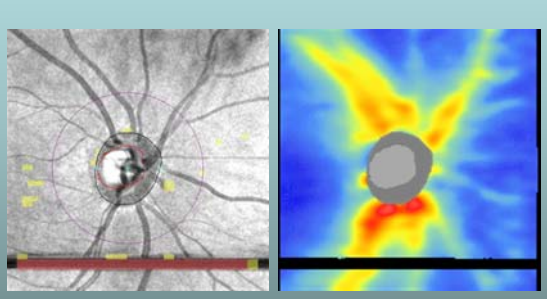
Blink Defects



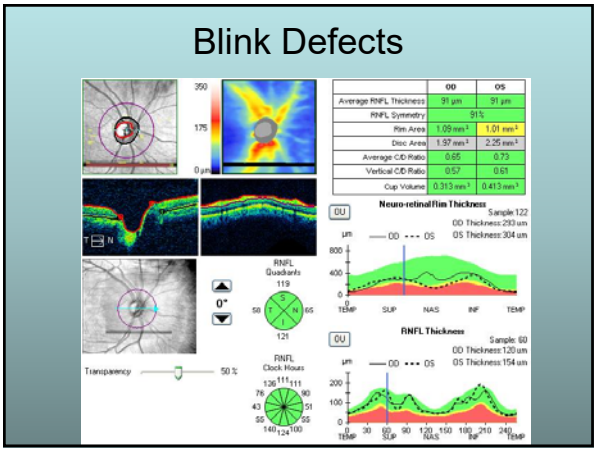
Blink Defects



Blink Defects



Blink Defects



Poor Signal Strength