

# **Advanced Interpretation of the Cirrus OCT**

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## **Glaucoma 101**

- Glaucoma is a disease of the ganglion cell axons
- Damage occurs at the level of the lamina cribrosa
- Selective damage to the superior and inferior poles of the optic nerve
- Relative preservation of the temporal and nasal poles

## **Glaucoma Discriminates**

- Glaucoma Often Asymmetrically Damages Between Above and Below and Between the Two Eyes
- Look for Notches in the Neuro-Retinal Rim Tissue
- Occurs in 30% of Glaucoma Patients
- Inferior Temporal Pole Most Common Site of Notching
- Associated With a Corresponding VF Defect

## **Compare Neuro-Retinal Rim Tissue Between Superior and Inferior**

- Vertical Extension of Cupping Supra or Infra Temporal
- Normal Ratio of Neuro Rim Tissue Is :
- 2.0 Inferior: 1.5 Superior: 1.0 Temporal
- Glaucoma Should Be Suspected When the Amount of Temporal Neuro-Retinal Rim Tissue Is Greater Than or Equal to the Inferior or Superior Rim Tissue

## **Does Size Really Matter?**

- Is there a C/D ratio that defines glaucoma?
- Do You Think This Nerve Has Glaucoma?

## **A Big Cup Does Not Necessarily Mean Glaucoma**

- There is No Demarcation Line Separating a Physiological Cup From a Glaucomatous Cup
- Physiological Cup Size Is Directly Related to Overall Disc Size
- Large Discs Will Have Large Physiologic Cups
- Small Discs Will Have Small Physiologic Cups
- Physiologic Disc and Cup Size Is Genetically Determined
- Physiologic Cup of .7 Or Greater Occurs in 2% of Normals
- A Small Disc With a Medium Size Cup Should Be As Suspicious As a Large Cup in a Medium Size Disc

## **How to Evaluate Disc Size**

- Use a 60 D Lens at the Slit Lamp

- Make a Thin Vertical Beam
- Adjust Beam Height
- Read Disc Diameter off Scale on Slit Lamp
- Vertical Disc Diameter > 2.2 mm Is a Large Disc
- Vertical Disc Diameter < 1.8 mm Is a Small Disc

**Expected Physiologic Cup Size  
Based on Measured Vertical Disc Diameter  
Using a 60 Diopter Lens At The Slit Lamp**

	-2std	-1std	Mean	+1std	+2std
<b>Vertical Height (mm)</b>	1.6	1.8	2.0	2.2	2.4
<b>Expected C/D ratio</b>	0.0	0.2	0.4	0.6	0.8

**NFL 101**

- Patterns of Diffuse NFL Loss
- Focal NFL Defects

**Cirrus™ HD-OCT**

- Cirrus OCT – RNFL Thickness

**Does the OCT Do It Better?**

- Caveat #1
  - It is difficult to create a normal data base with a structure like the optic nerve that varies significantly in regards to size, shape and number of ganglion cell axons

**Cirrus Database**

- 284 patients
- Image quality 6 or above
- Age 19-84

- Refractive range -12 to +8 diopters
- Ethnicity 43% Caucasian, 24% Asian, 18% African America, 12% Hispanic, 1% Indian

#### **Factors That Affect Normative Database**

- AGE
- RNFL and Neuro rim tissue slightly decreases with age
- The current software does account for age by comparing patients in similar age groups

#### **Factors That Affect Normative Database**

- DISC SIZE
- Disc Area range 1.06 – 3.38 mm<sup>2</sup> (ave 1.83 mm<sup>2</sup>)
- Small - disc area < 1.63 mm<sup>2</sup>
- Medium - disc area 1.63-1.97 mm<sup>2</sup>
- Large – disc area > 1.97 mm<sup>2</sup>
- Larger Discs will have larger c/d ratios
- Larger Discs generally have greater neuro rim tissue
- The current software does match disc size for optic nerve parameters but not RNFL
- Disc area <1.33 mm<sup>2</sup> or > 2.50 mm<sup>2</sup> is not compared to the normative database because there are too few in the database

#### **Factors That Affect Normative Database**

- RIM AREA
- Rim area range 0.75-2.38 mm<sup>2</sup> (ave 1.31)
- We are born with different number of ganglion cell axons (700,000-1.5 million)
- No way to account for this in the database

#### **Caveat #2:**

- There are structures (ie blood vessels, astrocytes and glial cells) that contribute to the measured RNFL by the OCT

#### **Caveat #3:**

- Your OCT is not shipped with a brain, so use yours

#### **Cirrus Optic Nerve and 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.

The RNFL thickness map shows the patterns and thickness of the nerve fiber layer.

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

### **Distribution of Normals**

- White represents upper 5% of normal database
- Green represents middle 90% of normal database
- Yellow represents lower 5% of normal database
- Red represents lowest 1% of normal database
- Gray not compared to the normal database

### **Quantitative Optic Nerve and Nerve Fiber Layer Parameters**

#### **Average RNFL Thickness**

- Represent the average thickness drawn along the 1.73 mm radius calculation circle around the optic nerve
- Measures the thickness of ganglion cell axons
- But along includes blood vessels, astrocytes and glial cells
- Global index (will miss focal loss)

#### **RNFL Symmetry**

- Compares the entire TSINT of the RNFL between and right and left eye

#### **Rim Area**

##### **SmartCube™ Defines Disc at Bruch's Membrane End**

Minimizes effect of peripapillary Atrophy on measurements

Cirrus Optic Nerve Head Calculations

The disc edge is determined by the termination of Bruch's membrane.

The rim width around the circumference of the optic disc is then determined by measuring the shortest distance from the edge of Bruch's membrane to inner edge of neuro-retinal tissue in the optic nerve.

#### **Rim Area**

- Rim area range 0.75-2.38 mm<sup>2</sup> (ave 1.31) in normative data base
- We are born with different number of ganglion cell axons (700,000-1.5 million)
- No way to account for this in the database other than to average values

#### **Disc Area**

- Disc Area range 1.06 – 3.38 mm<sup>2</sup> (ave 1.83) in normative data base
- Small - disc area < 1.63 mm<sup>2</sup>
- Medium - disc area 1.63-1.97 mm<sup>2</sup>
- Large – disc area > 1.97 mm<sup>2</sup>
- Disc Area is always Gray color coded
- Larger Discs will have larger c/d ratios

- Larger Discs generally have greater neuro rim tissue
- The current software does compare disc area to the optic nerve parameters but not to RNFL parameters

### **C/D Ratio**

- Average and Vertical C/D ratio are reported
- Dependent on Disc Area
- Dependent on the number of ganglion cell axons in our retina
- C/D ratio will increase as ganglion cell axons are lost
- Vertical C/D ratio is probably more important than average C/D ratio
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### **Cup Volume**

- Partially Dependent on Disc Area
- Can increase as glaucoma excavation progresses
- Poorer Reproducibility compared to other optic nerve parameters

### **Thickness Profiles**

Neuro-retinal Rim Thickness profile, OU

- compared to normative data

RNFL Peripapillary Thickness profile, OU

- compared to normative data

### **Quadrant and Clock Hour RNFL Analysis**

#### **Should We Look Elsewhere for Glaucoma Damage other than the Optic Nerve?**

- The ganglion cell complex (ILM – IPL)
- 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.
- RNFL distribution in the macula depends on individual anatomy, while the GCL+IPL appears regular and elliptical for most normals. Thus, deviations from normal are more easily appreciated in the thickness map by the practitioner, and arcuate defects seen in the deviation map may be less likely to be due to anatomical variations.

#### **Advantage of Ganglion Cell Analysis**

- More reproducible measurement than peripapillary RNFL
- Less physiological variation compared to peripapillary RNFL
- Less major blood vessels to create pseudo-thickness measurements
- Better symmetry between superior and inferior and between eyes than peripapillary RNFL

- Clinical Correlation is Paramount

### **Errors in Interpretation**

- Green always represents Non-Disease
- Red always represents Disease

### **Red Disease Does Not Always Mean Glaucoma**

- Clinical Correlation is Key

### **Does Green Always Mean Normal?**

- Symmetry is a Beautiful Thing!
- Lack of Symmetry Should Raise Suspicion!

### **Cirrus Guided Progression Analysis (GPA)**

- RNFL Thickness Change Maps demonstrate change in RNFL between exams. Up to 6 progression maps are compared to baseline. Areas of statistically significant change are color-coded yellow when first noted and then red when the change is sustained over consecutive visits.
- TSNIT values from baseline and current exams are plotted.
- Areas of statistically significant change are color-coded yellow when first noted and then red when the change is sustained over consecutive visits.
- Average RNFL Thickness values are plotted for each exam.
- Yellow marker denotes change from both baseline exams.
- Red marker denotes change sustained over consecutive visits.
- Rate and significance of change are shown in text

### **Cirrus GPA™ Analysis**

- RNFL Summary Legend summarizes GPA analyses and indicates with a check mark if there is possible or likely loss of RNFL
- RNFL Thickness Map Progression (best for focal change)
- RNFL Thickness Profiles Progression (best for broader focal change)
- Average RNFL Thickness Progression (best for diffuse change)

### **Updated Guided Progression Analysis (GPA™)**

*Optic Nerve Head information now included*

- Average Cup-to-Disc Ratio plotted on graph with rate of change information.
- RNFL/ONH Summary includes item “Average Cup-to-Disc Progression”.
- Printout includes an optional second page with table of values, including Rim Area, Disc Area, Average & Vertical Cup-to-Disc Ratio and Cup Volume. Each

cell of the table can be color coded if change is detected.

- Miscellaneous updates to the report design.
- Updated Guided Progression Analysis (GPA™)

### **OCT Clinical Pearls**

- Normal data bases for optic nerve and RNFL are difficult to construct
- Blood vessels, astrocytes and glial cells can taint optic nerve and RNFL measurements
- If you simply evaluate the OCT printout in isolation, you will make interpretation errors
- Understand that GREEN does not always mean NORMAL and RED does not always mean ABNORMAL
- Symmetry is a beautiful thing, lack of symmetry should be cause for concern

### **Summary**

- OCT is amazing technology that enhances glaucoma diagnosis
- Understand the potential for interpretation errors and you will make fewer
- OCT can uncover glaucoma damage before visual field loss occurs
- OCT can add another technique to judge for glaucoma progression
- Software updates and improved normal databases will improve OCT interpretation
- The doctor should always correlate the data from the OCT printout with clinical data before making management or treatment decisions in glaucoma.