Beyond the C/D Ratio: Evaluating a Glaucomatous Optic Nerve

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Points to Remember

- Glaucoma affects the ONH in characteristic patterns
- Typically affects the eyes and rims asymmetrically
- Damage usually occurs at the ONH before corresponding VF loss
- Monitoring for change is the key
Points to Remember

• More comprehensive documentation of the optic nerve at baseline helps better determine this change over time
• Scanning laser instrumentation and disc photography can be a huge aid
• With all the technology out there, don’t forget that you’re the best instrument in determining risk
Glaucmatous ONH Evaluation

- Optic nerve size
- Neural Retinal Rim evaluation
- Appearance of the cup
- Abnormal vasculature
- Retinal nerve fiber layer
- Peripapillary atrophy
- Disc hemorrhage
Why is a C/D ratio not enough?

- Doesn’t take into account nerve size
  - Small, Average, Large
- Doesn’t take into account rim configuration
  - ISNT rule
- Doesn’t tell us how C/D was determined
  - Color or contour
Why is a C/D ratio not enough?

- High degree of inter and intra-observer repeatability (trained glaucoma "specialists" could not duplicate their C/D assessment over 50% of the time)
- Poor indication for progression
- Other anatomy more apparent, sometimes more diagnostic, and easier to detect change to in the future
Rim-to-Disc vs Cup-to-Disc

- Judge the smaller structure
- Judge the rims and calculate the C/D ratio
- Judge based on contour vs color

STEREO is key!!!
Rim-to-Disc vs Cup-to-Disc
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Optic Nerve Size

• Small < 1.5mm
• "Normal" 1.5-2.2mm
• Large > 2.4mm
ON Size Affects C/D Estimation

C/D: .3/.3

C/D: .65/.65
Expected C/D Based on ONH Size

- Per Litwak (Glaucoma Handbook)
### Table 5-2. Suspicion of Glaucoma Based on Cup and Disc Size

<table>
<thead>
<tr>
<th>Cup size</th>
<th>Small disc</th>
<th>Medium disc</th>
<th>Large disc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Expected</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Medium</td>
<td>Abnormal</td>
<td>Expected</td>
<td>Normal</td>
</tr>
<tr>
<td>Large</td>
<td>Abnormal</td>
<td>Abnormal</td>
<td>Expected*</td>
</tr>
</tbody>
</table>

*Although a large cup should be expected in a patient with a large disc, glaucoma can be present in a large disc.*

- Per Litwak (Glaucoma Handbook)
Measuring the disc size

- Direct ophthalmoscope
  - Small spot size is usually 5 degrees ("average" disc size)

- SLE and fundus lens (coefficient factor)
  - +60D = 1.0x
  - +78D = 1.1x
  - +90D = 1.3x
  - Superfield = 1.5x

- Scanning laser instruments
  - Stratus, GDx, HRT, etc
Factors that affect disc size

• Refractive error
  - Hyperope – smaller discs » smaller C/Ds
  - Myope – larger discs » larger C/Ds
• Race
  - Black – larger disc
  - White – smaller disc
  - Hispanic – somewhere in the middle
Rim Evaluation

- Sectoral rim loss
  - ISNT rule
  - Document rim thicknesses
- Diffuse rim loss
  - Multiple rims thin
- Focal rim loss
  - Focal notch – 3x more common inf-temp
Rim Config Affects C/D Estimation

C/D: .7/.7
Rims: I=S=N>T

C/D: .7/.7
Rims: S>N>I=T
Rims: I=N=T>S
Sectoral

Rims: N>I>S=T

Rims: I=N>S>T
Diffuse

Rims: I=N>S=T
Focal Notch
Appearance of the Cup

- Depth of the cup
- Sloping
- Saucerization
- Laminar dots/laminar dot sign
- Bean potting
Depth of Cup

- Shallow
- Moderate
- Deep
Sloping
Sloping
Sloping
Saucerization
Saucerization
Saucerization
Laminar Dots
Laminar Dot Sign
Laminar Dot Sign
Bean potting
Bean potting
Bean potting
Abnormal Vasculature

- Bayoneting
- Vessel Overpass/Overhang or Baring of circumlinear vessels
- Nasalization
Bayoneting
Bayoneting
Vessel Overhang
Vessel Overhang
Vessel Overhang
Vessel Overhang
Nasalization
Nasalization
Nasalization
Nasalization
Retinal Nerve Fiber Layer

- Bright/Dim/Bright reflection
- Brighter reflections blur underlying blood vessels
- Best visualized with brighter illumination and with red-free (green) filter
- Don’t overlook photography as an aid
Nerve Fiber Layer Pattern
Normal NFL
Retinal Nerve Fiber Layer

- Wedge defect
  - Triangular-shaped dark area extending from disc
- Diffuse loss
  - Entire quadrant of disc with less reflectance
- Slit defect
  - Dark area at least an arteriole in width extending from disc
- Pseudo-slit defect
  - May be physiologic or could progress to a slit defect
Wedge Defect
Diffuse NFL Loss
Peripapillary Atrophy

- Atrophy of tissue surrounding ONH
- Pathogenesis: Ischemia of peripapillary choroidal circulation and/or vascular deficiency in the ONH
- Correlation of size and location of PPA to the extent of damage to ONH
- Correlation to changes in PPA associated with progression of VF loss
Peripapillary Atrophy

• Alpha (α) zone changes
  ▪ Irregular hyper/hypopigmentation of the RPE
  ▪ Normal variation with age

• Beta (β) zone changes
  ▪ Atrophy of the RPE and choriocapillaris making large choriodal vessels and sclera apparent
  ▪ More common and extensive in glaucomatous nerves
  ▪ May precede notch, disc heme, NFL defect
  ▪ If both changes are present, alpha changes occur outside the beta zone changes
Peripapillary Atrophy
Peripapillary Atrophy
Peripapillary Atrophy

Alpha

Beta
Disc Hemorrhage

- Usually flame-shaped hemes at/near disc or round hemes in the disc at the level of the lamina cribrosa
- Transient and can last for up to 6 months
- Recurrence is important
- Usually precede notching or rim thinning
- More common in NTG, but others too
Disc Heme
Disc Heme
Glucomatous ONH Evaluation

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Thank you for your attention

Questions?