The Optic Nerve Head In Glaucoma

Eric E. Schmidt, O.D., F.A.A.O.
Omni Eye Specialists
Wilmington, NC
schmidtvision@msn.com

Clinical Pearl #1

Glaucoma is an optic neuropathy

Initial detectable damage
Structure vs function

- The majority of patients in OHTS who developed glaucoma had defects in the optic disk only.


Describe this optic nerve

Characteristics of Normal Disk

- Vertical dimension = 2mm
- Avg disk = 10-12 vessel widths
- Avg disk = middle spot size
- Avg C/D = .4/.4
- Cup size correlates with disk size
- Symmetry between 2 eyes

Optic Disc Size

Size of cup varies with size of disc
Large discs have large cups in healthy eyes

Identify small and large optic discs
Small discs: avg vertical diameter <1.5 mm
Large discs: avg vertical diameter >2.2 mm
Characteristics of Normal Disk part 2
- Neuroretinal rim equal superiorly and inferiorly
- Temporal rim is thinnest
- ISNT Rule of Jonas
- Rim color – pink & symmetrical
- REMEMBER: C/D has a horizontal and vertical component

Normal Disk Variations
- Normal disk varies between .8mm² – 6mm²
- Myopes have larger disks
- Hyperopes have smaller disks
- African-Americans have largest normal disks
- Size Does Matter!

Pathologic Changes Due To Glaucoma
- Thinning of neuroretinal rim
- Deepening of optic cup
- NFL atrophy
- Increase cupping
- Splinter hemes
- PPA (Peripapillary atrophy)
- Vessel changes

Glaucmatous ONH Characteristics
- ONH asymmetry
- NFL dropout
- Neuroretinal rim defects
  - Focal notches
  - Loss of rim area
  - Sharp rim
  - C/D ratio
  - Lamina cribrosa
  - Alpha & Beta zones

3-D Model: Normal vs Glaucoma
- The 3-D model undergoes specific patterns of change as a result of glaucomatous damage:
- The RNFL surface becomes flatter as retinal ganglion cells and their axons are lost from the retina.
- The optic disc changes as the cup becomes larger, the slope steeper, and the depth greater.
What is the most commonly seen INITIAL change in the glaucomatous optic nerve?

40 year old white male with asymmetric cupping

Neuroretinal Rim

- What is it?
- ISNT Rule of Jonas
- In glaucoma the rim thins:
  - Sup/temp & inf/temp 1st
  - Temporal next
  - Nasal last remnant
- Can recede focally or globally
- Look at the donut, not the hole!

Inferior rim thinning OS
Recession of the rim

- Objective sign of clinical progression
- How do we notice this?
  - Serial photography
  - ONH imaging
  - Exquisite documentation
  - Increasing C/D
  - Thinner neuroretinal rim
  - Baring of circumlinear vessel
  - Focal notches

46 year old white female, borderline IOP

OD
OS

Temporal unfolding

Look at the donut, not the hole!!
Nerve Fiber Layer Atrophy

- Bright/Dim/Bright Pattern
- Obscures view of underlying vessels
- How to best view?
  - Hi mag
  - Bright illumination
  - Red free filter
- One of the earliest pathology to occur

Localized RNFL Loss

Localized RNFL defect
Wedge-shaped dark area

RNFL Assessment: Red-Free Photography

Benefits
- High resolution monochromatic image of RNFL
- Focal defects can be visualized

Limitations
- Requires
  - Dilated pupil
  - Skilled photographer
- Time to develop and process
- Difficult to obtain good grade
- Diffuse loss (more common) is difficult to detect

Estimating The C/D Ratio

- Our eyes allow a correct “estimate” to nearest 5%
- There is an interobservational accuracy of +/- 5%
- Be consistent in the way you grade this
C/D Ratio

- 2 dimensional
- Look at 4 quadrants
- Diffuse enlargement
- Focal changes
  - Notches
  - Optic pits
- Correlation to VF
Increase C/D

- Ophthalmoscopic manifestation of neuroretinal rim thinning
- Early sign of progression
- Verticalization
- Cup shape is not necessarily the same as disk shape

Deepening of Optic Cup

- Visible laminar dots
- Size of pores important
- Correlation w/ VF
- Slope changes
- Bean potting
- Excavation is sign of progression
Peripapillary Atrophy and Glaucoma

- Zone alpha, zone beta
- More frequent in NTG & POAG than in normals or OHTN
- Correlation between degree of PPA and optic disk damage
- Correlation between location of atrophy and location of disk damage and corresponding VF loss

Bean-potting

Zone alpha, zone beta

- Zone alpha – RPE hypo- and hyperpigmentation
  - More peripheral
- Zone beta – adjacent to optic disk
  - Paler area
  - Visible sclera and large choroidal vessels
- Strong association with glaucoma
In G cases with beta zone atrophy:
- Most likely pos’n sup/temp or inf/temp
- Most thin areas of rim correspond with largest areas of beta zone
- Localized beta zones correspond with focal VF defects

Parapapillary Atrophy

**Beta zone**
- Width of beta zone inversely correlates with rim width at same area
- Larger beta zone → thinner rim
- Progression of beta zone associated with progressive glaucoma
Size Does Matter!- (of alpha zone)
- The mere presence of a beta zone is significant (but its size does not matter!)
- Progression of either may be the earliest sign of progression

PPA – The Final Word

Disk hemorrhage
- 49.3% found inferotemporally
- 32.9% superotemporally
- Recurrences are likely at same location
Disk Hemorrhage in NTG
- Is the presence of disk heme prognostic of VF progression?
  - 53% progressed if disk heme present (MD)
  - 81% progressed if disk heme present (pointwise VF definition)
- Recurrence is important
  - 67% did not progress if no recurrence
  - 27% did not progress if recurrence
  - Mean recurrence 12.2 mths later

Disk Hemorrhage In NTG (cont)
- Is the heme the etiology or the result?
- Disk heme sign of progressive damage of NFL
- Disk heme leads to deterioration of VF
- Disk hemes are signs of active disease
- Disk hemes are a very strong risk factor for progression of VF (up to 20 fold increase)

Arteriolar Narrowing
- Focal constriction of vessel
- Seen just off ONH
- Sign of progression?
- Usually seen after VF defect has occurred
- Etiology – reduced demand for blood to that damaged, atrophic portion of retina/ONH

“Bayonnetting”
Physiologic Cupping

- Is it a risk factor for glaucoma?
- Can a person with physiologic cupping develop glaucoma?
- Does it run in families?
- How can you best differentiate?

Physiologic cupping?

Eric’s 4 Most Valuable Ophthalmoscopic Signs

1. Focal notches
2. Verticalization
3. NFL dropout
4. Violation of ISNT Rule

3 Most Valuable Indicators of Progression (MVPs)

- Enlargement of PPA
- Disk hemorrhage
- Focal recession of rim/ Baring of circumlinear vessel