

The Optic Nerve Head In Glaucoma

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Points To Live By

- 25% of G pxs NEVER have IOP >21mm
- 50% of G pxs have trough IOP < 21mm
- Glaucoma effects ONH in characteristic patterns
- ONH damage occurs well before VF changes appear
- Disk evaluation remains the most effective method of diagnosing glaucoma

Glaucoma

- Intraocular Pressure that is elevated to a level that causes dysfunction and loss of sensitivity of the optic nerve head in the form of:
 - Pathologic changes in the appearance of the optic nerve head
 - Subsequent characteristic visual field loss

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

Clinical Pearl #1742

Glaucoma is an optic neuropathy

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

How To Estimate Disk Size

- Middle spot on 'scope
- Blood vessel method
- Litwak Method
 - 60D and slit lamp
 - Normal is 1.8 – 2.2mm
 - Affected by mag
 - Affected by RE
- RTA/HRT

Why do these pathologies occur?

- Pressure induced
- Ischemia
- Poor autoregulation
- Microcirculation dysfunction
- Glutamate toxicity

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!

Glaucomatous 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

Pathologic Changes Due To Glaucoma

- Thinning of neuroretinal rim
- Deepening of optic cup
- NFL atrophy
- Increase cupping
- Splinter hemes
- PPA (Peripapillary atrophy)

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!

Recession of the rim

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

Nerve Fiber Layer Atrophy

- Focal, wedge or diffuse dropout
- Correlates with VF loss
- RTA or GDX

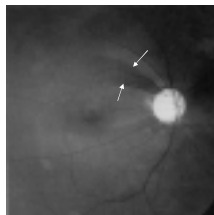
Nerve Fiber Layer Atrophy

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

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

RNFL Assessment: Red-Free Photography



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 should not necessarily be the same as disk shape

Zone alpha, zone beta

- The larger the area of atrophy:
 - Increased MD
 - Decreased MS
- Size correlates with:
 - Neuroretinal rim area
 - C/D
 - NFL thickness
 - VF loss
- Pathogenesis: ischemia of peripapillary choroidal circulation; vascular deficiency

Deepening of Optic Cup

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

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

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

Zone Beta

- 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

10 year retrospective study (Tezel)

- OHTN pxs who developed POAG had larger alpha & beta zones
- Had more frequent beta zones than OHTN
- Alpha zones were larger in G pxs than OHTN
- PPA enlarged with progression
- Enlargement of PPA was evident before disk or VF changes were seen

PPA – The Final Word

- 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

Uchida Study

- Found direct ass'n between increased cupping, VF damage and size of PPA
- POAG – 45% have beta zones
 - Only 7% of normals have beta zones
- POAG – alpha zones are larger and progress over time

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

Relationship between PPA and VF (AJO 6/99)

- MD, CPSD of SWAP and standard were significantly worse in eyes with zone beta (any zone beta at all)
- Size of zone alpha correlated with MD of standard but not SWAP

Disk Hemorrhage in NTG

- AJO 6/00
- 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 the strongest risk factor for progression of VF (up to 20 fold increase)

Optic Nerve Head Imaging

- RTA
- HRT
- OCT
- GDx

- What role do these play?
- How often should they be done?

Disk hemorrhage

- 49.3% found inferotemporally
- 32.9% superotemporally
- Recurrences are likely at same location

Physiologic Cupping

!#*\$%*&!#@+#!

- Is it a risk factor for glaucoma?
- Can a person w/ physiologic cupping develop glaucoma?
- Does it run in families?

How Does One Best

Examine The Optic Nerve Head?

Eric's 3 Most Valuable Ophthalmoscopic Signs

- 1. Focal notches
- 2. Verticalization
- 3. NFL dropout

3 Most Valuable Indicators of Progression (MVPs)

- Enlargement of PPA
- Disk hemorrhage
- Focal recession of rim