

The Mid Yorkshire Hospitals  
NHS Trust



# Optic Nerve Head Analysis

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Weekly Teaching  
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# Primary Open Angle Glaucoma

- Asymptomatic condition
- Very subtle signs early in its course
- Cannot be definitively diagnosed from the results of a single test, or sometimes, even a battery of tests
- IOP was considered to be one of the most important findings to diagnose glaucoma
- High IOP is not diagnostic for glaucoma
- Low IOP does not rule-out glaucoma.

# Diagnosis of POAG

- Most important test is ONH Analysis
- ONH Analysis has high specificity
- Stereoscopic viewing of the magnified optic nerve head with high contrast
- Binocular indirect ophthalmoscope, while allowing stereopsis, does not offer high enough magnification to provide the details necessary for complete evaluation.
- High plus lens fundus biomicroscopy and pupils must be maximally dilated

# Diagnosis of POAG

- High plus lens should be clear
- Yellow lens may be helpful in increasing patient comfort but may mask some early color changes found in the glaucomatous optic nerve head
- The angle between the illumination system and microscope system should be no more than 10 degrees to insure stereopsis
- It is important to remember that the image seen through a high plus lens is a virtual image, and will be inverted with the right on the left, and the top on the bottom.

# Optic Nerve Head Analysis

- Normal ON contains approximately 1.2 million axons in the NFL and circular depression - the cup
- The size of the cup is dependent on
  - the number of nerve fibers
  - the size of the disc
- Generalized loss of axons or a large ONH with all of the axons intact will C/D ratios larger than normal
- Small disc will have very little cupping even if a loss of axons has occurred
- Hence it is very important to evaluate the ONH size before determining the C/D ratio.



# Optic Nerve Head Analysis

- Size of Optic Nerve head
- Cup Disc Ratio
- Neuro Retinal Rim
- Peri-papillary Atrophy
- Splinter Haemorrhage
- CDR asymmetry

# Measuring Disc Diameter

- Vertical optic nerve diameter
- Technique:

Slit lamp with a high plus lens

- Vertical slit beam to create trapezoid of light
- Adjust length of beam to match vertical “height” of the nerve
- Scleral canal to scleral canal
- Read length of light column from the continuous scale on the slit lamp
- Multiply this length by a conversion factor
  - Lens specific
  - Manufacturer specific

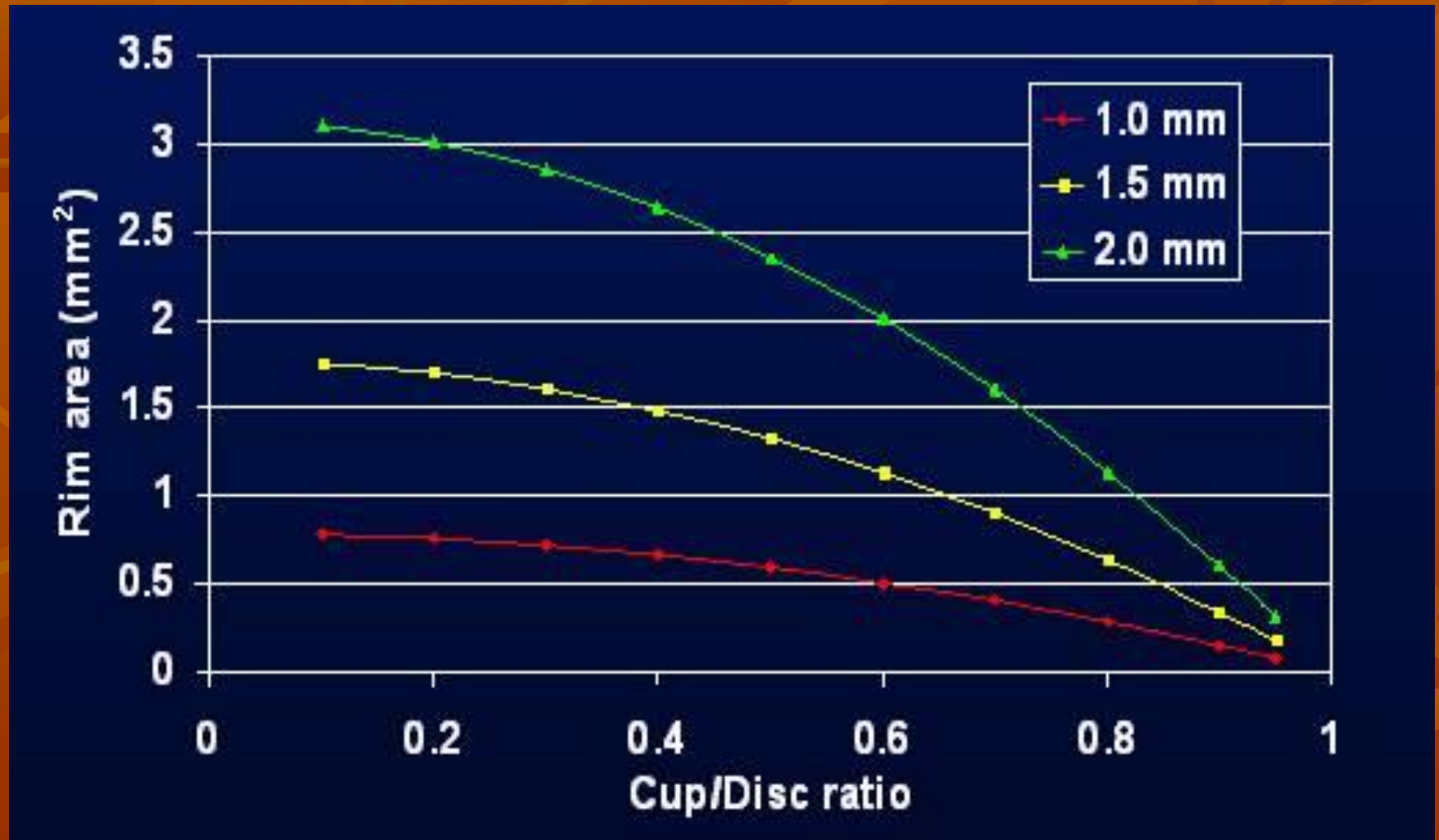
# Conversion Chart

Manufacturer		Lens	
	60 D	78 D	90 D
Volk	0.88	1.11	1.33
Nikon	1.03		1.63

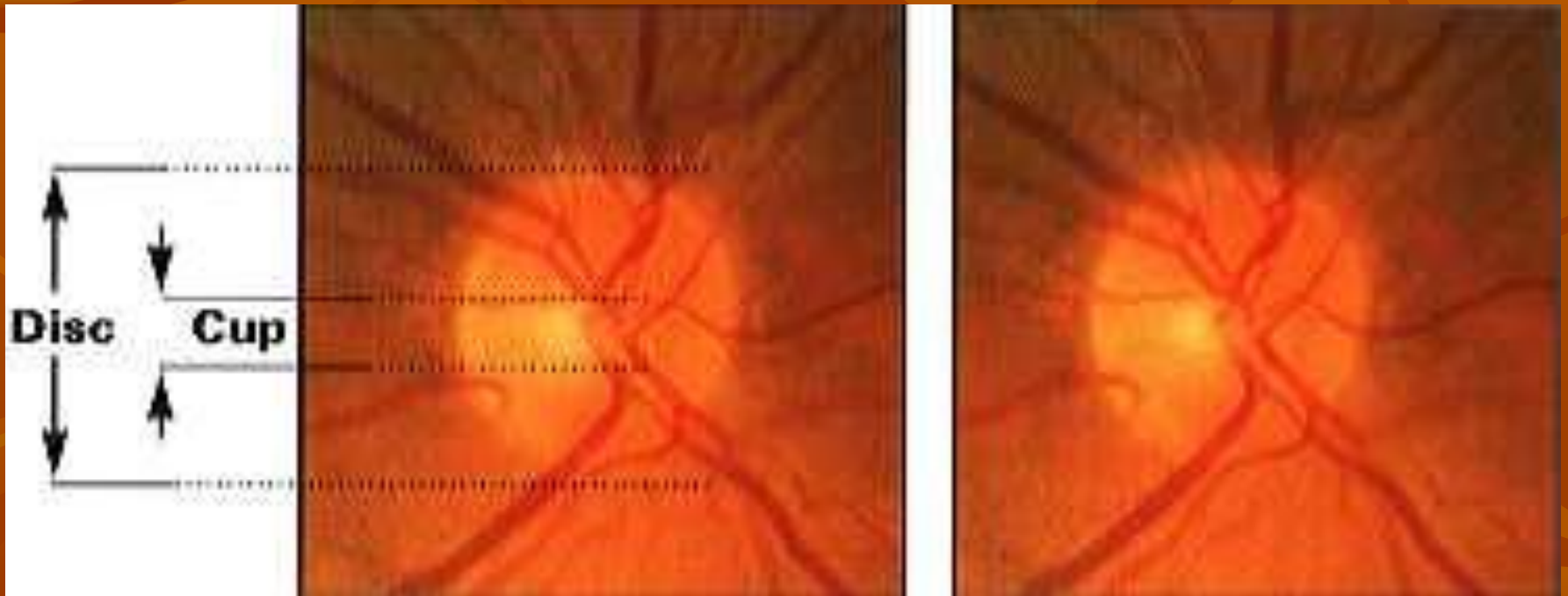
Lim, et al. J Glaucoma 1996;5:241



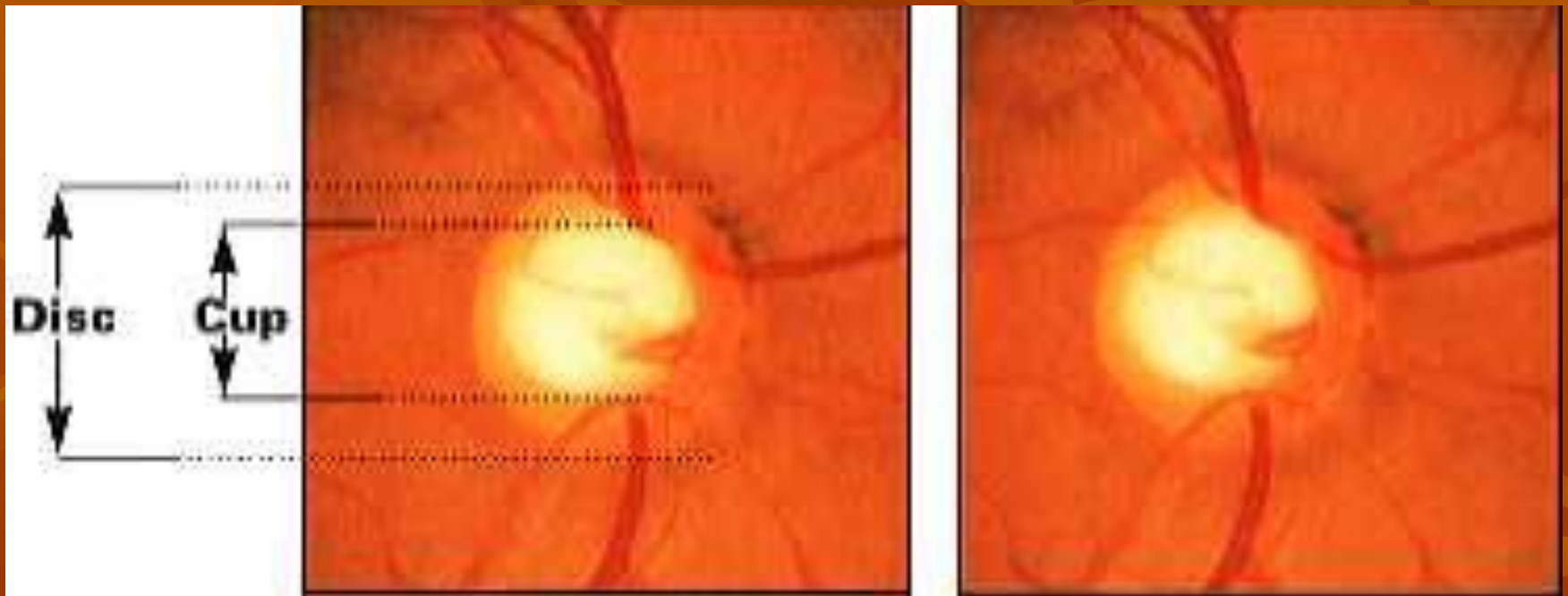
# Theoretical Rim Area by Optic Nerve Diameter



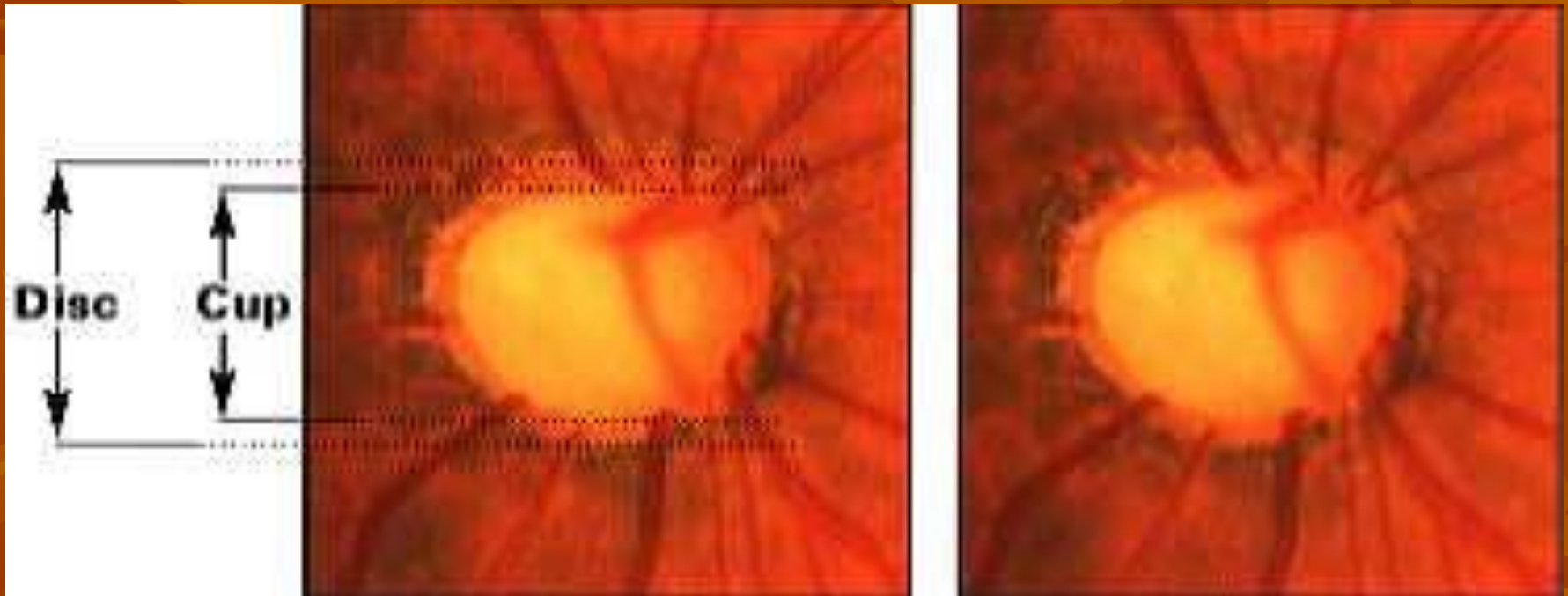
# Cup Diameter to Disc Diameter Ratio Estimates



# Cup Diameter to Disc Diameter Ratio Estimates



# Cup Diameter to Disc Diameter Ratio Estimates



# Optic Nerve Head Analysis

## Benefits:

- Disc damage (nerve fiber layer damage) may precede visual field defect

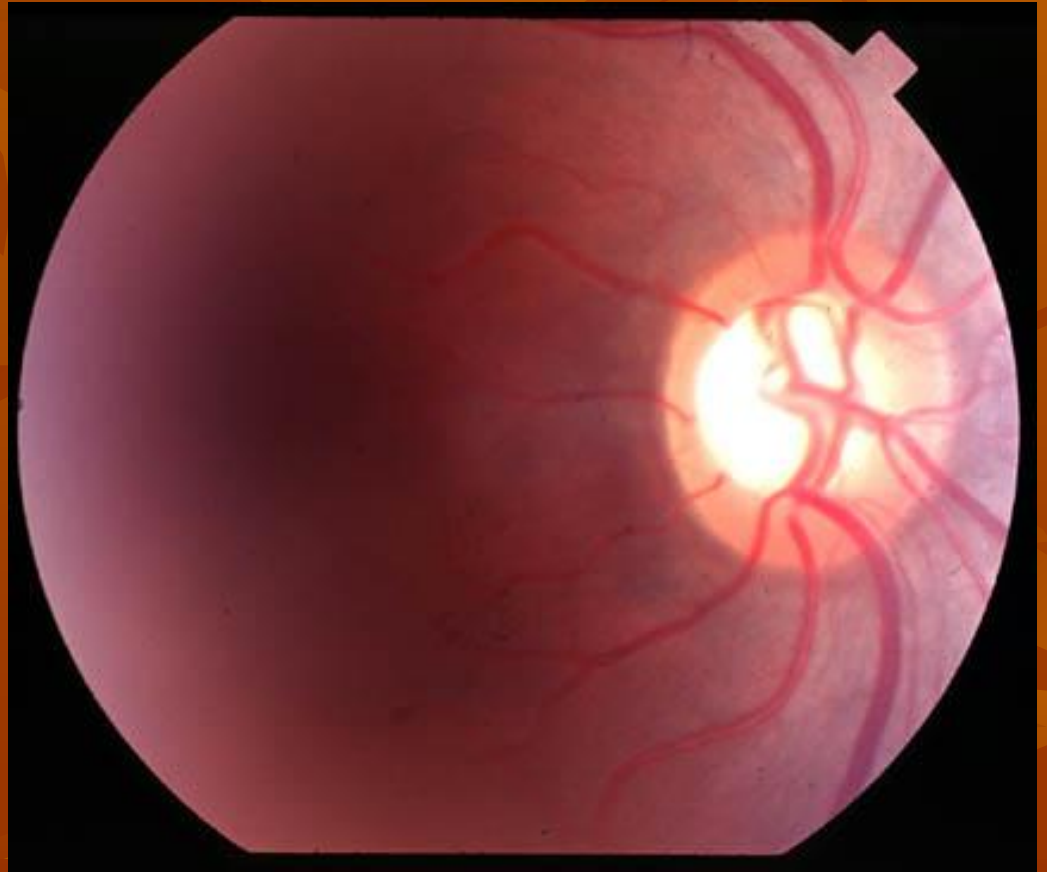
*Sommer, et al. Arch Ophthalmol 1991;109:77*

- Disc may be stable while the field fluctuates



# Physiologically large optic nerve cup

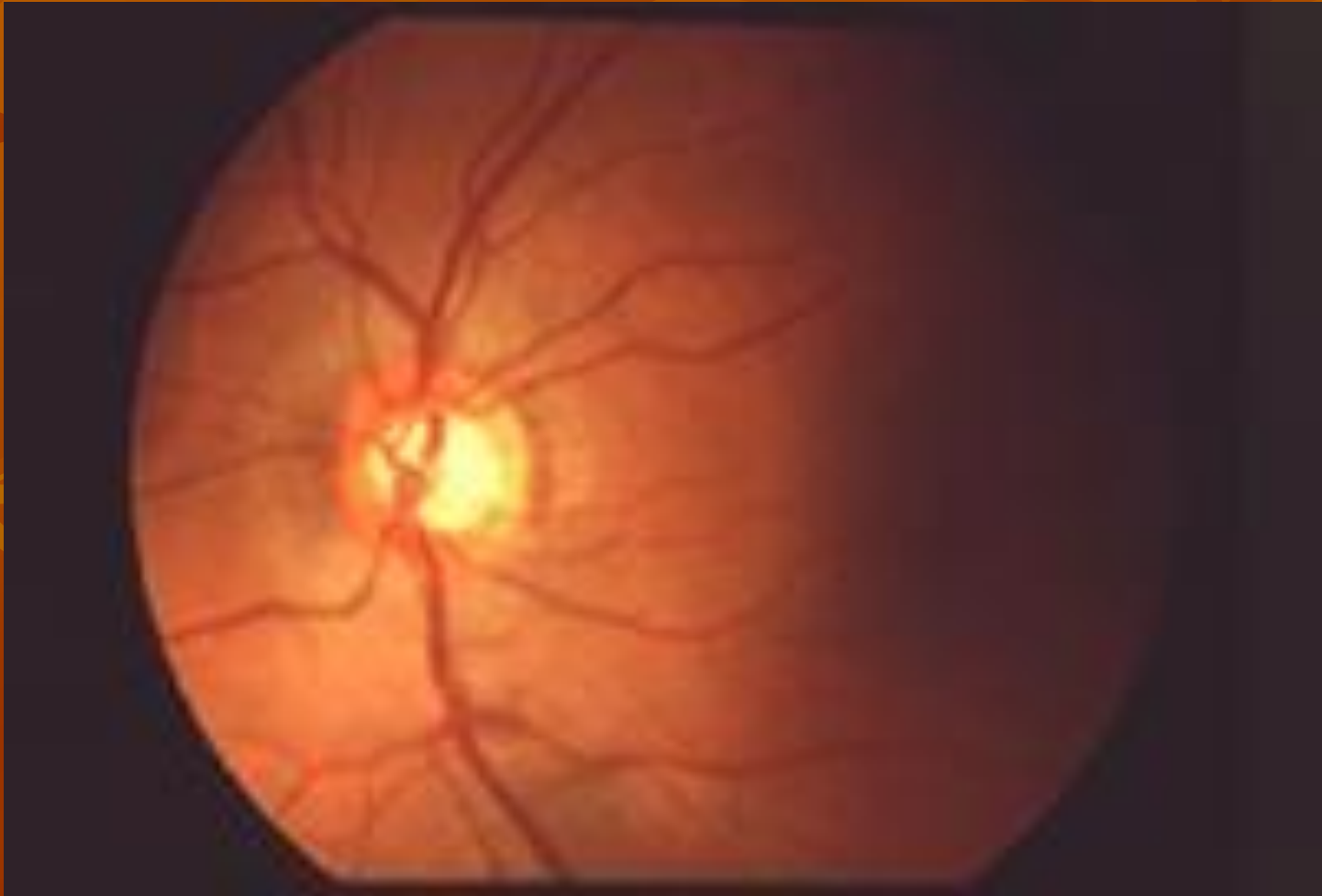
ISNT Rule: is independent of optic disc size so it applies to small, normal and large optic nerves.



# Optic Nerve Head Analysis

- Neuro retinal rim is often the first area to show changes in glaucoma
- Normal NRR is uniformly pink in color indicating good vascular perfusion
- Width of the neural rim tissue varies by quadrant the inferior quadrant has the widest rim tissue with the superior portion second in width. The nasal tissue is slightly thinner than the superior tissue and the tissue in the temporal quadrant is the thinnest – **ISNT Rule**
- This variation in rim sizes will cause large physiologic cups to appear elongated horizontally.

# Normal rim tissue in a disc with a large cup

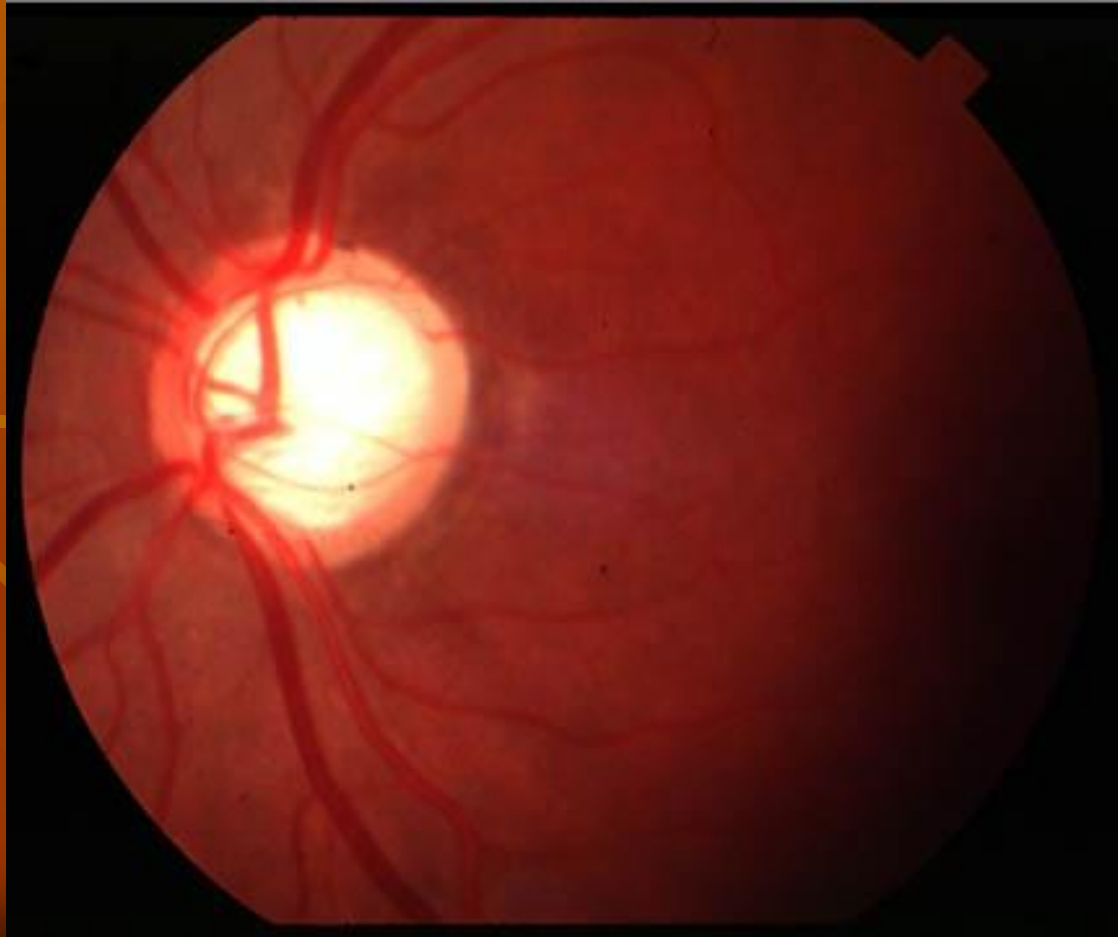


# Notching of the inferior optic rim tissue



# Large optic disc cup

Sup & Inf rim thickness same as Temporal





# Optic Nerve Head Analysis

- Normal size ONH - any asymmetry in CDR between the two eyes of a patient is due to a difference in the number of axons
- Asymmetry in CDR between the two eyes of a normal patient has been shown to be rare.
- CDR difference of 0.2 or less - 96% of normal eyes
- **Asymmetry of  $> 0.2$  with symmetrical discs and no anisometropia - greatly increases the suspicion of glaucoma**

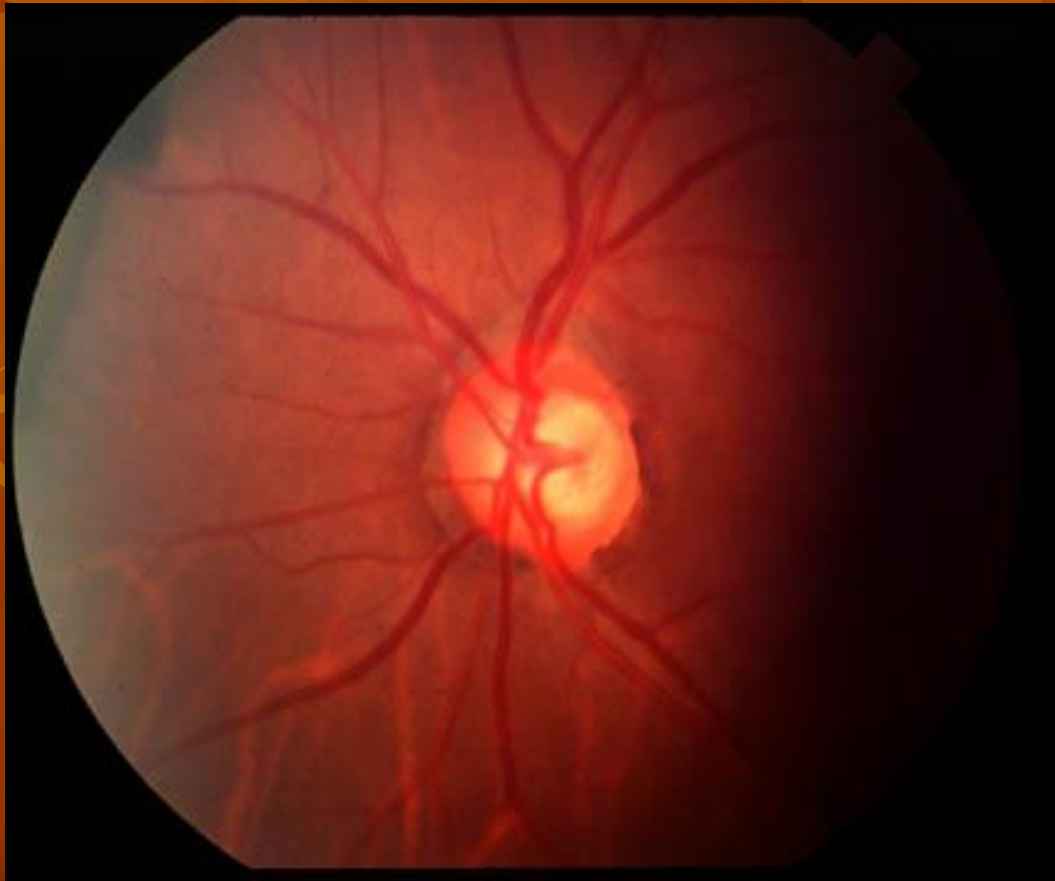
# Vertical elongation of the cup

Inferior Notching & PPA



# Temporal thinning of the Neuro-retinal rim

Temporal notch



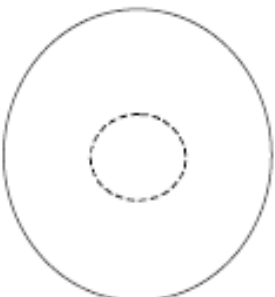
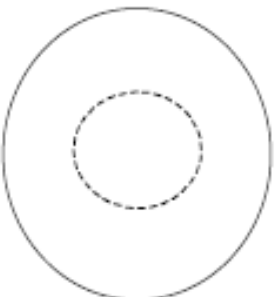
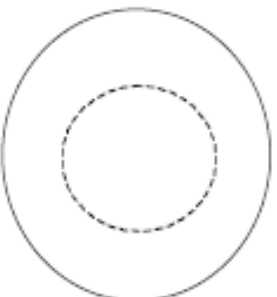
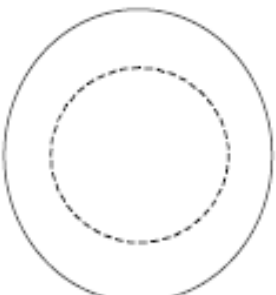
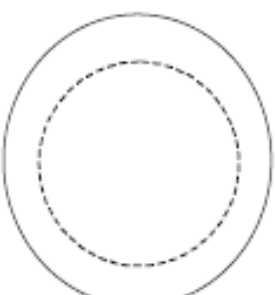
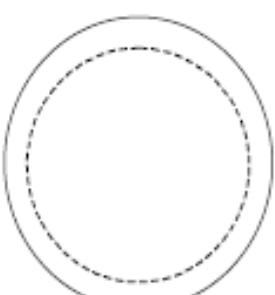
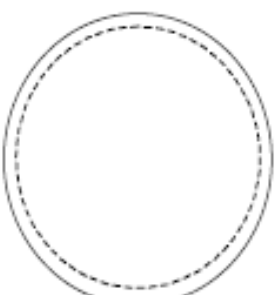


# Level of Glaucoma Suspicion & CDR

- ***High***            0.9 or greater
- ***Moderate***    0.6 - 0.8
- ***Low***            0.5 or less

# Optometric Grading Scale

VERTICAL CUP/DISC RATIO

0.1	0.2	0.3	0.4	0.5
				
0.6	0.7	0.8	0.9	95% confidence limit of normality Vert disc diam (mm)    Vert C/D ratio 1.2                      0.5 1.5                      0.6 1.8                      0.7 2.2                      0.8 (Garway-Heath et al 1998)
				



# History-Based Risk Factor Weights

## Variable Category Weight

- *Age* - <50 years 0  
50-64 years 1  
65-74 years 2  
>75 years 3
- *Race* - Caucasian/other 0  
African American 2
- *Family History of Glaucoma* –
  - ve or +ve in non-first degree relatives 0
  - Positive for parents 1
  - Positive for siblings 2

# History-Based Risk Factor Weights

## Variable Category Weight

- Last Eye Examination

- Within past 2 years 0
- 2 - 5 years ago 1
- > 5 years ago 2

- *Other historical variables*

- *high myopia or hyperopia,*
- *systemic hypertension,*
- *steroid use,*
- *diabetes*

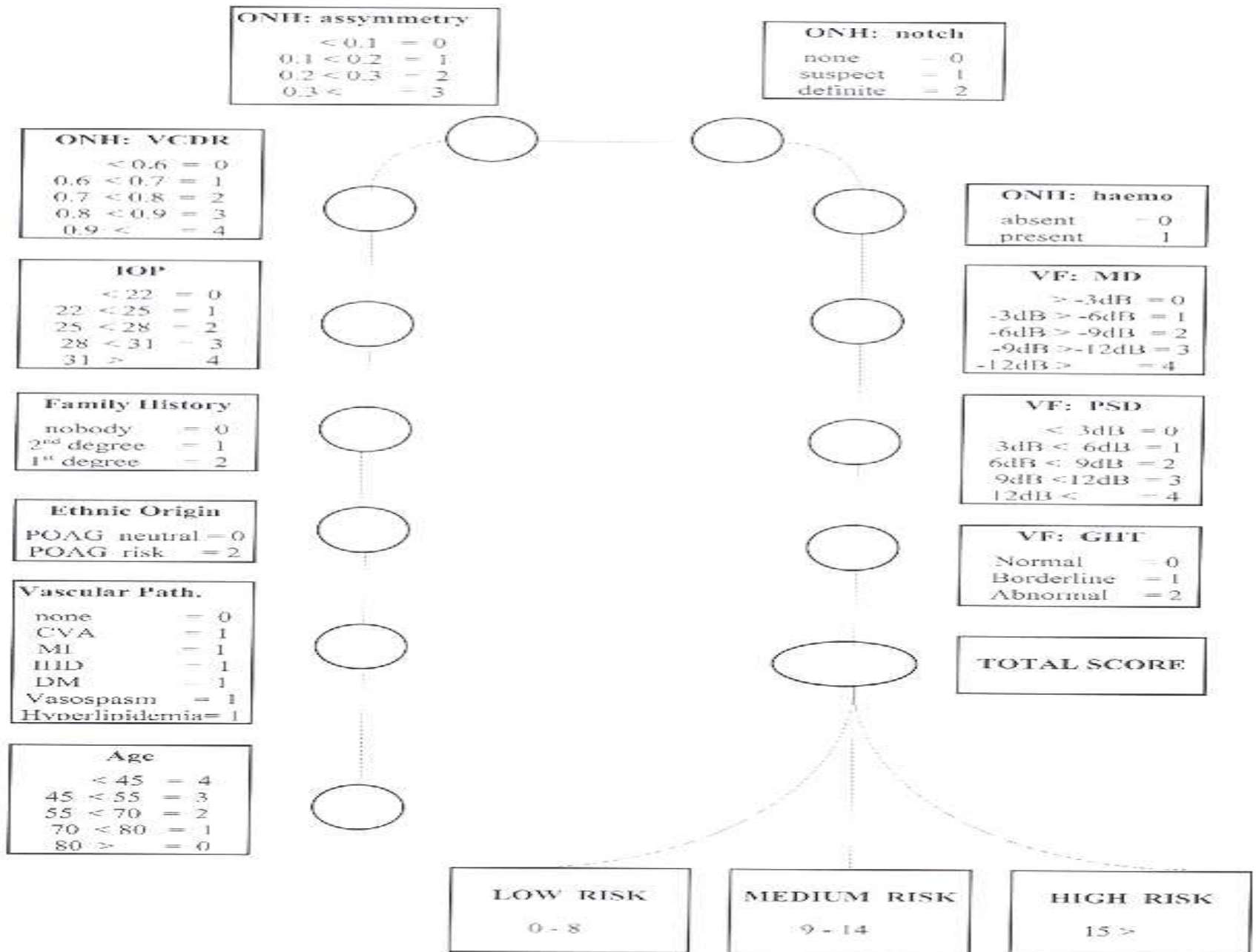
*are not strong enough to be assigned a weight, but may be considered in the overall assessment of glaucoma risk.*

# Level of Glaucoma Risk Weighting Score

- **High** 4 or greater
- **Moderate** 3
- **Low** 2 or less

Add weighted scores to determine risk level.

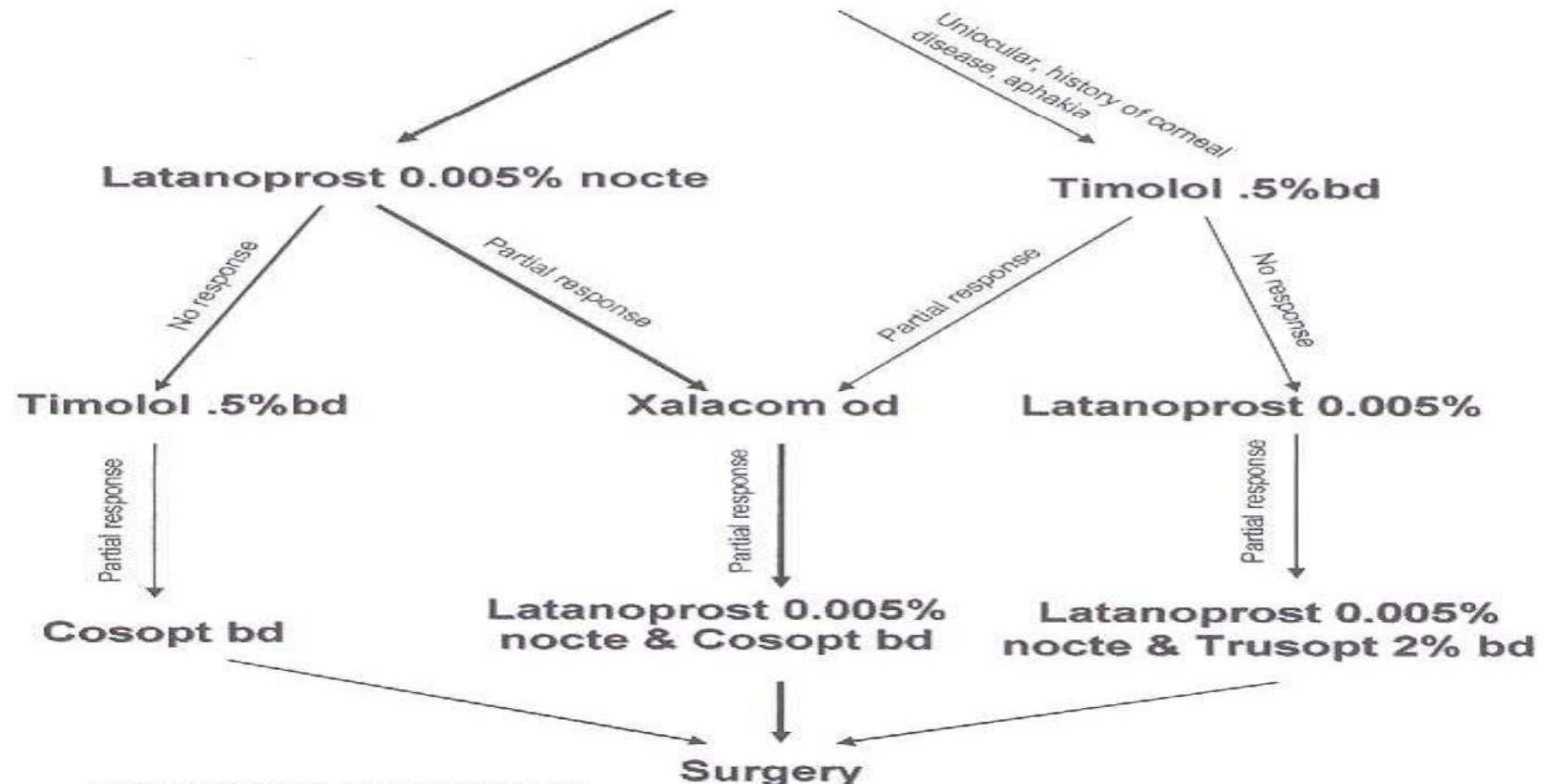
# CLINICAL RISK ASSESSMENT FOR OPEN ANGLE GLAUCOMA



# Protocol for management of glaucoma

patients without contraindication to B-blockers

**OAG, OH or NTG**



Interval between appointments:

1-2 months after any treatment change

6-12 months if glaucoma under control.

Interval between fields :

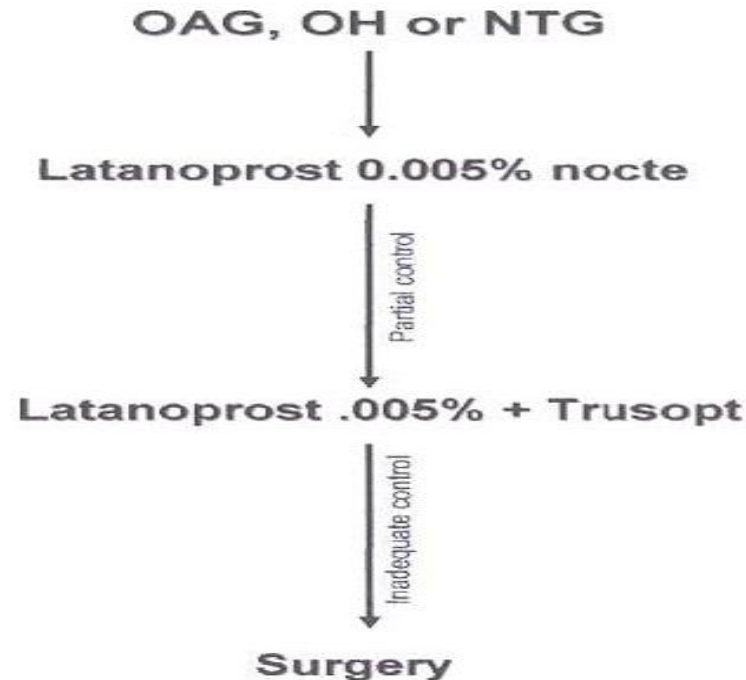
12 months

(no fields for most patients over 80, where VA is less than 6/18 or there is very advanced field loss):



# Protocol for management of glaucoma

in patients where B-blockers are contra-indicated



Interval between appointments:

1-2 months after any treatment change

6-12 months if glaucoma under control.

Interval between fields :

12 months

(no fields for most patients over 80, where VA is less than 6/18 or there is very advanced field loss):

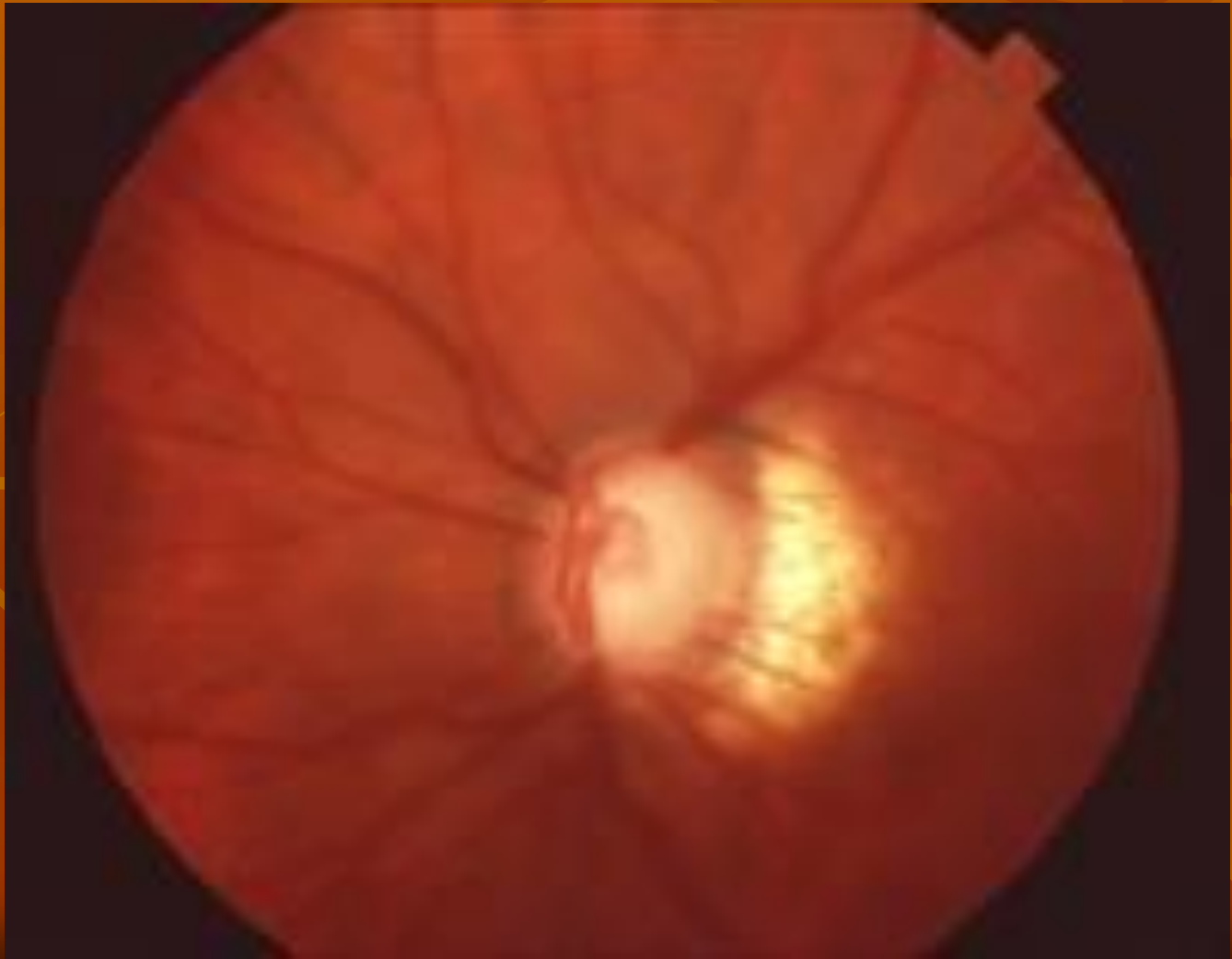


Thank you

# Splinter hemorrhage in the superior temporal quadrant



# Peri-papillary atrophy in a patient with glaucoma



# Optic Nerve Head Analysis

- The normal optic nerve diameter varies in size from 1.2 mm to 2.5 mm with the average being 1.88 mm vertically and 1.77 mm horizontally.
- African-Americans having a significantly larger disc area than Caucasians
- This variation in normal optic disc sizes can affect the cup/disc ratio in two ways
  - larger disc will have a larger cup
  - size of the disc is used as the denominator of the ratio