Ocular examination
FRONT TO BACK
Optic Nerve

Lecture 11
(Additional) Examination Tools

- **FUNCTIONAL ACUITY**
  - Ability to perform a vision task
    - Reading
    - Best correct visual acuity
- **Pupillary testing**
  - Proper technique is crucial
  - Afferent Pupillary Defect (APD)
- **Monocular color vision**
- **Contrast sensitivity**
- **Visual Fields**
- **SLE**
  - NFL analysis
  - Rim Tissue analysis
    - ISNT
  - VDD
- **Macular photostress recovery**
- **Amsler grid**
  - Suprathreshold testing
- **Neutral density filter**
- **FA**
- **OCT**
  - Nerve fiber layer analysis
- **CAT**
- **MRI**
Healthy ONH

THE NORMAL OPTIC NERVE
1. Size: Normal size variable: Usually 1.2 mm to < 2 mm
2. Neuroretinal rim: pink in color
3. ISNT rule usually obeyed in a normal optic nerve
   - The ISNT rule addresses disc rim thickness of the normal optic disc.
   - Inferior rim (I) greater than or equal to superior rim (S); greater than or equal to nasal rim (N); Greater than or equal to temporal rim (T) or (I=S=N=T)
   - The ISNT rule is useful in differentiating normal from glaucomatous optic nerves and is unaffected by race
4. Nerve fiber layer: Striations seen especially at superior and inferior pole
5. Blood vessels at rim are typically embedded in nerve fiber layer (NFL)
Optic Nerve Pathway
What can go wrong?

- Congenital defects
- Acquired pathologies
  - neuropathies

History (age particularly) + Symptoms + Signs = Diagnosis

What you see (or don’t see) on the ONH

“benign” to sight threatening to life threatening
Bergmeister’s papilla
Prepapillary vascular loop
Myelinated nerve fibers
Scleral crescent
Choroidal crescent
Circumpapillary staphyloma
Coloboma
Morning glory disc
Pits
Buried drusen
Cilioretinal artery
Macrovessels
Arteriovenous Anastomosis
Megalopapilla
Hypoplasia
Aplasia
Absence of ONH
Oblique/Tilted disc
Optic atrophy
Inherited familial
AD Juvenile
AR congenital
Leber’s Hereditary
Acquired Optic Nerve Pathology

“Signs”

- Indistinct borders
- Elevation
- Patton’s lines
- Pathologic “C”
- Neuroretinal rim thinning
  - Focal
  - Diffuse
  - Changes over time
- Nerve fiber layer loss
- Acquired optic pits

- Optic atrophy
- Shunt vessels

- SYMPTOMS
  - As varied as causes
• Bergmeister’s papilla
  – Hyaloid artery remnant
• Vascular loops
• Myelinated Nerve Fiber

• Scleral Crescent
• Choroidal Crescent
  – Pigment crescent

• Circumpapillary Staphyloma
• Coloboma

• Morning Glory Disc
• Pits
• Buried Drusen
- Cilioretinal artery

- Macrovessels
  - Crosses horizontal Raphé
• Arteriovenous Anastomosis
  – Racemose hemangiomas
  – Communication between artery/vein
• Megalopapilla

• Hypoplasia
  – Double ring sign
• **Oblique/Tilted insertion**
  – Dysversion
  – Ectasia

![Oblique/Tilted insertion](image)

- Nasal
- Inferior nasal
- Temporal
- Conus

**Situs Inversus**

- Oblique insertion - nasal and temporal dysversion
- Tilted insertion - inferior and superior dysversion
Inferior conus with inferior RPE atrophy
Visual field defect???

90 degree torsion

Temporal conus with macular staphyloma
Best corrected visual acuity decreased???

No torsion
• Oblique/Tilted insertion
  – torsions

Difficult to have a dysversion without some torsion

No oblique insertion
No torsion
Note: choroidal crescent

(relatively) No oblique insertion
(+ ) torsion

( + ) temporal oblique insertion
(relatively) No torsion
No torsion

Differences???

Why is this important?
1. Makes it difficult to assess rim tissue
2. Explains reduced best correct visual acuity
3. Explains HVF defects
Unilateral Situs Inversus
Bilateral Situs Inversus

Nasal ectasia

NOTE: how different the “cup” looks. What about the rim tissue?
• Optic Atrophy (hereditary)
Evaluation of the Healthy Optic Nerve - The 5 Rs

- Observe the scleral Ring to identify the limits of the optic disc and its size
- Identify the size of the Rim
- Examine the Retinal nerve fiber layer
- Examine the Region of parapapillary atrophy
- Look for Retinal and optic disc hemorrhages

— Weinreb, Medeiros, Susanna, 2005.

What can one see on an optic nerve head?
#1 Identify the Edge of the Optic Disc and Determine Disc Size

- **Border quality**
  - Scleral ring

As vessels bridge the scleral ring, they often make a slight change in direction (black arrow) which may be a clue to its inner edge.

The change in colour is also evident in this case (arrows mark inner (yellow) and outer (blue) edges).

Blurring of the image may occur due to media opacity or resolution of the image - this can make appreciation of the anatomy difficult.
• Size
  – Vertical disc diameter (VDD)
  – Approximately 1500 micrometers
    • Slightly oval with VD being about 9% greater than the horizontal
  – Varies from 0.96 to 2.91mm
    • As a result cupping can vary from .1 to .8

Hypoplastic

Average

Large
Crowded Disc

- Small scleral canal
- Hyperemic
- No cup
- “Disc at Risk”
• Small ONH = Small cup
• Large ONH = Large cup
  – Both of the holes have about 1.2 million axons entering to form the ON

**Optic Disc Size**

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

- Small: avg vertical diameter < 1.5 mm
- Average: avg vertical diameter > 1.5 mm, < 2.2 mm
- Large: avg vertical diameter > 2.2 mm

**Vertical Disc Diameter**
African-Americans 1.81 mm
Caucasians 1.69 mm
Male = Female
*Pearlman, et al. AAO poster 2000*
Measuring VDD

- **Direct Ophthalmoscope**
  - Smallest white round spot casts a light of 1.5mm diameter on the retina
    - Spot size remains constant in phakic eyes with refractive errors between -5.00 and +4.00D

- **Slit Lamp**
  - Beam 1/4 to 1/3 size of DD width
  - Adjust length of beam to match vertical height

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**Conversion Chart**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>LENS</th>
<th>LENS</th>
<th>90D</th>
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<tr>
<td>VOLK</td>
<td>0.88</td>
<td>1.11</td>
<td>1.33</td>
</tr>
<tr>
<td>NIKON</td>
<td>1.03</td>
<td></td>
<td>1.63</td>
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#2 Identify the Rim Edge And Evaluate the Rim Tissue

- **ISNT Rule**
  
  - Inferior rim > superior rim > nasal rim > temporal rim

GET THE “CUP” BY DEFAULT
• Rim Tissue
  – Vessel deflection

The Cup Edge:
3 blood vessels here show the edge of the cup:
The points of maximum inflection (bend) are marked by arrows.
• **Sloping Rim**
  - Is the slope part of the rim or part of the cup?
  - Contour of vasculature
  - NOT just color change
• Normal rim tissue
• Depth (of cup)
  – HRT
  – Direct ophthalmoscope
• Lamina Cribrosa
#3 Evaluation of the Retinal NFL

- Superior VS inferior
- Intact 360
- Red-free filter
• Observations
GDx and OCT
#4 Evaluation of Regions of Parapapillary Atrophy (PPA)
#5 Look for Retinal and Disc Hemorrhages

Visual field loss in a patient with disc hemorrhage. Early superior visual field loss corresponds to the presence of an inferior disc hemorrhage; dense inferior visual field loss corresponds to a superior disc hemorrhage at the edge of the retinal nerve fiber layer.
Etiology of Acquired Optic Nerve pathology: Neuropathies

- Inflammatory: 1-10 years
- Post-infectious: 11-20 years
- Demyelinizing: 21-40 years
- Ischemic
  - Arteriosclerosis-HTN: 50-70 years
  - Temporal arteritic: 60-80 years
  - Diabetic
- Toxic
- Compressive
- Papilledema
- Glaucomatous
• Indistinct borders
  – Inflammatory
  – Ischemic
  – Edematous (↑CSF)
• Vessel obscurcation
• Elevation

12. In a patient with visible optic disc drusen, disc topography (left) shows an elevated optic nerve head with a lumpy internal contour and abrupt end to the hyporeflective space. Compare this with the smooth internal contour and V-shaped hyporeflective space between the retinal pigment epithelial and photoreceptor layers in a patient with optic disc edema (right).
• Paton’s lines
  – circumferential retinal folds that surround the disc (usually temporal)
  – Seen with Papilledema
• Pathologic "C"
  – shaped halo surrounding the disc.
  – Early papilledema

Note: deflection of vessels
• Rim Tissue Thinning (loss)
  • “Cupping”
  • Diffuse loss
    – Can loss about 50% of axons before detectable visual field loss

Concentric cupping

Baring

Excavated glaucomatous optic disc. The rim of the nerve is usually much thicker.
• Focal Thinning
  – Notching

Acquired optic pit
Bayonet-ing

"excavation"

Color change secondary to middle cup being very deep

Bean potting
• Change over time

• Excavation over Time
OCT

Figure 3

RNFL Thickness Map

RNFL Thickness Deviation

RNFL TSNIT Normative Data

Pattern Deviation

:: <5%
:: <2%
:: <1%
:: <0.5%
• Nerve Fiber Layer Loss
  – Slit
  – Wedge

Figure 1 - The inferior localized retinal nerve fiber layer defect (arrow)
• Acquired Optic Pit

• Parapapillary Atrophy (Changes)
Parapapillary atrophy
Marked rim pallor

Marked rim pallor
Parapapillary atrophy
• Optic atrophy
Permanent visual field loss and decreased central acuity

Note: PPA

Pale rim tissue = Pallor
• Optociliary Shunt Vessel
TAKE TO CLINIC MESSAGE

- If the rim tissue is pale (pallor) it in NOT glaucoma
TAKE TO CLINIC MESSAGE

• Always, always compare the two eyes
  • CUPPING MEANS NOTHING IF THE VDD IS NOT DOCUMENTED
  • Size matters......
Once upon a time....... 

- 65 year old Caucasian Male 
- Long time patient....... 
  - That had a pretty optic nerve head
• Reported to clinic between annual visits with a CC of hazy, blurred vision OD
  – You see this

  – 4 months later....
The end....