

Centre for Eye Health

Clinical nuggets – visual pathway assessment

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UNSW **Guide Dogs**

Overall topics to be covered

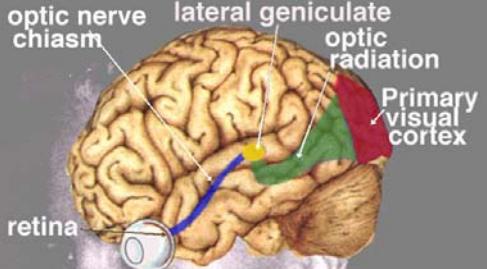
- Review the visual pathways and the associated characteristics of visual field loss
- Application of key principles in clinical practice
 - Visual fields, optic nerve head, RNFL, Ganglion Cell Analysis
 - Clinical challenges
 - Optic atrophies
 - Post-chiasmal lesions
 - (may include retrograde degeneration at the ON/RNFL level)
- Five participant polls #1-5 during the lecture

Polls are anonymous, please participate

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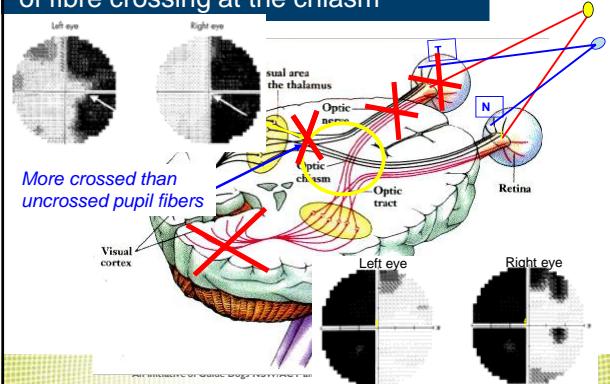
Postretinal Pathways

▪ Visual pathway



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Postretinal Pathways - the significance of fibre crossing at the chiasm



<https://cim.ucdmc.ucdavis.edu/eyerelease/interface/topframe.htm>

Eye Simulator Version 2.0

Pupil Response Simulator

Nerve Defect Settings

Right Eye Left Eye

None Marked RAPD* Mild RAPD* Homer's Syndrome Partial Third Nerve Efferent

None Marked RAPD* Mild RAPD* Homer's Syndrome Partial Third Nerve Efferent

Click to change mode

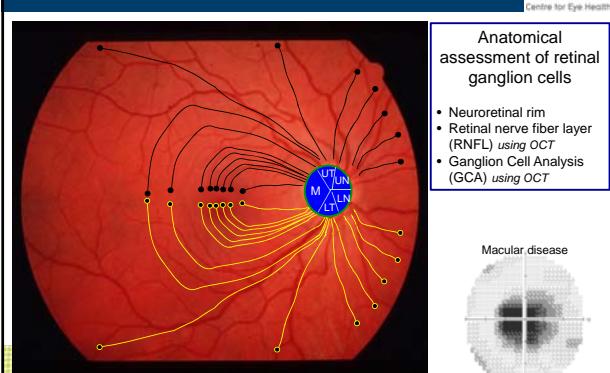
Click to enable a nerve defect

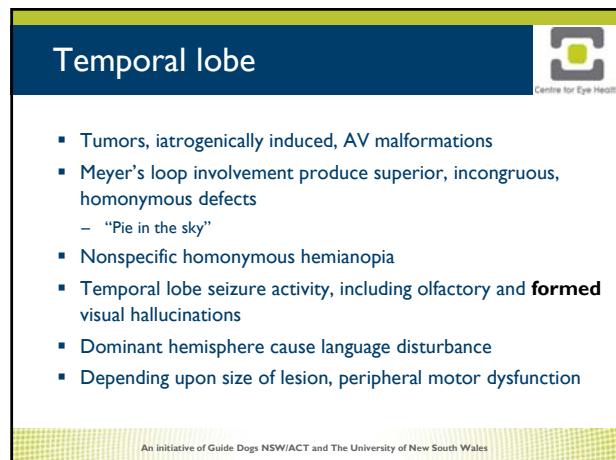
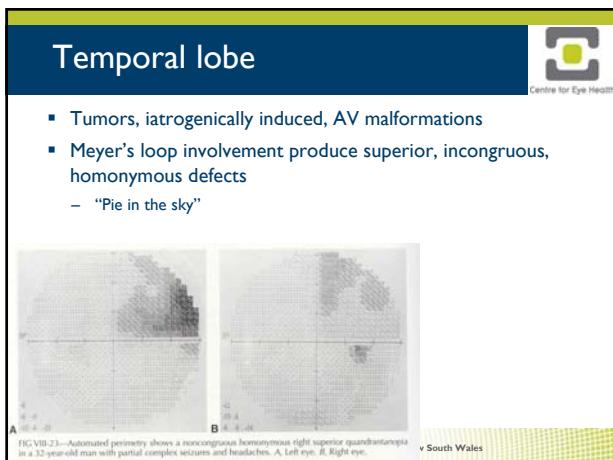
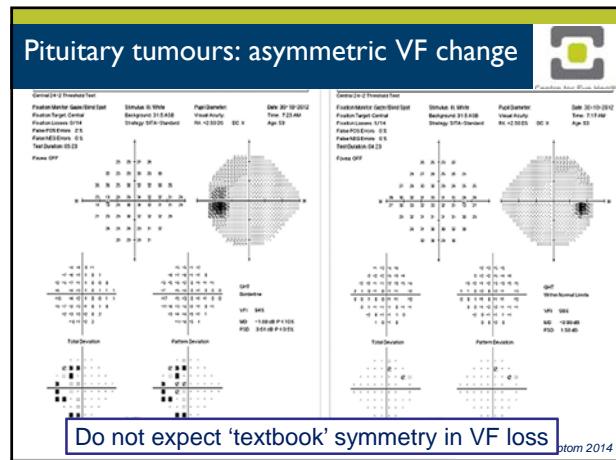
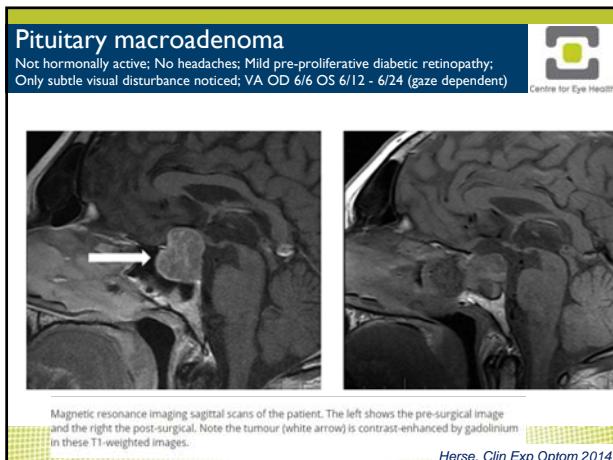
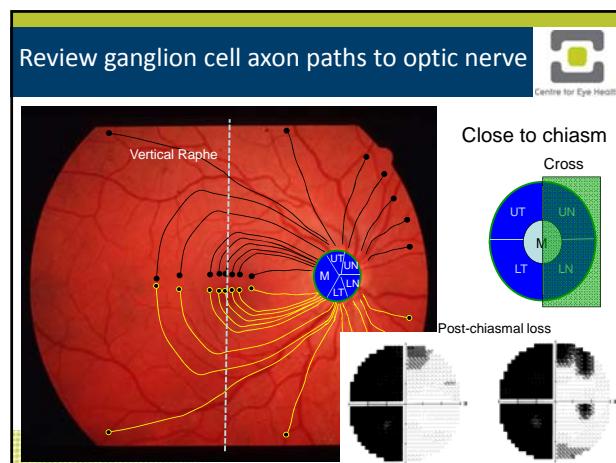
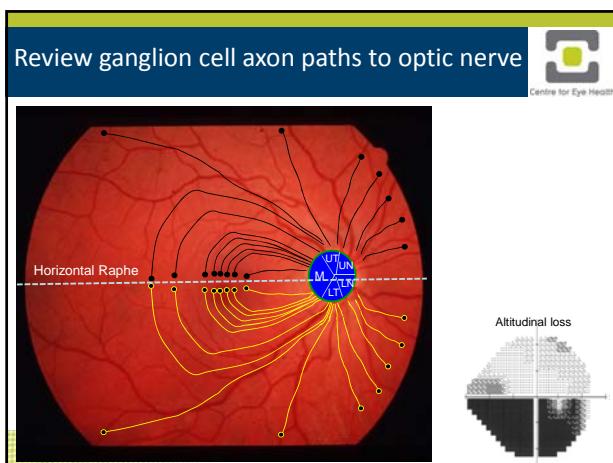
Click on the flashlight to examine pupillary response.

Return to the eye and retina release

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Review ganglion cell axon paths to optic nerve





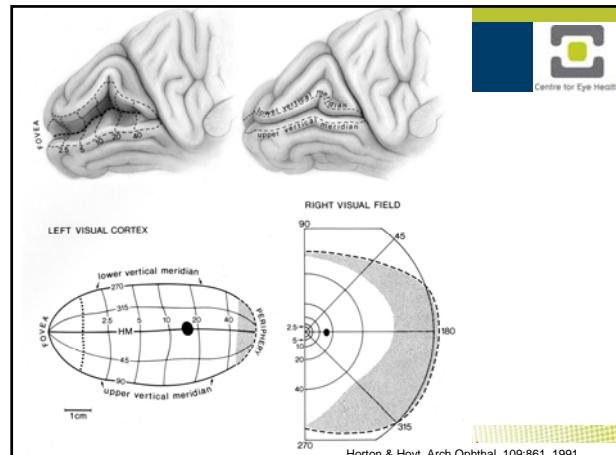
Parietal lobe

- Superior fibers involved first hence
 - "Pie on the floor"
- Usually vascular lesions
- Associated neuro-ophthalmic changes
 - Agnosias
 - Apraxia
 - Dominant hemisphere
 - Gerstmann syndrome: acalculia, agraphia, finger agnosia, and left-right confusion
 - OKN nystagmus inability to side of lesion (if damage near visual radiations)
 - Conjugate movements of the eyes to the side opposite the lesion on forced lid closure
 - Inattention (nondominant parietal lobe lesions)

OS OD

<http://www.ukoptometry.co.uk>

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Scotoma

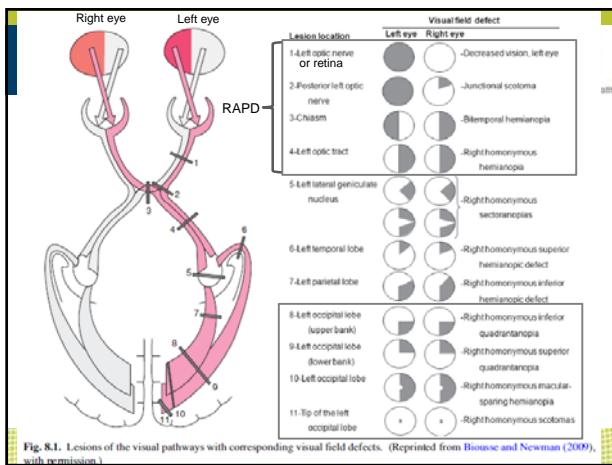
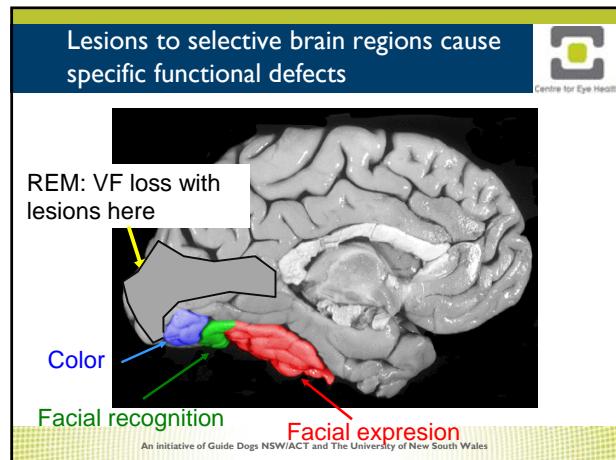
Quadrantanopia

Hemianopia

REM: VF would be **bilateral** except temporal crescent

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Key Points #1

Key questions to ask yourself

- Does the retinal and optic nerve look normal?
- Is there a RAPD?
- Is vision anomaly monocular or binocular?
- Are there other associated signs/symptoms?
- Is the vertical or horizontal midline in visual fields followed?
- Does the patient display anomalies consistent with higher visual areas?
- Are flashing lights achromatic or chromatic?

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Applying these principles in clinical practice

Clinical challenges

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Poll #1 - Patient #13: 77 yo male with a history of stroke (15 yrs ago). Visual field stable over a ~13 yr period (left partial quadrantanopia)

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Poll #1: Which of the following is **most correct** relating to the superior quadratic visual field loss?

- a. **The visual field loss is largely congruous**
- b. The lesion is most likely on the left side of cerebral cortex (expect right sided lesion)
- c. The lesion is most likely at the chiasm (not bi temporal)
- d. A left RAPD will likely be present (not a complete cut and thus congruous nature of quadrantanopia suggests post LGN)

Poll #1: A 77 yo male with a history of stroke (15 yrs ago). Visual field stable over a ~13 yr period (left partial quadrantanopia)



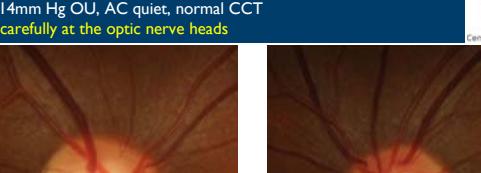
Poll #2: 33 yo female; family history of glaucoma:
IOPs 14mm Hg OU, AC quiet, normal CCT
Look carefully at the optic nerve heads



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Poll #2: 33 yo female; family history of glaucoma: IOPs 14mm Hg OU, AC quiet, normal CCT

Central 30-2 Threshold Test

Central Monitor: Gotoe (Brd Spot)
Stimulus: III. White
Background: 11.8 AUB
Pupil Diameter: 4.61 + 0.00 DC X
Fixation Losses: 1/24
False POS Errors: 1/14
False Neg Errors: 1/14
Test Duration: 14.15
Fixates: 37 dB

Central 30-2 Threshold Test

Central Monitor: Gotoe (Brd Spot)
Stimulus: III. White
Background: 21.3 AUB
Pupil Diameter: Visual Acuity: 6.61 + 0.00 DC X
Fixation Target: 1/23
Fixation Losses: 1/23
False POS Errors: 0/14
False Neg Errors: 0/14
Test Duration: 12.26
Fixates: 35 dB

Perimetry Results

Left Eye (a):

- Visual Acuity: 6.61 + 0.00 DC X
- MD: -0.20 dB
- SD: 2.48 dB
- Pattern Deviation:

 - 14.45%
 - 8.72%
 - 5.11%
 - 2.55%

Right Eye (b):

- Visual Acuity: 6.61 + 0.00 DC X
- MD: -0.20 dB
- SD: 2.48 dB
- Pattern Deviation:

 - 14.45%
 - 8.72%
 - 5.11%
 - 2.55%

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Applying these principles in clinical practice

Optic atrophy

Optic atrophy (OA)



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- Optic atrophy
 - Morphologic description of the endpoint of any disease that causes RGC axon degeneration
 - Neuroretinal rim atrophy or pale appearance of ONH
- Categories
 - 1. Primary OA
 - 2. Secondary OA
 - 3. Consecutive OA
 - 4. Glaucoma
 - 5. Retrograde degeneration OA

I. Primary Optic atrophy (OA)

- Primary optic atrophy: occurs without ONH swelling preceding the atrophy
 - Compressive
 - Retro-bulbar neuritis (optic neuritis)
 - Hereditary optic neuropathy
 - Toxic & nutritional neuropathies
 - ONH drusen
 - Trauma

From: Visual Field Profile of Optic Neuritis: A Final Follow-up Report From the Optic Neuritis Treatment Trial From Baseline Through 15 Years
 Arch Ophthalmol. 2010;128(3):330-337.

The JAMA Network

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Visual field loss in fellow (unaffected) eye

| Years | Visual field anomalies in 'unaffected' fellow eye (%) |
|-------|-------------------------------------------------------|
| 0 | 75 |
| 1 | 35 |
| 5 | 38 |
| 10 | 33 |
| 15 | 33 |

. Therefore, these findings appear to show that optic neuritis is not typically a unilateral disease.

2. Secondary Optic Atrophy (OA)

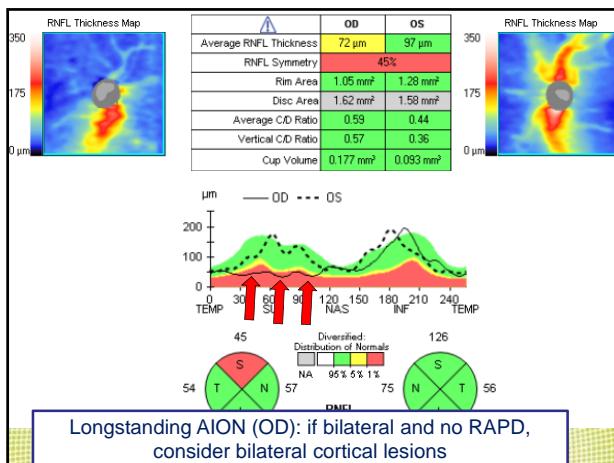


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- Secondary optic atrophy: occurs secondary to long-standing swelling of the ONH
 - Chronic papilloedema
 - Anterior ischaemic optic neuropathy (AION)
 - Papillitis (most common form of optic neuritis in children but also present in adults)
 - No ONH fundus autofluorescence (**exclude ONH drusen**)
 - Critical to differentiate this from other causes of ONH crowding
 - See Chiang et al *Clin Exp Optom* 2015

71 yo male with long-standing VF loss in OD (noticed after cardiac surgery 35 yrs ago). VA 6/12 OD, 6/75 OS.
RAPD OD



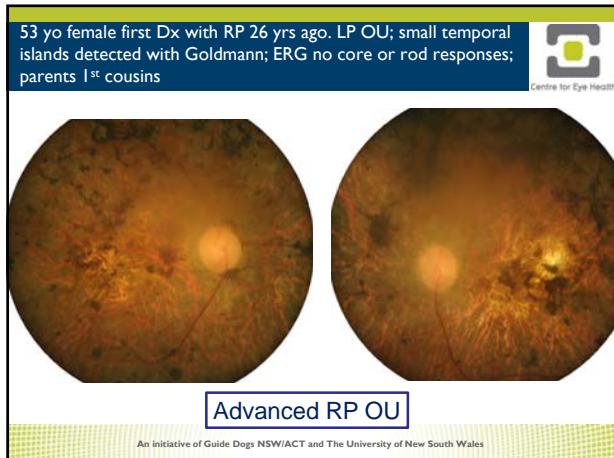


3. Consecutive Optic Atrophy (OA)

- Consecutive optic atrophy: occurs due to diseases of the inner retina or retinal blood supply
 - Retinitis pigmentosa (rod-cone) or cone-rod dystrophies
 - Vasculitis
 - Retinal necrosis/neuroretinitis
 - Excessive photocoagulation
 - Vascular (arterial or venous occlusive disease)



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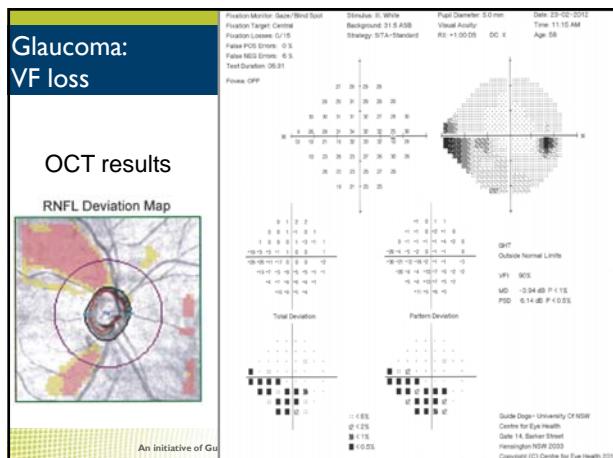
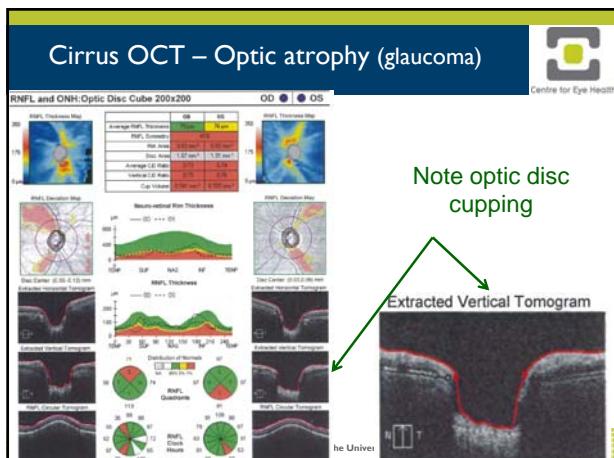
Glucoma

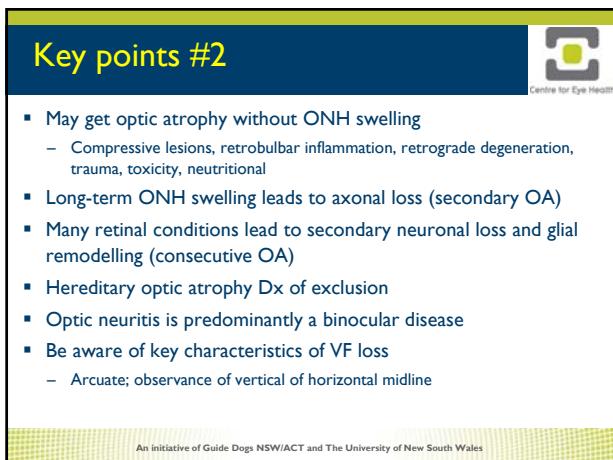
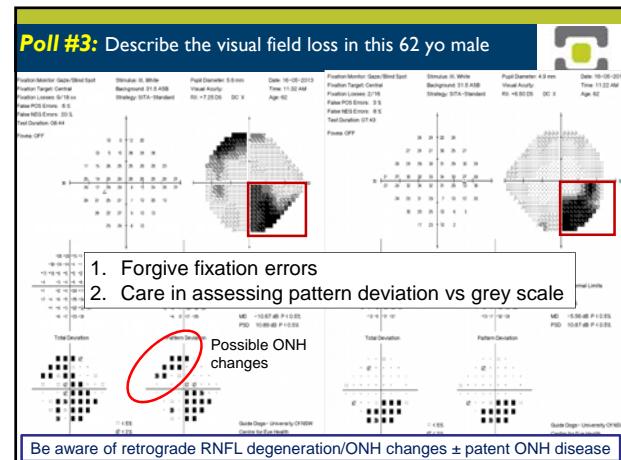
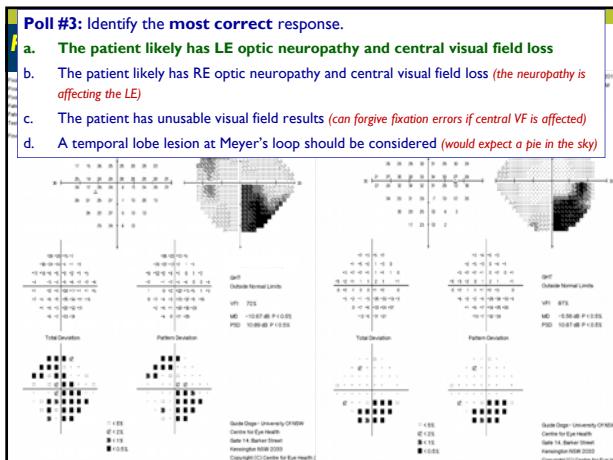
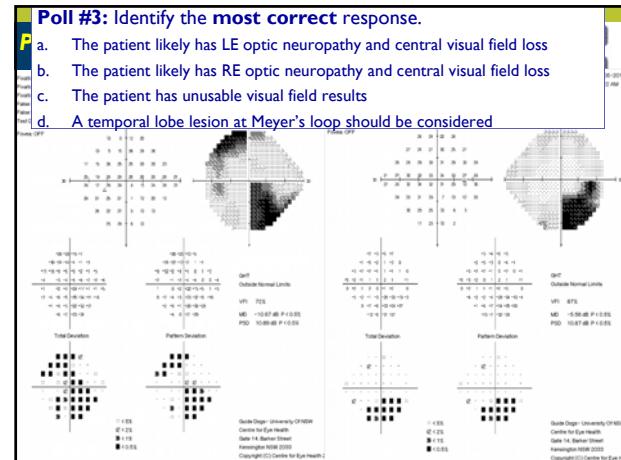
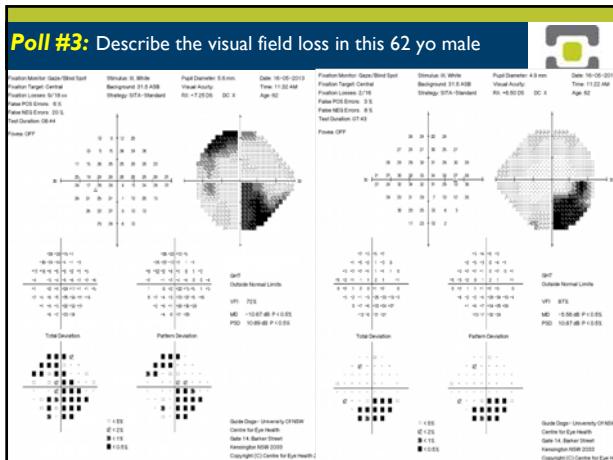


- Most common optic nerve disease?
- An optic neuropathy
 - chronic destruction of ganglion cells
 - characteristic atrophy (cupping)
- Functional loss
 - Typical “distinctive” visual field defects involving the nerve fiber bundles



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5. Post-chiasmal lesions
(may include retrograde degeneration ON/RNFL)

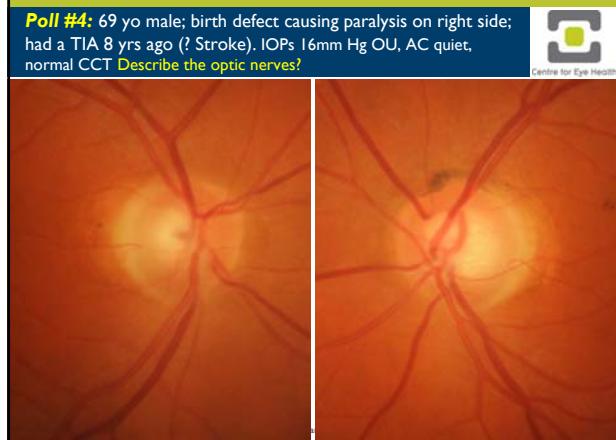
▪ Retinal nerve fiber layer loss and associated ONH changed due to RGC loss due to post-LGN lesions (temporal/parietal/cortical)

▪ **Retrograde (trans-synaptic) degeneration: relatively new concept**

- The visualisation of retrograde trans-synaptic degeneration secondary to **stroke** depends upon:
 - Time post insult
 - Brain location
 - Size of insult & size of GCA imaging
- Retrograde degeneration secondary to **Multiple Sclerosis (MS)** lesions post-LGN

Jindahra et al 2012; Park et al 2013
Klistorner et al 2014; Huang-Link et al 2014

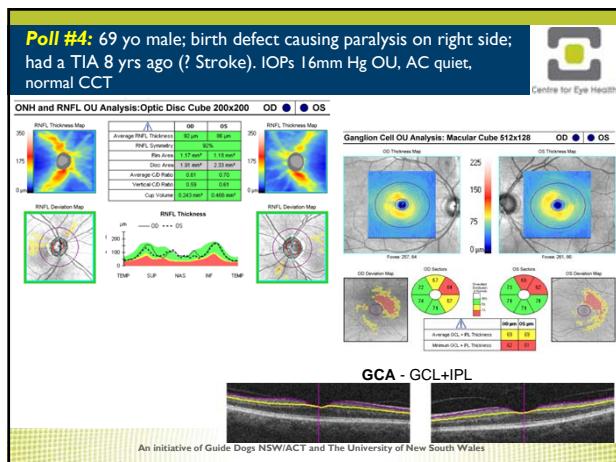
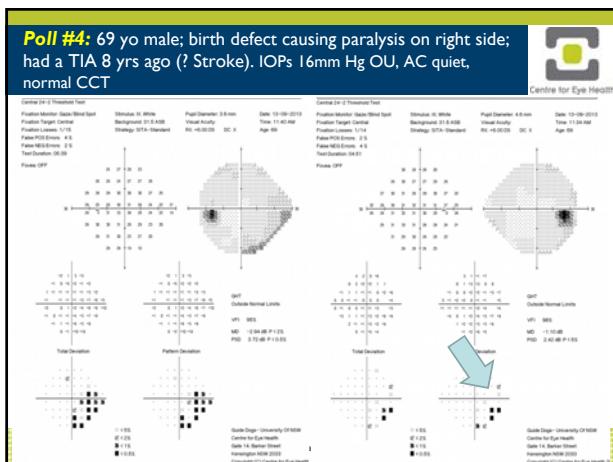
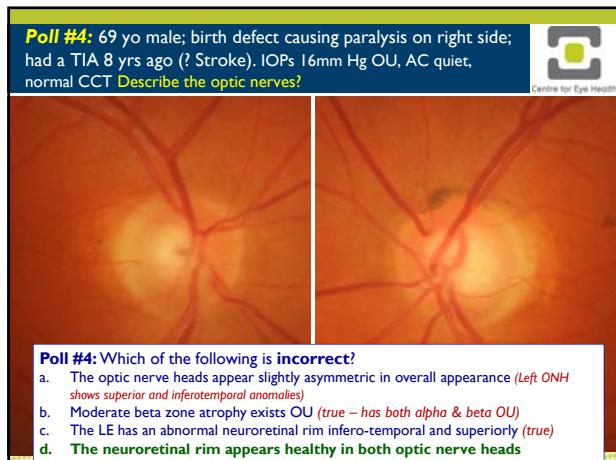
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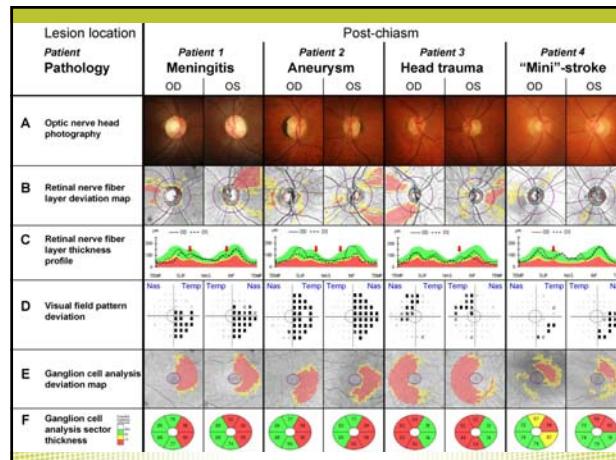
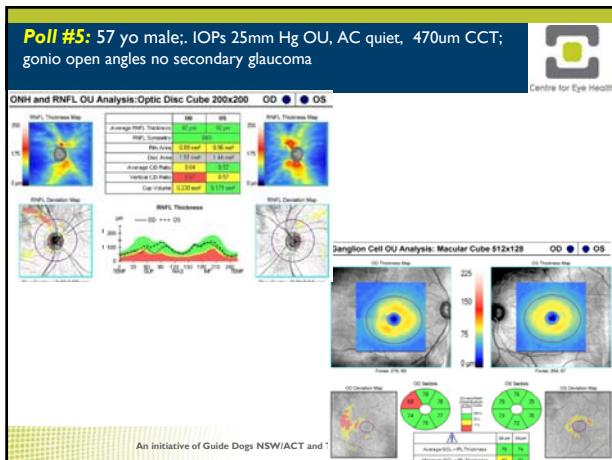
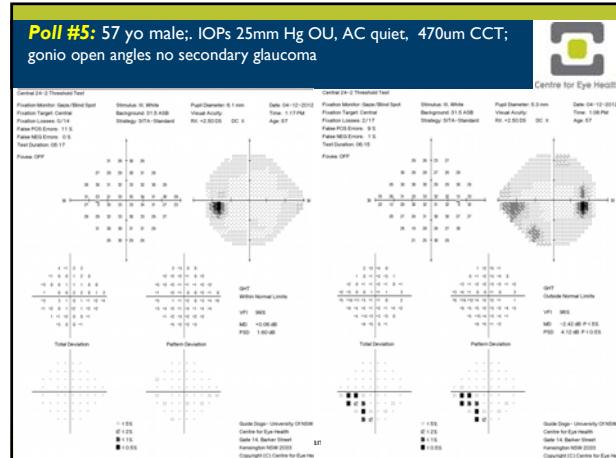
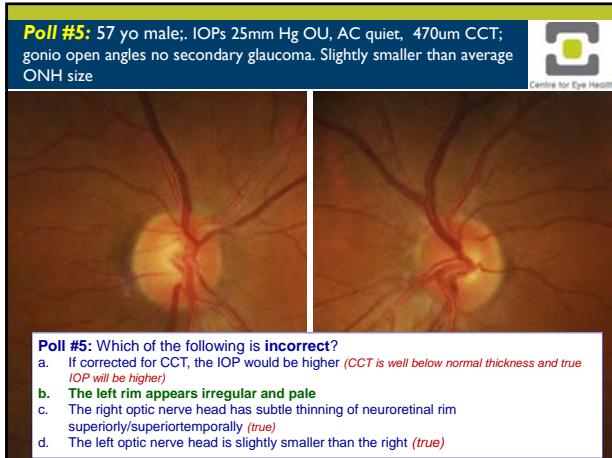
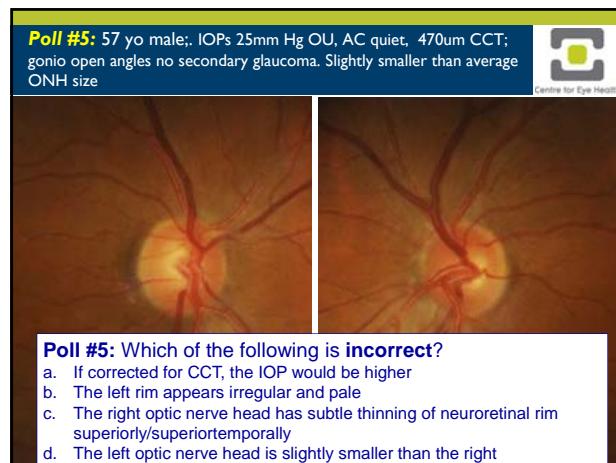


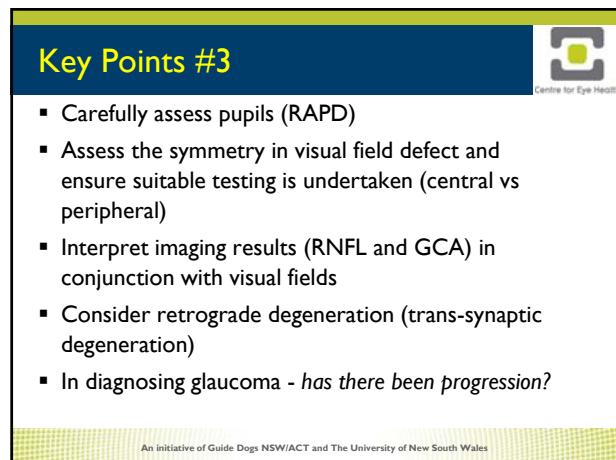
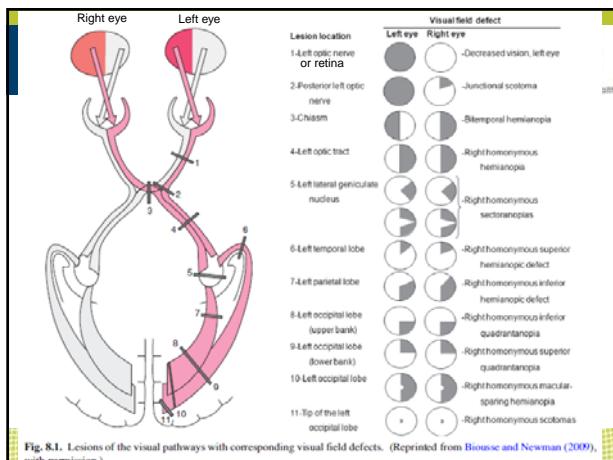
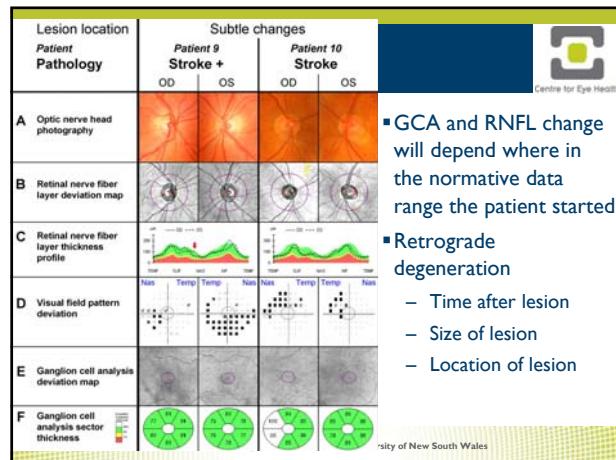
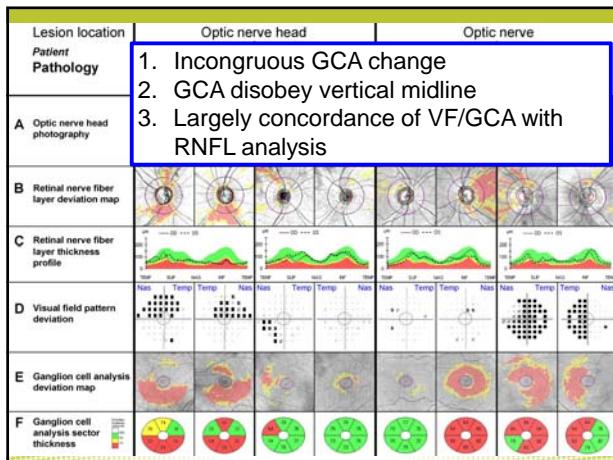
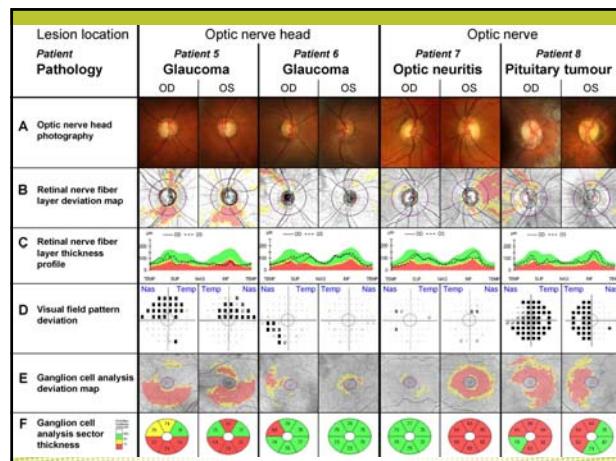
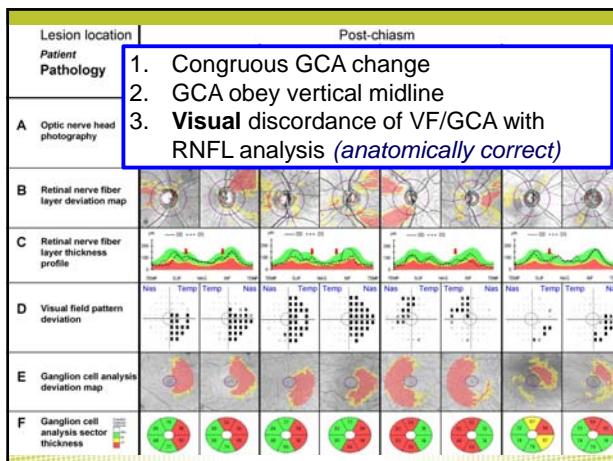
Poll #4: 69 yo male; birth defect causing paralysis on right side; had a TIA 8 yrs ago (? Stroke). IOPs 16mm Hg OU, AC quiet, normal CCT Describe the optic nerves?

Poll #4: Which of the following is incorrect?

- The optic nerve heads appear slightly asymmetric in overall appearance
- Moderate beta zone atrophy exists OU
- The LE has an abnormal neuroretinal rim infero-temporal and superiorly
- The neuroretinal rim appears healthy in both optic nerve heads





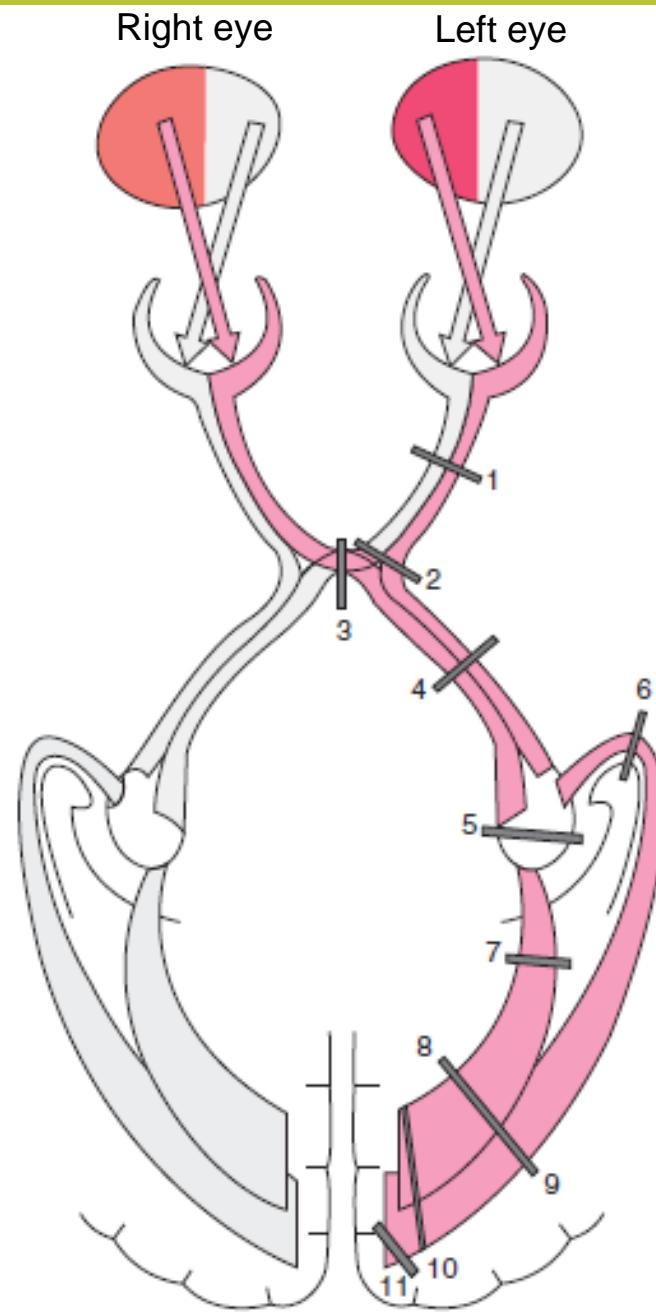




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Thank you for your attention
End of lecture





| Lesion location | Visual field defect | | |
|------------------------------------|---------------------|-----------|---------------------------------------------|
| | Left eye | Right eye | |
| 1-Left optic nerve or retina | | | -Decreased vision, left eye |
| 2-Posterior left optic nerve | | | -Junctional scotoma |
| 3-Chiasm | | | -Bitemporal hemianopia |
| 4-Left optic tract | | | -Righthomonymous hemianopia |
| 5-Left lateral geniculate nucleus | | | -Righthomonymous sectoranopias |
| | | | |
| 6-Left temporal lobe | | | -Righthomonymous superior hemianopic defect |
| 7-Left parietal lobe | | | -Righthomonymous inferior hemianopic defect |
| 8-Left occipital lobe (upper bank) | | | -Righthomonymous inferior quadrantanopia |
| 9-Left occipital lobe (lower bank) | | | -Righthomonymous superior quadrantanopia |
| 10-Left occipital lobe | | | -Righthomonymous macular-sparing hemianopia |
| 11-Tip of the left occipital lobe | | | -Righthomonymous scotomas |

Fig. 8.1. Lesions of the visual pathways with corresponding visual field defects. (Reprinted from Biousse and Newman (2009), with permission.)