



## **5<sup>th</sup> Congress of the European Academy of Neurology**

**Oslo, Norway, June 29 - July 2, 2019**

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### **Hands-on Course 15**

**Bedside examination of the vestibular and ocular  
motor system (Level 2)**

**How to examine binocular control and  
pupillary function**

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# The Pupil Examination

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## Conflict of Interest



### In relation to this presentation and manuscript:

the Author has no conflict of interest in relation to this manuscript.

- Eye (Lond). 2013 Mar;27(3):291-8. doi: 10.1038/eye.2012.281. Epub 2013 Feb 1.
- **Adult Horner's syndrome: a combined clinical, pharmacological, and imaging algorithm.**
- Davagnanam I<sup>1</sup>, Fraser CL, Miszkiel K, Daniel CS, Plant GT.

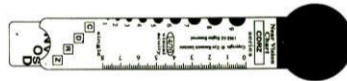
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- Pract Neurol. 2014 Jun;14(3):145-51. doi: 10.1136/practneurol-2013-000763. Epub 2014 Feb 11.
- **Eye drop neurology.**
- Bennetto L<sup>1</sup>, Guly C, Ormerod I, Plant GT.

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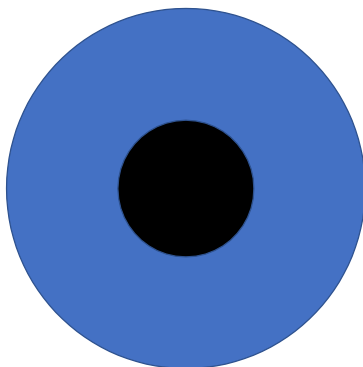
## What equipment do we need?

- Your own eyes – to observe
- A transparent ruler to measure **mm** differences
- A bright focussed light source
- A means to alter the ambient lighting
- An accommodative target to assess near response
- You may need some special drops

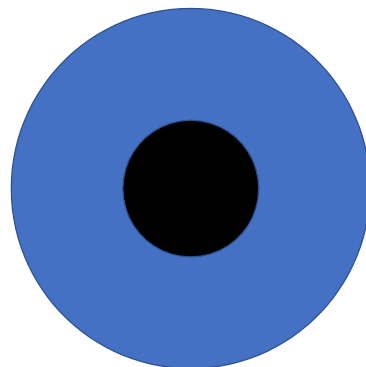


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## The Pupils!



LEFT



RIGHT

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## What do we need to ask?

- How was the abnormality noticed?
- How long has the abnormality been present? May need to consult historical images.
- Is the abnormality variable/paroxysmal?
- Has there been a prior ophthalmic disorder, headache or injury?
- Has there been a previous non-ophthalmic disorder or injury?
- Is the patient taking any medication?

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## What do we need to observe?

- Size
- Equal or unequal?
- Shape
- Ptosis?
- Reaction to light
- Reaction to near
- Response to topical drugs
- Iris colour

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Anisocoria: which is the abnormal pupil



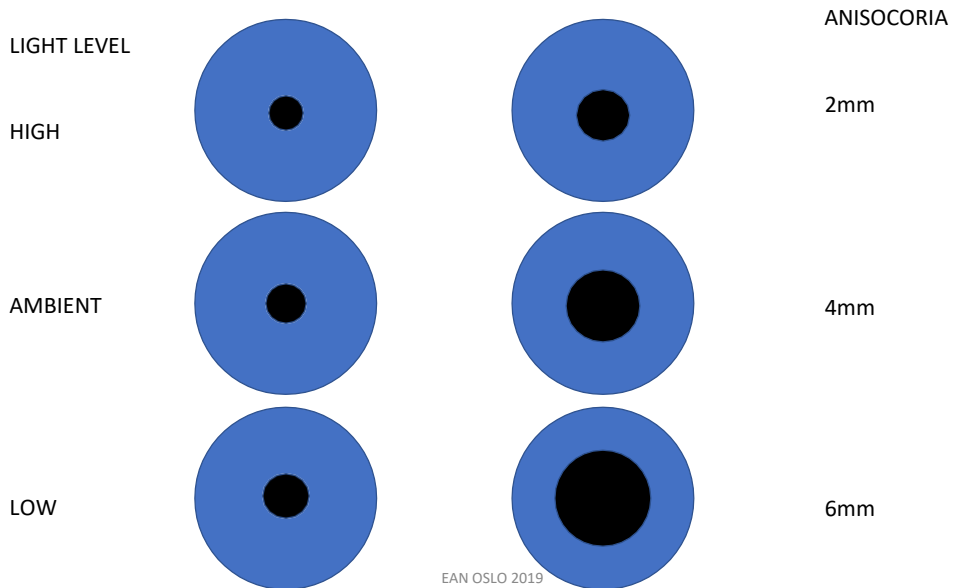
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What do we need to observe?

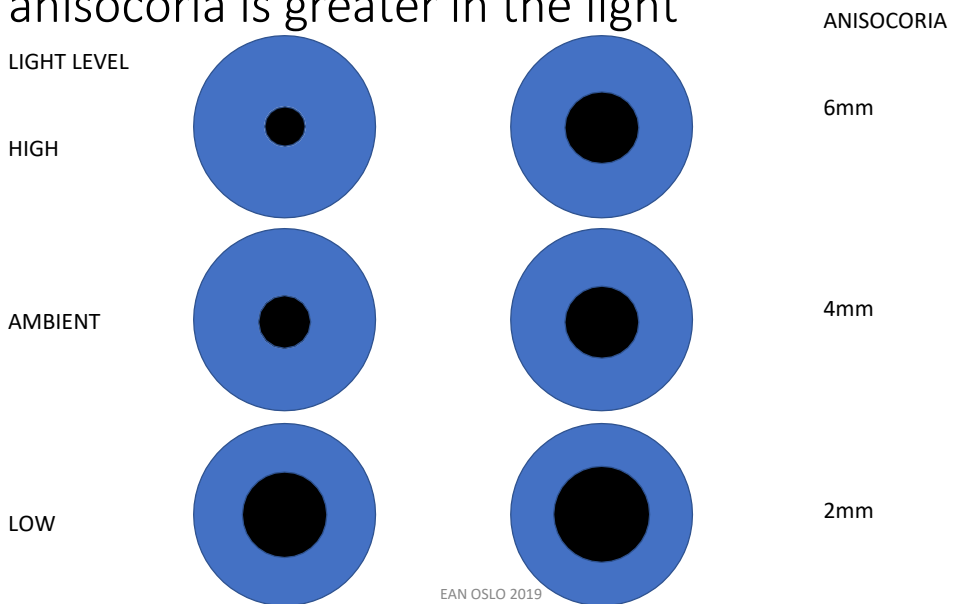
- Is the abnormality due to a sympathetic paresis on the right or parasympathetic paresis on the left?
- Is the anisocoria “physiological” (an asymmetry related to difference in sympathetic tone)

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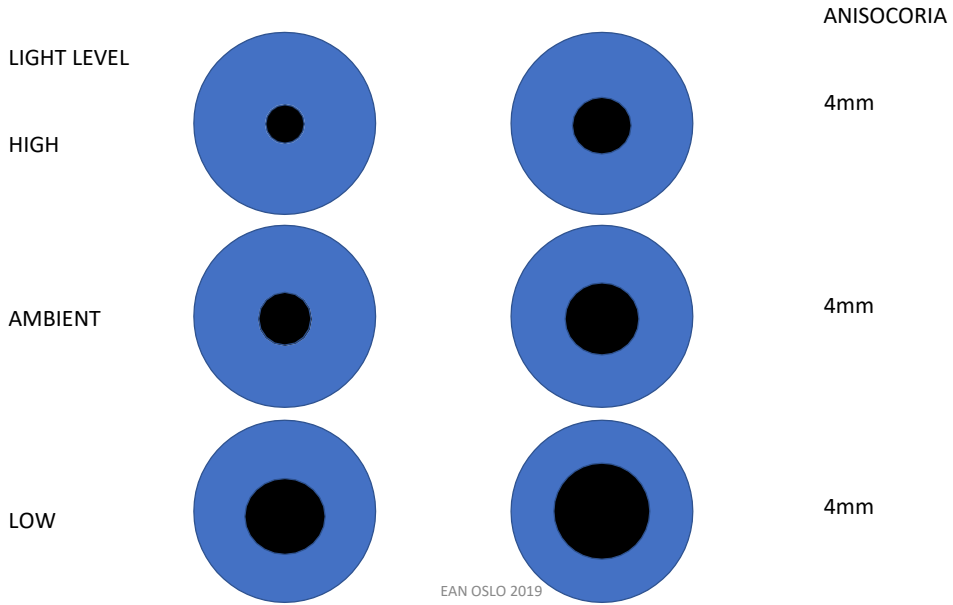
## Anisocoria: the Horner pupil does not dilate in the dark



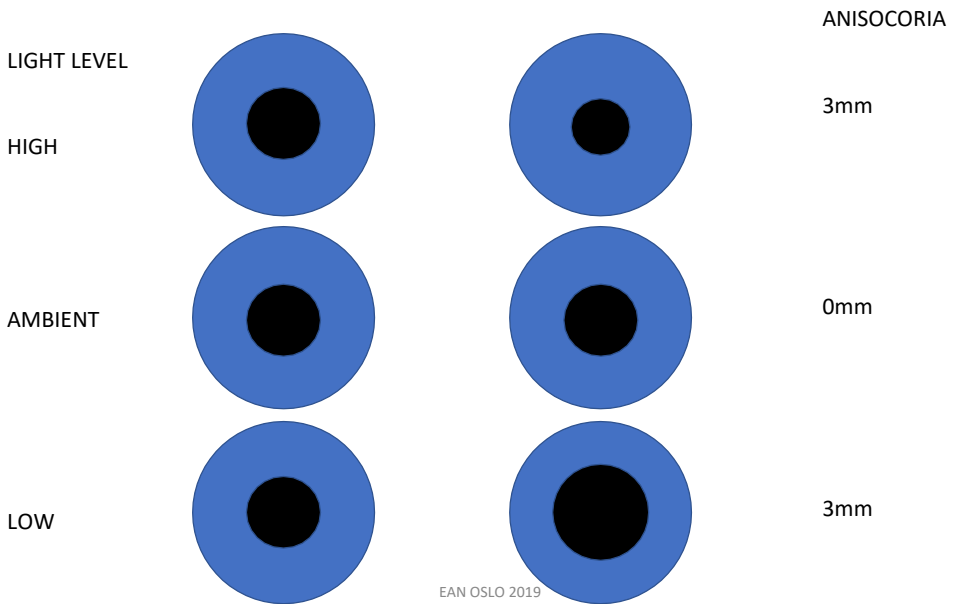
## Anisocoria: in parasympathetic dysfunction the anisocoria is greater in the light



### Physiological Anisocoria remains the same at all light levels



### What could this be?





## Assessment of parasympathetic dysfunction

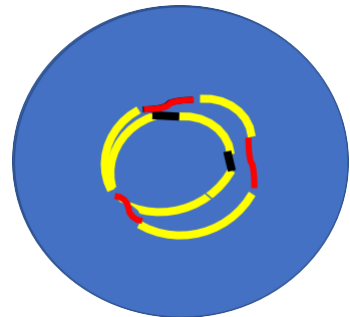
- Is there other evidence of an oculomotor nerve palsy?
- If so is there evidence of aberrant re-innervation?
- Is the pupil irregular
- Is there light-near dissociation?

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## Aberrant re-innervation in Adie pupil



- Sectors are now innervated by ciliary muscle fibres
- These respond to near in a tonic manner
- But do not respond to light

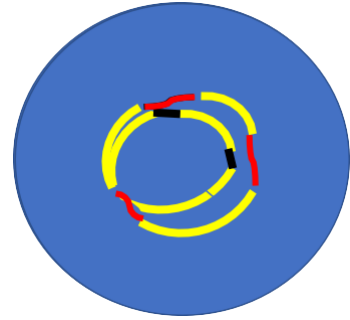
If hippus is set up the pupil changes shape as it oscillates, giving a rippling movement known as “vermiform movement” when viewed on the slit lamp



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## Abberant reinnervation of the pupil sphincter in Adie pupil

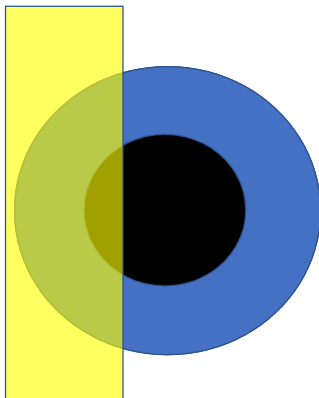
-  Sectors innervated by pupillomotor fibres respond to light and near
-  Sectors innervated by ciliary muscle fibres respond to near only



The result is that the pupil is **IRREGULAR**  
 Responds to near in a **TONIC** manner (slow redilatation)  
 Shows **VERMIFORM MOVEMENTS** when hippus is induced

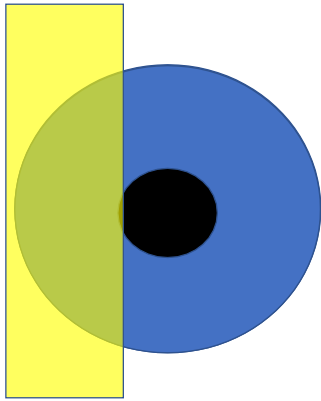
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To induce hippus use the slit lamp and place the beam at the edge of the pupil:

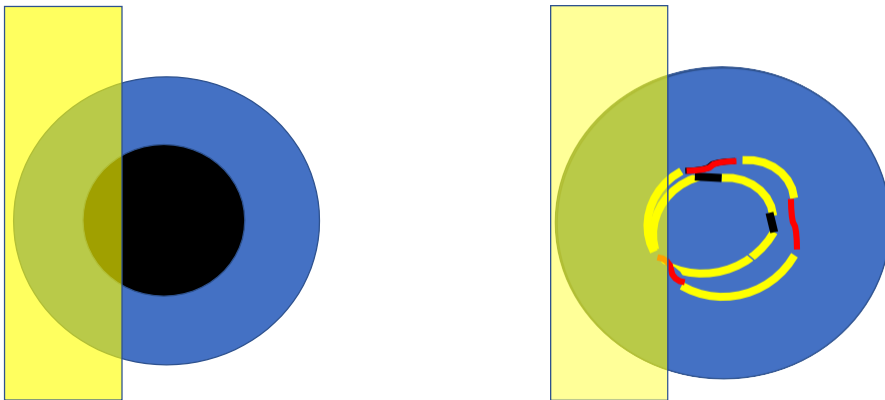


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As the pupil constricts it cuts out the light and the pupil dilates again

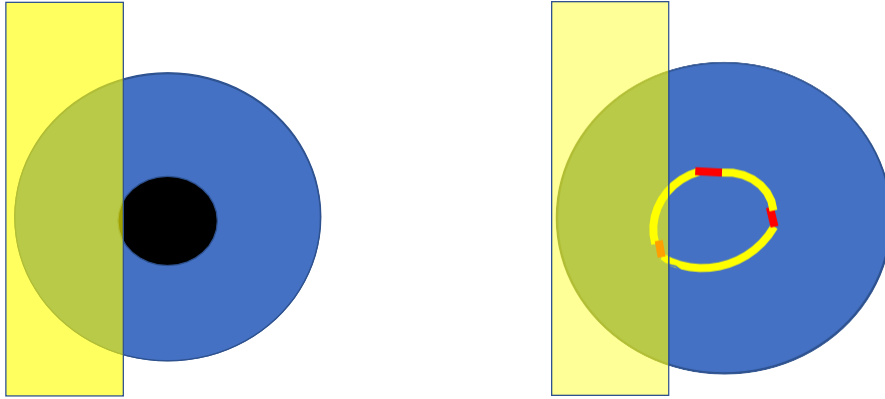


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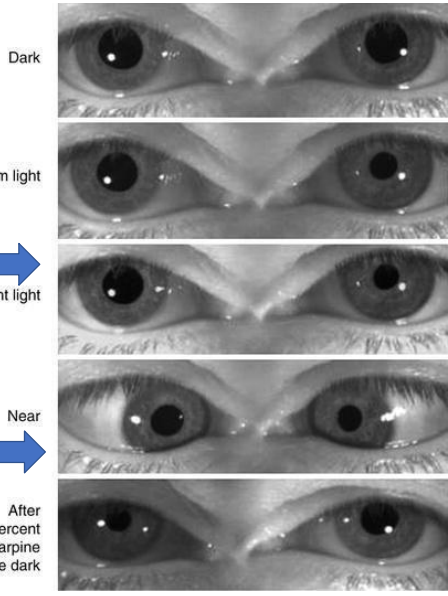
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The normal pupil remains a circle  
The Adie pupil changes shape



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### Adie pupil



Anisocoria greater in the light



You will see reversal of anisocoria as pupils relax



Supersensitivity to dilute pilocarpine

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## Other things to look for in Adie syndrome:

- If acute there will be paralysis of accommodation, this always recovers
- In older patients the pupil can be small “little old Adie’s”
- Areflexia (Holmes-Adie syndrome)
- Areflexia and sudomotor denervation (Ross syndrome)
- Beware the pupil which does not dilate normally if there is also adrenergic dysfunction this indicates an autonomic neuropathy
- If severe, bilateral and symmetrical, also indicates a generalised disorder e.g. Sjogren

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What is this likely to be due to and how would you confirm the diagnosis?



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Atropine dilatation, may be deliberate or accidental. No response to 1% pilocarpine



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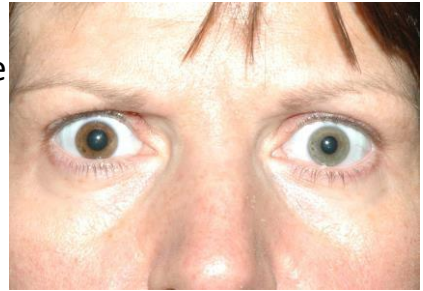
This pupil also will not respond to light:  
diagnosis?



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## Other things to look for in Horner syndrome:

- Ptosis (paresis of Müller's muscle – a few mm only of ptosis)
- “Upside down” ptosis (paresis of sympathetic fibres in lower lid)
- These together give the *appearance* of enophthalmos
- Loss of sudomotor innervation Loss of vasomotor innervation (Harlequin syndrome)
- Heterochromia in congenital Horner syndrome



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## Cocaine and apraclonidine testing

Horner syndrome



Failure to dilate with cocaine



Reversal of anisocoria and ptosis with apraclonidine



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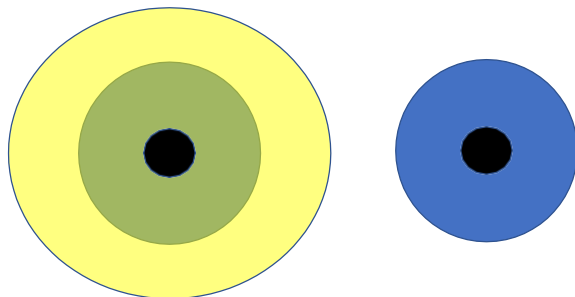


## Afferent pupil function



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## Normal direct and consensual response



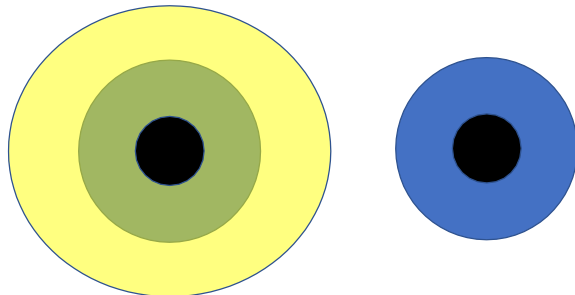
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## Afferent pupil function



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## A blind eye: amaurotic pupil response



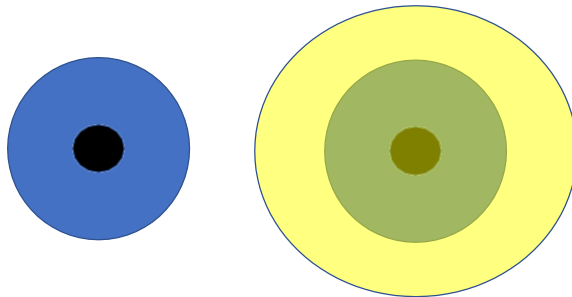
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A blind eye – normal eye response



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Response to the normal eye



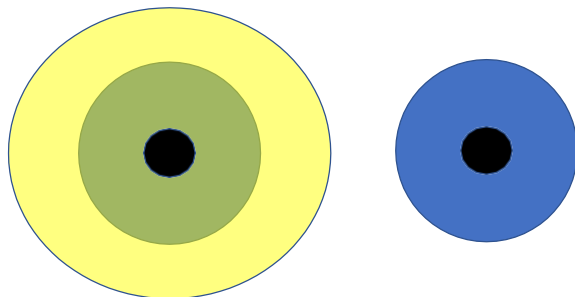
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A partial optic nerve deficit



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Normal eye response



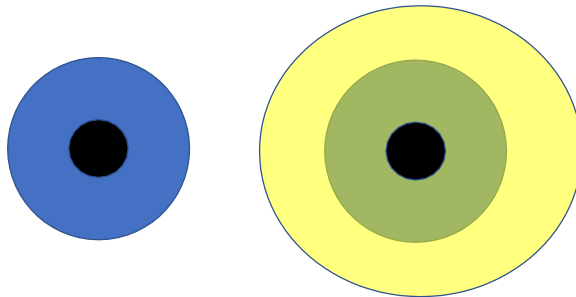
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A partial optic nerve deficit



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Response to the affected eye



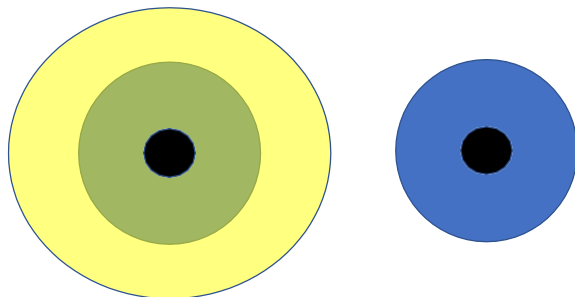
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A partial optic nerve deficit – swinging  
flashlight test



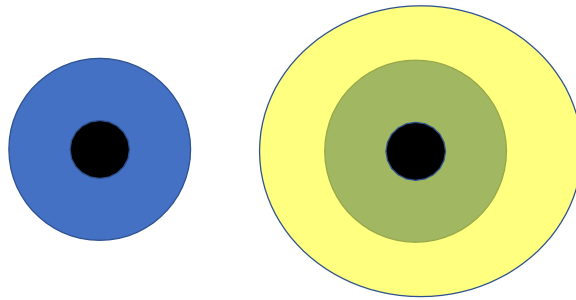
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Normal eye response



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Response to the affected eye



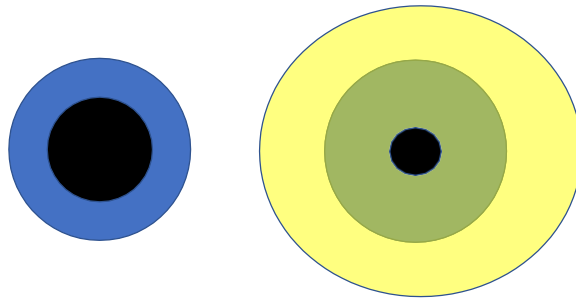
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I have an oculomotor palsy/Adie/atropine pupil on the right: what do you do?



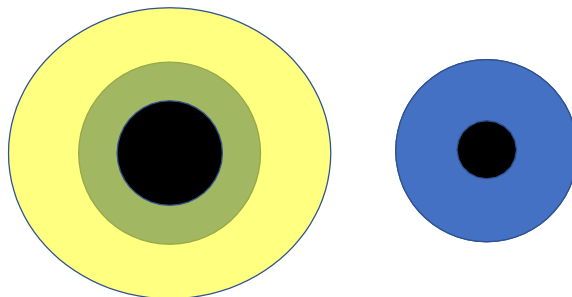
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You need only one functioning pupil to check for an RAPD



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There is a right RAPD  
this could be an orbital apex lesion



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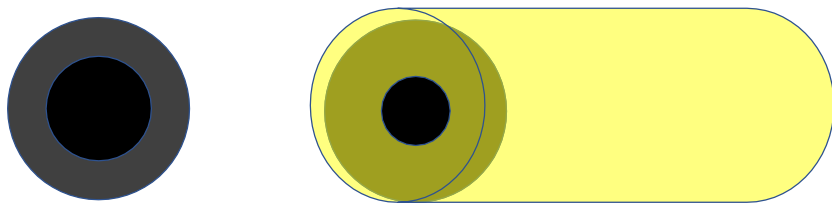


I have an oculomotor palsy/Adie/atropine pupil on the right: and a dark iris?  
what do you do?



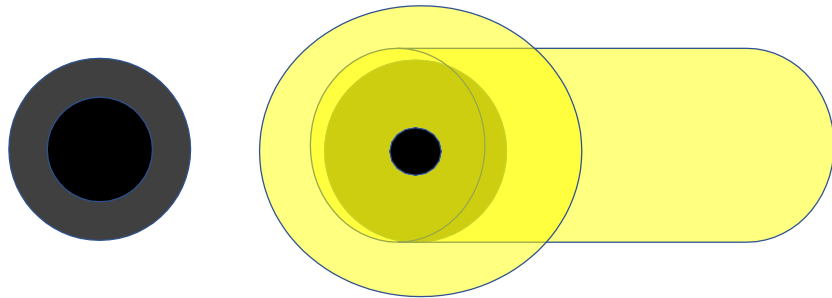
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With your third hand direct another light source *obliquely* across the functioning pupil



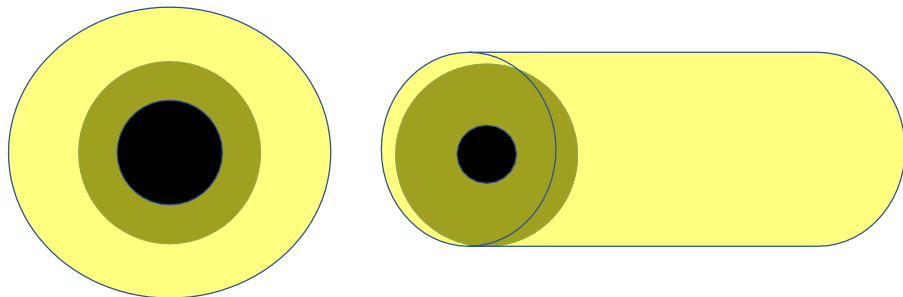
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Now you perform the swinging flashlight test



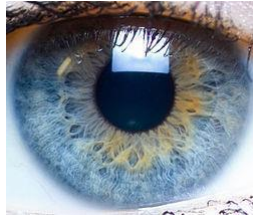
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It is easier to see the pupil when not directly illuminated



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# There are many more interesting pupils than ours



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## True polycoria or pseudo-polycoria?

Niaz Islam,<sup>1</sup> Jodhbir S. Mehta<sup>1</sup> and Gordon T. Plant<sup>1,2</sup>

<sup>1</sup>Moorfields Eye Hospital, London, UK  
<sup>2</sup>National Hospital for Neurology and Neurosurgery, London, UK

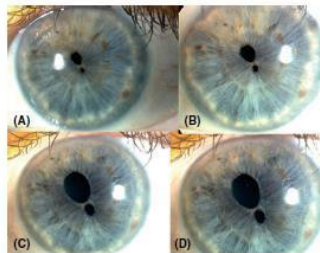


Fig. 1. The patient's left eye in (A) light and (B) dim light. (C, D) The pupillary margins are no longer puckered up following dilation with guttae tropicamide 1% and phenylephrine 2.5%.

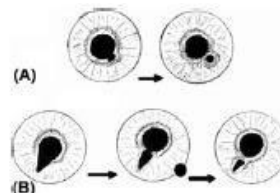
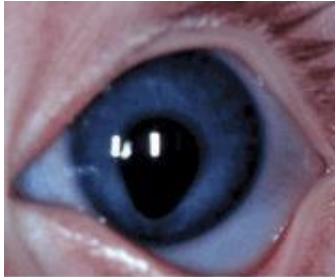


Fig. 2. Possible formation of two pupils by (A) snaring off a portion of the pupillary margin, or (B) secondary closure of a coloboma.

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## Congenital Disorders: Coloboma



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## Anisocoria

Seen with red reflex

“red eye”

Recommend

FAT-fMRI scan



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# Family Album Tomography

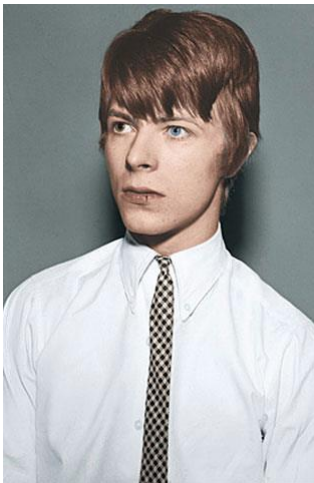
1947

1953



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# 1962 (Beware Lateral Inversion)



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Lord Horatio Nelson Age 42  
(injury occurred battle of Calvi Age 36)



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Battle of Copenhagen



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## Another family album diagnosis



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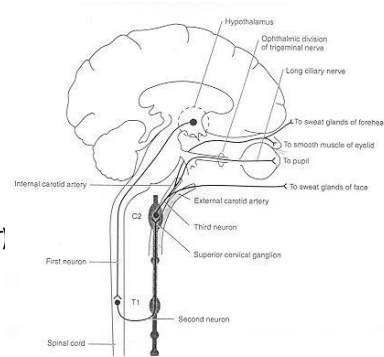
## Heterochromia = longstanding



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## Horner Syndrome – 1st IInd or IIIrd order neurone?

- History
  - Trauma
  - Surgery
- Associated symptoms/signs
  - Pain
  - Sweating
  - Vasomotor (Harlequin syndrome)
  - Lateral rectus/Hypoglossal palsy
  - T1 radiculopathy (pain/sensory/motor)
  - Evidence of vasculopathy
- Cocaine
- Apraclonidine
- Hydroxyamphetamine

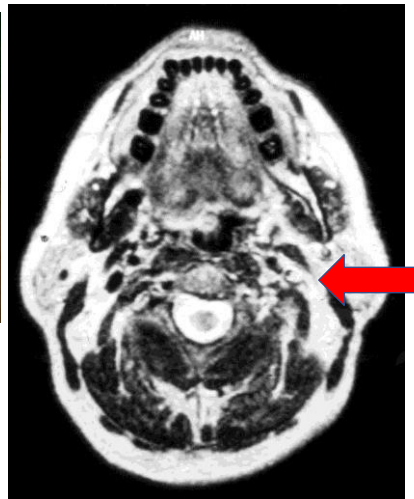


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Pain  
IIIrd order



Carotid dissection



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## Carotid Artery Dissection

- Medical emergency
- Risk of thromboembolism
- Commonest cause of stroke in younger people
- Management
  - Refer HASU
  - Later management uncertain

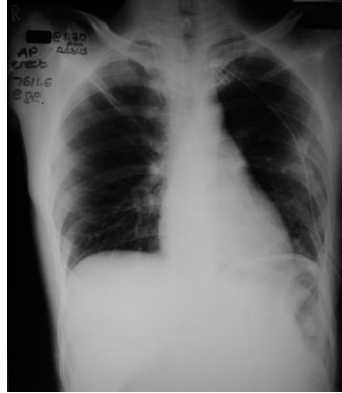
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## IIInd order



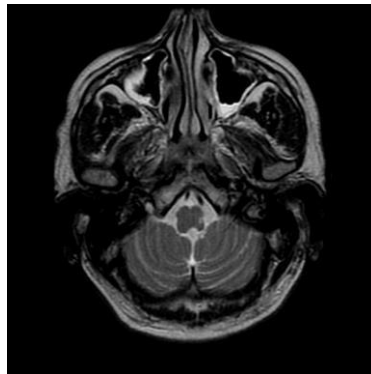
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## IIInd order



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## Ist order



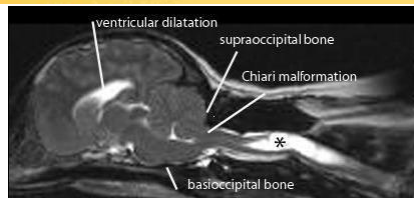
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Ist order



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Ist order



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