Pupil Abnormalities

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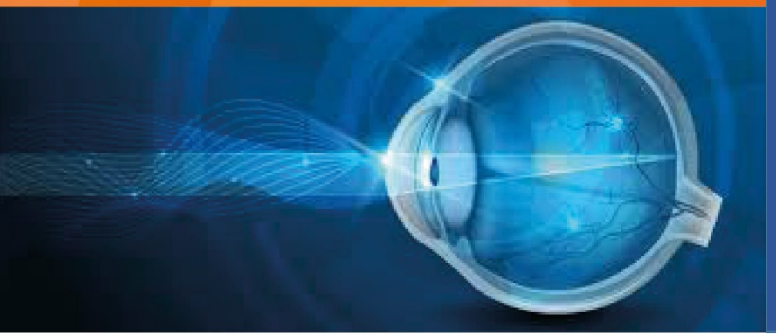

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Case Scenario Links

Pupil Abnormalities

- Pupil abnormality (Oph08)
- Diplopia (Oph06)
- Infant with strabismus (Oph09)
- Sudden loss of vision and headache (Oph05)
- Altered level of consciousness in an adult (N04)Subtitle

Pathway of the pupillary light reflex consists of:

- Retinal receptor cells
- Bipolar cells
- Ganglion cells
- Optic nerve and tract

Afferent visual pathway

- **Pretectal nucleus** in the midbrain
- **Edinger-Westphal** nucleus
- Two neurone pathway via the
- Oculomotor nerve
- Sphincter pupillae (constrictor muscle of iris)

Efferent visual pathway

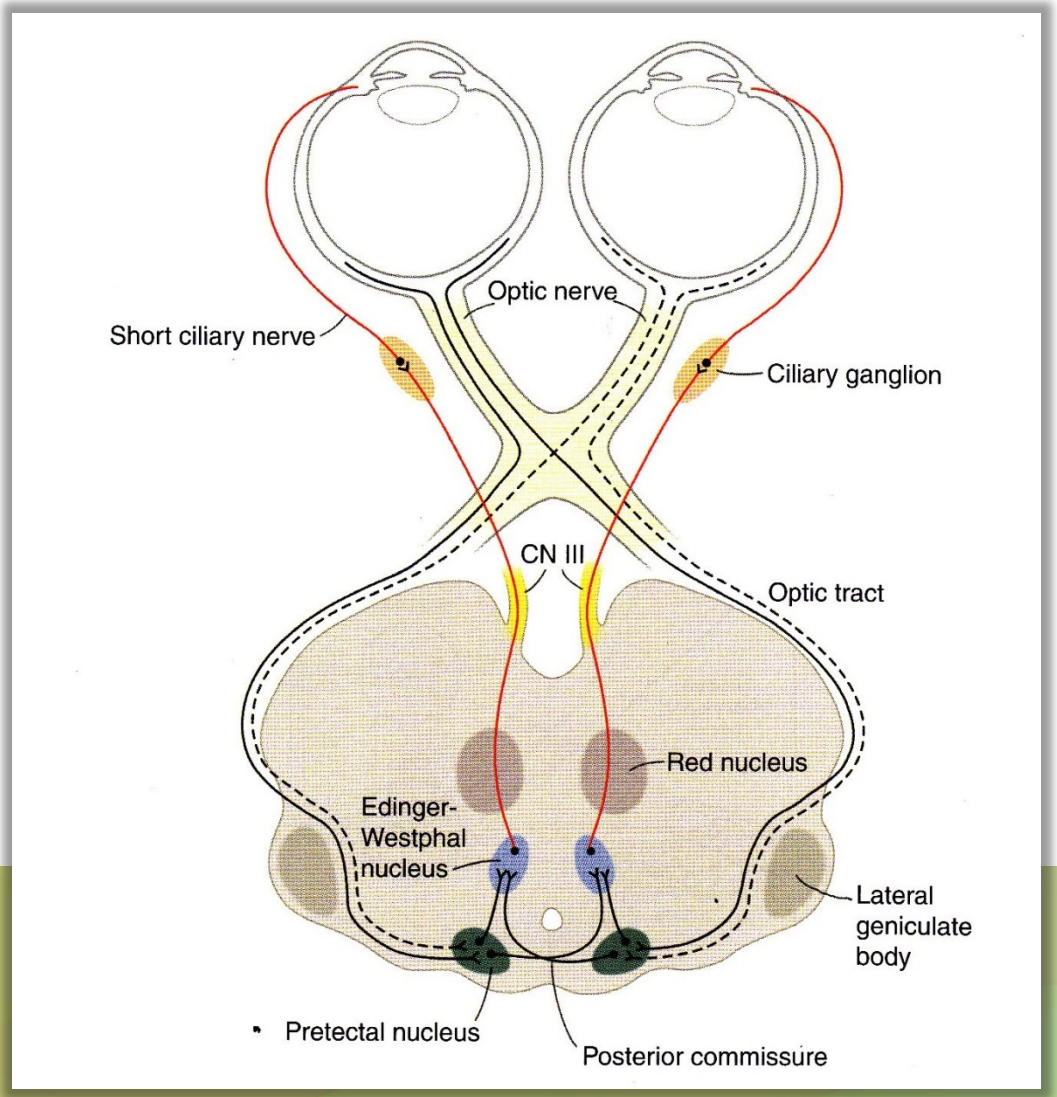
Anatomy of Pupil Reflexes

The size of the pupils depends on the balance of **parasympathetic** and **sympathetic** activity supplying the iris (efferent visual pathway):

- **parasympathetic** activity **constricts** the pupil
- **sympathetic** activity **dilates** the pupil

.

The Light Reflex



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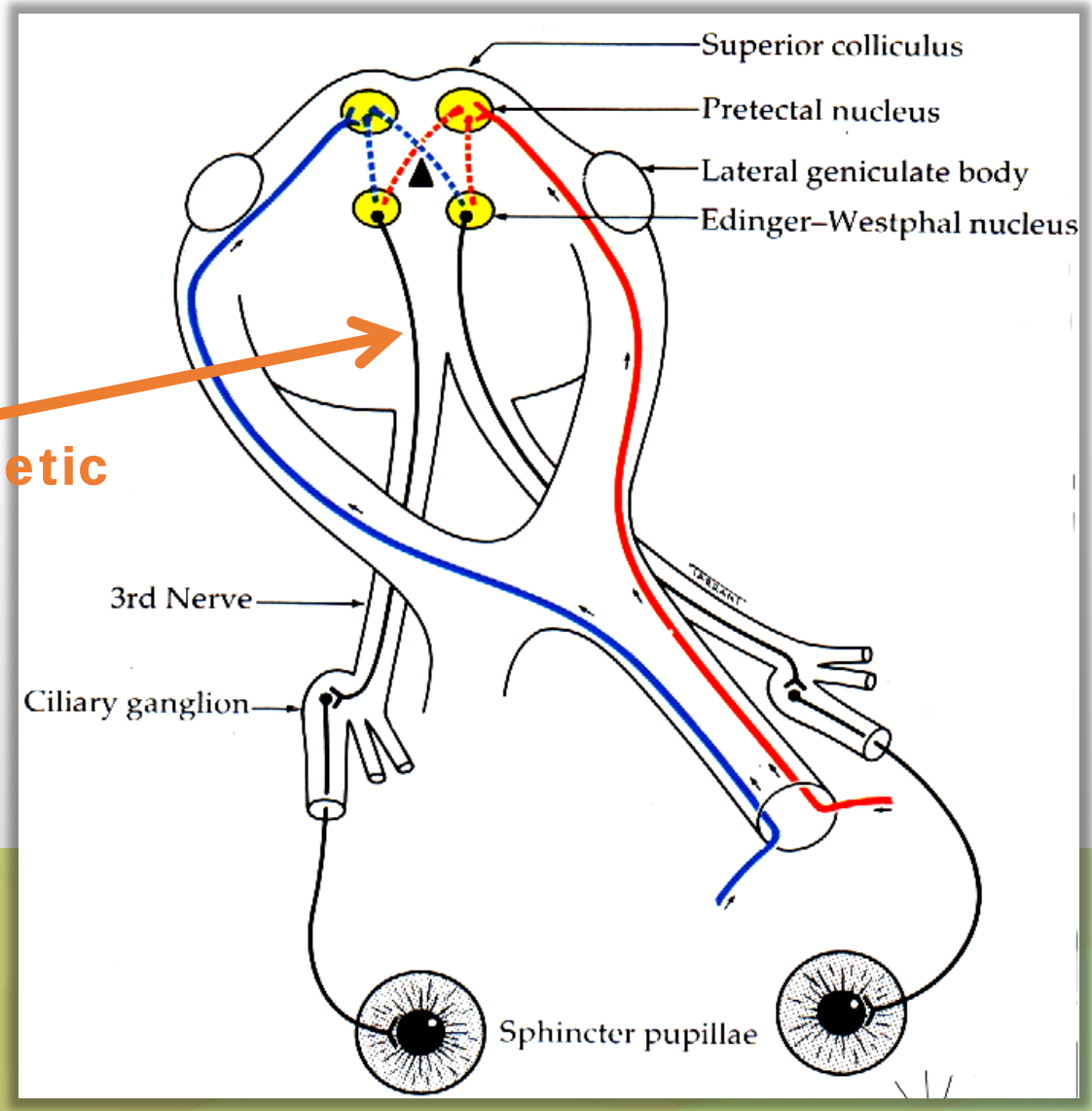
The Light Reflex



The parasympathetic pathway

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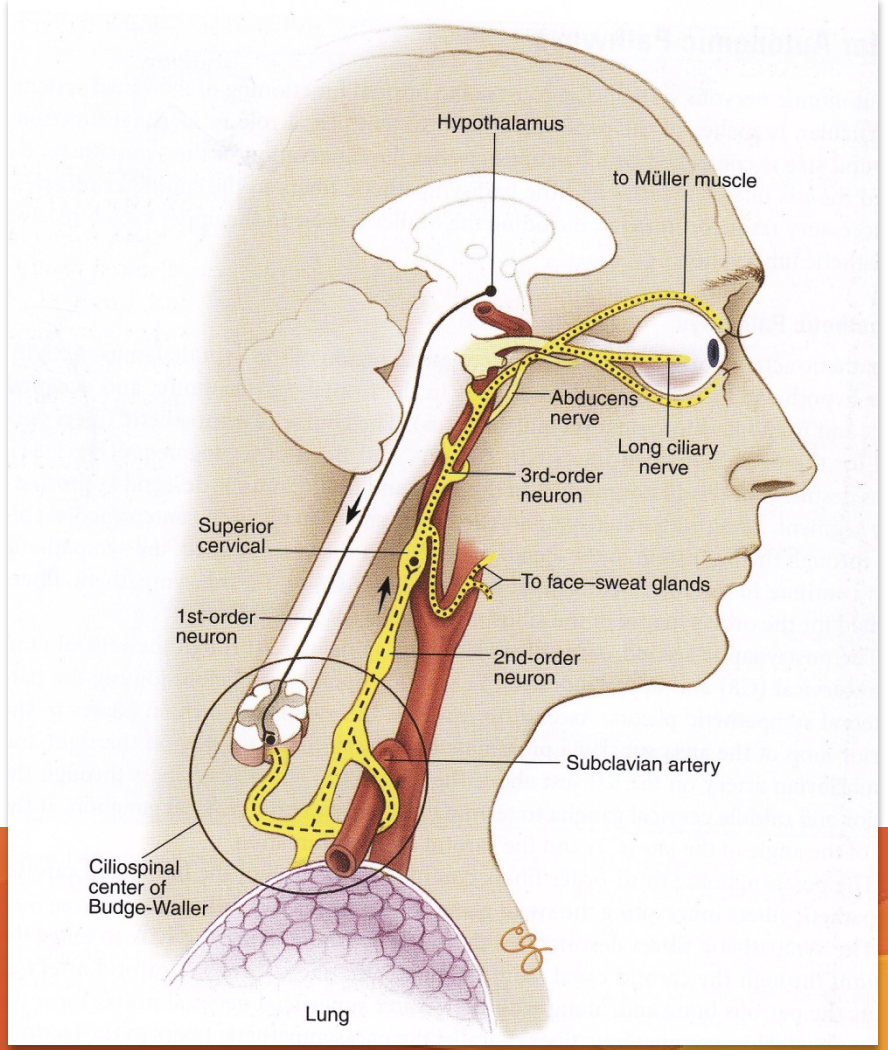
Sympathetic Pathway



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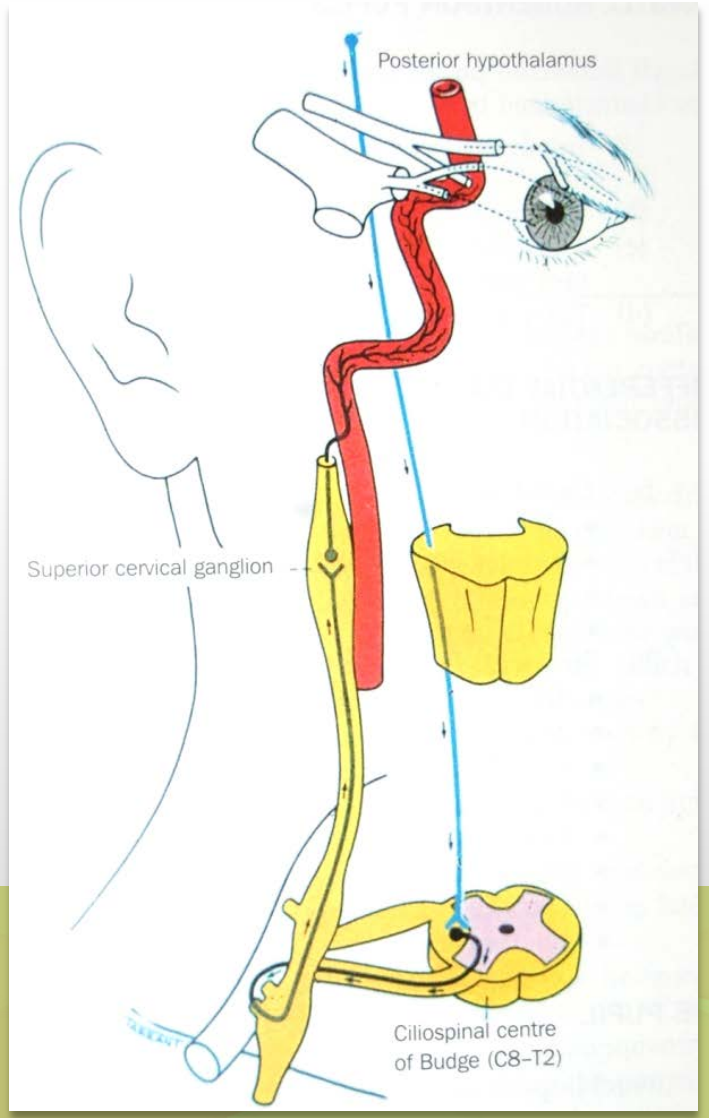
Sympathetic Pathway



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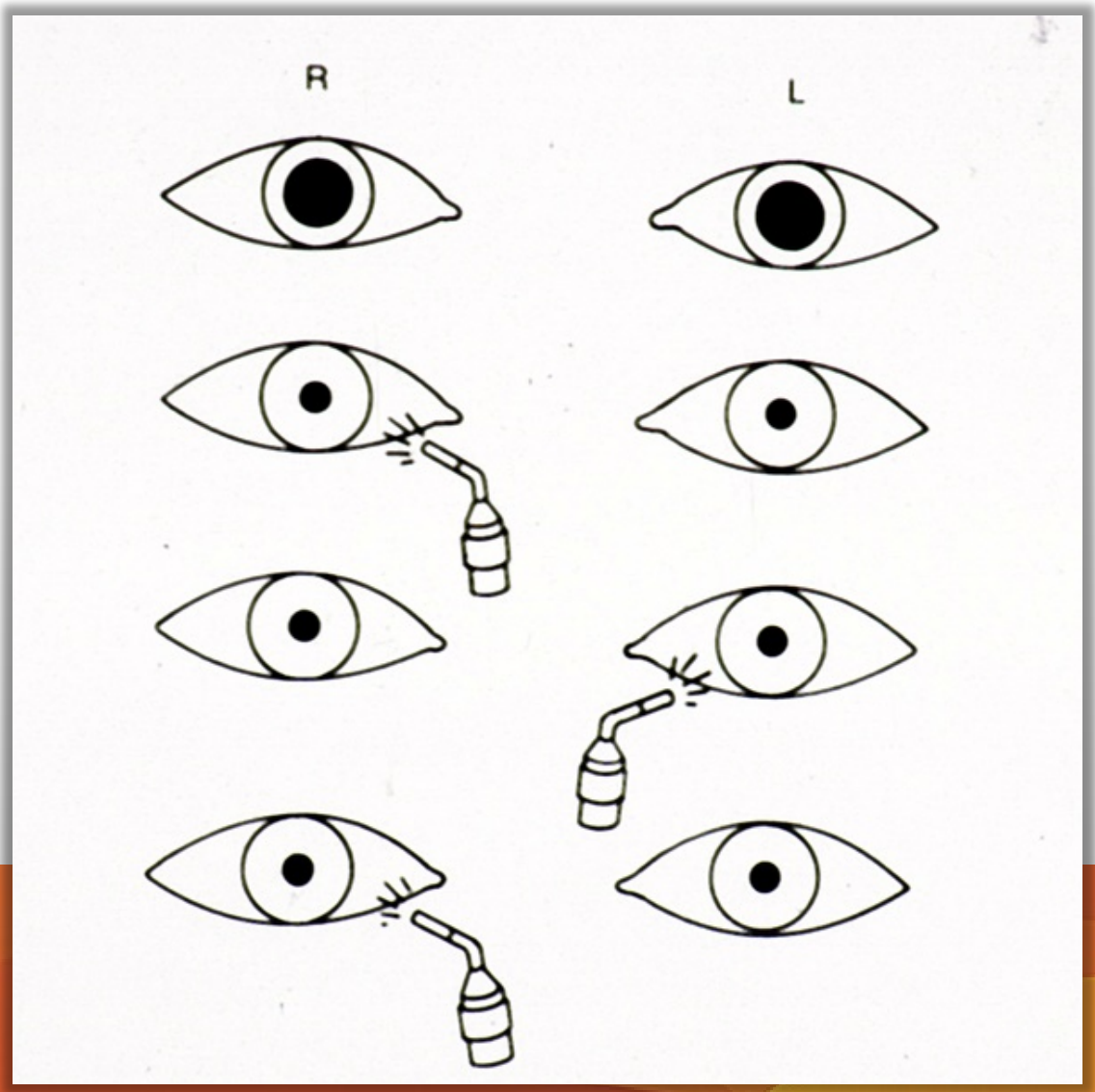
Normal Light Reflex



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Examination of Pupils

Before dilating

- size, symmetry
- shape
- near reflex
- light reflex
- Relative afferent pupil defect (RAPD)

Anisocoria

- Difference in pupil size between the eyes
- May be physiological or pathological
- Physiological anisocoria
  - normal variation in pupil size
  - uncommon
  - usually less than 1mm

Factors Affecting Pupil Size

- **Topical medications:**
  - Mydriatics /miotics/other agents
- **Trauma:**
  - traumatic mydriasis / sphincter rupture / surgical trauma / posterior synechiae
- **Disease processes:**
  - uveitis / acute angle closure glaucoma
- **Systemic medications:**
  - Narcotics (morphine, pethidine) cause miosis

Conditions with Pathological Pupil Size

- **Abnormally small pupil:**
  - Horner's syndrome
  - Argyll Robertson pupil
  - Narcotics
- **Abnormally large pupil:**
  - Adie's tonic pupil
  - Pupil involved 3rd nerve palsy
  - Bilateral dilated pupils- coma

Horner’s Syndrome

Oculosympathetic paresis….interruption of the sympathetic supply along the three neuron pathway

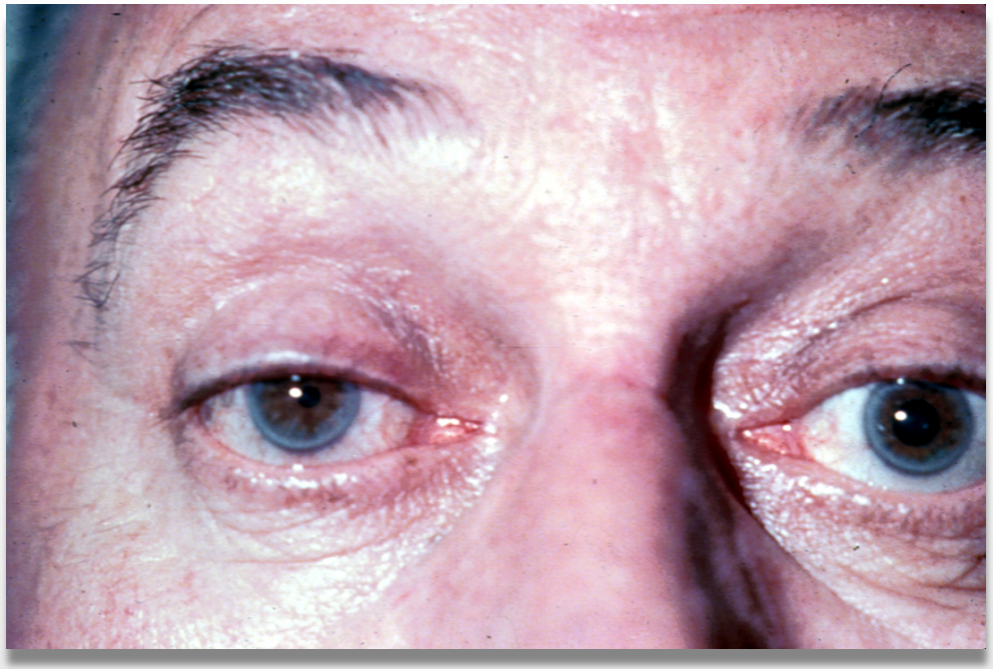
Miosis

- Ptosis
- Apparent enophthalmos
- Cutaneous anhydrosis
- Other features –iris hypopigmentation in congenital cases

Horner's Syndrome

- Diagnosis confirmed by topical cocaine test
- Abnormal pupil fails to dilate whilst the normal pupil will dilate
  (loss of noradrenaline at nerve junction)
- Other associated clinical signs and symptoms....
  (headache / apical lung pathology/ long tract neurology signs)
  will determine appropriate investigations

Right Horner’s Syndrome



Argyll Robertson Pupil

- Specific sign of neurosyphilis
- Small and irregular pupils
- Usually bilateral but asymmetric
- Do not respond to light but near response normal (light-near dissociation)

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Adie's Pupil

Postganglionic parasympathetic denervation:

- Causes: idiopathic, viral, diabetes, trauma
- Glare / accommodative difficulties

Mydriasis

- Light – near dissociation….slow constriction on prolonged near effort and slow re-dilation to distance
- Usually young females – 90% unilateral initially , but often becomes bilateral
- Pupil becomes tonic with time….even miotic
- If decreased tendon reflexes present- Holmes Adie syndrome

Adie's Pupil

- Diagnosis confirmed by **denervation hypersensitivity** to weak cholinergic (pilocarpine 0.1%)... abnormal pupil will constrict whilst normal pupil remains unaffected

- Aberrant re-innervation of pupillary sphincter muscle ... contractions of part of the pupil margin (**vermiform movement**)

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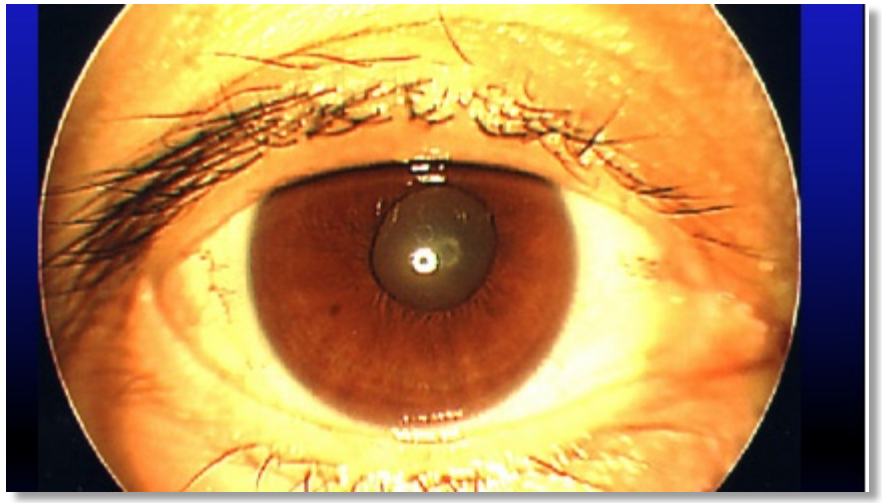
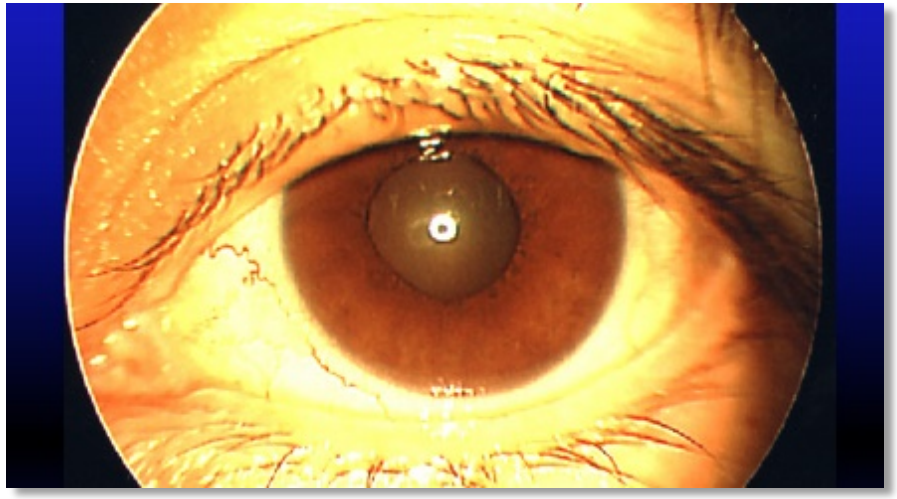
Bilateral recent Adie’s pupils





Semi-dilated, irregular; iris affected segmentally

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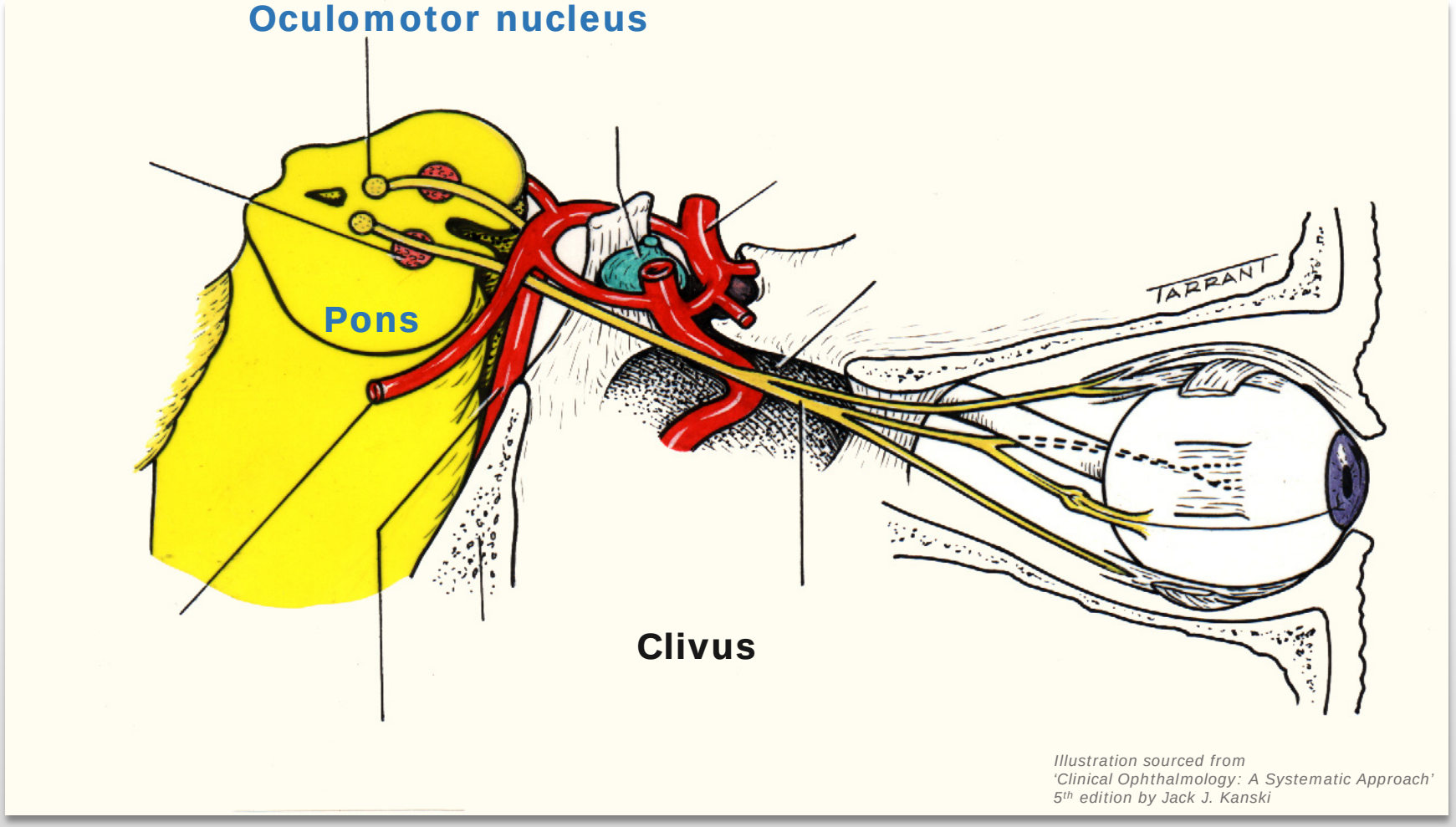
Anatomy of the CN III



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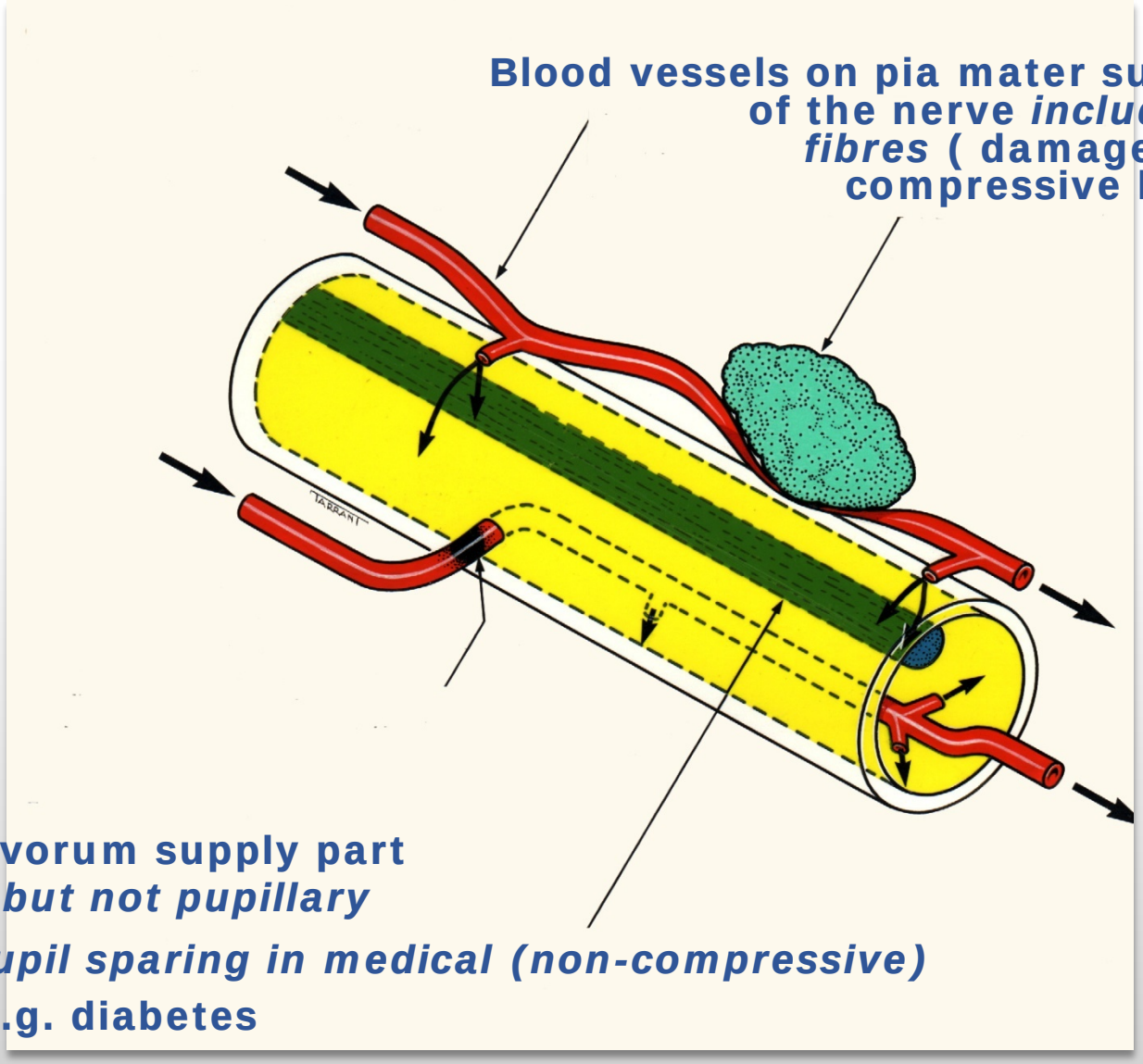
Applied Anatomy of the CN III



Blood vessels on pia mater supply surface of the nerve *including pupillary fibres* (damaged by compressive lesions)

Vasa nervorum supply part of nerve *but not pupillary*

fibres. Pupil sparing in medical (non-compressive)

lesions e.g. diabetes

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Causes of CN III palsy

Microvascular infarction

- Occlusion vasa nervorum
- Risks: diabetes, hypertension, atherosclerosis

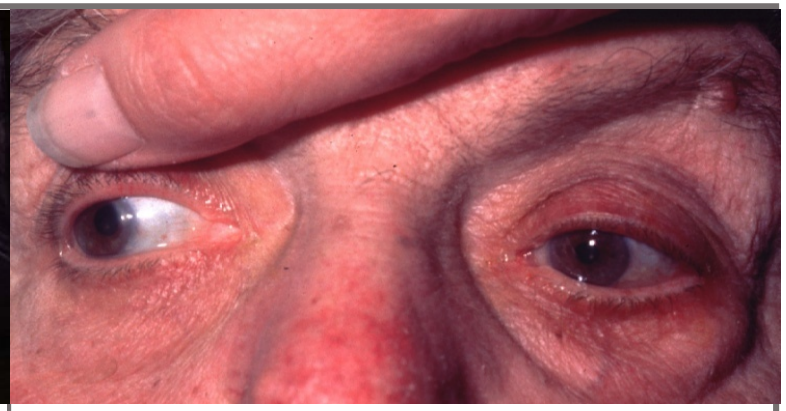
Compressive lesion

- Aneurysm (usually post communicating artery)
- Tumour

Trauma

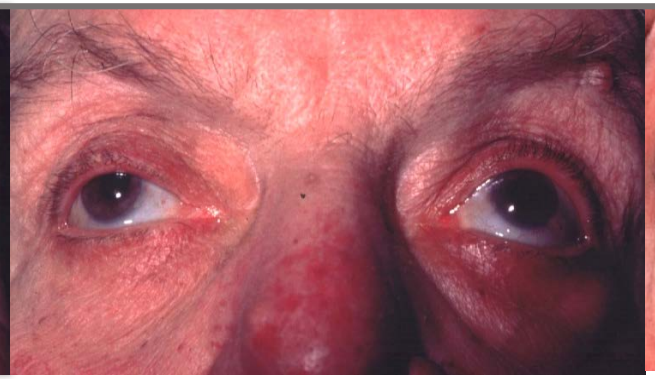
CN III Palsy

- **Ptosis, mydriasis and cycloplegia**
- **Eye down and out**



- **Normal abduction**

- **Limited adduction**



- **Limited elevation**

- **Limited depression**

Partial right CN III Palsy

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Left CN III palsy

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What do you look for if there is anisocoria?

- Make sure patient has not had any eye drops instilled
- Check for prescription, over the counter vasoconstrictors or ‘herbal’ medications
- Any history of eye surgery (iatrogenic)
- Check for other signs such as ptosis, or ocular motility problems

Relative Afferent Pupil Defect (RAPD)

- The presence of RAPD in the absence of gross ocular disease indicates a neurological lesion of the anterior visual pathway **(afferent system)**
- Detected using the ‘swinging flashlight test’
- Abnormal pupil responds to consensual light but not direct light

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Causes of RAPD

- **Optic nerve disorders** (optic nerve compression, optic neuritis)
- **Chiasma compression**
- **Retinal detachment**
- **Large unilateral macular lesion**
- **Unilateral glaucoma**

- RAPD **not produced by** corneal opacity, cataract, vitreous haemorrhage, refractive error, amblyopia.

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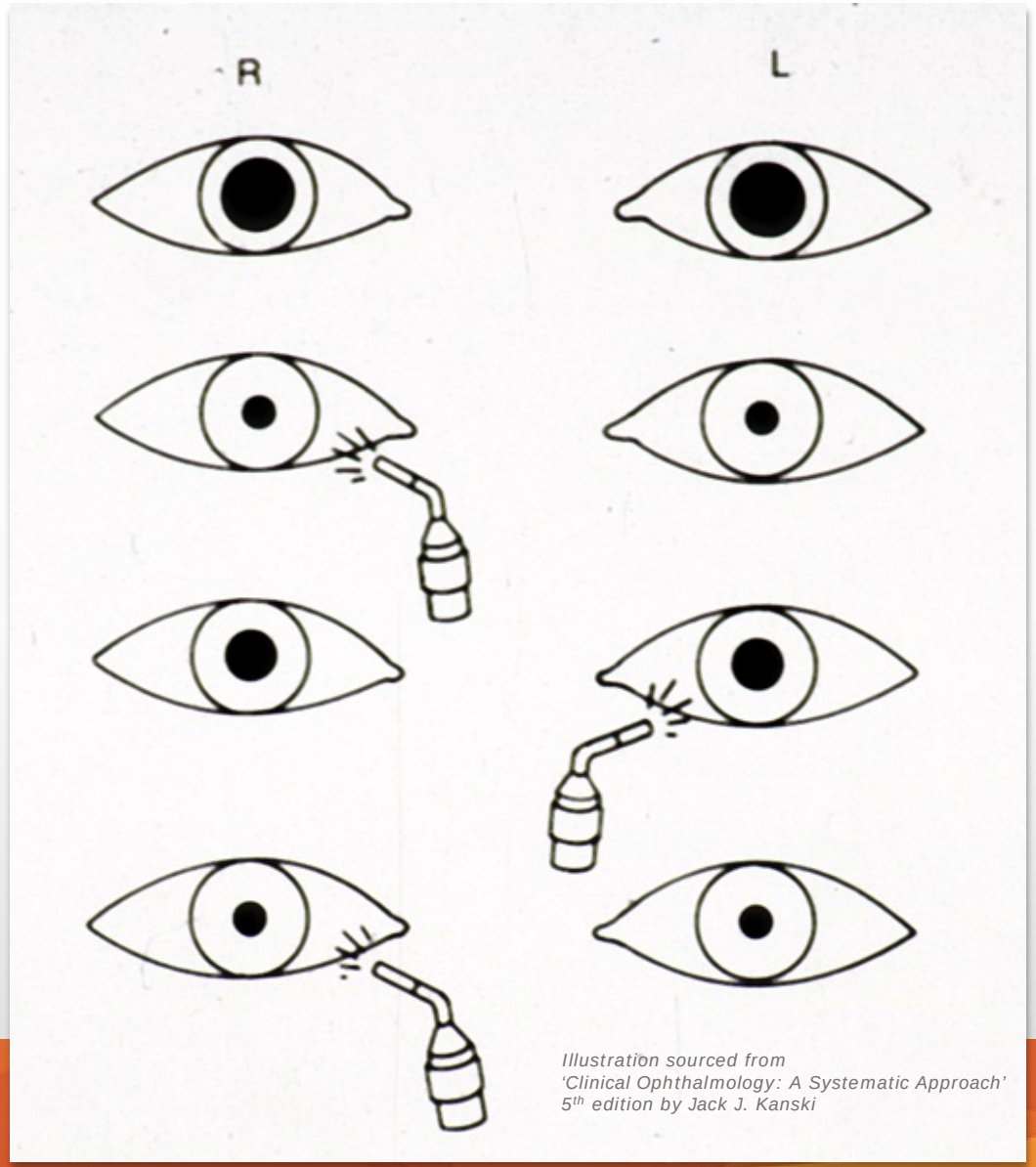
Relative
Afferent
Pupil
Defect



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Relative Afferent Pupil Defect

RAPD video

Available for viewing on UOA Ophthalmology website

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Mydriatics

- Cholinergic antagonists (anticholinergics)
  - o Atropine
  - o Cyclopentolate (*Cyclogyl*)
  - o Tropicamide (*Mydriacyl*)

  Systemic effects: Atropine: “Hot as a hare, mad as a hatter, red as a beet”

Mydriatics continued

- **Adrenergic agents**

  adrenergic agonist- phenylephrine 2.5% and 10%

  Systemic effects: Hypertension, stroke, myocardial infarct

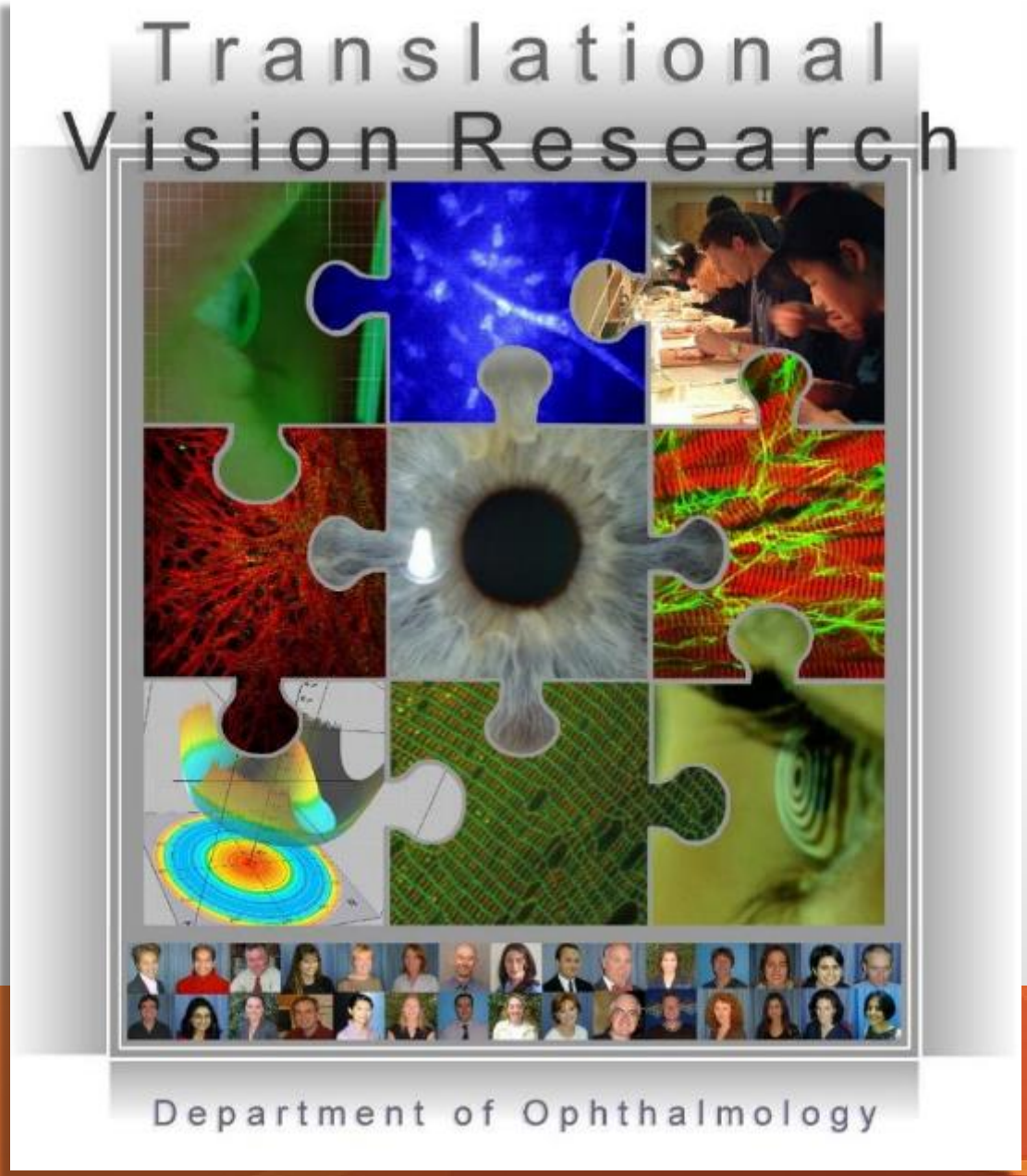
  α_1 receptors mediate smooth muscle contraction

  Cocaine blocks reuptake of noradrenalin into presynaptic vesicles, thus accumulating and causing dilatation in an intact neuron

Miotics

- **Cholinergic** (direct): Pilocarpine
- **Anticholinesterases** (indirect cholinergic): physostigmine, neostigmine

Postganglionic parasympathetic nerves respond to muscarine.
Somatic motor and preganglionic autonomic nerves respond to nicotine



The End

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