# OCULOMOTOR SYSTEM

***1st order neuron*** – retina to pretectal nucleus

- nasal fibres – contralateral pretectal nucleus
- temporal fibres – ipsilateral pretectal nucleus

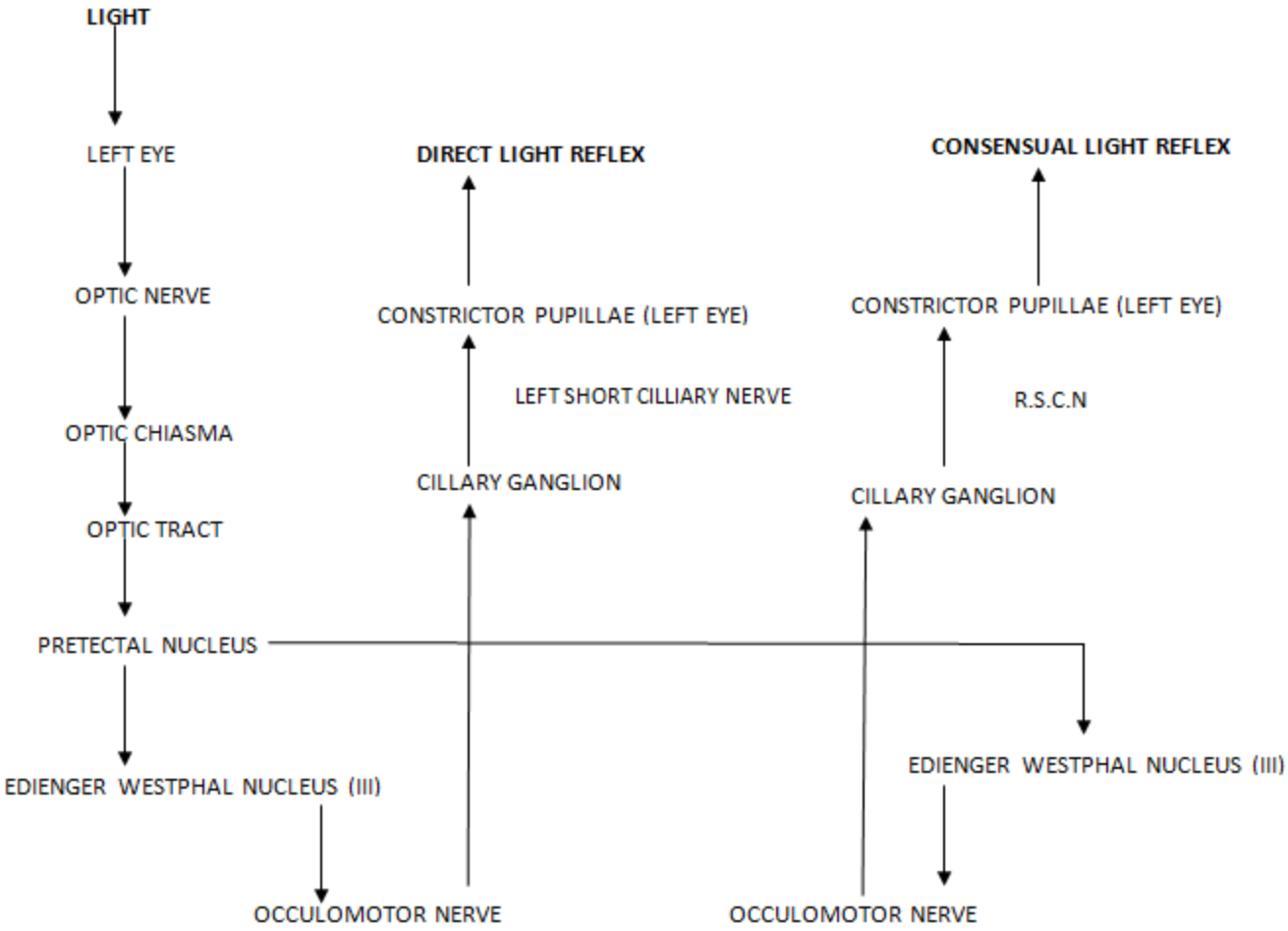
***2nd order neuron*** – connects each pretectal nucleus to both edinger westphal nuclei,therefore unilateral light stimulus – bilateral symmetrical pupillary constriction

- damaged by syphilis – light – near dissociation

***3rd order neuron*** – E.W. nucleus to ciliary ganglion

- Aneurysm – 3rd nerve palsy + pupil involvement
- In orbit – parasympathetic fibres – inferior division of 3rd nerve – via nerve to I.O. – ciliary ganglion

***4th order neuron*** – leaves ciliary ganglion , passes with short ciliary nerves- innervate the sphincter pupillae


LIGHT
LEFT EYE
OPTIC NERVE
OPTIC CHIASMA
OPTIC TRACT
PRETECTAL NUCLEUS
EDIENGER WESTPHAL NUCLEUS (III)
OCCULOMOTOR NERVE
DIRECT LIGHT REFLEX
CONSTRICTOR PUPILLAE (LEFT EYE)
LEFT SHORT CILLIARY NERVE
CILLARY GANGLION
CONSENSUAL LIGHT REFLEX
CONSTRICTOR PUPILLAE (LEFT EYE)
R.S.C.N
CILLARY GANGLION
EDIENGER WESTPHAL NUCLEUS (III)
OCCULOMOTOR NERVE

# 7 types of 3rd cn palsies

1. *nuclear IIIrd nerve palsies*
2. *fascicular syndromes of the IIIrd nerve*
3. *uncal herneation syndrome of IIIrd nerve*
4. *posterior communicating artery aneurysm*
5. *cavernous sinus syndrome of IIIrd nerve*
6. *orbital syndrome of the IIIrd nerve*
7. *pupil-sparing, isolated IIIrd nerve palsies*

1) ***nuclear III$^{rd}$ nerve palsies***
- very rare
specific prerequisites for diagnosis based on III$^{rd}$ n. subnuclear arrangements

- ORIGIN:3$^{rd}$ nerve complex in periaqueductal gray matter just anterior to the aqueduct of sylvius at level of superior colliculus
- The MLF abuts the the nucleus laterally and ventrally
- LATERAL SUBNUCLEUS-ipsilateral IO+IR+MR(***inferior division)***
- MEDIAL SUBNUCLEUS-contralateral SR(*major clue in identifying nuclear palsy)*
- CENTRAL CAUDAL SUBNUCLEUS-b/l LPS
- EW SUBNUCLEUS-parasympathetic innervation b/l

superior division

- 2) ***fascicular syndromes of the III$^{rd}$ nerve***
- - III$^{rd}$ nerve + superior cerebellar peduncle = **Nothnagel's syndrome**
- - III$^{rd}$ nerve + red nucleus = **Benedikt's syndrome**
- - III$^{rd}$ nerve + cerebral peduncle = **Weber's syndrome**
- - III$^{rd}$ nerve + superior cerebellar peduncle + red nucleus = **Claude's syndrome**

- 3) ***uncal herneation syndrome of III$^{rd}$ nerve***
- - III$^{rd}$ passes along free edge of tentorium cerebelli
- - with expanding supratentorial mass lesions, the uncal portion of the undersurface of the temporal lobe may compress the III$^{rd}$ nerve
- Pupil is usually involved early and predominantly- HUTCHINSON PUPIL
- Generally ipsilateral 3$^{rd}$ cn palsy but sometimes contralateral (false localizing)
- *A false localizing hemiparesis is much more common than a false localising 3 rd cn palsy*

# 5) *cavernous sinus syndrome of III$^{rd}$ nerve*

- - involvement of III +/- IV +/- VI nerves +/- oculosympathetics
- - may give rise to **primary misdirection syndromes of the III$^{rd}$ nerve**
- **Aberrant Regeneration of the III$^{rd}$ Nerve = misdirection syndrome = acquired oculomotor synkinesis**
- **Bielschowsky's Hard-Wiring theory:** - after a III$^{rd}$ palsy, anomalous branching develops during regeneration so that structures originally supplied are anomalously re-innervated on the basis of miswiring = **secondary misdirection syndromes**
- **primary misdirection syndromes = where no previous III$^{rd}$ nerve palsy was present**
- **eyelid-gaze dyskinesis –pseudo grafes sign-***upper lid may retract on down gaze due to IR fibres aberrantly innervating LPS*
- **pupil-gaze dyskinesis –pseudo argyll robertson pupil –***pupillary light reaction is poor but constriction occurs on ocular adduction with early convergence or horizontal gaze*

4) ***posterior communicating artery aneurysm***-most common cause of **painful, non-traumatic, III$^{rd}$ nerve palsy**

***3$^{rd}$ cn passes between posterior cerebral***

***artery and superior cerebellar artery***

***parallel to posterior communicating artery***

***PUPIL RULE*-<u>complete isolated 3$^{rd}$ cn palsy with pupil sparing is never due to aneurysm</u>**

6) ***orbital syndrome of the III$^{rd}$ nerve***

- - at orbital apex, III$^{rd}$ nerve splits into **superior division (*levator + SR muscle) and the inferior division (MR, IR, IO & parasympathetics)***
- **- divisional III$^{rd}$ nerve palsies arise which are of localizing value to this locale**
- **Pseudodivisional palsy-**incomplete lesions involving fascicles in midbrain

•Pupillomotor fibres pass superficially in superomedian part of nerve – supplied by pial blood vessels – *while main trunk of 3rd nerve is supplied by vasa nervosum*
Therefore aneurysm presses on pial vessels externally – total 3rd nerve palsy including pupils
***Microangiopathy affects vasa nervosa- produces pupil sparing 3rd nerve palsy***

7) ***pupil-sparing, isolated IIIrd nerve palsies***

- *small caliber, poorly myelinated parasympathetic fibers tend to locate to the superonasal portion of the peripheral IIIrd nerve*

- 80% of **diabetic IIIrd nerve palsies are *pupil sparing***

- 95% of **compressive IIIrd nerve palsies have pupil involvement**

***Microvascular palsies are sudden onset painful,usually pupillary sparing,begin to resolve by about 2 months and donot result in aberrant regeneration***

- very short fascicular course so **fascicular syndromes are rare**
- - IV$^{th}$ nerve usually affected at point of decussation [ = ***anterior medullary velum]***
- or along subarachnoid course
- clinically:
- - a IV$^{th}$ nerve palsy is the **most common, isolated oculomotor nerve palsy seen**
- - in almost all of the neurological literature, a VI$^{th}$ nerve palsy is always quoted as #1
- - the major problem in diagnosis is
- **in only 30% of recent onset IV$^{th}$ n. palsies is the diplopia maximal down-and-in where it customarily assessed**
- - ***vertical diplopia after closed head trauma is a IV$^{th}$ n. palsy until proven otherwise***

# FASCICULUS

## Passes through red nucleus and then through medial aspect of cerebral peduncle

- Lesion of the fasciculus leads to:
- **BENEDIKT' S SYNDROME** – damage to dorsal part of fasciculus as it passes through red nucleus leads to ipsilateral 3rd nerve palsy , contralateral ataxia ,flapping tremors.
- **WEBERS SYNDROME-** damage to the ventral part of fasciculus as it passes through cerebral peduncle leads to ipsilateral 3rd nerve palsy, contralateral hemiplegia.