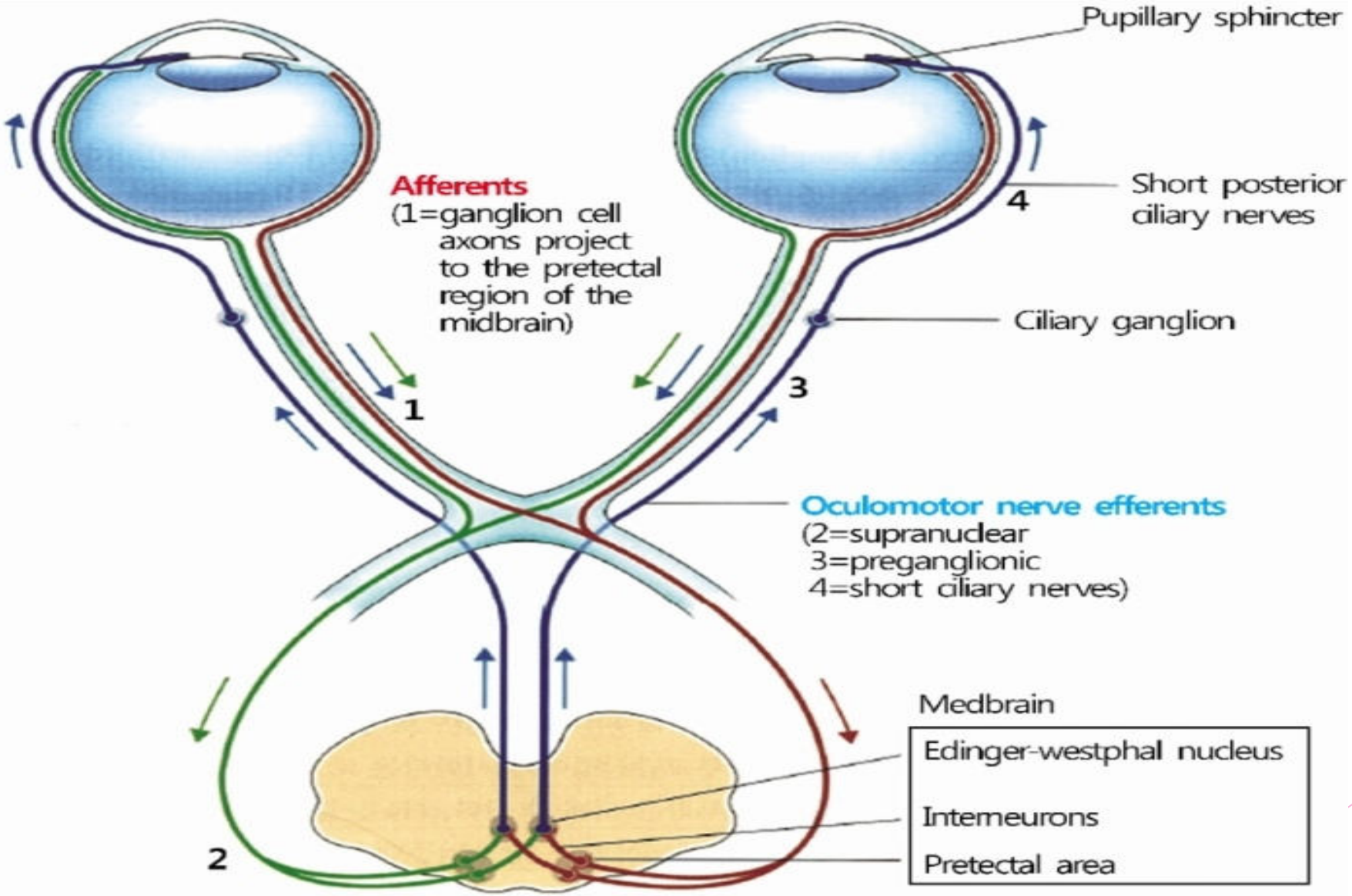
Pupillary Reflex Pathway

Light Reflex

- When light is shown in one eye both pupils constrict .Constriction of pupil to which light is shown is called direct light reflex and that of other pupil is called consensual or indirect reflex. Light reflex is initiated by rods and cones.

Pathway of light reflex :

Afferent fibers extend from retina to the pretectal nucleus in the midbrain**. Internuncial fibers** connect each pretectal nucleus with Edinger Westphal nuclei of both sides .This connection forms the basis of consensual light reflex. **Efferent** pathway consists of parasympathetic fibers which arise from the Edinger Westphal nucleus in midbrain and travel along the oculomotor cranial nerve.The preganglionic fibers enter the inferior division of third nerve and via the nerve to inferior oblique reach the ciliary ganglion to relay.post ganglionic fibres travel along the short ciliary nerves to innervate the sphincter pupillae.



NEAR REFLEX

Near reflex occurs on looking at a near object.It consists of two components.

a)Convergence reflex-contraction of pupil on convergence

b)Accommodation reflex-contraction of pupil associated with accommodation.

PATHWAY OF CONVERGENCE REFLEX:

- Afferents from medial recti travel centrally via the third nerve to the mesencephalic nucleus of the 5th nerve to a presumptive convergence center in the tectal or pretectal region.From this the impulse is relayed to the Edingher-Westphal nucleus and subsequent efferent pathway of near reflex is along the third nerve.The efferent fibres relay in the accessory ganglion before reaching the sphincter pupillae

PATHWAY OF ACCOMODATION REFLEX

- The afferent impulses extend from the retina to the parastriate cortex via the optic nerve,chiasma,optic tract,lateral geniculate body,optic radiation and striate cortex.From the parastriate cortex the impulses are relayed to the Edingher-Westphal nucleus of both sides via the occipito mesencephalic tract and the pontine center.From the Edingher-Westphal nucleus efferent impulses travel along the 3rd nerve and reach the sphincter pupillae and ciliary muscle after relaying in the accessory and ciliary ganglion.

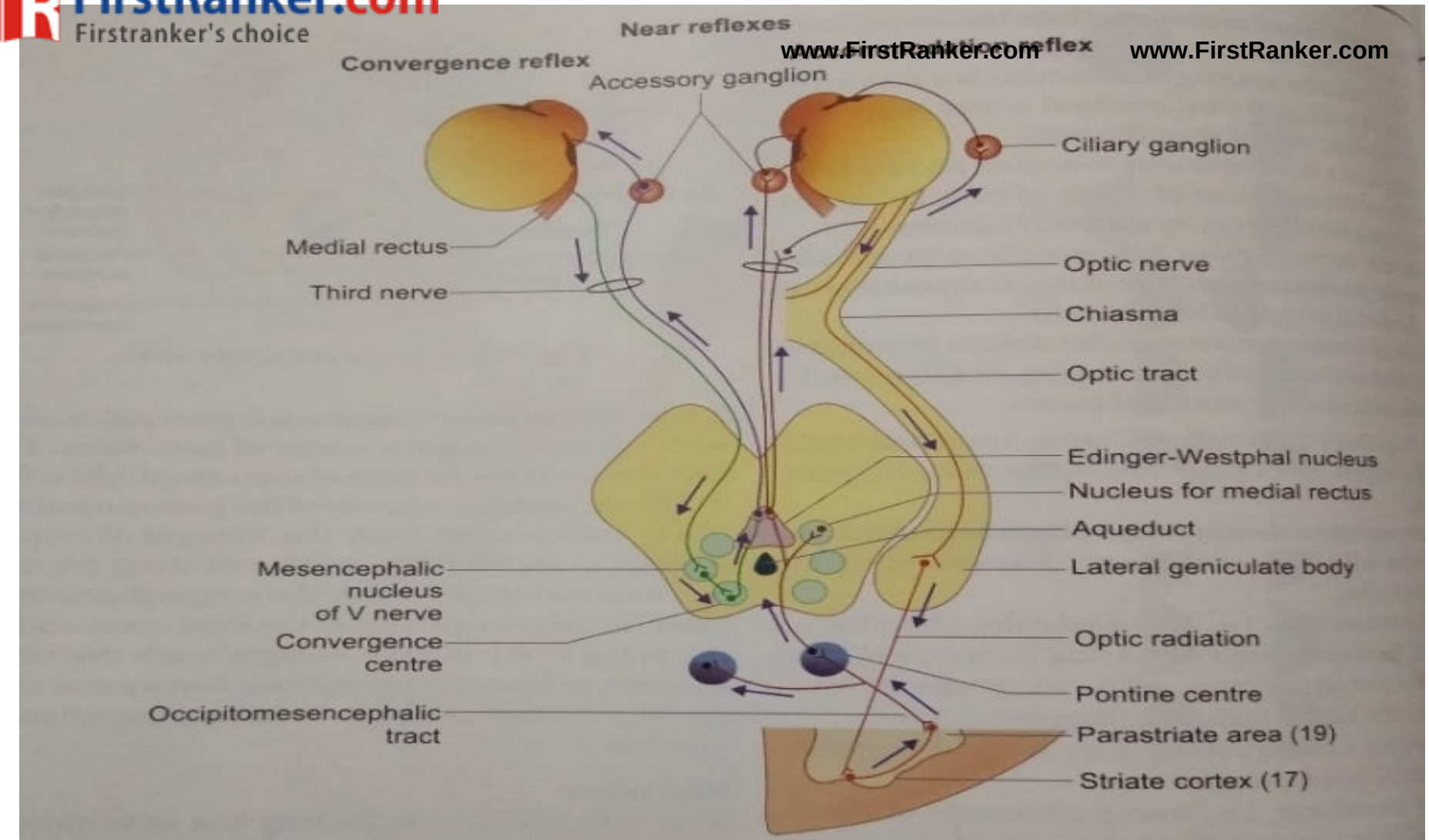


Fig. 13.7 *Pathway of the near reflex*

EXAMINATION OF PUPILLARY REFLEX

- **DIRECT LIGHT REFLEX**:

To elicit this reflex,patient is seated in a dimly lighted room.With the help of a palm,one eye is closed and a narrow beam of light is shown to other pupil and its response is noted.the procedure is repeated for the second eye.A normal pupil react briskly and its constriction to light is well maintained.

CONSENSUAL LIGHT REFLEX:

Patient is seated in a dimly lighted room and the two eyes are separated from each other by an opaque curtain kept at the level of nose.(either hand of examiner or a piece of cardboard).Then one eye is exposed to a beam of light and pupillary response is observed in the other eye.The same procedure is repeated for the second eye.normally the contralateral pupil should also constrict briskly when light is thrown on to other pupil.

SWINGING FLASH LIGHT TEST

- It is performed when relative afferent pathway defect or Marcus Gunn Pupil is suspected in one eye.
- To perform this test a bright flash light is shown on to one pupil and constriction of that pupil is noted.Then after 3sec, the flash light is quickly moved to the contralateral pupil and response is noted.This swinging to and fro of flash light is repeated several times while observing the pupillary response.

- Normally both pupils constrict equally and the pupil to which light is transferred remains tightly constricted.
- In the presence of RAPD in one eye the affected pupil will dilate when the flash light is moved from normal eye to the abnormal eye.This response is called Marcus gunn pupil or RAPD.It is the earliest indication of optic nerve disease.

NEAR REFLEX - EXAMINATION

- To determine the near reflex, patient is asked to focus on a far object and then instructed suddenly to focus at an object (pencil or tip of index finger) held about 15 cm from patient's eye. While the patient's eye converges and focuses the near object, observe the constriction of pupil.

ABNORMALITIES OF PUPILARY REACTIONS

Amaurotic light reflex

It refers to the absence of direct light reflex on the affected side (say right eye) and absence of consensual light reflex on the normal side (i.e., left eye). This indicates lesions of the optic nerve or retina(optic neuritis or ischaemic optic neuropathy) on the affected side (i.e., right eye), leading to complete blindness. In diffuse illumination both pupils are of equal size.

Efferent pathway defect.

- Absence of both direct and consensual light reflex on the affected side (say right eye) and presence of both direct and consensual light reflex on the normal side (i.e., left eye) indicates efferent pathway defect (sphincter paralysis).
- Near reflex is also absent on the affected side.
- Its causes include: effect of parasympatholytic drugs (e.g., atropine, homatropine), internal ophthalmoplegia, and third nerve paralysis.

Wernicke's hemianopic pupil

- It indicates lesion of the optic tract. In this condition, light reflex (ipsilateral direct and contralateral consensual) is absent when light is thrown on the temporal half of the retina of the affected side and nasal half of the opposite side; while it is present when the light is thrown on the nasal half of the affected side and temporal half of the opposite side.

Marcus Gunn pupil

- It is the paradoxical response of a pupil to light in the presence of a relative afferent pathway defect (RAPD).
- Causes of Marcus Gunn pupil include incomplete optic nerve lesions and severe retinal diseases.
- If a patient with mild optic nerve lesion in left eye,shine light into affected eye and a seemingly normal response noted.After 2sec,move torch briskly to shine the normal right eye.the right pupil which is already constricted due to consensual response will stay constricted.now when torch is moved to the left side,because of the subtle afferent defect ,signal strength of input to midbrain pupilloconstrictor or Edingher Westphal nuclei is reduced,resulting in apparently paradoxical dilatation of left pupil.

Argyll Robertson pupil (ARP)

- Here the both pupils are slightly small in size and reaction to near reflex is present but light reflex (both direct and consensual) is absent, i.e., there is light near dissociation (to remember, the acronym ARP may stand for ‘accommodation reflex present’).Both pupils are involved and dilate poorly with mydriatics.
- It is caused by a lesion (usually neurosyphilis,multiple sclerosis,syringobulbia,autonomic neuropathy) in the region of tectum.

Adie's tonic pupil

- In this condition, reaction to light is absent and to near reflex is very slow and tonic. The affected pupil is larger (anisocoria).
- It is caused by post ganglionic parasympathetic pupillomotor damage. It is usually unilateral, associated with absent knee jerk and occurs more often in young women.
- Adie's pupil constricts with weak pilocarpine (0.125%) drops, while normal pupil does not, because the denervated iris sphincter is supersensitive to topical parasympathomimetics.

LIGHT NEAR DISSOCIATION

- ARGYLL ROBERTSON PUPIL
- HOLMES ADIE PUPIL
- PARINAUD'S SYNDROME
- ABERRANT THIRD NERVE REGENERATION
- MYOTONIC DYSTROPHY
- DIABETES MELLITUS

THANK YOU…