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SIXTH EDITION



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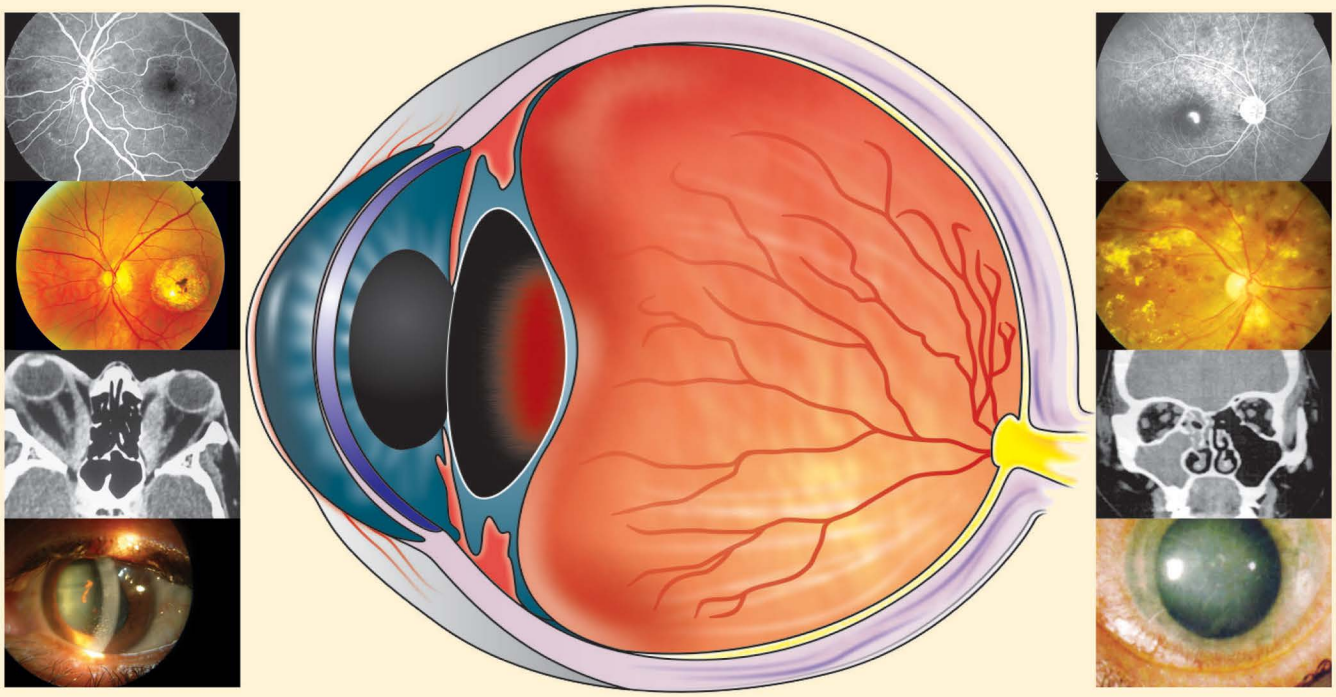
Textbook of OPHTHALMOLOGY



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3 Neurology of Vision

VISUAL PATHWAY
- Pupil

PUPILLARY PATHWAYS AND REACTIONS
- Light Reflex
- Near Reflex
- Psychosensory Reflex

OVERVIEW

This chapter will:
- Describe the visual pathway of the eye
- Give description of pupil and its functions
- Discuss pupillary pathways and reactions: light reflex, near reflex and psychosensory reflex.

Visual Pathway

The visual sensations are perceived by the rods and cones and conducted to the brain through three sets of neurons. The conducting nerve cells or neurons of the first order are the bipolar cells of the inner nuclear layer of the retina with their axons in the inner plexiform layer. The neurons of the second order extend from the ganglion cells to the lateral geniculate nucleus. From here, the neurons of the third order transmit the impulse through the optic radiations to the visual center situated in the occipital lobe (Fig. 3.1).

The arrangement of the nerve fibers in the optic nerve is peculiar; the fibers from the peripheral retina enter the periphery of the optic nerve, while the fibers from the adjoining parts of the disk enter the central part of the nerve. The macular fibers or papillomacular fibers initially enter the nerve on the outer aspect, but they soon become more centrally arranged in the posterior part of the nerve. These fibers undergo a partial decussation in the chiasma wherein the nasal fibers cross, while the temporal ones enter the optic tract of same side. Similarly, the fibers of the peripheral retina form two separate groups. If a vertical line is drawn through the macula, it divides the retina into two halves—temporal and nasal. The fibers from the nasal half enter the chiasma, decussate and pass into the opposite optic tract. The fibers from the temporal half enter the chiasma and pass into the optic tract of same side. Both uncrossed and crossed fibers pass to alternating laminae in the lateral geniculate nucleus. The neurons of the third order pass in the optic radiations to reach the occipital lobe.

A lesion of an optic tract or of one occipital lobe leads to blindness of temporal half of the retina on the same side

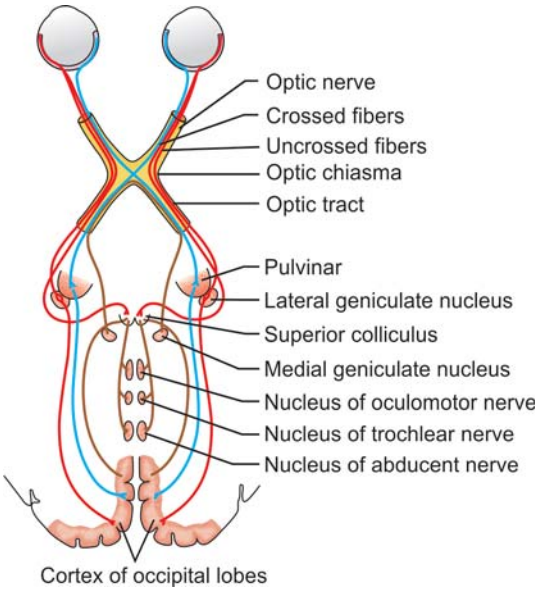

Fig. 3.1: Visual pathway

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and of the nasal half of the retina on the opposite side. In other words, it causes loss of vision in the opposite half of the binocular field of vision, a defect known as *homonymous hemianopia*. The visual fibers in optic radiations are closely related to the internal capsule, temporal lobe of the brain and the lateral ventricle. The fibers are liable to be compressed in cases of tumors of the temporal lobe and distention of the lateral ventricle.

The visual center is situated in and about the calcarine fissure of the occipital cortex. The part above the calcarine fissure represents the upper corresponding quadrants of both retinas and the part below, the lower quadrants. The posterior part of the occipital lobe represents the macula.

Pupil

The central opening in the iris is called *pupil*. The pupillary size varies between 1 and 8 mm. It tends to be smaller in newborn (parasympathetic tone) and elderly persons (decreased sympathetic activity). Pupils are wider in teenagers and in dim light. They are relatively dilated in the state of joy, fear or surprise due to increased sympathetic tone. The average diameter of pupil in an adult is 4 mm in ordinary room light. The pupil during sleep is usually constricted due to reduced tone of dilator pupillae and diminution of inhibitory impulses to the constrictor center. Abnormal constriction of pupil is called *miosis*, while abnormal dilatation is known as *mydriasis*.

Functions of Pupil

The pupil has mainly optical function. Constriction of pupil regulates the entry of light inside the eye and allows the retina to adapt to the changes in the illumination. The constriction of pupil cuts off the peripheral and chromatic aberration and astigmatism, it also increases the depth of perception.

Pupillary Pathways and Reactions

The pupil is controlled by two muscles—sphincter and dilator pupillae. The former constricts the pupil while the latter dilates. The sphincter pupillae is supplied by the cholinergic nerves of parasympathetic system through the III cranial nerve (Fig. 3.2), while the dilator by the adrenergic fibers of the cervical sympathetic nerves (Fig. 3.3).

The pupils take part in the following three reflexes which are of clinical importance.

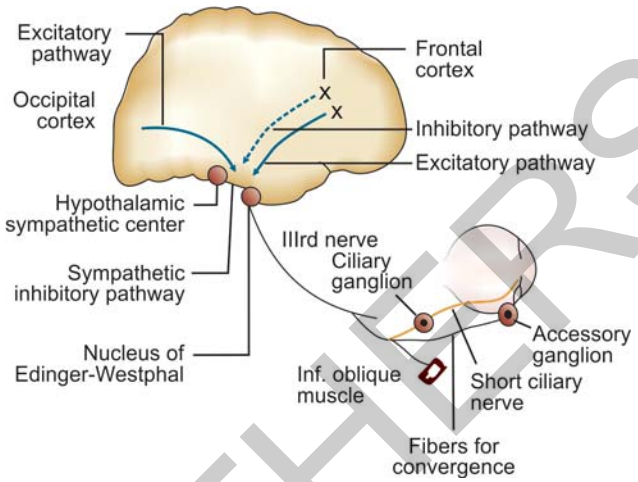

Fig. 3.2: Parasympathetic pupillary system

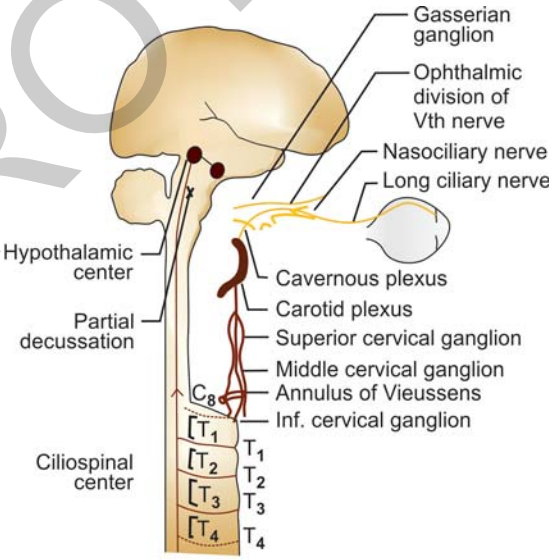

Fig. 3.3: Sympathetic pupillary system

1. Light reflex
2. Near reflex, and
3. Psychosensory reflex.

When light above a threshold value enters the eye the pupil constricts, which is called *direct light reflex*, while the constriction of the contralateral pupil is known as *consensual light reflex*.

Light Reflex

The afferent pathways of light reflex follow the course of visual fibers (optic nerve) and undergo semidecussation

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in the chiasma. The pupillary fibers travel along the visual fibers in the optic tract. Just before reaching the lateral geniculate nucleus they leave the tract to enter the superior collicullus and the pretectum. The pupillary fibers are relayed in the pretectal nucleus. The neurons from pretectum, after getting partially decussated in the midbrain, project their axons to Edinger-Westphal nucleus of oculomotor nerve and thus distribute the impulses of each tract to both III nerve nuclei. This decussation is important because it is responsible for the consensual light reflex (Fig. 3.4).

The efferent pathways of the sphincter mechanism are controlled by Edinger-Westphal nucleus which lies under the aqueduct of Sylvius. The efferent impulses run through the III nerve to the ciliary ganglion lying in the muscle cone. The postganglionic fibers relay through the short ciliary nerves to innervate the sphincter pupillae.

Near Reflex

The constriction of pupil occurs on looking at a near object or with convergence and accommodation. Basically, near reflex is not a true reflex but an associated reaction.

Convergence Reflex

The constriction of pupil in near reflex is independent of any change in illumination. It is initiated by the fibers from the medial rectus muscles, which contract on convergence. The afferent fibers from these muscles run centrally perhaps through the oculomotor nerve to the mesencephalic nucleus of the trigeminal nerve, to a presumptive convergence center situated in the tectal or pretectal region. Then they reach the Edinger-Westphal nucleus. The efferent impulses run through the III cranial nerve via an accessory ganglion and reach the sphincter pupillae.

Accommodation Reflex

Accommodation reinforces the near reflex along with convergence. The afferent pathway of accommodation is through the optic nerve. The impulse for the accommodation reflex goes with the visual fibers to the lateral geniculate nucleus and then to the striate area of the calcarine cortex to relay in the parastriate area. The efferent fibers travel to nucleus of Perlia via occipitomesencephalic tract. From Perlia's nucleus fibers go to the Edinger-Westphal nucleus. Then they are carried to the sphincter pupillae muscle through the III cranial nerve via an accessory ganglion.

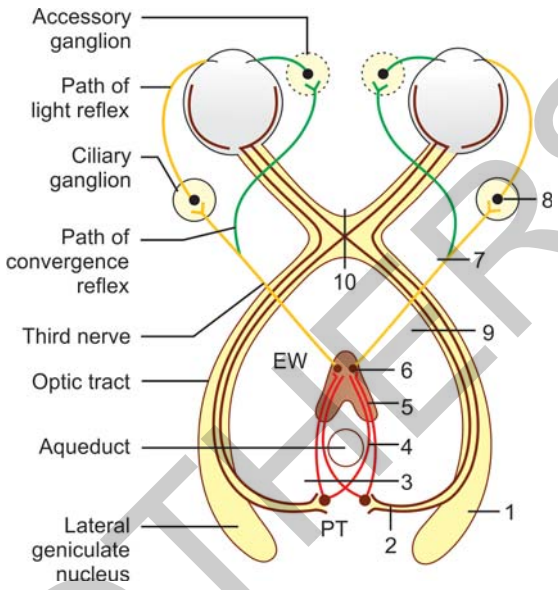

Fig. 3.4: Pathways for light and convergence reflexes and their lesions

1. Lesion of proximal part of optic tract retains *normal pupillary reaction.*
2. Lesion in the region of tectum causes *contralateral hemianopic paralysis*.
3. Lesion of central decussation leads to *bilateral reflex paralysis*—inactivity to light (direct and consensual) with retention of near reflex, lid reflexes and psychosensory reflex—*bilateral Argyll Robertson pupil* (according to Behr).
4. Lesion between decussation and constrictor center causes ipsilateral abolition of direct and consensual reactions with retention of both contralaterally (*unilateral Argyll Robertson pupil*).
5. A partial lesion corresponding to 4 causes ipsilateral abolition of direct reaction with retention of consensual reaction; retention of both contralaterally.
6. Nuclear or extensive supranuclear lesion causes ipsilateral absolute pupillary paralysis.
7. Lesion of III cranial nerve produces absolute pupillary paralysis.
8. Lesion of ciliary ganglion results in abolition of light reflex with retention of near reflex.
9. Lesion of distal part of optic tract causes contralateral hemianopic paralysis (*Wernicke's hemianopic pupillary reaction*)
10. Lesion of medial chiasma leads to *bitemporal hemianopic paralysis.*

PT: Pretectal nucleus, EW: Edinger-Westphal nucleus

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Psychosensory Reflex

The psychosensory reflex is more complicated and initiated by the stimulation of sensory nerve during pain or emotional states. Sensory excitation initially causes a rapid dilatation of pupil owing to augmentation of the dilator tone via the cervical sympathetics. Then it is followed by a quick second dilatation which lasts longer due to inhibition of the constrictor tone.

The dilator pupillae is supplied by the adrenergic fibers of the cervical sympathetic nerve. Perhaps the tract commences in the hypothalamus and descends downwards through the medulla oblongata into the lateral columns of the spinal cord. The preganglionic fibers leave through the ventral roots of C8, T1, T2 and T3 nerves and enter the corresponding cord to reach the superior cervical ganglion. From here the postganglionic fibers pass along with the carotid plexus into the skull. Thence, the fibers run along the ophthalmic division of the V cranial nerve, follow the nasociliary nerve and finally reach the dilator pupillae muscle via the long ciliary nerves.

Examination of Pupil

The examination of pupil and pupillary reflexes are described in the Chapter 9: *Examination of the Eye and Diagnostic Procedures*.

Key Features

- In the eye, visual sensations are perceived by the rods and cones and conducted to the brain through three sets of neurons
- The central opening in the iris is called pupil. The pupillary size varies between 1 and 8 mm
- The afferent pathways of light reflex follow the course of visual fibers
- Near reflex is not a true reflex but an associated reaction It includes convergence and accommodation reflexes
- Psychosensory reflex is more complicated and initiated by the stimulation of sensory nerve during pain or emotional states.

Bibliography

1. Kennard C, Clifford RF. Physiological Aspects of Clinical Neuro-Ophthalmology. London: Chapman and Hall; 1988.
2. Trabe JD. Neurology of Vision. New York: Oxford; 2001.

Review Questions

1. What is homonymous hemianopia?
2. What are the functions of pupil?
3. What is light reflex?
4. What is accommodation reflex?

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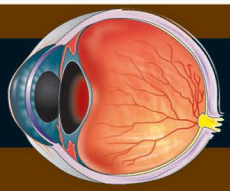

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The format of book is changed to suit the students. Each chapter begins with broad contents, overview, description of diseases, treatment both medical and surgical, key features, references and review questions.

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HV Nema has a distinguished academic career and is well known for his teaching, researches and publications. He has served as a consultant editor/advisory editor to Indian Journal of Ophthalmology, Afro-Asian Journal of Ophthalmology and Indian Journal of Optometry. He has published more than 6 dozen papers in the national and international journals. He is an established author in the field of ophthalmology. Ophthalmic Syndromes (Butterworth, London, 1973) and Textbook of Ophthalmology (Jaypee Brothers Medical Publishers, New Delhi, 6th ed., 2012) are some of his popular books. He edited 10 volumes of Recent Advances in Ophthalmology and 2 editions of Diagnostic Procedures in Ophthalmology, which were well received by readers and favorably reviewed in Indian and International Journals. He delivered guest-lectures in many universities.



Nitin Nema is an experienced phaco and vitreoretinal surgeon. He did his Fellowship from the Aravind Eye Hospital, Madurai, Tamil Nadu, India. He gained clinical and research experience from the University of Illinois at Chicago, and the University of Wisconsin at Madison. He was awarded a Fellowship by the All India Ophthalmological Society to work on a Uveitic Project at Sankara Nethralaya, Chennai, Tamil Nadu, India. He was awarded Dr Mohan Lal Gold Medal for the best paper. He had authored (in collaboration with Dr HV Nema) 2 textbooks: Anatomy of the Eye and Adnexa, 3rd edition and Textbook of Ophthalmology, 6th edition, and edited 9 volumes of Recent Advances in Ophthalmology, and 2 editions of Diagnostic Procedures in Ophthalmology.

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