

# Oculomotor nerve

**Nervus oculomotorius (N. III.),** oculomotor nerve. Like most other cranial nerves (*nervi craniales*) it emerges from the brainstem.

## Anatomy

Contains 2 types of efferent fibers:

somatomotor

- innervate the oculomotor muscles together with *N. IV.* (*m. obliquus bulbi superior*) and *N. VI.* (*m. rectus lateralis*)
- They come from the motor nucleus *ncl. nervi oculomotorii* in the tegmentum

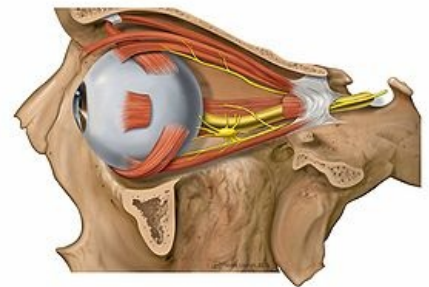
visceromotor parasympathetic

- parasympathetic innervating **ganglion ciliare** and through it **m. ciliaris** (accommodation) and **m. sphincter pupillae** (miosis)
- come from *ncl. accessorius nervi oculomotorii* in the mesencephalon tegmentum

## Progress

### Extracerebral course of the nerve:

- exit from the brain medially from the *crura cerebri* to the side of the *fossa interpeduncularis*
- penetrates into the subarachnoid cistern – a sheath is formed around the nerve and the *a. superior cerebelli* and *a. cerebri posterior* run there
- leaves the subarachnoid space between the attachment of the *tentorium cerebelli* and its free edge



*n. opticus, n. oculomotorius, ganglion ciliare*

### Extradural course:

- first under the inner sheet '**dura mater encephali**' laterally from the *processus clinoideus posterior* and goes to the ceiling of the *sinus cavernosus*
- before entering the orbit, sympathetic fibers from the sulcus caroticus internus join it and attach to the *n. ophthalmicus*
- enters the orbit at the *fissura orbitalis superior*, but even before that it divides into 2 branches: *ramus superior et inferior*

### Extracranial course:

- **ramus sup.:** runs along the lateral edge of the optic nerve and heads forward, where it divides into smaller branches innervating the *m. rectus superior bulbi* and *levator palpebrae superioris*
- **ramus inf.:** divides into 3 branches, they go under the *n. opticus* and innervate the **m. rectus medialis**, **m. rectus inferior**, **m. obliquus inferior**,

It emerges from the brainstem on the medial side of the peduncle in the *sulcus nervi oculomotorii* in the **fossa interpeduncularis**. It continues in the subarachnoid space, laterally from the *ramus communicans posterior* (Willis circle). It pierces the *dura mater*, laterally from the *processus clinoideus posterior* it enters the **sinus cavernosus** and continues in its lateral wall to the *fissura orbitalis superior*. It enters the orbit through **anulus tendineus communis** (Zinni) and there it divides into **ramus superior** (weaker) and **ramus inferior** (stronger). These branches further lead to the oculomotor muscles.

Near the ramus inferior lies the nervus opticus in the eye socket and about 1 cm behind the eyeball the parasympathetic ganglion ciliare, into which N. III. supplied by parasympathetic preganglionic fibers.

## Ganglion ciliare :

- 1-2 mm
- in the orbit in front of the *fissura orbitalis superior*

- in the fatty tissue between n. opticus and m. rectus lateralis bulbi
- also receives sympathetic fibers that just pass through it

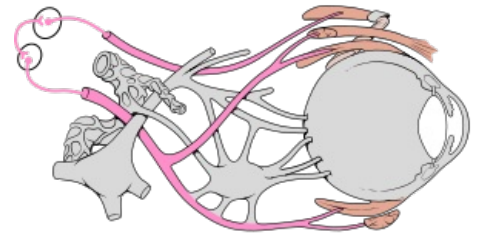
## Main Branches

### a) motor

- **ramus superior** - innervates **m. levator palpebrae superioris** and **m. rectus superior**;

### b) motor and parasympathetic

- **ramus inferior** - m. rectus medialis, m. rectus inferior, m. obliquus inferior ;
- **ramus ad ganglion ciliare** (*radix parasympathica ganglii ciliaris*) continues from the *ganglion ciliare* as postganglionic fibers **nn. ciliares breves** for **m. sphincter pupillae** and **m. ciliaris**



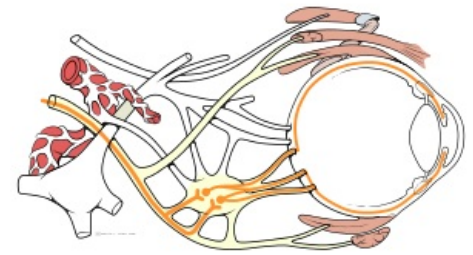
Somatic fibers via the *ramus superior et inferior* for innervation of oculomotor muscles

## Neurology

### Pupil innervation

Parasympathetic fibers n. III. they innervate the **m. sphincter pupillae** which causes miosis. Mydriasis (dilation) is made possible by the sympathetic.

Sympathetic pathways for innervation of the pupil originate in the **hypothalamus, pass through the brainstem and terminate in the ciliospinal sympathetic center in the spinal cord segments C8-Th1**. Here the preganglionic fibers exit to the cervical ganglia - **ggl. stellatum** and **ggl. cervicale superius**. Postganglionic fibers accompany the *a. carotis interna* to the sinus cavernosus and join the *n. ophthalmicus* and innervate the **m. dilatator pupillae** and **m. tarsalis**.



Parasympathetic fibers via the inferior ramus for innervation of the sphincter pupillae and ciliaris muscles

### Pupil photoreaction

Tr. opticus sends nerve fibers **contralaterally and ipsilaterally** to both *Edinger-Westphal nuclei*, each innervating its ipsilateral **m. sphincter pupillae**, so eye miosis occurs when one eye is illuminated (direct photoreaction) and unilluminated (indirect photoreaction).

- If the N. II. is affected, the direct photoreaction of the affected eye and the indirect photoreaction of the healthy eye will be extinguished.
- When the N. III. is affected, the direct reaction is extinguished in the affected eye, the indirect photoreaction is preserved in the healthy one.

### Impairment of the oculomotor nerve

As a result of the lesion N. III. a set of symptoms arises:

- **ptosis** - drooping of the upper eyelid,
- **strabismus divergens** - divergent squinting (predominance of the unaffected muscles *m. obliquus superior* and *m. rectus lateralis*) and as a result **diplopia** double vision)
- **iridoplegia (ophthalmoplegia)** - mydriatic pupil unresponsive to light,
- **disorders of close accommodation**.

### Impairment of sympathetic fibers - Horner's syndrome

- *Horner syndrome* = **ptosis** (mild), **miosis**, **enophthalmos** (rather apparent);
- central lesion - disruption of the sympathetic between the hypothalamus and the spinal cord center;
- peripheral lesion - disruption of the cervical sympathetic system;

## Links

### Related Articles

- Cranial Nerve Exits
- Ocular muscles
- Orbit
- Disorders of selected cranial nerves/PGS

## References

- ČIHÁK, Radomír. *Anatomy 3*. 2. edition. Grada Publishing a. s., 2004. 692 pp. pp. 473-474. ISBN 80-247-1132-X.
- AMBLER, Zdeněk. *Neurology for medical students*. 1. edition. Karolinum, 2001. 399 pp. pp. 45-50. ISBN 80-246-0080-3.
- FENEIS, Heinz. *Anatomický obrazový slovník*. 2. edition. Grada Publishing, 1996. 455 pp. pp. 320. ISBN 80-7169-197-6.
- KACHLÍK, David. *Hlavové nervy 1. díl : Přednáška* [online]. ©2012. [cit. 2012-01-24]. <<http://old.lf3.cuni.cz/anatomie/Hlavovenervy1.zip>>.
- GRIM, Miloš – DRUGA, Rastislav. *Základy anatomie, Periferní nervový systém, smyslové orgány a kůže*. 1. edition. Galén, 2014. 173 pp. ISBN 978-80-7492-156-8.