Anatomy

Cranial nerves & special senses

Introduction

- The 12 pairs of cranial nerves are referred to by either name or Roman numeral.
- Named according to their order in exist from the brain and from the skull.
- The optic nerve are ~~not true nerves~~ but rather fiber tracts of the brain, whereas nerve XI (the spinal accessory nerve) is derived, in part, from the upper cervical segments of the spinal cord.
- The remaining 9 pairs relate to the brain stem.
- Cranial nerve fibers with motor functions arise from the **motor nuclei** that lie deep within the brain stem; they are homologous to the **AHCs of the spinal cord**.
- Cranial nerve fibers with sensory functions have their cells of origin (**first-order nuclei**) outside the brain stem, usually in ganglia that are homologous to the dorsal root ganglia of the spinal nerves.

Nerves:

○ **Nerves I, II, and VIII**	➞ special sensory input
○ **Nerves III, IV, and VI**	➞ control eye movements and pupillary constriction
○ **Nerves III,IV,VI,XI and XII**	➞ pure motor
○ **Nerves V, VII, IX, and X**	➞ mixed (1975)
○ **Nerves III, VII, IX, and X**	➞ carry parasympathetic fibers (1973)

A. Olfactory nerve (I) : -	
Description	▪ First and shortest CN.
Course	▪ Olfactory epithelium (Olfactory receptor cells in nasal mucosa ⇢ 9 to 15 olfactory nerves that are short connections) ➞ passes through **cribriform plate** of ethmoid bone ➞ run through olfactory bulb within cranial cavity (lies just above the cribriform plate) ➞ olfactory tract ➞ olfactory areas in the brain .
Termination	▪ **Primary olfactory area:** located in the uncus. ▪ **Olfactory association area (area 28):** in the anterior part of the Para-hippocampal gyrus.
Function	▪ Smell
Lesion	▪ Partial or complete loss of smell

B. Optic nerve (II) & Visual pathway: -

Intro

- Optic N contains myelinated axons that arise from the ganglion cells in retina.
- Axons within optic nerve are myelinated by oligodendrocytes.
- It contains a central retinal artery and vein.
- It is covered by the brain meninges and CSF.
- The optic nerve is considered a part of **central nervous system.**
- The optic nerve passes through the optic papilla to the orbit.

Visual pathway

- **Retina** (retinal ganglion cells) ⇢ **optic nerve**" passes through optic canal" ⇢ **optic chiasma** "temporal fibers enter ipsilateral optic tract, while nasal fibers cross midline and enter contralateral optic tract" ⇢ Thalamus at Lateral geniculate body (**LGB**) ⇢ **Optic radiation** ⇢ Retro-lenticular part of the internal capsule ⇢ Primary visual area (**area 17**) ⇢ Visual association areas (**areas 18 & 19**).

Optic Tract	Left optic tract ➔ contains fibers from left temporal (lateral) retina, and right nasal (medial) retina.
	Right optic tract ➔ contains fibers from right temporal retina and left nasal retina.
optic Radiation	Upper optic radiation ➔ carries fibers from superior retinal quadrants (inferior visual field). It travels through the parietal lobe to reach visual cortex.
	Lower optic radiation – carries fibers from inferior retinal quadrants (superior visual field). It travels through the temporal lobe to reach the visual cortex

Lesions

Site	Lesion
Optic nerve	- Total blindness of the same eye.
Optic chiasma	- **Midline "Pituitary tumor"** → Bitemporal hemianopia. - **Peripheral lesion on 2 sides** → Binasal hemianopia.
Optic tract	- Contralateral homonymous hemianopia. (CHH)
LGB & optic radiation	
Visual area	- **Total lesion** → contralateral homonymous hemianopia with macular sparing. Sparing is due anastomoses between MCA & PCA. - **Above calcarine sulcus (cuneus)** → contralateral homonymous lower quadrantic anopia. - **Below calcarine sulcus (lingual gyrus)** → contralateral homonymous upper quadrantic anopia.

EYE MOVEMENT NERVES

	Oculomotor nerve (III)	Trochlear nerve (IV)	Abducent nerve (VI)
Type	**Motor nerve**		
	All eye ms except LR6, SO4	SO4	LR6
Deep Origin	**It has a nuclear complex at the level of superior colliculus of midbrain.** **Somatic motor nucleus:** - It supplies Levator palpebrae superioris and all EOM except SO4, LR6 **Parasympathetic nucleus (Edinger-Westphal):** - Medial - Fibers synapse in ciliary ganglion and supply sphincter pupillae and ciliary muscles. **Accessory oculomotor nuclei:** - Interstitial nucleus of Cajal ⇢ For vertical movements of 2 eyes - connects: a. The oculomotor nuclei of the 2 sides for upward eye movement. b. Oculomotor and trochlear nuclei of the 2 sides for downward eye movement. - Pretectal nucleus ⇢ for the pupillary light reflex.	The motor nucleus is located at the level of **inferior colliculus of midbrain.** The axons cross to the opposite side to supply the opposite superior oblique muscle. **It is the only cranial nerve which appears from the back of the brain stem.** It has the longest intracranial course.	**The abducent nucleus is formed of 2 parts:** 1) **Abducent motor nucleus:** - It supplies the lateral rectus muscle. - with the encircling facial nerve fibers forms facial colliculus of the 4th ventricle. 2) **Para-abducent nucleus (horizontal gaze center):** - It connects abducent nucleus of the same side with oculomotor nucleus of the opposite side through the MLF for the ipsilateral lateral gaze (lateral rectus of the same side and medial rectus of the opposite side).
Course & Distribution	**The nerve then pierces the dura mater and enters the lateral wall of the cavernous sinus.** **The nerve leaves the cranial cavity via superior orbital fissure.** ▪ Motor ➝ Innervates the majority of extraocular muscles (laevator palpebrae superioris, SR, IR, MR and IO). ▪ Parasympathetic ➝ Supplies: ✓ sphincter pupillae➝ constricts the pupil ✓ ciliary muscles of the eye➝makes eye more adapted to short range vision. (Accommodation)	It moves along lateral wall of cavernous sinus before entering the orbit of the eye via the **superior orbital fissure.** The trochlear nerve innervates the contralateral superior oblique. The action of superior oblique is: ▪ Depress the eye ▪ Intorsion of eye.	Enters cavernous sinus. It travels through the cavernous sinus and enters the bony orbit via **superior orbital fissure.** Within the bony orbit, the abducens nerve terminates by innervating the lateral rectus muscle.
Lesions	1) **Paralysis of Levator palpebrae superioris:** ptosis (drooping of the upper eyelid). 2) **Paralysis of medial rectus muscle:** external strabismus (by lateral rectus). 3) **Paralysis of sphincter pupillae muscle:** mydriasis (dilatation of pupil). 4) **Loss of light and accommodation reflex of the same eye**	▪ **Paralysis of superior oblique muscle.** - It causes inability to depress the adducted eye causing **difficulty in walking downstairs.**	▪ **Paralysis of lateral rectus muscle** ⇢ internal strabismus (squint).