

Cranial Nerves and Common Peripheral Lesions

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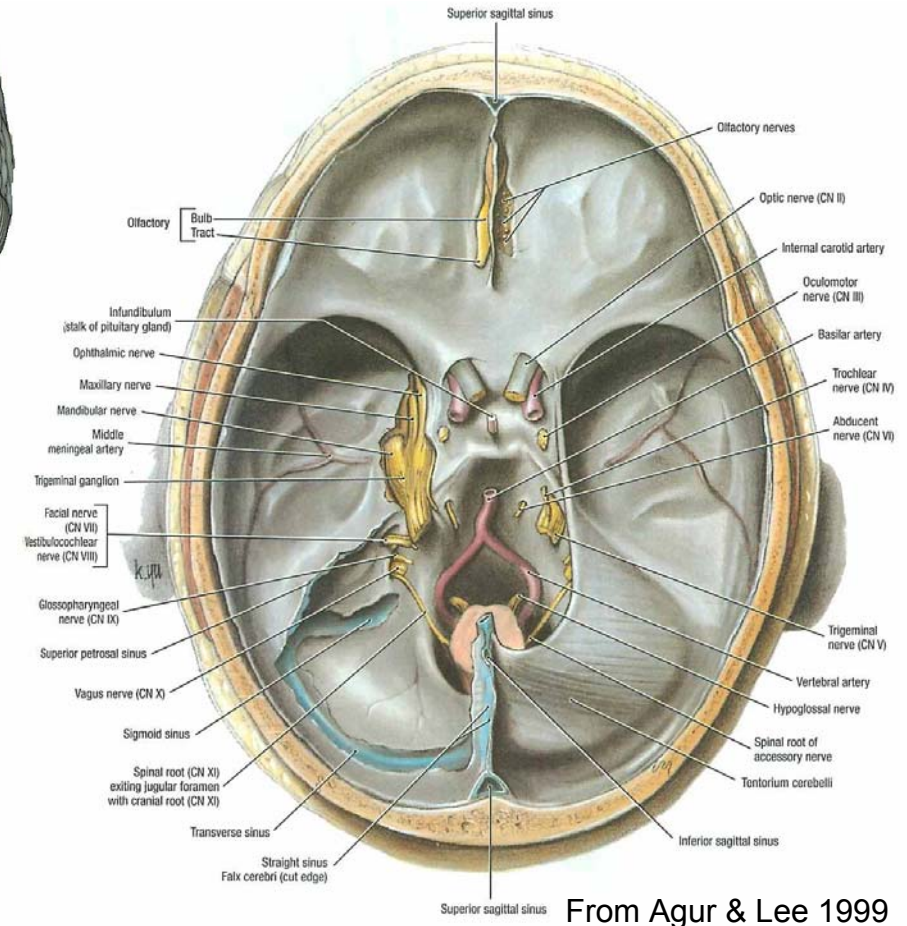
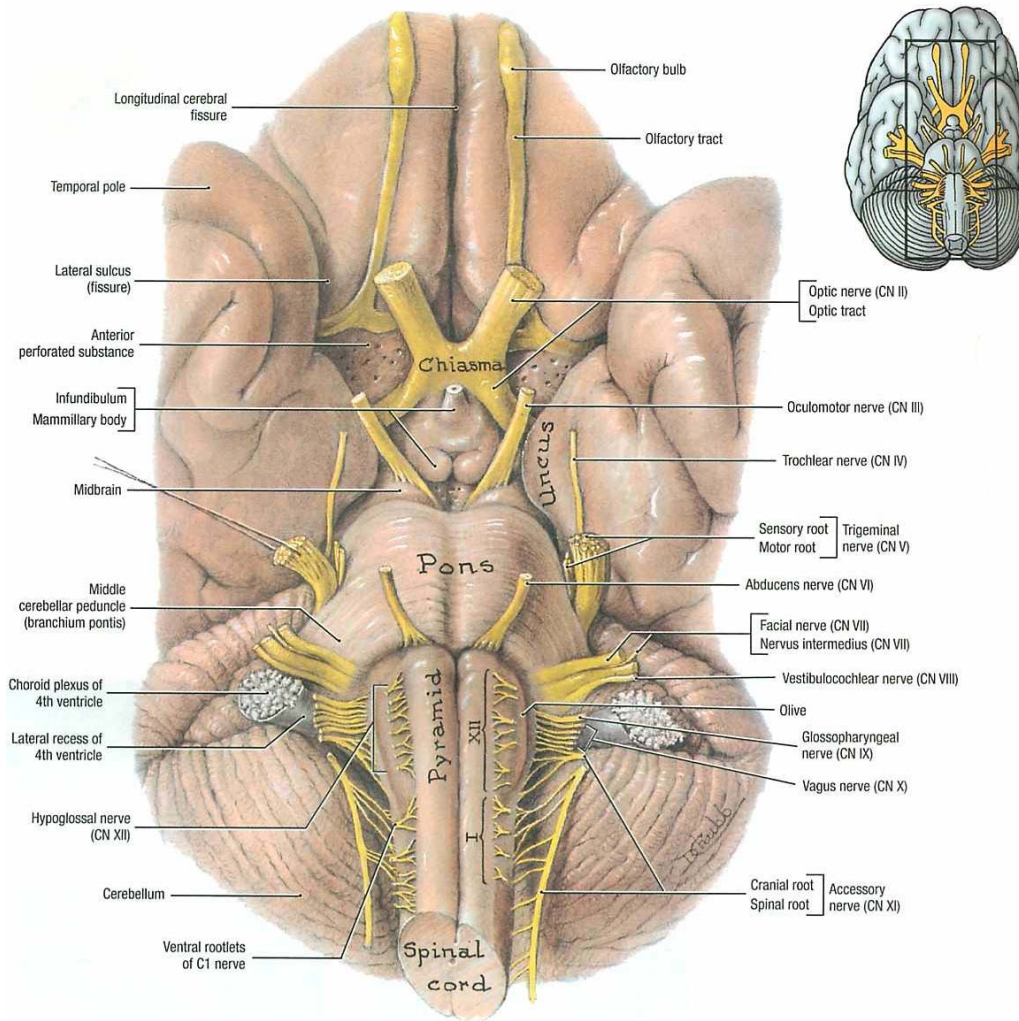
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Basic Organization of the Cranial Nerves



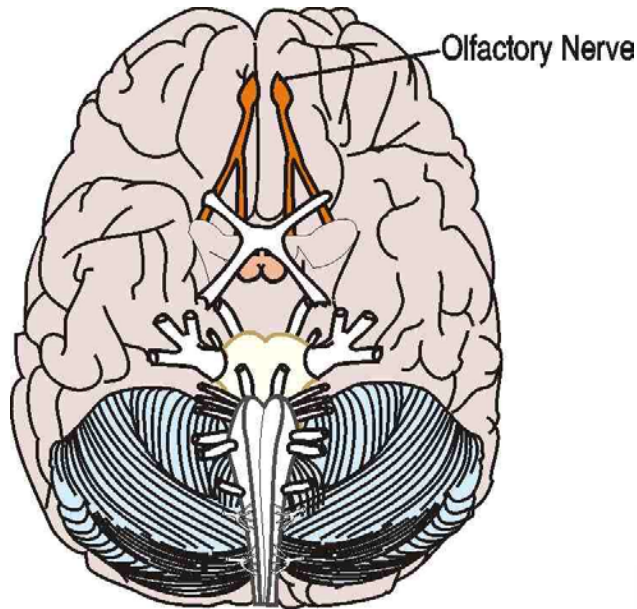
From Agur & Lee 1999

- I. Olfactory nerve
- II. Optic nerve
- III. Oculomotor nerve
- IV. Trochlear nerve

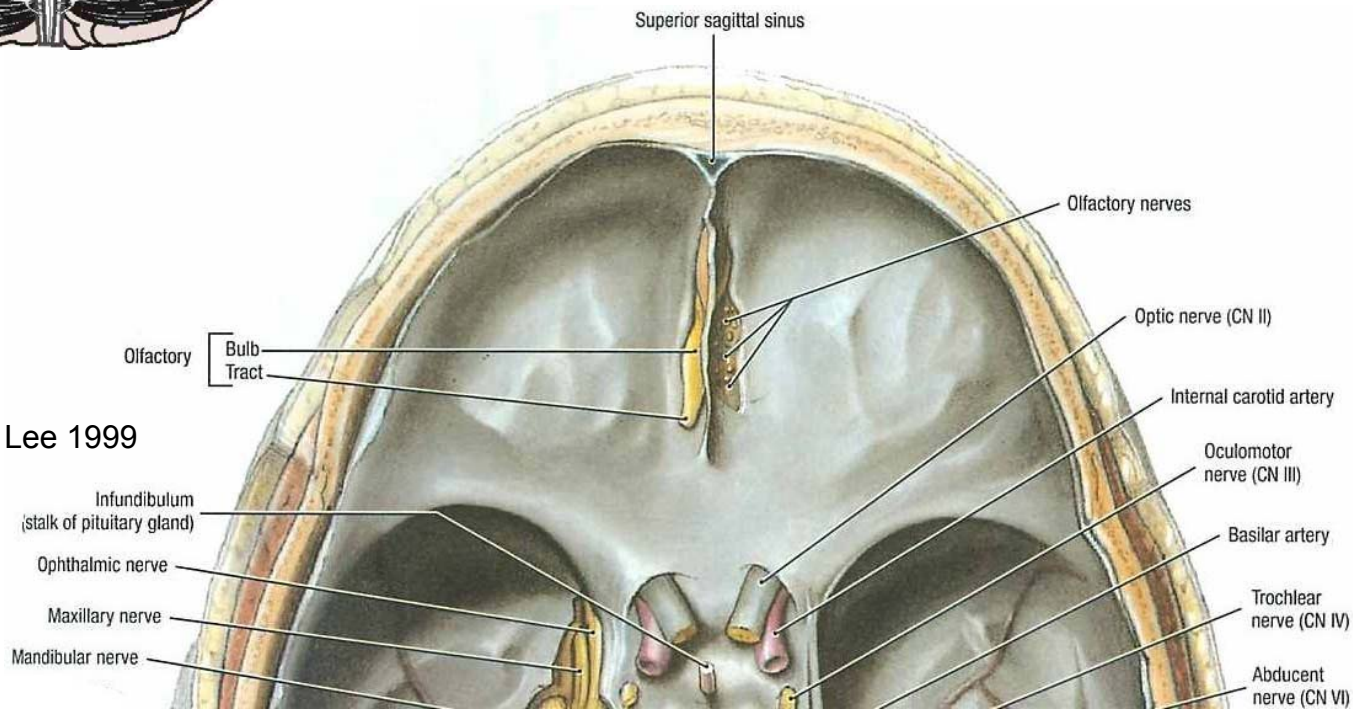
- V. Trigeminal nerve
- VI. Abducens nerve
- VII. Facial nerve
- VIII. Auditory nerve

- IX. Glossopharyngeal nerve
- X. Vagus nerve
- XI. Accessory nerve
- XII. Hypoglossal nerve

Olfactory Nerves (CN I)

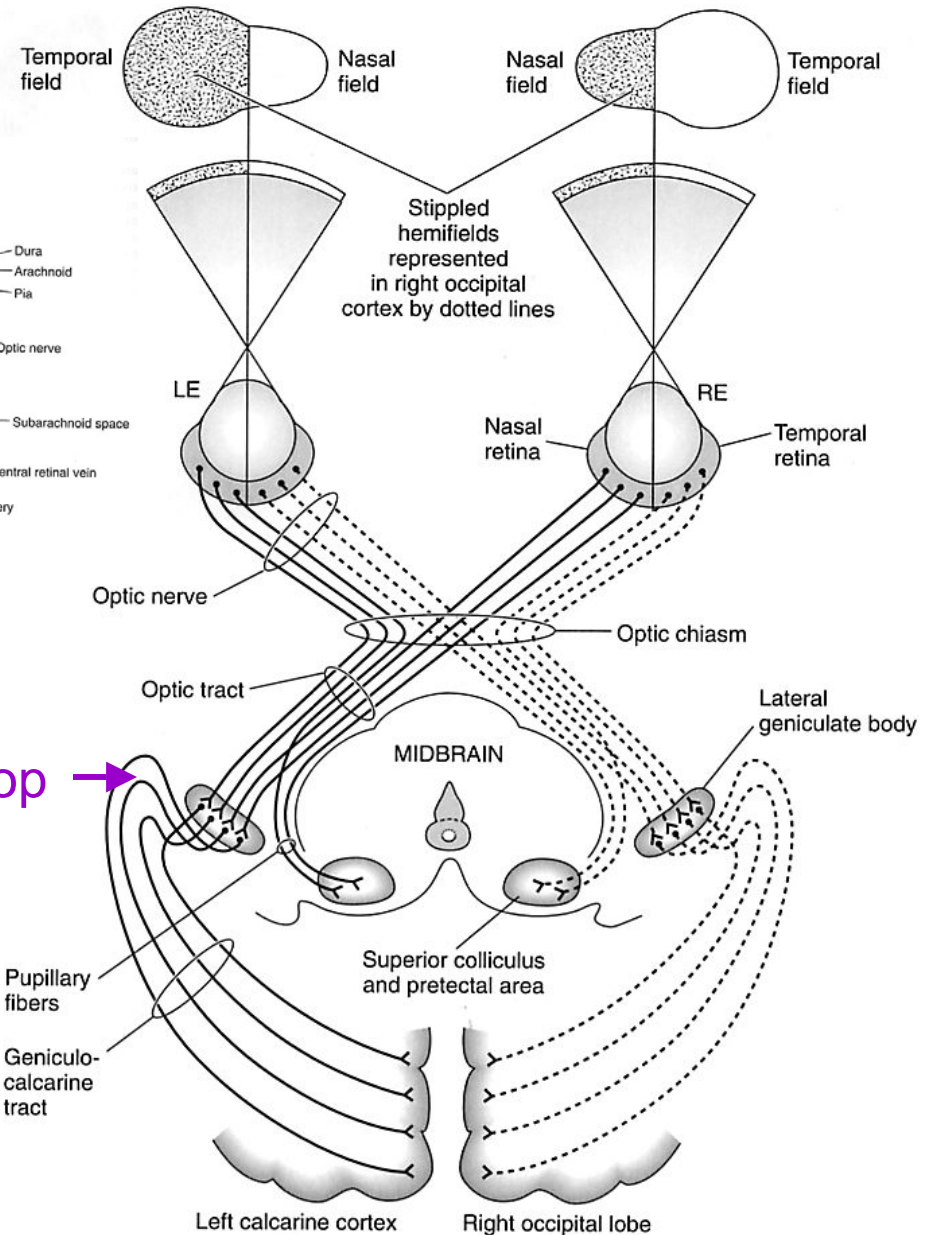
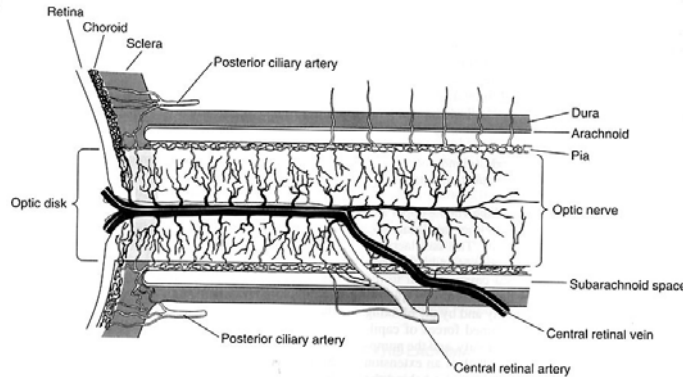
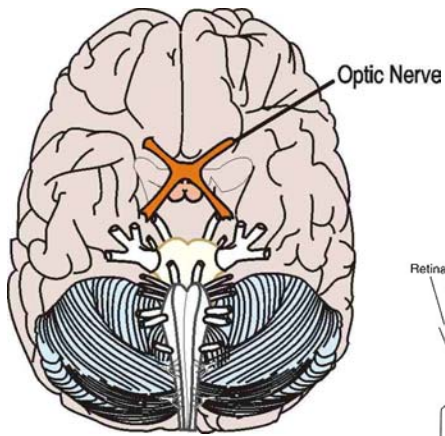


- Anosmia: diminished sense of smell
 - Transient (non-neural): upper respiratory tract infection
 - Fracture of cribriform plate
 - Frontal lobe tumor
 - Purulent meningitis or hydrocephalus
- Testing: each nostril separately
 - As early as 32 weeks gestation
 - Familiar odors: coffee, peppermint



From Agur & Lee 1999

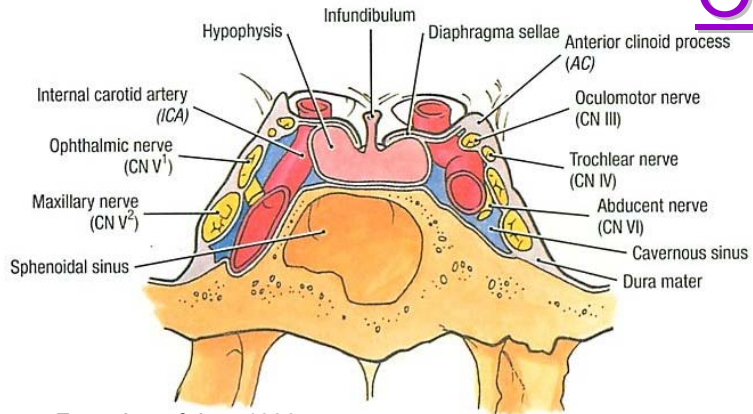
Optic Nerve (CN II)



- Optic nerve is technically CNS
- Complicated course from retina to visual cortex
- Quadrants of visual fields
 - temporal vs. nasal
 - upper vs. lower
- Crossing of axons in optic chiasm
- Info from left or right visual field is carried to contralateral visual cortex
- Info from upper or lower visual field is carried lower or upper side, respectively, of calcarine fissure

Meyer's loop →

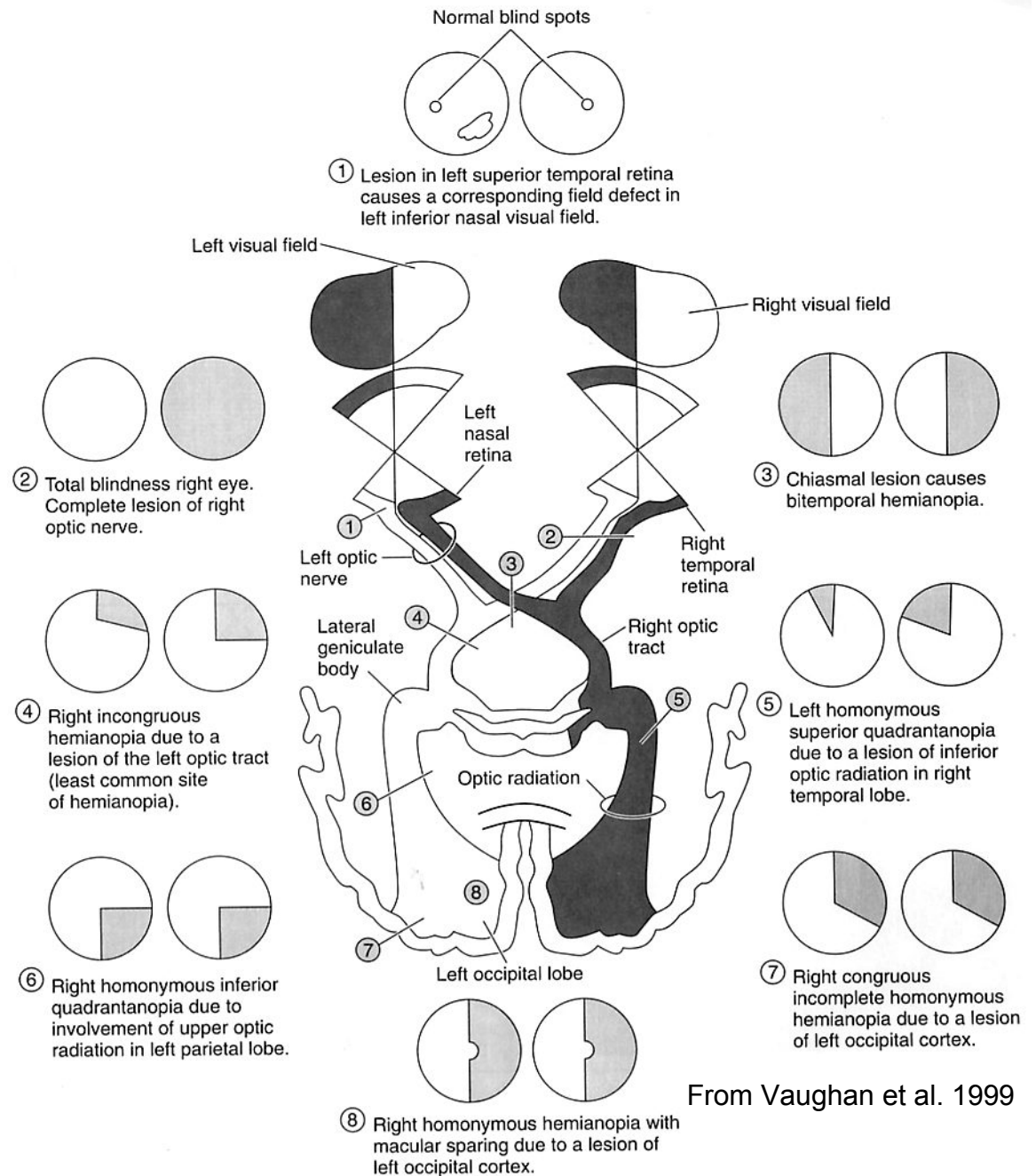
Optic Nerve (CN II)



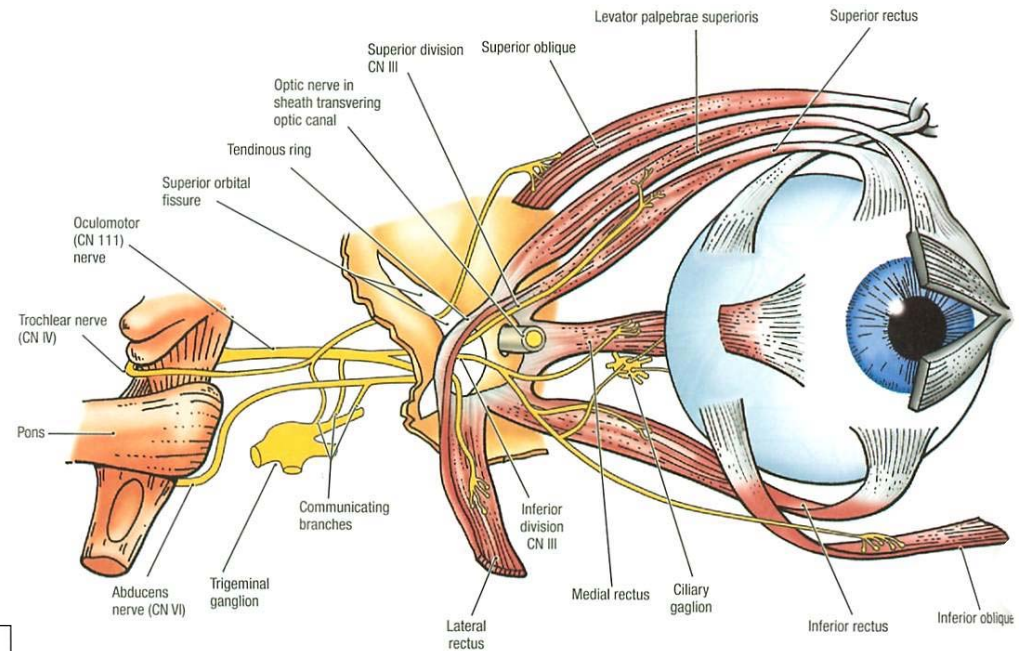
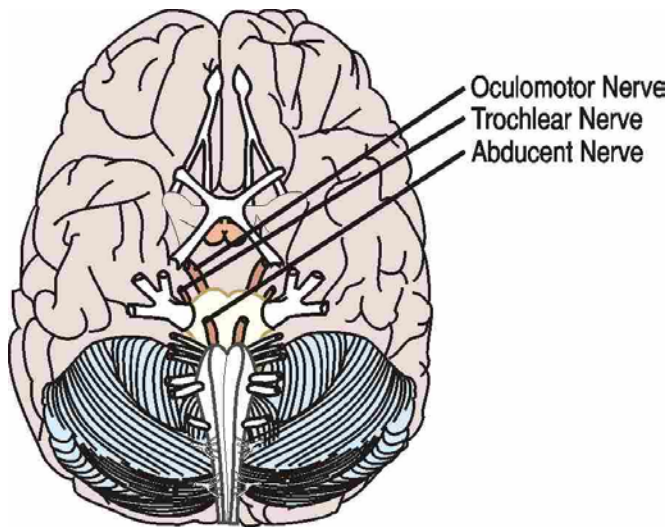
From Agur & Lee 1999

Visual Field Defects

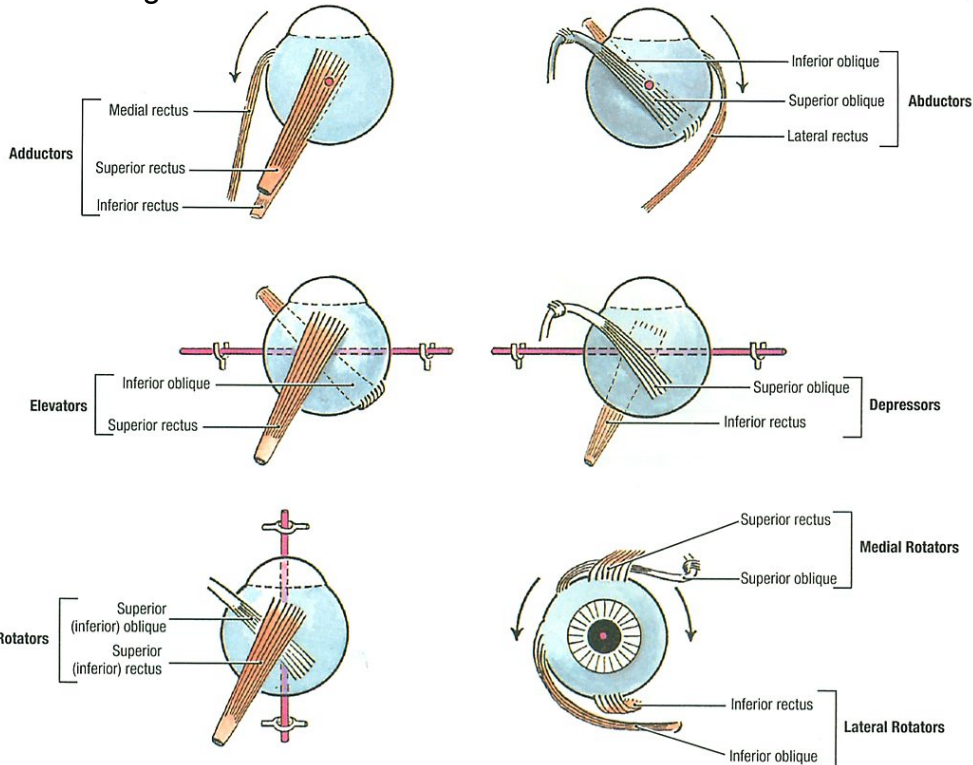
- Complicated but predictable
- Optic n.: ipsilateral blindness; retinal a. obstruction, retrobulbar optic neuritis
- Optic chiasm
 - Central: bitemp. hemianop., pituitary tumors, etc.
 - Lateral: ipsilat. nas. hemianop., carotid aneurysm
- Optic tract, radiations, cortex: contralat. homonym. hemianop., stroke, tumor, trauma, quadrantanopia



Oculomotor N., Trochlear N., & Abducens N. (CN III, IV, & VI)



From Agur & Lee 1999



From Agur & Lee 1999

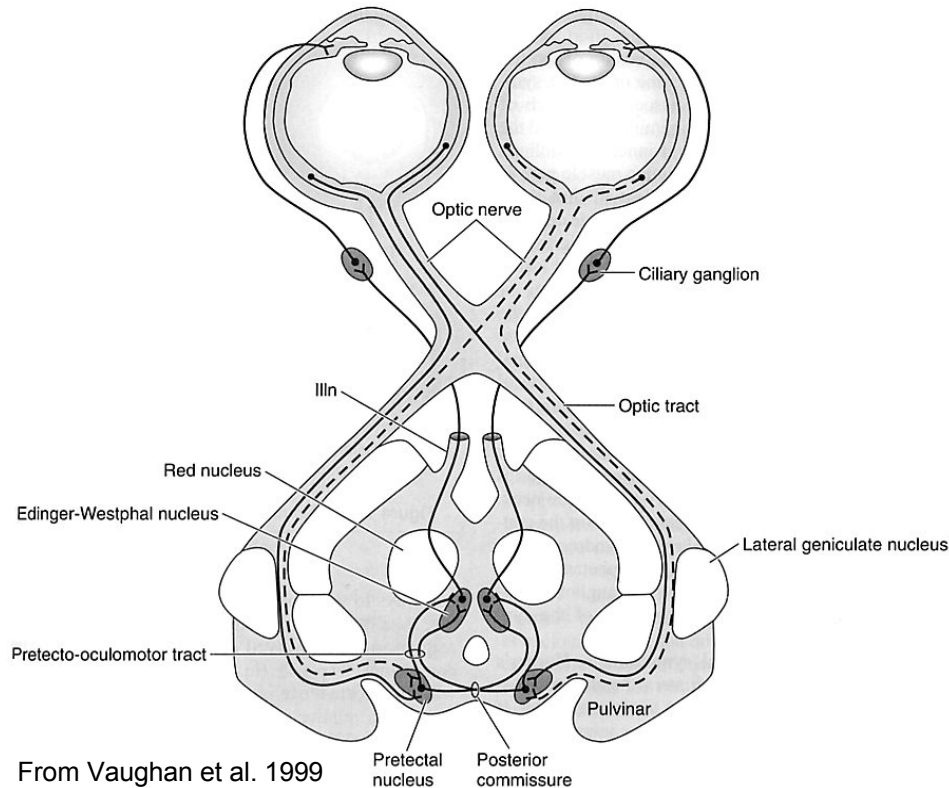
Oculomotor N. (CN III)

- Somatic innervation: superior, medial, & inferior rectus, inferior oblique, levator palpebrae
- Visceral innervation: constrictor pupillae, ciliary muscle (accommodation)

Trochlear N. (CN IV): superior oblique

Abducens N. (CN VI): lateral rectus

Oculomotor N. (CN III)

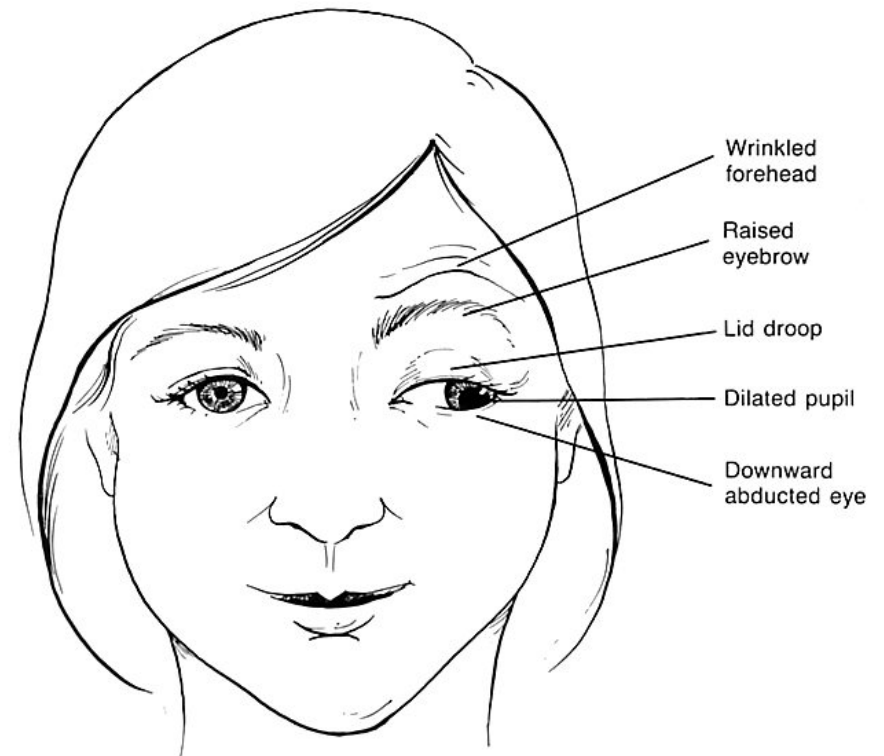


Pupillary light reflex

- afferent limb: retina, optic n., etc.
- efferent limb: visceral oculomotor fibers to constrictor pupillae
- Afferent limb crosses to contralateral side: consensual light reflex
- Oculomotor lesion: ipsilateral dilation but contralateral constriction

Ophthalmoplegia: Oculomotor lesion

- Causes: aneurysm, inflammation, cavernous sinus lesion, herniation of temporal lobe
- Effects: strabismus, diplopia, ptosis, mydriasis, downward abducted gaze, loss of accommodation



From Wilson-Pauwels et al. 1988

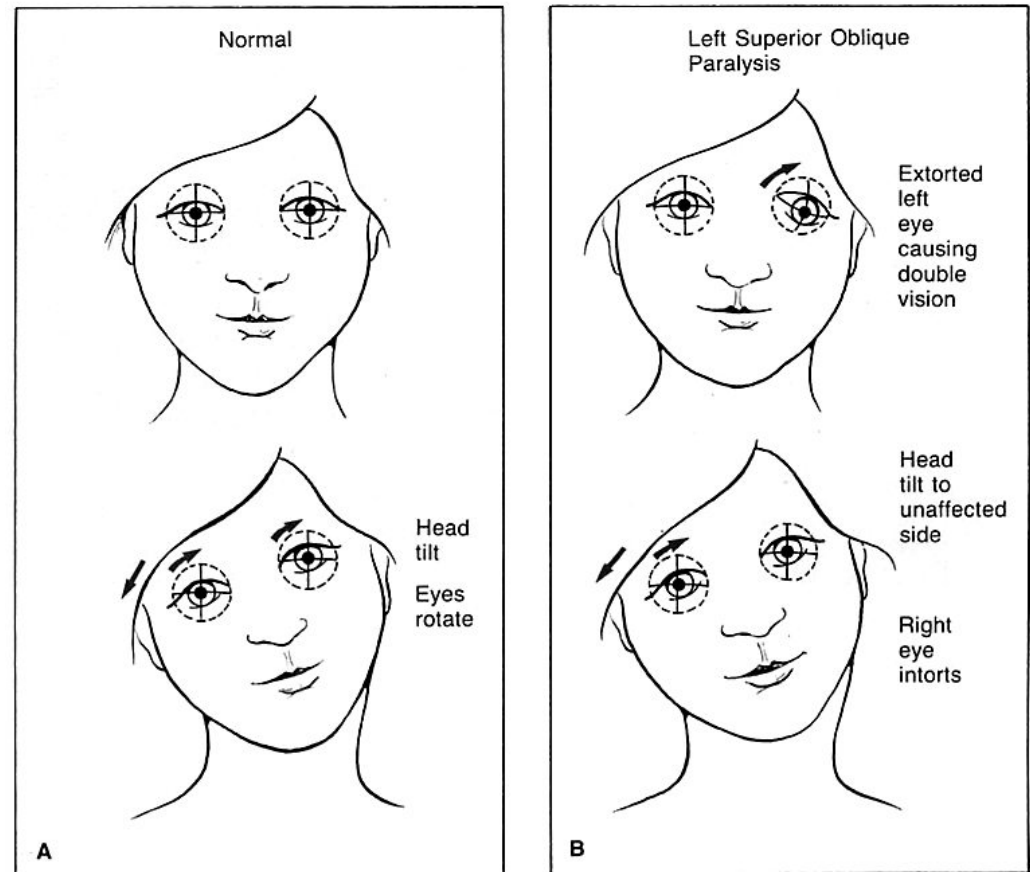
Trochlear N. (CN IV)

Trochlear N. lesions

- Causes: aneurysm, inflammation, cavernous sinus lesion, herniation of temporal lobe (long course & thin caliber makes it delicate)
- Effects: strabismus, diplopia, extorsion, weakness in depression & abduction of gaze

Head tilting

- Normally: eyes rotate in opposite direction of tilt
- Fourth nerve palsy compensation: intentionally tilt contralaterally so that normal eye intorts and lines up with affected eye

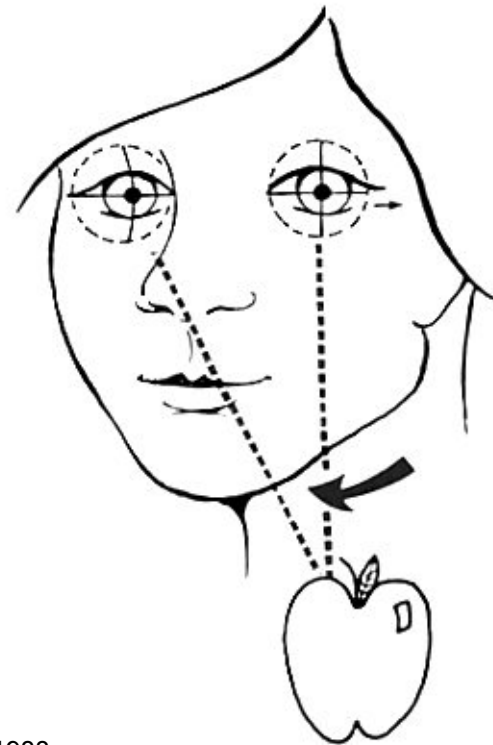
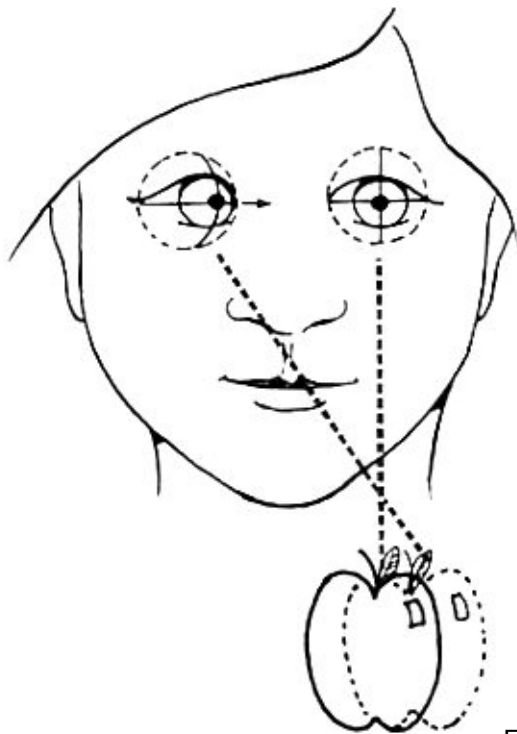


From Wilson-Pauwels et al. 1988

Abducens N. (CN VI)

Abducens N. lesions

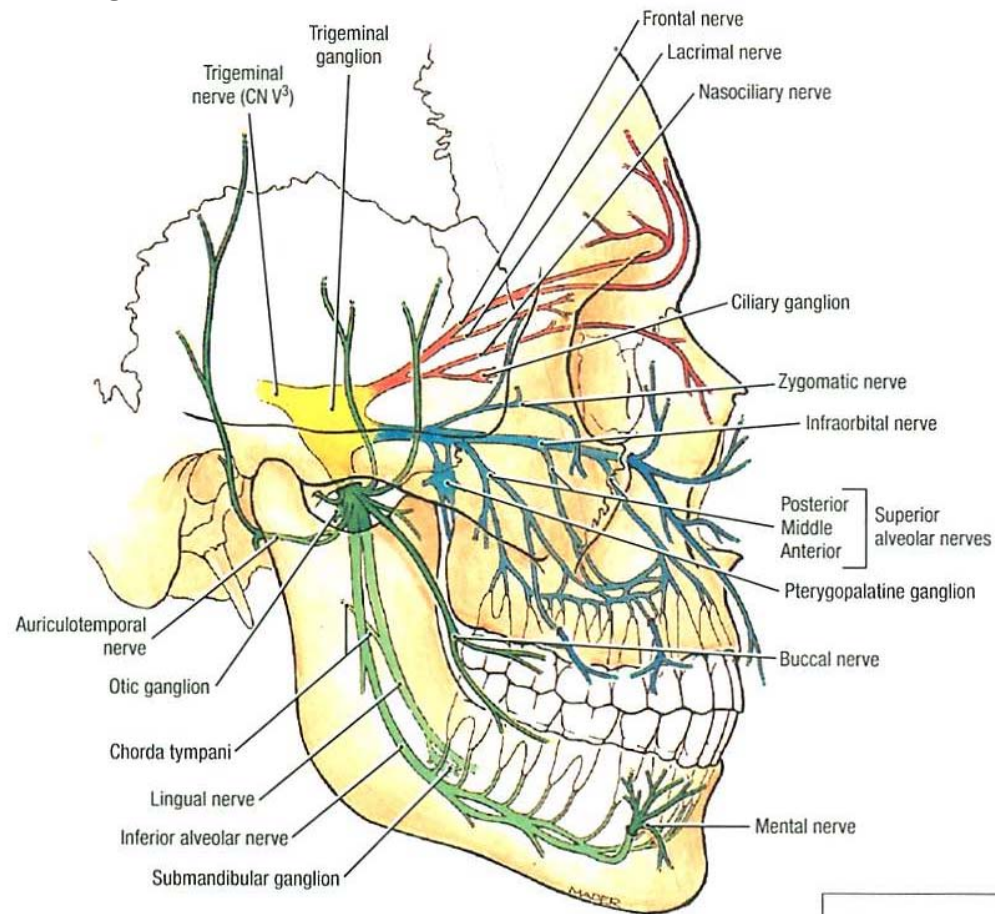
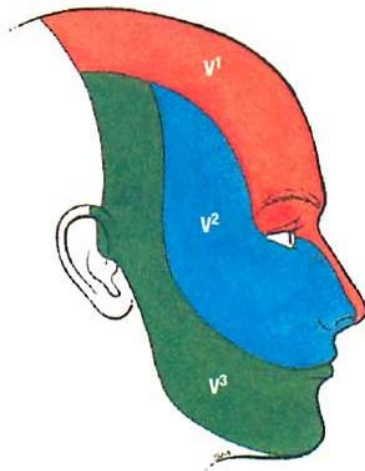
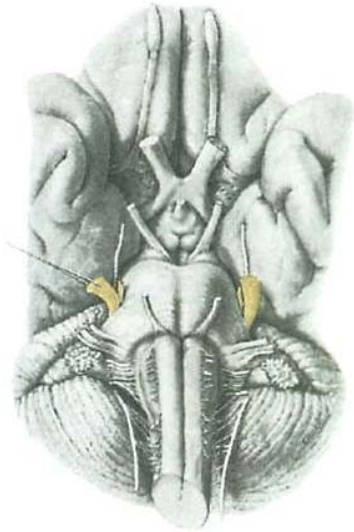
- Causes: aneurysm, inflammation, cavernous sinus lesion, increased intracranial pressure, fourth ventricle lesions, lesions within cavernous sinus or superior orbital fissure, skull base fractures
- Effects: strabismus, diplopia, inability to abduct past midline
- Compensation for sixth nerve palsy: turn head contralaterally to align gaze



From Wilson-Pauwels et al. 1988

Trigeminal N. (CN V)

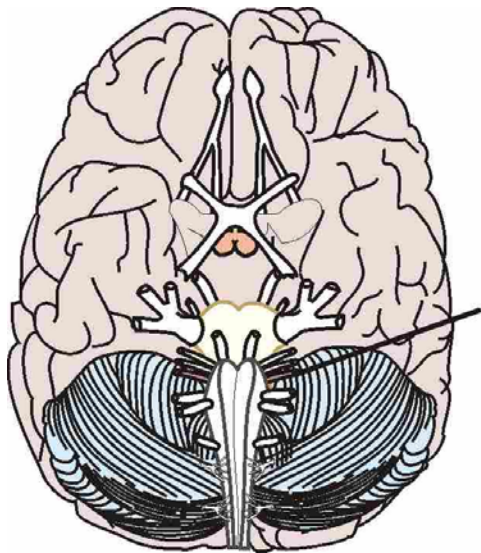
- Clinical testing: facial sensation corresponding to areas innervated by V_1 , V_2 , & V_3 , masticatory strength, jaw jerk reflex, corneal reflex
- Trigeminal neuralgia (tic douloureux)
- Ophthalmic herpes zoster (“shingles”)



Nerves:	
■	Ophthalmic
■	Maxillary
■	Mandibular

From Agur & Lee 1999

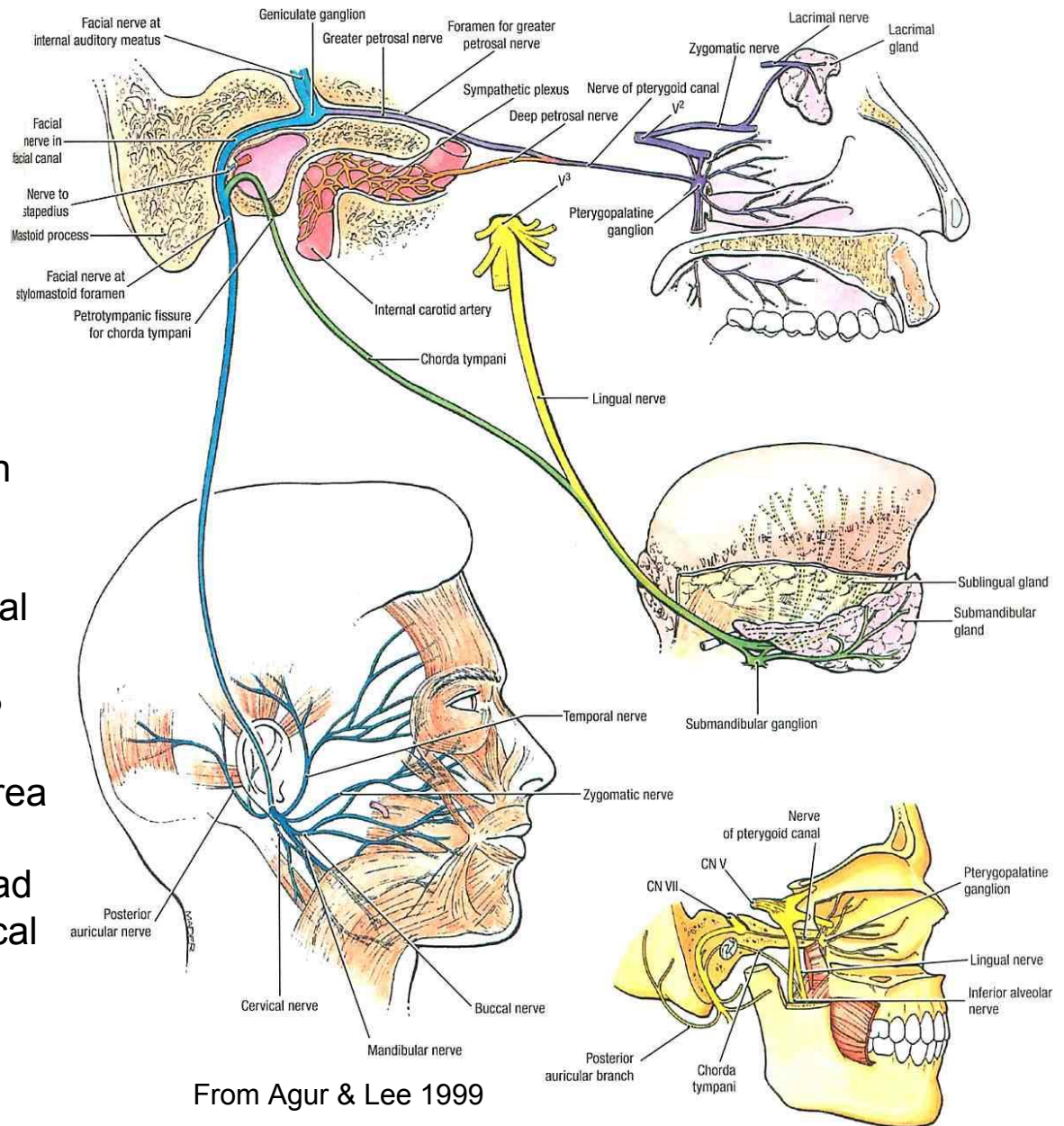
Facial N. (CN VII)



Facial Nerve

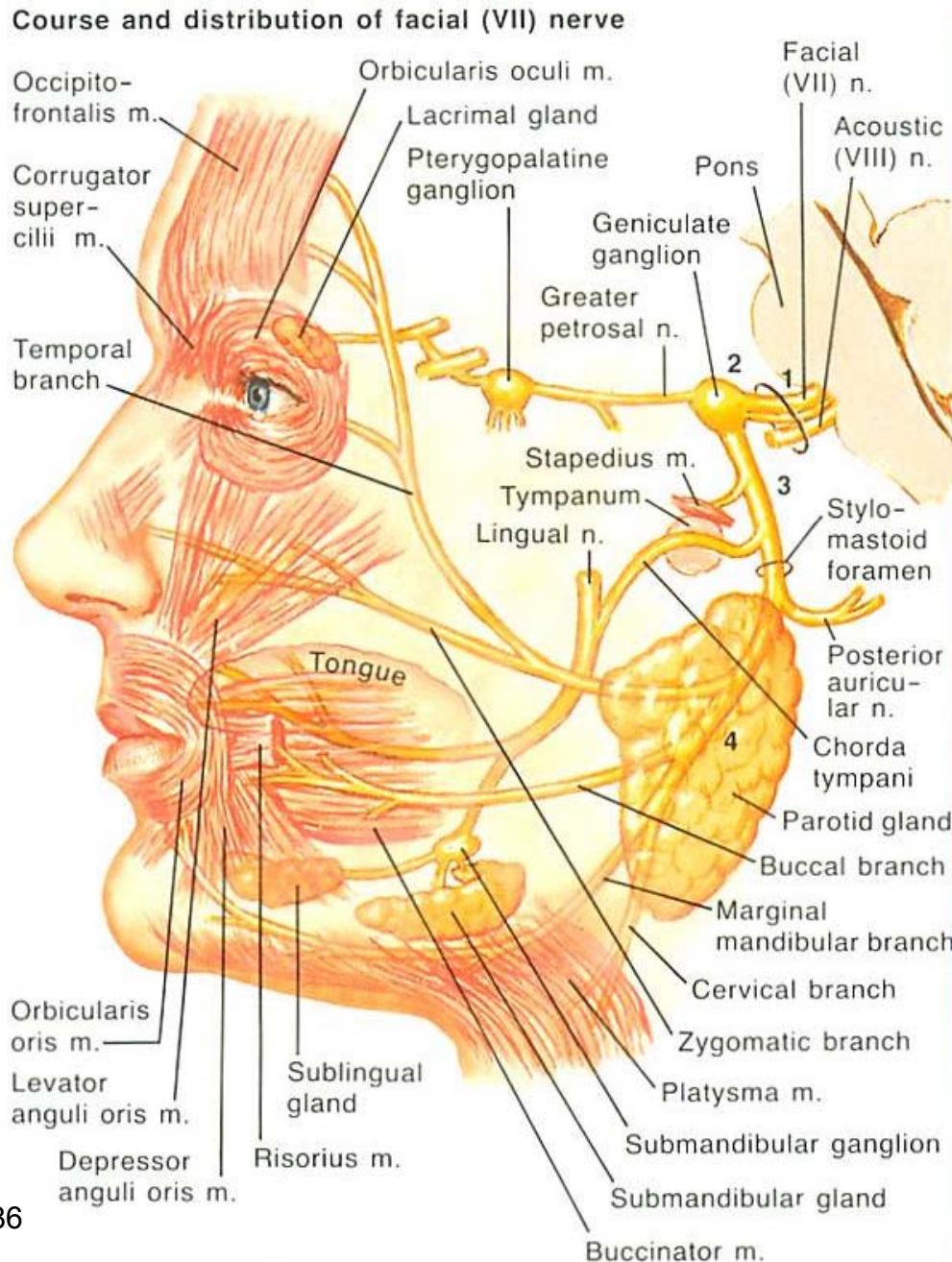
Complicated!

- Motor: muscles of facial expression & some others
- Parasympathetic: stimulation of lacrimal, submandibular, sublingual glands, nasal/palatal mucosa
- Special sense: taste to anterior 2/3 of tongue and palate
- Somatic sense: small part of ear area
- Branches travel throughout the head
- Complexity provides basis for clinical testing



From Agur & Lee 1999

Facial N. (CN VII) Lesions & Their Consequences



Sites of lesions and their manifestations

1. Intracranial and/or internal auditory meatus. All symptoms of 2, 3 and 4, plus deafness due to involvement of eighth cranial nerve
2. Geniculate ganglion. All symptoms of 3 and 4, plus pain behind ear. Herpes of tympanum and of external auditory meatus may occur
3. Facial canal. All symptoms of 4, plus loss of taste in anterior tongue and decreased salivation on affected side due to chorda tympani involvement. Hyperacusia due to effect on nerve branch to stapedius muscle
4. Below stylomastoid foramen (parotid gland tumor, trauma). Facial paralysis (mouth draws to opposite side; on affected side, patient unable to close eye or wrinkle forehead; food collects between teeth and cheek due to paralysis of buccinator muscle)

Facial N. (CN VII) Lesions & Their Consequences

UMNL

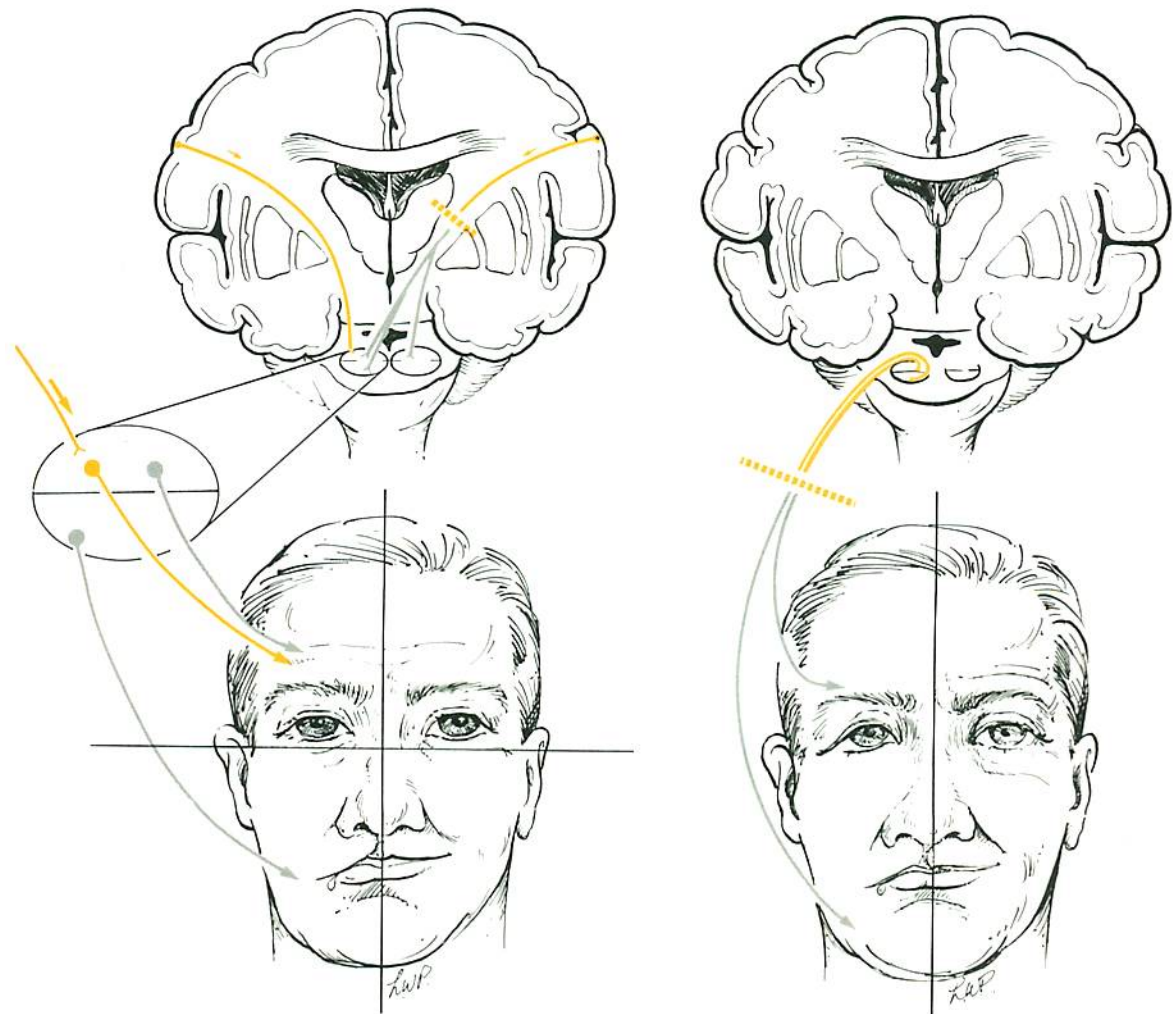
LMNL

Lower Motor Neuron Lesions (LMNL)

- lesion of facial nucleus or more peripheral
- Ipsilateral effects on both upper and lower quadrants of face

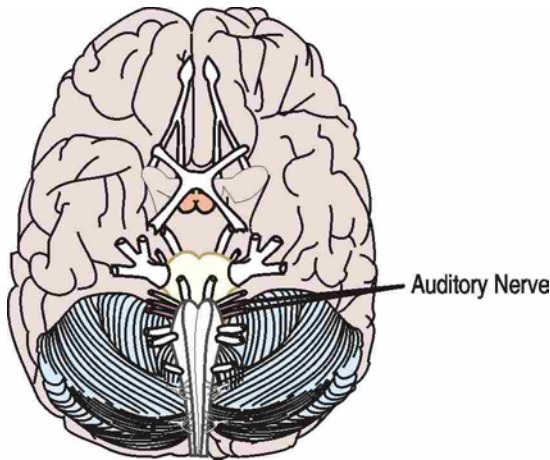
Upper Motor Neuron Lesion (UMNL)

- Supranuclear lesion (e.g., cortex)
- Contralateral effects on lower quadrant only
- Upper quadrant receives input from both hemispheres whereas lower quadrant only contralateral input



From Wilson-Pauwels et al. 1988

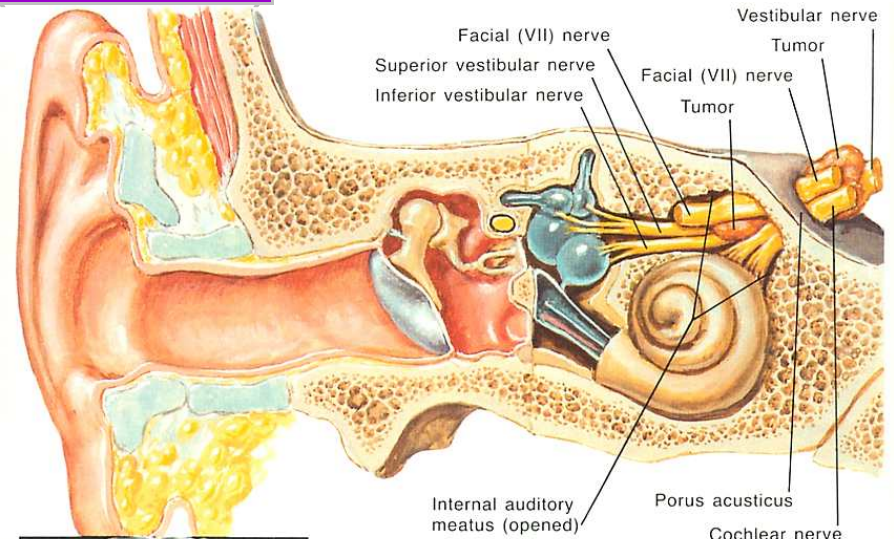
Auditory N. (CN VIII)



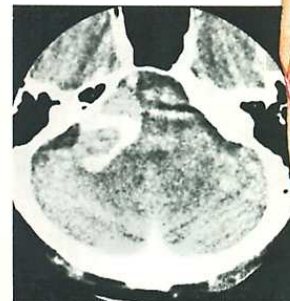
Auditory N.

(= Vestibulocochlear, Acoustic N.)

- No extracranial course
- Hearing and equilibrium
- Tumors within internal auditory meatus (acoustic neuromas, meningiomas) will affect not only CN VIII but also CN VII
- A variety of more central lesions or lesions of the end organs (cochlea or labyrinth) can affect hearing, equilibrium, the oculovestibular reflex, etc., producing deafness, vertigo, nystagmus, etc.

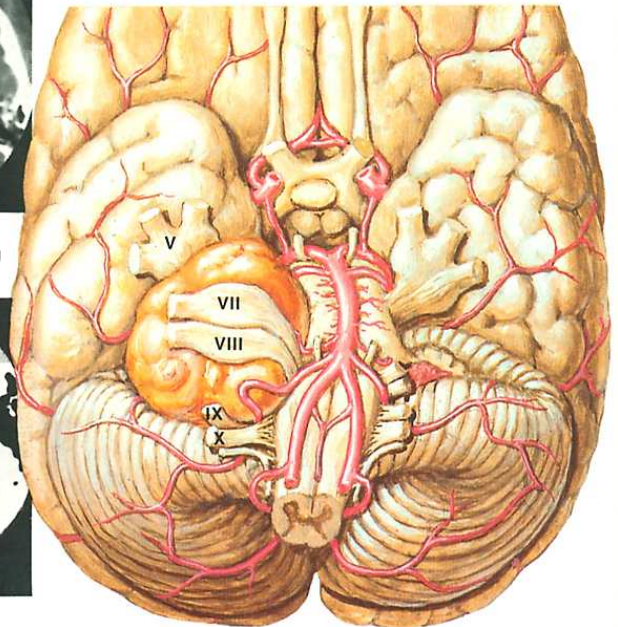


CT scan showing small acoustic neurinoma expanding left porus acusticus



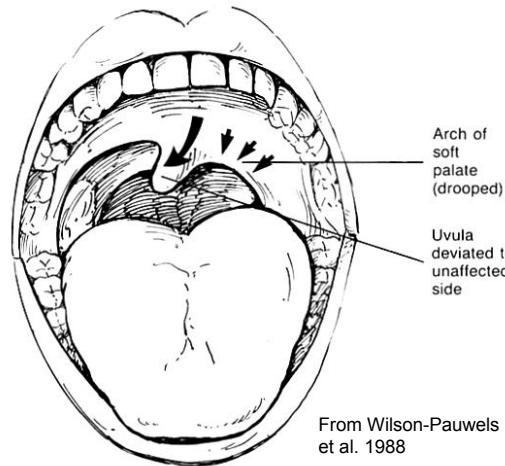
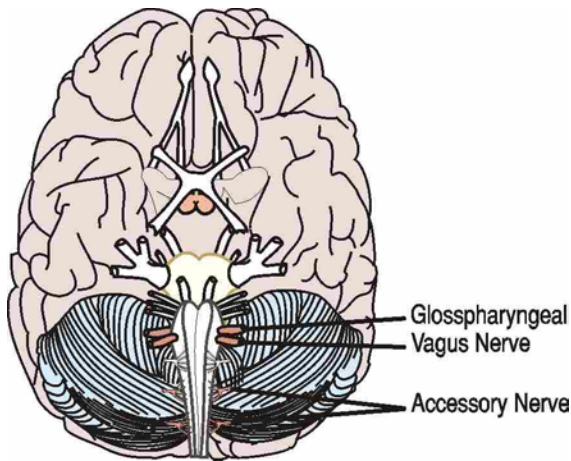
Contrast-enhanced CT scan showing moderate-sized left neurinoma, with some distortion of 4th ventricle

Small neurinoma arising from superior vestibular nerve in internal auditory meatus and protruding into posterior fossa

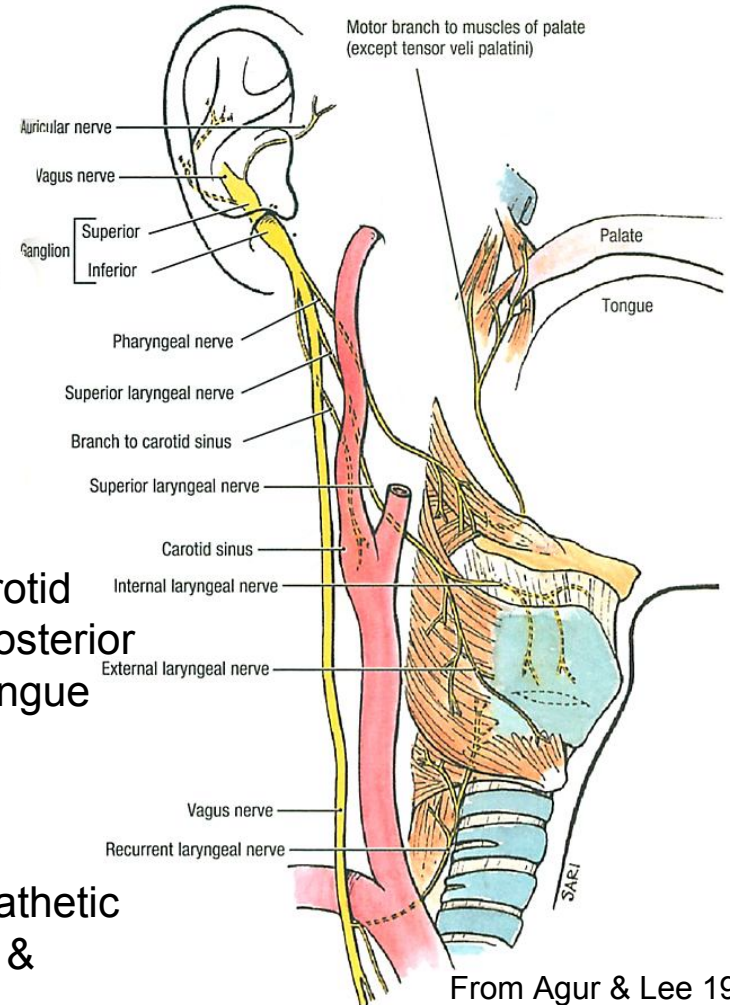


Large acoustic neurinoma filling cerebellopontine angle, distorting brainstem and cranial nerves V, VII, VIII, IX, X

Glossopharyngeal N., Vagus N., & Accessory N. (CN IX, X, & XI)



From Wilson-Pauwels et al. 1988



From Agur & Lee 1999

Glossopharyngeal N. (CN IX) unilateral lesion of left vagus n.

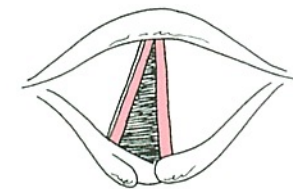
- motor to stylopharyngeus, parasympathetic outflow to parotid gland, sensation from carotid body & sinus, taste from posterior 1/3 of tongue, somatic sensation from posterior 1/3 of tongue and pharynx
- Tested by gag reflex

Vagus N. (CN X)

- motor to most all muscles of pharynx & palate; parasympathetic outflow to and visceral sensation from cervical, thoracic, & abdominal viscera; somatic sensation from small areas
- Tested by symmetry of palatal elevation; recurrent laryngeal branch commonly injured with effects on glottis

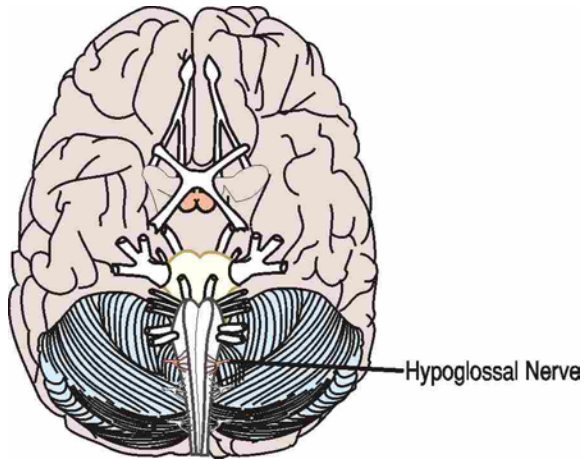
Accessory N. (CN XI)

- Motor to sternocleidomastoid & trapezius
- Tested by strength of lateral neck rotation & shoulder shrug

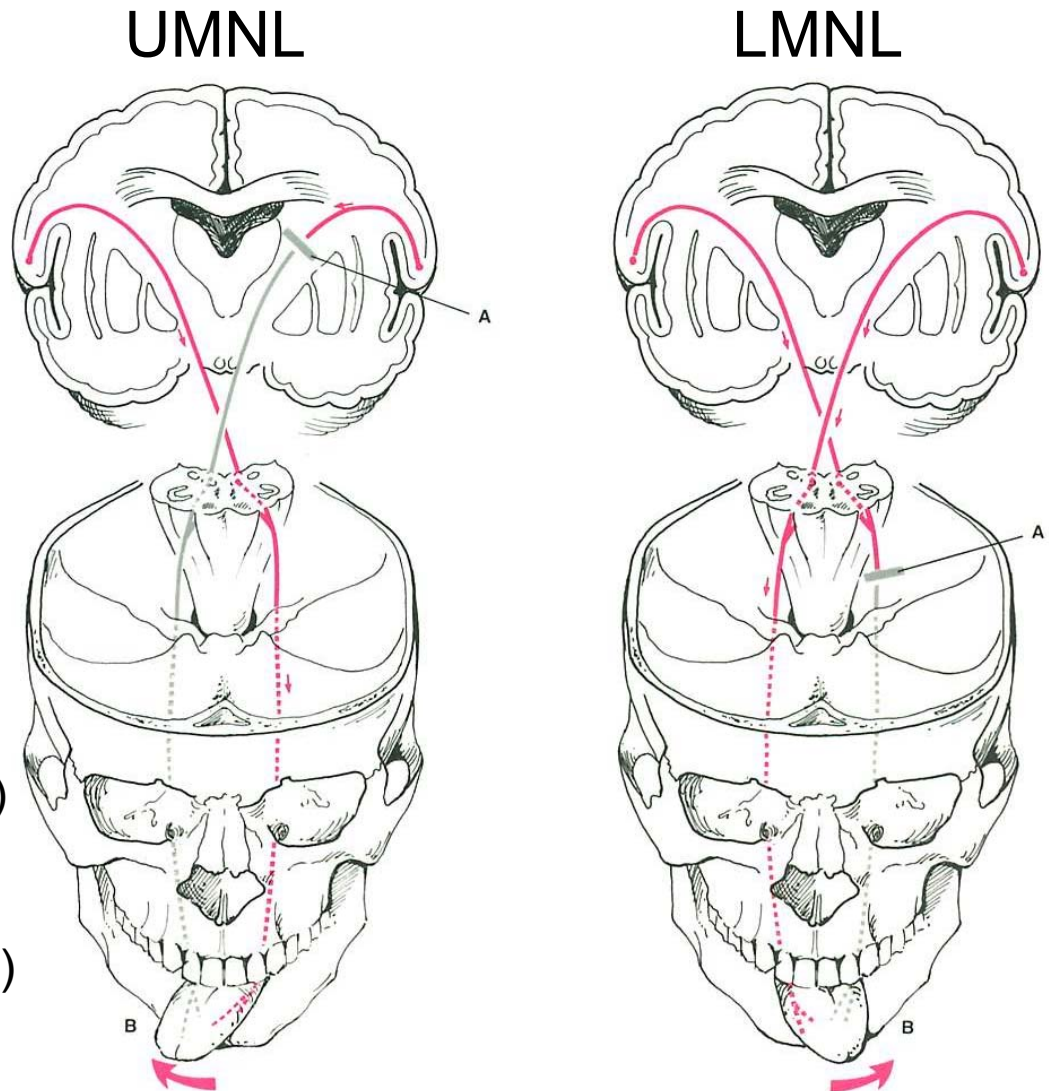


unilateral section of right recurrent laryngeal n.

Hypoglossal N. (CN XII)



- Innervates all tongue muscles except one
- Lesions uncommon, often due to congenital abnormalities in region of foramen magnum
- Lower Motor Neuron Lesion (LMNL)
 - Peripheral to brain stem
 - Ipsilateral atrophy & deviation
- Upper Motor Neuron Lesion (UMNL)
 - Supranuclear (e.g., cortex)
 - Contralateral atrophy & deviation



From Wilson-Pauwels et al. 1988

References

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- Netter, F. H. 1986. *The CIBA Collection of Medical Illustrations. Volume 1. Nervous System. Part II. Neurologic and Neuromuscular Disorders.* CIBA, West Caldwell.
- Vaughan, D., T. Asbury, P. Riordan-Eva. 1999. *General Ophthalmology, 15th Ed.* Appleton & Lange, Stamford.
- Wilson-Pauwels, L., E. J. Akesson, and P. A. Stewart. 1988. *Cranial Nerves.* Decker, Philadelphia.