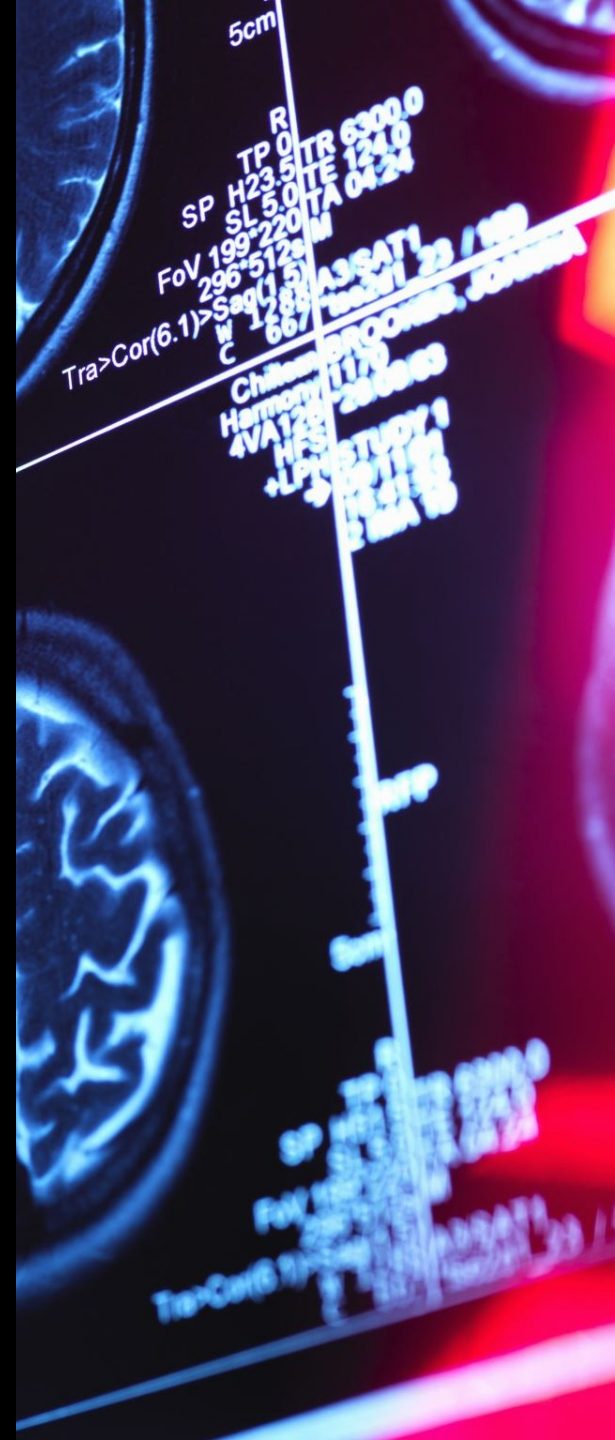


Clinical anatomy of cranial nerves

MUDr. Erik Kročka



Development of the CNS – neural tube

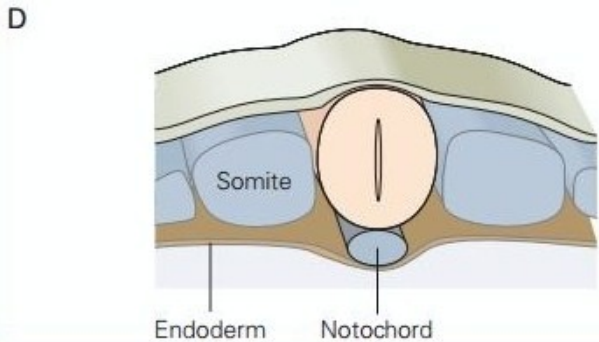
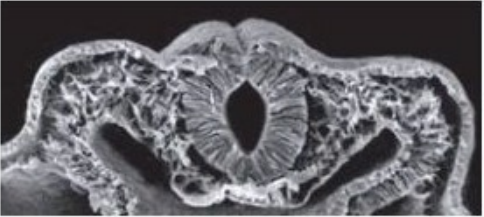
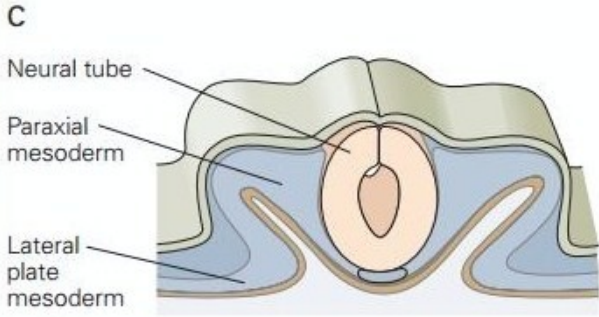
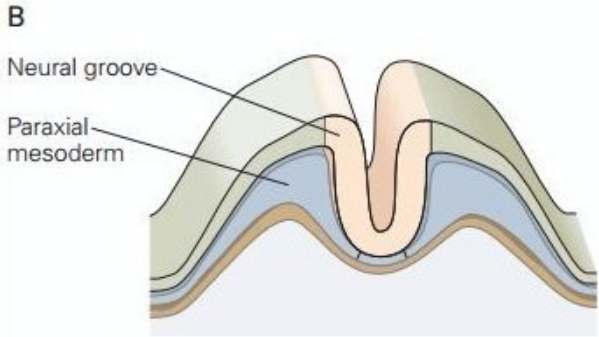
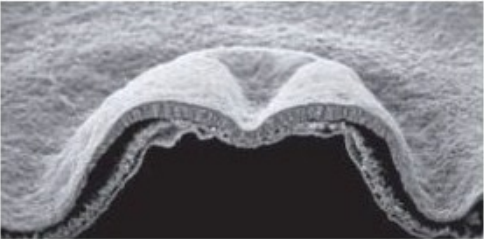
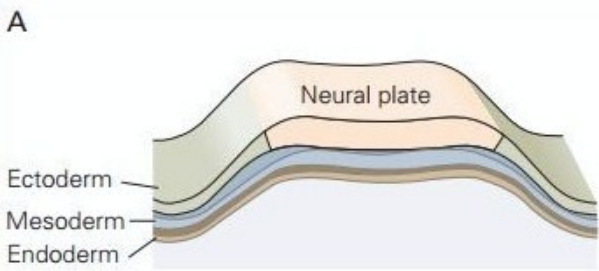
Neural plate



Neural groove

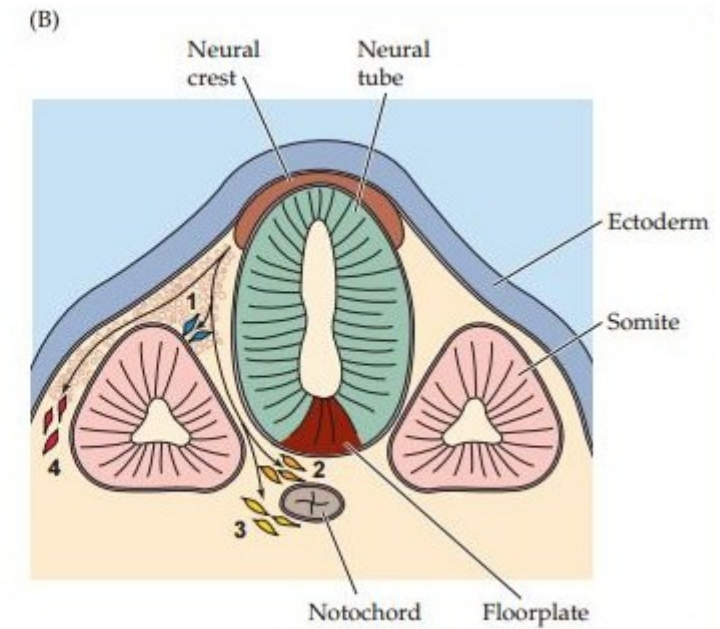
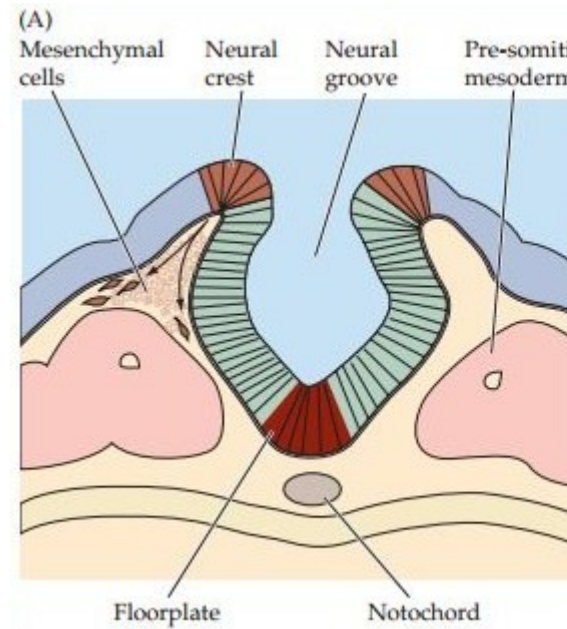


Neural tube

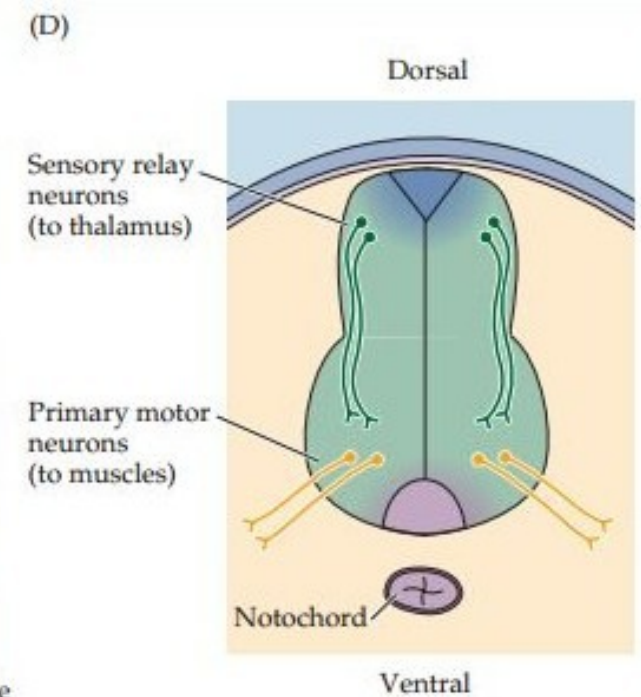
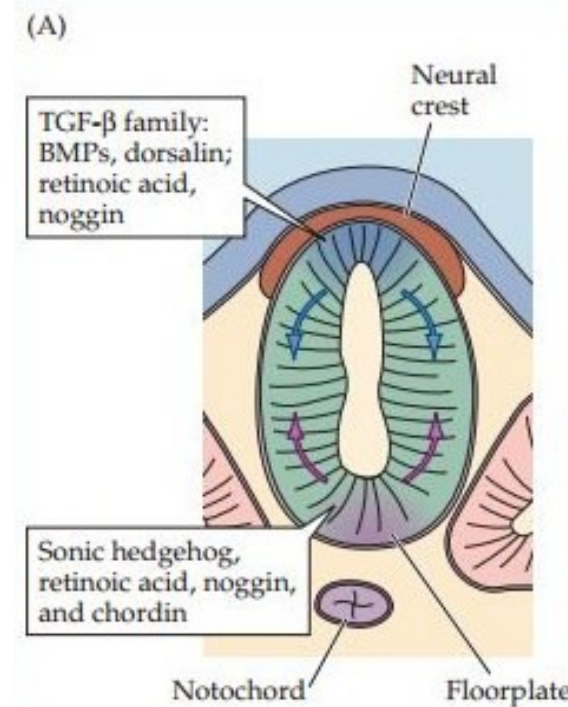


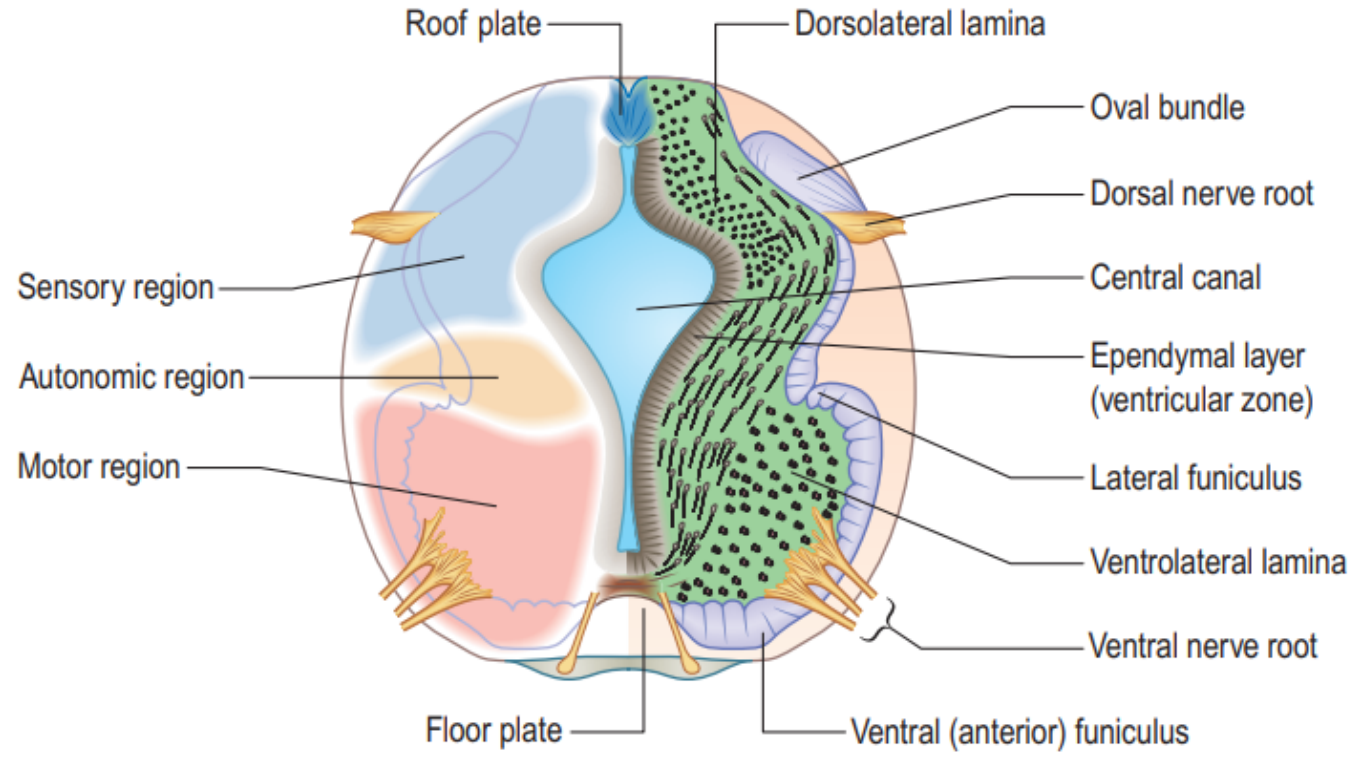
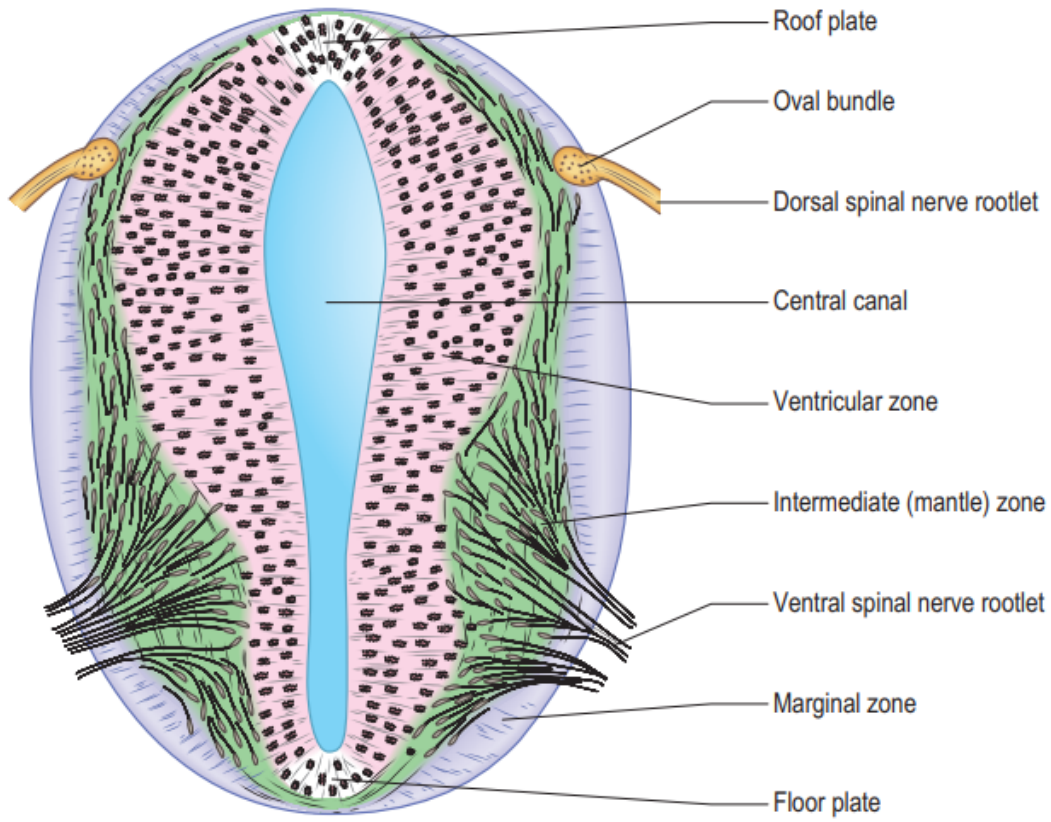
Development of the CNS – neural tube

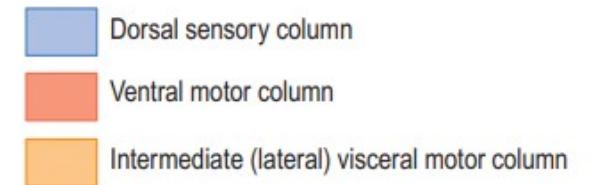
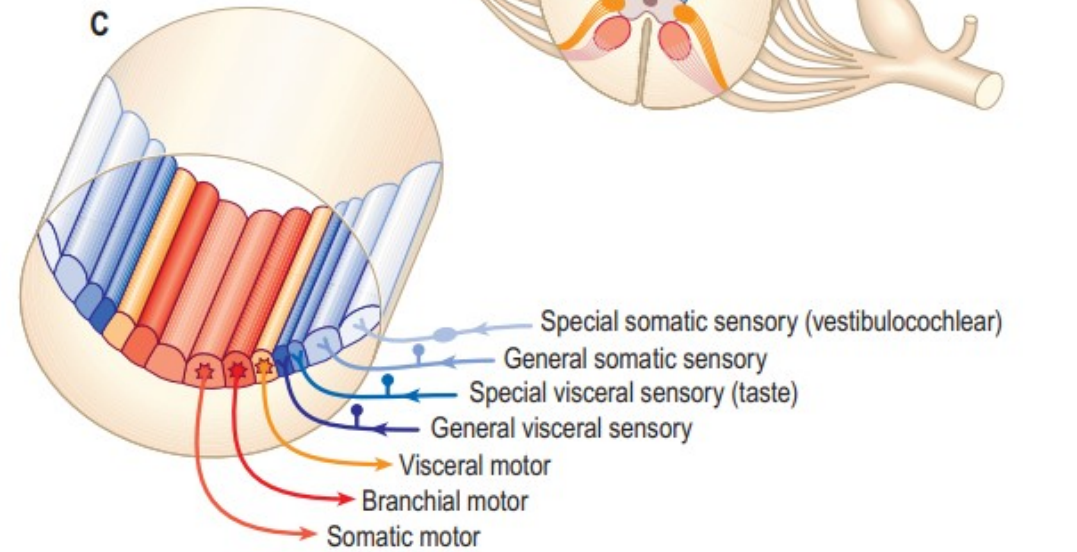
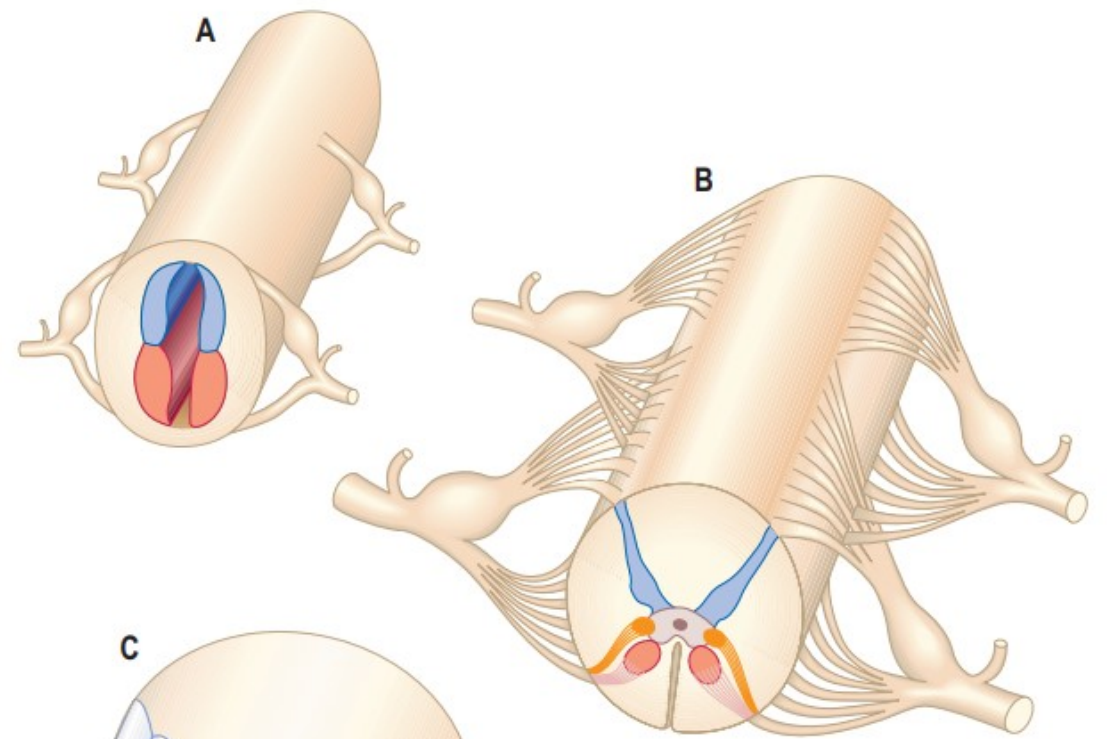
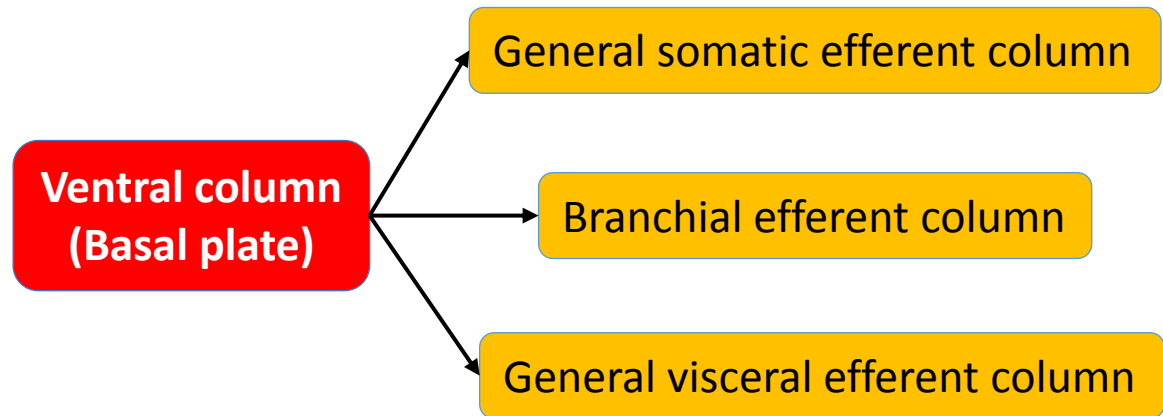
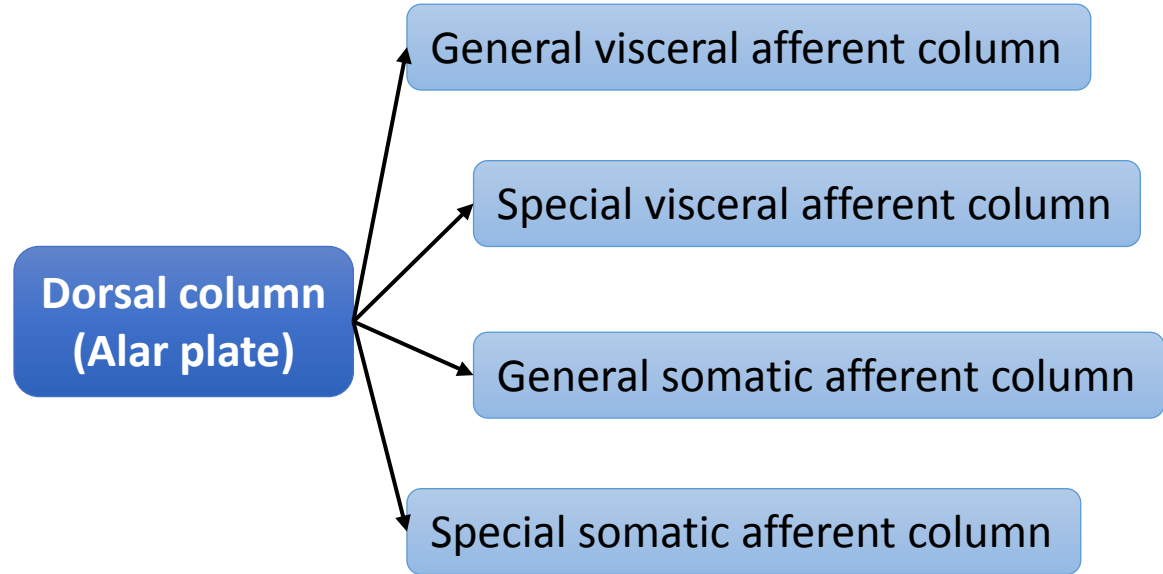
- Basal plate (roof plate)
- Alar plate (floor plate)
- *Sulcus limitans*
- Neural crest

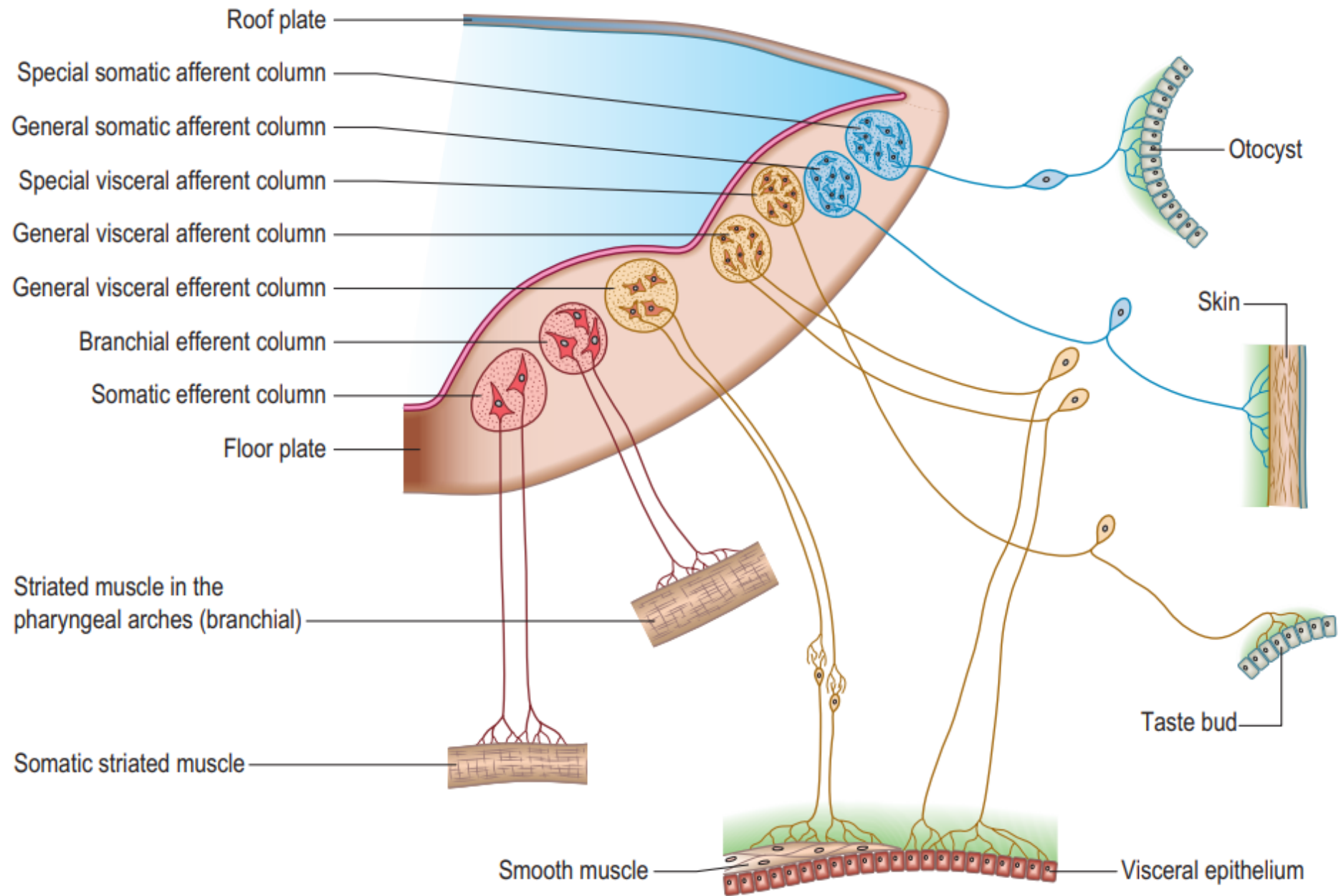


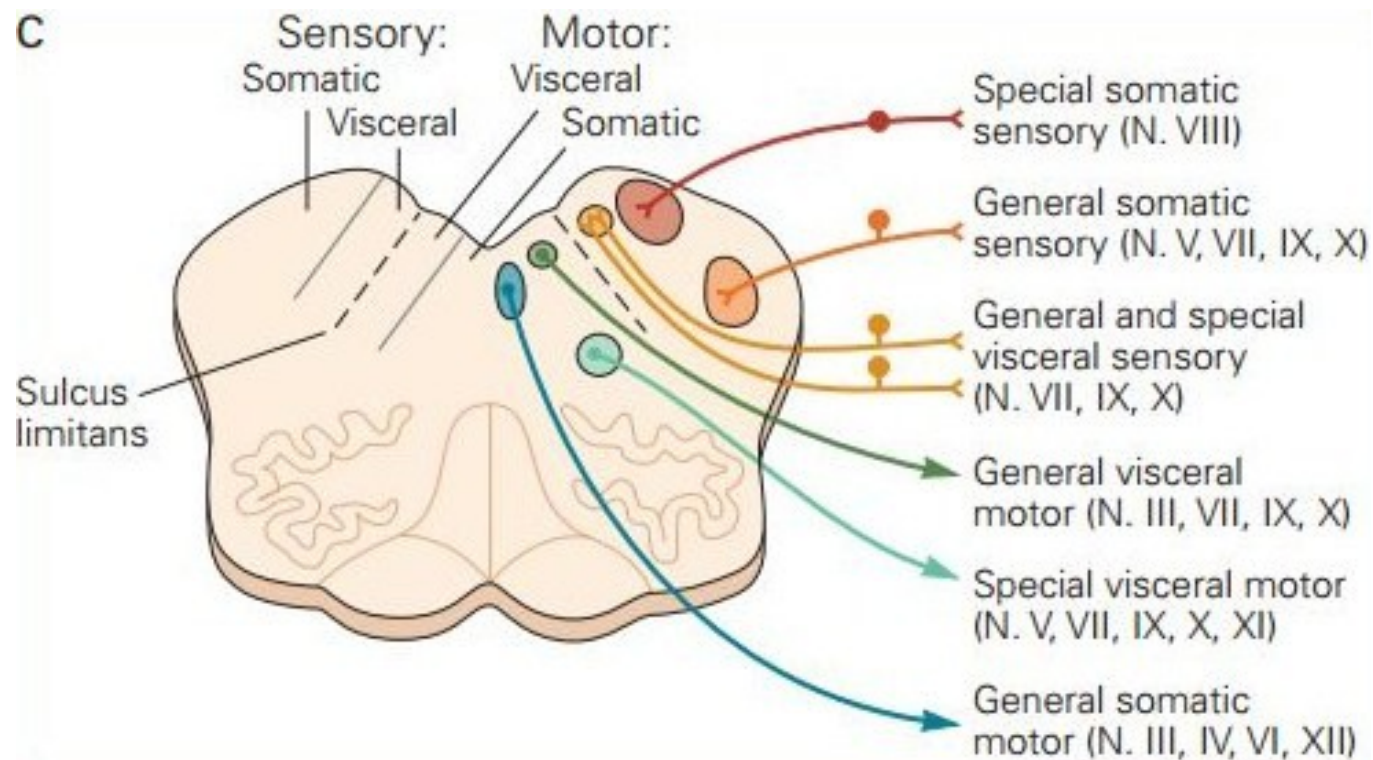
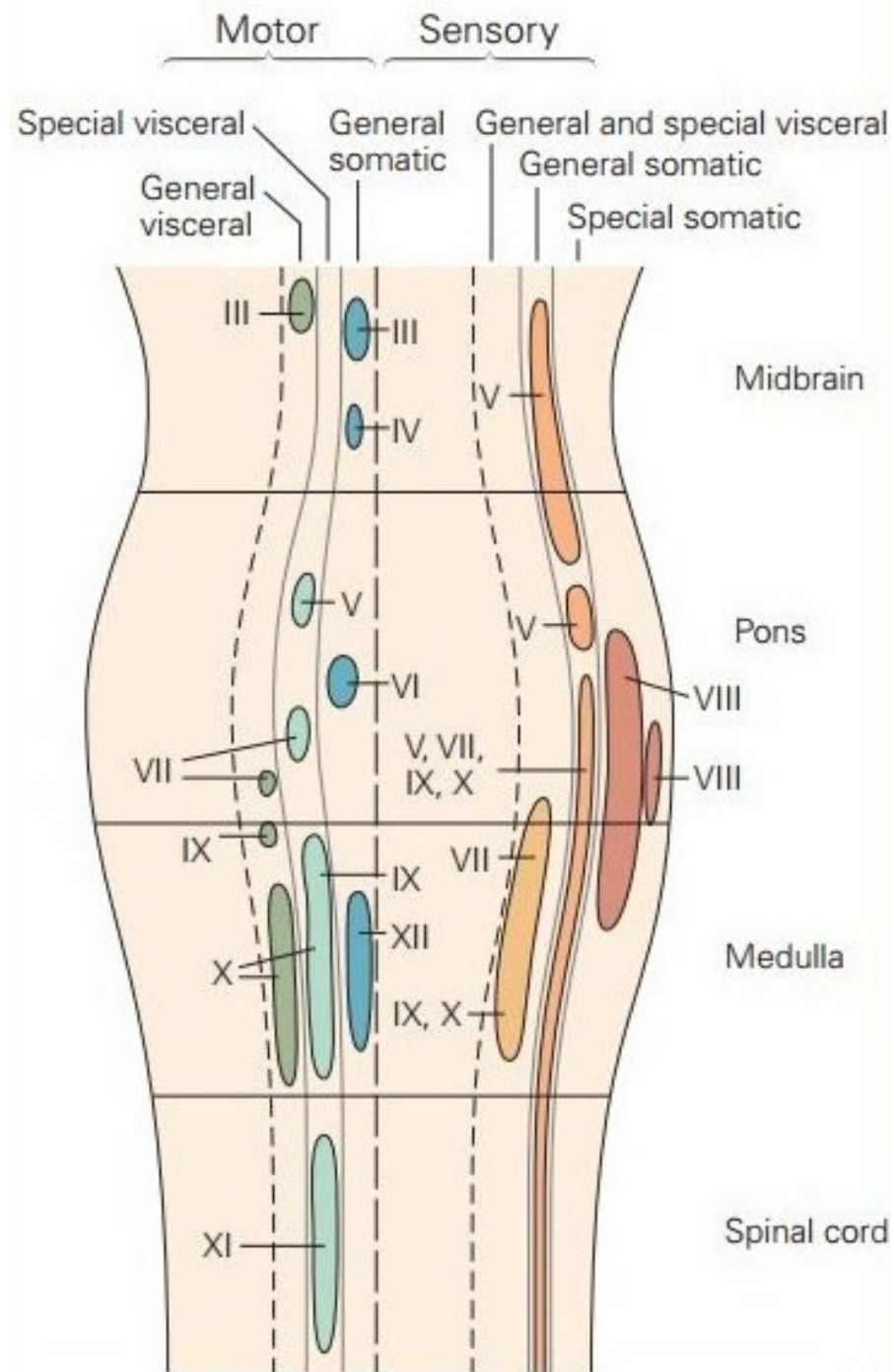
- Ventricular (ependymal) layer
- Intermediate (mantle) layer
- Marginal layer

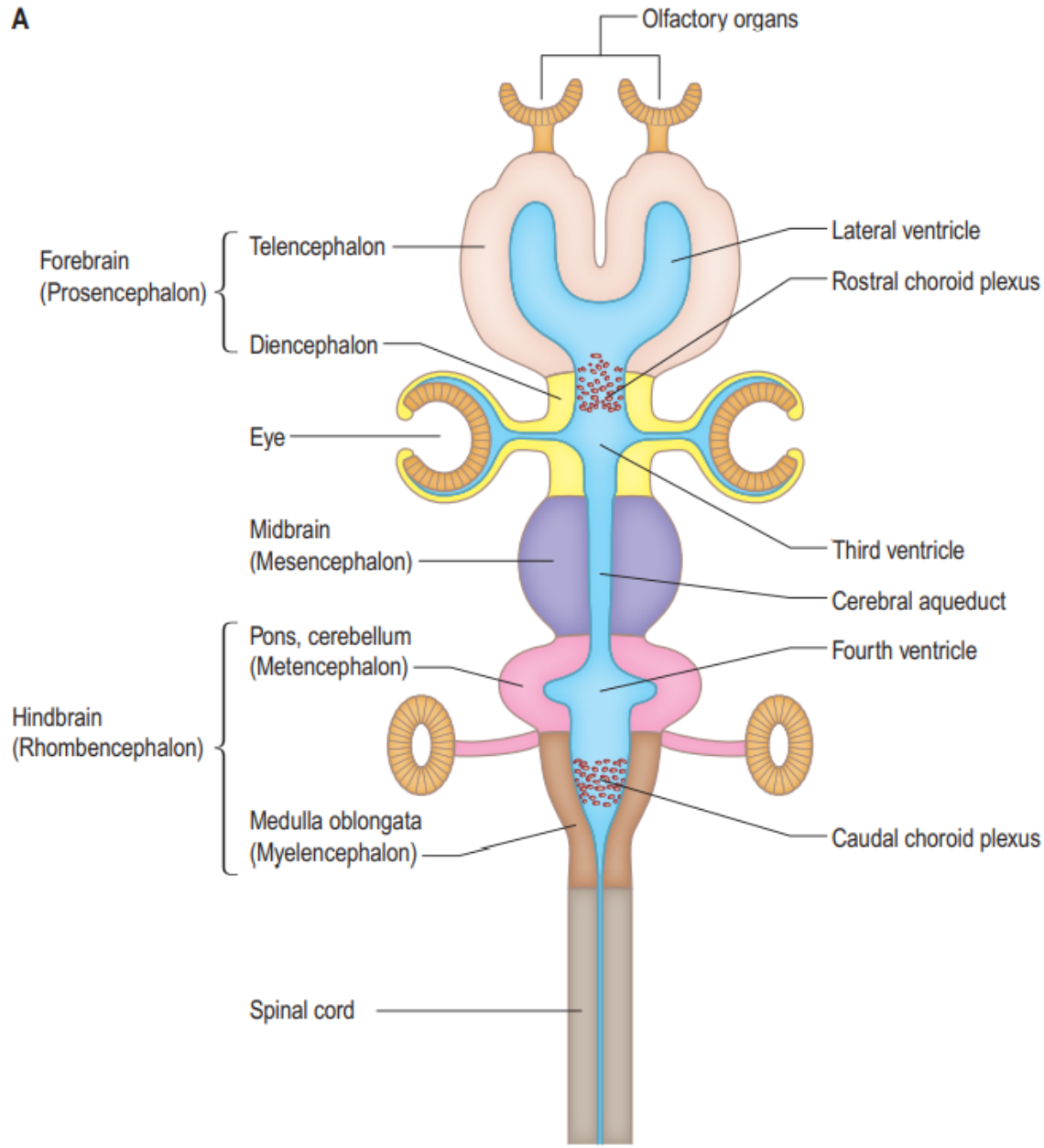
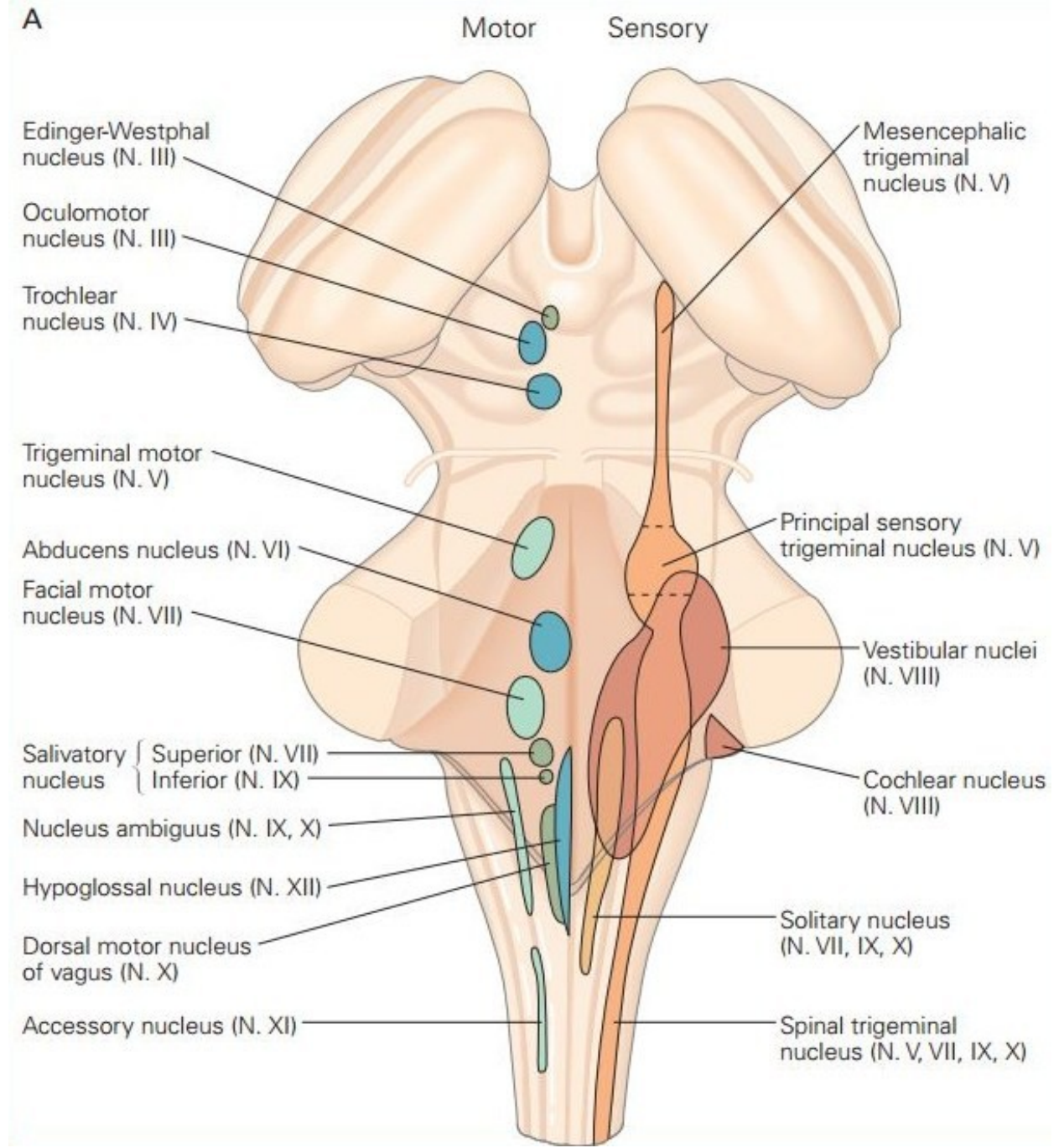











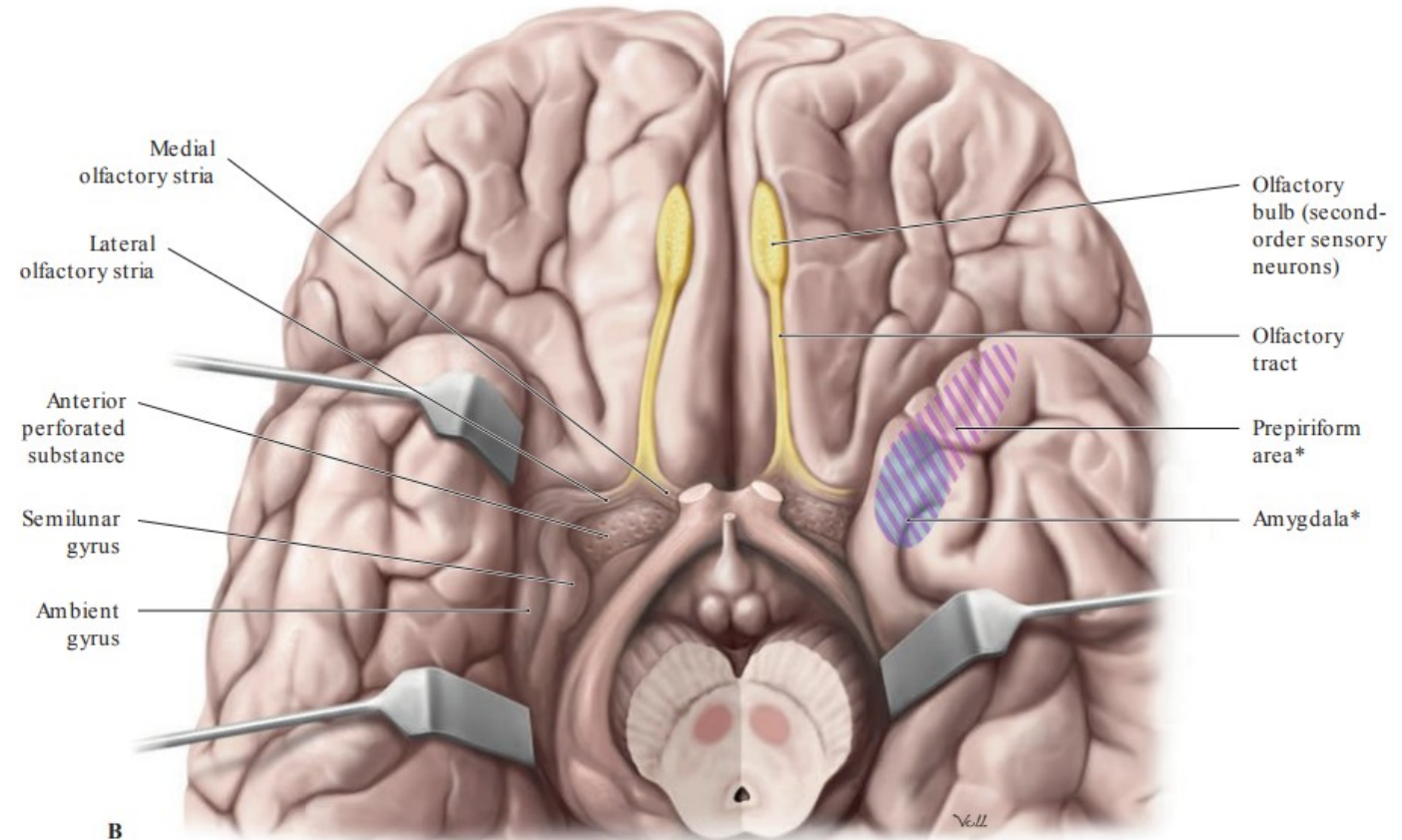
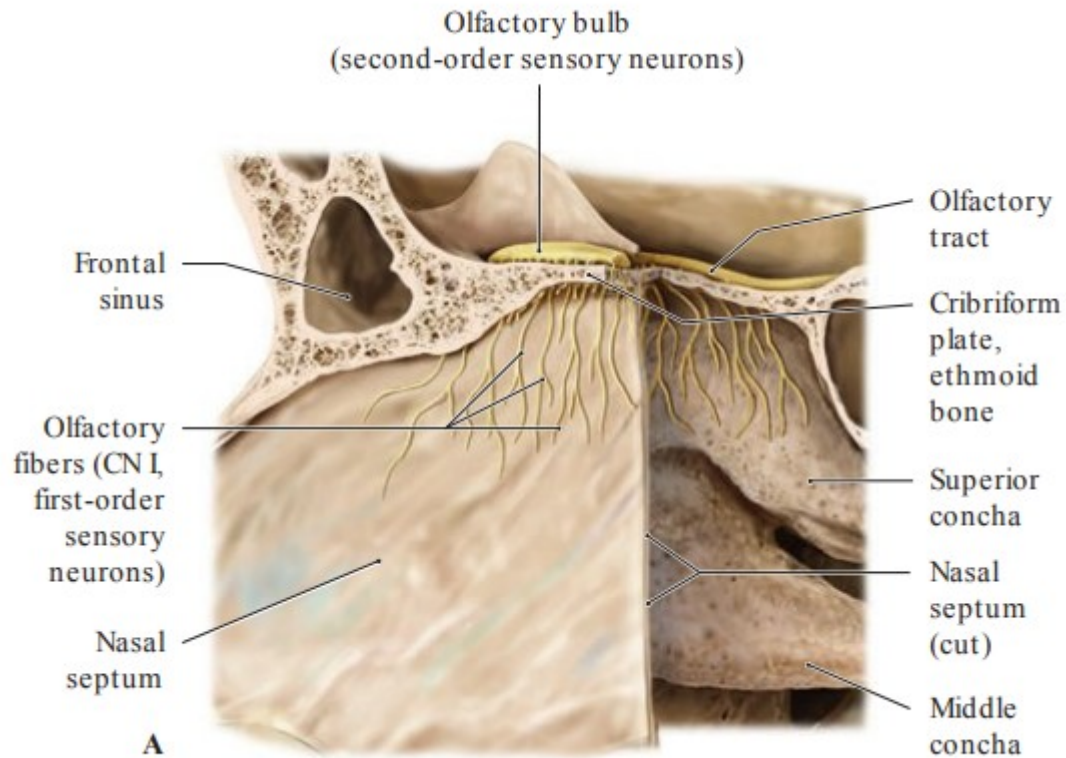
A**A**

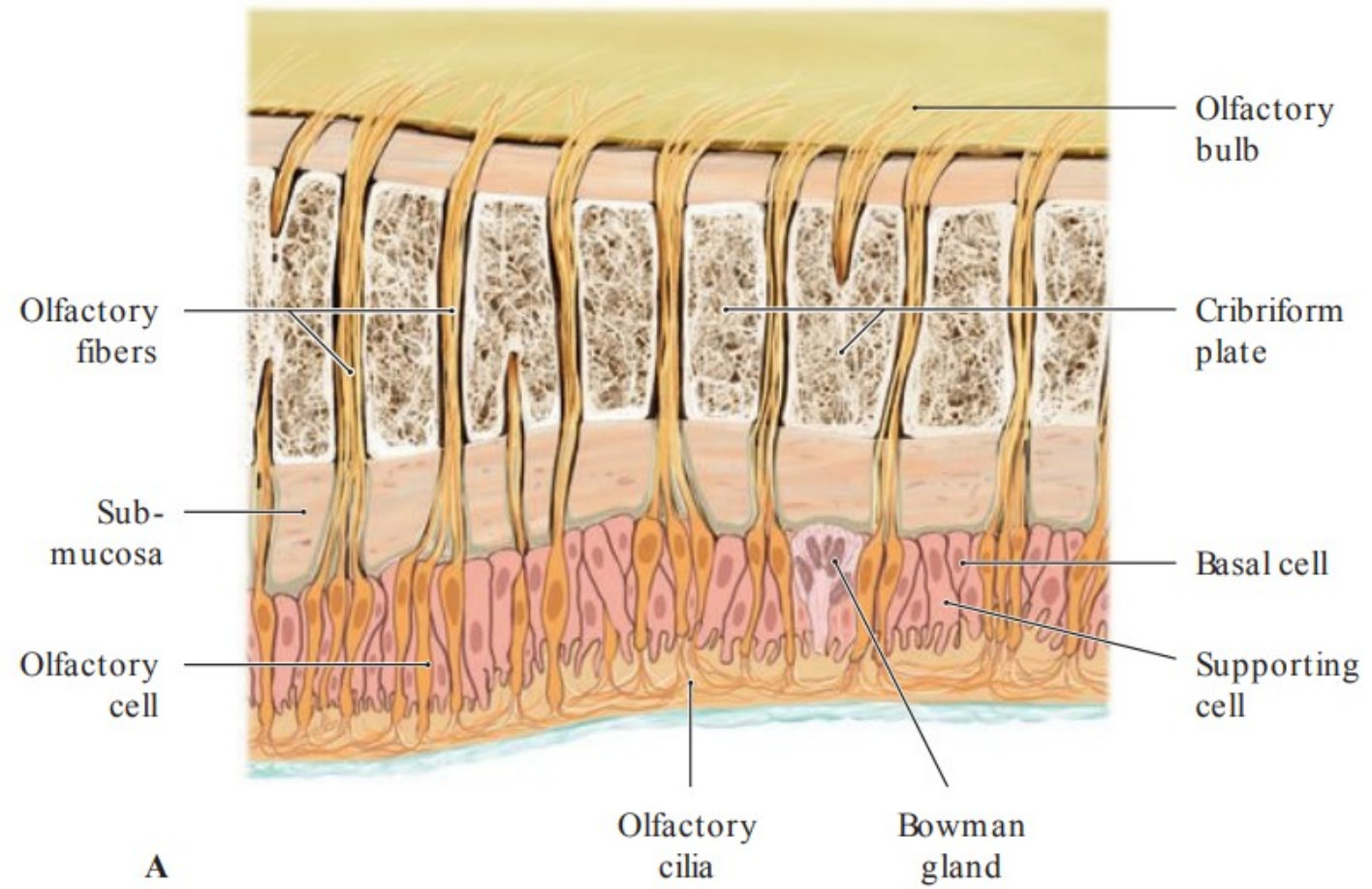
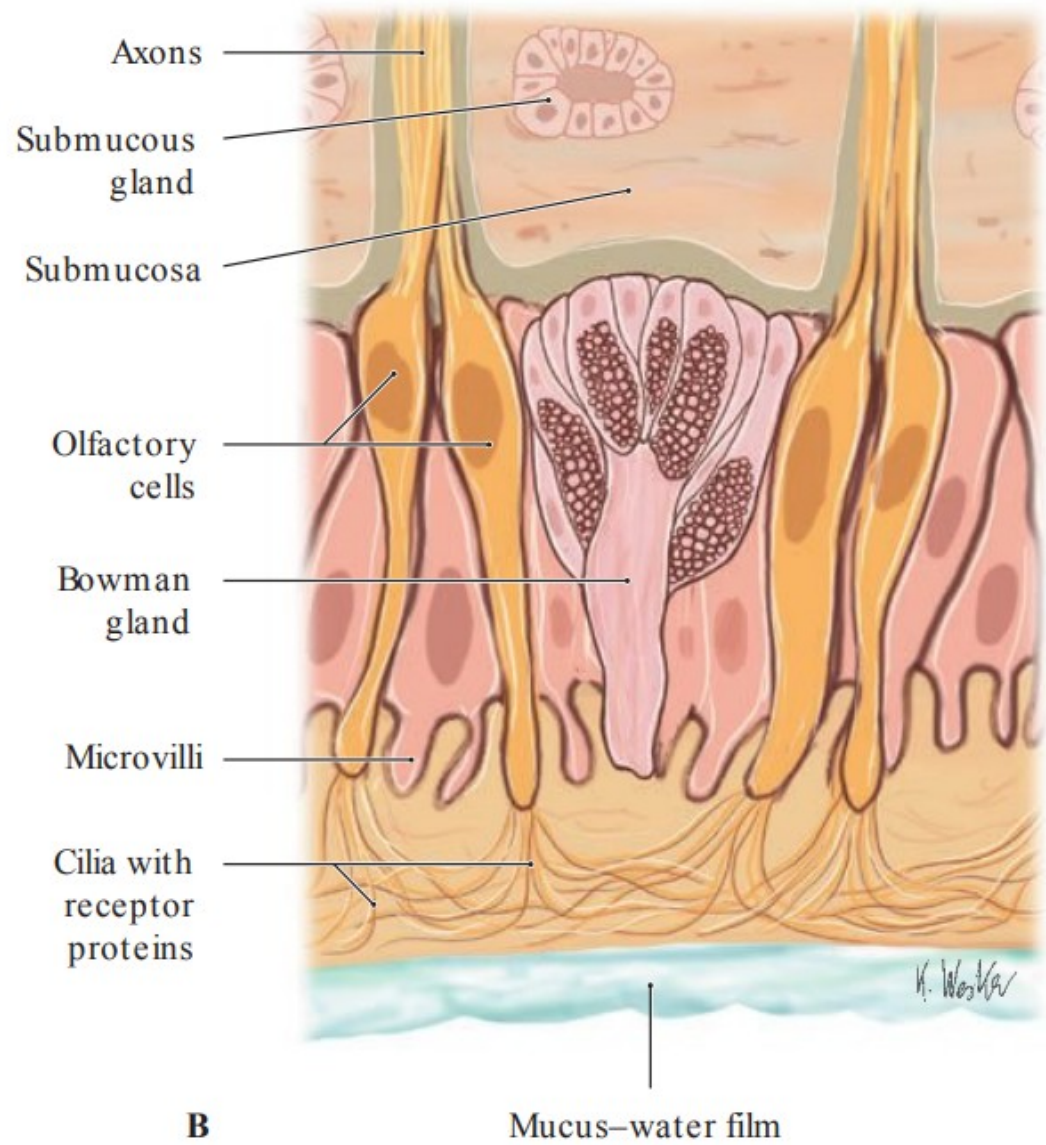


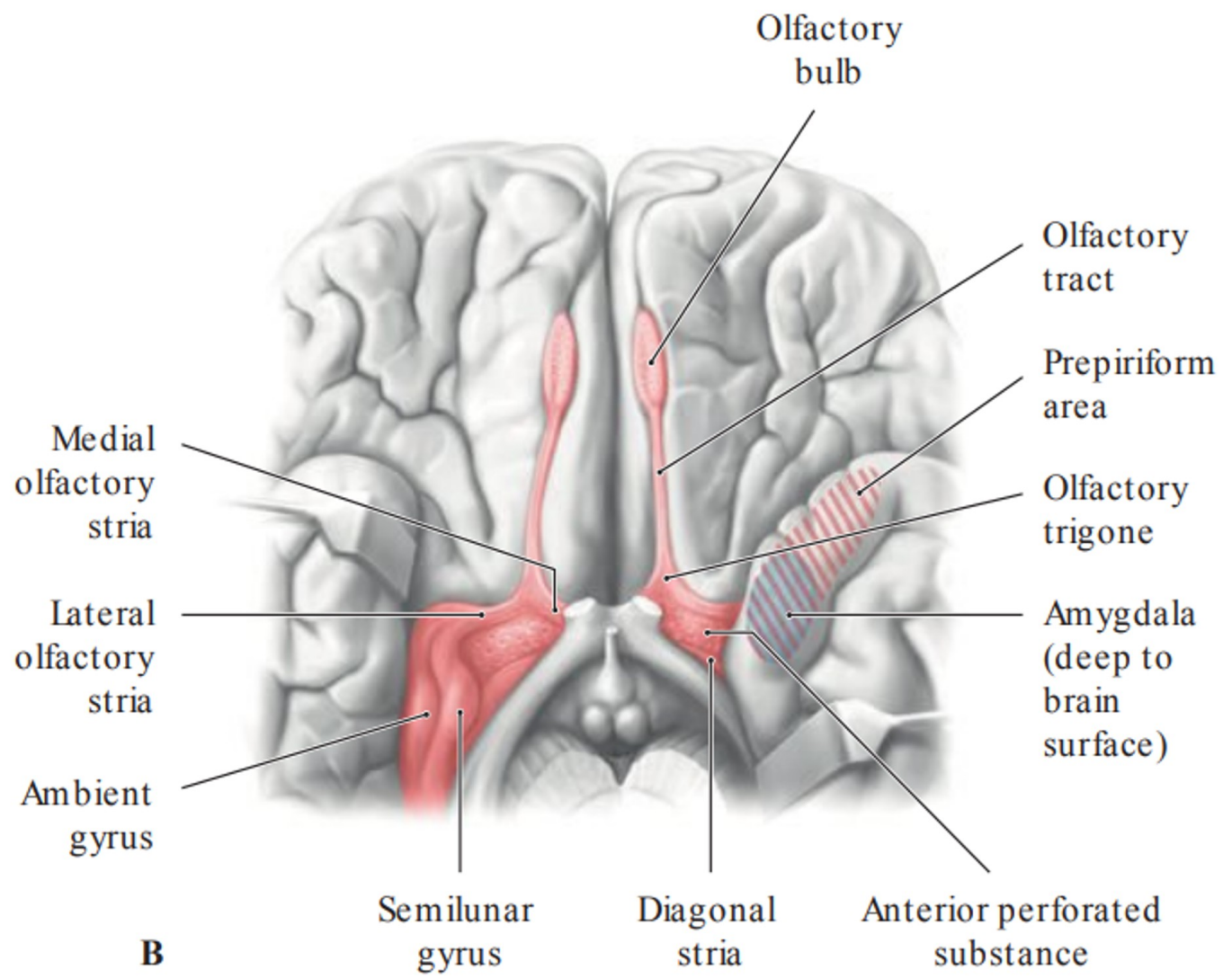
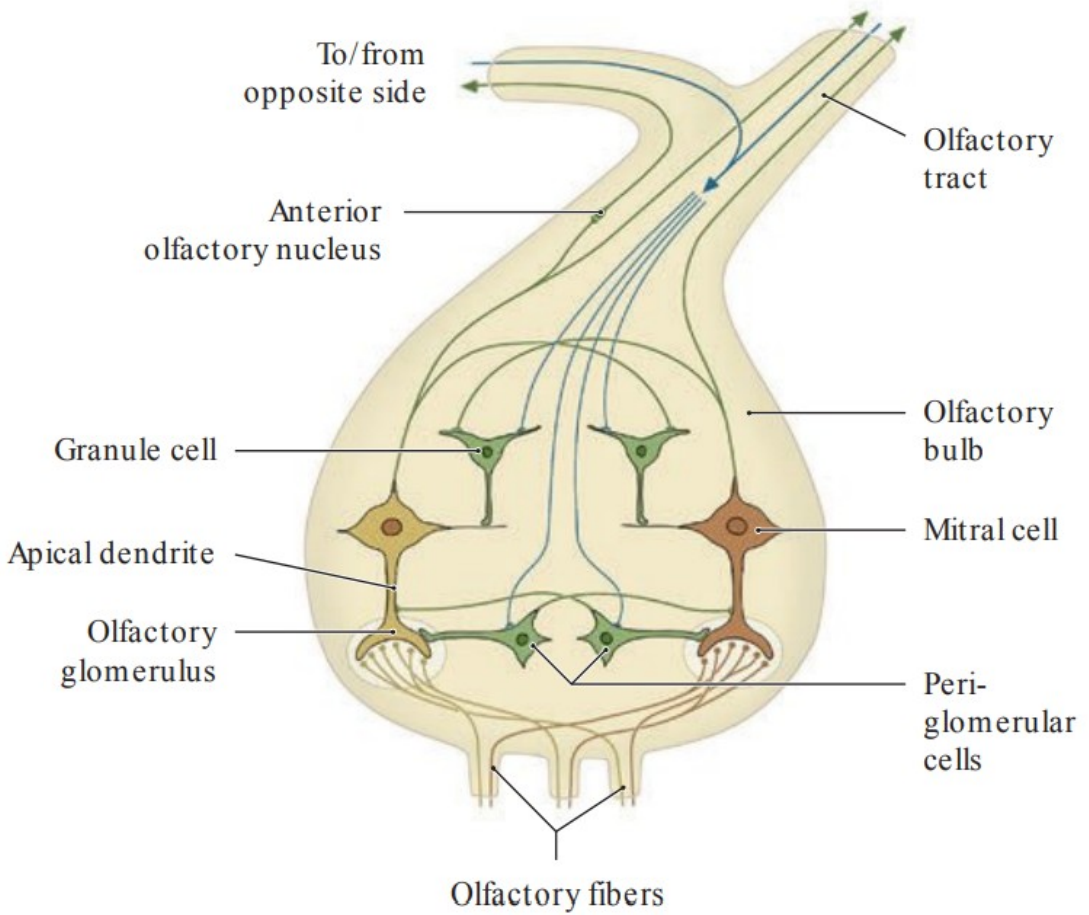
Olfactory nerve (n. I)



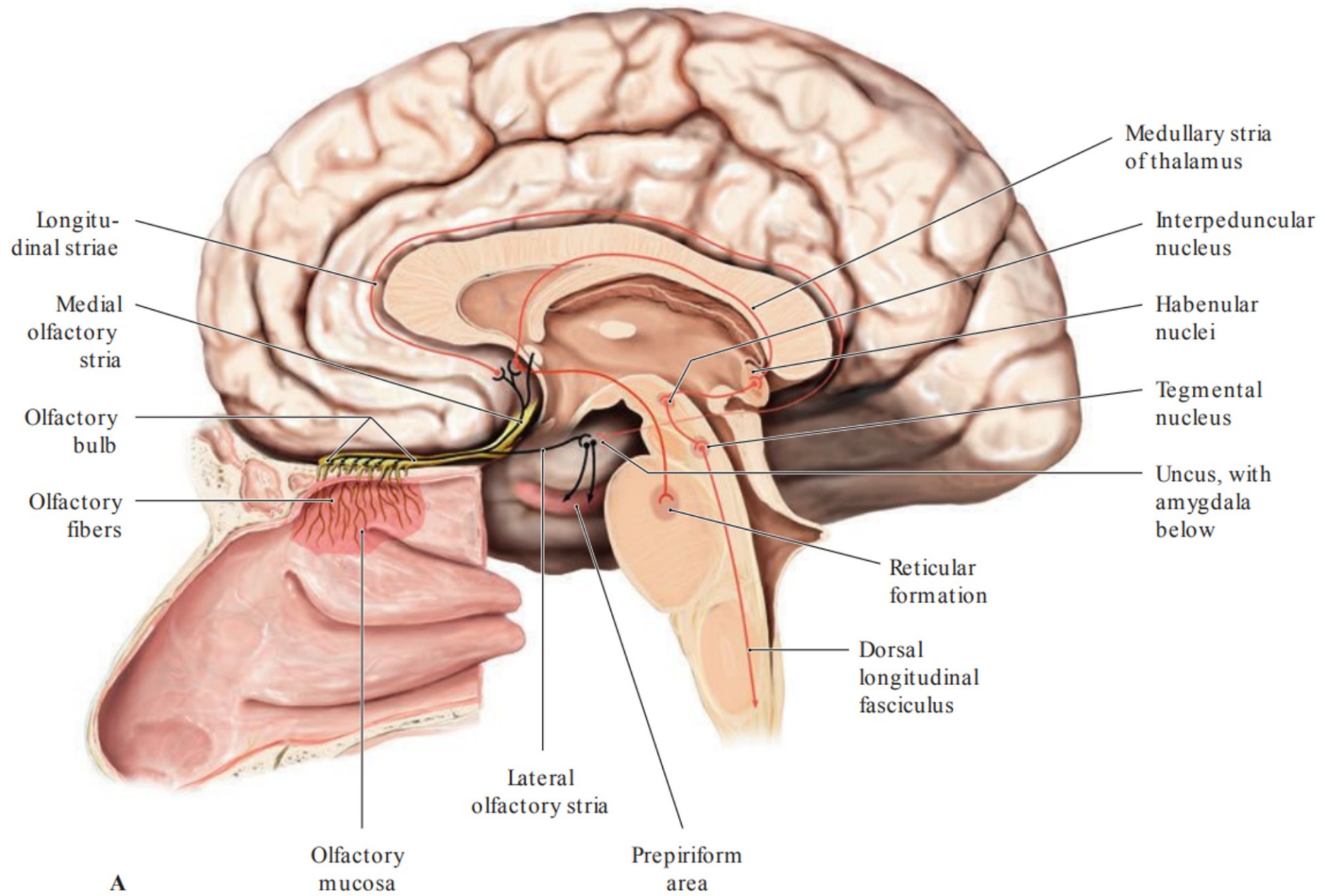
- **part of the telencephalon**, not really a cranial nerve in the conventional sense
- humans belong to microsmatic vertebrates → a poor sense of smell
- **olfactory area** is approximately **5 cm²** (10⁷ olfactory cells)
- humans can distinguish ca. **10 000 smells**
- **the olfactory neurons can regenerate**





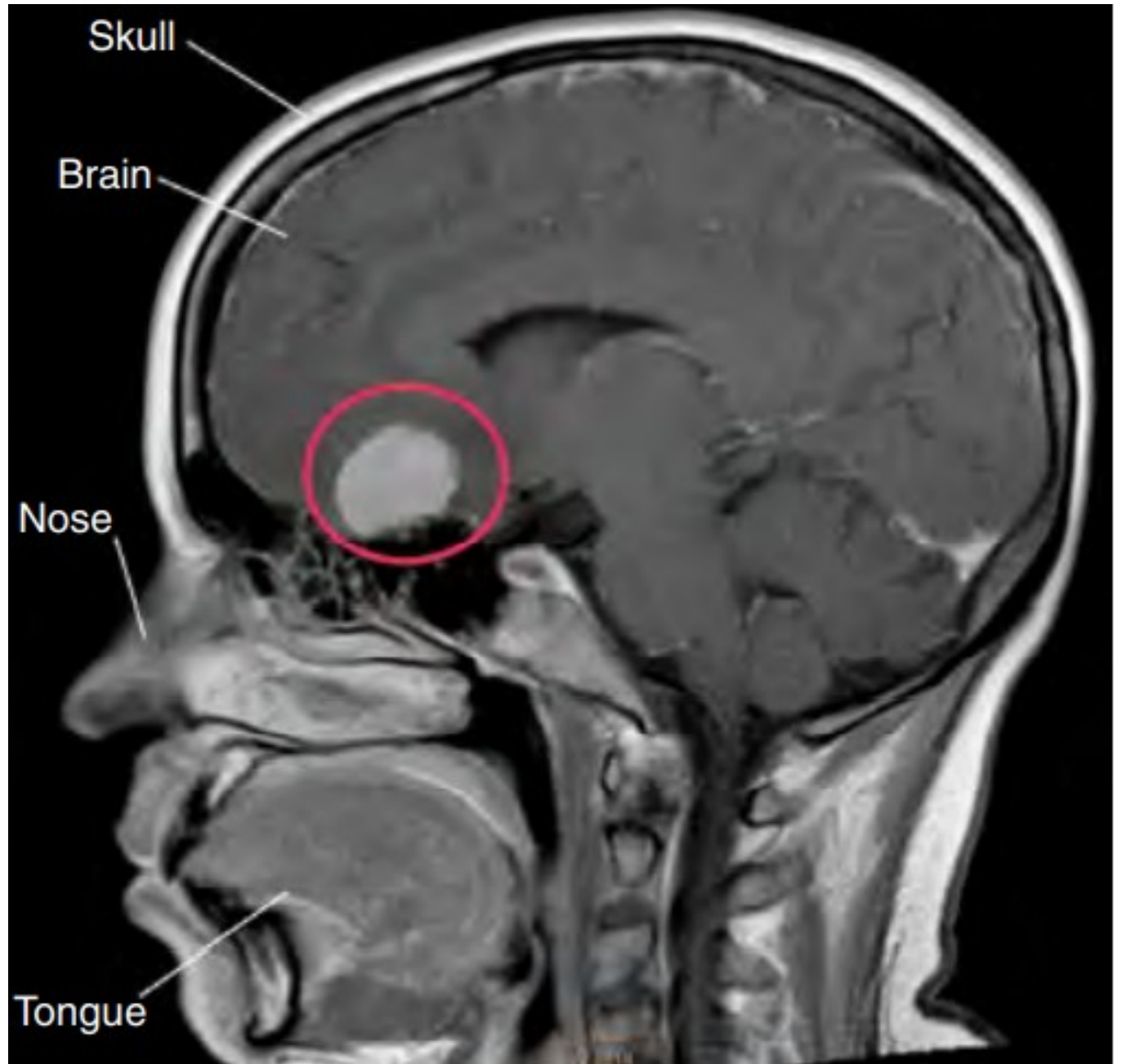


B



SYMPTOMS OF OLAFACTORY NERVE LESION

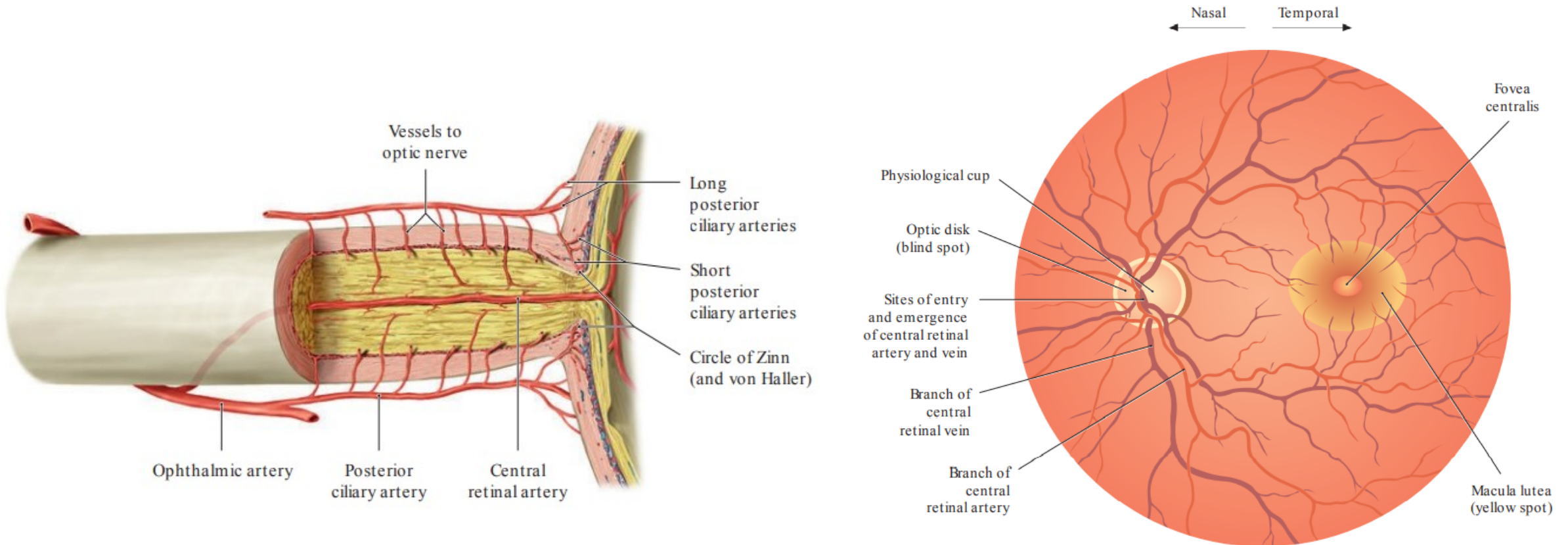
- hyposmia/mikrosmia
- anosmia
- parosmia (cacosmia)
- uncinata seizure

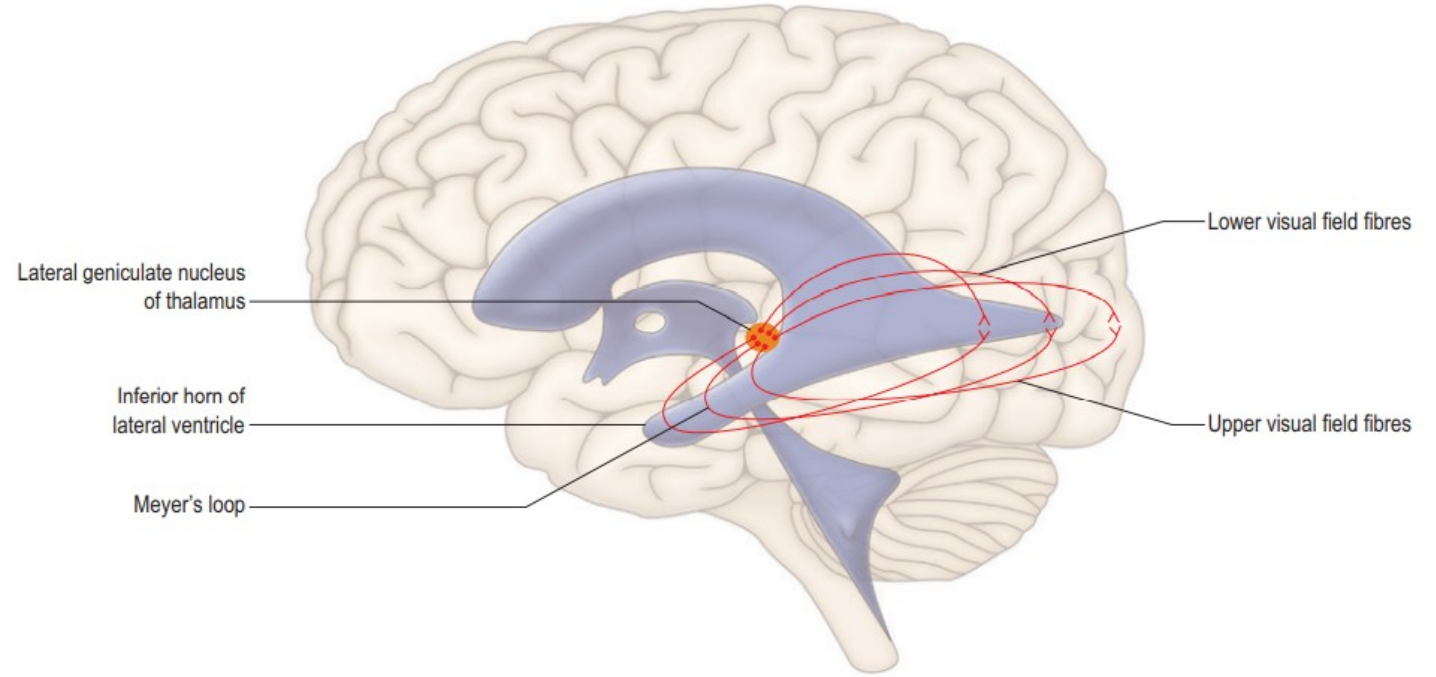
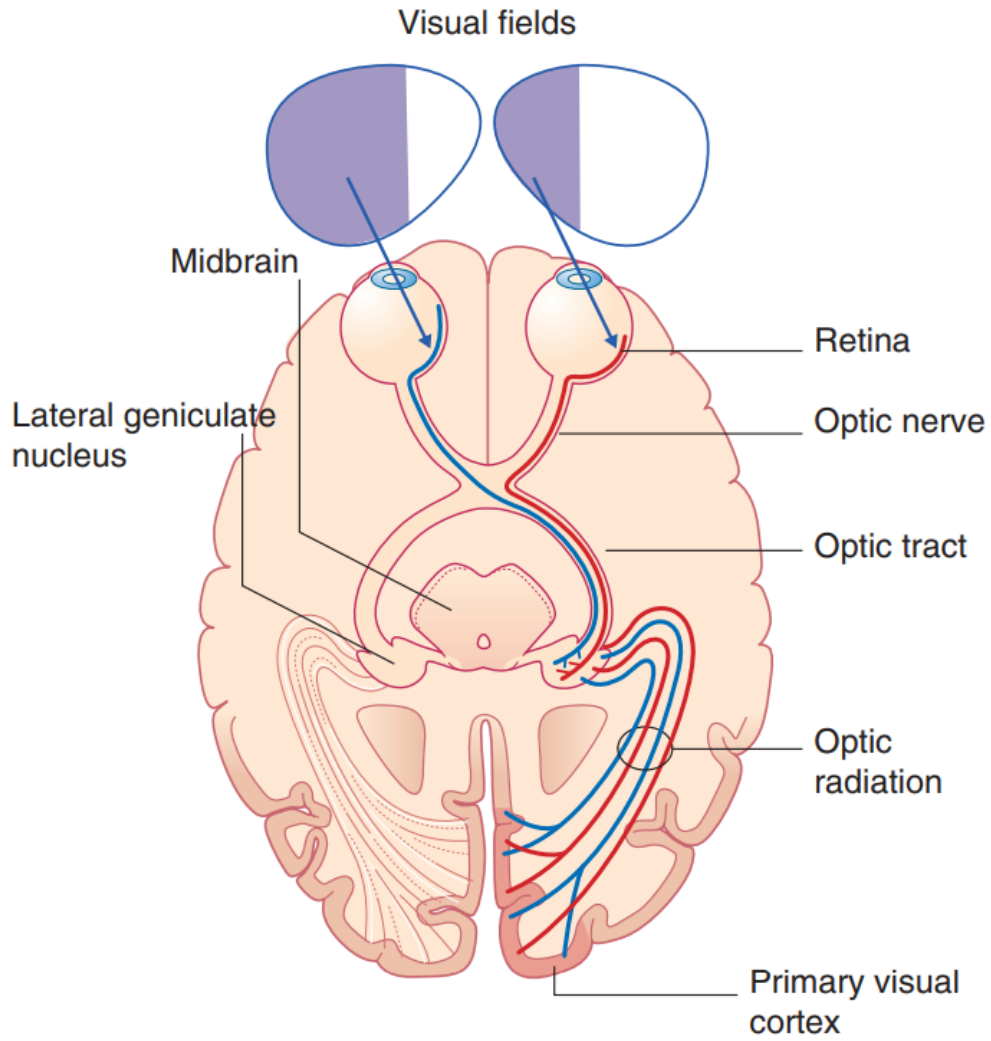




Optic nerve (n. II)

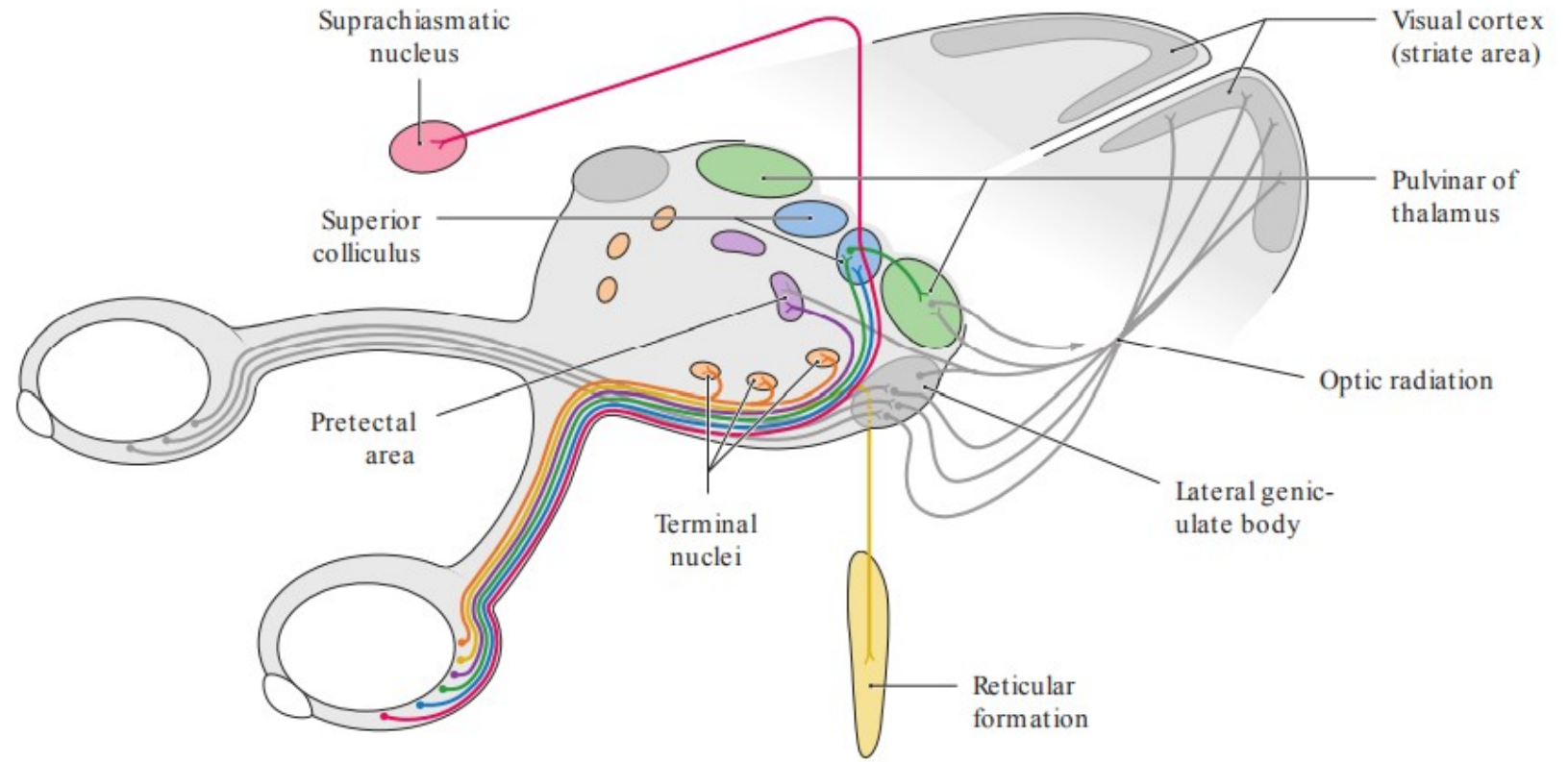
- **part of the diencephalon**, not really a cranial nerve in the conventional sense
- **doesn't regenerate after injury**
- is formed from the central processes of the ganglionic cells (3th neuron of the optic pathway)
- contains approximately 1,2 milions of the afferent fibers (1/3 come from central 5° of the retina)
- 80% fibers ends in the lateral geniculate nucleus, remain fibers leads to the mesencephalon and hypothalamus





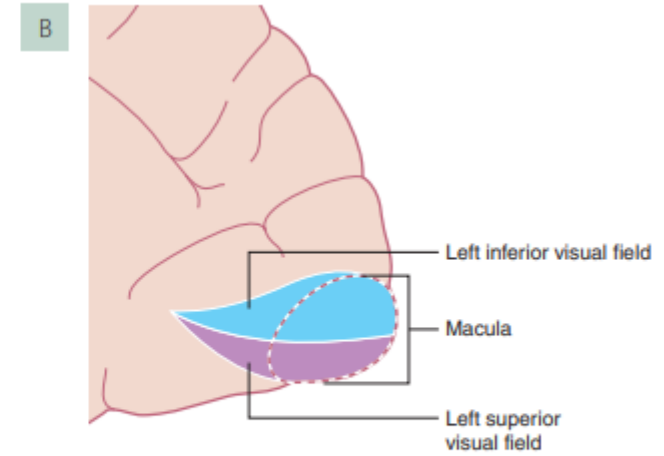
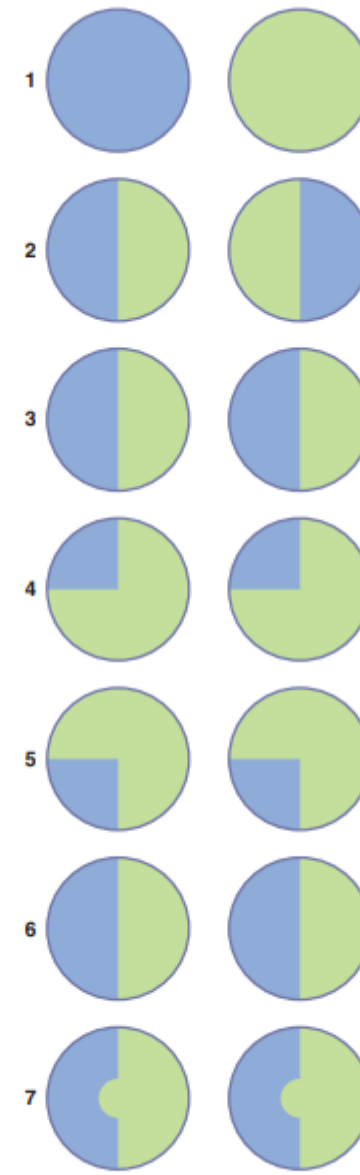
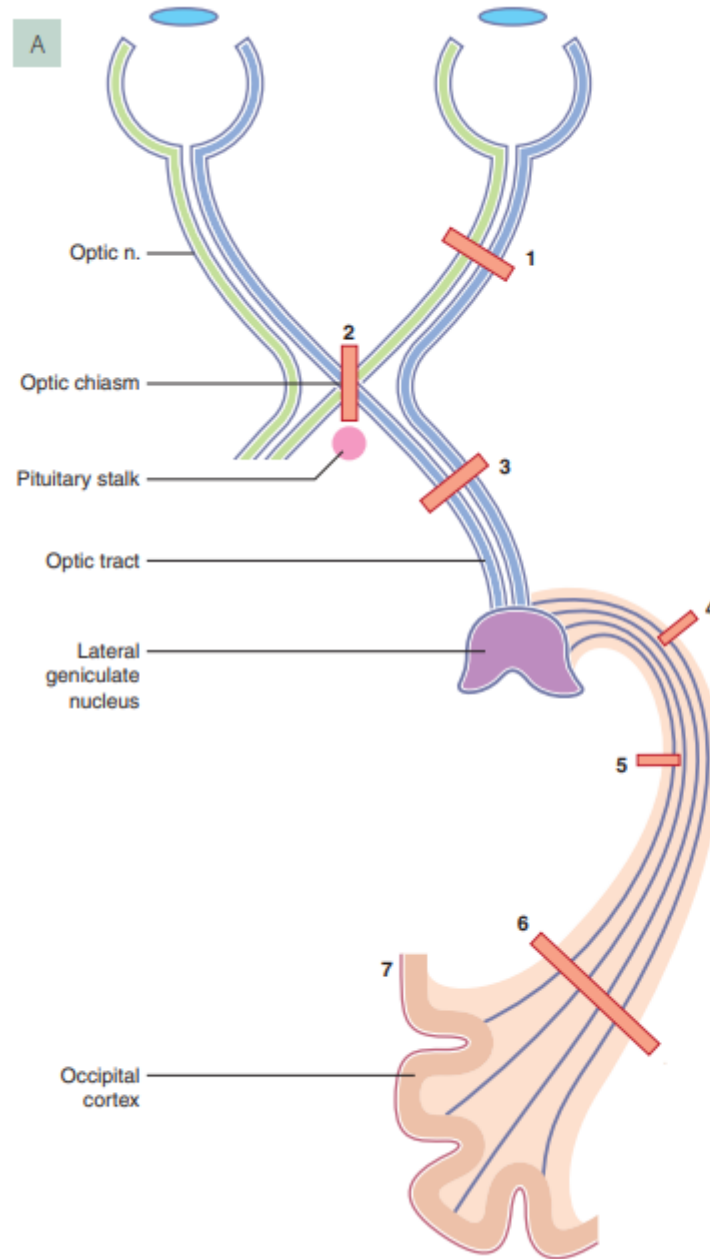
The extrageniculate visual pathway

- 10-20% fibers
- *radix optica mesencephalica*
- *radix optica hypothalamica*
- retinohypothalamic tract

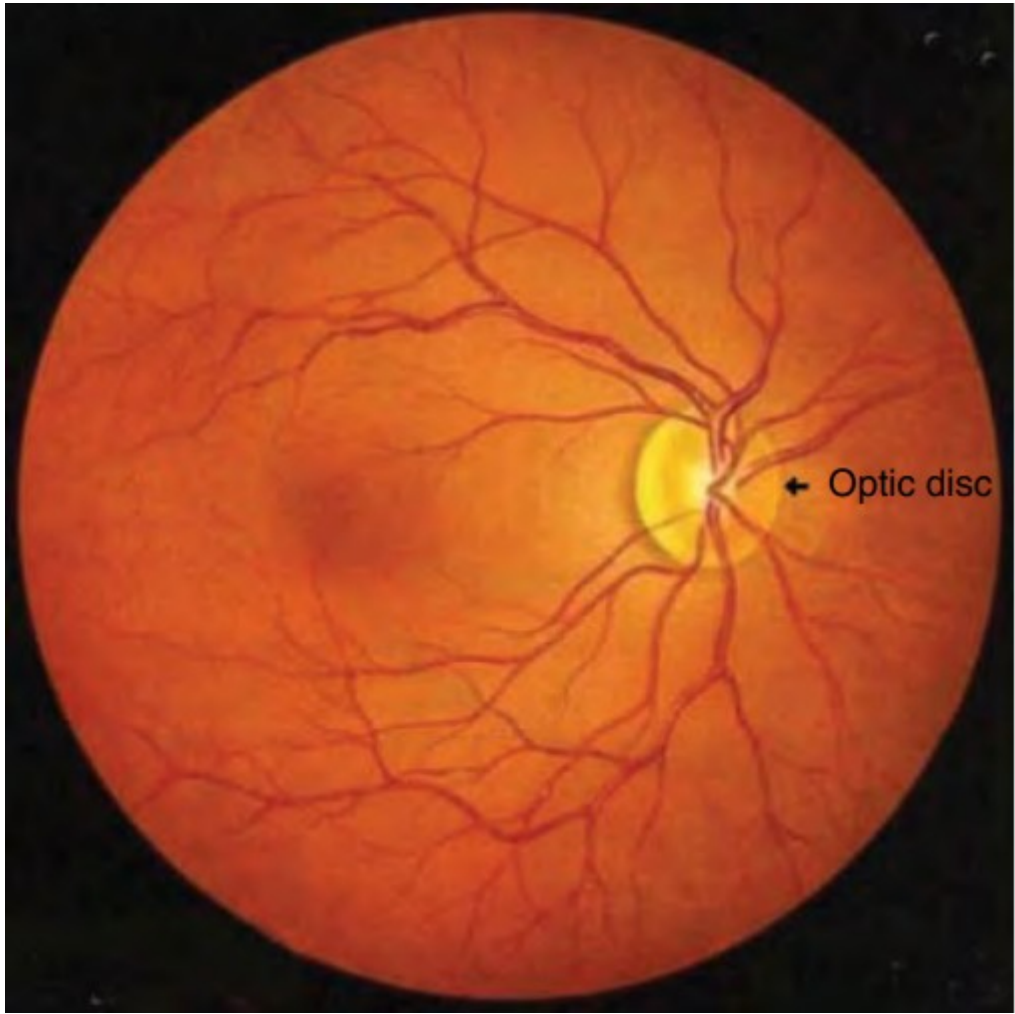


SYMPTOMS OF OPTIC NERVE LESION

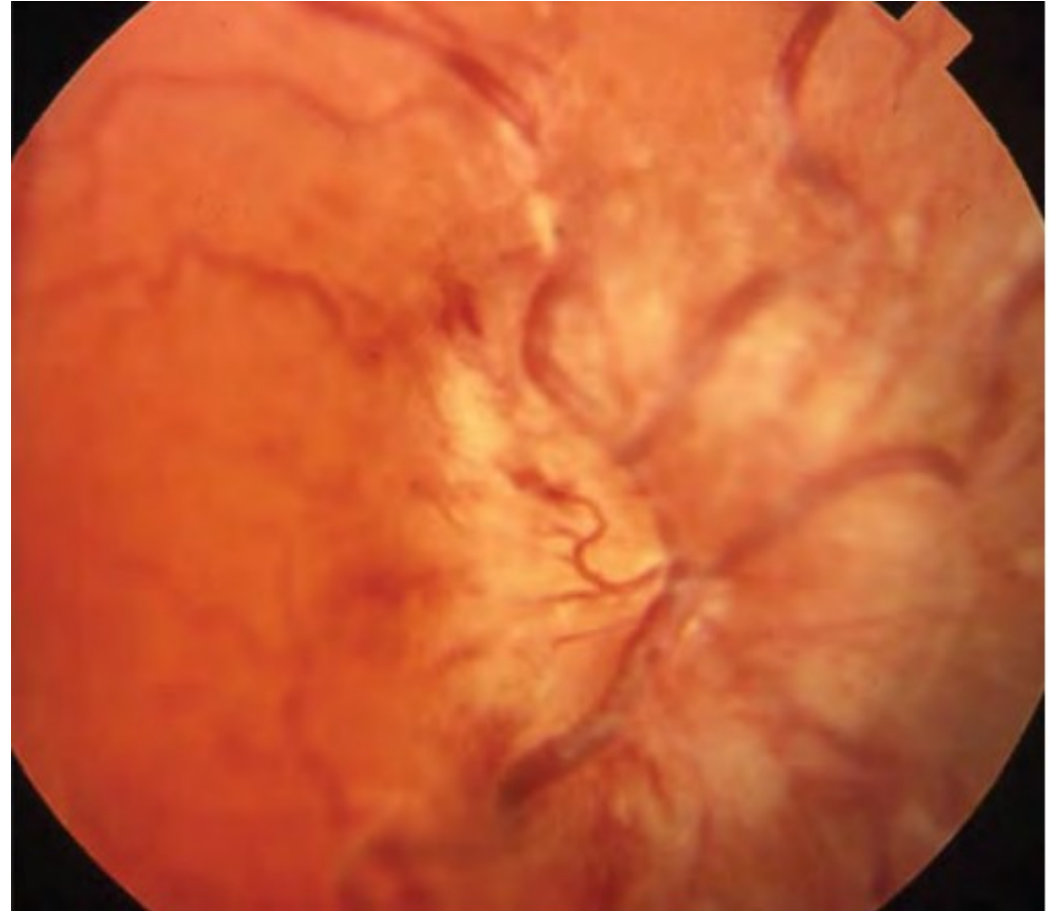
- amaurosis
- heteronymous hemianopsia
- homonymous hemianopsia
- quadrantopsia
- scotoma
- phosphene



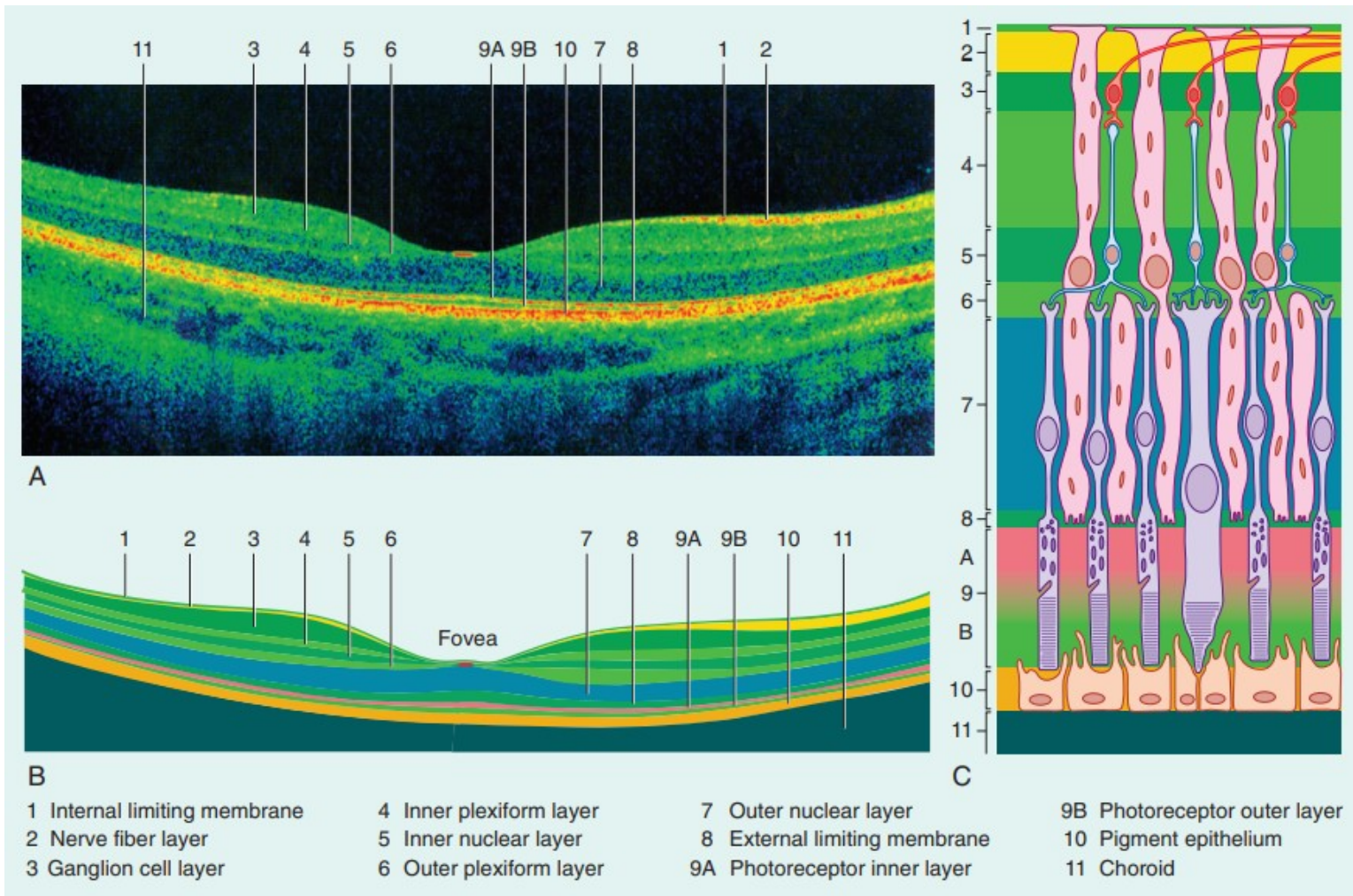
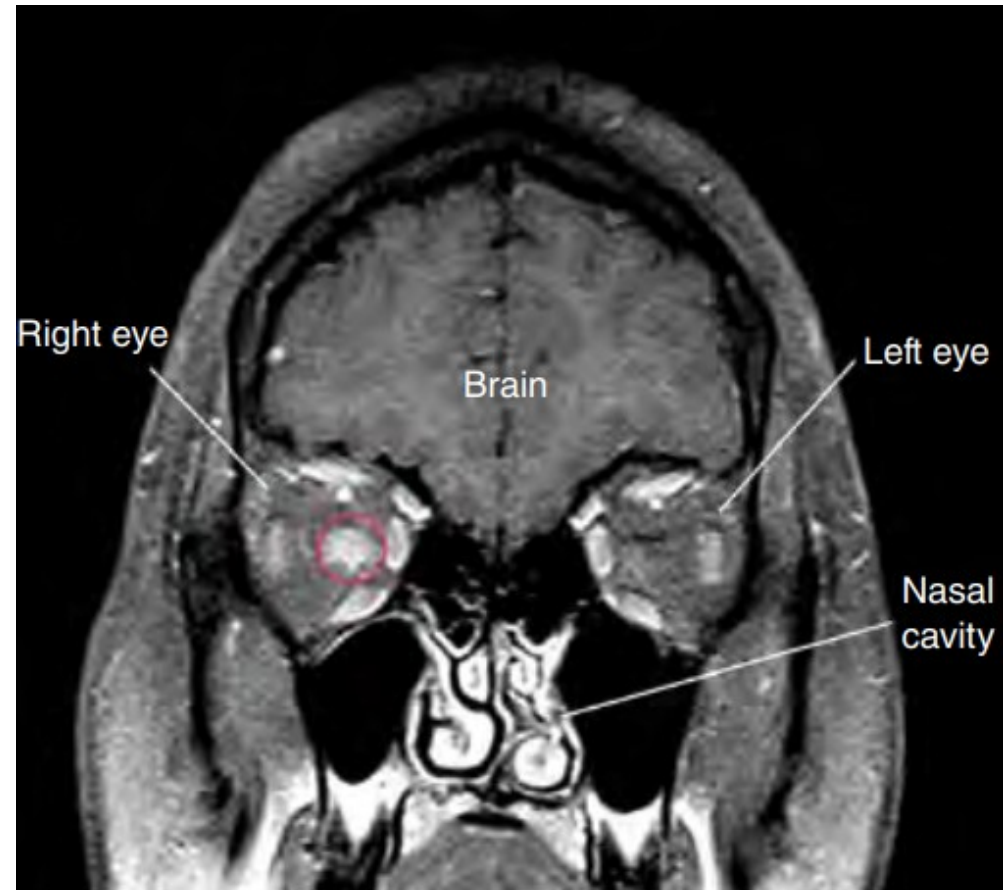
- 1 Optic nerve: monocular visual loss
- 2 Optic chiasm: bitemporal hemianopia
- 3 Optic tract: homonymous hemianopsia
- 4 Optic radiation, temporal lobe (Meyer's loop): homonymous superior quadrantopsia
- 5 Optic radiation, parietal lobe: homonymous inferior quadrantopsia
- 6 Optic radiation, posterior fibres: homonymous hemianopia.
- 7 Calcarine cortex, occipital lobe: homonymous hemianopsia with macular sparing; e.g. posterior cerebral artery occlusion (the macula is represented in the posterior visual cortex, with supply from middle cerebral artery branches)



Physiological finding

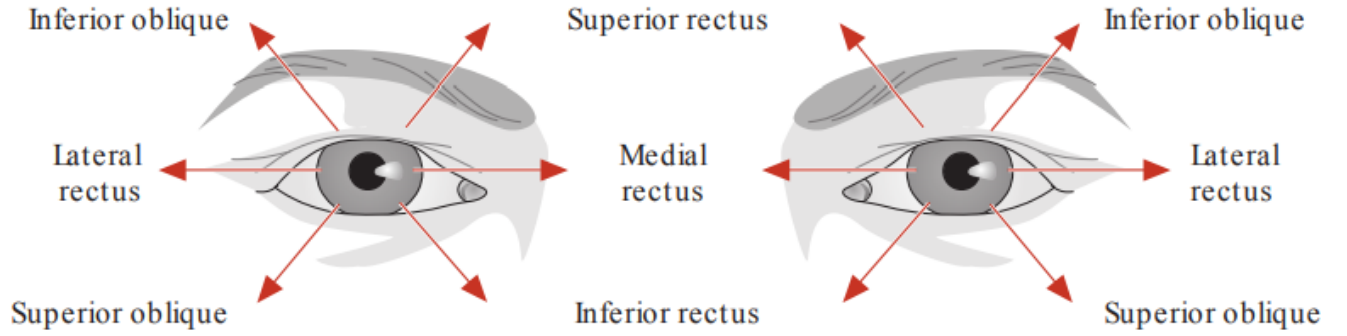
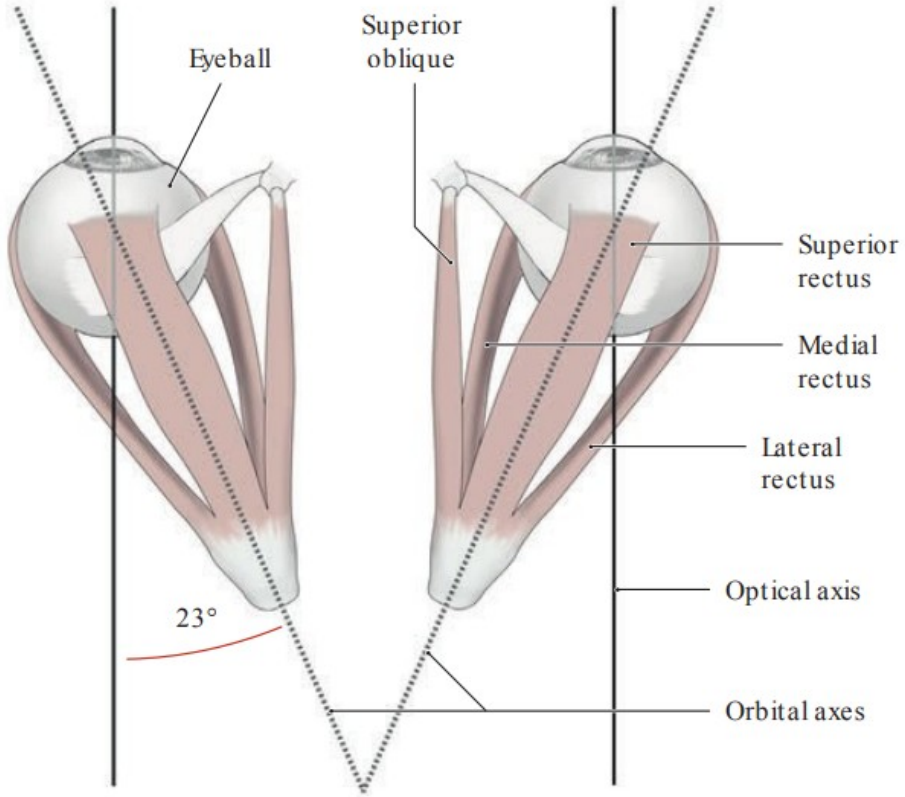


Papilledema (optic disc swelling)



Optic coherence tomography – physiological finding

INTRODUCTION TO EYE MOVEMENT I



Up and to the right



Inferior oblique Superior rectus

Up and to the left



Superior rectus Inferior oblique

To the right



Lateral rectus Medial rectus

To the left



Medial rectus Lateral rectus

Down and to the right



Superior oblique Inferior rectus

Down and to the left

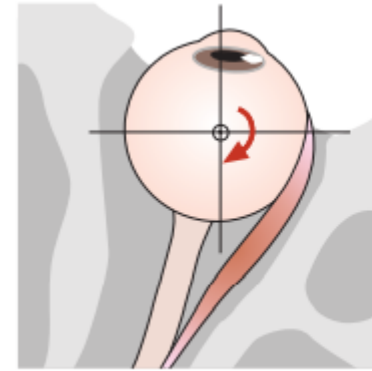


Inferior rectus Superior oblique

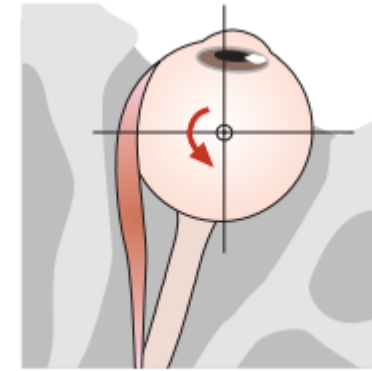
INTRODUCTION TO EYE MOVEMENT II

Table 9.2 Actions and innervation of the extraocular muscles

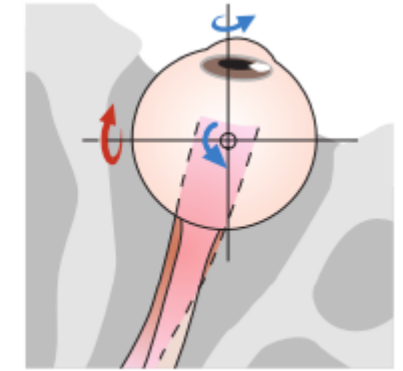
Muscle	Primary action	Secondary action	Innervation
A Lateral rectus	Abduction	—	Abducent n. (CN VI)
B Medial rectus	Adduction	—	Oculomotor n. (CN III), inferior branch
C Inferior rectus	Depression	Adduction and lateral rotation	
D Inferior oblique	Elevation and abduction	Lateral rotation	
E Superior rectus	Elevation	Adduction and medial rotation	Oculomotor n. (CN III), superior branch
F Superior oblique	Depression and ab- duction	Medial rotation	Trochlear n. (CN IV)



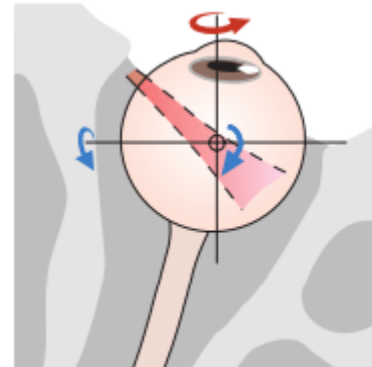
A



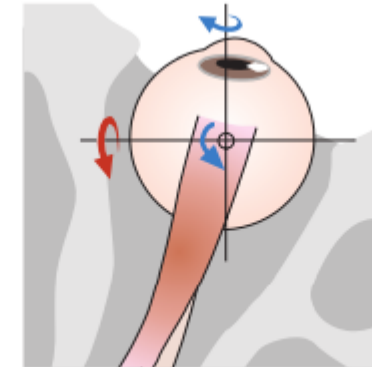
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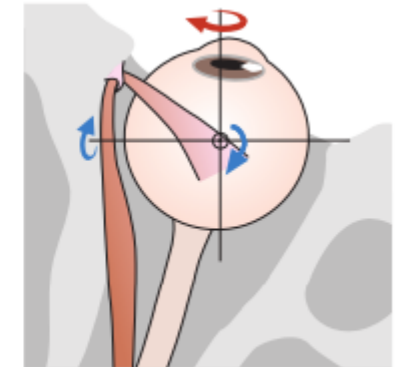
C



D



E



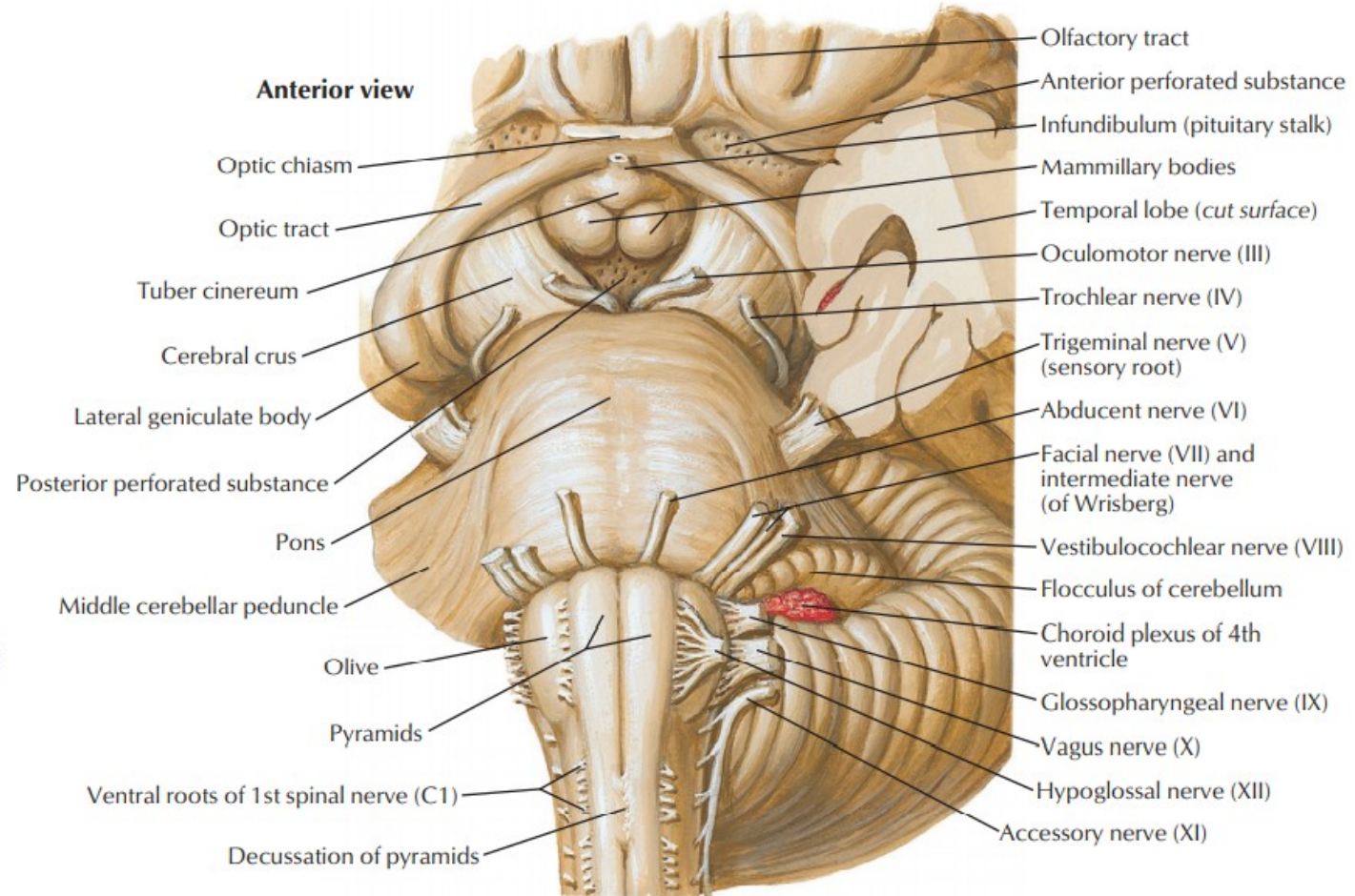
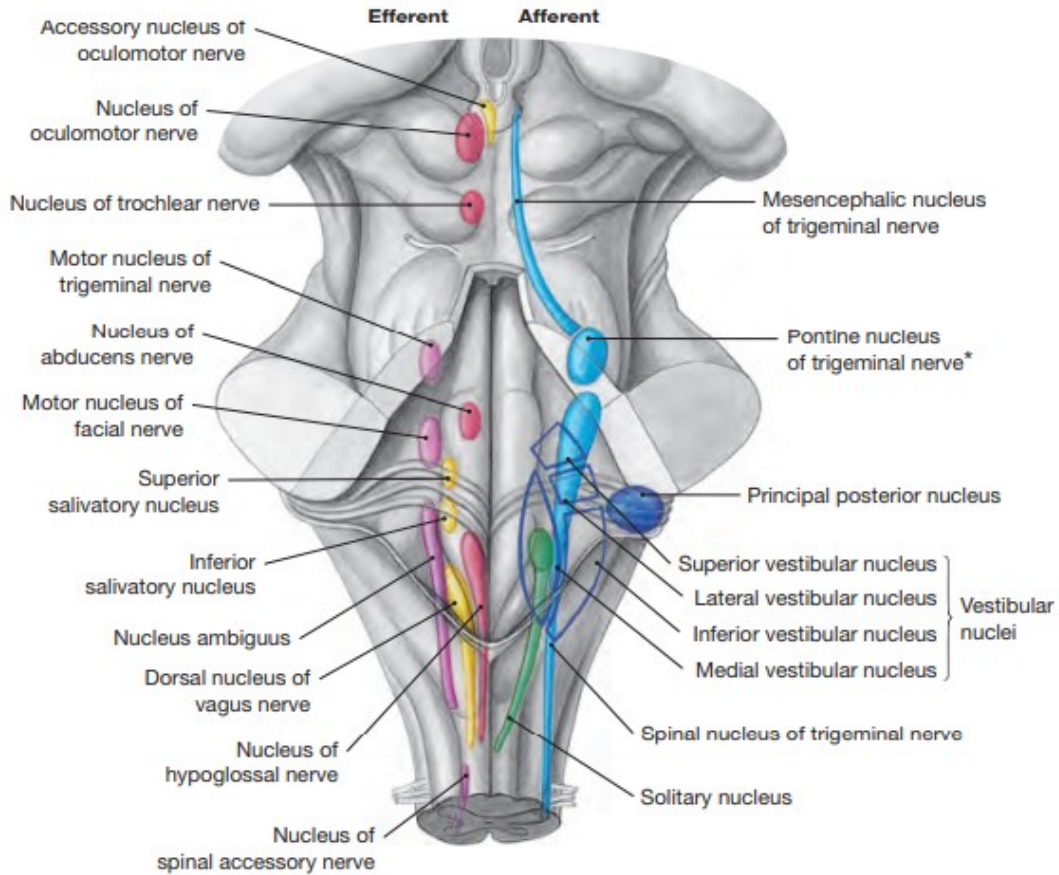
F



**Oculomotor nerve
(n. III)**

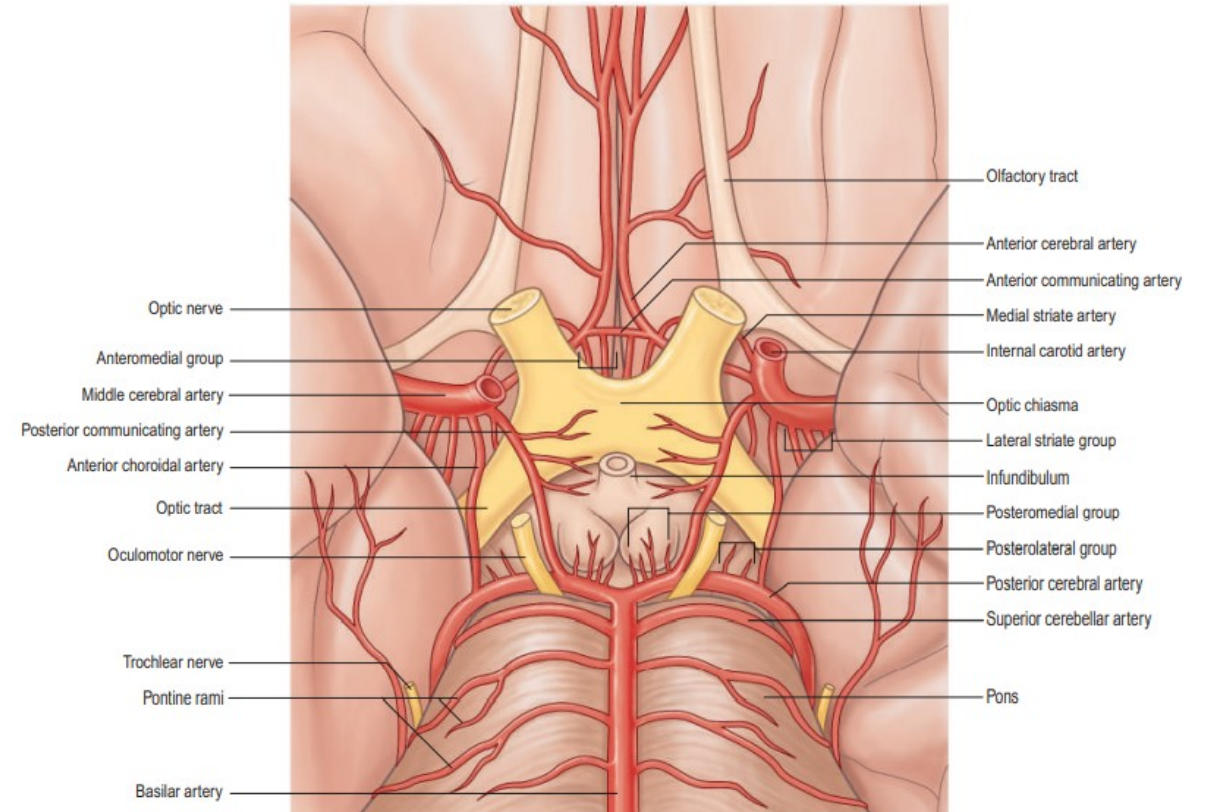
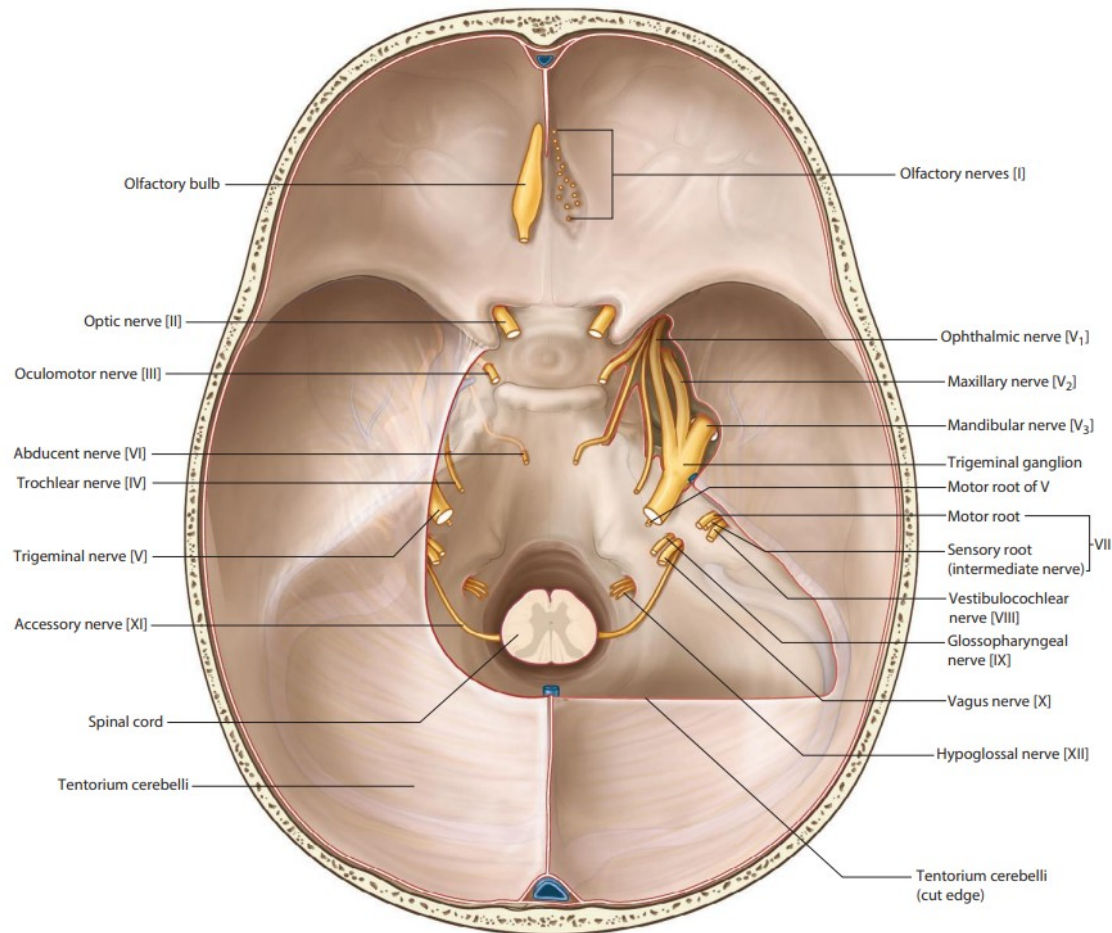


- arises from the **interpeduncular fossa (*sulcus nervi oculomotorii*)** of the midbrain
- innervates **all of the extraocular muscles except superior obliquus muscle and lateral rectus muscle**
- preganglionic parasympathetic fibers from the **accessory nucleus of n. III (*Edinger-Westphali*)** synapse in the ciliary ganglion and supply **sphincter pupillae muscle (miosis)** a **ciliary muscle (accommodation)**



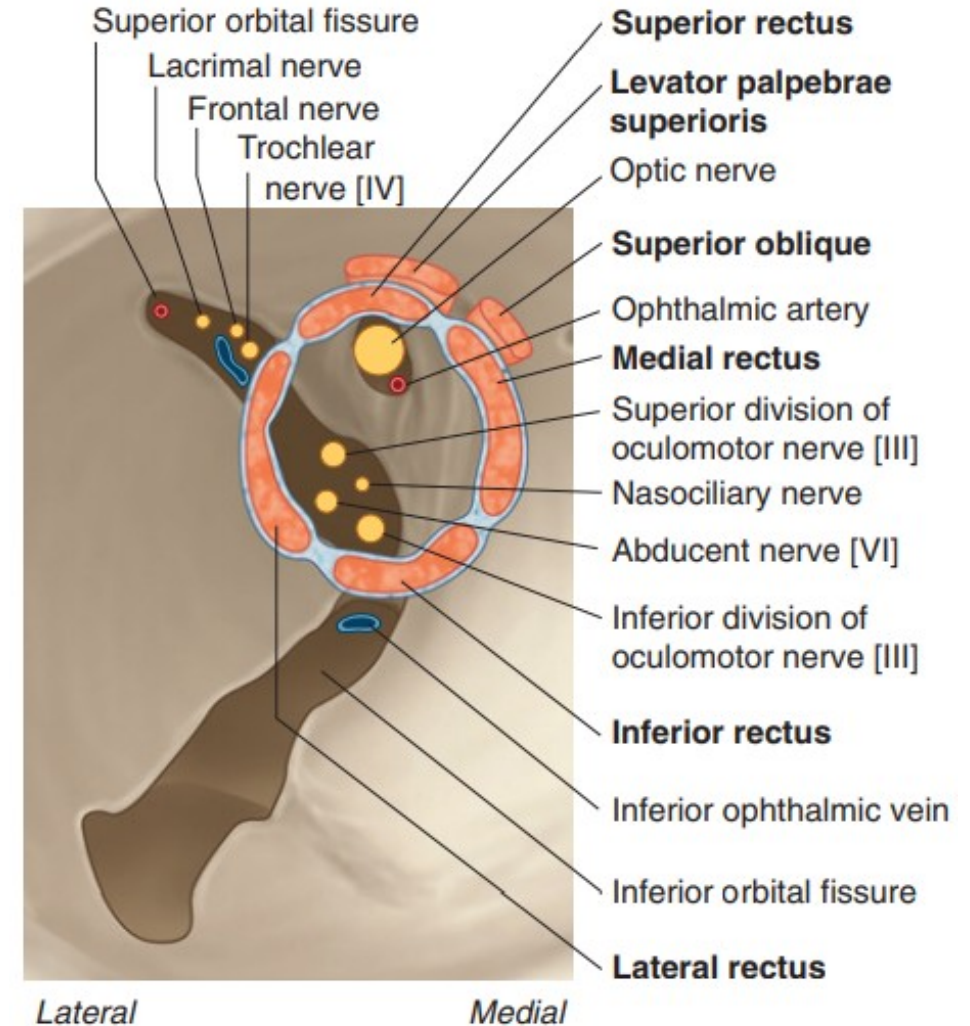
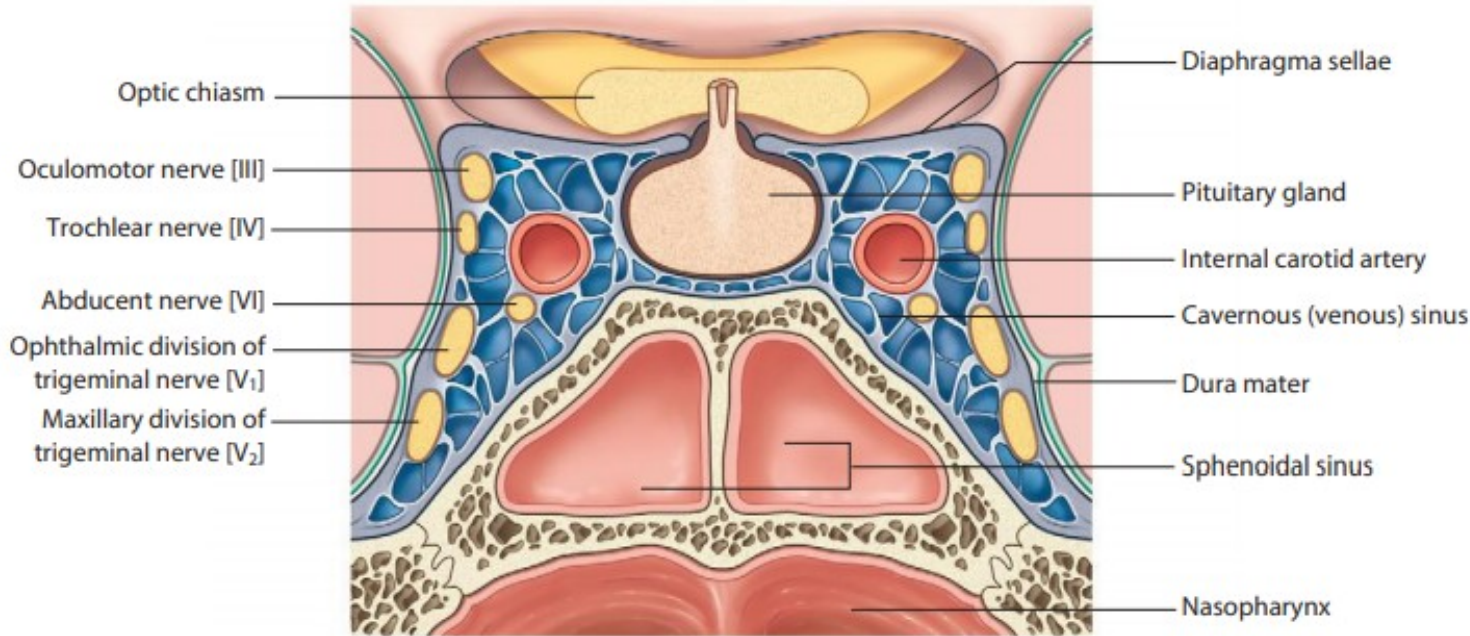
- passes through subarachnoid space (interpeduncular cistern) lateral to the posterior communicating artery
- pierces *dura mater* lateral from the posterior clinoid process and enters the **cavernous sinus**

CAVE: oculomotor nerve palsy caused by posterior communicating artery aneurysm!



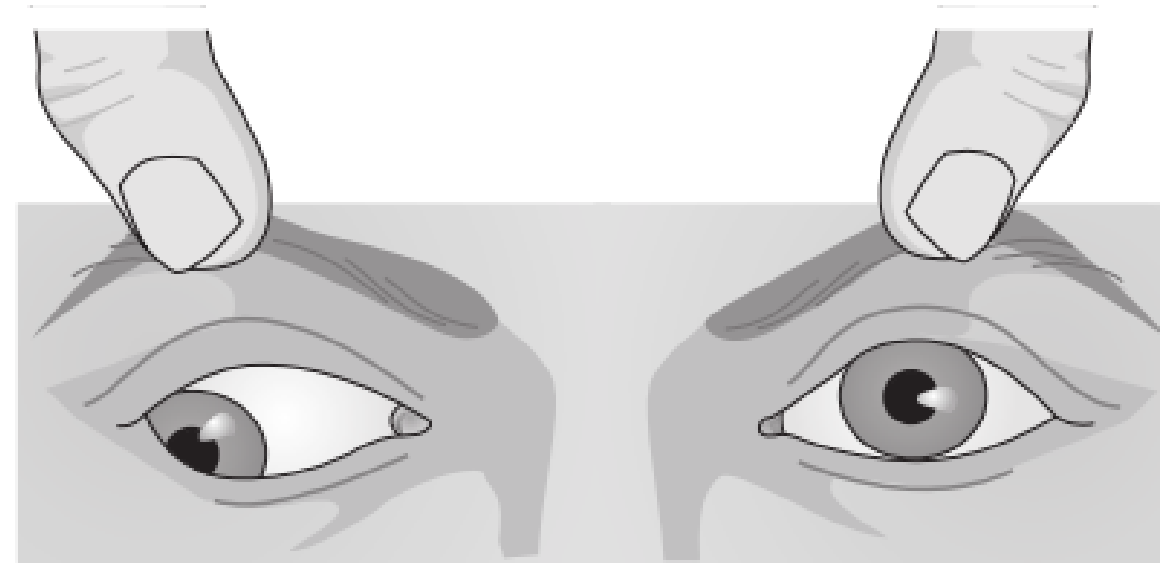
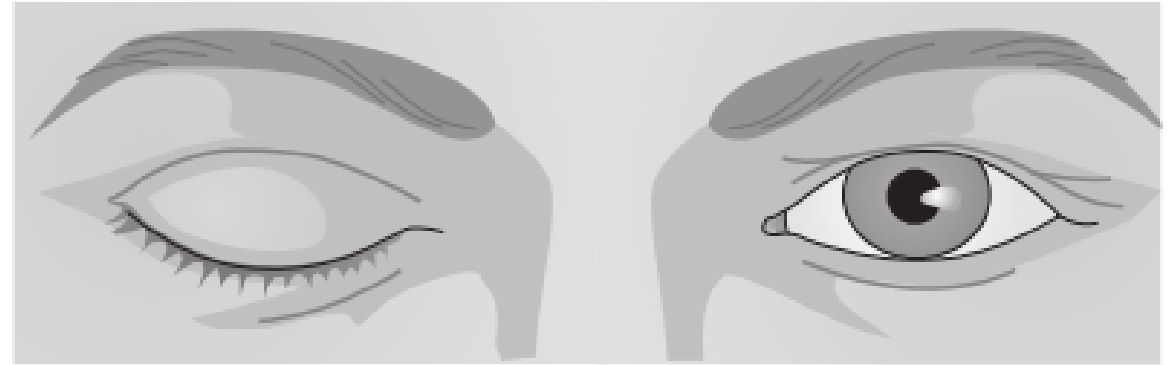
In the cavernous sinus:

- **receives sympathetic branches** from internal carotid plexus for innervation of superior tarsal muscle (*ncl. intermediolateralis Th1-Th5* → *ganglion cervicale superius* → *n. caroticus internus* → *plexus caroticus internus*)
- **proprioceptive fibers** hitchhike along **the ophthalmic nerve to the mesencephalic trigeminal nucleus**



SYMPTOMS OF OCULOMOTOR NERVE LESION

- ptosis
- exotropia (outward) and hypotropia (downward)
- limitations of eye movements
- diplopia
- mydriasis



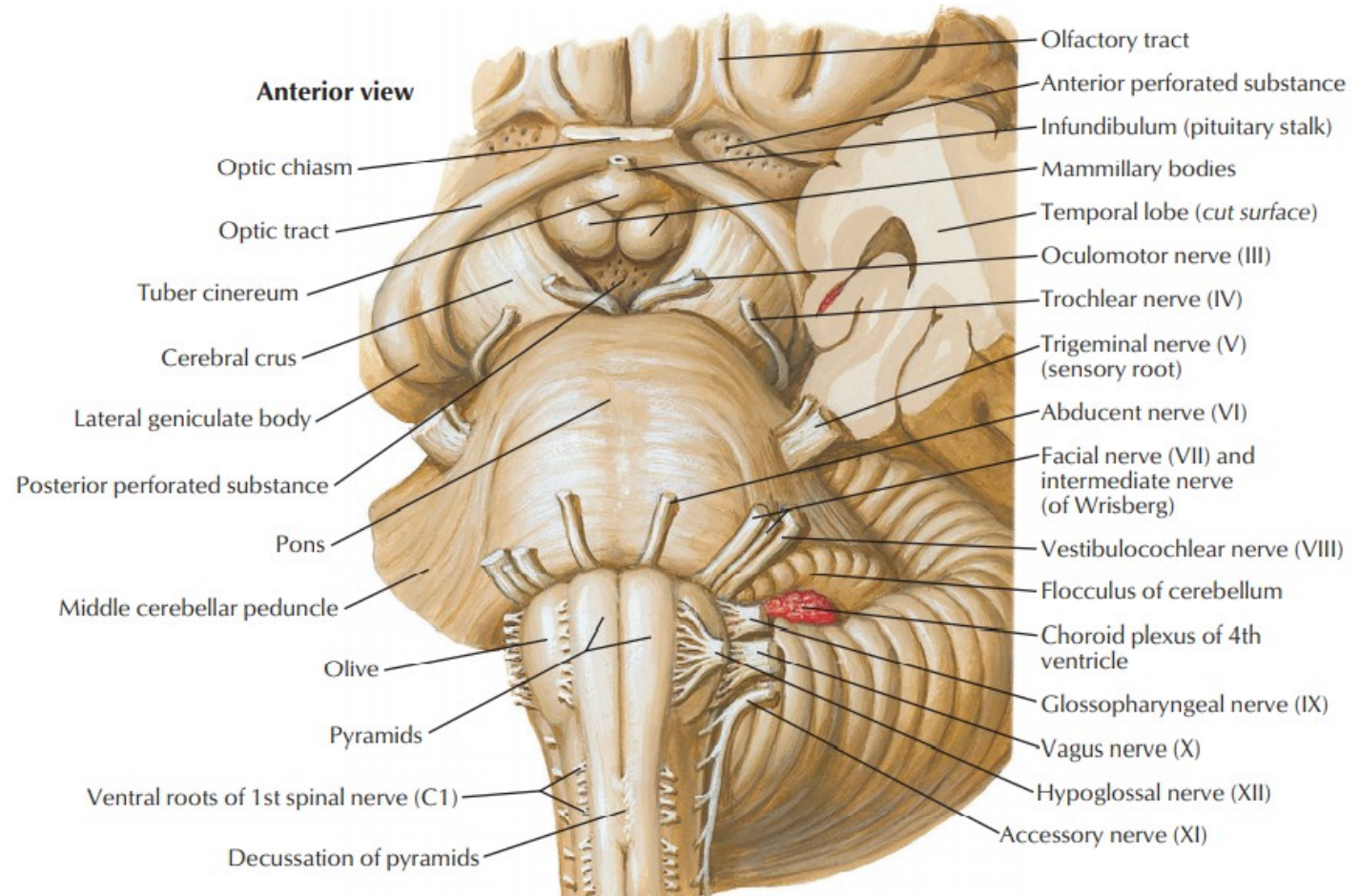
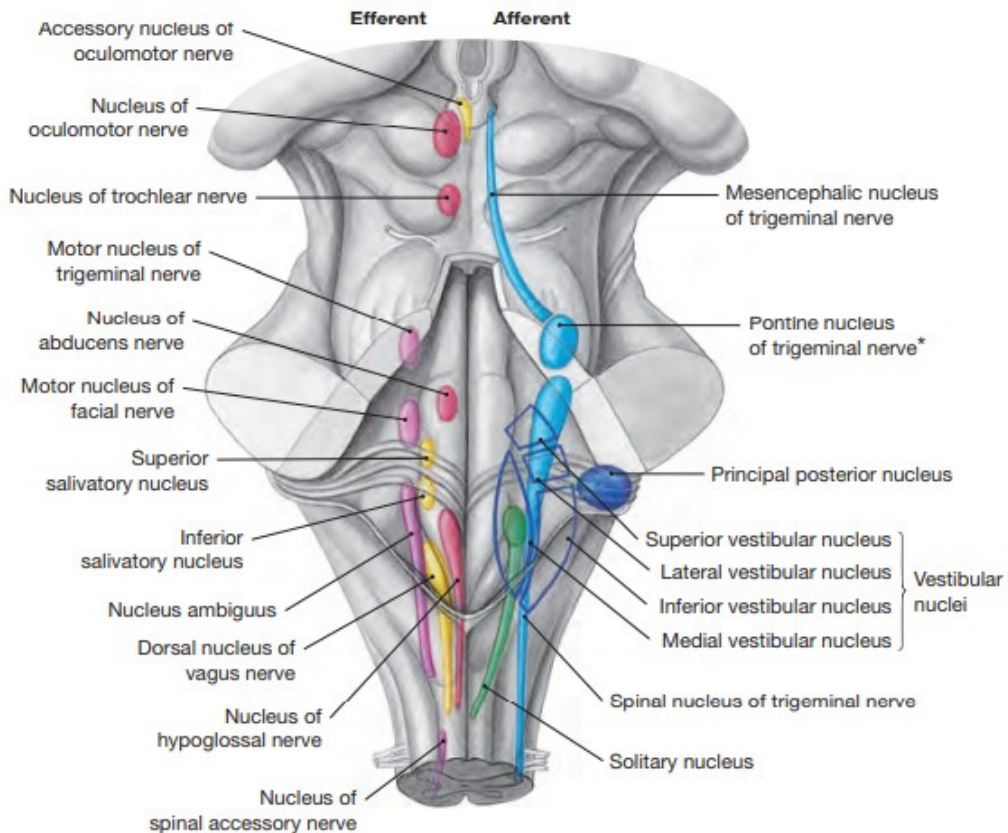
OVERVIEW OF THE OCULOMOTOR NERVE BRANCHES

1. ***Ramus superior*** (innervation of *m. levator palpebrae superioris* a *m. rectus superior*)
 - *rr. orbitales*
2. ***Ramus inferior*** (innervation of *m. rectus medialis*, *m. rectus inferior* a *m. obliquus inferior*)
 - *ramus ad ganglion ciliare / radix parasympathica (oculomotoria) ganglii ciliaris*
 - *nn. ciliares breves*

Trochlear nerve (n. IV)



- the trochlear motor nucleus in the midbrain
- **fibers decussate within the brainstem**
- arises as **only cranial nerve** from the **dorsal aspect of the brainstem**
- innervates the **superior oblique muscle**



SYMPTOMS OF TROCHLEAR NERVE LESION

- central (contralateral) x periferal (ipsilateral) palsy
- endotropia (inward) and hypertropia (upward)
- mediocaudal limitation of eye movement
- diplopia

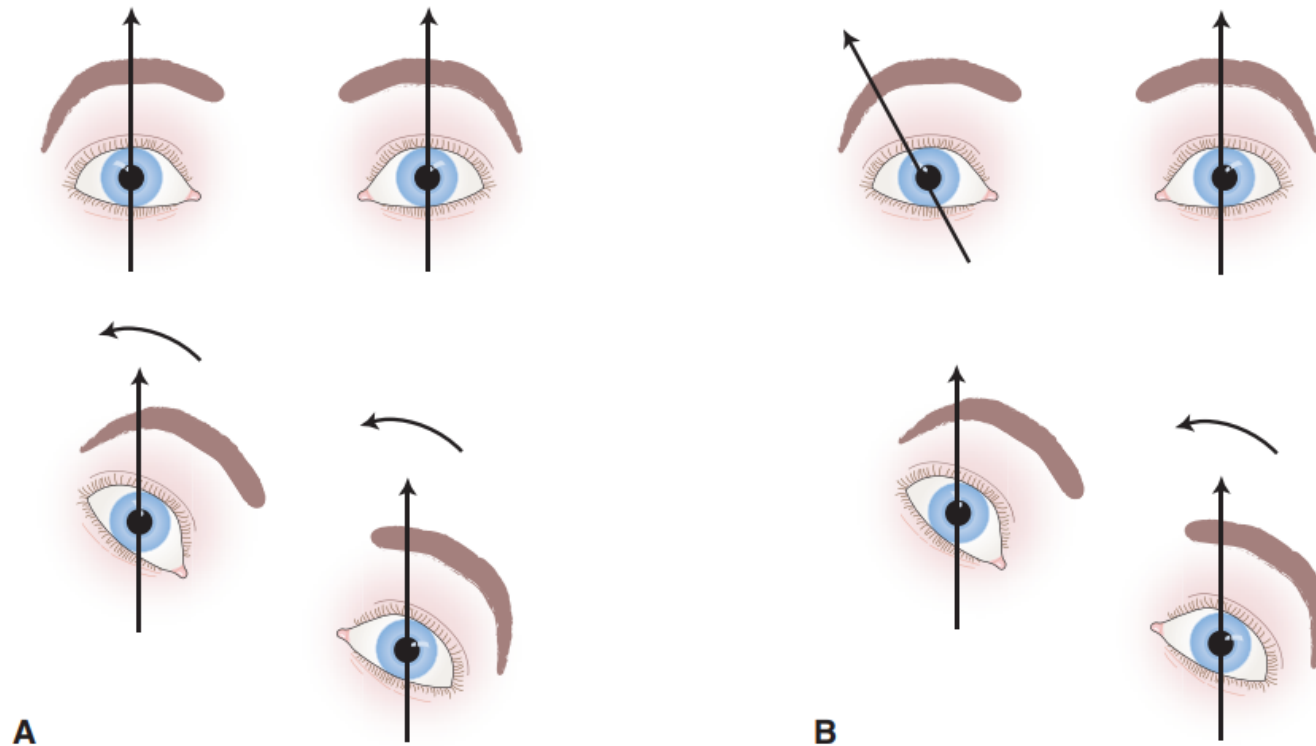
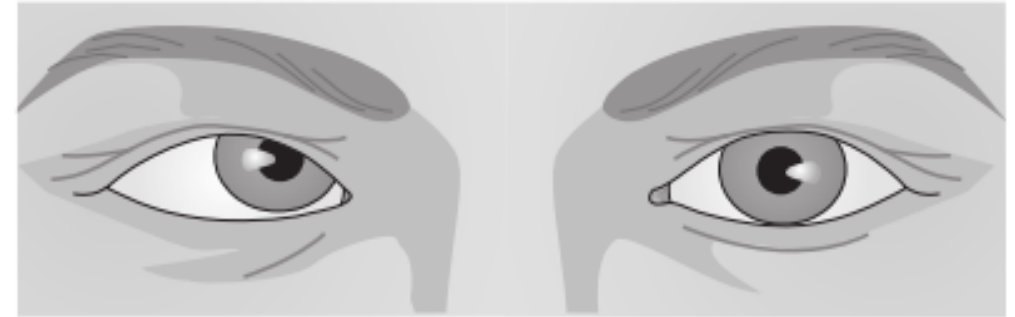


FIGURE 10.4. Paralysis of the right superior oblique. **(A)** A pair of eyes with normal extorsion and intorsion movements. Tilting the chin to the right side results in compensatory intorsion of the left eye and extorsion of the right eye. **(B)** Paralysis of the right superior oblique results in extorsion of the right eye, causing diplopia. Tilting the chin to the right side results in compensatory intorsion of the left eye, thus permitting binocular alignment.

Trigeminal nerve (n. V)



- the biggest cranial nerve
- mixed nerve with large nuclear complex

1. Motor nucleus of trigeminal nerve (masticatory)

- **branchiomotor nucleus** supplies muscles derived from 1th pharyngeal arch (muscles of mastication, *m. mylohyoideus*, *venter anterior m. digastrici*, *m. tensor tympani*, *m. tensor veli palatini*)

2. Principal sensory nucleus of trigeminal nerve (pontine)

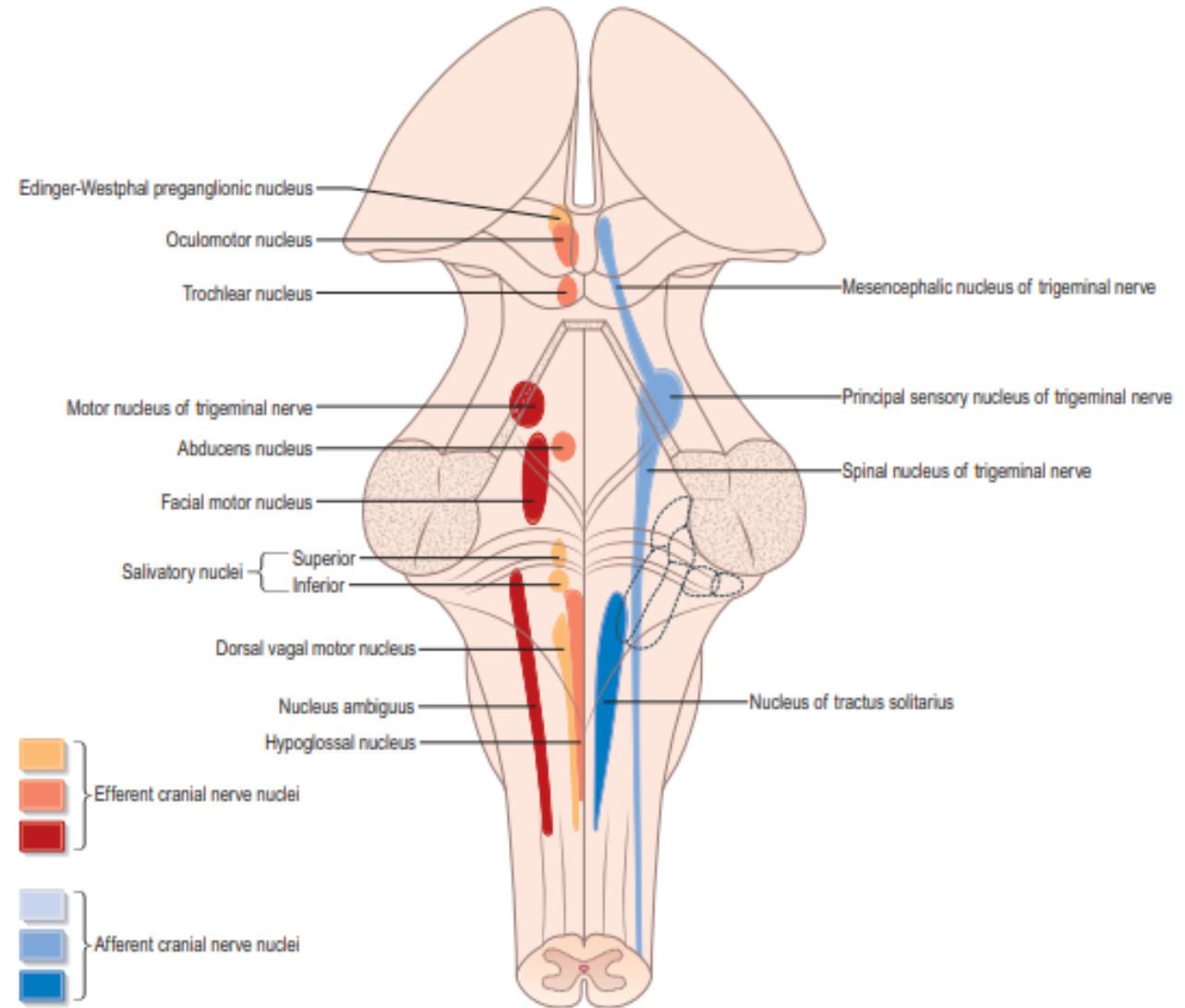
- **somatosensory nucleus**, receives discriminative sensations, proprioception, light touch and vibration

3. Spinal nucleus of trigeminal nerve

- **somatosensory nucleus** for perception of cold, heat, pain and partial proprioception from n. V, VII, IX, X

4. Mesencephalic nucleus of trigeminal nerve

- **ganglion with pseudounipolar neurons**, receives proprioception from periodontium, hard palate, temporomandibular joint and from extraocular, masticatory, mimic and lingual muscles too



Spinal nucleus of the trigeminal nerve

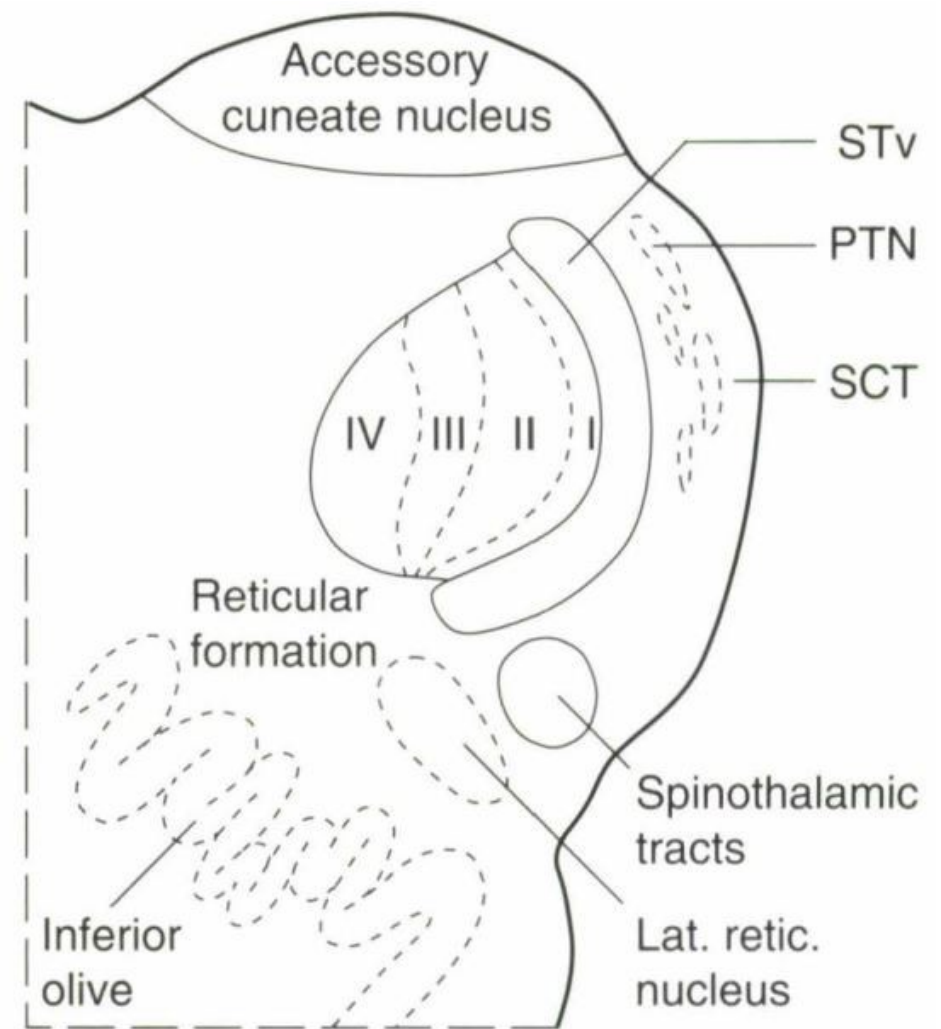
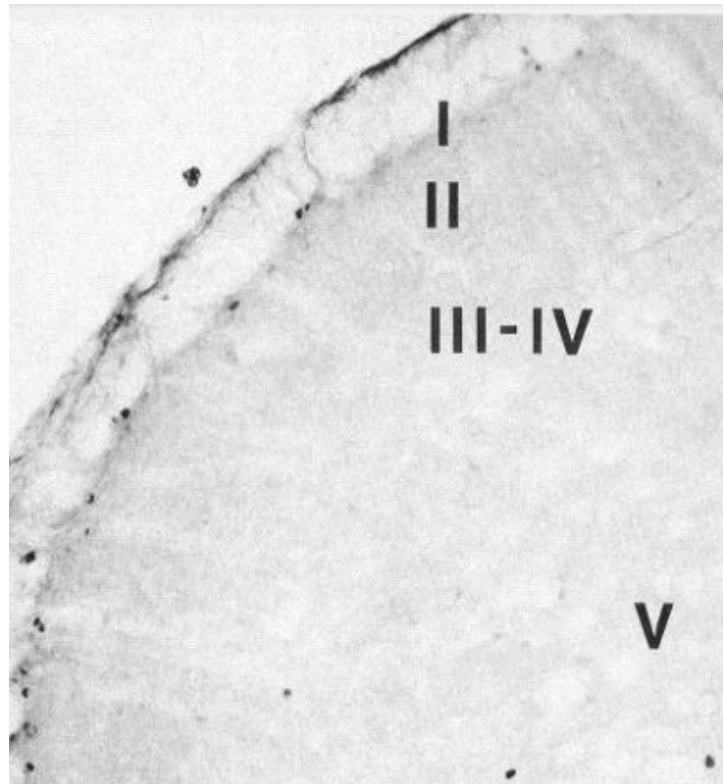
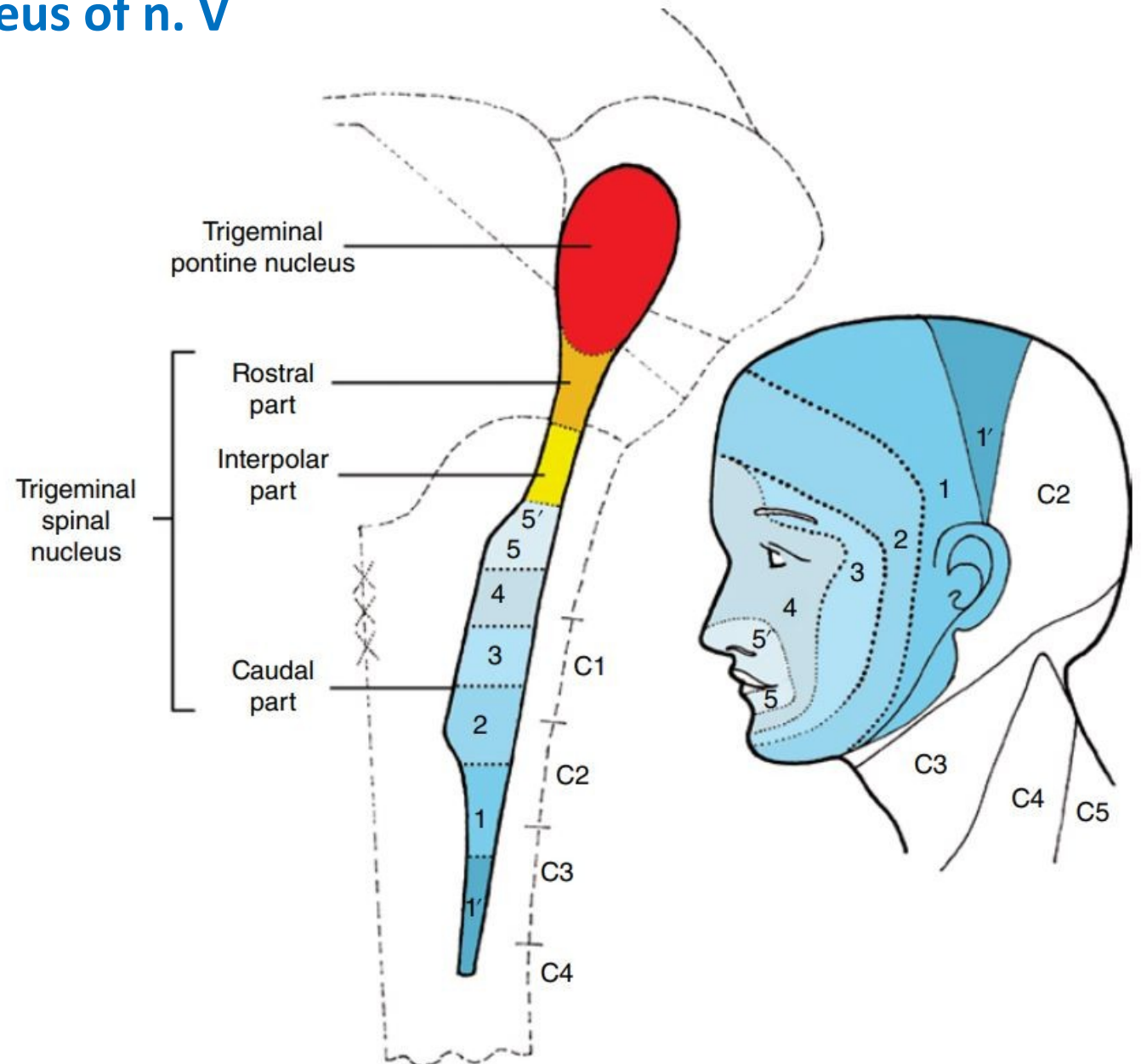


Figure 12.10. Laminar organization of the spinal trigeminal nucleus. Lamina I adjacent to the spinal trigeminal tract (*STv*) is called the marginal layer. Cells in lamina I resemble those of the posteromarginal nucleus at spinal levels. Laminae II corresponds to the substantia gelatinosa, and laminae III and IV form the magnocellular subdivision. *PTN* indicates the paratrigeminal nucleus and *SCT* the spinocerebellar tracts.

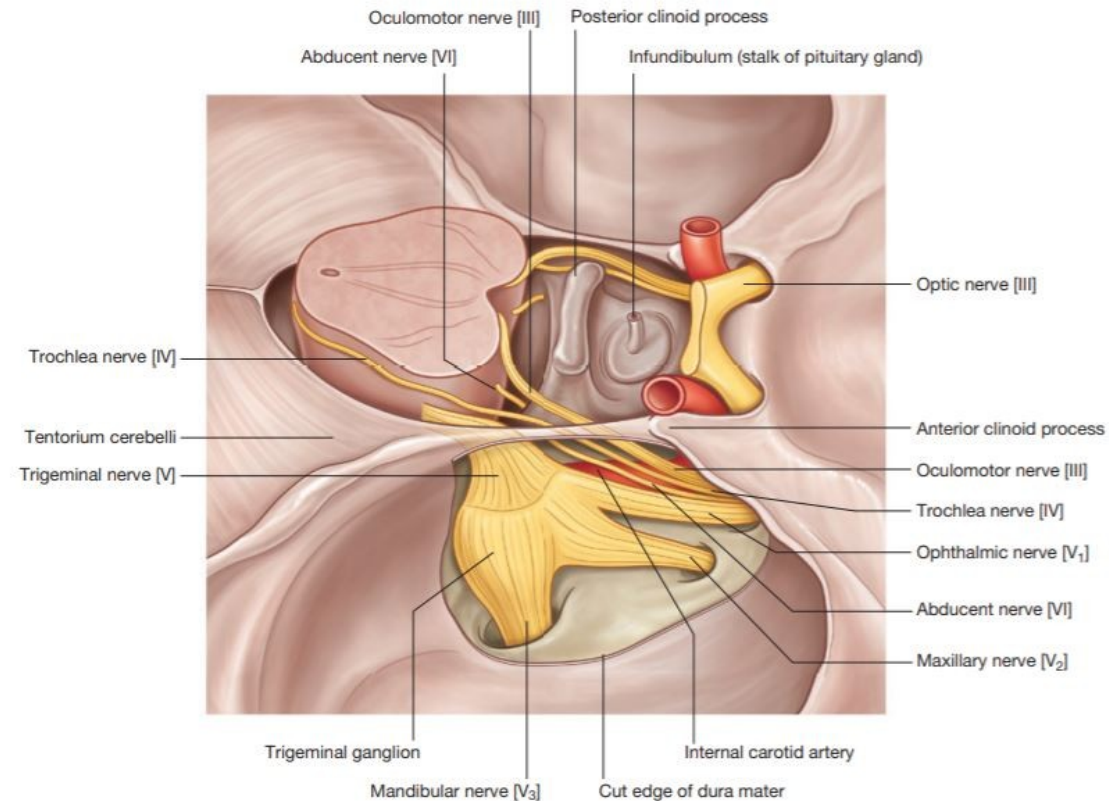
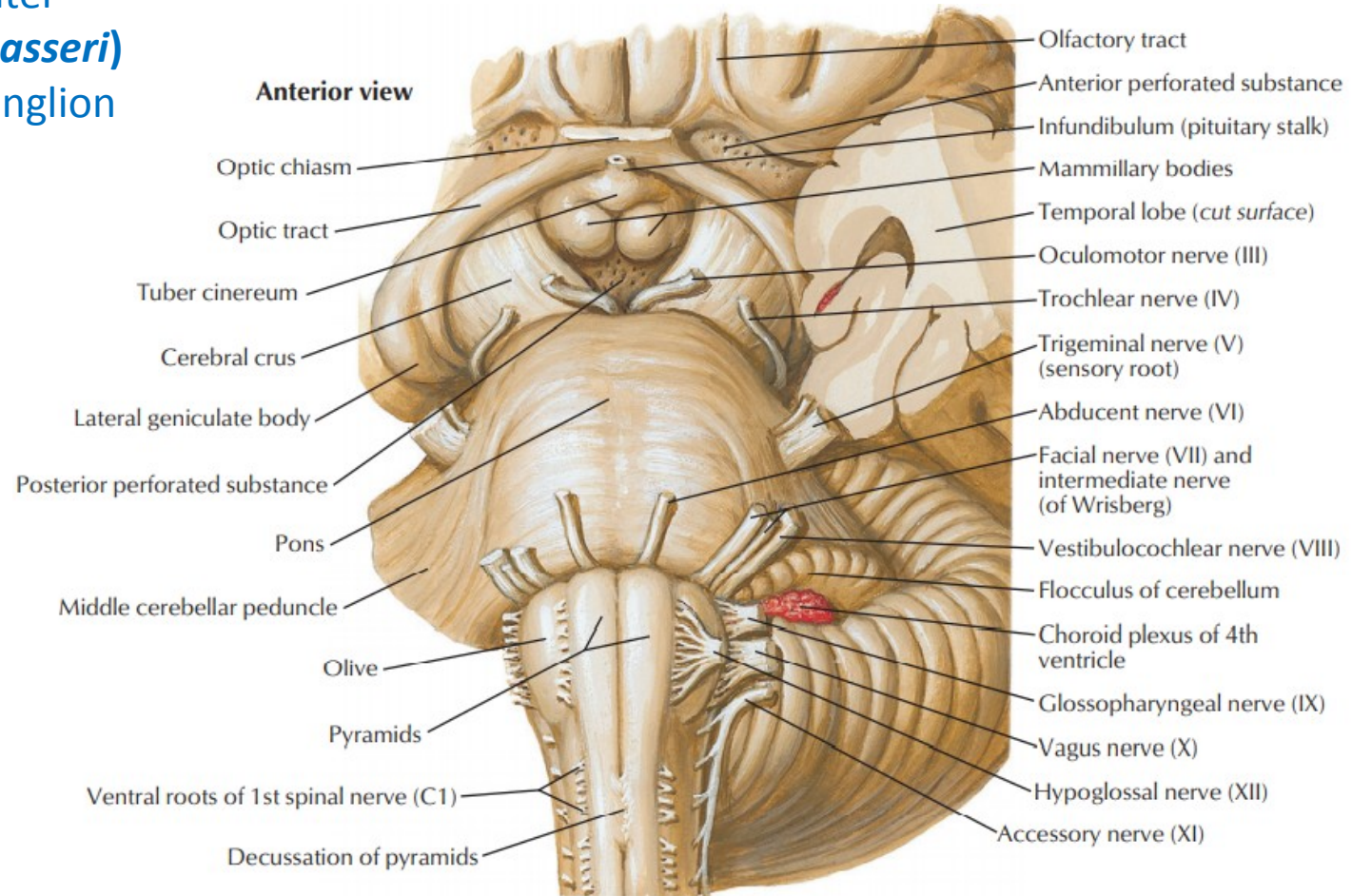
Somatotopic arrangement of spinal nucleus of n. V

- termination of the A δ and C fibers

1. Subnucleus (pars) oralis
2. Subnucleus (pars) interpolaris
3. Subnucleus (pars) caudalis

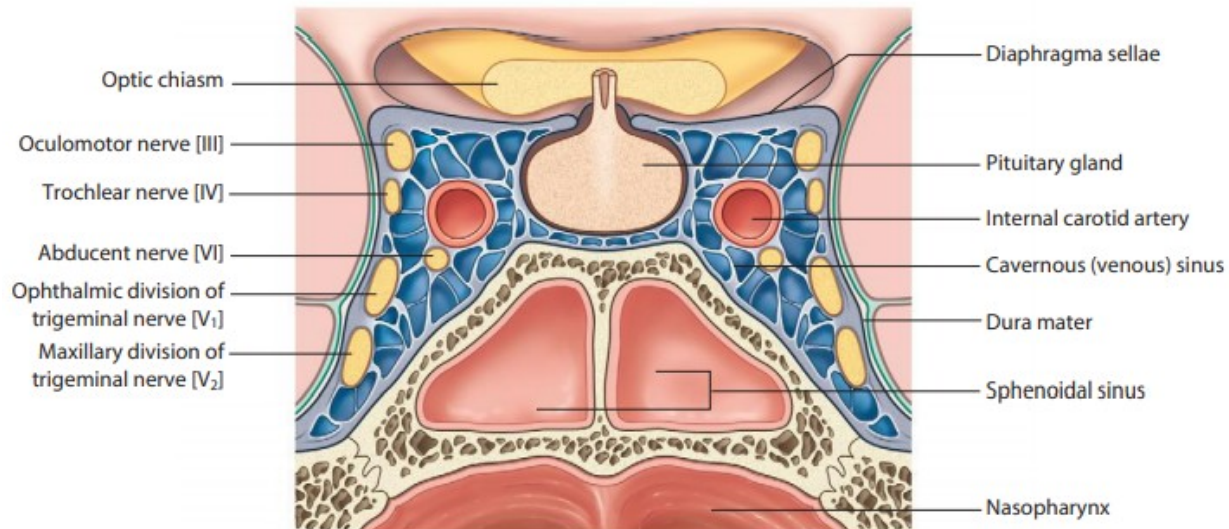
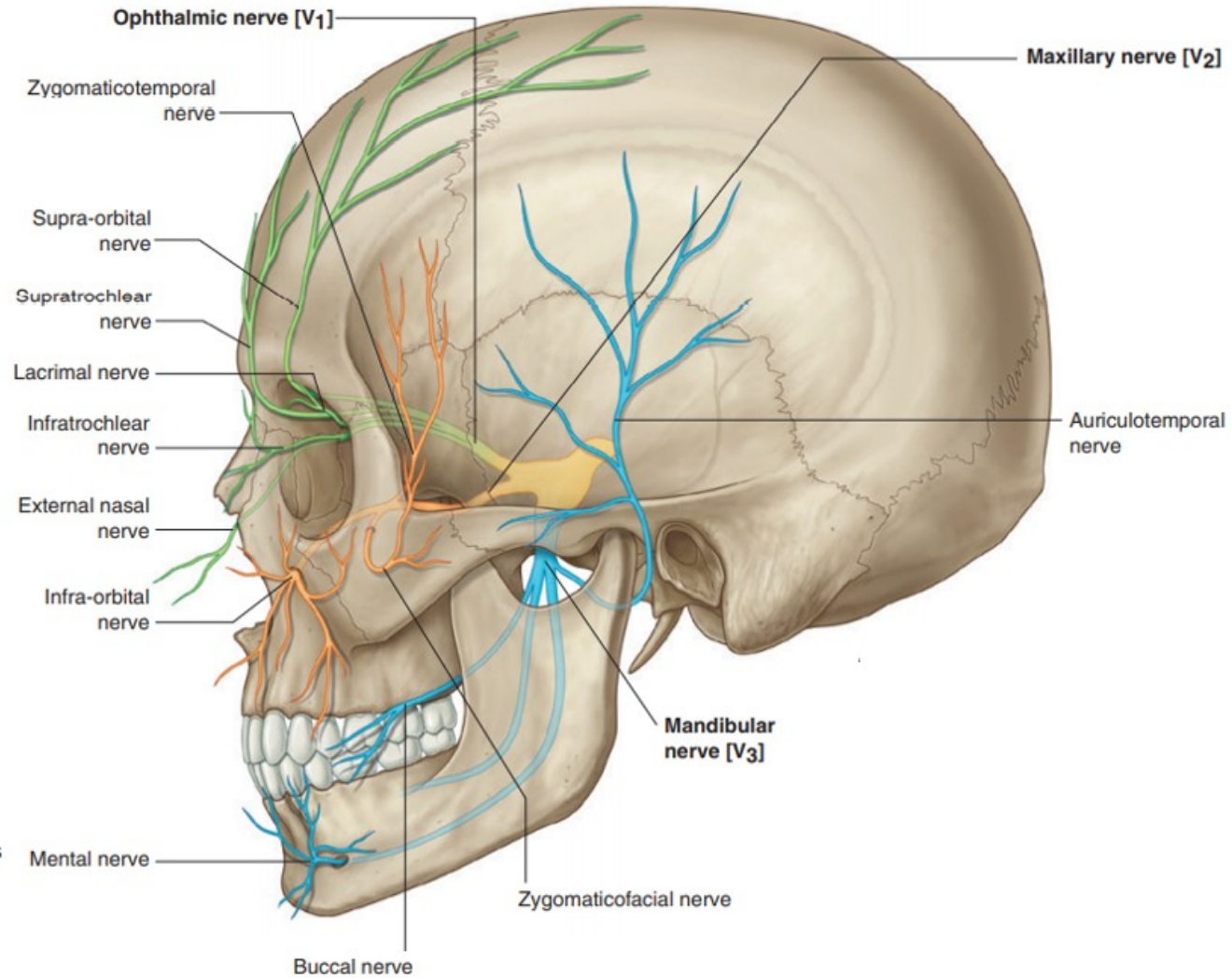


- arises from the middle part of pons
- enters the trigeminal cave (Meckel's cave), a dura mater pouch containing **trigeminal ganglion (*semilunare, Gasseri*)**
- **motor root (*portio minor trigemini*)** underruns the ganglion and joins the mandibular nerve directly



Ophthalmic nerve

- 1th branch of the trigeminal nerve
- counts approx. 26 000 myelinated fibers
- the most medial branch of the trigeminal ganglion
- passes through the lateral wall of cavernous sinus
- supplies (somatosensory):
 - orbit with periosteum, ocular bulb, lacrimal gland
 - conjunctiva of the upper eyelid
 - skin of nasal dorsum and tip, upper eyelid and forehead to the interauricular line
 - ethmoidal cells mucosa, *sphenoid sinus* and ventral part of nasal cavity



Ophthalmic nerve

- divides in superior orbital fissure to:

- *nervus frontalis*
- *nervus lacrimalis*
- *nervus nasociliaris*

Nervus frontalis

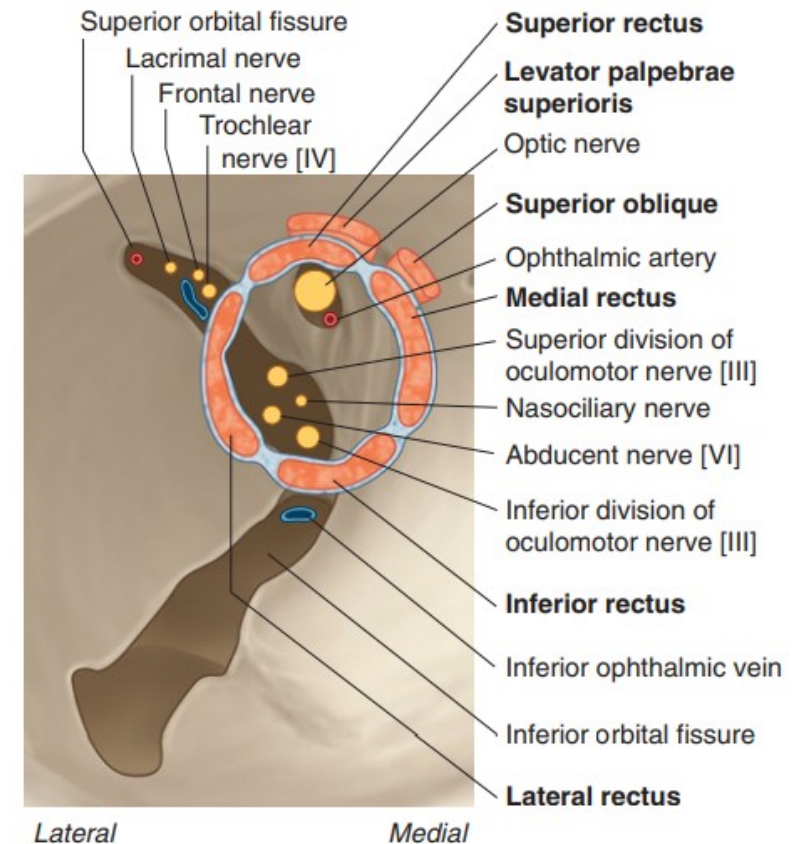
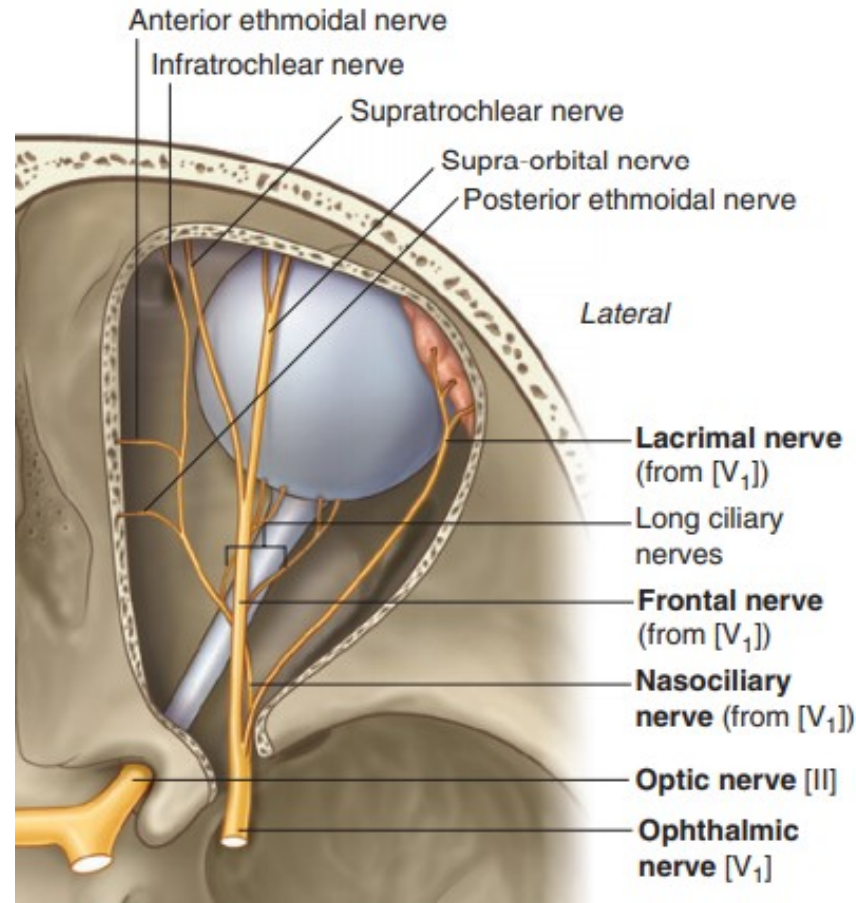
- n. supraorbitalis*
→ *r. medialis*
→ *r. lateralis*
- n. supratrochlearis*

Nervus lacrimalis

- r. communicans cum nervo zygomatico*

Nervus nasociliaris

- r. communicans cum ganglio ciliari*
- nn. ciliares longi*
- n. ethmoidalis posterior*
- n. ethmoidalis anterior*
→ *rr. nasales*
→ *r. nasalis externus*

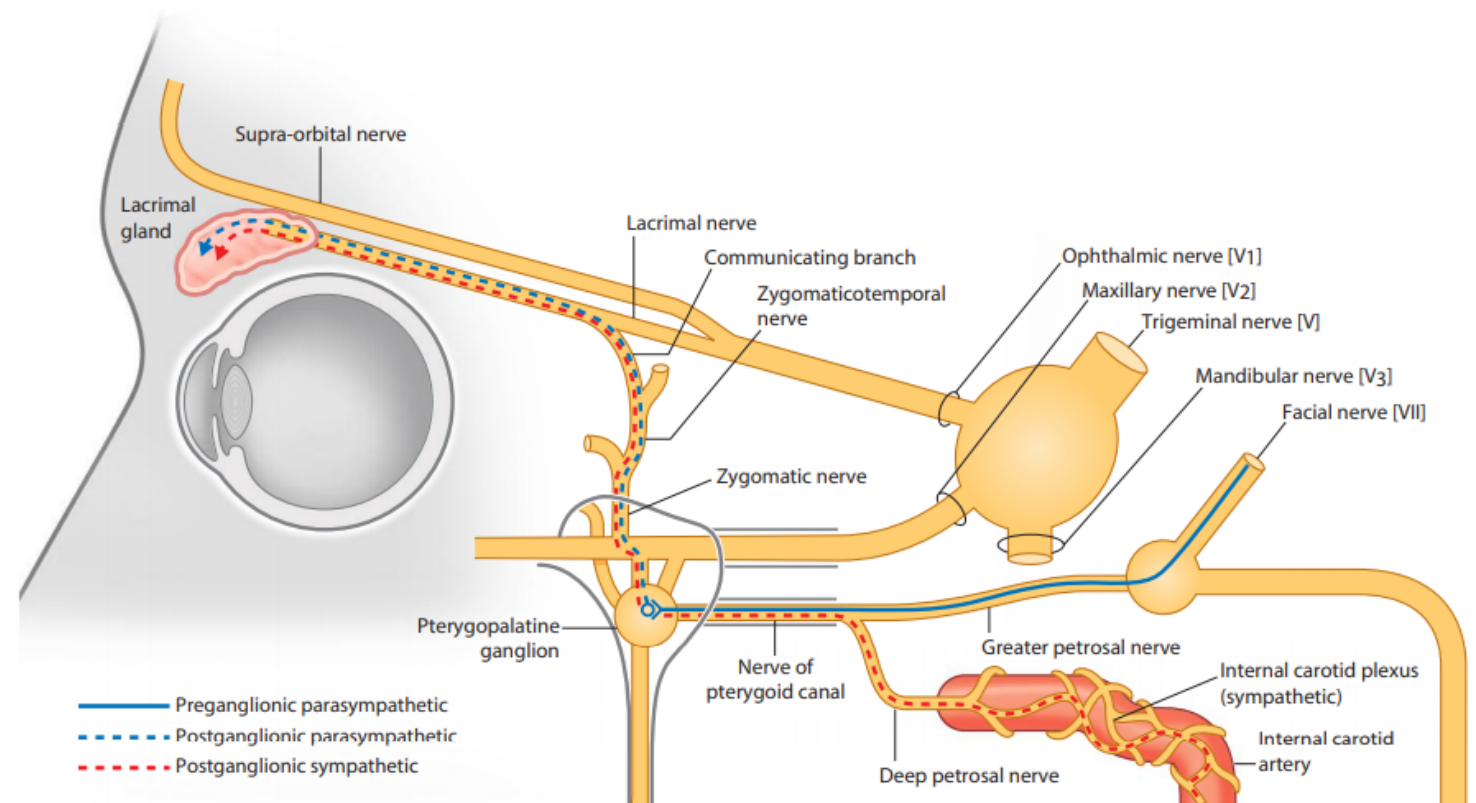
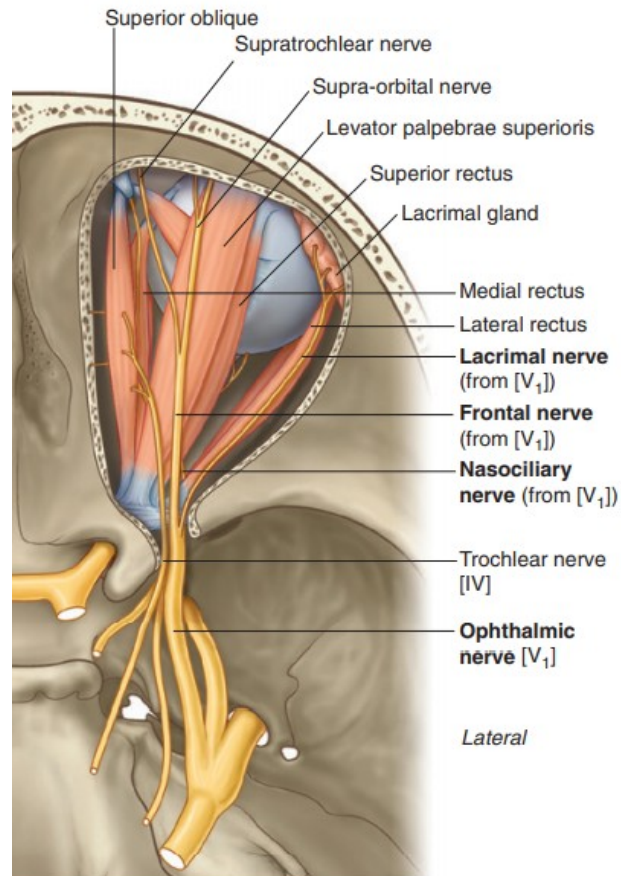


Ophthalmic nerve

➤ **lacrimal nerve** carries also autonomic fibers for innervation of lacrimal gland

(plexus caroticus internus → n. petrosus profundus → n. canalis pterygoidei → rr. ganglionares → n. zygomaticus → r. communicans cum nervo zygomatico → n. lacrimalis)

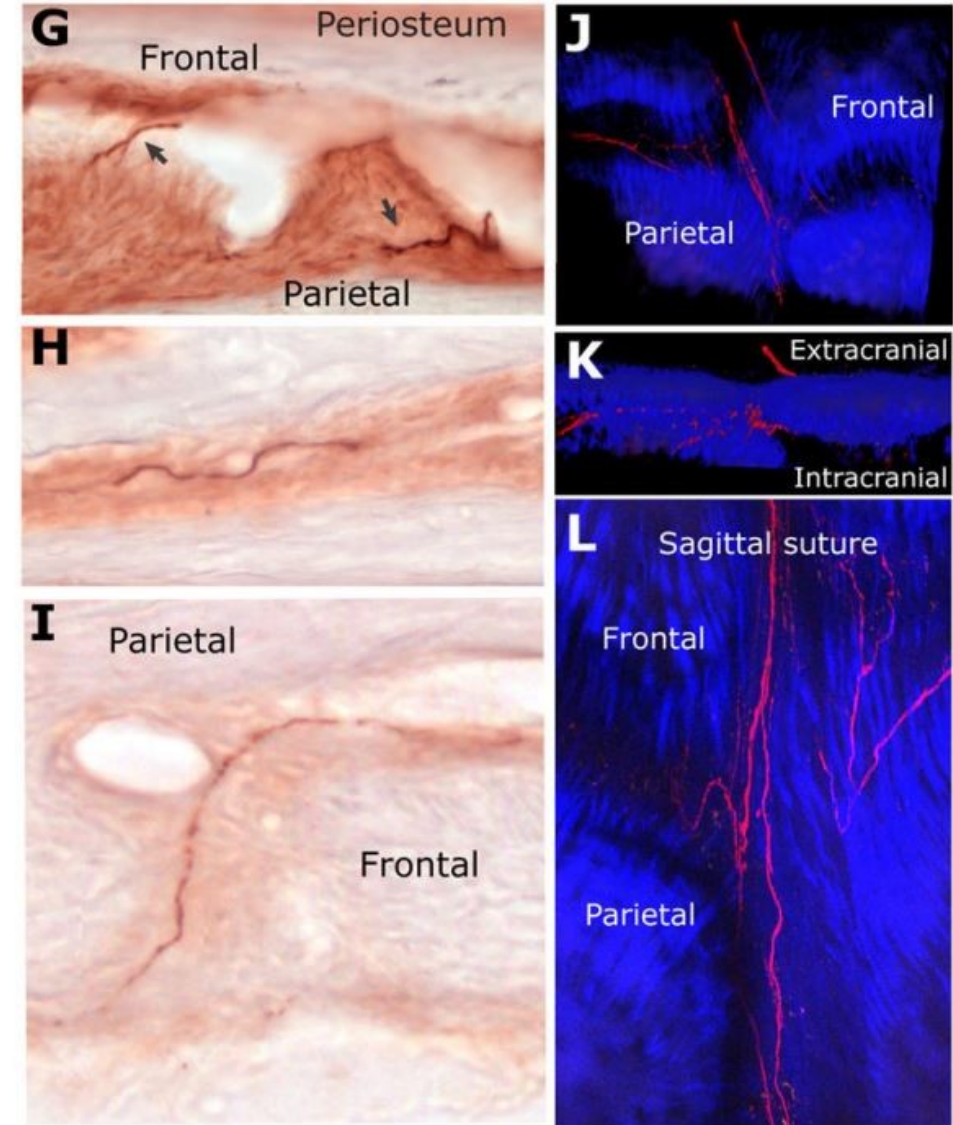
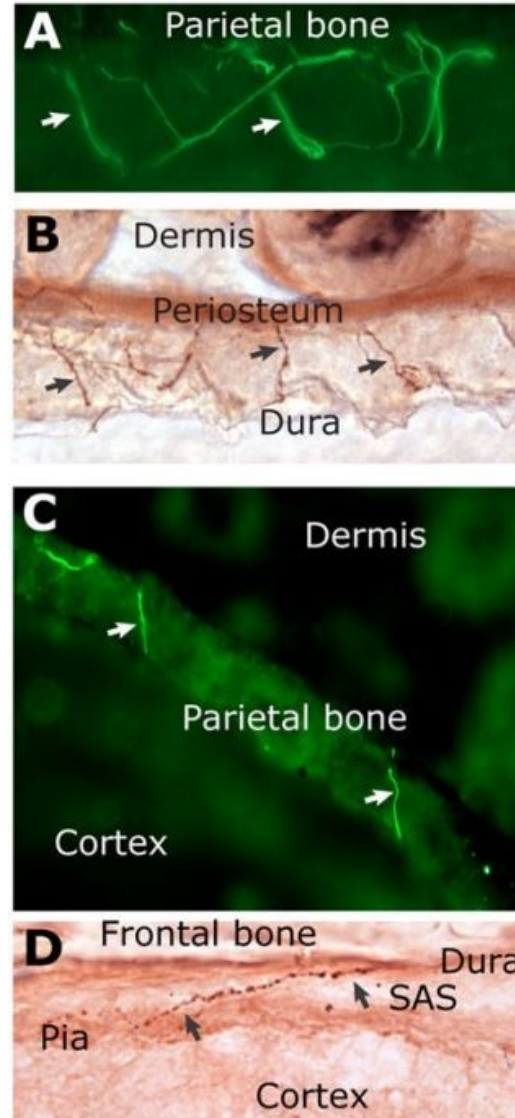
(n. VII → n. petrosus major → n. canalis pterygoidei → ganglion pterygopalatinum → rr. ganglionares → n. zygomaticus → r. communicans cum nervo zygomatico → n. lacrimalis)

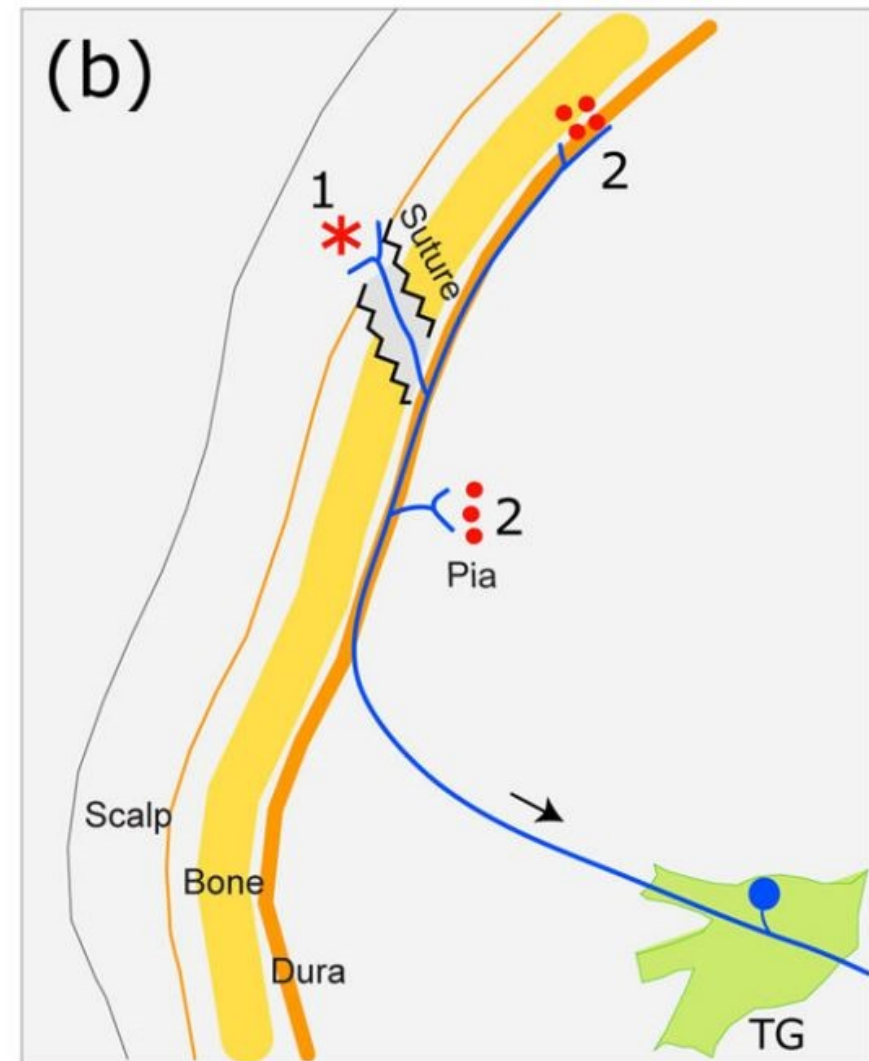
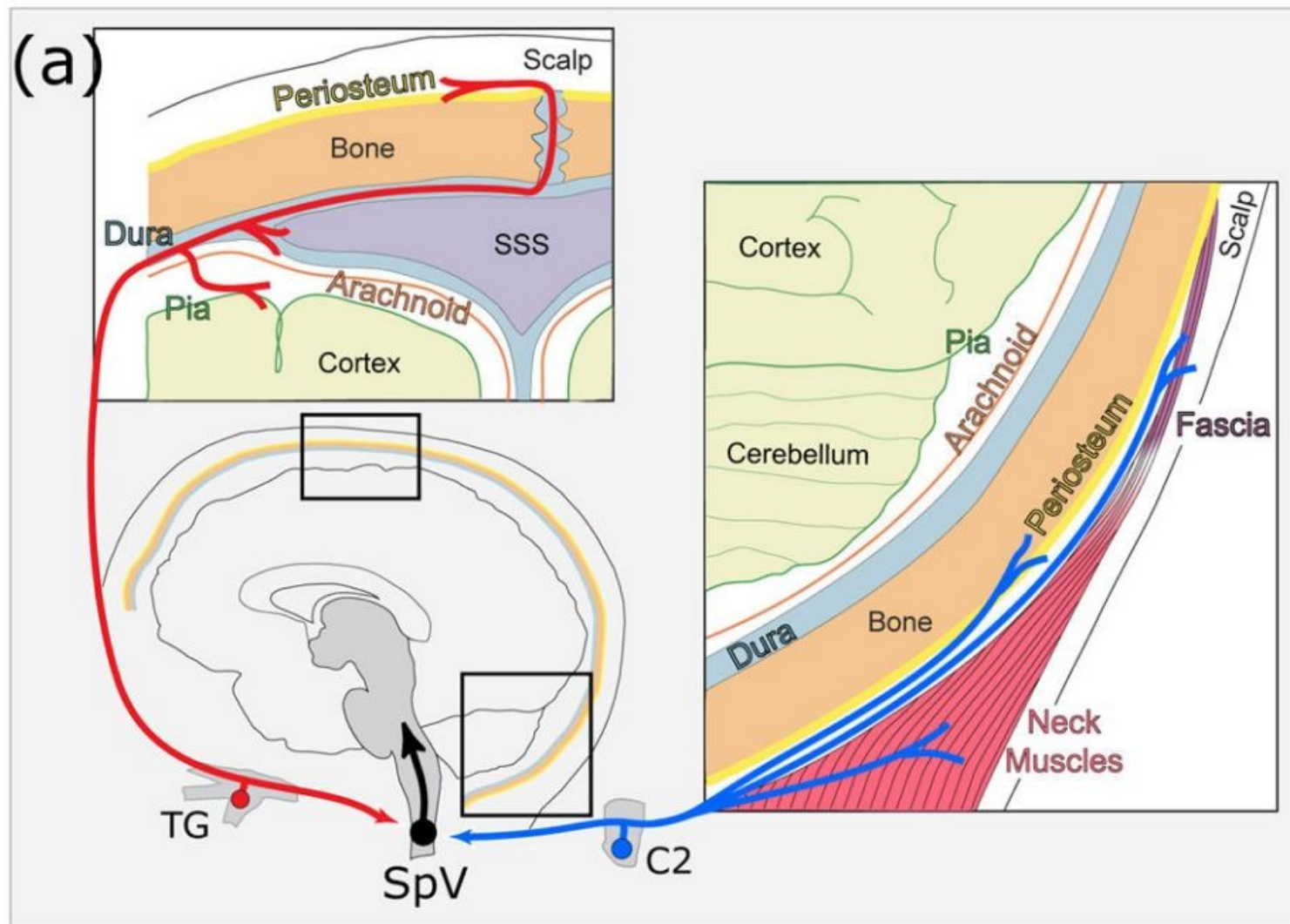


- a small number of the meningeal branch supplying dura mater of the cranial venous sinuses pass through cranial sutures and innervate extracranial periost



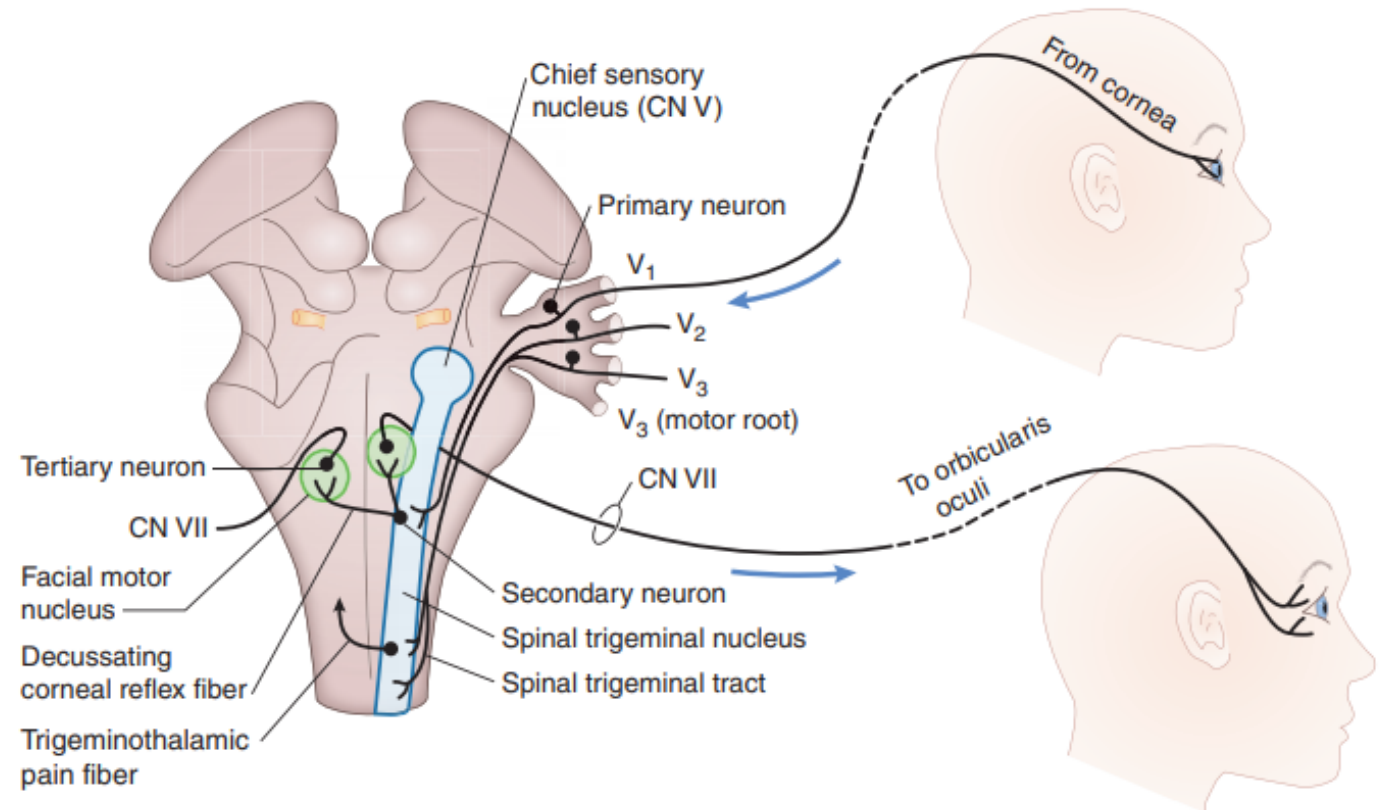
ANATOMICAL BACKGROUND OF THE TENSION HEADACHE !





Corneal reflex (trigemino-facial)

- differential diagnosis of **bulbar vs. pseudobulbar syndrome**
- hyperreflexia: supranuclear lesion of the corticobulbar tract
- hypo/areflexia: lesion of spinal nucleus of trigeminal nerve, facial motor nucleus, pontine fibers or trunks of n. V / n. VII



Herpes zoster ophthalmicus



OVERVIEW OF THE OPHTHALMIC NERVE BRANCHES

1. *Ramus meningeus recurrens / ramus tentorius (tentorii)*

2. *Nervus lacrimalis*

- *r. communicans cum nervo zygomatico*

3. *Nervus frontalis*

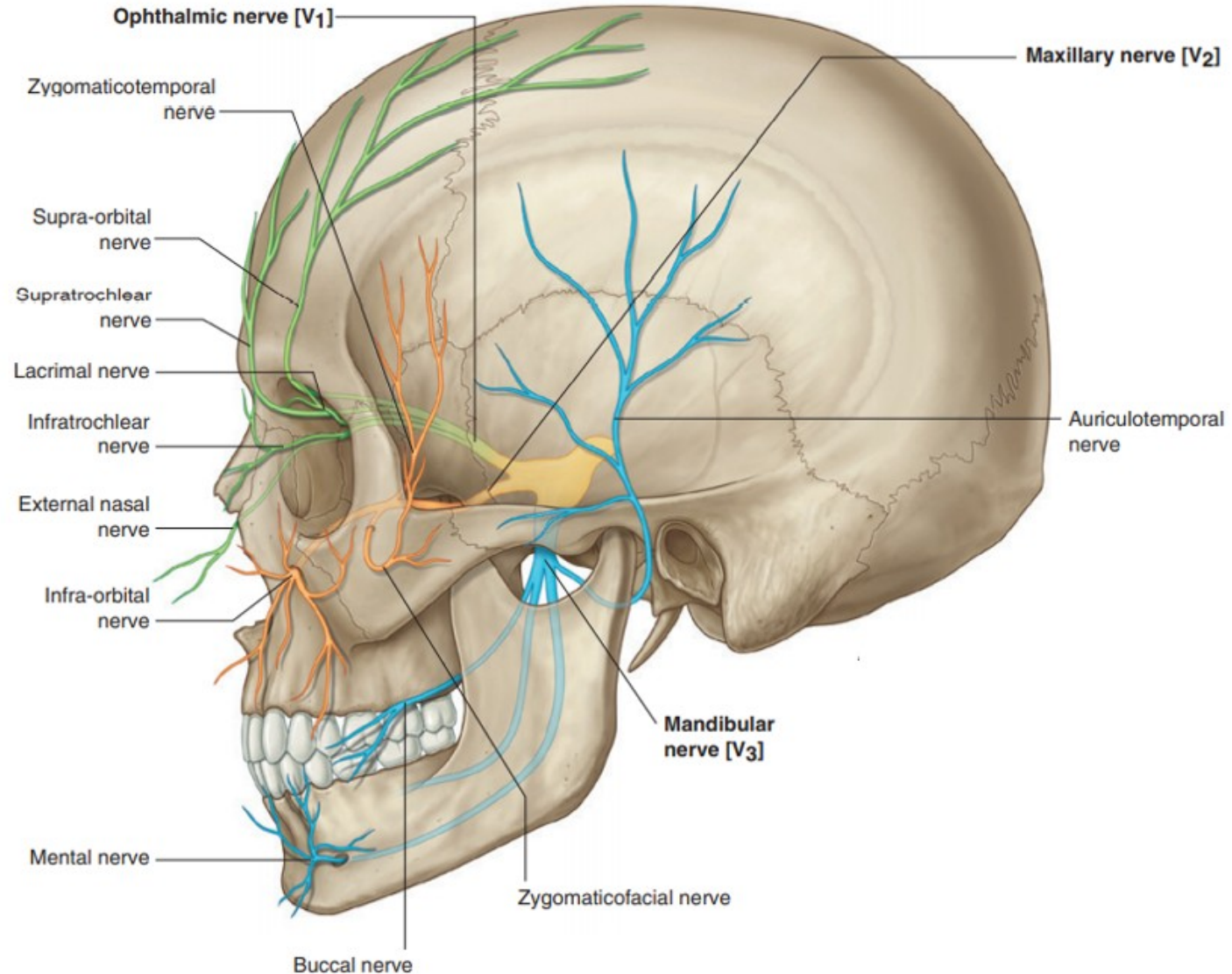
- *n. supraorbitalis*
 - *r. lateralis*
 - *r. medialis*
- *n. supratrochlearis*

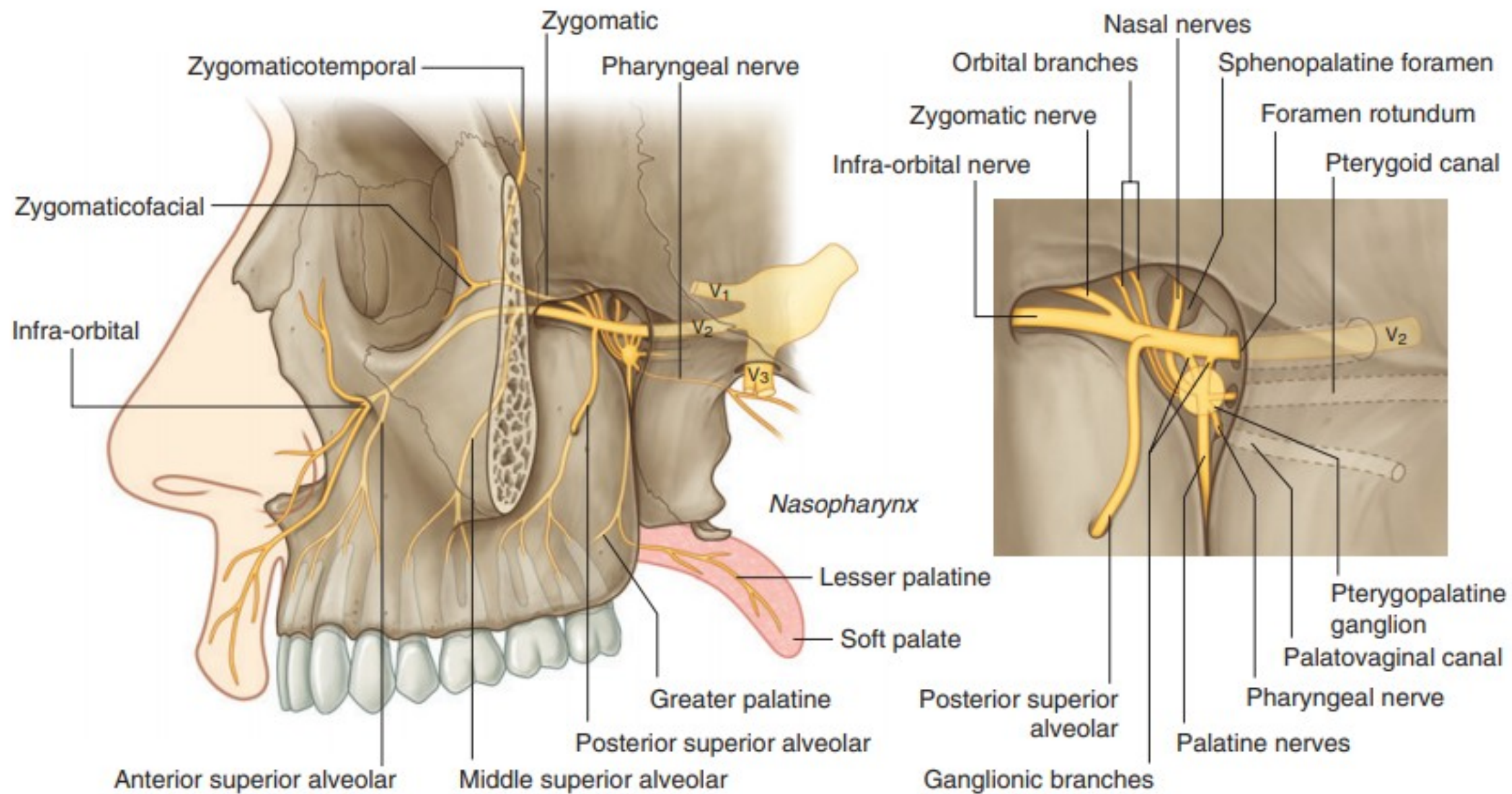
4. *Nervus nasociliaris*

- *r. communicans cum ganglio ciliari (radix sensoria / nasociliaris ganglii ciliaris)*
- *nn. ciliares longi*
- *n. ethmoidalis posterior*
 - *r. meningeus anterior*
- *n. ethmoidales anterior*
 - *rr. nasales interni*
 - *rr. nasales laterales*
 - *rr. nasales mediales*
 - *r. nasalis externus*
- *n. infratrochlearis*
 - *rr. palpebrales*

Maxillary nerve

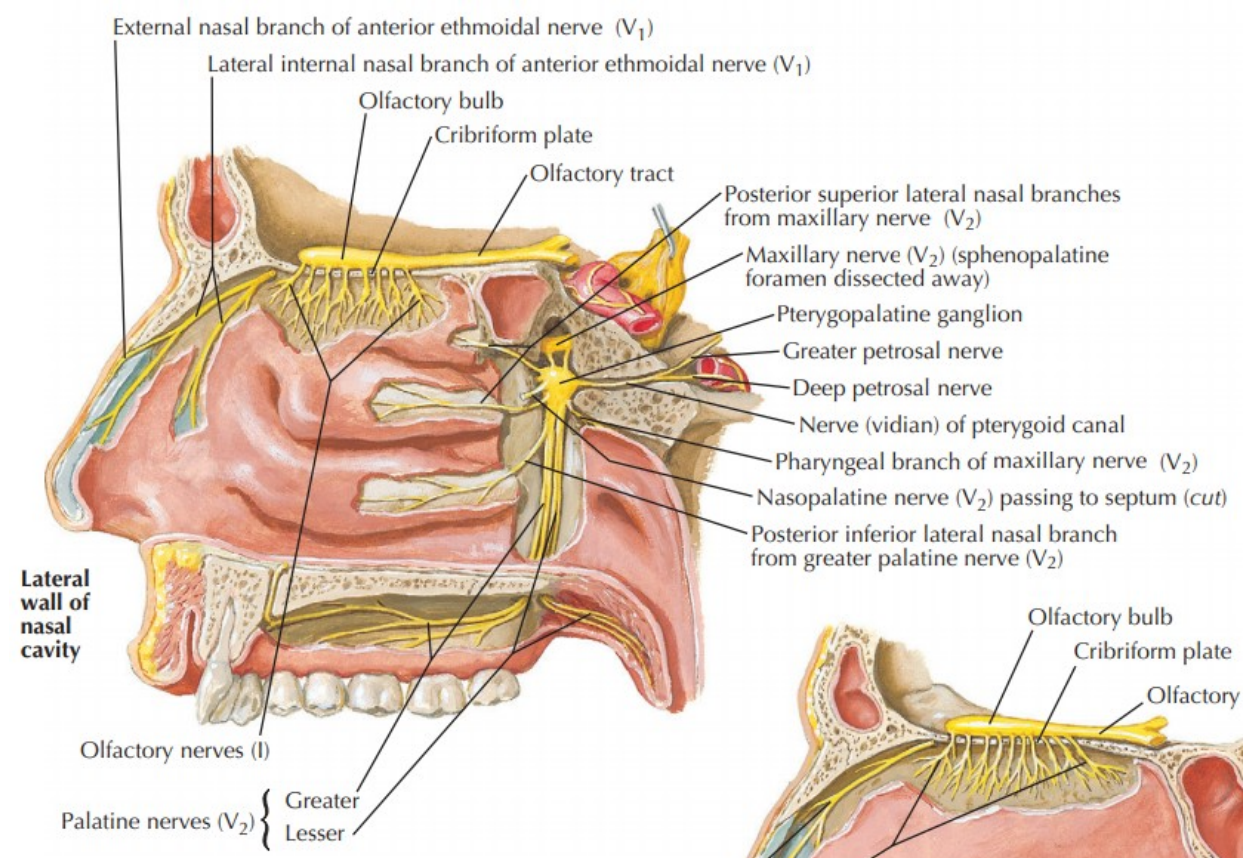
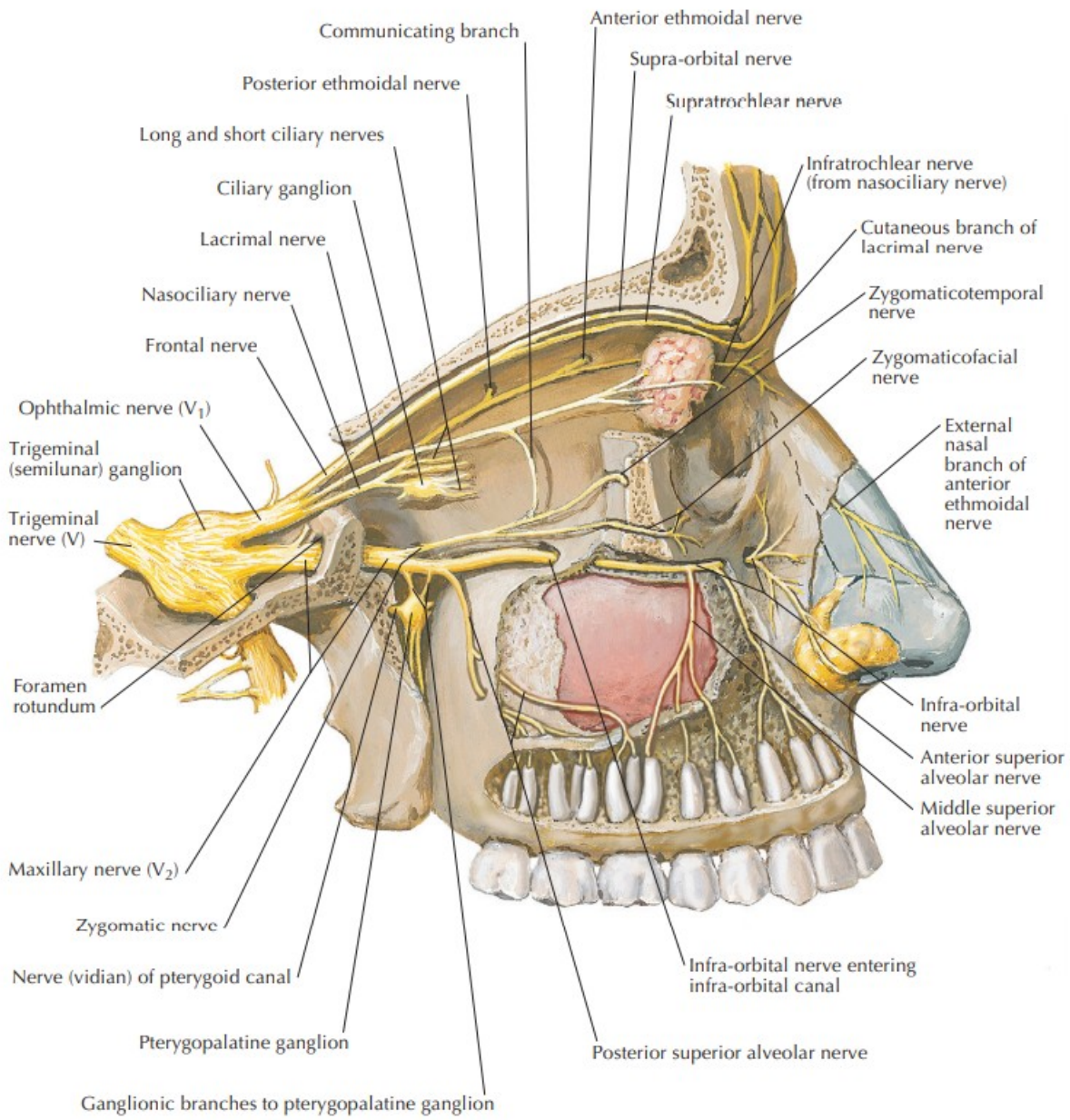
- 2nd branch of the trigeminal nerve
- counts approx. 50 000 myelinated fibers
- passes through the lateral wall of cavernous sinus, enters fossa through the foramen rotundum to the pterygopalatine ganglion
- supplies (somatosensory):
 - *dura mater* in the middle cranial fossa
 - cheek skin between the palpebral and oral fissure
 - mucosa of the upper cheeks
 - mucosa of the maxillary sinus and posterior 2/3 of the nasal cavity
 - mucosa of the palate, *isthmus faucium*, nasopharynx and adjacent part of the Eustachian tube
 - maxilla and upper teeth



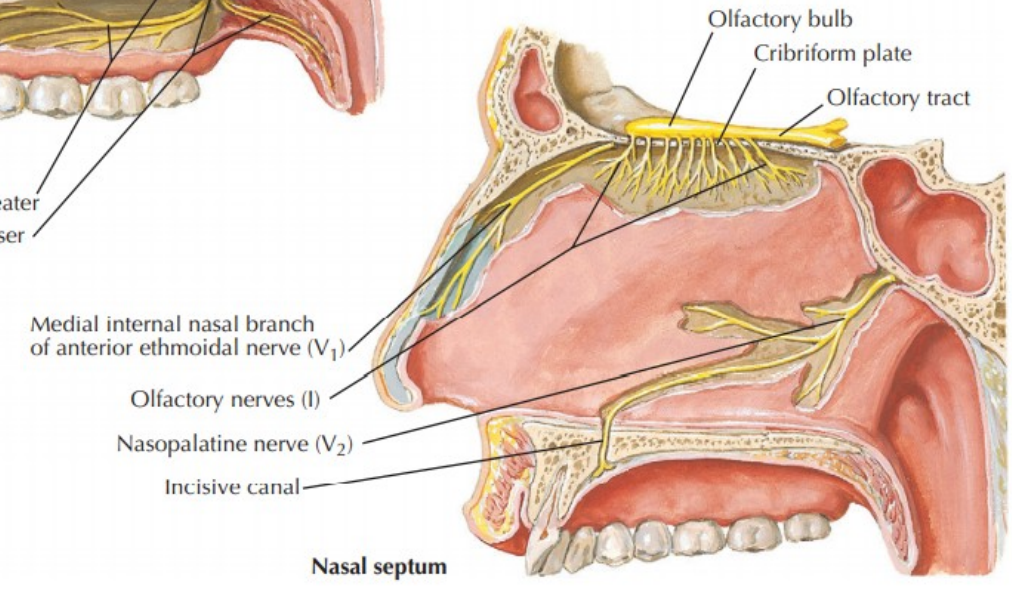


A

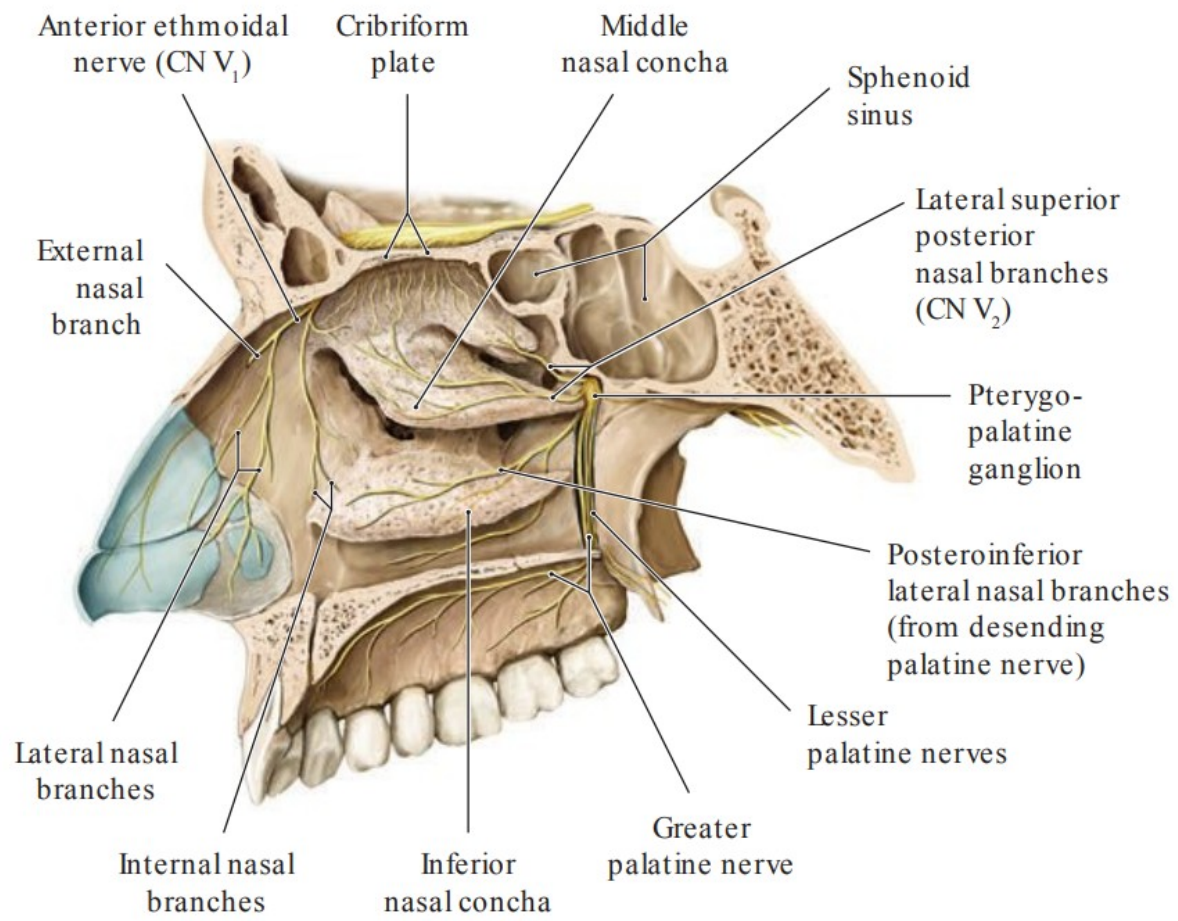
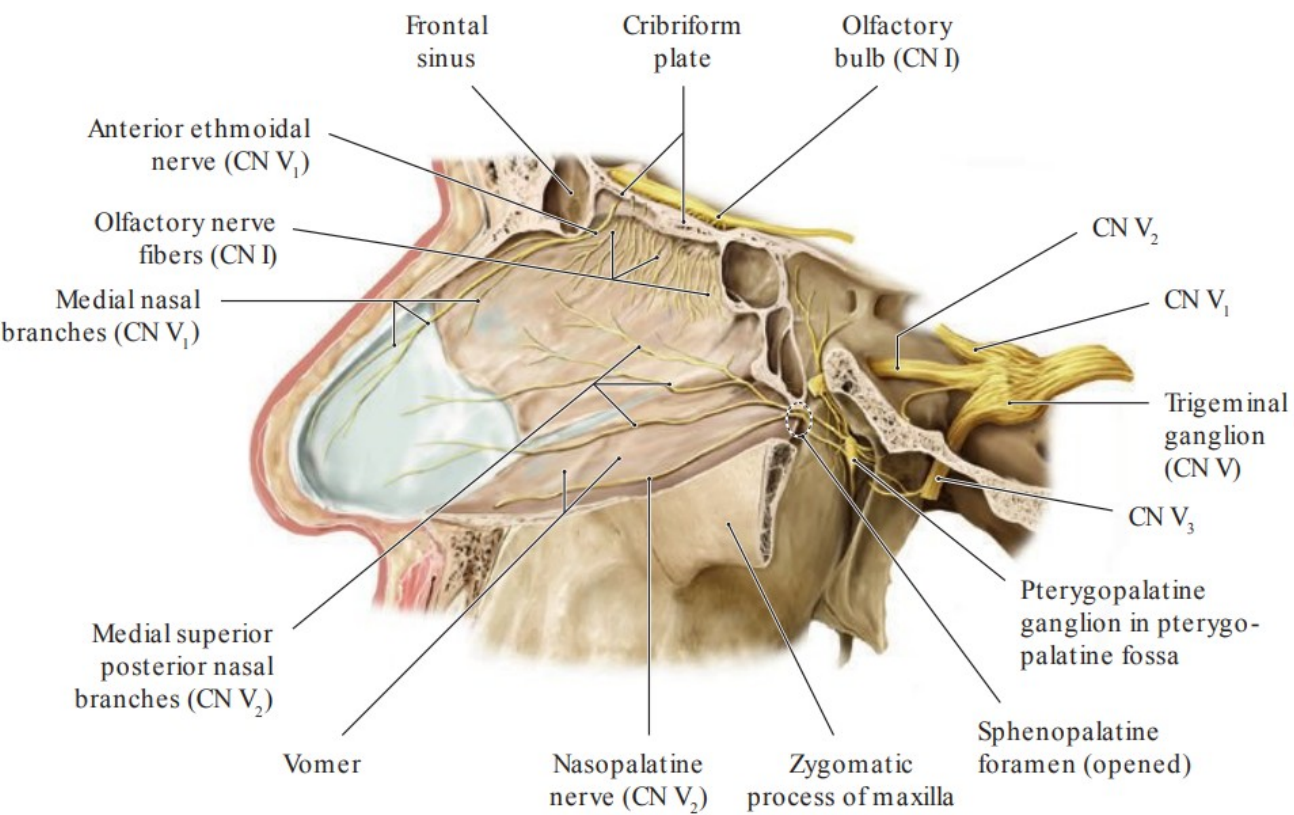
B



F. Netter M.D.



Nasal septum



Percutaneous intervention on the Gasserian ganglion

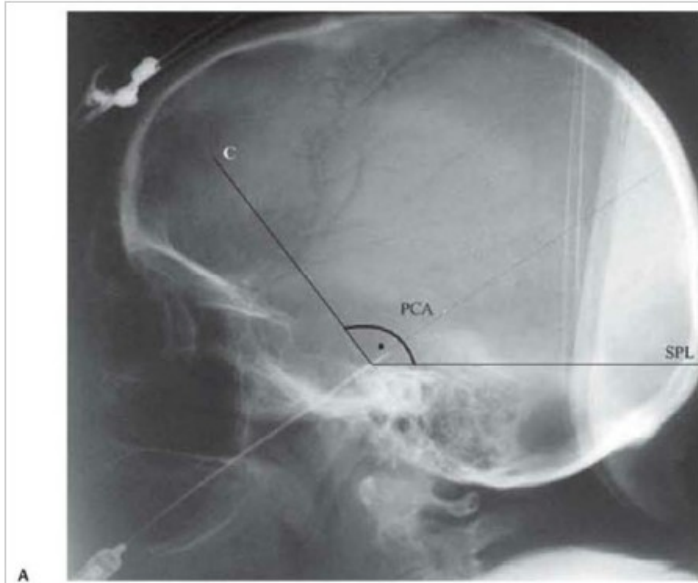


Fig. 132.3 (A) Method for localization of the petroclival angle (PCA) on lateral cranial X-ray. The PCA is formed by the clival line (C) and the superior petrosal line (SPL). Uninsulated tip of the electrode should be just behind the C line. (mean: 2.77 mm, ranging from 1.57–3.50 mm). (B) Method for localization of the electrode tip height (h) based on the electrode uninsulated tip position and the orbitomeatal line can be used as well for electrode placement accuracy. This distance (h) is usually from 13–15 mm. Of note is that fibers corresponding to the V1 division are in a superomedial position, fibers of V3 are inferolateral, and those of V2 are in between; for instance when V3 is targeted, it is expected to have the lower height (as demonstrated by other authors). O, orbita; MAE, meatus acusticus externus.

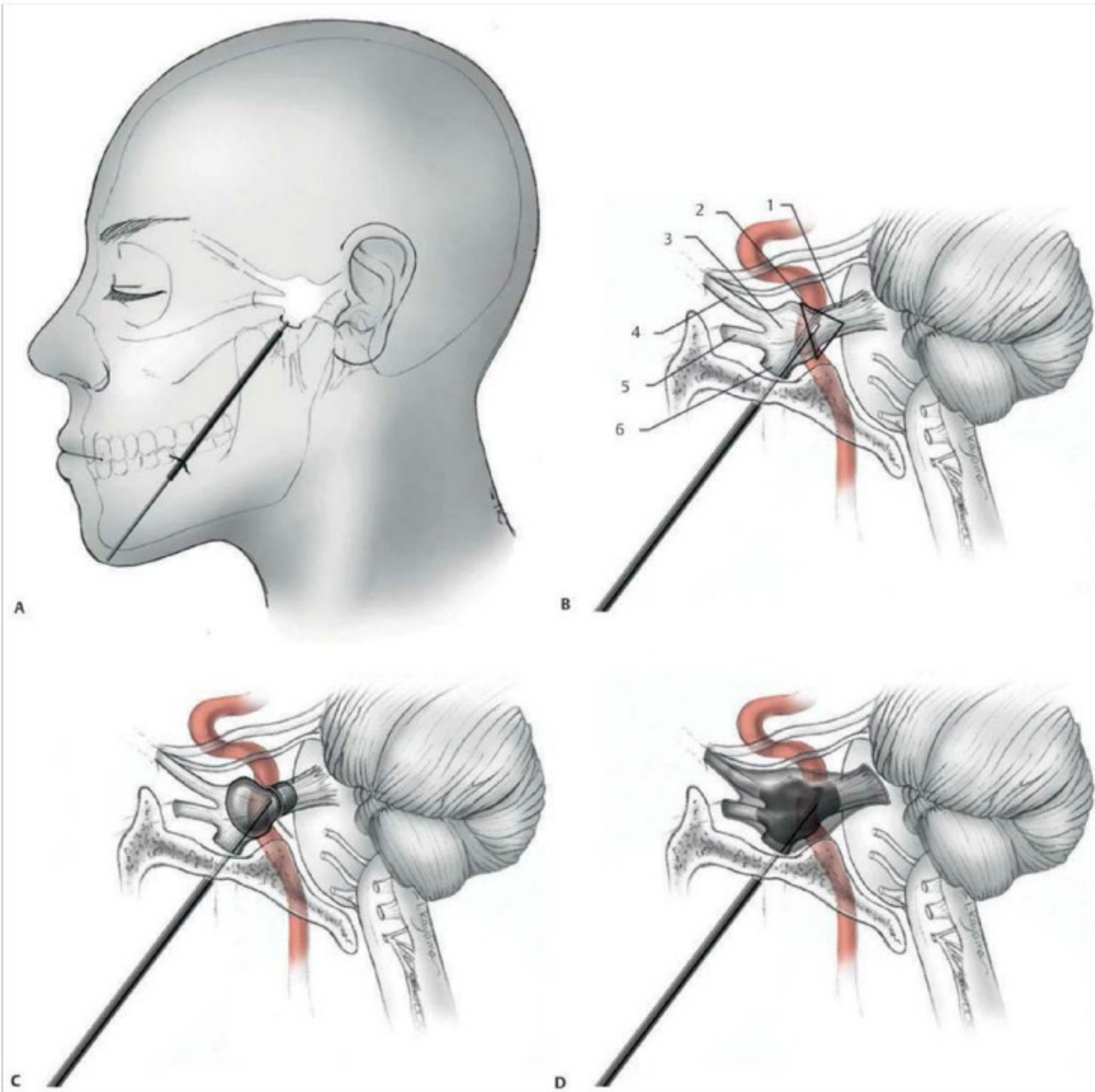
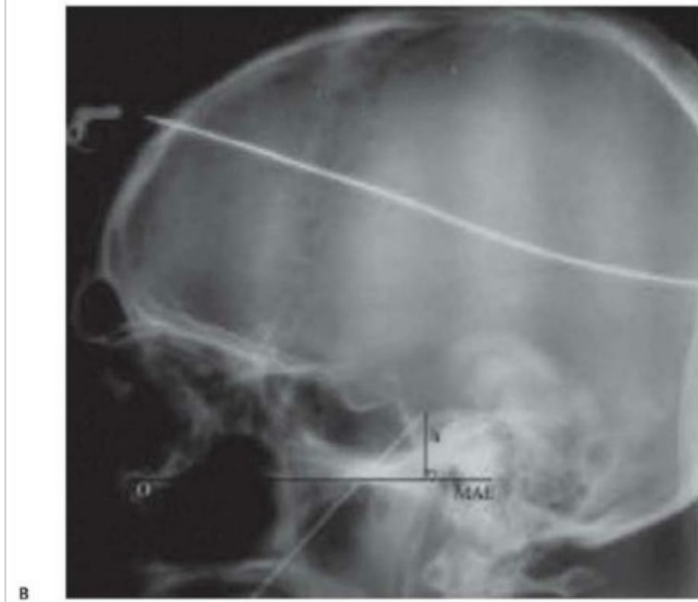


Fig. 132.4 (A) Schematic drawing showing the three percutaneous lesioning-techniques for the treatment of trigeminal neuralgia. (B) Glycerol injection (presence of cerebrospinal fluid must be checked before injection). (C) Balloon compression (inflated balloon with contrast-medium must be pear-shaped to confirm location inside the Meckel cave). (D) Retrogasserian thermocoagulation. Note: Somatotopy of trigeminal system; uninsulated electrode tip has to be retrogasserian at the triangular plexus. 1. Motor branch of the trigeminal nerve; 2. plexus triangularis; 3. Gasserian ganglion; 4. V1: ophthalmic branch; 5. V2: maxillary branch; 6. V3: mandibular branch.

Neurosurgic decompression of the trigeminal nerve

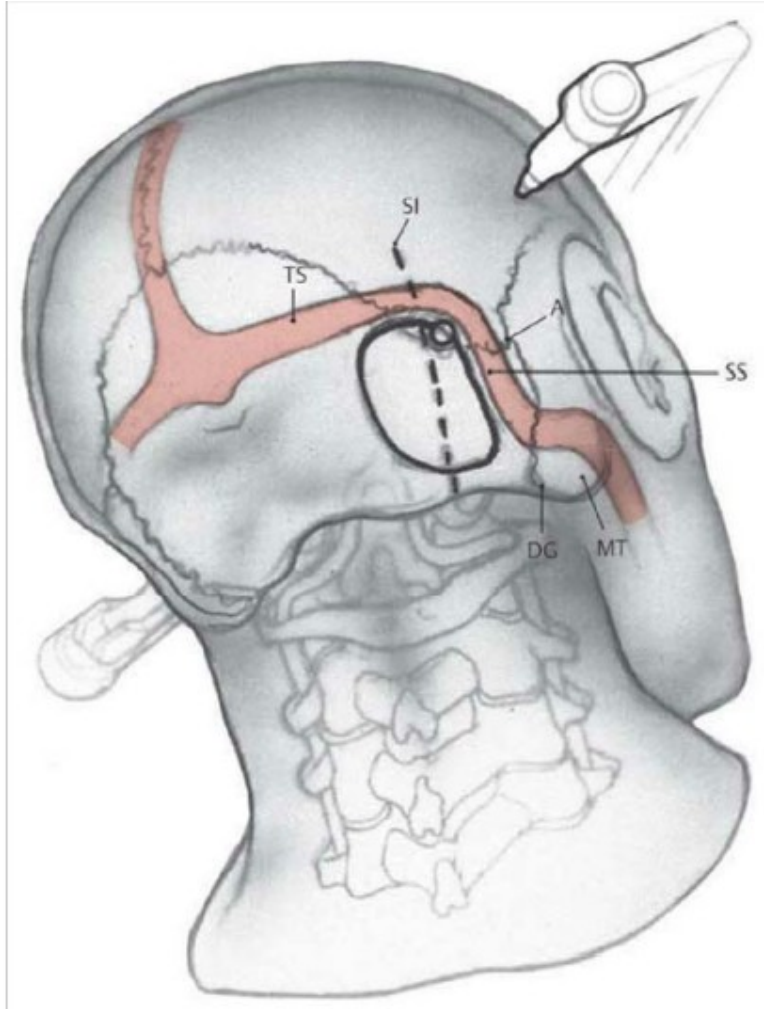


Fig. 133.1 Retrosigmoid skin incision and shown along with burr hole placement and craniotomy site immediately posterior and inferior to the transverse-sigmoid junction. A, asterion; MT, mastoid tip; DG, digastric groove; SMT, suprameatal tubercle; SS, sigmoid sinus; SI, skin incision.

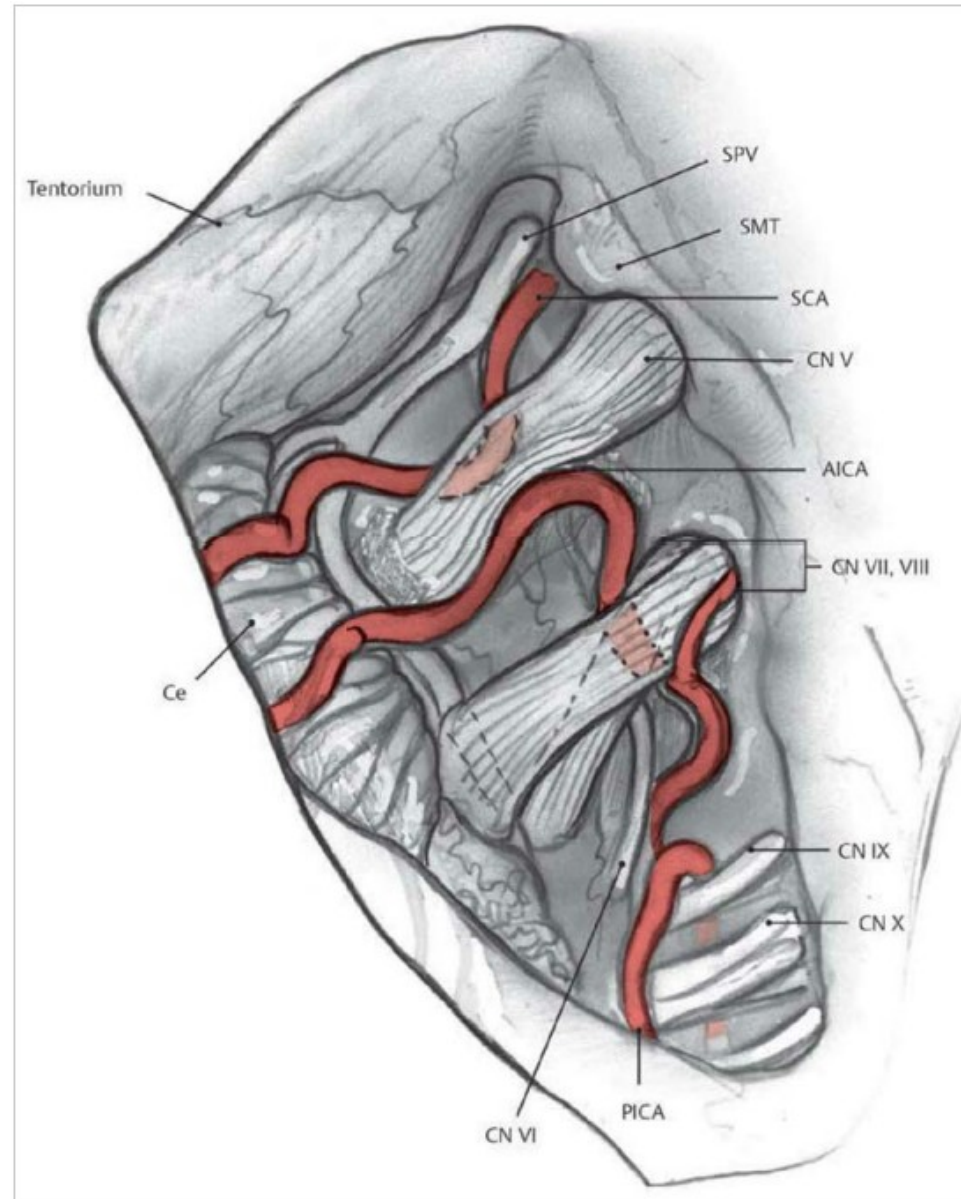


Fig. 133.3 Exposure of the cranial nerves and arteries along the cerebellopontine angle. The trigeminal nerve is seen to be compressed by the superior cerebellar artery (SCA) as well as the anterior inferior cerebellar artery (AICA). SMT, suprameatal tubercle; SPV, superior petrosal vein; PICA, posterior inferior cerebellar artery; Ce, cerebellum; CN, cranial nerve.

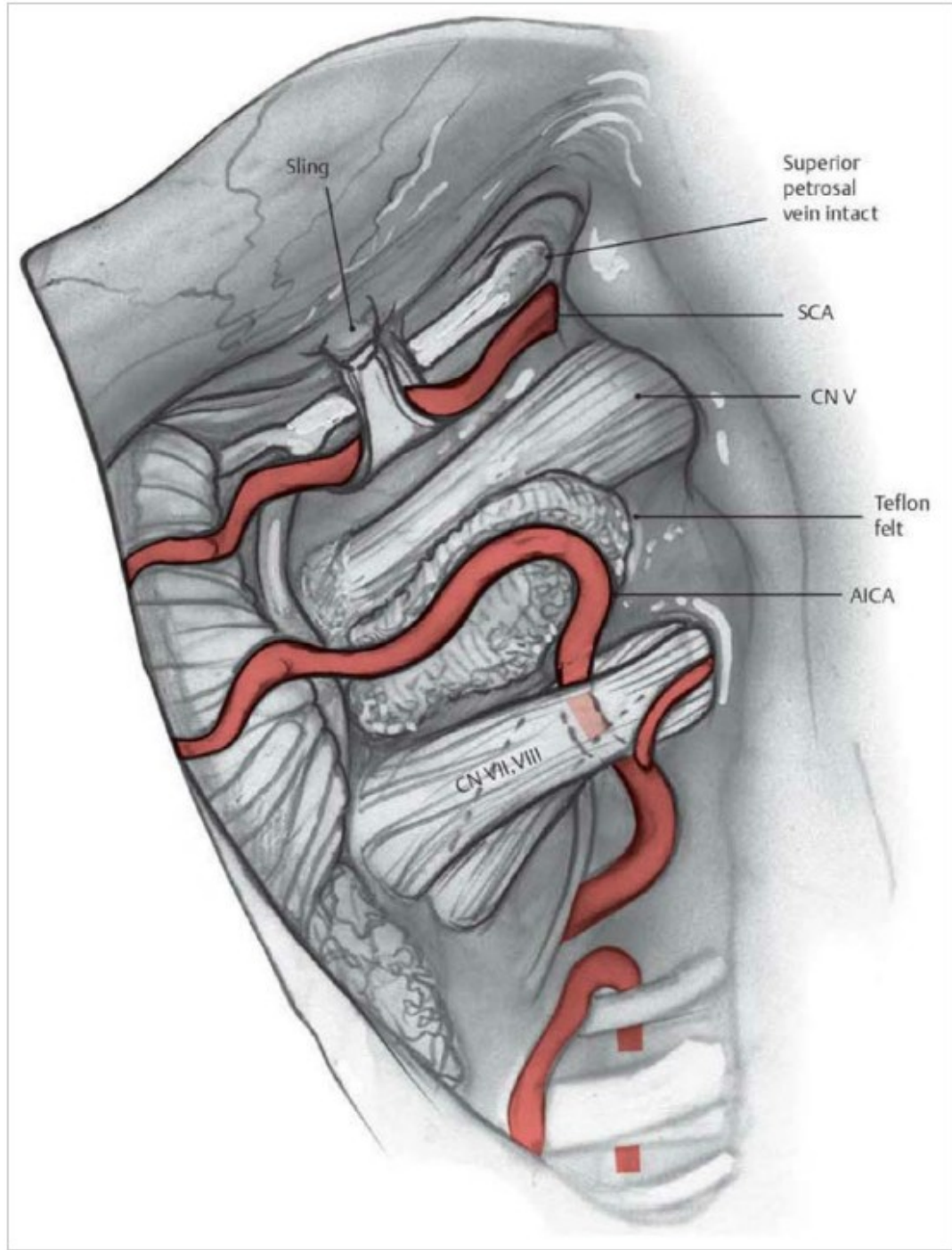


Fig. 133.4 Decompression of the trigeminal nerve by wedging shredded Teflon or hydroxylated polyvinyl acetal sponge (Ivalon™, Fabco Inc., Old Mystic, CT) between the vessel (AICA) and the nerve. The alternative is to use a fascial sling or arachnoid membrane to hitch the vessel (SCA) to the tentorium. The offending superior cerebellar artery is transposed superomedially with a sling sutured to the tentorium. SCA, superior cerebellar artery; AICA, anterior inferior cerebellar artery; CN, cranial nerve.

OVERVIEW OF THE MAXILLARY NERVE BRANCHES

1. *R. meningeus*

2. *Rr. ganglionares ad ganglion pterygopalatinum / radix sensoria ganglii pterygopalatini*

- *rr. orbitales*
- *rr. nasales posteriores superiores laterales*
- *rr. nasales posteriores superiores mediales*
- ***n. nasopalatinus (incisivus)***
- *n. pharyngeus*
- ***n. palatinus major***
- *rr. nasales posteriores inferiores*
- ***nn. palatini minores***
 - *rr. tonsillares*

3. *N. zygomaticus*

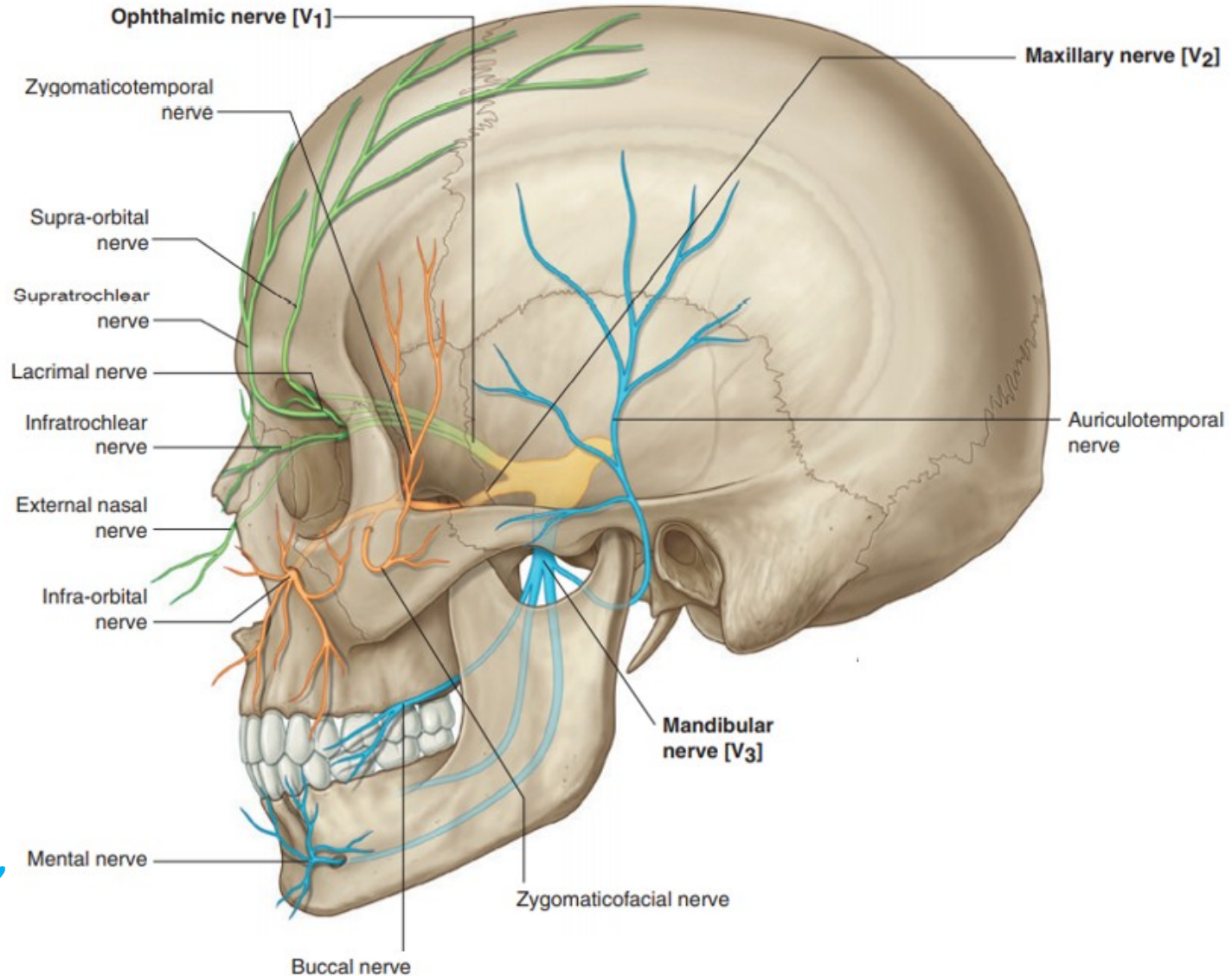
- *r. communicans cum nervo lacrimali*
- *r. zygomaticotemporalis*
- *r. zygomaticofacialis*

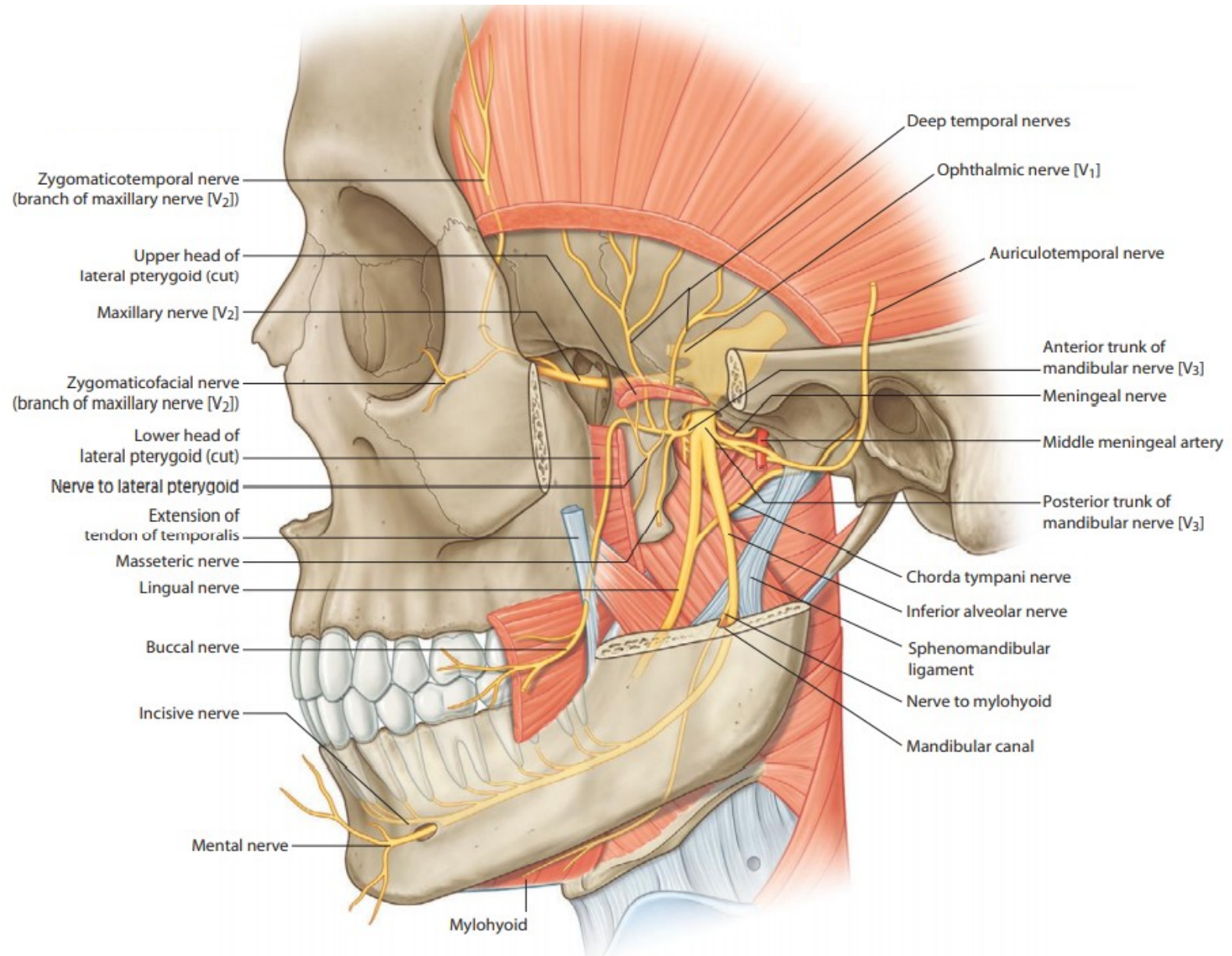
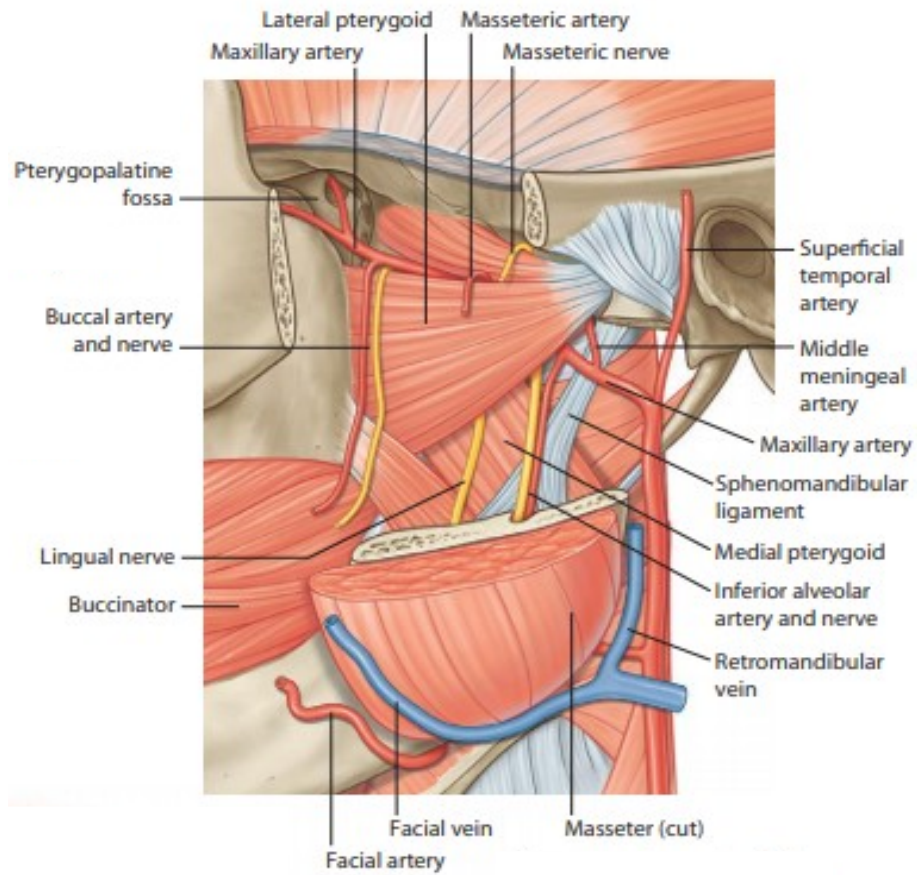
4. *N. infraorbitalis*

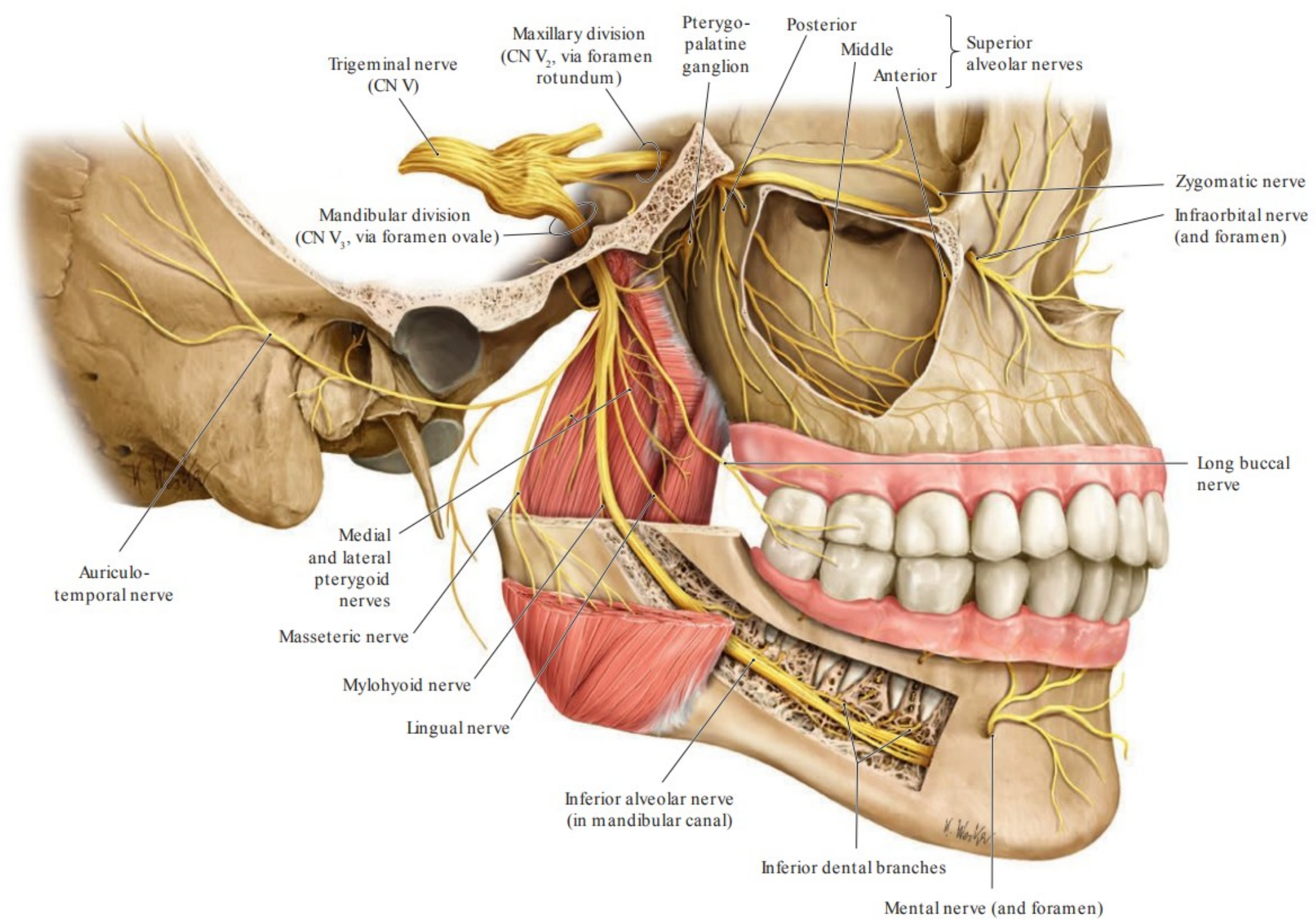
- ***rr. alveolares superiores posteriores***
- ***r. alveolaris superior medius***
- ***rr. alveolares superiores anteriores***
 - ***plexus dentalis superior***
 - *rr. dentales superiores*
 - *rr. gingivales superiores*
- *rr. palpabrales inferiores*
- *rr. nasales externi*
- *rr. nasales interni*
- *rr. labiales superiores*

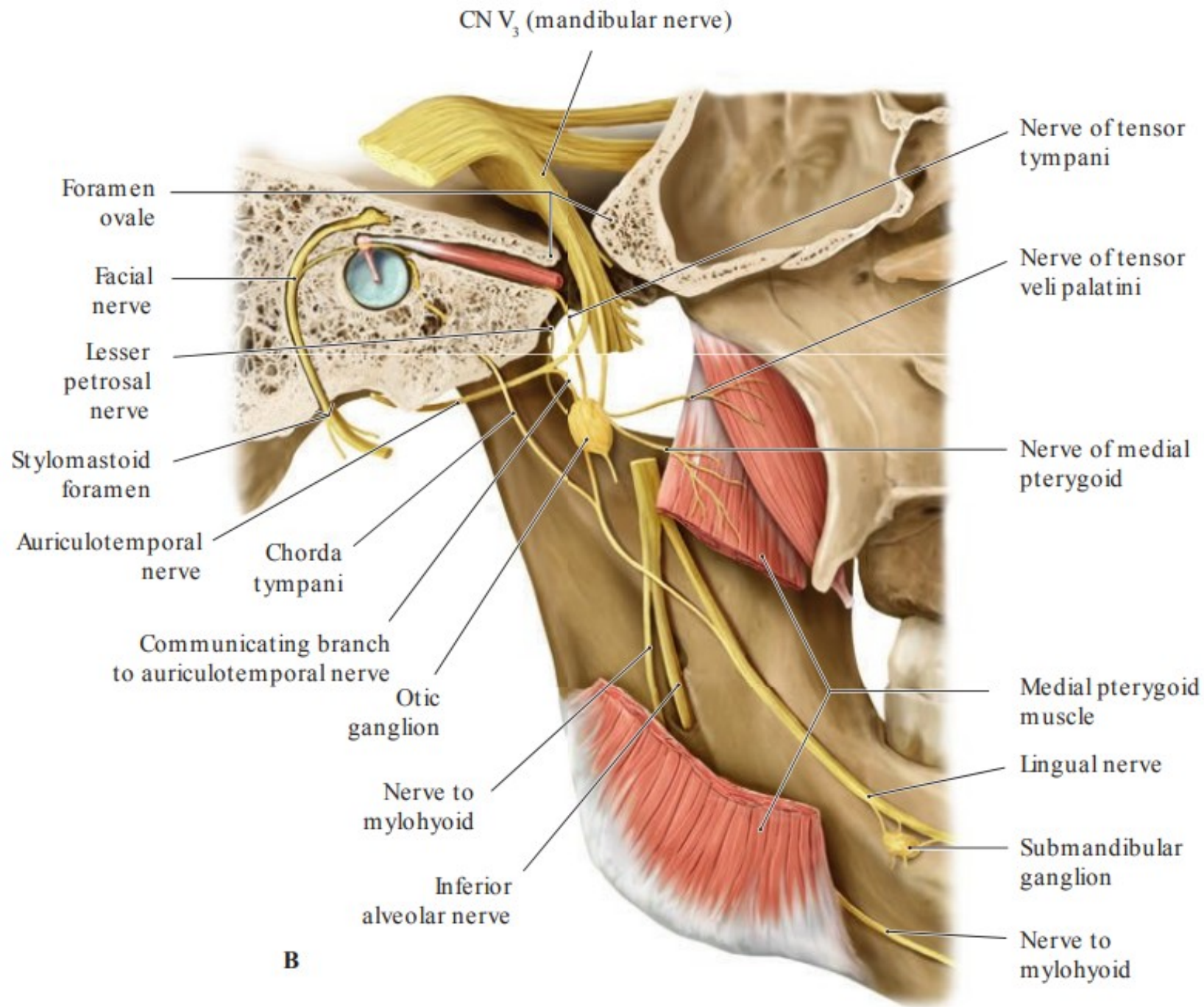
Mandibular nerve

- 3th branch of the trigeminal nerve
- counts approx. 26 000 myelinated fibers
- the most lateral branch of the trigeminal ganglion
- receives motor root
- enters to the infratemporal fossa through the foramen ovale
- supplies (somatosensory):
 - *dura mater* near the posterior branches of middle meningeal artery
 - skin of temporal region and around mandibula
 - mucosa of the lower cheeks, *isthmus faucium*, palatine tonsil and the floor of the oral cavity
 - mucosa of the ventral 2/3
 - mandible and lower teeth
- innervates (branchiomotor):
 - masticatory muscles (*m. masseter*, *m. temporalis*, *m. pterygoideus medialis et lateralis*)
 - *m. mylohyoideus*, venter anterior *m. digastrici*
 - *m. tensor tympani*, *m. tensor veli palatini*

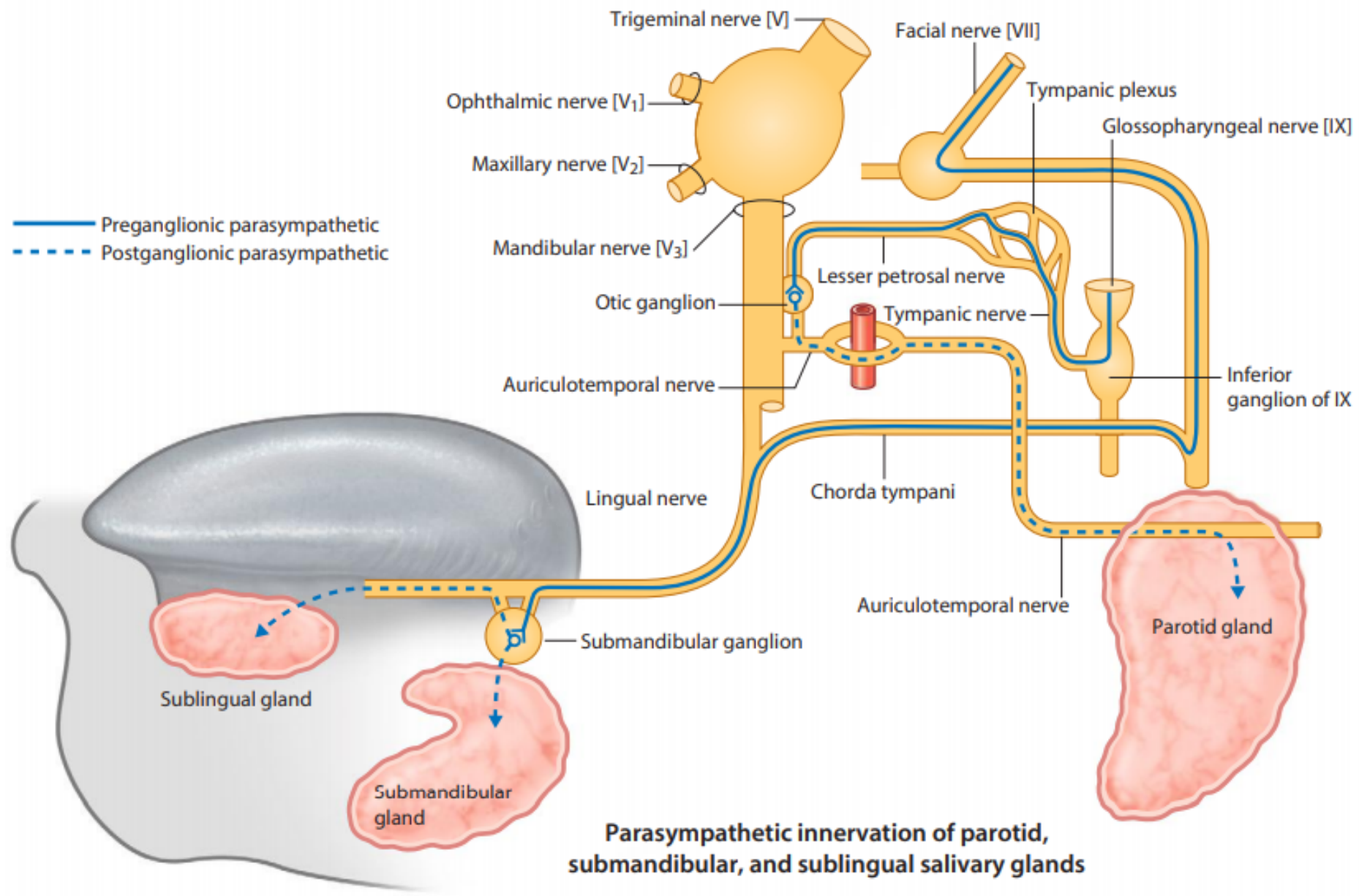






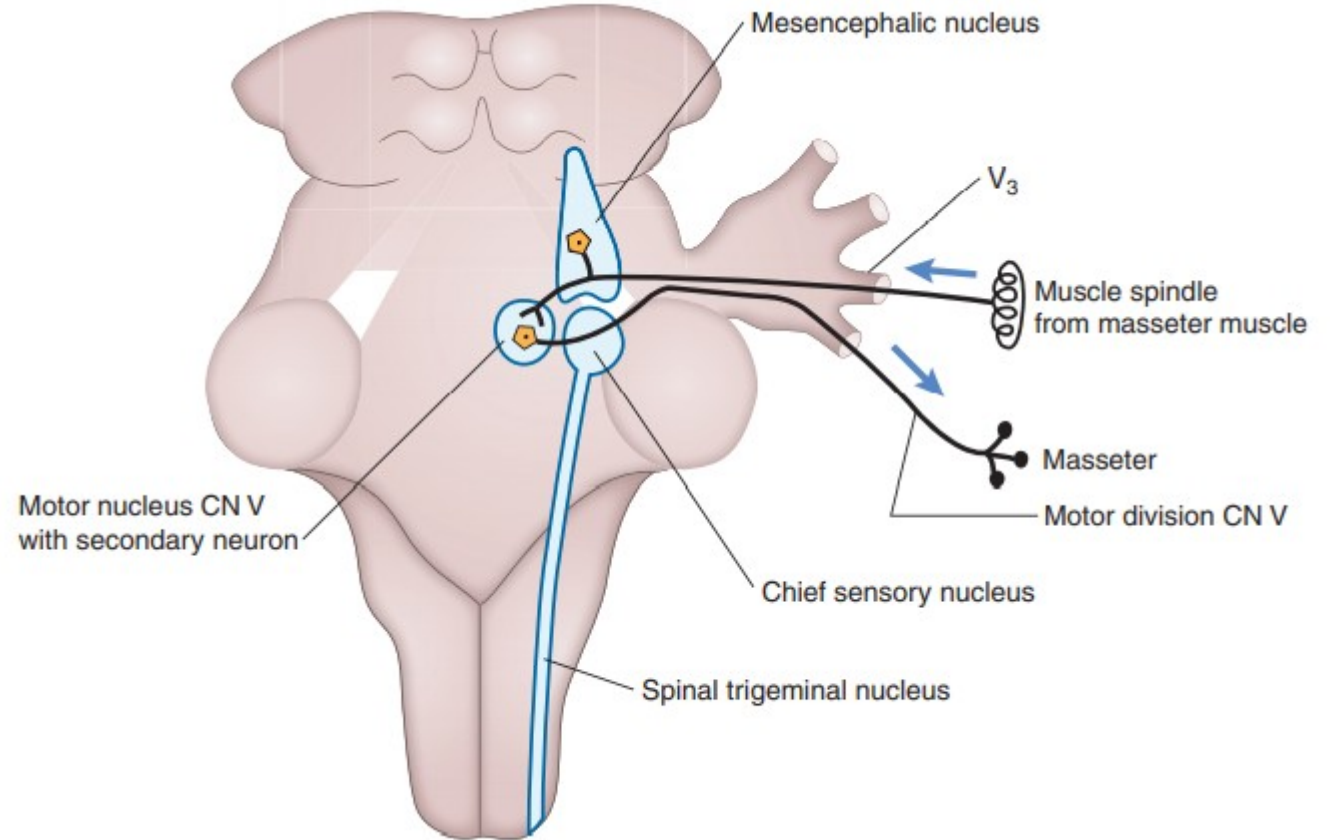


B



Jaw jerk (masseter) reflex

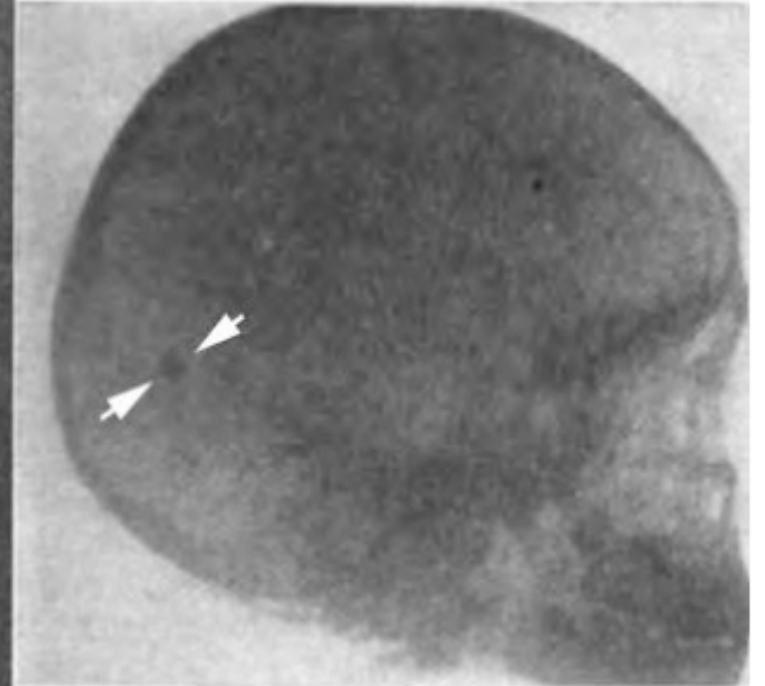
- differential diagnosis of **bulbar vs. pseudobulbar syndrome**
- hyperreflexia: supranuclear lesion of the corticobulbar tract
- hypo/areflexia: lesion of mesencephalic nucleus of trigeminal nerve, motor nucleus of trigeminal nerve, pontine fibers or trunk of n. V



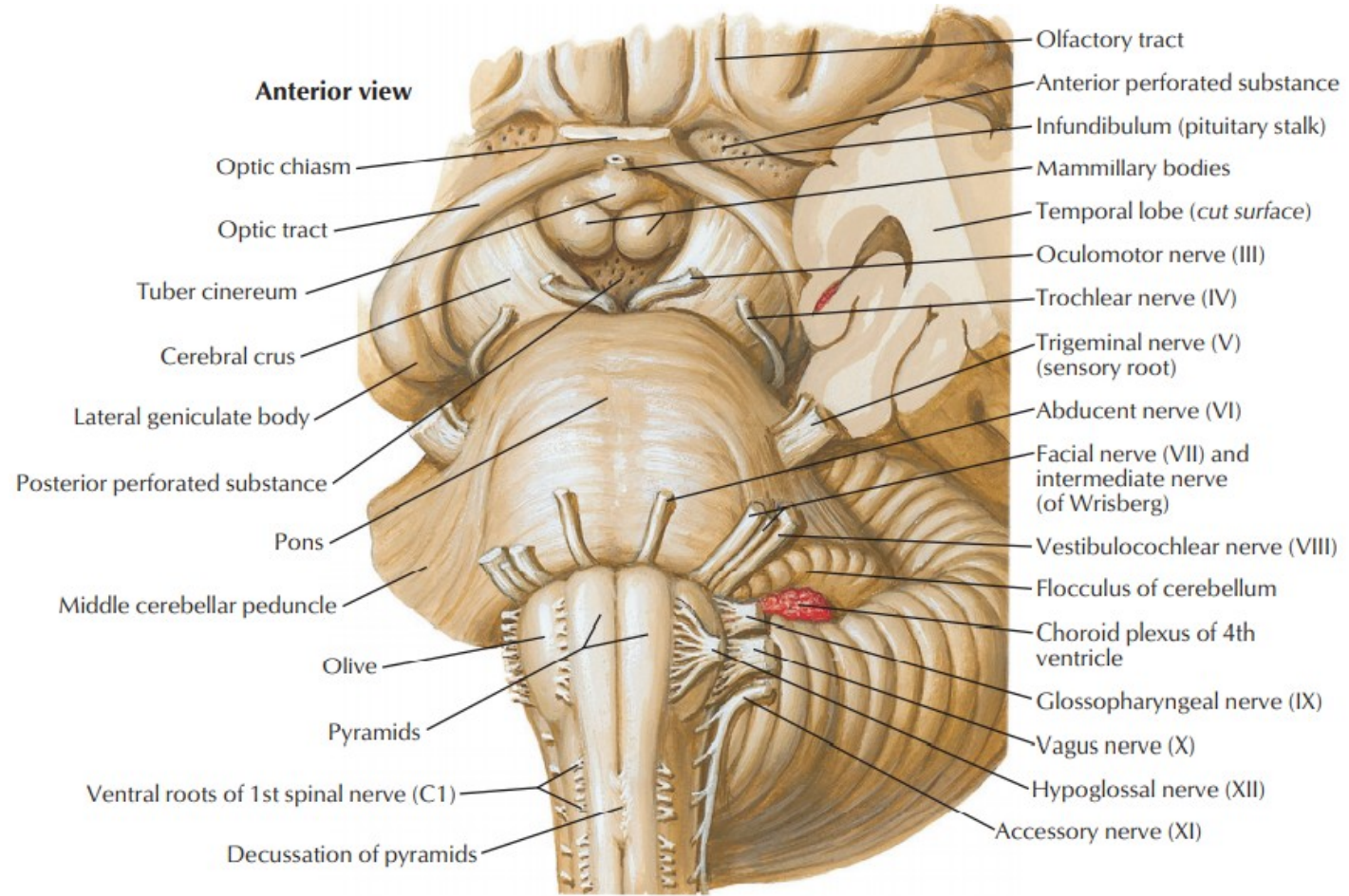
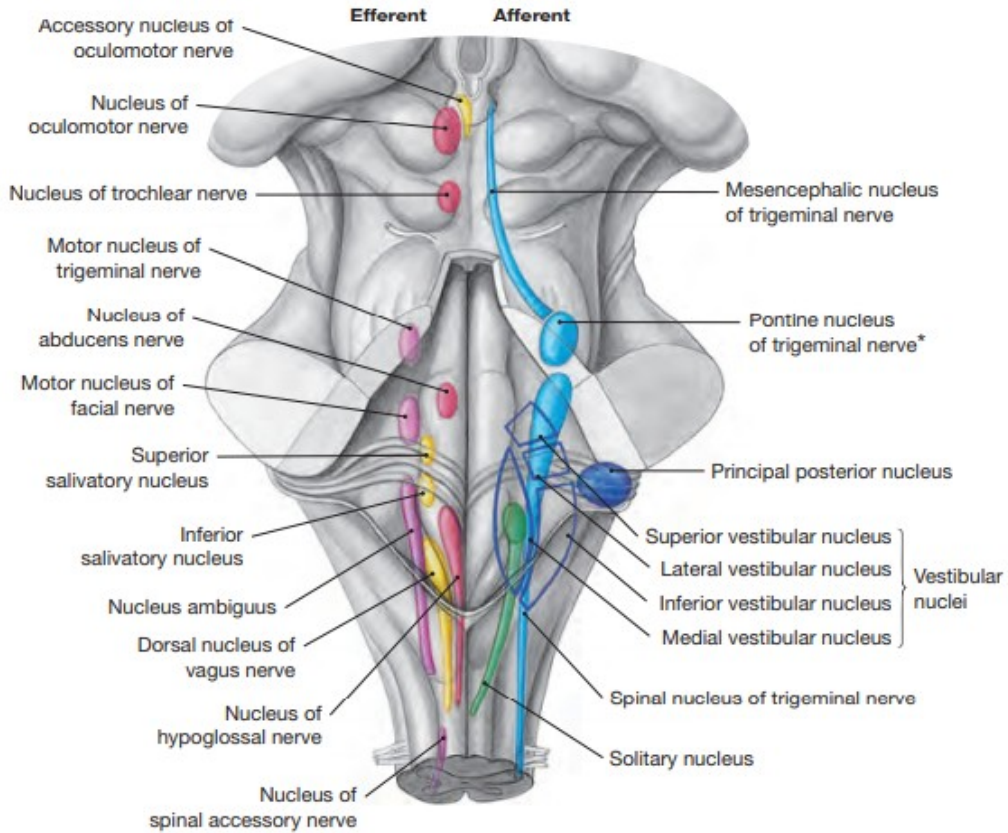
OVERVIEW OF THE MANDIBULAR NERVE BRANCHES

1. *Ramus meningeus (nervus spinosus)*
2. *Nervus pterygoideus medialis*
3. *Rami ganglionares ad ganglion oticum / radix sensoria ganglii otici*
4. *Nervus musculus tensoris veli palatini*
5. *Nervus musculus tensoris tympani*
6. *Nervus massetericus*
7. *Nervi temporales profundi*
8. *Nervus pterygoideus lateralis*
9. *Nervus buccalis*
10. *Nervus auriculotemporalis*
 - *n. meatus acustici externi*
 - *rr. membranae tympani*
 - *rr. parotidei*
 - *rr. communicantes cum nervo faciali*
 - *nn. auriculares anteriores*
 - *rr. temporales superficiales*
11. *Nervus lingualis*
 - *rr. isthmi faucium*
 - *rr. communicantes cum nervo hypoglosso*
 - ***chorda tympani***
 - *n. sublingualis*
 - *rr. linguales*
 - *rr. ganglionares ad ganglion submandibulare / radix sensoria ganglii submandibularis*
 - *rr. ganglionares ad ganglion sublinguale / radix sensoria ganglii sublingualis*
12. *Nervus alveolaris inferior*
 - *n. mylohyoideus*
 - ***plexus dentalis inferior***
 - *rr. dentales inferiores*
 - *rr. gingivales inferiores*
 - ***n. mentalis***
 - *rr. mentales*
 - *rr. labiales inferiores*
 - *rr. gingivales*

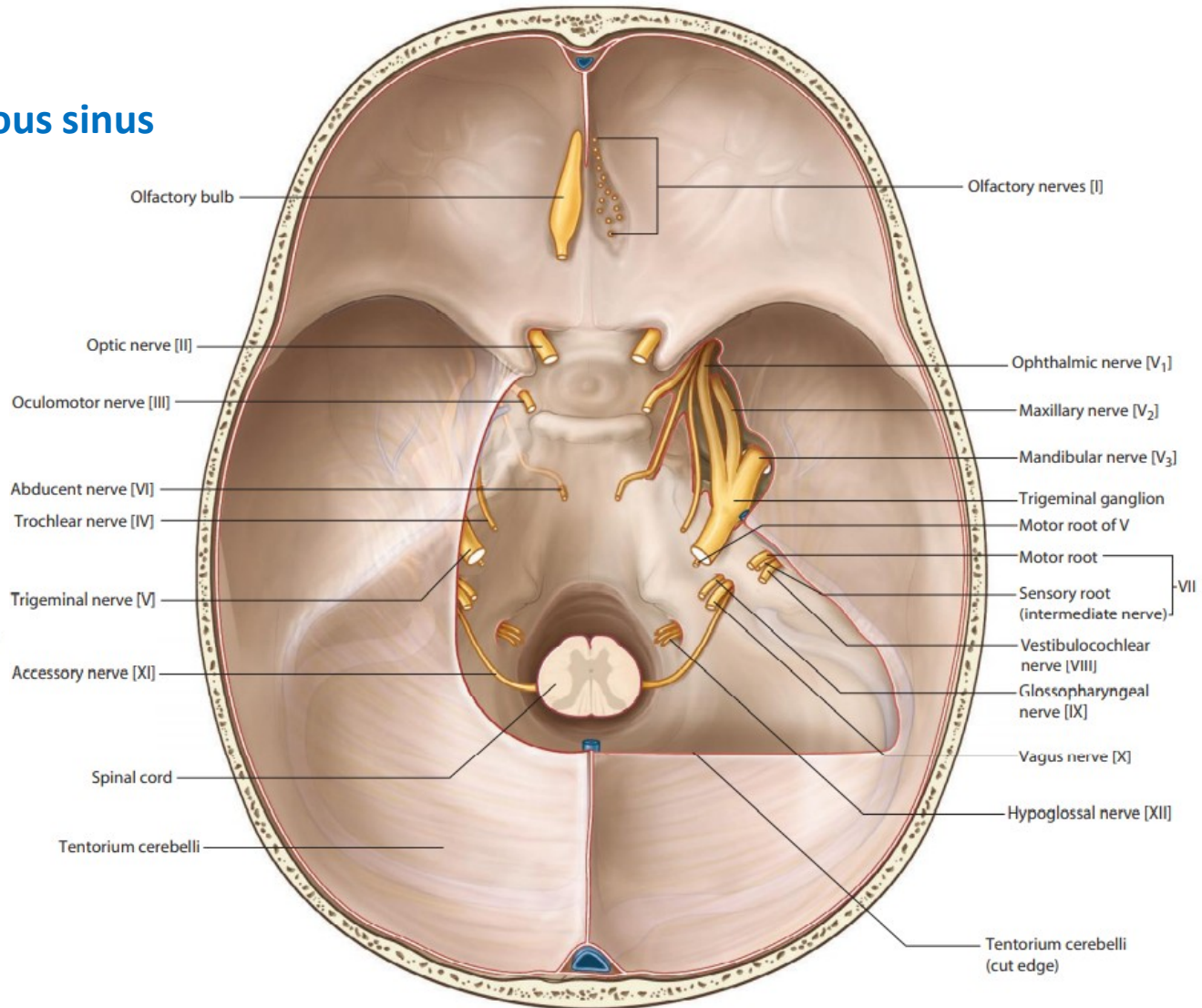
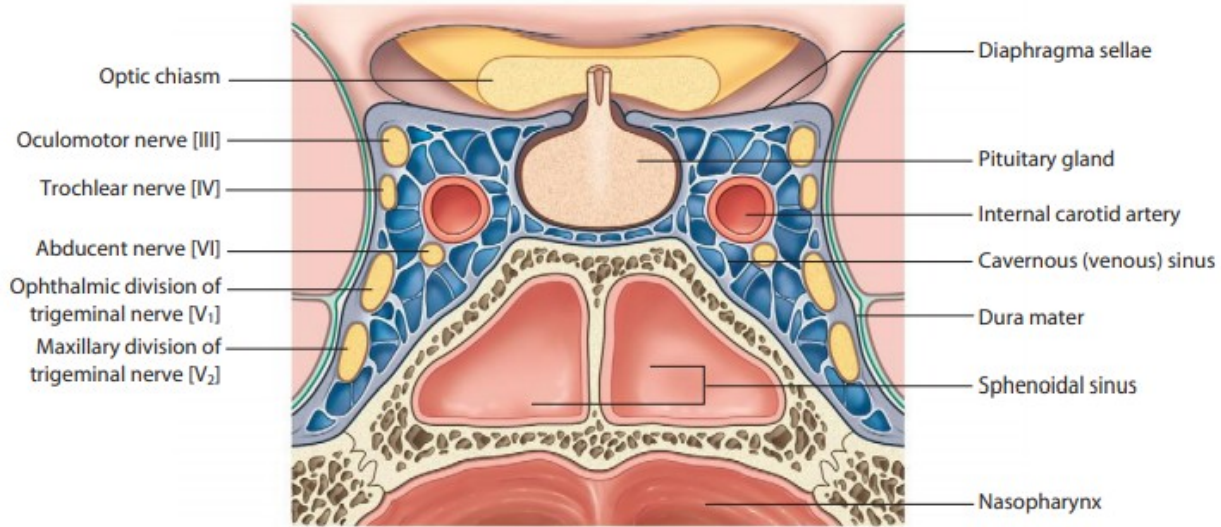
Abducens nerve (n. VI)

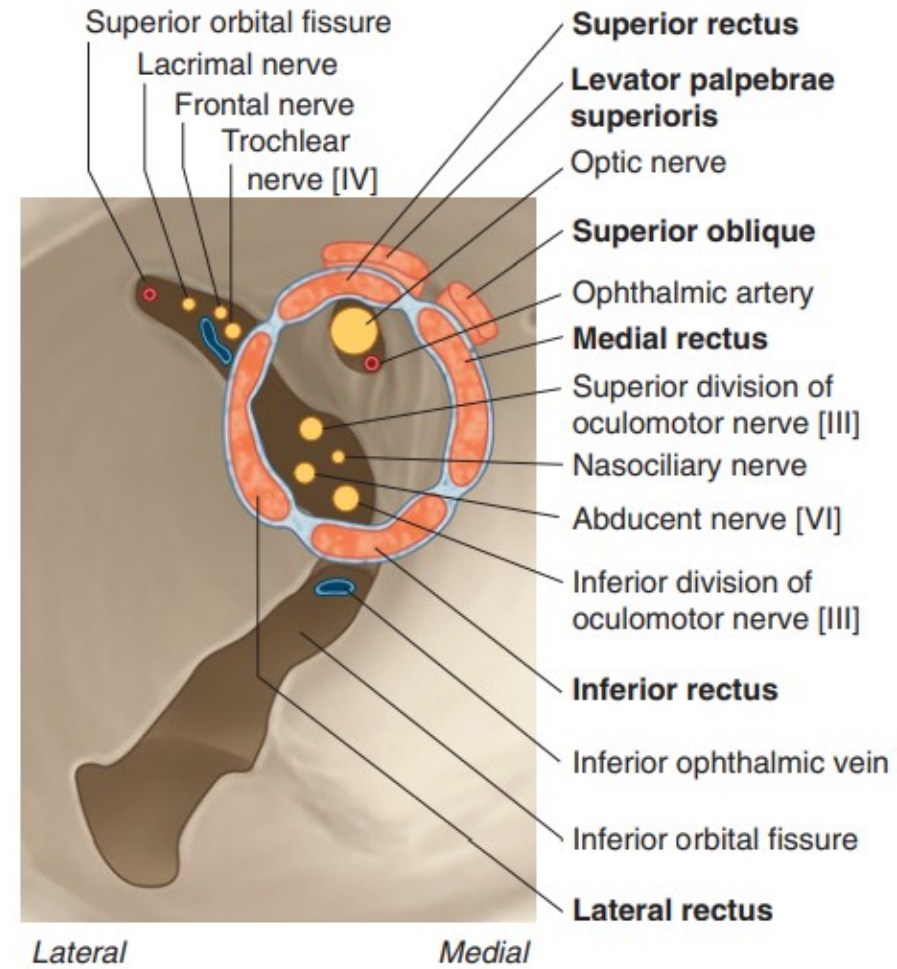
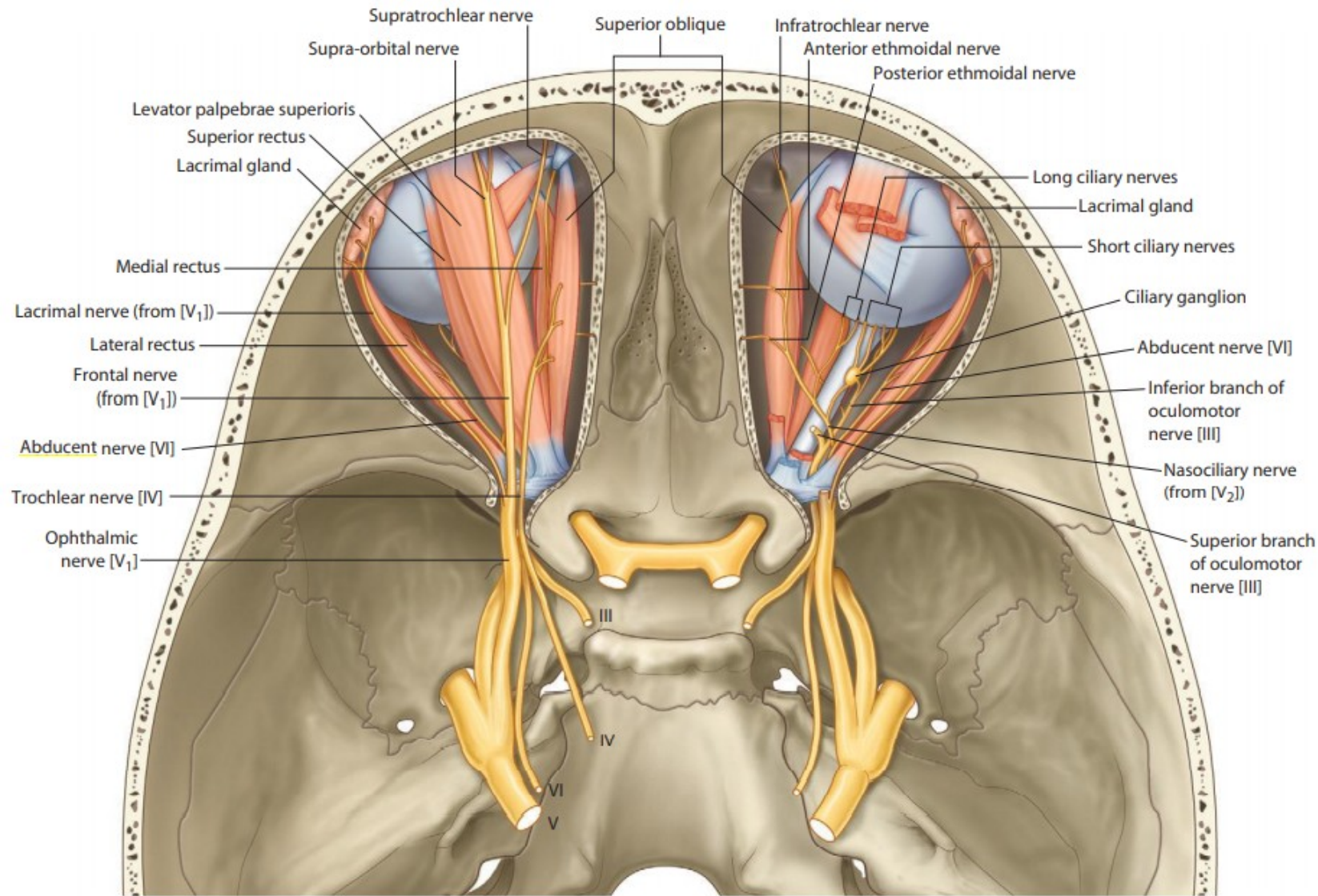


- the abducens motor nucleus in the pons
- arises from the **bulbopontine groove** medial to the n. VII
- innervates **the lateral rectus muscle**



- runs upward between the pons and the clivus
- pierces the dura at the tip of petrous bone
- runs alongside the internal carotide artery in the cavernous sinus





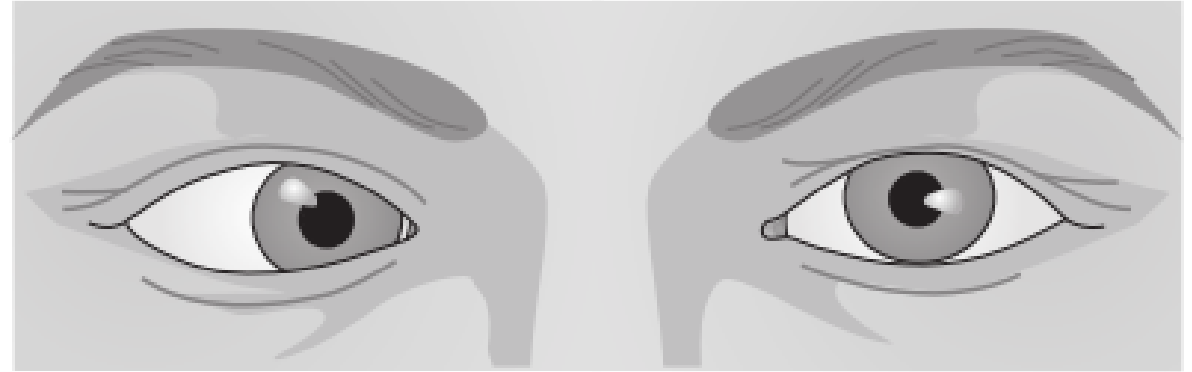
→ *fissura orbitalis superior* → *anulus tendineus communis Zinni*

SYMPTOMS OF ABDUCENS NERVE LESION

- endotropia
- lateral limitation of eye movement
- diplopia

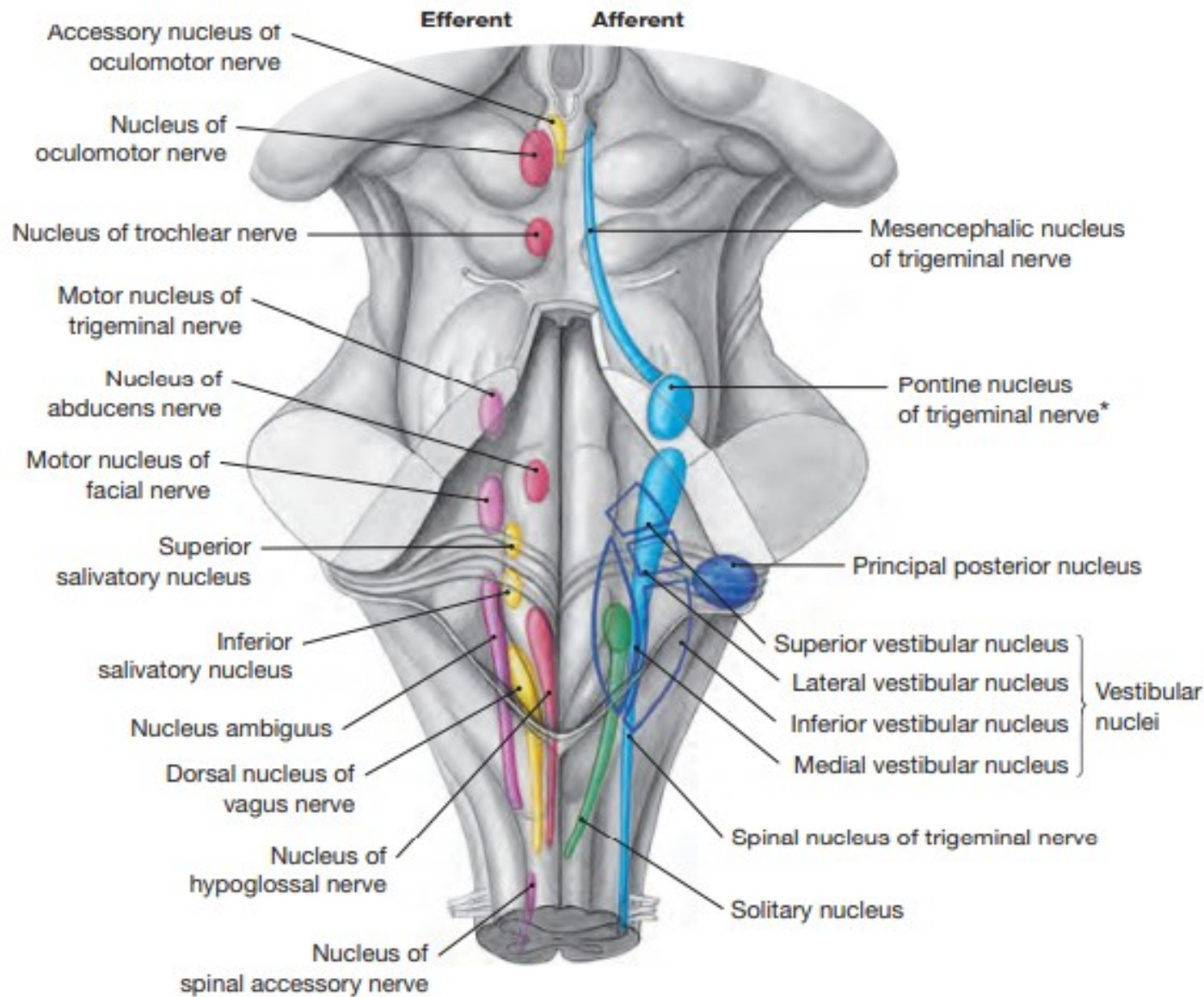
Etiology:

- trauma
- tumor compression
- internal carotid artery aneurysm
- arteriovenous fistula of the cavernous sinus
- intracranial hypertension
- iatrogenic (after lumbar puncture)
- Tolosa-Hunt syndrome
- meningitis, basal tuberculosis, sarcoidosis
- Guillain-Barré syndrome
- diabetic poly(mono)neuropathy
- sclerosis multiplex
- febrile state in children
- thrombophlebitis of the cavernous sinus





Facial nerve (n. VII)



1. Motor nucleus of facial nerve

- **branchiomotor nucleus** for innervation of muscles derived from 2nd pharyngeal arch (mimic muscles, *platysma*, *m. stylohyoideus*, *m. stapedius* a *venter posterior m. digastrici*)

2. Superior salivatory nucleus

- **visceromotor nucleus** for parasympathetic innervation lacrimal / submandibular / sublingual glands, glands in nasal mucosa, nasopharynx and *isthmus faucium*

3. Solitary nucleus (gustatory)

- **viscerosensory nucleus** (rostral part) for taste from ventral 2/3 of the lingua

4. Spinal nucleus of trigeminal nerve

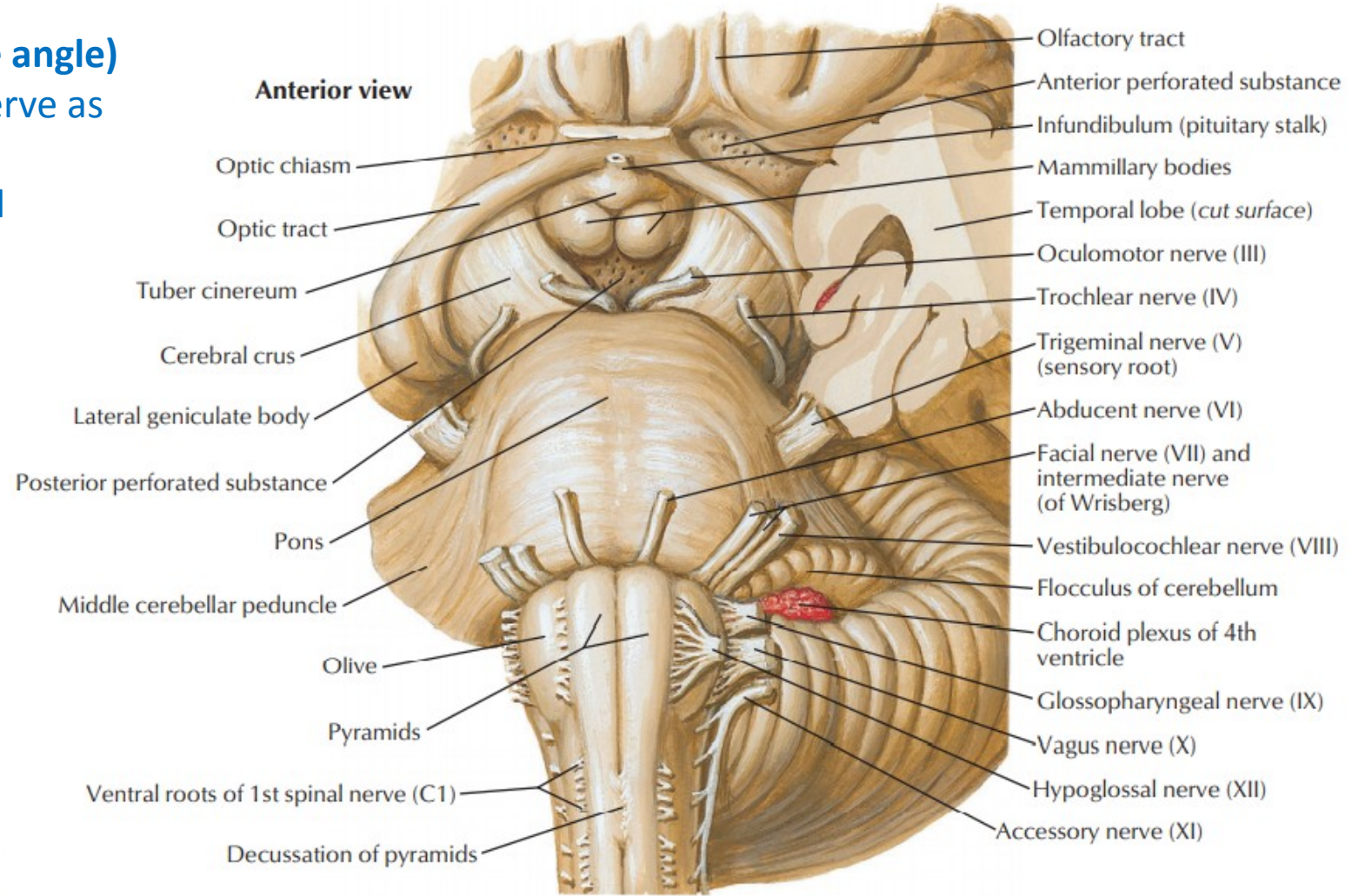
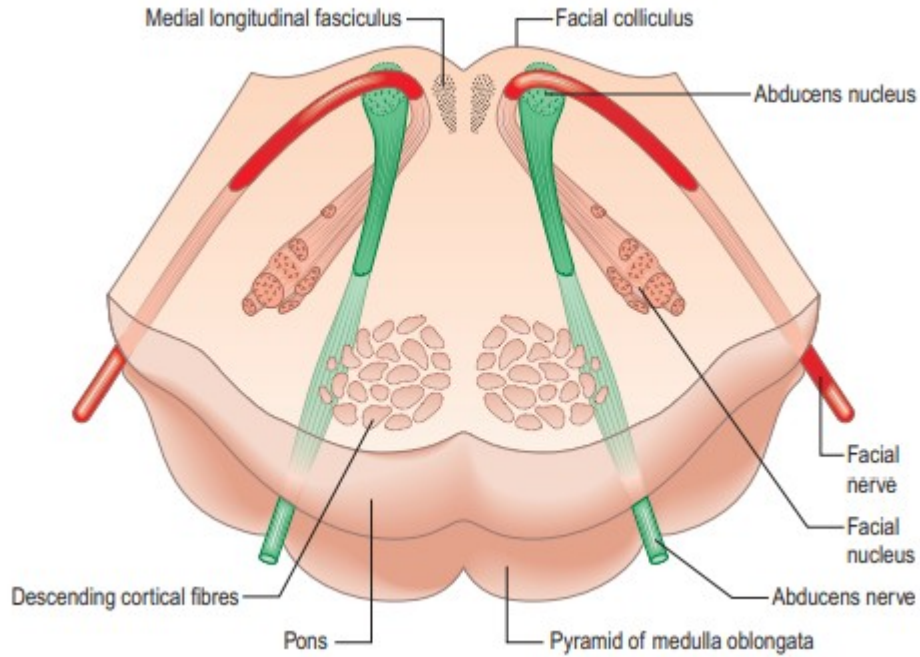
- **somatosensory nucleus** for perception from auricle, external auditory meatus

5. Mesencephalic nucleus of trigeminal nerve

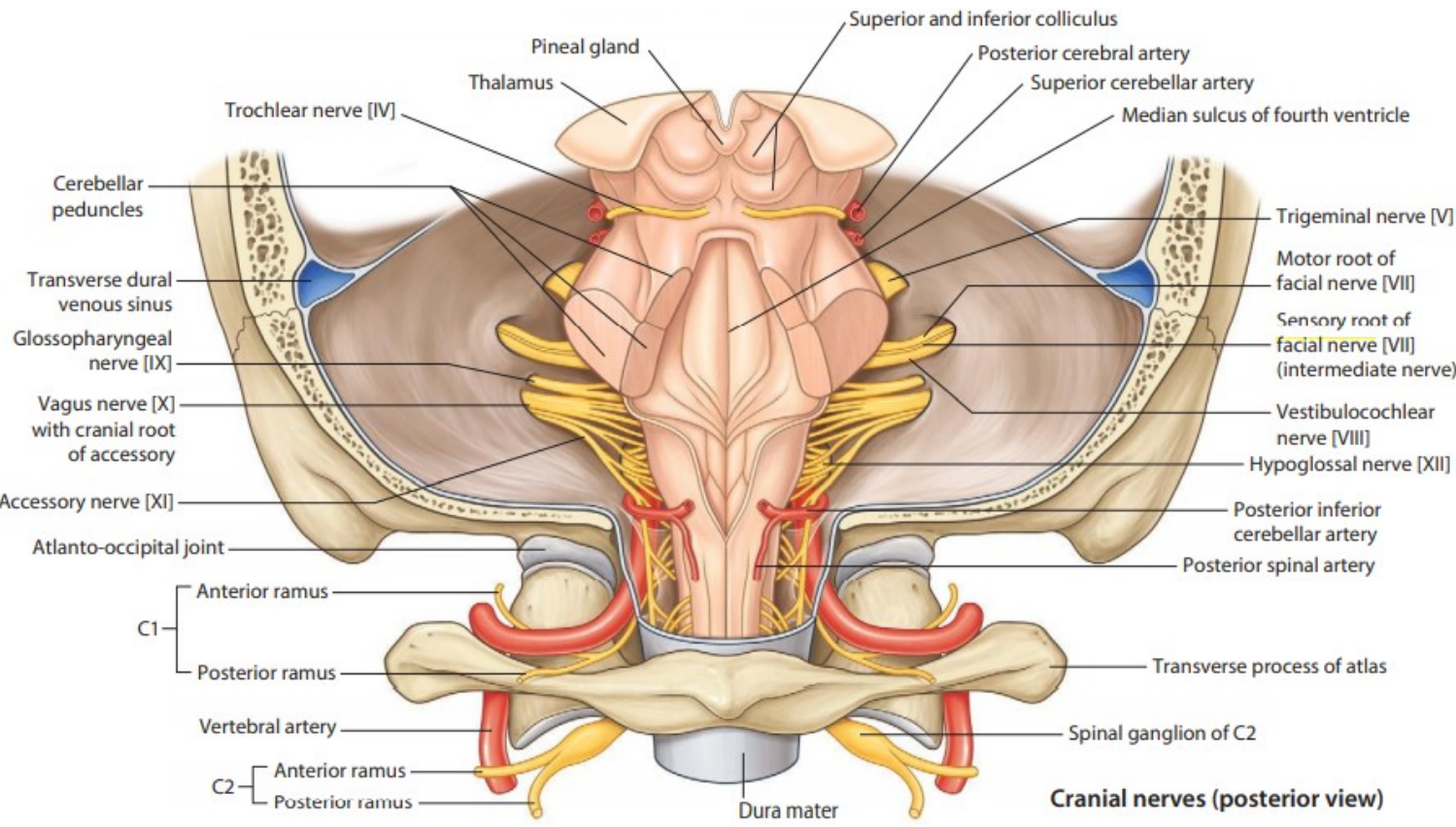
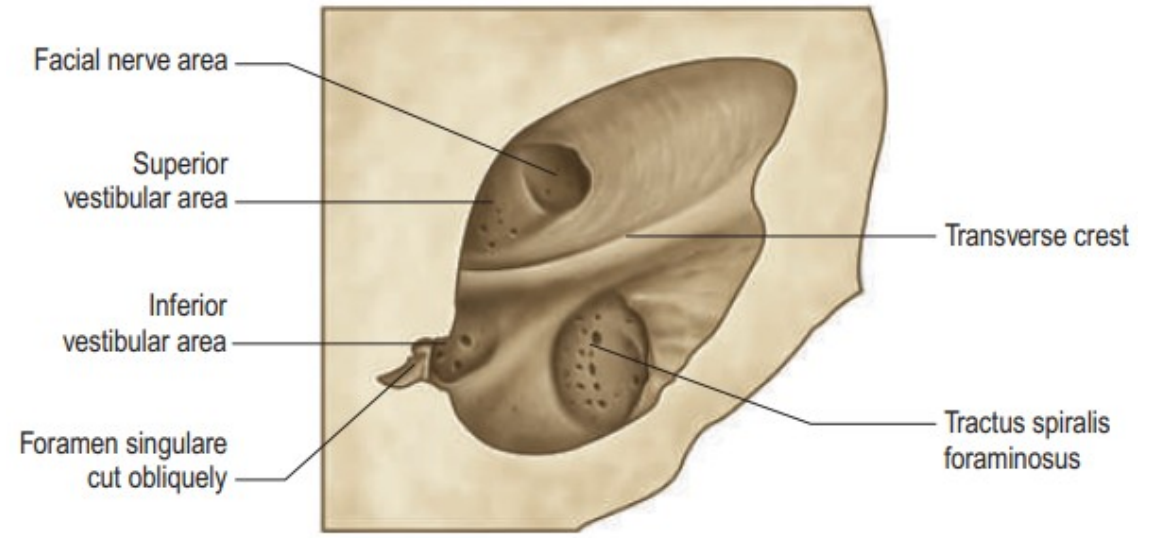
- **ganglion with the pseudounipolar neurons**, receives proprioception from mimic muscles

Arising of the n. VII

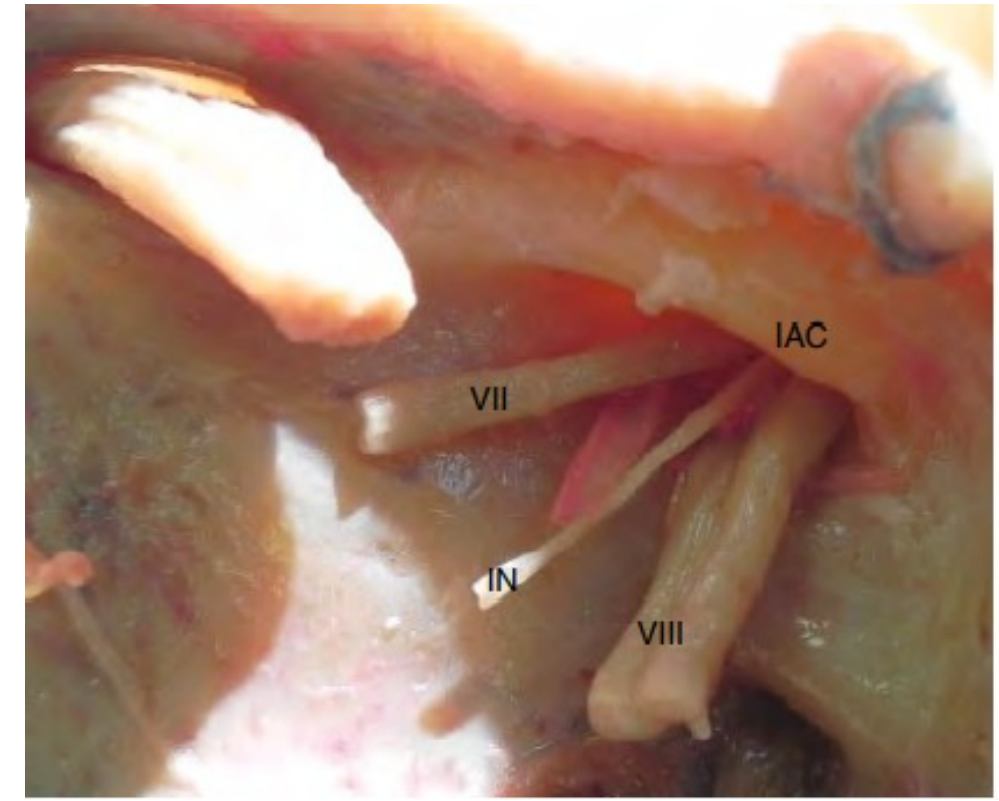
- *trigonum pontocerebellare* (cerebellopontine angle)
- fibers turn around the nucleus of abducens nerve as *genu nervi facialis* (base of facial colliculus)
- **intermediate nerve** carries parasympathetic and gustatory fibers



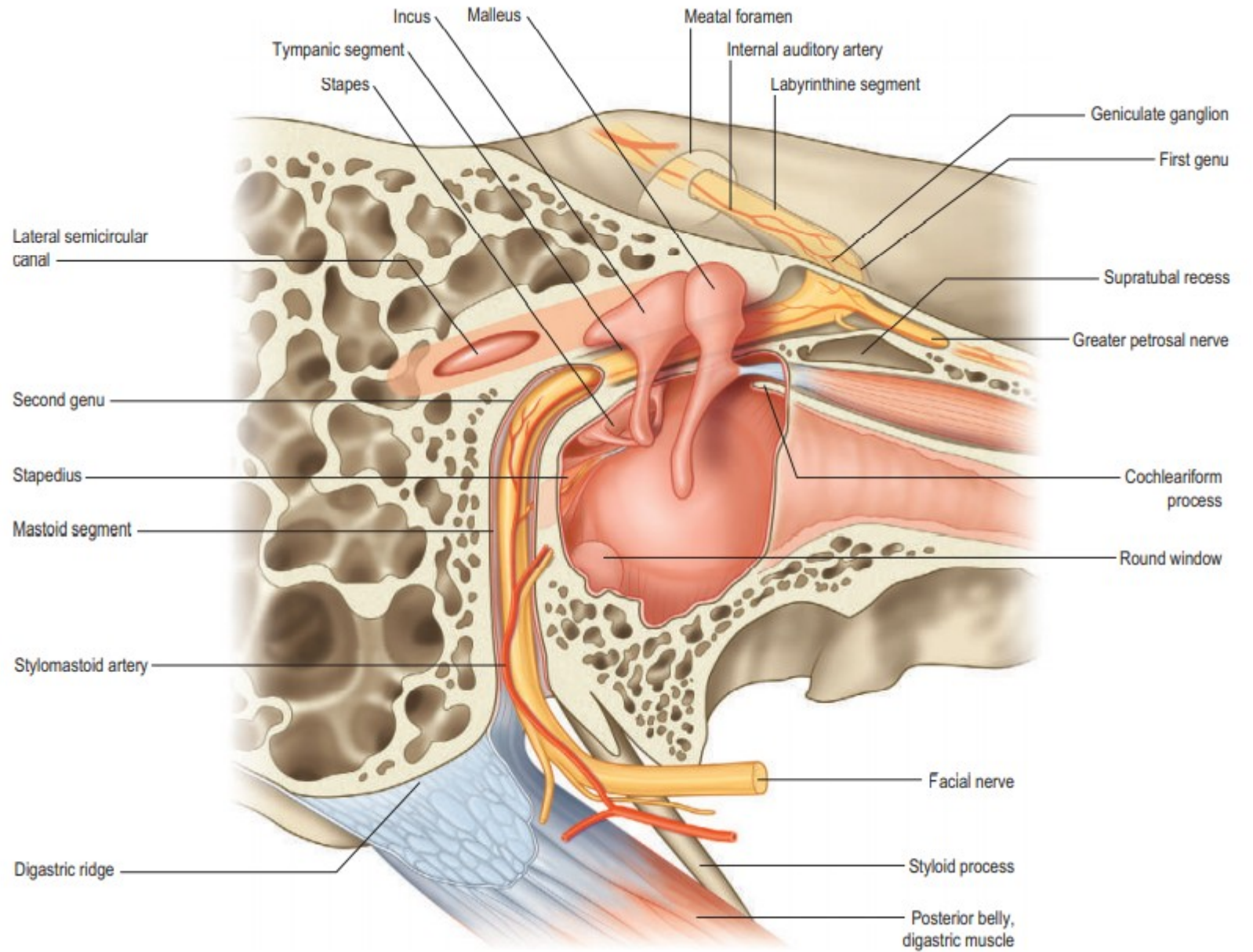
- enters the pyramid through ***fundus meatus acustici interni*** (***area nervi facialis*** ventrocranial)
- receives fibers from the ***intermediate nerve***



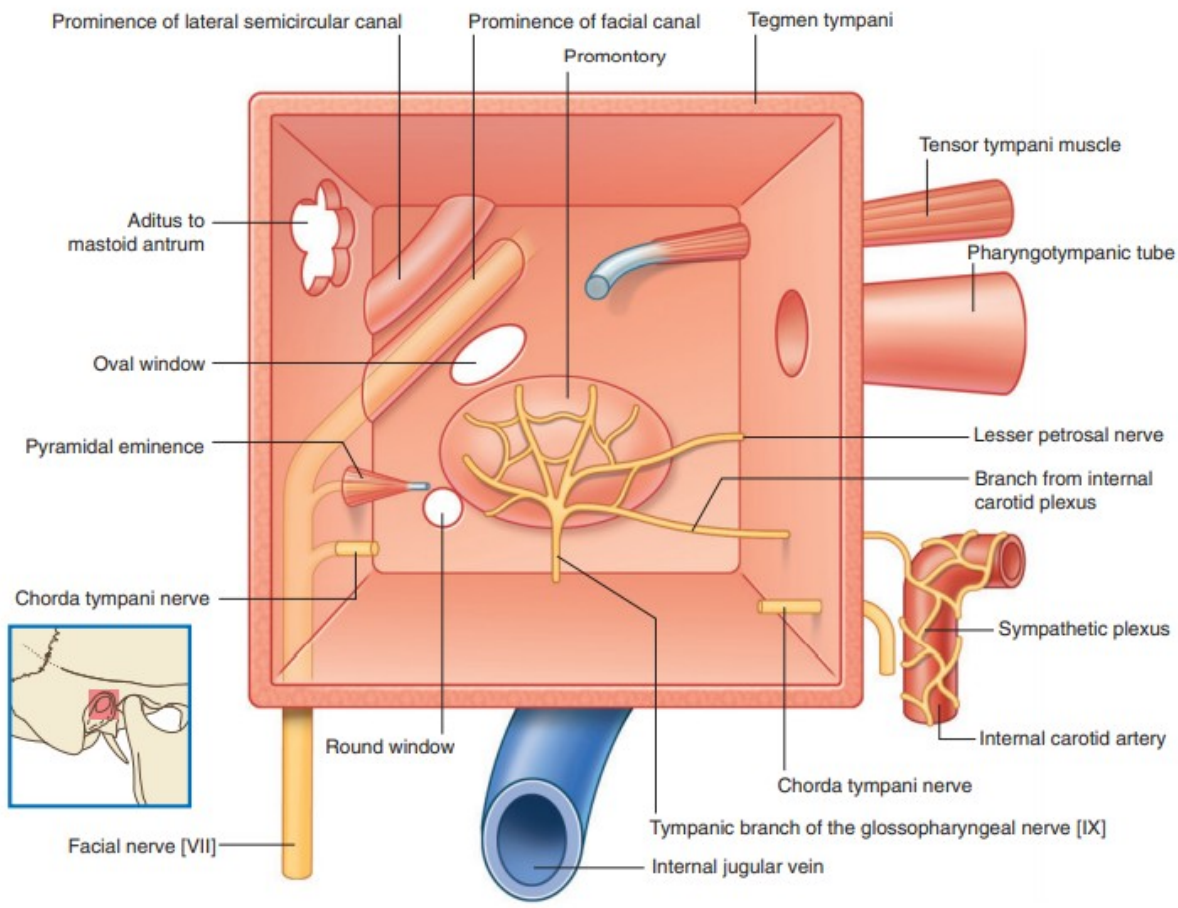
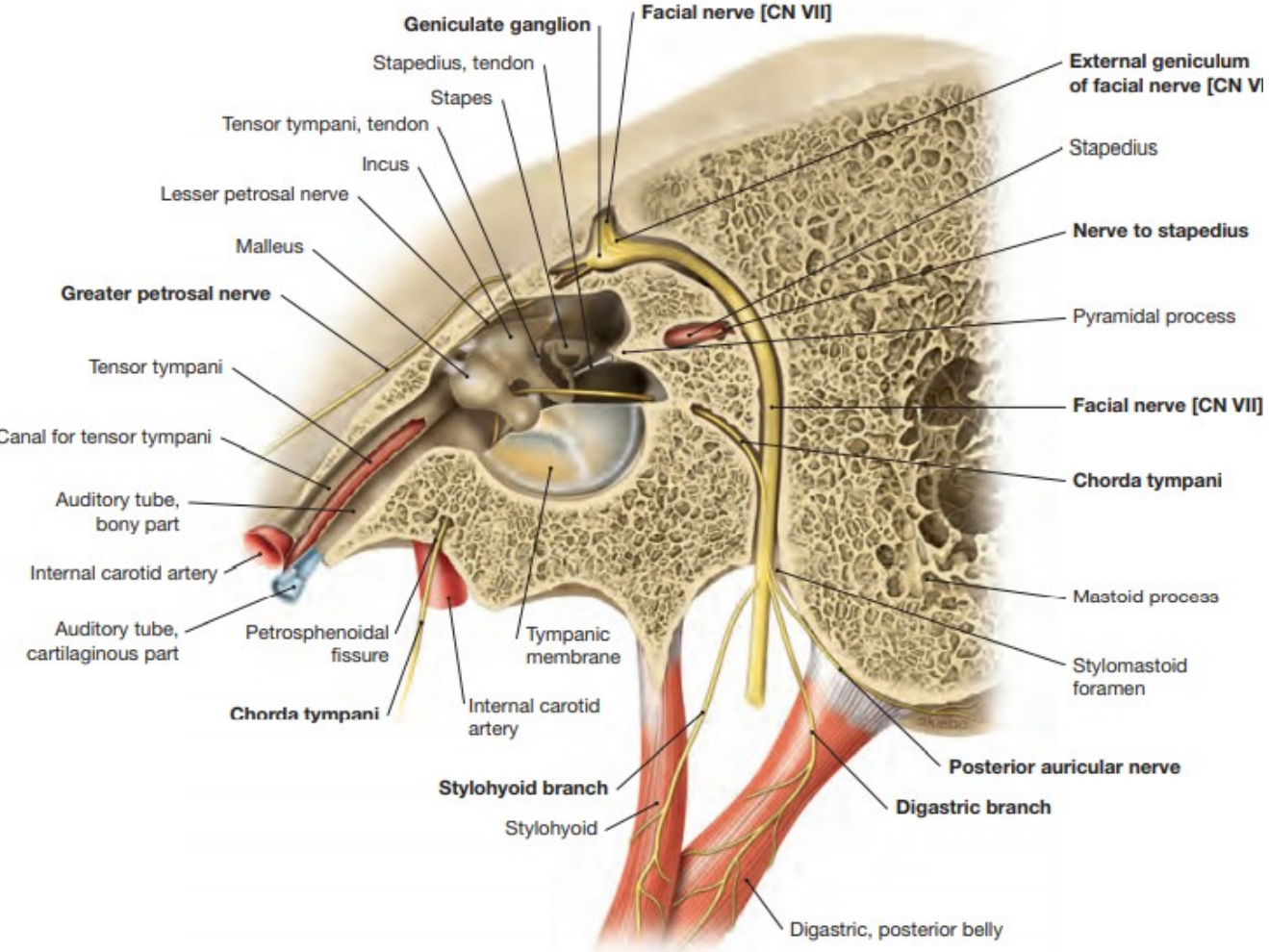
Cranial nerves (posterior view)



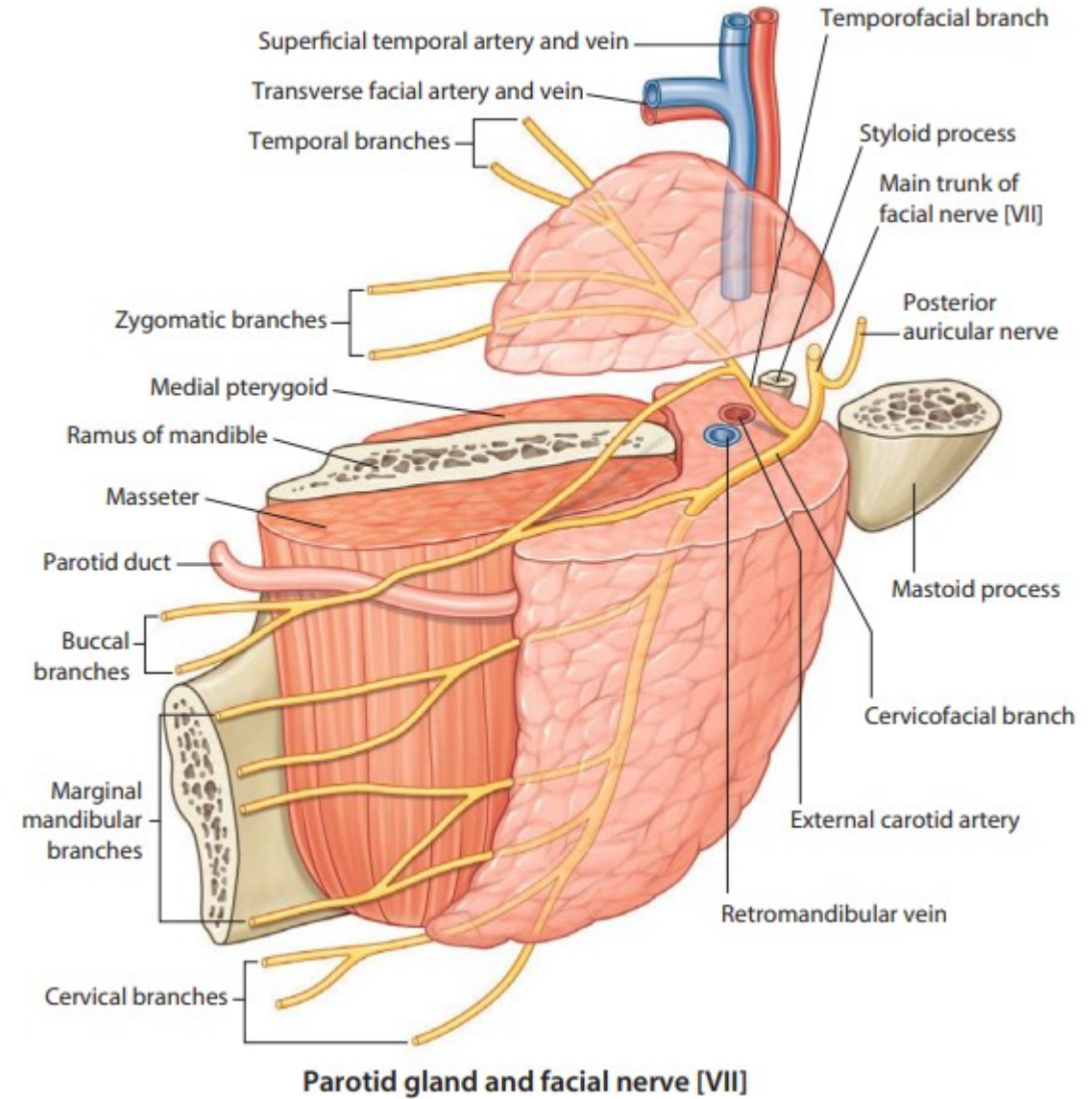
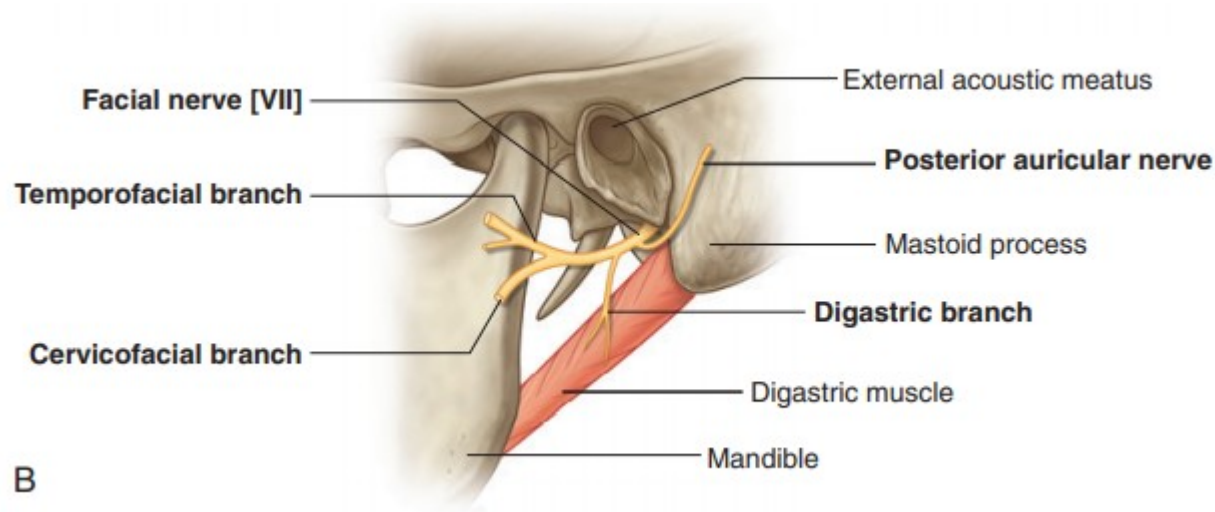
Course of the facial nerve in the petrous bone I

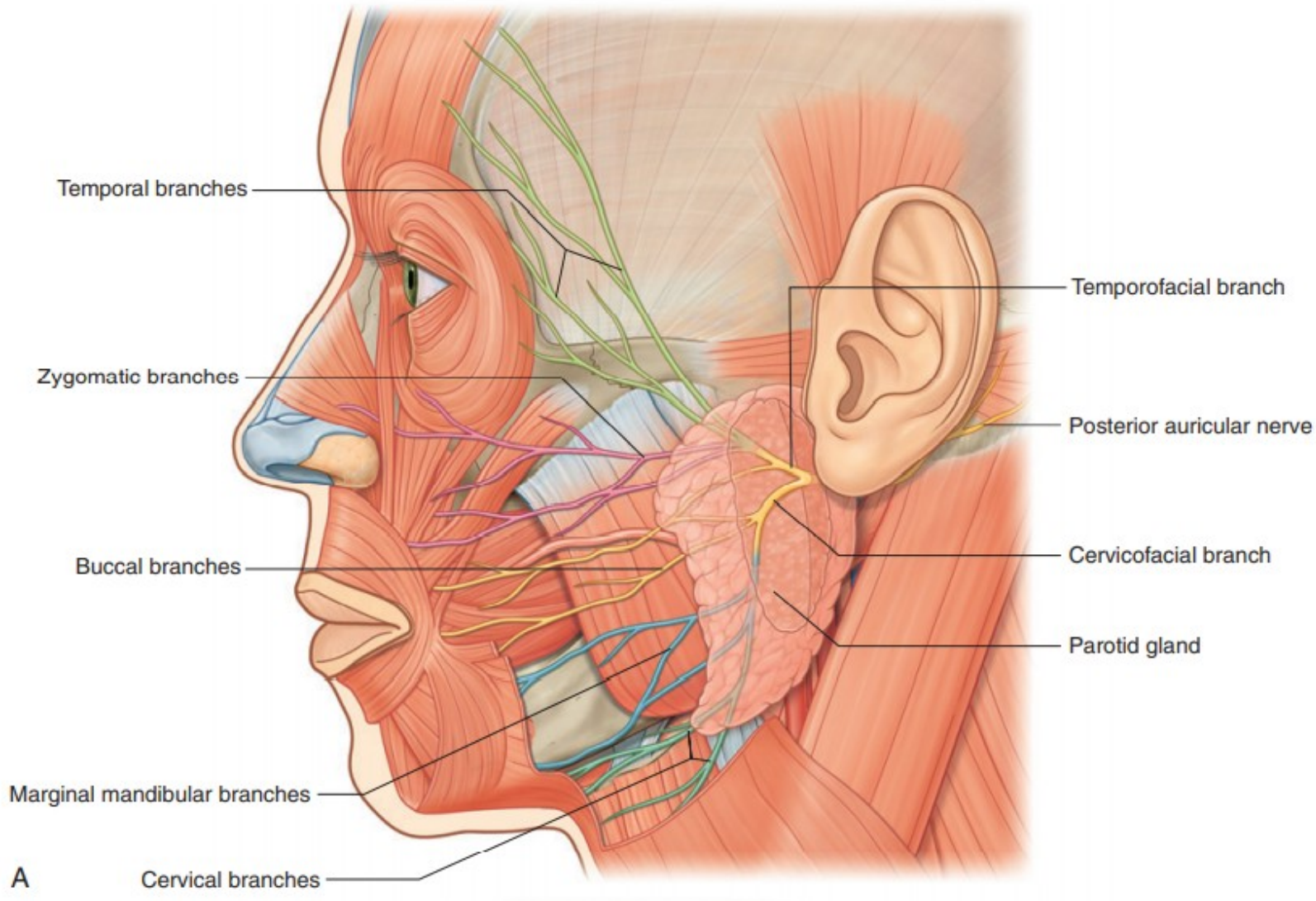


Course of the facial nerve in the petrous bone II



- exit from the petrous bone: **stylomastoid foramen**
- enters the parotid gland
- runs dorsally and laterally from the retromandibular vein and external carotid artery
- creates the **(intra)parotid plexus**





1. Temporal branches

- muscles of the frontal and temporal region

2. Zygomatic branches

- *m. orbicularis oculi*, *mm. zygomatici* and muscles of the nose

3. Buccal branches

- muscles of the upper lip and buccal region

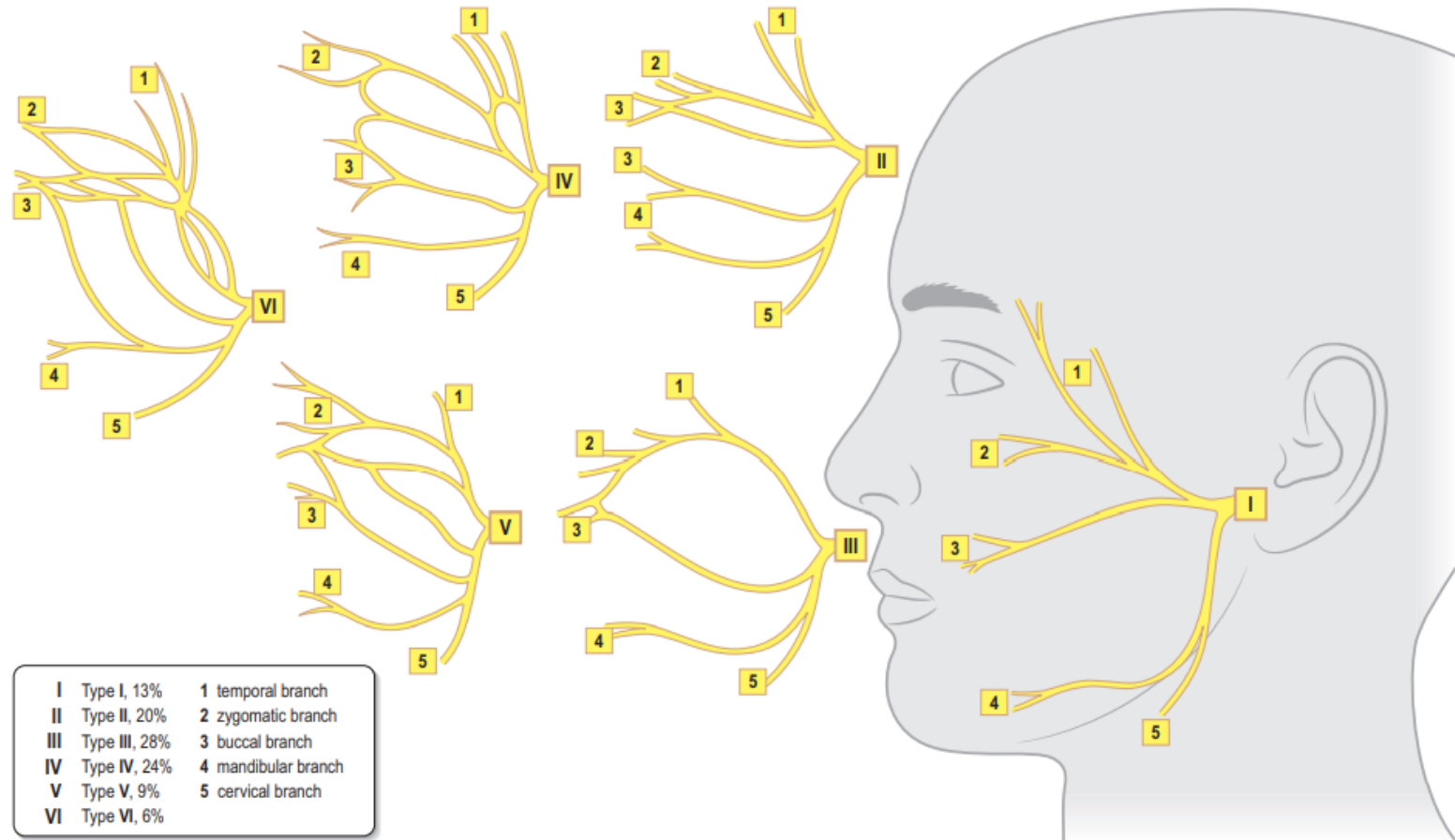
4. Marginal mandibular branches

- muscles of the chin and lower lip

5. Cervical branches

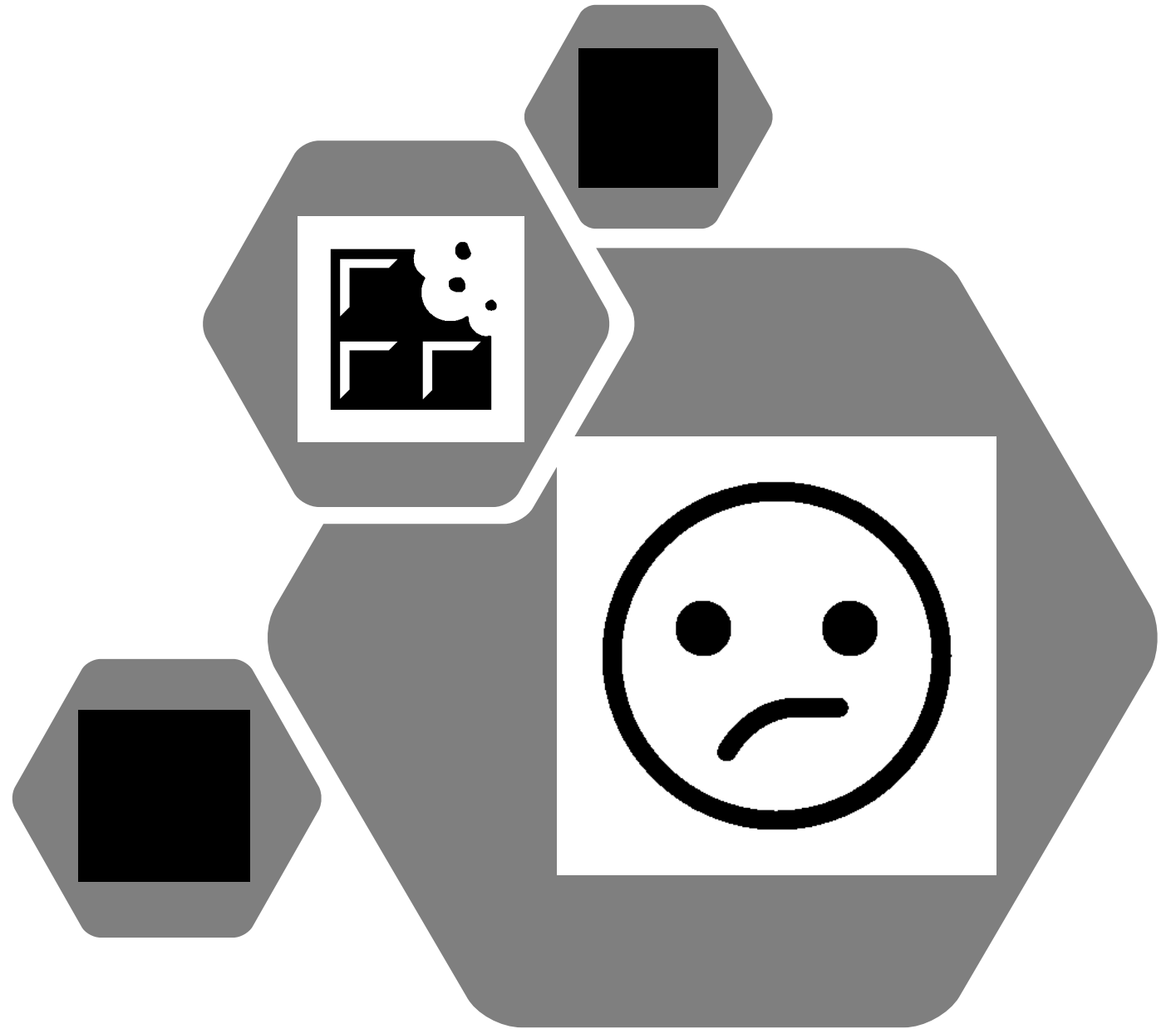
- *m. platysma*, *ansa cervicalis superficialis*

A

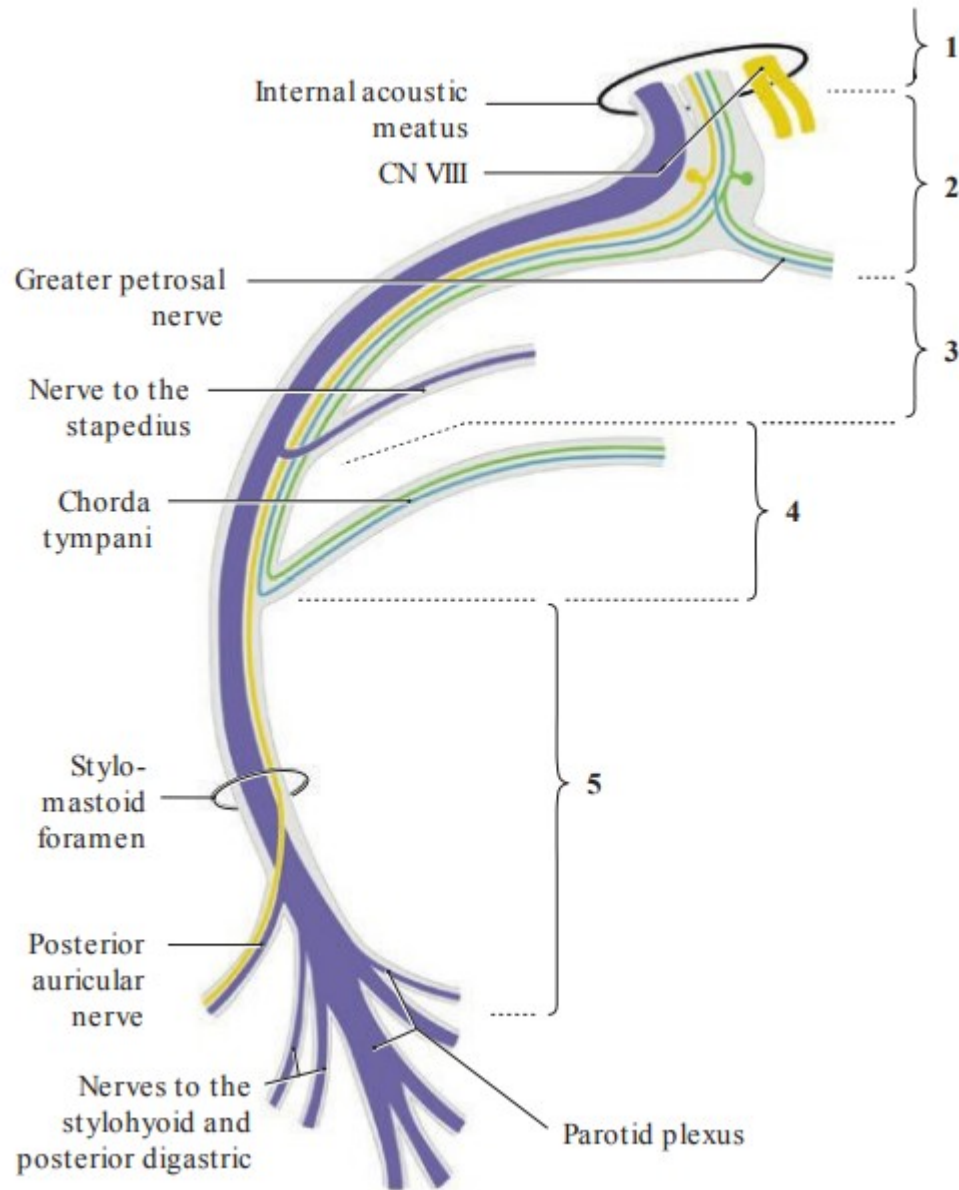


Symptoms

- mimic muscles palsy
- lagophthalmos
- ageusia, hyposalivation of saliva
- hyperacusis
- hyposalivation of tears



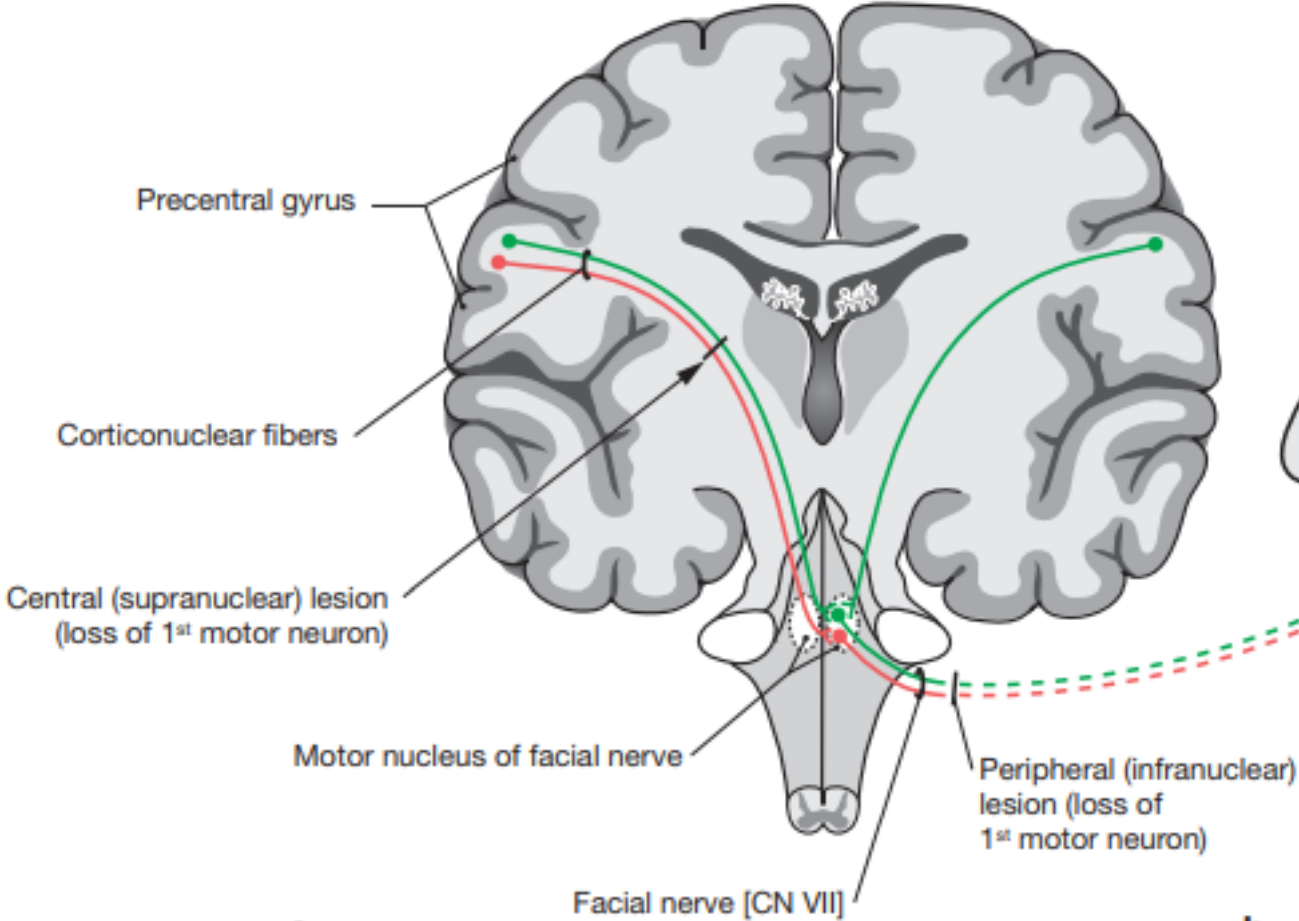
Peripheral palsy of n. VII



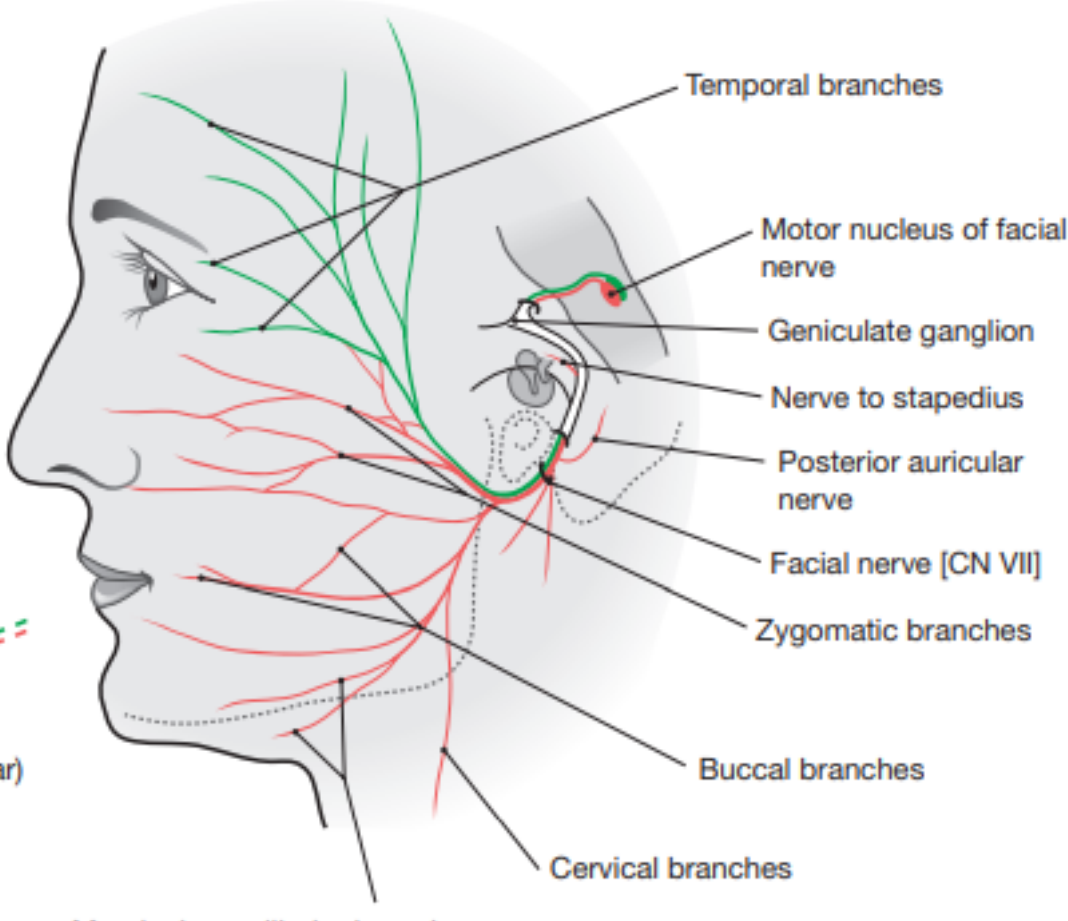
- 2. Ipsilateral mimic muscles palsy + ageusia (anterior 2/3 of the tongue) + hyposalivation + hyperacusis**
- 3. Ipsilateral mimic muscles palsy + ageusia (anterior 2/3 of the tongue) + hyposalivation + hyperacusis**
- 4. Ipsilateral mimic muscles palsy + ageusia (anterior 2/3 of the tongue) + hyposalivation**
- 5. Ipsilateral mimic muscles palsy**

Central and peripheral palsy of n. VII

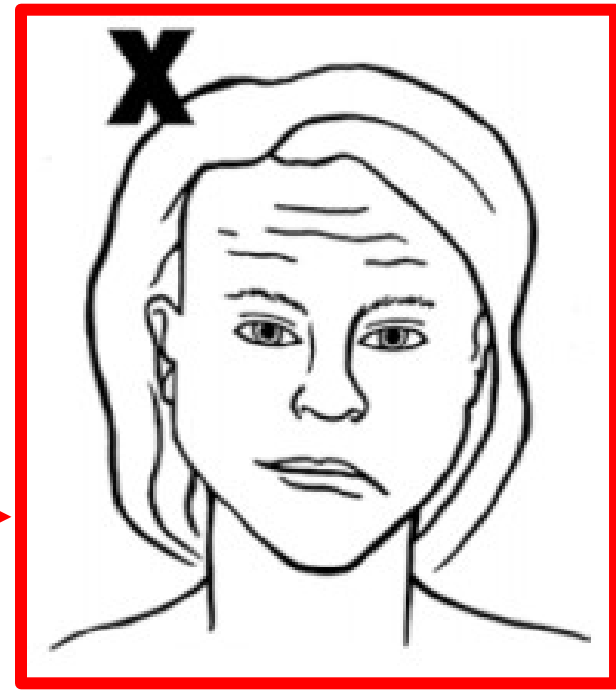
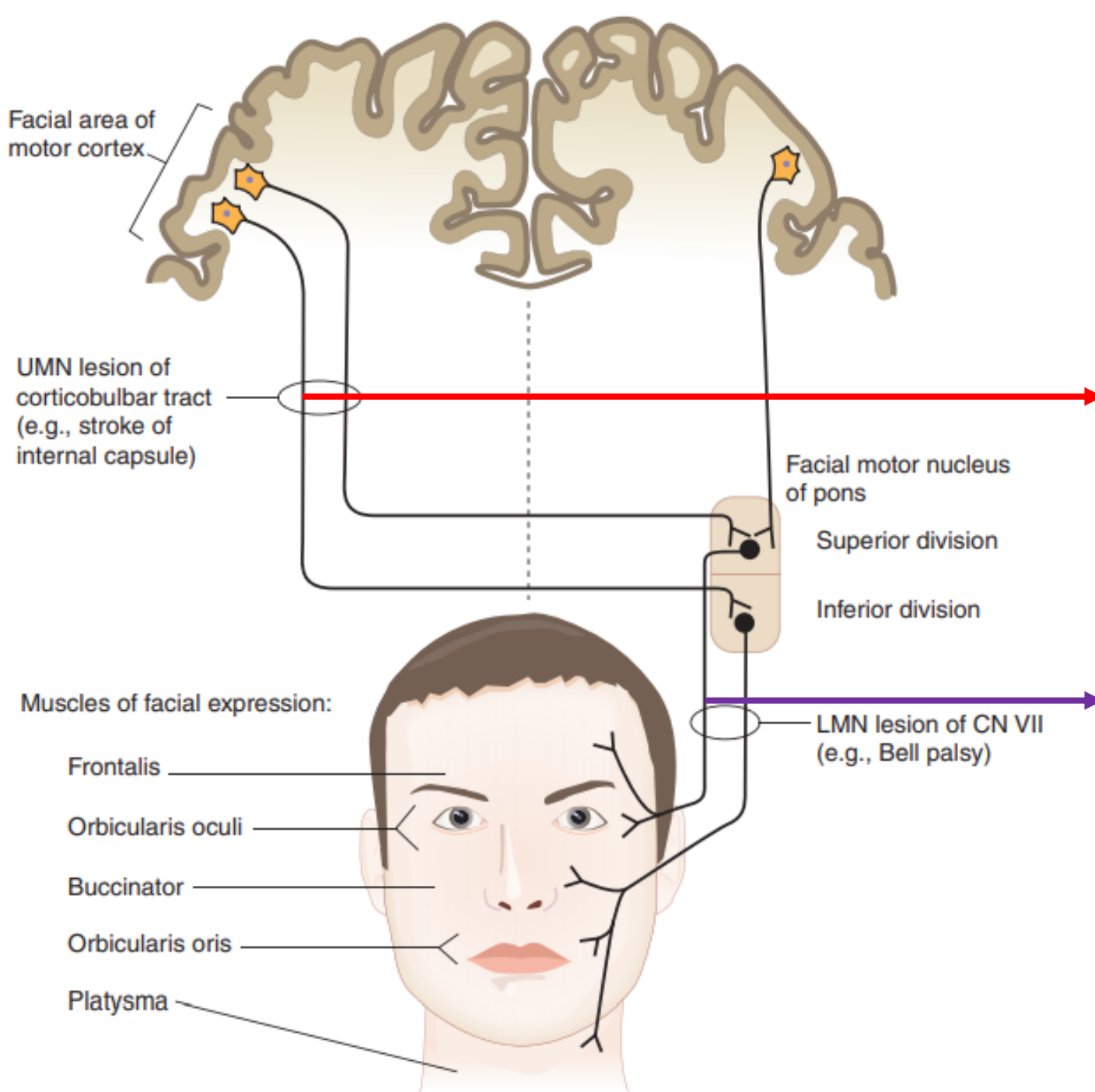
... or why seems the peripheral palsy of n. VII more dramatic?



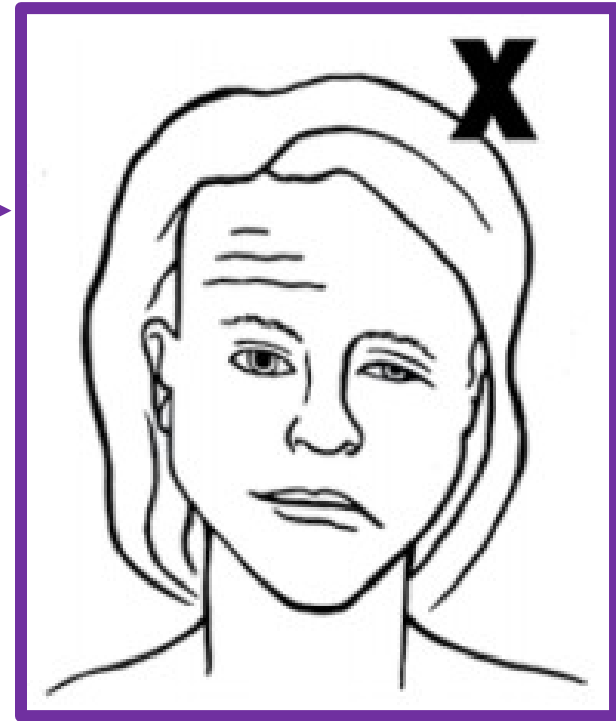
a



b



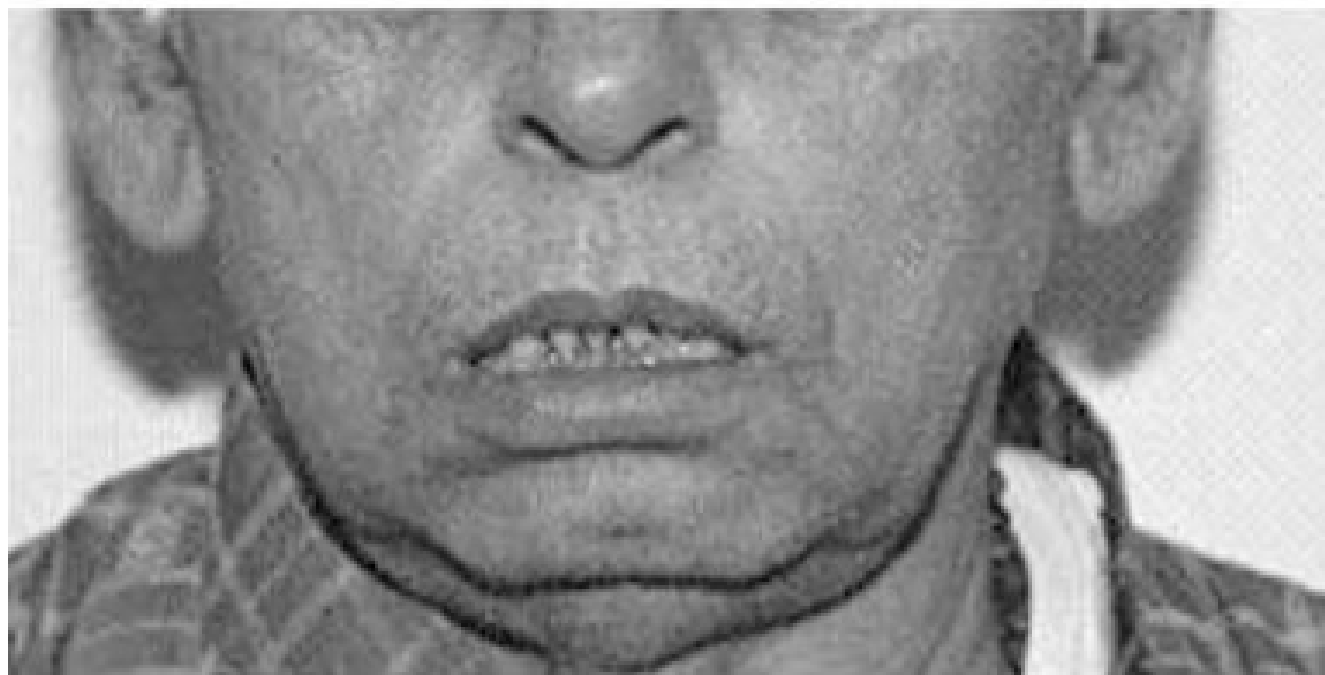
Central palsy
 → oral commissure drooping



Peripheral palsy
 → oral commissure drooping
 → ptosis



„BELL'S SIGN“



OVERVIEW OF THE FACIAL NERVE BRANCHES

1. *Nervus petrosus major / radix parasympathica (intermedia) ganglii pterygopalatini*

- *n. canalis pterygoidei* (vzniká spojením s *n. petrosus profundus*)
 - vede pregangliové parasympatické (*n. petrosus major*) a postgangliové sympatické vlákna (*n. petrosus profundus*) do *ganglion pterygopalatinum*
 - inervace *glandula lacrimalis* a malých žláz nosu a patra

2. *Nervus stapedius*

3. *Chorda tympani*

- pregangliové parasympatické vlákna do *ganglion submandibulare* (inervace *glandula submandibularis* a *glandula sublingualis*)
- senzorické (chuťové) vlákna z předních 2/3 jazyka skrze *ganglion geniculi*

4. *Ramus communicans cum plexu tympanico*

5. *Ramus communicans cum nervo vago*

6. *Ramus communicans cum nervo glossopharyngeo*

7. *Nervus auricularis posterior*

- *r. occipitalis*
- *r. auricularis*

8. *Ramus digastricus*

9. *Ramus stylohyoideus*

10. *Plexus (intra)parotideus*

- *rr. temporales*
- *rr. zygomatici*
- *rr. buccales*
- *r. marginalis mandibulae*
- *r. colli*

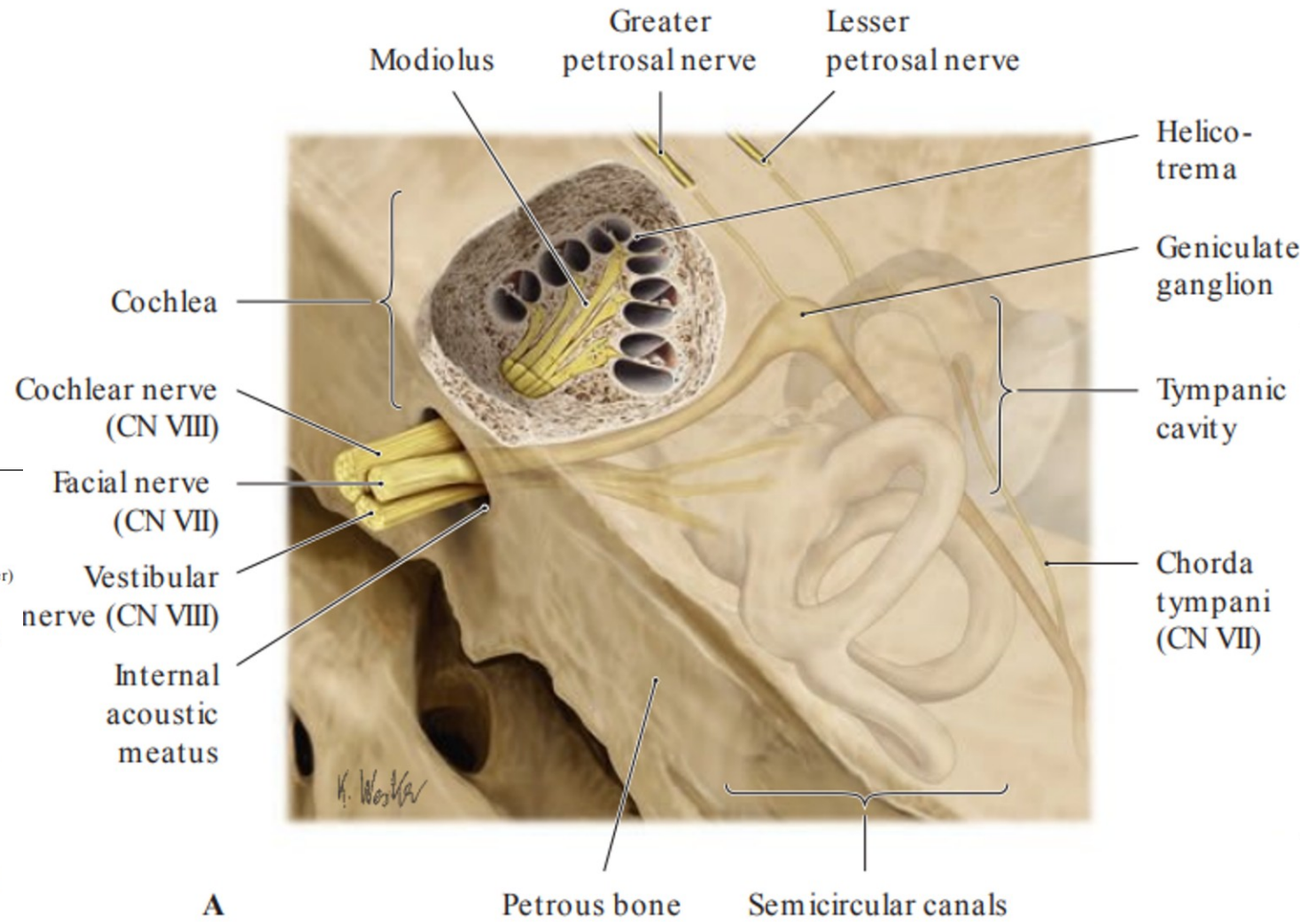
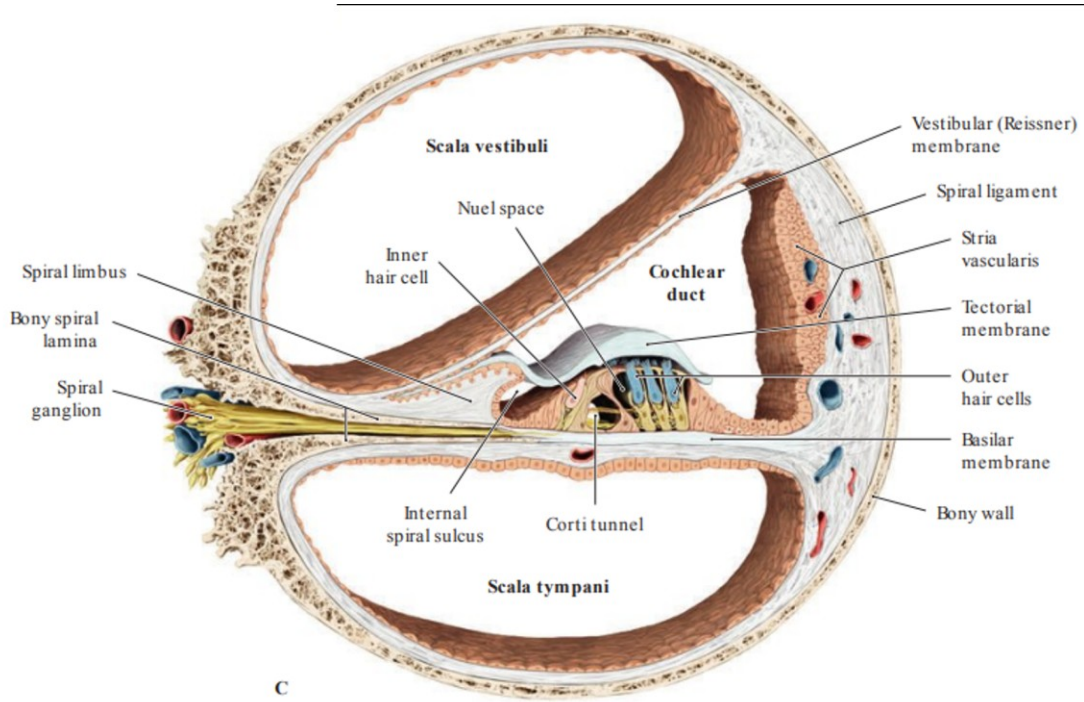
**Vestibulocochle
ar nerve (n. VIII)**



Nervus cochlearis

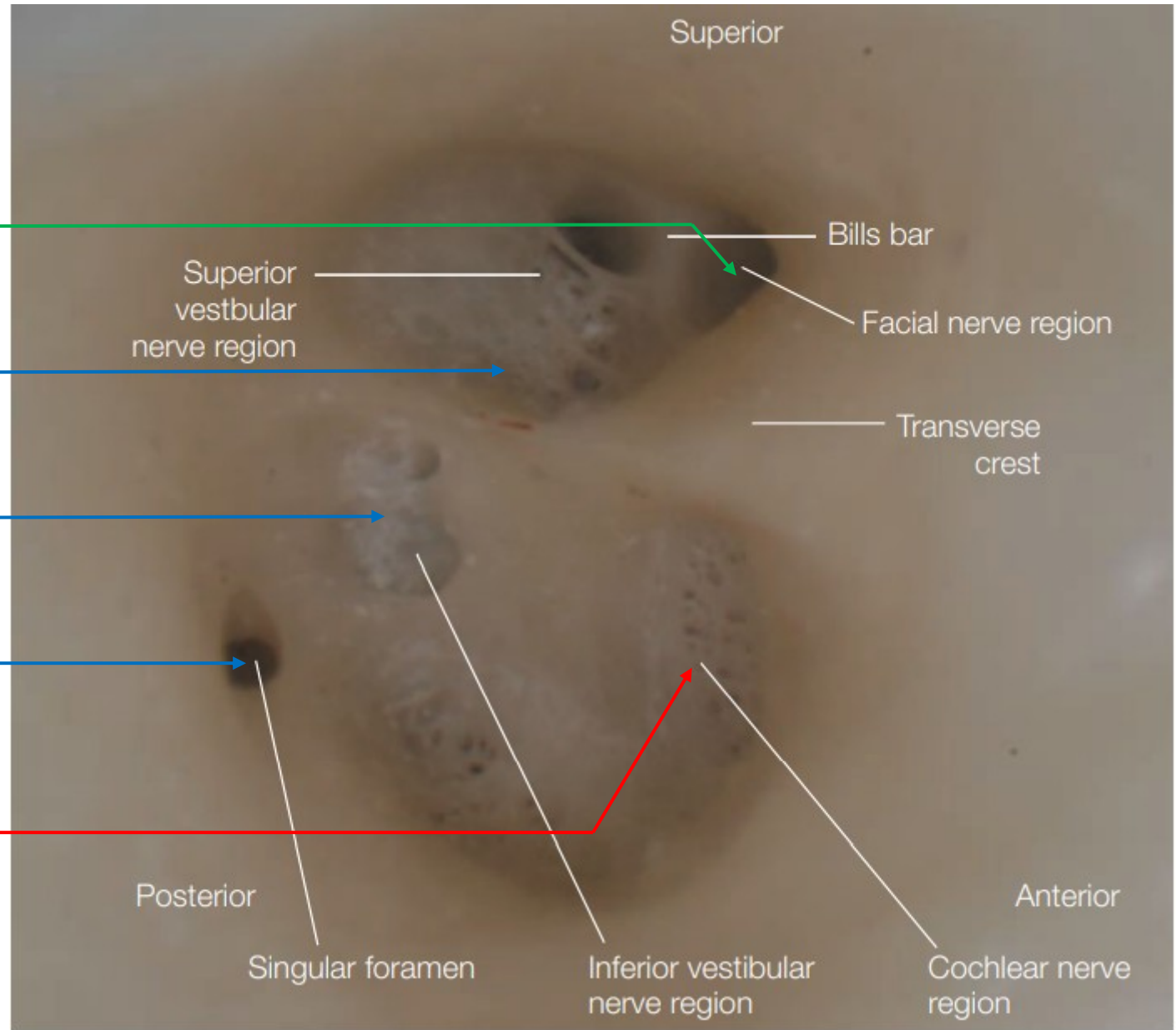
Area cochlae (*tractus spiralis foraminosus*)

- central fibers of the spiral ganglion



C

A



Nervus facialis

Nervus utriculoampullaris

Nervus ampullaris posterior

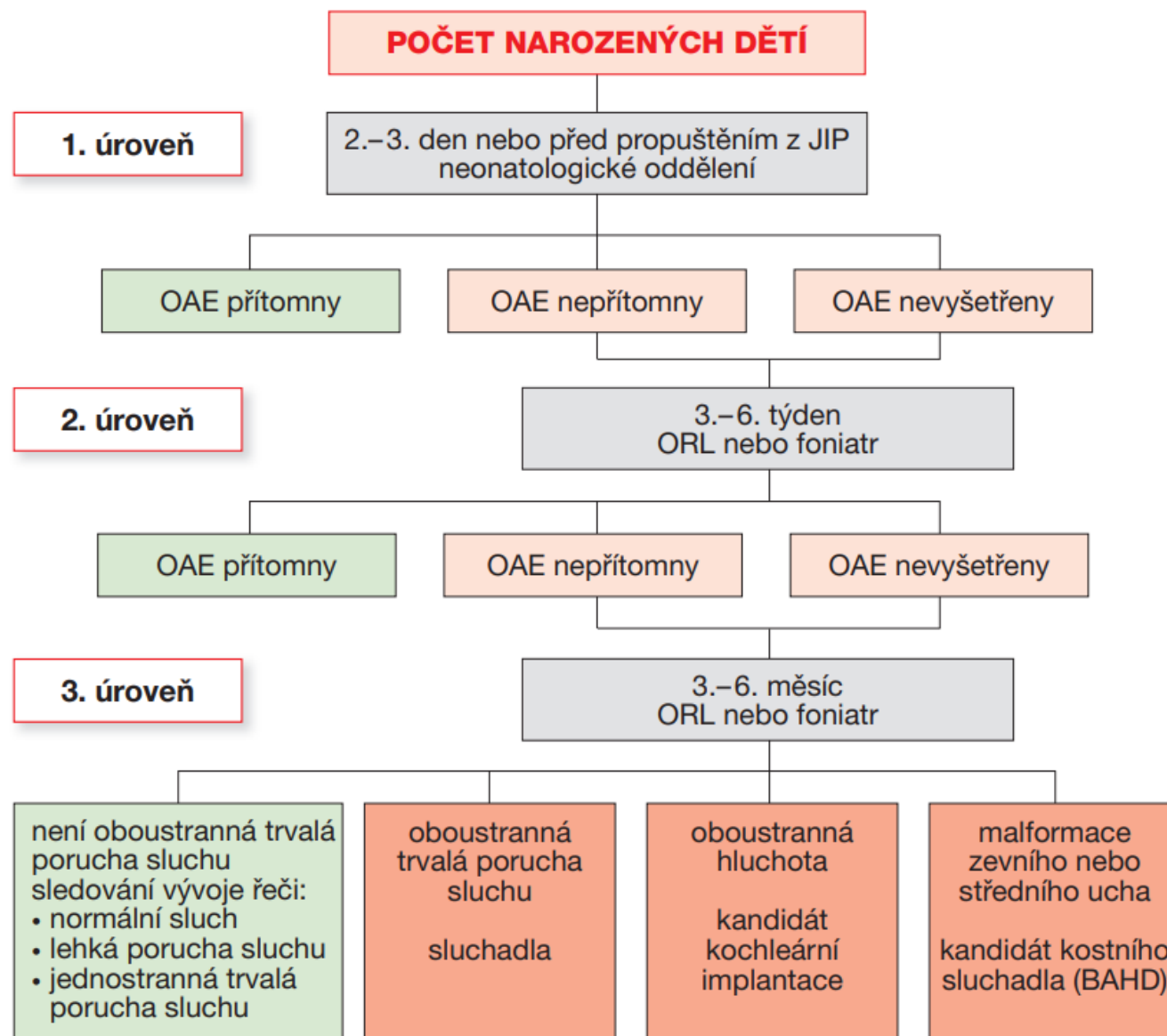
Nervus saccularis

Nervus cochlearis
(tractus spiralis foraminosus)

Screening sluchu novorozenců

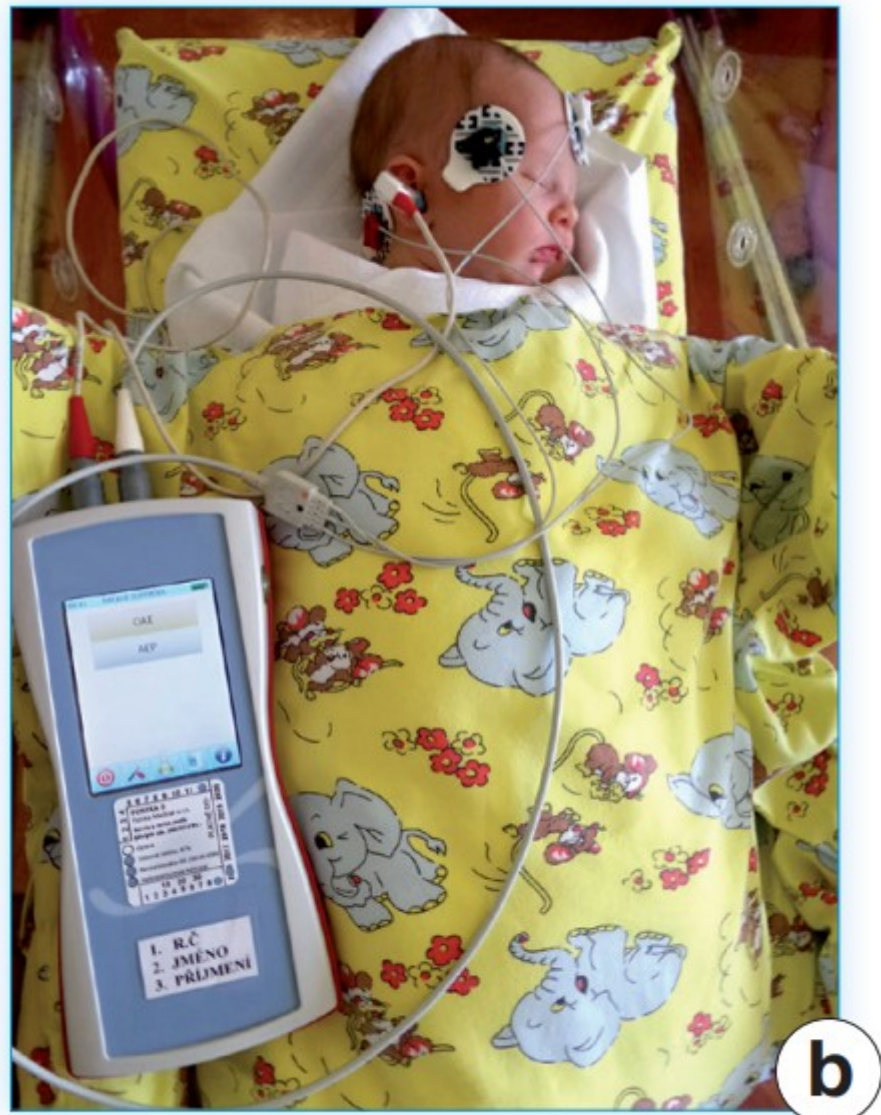
- definovaný ve vyhlášce č. 70/2021 Sb. o preventivních prohlídkách ve znění pozdějších předpisů (nabytí účinnosti zákonu č. 45/2021 Sb. dne 24.2.2021)
- fáze screeningu:
 1. screeningové vyšetření sluchu novorozenců (TEOAE, AABR)
 2. screeningové vyšetření sluchu dětí metodou tónové audiometrie ve věku 5 let

Schéma 1: Screening sluchu (fyziologických*) novorozenců

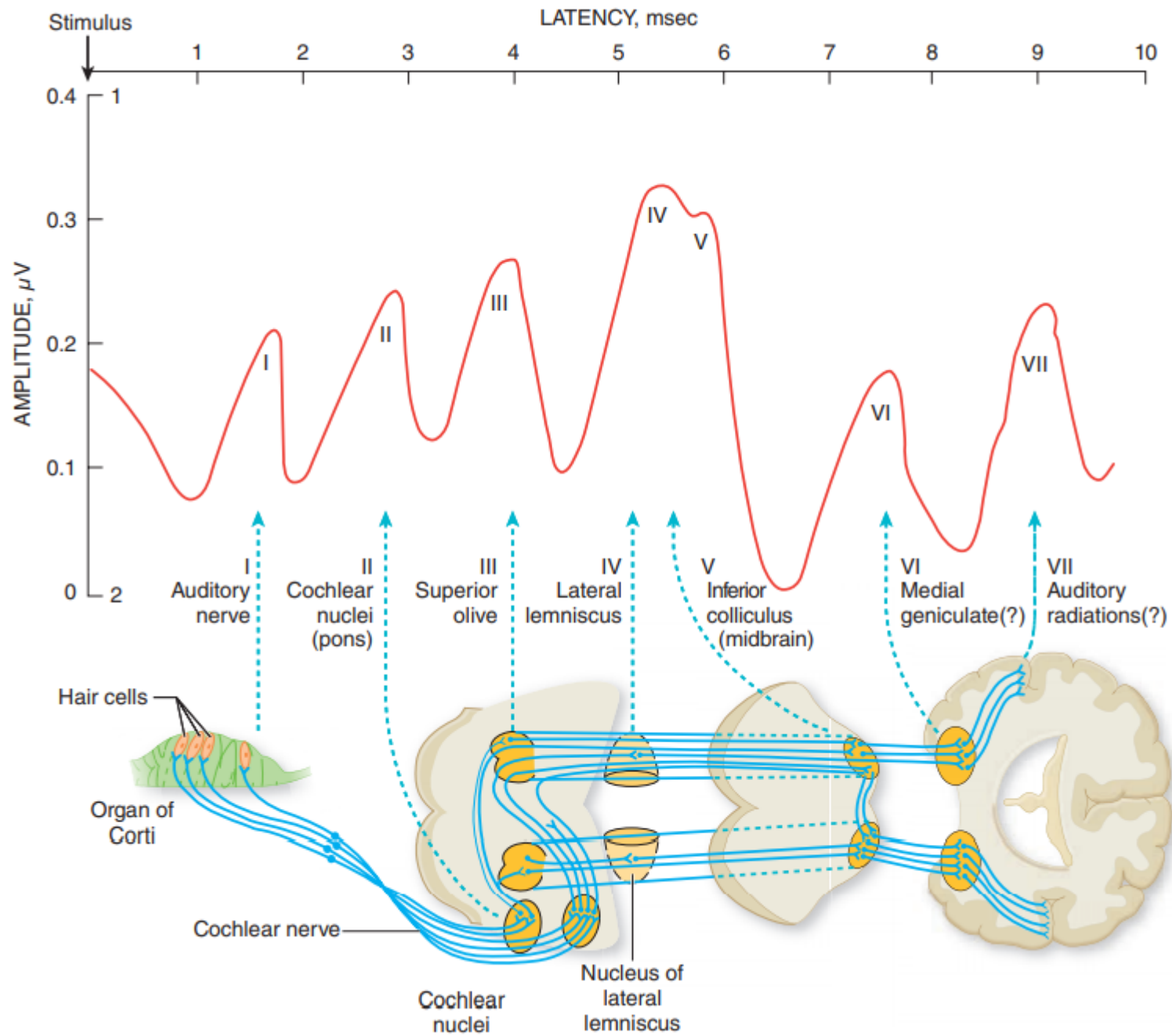
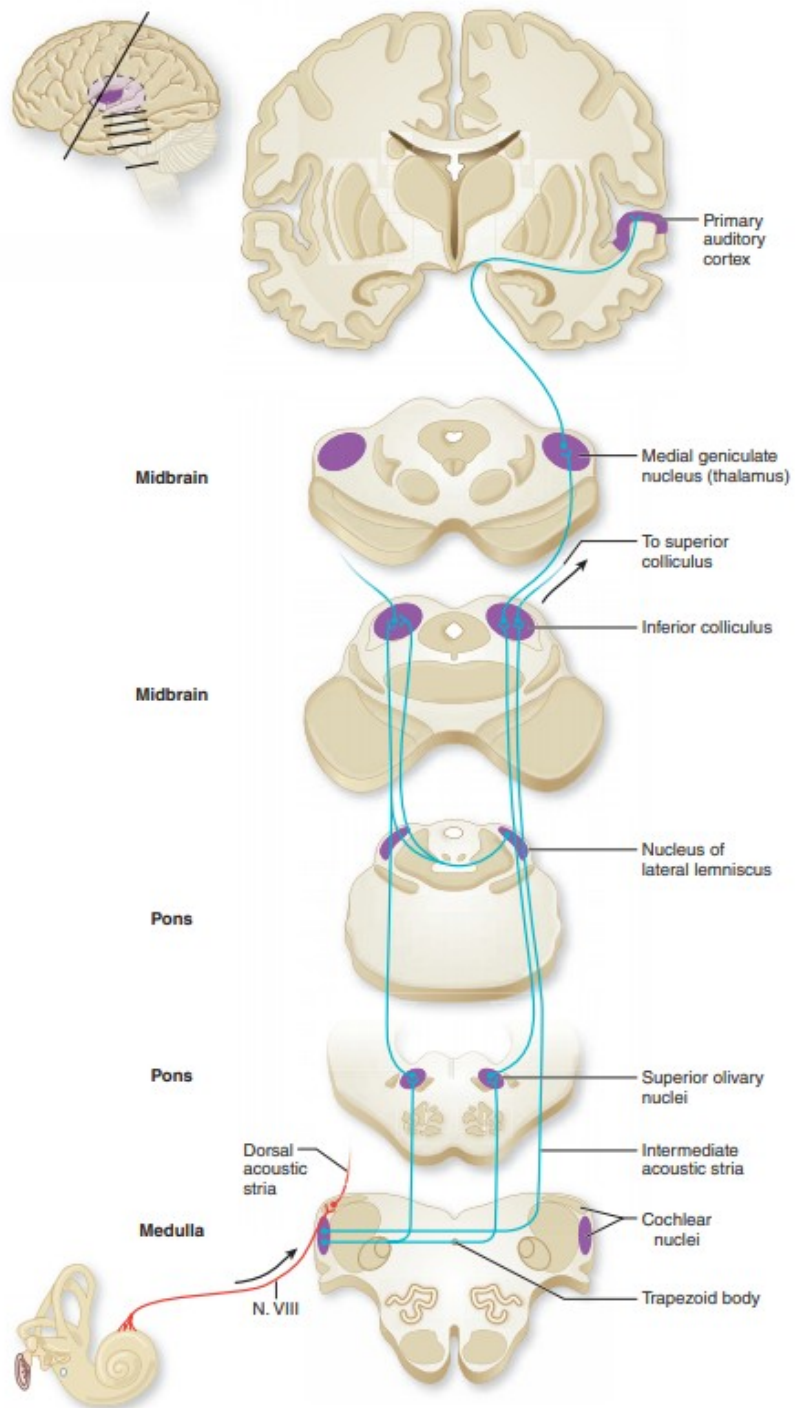


Termín vyšetření odpovídá věku dítěte.

* U rizikového novorozence hospitalizovaného v PCIP nebo PCIMP je doporučeno vyšetření AABR.



Obr. 1: Vyšetření sluchu novorozence metodou: a – TEOAE, b – AABR



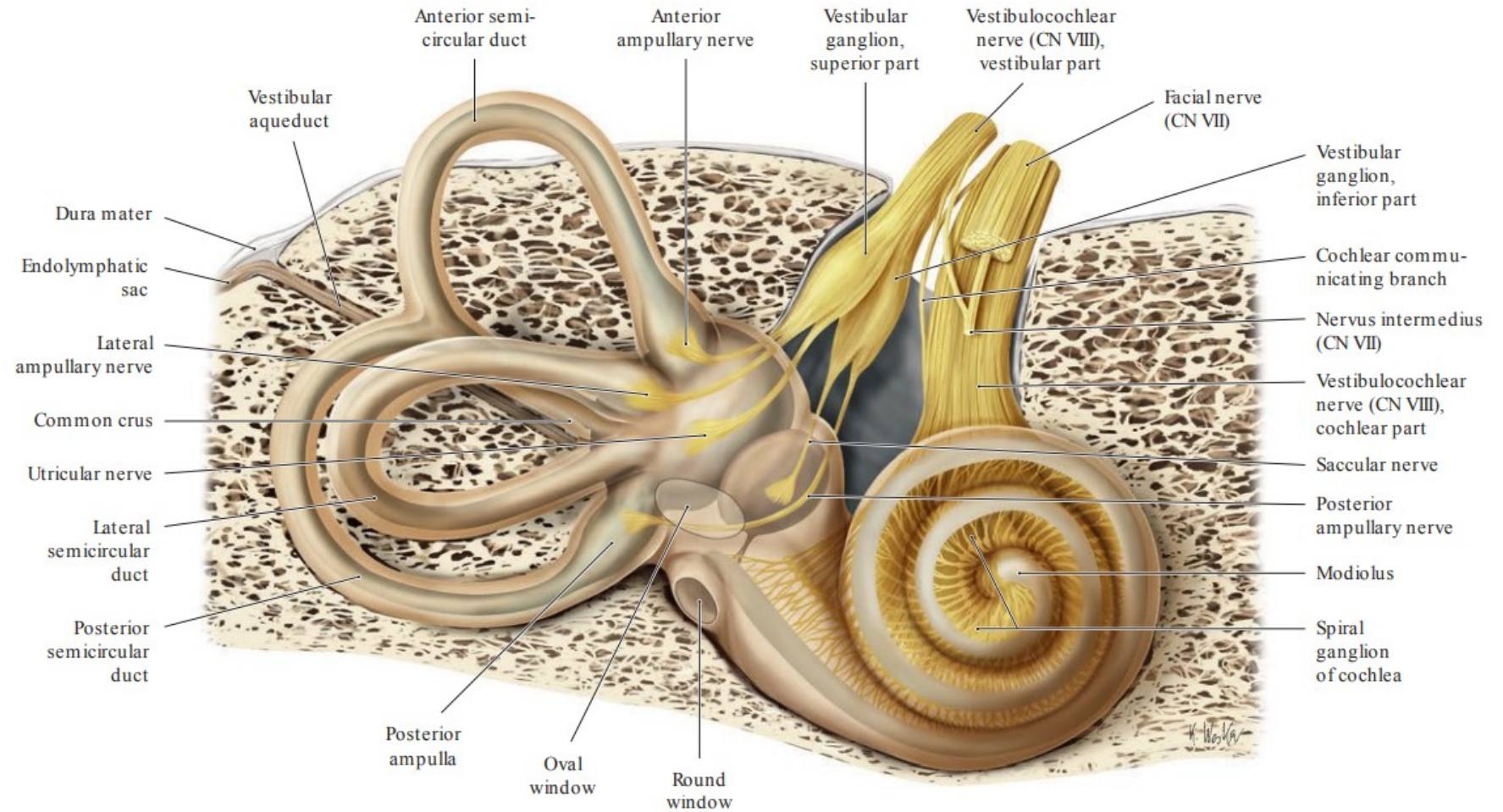
Vestibular nerve

→ *utrículoampullary nerve*

- *utricular nerve*
- *anterior ampullary nerve*
- *lateral ampullary nerve*

→ *saccular nerve*

→ *posterior ampullary nerve*



Area vestibularis superior → *n. utrículoampullaris*

Area vestibularis inferior → *n. saccularis*

Foramen singulare → *n. ampullaris posterior*

Vestibulum

Recessus ellipticus (utriculi)

- *macula cribrosa superior*
- *aqueductus vestibuli*

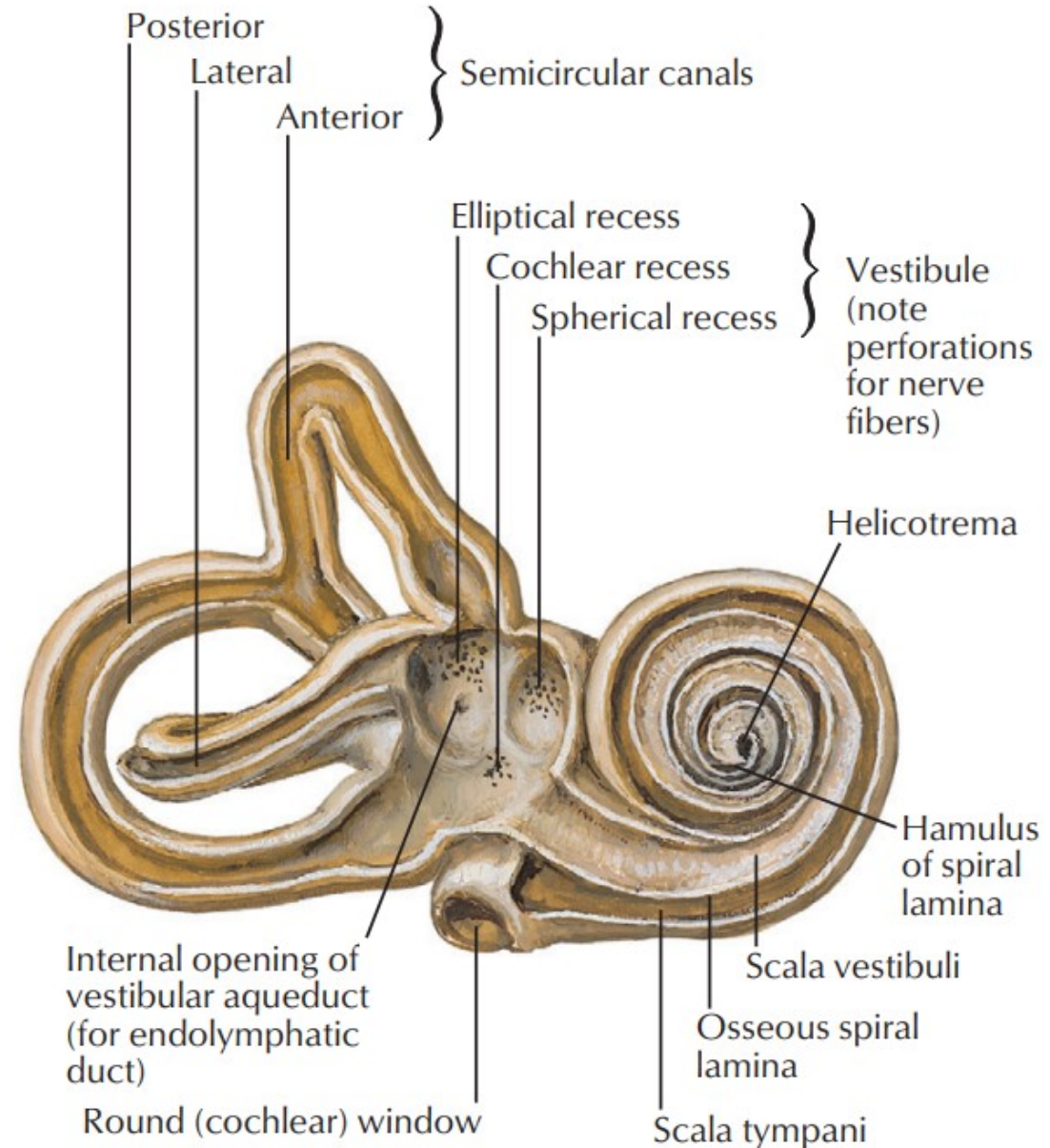
Recessus sphericus (sacculi)

- *macula cribrosa media*

Recessus cochlearis

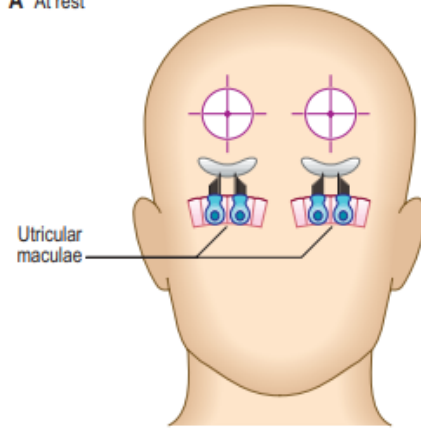
- *macula cribrosa inferior*

Dissected right bony labyrinth (otic capsule): membranous labyrinth removed

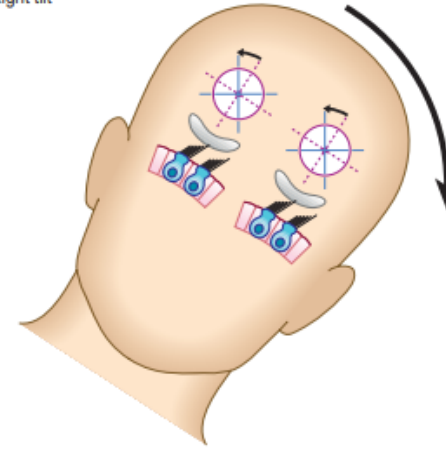


Perception of head orientation

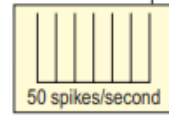
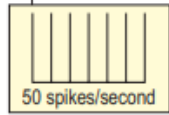
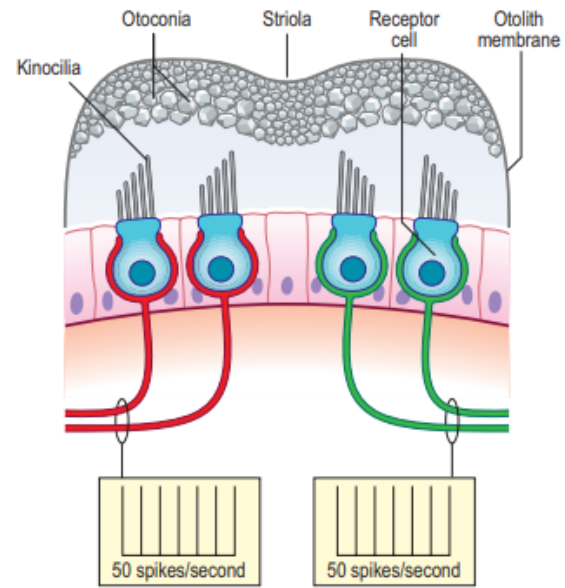
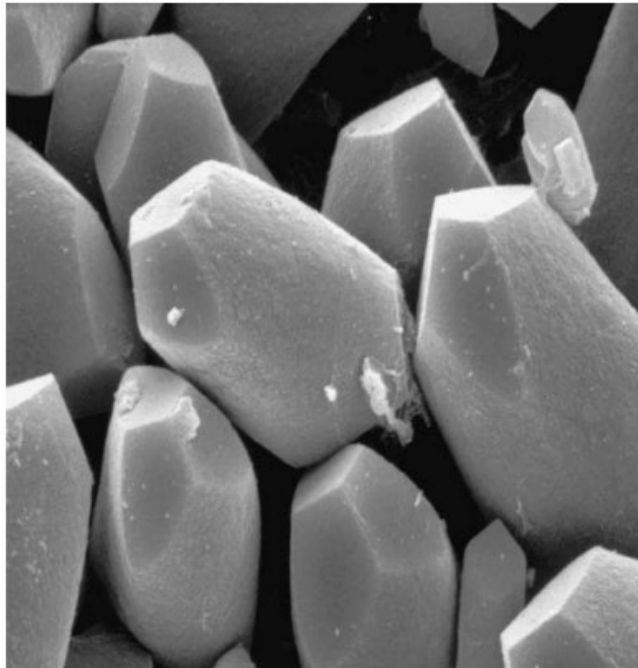
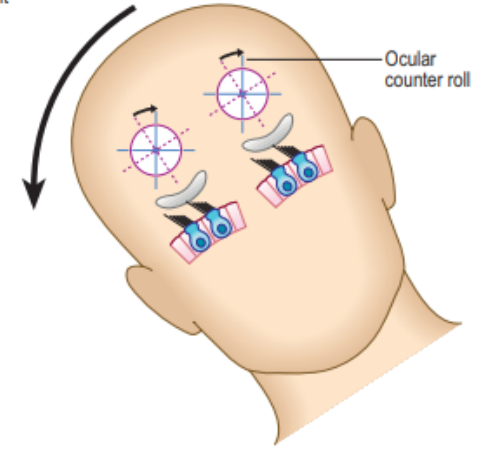
A At rest



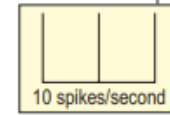
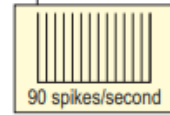
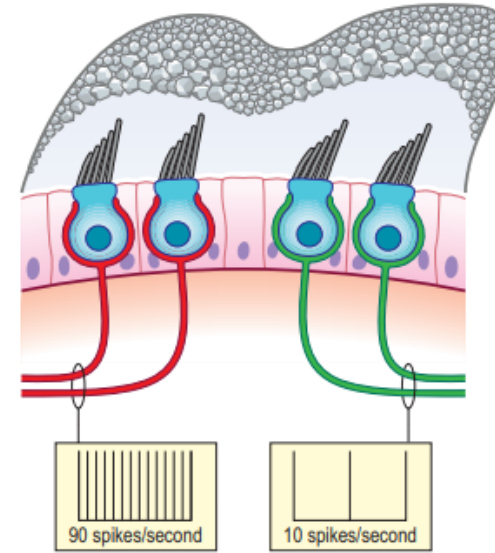
B Right tilt



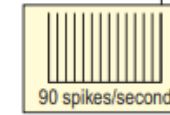
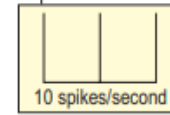
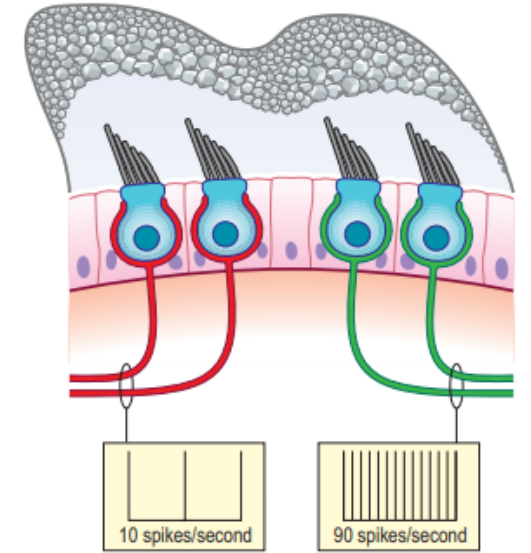
C Left tilt



Discharge rate of afferents on left and right sides



Discharge rate of afferents on left and right sides



Discharge rate of afferents on left and right sides

Canales semicirculares ossei

- 3 bony semicircular canals in the petrous temporal bone
- **occupy 3 planes in space**

Anterior (superior) semicircular canal

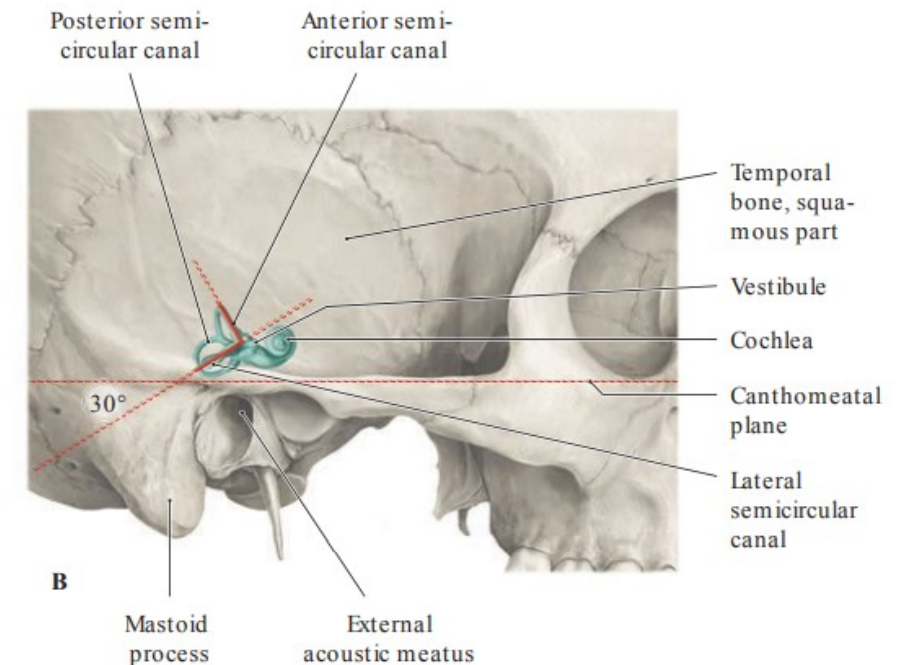
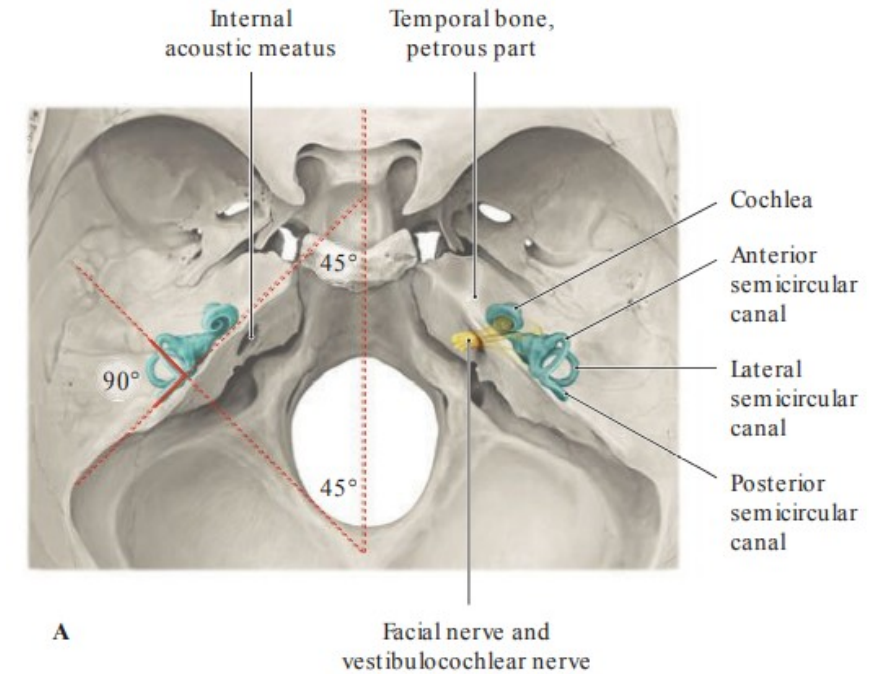
- transversely to the long axis of the petrous bone
- dorsal angulation by 30 degrees

Posterior semicircular canal

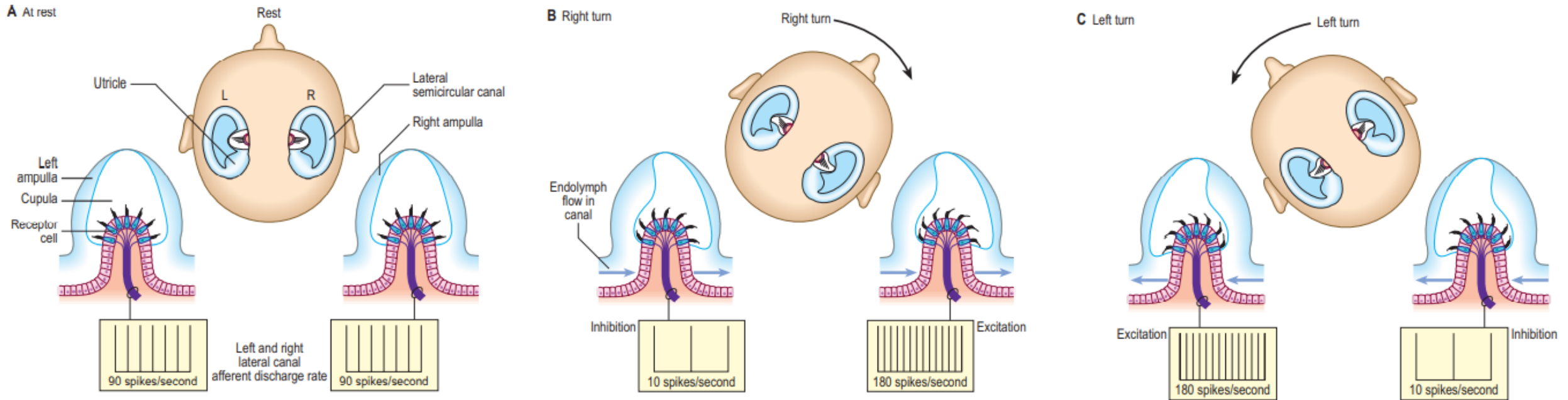
- parallel to the long axis of the petrous bone

Lateral (horizontal) semicircular canal

- transversely to the anterior semicircular canal
- dorsal angulation by 30 degrees



Perception of head rotation



SYMPTOMS OF VESTIBULOCOCHLEAR NERVE LESION

- vertigo
- nystagmus
- nauzea, vomitus

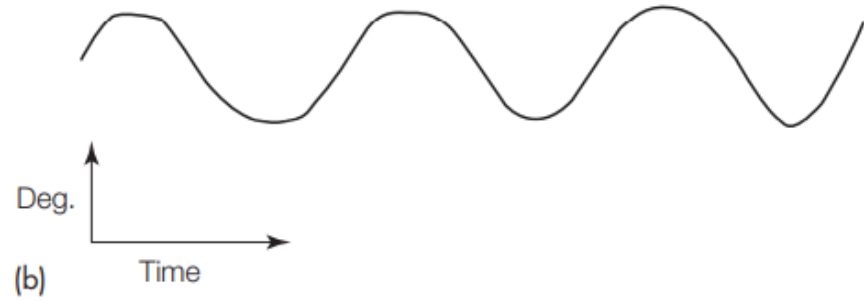
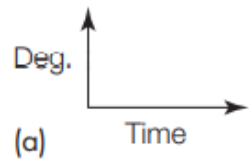
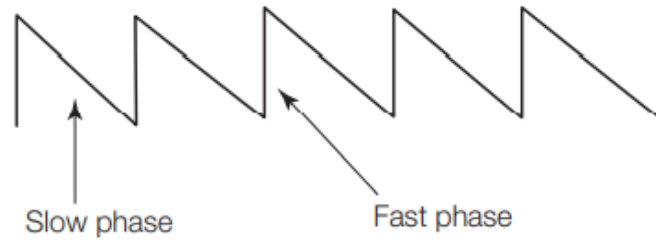


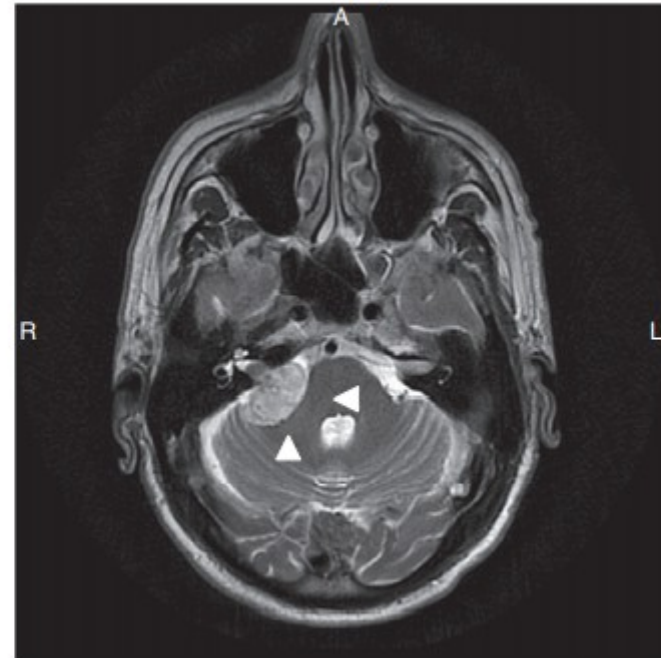
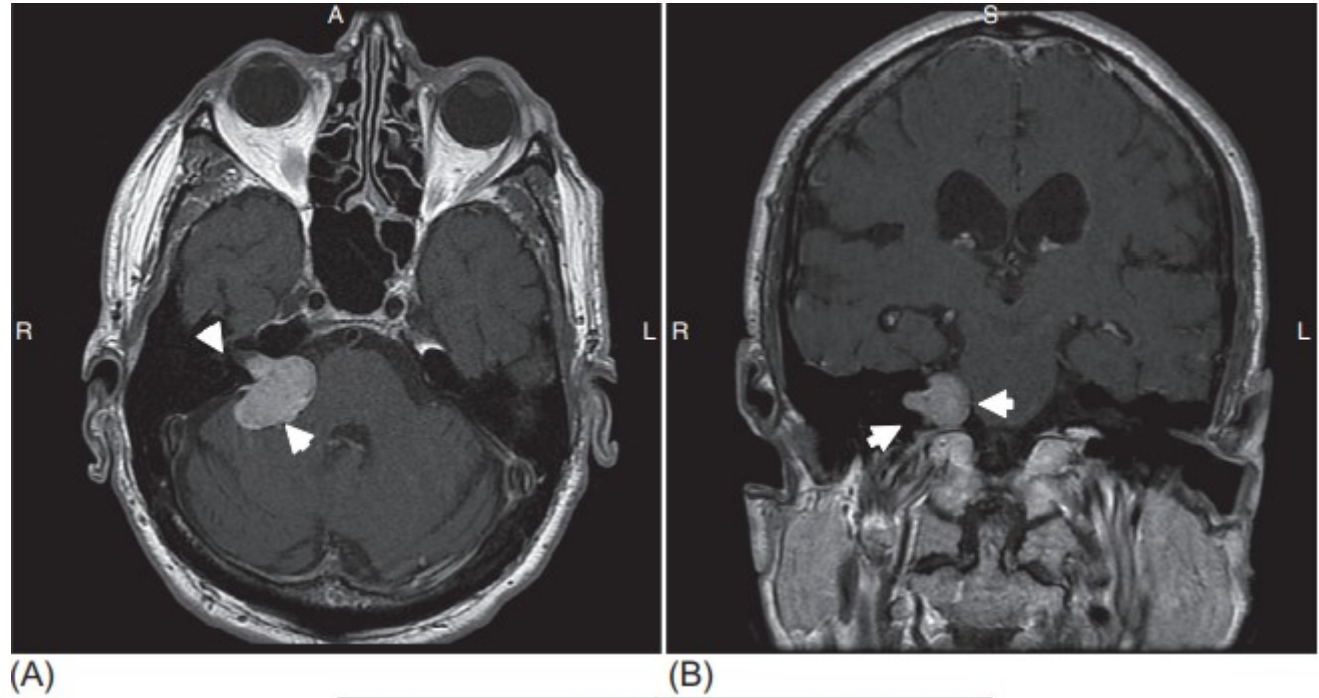
Figure 240b.1 (a) Nystagmus waveforms, jerk or saw-tooth; and (b) pendular nystagmus.



Dix-Hallpike test

Acoustic neurinoma

- benign tumor from the Schwann's cells
- symptoms: hypacusis, tinnitus, vertigo, peripheral palsy of n. VII, hypesthesia of the n. V



OVERVIEW OF THE VESTIBULOCOCHLEAR NERVE BRANCHES

NERVUS COCHLEARIS

Ganglion spirale cochleae

- **aferentní vlákna (95%)**
 - **bipolární neurony** (90%, dendrity inervují vnitřní vláskové buňky)
 - **pseudounipolární neurony** (10%, periferní raménka inervují zevní vláskové buňky)
- **eferentní vlákna (5%)**
 - ***tractus olivococlearis lateralis*** (synapse na dendritech bipolárních buněk)
 - ***tractus olivocochlearis medialis*** (synapse na zevních vláskových buňkách)

NERVUS VESTIBULARIS

Ganglion vestibulare

- ***pars superior***
 - ***n. utriculoampullaris***
 - *n. utricularis*
 - *n. ampullaris anterior*
 - *n. ampullaris lateralis*
- ***pars inferior***
 - ***n. ampullaris posterior***
 - ***n. saccularis***



**Glossopharyn
geal nerve (n.
IX)**

1. Nucleus ambiguus (rostral part)

- **branchiomotor nucleus** for innervation of the muscles derived from the 3rd – 4th branchial arch (muscles of the pharynx, soft palate except of *m. tensor veli palatini*)

2. Dorsal nucleus of glossopharyngeal nerve (*salivatorius inferior*)

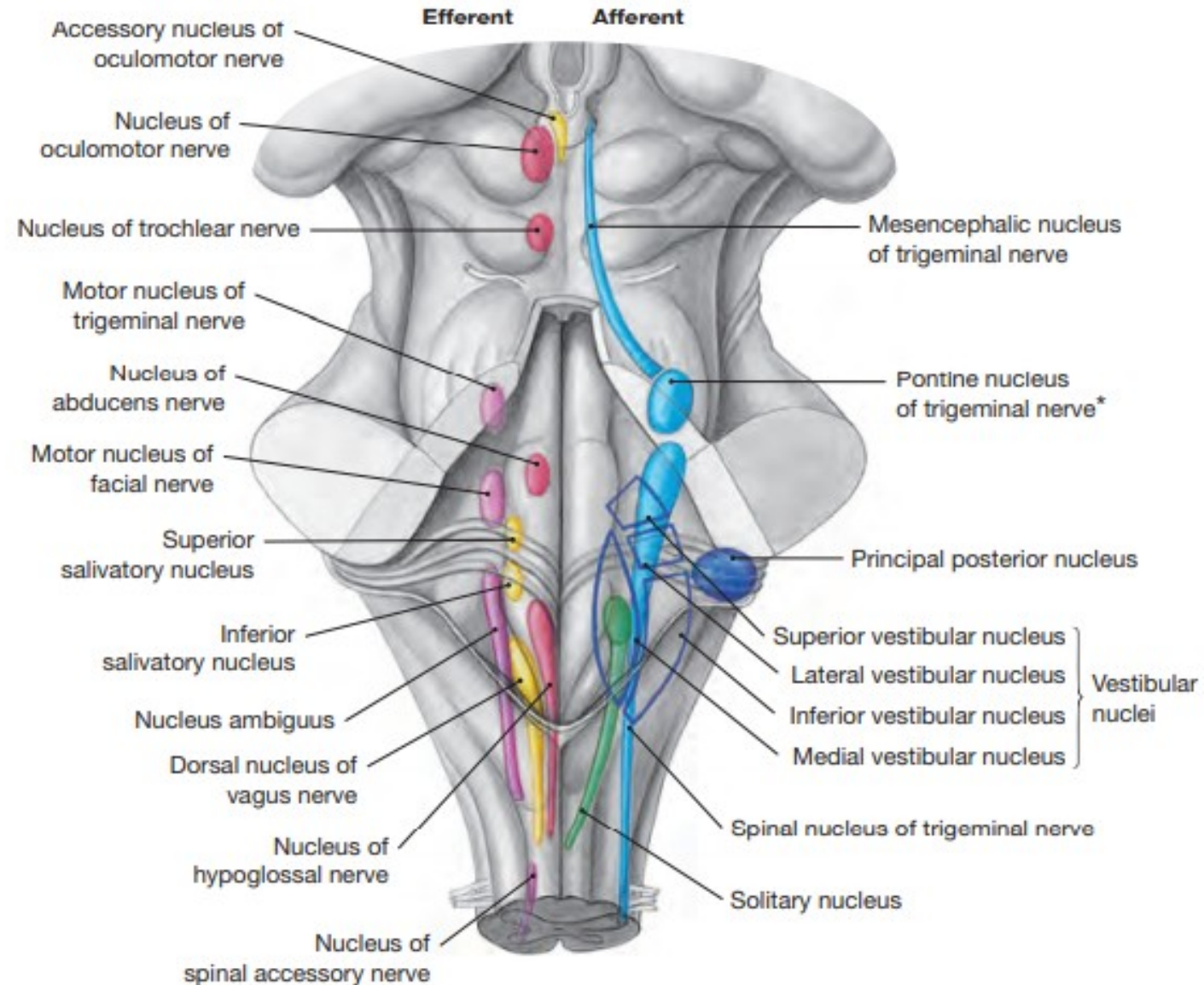
- **visceromotor nucleus** for parasympathetic innervation of the parotid gland

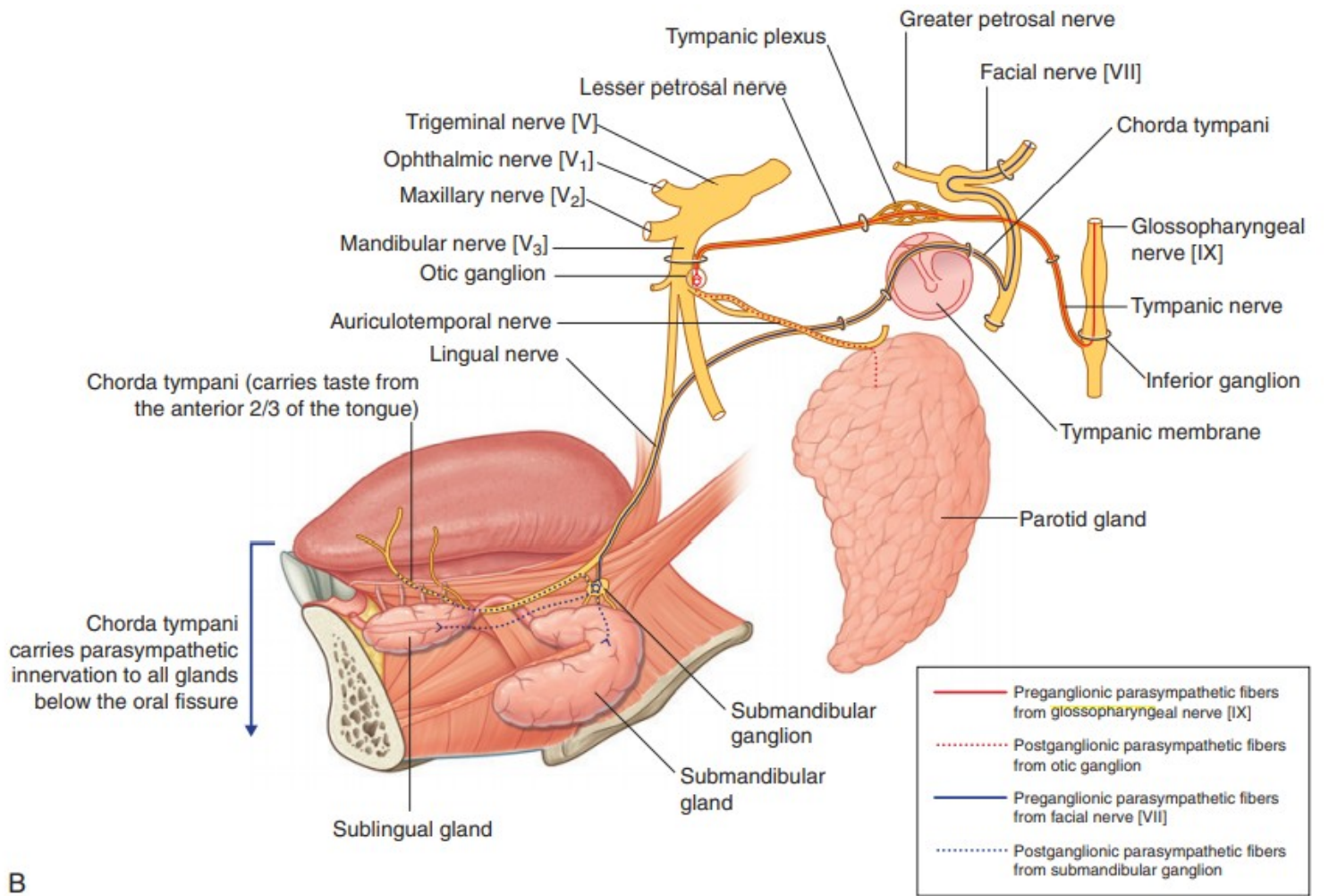
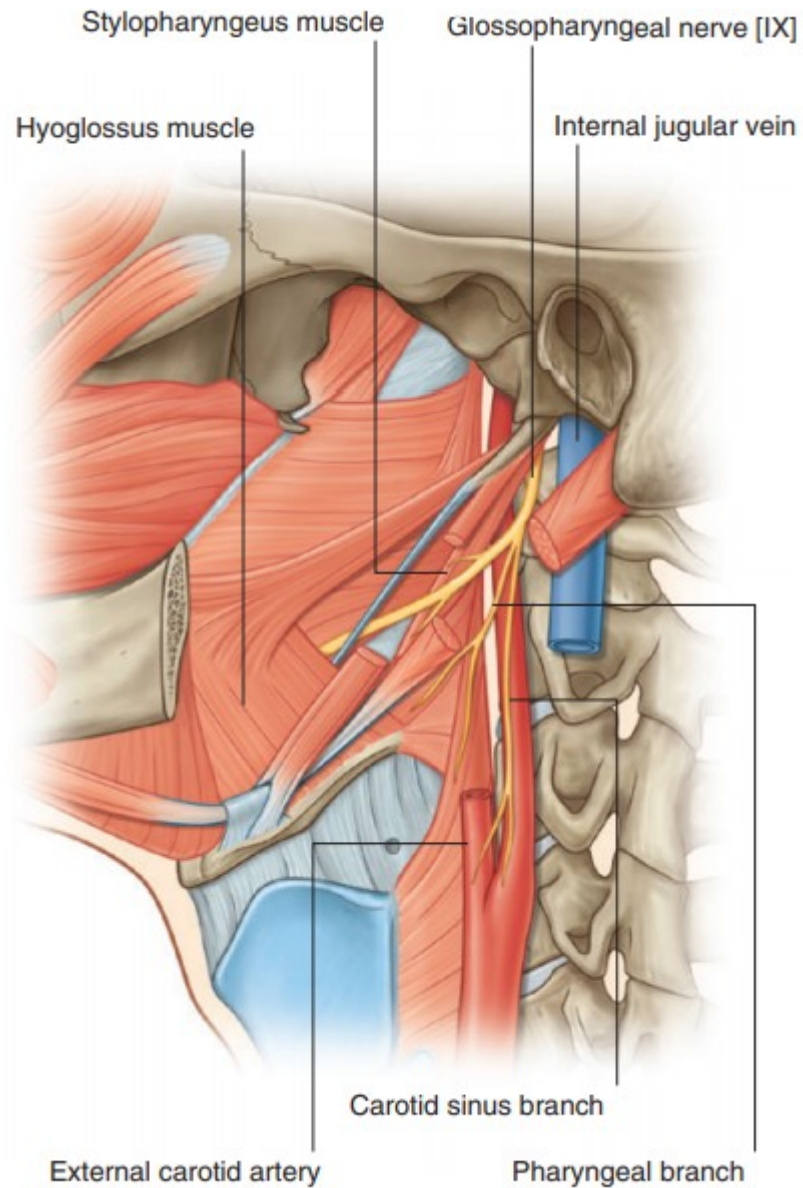
3. Solitary nucleus (gustatory)

- **viscerosensory nucleus** (rostral part) for taste perception from dorsal 1/3 of the tongue

4. Spinal nucleus of trigeminal nerve

- **somatosensory nucleus** for perception from the pharynx, palatine tonsil, dorsal 1/3 of the tongue, tympanic cavity and adjacent part of the Eustachian tube





B

OVERVIEW OF THE GLOSSOPHARYNGEAL NERVE BRANCHES

1. *Nervus tympanicus*

▪ *plexus tympanicus (ganglion tympanicum)*

- *r. tubarius*
- *n. petrosus minor* → *ganglion oticum* (innervation of *glandula parotis* through *n. auriculotemporalis* → *rr. parotidei*)
 - *r. communicans cum ramo meningeo*
 - *r. communicans cum nervo auriculotemporalis*
 - *r. communicans cum chorda tympani*

2. *Ramus communicans cum ramo auriculari nervi vagi*

3. *Ramus communicans cum trunco tympanico / nervus jugularis*

4. *Ramus stylopharyngeus (ramus musculi stylopharyngei)*

5. *Rami pharyngei*

6. *Ramus sinus carotici*

7. *Rami tonsillares*

8. *Rami linguales*

Vagus nerve (n. X)

1. Nucleus ambiguus (middle part)

- **branchiomotor nucleus** for innervation of the muscles derived from the 3rd – 4th branchial arch (muscles of the pharynx, esophagus and *m. cricothyroideus*)

2. Dorsal nucleus of vagus nerve

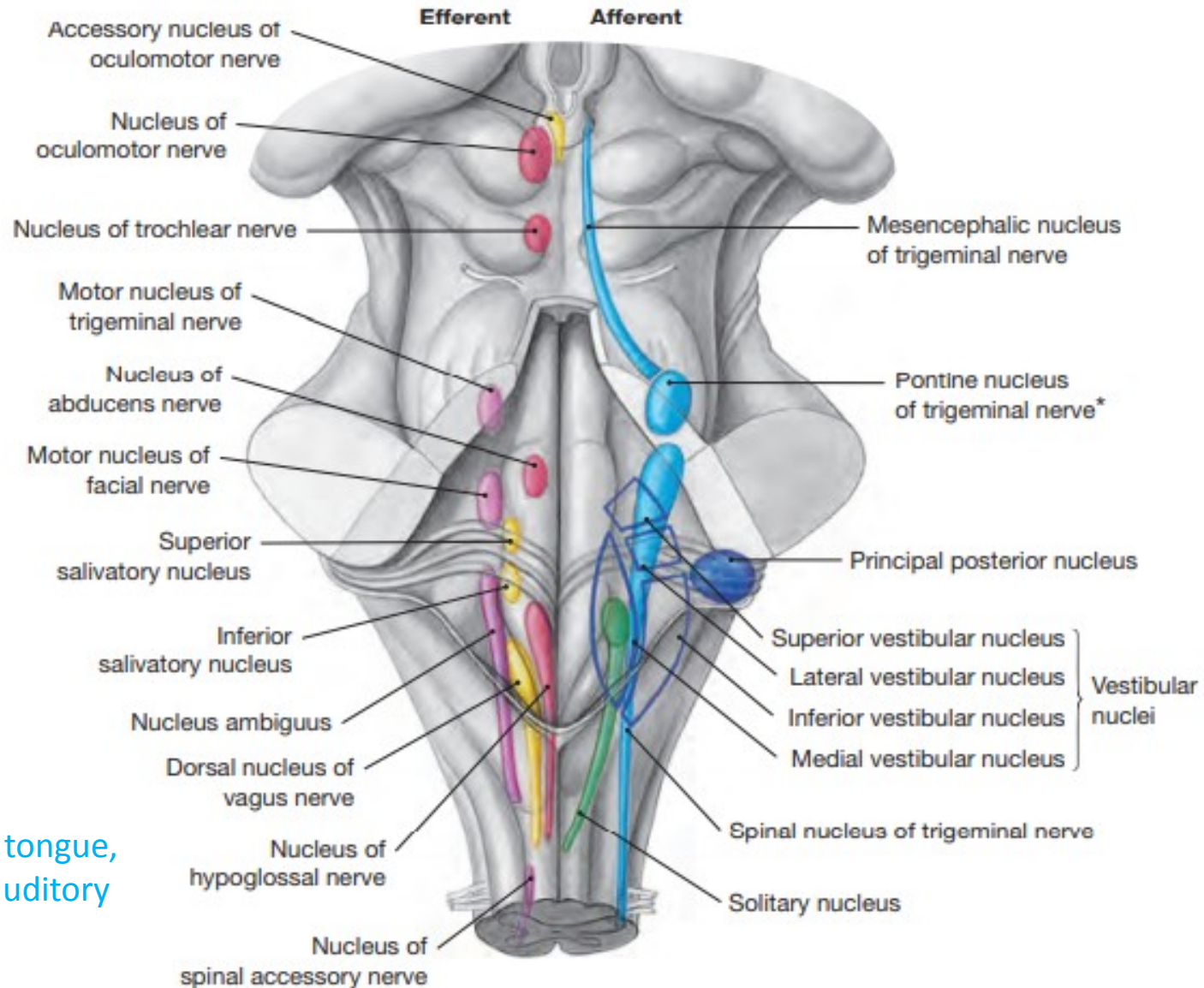
- **visceromotor nucleus** for parasympathetic innervation of the digestive tract to *flexura coli sinistra*, thyroid gland, lungs, heart, kidneys and gonads

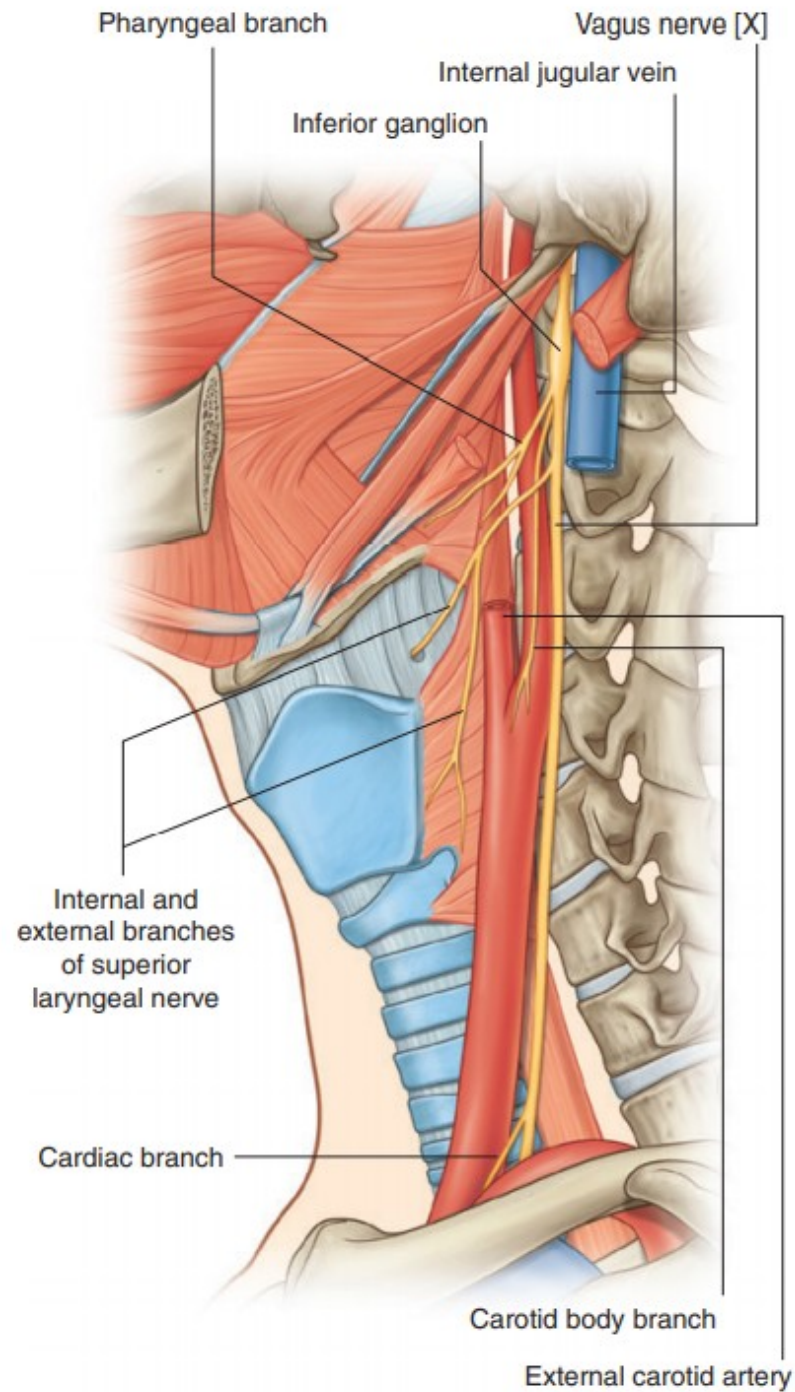
3. Solitary nucleus (gustatory)

- **viscerosensory nucleus** (rostral part) for taste perception from the epiglottis and epiglottic valleculae
- also for viscerosensory afferents from mentioned innervation zones

4. Spinal nucleus of trigeminal nerve

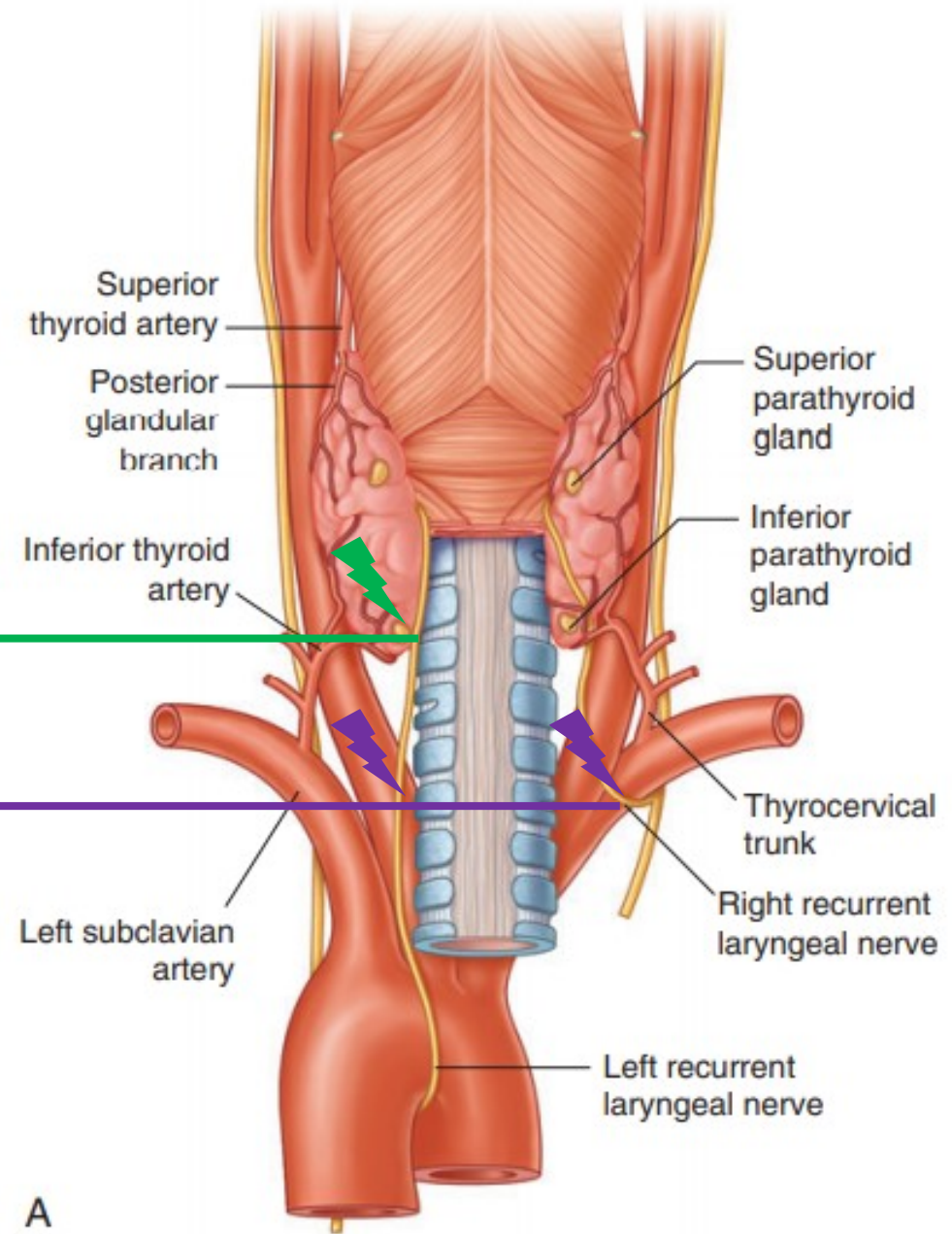
- **somatosensory nucleus** for perception from the root of the tongue, small part of the posterior and inferior wall of the external auditory canal and upper part of the auricle

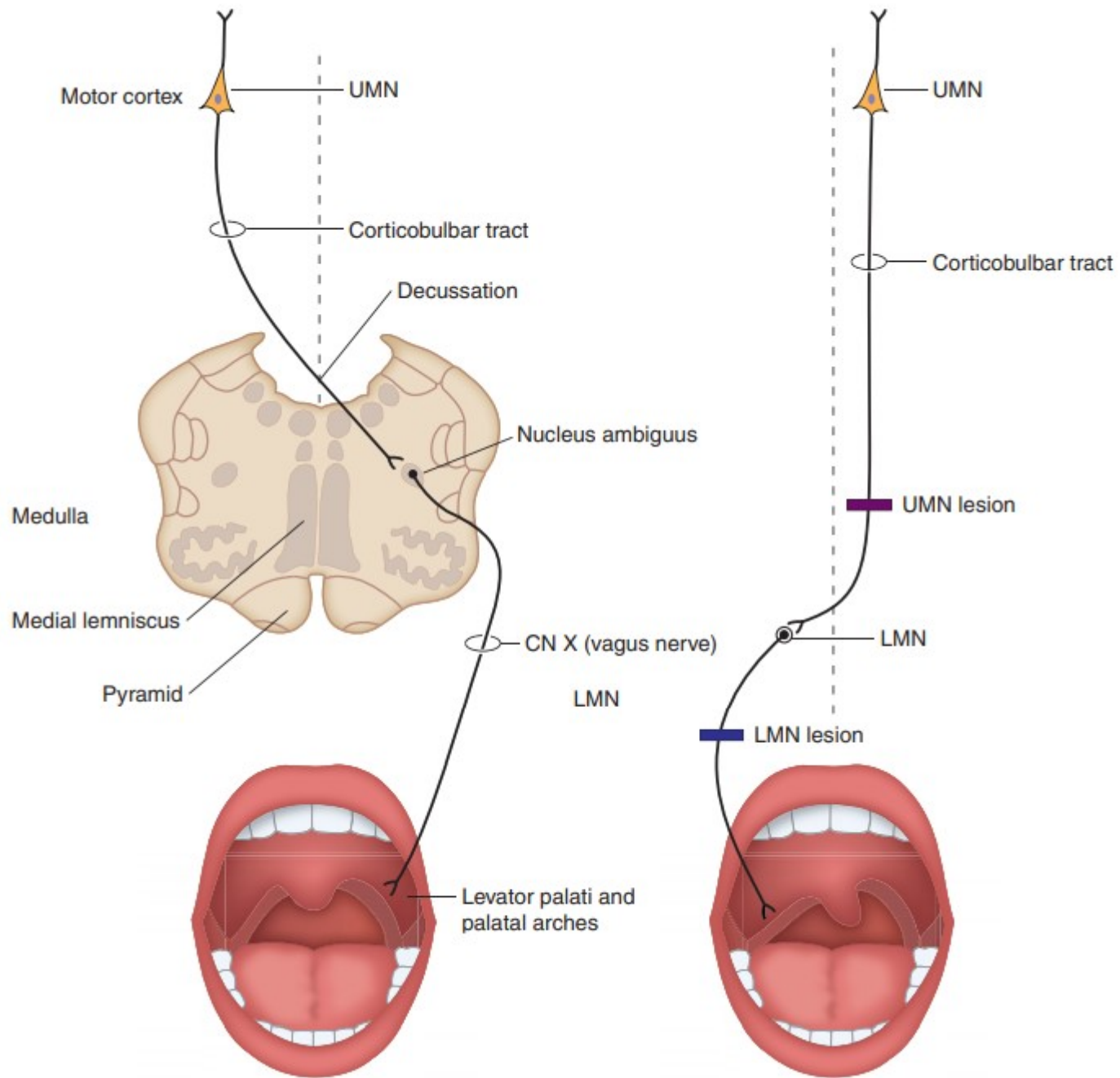




DYSPHONIA

APHONIA





„PŘÍZNAK OPONY“

Vagal stimulation

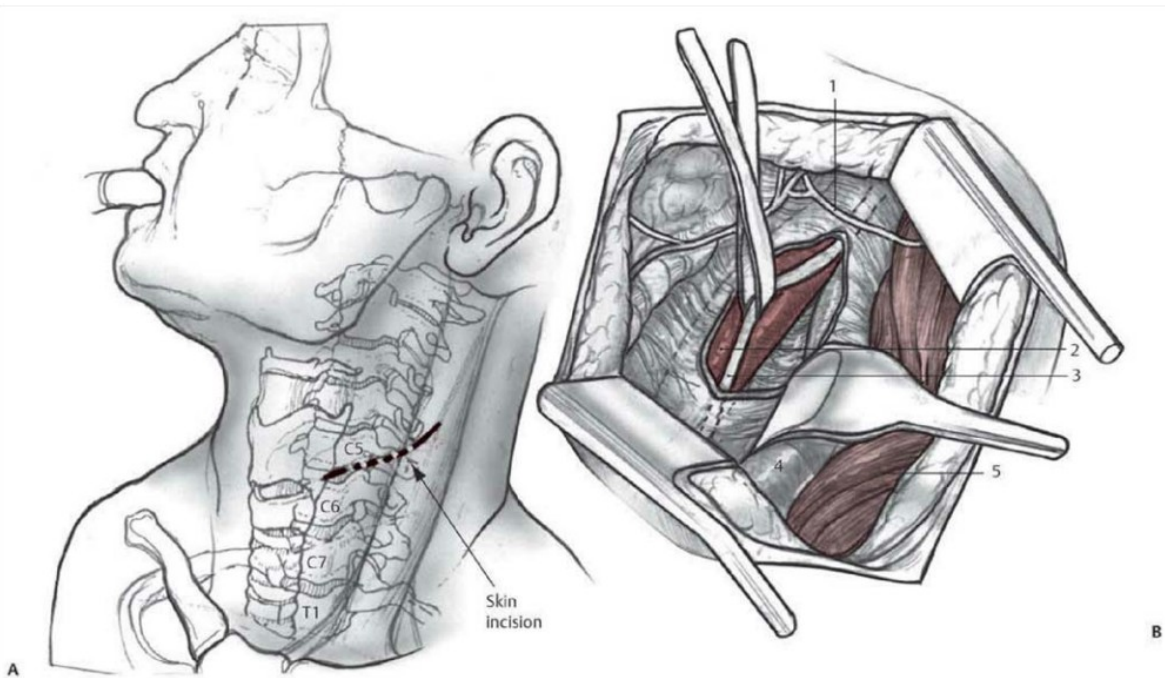


Fig. 127.1 (A) The head is placed in gentle extension and rotated approximately 15 degrees to the right. A left transverse incision is planned in a skin fold at about C5–C6, below the carotid bifurcation. (B) The jugular vein and sternocleidomastoid muscle are retracted laterally revealing the carotid artery and the vagus nerve (elevated by a vessel loop). It is important to differentiate the vagus nerve, which is deep between the carotid artery and jugular vein, from branches of the ansa cervicalis that typically cross the incision superficial to the carotid sheath. 1. Ansa cervicalis branch; 2. carotid artery; 3. vagus nerve (cranial nerve X); 4. jugular vein; 5. sternocleidomastoid muscle.

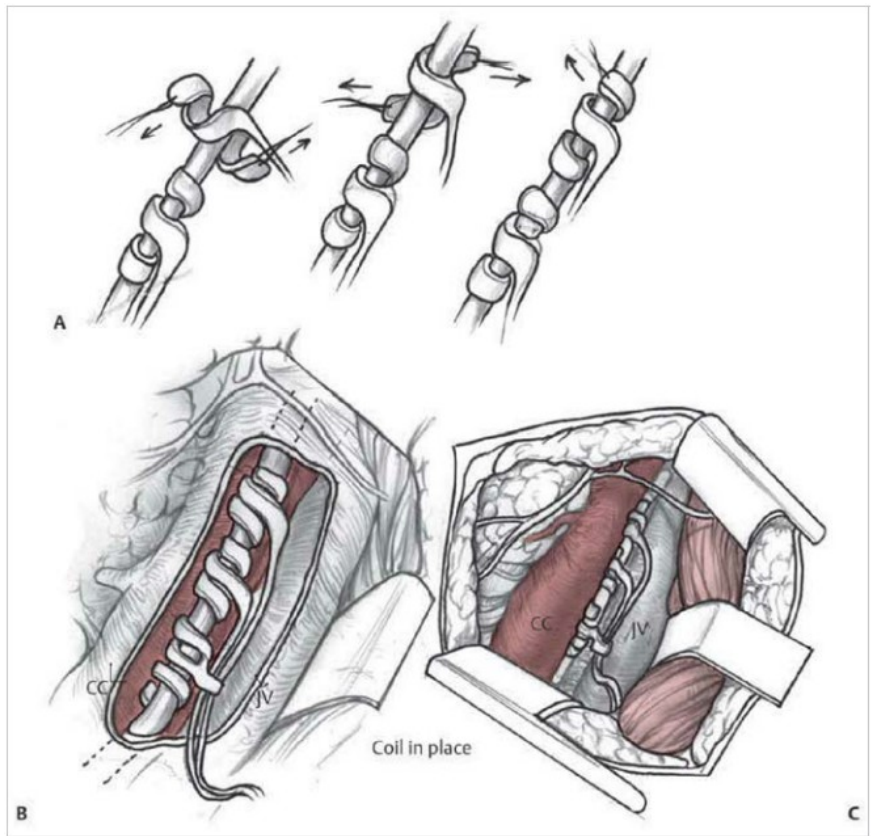


Fig. 127.2 Steps for implantation of the vagal nerve electrode. The electrode is oriented perpendicular to the nerve and gently stretched by grasping the embedded sutures. The nerve is slid between the loops of the coil. (A) Tensioning both sutures, the electrode is wound around the vagus nerve. (B) The electrode naturally coils around the nerve. (C) Proper electrode configuration and final position in relation to surrounding structures. JV, jugular vein; CC, common carotid artery.

OVERVIEW OF THE VAGUS NERVE BRANCHES

1. *Ramus meningeus*

2. *Ramus auricularis* (Arnoldův nerv)

3. *Ramus communicans cum nervo glossopharyngei*

4. *Ramus pharyngeus*

5. *Ramus glomi carotici*

6. *Nervus laryngeus superior*

- *r. externus*
- *r. internus*
- *r. communicans cum nervo laryngeo recurrenti* (Galen's anastomosis)

7. *Rami cardiaci cervicales superiores*

8. *Rami cardiaci cervicales inferiores*

9. *Nervus laryngeus recurrens*

- *rr. tracheales*
- *rr. oesophagei*
- *rr. pharyngei*
- *n. laryngeus inferior*

10. *Rami cardiaci thoracici*

11. *Rami bronchiales / pulmonales*

12. *Plexus oesophageus*

13. *Truncus vagalis anterior*

- *plexus gastricus anterior (rr. gastrici anteriores)*
- *n. curvaturae minoris anterior*
- *r. pyloricus*
- *rr. hepatici*
- *rr. coeliaci*

14. *Truncus vagalis posterior*

- *plexus gastricus posterior (rr. gastrici posteriores)*
- *n. curvaturae minoris posterior*
- *rr. coeliaci*
 - *rr. hepatici, rr. pancreatici, rr. lienales, rr. renales, rr. suprarenales, rr. intestinales, rr. ovarici, rr. testiculares*

•••••

Accessory nerve (n. XI)

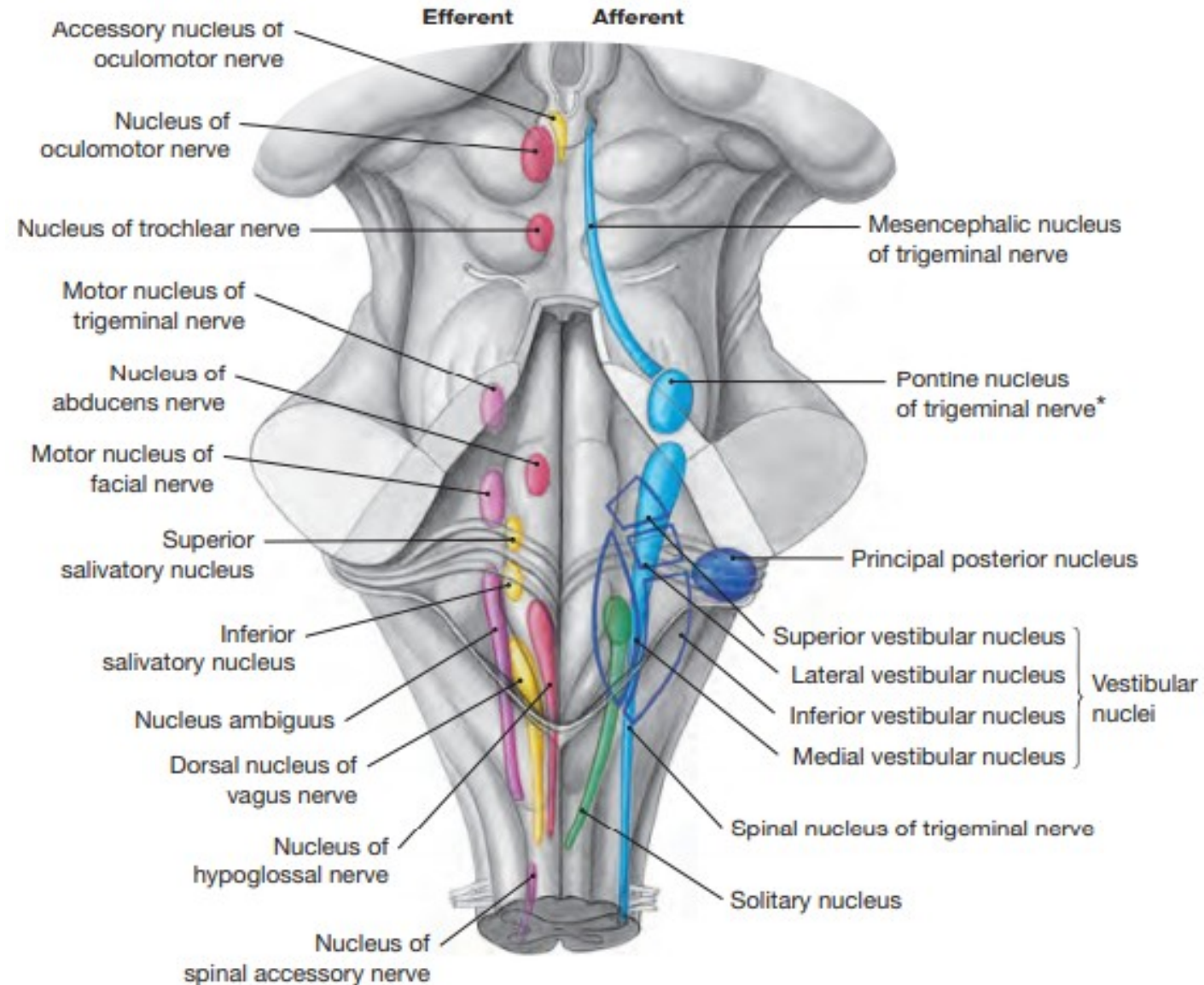


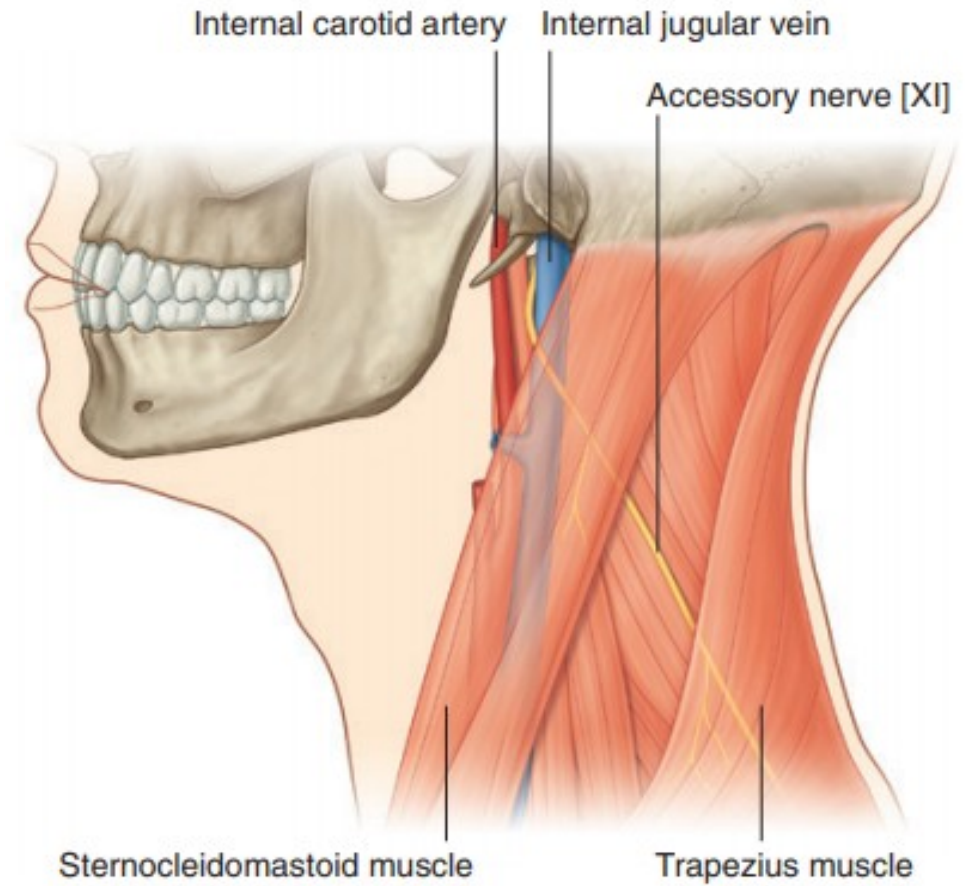
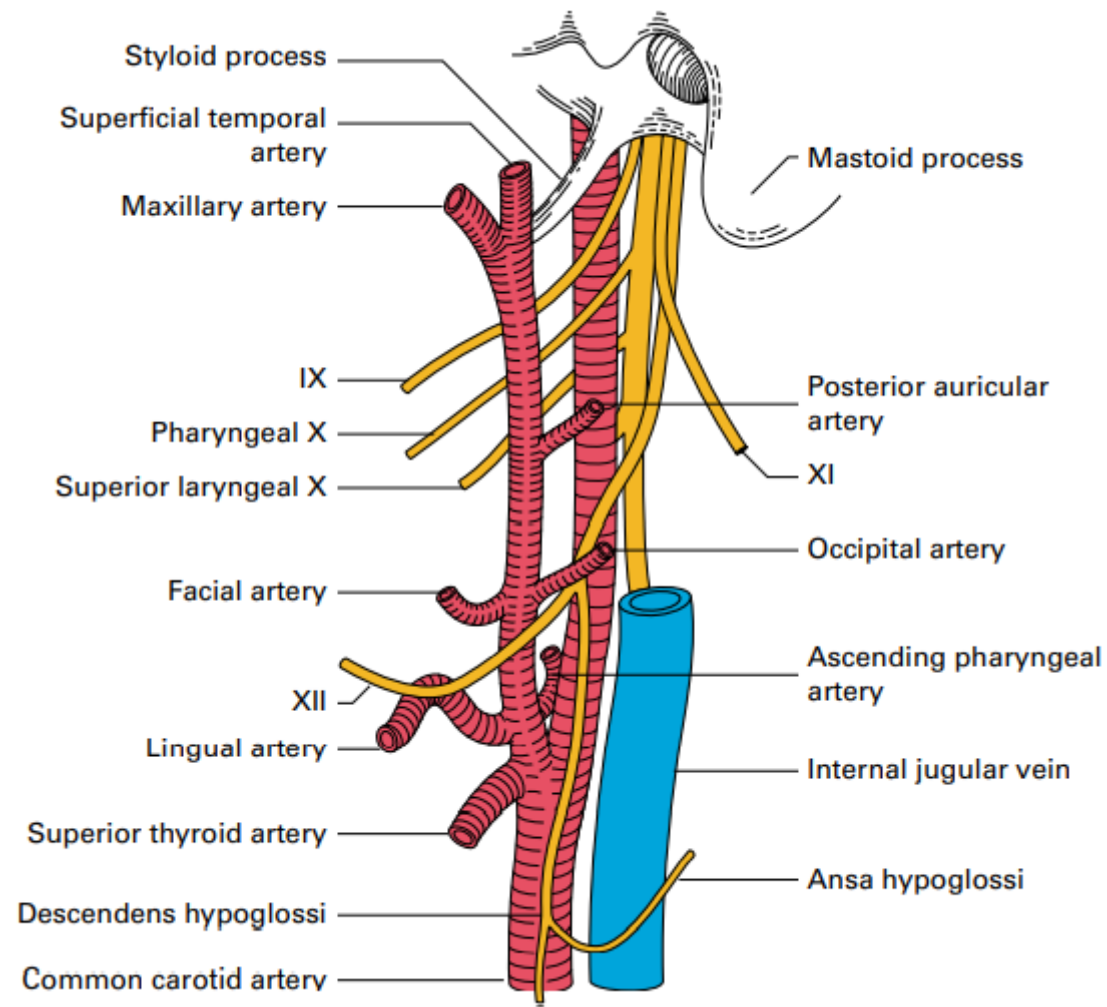
1. Nucleus ambiguus (caudal part)

- **branchiomotor nucleus** for innervation of the muscles derived from the 3rd – 4th branchial arch (muscles of the larynx except of *m. cricothyroideus*)
- fibers create **cranial root of the n. XI**

2. The spinal accessory nucleus (C1-C4/C6)

- **somatomotor nucleus** for innervation of the sternocleidomastoid and trapezius muscles
- fibers create **spinal root of the n. XI**





OVERVIEW OF THE ACCESSORY NERVE BRANCHES

1. *Radix cranialis (pars vagalis)*

2. *Radix spinalis (pars spinalis)*

3. *Truncus nervi accessorii*

- *ramus internus*

- motor fibers for *n. vagus (rr. pharyngei and n. laryngeus recurrens)*

- *ramus externus*

- *rr. musculares* for *m. sternocleidomastoideus* a *m. trapezius*



Hypoglossal nerve (n. XII)



1. The hypoglossal nucleus

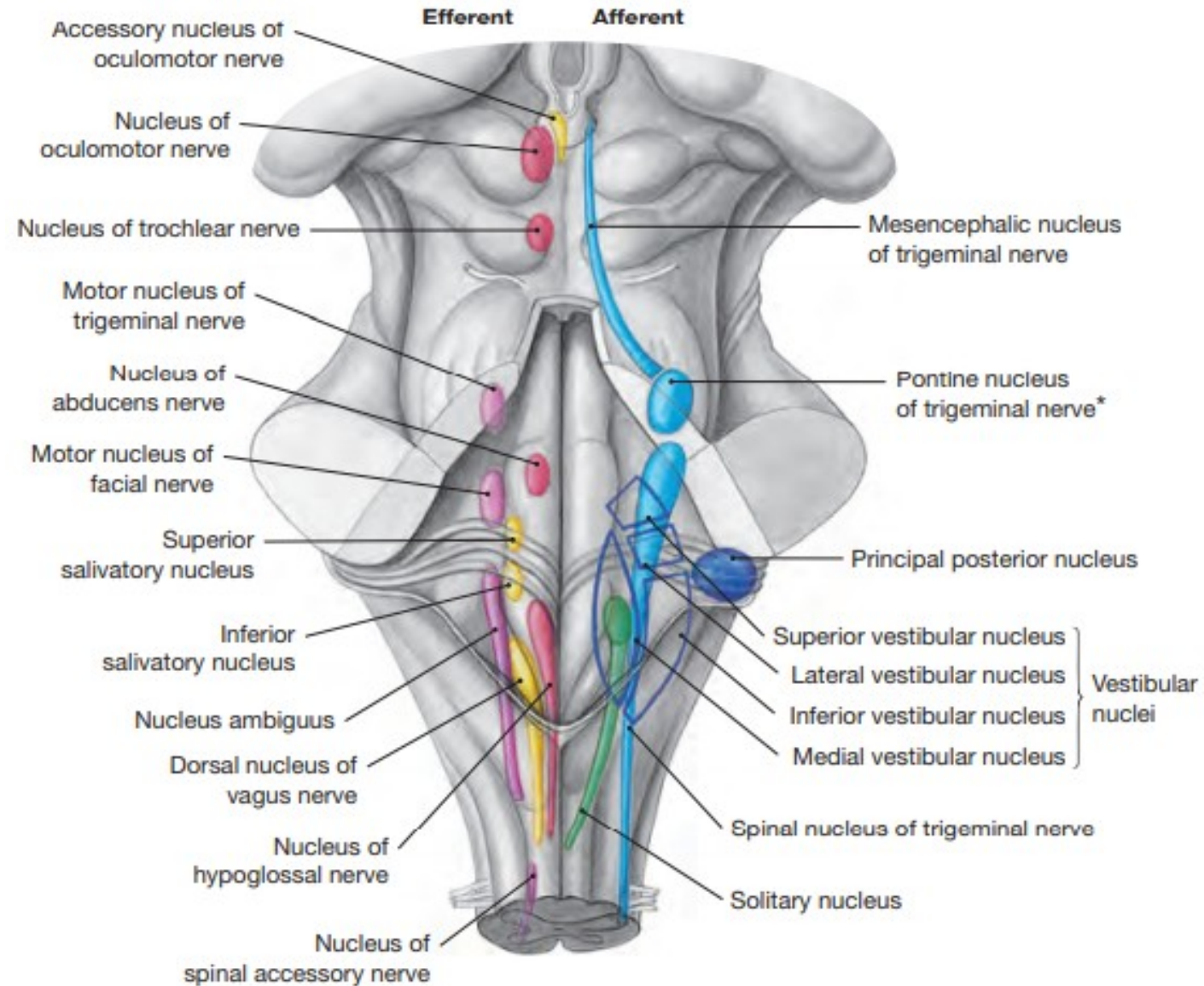
- somatomotor nucleus for intrinsic and extrinsic muscles of the tongue (except of *m. palatoglossus*)

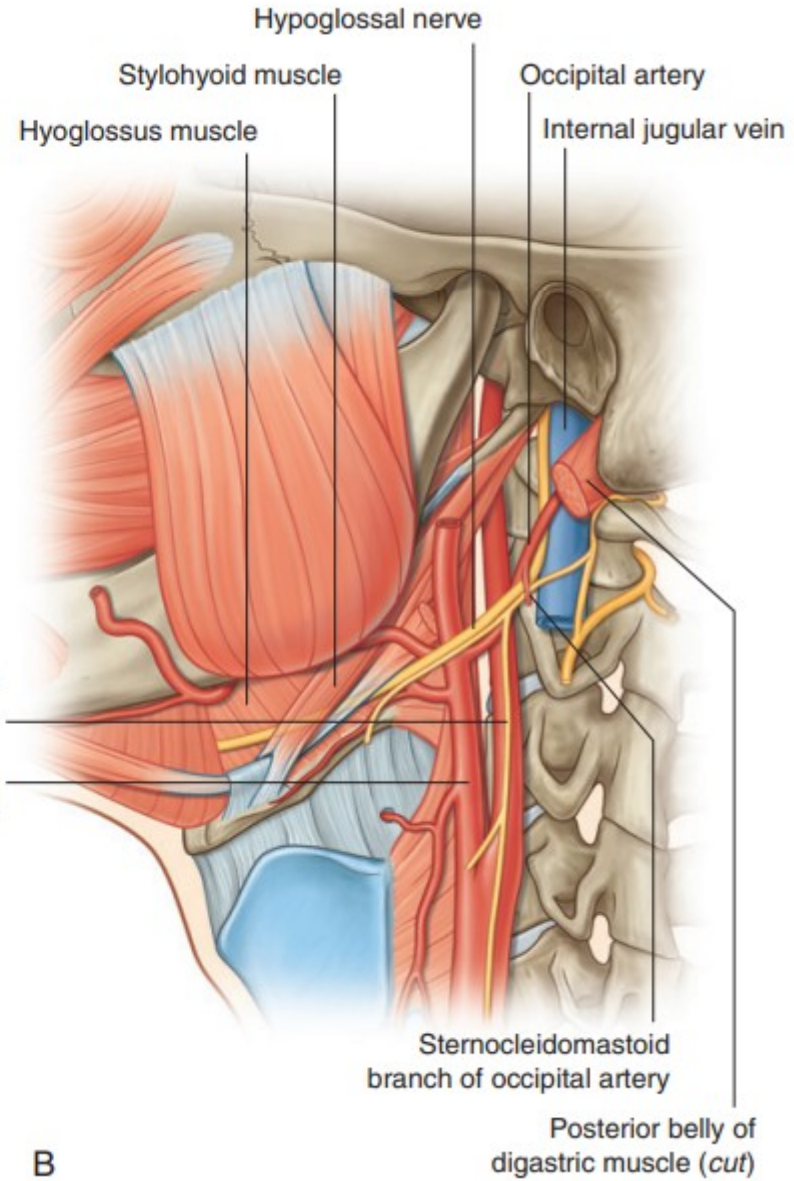
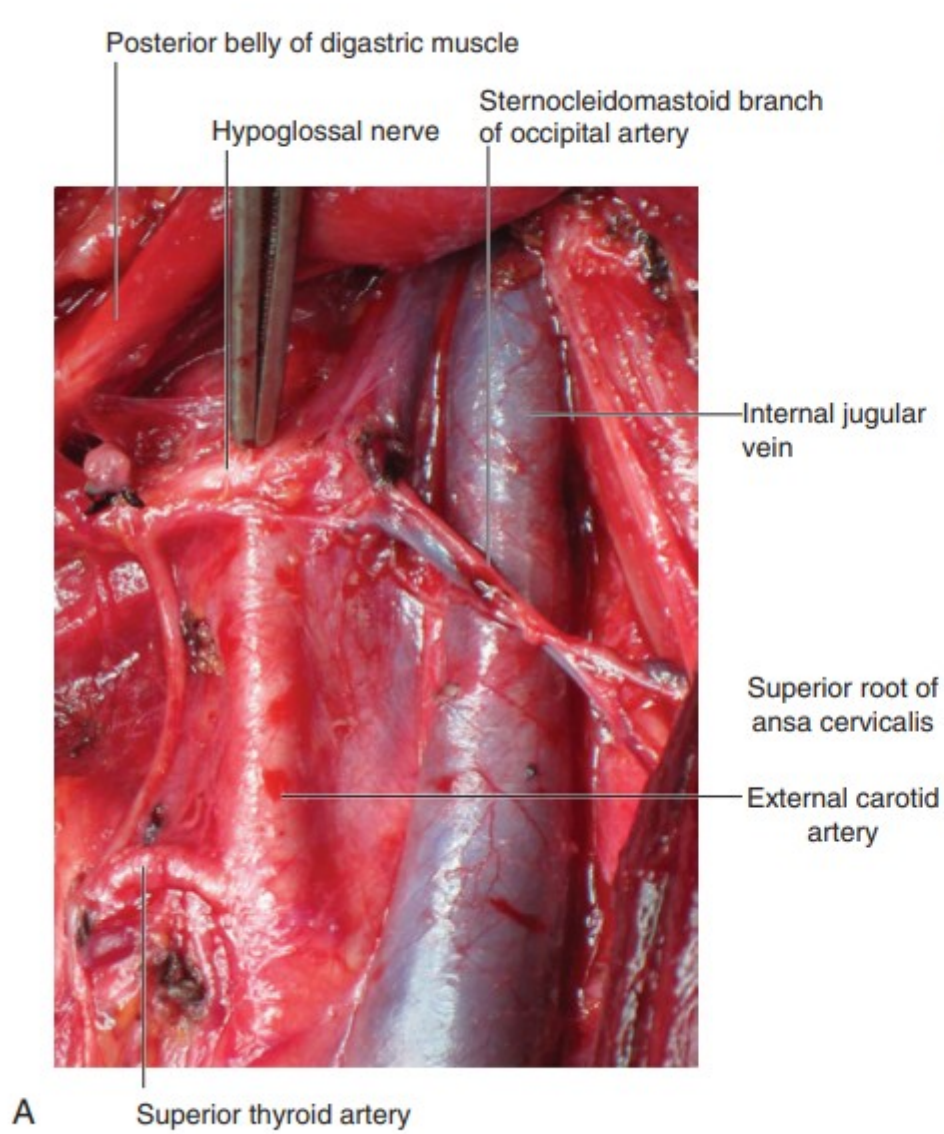
2. Dorsal nucleus of vagus nerve

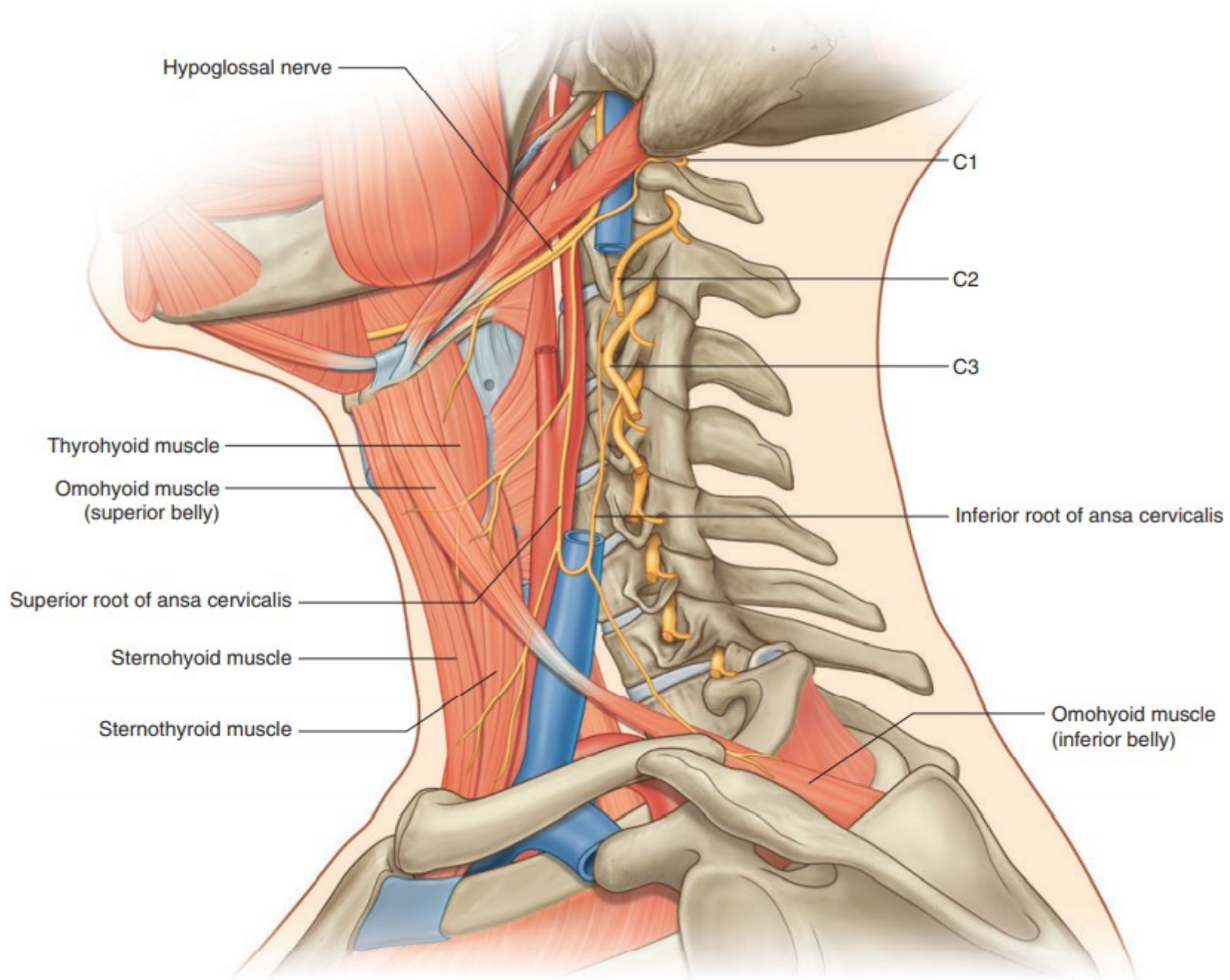
- visceromotor nucleus for parasympathetic innervation of the lingual vessels

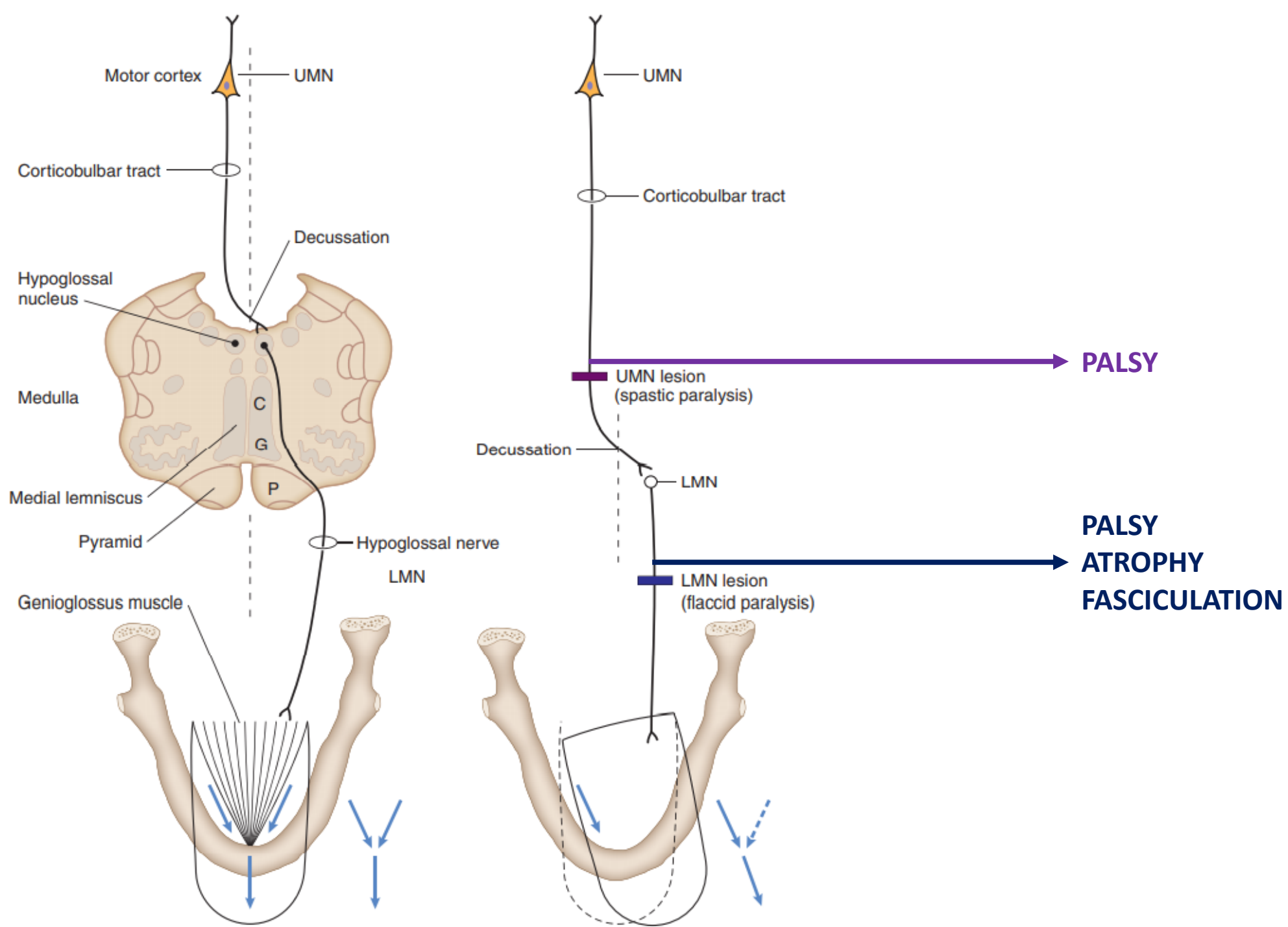
3. Mesencephalic nucleus of trigeminal nerve

- ganglion with the pseudounipolar neurons, receives proprioception from the muscles of the tongue









OVERVIEW OF THE HYPOGLOSSAL NERVE BRANCHES

1. Spojka z *ansa cervicalis prima* (ventrální větve C1 a C2)

2. Spojky z *truncus sympathicus* a *nervus vagus*

3. **Radix superior ansae cervicalis (ramus descendens nervi hypoglossi)**

- motorické vlákna z *ansa cervicalis prima*
- spojením s *radix inferior ansae cervicalis* (ventrální větve C2 a C3) vzniká ***ansa cervicalis sekunda***
- inervace některých infrahyoidních svalů

4. **Rami musculares**

- inervace *m. geniohyoideus* a *m. thyrohyoideus* (vlákna původem z *ansa cervicalis prima*)

5. **Rami communicantes cum nervo hypoglosso**

- somatosenzorické a propiocepční vlákna z n. lingualis

6. **Rami linguales**

- inervace intraglosálních svalů a *m. genioglossus*, *m. hyoglossus* a *m. styloglossus*

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