Univerzita Karlova v Praze – 1. lékařská fakulta

Cranial nerves – nn. craniales - parasympathetic fibres

Institute of Anatomy

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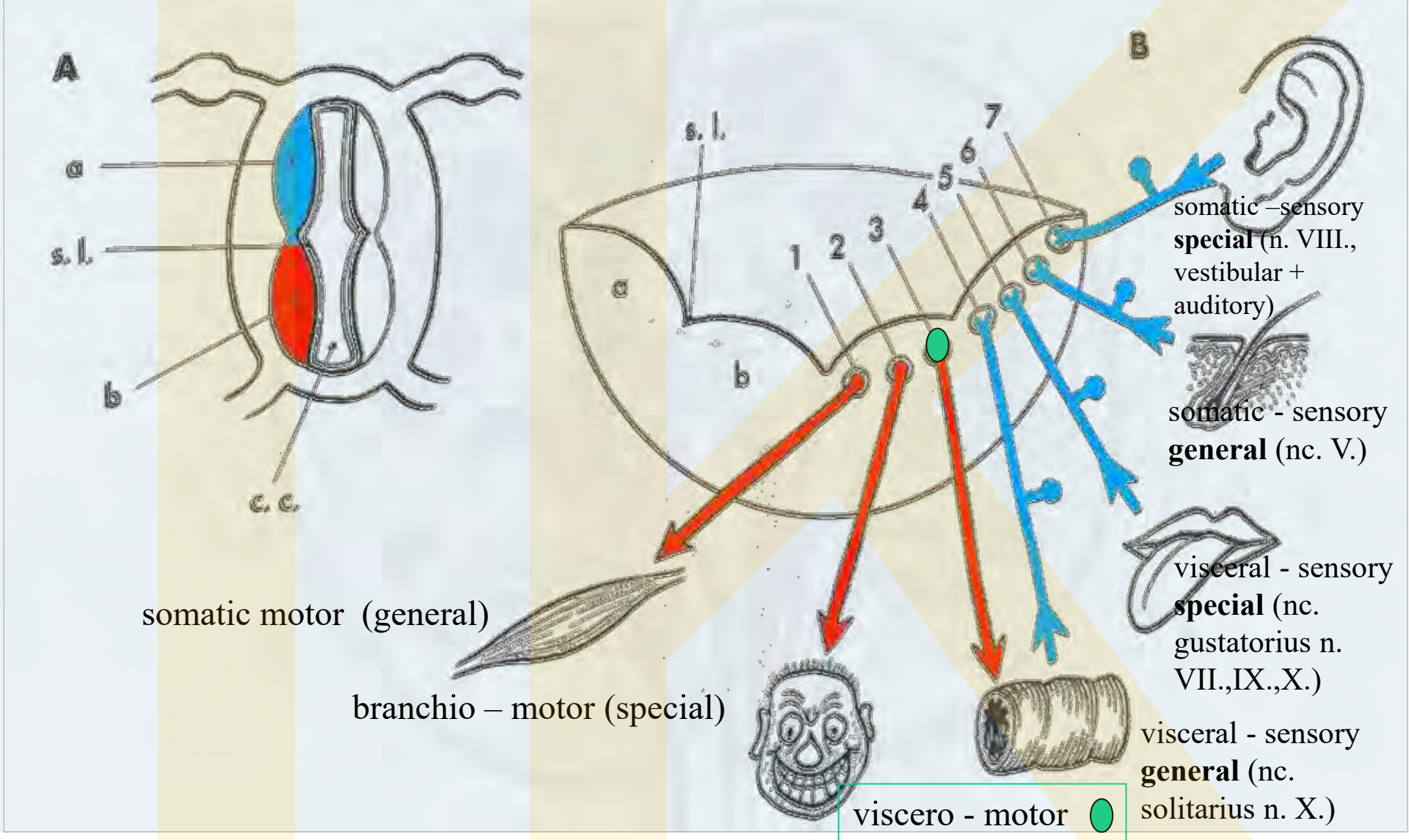
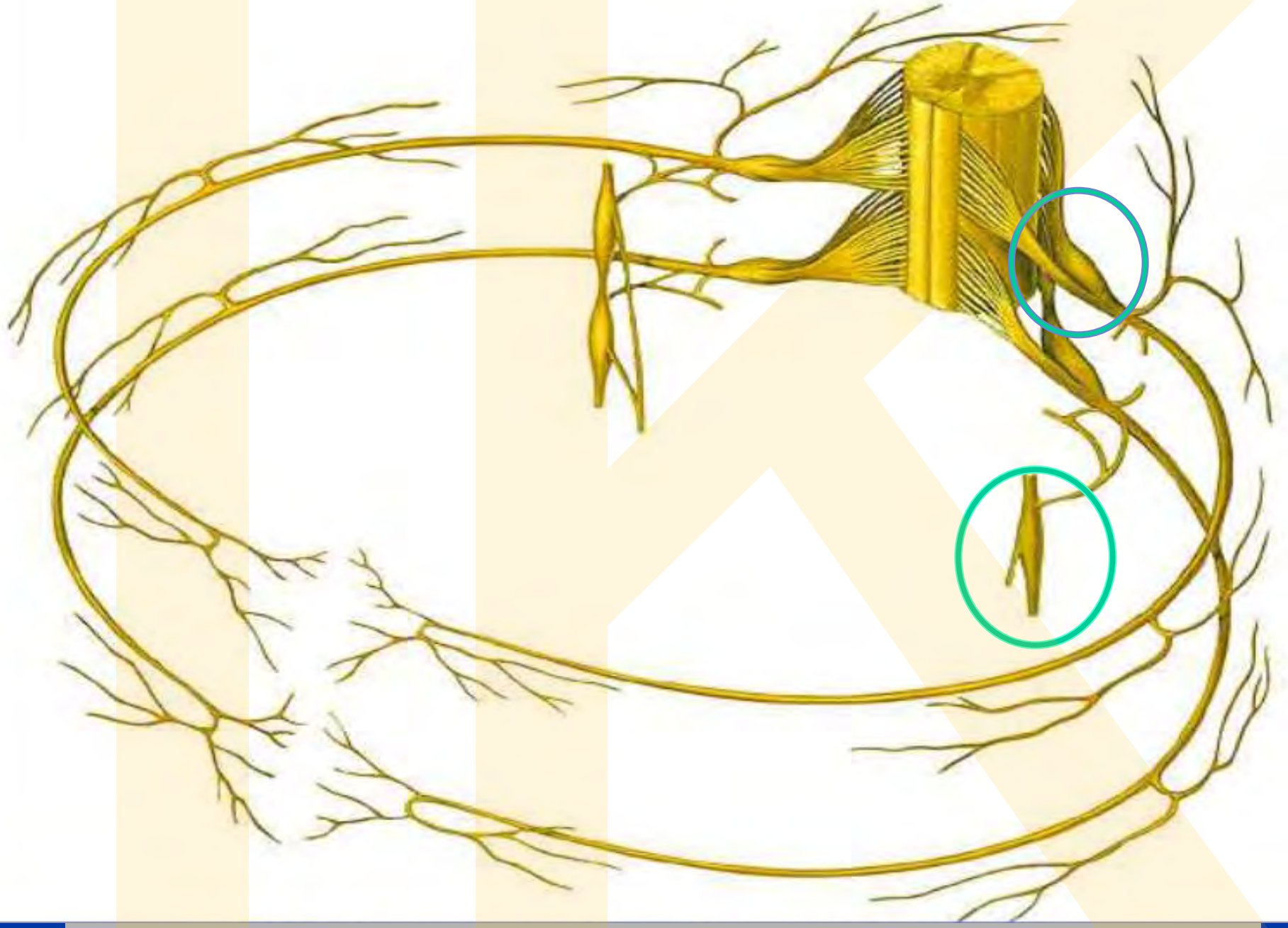


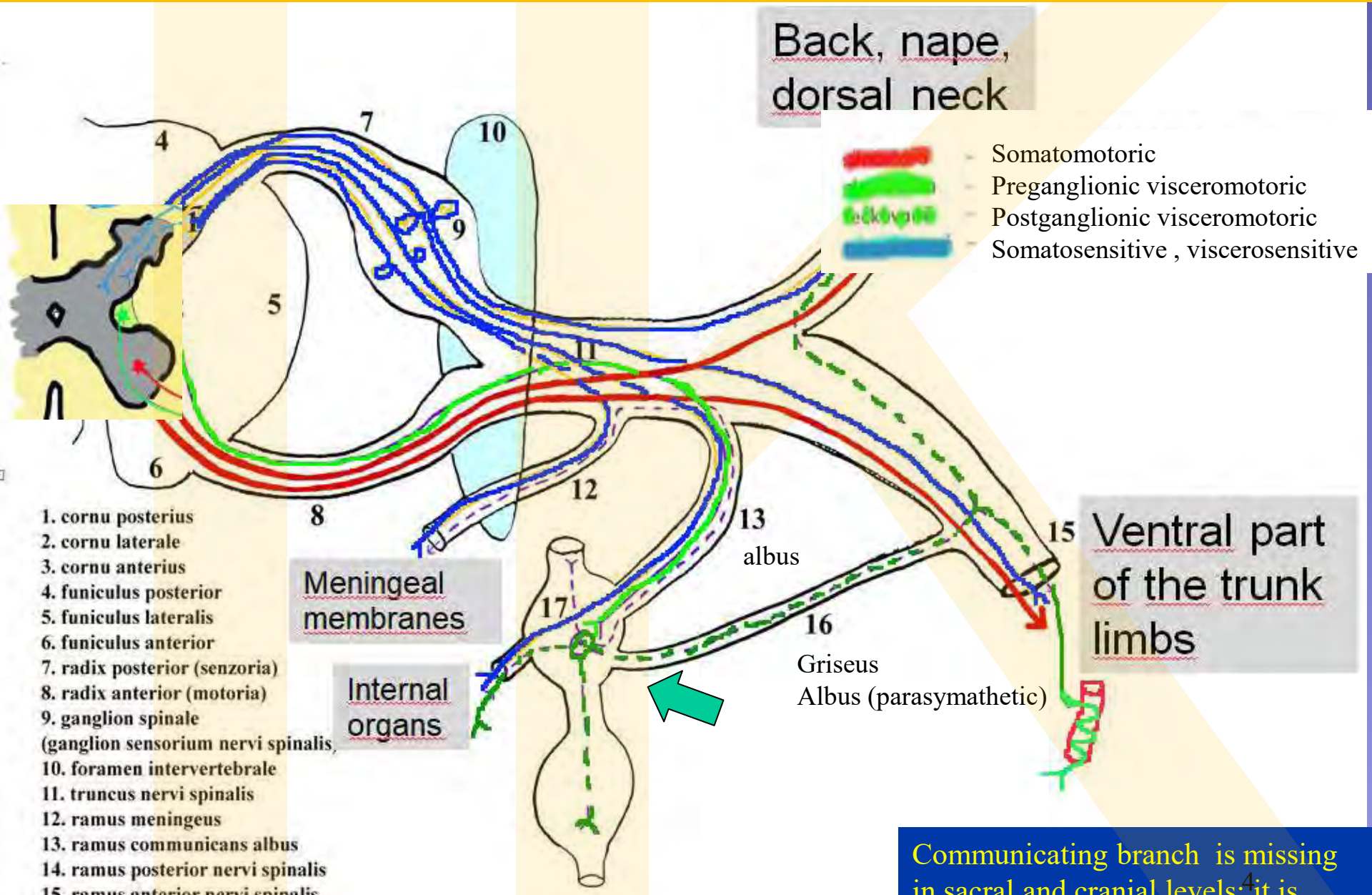
B: Uspořádání motorických a senzitivních jader hlavových nervů pod spodinou IV. mozkové komory. 1 – motorická jádra inervující svaly po materiálu žaberních oblouků (V, V III., VII., IX. a X. hlavového nervu, us) n. VII, IX a X, 6 – somatosenzitivní jádro (n. V), 7 – vestibulární a sluchová jádra

How the nervous fibres are arranged ?



Thea are arranged in spinal and cranial nerves

Scheme of the spinal nerve including fibers

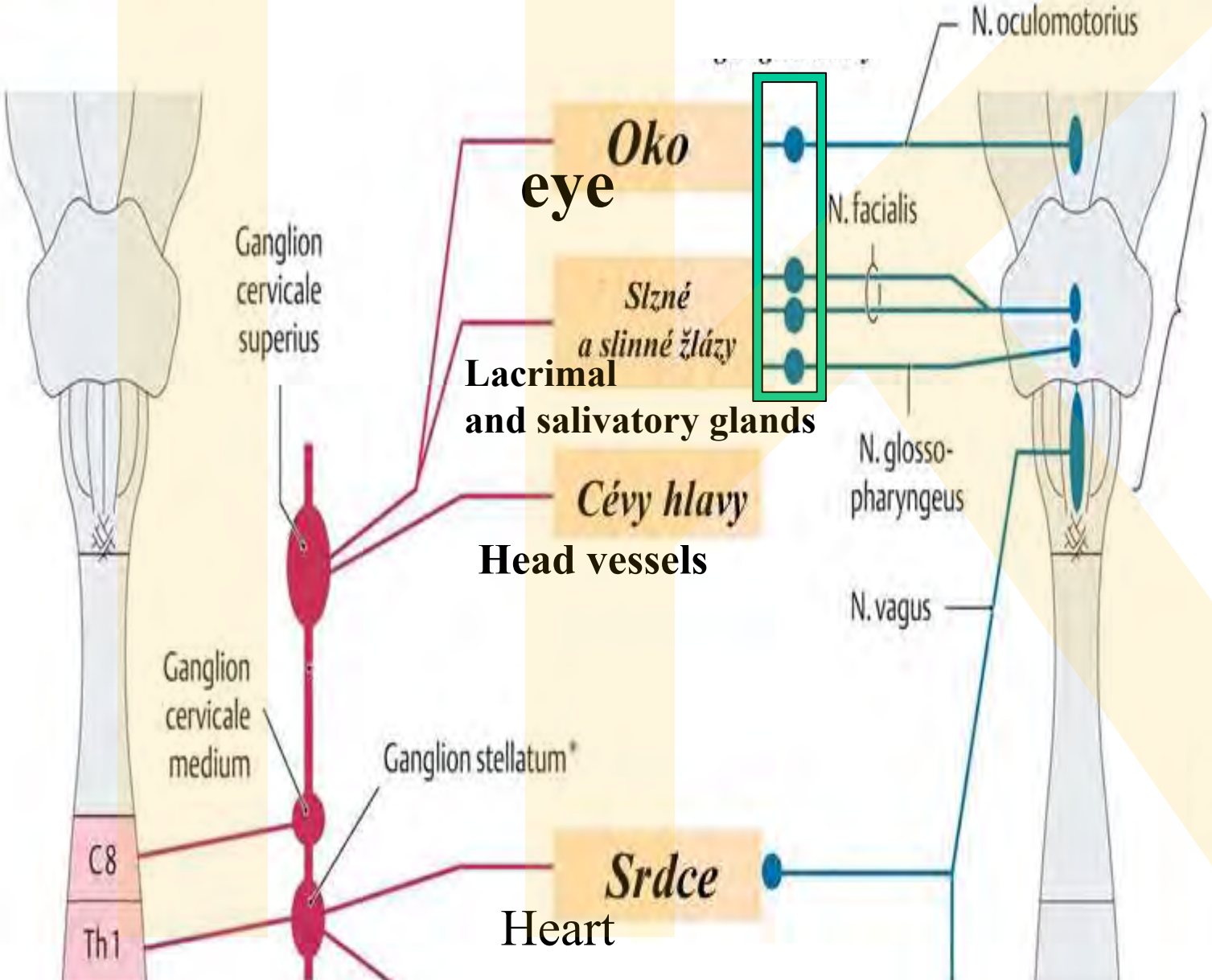


Communicating branch is missing in sacral and cranial levels; it is changed by interganglionar branch

Sympaticus

Parasympaticus

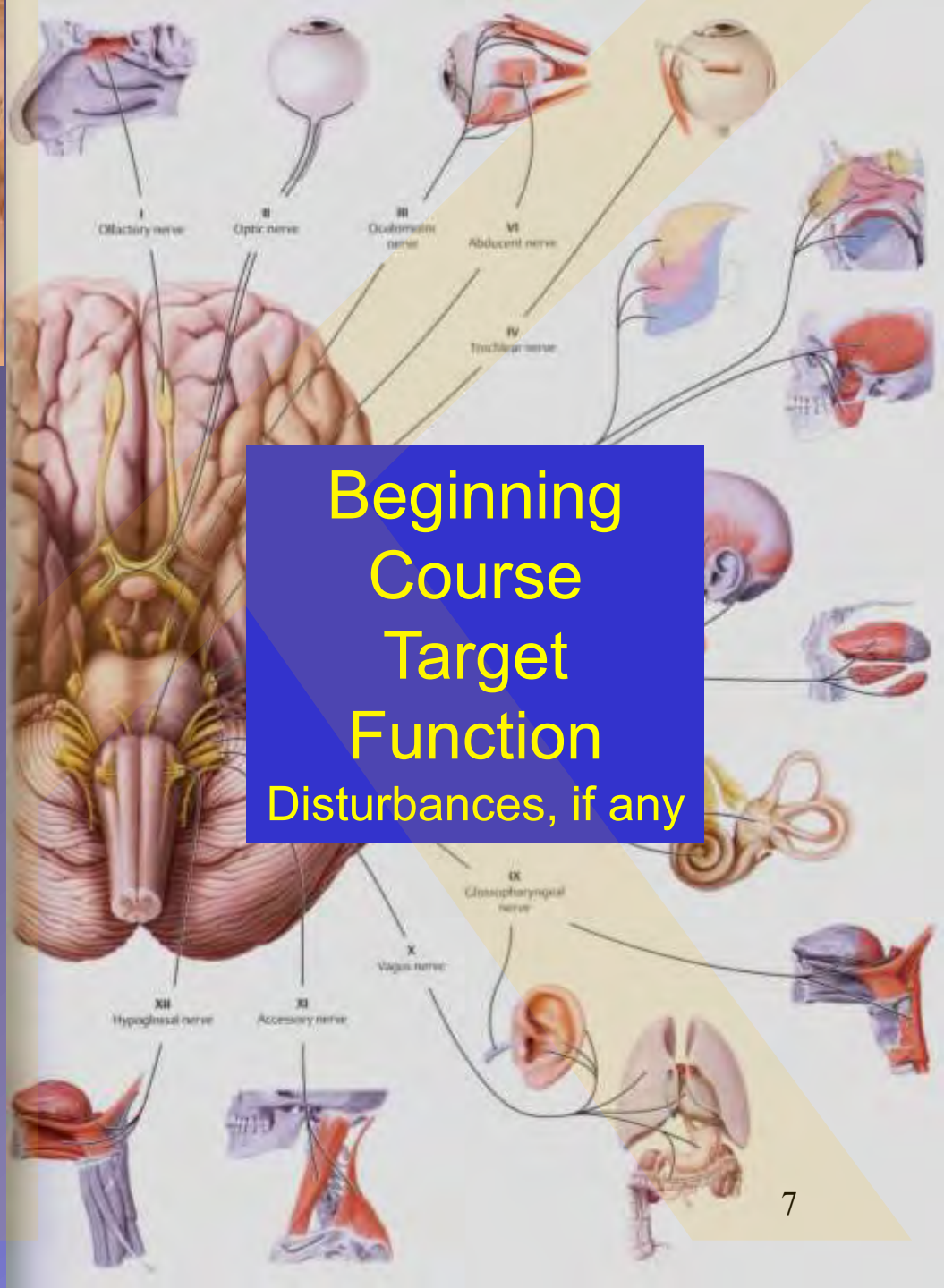
Parasympathetic ganglions in head



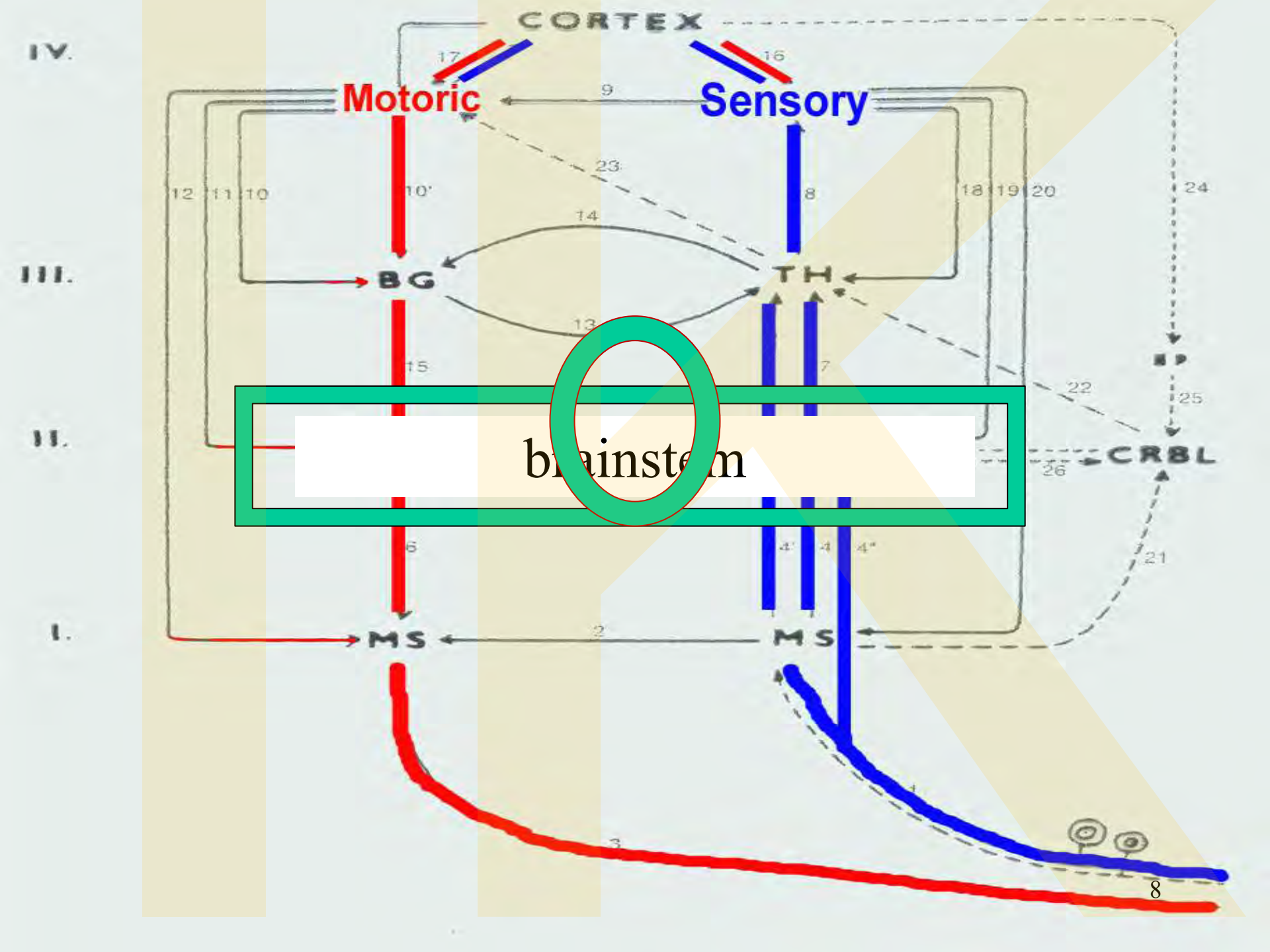
Main differences between parasympathetic and sympathetic fibers

	Sympatikus	Parasympatikus
Position of preganglionic neurons	spinal cord, intermediolateral nc. C8-L2/3	nuclei inside brainstem, sacral spinal cord S2-S4
Ganglion positions	paravertebral and prevertebral ganglions (far from organs)	ganglions close to organs or inside walls of organs
Mediator of preganglionic neuron	acetylcholin	acetylcholin
Mediator of postganglionic neuron	noradrenalin	acetylcholin
Course of fiber to target	mostly in periarterial plexuses	mostly in cranial nerves, sacral nerves, periarterial plexuses

Cranial nerves



Beginning
Course
Target
Function
Disturbances, if any


IV.
III.
II.
I.
CORTEX
Motoric
Sensory
BG
TH
MS
MS
CRBL
brainstem
17
16
9
23
12
11
10
10'
8
18
19
20
24
14
13
15
7
22
25
26
6
4'
4
4"
21
2
3
1

Introduction - basic characteristic features

CN nerves (instead CN I. and CN II.) have nuclei in the brainstem (rhomboid fossa) leave brainstem in defined areas

Arrangement of that fibers in relation to the general spinal nerve scheme exhibit **exceptions**:

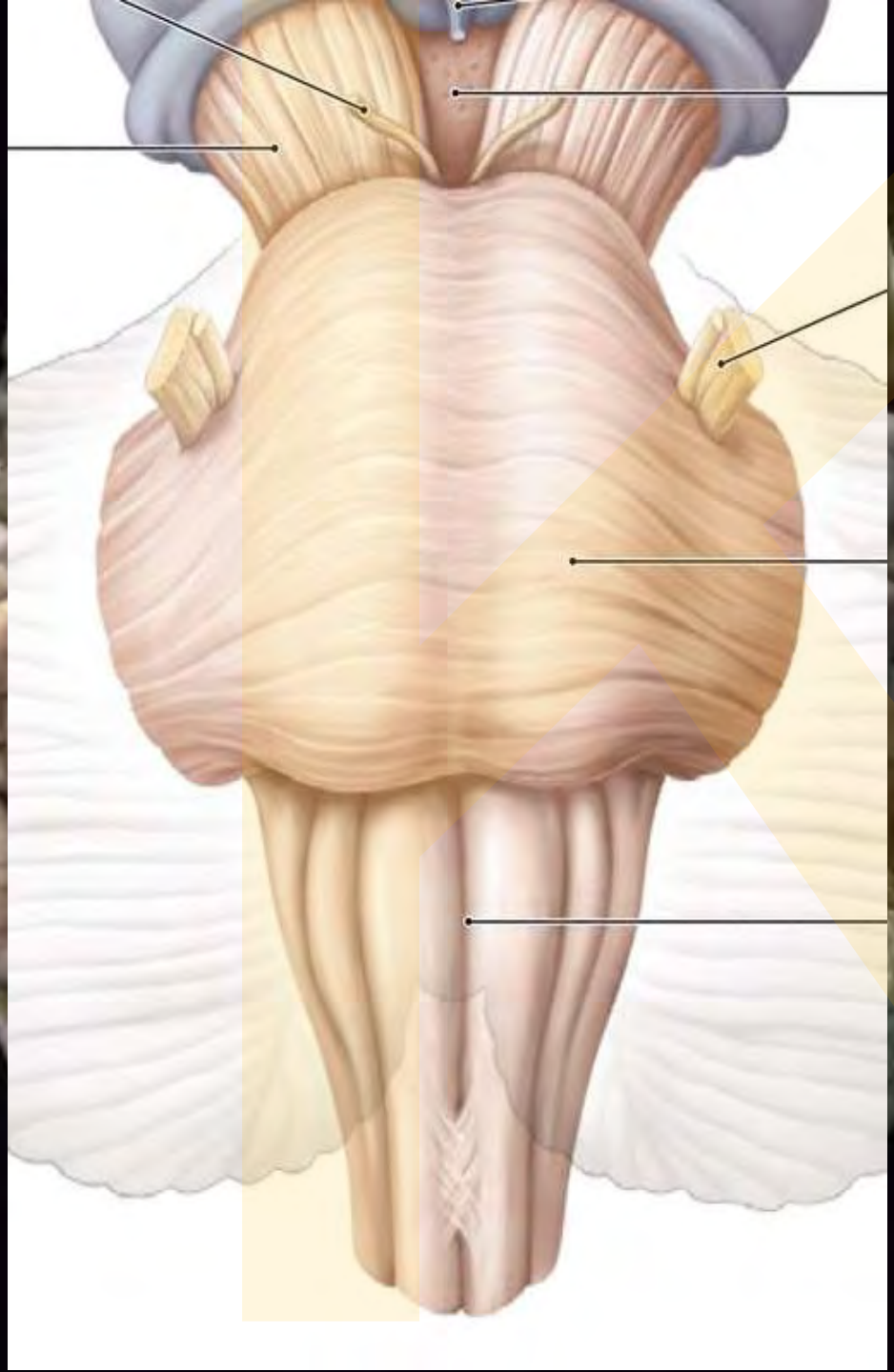
* one root

* vegetative part is parasympathetic and its ganglion is closely to targeting organ

* innervate head and neck (CN X. also thoracic and abdominal organs)

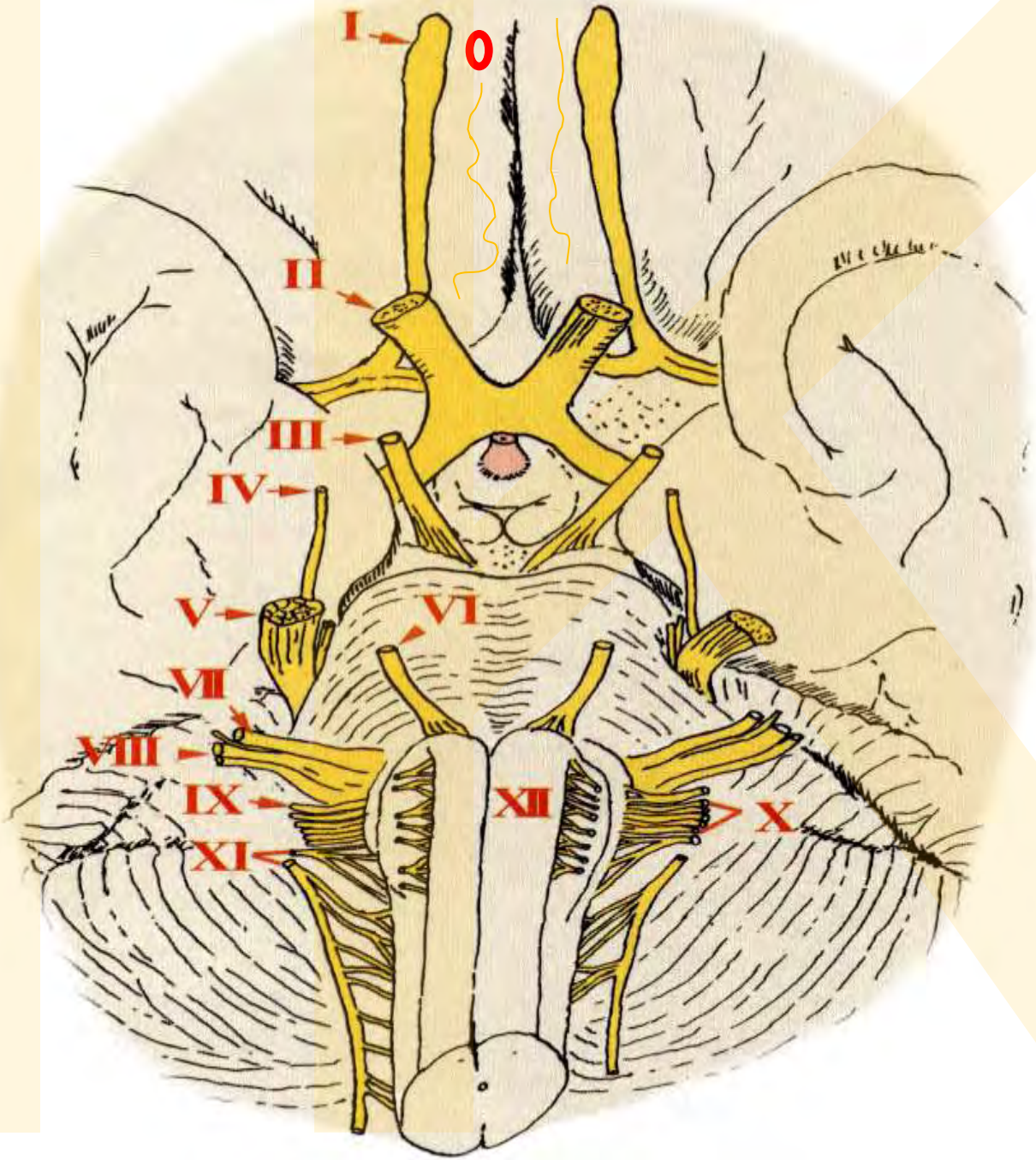
* sensitive ganglion is found close to skull basis

they mutually different from each other by structure of fibers



CN nerves can be categorized: using anteroposterior order

(in that order they pass through skull openings)


I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII

CN nerves leave basis of the brain in anteroposterior order

III - fossa interpeduncularis

IV - pod lateral from pedunculi cerebri

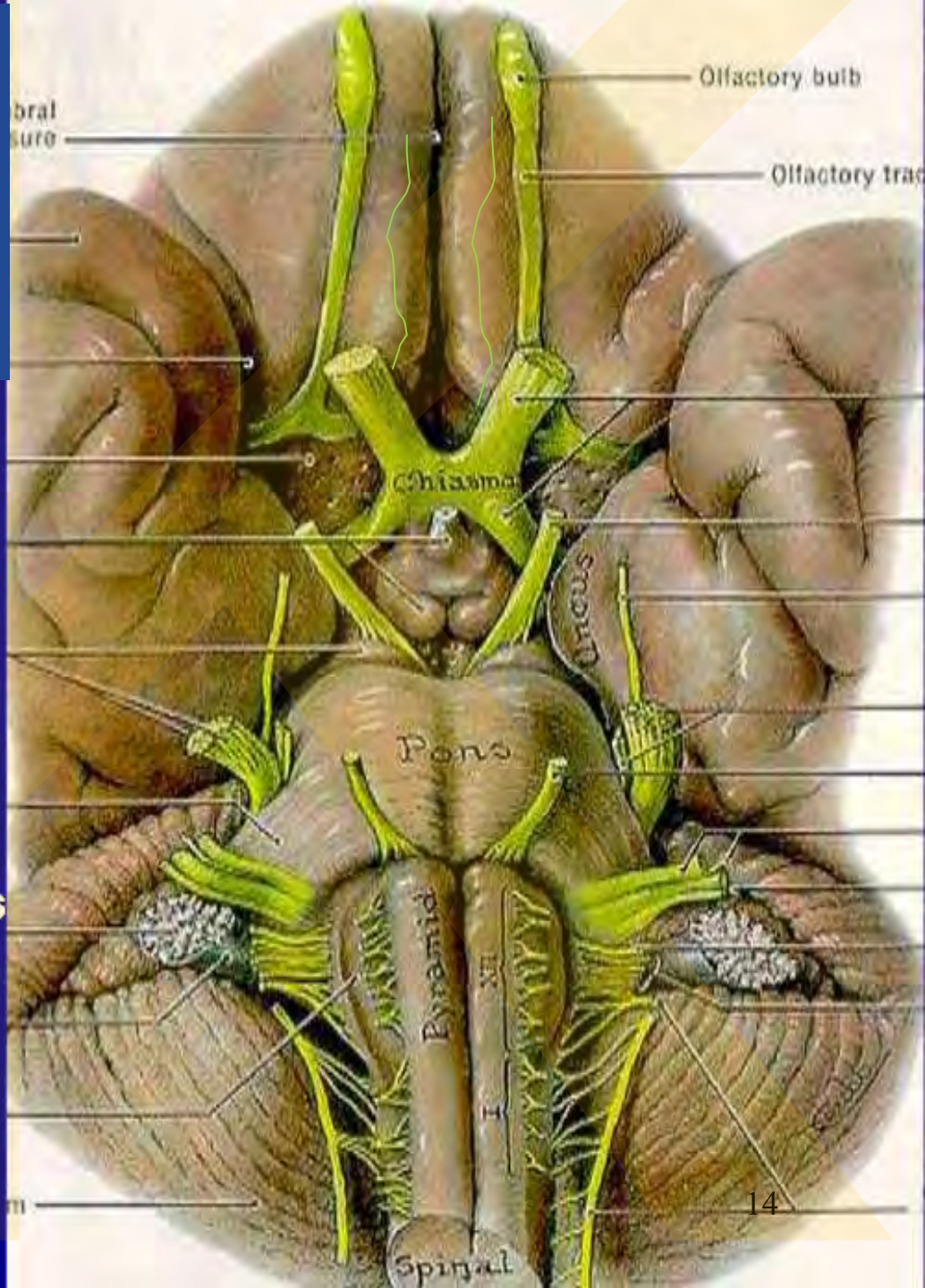
V – ½ brachia pontis

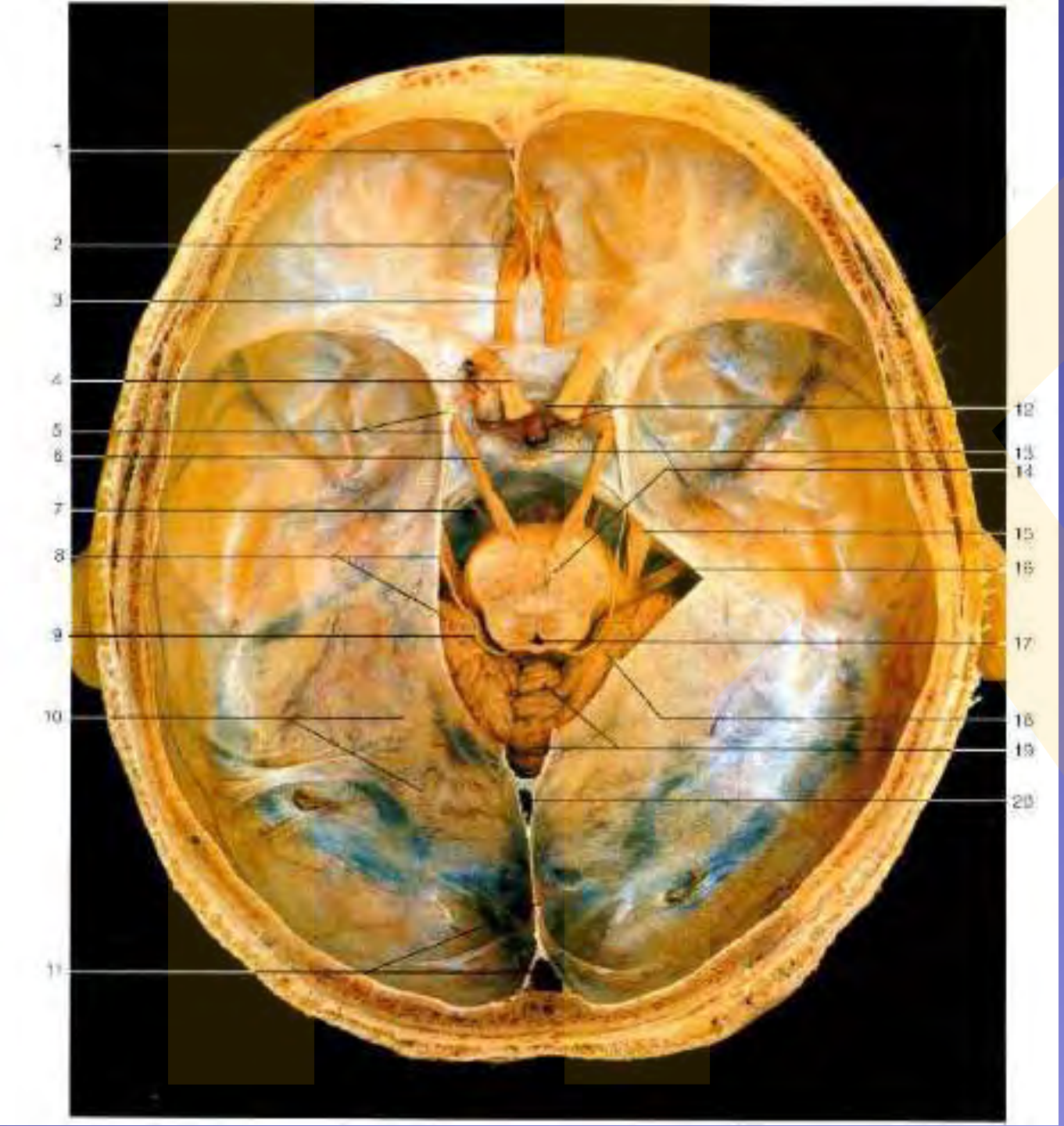
VI - sulcus bulbopontinus

VII, VIII - angulus pontocerebellaris

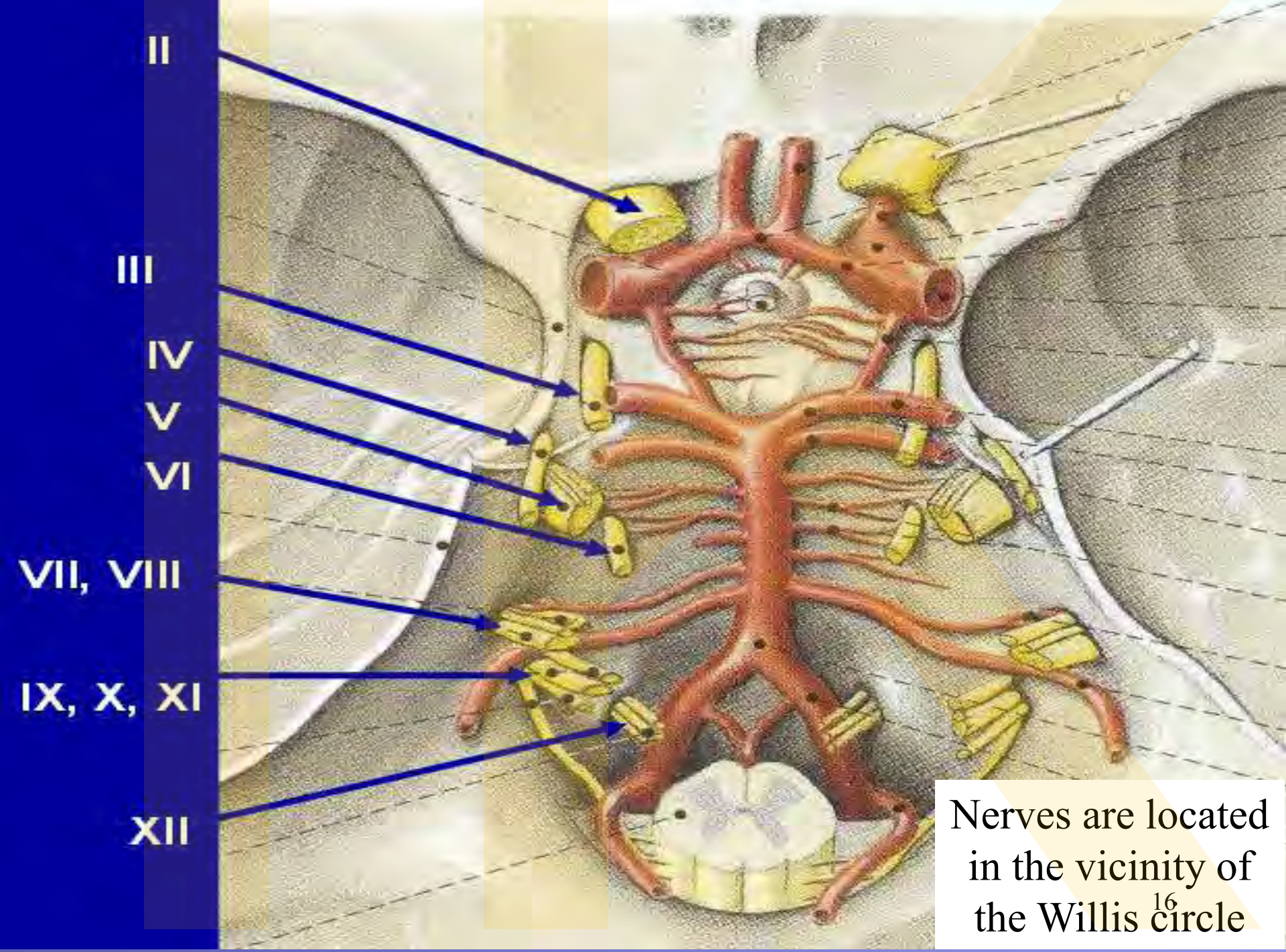
IX,X, XI – sulcus dorsolateralis

XII –sulcus ventrolateralis

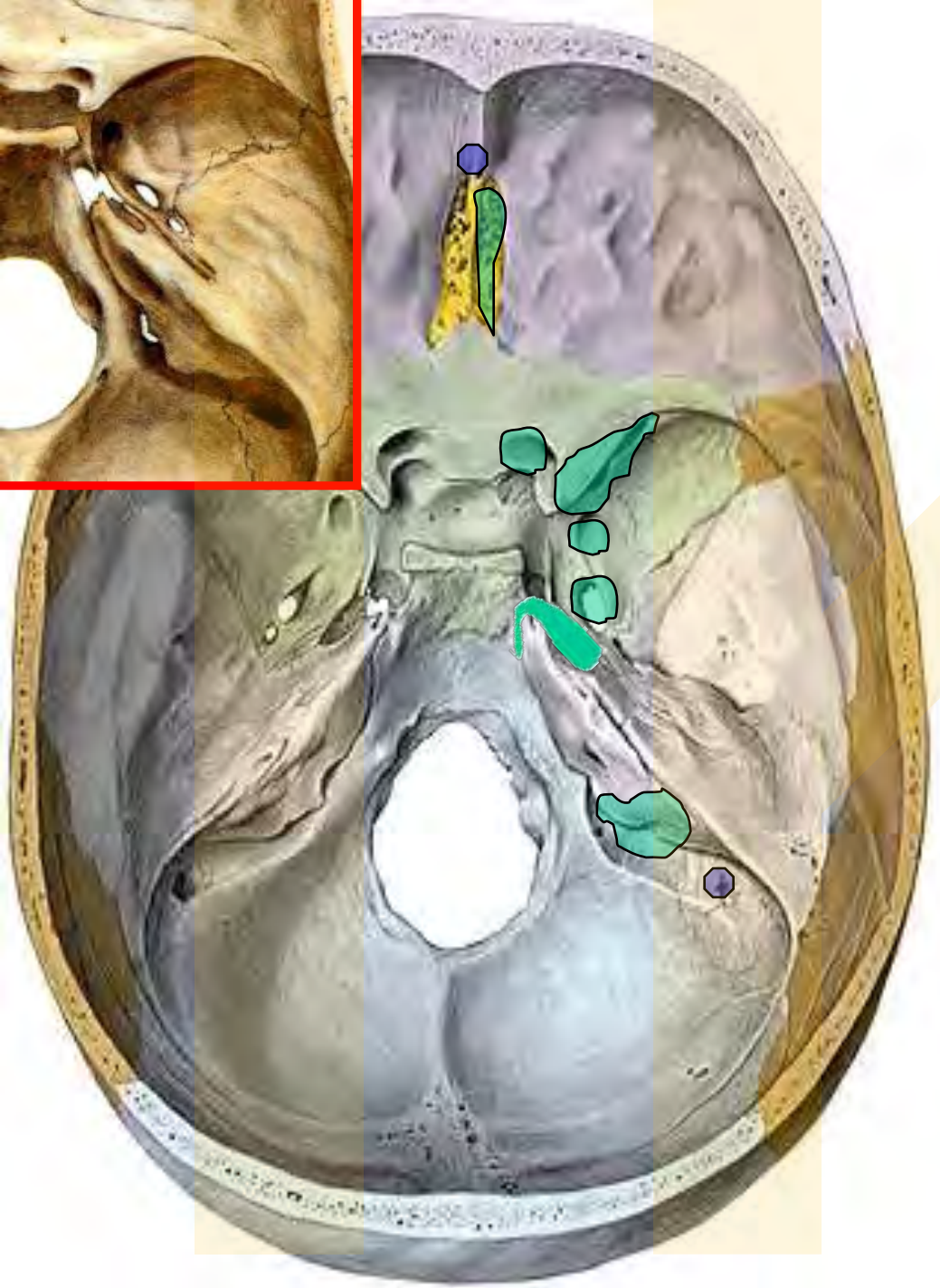




Cranial nerves pass through dura mater (fibrous meningeal membrane)



Nerves are located in the vicinity of the Willis circle



Lamina cribriformis - I.

Canalis opticus

- II., a. ophtalmica

Fissura orbitalis superior

- III., IV., V1. (nasociliaris, lacrimalis,frontalis), VI., v. ophtalmica sup.

Foramen lacerum

(canalis caroticus + synchondroses sphenopetrosalis et sphenooccipitalis)

- a. carotis interna

Foramen rotundum V2

Foramen ovale

- V3., vv.communicantes

Foramen spinosum

- a. meningea media

Canalis caroticus

- a. carotis int., nn. sympathici (caroticotympanici)

Foramen jugulare

- IX.,X.,XI. V. jugulars int.

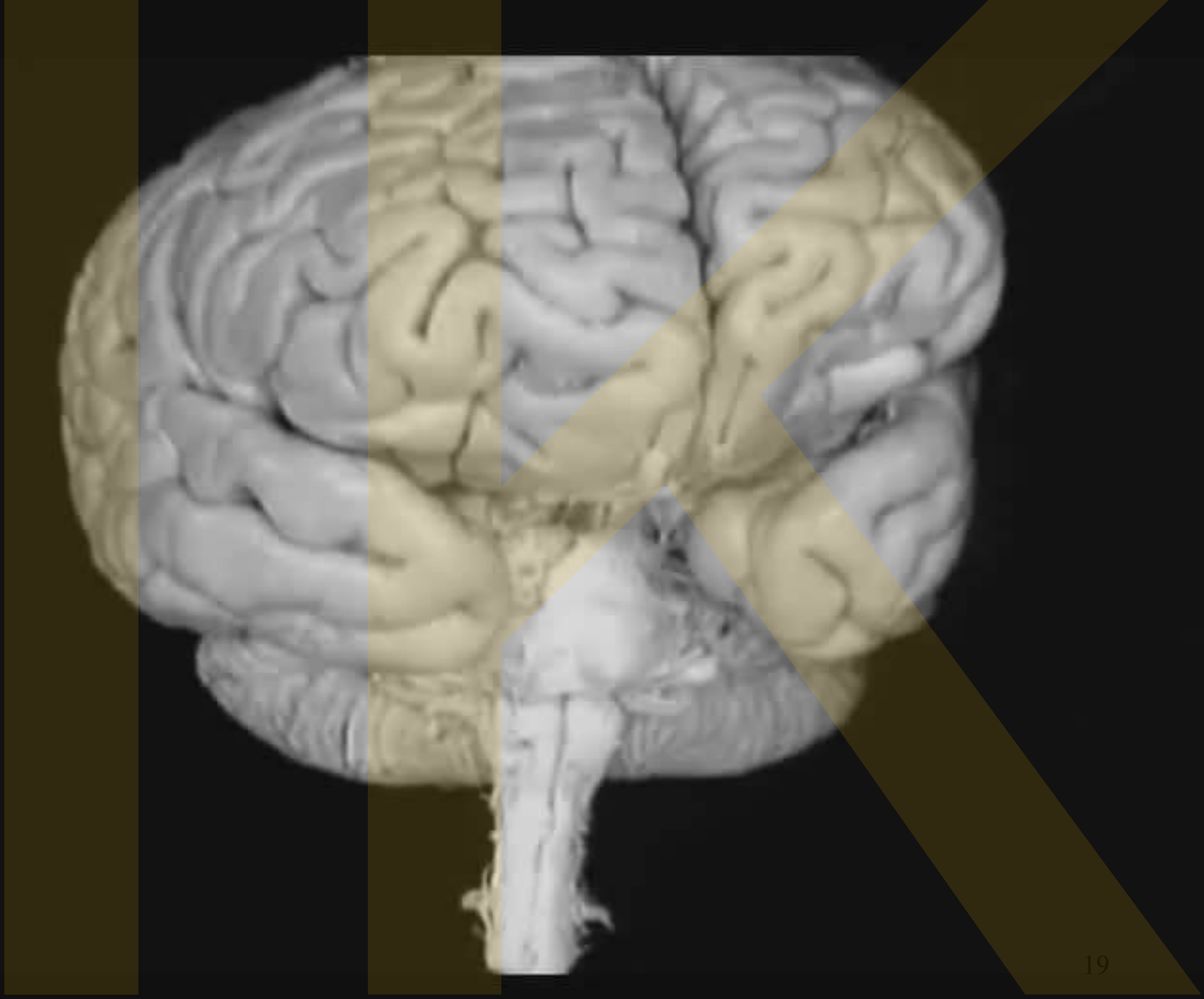
Cranial nerves

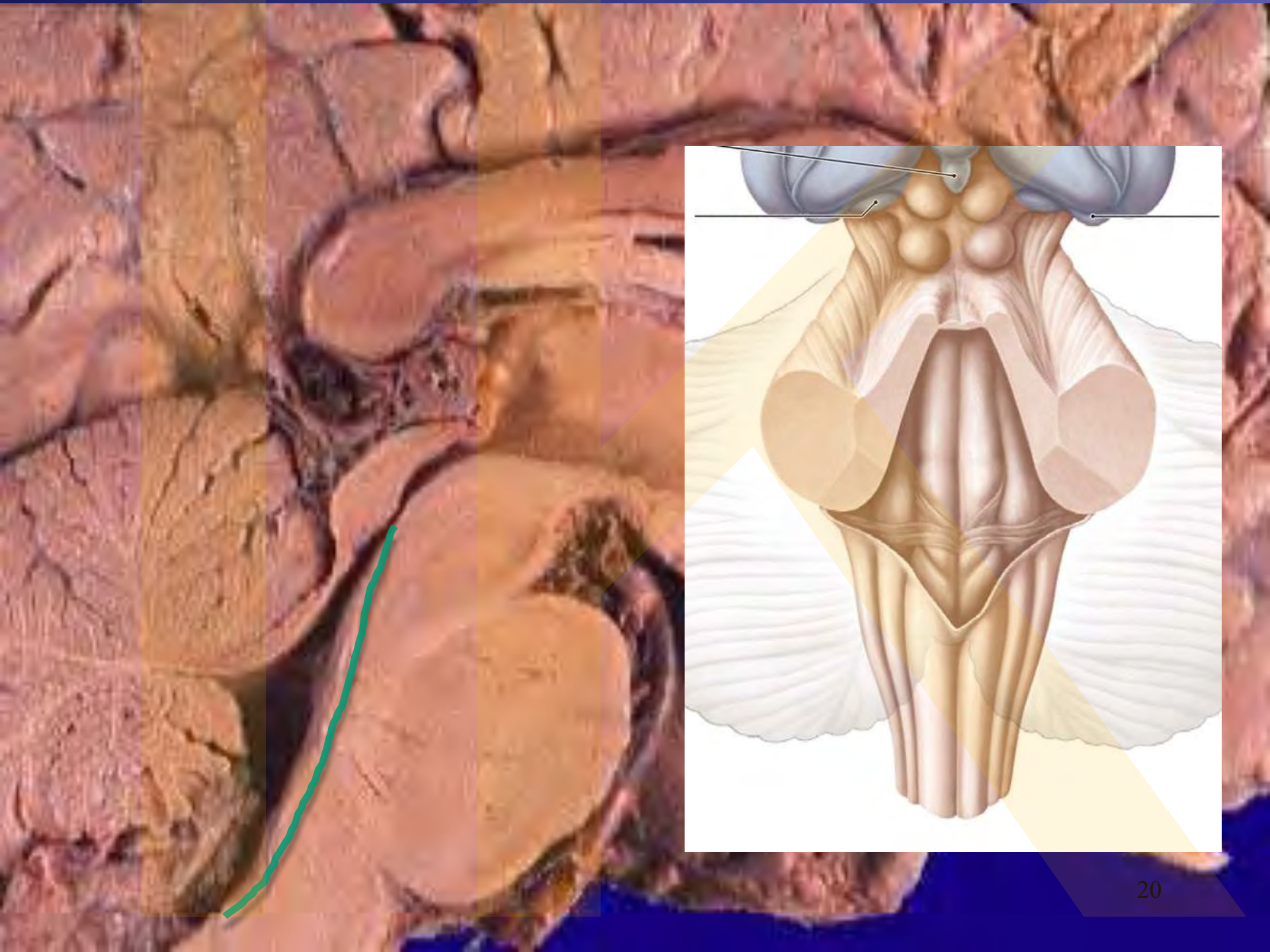
- 0. n. terminalis - terminal nerve
- I. n.olfactorius - smell nerve
- II. n.opticus - optic nerve
- III. n.oculomotorius - oculomotory nerve
- IV. n.trochlearis - trochlear nerve
- V. n.trigeminus - trigeminal nerve
- VI. n.abducens - abductory nerve
- VII. n.intermediofacialis - facial nerve

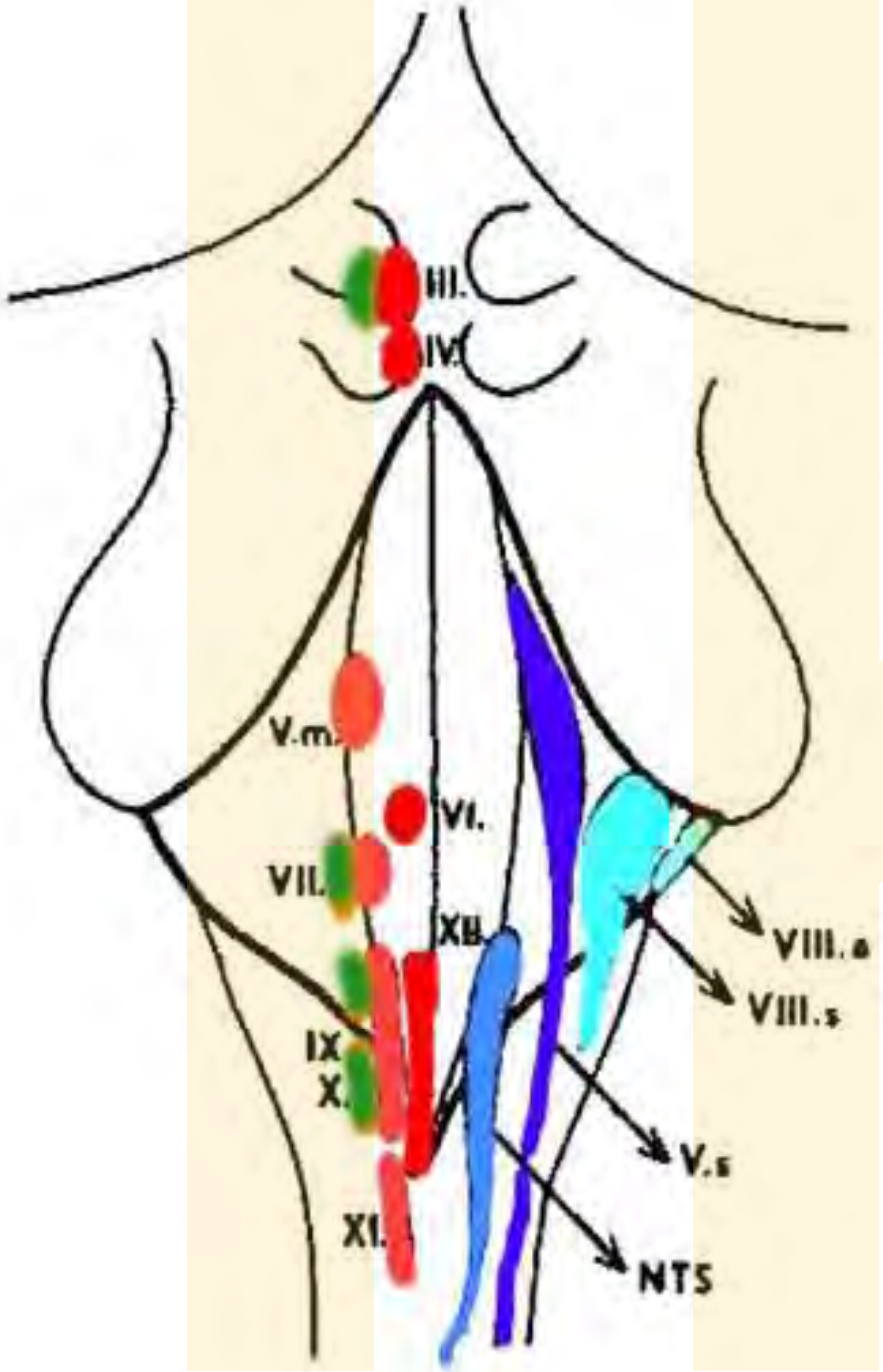
(somatomotoric **facialis -** mimic actions, posterior belly of digastric m., stapedial m., tensor tympani m., stylohyoid m.)

visceromotoric **intermedius** , it has also somatosensitive innervation of auricula, viscerosensitive taste fibers from ventral 2/3 tongue)

- VIII. n.vestibulocochlearis - vestibular and hearing nerve
- IX. n.glossopharyngeus - glossopharyngeal nerve
- X. n.vagus (pneumogastricus) - vagal nerve
- XI. n.accessorius (cranialis, spinalis) - accessory nerve
- XII. n.hypoglosus - subglossal nerve







Mother cells and nuclei of the CN nerves

nuclei origines
et parasympathici
(dorsales)
somato and viscero
motor

nuclei terminationes
Sensitive and sensory

somatomotoric fibers - nn. IV., VI., XI.,XII.

somatomotoric and visceromotoric (parasympathetic) – n. III.

Somatomotoric and somatosensitive – n.V.

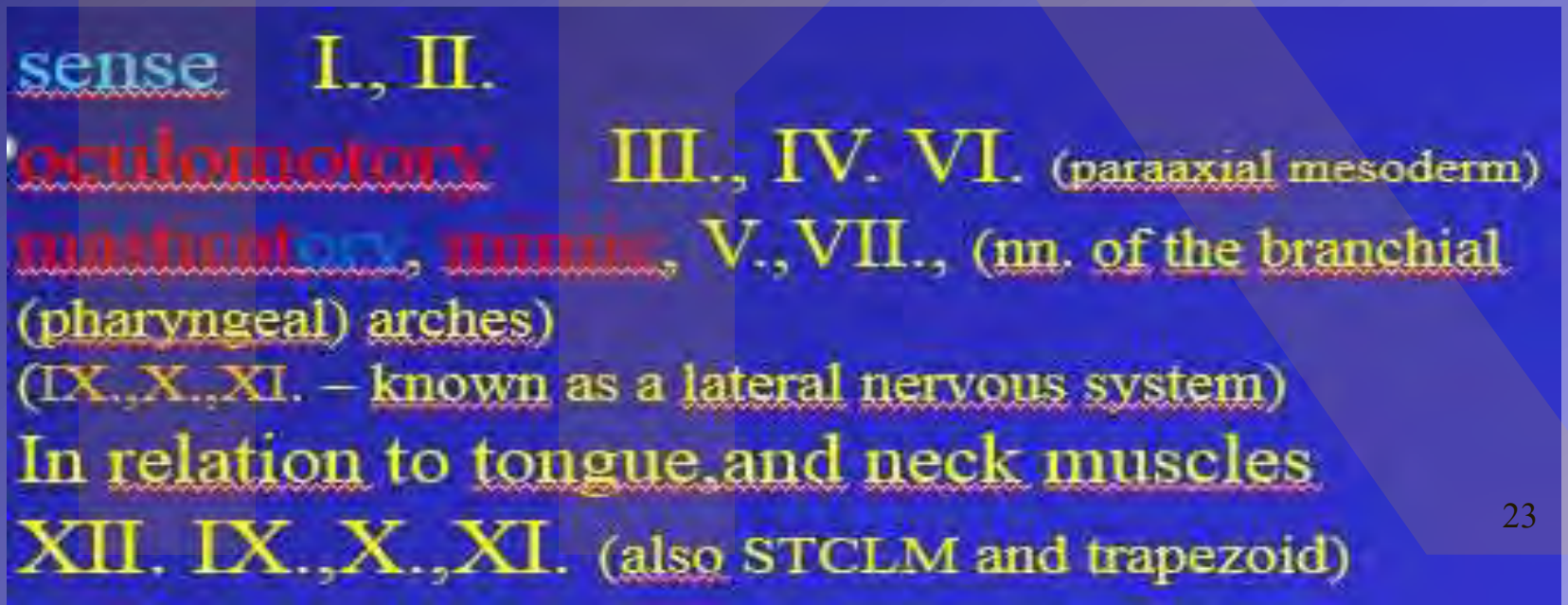
special sensitive (sensoric) nn. I.,II. VIII.,

all sorts of fibers – nn. VII, IX., X.

CN nerves can be categorized:

using fiber types and target organs

in that order they are:



12 pairs of the cranial nerves
nervi craniales (traditional view)

CNS I. Olfactorius

CNS II.Opticus

III.Oculomotorius

IV.Trochlearis

V.Trigeminus

VI.Abducens

VII. Facialis

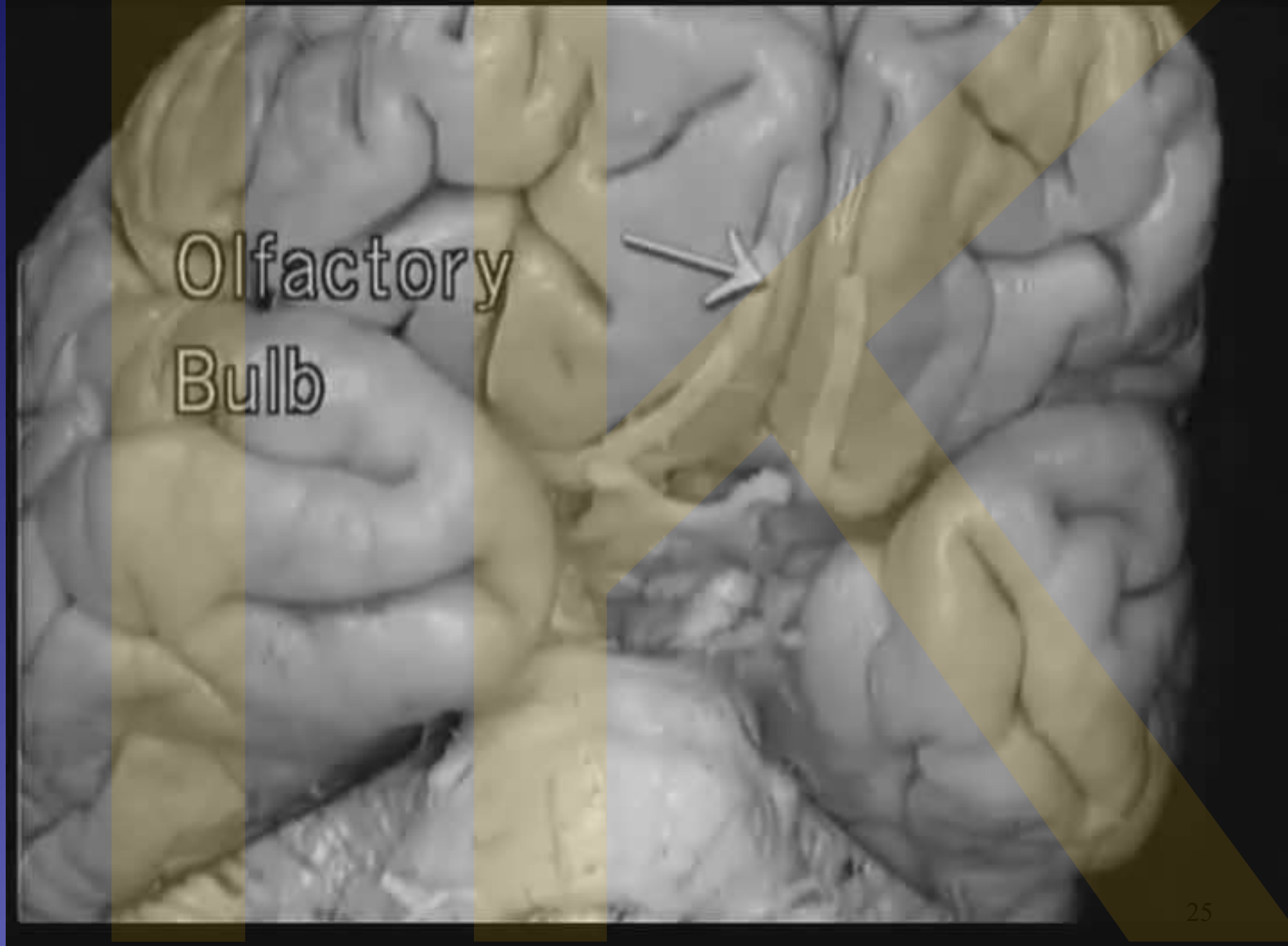
CNS VIII. Vestibulocochlearis

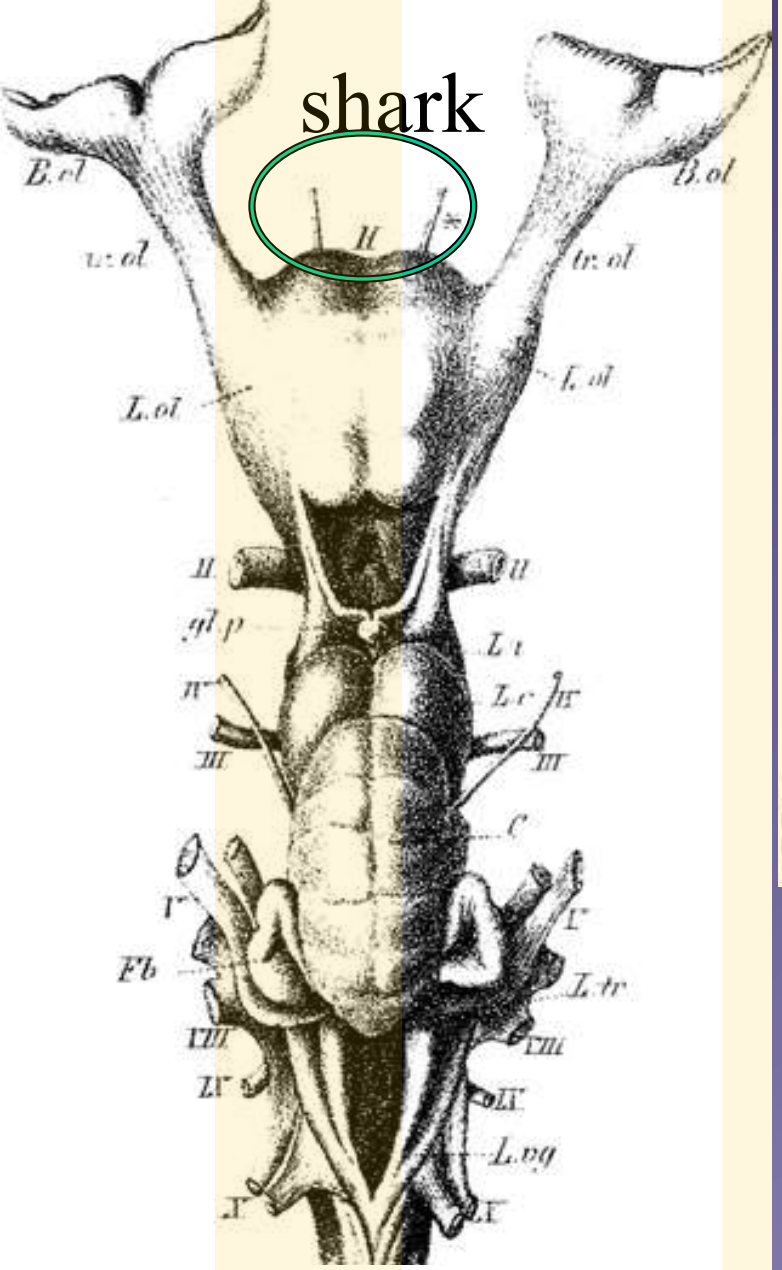
IX. Glossopharyngeus

X. Vagus

XI. Accessorius cranialis spinalis

XII. Hypoglossus


Olfactory
Bulb



XIII nerve, Zero nerve,
N nerve NT nerve

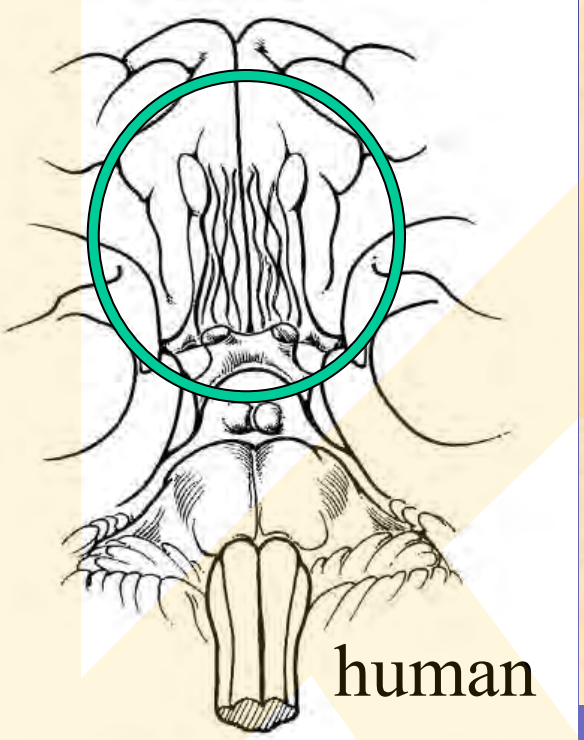
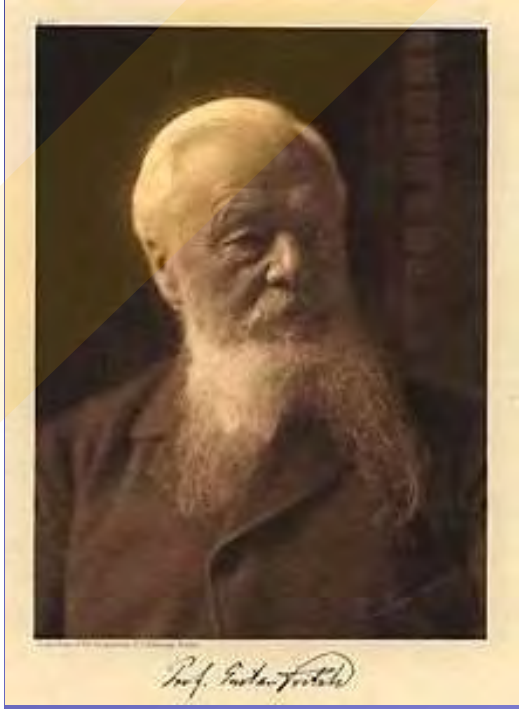


Fig. 4. Figure 1 from Fuller and Burger (1990). "Intracranial course of the nervus terminalis in the adult human. The nerve was identified in all specimens as a bilateral plexus of fascicles in the subarachnoid space covering the gyrus rectus."

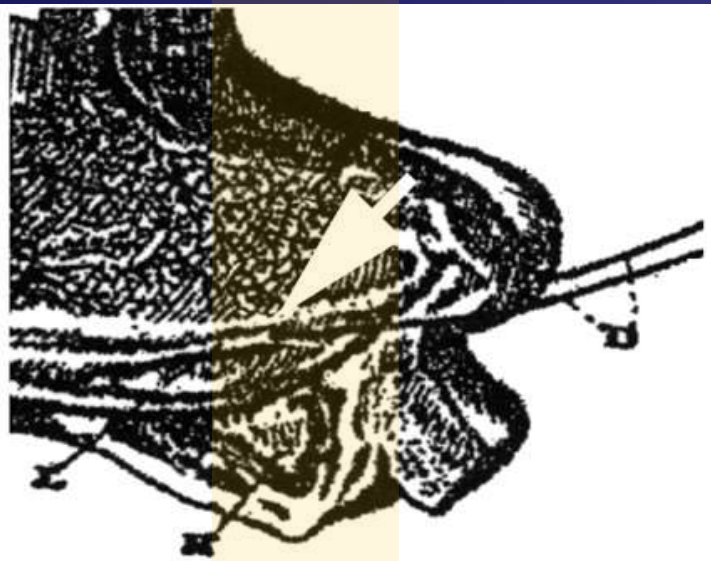
CN 0 – **Terminal**
CN I – Olfactory
CN II – Optic……..

it be sensing of pheromones

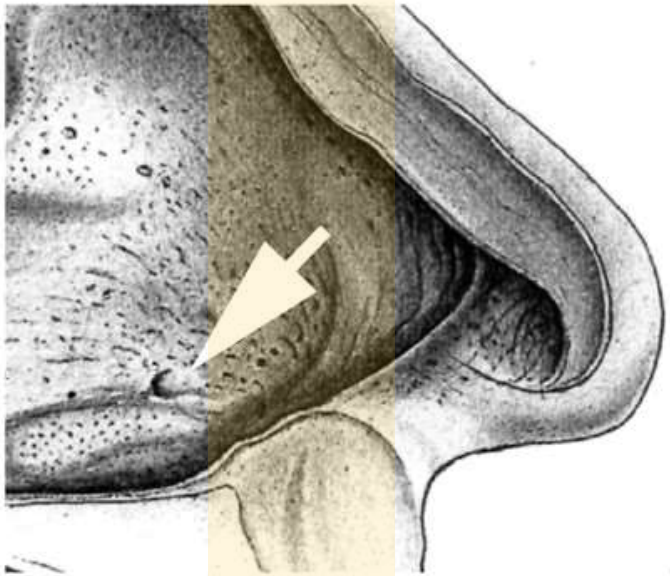
microscopic plexus of unmyelinated fascicles covering gyrus rectus; connections with olfactory trigone, olfactory gyrus and lamina terminalis



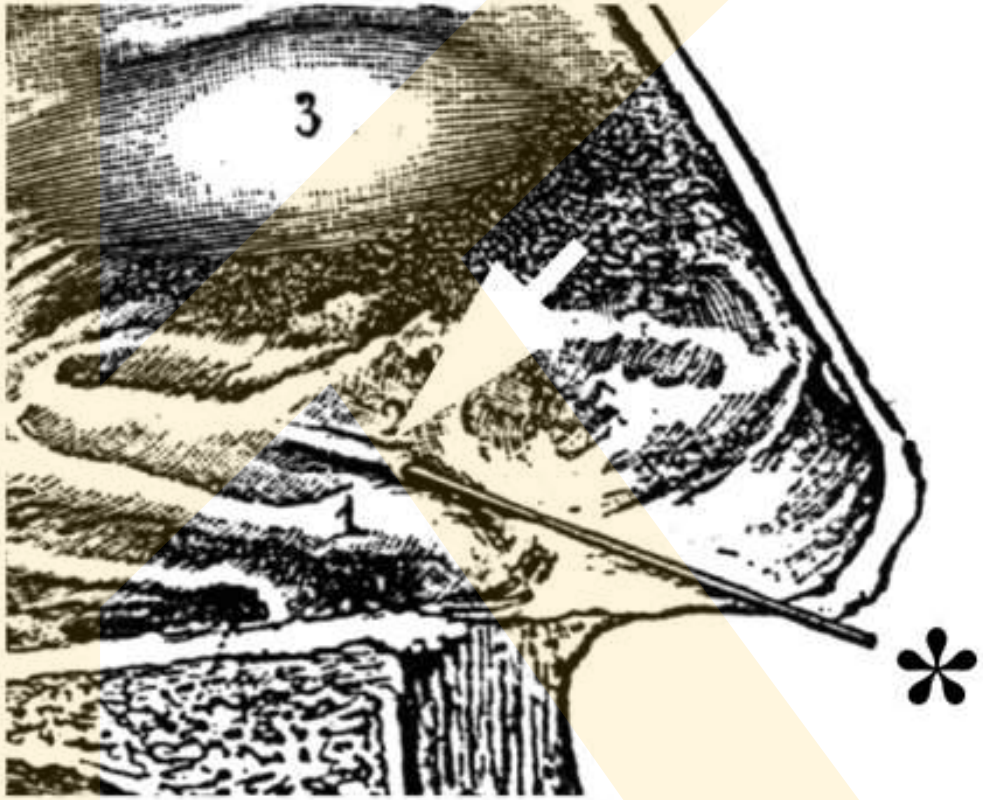
Gustav Theodor Fritsch
(1838 – 1927)
a German anatomist anthropologist



Ruysch (1703)



Kölliker (1877)



Potiquet (1891)

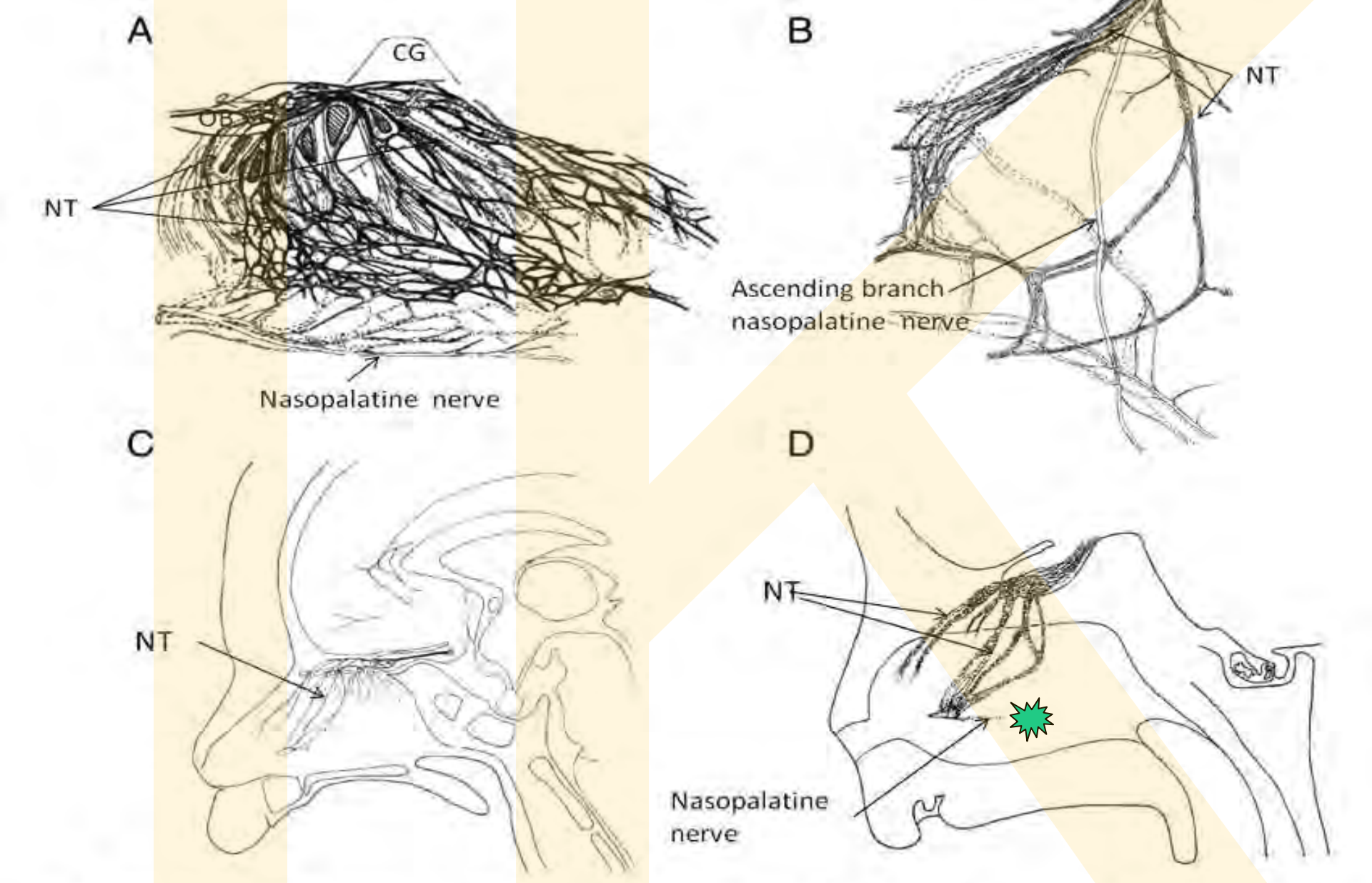
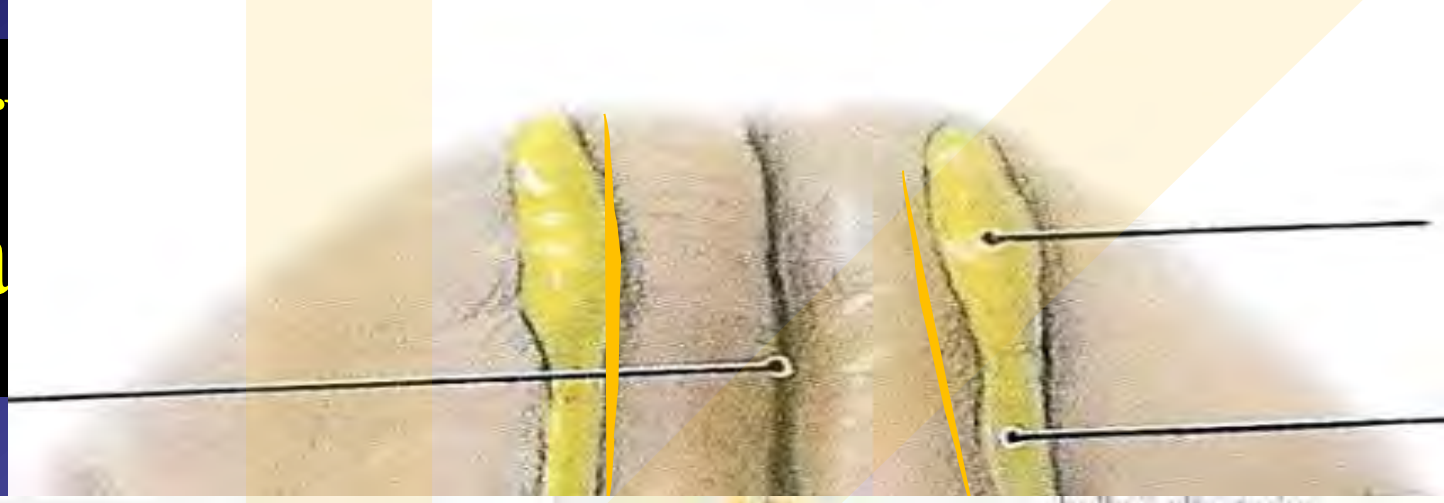
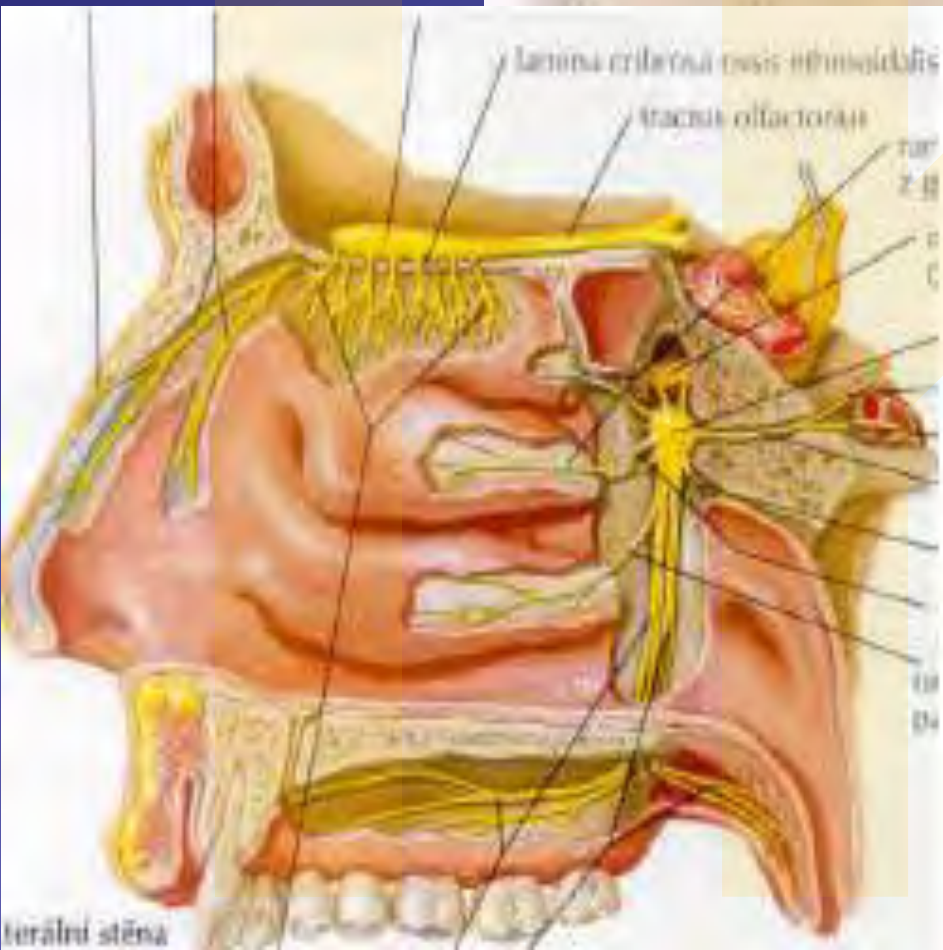
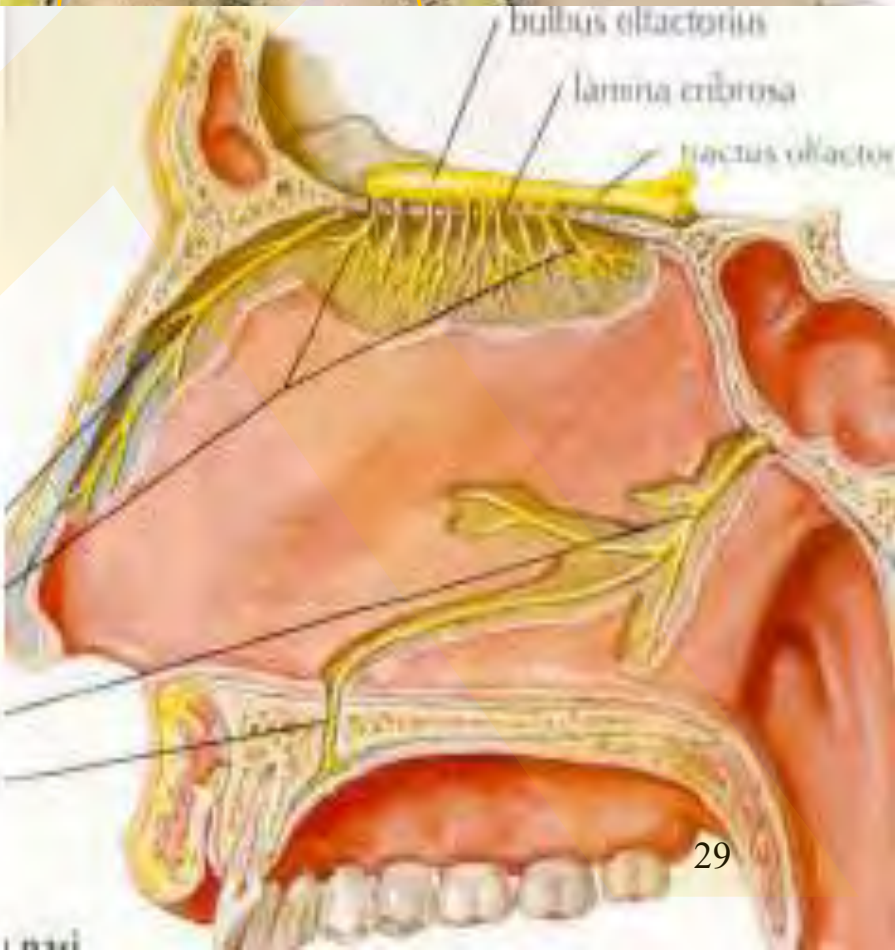


Fig. 5. A: Modified from Figure 1 Brookover (1917); "semidiagrammatic" illustration of the septal view of the NT in a human infant. Dashed lines represent vessels (also in B). **B**: Modified from Figure 2 Brookover (1917); enlargement of the posterior ventral between the NT and the ascending septal branch of the nasopalatine nerve. **C**: Modified from Figure 1 McCotter (1915) showing a septal view of the NT in a six-month-old human fetus. **D**: Modified from Figure 10 Pearson (1941) showing a septal view from a 45 mm human

I. Ner
Olfa



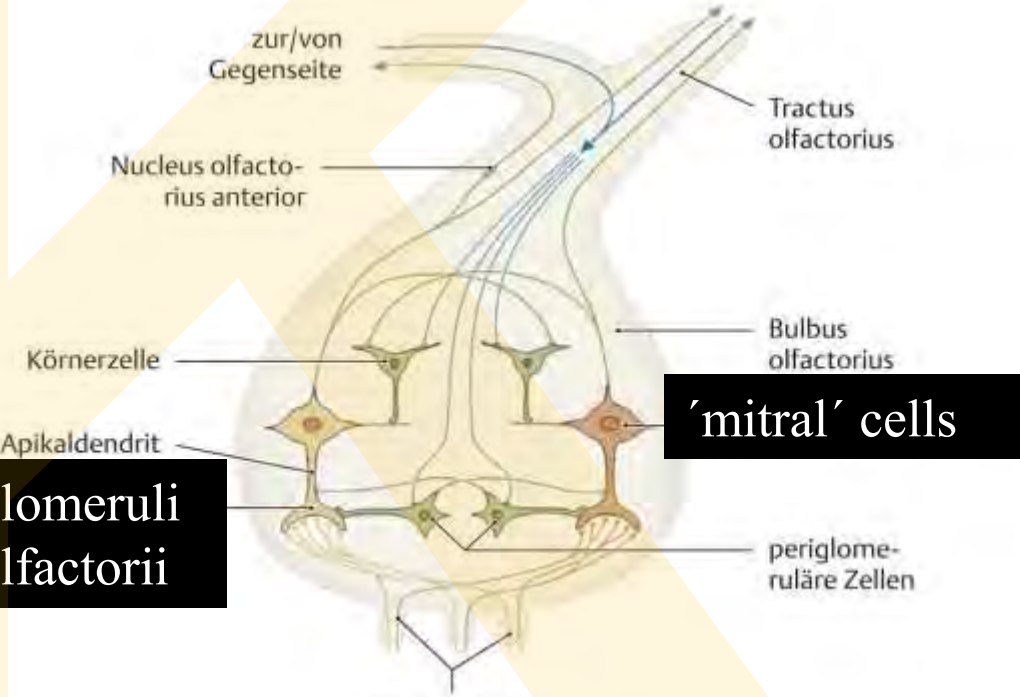

lamina cribrosa ossis ethmoidalis
tractus olfactorius


bulbus olfactorius
lamina cribrosa

Bulbus olfactorius

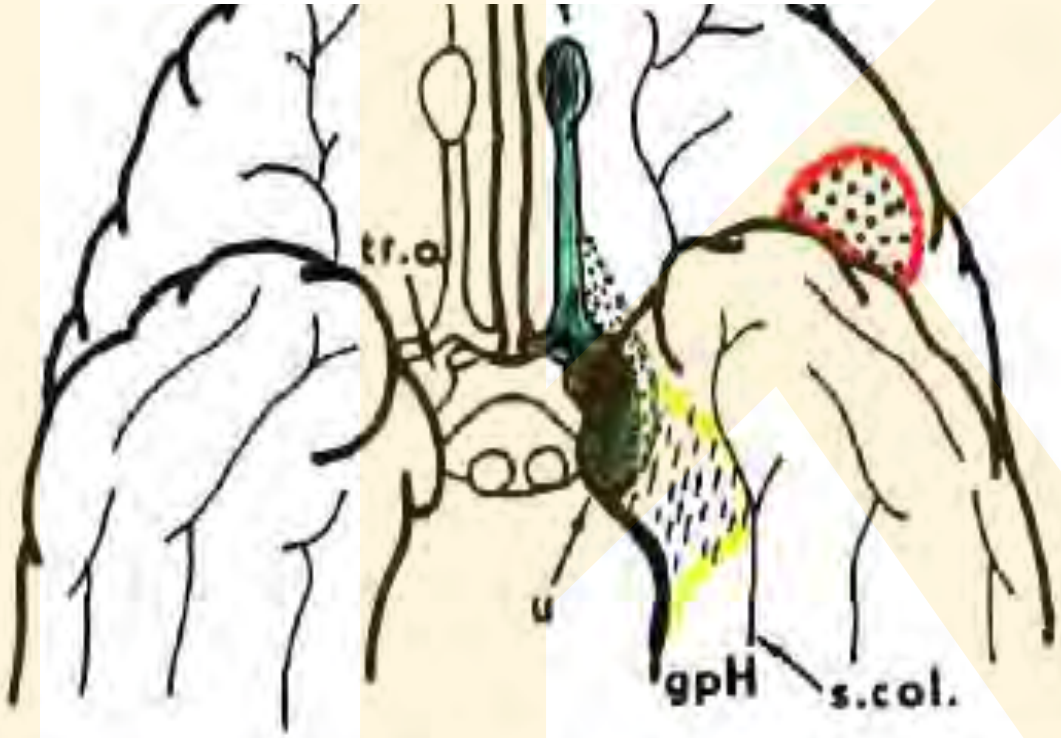
No myelinated smell area - regio olfactoria

10 mil of the smell cells



fila olfactoria
olfactory fibers

Connection to the brain ´smell´ cortex



Terminal projection of the nerve to brain areas:
Paleocortex, mesocortex, parahipocampal gyrus, orbitofrontal smell cortex

Obr. 111.: Schema terminací čichové dráhy, srovnej s obr. 110.
Jemné tečky - paleocortex a prepiriformní mesocortex (P, M_{pp}),
čárky - entorhinální mesocortex (M_{ent}),
hrubé tečky - orbitofrontální čichová kůra
gpH - gyrus parahippocampalis, s.col. - sulcus collateralis,
tr.o - trigonum olfactorium, u - uncus.

Cranial nerve I CN I

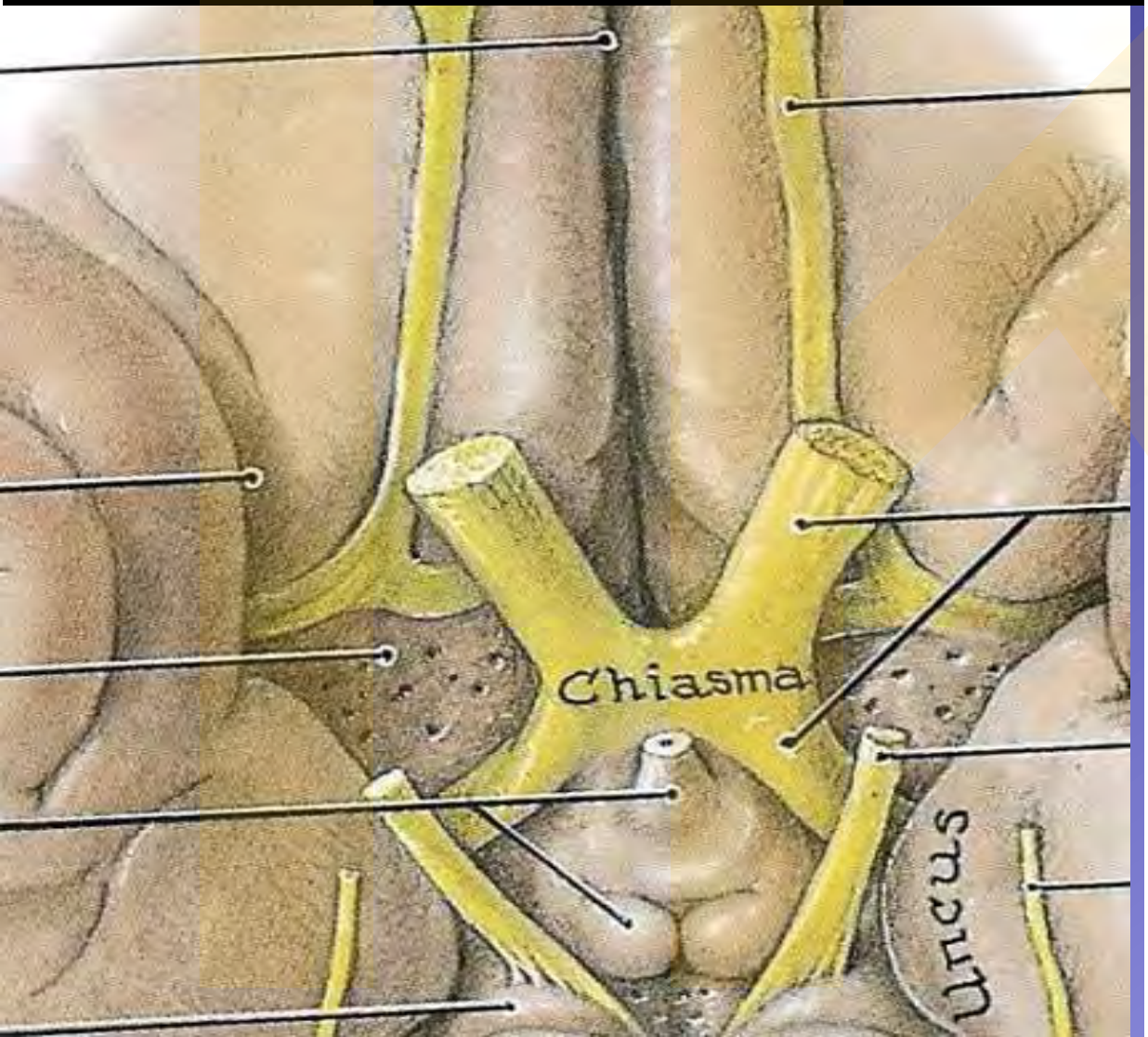
smell olfactory (olfactorius)

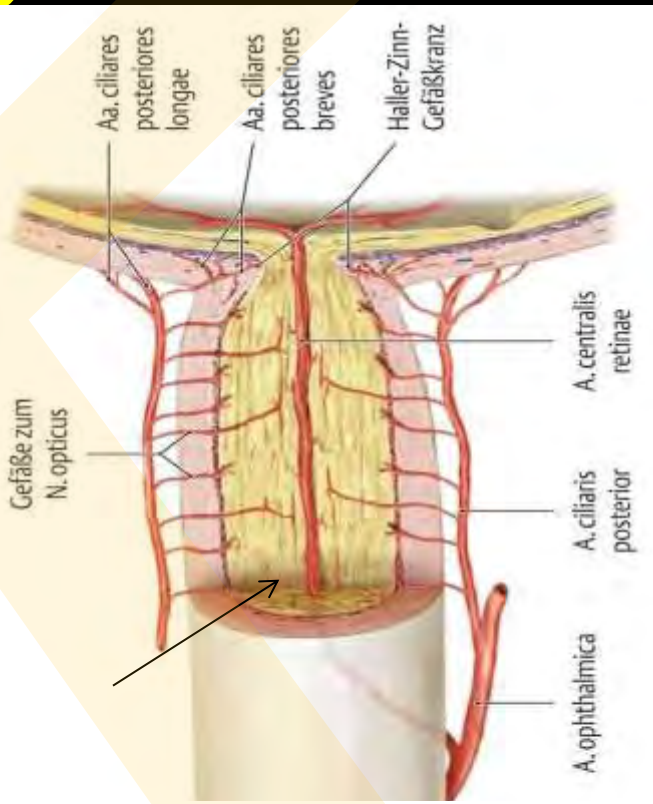
Signal type : (sensitive)

Transmits smell impulses to the brain from olfactory mucous membrane

It can be irritated after traumatic events (frontal bone, skull basis, facial trauma)

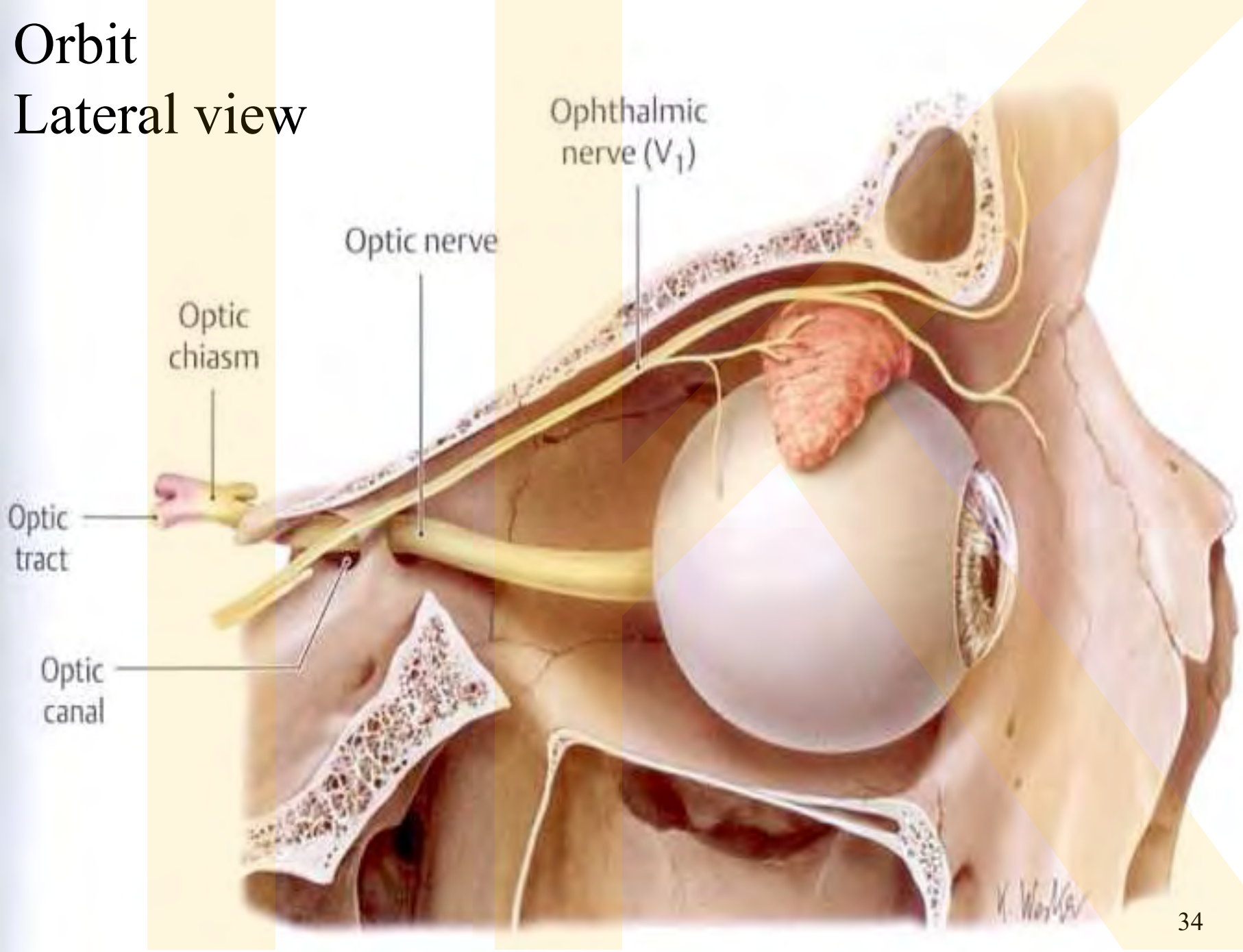
II. Nervus opticus
Optic nerve

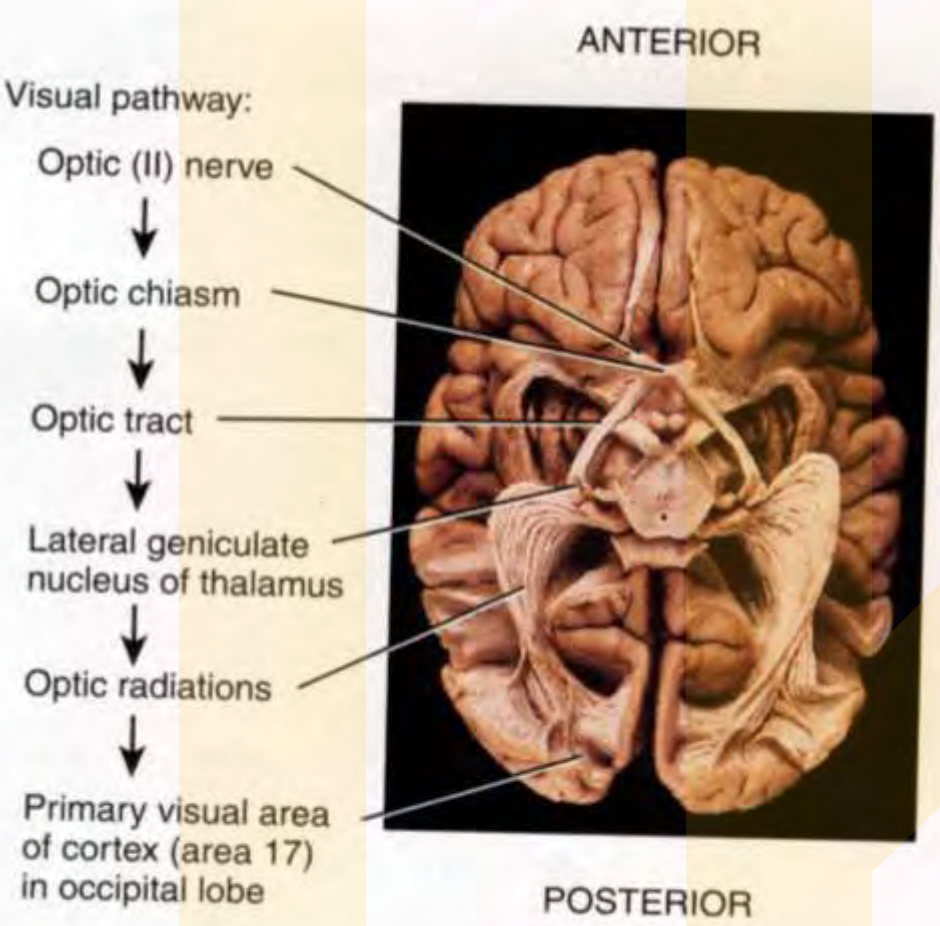


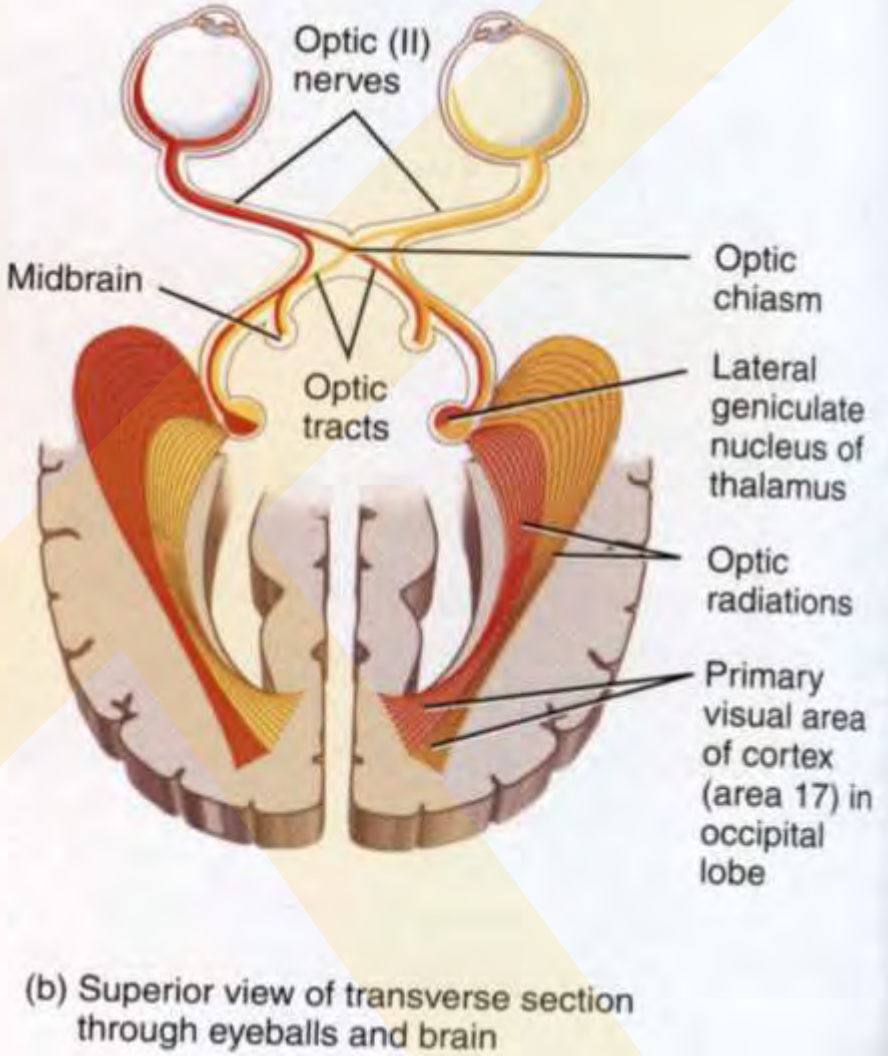


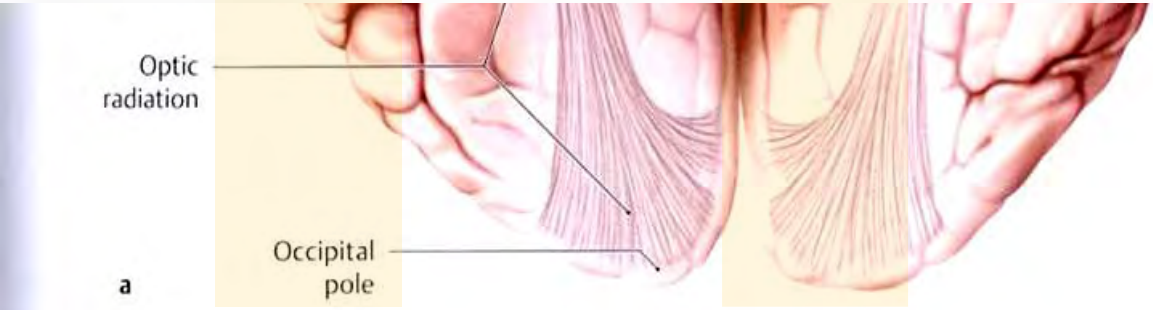
Space between vagina **intermedia** and **interna of the optic nerve contains** liquor cerebri (cerebrospinal liquid)

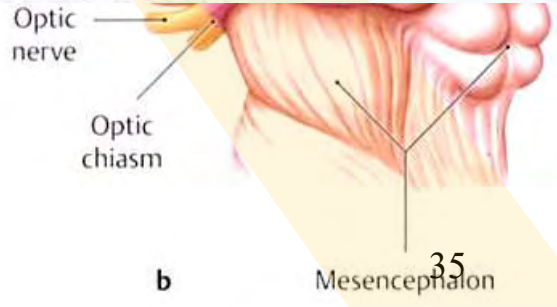
Orbit
Lateral view

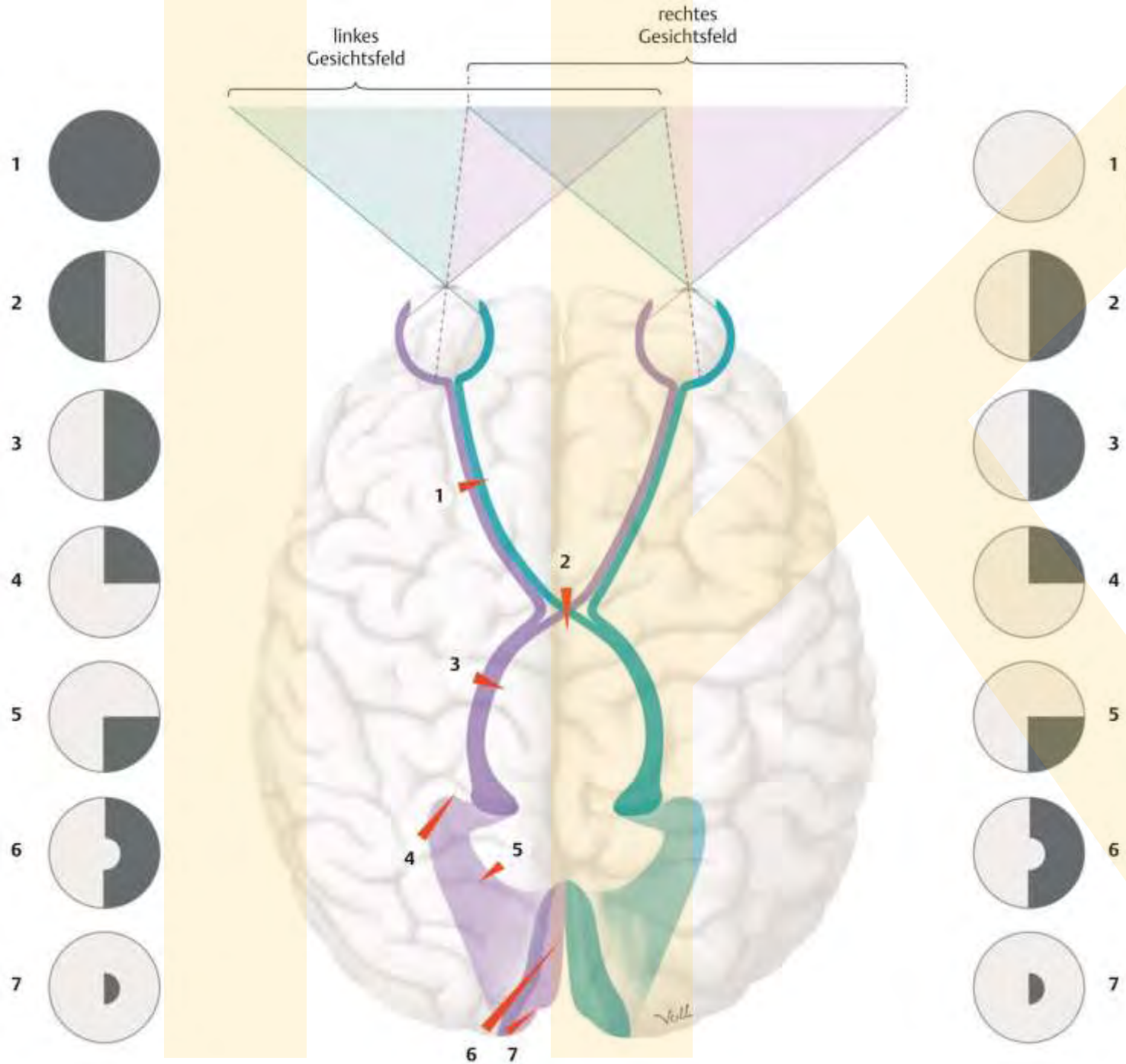


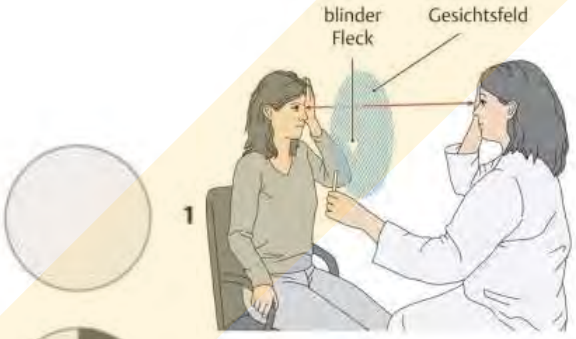

ANTERIOR
Visual pathway:
Optic (II) nerve
Optic chiasm
Optic tract
Lateral geniculate nucleus of thalamus
Optic radiations
Primary visual area of cortex (area 17) in occipital lobe
POSTERIOR
(a) Inferior view


Optic (II) nerves
Midbrain
Optic chiasm
Optic tracts
Lateral geniculate nucleus of thalamus
Optic radiations
Primary visual area of cortex (area 17) in occipital lobe
(b) Superior view of transverse section through eyeballs and brain


Optic radiation
Occipital pole
a


Optic nerve
Optic chiasm
Mesencephalon
b





parts of the field of vision fall out when the nerve is damaged

Cranial nerve II CN II

optic Opticus

Signal type : (sensoric)

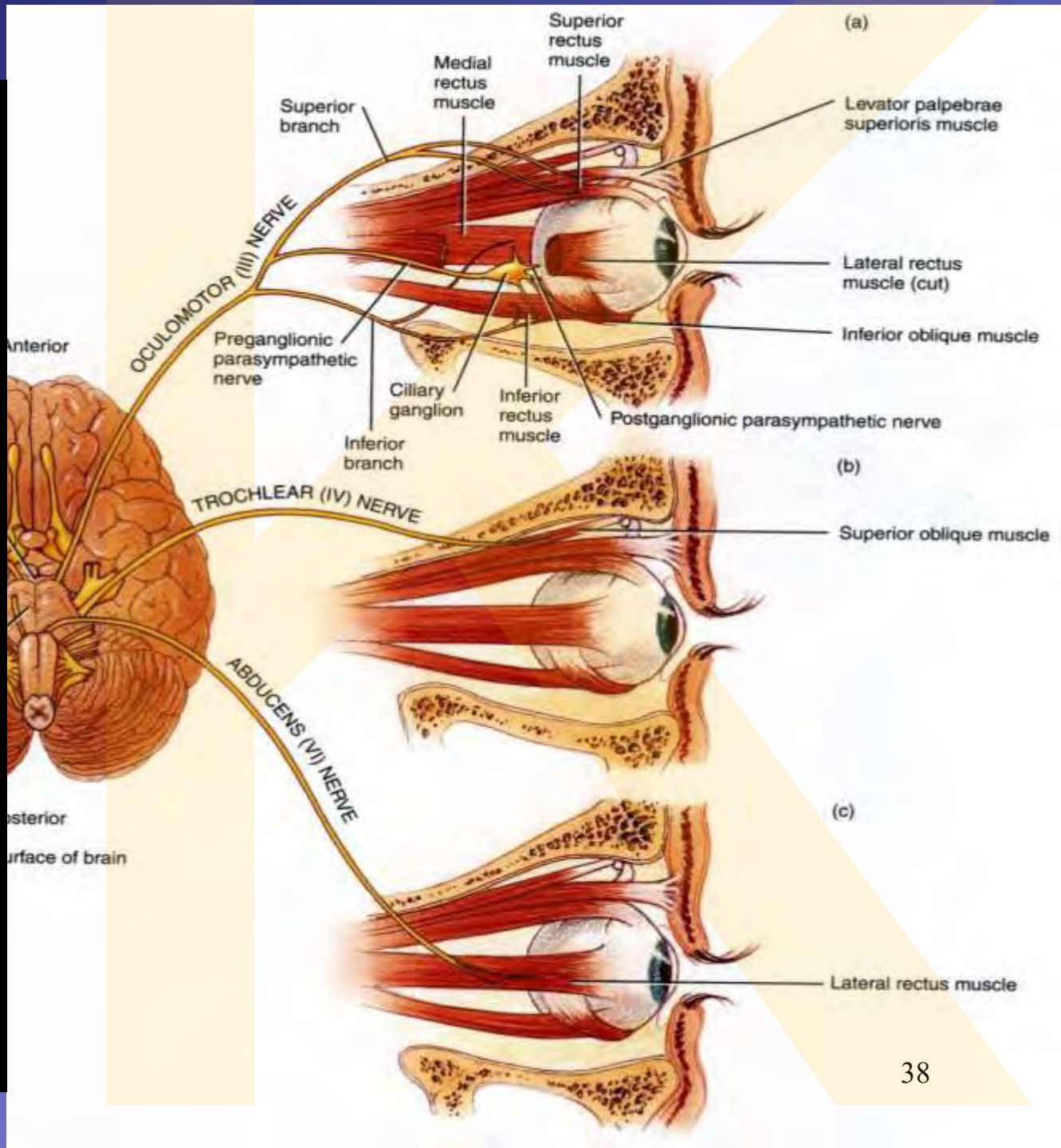
Transmits signals from optic retina to brain

Difference between light and dark, colours, optic activity, optic sharpness, extent of the optic field

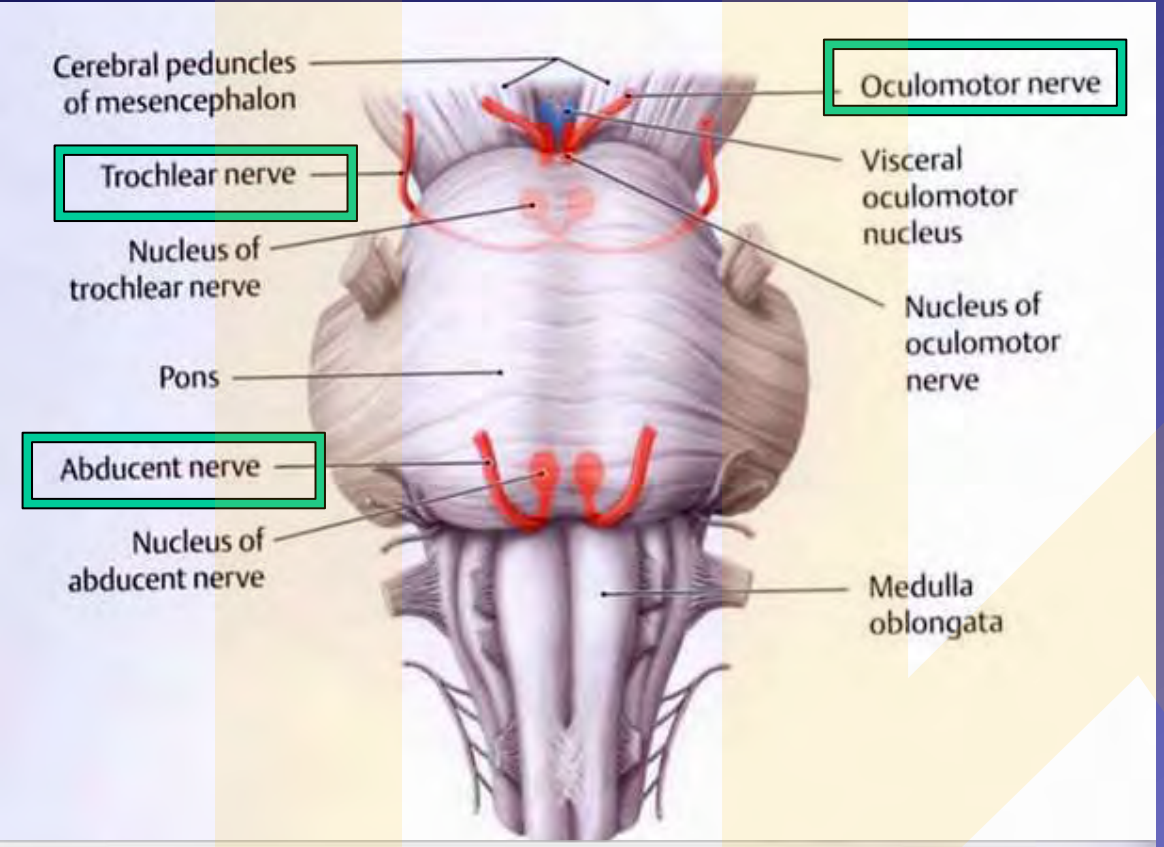
III. Nervus oculomotorius oculomotory

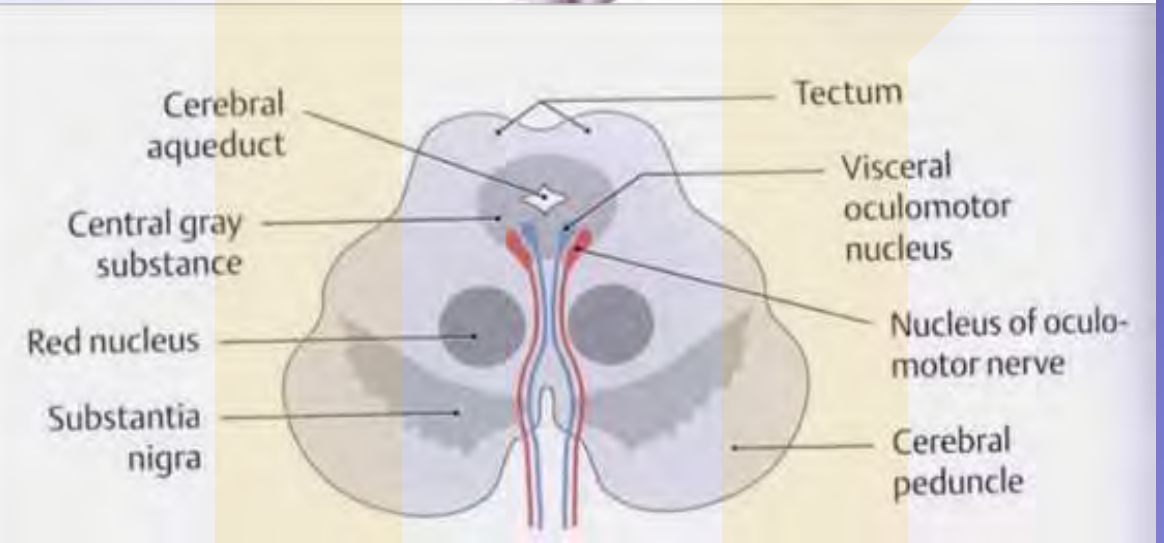
IV. Nervus trochlearis trochlear

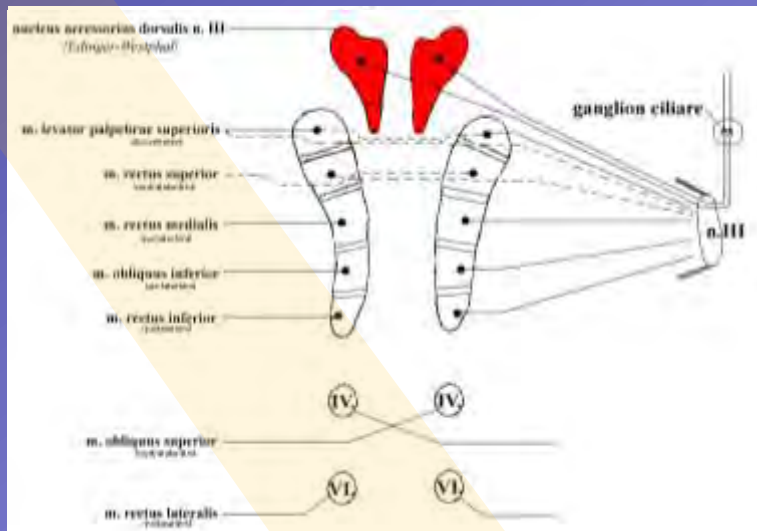
VI. Nervus abducens abductory

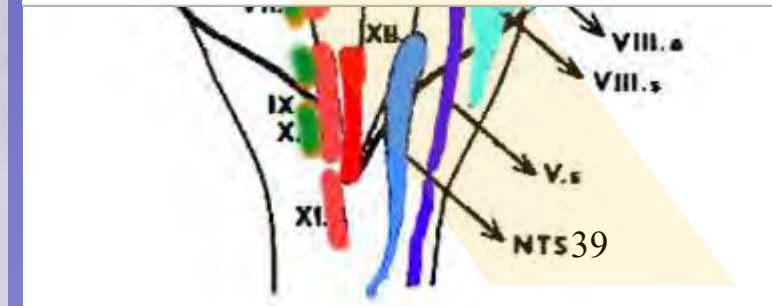


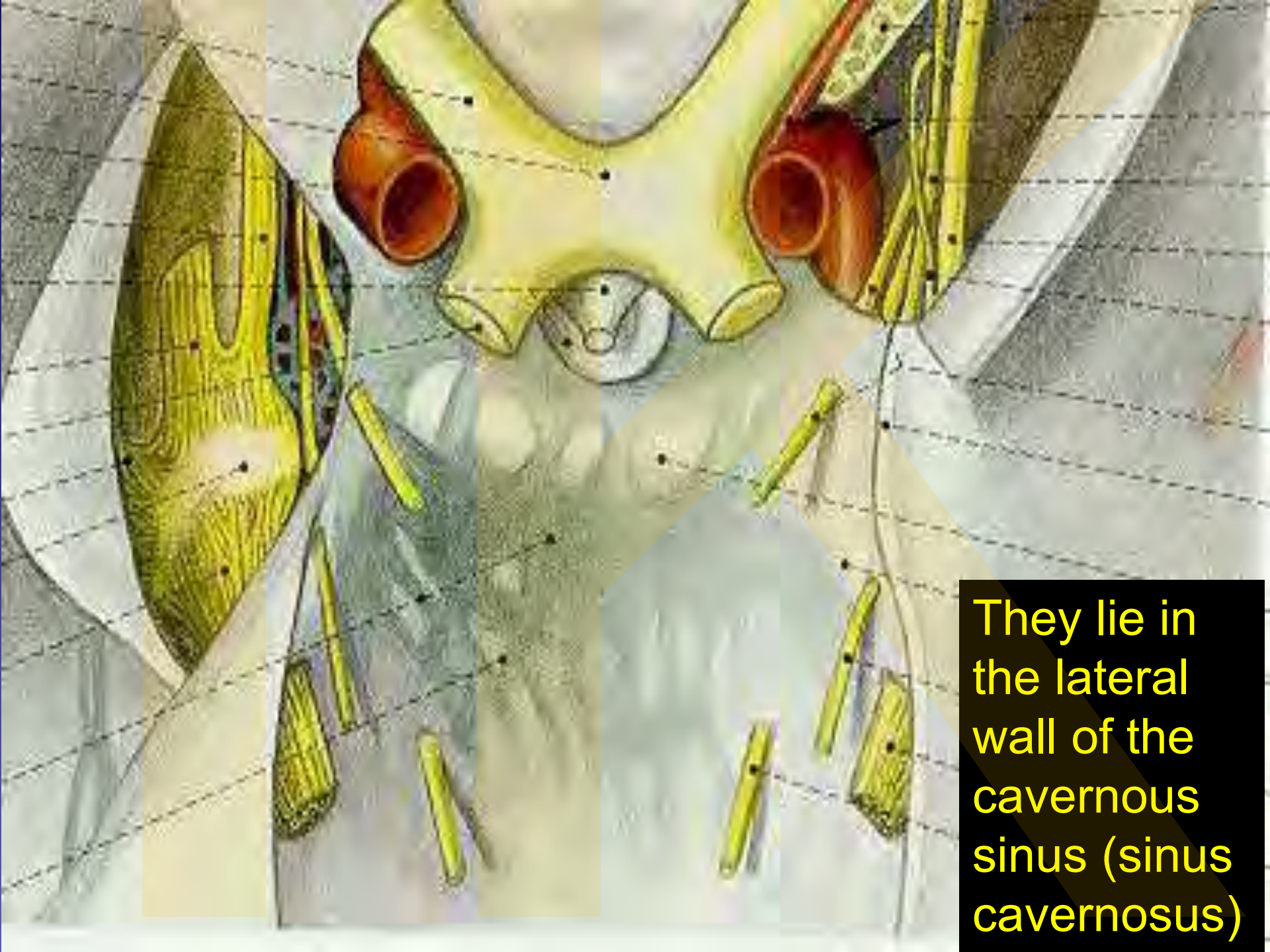
Nuclei of the oculomotory nerves III, IV, VI

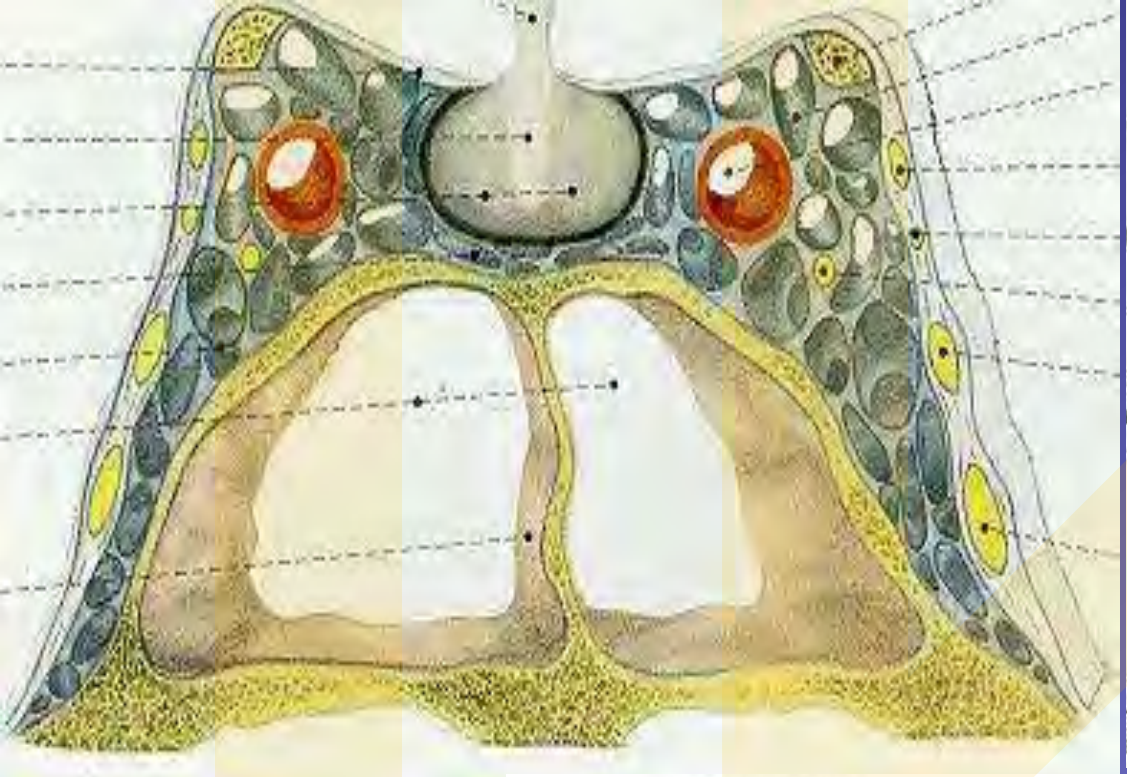


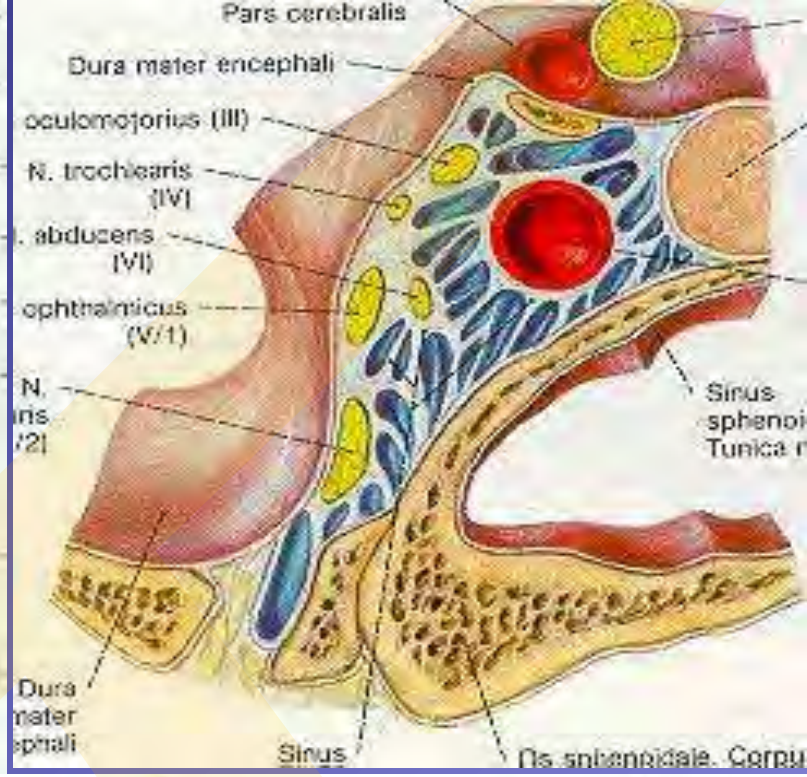






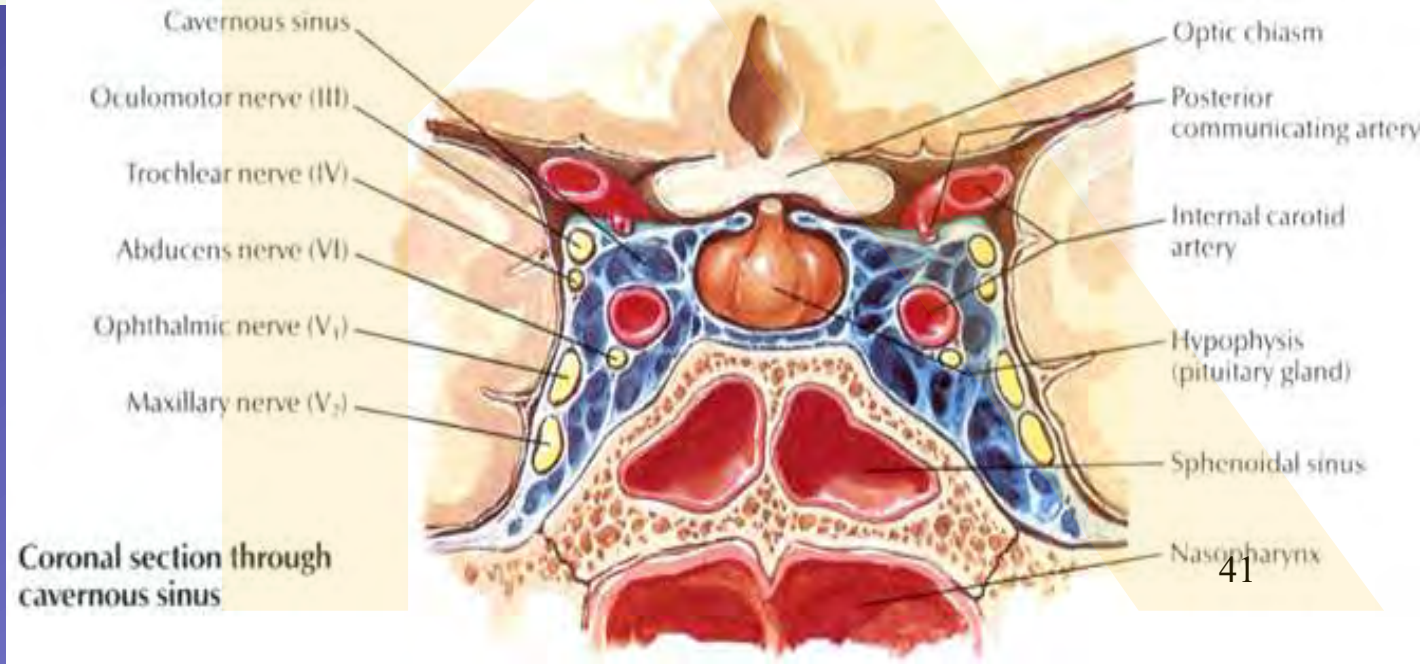

They lie in the lateral wall of the cavernous sinus (sinus cavernosus)





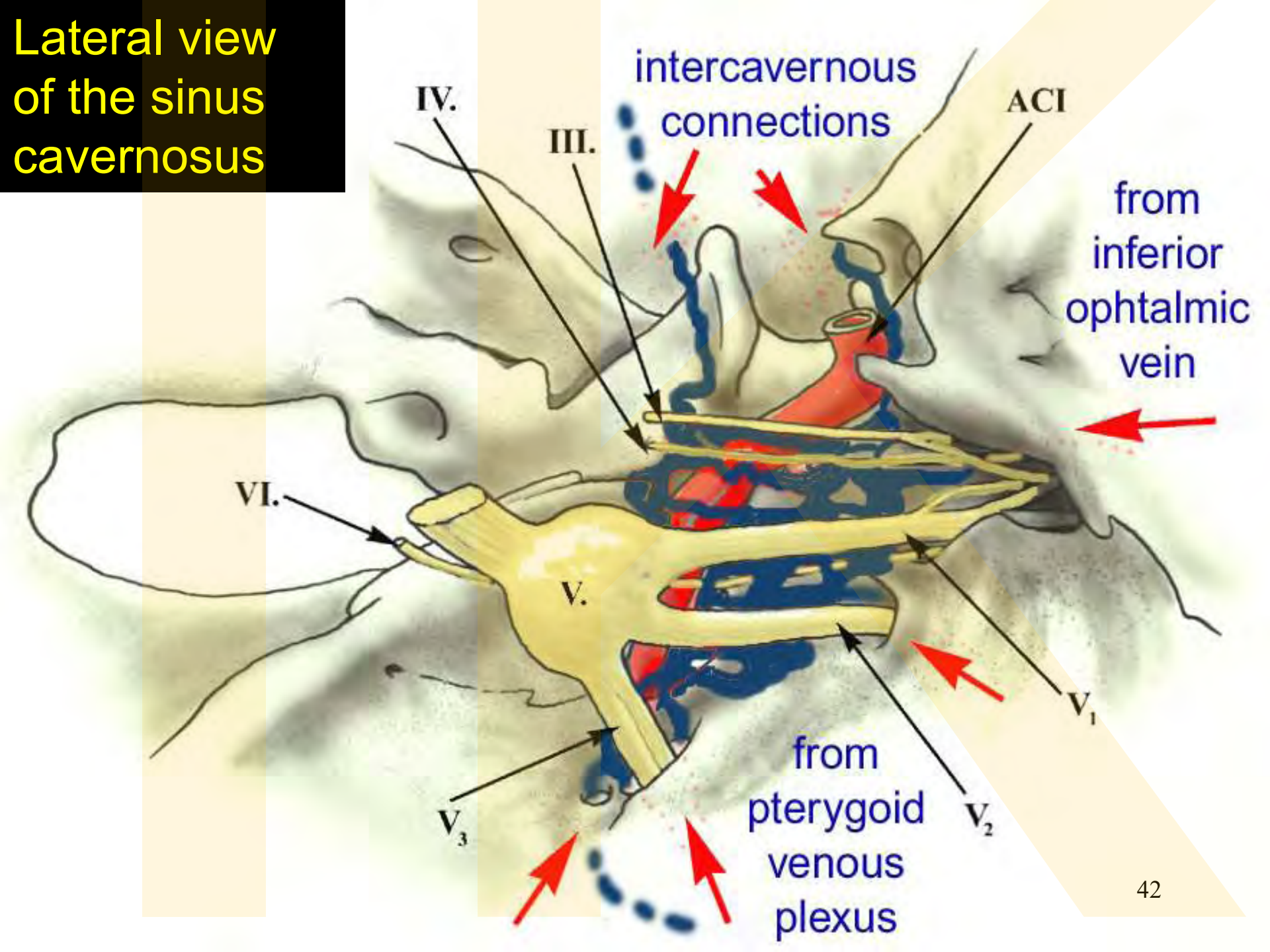
sinus cavernosus

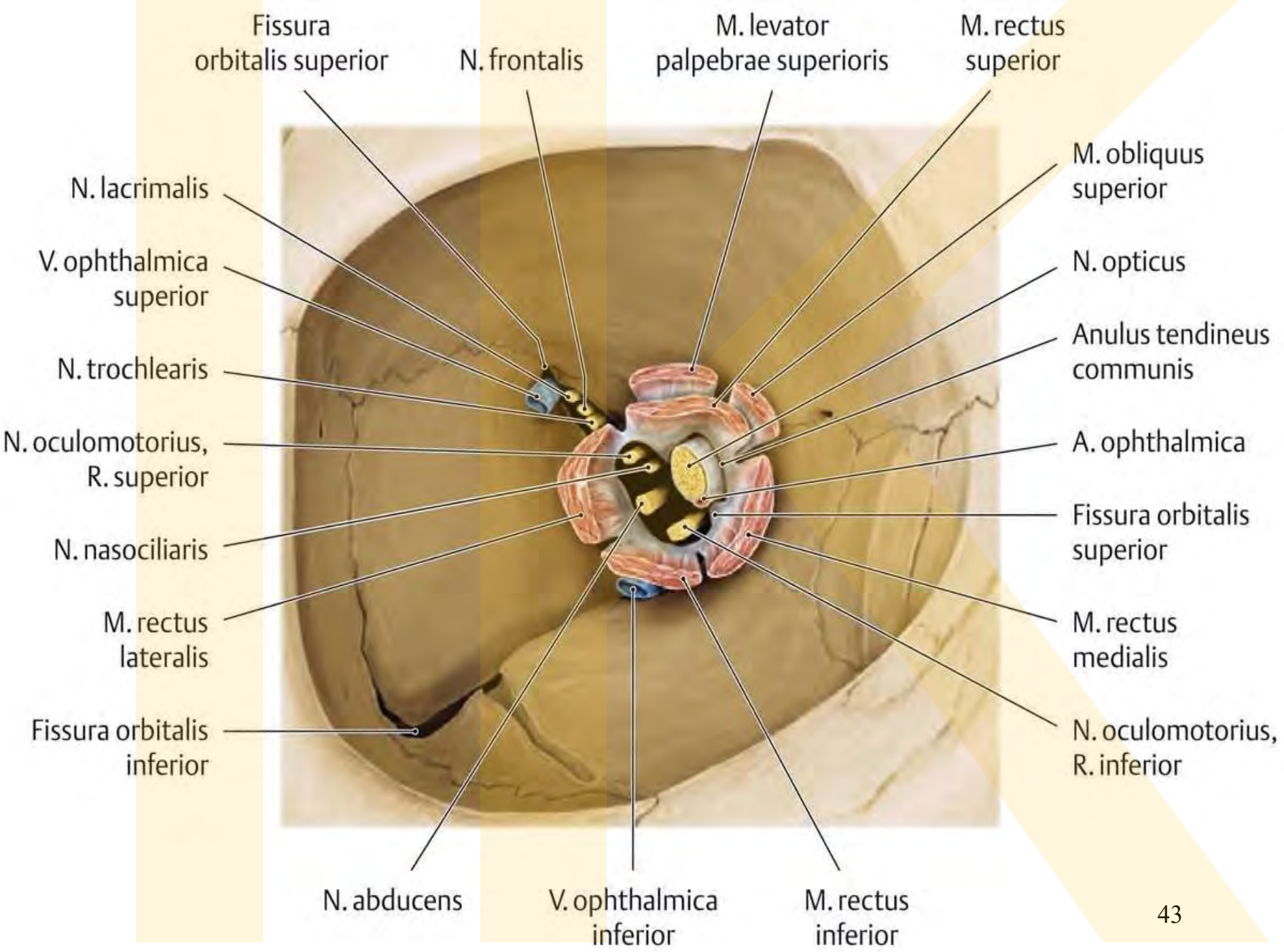
cavernous sinus



Coronal section through cavernous sinus

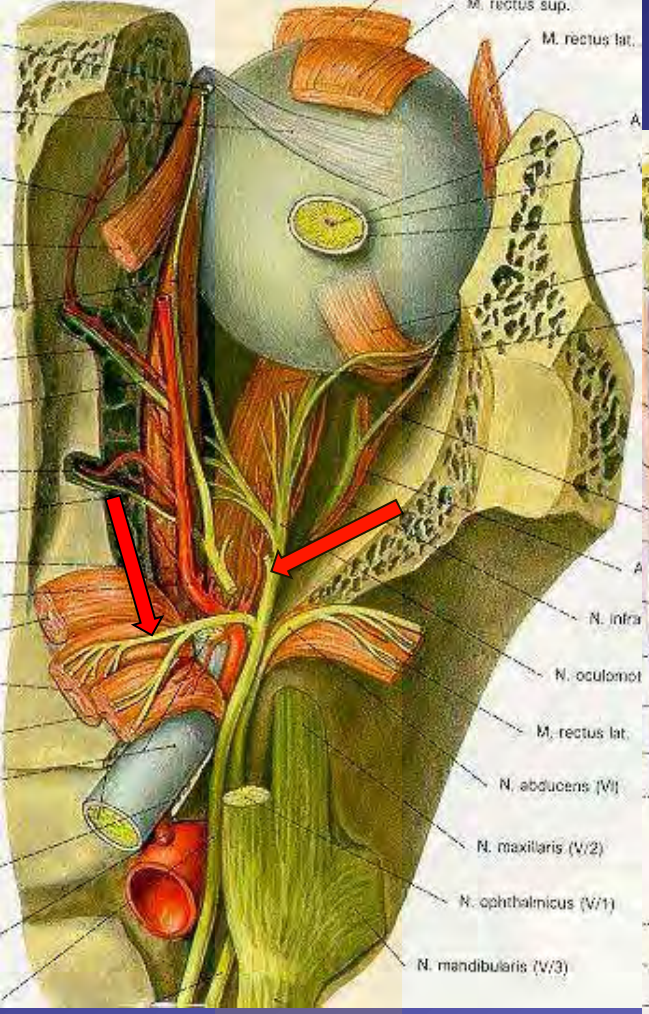
Lateral view of the sinus cavernosus



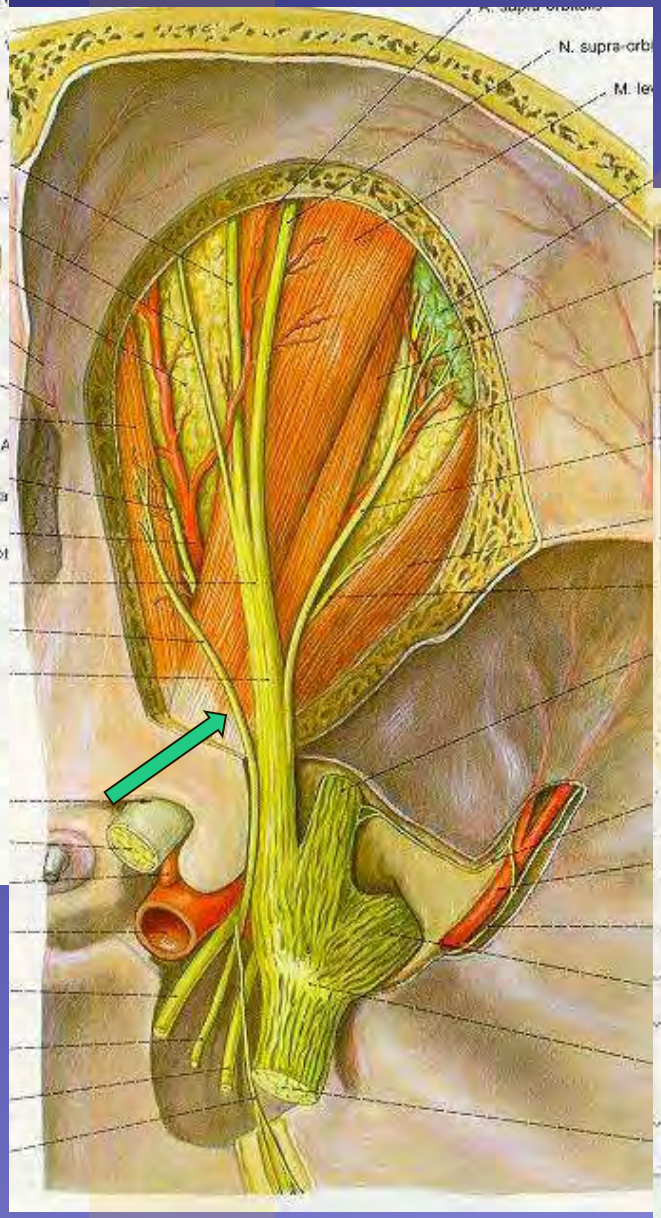

Fissura orbitalis superior
N. frontalis
M. levator palpebrae superioris
M. rectus superior
N. lacrimalis
V. ophthalmica superior
N. trochlearis
N. oculomotorius, R. superior
N. nasociliaris
M. rectus lateralis
Fissura orbitalis inferior
M. obliquus superior
N. opticus
Anulus tendineus communis
A. ophthalmica
Fissura orbitalis superior
M. rectus medialis
N. oculomotorius, R. inferior
N. abducens
V. ophthalmica inferior
M. rectus inferior

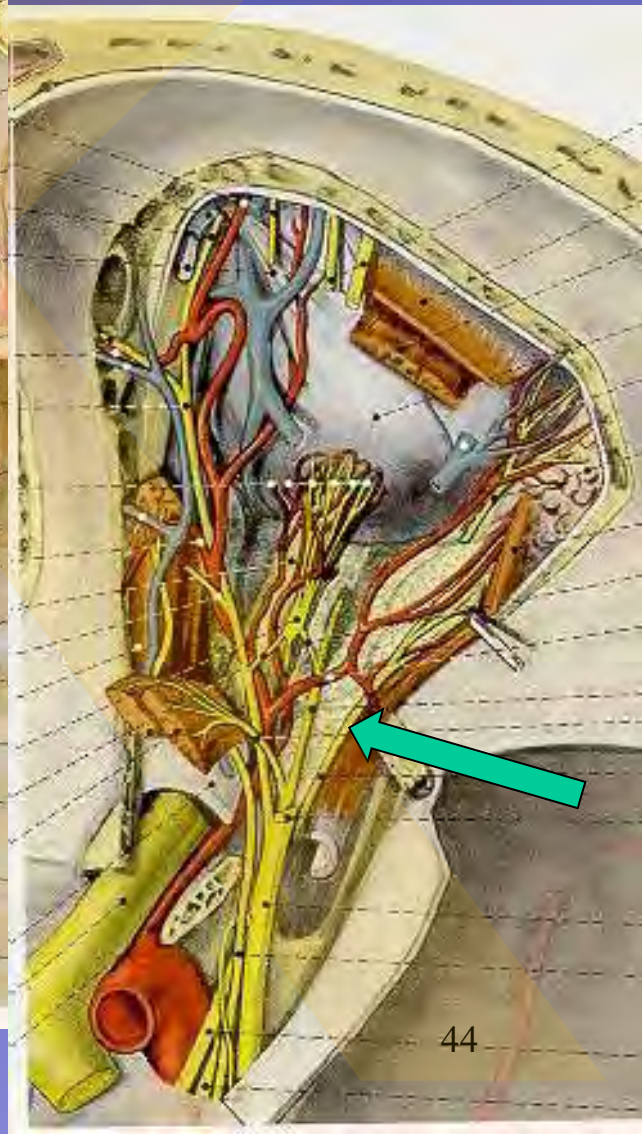
n. IV.

n. VI.

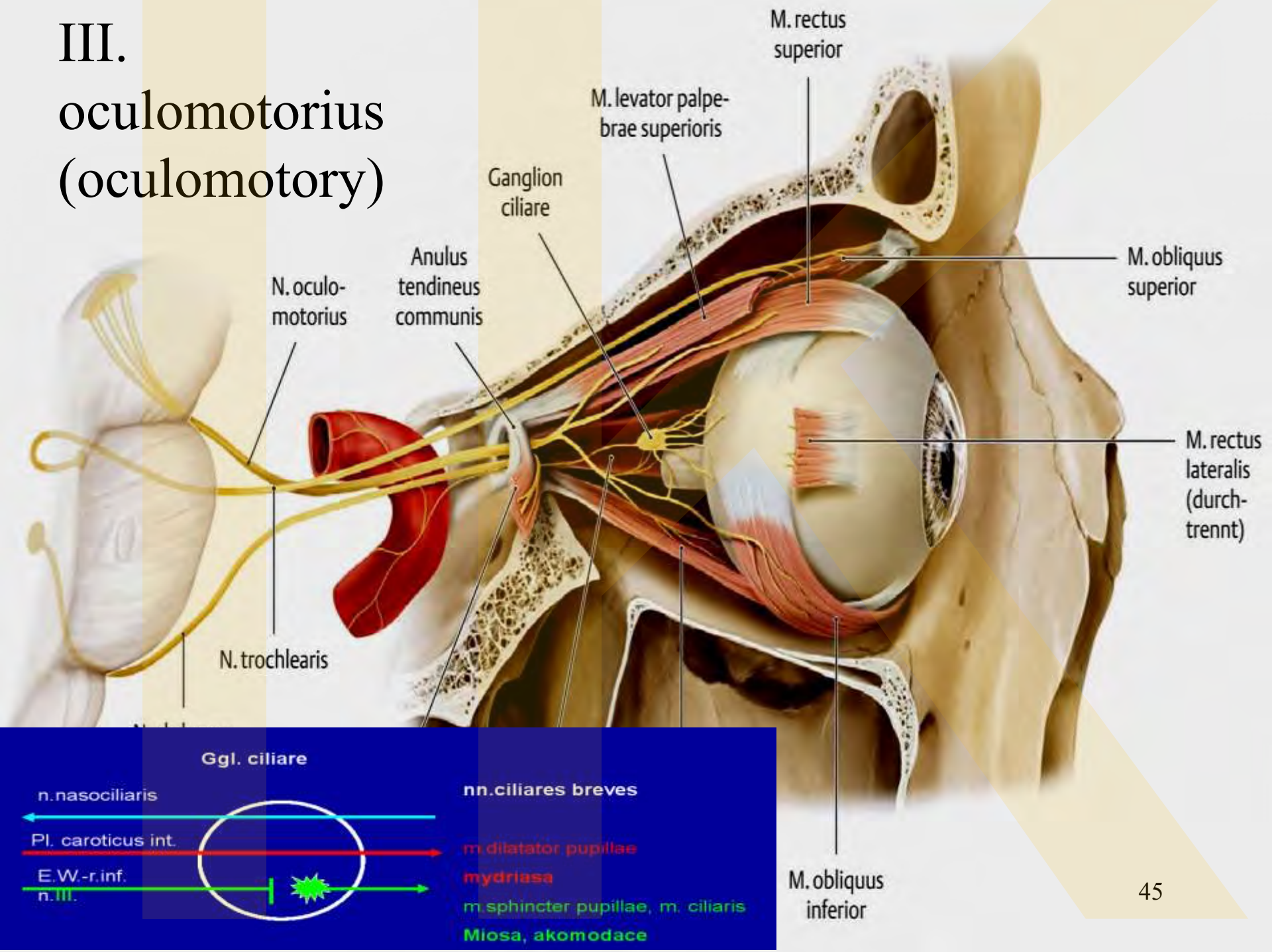

M. rectus sup.
M. rectus lat.
N. infra
N. oculomot
M. rectus lat.
N. abducens (VI)
N. maxillaris (V/2)
N. ophthalmicus (V/1)
N. mandibularis (V/3)

n. III.


N. supra-orb



III. oculomotorius (oculomotory)



Ganglion ciliare (3000-3500 neurons)

AFFERENT FIBERS

Radix parasympatica (oculomotoria) from Edinger-Westphal nc. – inferior branch of n. III. – parasympathetic branch of n. III. o ganglion ciliare.

Radix sympatica – internal carotid plexus: nc. Intermediolateralis (C8-Th1) – spinal nerve – r. communicans albus of the cervical sympathetic ganglion – superior cervical ganglion – internal carotid plexus – sympathetic fiber through ganglion ciliare to dilator pupillae.

Radix sensitiva – from eyeball through ciliary ganglion (communicating branch of ganglion ciliare) to n. nasociliaris.

EFFERENT FIBERS

Nervi ciliares breves (short ciliary nerves). 6-10 branches, which contain sympathetic, parasympathetic and sensitive fibers. They supply corpus ciliare (ciliar body), dilatator pupillae and cornea.

Cranial nerve III CN III

oculomotory oculomotorius

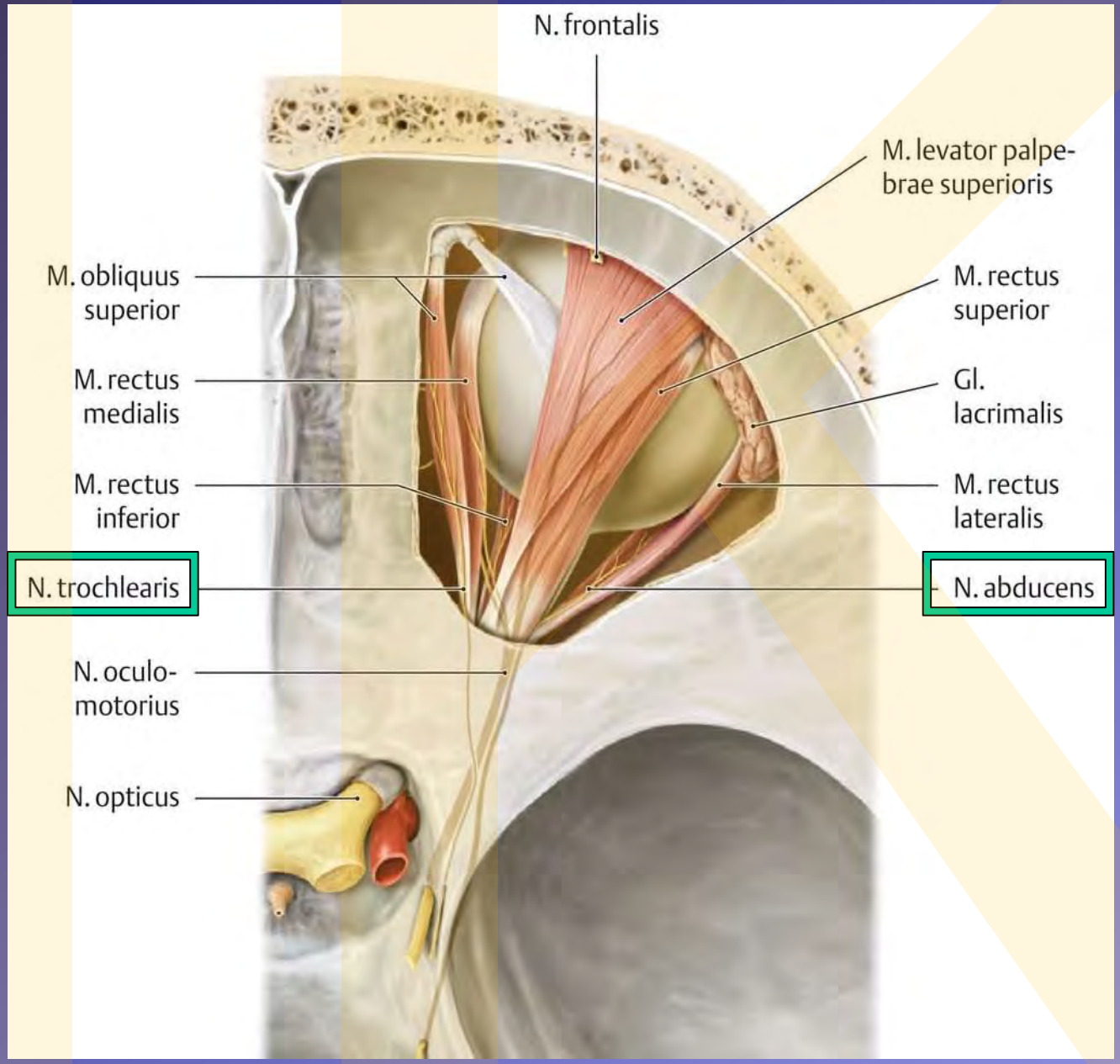
Signal type : motor and parasympathetic

contracts mm. levator palpaebrae superioris, rectus bulbi superior, medialis and obliquus bulbi inferior

Lifts upper eyelid
Makes pupil small;
together with pupil dilators (sympathetic) participates on accomodation

Normal response:
PERRLA- pupils equal round reactive to light and accommodation

IV.
trochlearis



VI.
abducens

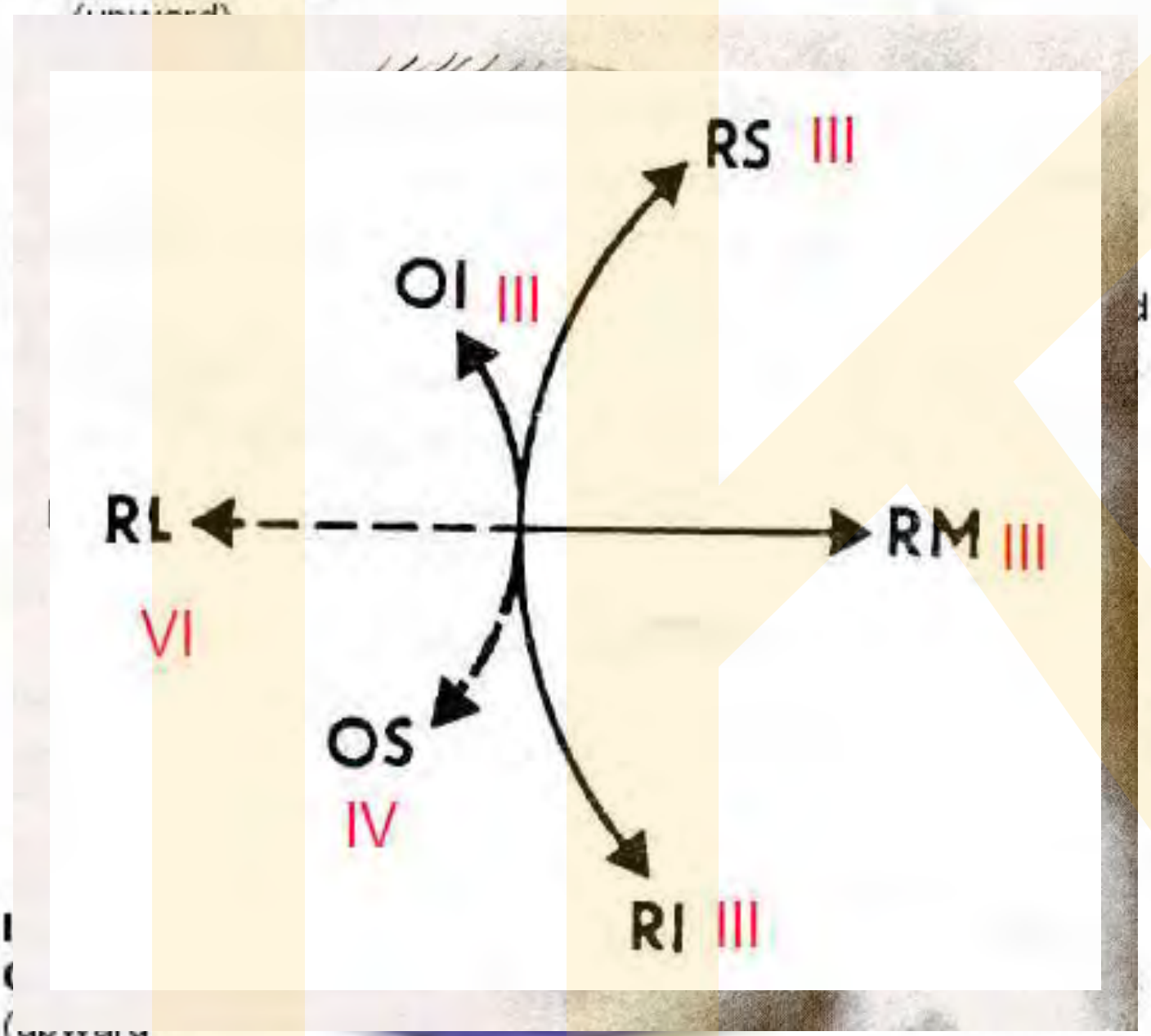
Cranial nerves IV, VI CN IV, VI
trochlear trochlearis, abductory abducens

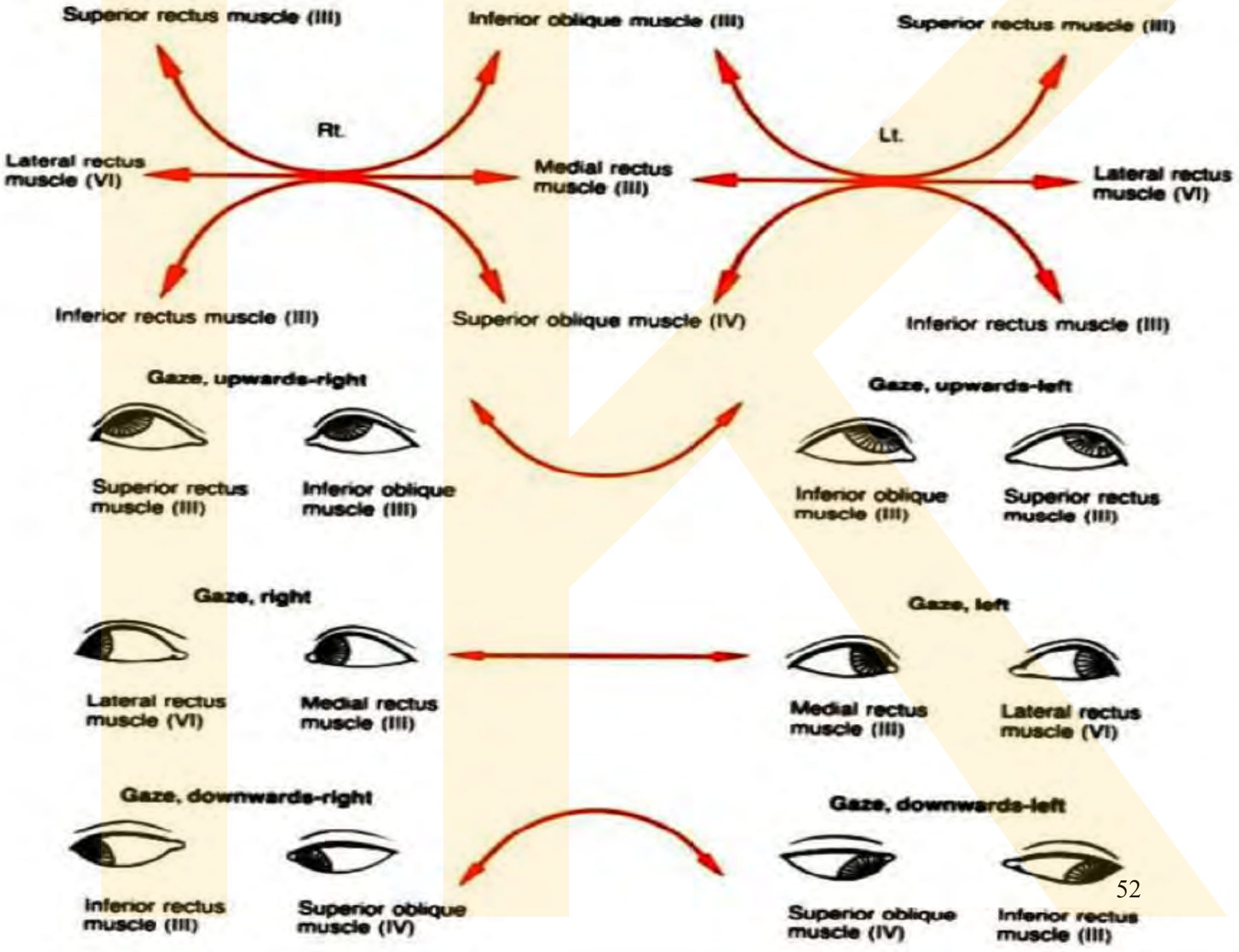
Signal type: motor

helps to semirotate eye bulb to side and down
Helps to rotate eye bulb to lateral side

Extrinsic eyball muscles

Zevní svaly oční

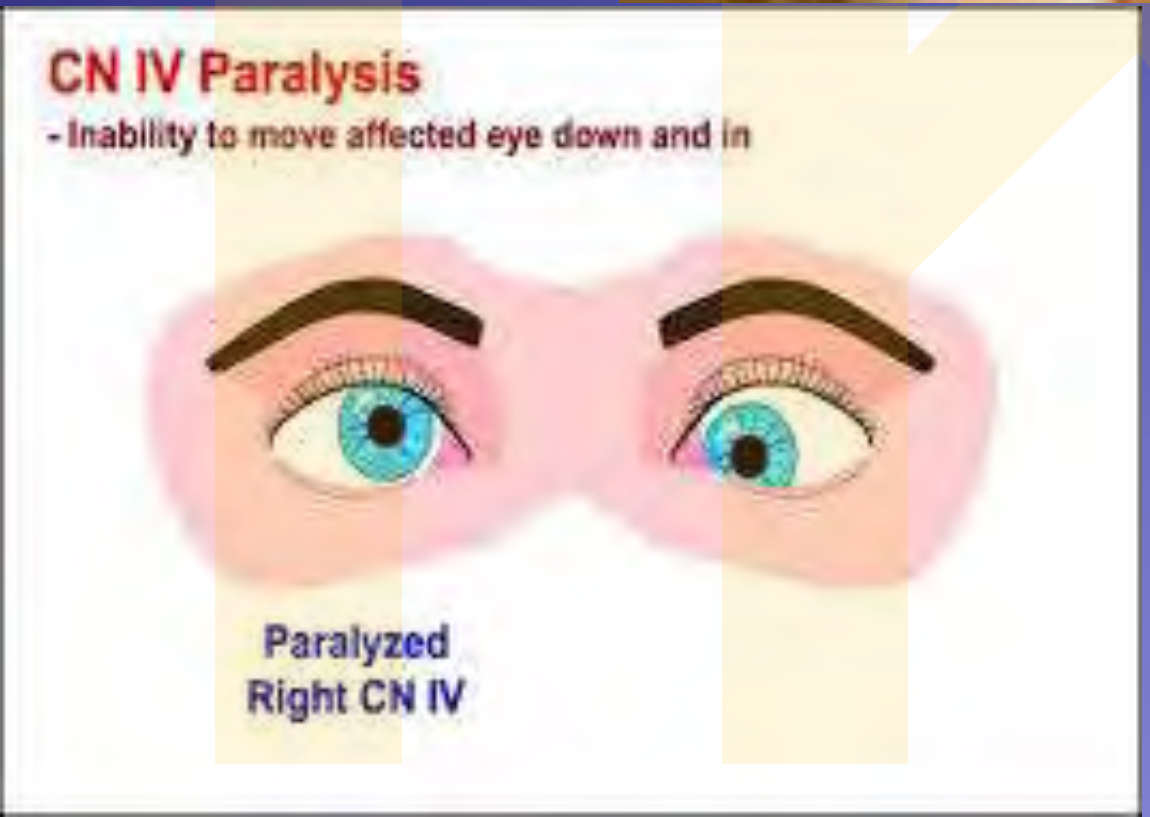



Superior rectus muscle (III)
Inferior oblique muscle (III)
Superior rectus muscle (III)
Rt.
Lt.
Lateral rectus muscle (VI)
Medial rectus muscle (III)
Medial rectus muscle (III)
Lateral rectus muscle (VI)
Inferior rectus muscle (III)
Superior oblique muscle (IV)
Inferior rectus muscle (III)
Gaze, upwards-right
Gaze, upwards-left
Superior rectus muscle (III)
Inferior oblique muscle (III)
Inferior oblique muscle (III)
Superior rectus muscle (III)
Gaze, right
Gaze, left
Lateral rectus muscle (VI)
Medial rectus muscle (III)
Medial rectus muscle (III)
Lateral rectus muscle (VI)
Gaze, downwards-right
Gaze, downwards-left
Inferior rectus muscle (III)
Superior oblique muscle (IV)
Superior oblique muscle (IV)
Inferior rectus muscle (III)

Right
outwa
eyelid
to ptos

iplopie

Palsy of CN IV



Diplopia if look down is; convergenting squint

n. VI. palsy on right side

Convergenting squint, diplopy

Figure 1: Mild Duane's syndrome type I. Few fibers leave the medial rectus' nerve toward the lateral rectus; very asymmetric co-contraction; absence of normal abduction, presence of normal adduction and no abnormal vertical movements

Horner syndrome

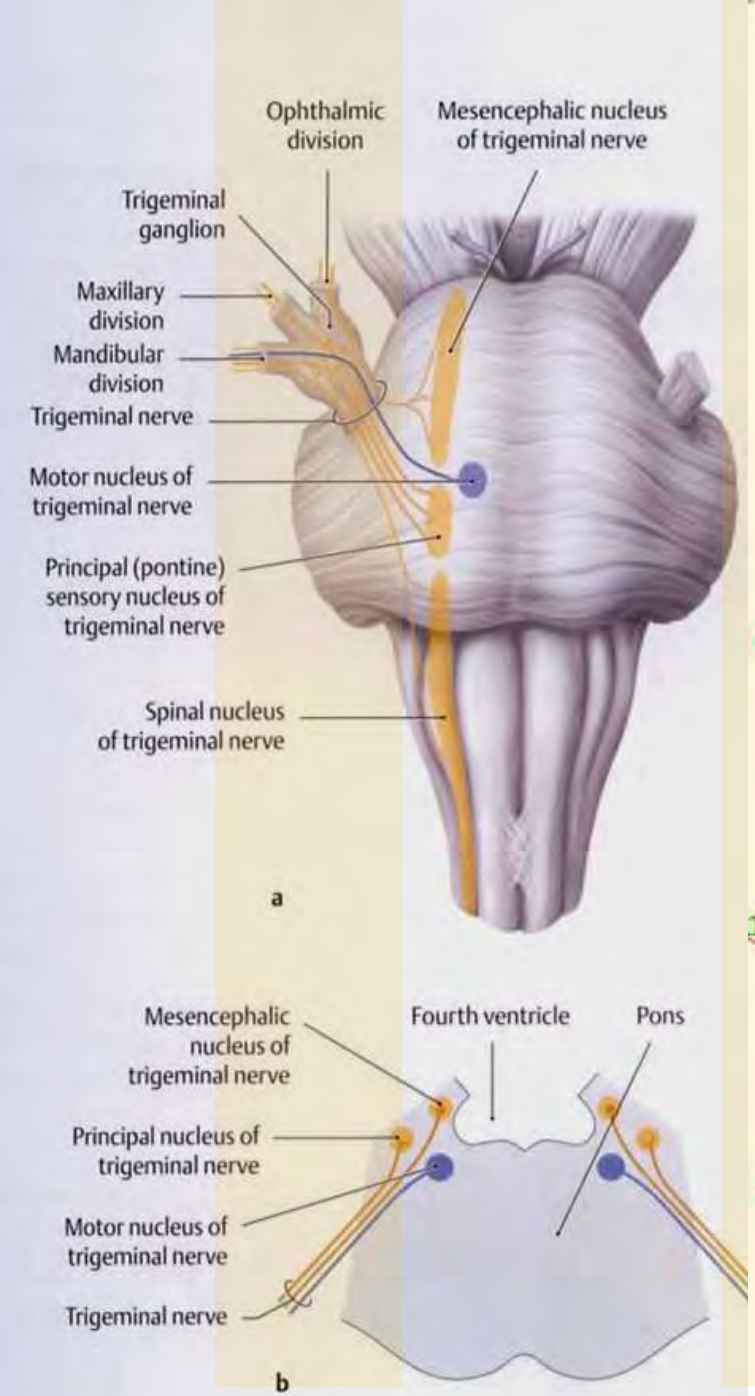
Poškození sympatiku v krční oblasti
- miosis (m. dilatator pupillae)
- ptosis (m. tarsalis)
- enophthalmus (mm. orbitales)

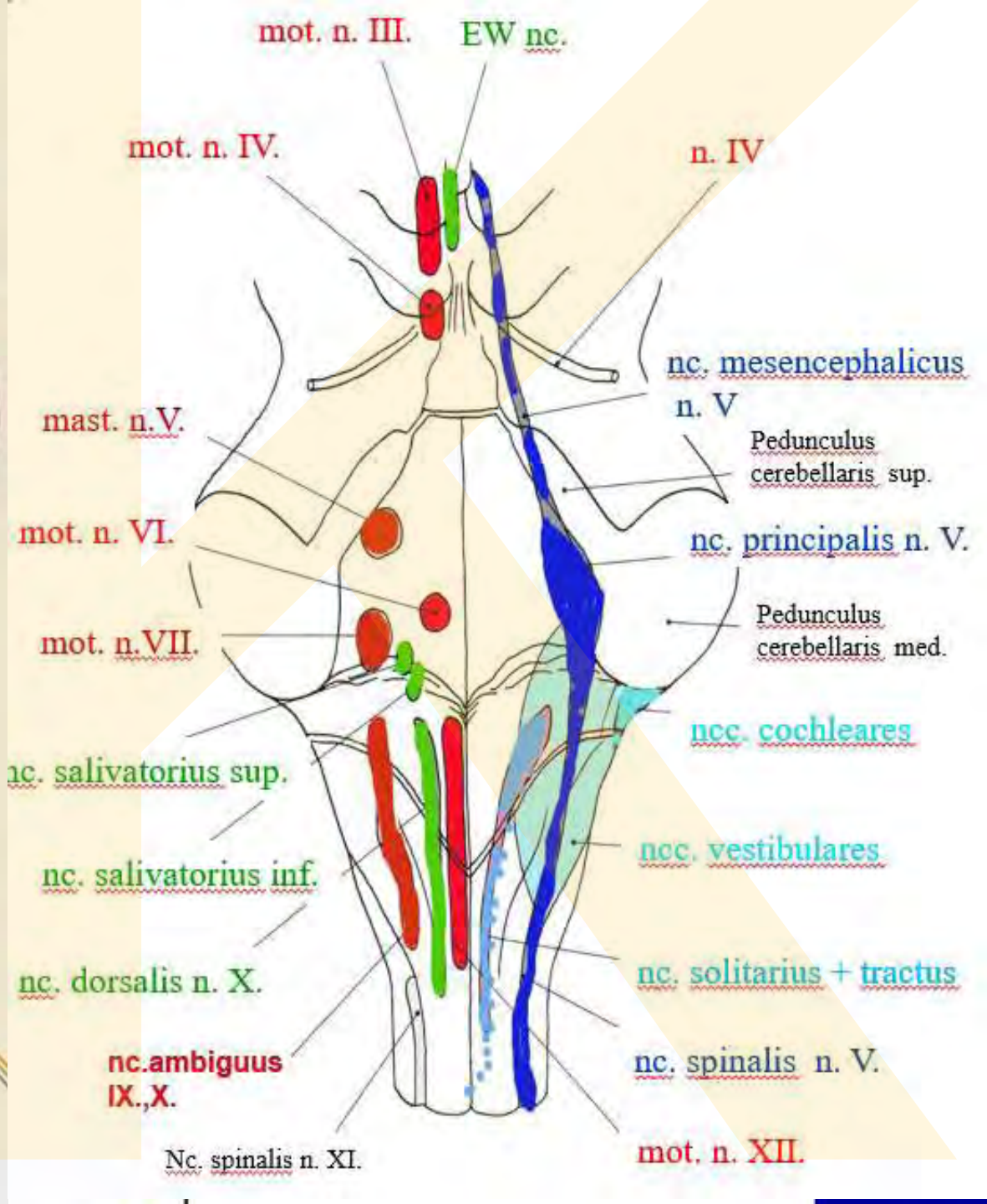
Trauma of sympathetic fibers in neck

Ptosis
Miosis
enophtalmus

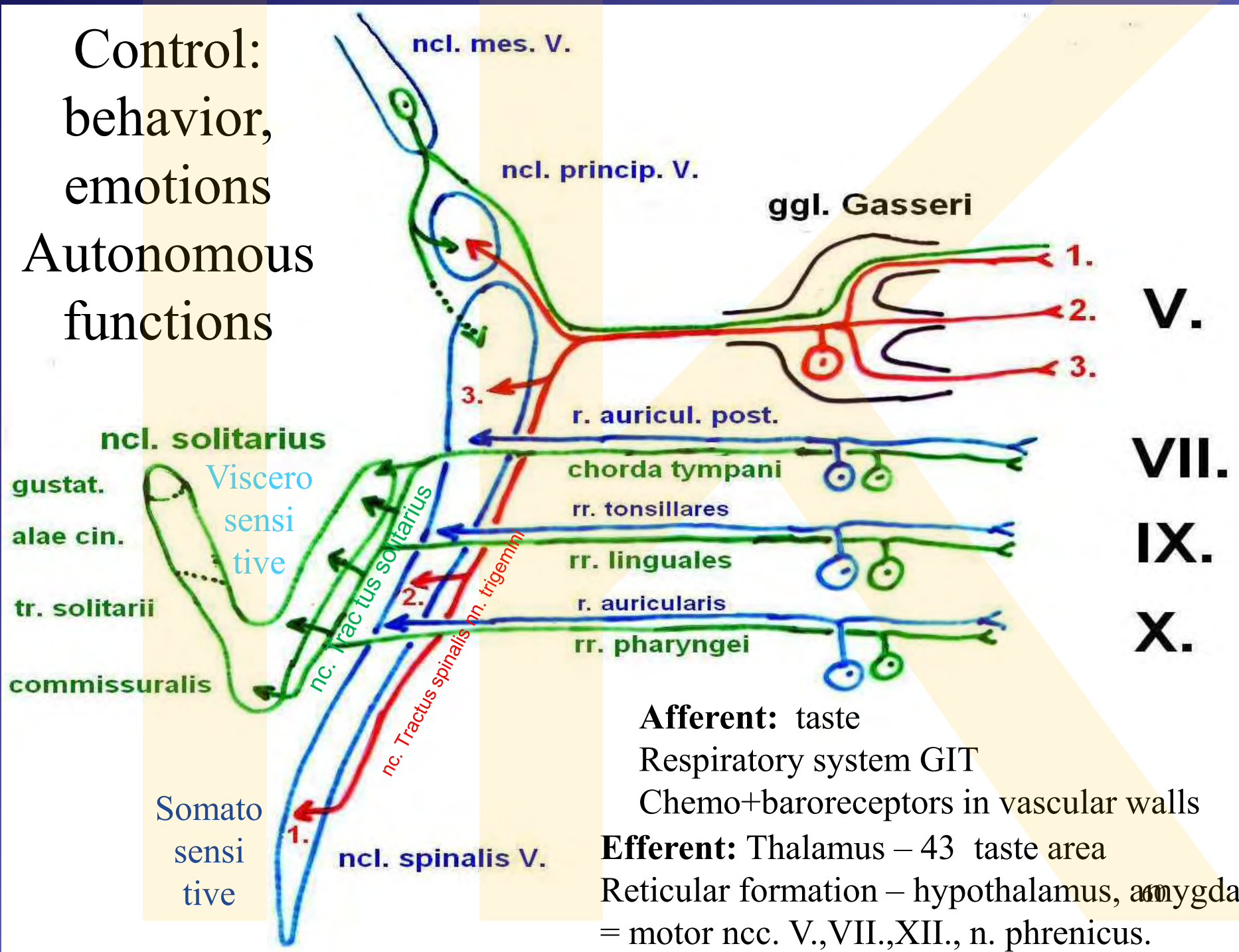
CN V. Trigeminal nerve, trigeminus (three branches)

Sensory and motor


Ophthalmic division
Mesencephalic nucleus of trigeminal nerve
Trigeminal ganglion
Maxillary division
Mandibular division
Trigeminal nerve
Motor nucleus of trigeminal nerve
Principal (pontine) sensory nucleus of trigeminal nerve
Spinal nucleus of trigeminal nerve
a
Mesencephalic nucleus of trigeminal nerve
Fourth ventricle
Pons
Principal nucleus of trigeminal nerve
Motor nucleus of trigeminal nerve
Trigeminal nerve
b

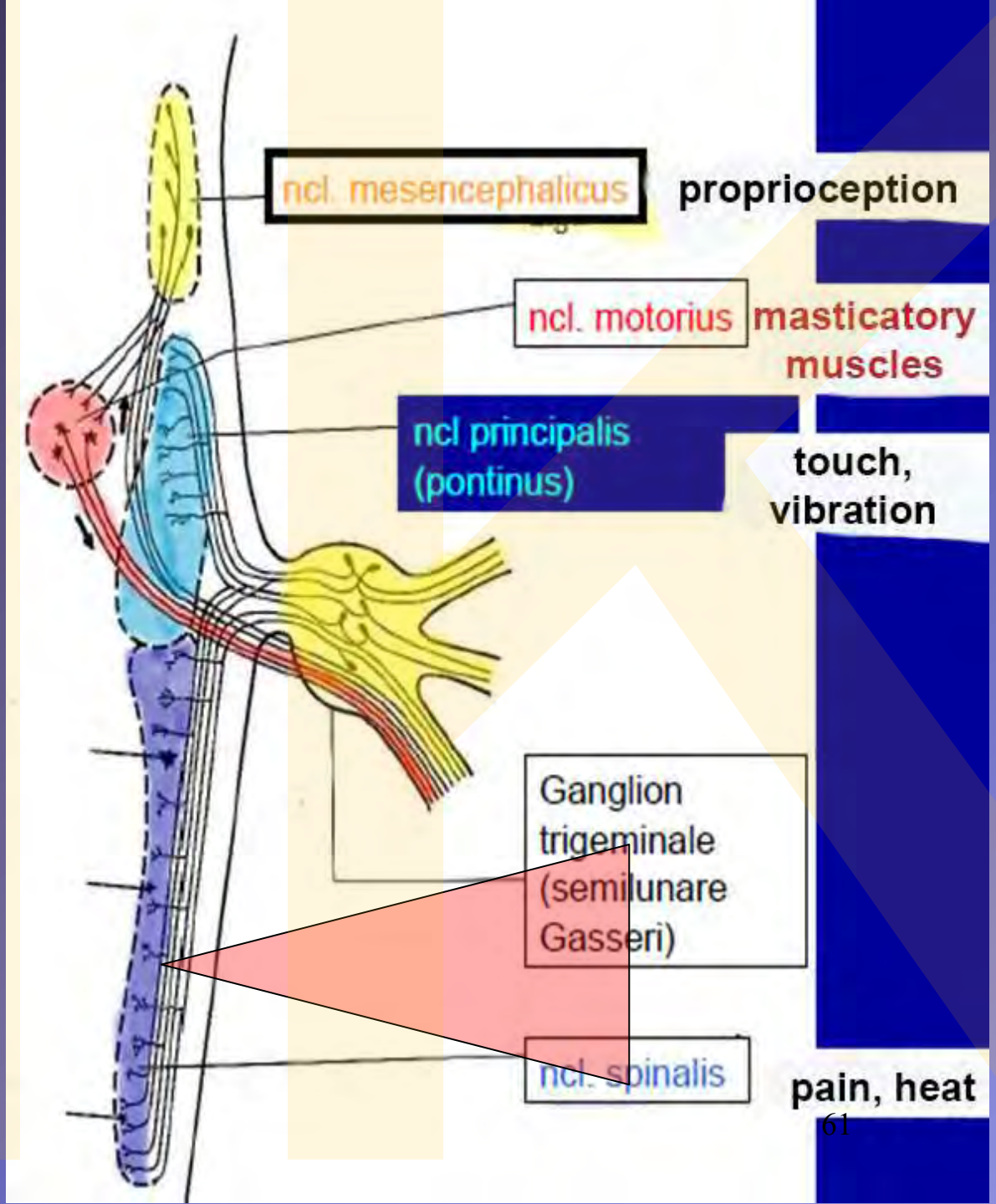

mot. n. III.
EW nc.
mot. n. IV.
n. IV
nc. mesencephalicus n. V
mast. n.V.
Pedunculus cerebellaris sup.
mot. n. VI.
nc. principalis n. V.
Pedunculus cerebellaris med.
mot. n.VII.
ncc. cochleares
nc. salivatorius sup.
ncc. vestibulares
nc. salivatorius inf.
nc. solitarius + tractus
nc. dorsalis n. X.
nc. spinalis n. V.
nc.ambiguus IX.,X.
mot. n. XII.
Nc. spinalis n. XI.

Control: behavior, emotions Autonomous functions



Afferent: taste
Respiratory system GIT
Chemo+baroreceptors in vascular walls

Efferent: Thalamus – 43 taste area
Reticular formation – hypothalamus, amygdala
= motor ncc. V.,VII.,XII., n. phrenicus.


ncl. mesencephalicus
proprioception
ncl. motorius
masticatory muscles
ncl principalis (pontinus)
touch, vibration
Ganglion trigeminale (semilunare Gasseri)
ncl. spinalis
pain, heat

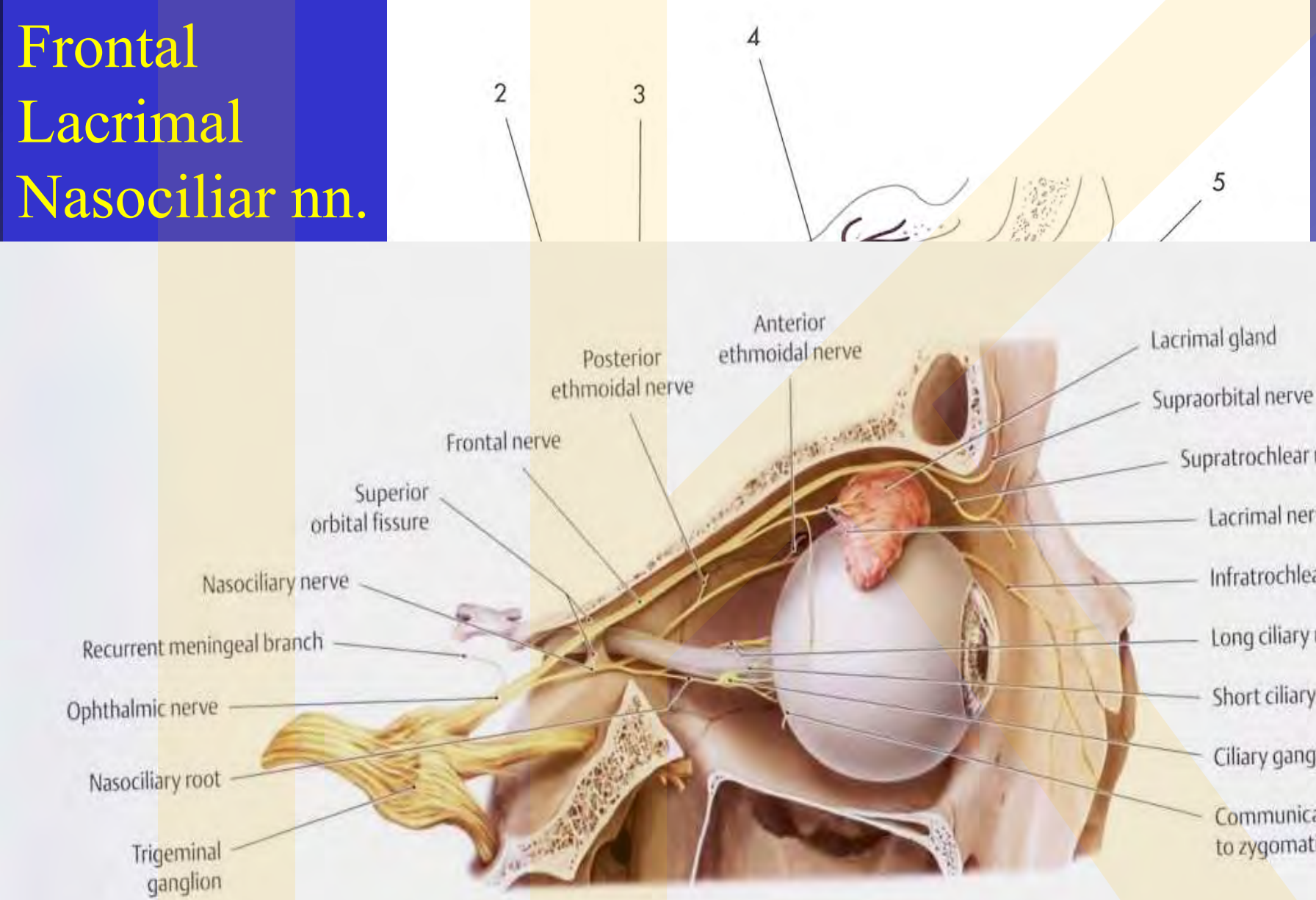
1. Branch of the CN V.

- n. ophtalmicus ophtalmic sensitive

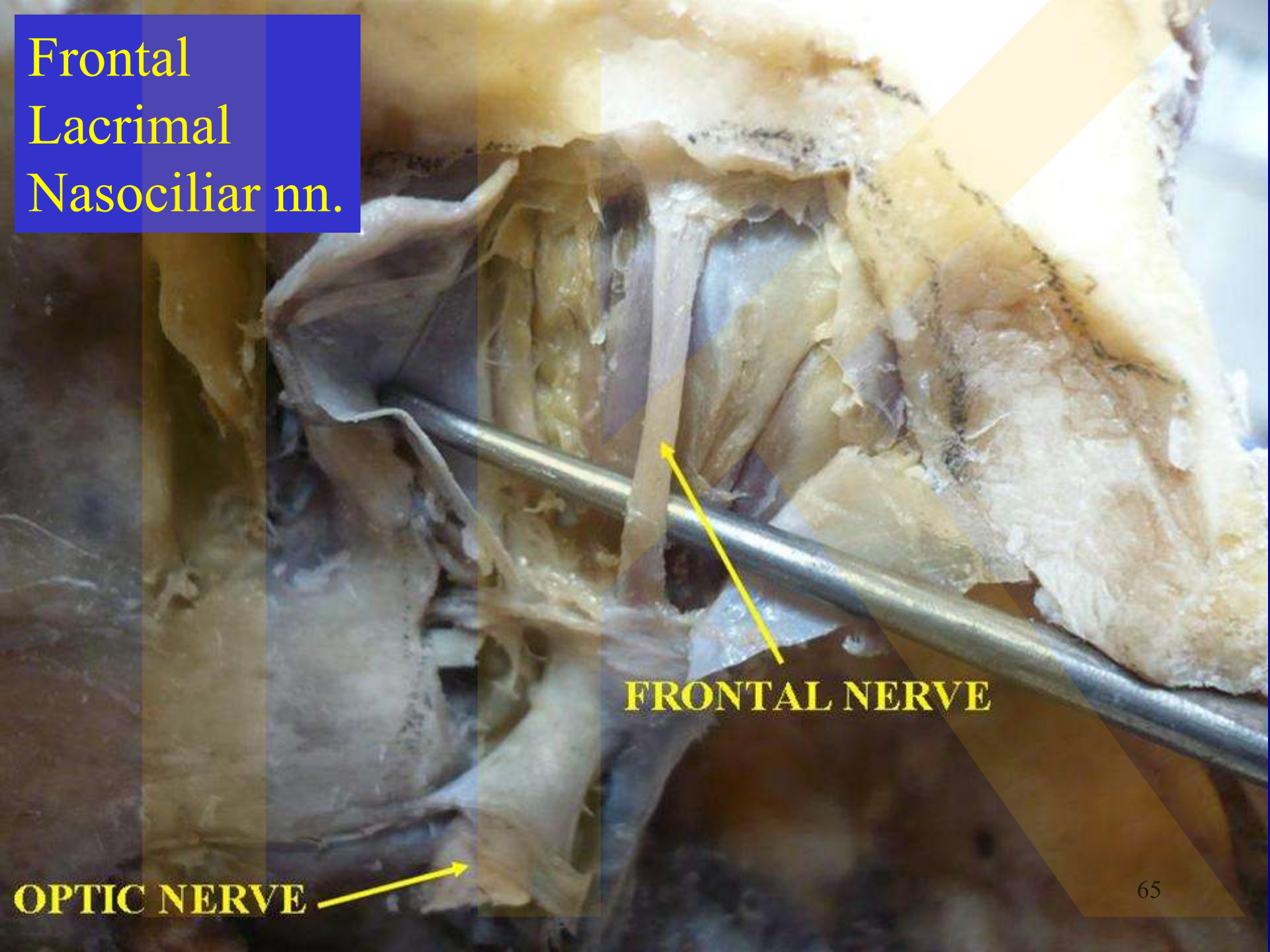
- N. frontalis – n. supratrochlearis – glabela
- n. supraorbitalis – forehead
- N. lacrimalis – gl. lacrimalis, outer corner of the orbit
- r. commun. cum n. zygomatico
- N. nasociliaris – nasal cavity ventrally, dorsum of nose - n. ethmoidalis post.et ant.

nn. cilares longi – eyball

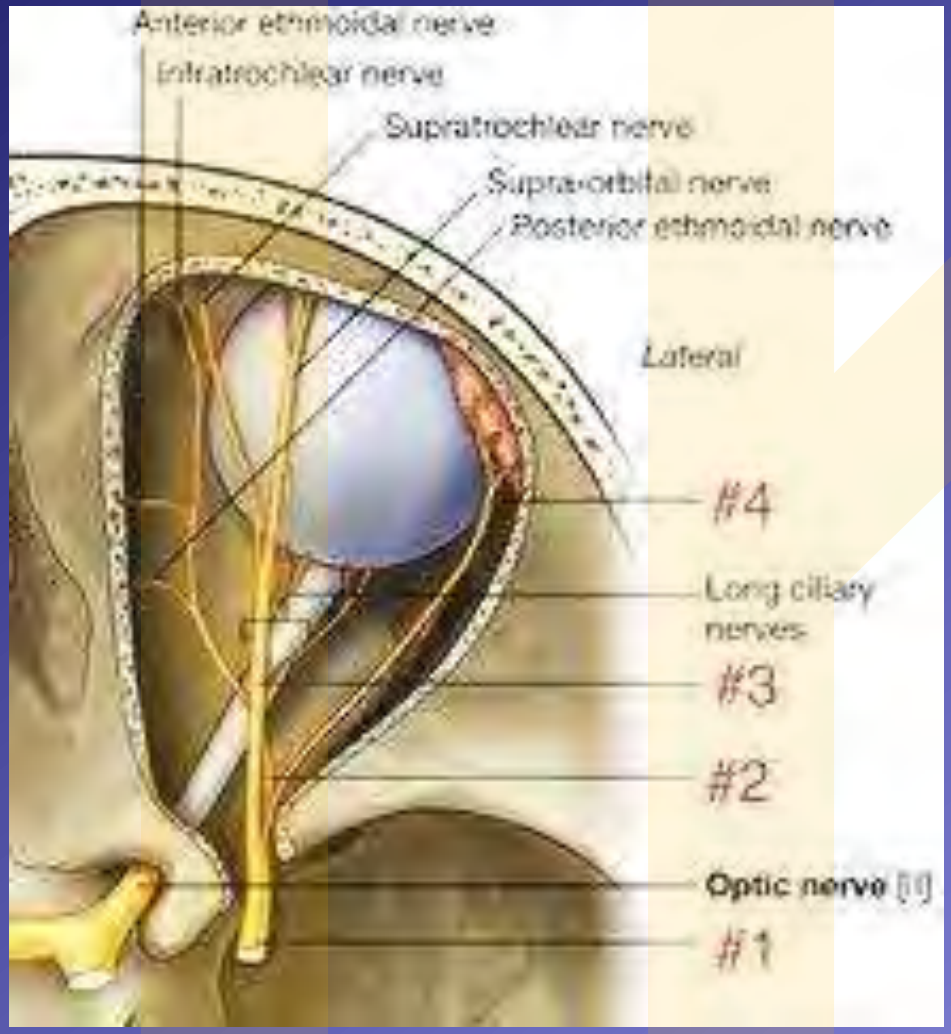
Frontal
Lacrimal
Nasociliar nn.



Obr. 1.42. Nervus nasociliaris a jeho větve. 1 – nervus frontalis, 2 – nervus nasociliaris, 3 – nervus ethmoidalis posterior, 4 – nervus ethmoidalis anterior, 5 – n. infratrochlearis a jeho konečné větve pro kůži vnitřního koutku, 6 – ramus communicans cum ganglio ciliari, 7 – ganglioin ciliare, 8 – nervi ciliares longi, 9 – ganglion trigeminale, 10 – nervus trigeminus


Frontal
Lacrimal
Nasociliar nn.
FRONTAL NERVE
OPTIC NERVE

Identify



#4 n. lacrimalis
#3 n. frontalis
#2 n. nasociliaris
#1 n. ophtalmicus

2. Branch of the CN V

maxillary n., upper jaw nerve – sensitive

- nn. pterygopalatini – through ganglion on dorsal half of the nasal cavity and palate
- – n.palatinus major and nn. palatini minores
- n. infraorbitalis – rr. alveolares sup. post.
- r. alveolaris medius

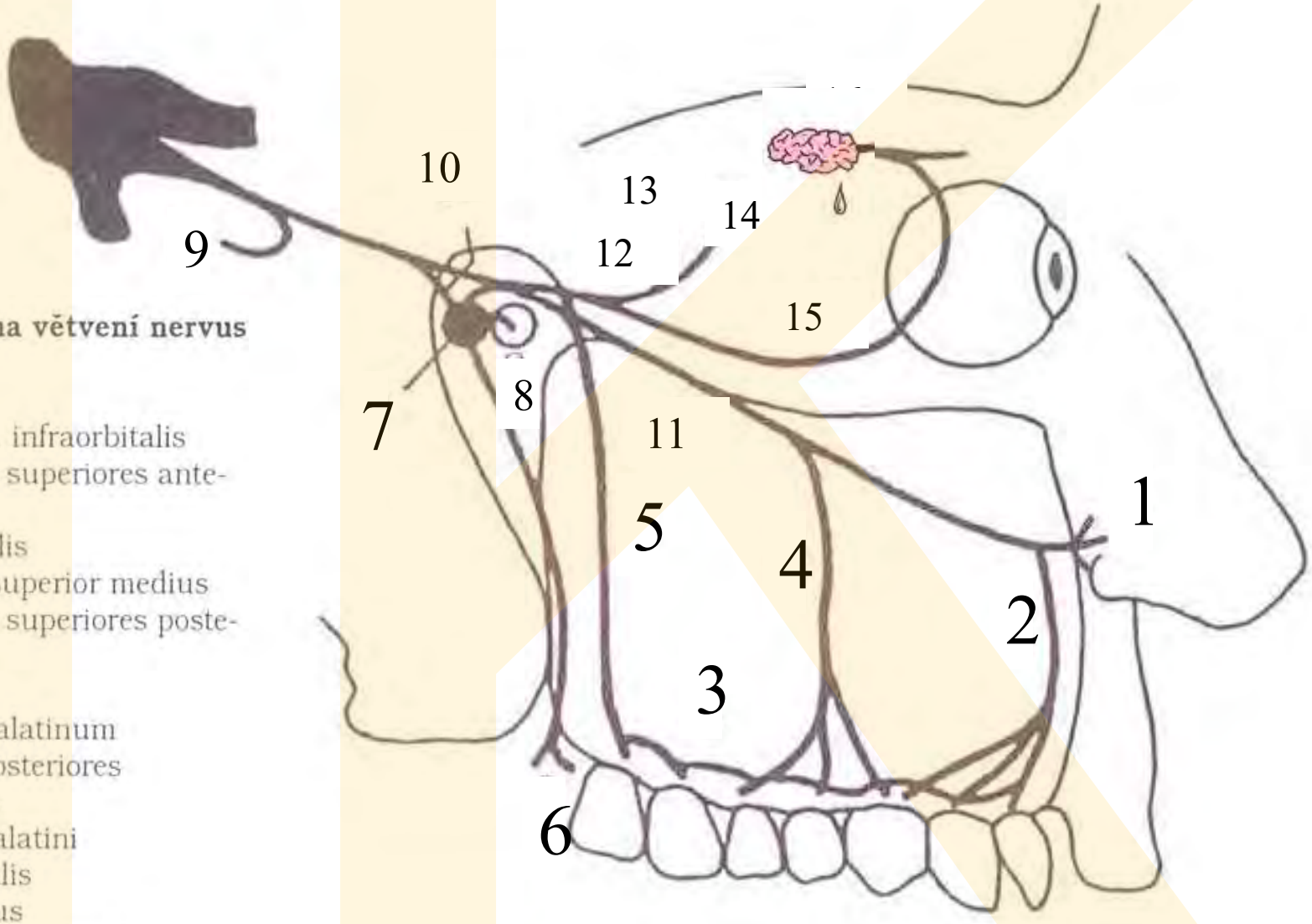
rr. alveolares sup. ant.

n. zygomaticus - through FOI into orbit ,

- n. zygomaticofacialis

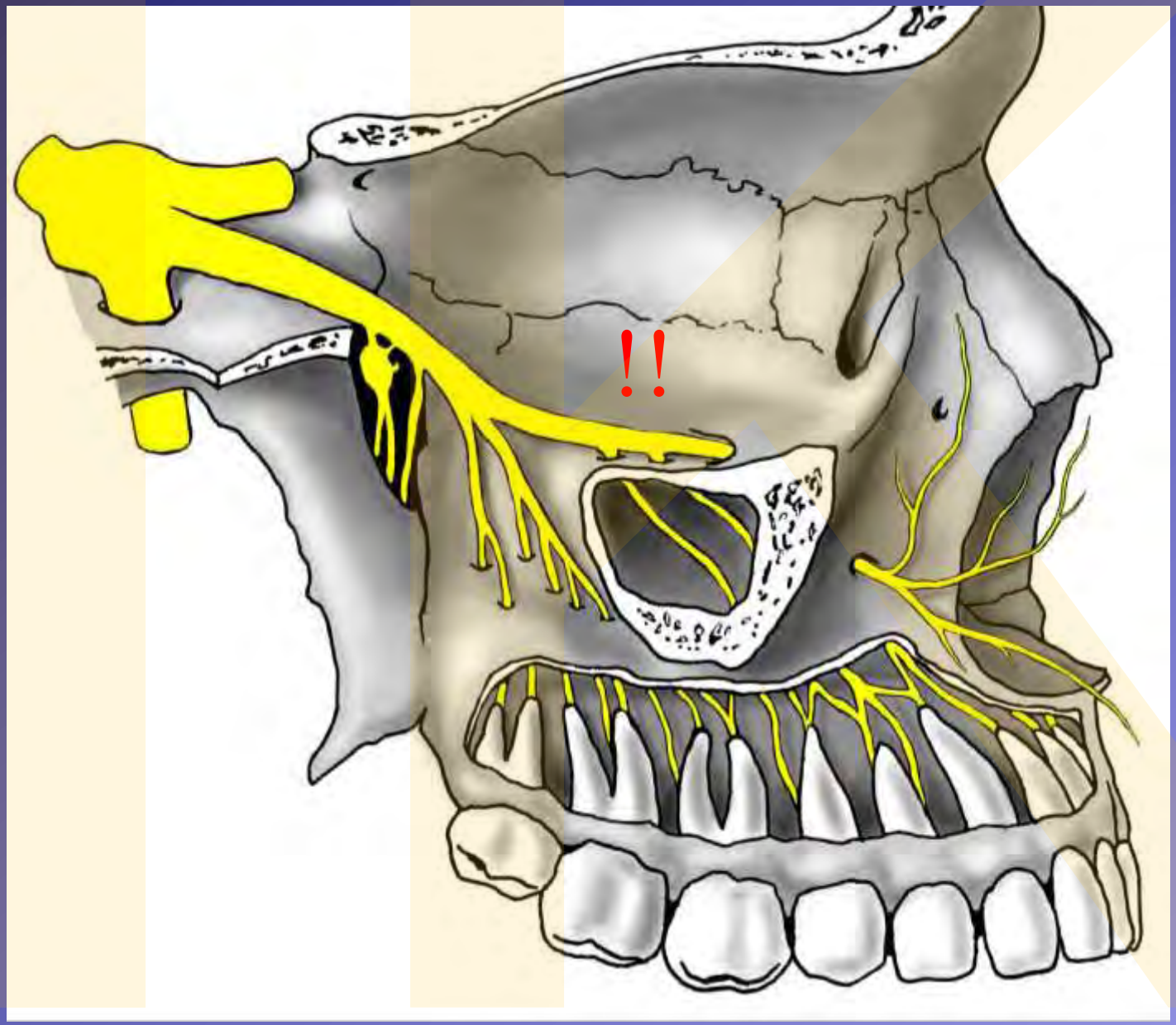
- n. zygomaticotemporalis

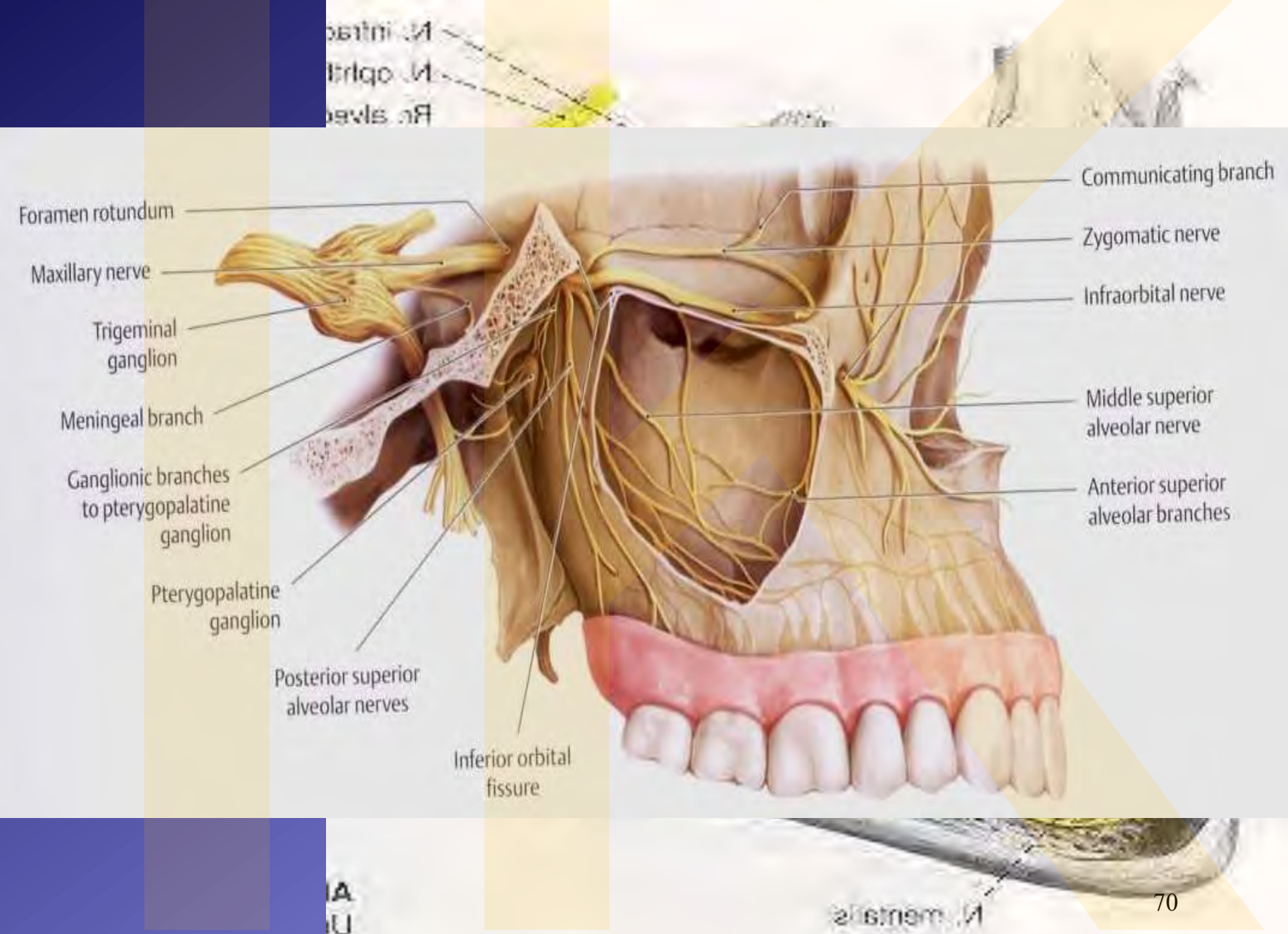
V_2



Obr. 31/II. Schéma větvení nervus maxillaris.

1 – rr. cutanei n. infraorbitalis
2 – rr. alveolares superiores anteriores
3 – plexus dentalis
4 – r. alveolaris superior medius
5 – rr. alveolares superiores posteriores
6 – nn. palatini
7 – ggl. pterygopalatinum
8 – rr. nasales posteriores
9 – r. meningeus
10 – nn. pterygopalatini
11 – n. infraorbitalis
12 – n. zygomaticus
13 – n. zygomaticotemporalis
14 – n. zygomaticofacialis
15 – r. communicans cum nervo lacrimali
16 – n. lacrimalis




Foramen rotundum
Maxillary nerve
Trigeminal ganglion
Meningeal branch
Ganglionic branches to pterygopalatine ganglion
Pterygopalatine ganglion
Posterior superior alveolar nerves
Inferior orbital fissure
Communicating branch
Zygomatic nerve
Infraorbital nerve
Middle superior alveolar nerve
Anterior superior alveolar branches

3. Branch of the CN V

mandibularis, lower jaw nerve - sensitive and motor

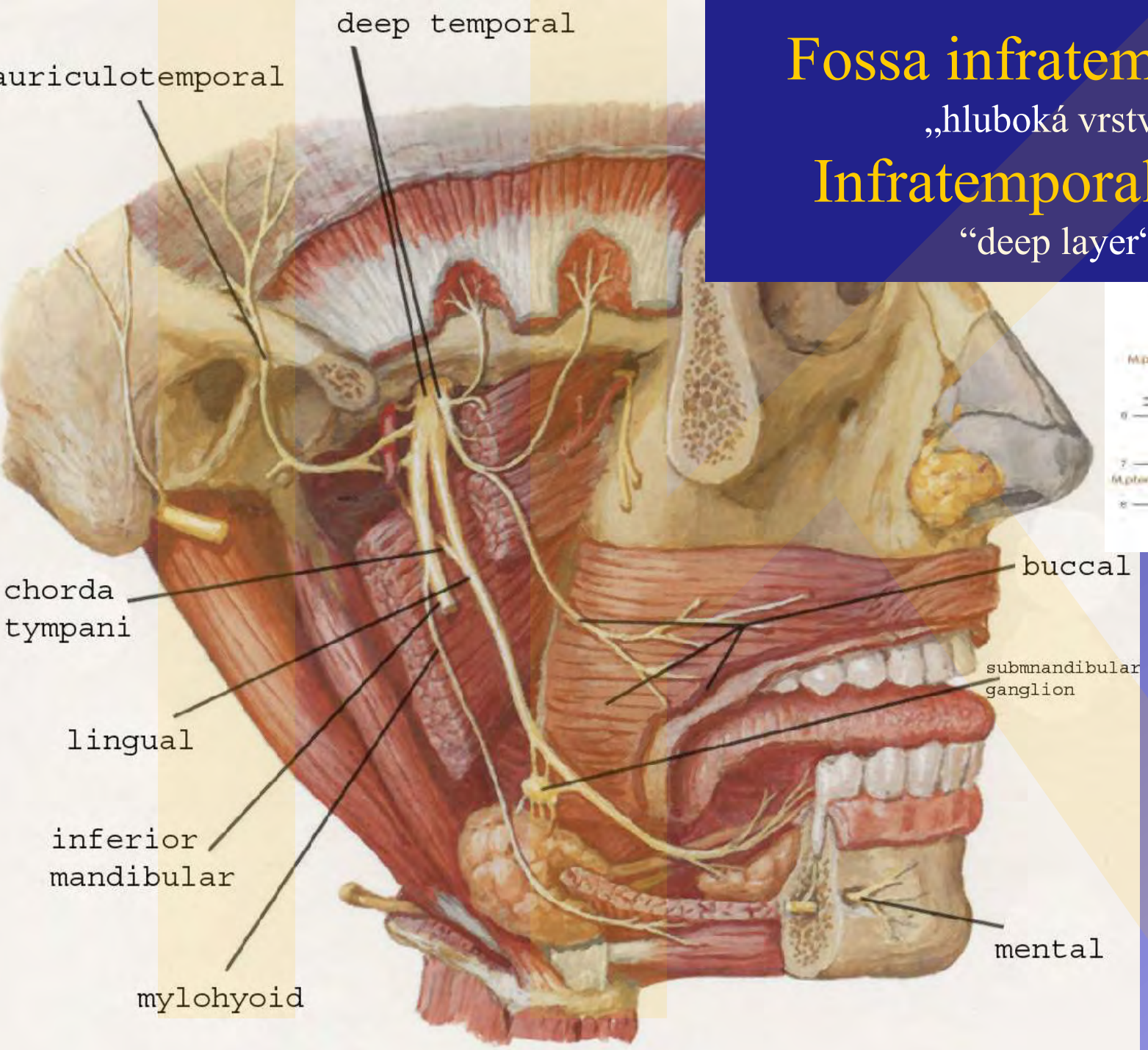
- rr. musculares for masticatory muscles, m. tensor tympani,tensor veli palatini,
- n. mylohyoideus
- n. buccalis – mucous layer of the vestibulum oris
- n. auriculotemporalis – rr. communicantes
- cum ganglio otico – parasympaticus for gl. parotis
- n. lingualis – connection with chorda tympani –
- parasympaticus gl submandibularis a sublingualis from CN VII.
- n. alveolaris inferior

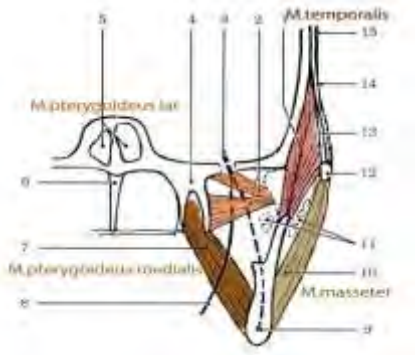
Fossa infratemporalis

„hluboká vrstva“

Infratemporal fossa

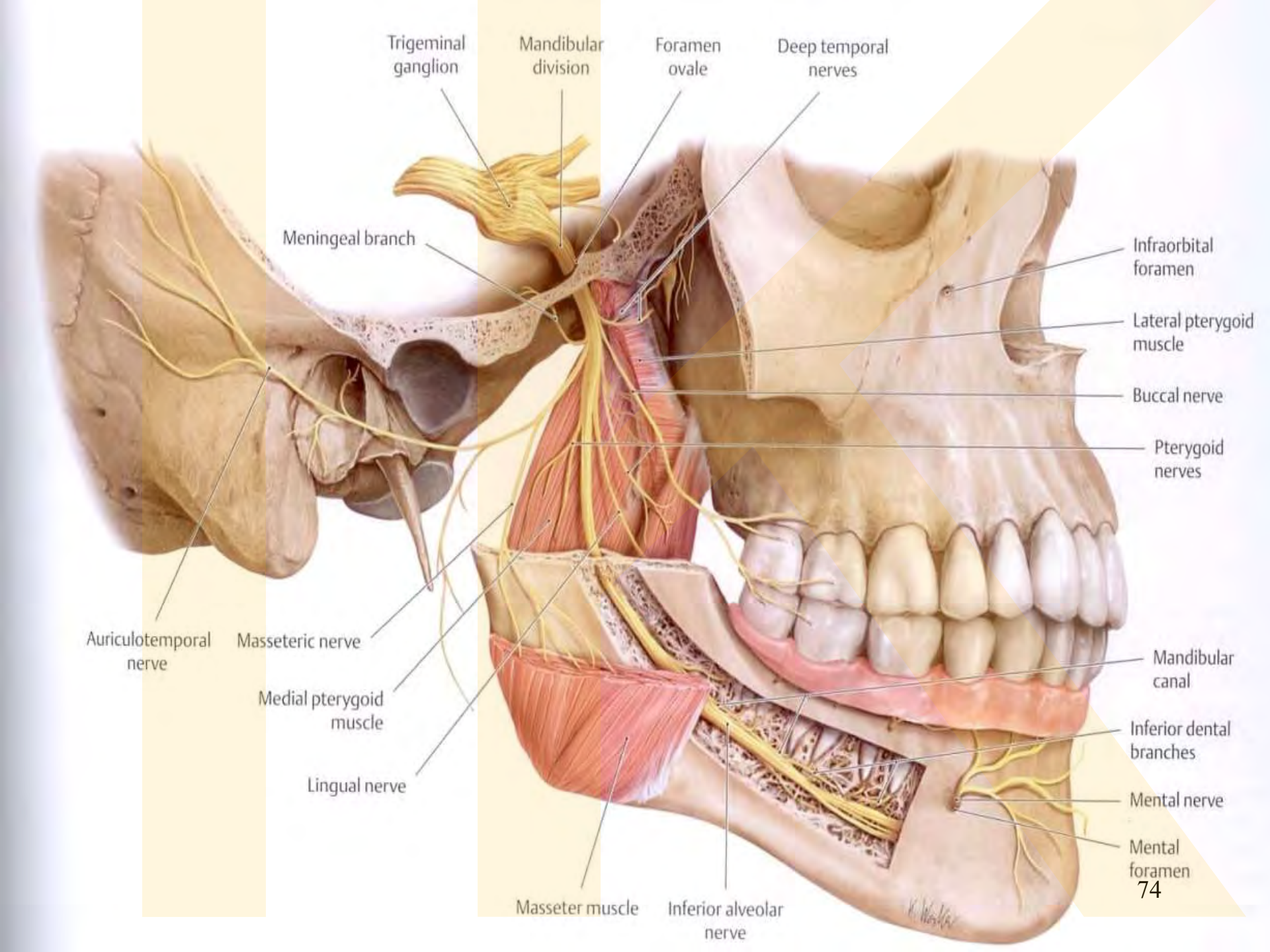
“deep layer“

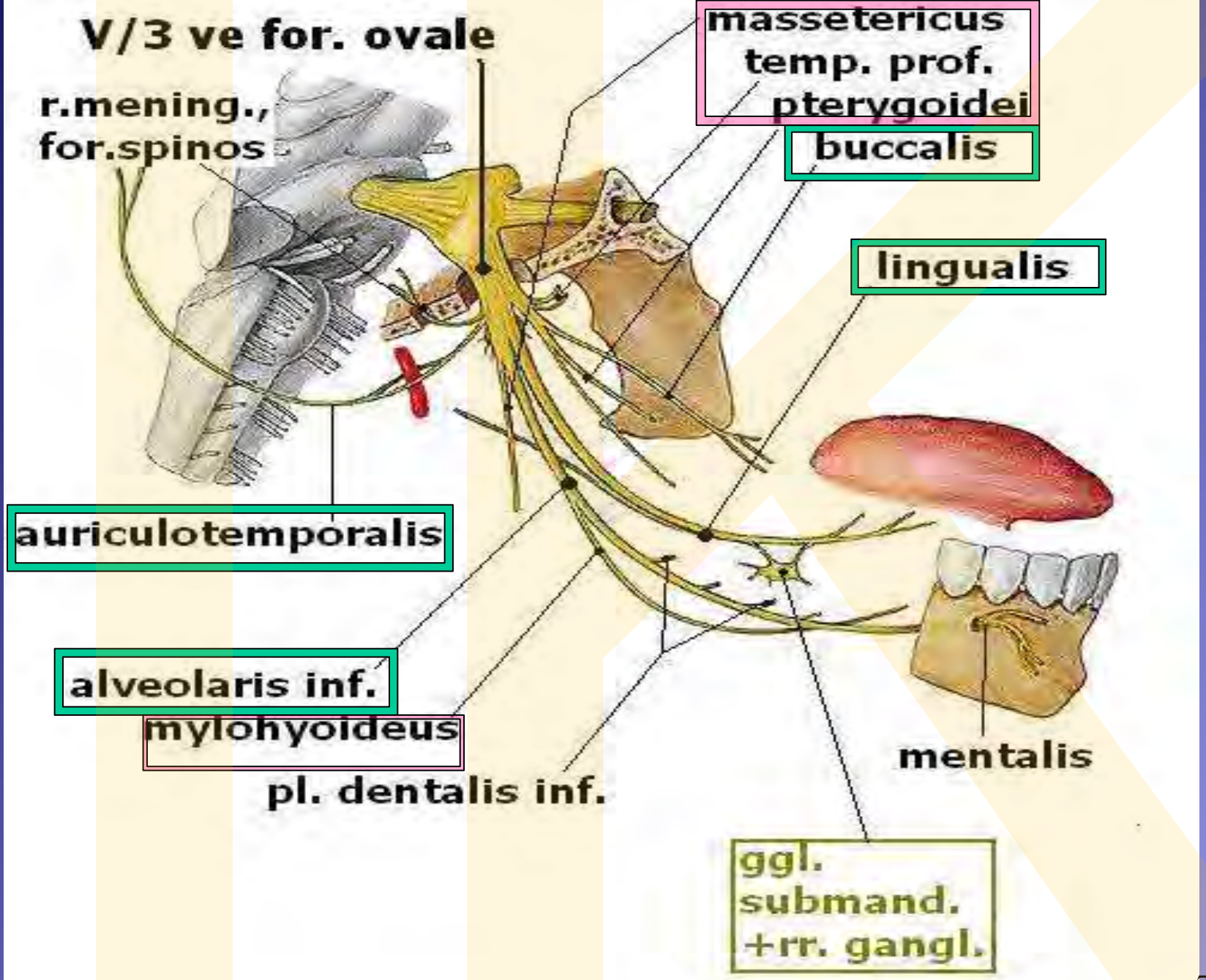


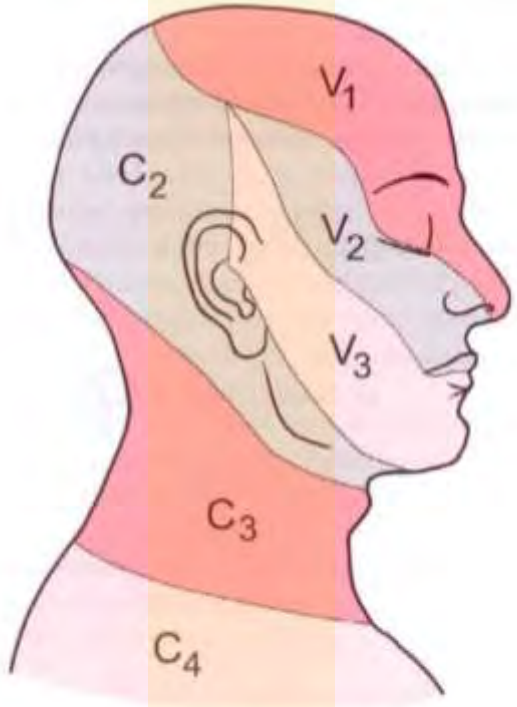


Větve V_3

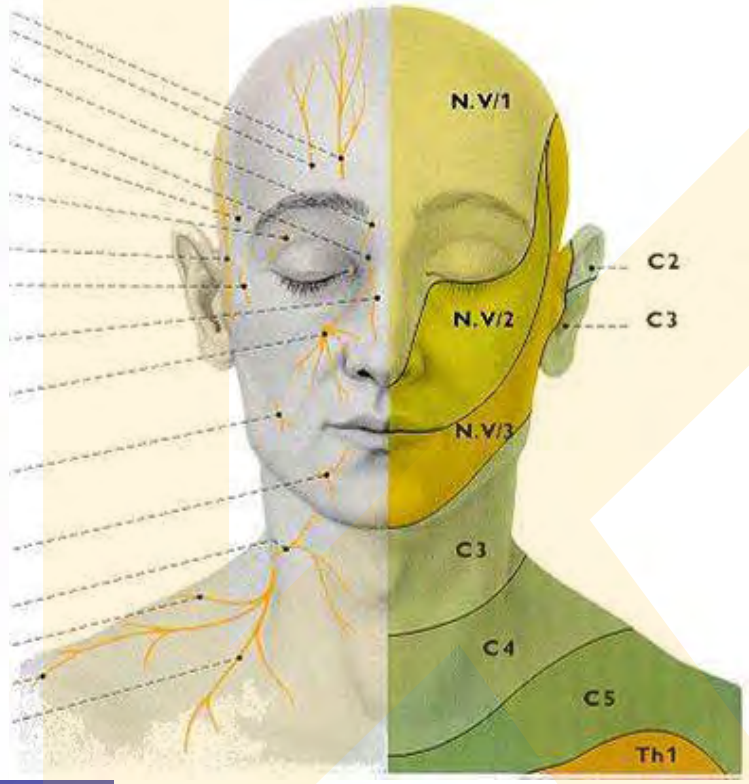
Mandibular branches


Trigeminal ganglion
Mandibular division
Foramen ovale
Deep temporal nerves
Meningeal branch
Infraorbital foramen
Lateral pterygoid muscle
Buccal nerve
Pterygoid nerves
Auriculotemporal nerve
Masseteric nerve
Medial pterygoid muscle
Lingual nerve
Mandibular canal
Inferior dental branches
Mental nerve
Mental foramen
Masseter muscle
Inferior alveolar nerve


V/3 ve for. ovale
r.mening.,
for.spinos
masseter
temp. prof.
pterygoidei
buccalis
lingualis
auriculotemporalis
alveolaris inf.
mylohyoideus
pl. dentalis inf.
mentalis
ggl.
submand.
+rr. gangl.



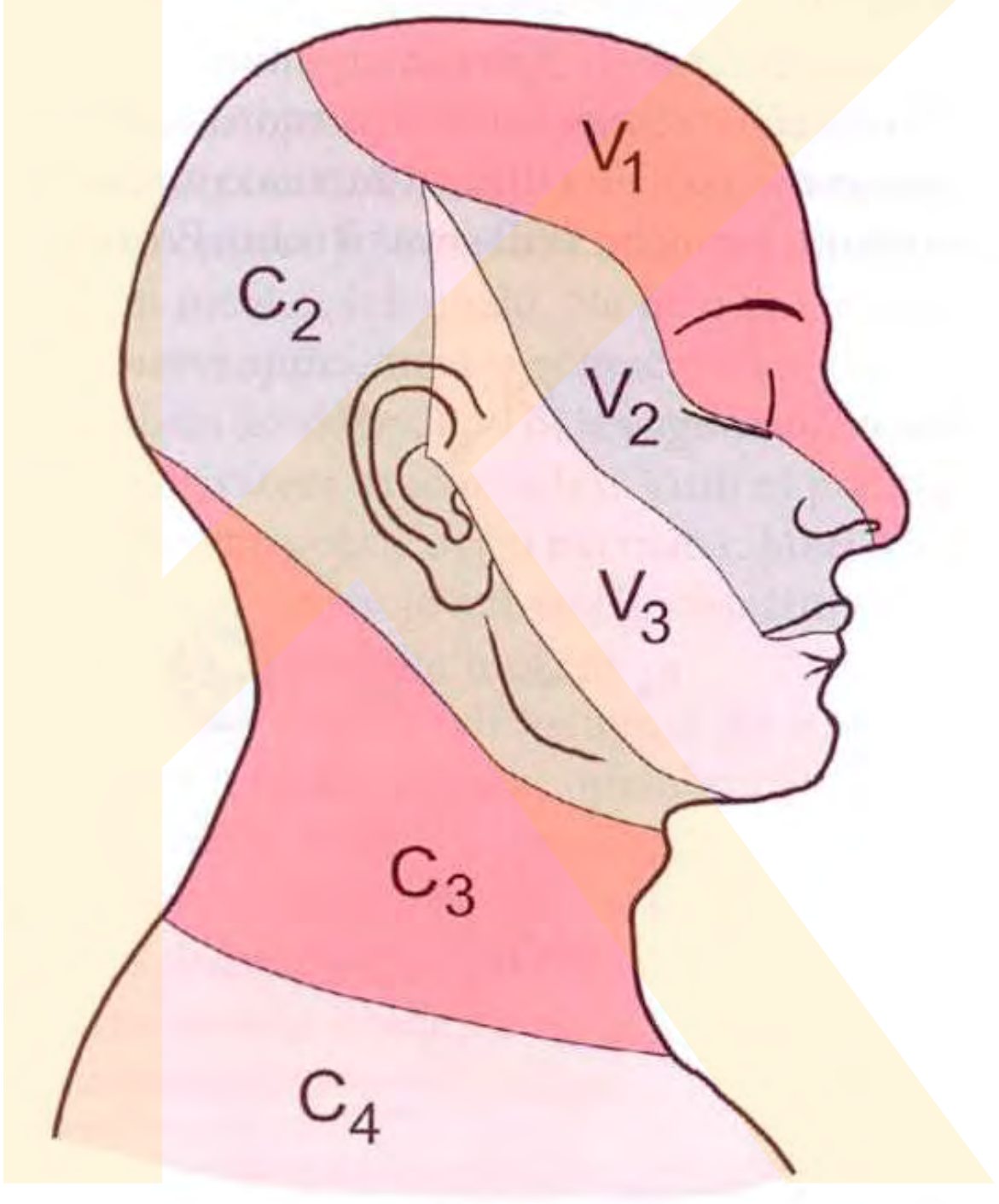
Obr. 1.39. Hranice kožních inervačních okrsků n. trigeminus (V_1–V_3) a kožních segmentů (C_2–C_4)

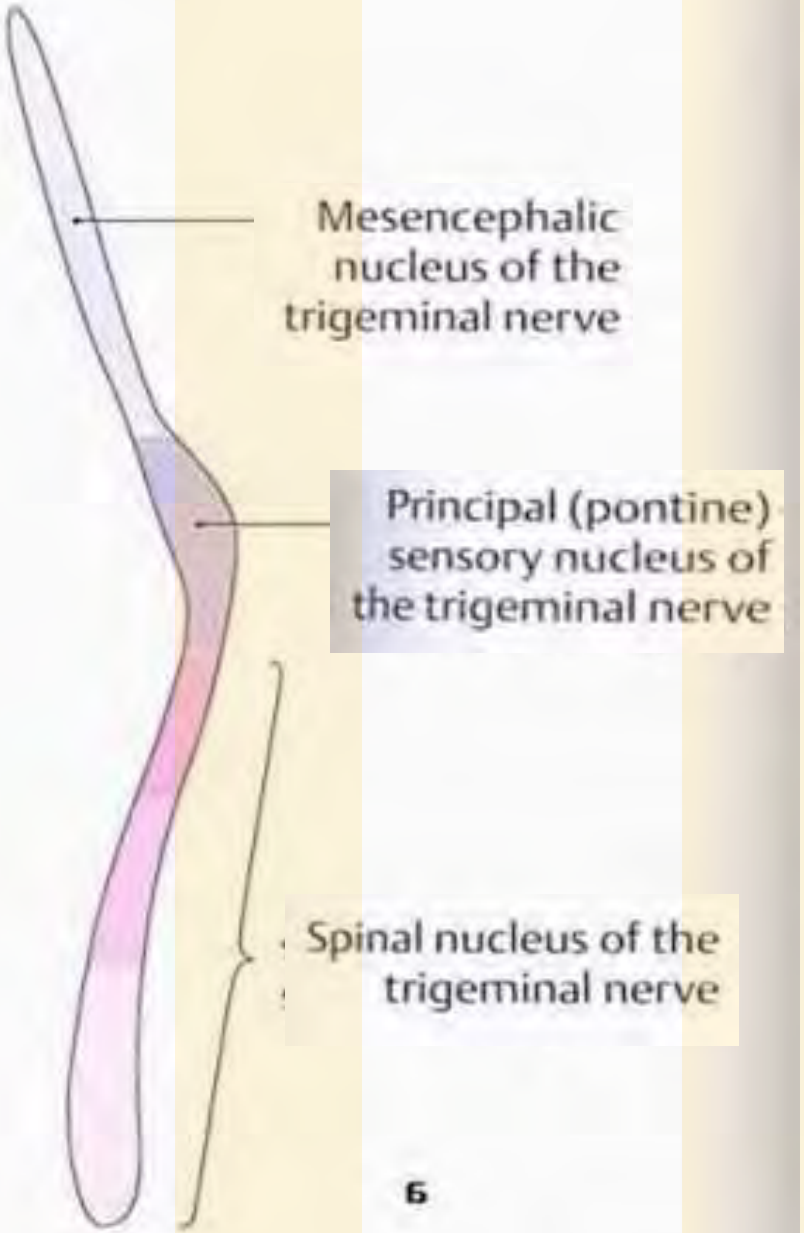


Sensitive areae of the CN V.

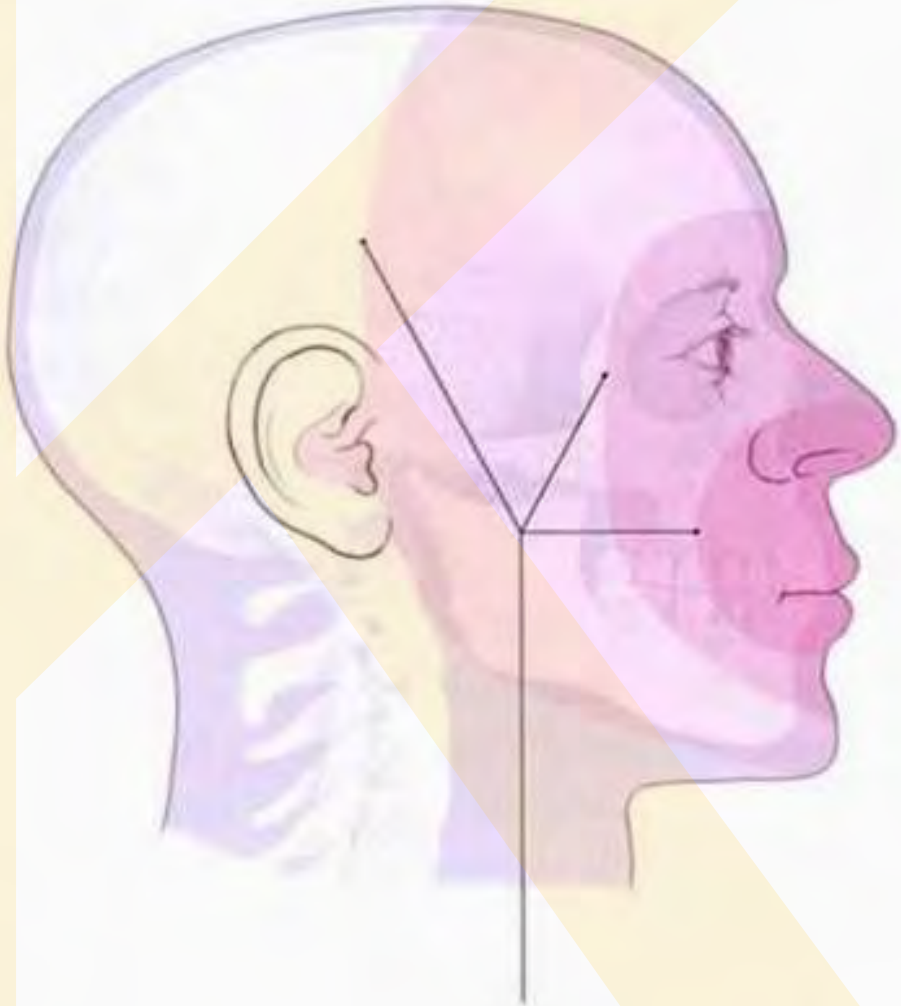
Dermatomy hlavy a krku
Head and neck dermatomes

- V1
- V2
- V3
- C2
- C3





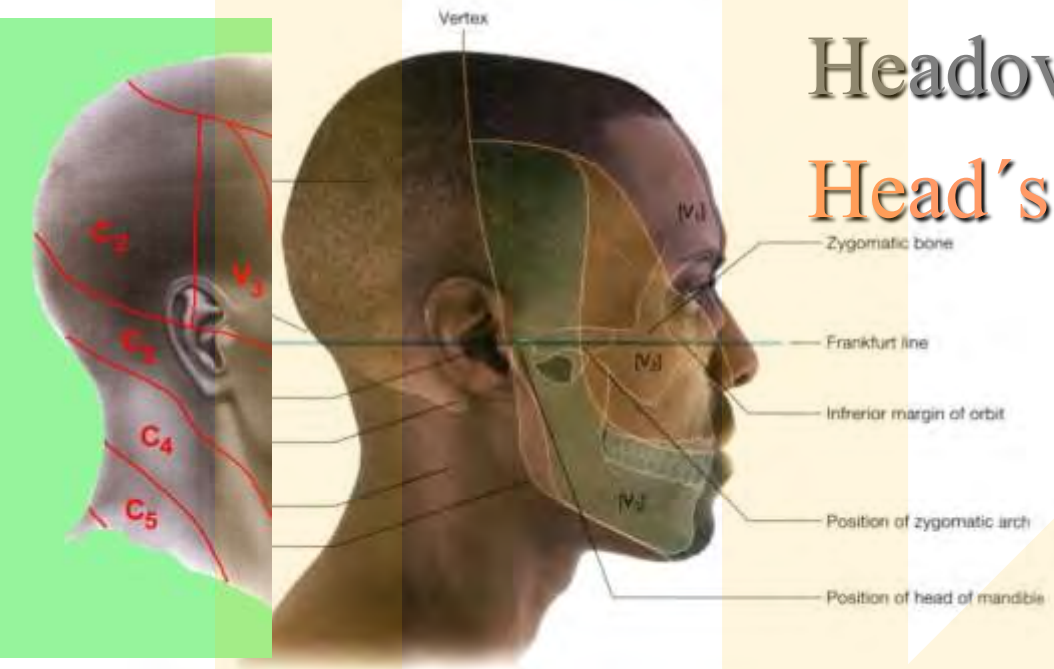
б

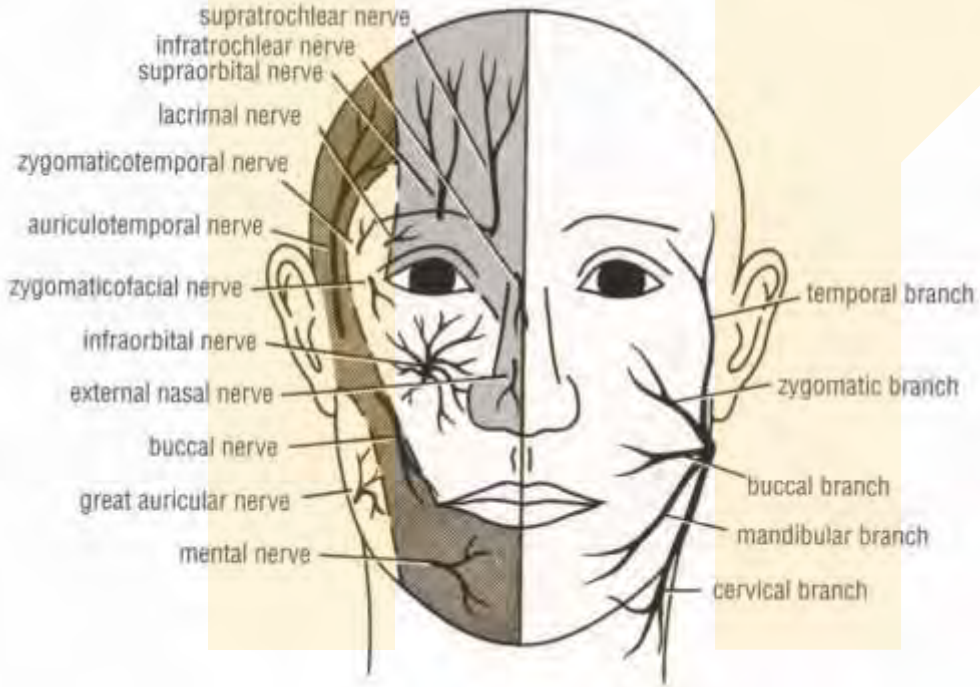


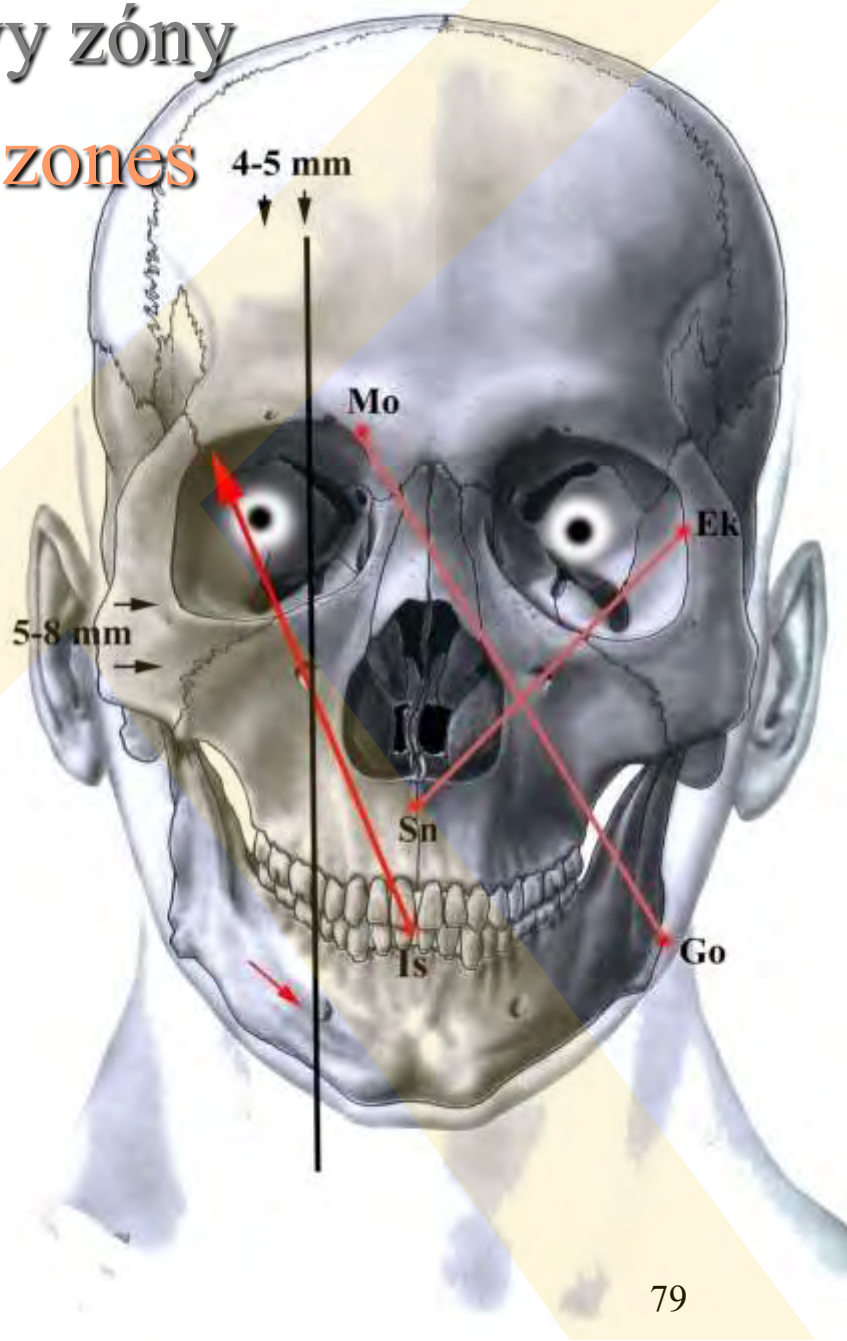
b Sölder lines

Headovy zóny

Head´s zones







Klinická anatomie
Clinical anatomy

- herpes zoster ophthalmicus (V1) →
- herpes simplex (V2,V3) ↓

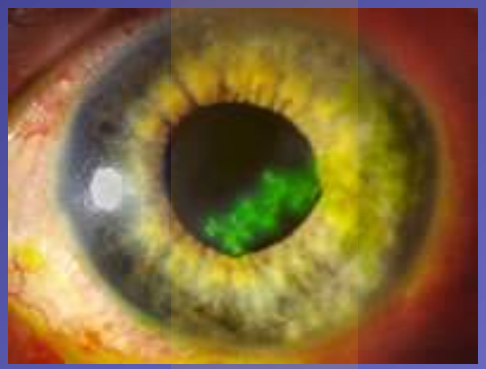
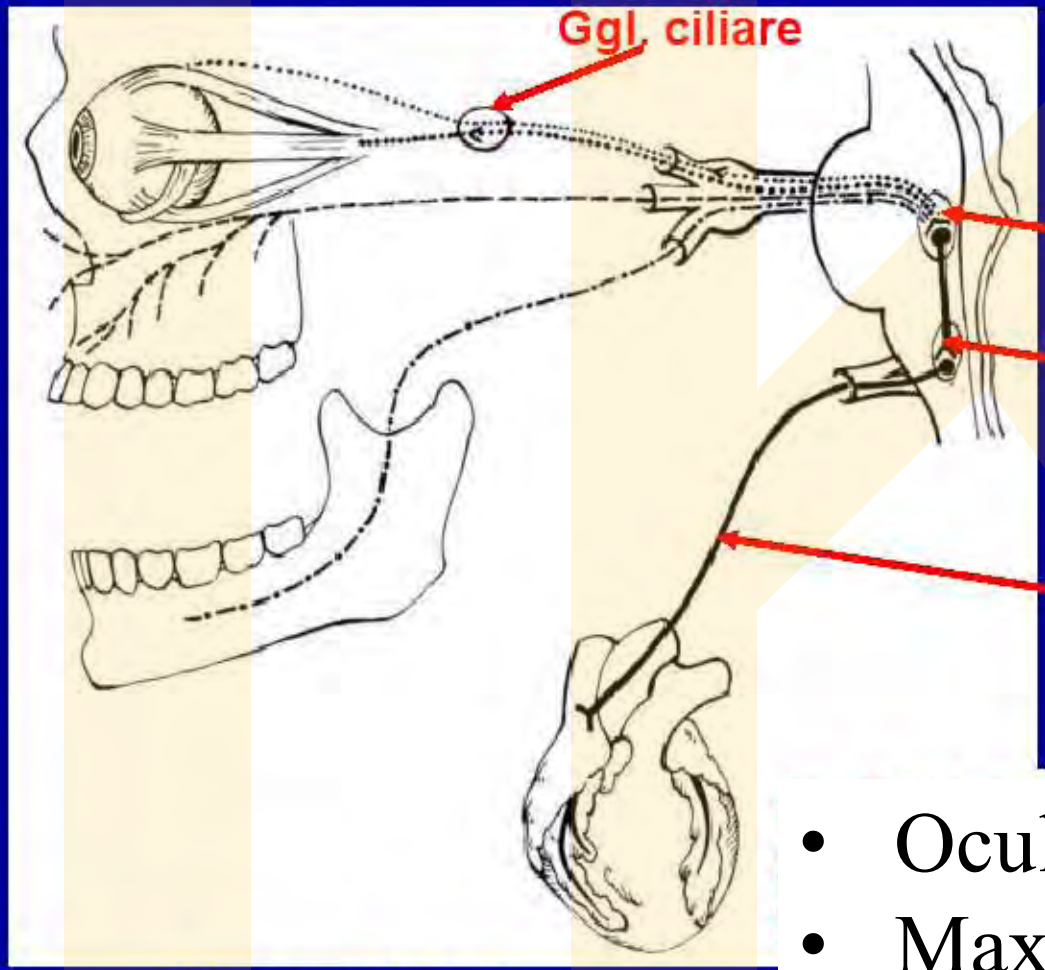



FIGURE 2. Case of herpes zoster ophthalmicus

Photo/MN Oxman, University of California, San Diego

Trigemino-cardiac reflex



Stimulation of the CNV. Branches results in low heart beating

Ncl. spinalis. n V.

Ncl dorsalis n.X

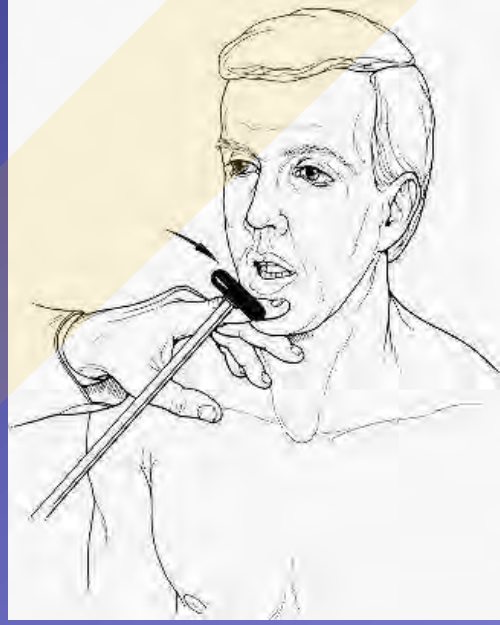
r. cardiacus

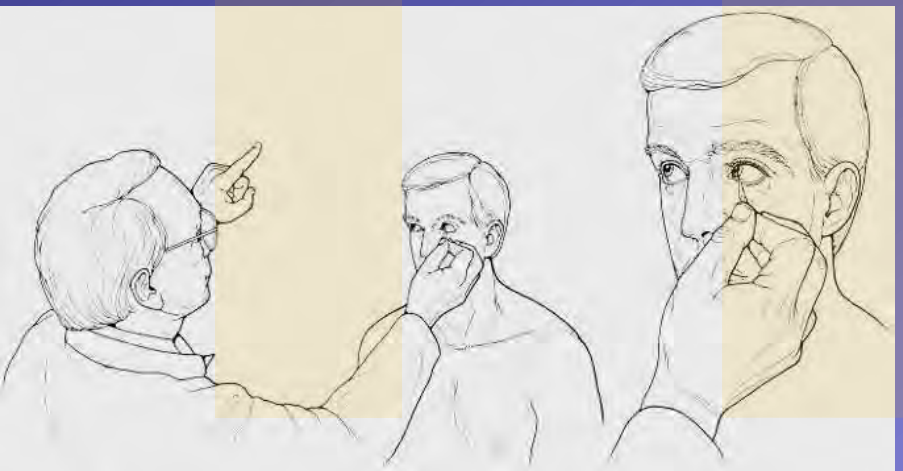
- Oculo-cardial
- Maxillo-cardial
- Mandibulo-cardial

reflexes

Examination of the reflex ACTIVITY OF CHOOSEN NERVE

- maseteric reflex
- Corneal reflex





Sensitive fibers of the CN V.
- Afferent branch for the **corneal, sucking and masseteric reflexes**

Motor fibers of the CN V. portio minor n.V. (masseter)
efferent branch for masticatory muscles

Reflectoric movements of the masticatory muscles – afferent branch is CN. V., IX., X.
Efferent branch is CN V. mandubular n.

CN VII.
facial facialis

N facialis SM ncl. motorius

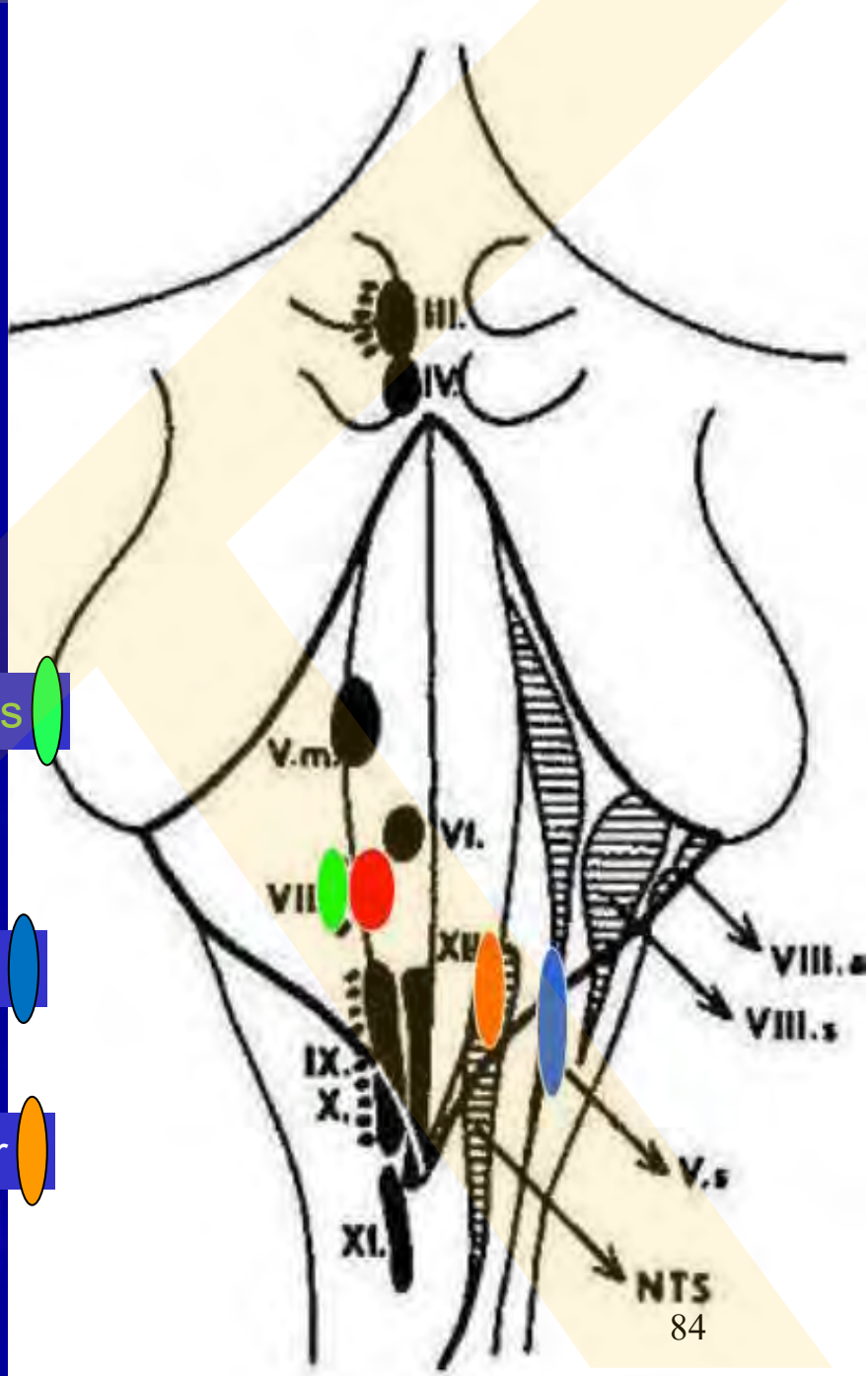
Mimic muscles v.p.m.digastricI , m. SH, m.platysma, m.stapedius

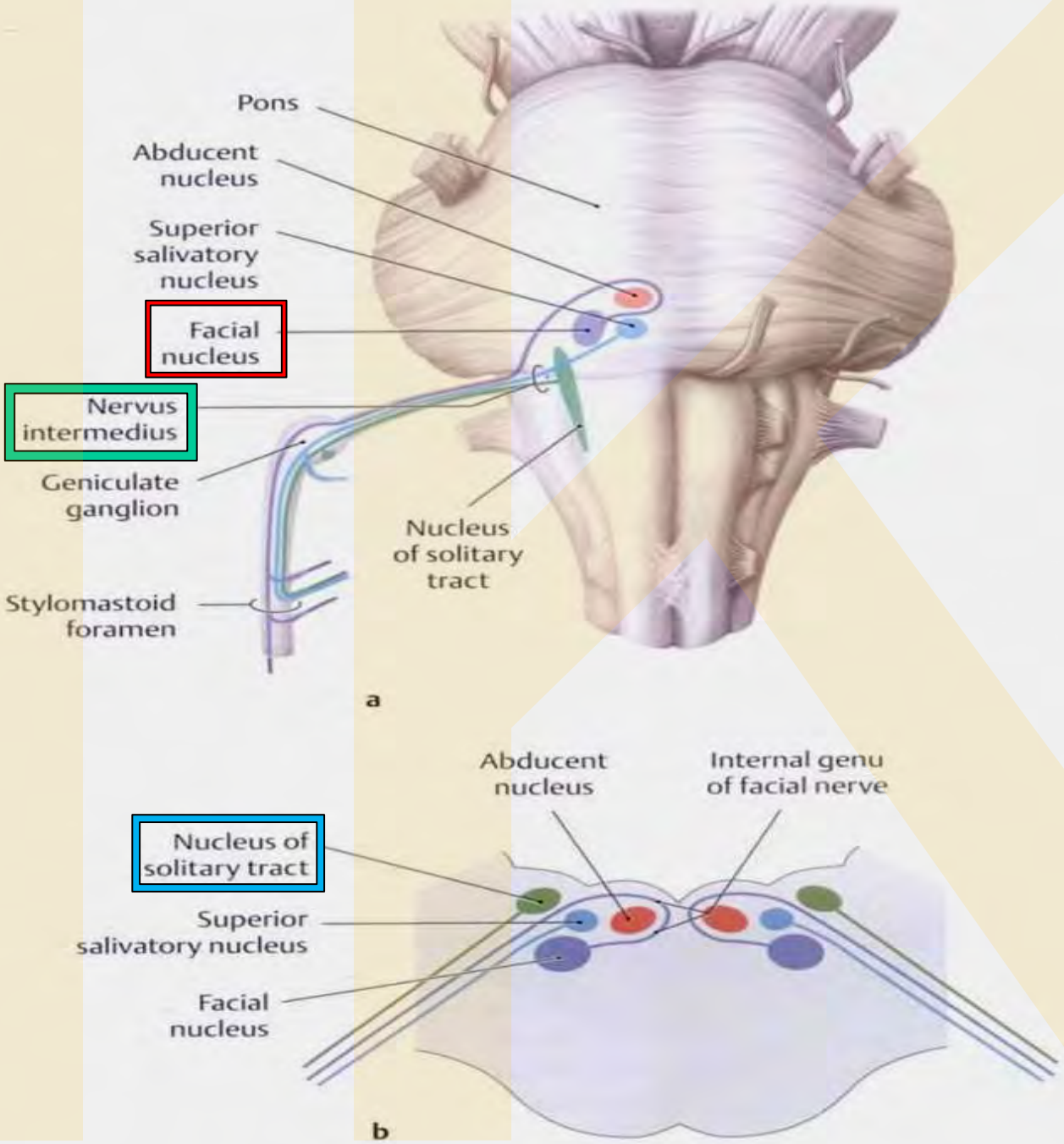
N. intermedius VM ncl. salivatorius sup.

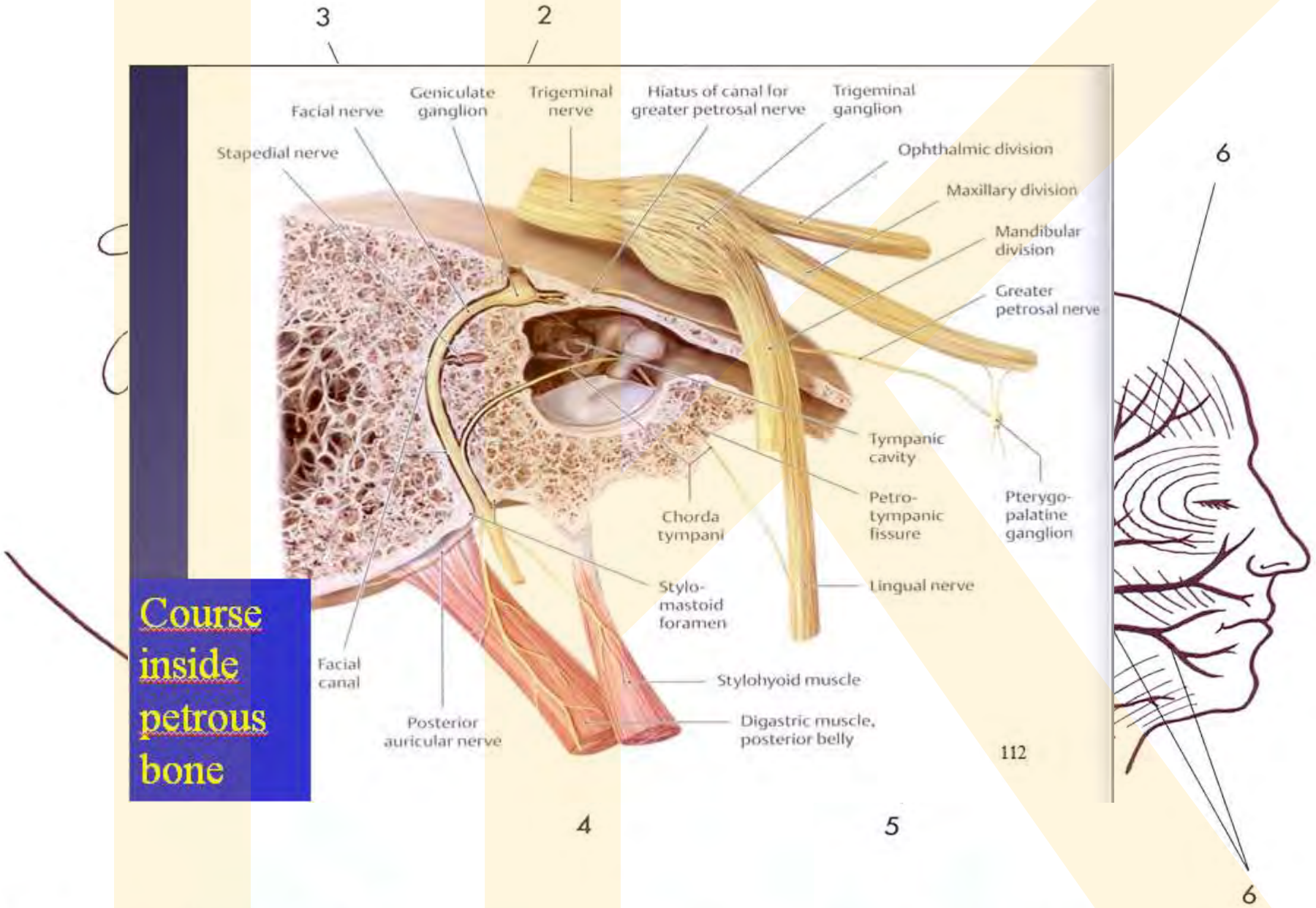
Gl. lacrimalis, Nasal , palate and tongue glands
gl. submandibularis a sublingualis

SS Pinna skin through genicular gangl. to Vs

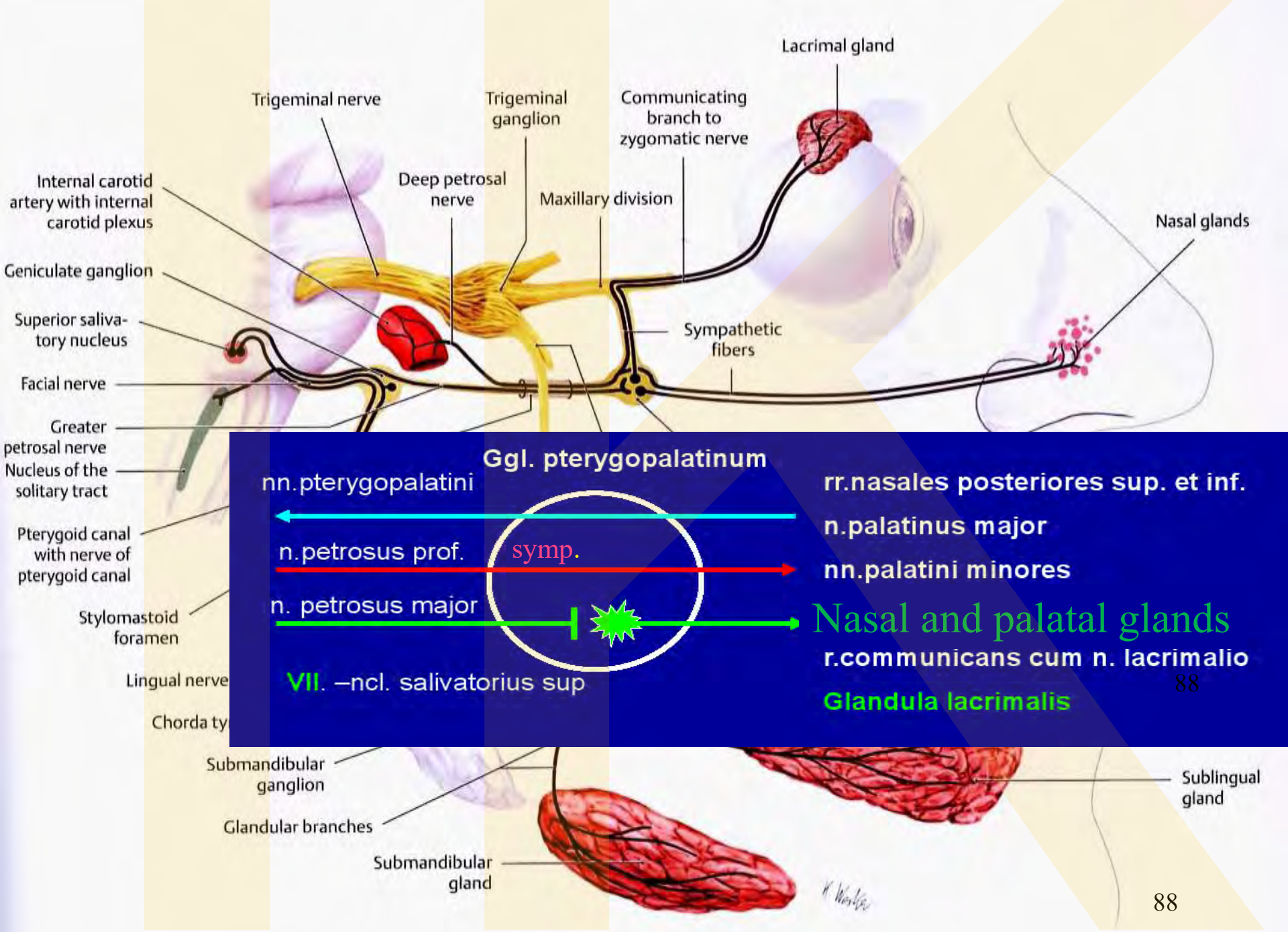
Ventral 2/3 tongue (taste) through ggl. genicular to ncl. tractus solitarii IX (ncl. gustatorius)



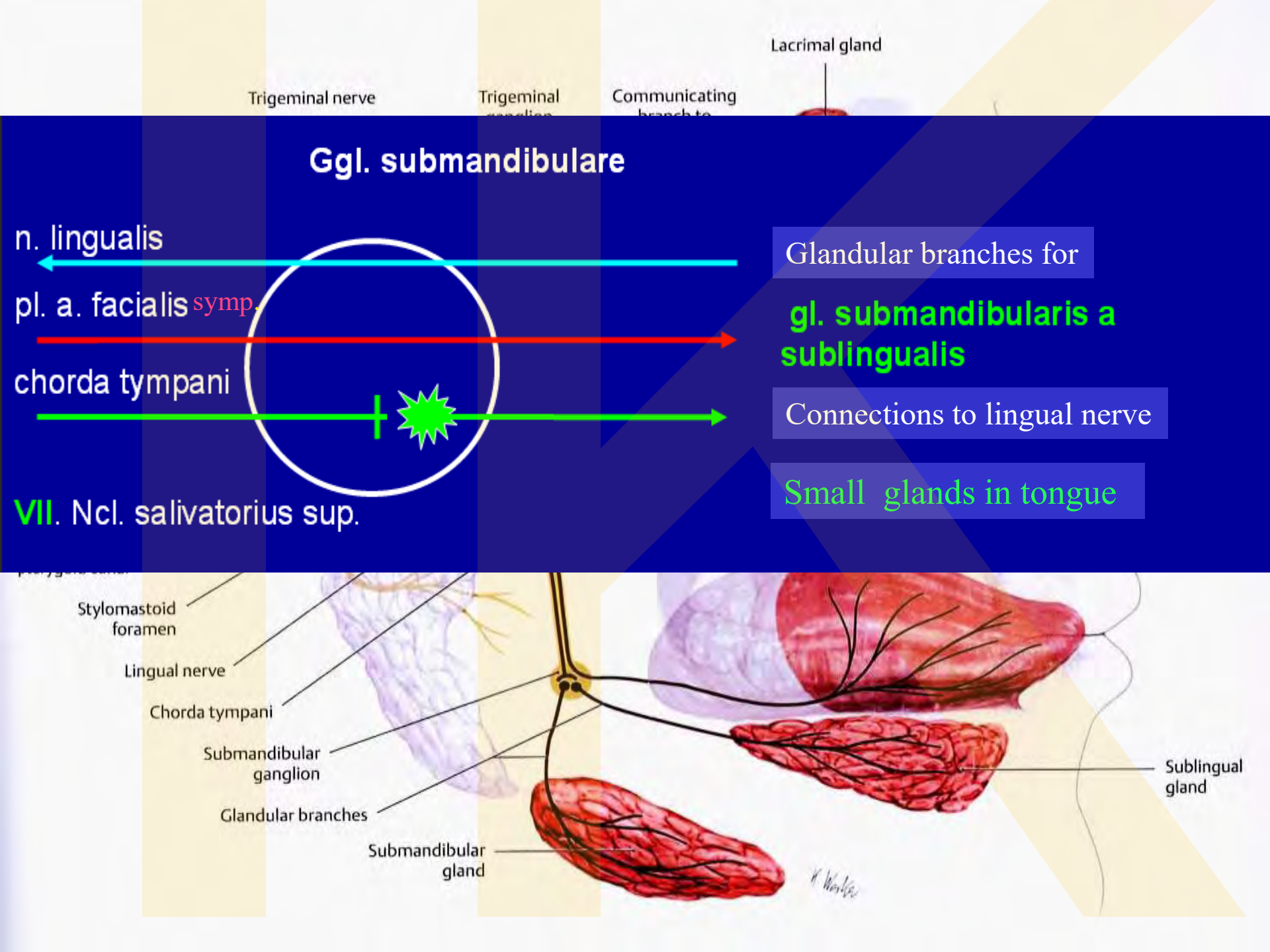

Pons
Abducent nucleus
Superior salivatory nucleus
Facial nucleus
Nervus intermedius
Geniculate ganglion
Stylomastoid foramen
Nucleus of solitary tract
a
Abducent nucleus
Internal genu of facial nerve
Nucleus of solitary tract
Superior salivatory nucleus
Facial nucleus
b



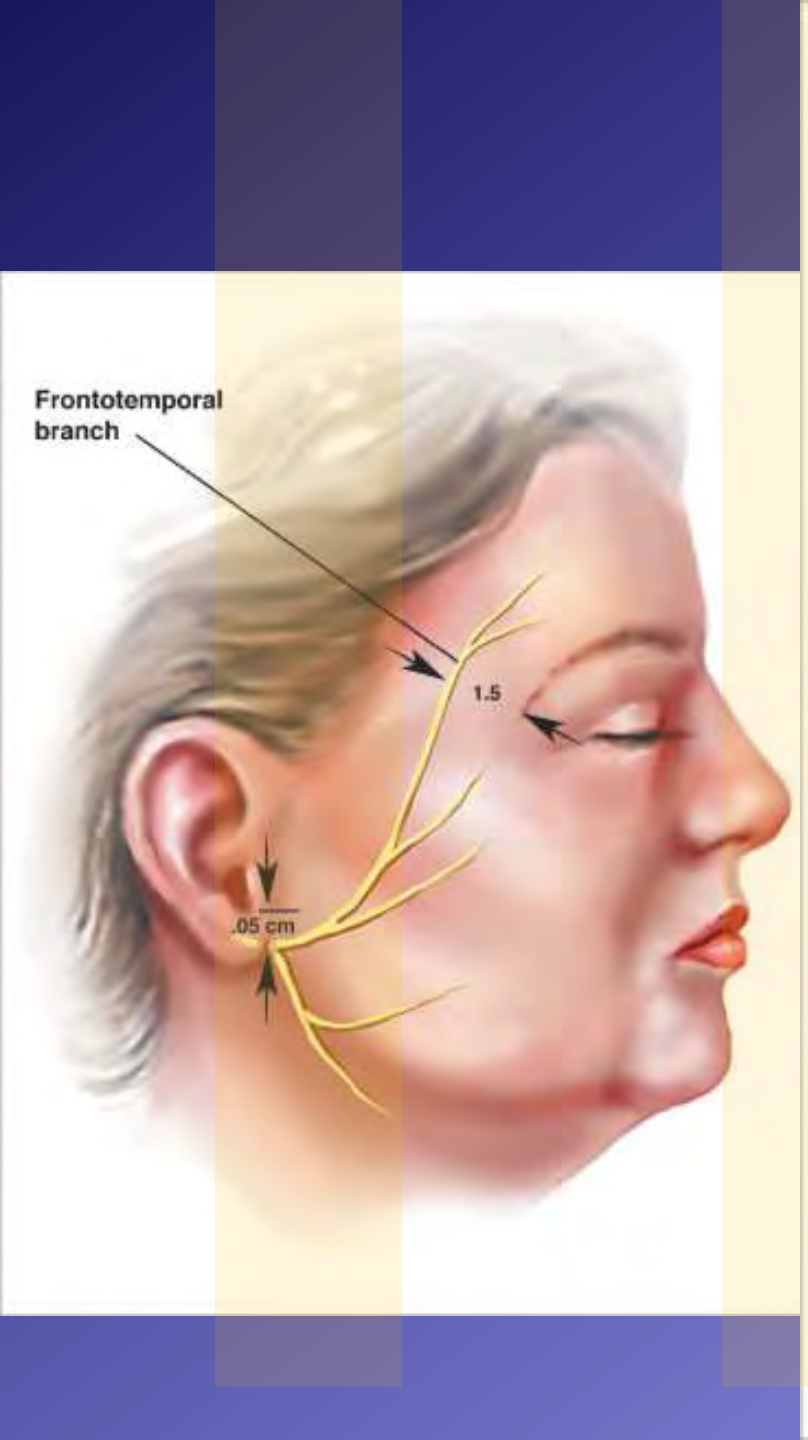
Obr. 1.49. Motorická složka n. facialis (schéma). 1 – nc. n. facialis, 2 – genu internum n. facialis, 3 – nc. n. abducentis, 4 – porus acusticus internus, 5 – foramen stylomastoideum, 6 – periferní větvení n. facialis

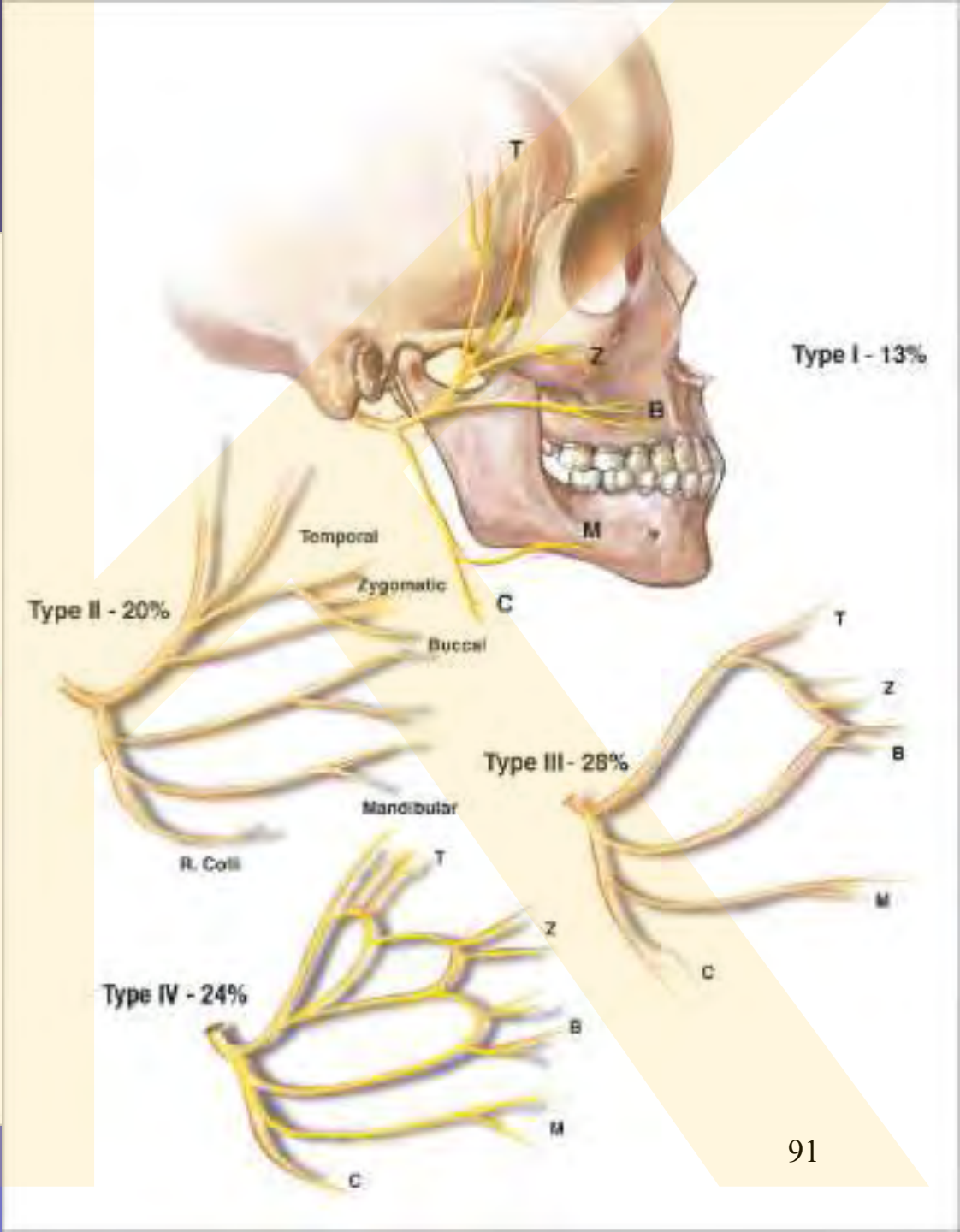

Lacrimal gland
Trigeminal nerve
Trigeminal ganglion
Communicating branch to zygomatic nerve
Internal carotid artery with internal carotid plexus
Deep petrosal nerve
Maxillary division
Nasal glands
Geniculate ganglion
Superior salivatory nucleus
Sympathetic fibers
Facial nerve
Greater petrosal nerve
Nucleus of the solitary tract
Pterygoid canal with nerve of pterygoid canal
Stylomastoid foramen
Lingual nerve
Chorda ty
Submandibular ganglion
Glandular branches
Submandibular gland
Sublingual gland
Ggl. pterygopalatinum
nn.pterygopalatini
n.petrosus prof.
symp.
n. petrosus major
VII. –ncl. salivatorius sup
rr.nasales posteriores sup. et inf.
n.palatinus major
nn.palatini minores
Nasal and palatal glands
r.communicans cum n. lacrimalio
Glandula lacrimalis

88


Lacrimal gland
Trigeminal nerve
Trigeminal
Communicating
Ggl. submandibulare
n. lingualis
pl. a. facialis symp.
chorda tympani
VII. Ncl. salivatorius sup.
Glandular branches for
gl. submandibularis a sublingualis
Connections to lingual nerve
Small glands in tongue
Stylomastoid foramen
Lingual nerve
Chorda tympani
Submandibular ganglion
Glandular branches
Submandibular gland
Sublingual gland

Radially oriented skin cuts !!


Frontotemporal branch
1.5
.05 cm


T
Z
B
M
C
Type I - 13%
Temporal
Zygomatic
Buccal
Type II - 20%
Mandibular
R. Colli
Type III - 28%
Type IV - 24%

Frontalis

Orbicularis oris

Mentalis

Depressor anguli oris

Zygomaticus major

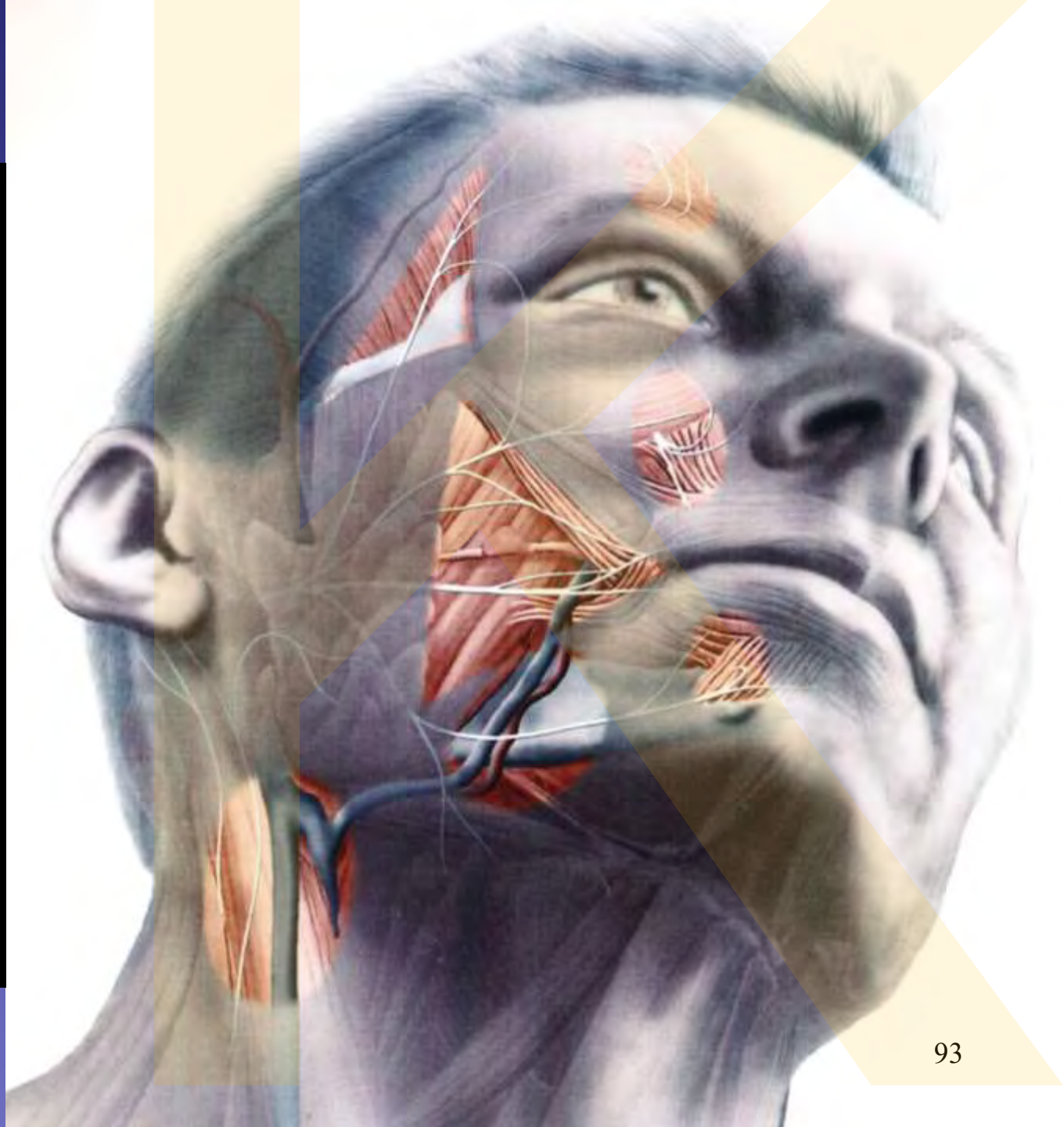
Risorius

Corrugator supercilii

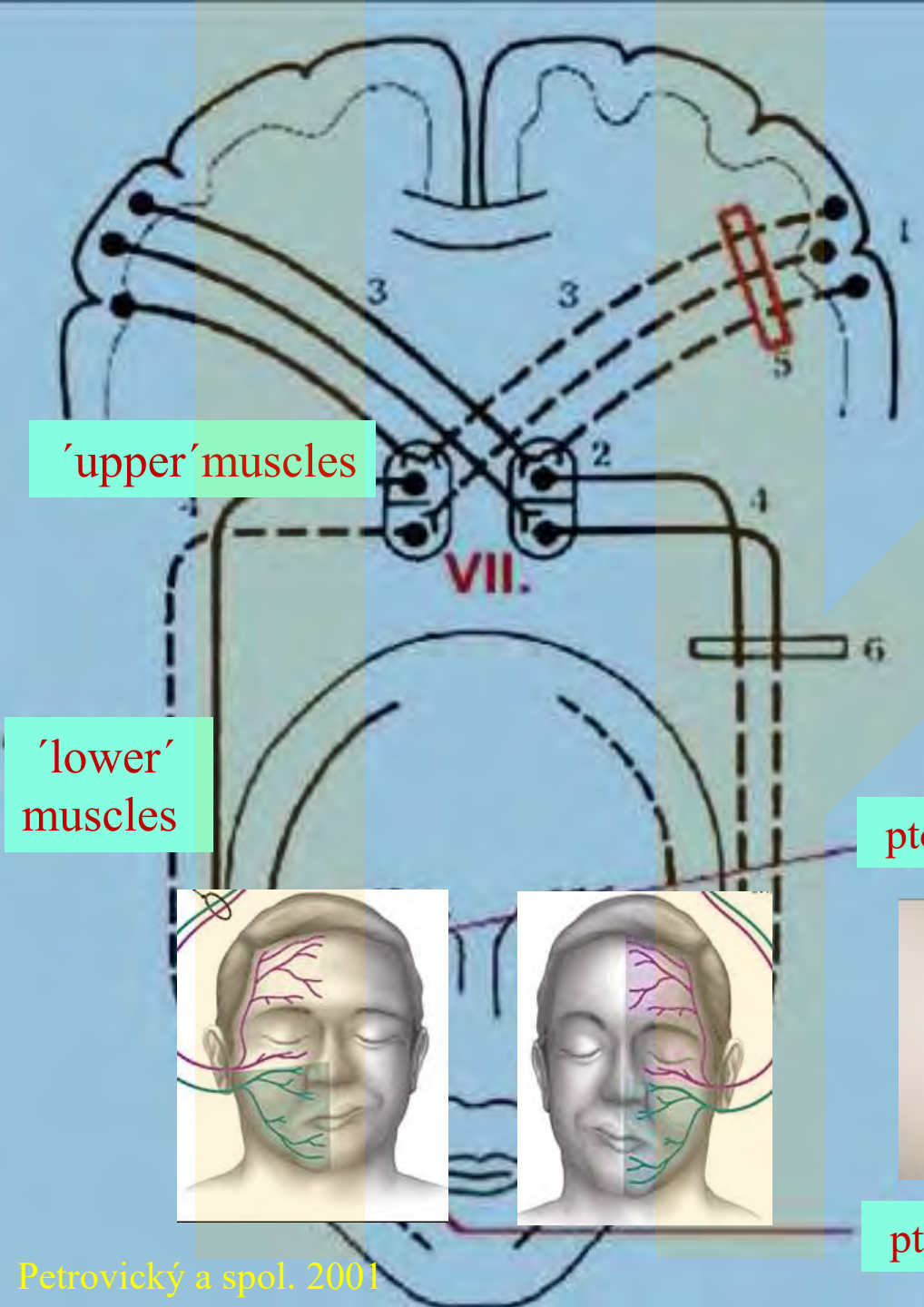
Nasalis

Procerus

CN VII. : tzv. „facial danger zones“ - Areas, where CN VII. Can be found closer to skin surface



During central palsy there is saved motion of the muscles around orbit (their CNC centers are bilateral)
During peripheral palsy are disturbed all muscles in corresponding halfface
Full line – non disturbed fibers
Interrupted line – disturbed fibers



1 – kortikové motorické centrum pro svaly obličeje
2 – nel. n. facialis
3 – tr. cortico-nuclearis
4 – n. facialis
5 – léze tr. corticonuclearis při centrální poruše
6 – léze periferních vláken n. facialis

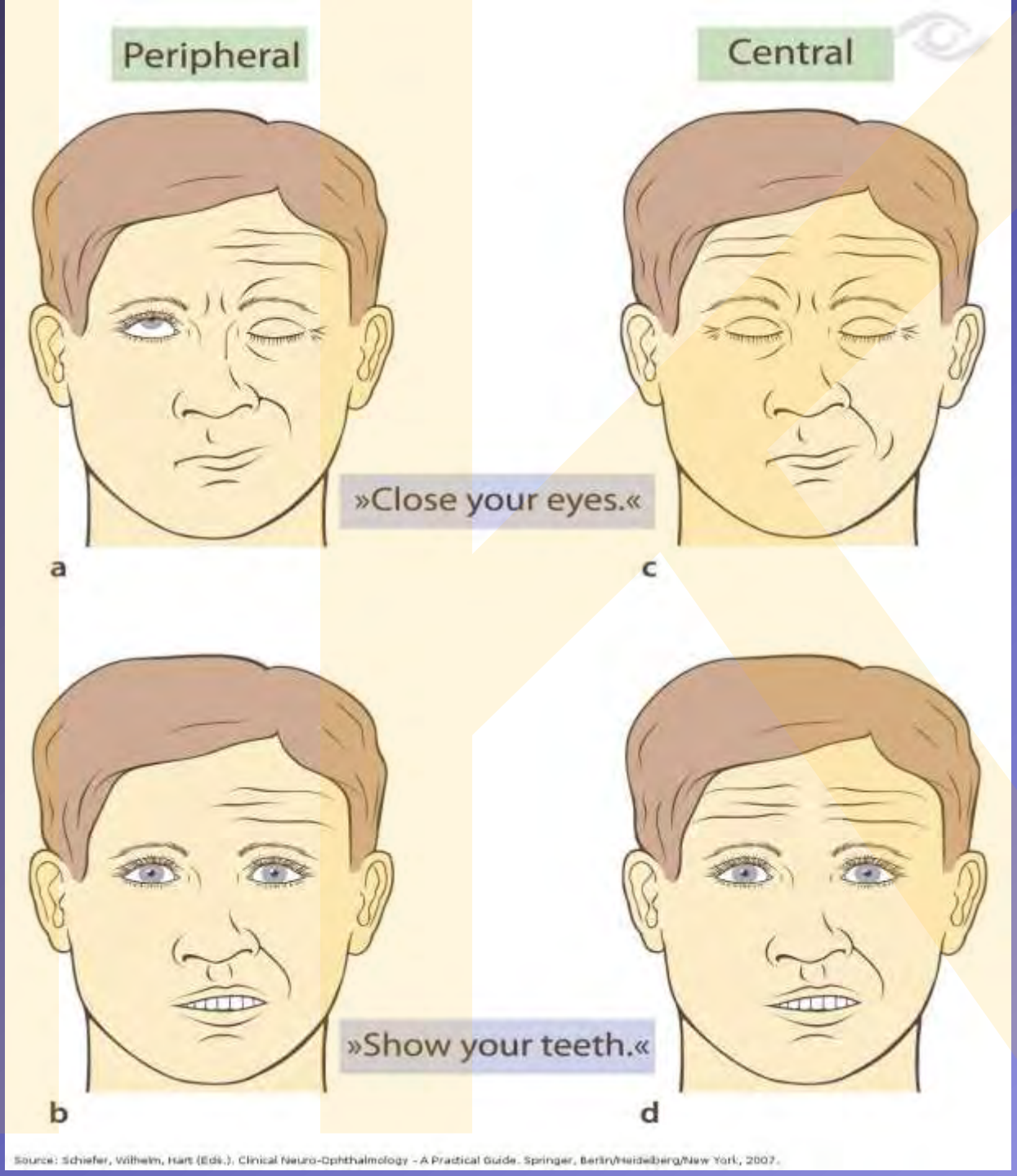
´upper´muscles

´lower´ muscles

ptosis of palpebra – only ½ afferent fibers

ptosis of oral corner – no afferent fibers

Petrovický a spol. 2001



Source: Schiefer, Wilhelm, Hart (Eds.). Clinical Neuro-Ophthalmology – A Practical Guide. Springer, Berlin/Heidelberg/New York., 2007.

Less and more noted peripheral CN VII. palsy

Charles Bell
Army surgeon, neurologist
1774-1842

A System of Dissection Explaining the Anatomy of the Human Body

Droopy eyelid, dry eye; or excessive tears

Twitching or weakness

Dropping corner of mouth, dry mouth

CN VII palsies : depends on level of irritation

A – **Bell´s palsy – peripheral palsy of CN VII.** - Colds, inflammation of the middle ear, tumors, fractures, meningitis, haemorrhage.

1) **Pons: colliculus facialis** – affected only motor fibers – ipsilateral paralysis of facial muscles
2) **Pons – pontocerebellar angle** (meningitis) irritated also other CN nerves (VIII. and V.)
3) **Meatus acusticus internus** irritated VII. a VIII. nerves – deafness, dizziness
4) **Canalis n. facialis, + ganglion geniculi** – tearing disorder due to herpes zoster, pain in the ear
5) **Canalis n. facialis above n. stapedius** – hyperacusis and loss of appetite, decreased salivation, and paralysis of mimic muscles
6) **Canalis n. facialis above chorda tympani** – loss of taste on the front 2/3 of the tongue, reduced salivation and paralysis of facial muscles
7) **Out of foramen stylomastoideum** ipsilateral paralysis of mimic muscles

CN VIII. vestibulo-cochlearis balance and hearing

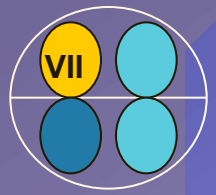
- Pars vestibularis

N. utriculoampullaris

N. saccularis

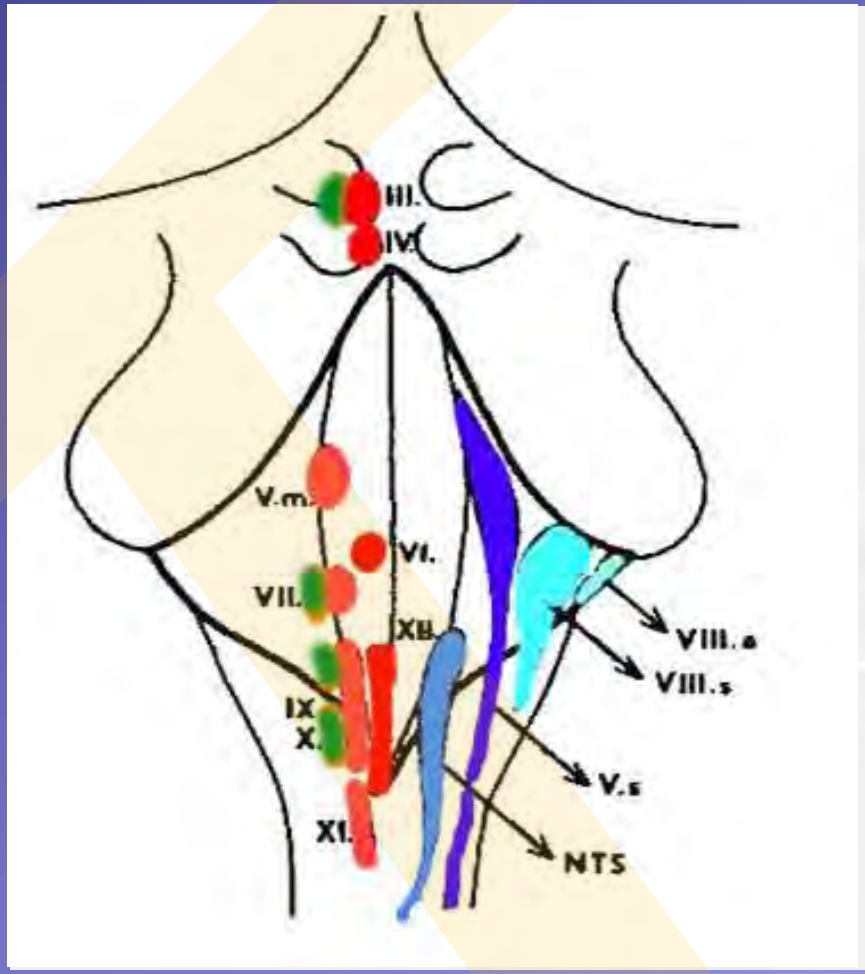
N. ampullaris posterior

- Pars cochlearis

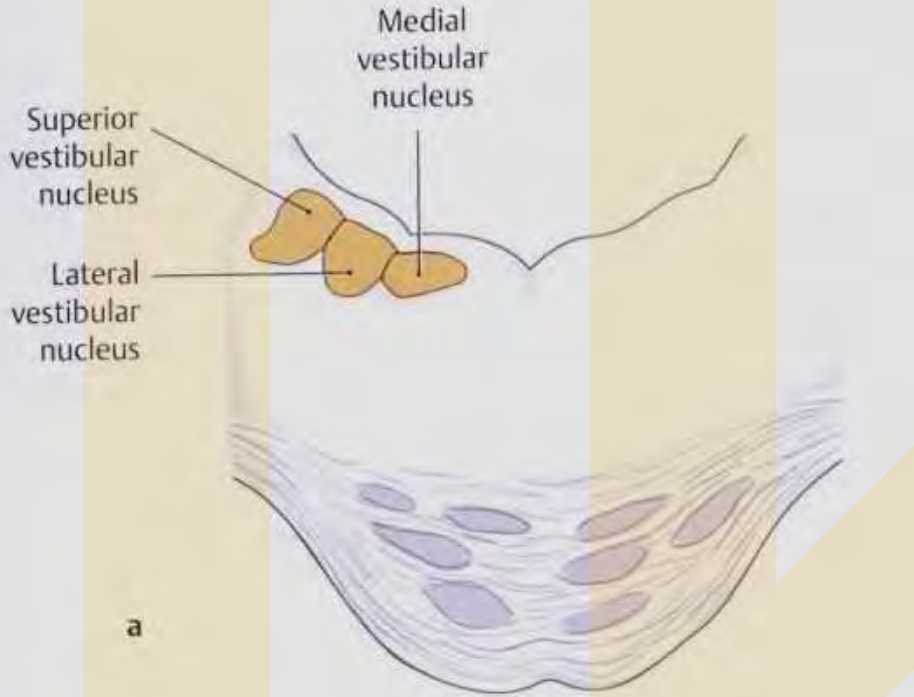


A P

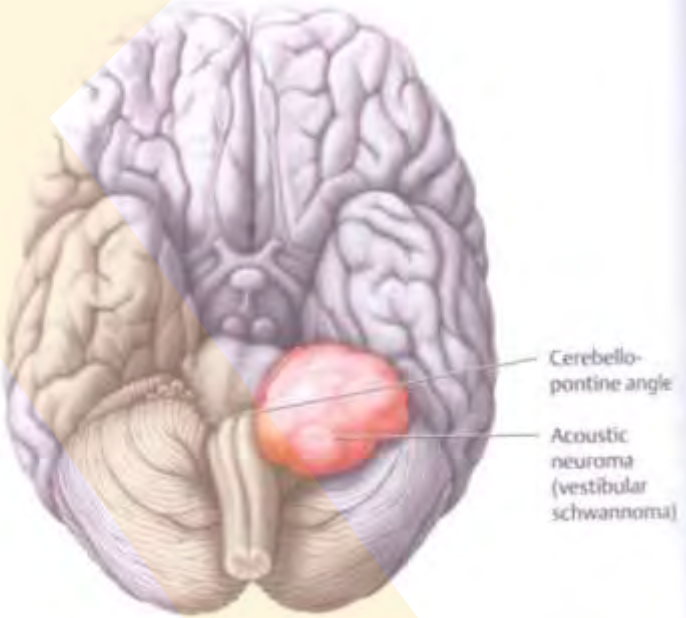
Fundus meati acustici interni



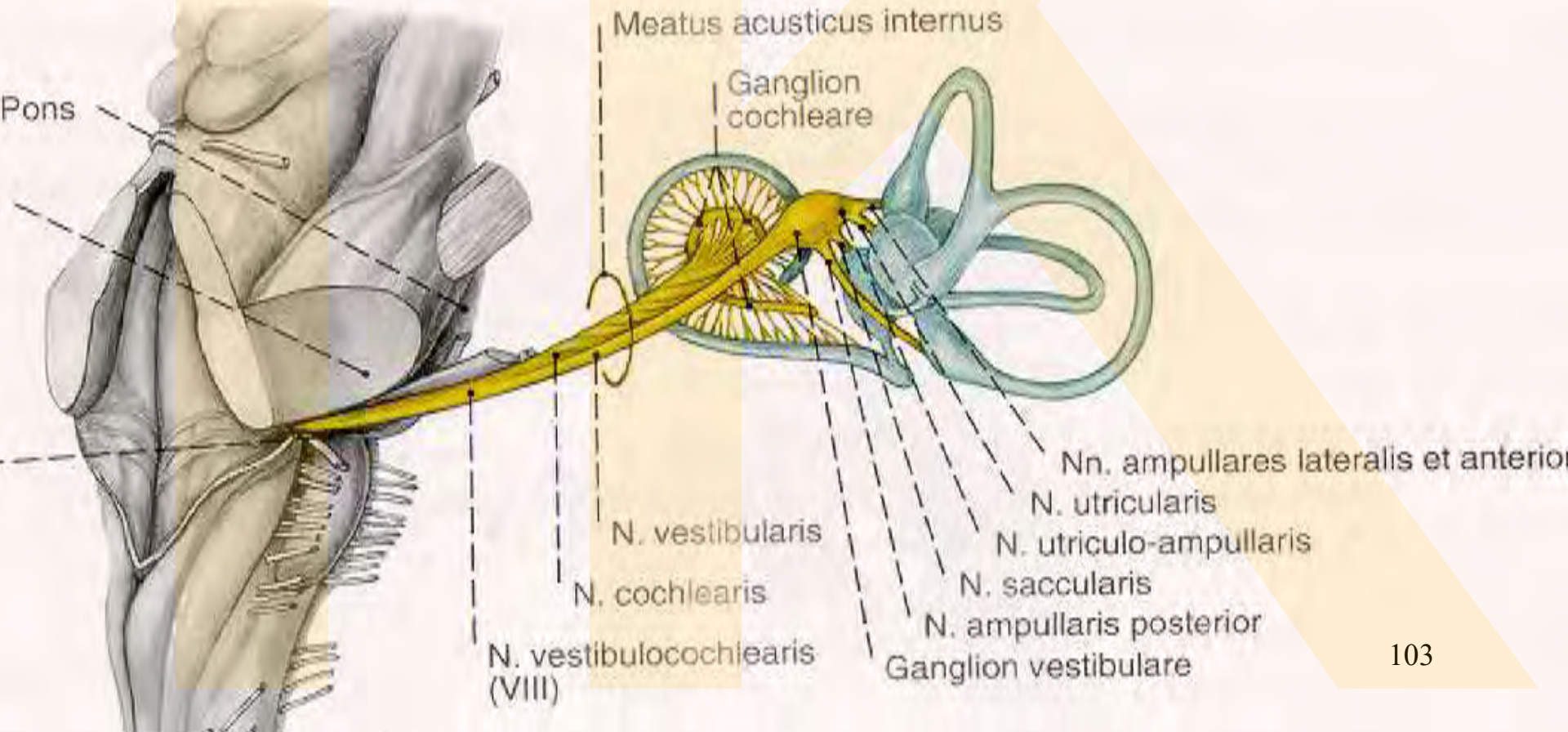
Damage: deafness, dizziness, balance disturbing, nystagm

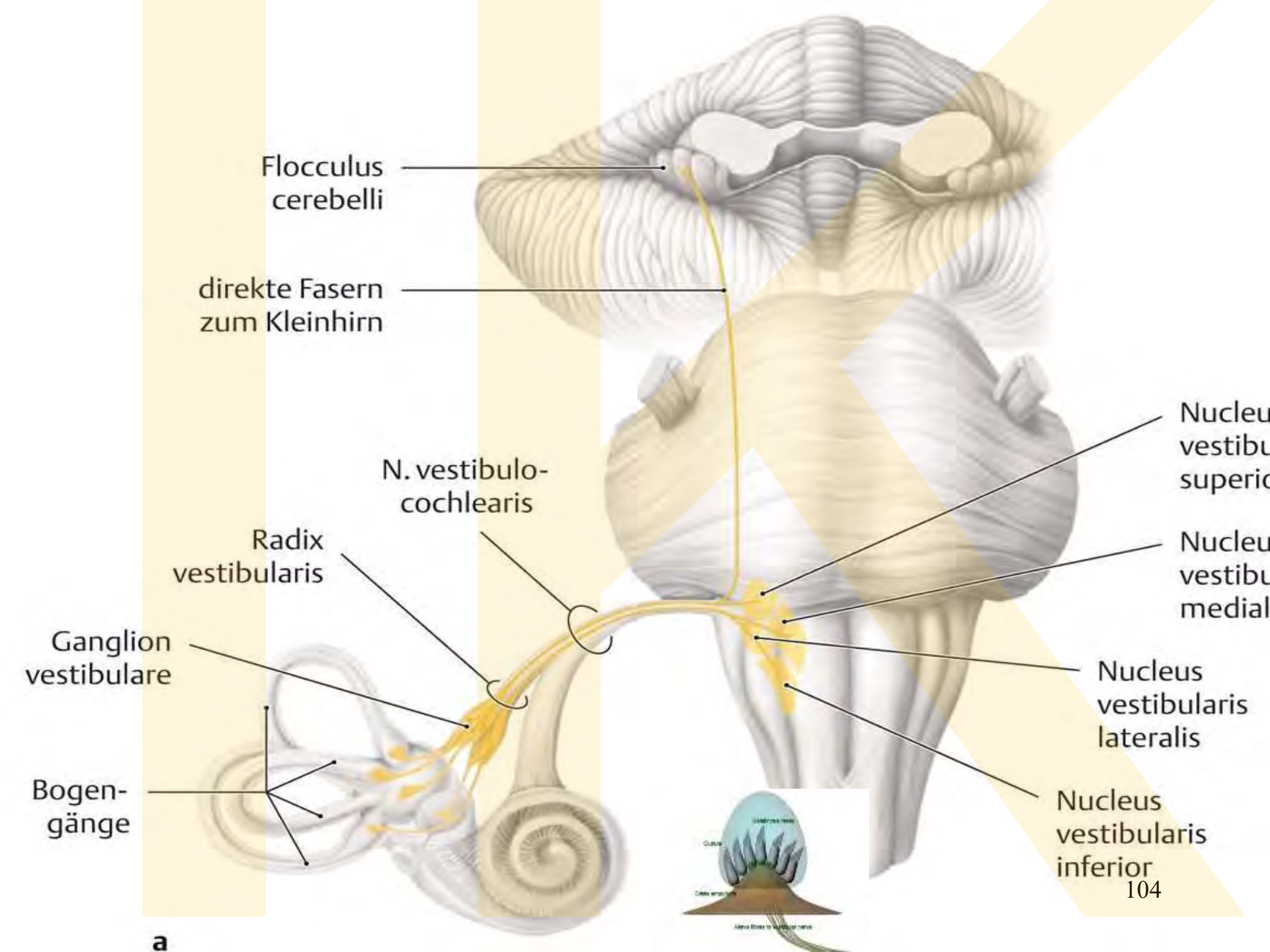

Medial
vestibular
nucleus
Superior
vestibular
nucleus
Lateral
vestibular
nucleus
a


Posterior
cochlear
nucleus
Anterior
cochlear
nucleus
b


Cerebello-
pontine angle
Acoustic
neuroma
(vestibular
schwannoma)

NAME	TYPE	ORIGIN (Pons/Medulla)	TERMINATION	FUNCTION
Vestibulocochlear CN VIII	S	Organ of Corti → Spiral ganglion	Cochlear nuclei	Hearing
		Vest. apparatus → Vest. Ganglion	Vestibular nuclei	Balance & equilibrium




Flocculus cerebelli
direkte Fasern zum Kleinhirn
N. vestibulo-cochlearis
Radix vestibularis
Ganglion vestibulare
Bogen-gänge
Nucleus vestibularis superior
Nucleus vestibularis medialis
Nucleus vestibularis lateralis
Nucleus vestibularis inferior
a

Nucleus coch-
learis anterior

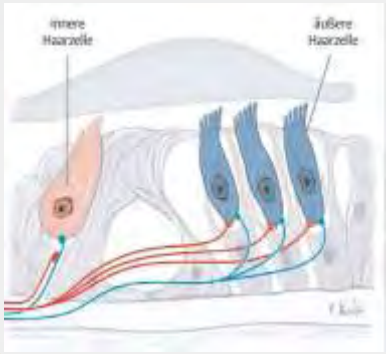
Nucleus coch-
learis posterior

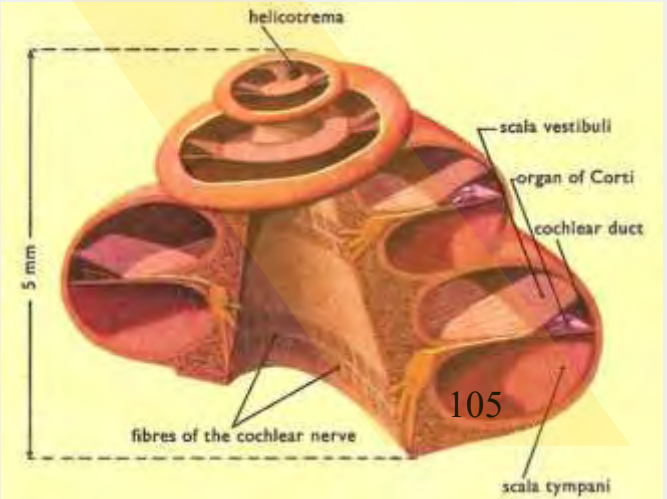
Radix
cochlearis

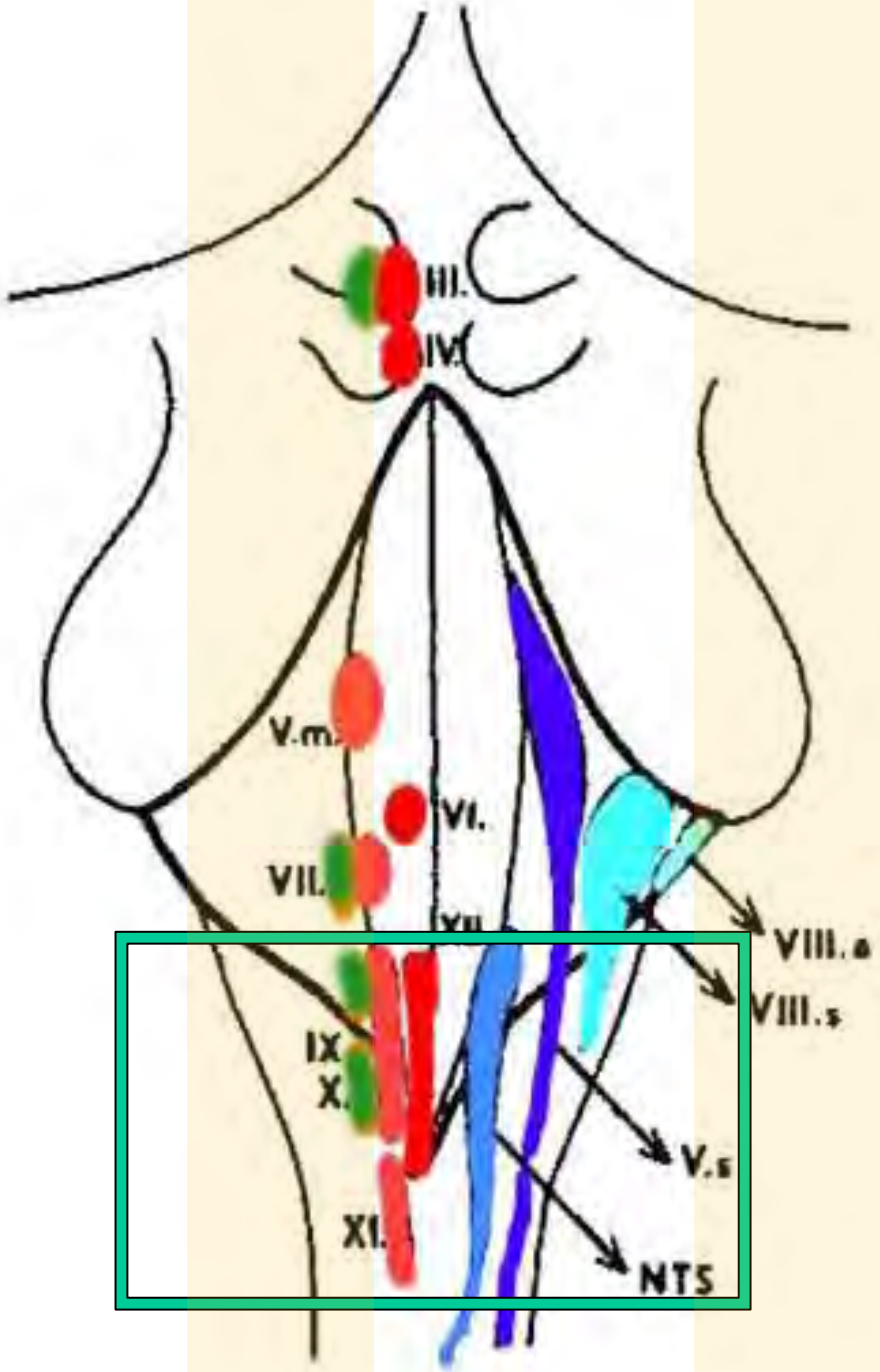
Cochlea mit
Ganglia spiralia

N. vestibulo-
cochlearis

b







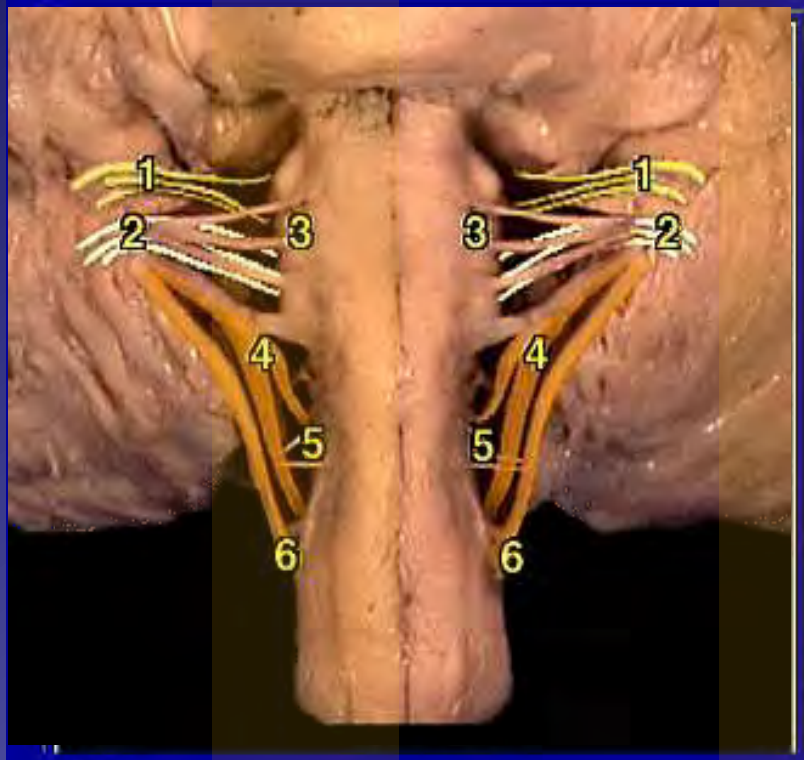
Nuclei of the lateral nervou system of the CN nerves

nuclei origines
et parasympathici
(dorsales)
somato and viscero
motor

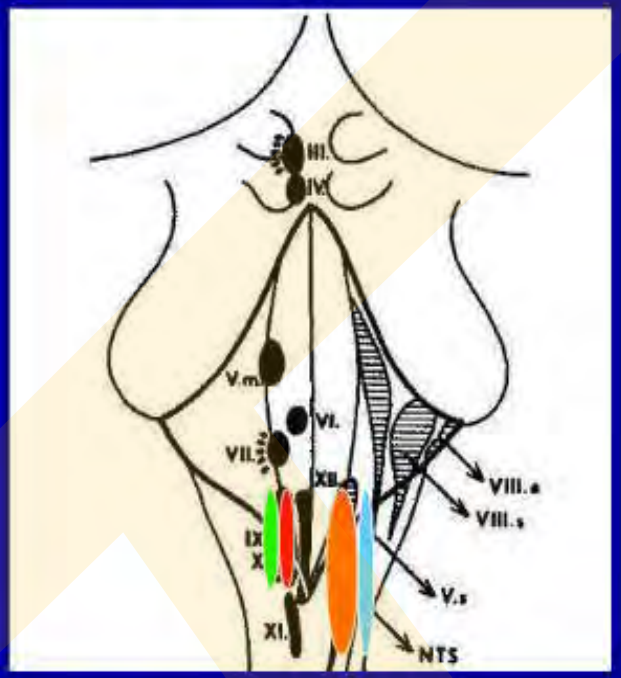
nuclei terminationes
Sensitive and sensory

Lateral nervous system

IX, X, IX



1-IX
2 – X
3 - XII
4 – r.cranialis XI
5 - C1
6 – r.spinalis XI



Ncl ambiguus – SM IX a X – s

Pharyngeal arches

Pharynx, larynx, oesophagus

Ncl. dorsalis n. vagi – VM –parasympaticus IX, X

Upper part

ncl. salivatorius inf.-gl.parotis

Ncl. solitarius VS – IX, X, ale i VII

Upper part

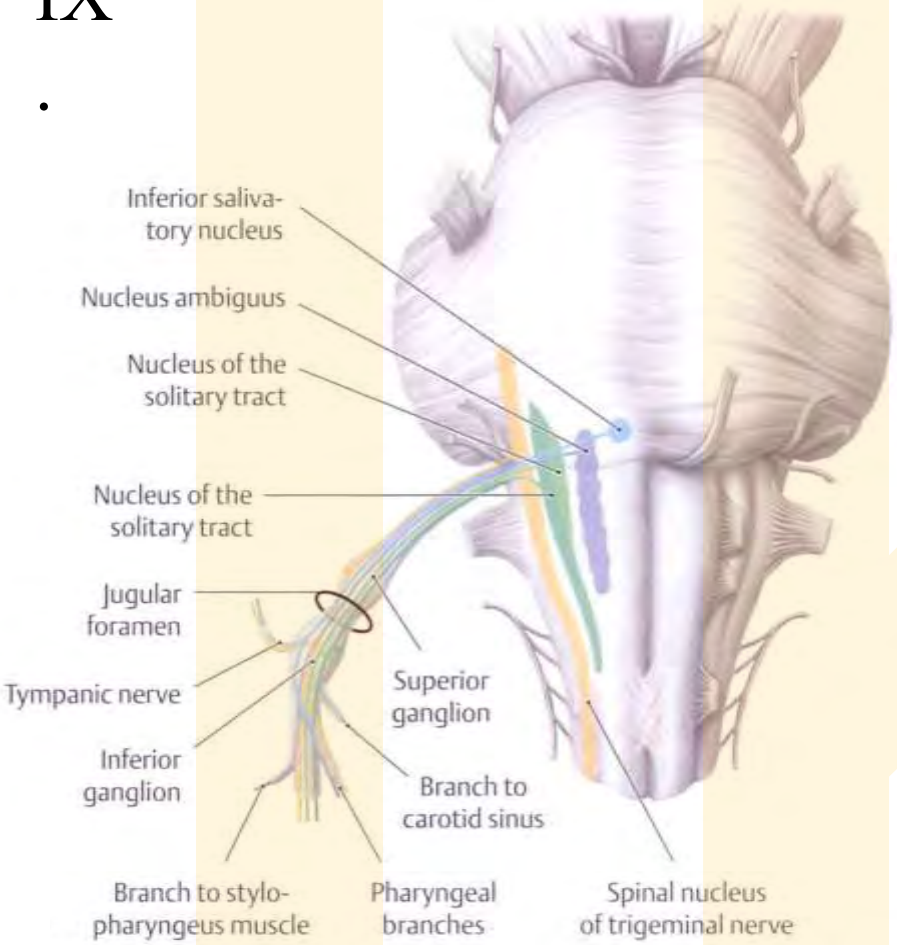
- ncl. gustatorius

Ncl. spinalis n.V. – SS

Pinna, outer acoustic tube,
Dorsal 1/3 tongue, palatal tonsil, soft plalate

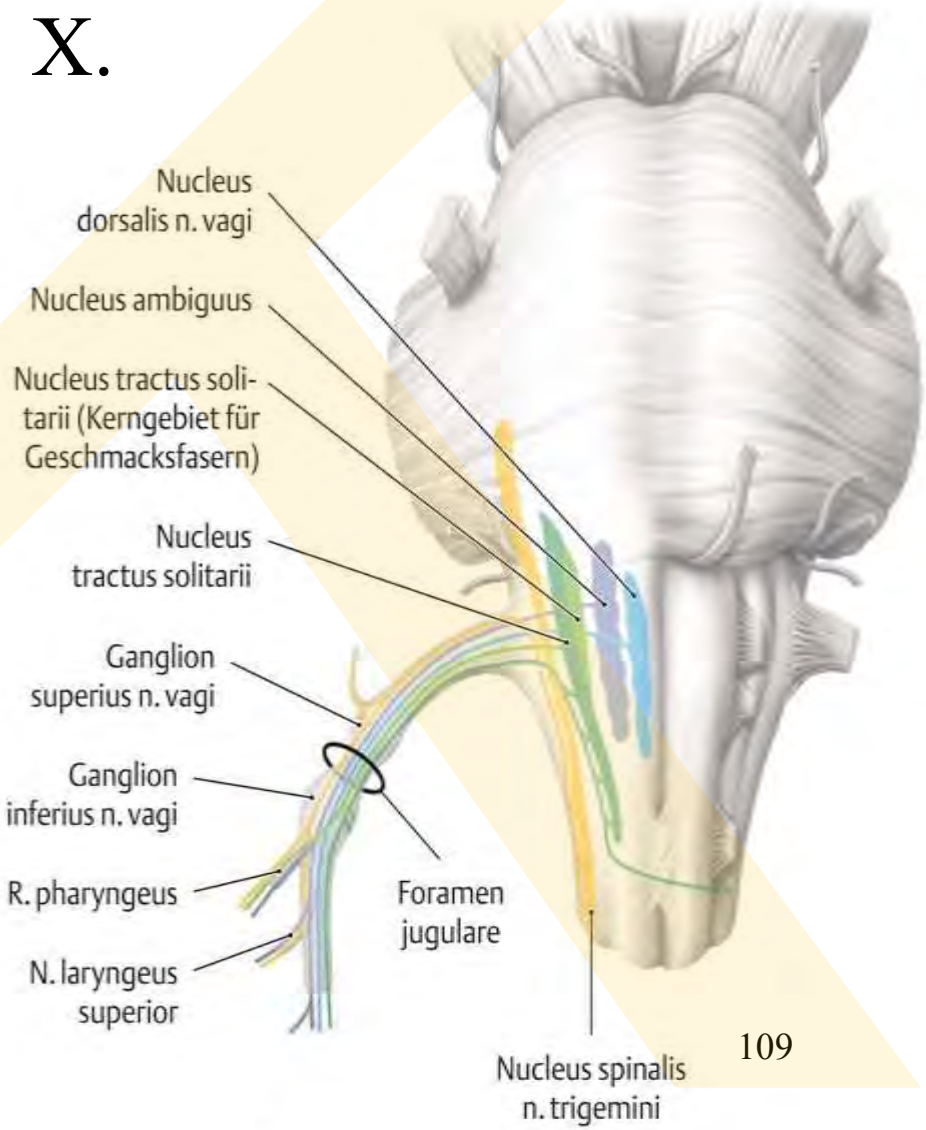
Nuclei of the lateral nervous systém inside brainstem

IX
.

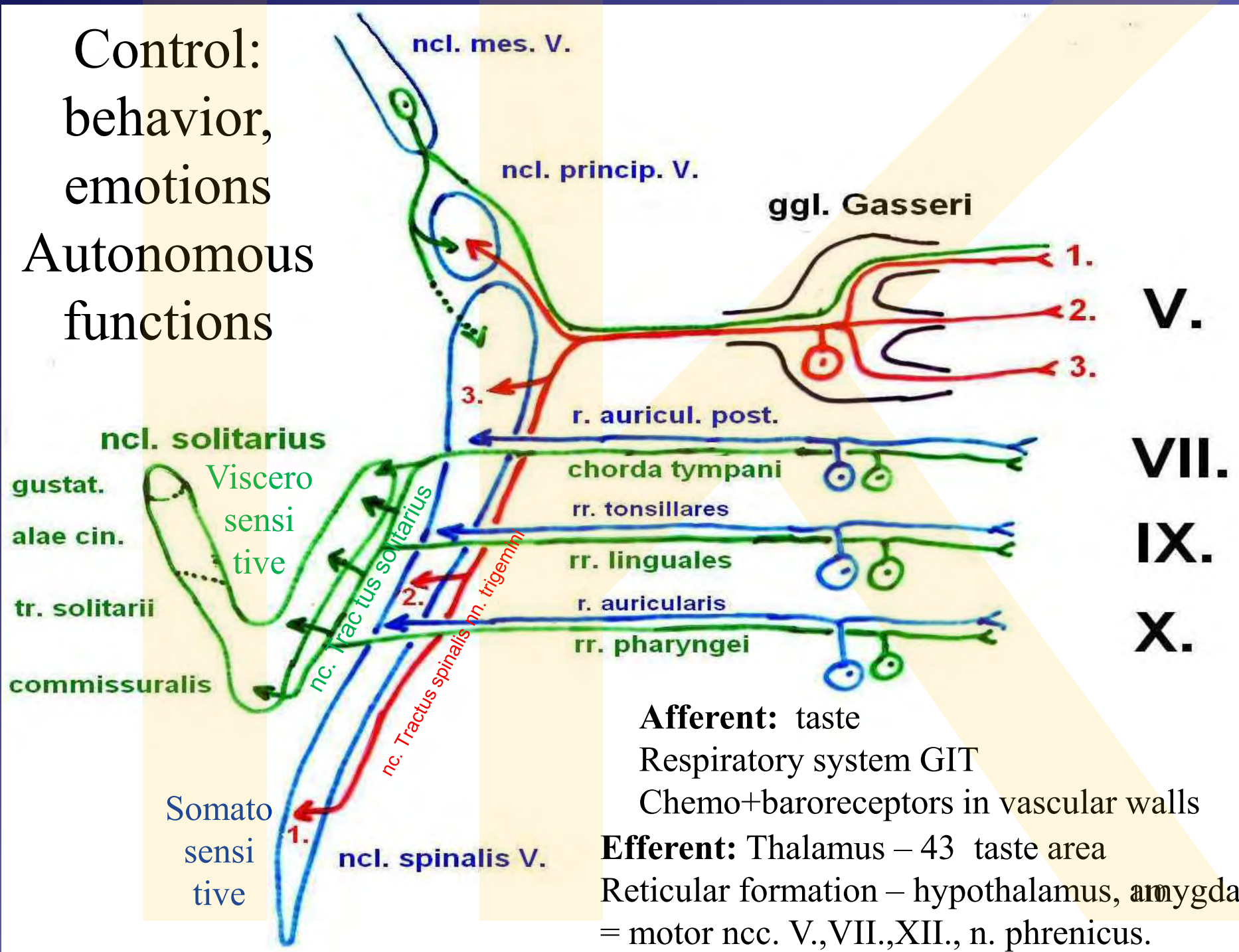


Nucleus solitarius - nucleus stored externally from the sulcus limitans. Viscerosenzitive part receives information from the heart, digestive, respiratory system and baroreceptors and chemoreceptors inside vascular walls. They enter into the nucleus via axons of sensory ganglia IX. and X. cranial nerves. Axons issued ascending and descending collaterals. Descending collaterals before entering are called the **nucleus tractus solitarius.**

X.

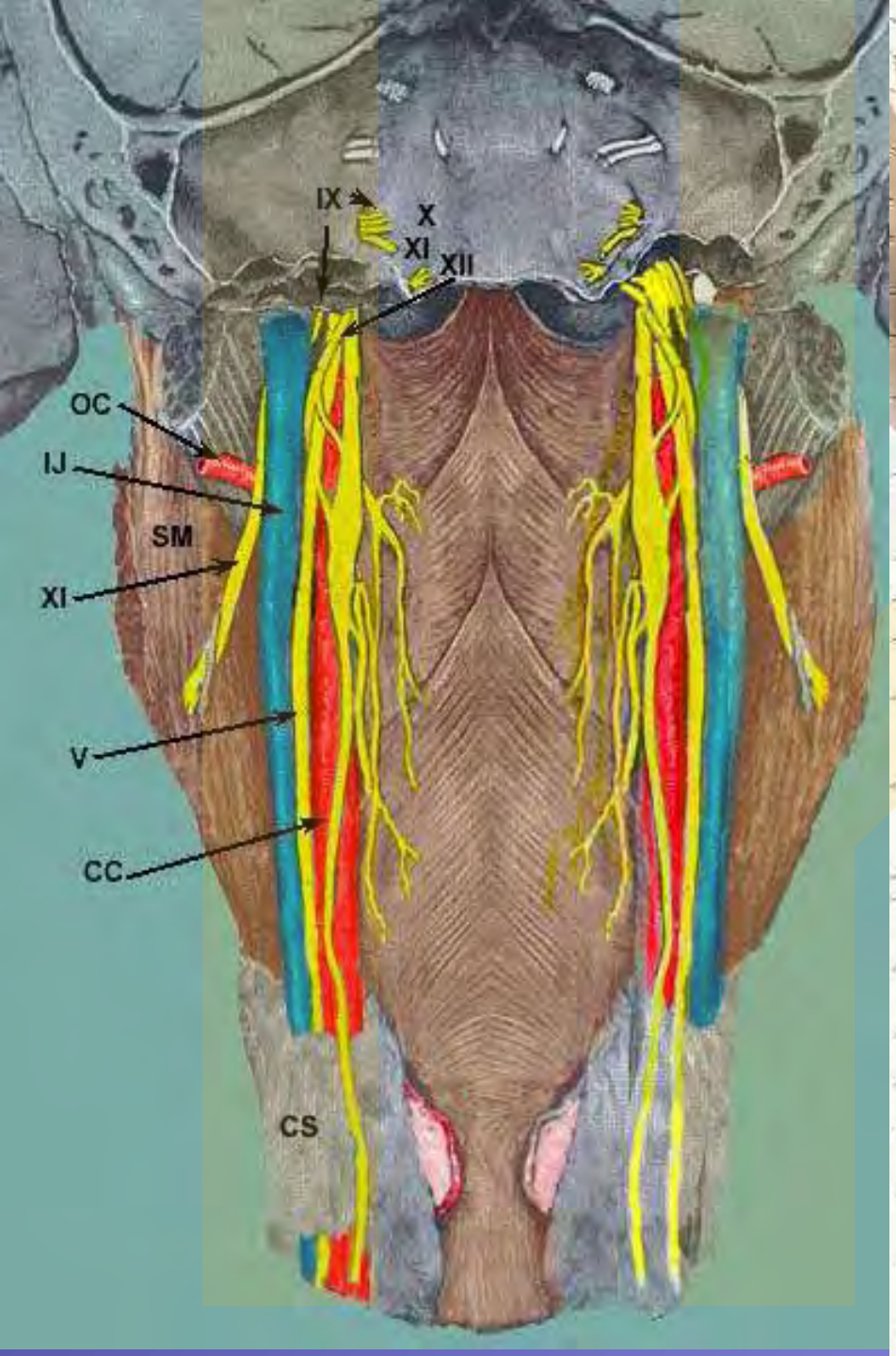


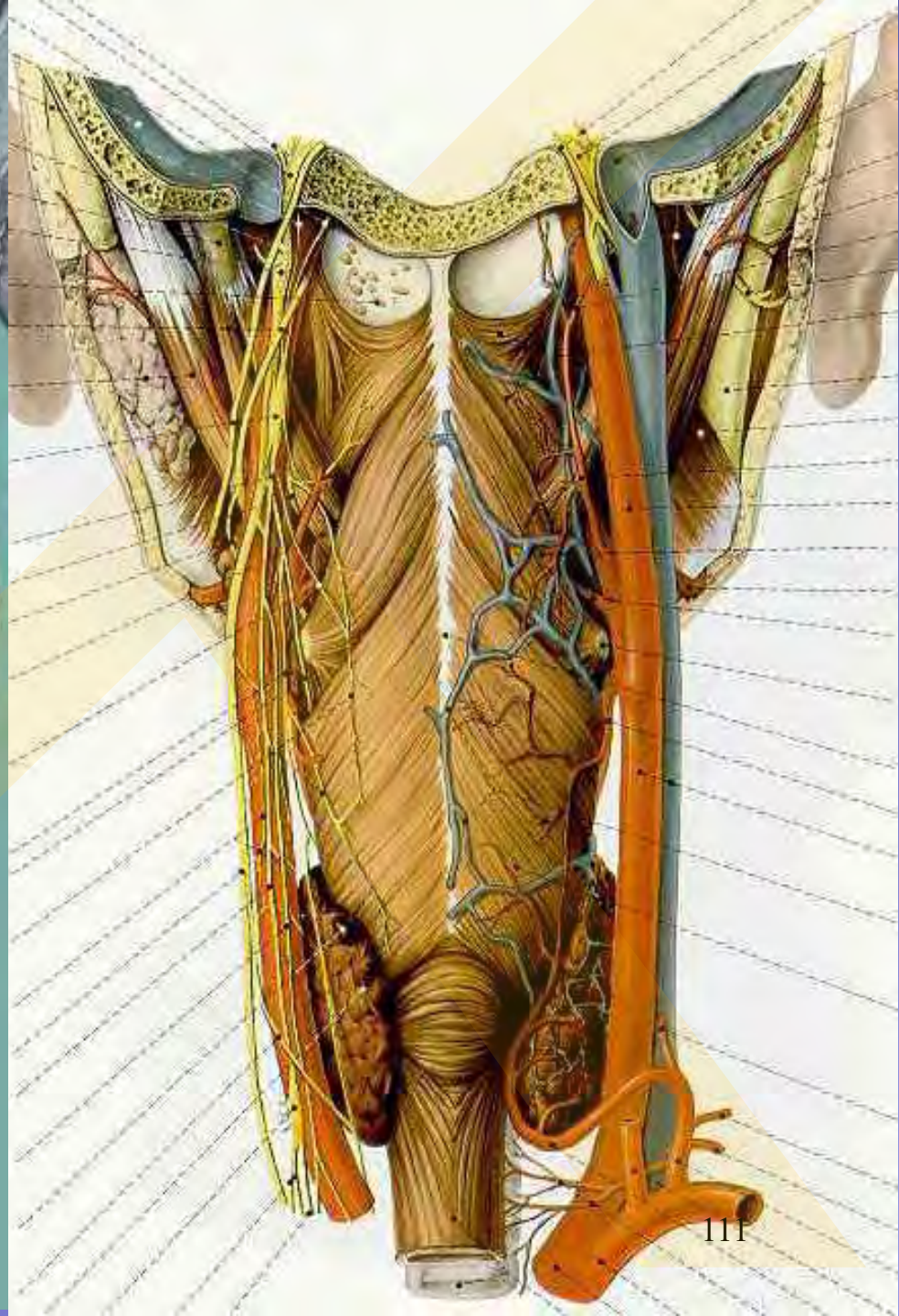
Control: behavior, emotions Autonomous functions



Afferent: taste
Respiratory system GIT
Chemo+baroreceptors in vascular walls

Efferent: Thalamus – 43 taste area
Reticular formation – hypothalamus, amygdala
= motor ncc. V.,VII.,XII., n. phrenicus.


IX
X
XI
XII
OC
IJ
SM
XI
V
CC
CS



CN IX. Nervus glossopharyngeus

SM – palatal and pharyngeal mm

VM – gl.parotis (Jacobson anastomosis),
cavum tympani

SS +VS- pharynx, tonsils, dorsal 1/3 tongue, tuba auditiva, cavum tympani

taste – dorsal 1/3 tongue

DISTURBANCES

Dysphagy – swallowing trouble,

Low vomiting reflex

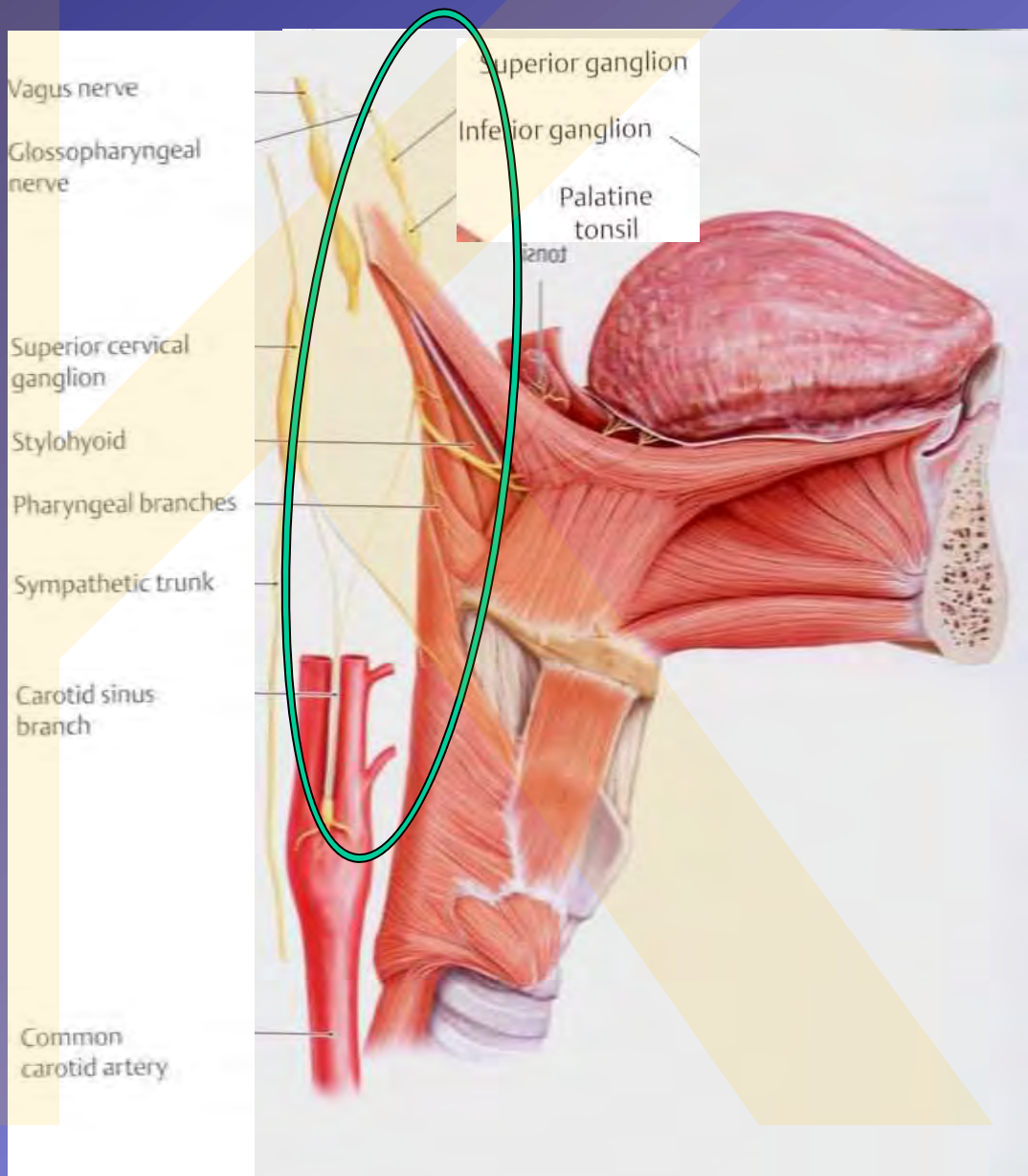
Taste disturbed dorsal 1/3 tongue

Hypesthesia dorsal 1/3 tongue, pharynx, tonsills

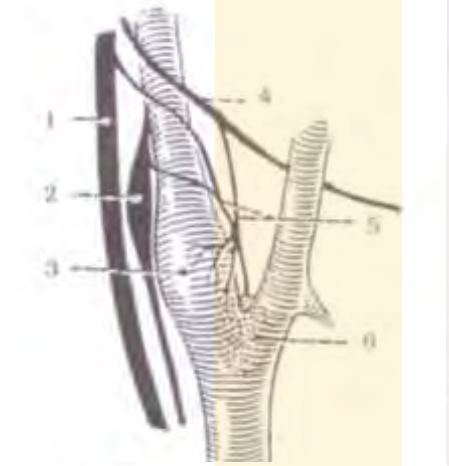
Uvular deviation to healthy side

Sometime tachycardia

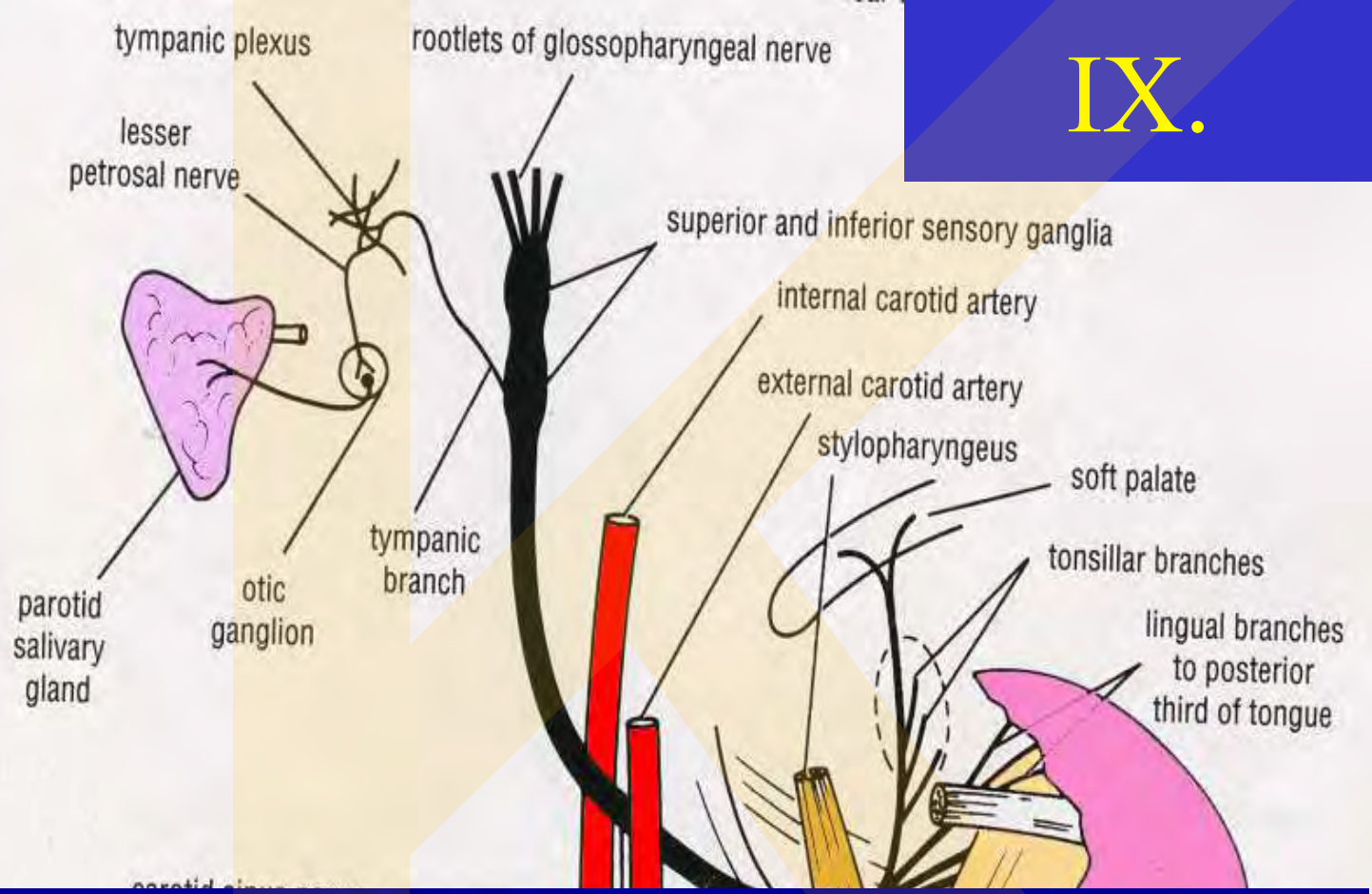
Neuralgy of the CN IX.

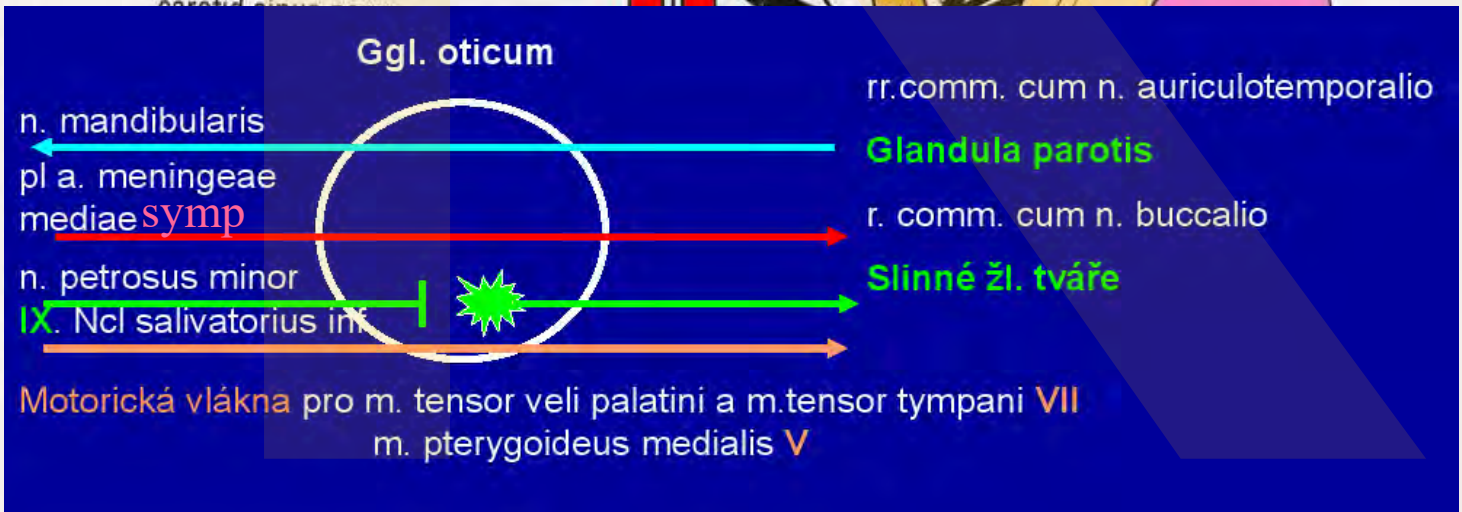


IX.

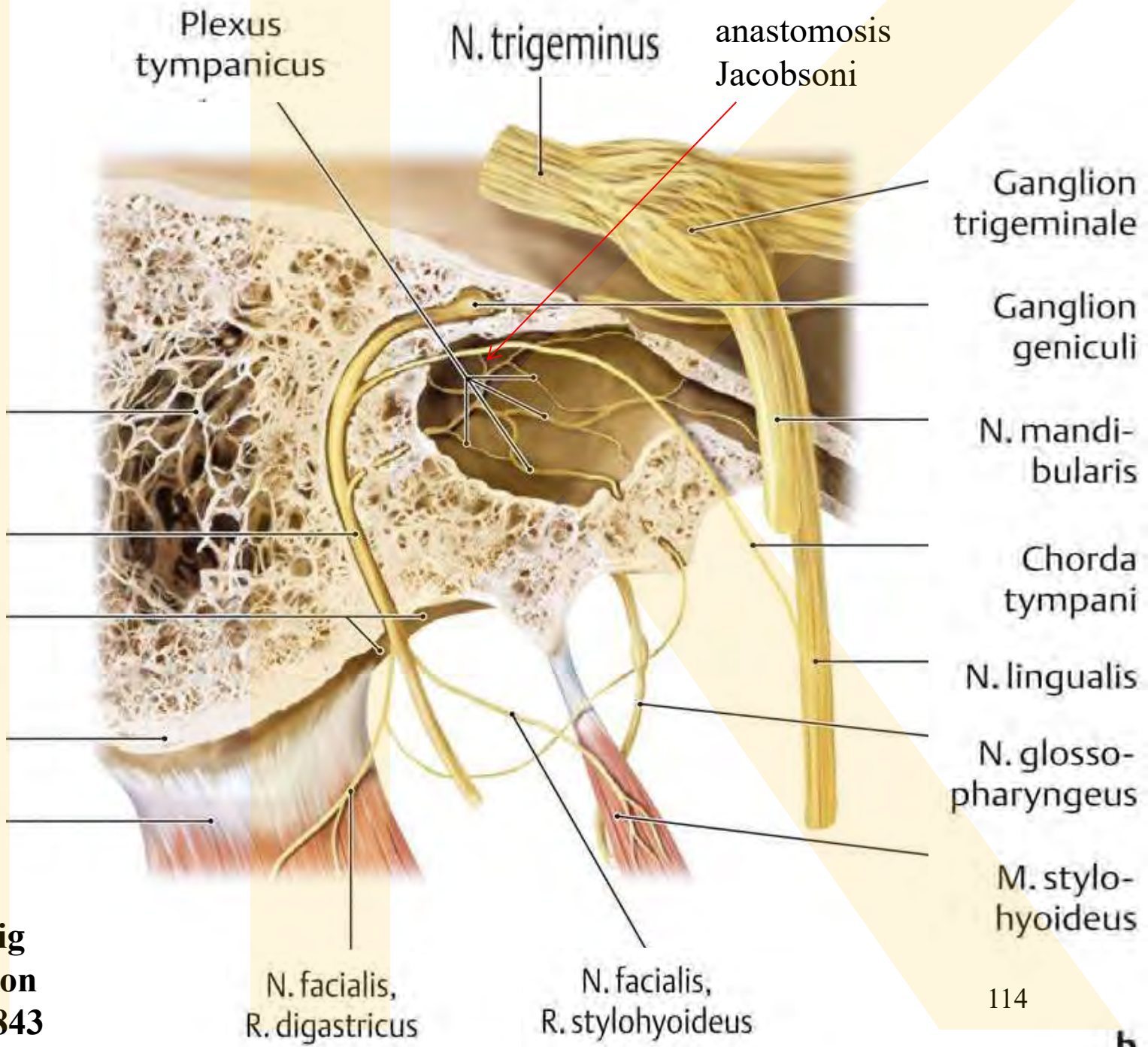


1 – n. vagus
2 – ganglion cervicale superius
3 – sinus caroticus
4 – n. glossopharyngeus
5 – větve pro sinus caroticus a
glomus caroticum z n. IX.
a z n. X.
6 – poloha glomus caroticum

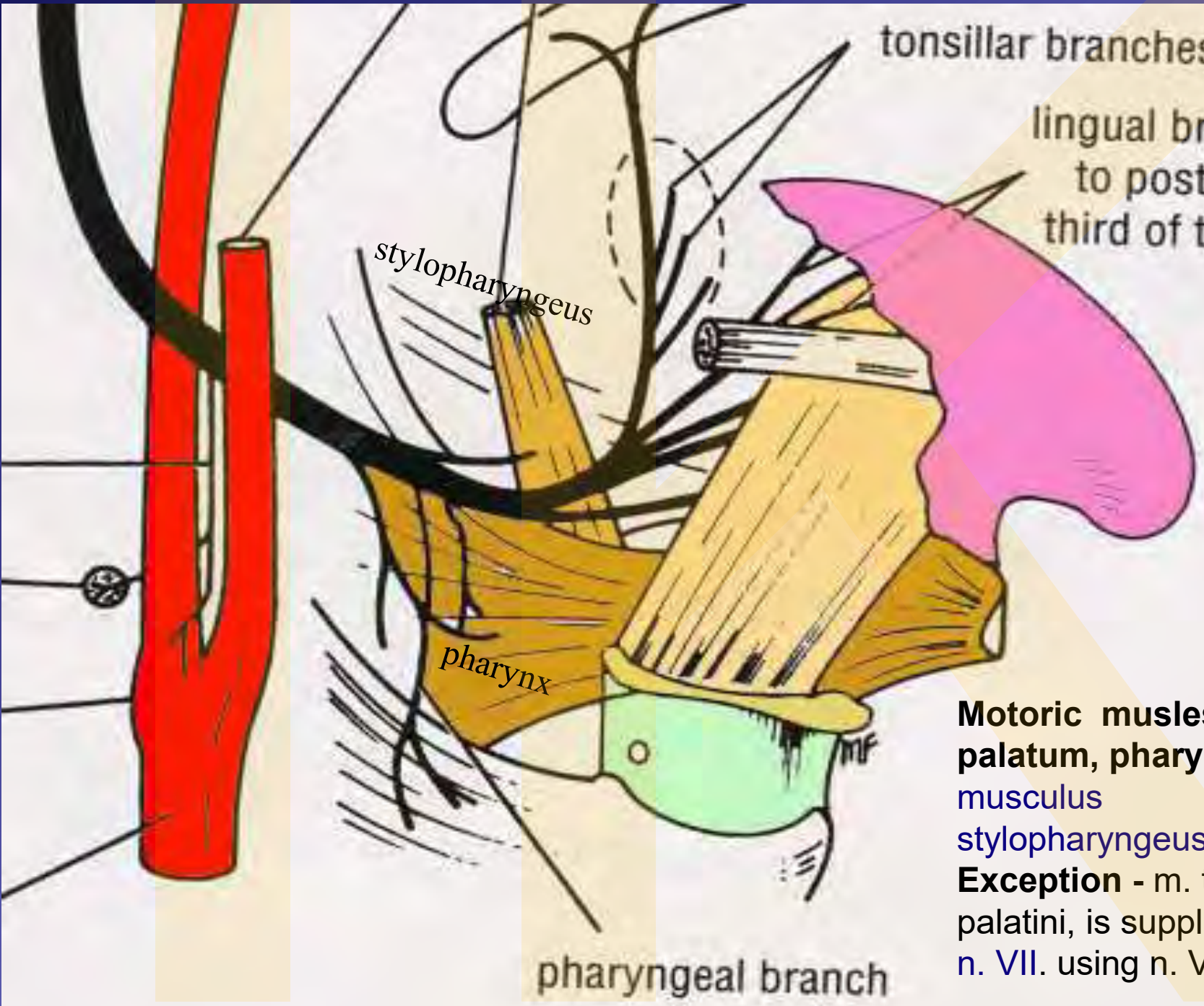




Course inside petrous bone

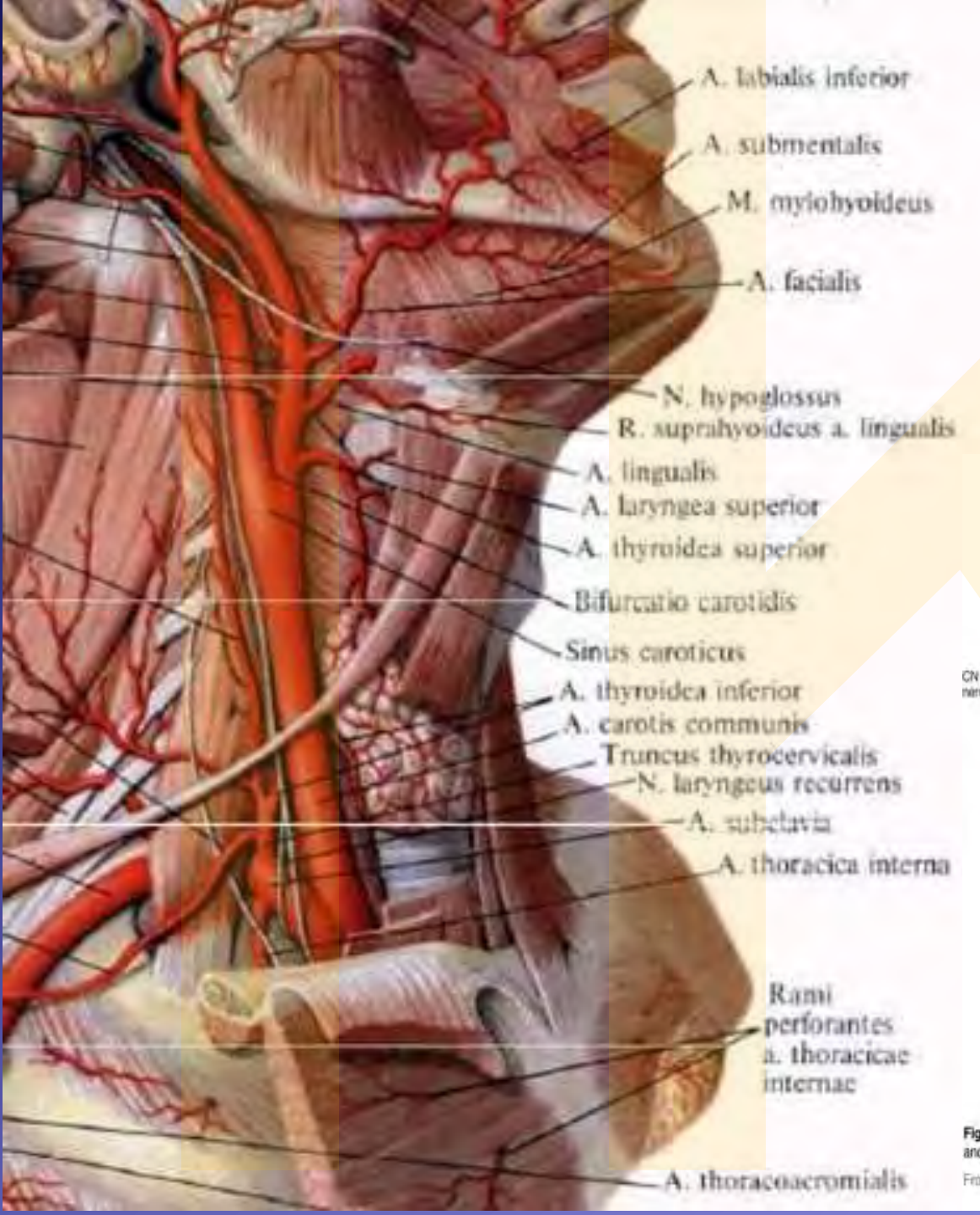


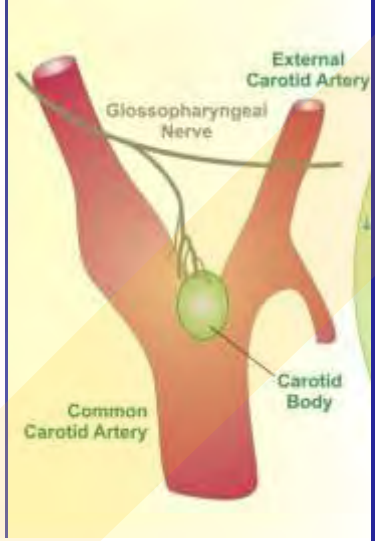
Ludwig Jacobson 1783-1843



Motoric musles in palatum, pharynx and musculus stylopharyngeus.
Exception - m. tensor veli palatini, is supplied from n. VII. using n. V.

Branch for carotid sinus and carotid body





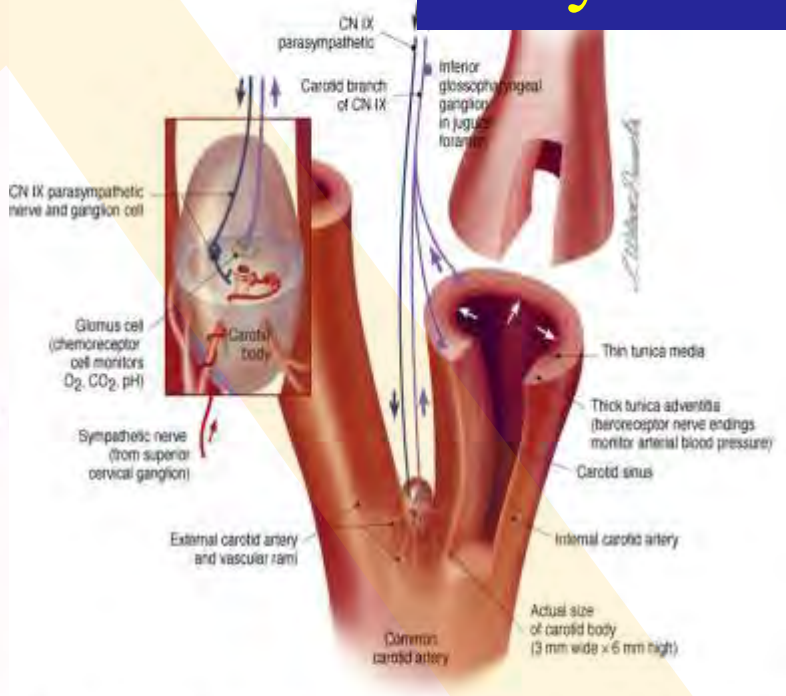


Figure IX–6 The bifurcation of the common carotid artery demonstrating baroreceptors in the wall of the carotid sinus and chemoreceptors within the carotid body.

Reflexes of carotid sinus

Negative feedback in the autonomous system.

1. It is necessity to make active mechanoreceptors in sinus caroticus (body) and aortic sinus.
2. When blood pressure increases the mechanoreceptors are elongated following enlargement of artery. This is followed by increasement of the frequency of discharges, which are conducted to the NTS through afferents n. X.

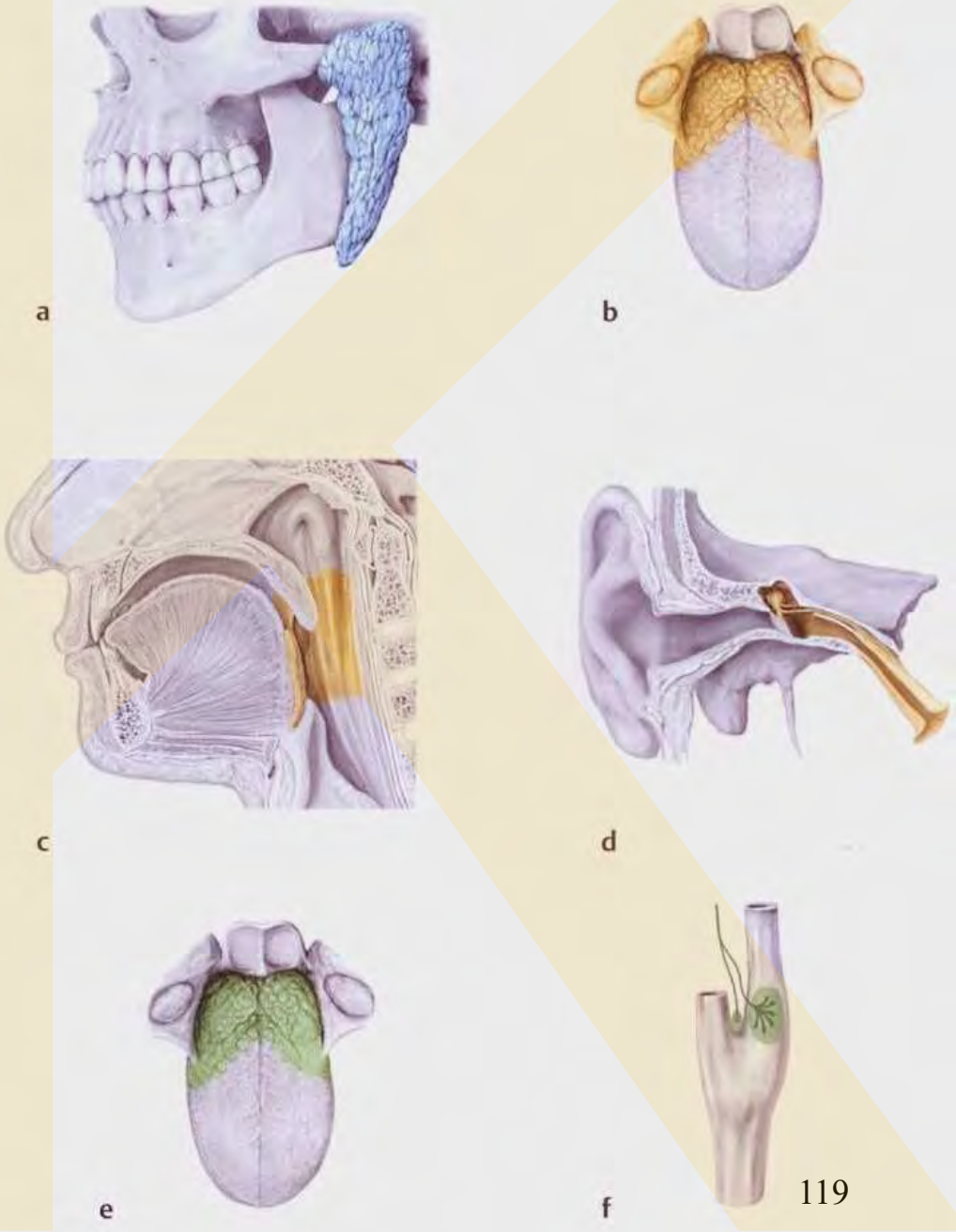
Answer:

3. NTS then modulates decreasing of sympathetic tone. At the same time tone n. X. increases reciprocity). Results: vasodilation in the periphery, run-down of heart rate and depressurization of the blood pressure to the original level

When blood pressure is very low, you see an opposite action:

- vasoconstriction and increasement of heart rate to be blood pressure been returned to normal.

Sensitive regions of the CN IX. glossopharyngeus



N. Glossopharyngeus

- n. tympanicus – pl. tympanicus on promontory,– n. petrosus minor, through foramen ovale to g. oticum –
- Jacobson´s anastomosis – there are preganglionic fibers from nc. salivatorius inf.

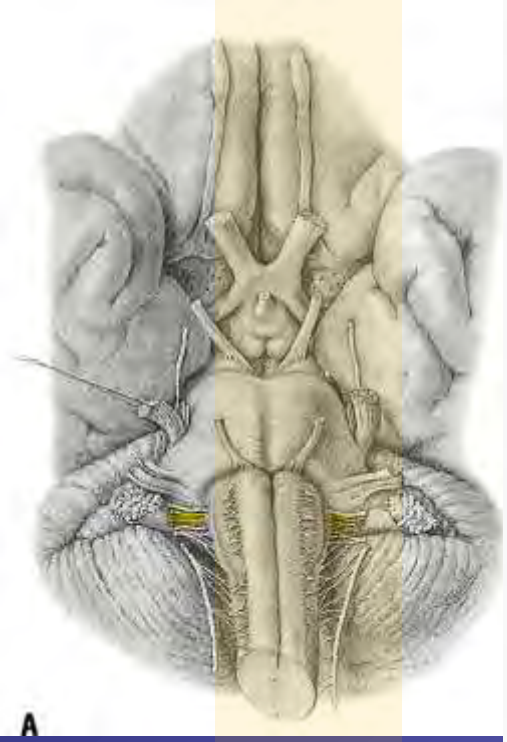
Motor fibers for the soft palate muscles, pharyngx m stylopharyngeus
parasympaticus for ganglion oticum,

sensitivity from pharynx, tonsils, dorsal tongue third, auditory tube and tympanic cavity

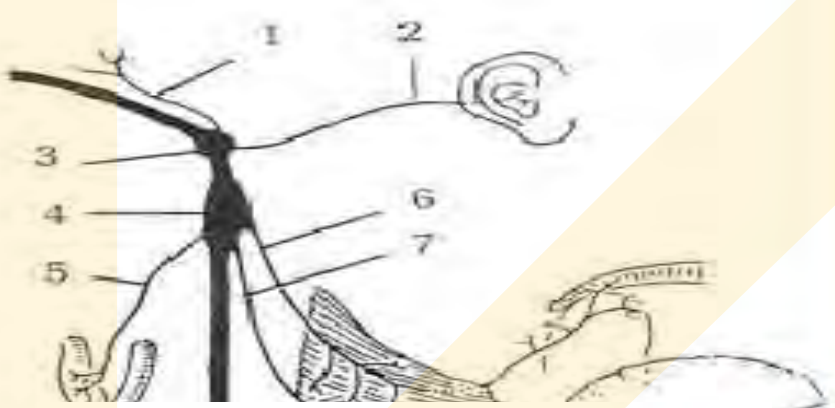
CN IX palsy – swallowing disturbances (dysphagia)
Taste disturbances in dorsal one third of the tongue, **hypesthesia** even anaesthesia of the sensitive regions of the CN IX.

Low vomiting reflex, low activity of the parotid gland

Irritation of the CN IX. – pain attacks (neuralgia), shooting from tonsil to auditory meatus
Pain in the tympanic cavity

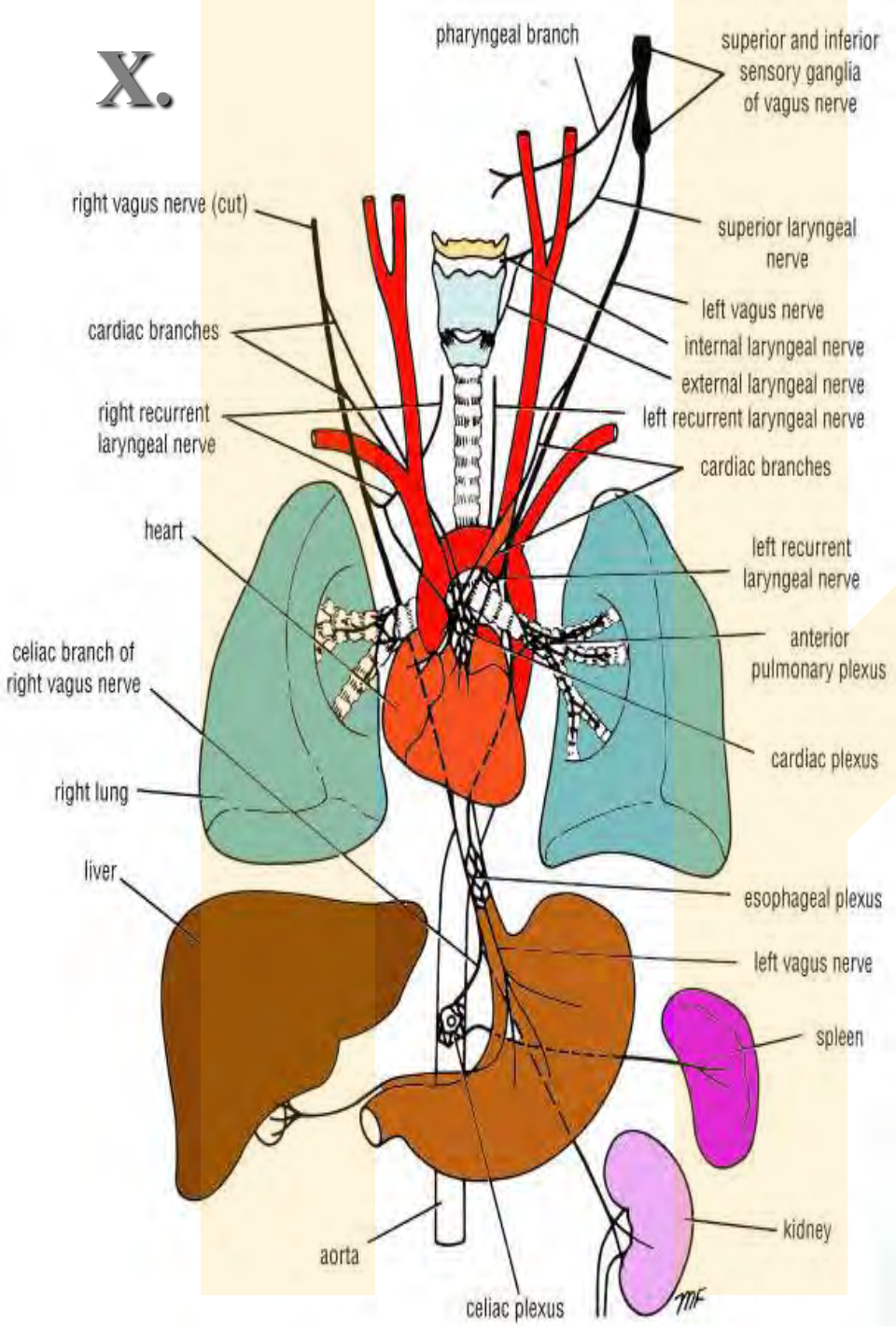


X. vagus



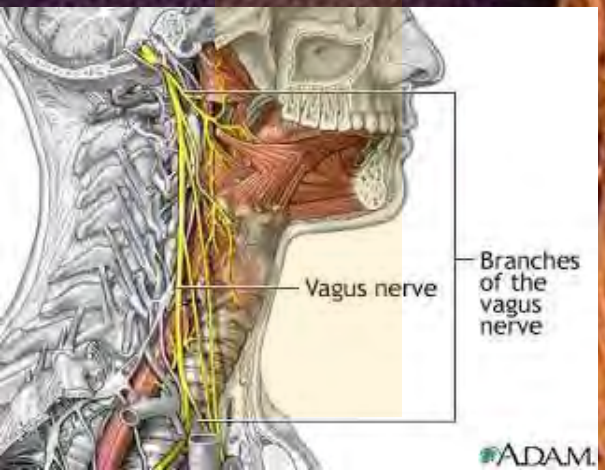
Cannon Böhm

X.

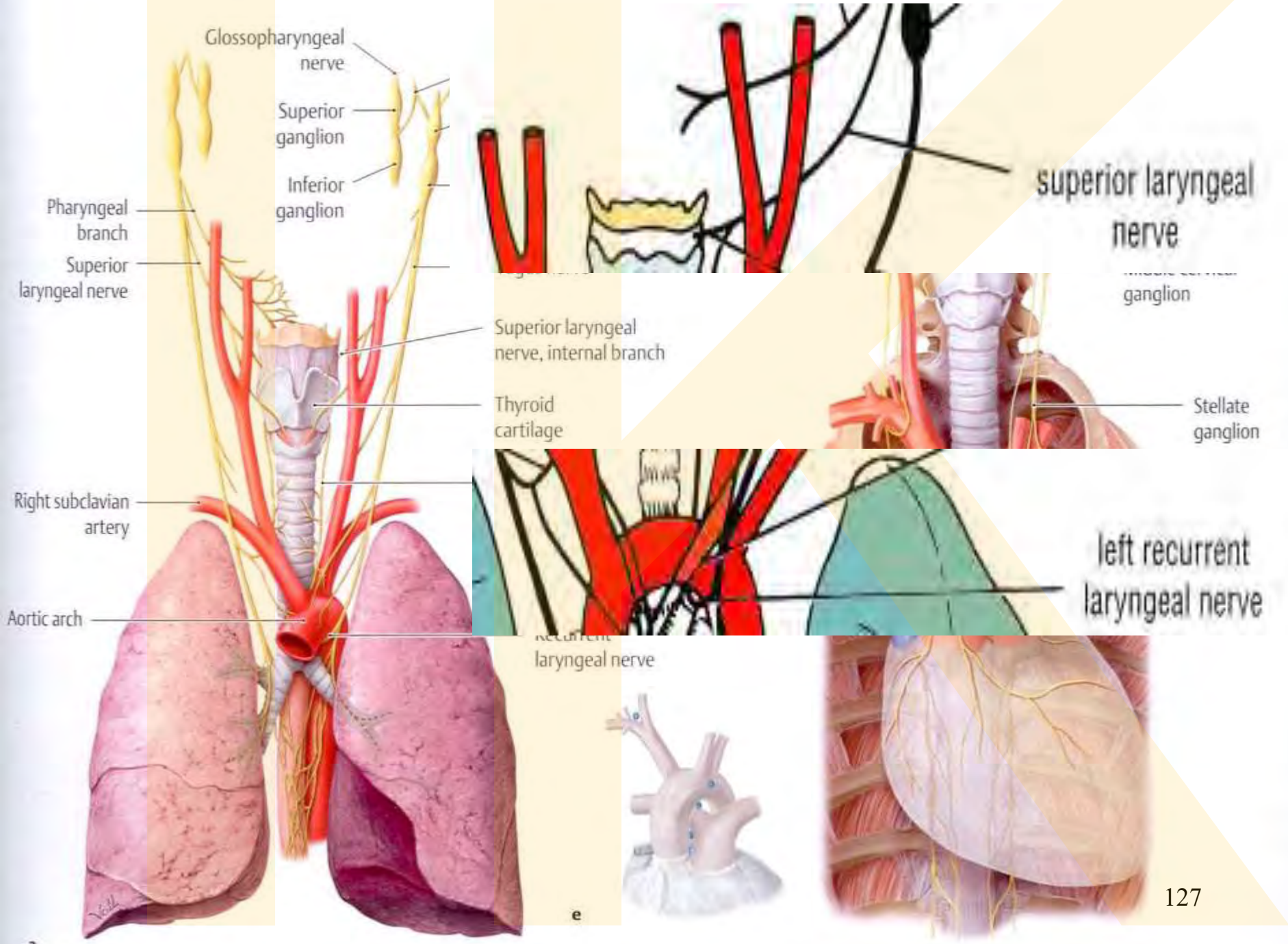


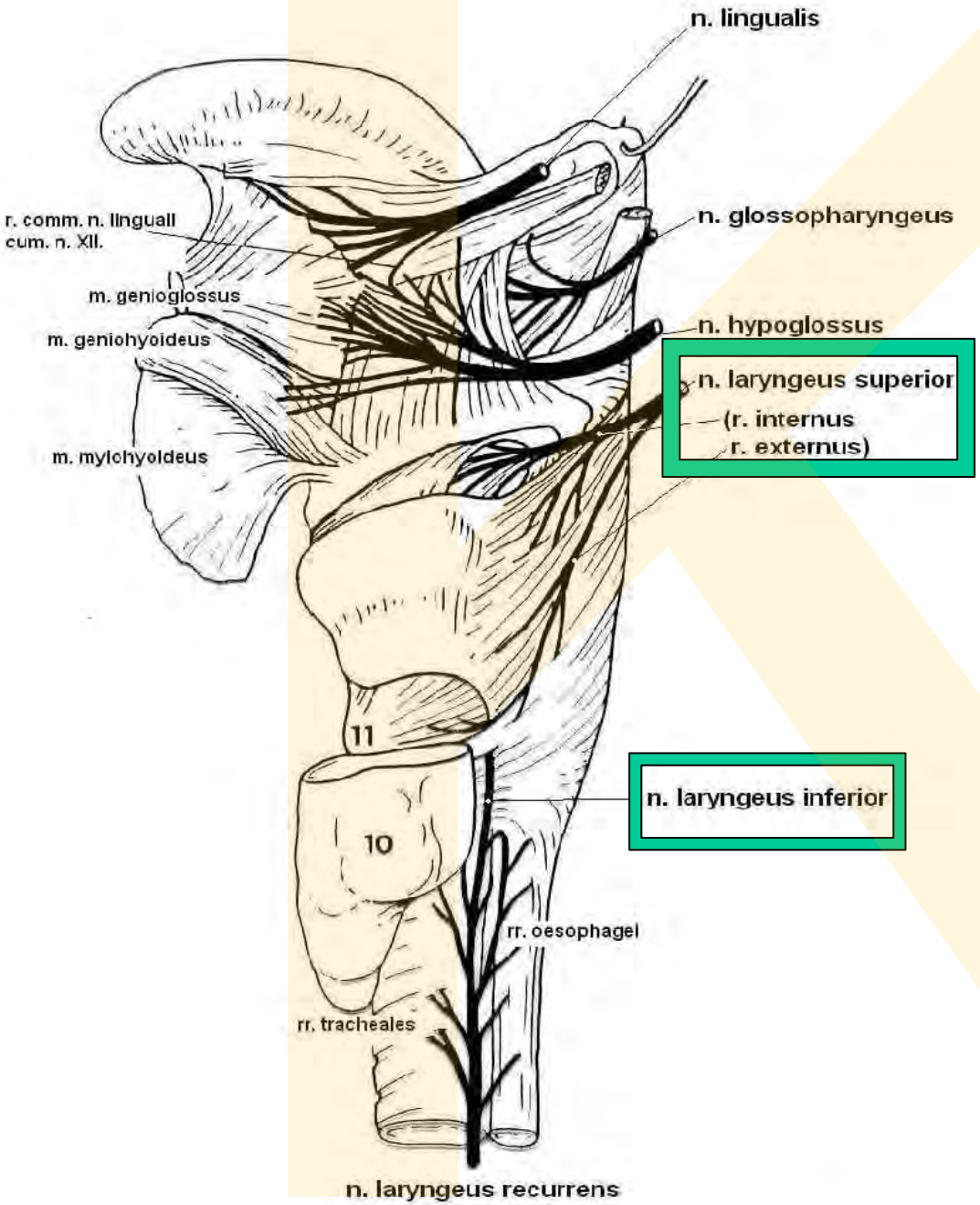
Summary of Vagus Nerve

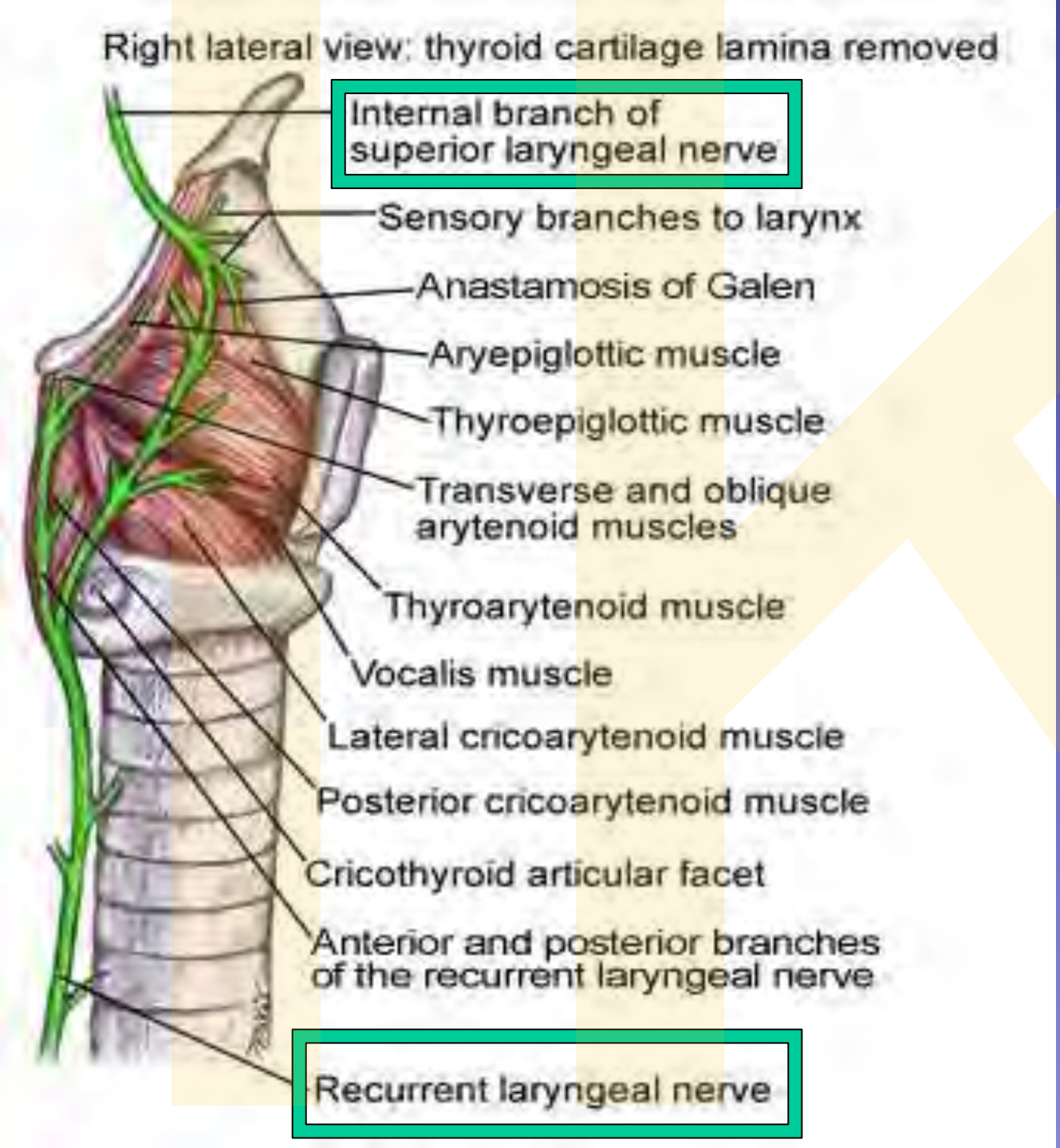
Divisions	Branches
Arises by a series of rootlets from medulla	
Leaves skull through jugular foramen	Receives cranial root of accessory nerve (CN XI) Meningeal branch to dura mater Auricular nerve
Enters carotid sheath and continues to root of neck	Pharyngeal nerves Superior laryngeal nerves Right recurrent laryngeal nerve Cardiac nerves
Passes through superior thoracic aperture into thorax	Left recurrent laryngeal nerve Cardiac nerves Pulmonary branches to bronchi and lungs Esophageal nerves
Passes through esophageal hiatus in diaphragm and enters abdomen	Esophageal branches Gastric branches Pancreatic branches Branches to gallbladder Branches to intestine as far as left colic flexure


Vagus nerve
Branches of the vagus nerve
A.D.A.M.

	n. V. (nc. IX)
	n. V. (nc. VII)
	n. VII.
	n. XII.
m. styloglossus	
m. stylopharyngeus	n. IX.
m. constrictor pharyngis superior	n. IX.
m. constrictor pharyngis medius	n. IX., n. X.
m. constrictor pharyngis inferior	n. X.
m. palatoglossus	n. IX.
m. palatopharyngeus	n. IX.


Glossopharyngeal nerve
Superior ganglion
Inferior ganglion
Pharyngeal branch
Superior laryngeal nerve
Superior laryngeal nerve, internal branch
Thyroid cartilage
Right subclavian artery
Aortic arch
laryngeal nerve
superior laryngeal nerve
ganglion
Stellate ganglion
left recurrent laryngeal nerve
a
e

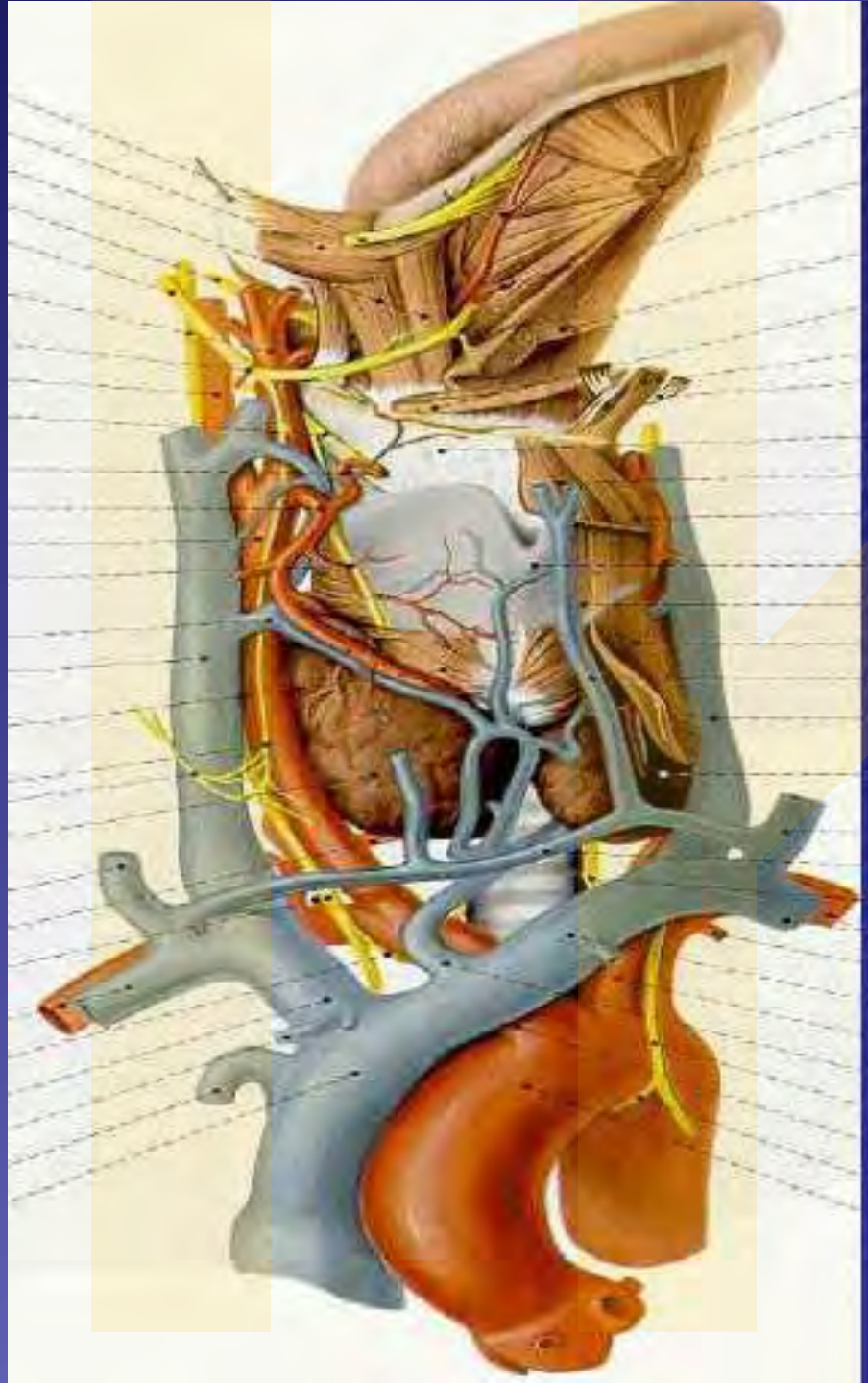

n. lingualis
n. glossopharyngeus
r. comm. n. lingualis cum. n. XII.
m. genioglossus
m. geniohyoideus
n. hypoglossus
n. laryngeus superior
(r. internus
r. externus)
m. mylohyoideus
11
10
n. laryngeus inferior
rr. oesophagei
rr. tracheales
n. laryngeus recurrens

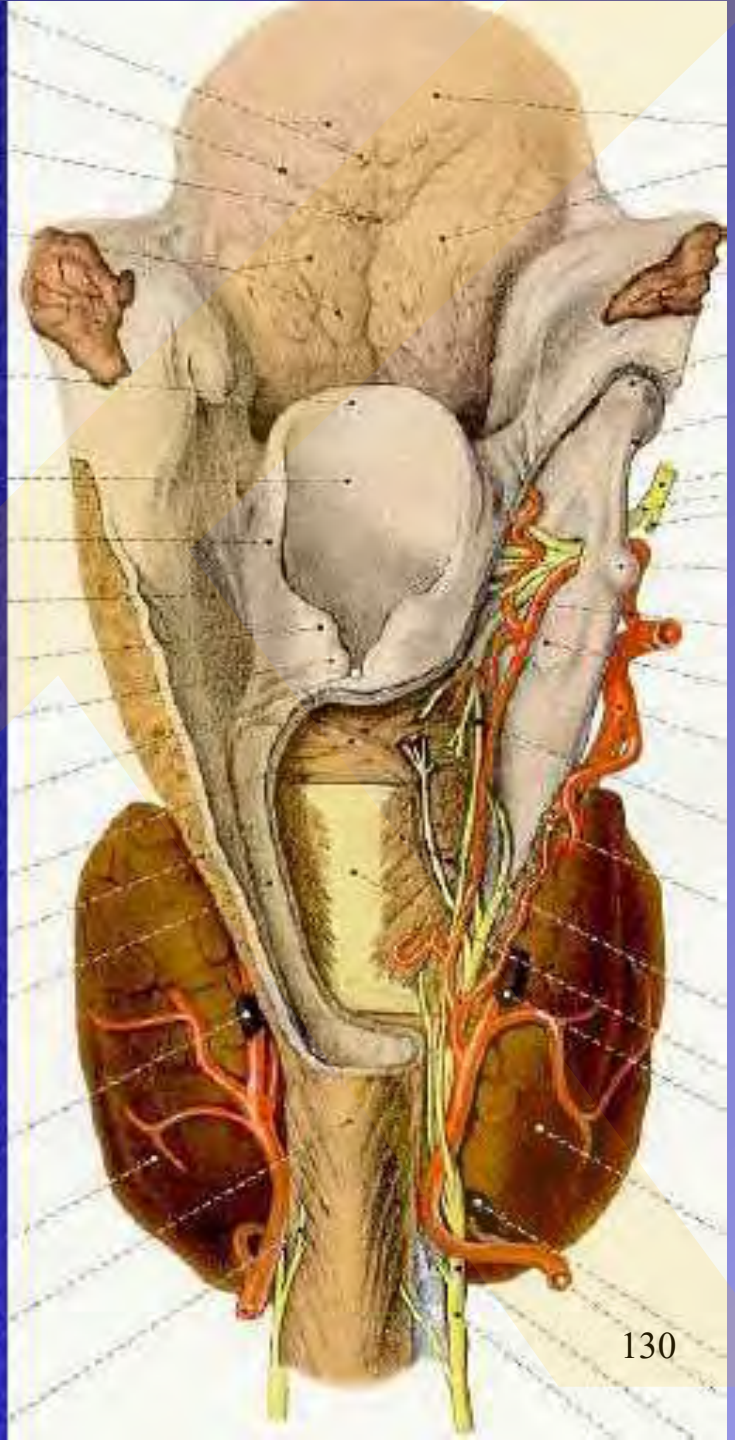


Anastomosis (ansa) of Galenos (Galen)

connection between nn. laryngeus superior et inferior

Klaudios Galénos
129 – 200?

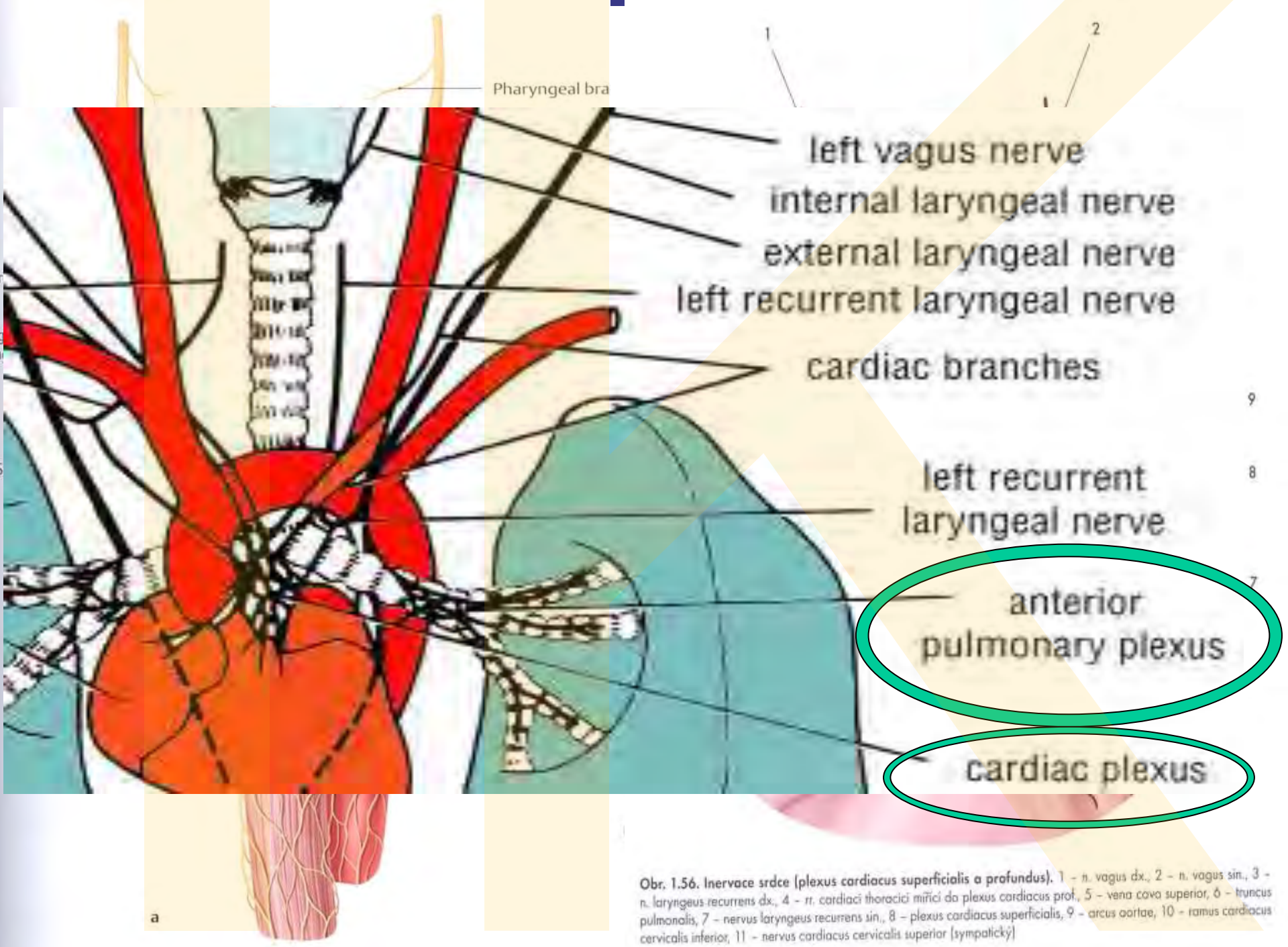




n. laryngeus recurrens – last branch containing somatomotor fibers

Further below that, the outgoing branches have only visceromotoric (parasympathetic) and viscerosensitive fibers

Parasympathetic fibers contain acetylcholine and VIP. They supply the atrial myocardium, coronary arteries and conducting system (substance P, CGRP) ;
right vagus rather n. sinuatrialis,
left vagus rather n. atrioventricularis



Obr. 1.56. Inervace srdce (plexus cardiacus superficialis a profundus). 1 – n. vagus dx., 2 – n. vagus sin., 3 – n. laryngeus recurrens dx., 4 – rr. cardiaci thoracici mířící do plexus cardiacus prof., 5 – vena cava superior, 6 – truncus pulmonalis, 7 – nervus laryngeus recurrens sin., 8 – plexus cardiacus superficialis, 9 – arcus aortae, 10 – ramus cardiacus cervicalis inferior, 11 – nervus cardiacus cervicalis superior (sympatický)

Plexus pulmonalis can be divided into:

Periarterial plexus – there are sympathetic fibers
! not coming from CN X. !

Peribronchial plexus – there are dominant vagal parasympathetic fibers (bronchial constriction)
! coming from CN X. !

Sensitive fibers from CN X. surround pulmonary hilus – anaesthesia of that structures in important during pulmonary operations !

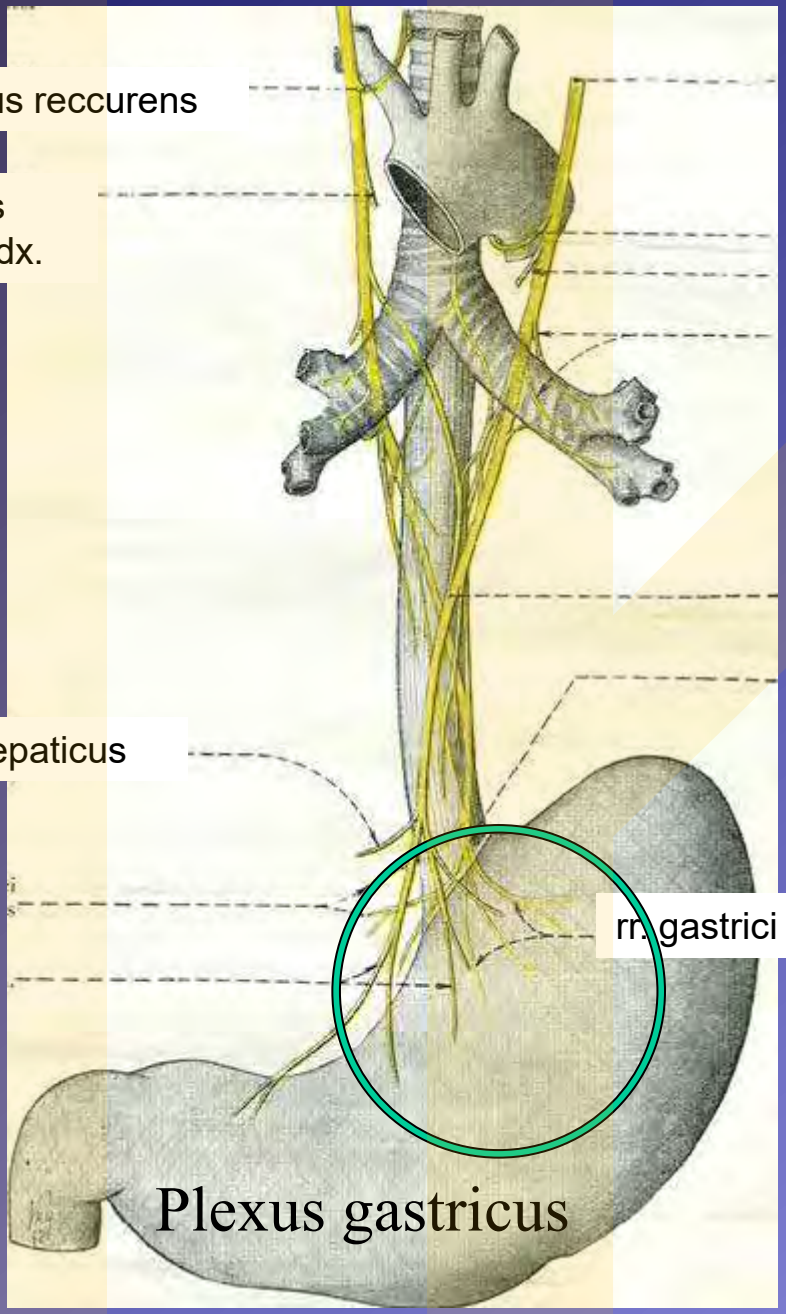
N. laryngeus reccurens

r. cardiacus thoracicus dx.

r. hepaticus

rr. coeliaci
rr. renales

rr. gastrici ant.



N. vagus sin.

n. laryngeus reccurens sin.

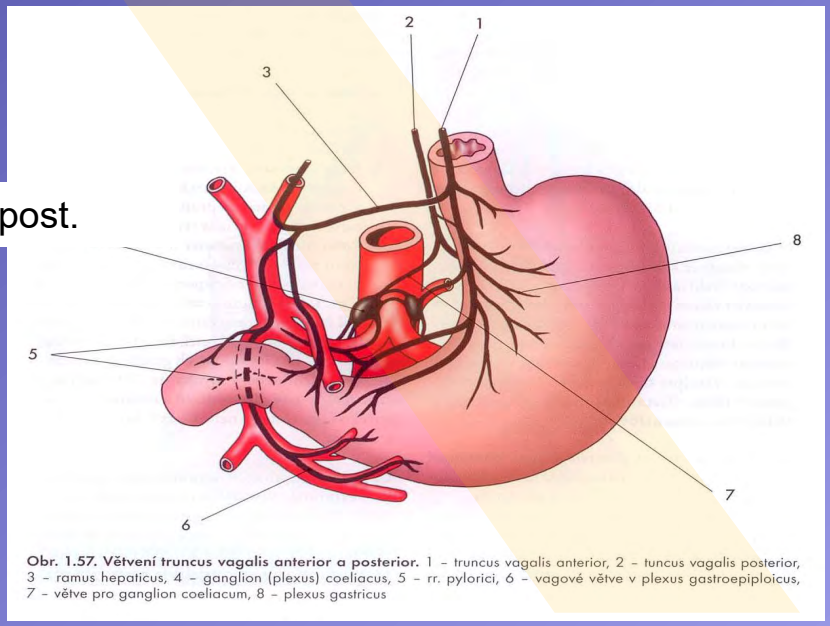
r. cardiacus thoracicus sin.

rr. bronchiales

truncus vagalis ant.

truncus vagalis post.

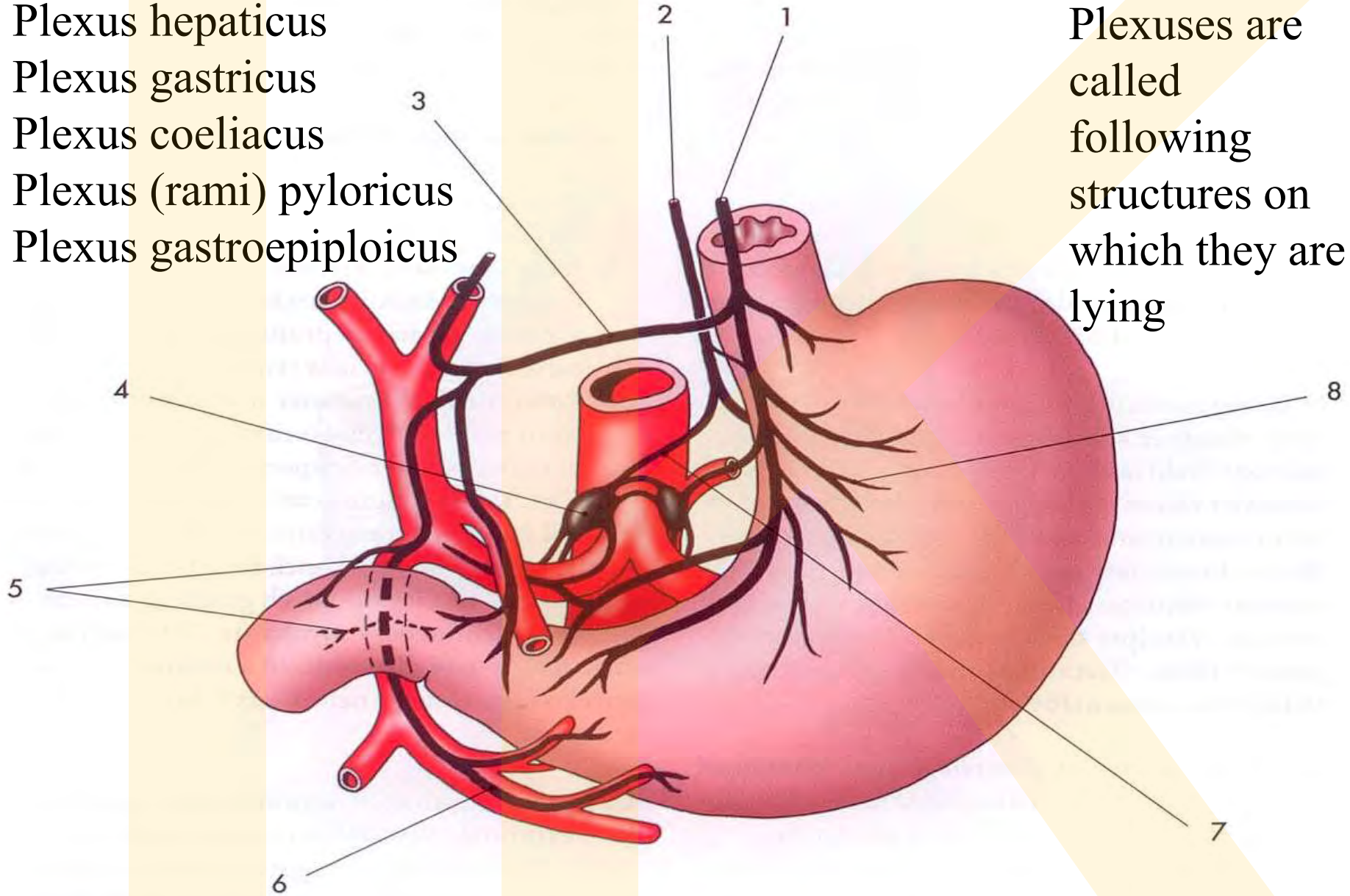
rr. gastrici post.



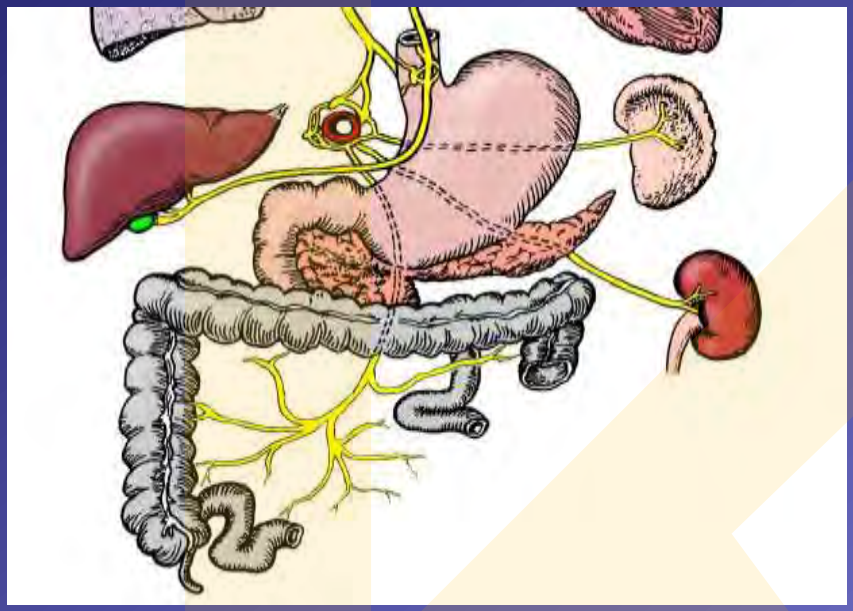
Obr. 1.57. Větvení truncus vagalis anterior a posterior. 1 – truncus vagalis anterior, 2 – tuncus vagalis posterior, 3 – ramus hepaticus, 4 – ganglion (plexus) coeliacus, 5 – rr. pylorici, 6 – vagové větve v plexus gastroepiploicus, 7 – větve pro ganglion coeliacum, 8 – plexus gastricus

Plexus hepaticus
Plexus gastricus
Plexus coeliacus
Plexus (rami) pyloricus
Plexus gastroepiploicus

Plexuses are called following structures on which they are lying



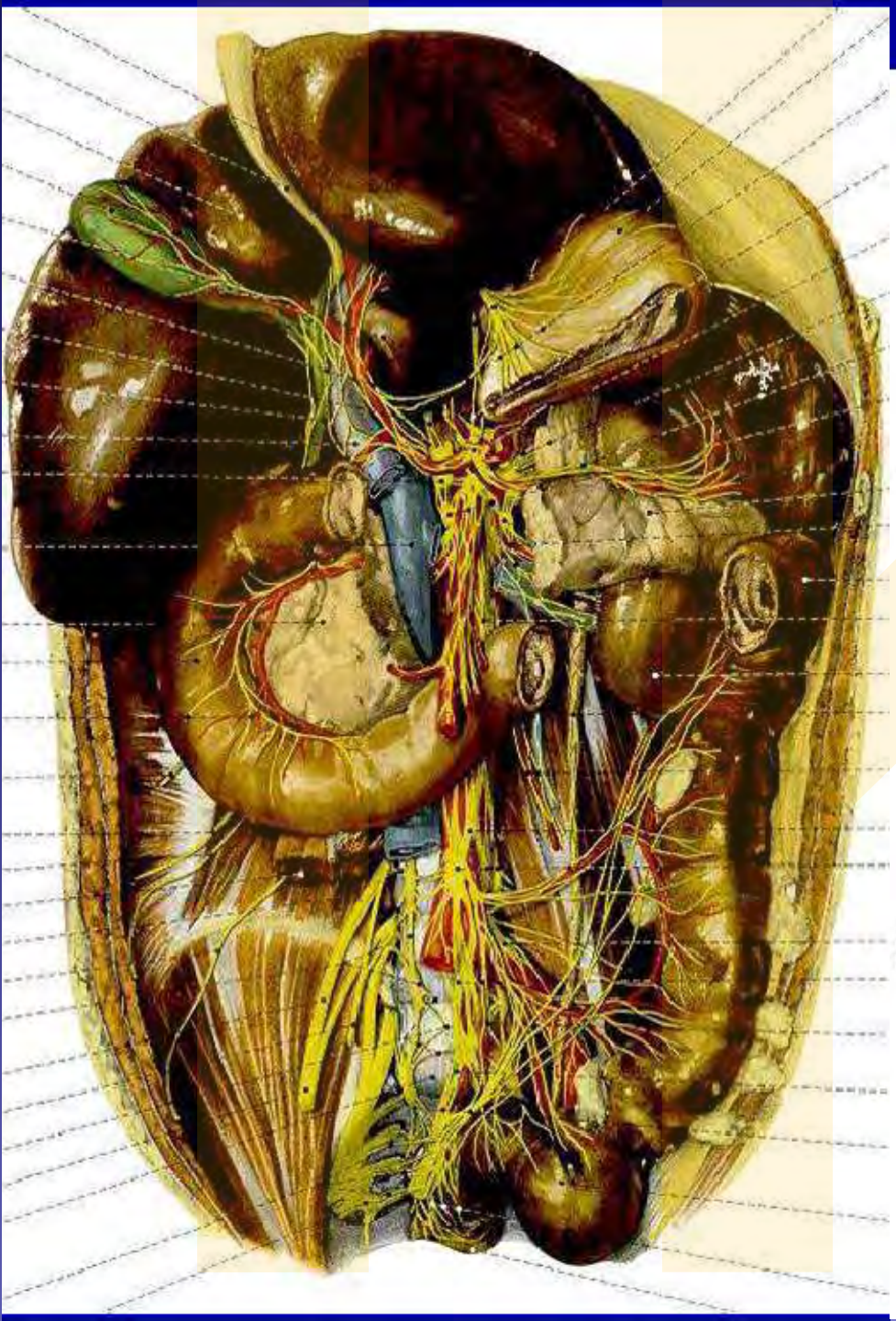
Obr. 1.57. Větvení truncus vagalis anterior a posterior. 1 – truncus vagalis anterior, 2 – tuncus vagalis posterior, 3 – ramus hepaticus, 4 – ganglion (plexus) coeliacus, 5 – rr. pylorici, 6 – vagové větve v plexus gastroepiploicus, 7 – větve pro ganglion coeliacum, 8 – plexus gastricus

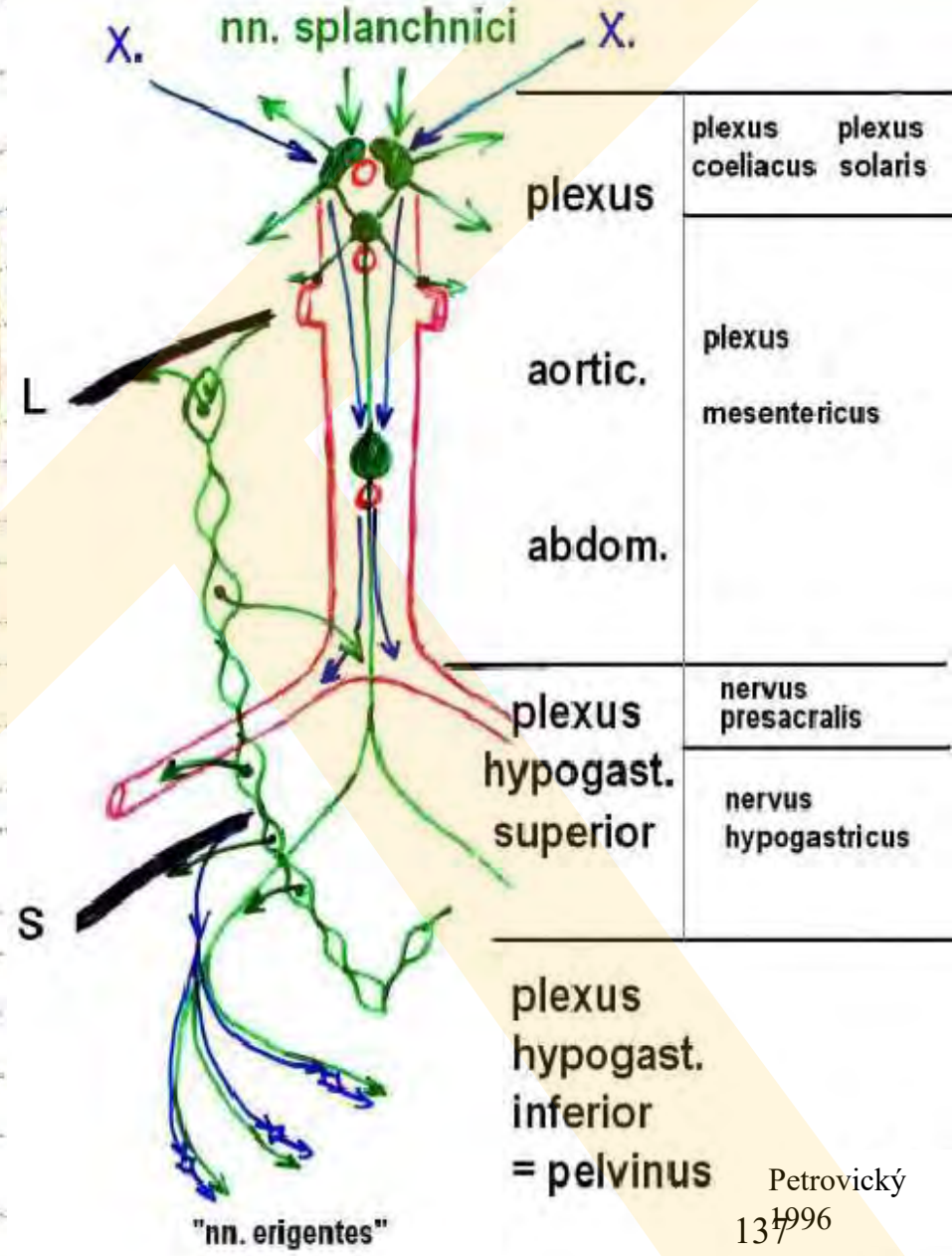


Parasympathetic vagal fibers supply myenteric plexus

Viscerosensitive fibers come from mucous layer, submucous layer and muscular layer of the alimentary tube GIT

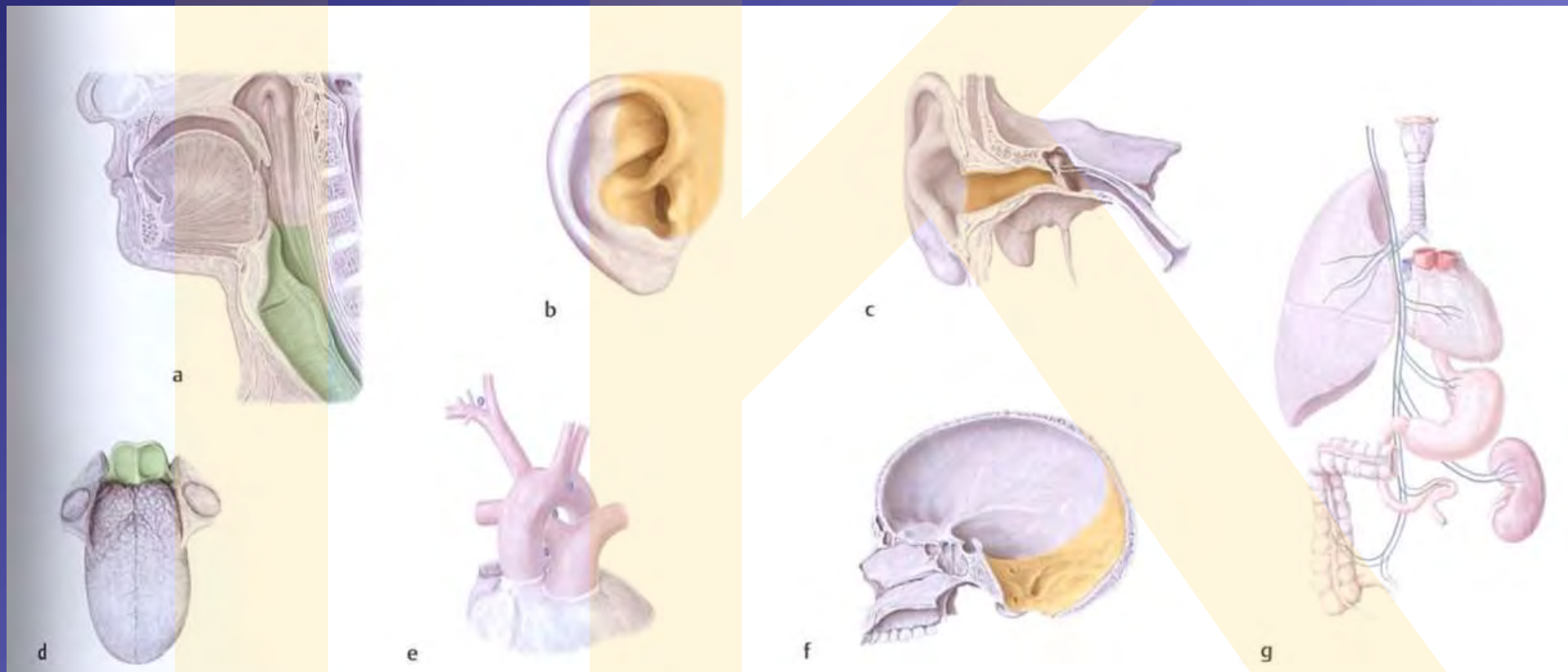
Also pelvic organs (womb, vagina, ovary glands)





Petrovický 1996

Sensitive regions of the CN X.

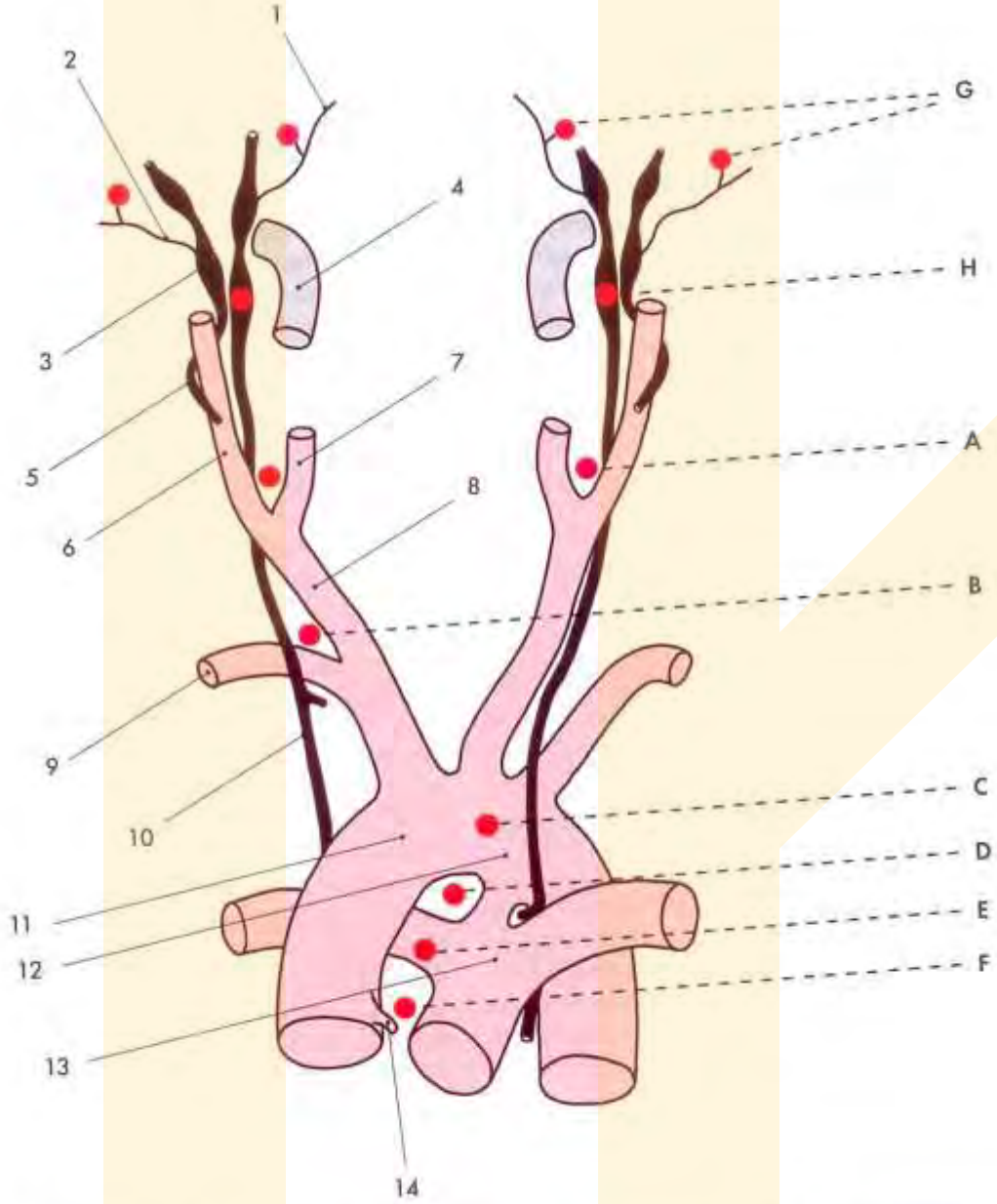


D Visceral and sensory distribution of the vagus nerve (CN X)

Reflexes in the vagal region - whooping (IX.,X.) oculocardial (V.,X.)
Pressure on the bulbs can iniciate paroxysmal tachycardia

If CN X is cut – we can observe pharyngeal muscle palsies (dysfagia), laryngeal palsy (dysphonia, aphonia)

CN X. palsy - tachykardia,
CN X irritation - bradykardia



Obr. 1.80. Poloha paraganglií v krční a hrudní oblasti (schéma). 1 – r. auricularis n. vagi, 2 – n. tympanicus (n. IX.), 3 – ganglion inferior n. vagi, 4 – v. jugularis interna, 5 – n. glossopharyngeus, 6 – a. carotis interna, 7 – a. carotis externa, 8 – a. carotis communis, 9 – a. subclavia, 10 – n. vagus, 11 – arcus aortae, 12 – ductus arteriosus, 13 – truncus pulmonalis, 14 – a. coronaria sinistra, A – glomus caroticum, B – glomus subclavium, C, D, E, F – aortikopulmonální tělísko, G – tympanojugulární tělísko, H – vagové tělísko

Paraganglia – collections of the *neuroectodermal , endocrinic cells* (similar to ones inside suprarenal medulla); they are diffused in the interstitial tissue around bid vessels, vegetative nerves and near to sympathetic ganglions.

Paraganglia are considered to be sympathetic structures, because they are producing katecholamins (adrenalin, noradrenalin, dopamin).

We recognise:

- chromafinnic (they are coloured brownish – feochromocytes)
- without chromafinnic reaction

They are made from **feochromocytes** (main cells containing granula with catecholamins), **supporting cells** (they are similar to Schwann cells or to satelite cells of the PNS ganglions) and fibrous stroma

chemoreceptors

central – in brainstem

peripheral – carotic (n. IX) and aortic (n. X) bodies

baroreceptors

High pressure – in carotic sinus, arcus aortae, vas afferens

Low pressure – inside heart chambers

CN X. Nervus vagus,vagal nerve

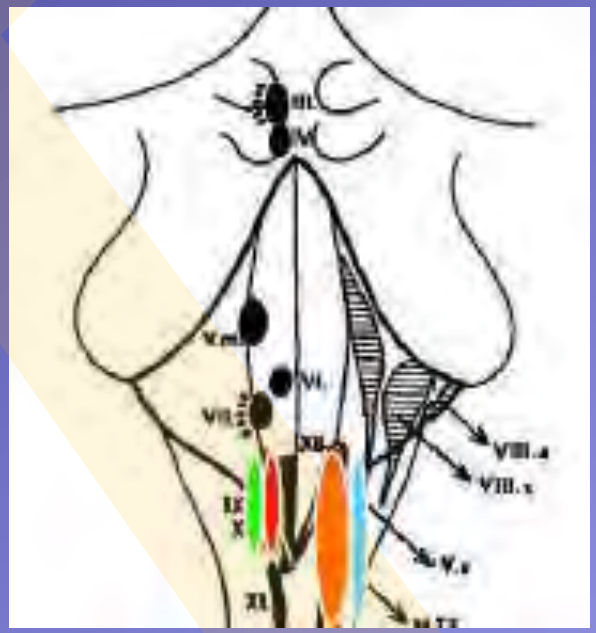
SM – pharyngeal and laryngeal muscles (ncl. ambiguus)

VM – parasympathetic signals for digestive and respiratory tract, heart and bid vessels (ncl. dorsalis n.X)

SS - outer auditory meatus, pinna part (ncl.Vs)

VS – from organs (ncl. solitarius)

taste - from the epiglottis (ncl. gustatorius)



DISTURBANCES

Aphony, dysphony

Dysphagia

Soft palate palsy rhinolalia (nose chatter)

Tachykardia

Oculomotor reflex can be lost

IRRITATION

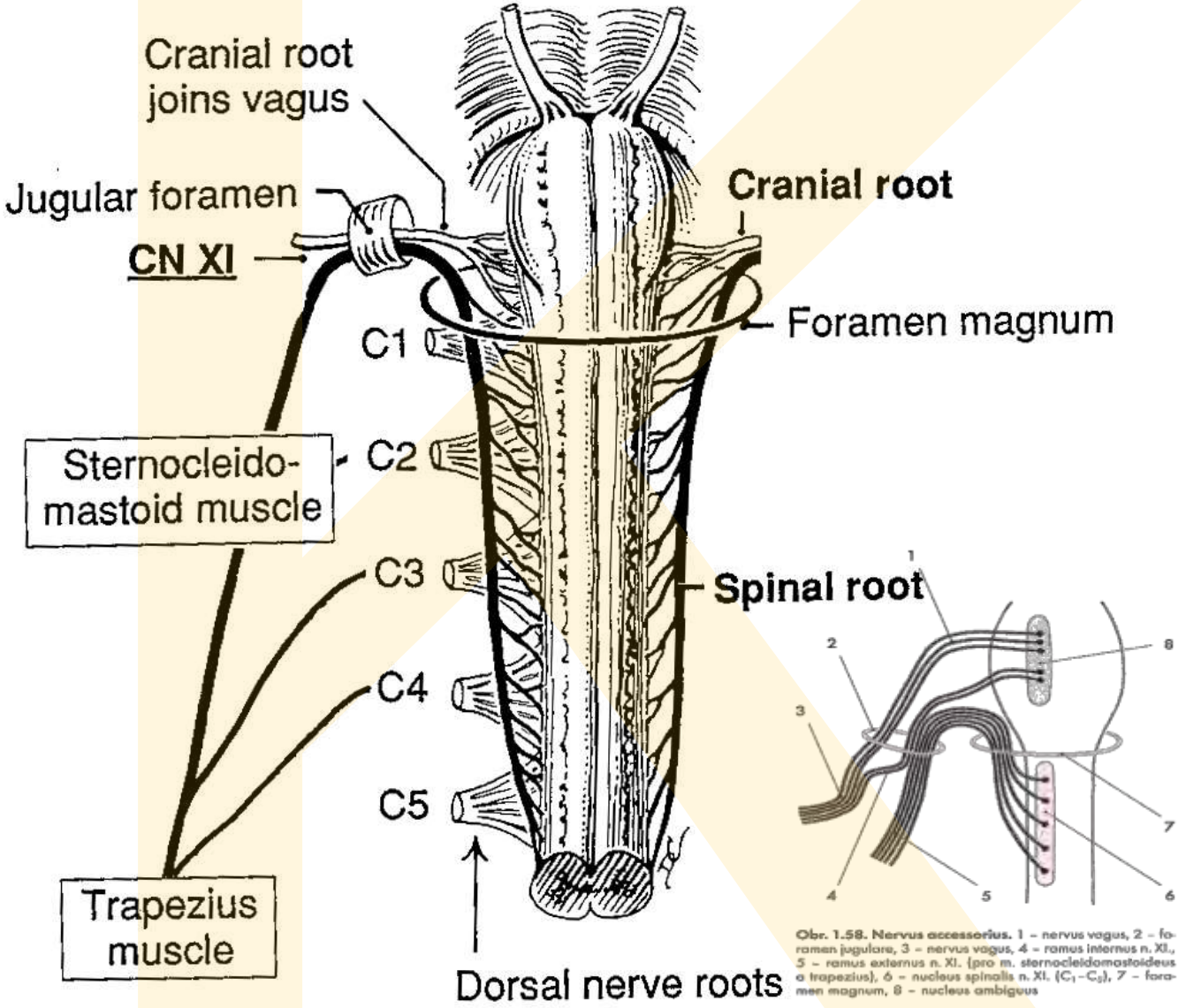
Laryngospasm, esofagospasm, pylorospasm, bradycardia even heart stop, nausea, vomitus, hiccup, caugh, dyspnoe

CN XI. accessory

Accessorius

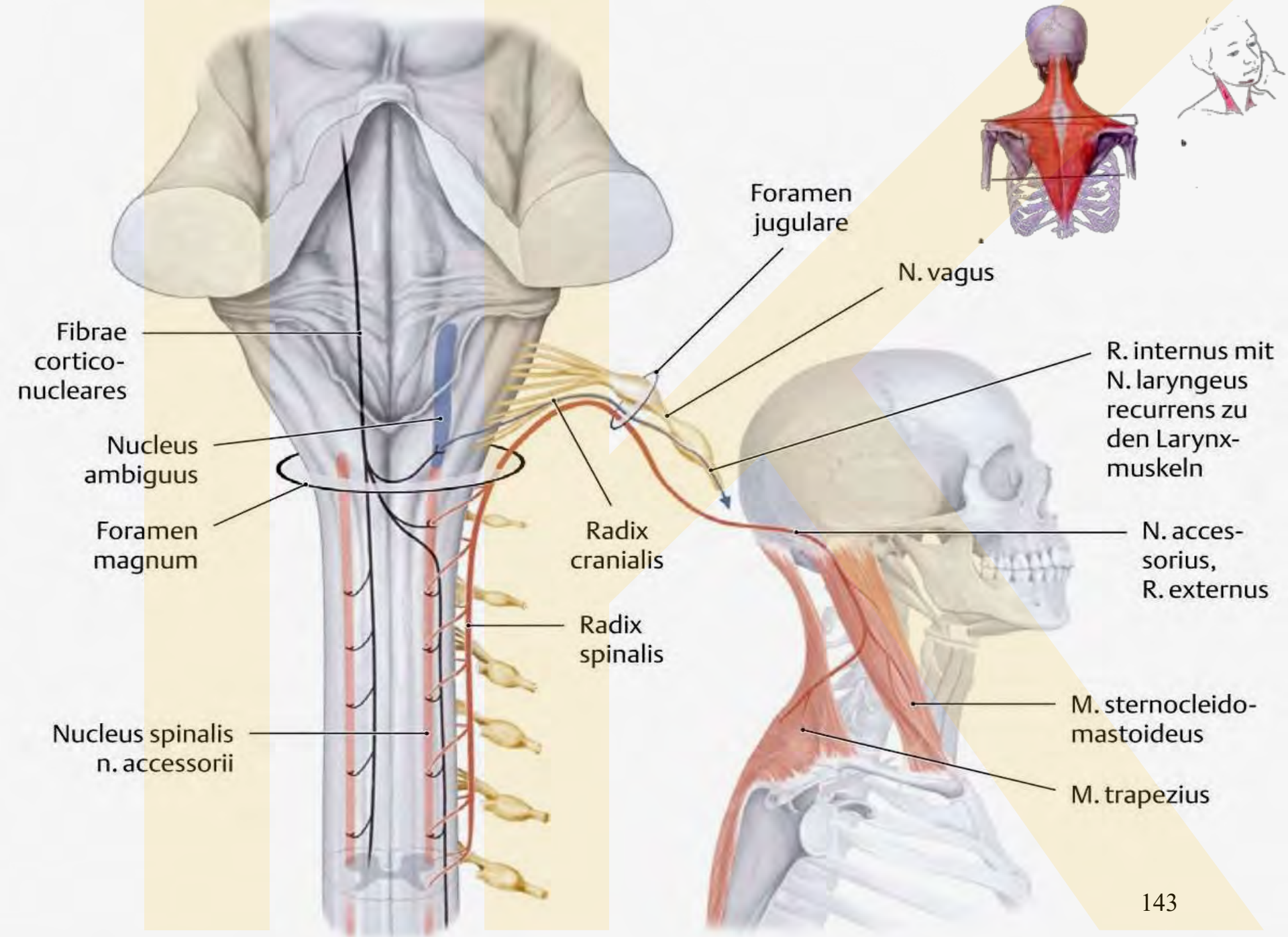
cranialis

spinalis

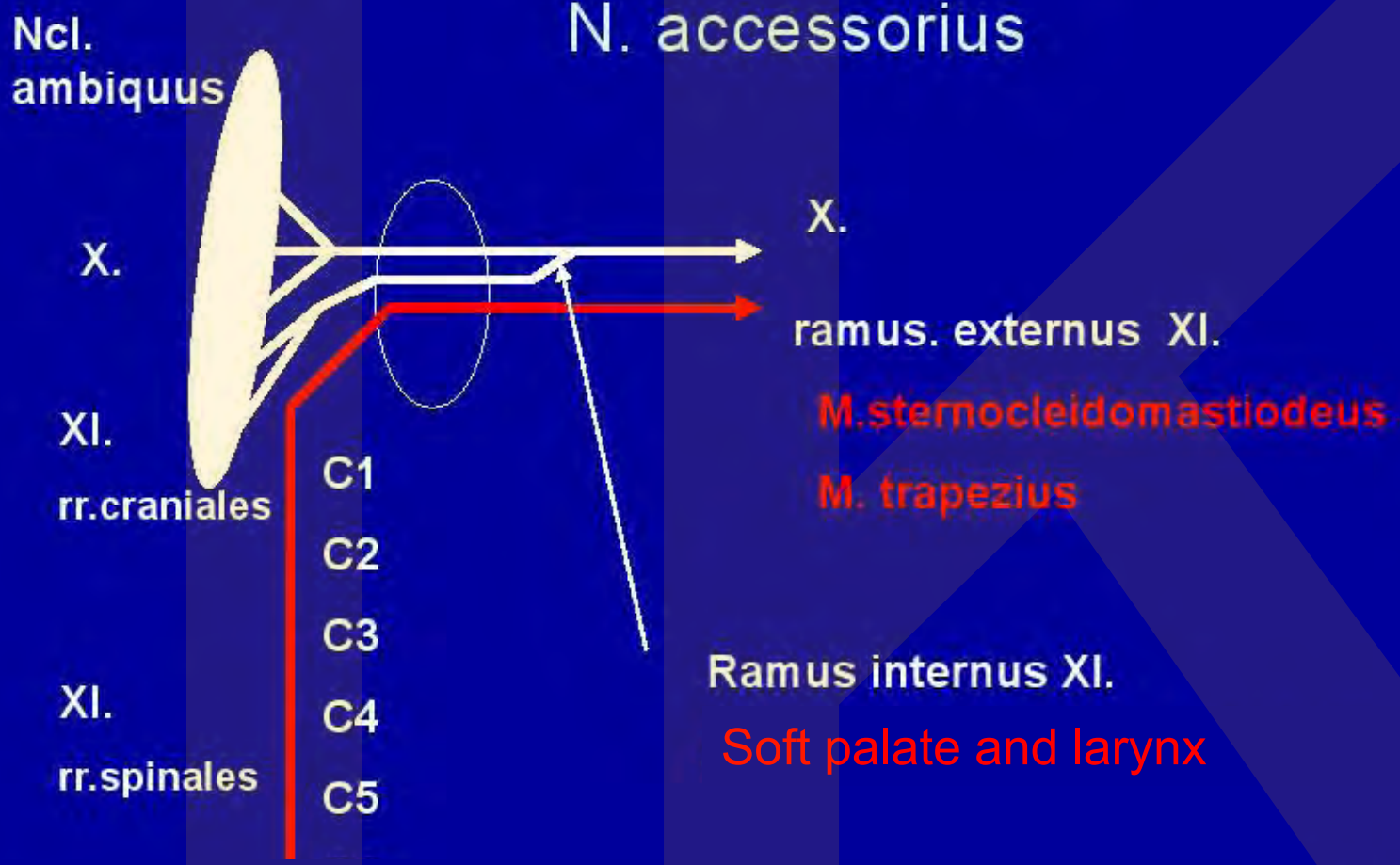


Obr. 1.58. Nervus accessorius. 1 – nervus vagus, 2 – foramen jugulare, 3 – nervus vagus, 4 – ramus internus n. XI., 5 – ramus externus n. XI. (pro m. sternocleidomastoideus a trapezius), 6 – nucleus spinalis n. XI. (C_1–C_5), 7 – foramen magnum, 8 – nucleus ambiguus

The accessory nerve (CN XI). Observe that its spinal root is joined by fibers from the ventral ramus of C2 and supplies the sternocleidomastoid muscle. Also note that after it is joined by fibers from C3 and C4 it supplies the trapezius muscle (see also Fig. 8-27).


Foramen jugulare
N. vagus
Fibrae cortico-nucleares
R. internus mit N. laryngeus recurrens zu den Larynx-muskeln
Nucleus ambiguus
Foramen magnum
Radix cranialis
N. acces-sorius, R. externus
Radix spinalis
M. sternocleido-mastoideus
Nucleus spinalis n. accessorii
M. trapezius

N. accessorius

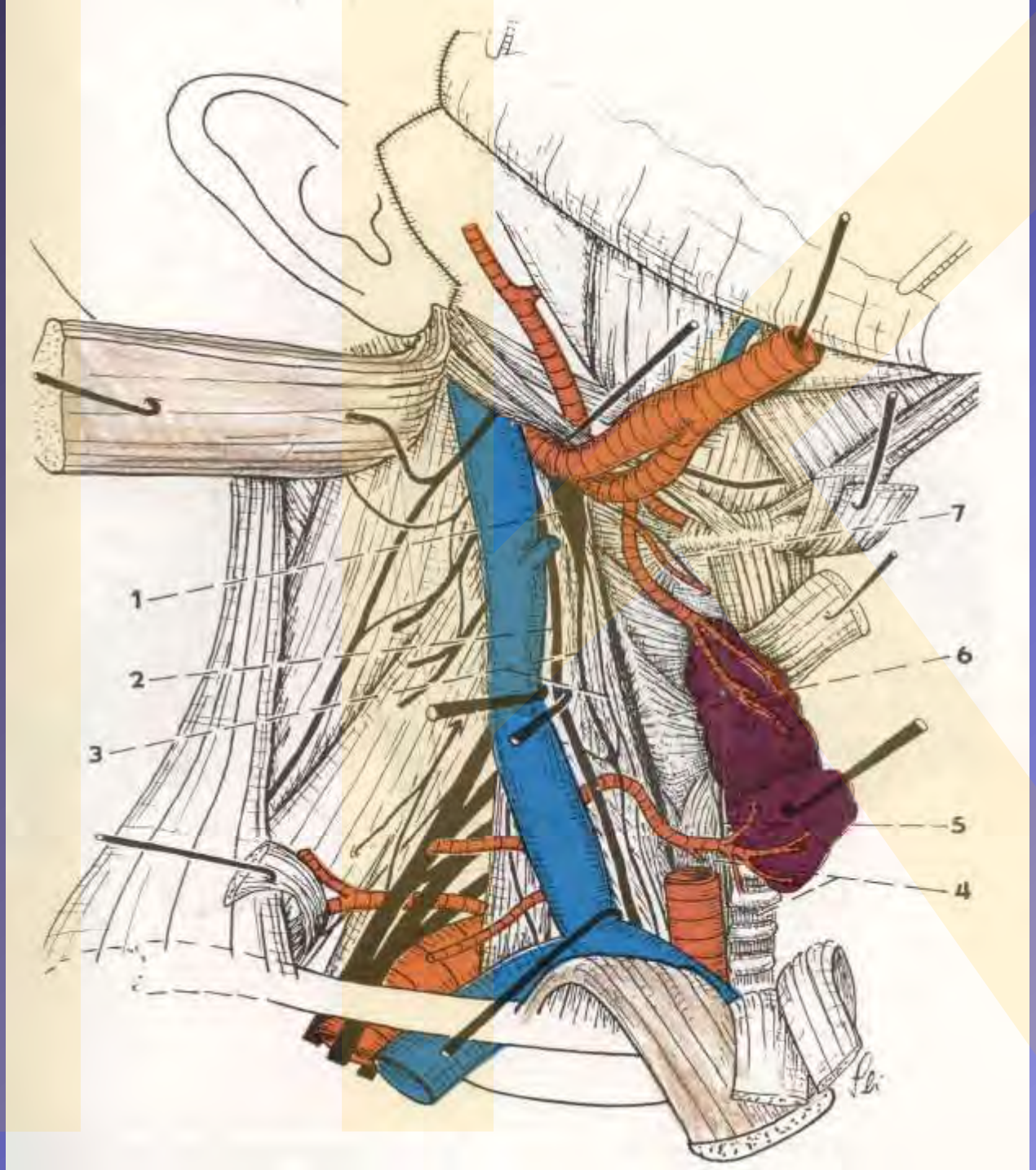


Disturbances:

Internal branch – soft palate palsy
External branch – head rotation to healthy side is poor
Abduction above shoulder
Descent of shoulder

Irritation:

Torticollis spastica


1
2
3
4
5
6
7

Palsy r. internus – palsy of soft palate and speech disturbances (dysfonation)

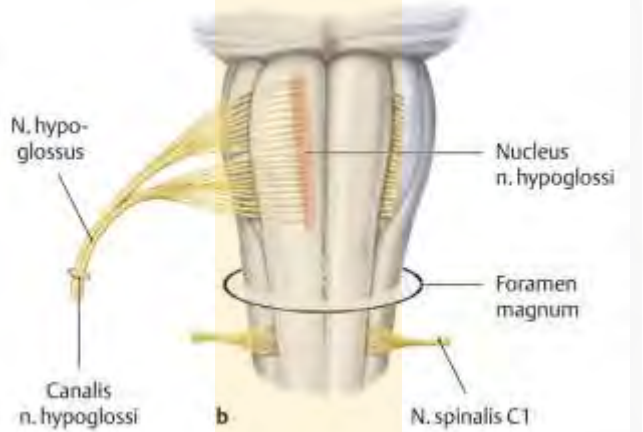
Palsy r. externus – head tilt to disturbed side

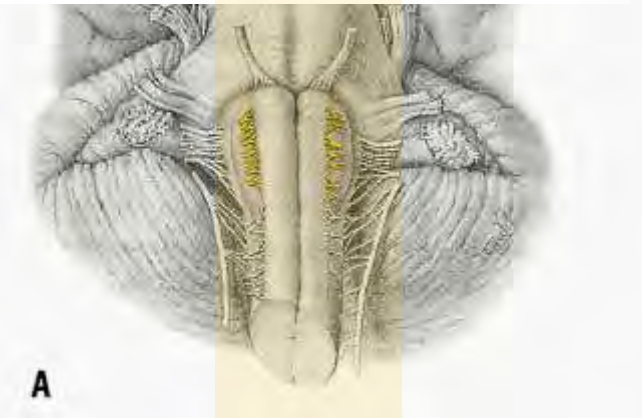
Shoulder is pushed down, no abduction above horizontal line

CN XI palsy – soft palate palsy and speech disturbances (phonation)

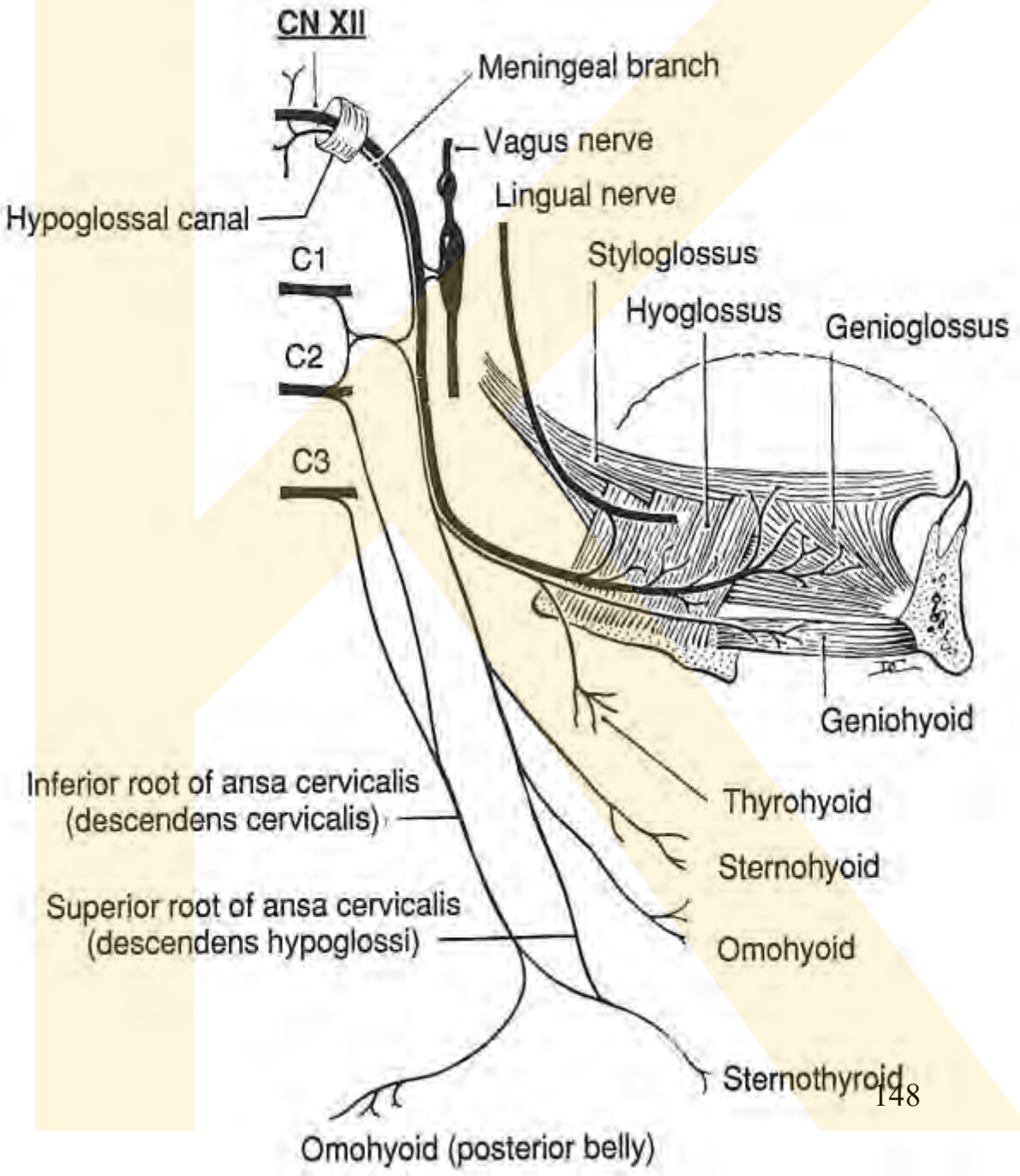
External branch palsy – head rotates to disturbed side

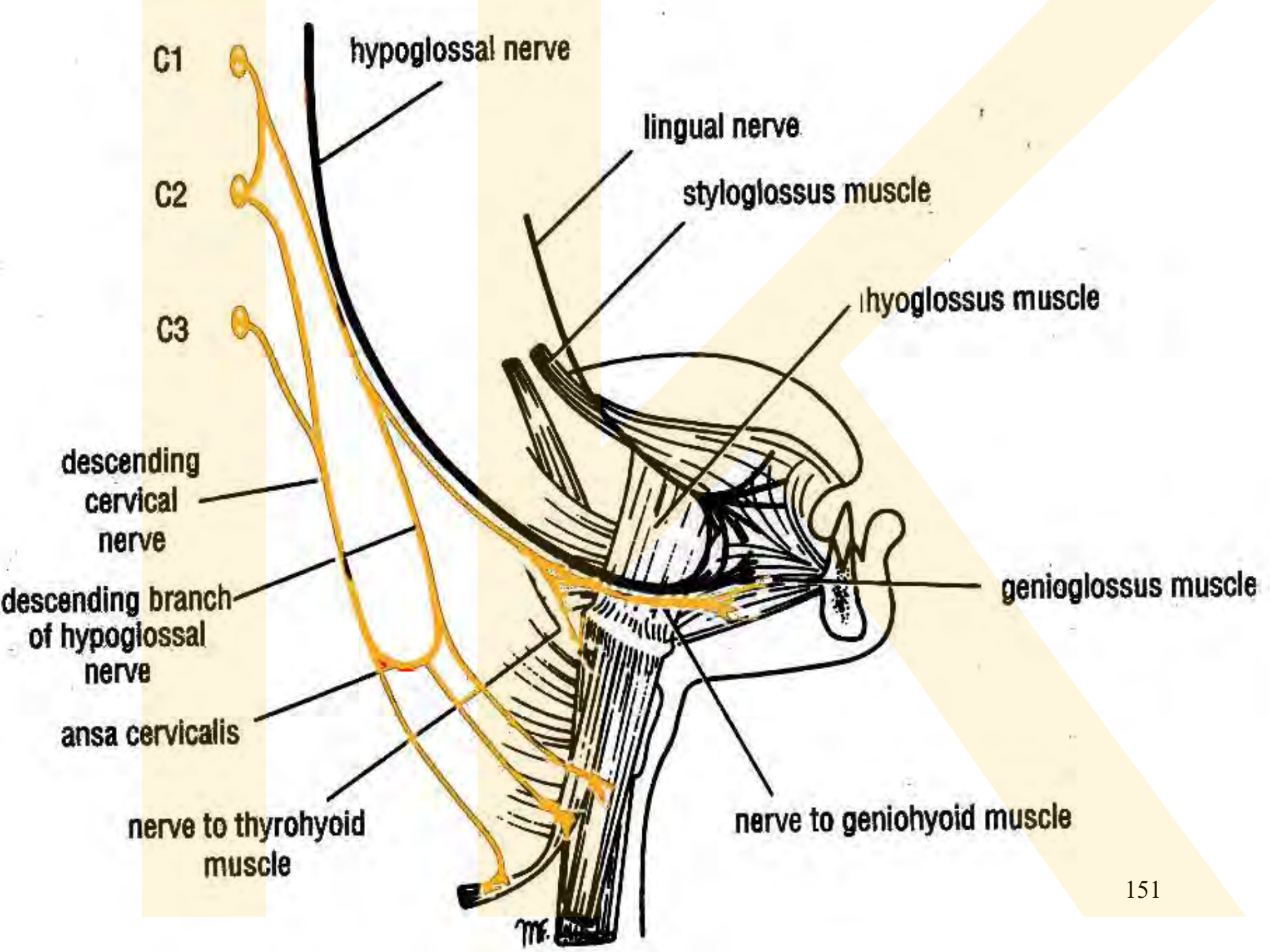
Shoulder is low; abduction up horizontal line is impossible



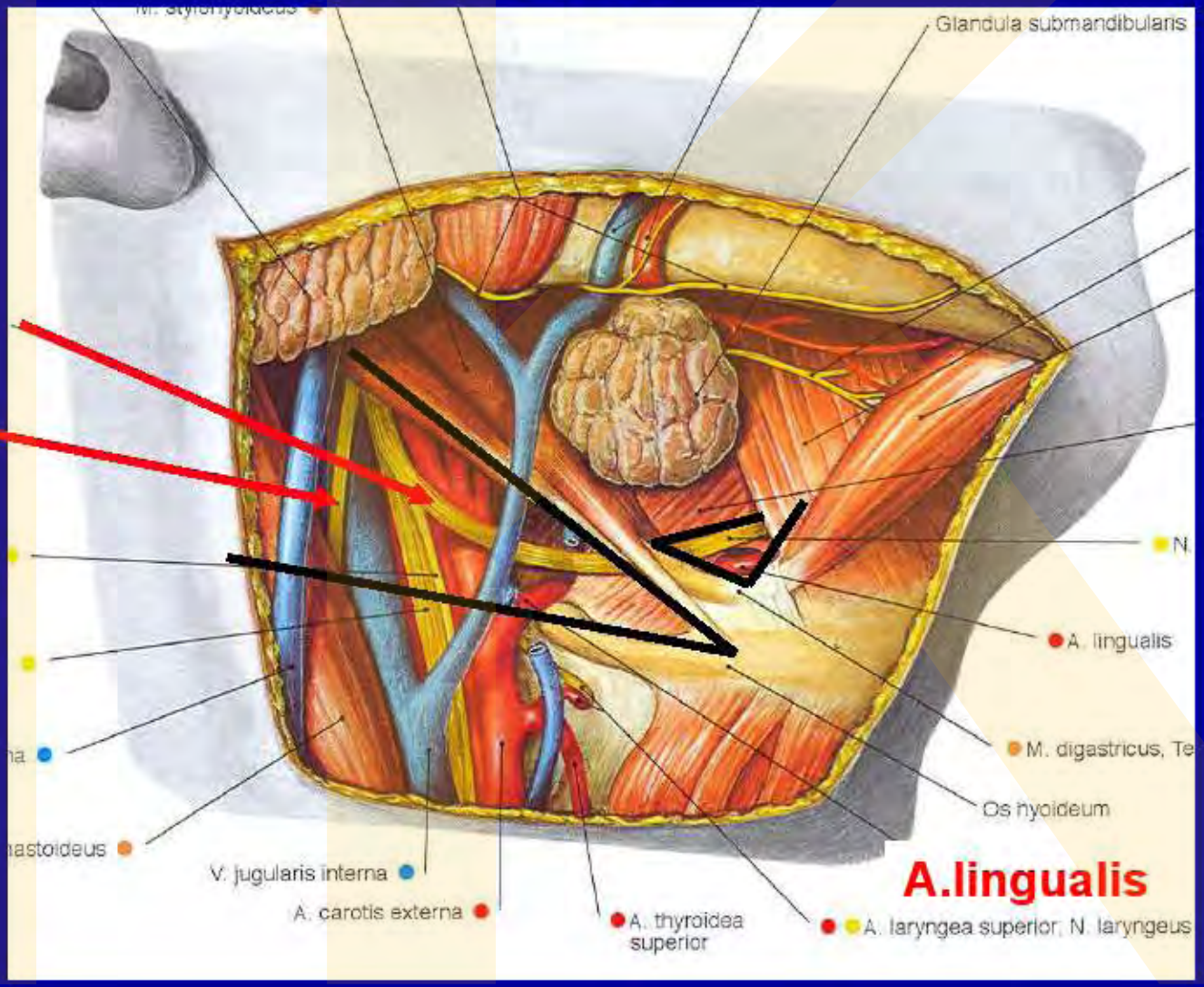


CN XII. hypoglossus

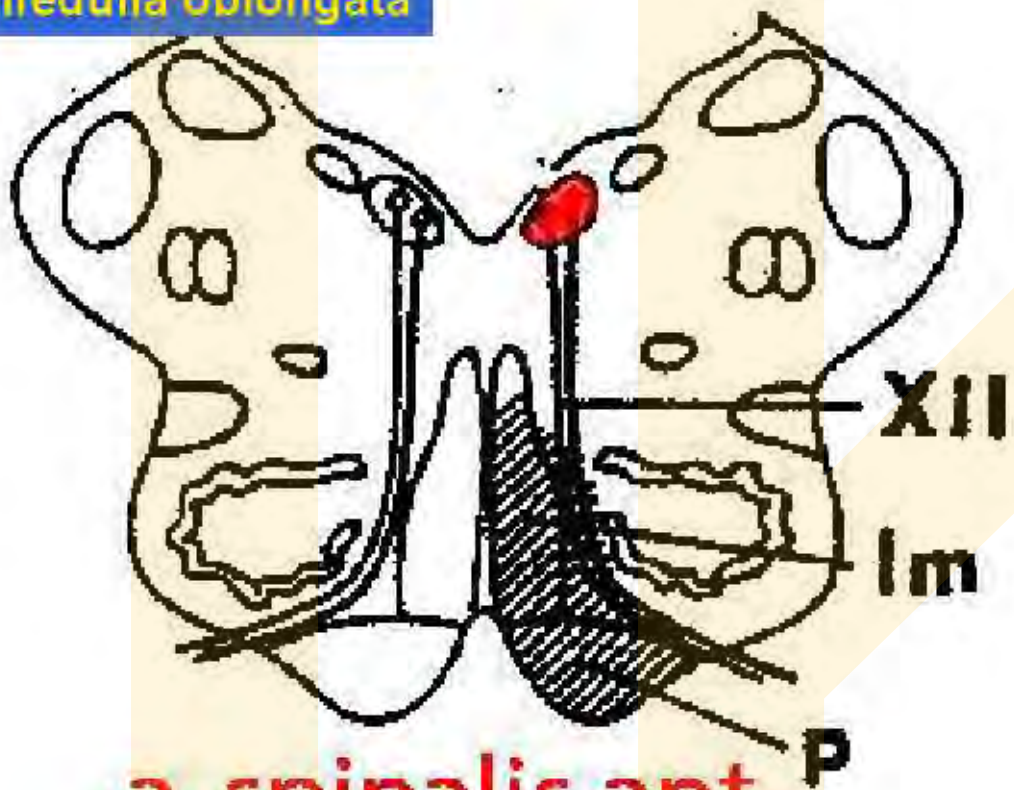



C1
C2
C3
hypoglossal nerve
lingual nerve
styloglossus muscle
hyoglossus muscle
descending cervical nerve
descending branch of hypoglossal nerve
ansa cervicalis
nerve to thyrohyoid muscle
genioglossus muscle
nerve to geniohyoid muscle

Nervus XI. a XII. v trigonum caroticum

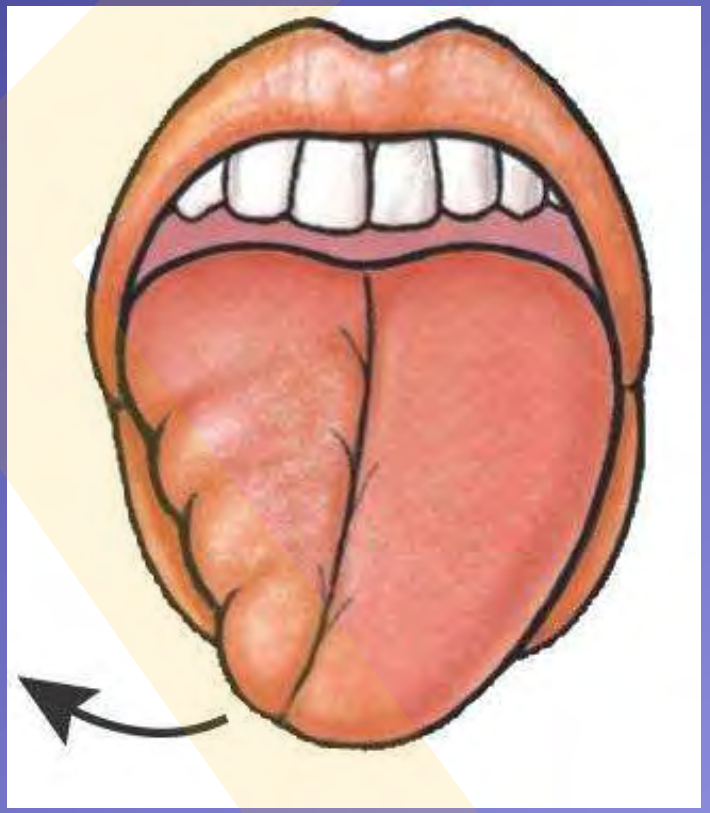


medulla oblongata



a. spinalis ant.

hemiplegia alternans inferior



Loll out tongue!!