Literature:

- Gdovinová Z., Szilasiová J.: Textbook of general neurology. Košice : Aprilla Ltd. for Hanzluvka Books, 2009. 189 s. ISBN 9788089346158 (brož.).

- Brust J.C.M.: Neurology. Current Diagnosis and treatment. Lange Medical Books/McGraw-Hill, 2007. 601 pp. ISBN: 13: 978-0-07-110554-5

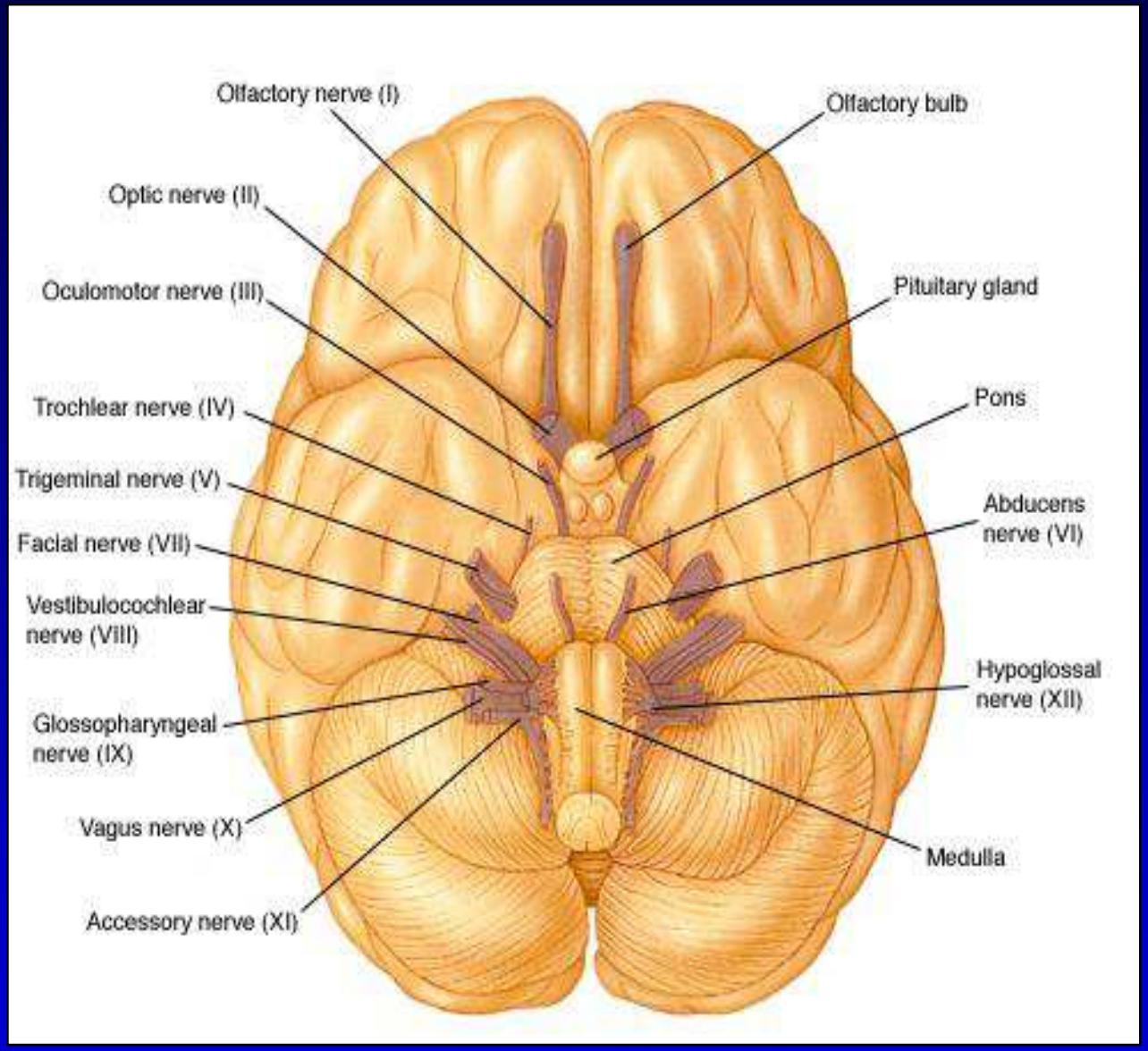
Podmienky pre absolvovanie predmetu

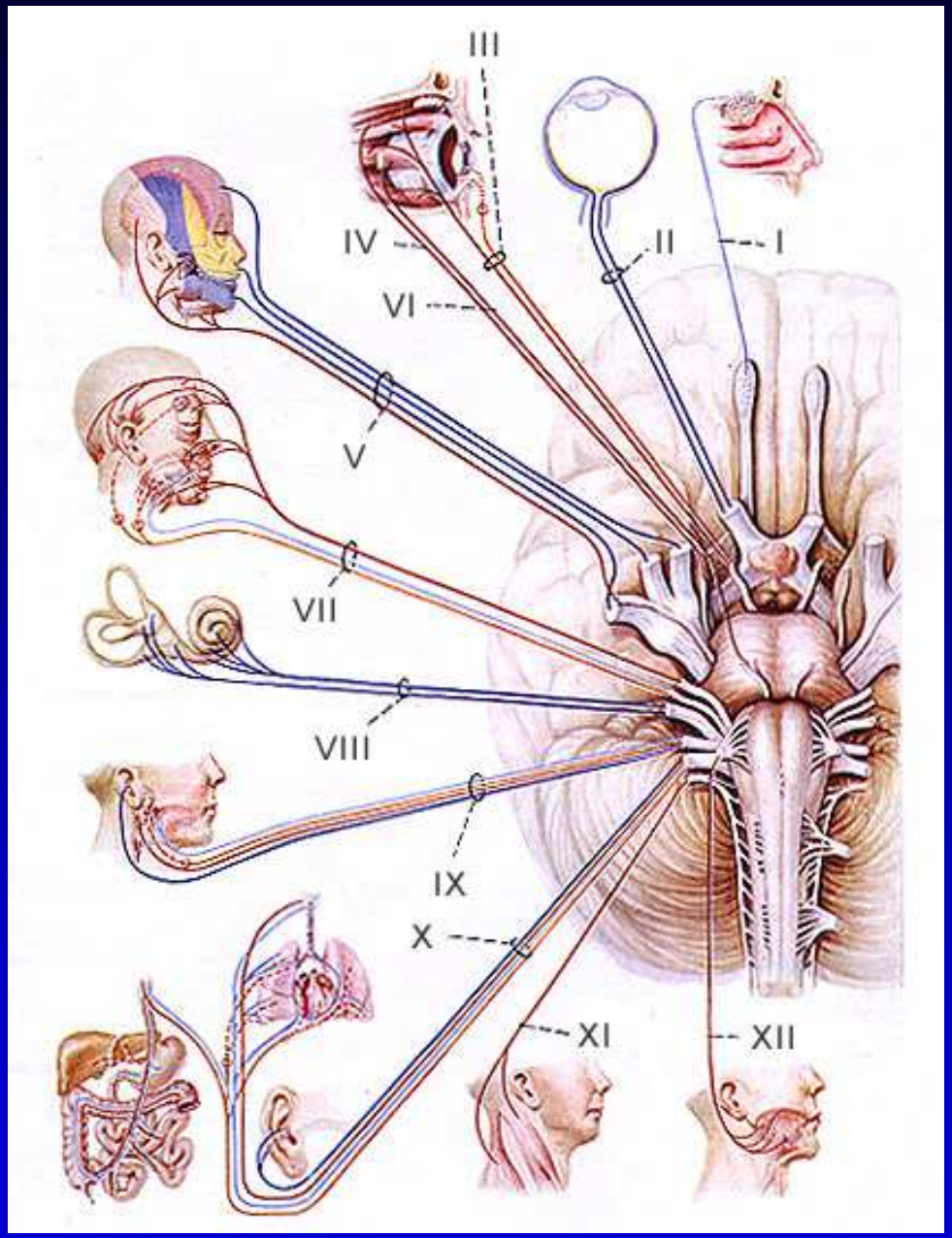
- 100 % active participation in practical exercises, in the case of absence, may substitute up to 3 exercises per semester

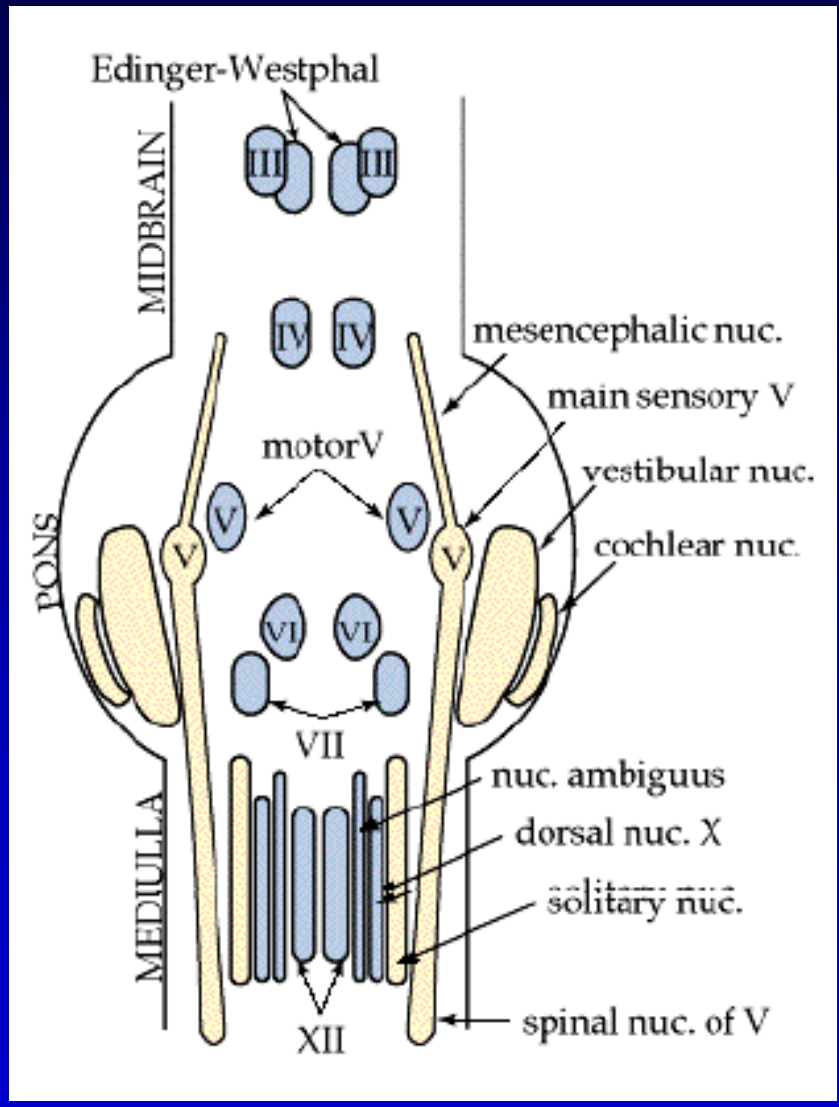
- Successful completion of the test, evaluation A – E (possibility to repeat the test 2 times).

Teachers

- Prof. MUDr. Zuzana Gdovinová, CSc.
- Doc. MUDr. Jarmila Szilasiová, PhD
- MUDr. Eva Feketeová, PhD
- MUDr. Matej Škorvánek, PhD
- MUDr. Marianna Vitková, PhD
- MUDr. Milan Maretta
- MUDr. Vladimír Haň


Olfactory nerve (I)
Olfactory bulb
Optic nerve (II)
Oculomotor nerve (III)
Pituitary gland
Trochlear nerve (IV)
Pons
Trigeminal nerve (V)
Abducens nerve (VI)
Facial nerve (VII)
Vestibulocochlear nerve (VIII)
Hypoglossal nerve (XII)
Glossopharyngeal nerve (IX)
Vagus nerve (X)
Medulla
Accessory nerve (XI)


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


Edinger-Westphal
MIDBRAIN
PONS
MEDULLA
III
IV
V
VI
VII
XII
mesencephalic nuc.
main sensory V
motorV
vestibular nuc.
cochlear nuc.
nuc. ambiguus
dorsal nuc. X
solitary nuc.
spinal nuc. of V

Cranial nerves

1. N. olfactorius
2. N. opticus
3. N. oculomotorius
4. N. trochlearis
5. N. trigeminus
6. N. abducens
7. N. facialis
8. N. vestibulocochlearis
9. N. glossopharyngeus
10. N. Vagus
11. N. accessorius
12. N. hypoglossus

mesenecefalon

pons

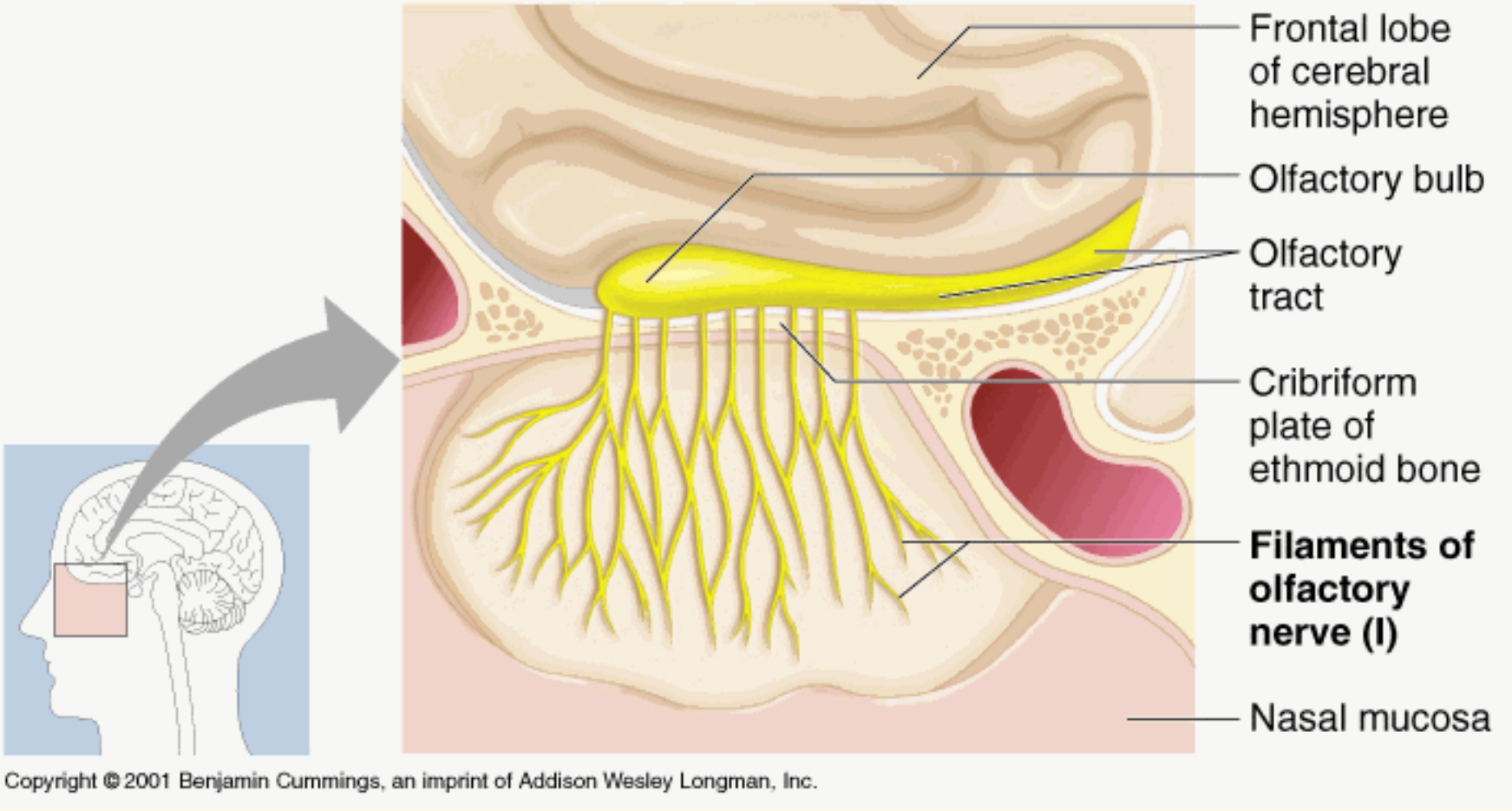
medulla oblongata – bulbar nerves, lateral mixed system

Cranial nerves

- Except of I. and II. nerves all other are PERIPHERAL NERVES
- Nucleus (body of the nerve in brainstem) + nerve (axons and dendrites) + neneuromuscular (gland.) junction
- **Functions of cranial nerves**:

1. Motoric - muscle, gland
2. Sensation - sensitivity
3. Senzoric - vision, hearing, balance, smell
4. Vegetative - sympat., parasympat., glands.

The oflactory nerve - n.l.



The oflactory nerve - n.l.

Anatomy: fila olf.– bulbus olf. (I.n.)–tractus. olf (II.n.) – trigonum olf., subst.perf.ant., septum pellucidum (prim. subcortical centres) – **cortex** (III.n.) (temporal lobes)

Examination: each nosdril separately – patient sniff the test substance – coffee, soap, etc.

Pathology:

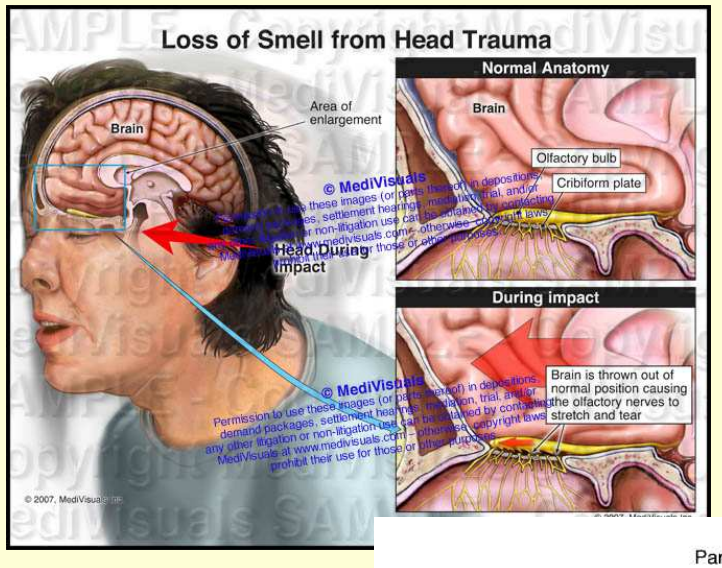
hyposmia, anosmia –

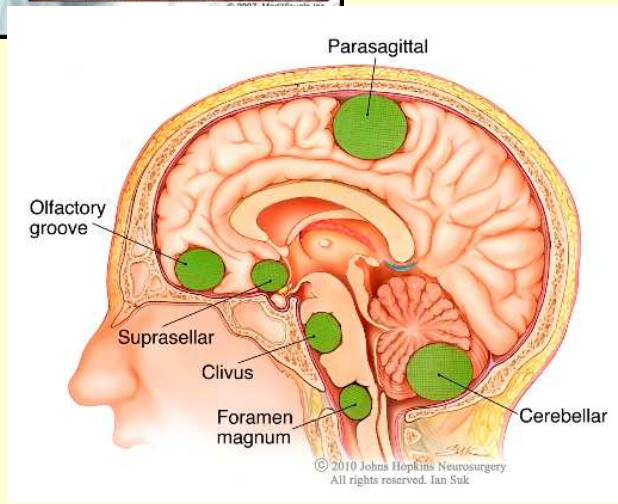
partial or complet loss of sense

parosmia

Uncinate fits – hallucination of smell

The oflactory nerve - n.l.

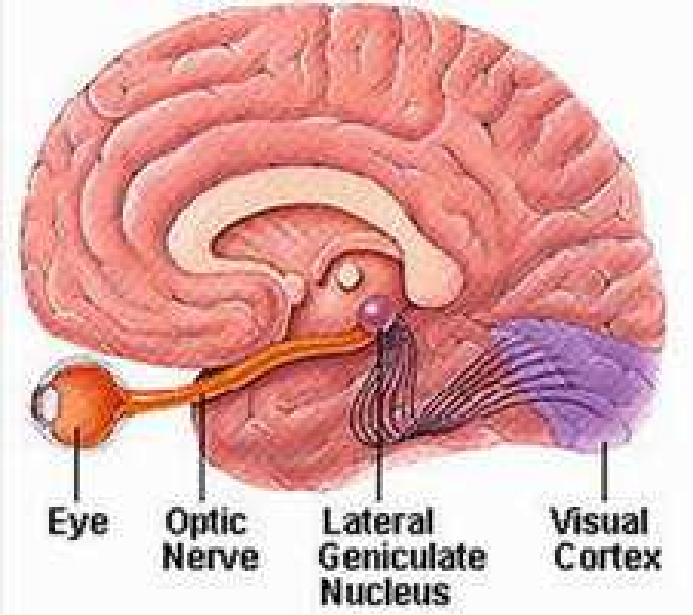


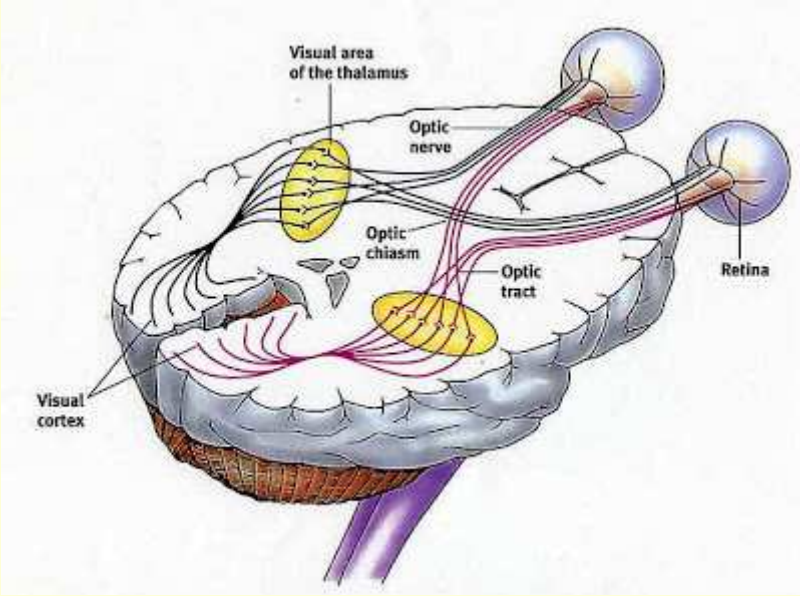


- Head injury
- Tumors
- Parkinson´s disease
- Alzheimer disease

The optic nerve - n.II.

Anat.: retinal ganglial cells – optic nerve – optic tract – corpus genic. laterale – colliculus sup.laminae quadrig.– tr. geniculocalcarinus (radiatio Gratioleti) – area calcarina (BA 17)





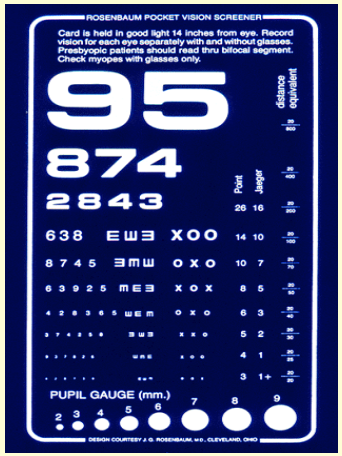
The optic nerve - n.II.

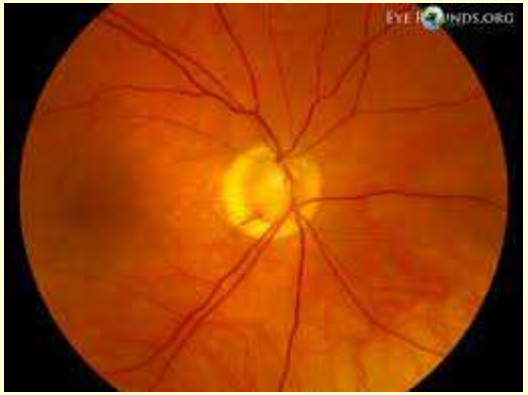
Examination:

- **Neurologist – counting of fingers, perimeter**
- **Oflamologist**:

1. **Visual aquity**
2. **perimeter** (visual field)
3. **Optic fundus** (vessels, yellow and blind spot, papilla of the n. II.)

Visual aquity





- **Refraction problems,**

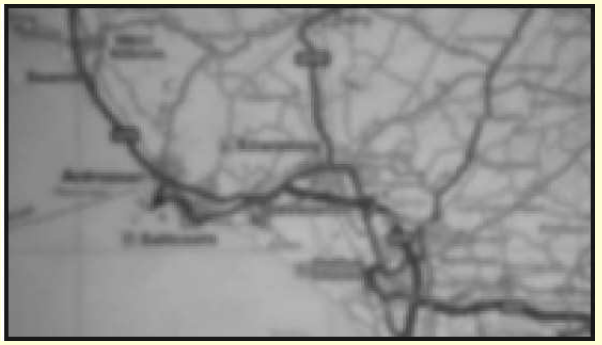
  cataracta, ...

- **Glaukoma**
- **disease of retina, DM, ...**
- **<u>diseases of optic</u>**

  <u>nerve</u> – inflammation,, compression,

  oedema – blurred vision,

  atrophy - blindness

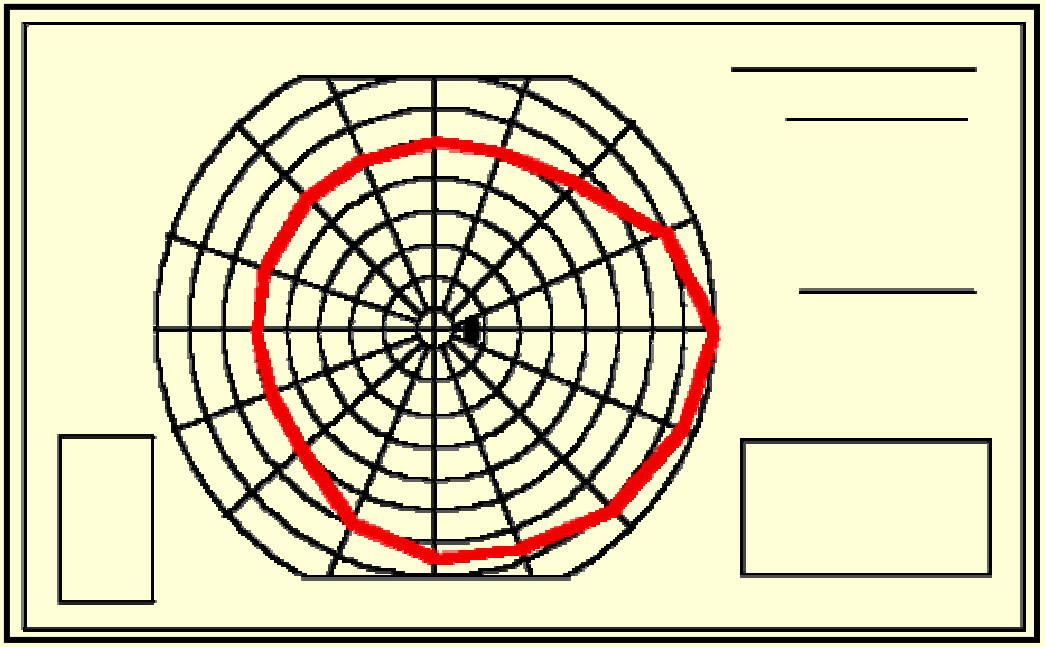


Perimeter

Visual field:

deficit = skotoma

Blindness



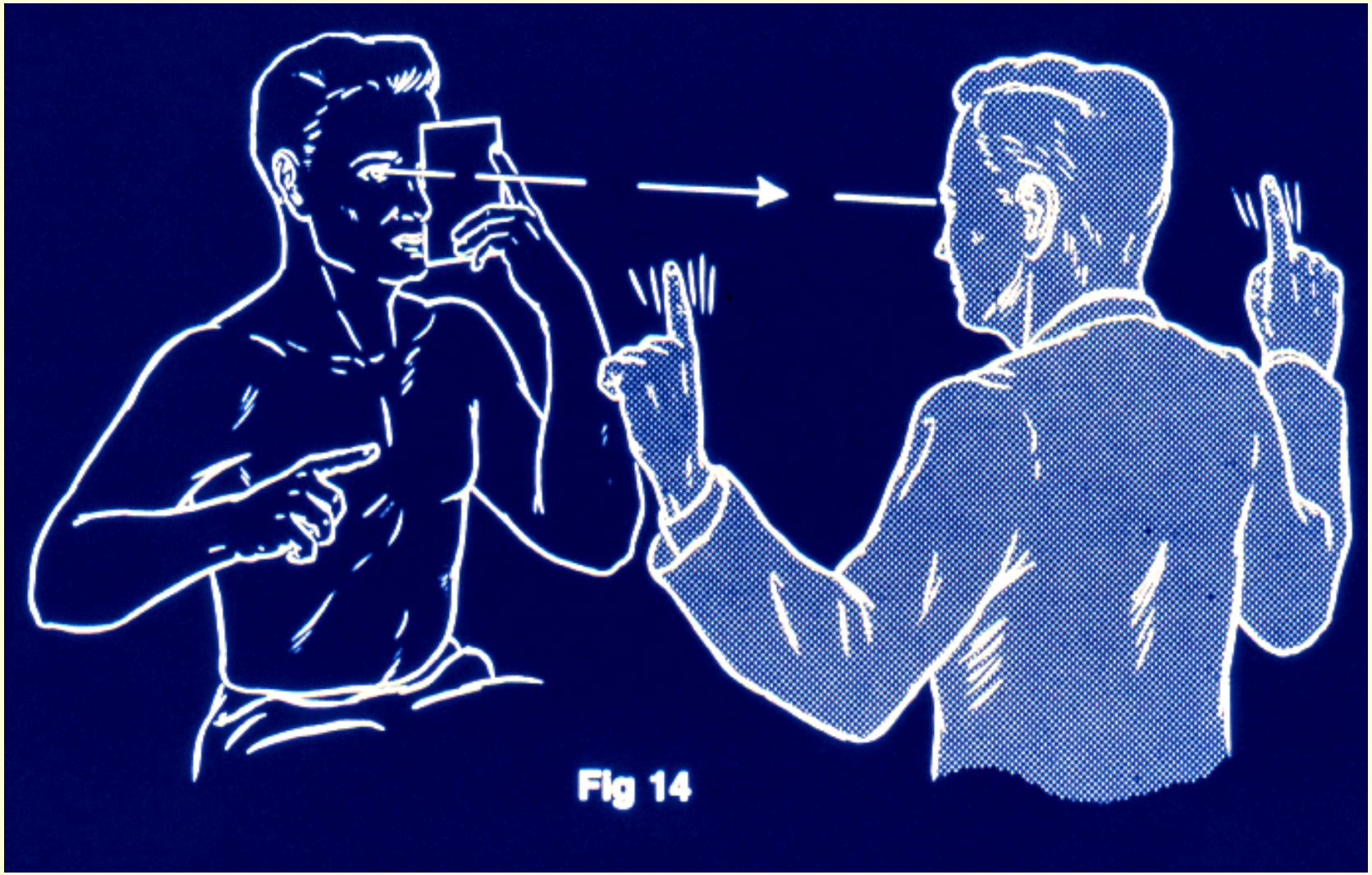
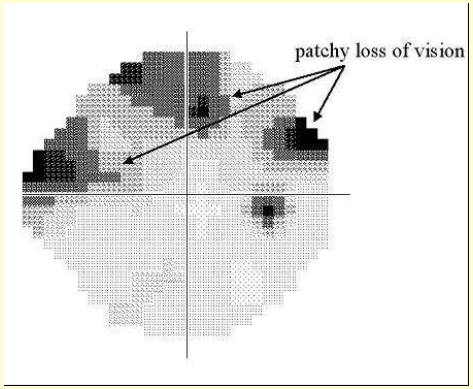
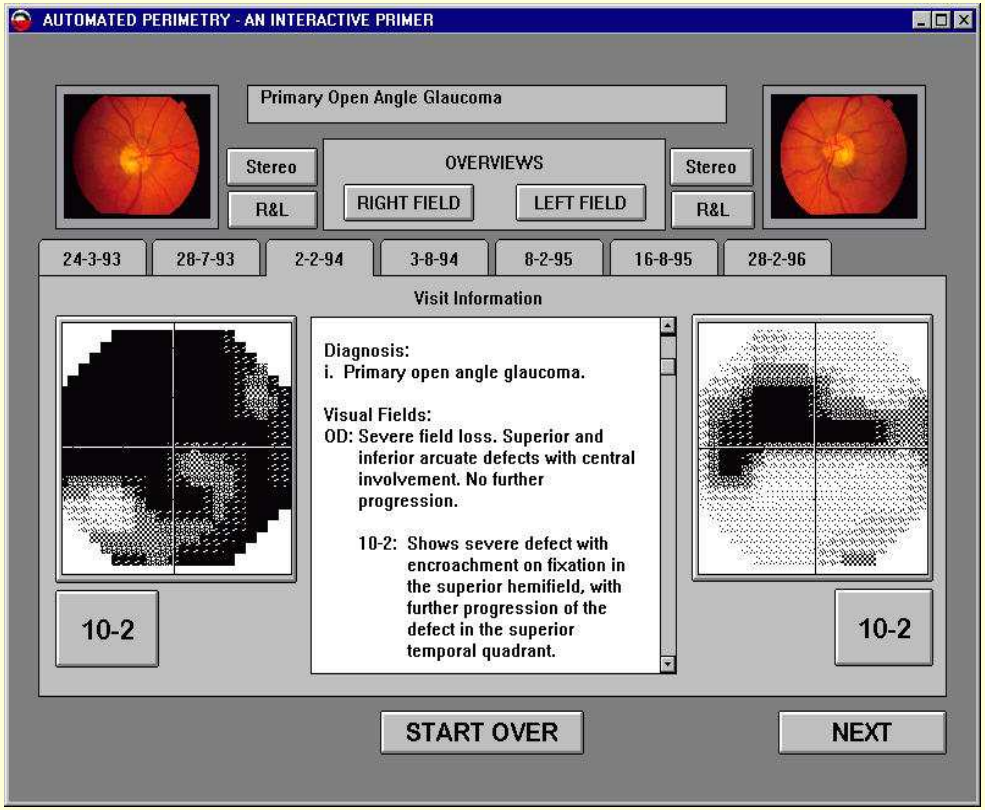
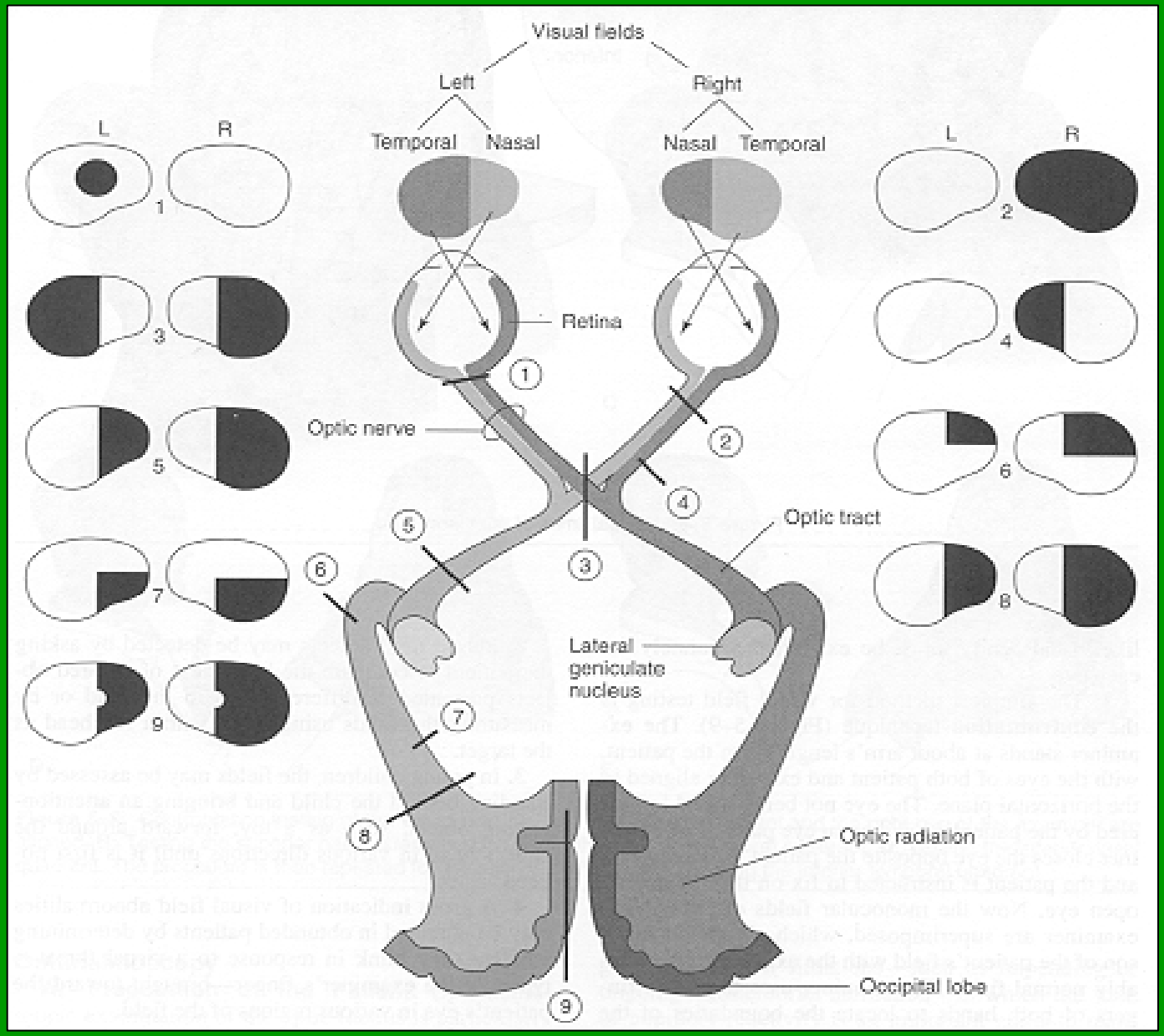


Fig 14

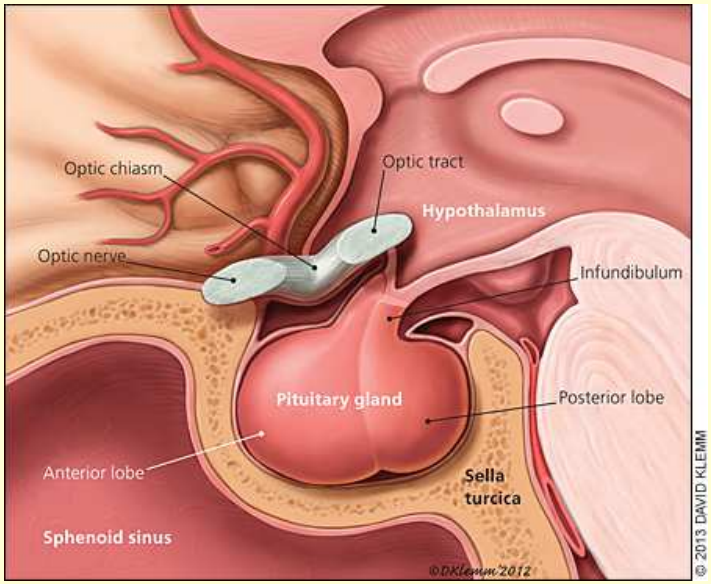

patchy loss of vision

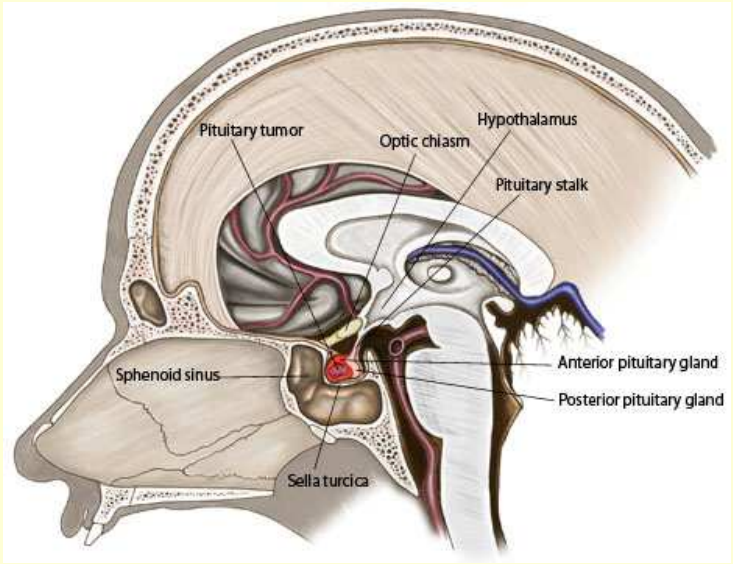

AUTOMATED PERIMETRY - AN INTERACTIVE PRIMER
Primary Open Angle Glaucoma
Stereo
R&L
OVERVIEWS
RIGHT FIELD
LEFT FIELD
Stereo
R&L
24-3-93
28-7-93
2-2-94
3-8-94
8-2-95
16-8-95
28-2-96
Visit Information
Diagnosis:
i. Primary open angle glaucoma.
Visual Fields:
OD: Severe field loss. Superior and inferior arcuate defects with central involvement. No further progression.
10-2: Shows severe defect with encroachment on fixation in the superior hemifield, with further progression of the defect in the superior temporal quadrant.
10-2
10-2
START OVER
NEXT


Visual fields
Left
Right
Temporal
Nasal
Nasal
Temporal
L
R
L
R
1
2
3
4
5
6
7
8
9
Retina
Optic nerve
Optic tract
Lateral geniculate nucleus
Optic radiation
Occipital lobe
1
2
3
4
5
6
7
8
9

Pituitary Adenoma

- Arise within the adenohypophysis
- Nonsecreting adenomas – mass effect
  Bitemporal hemianopsia
- Secreting adenomas – endocrine syndrome
  Prolactinemia, Cushing's disease
  Acromegaly, Giantism





Optic fundus

Papilla of n. II:

normal- circular

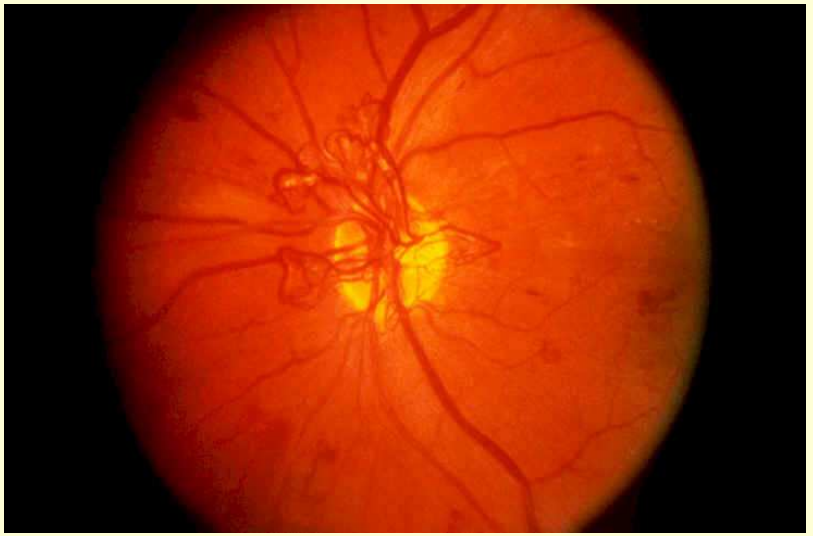
light pink

oedema – blurred margines

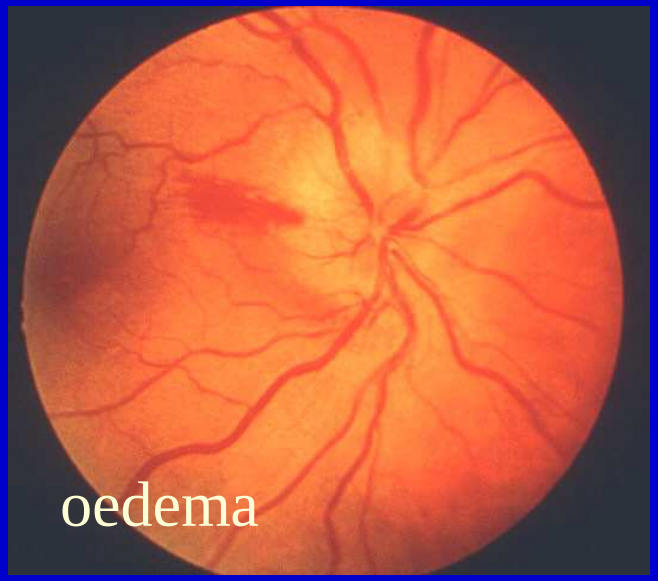
elevated, Dpt (mm)

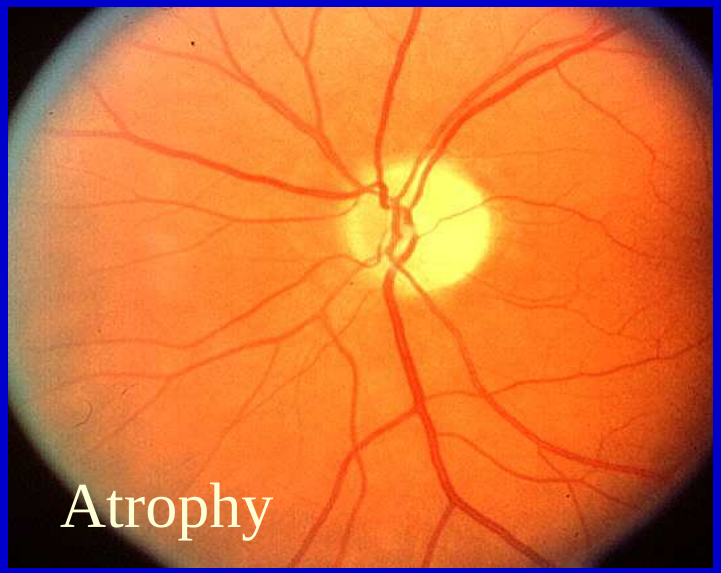
atrophy – papilla is pale

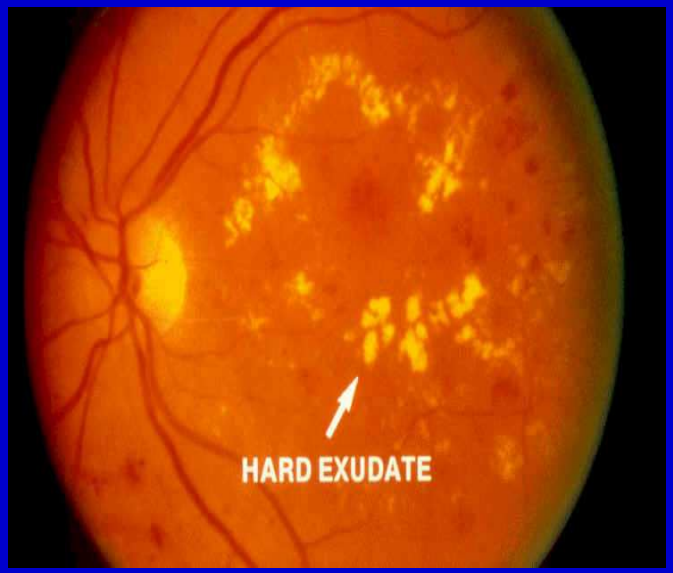
- with sharp margines, irreversible changes (blindness)




normal


oedema


Atrophy

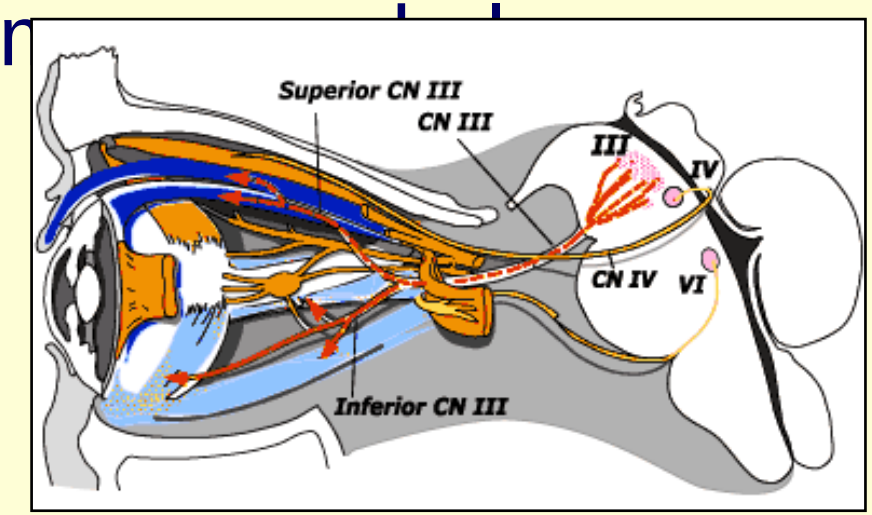

HARD EXUDATE

Eye moving nerves

- III.- oculomotor nerve
- IV.- trochlear nerve
- VI.- abducens nerve

The oculomotor nerve - n. III

Anatomy: nuclei in the m

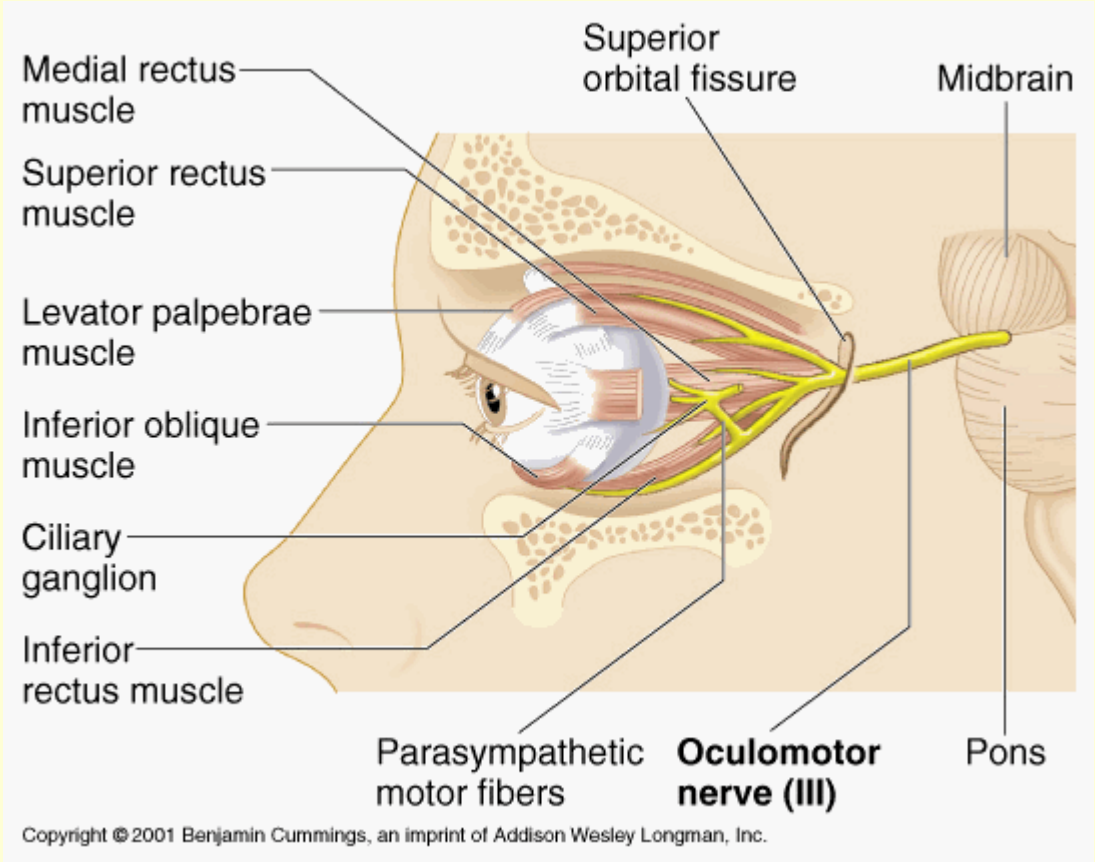


- **2 somatomotor**
- **2 visceralmotor**

  parasympat. (E-W.)
- **1 nucelus Perli**

  (acommodation, , konvergention)

The oculomotor nerve - n. III



The oculomotor nerve - n. III

- **Intervated muscles**

- **Medial rectus, inferior rectus, superior rectus muscles, inferior oblique muscle and levator palpebrae superioris muscle**

- **Ciliary muscle and constrictor pupillae muscle**

N. Oculomotorius- n. III

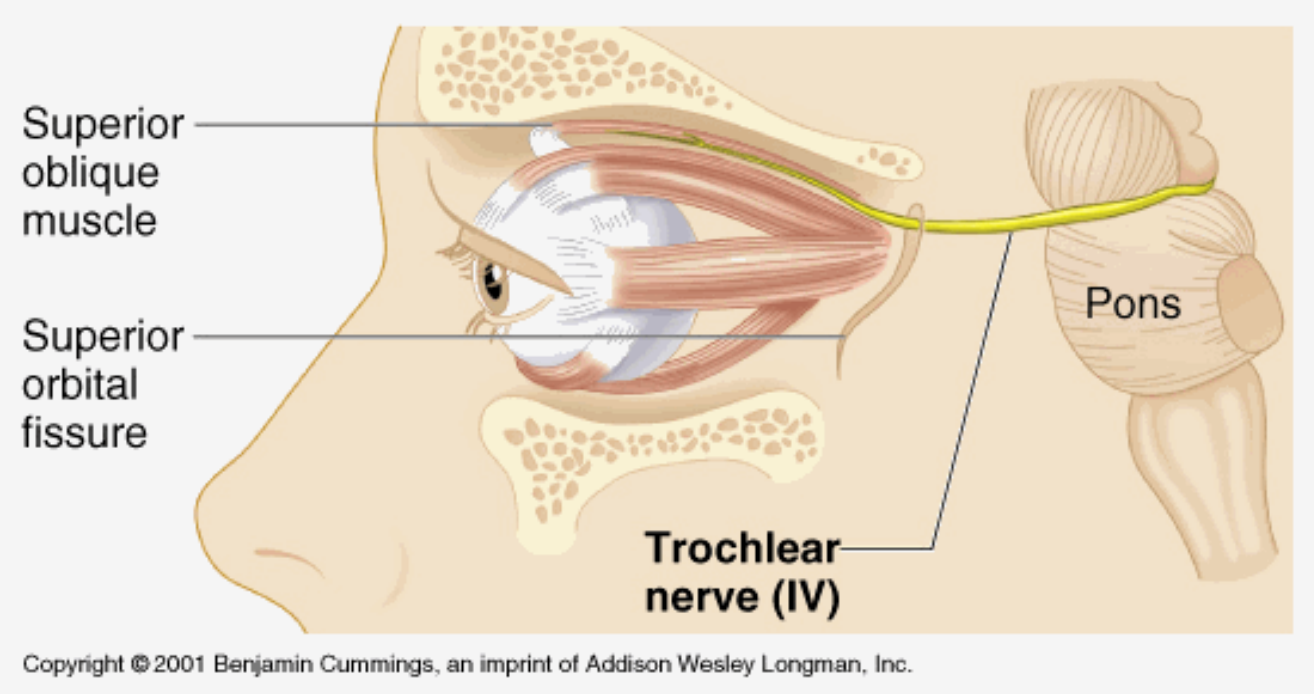
- **Examination:**

1. **Position of eyeballs**
2. **Wideness of eye**
3. **Movements of eyeball - horiz., vertik., diagon.,konvergention**
4. **Pupils - shape, size, symmetry, reaction to light (direct, indirect) reaction to konvergention**

The trochlear nerve - n. IV

- Anat.:
- Inervation of the superior oblique muscle
- Examination: looking downward

The trochlear nerve - n. IV



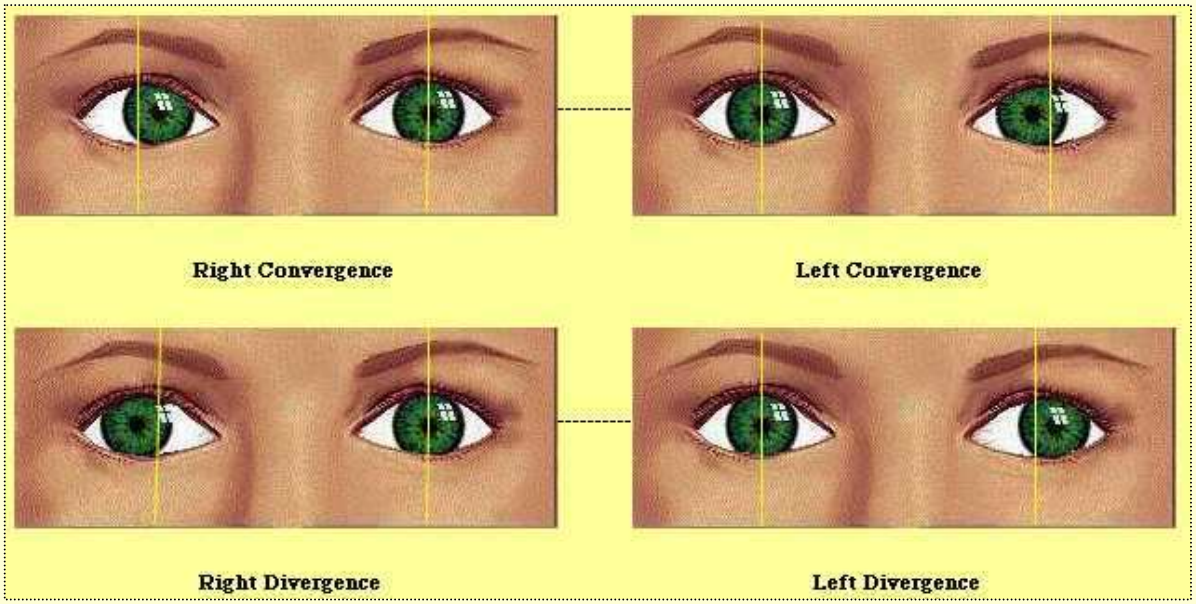
The abducens nerve – n.VI.

- Anat.:
- Lateral rectus muscle

- Examination: looking to sides

Examination

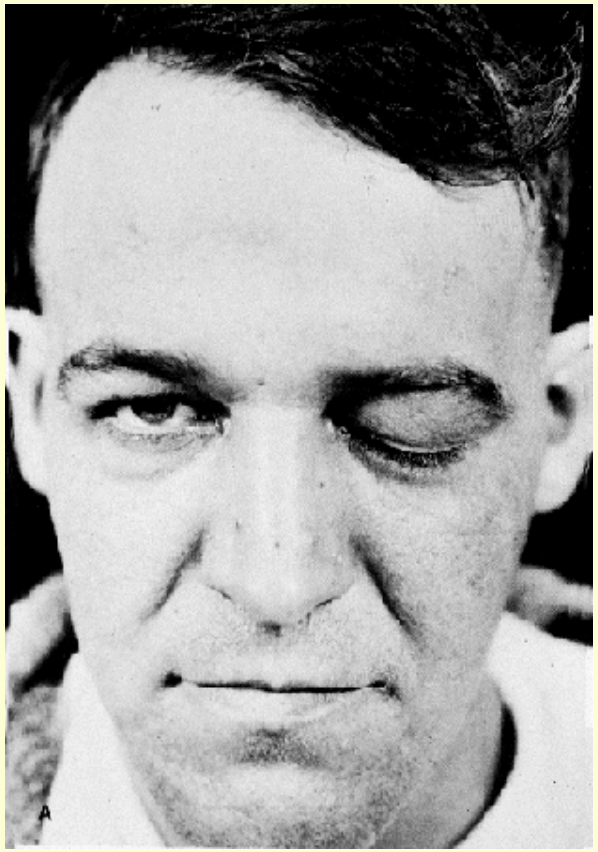
1. **Position of eyeballs** -



N. III- ptosis

Mitoch. lesion, bilateral ptosis

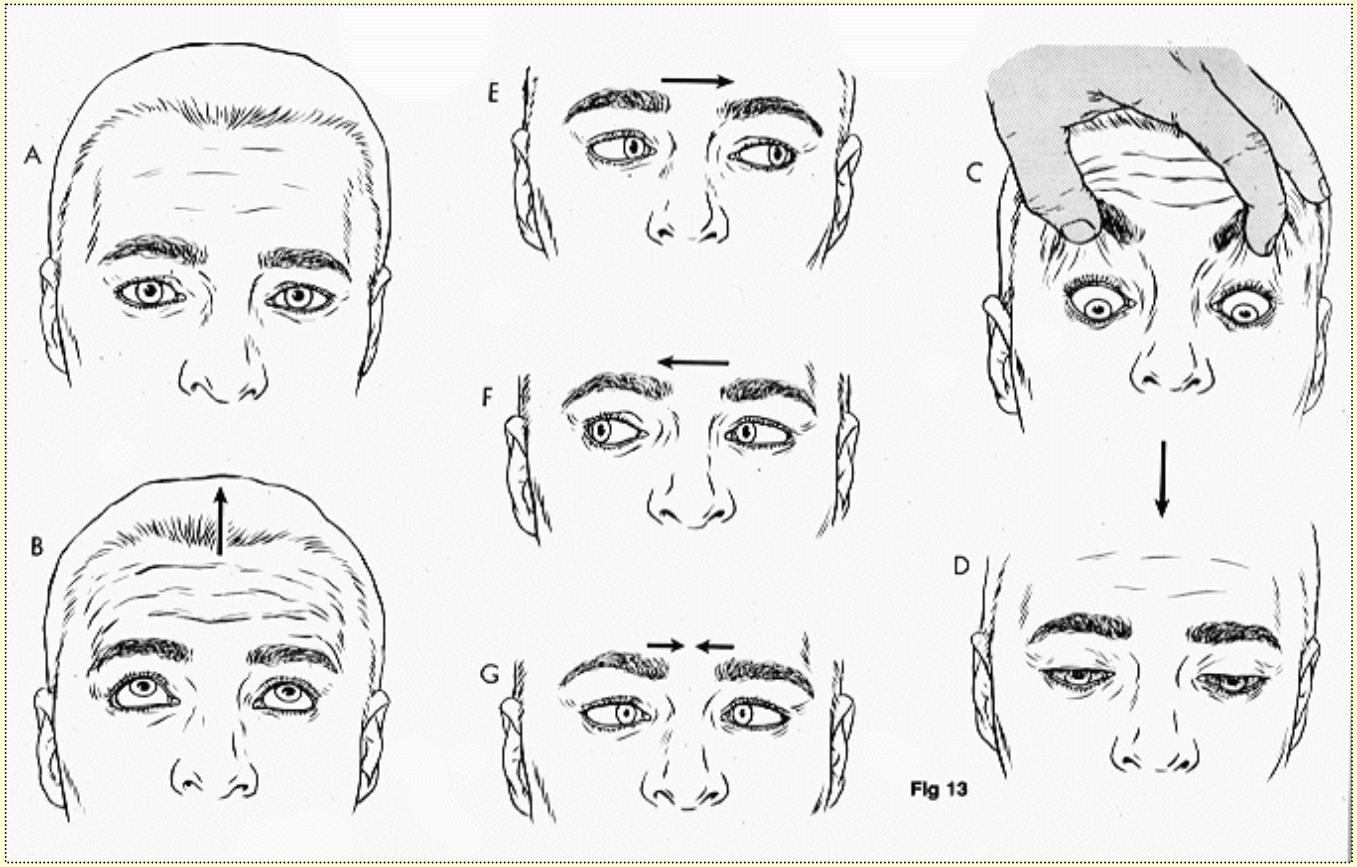
N. III - ptosis



Examination

2. Wideness of eye (n.III)- symmetrical
   (ptosis, exoftalmus, enoftalmus)
3. Movements of eyeballs-
   horizontally (III.,VI)
   vertically (III.,)
   diagonally (III.,IV.)
   konvergention (III)

Movements of eyeballs (III,IV,VI)



Lesions of III., IV., VI. nerves

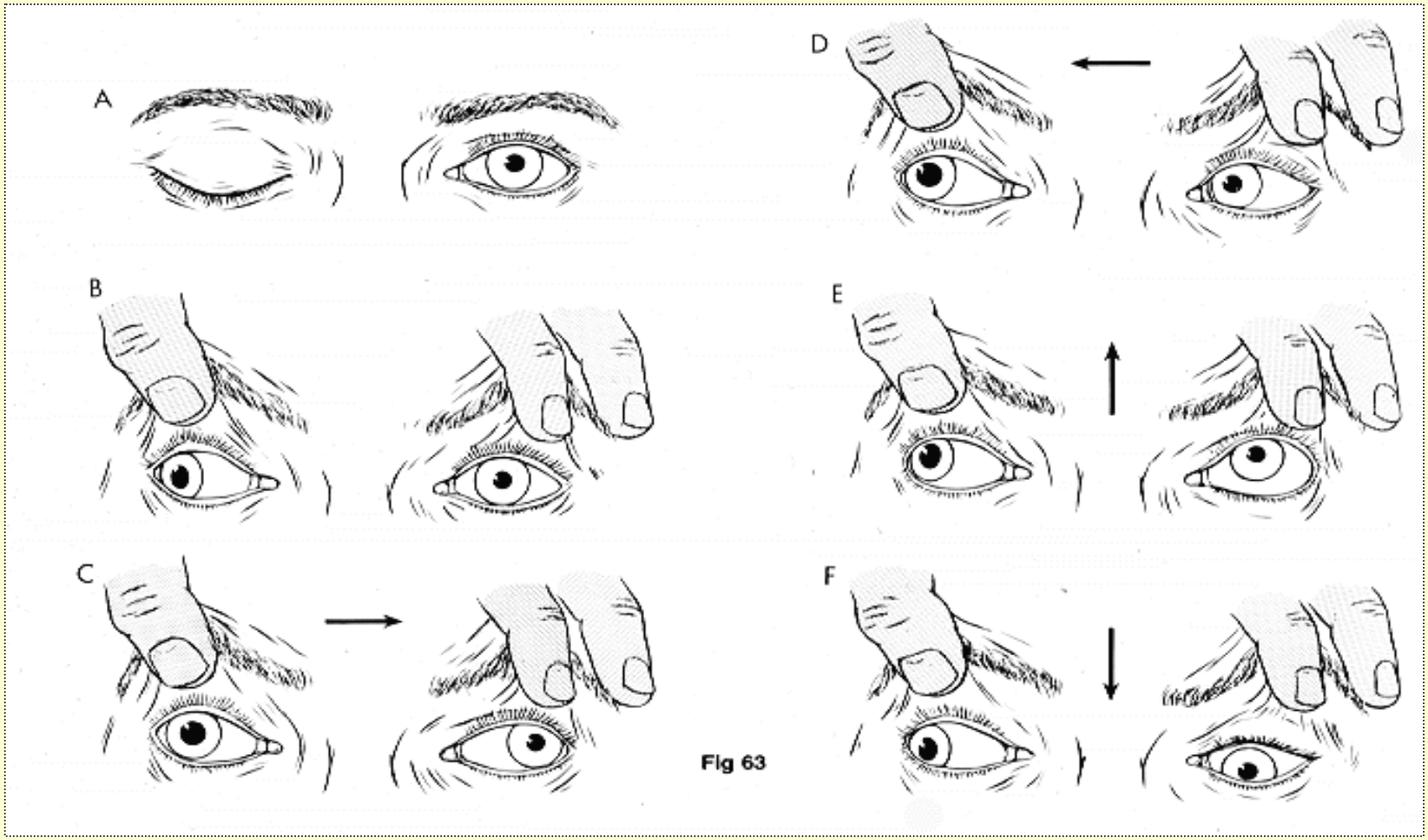


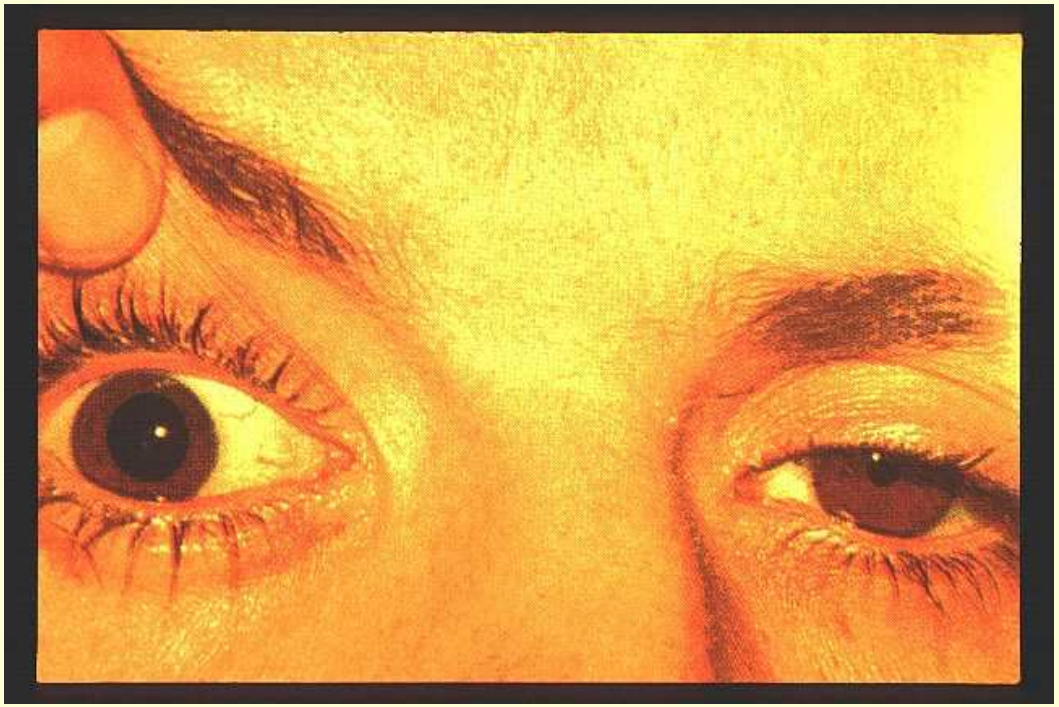
Fig 63

5. Examination of pupils

size

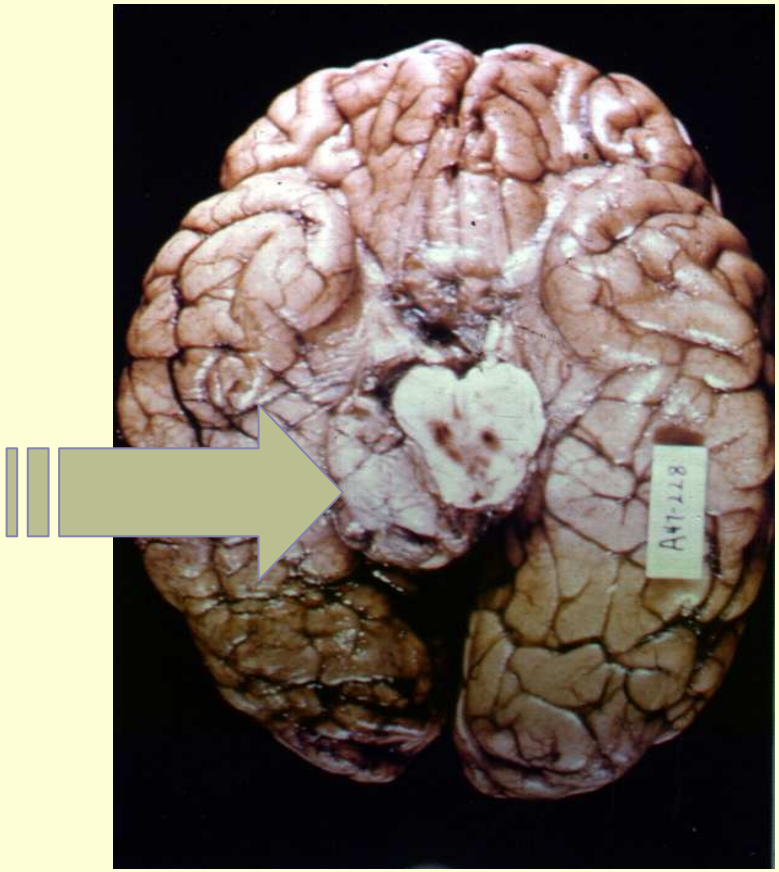
shape

reaction ot light, convergention



Anizokoria - mydriazis

Temporal herniation



- Compression of mesencephalon and n. III. – **mydriasis on one side, FR: not present**
- Unconsciousness
- Hemiparesis (plegia)

Lesion of n. VI.

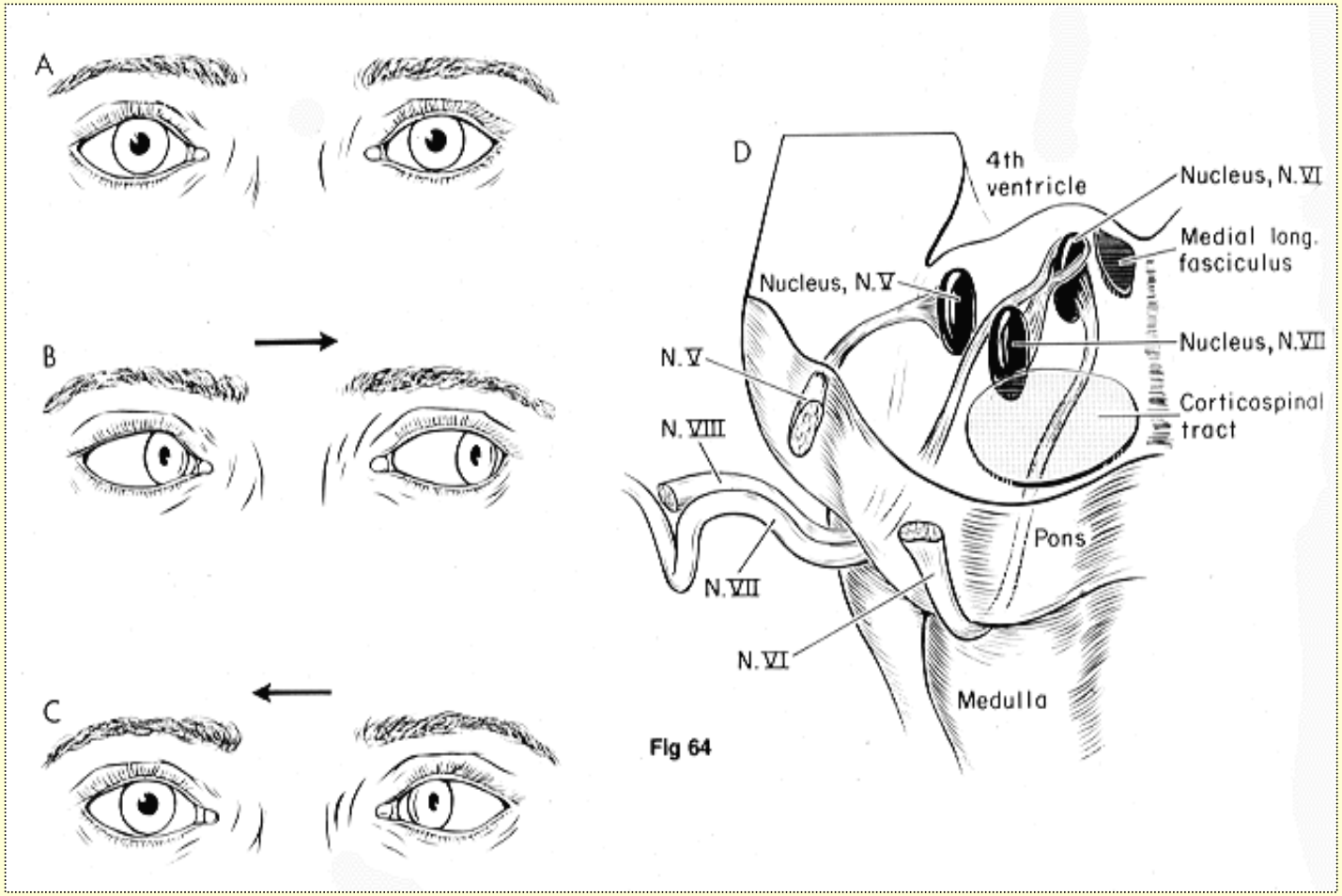


Fig 64

Lesion of n. III., IV., VI.

DIPLOPIA – double vision

OFTALMOPLÉGIA:

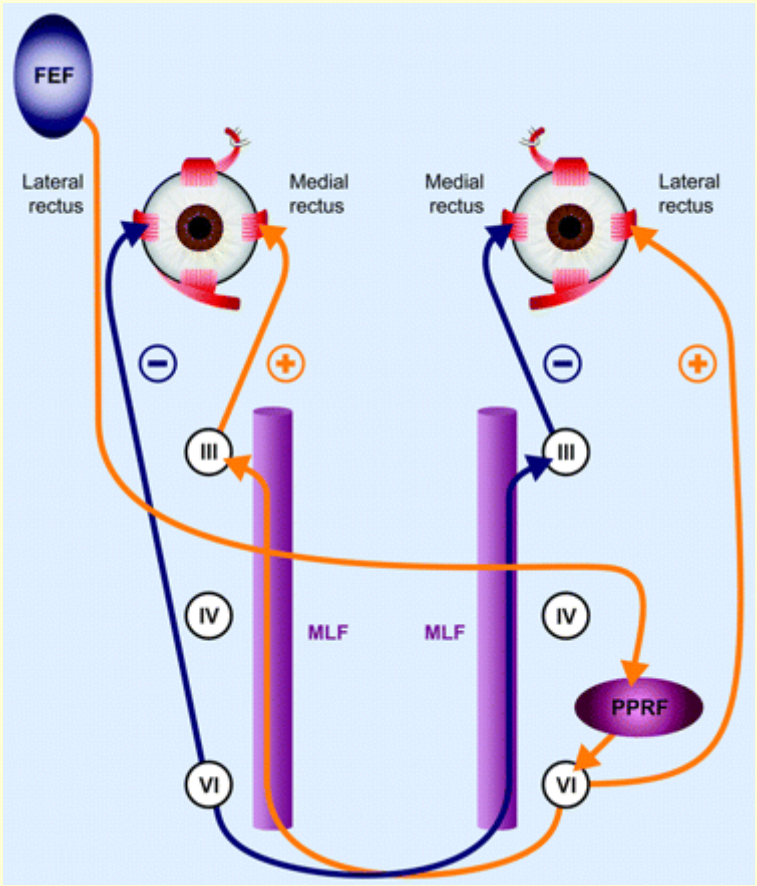
- **OP interna**- parasymp. muscles, mydriasis+lost FR + lost accomodation
- **OP externa**-incompleta
- OP externa completa
- **OP totalis**=OP interna+OP ext. completa

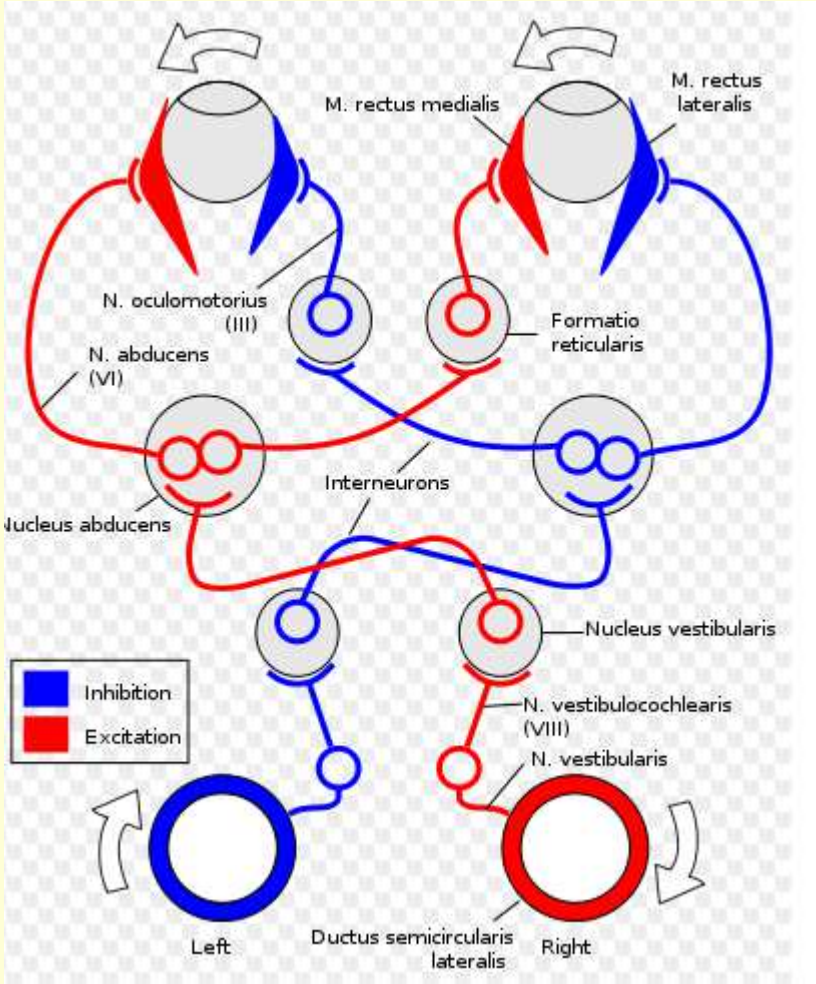
Conjugate movements of eyeballs

Centres:

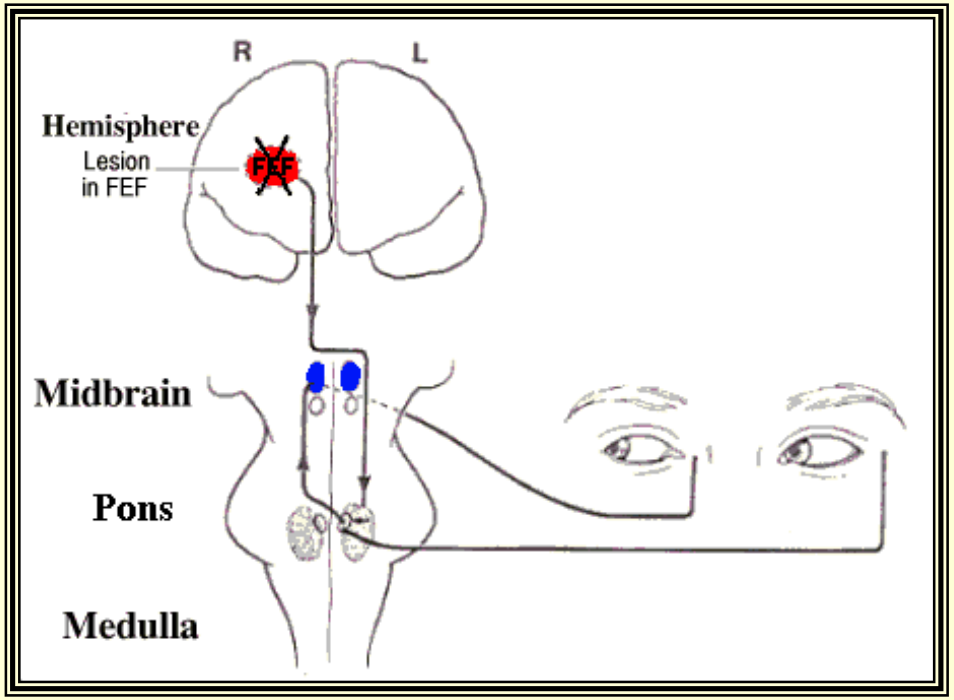
- A) in pons - nc.paraabducens (PPRF) – reflectoric extravoluntary movements
- B) cortical frontal - gy front. medius- FEF- voluntary movements
- C) cortical P-O - extravoluntary watching movements of subjects in visual field

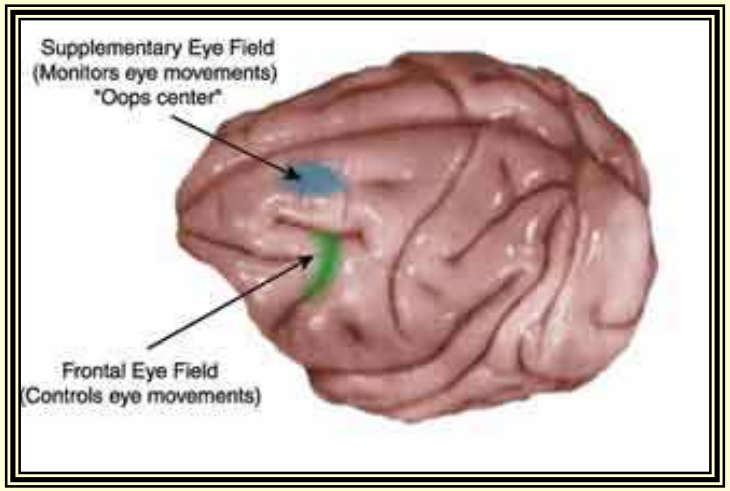
Conjugate movements of eyeballs



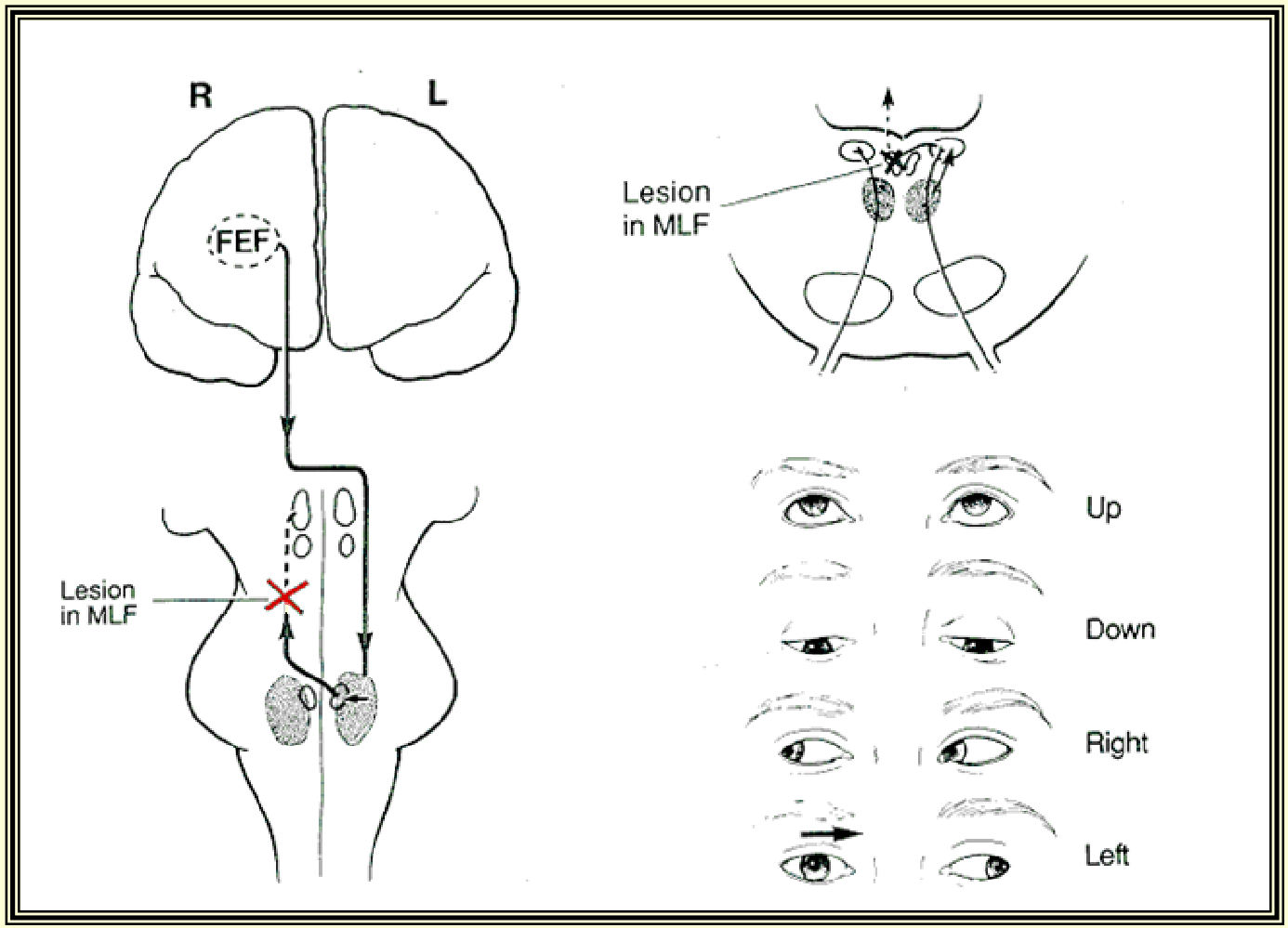


(frontal centre - FEF)





INOP-anterior, lesion in FLM



Parinaud sy-
paralysis of upward gaze

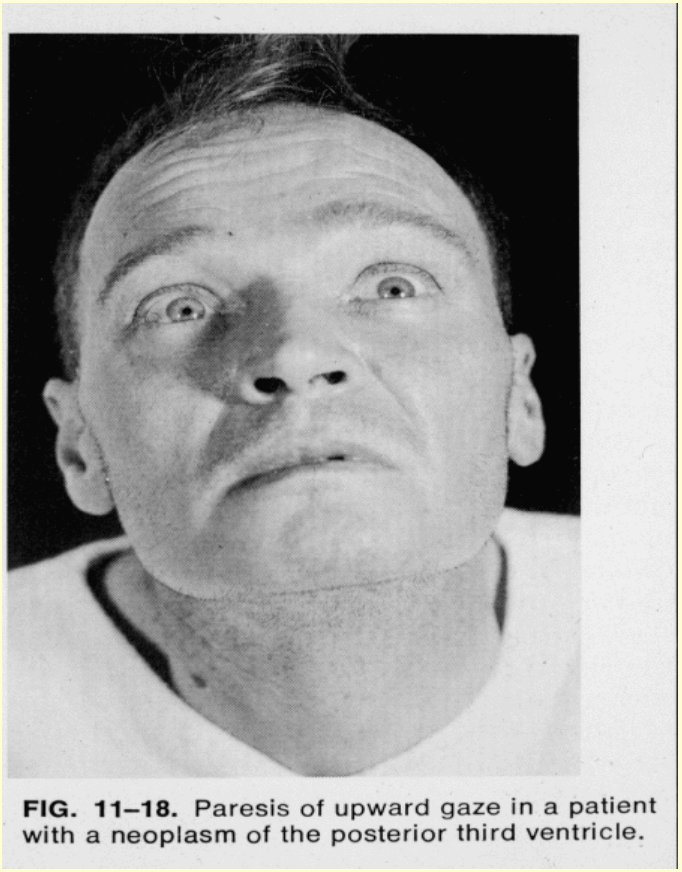


FIG. 11–18. Paresis of upward gaze in a patient with a neoplasm of the posterior third ventricle.

CBH sy – Claude Bernard Hornerov sy

- Lesion of cervical sympathicus
  centre ciliospinale Budge
- Trias:
  - miosis
  - ptosis
  - enophtalmus

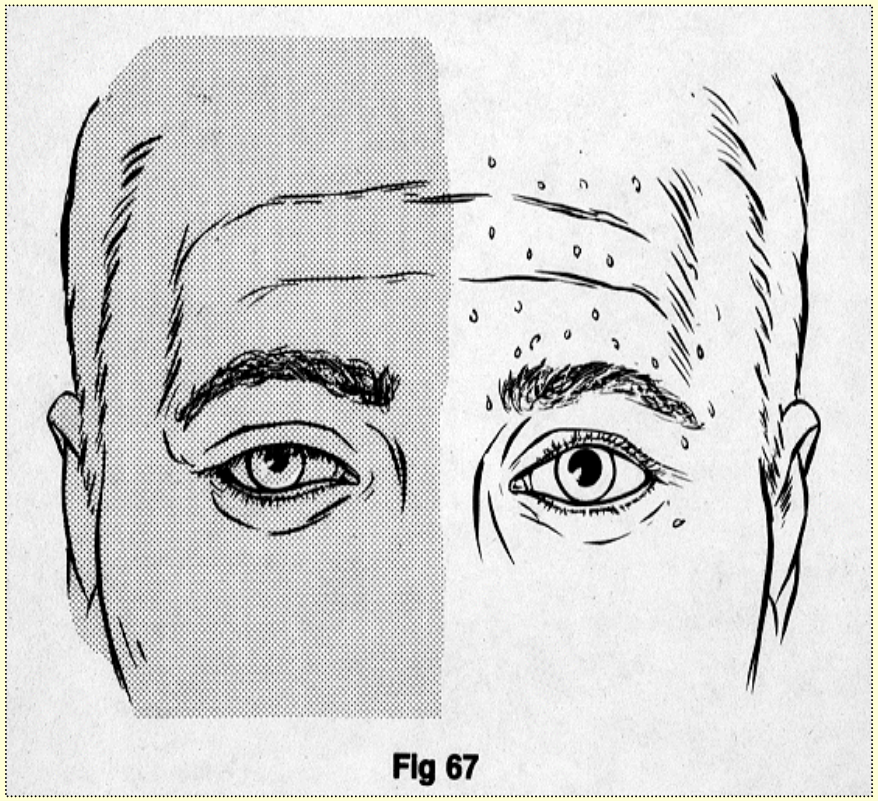


Fig 67

The trigeminal nerve - n. V.

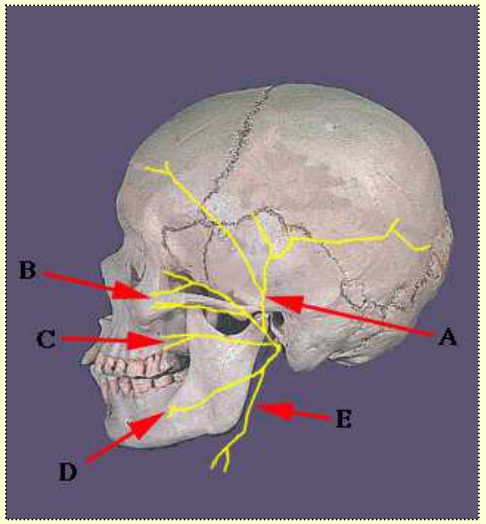
Anatomy – nn. in pons

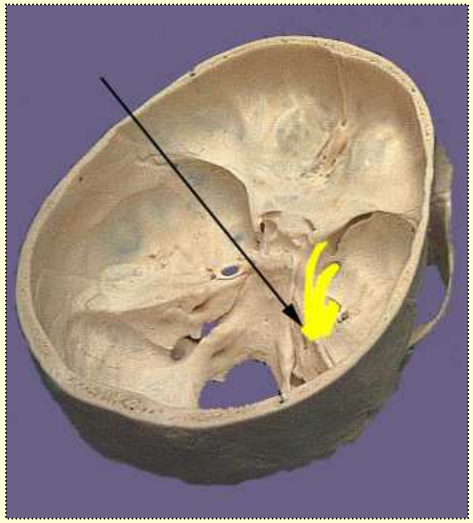
- Senzit. 2nn. + motoric 1n.
- Inervation:

n. Ophthalmicus
n. Maxillaris
n. Mandibularis
Masseter muscles

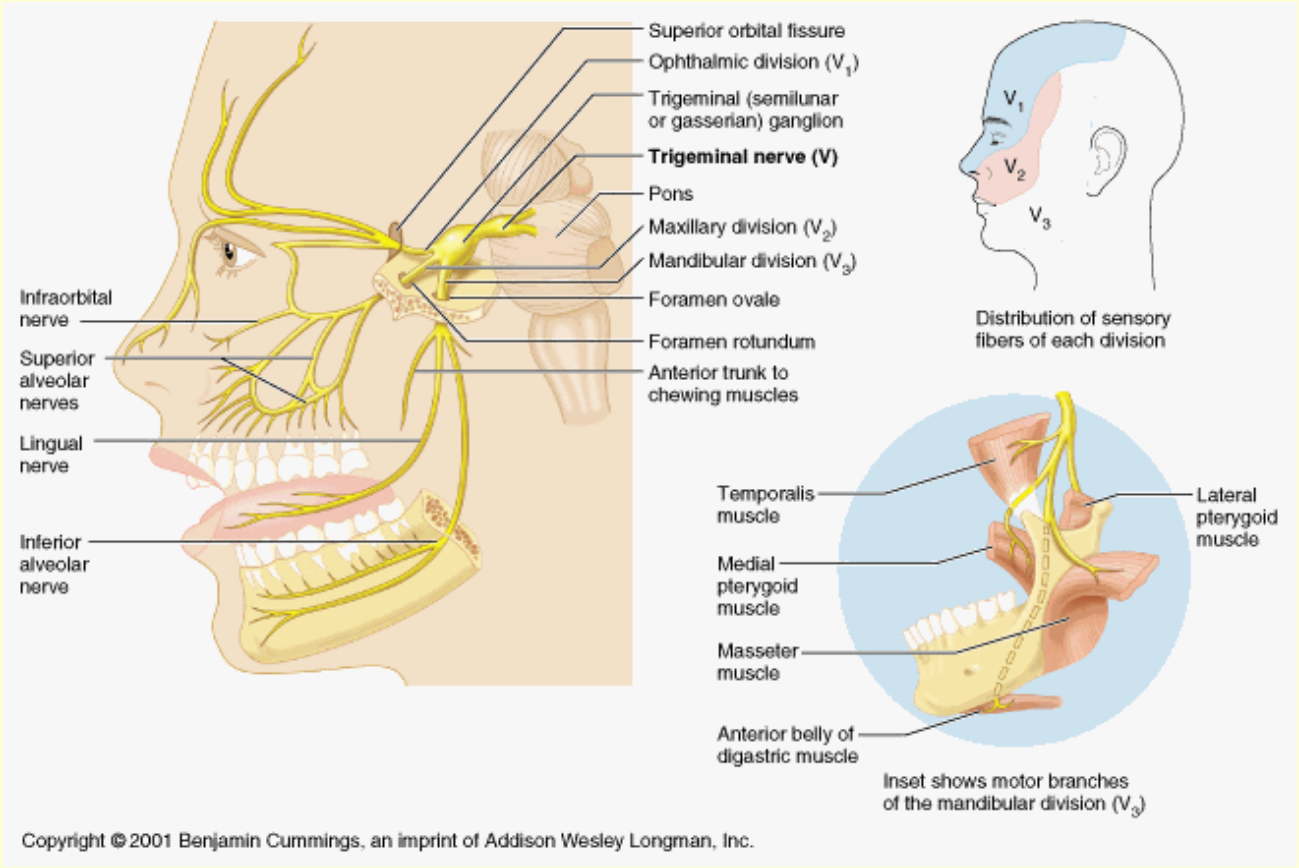
Face sensitivity

- Vegetat.:cornea

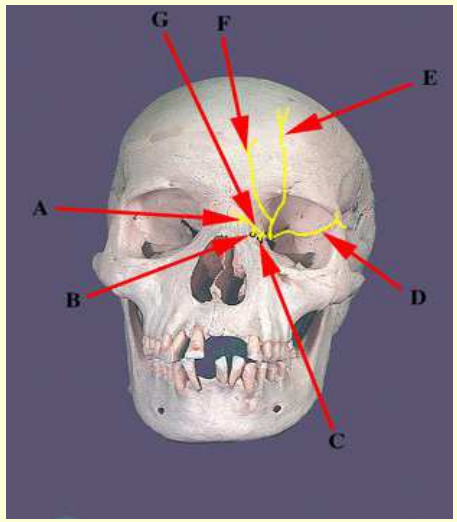


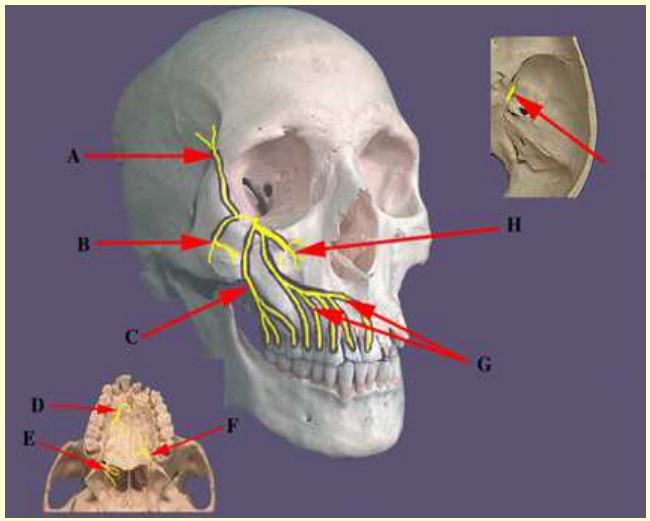


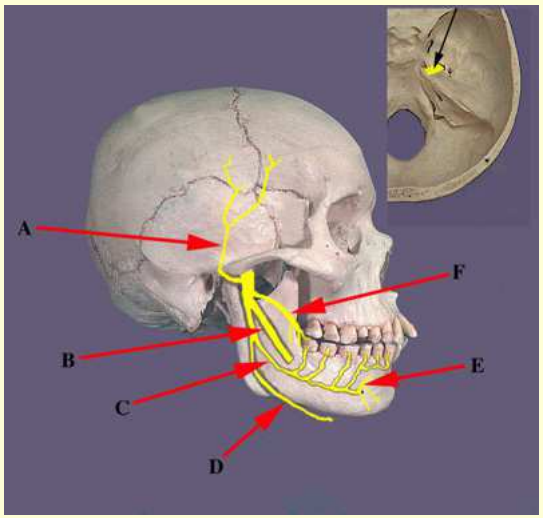
The trigeminal nerve - n. V.



N. V.







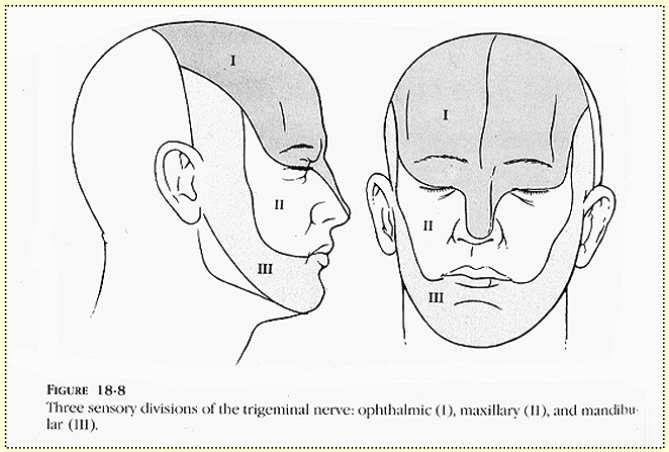
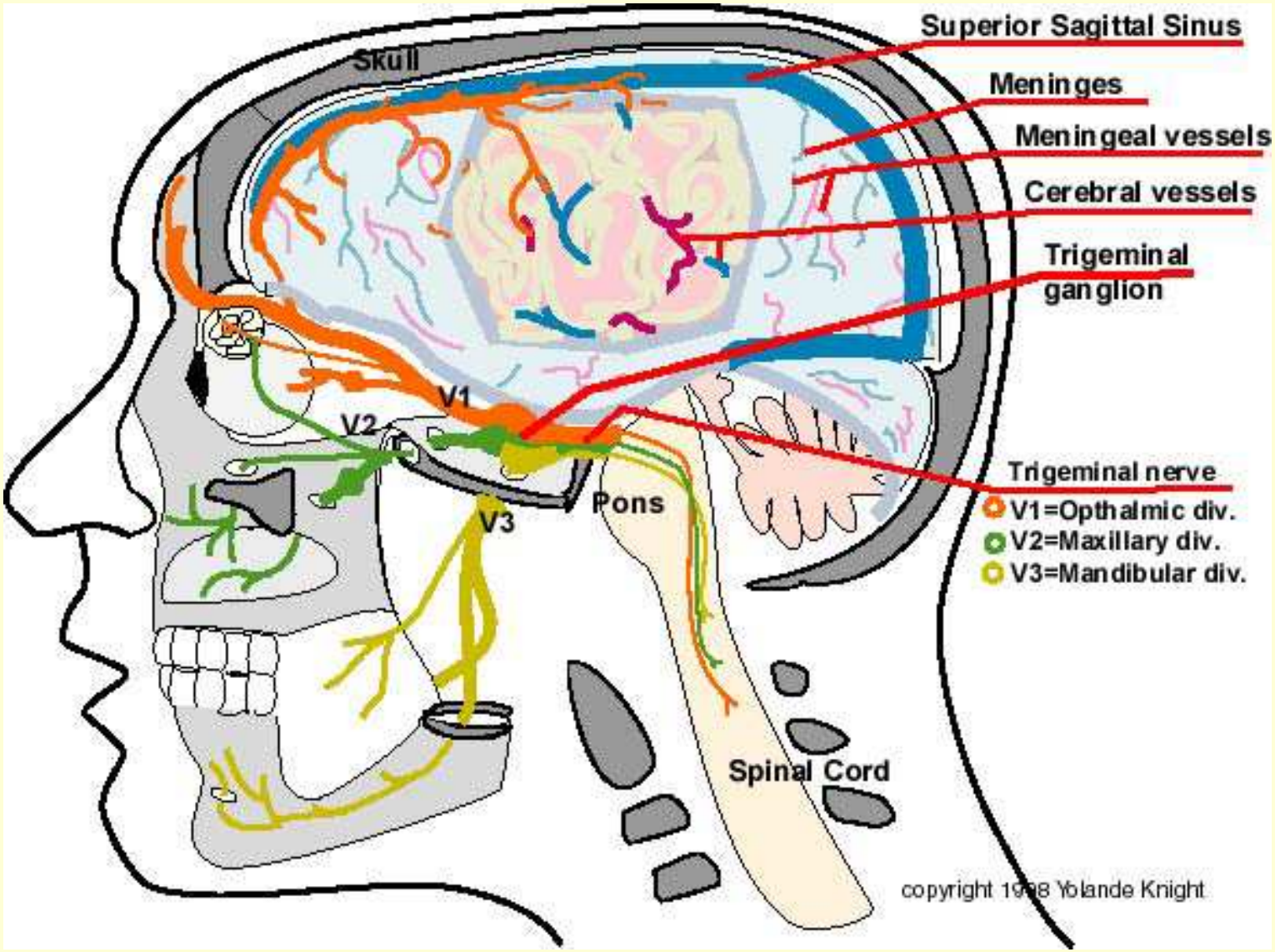


FIGURE 18-8
Three sensory divisions of the trigeminal nerve: ophthalmic (I), maxillary (II), and mandibular (III).


Superior Sagittal Sinus
Skull
Meninges
Meningeal vessels
Cerebral vessels
Trigeminal ganglion
V1
V2
V3
Pons
Trigeminal nerve
V1=Opthalmic div.
V2=Maxillary div.
V3=Mandibular div.
Spinal Cord
copyright 1998 Yolande Knight

Examination

1. **Sensitivity of face**
2. **Outlets of n.V.** (pain)
3. **Corneal reflex** (V.-VII.)
4. **Tone of masseter muscles**
5. **Masseter reflex** (V.-V.)

Corneal reflex

- aferent part **n.V.** (touching cornea)
- eferent part **n. VII.** (closing of the eye, mimic muscles)

Examination of n. V.

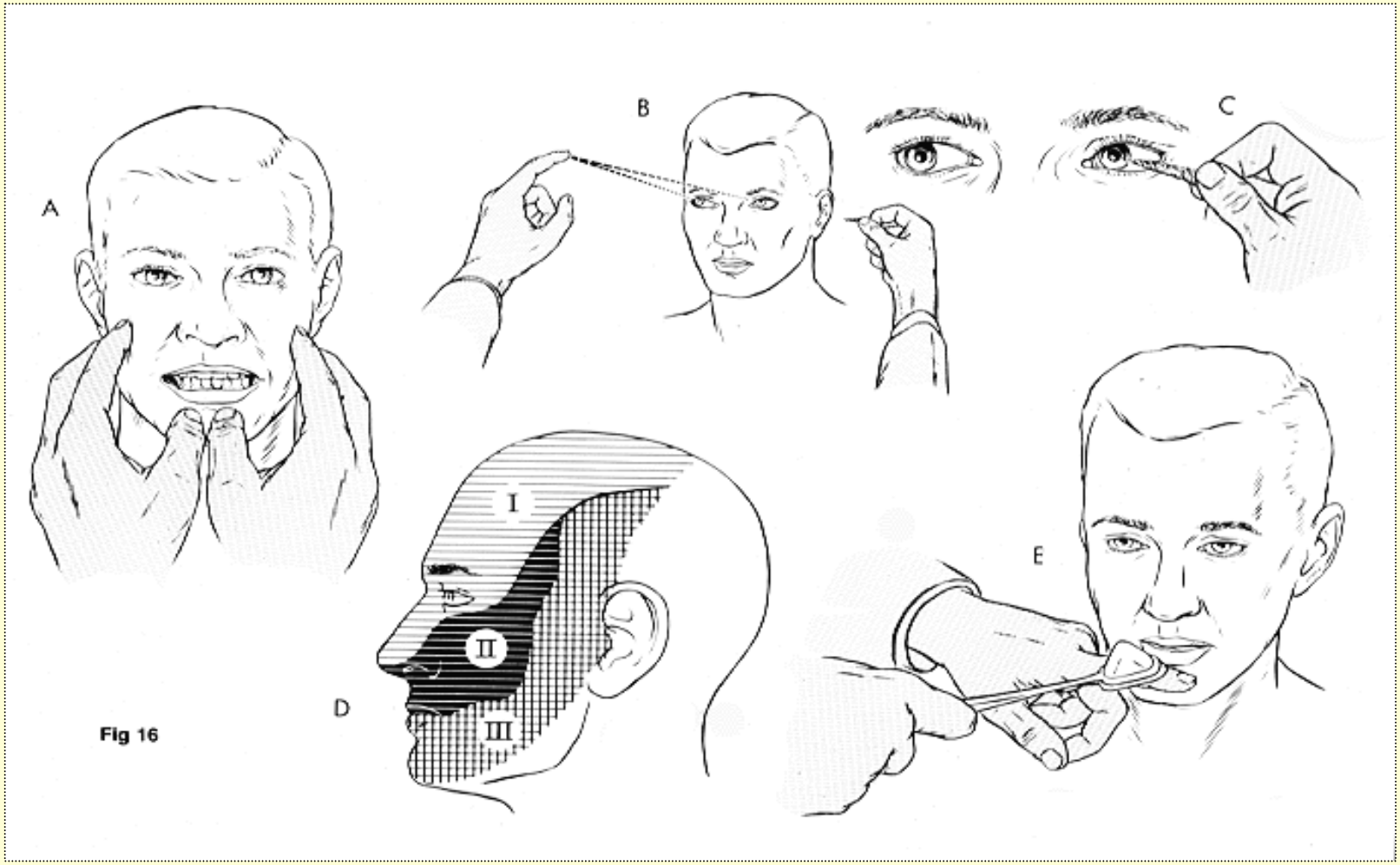
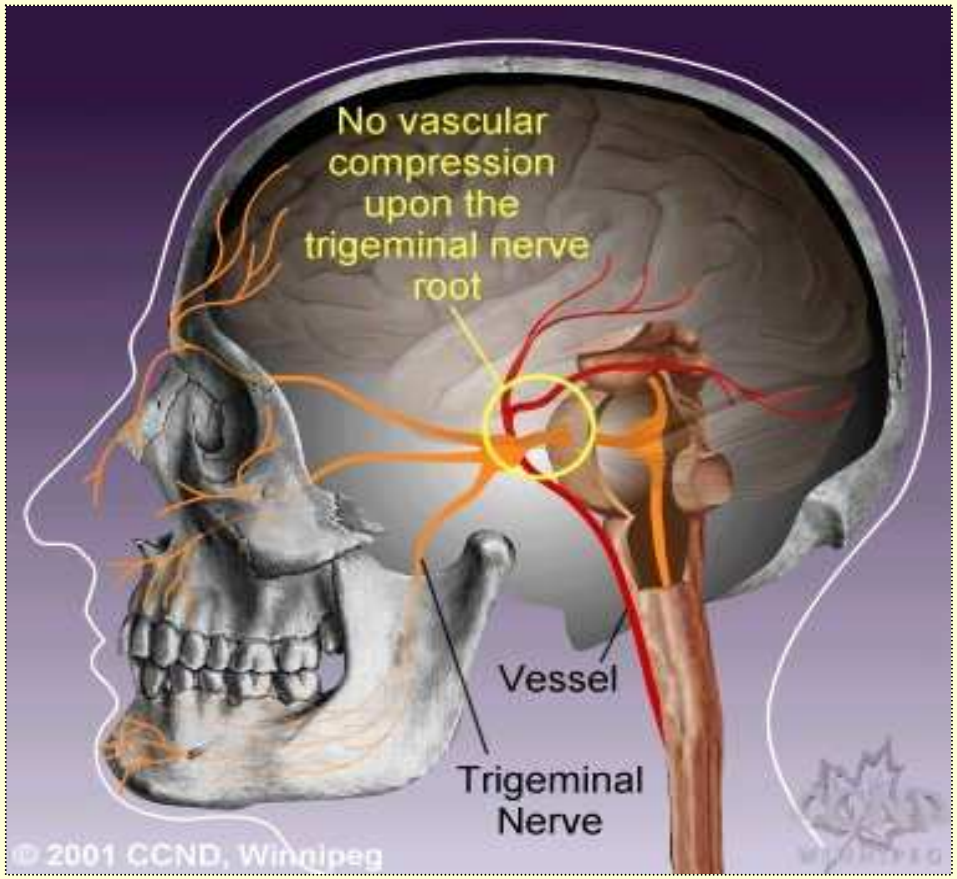
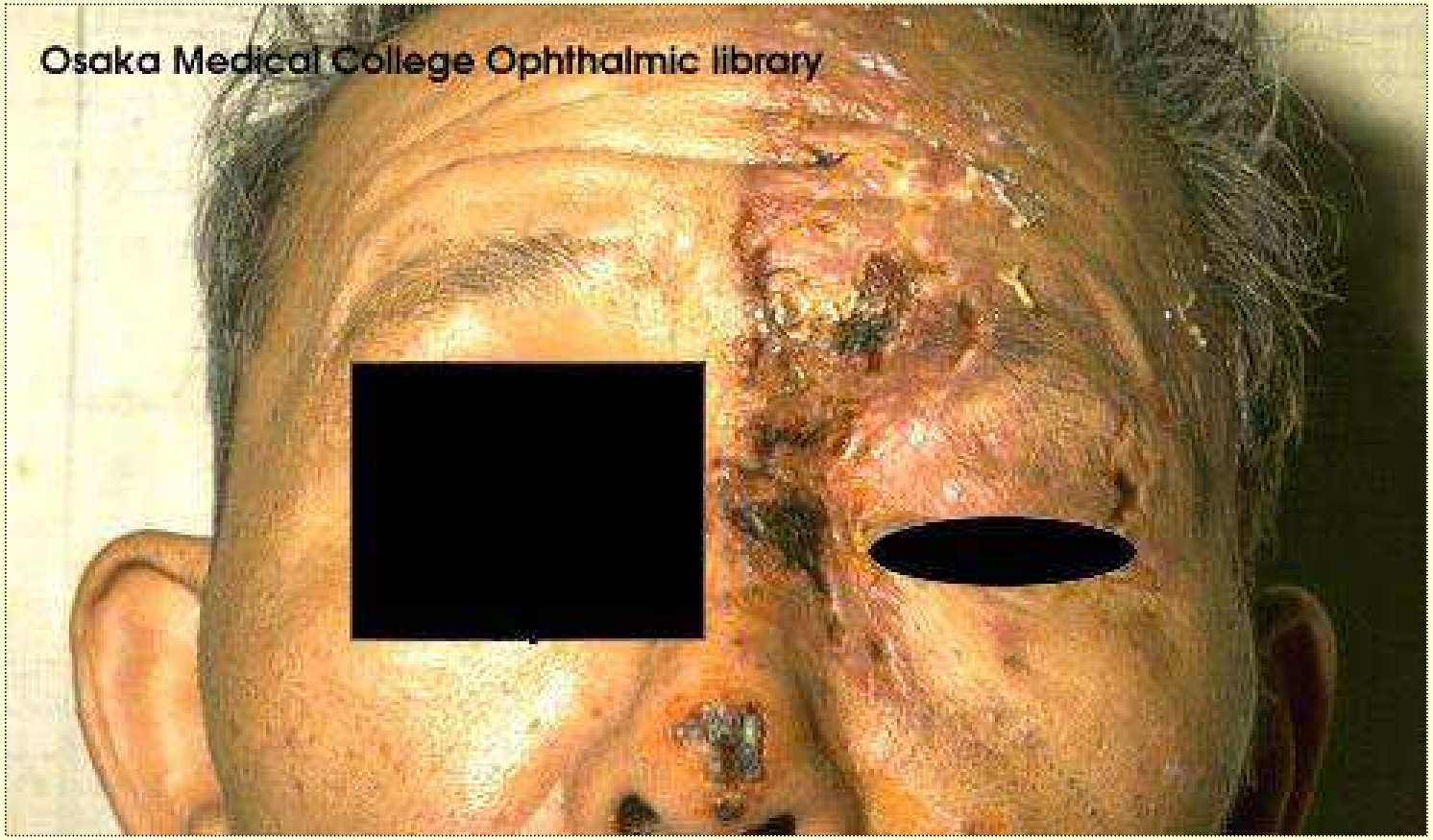


Fig 16

Trigeminal neuralgia



Herpes zoster – n.V.

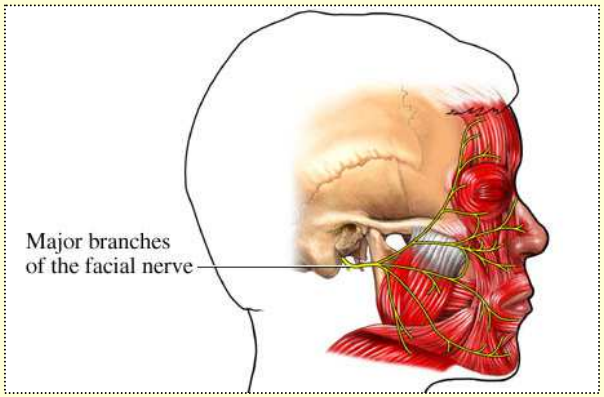


Trizm –
spasm of masseter muscles

The facial nerve – n.VII.

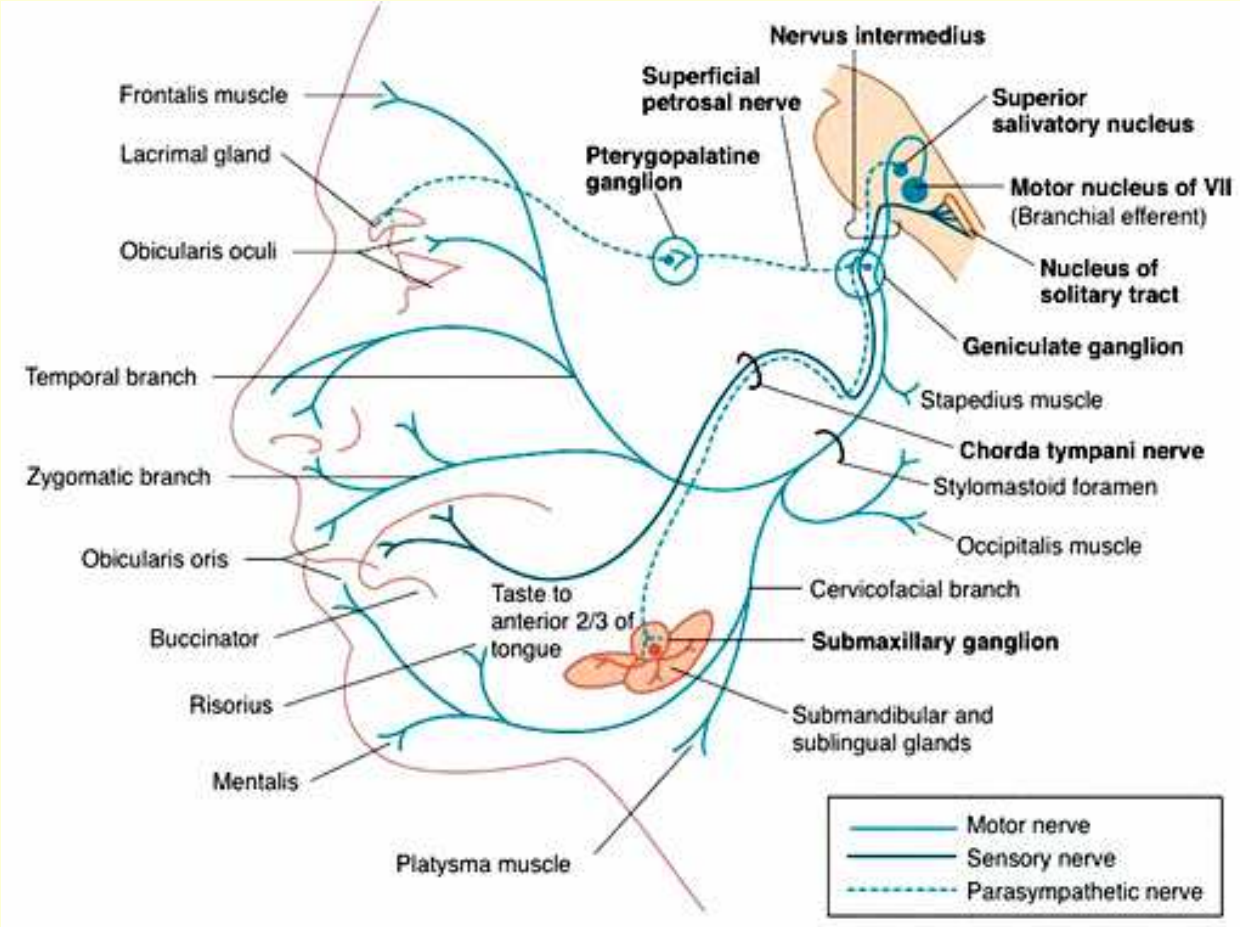
Anat.: nuclei in pons

Inervation:

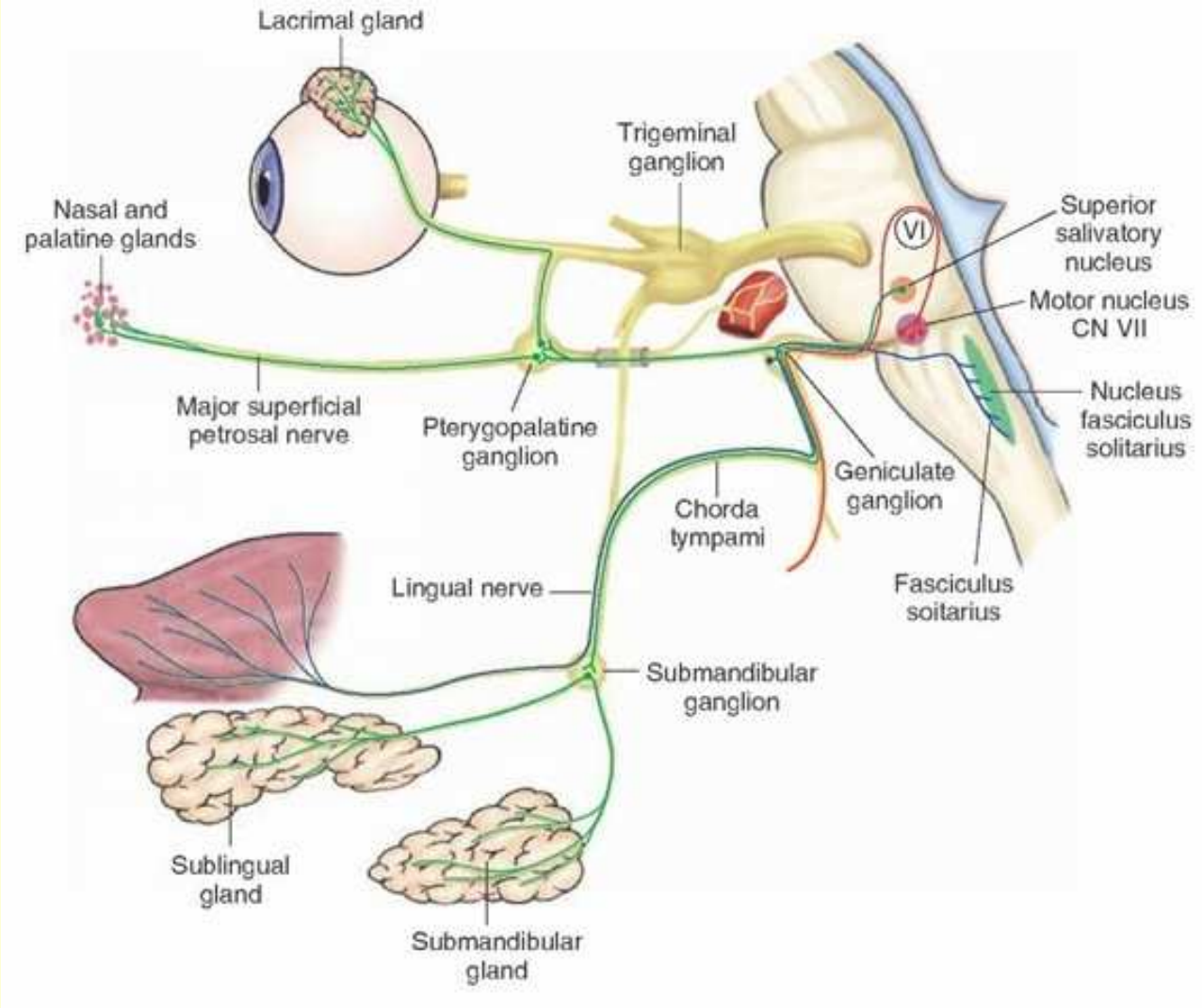


- Senzoric - taste
- Autonomic: salivation
- Motoric: mimic muscles of face and neck
- Sensory: tympanum, external auditory canal, part of the ear (Ramsay-Hunt)

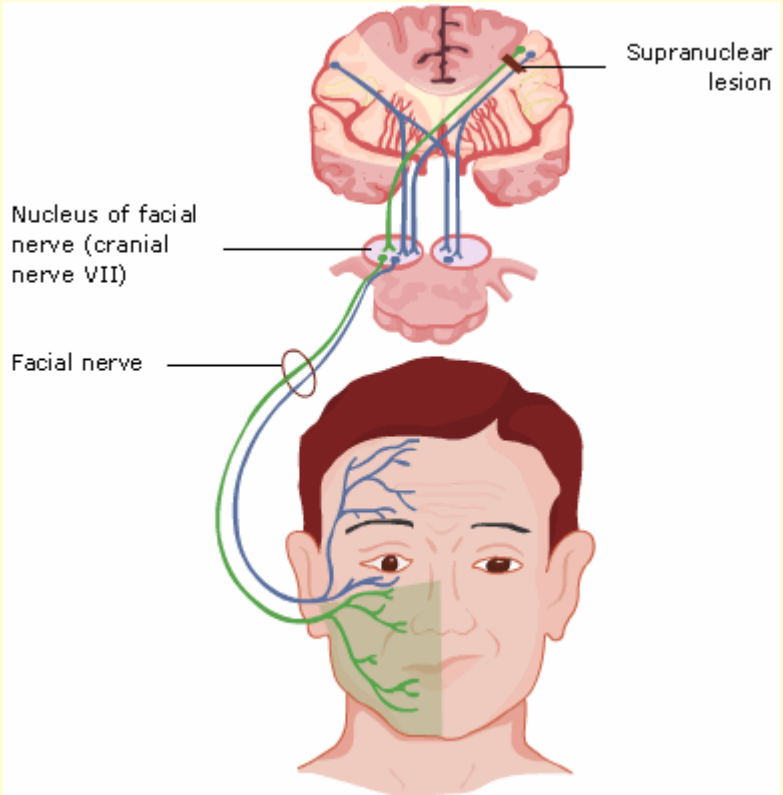
The facial nerve – n.VII.



The facial nerve – n.VII.



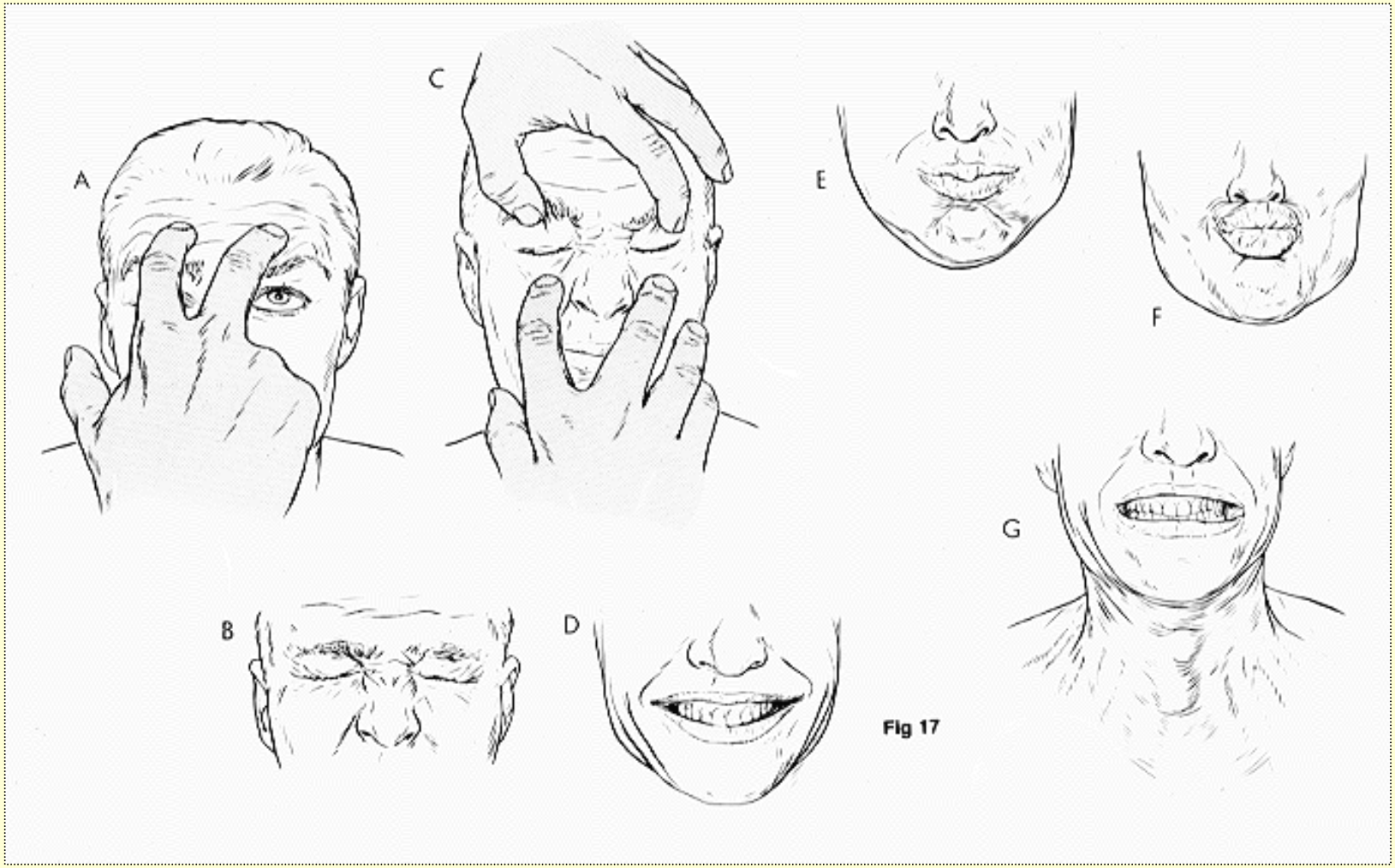
Facial nerve - nuclei



Examination of the n. VII.

- **Motor**: mimic of the face, in rest and voluntary mimic, lower and upper branch
- **Autonomic:** salivation - gl. sublingualis, gl. submandibularis, gl.lacrimalis
- **Senzoric**: taste - anterior 2/3 of tangue

Examination function of n. VII. (wrinkles, whistle, smile)



Examination of the upper branch – rise eyebrows frown, shut eyes tightly

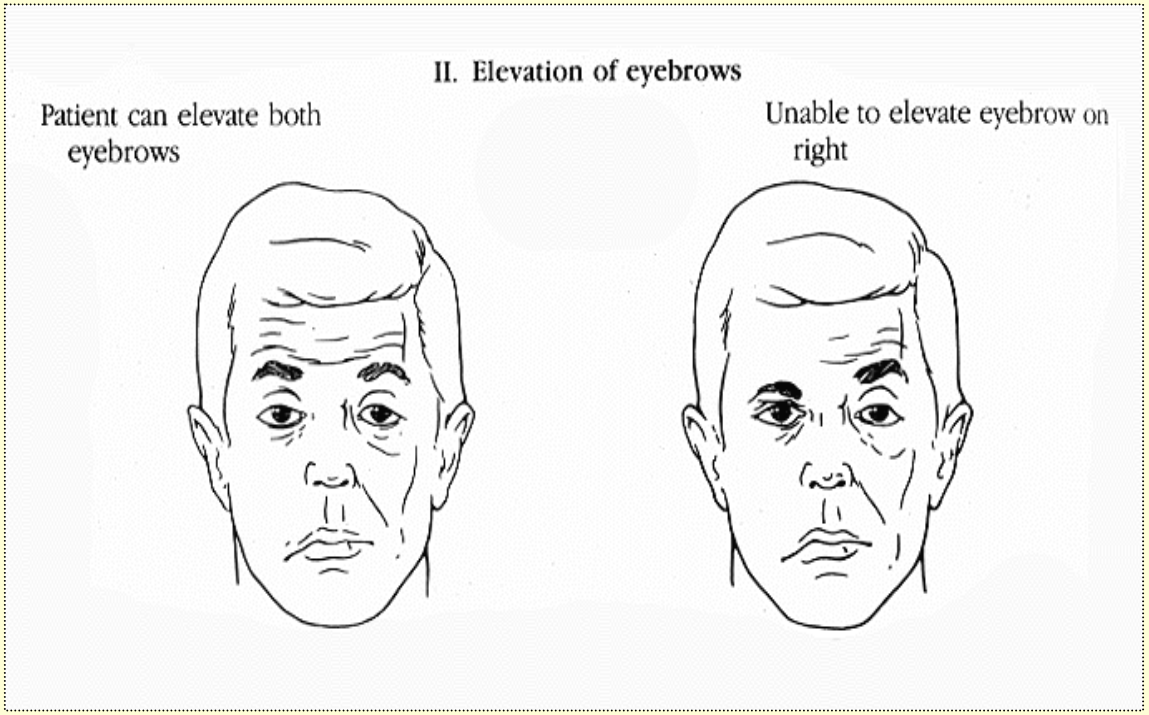
Examination of the upper branch blinking

Examination of the lower branch showing the teeth

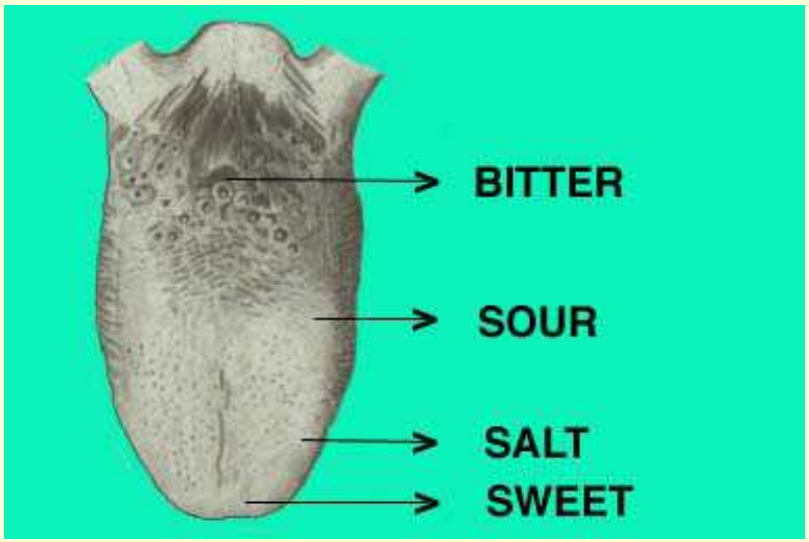
Bell´s palsy – periferal n. VII. lesion

- **Smooth forehead without wrinkles**
- **Drawn eyebrow**
- **Lagophthalmus**
- **Smooth nasolabial curve**
- **Assymetry of mouth**
- **Drawn lips on one side**
- **Not able to show the teeth**
- **All on one side – homolateral side to lesion**
- **± taste**

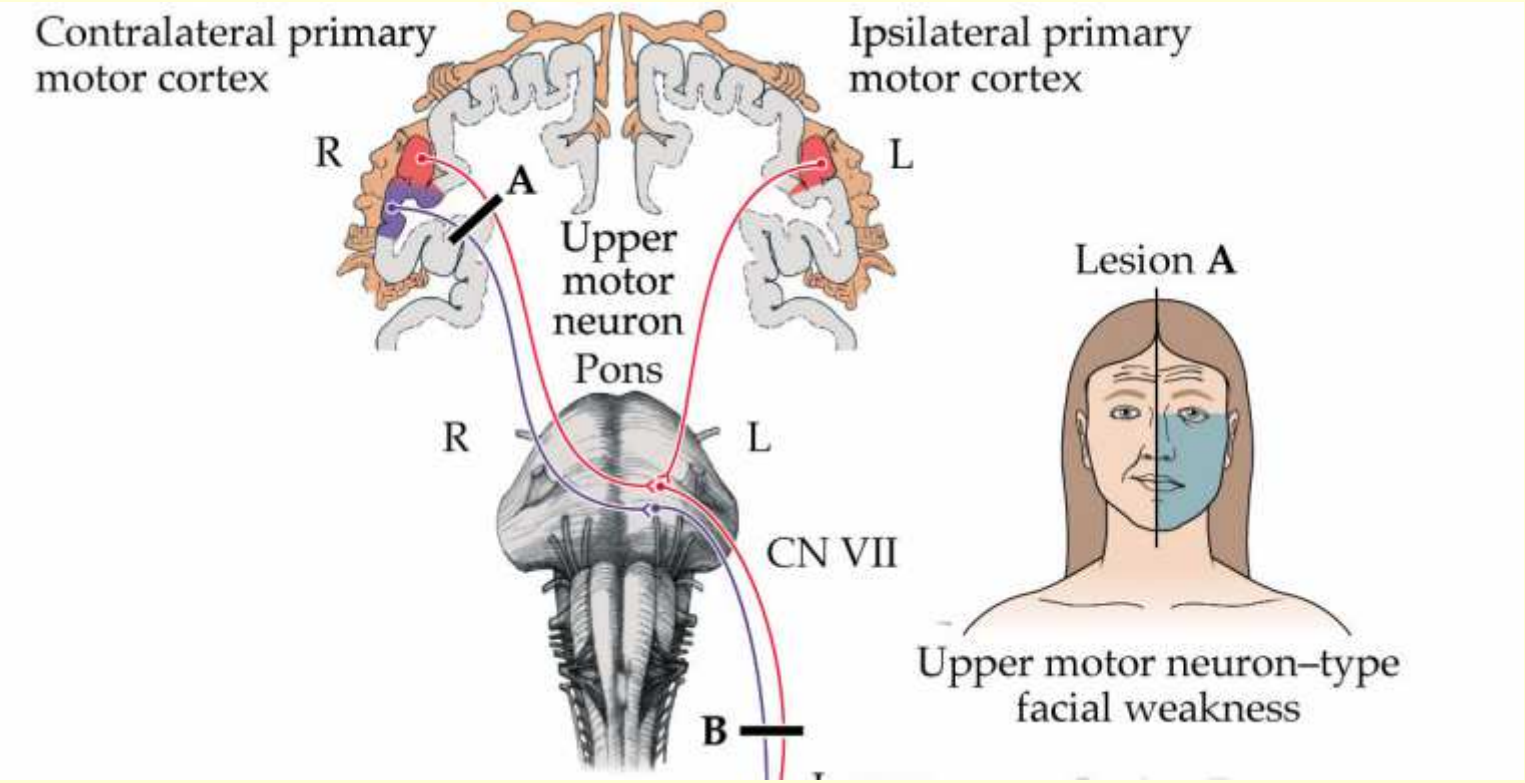
Bell´s palsy – periferal n. VII. lesion



Examination of the taste

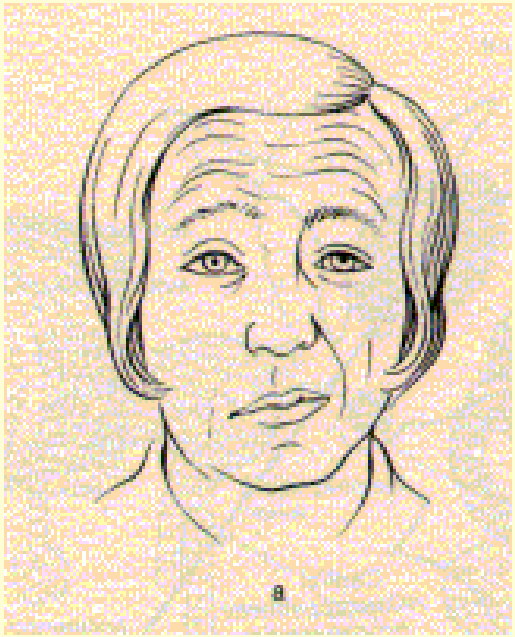


Upper motor neuron – type facial weakness



Central lesion of the n. VII.

- **Assymetry of mouth**
- **Drawn lips on one side**
- **Not able to show the teeth**
- **On one side – contralateral to affected corticobulbar tract**



Axial reflexes – n. VII.

- **Fysiological – nasopalpebral (V.+VII)**
- **Patological**

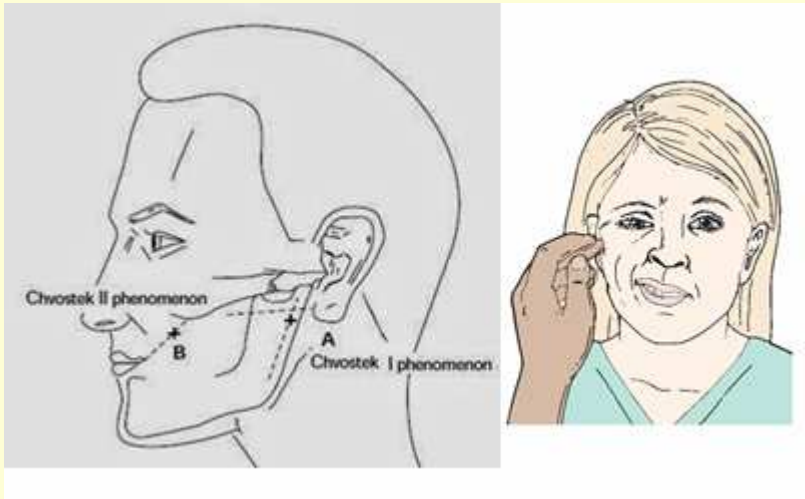
1. **Nasolabial (nasal)**
2. **Mentolabial (mental)**
3. **Saccing**

Fysiological in newborns, important for nutrition

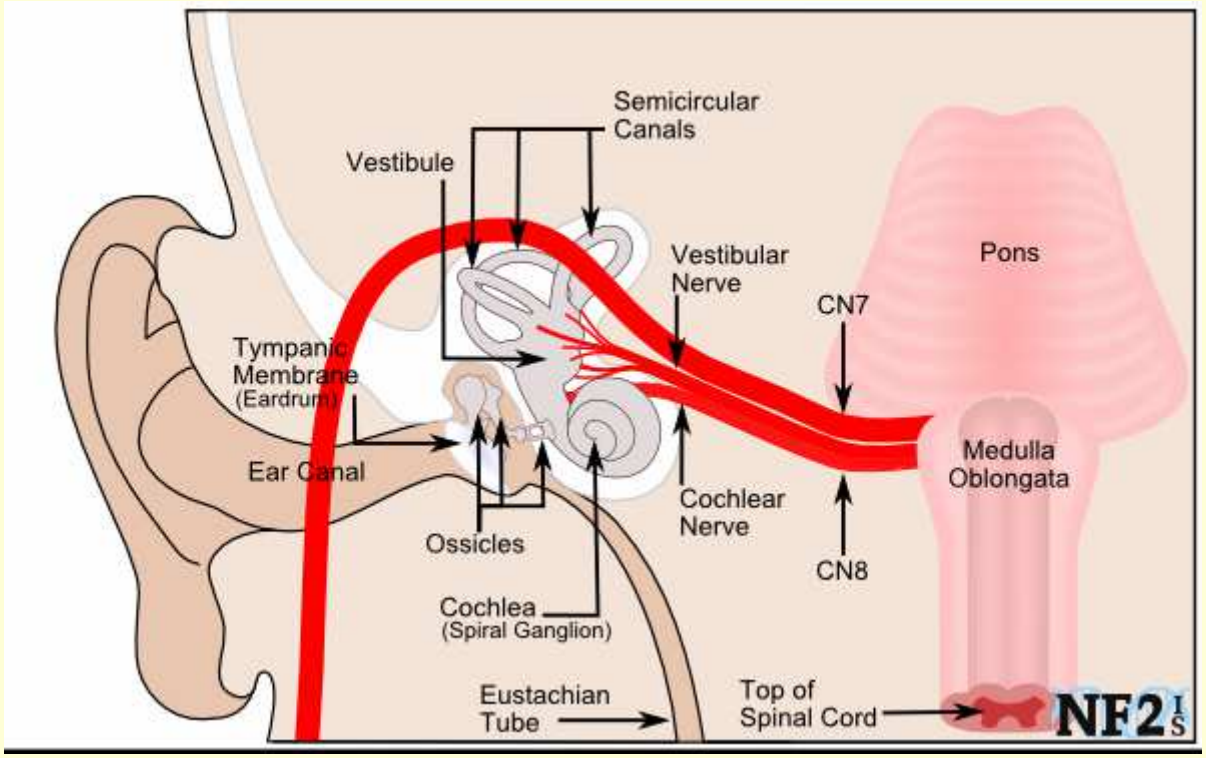
Patological in adults: lesion of frontal lobe, atrophy of the brain cortex, lesion of both hemispheres – MTS, TU, ...

Chvostek sign

- Nocking in front of tragus
- Patol. response:contraction of mouth angle, face muscles or nose muscles
- Increased neuromuscular irritation – tetania

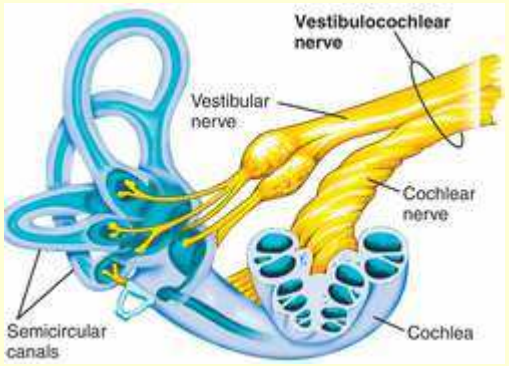


Vestibulocochlear nerve – n. VIII



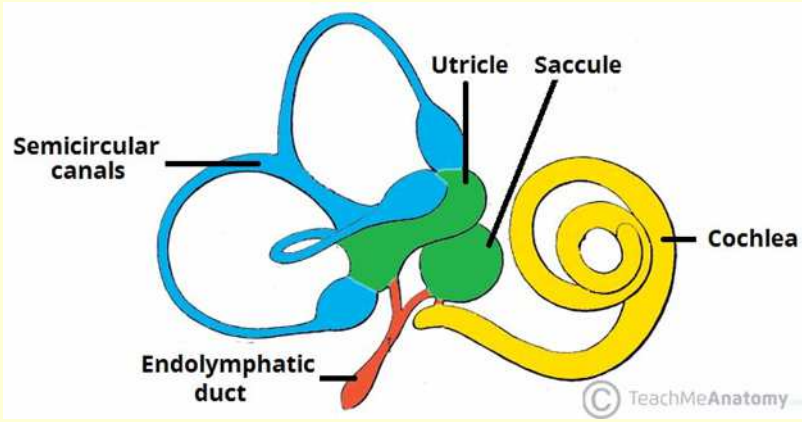
Vestibulocochlear nerve – n. VIII

- After a short distance from the Brainstem
- the Vestibulocochlear Nerve splits to become
- **Vestibular Nerve** (balance nerve) and
- **Cochlear Nerve** (hearing nerve), as it extends towards the **Inner Ear**.

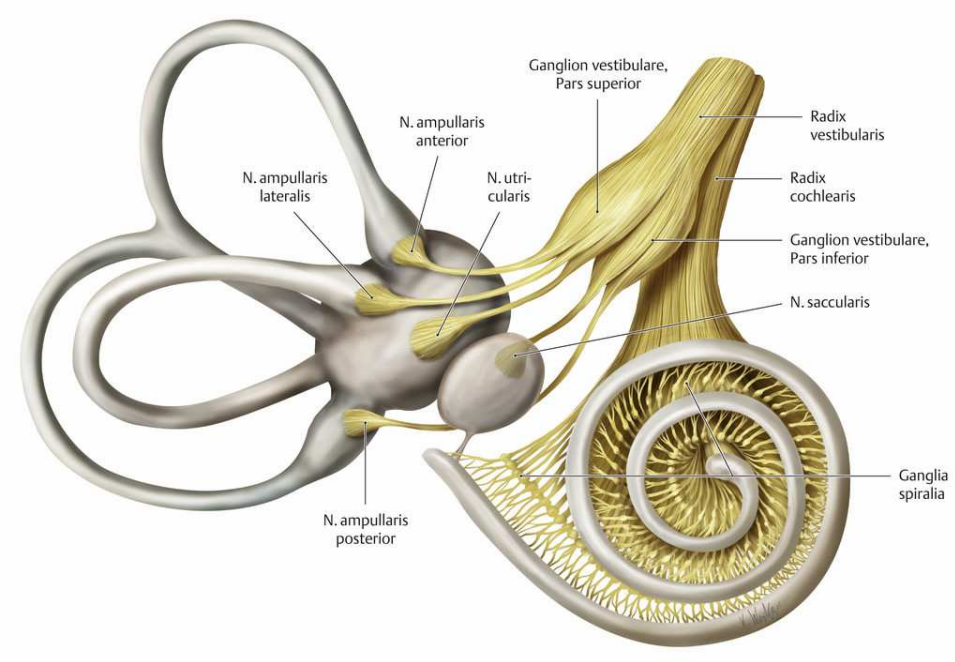


- Loss of function on CN8 for one side of the head would leave an individual with **Single Sided Deafness (SSD)** and some balance issues.
- Loss of function of left and right of the **Vestibulocochlear Nerve** results in severe balance issues and deafness.

Vestibular nerve



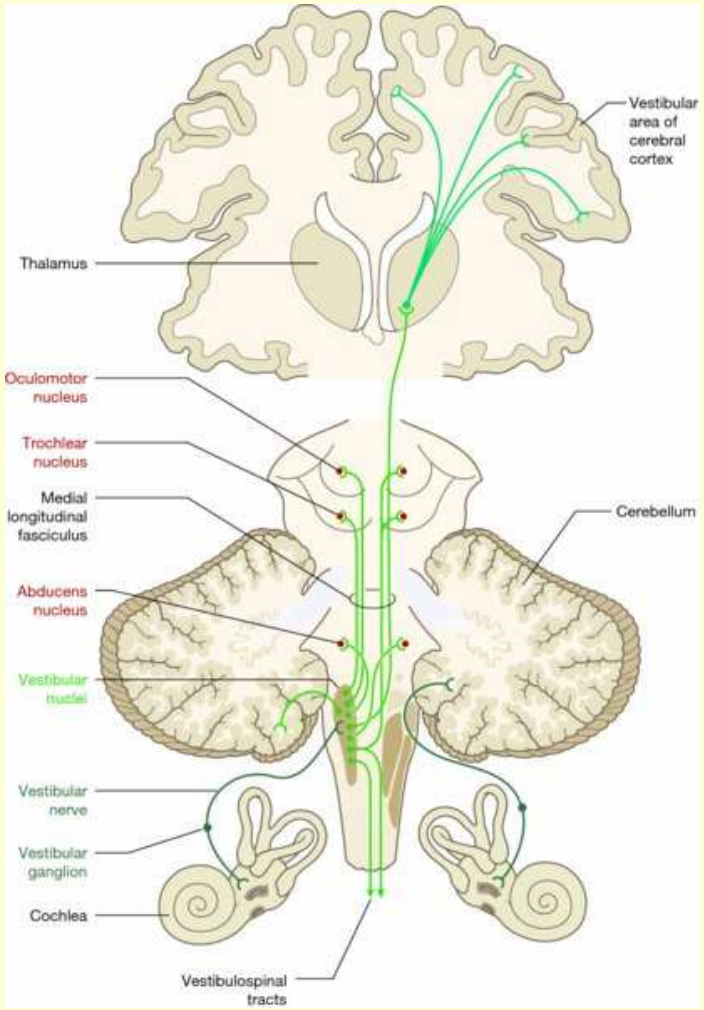
- The vestibule is filled with endolymphatic fluid and is responsible for the somatic balance of the Human Body.
- It is also innervated by small sensory branches that innervate the parts of the vestibule which include the saccule, the utricle, the anterior, posterior and lateral membrane of the ampulla. Those enter the vestibular ganglion.



Vestibular nerve

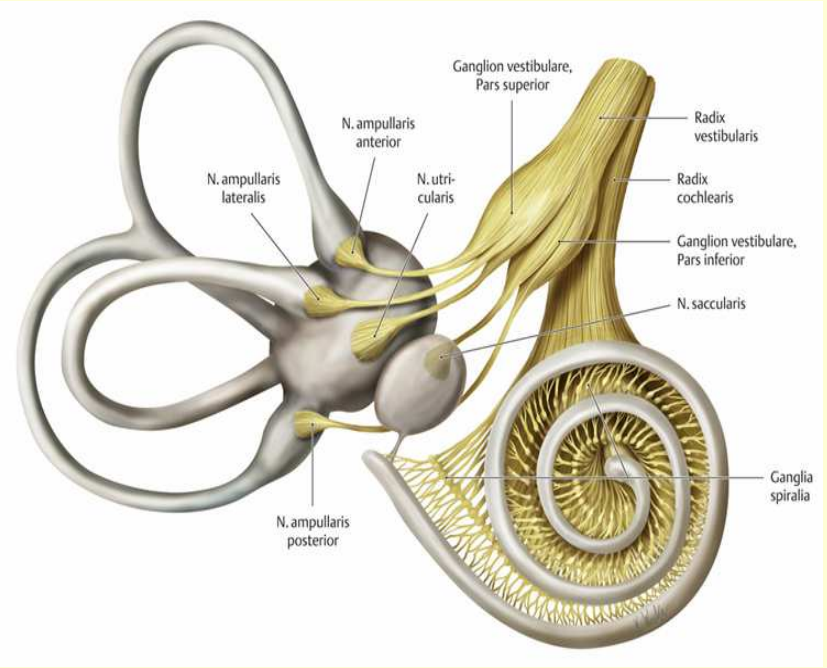
- 1st neuron

  bipolar cells from **ganglion vestibulare** in the meatus acusticus internus
- The end of these cells – nuclei (4)
- 2nd neuron
  - **tractus vestibulospinalis**
  - **tractus vestibuloreticularis**
  - **tractus vestibulocerebellaris**
  - **tractus vestibulobulbaris**
  - **tractus vestibulocorticalis** to temporoparietal cortex



Cochlear nerve

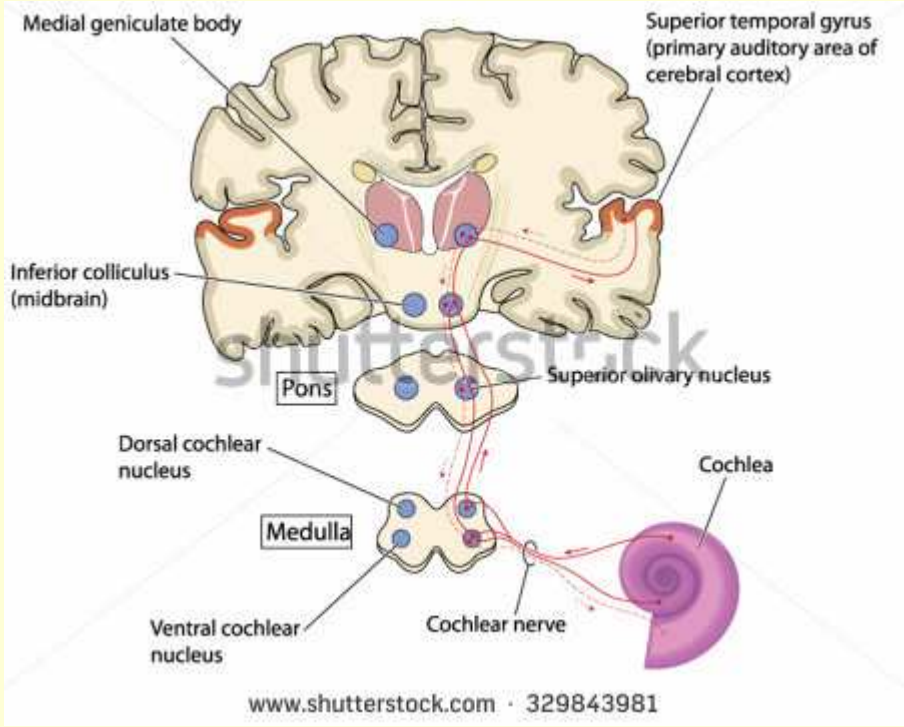
- The cochlea is responsible for sensory hearing
- the hair cells sits in the spiral organ of corti;
- 1st neuron
- ganglion spirale cochlae - nervus cochlearis,
- through **meatus acusticus internus** of pyramid
- to **nucleus cochlearis anterior**
- and **posterior** in brainstem



Cochlear nerve

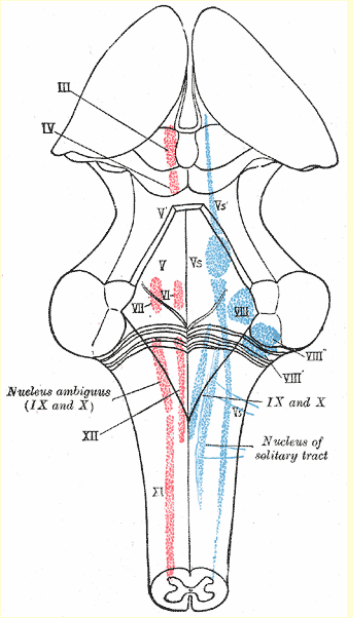
- 2nd neuron
- lemnisus medialis to colliculus inferior

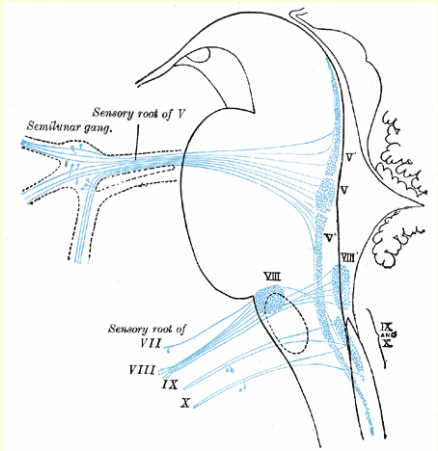
- 3rd neuron
- To corpus geniculatum laterale, continue to cortex (gyri temporales transversi) area 41 a 42.



Vestibulocochlear (statoacusticus) nerve – n. VIII)

Vestibular nerve – *ncl. vestibularis medialis, lateralis, superior, inferior* (4)
Cochlear nerve – *ncl. cochlearis anterior, posterior* (2)
Entrance through - meatus acusticus internus, continue to brainstem





Vestibular syndrome

- Lesion of vestibular nuclei and pathways - peripheral
- Cause:
- ,…
- symptoms:
- Spinning
- Tilting
- Swaying
- Unbalanced
- Pulled to one direction
- Abnormal or jerking eye movements (nystagmus)
- Feeling nauseated
- Vomiting
- Abnormal or jerking eye movements (nystagmus)
- Headache
- Sweating
- Ringing in the ears or hearing loss

Vestibular syndrome

Peripheral	Central

• Nystagmus generally horizontal
• Vertigo as severe as nystagmus
  ◦ Response typically fatigues or habituates
• More intense feeling of vertigo
• Hearing loss & tinnitus frequent
• Long-tract sensory, motor involvement are unusual
	• Nystagmus can be horizontal, rotatory or vertical; multi-directional
	• Vertigo relatively mild or absent
	  ◦ persistent
	• Hearing loss & tinnitus rare
	• Associated sensory, motor, cerebellar, & other CN involvement more common

General: Vestibular Disorders[2,3]

Pathology of n. VIII.

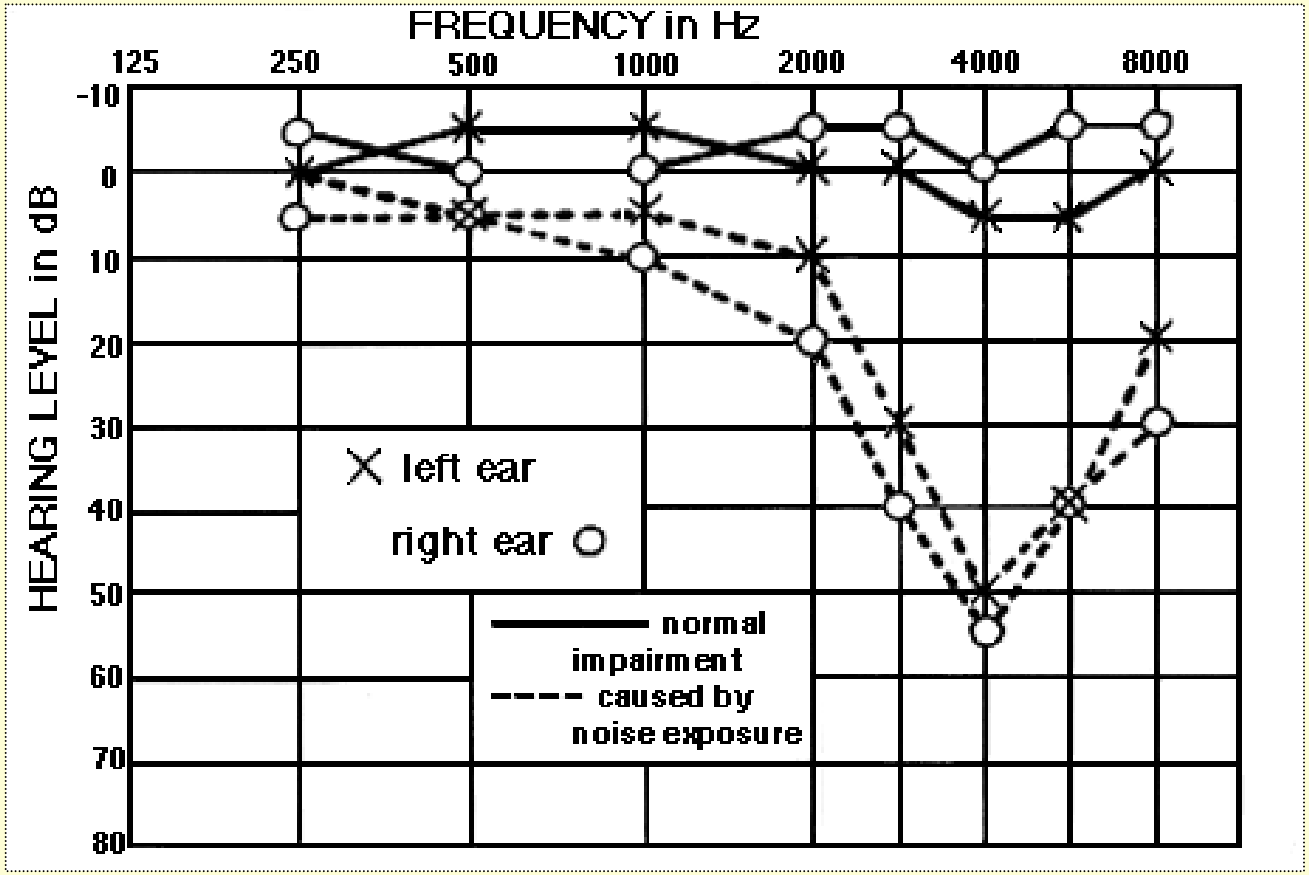
- **Hearing loss -** Hypacusis, anacusis
- Deafness - Bilateral lesion

- Tinnitus - noises in the head, not related to any psychiatric condition. The noise can be heard anywhere in the head or in one or both ears. So far there are no scientific proven cure for tinnitus.

- Hearing pseudohallucinations - e.g. hearing of voices

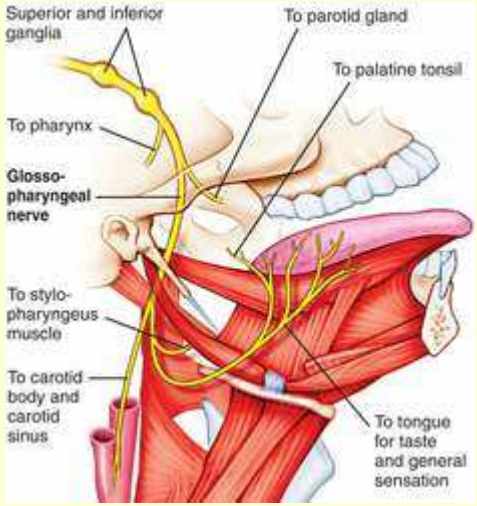
- A pseudohallucination is an involuntary sensory experience vivid enough to be regarded as a hallucination, but recognised by the patient not to be the result of external stimuli.

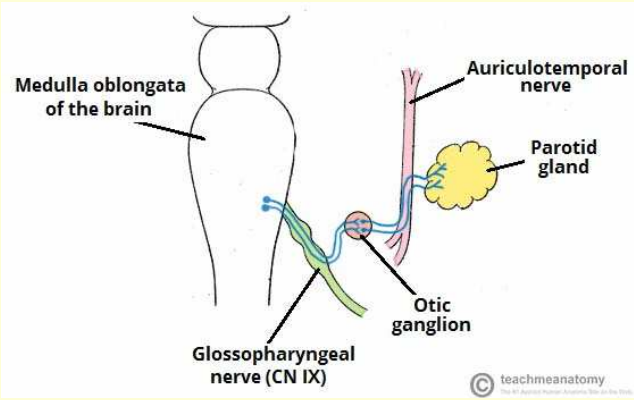
Audiogram


FREQUENCY in Hz
125
250
500
1000
2000
4000
8000
HEARING LEVEL in dB
-10
0
10
20
30
40
50
60
70
80
left ear
right ear
normal
impairment
caused by
noise exposure

Glossopharyngeal nerve – n.IX.

- Inervated structures: stylofaryngeal muscle which elevate the pharynx during swallowing and talking
- Examination: together with n. X. – swalowing, talking
- Taste from the posterior 1/3 of tangue
- Sensory function – parotid, salivatory gland



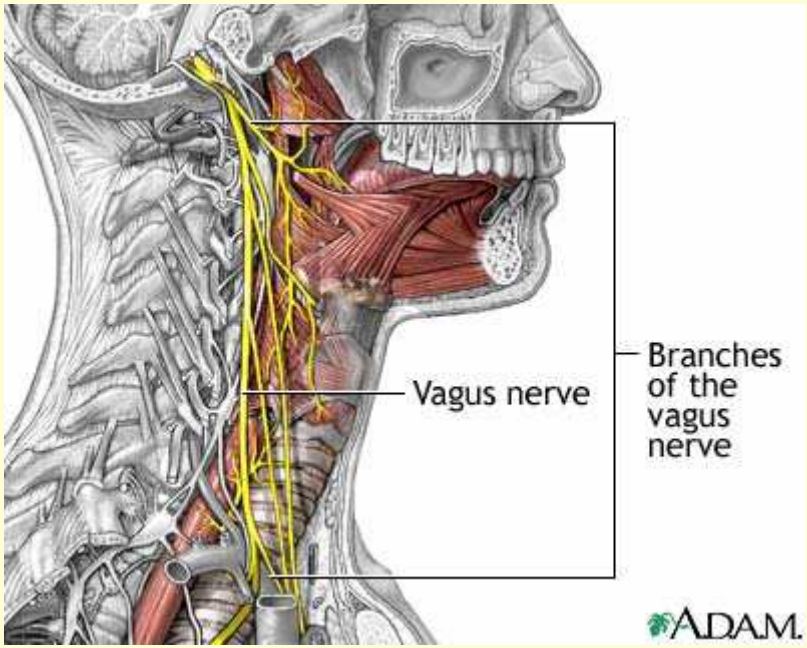


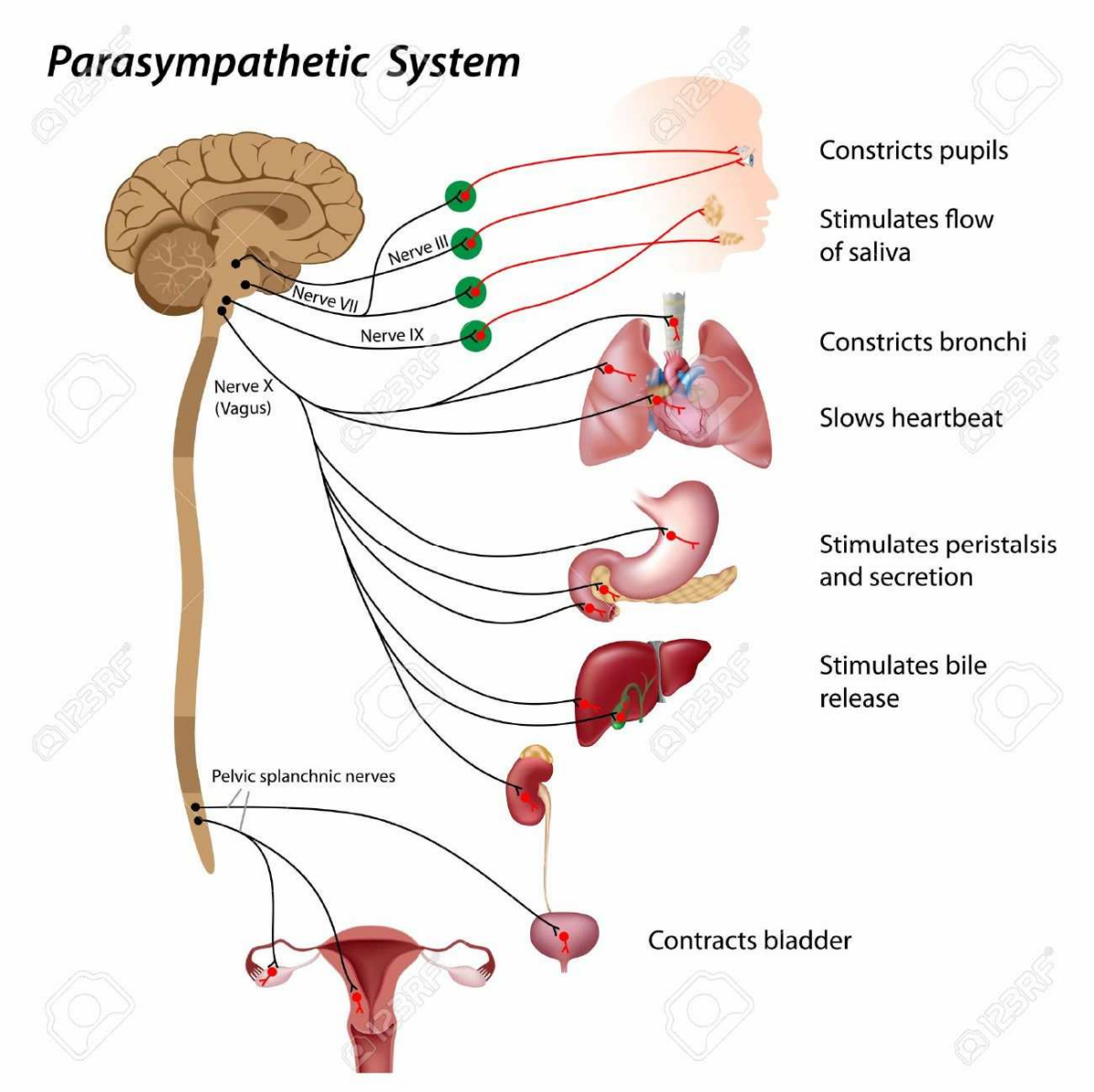
The vagal nerve – n.X.

- Inervated structures: all muscles of the pharynx and soft palate except stylopharynegal and tensor fascie latae
- Peripheral parasympaticus
- Clinical consideration: unilateral paralysis of palate, pharynx, larynx

  hoarseness – unilateral lesion – paralysis of the vocal cord

PS – slow pulse




Parasympathetic System
Nerve III
Nerve VII
Nerve IX
Nerve X
(Vagus)
Pelvic splanchnic nerves
Constricts pupils
Stimulates flow
of saliva
Constricts bronchi
Slows heartbeat
Stimulates peristalsis
and secretion
Stimulates bile
release
Contracts bladder

Lesion of n. IX. a X.

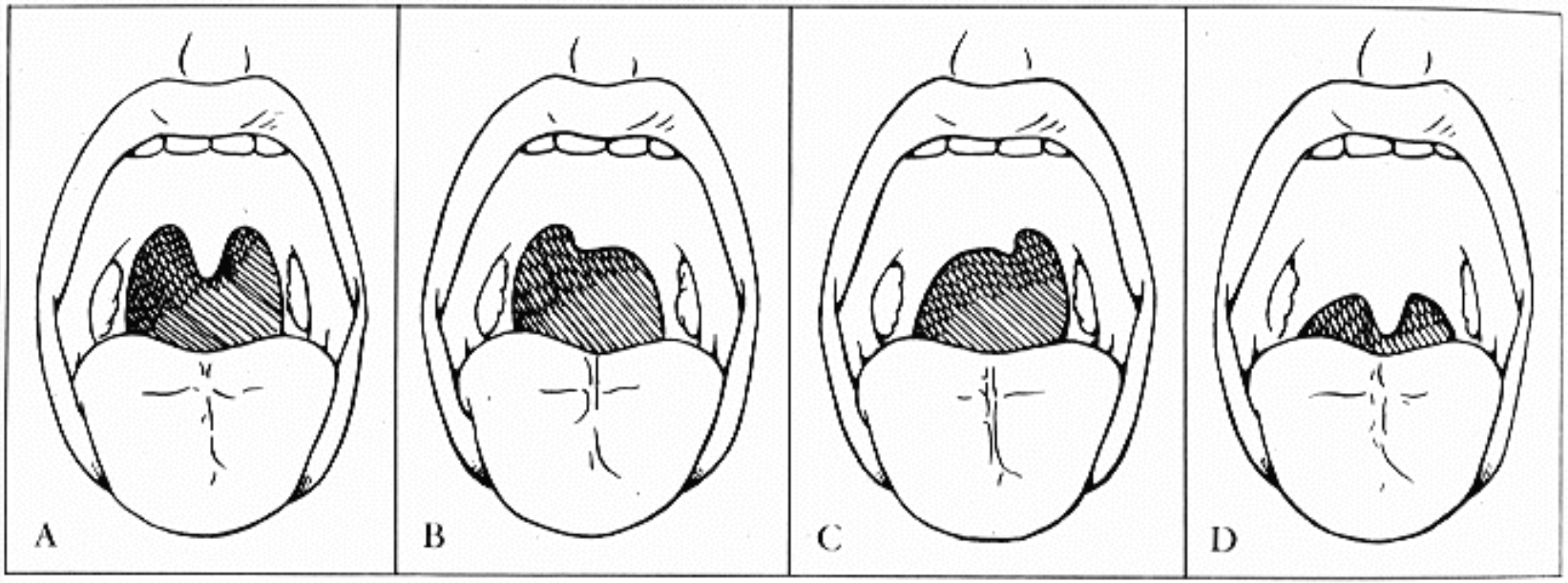
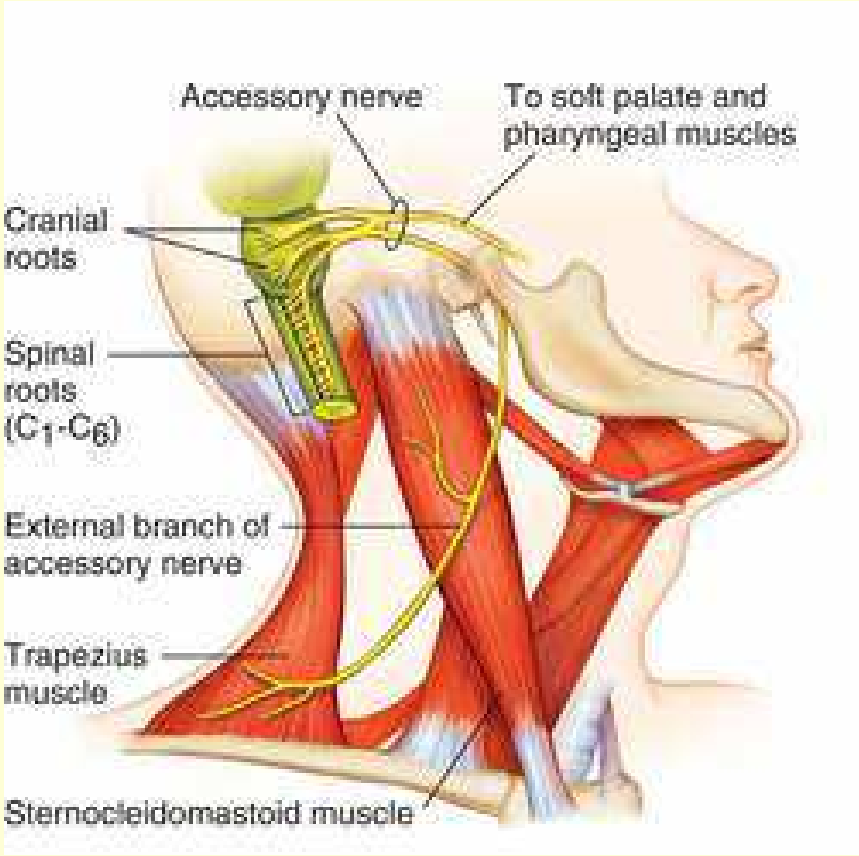


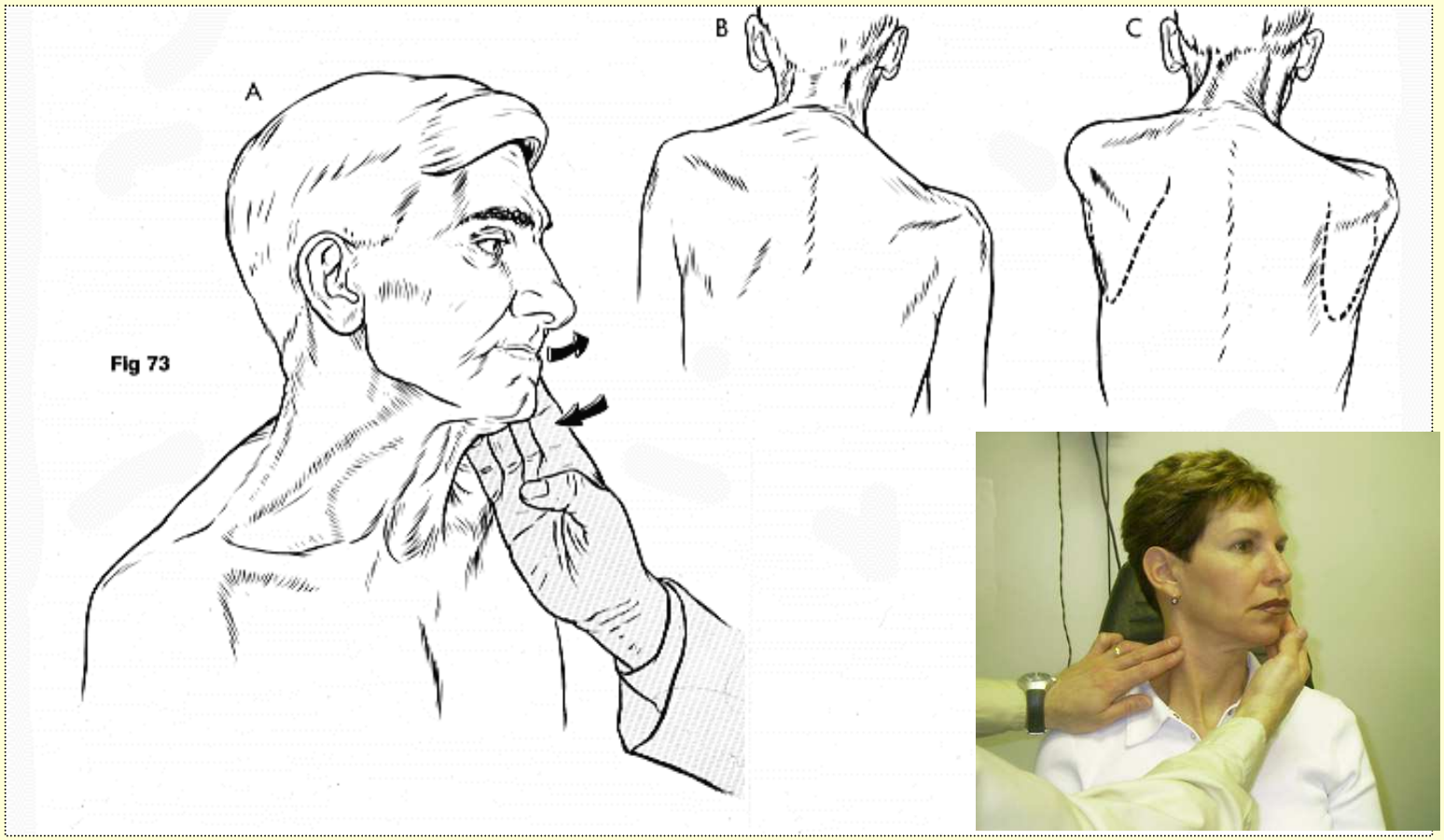
FIGURE 18-10
Tests of uvular deviation (cranial nerves IX and X). A. Normal. B. Left IX and X palsy. C. Right IX and X palsy. D. Bulbar palsy.

Accessorial nerve – n. XI.

- Inervated structures: sternocleidomastoid and trapezius muscles in the neck and back
- Examination: turning the neck (cannot turned to opposite side)
- elevation of the shoulder – displacement of the scapula



Examination n. XI. - position of scapula, movements of shoulder and SCM



Hypoglossal nerve – n.XII.

- Inervated structures:
- Tongue
- Examination: protrusion of the tongue
- Pathology – protruted tongue deviates toward the paralysed side

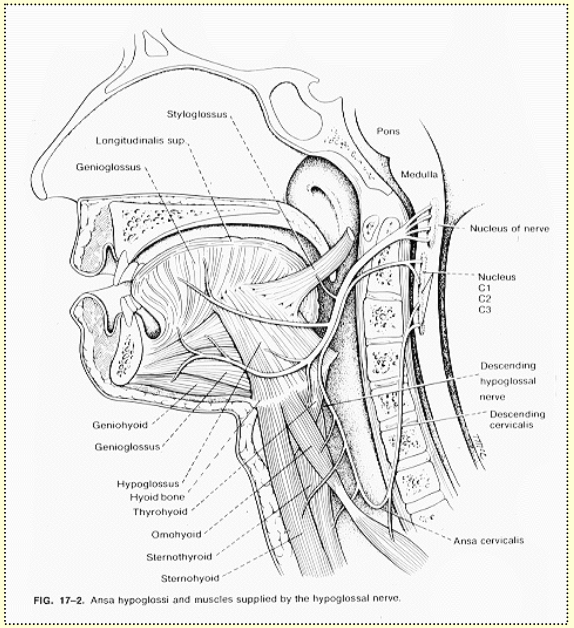


FIG. 17–2. Ansa hypoglossi and muscles supplied by the hypoglossal nerve.

Examination (n.XII)

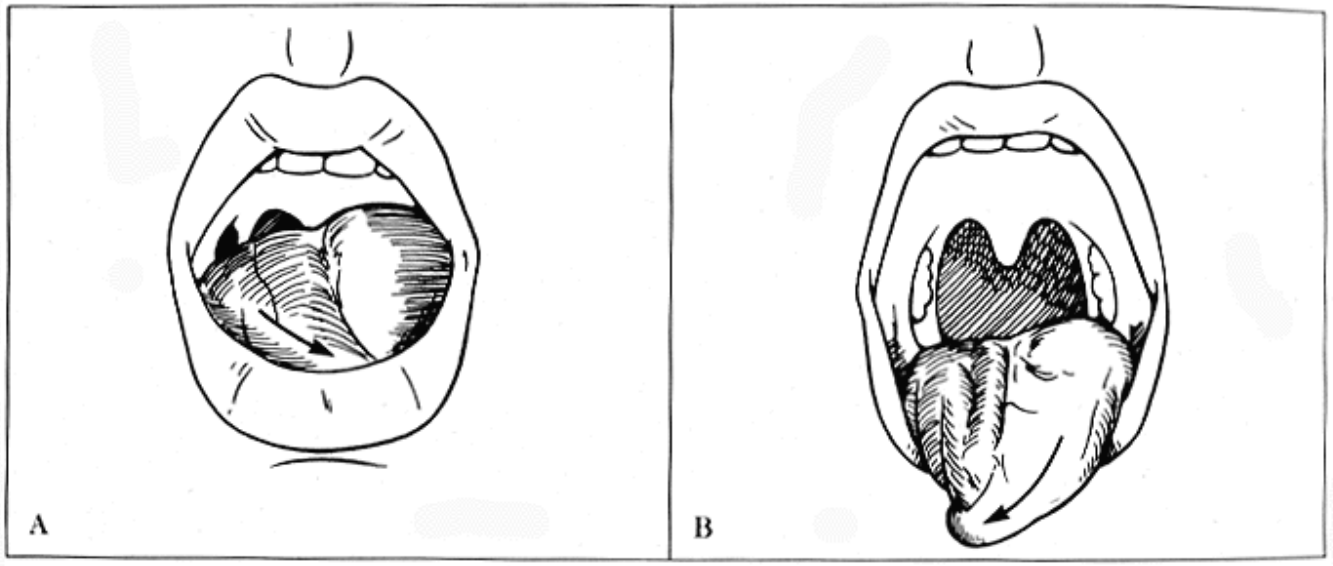


FIGURE 18-12
Hypoglossal nerve (cranial nerve XII). A. Right XII paralysis, tongue at rest. B. Right XII paralysis, tongue protruding.

Hypoglossal nerve lesion – right side

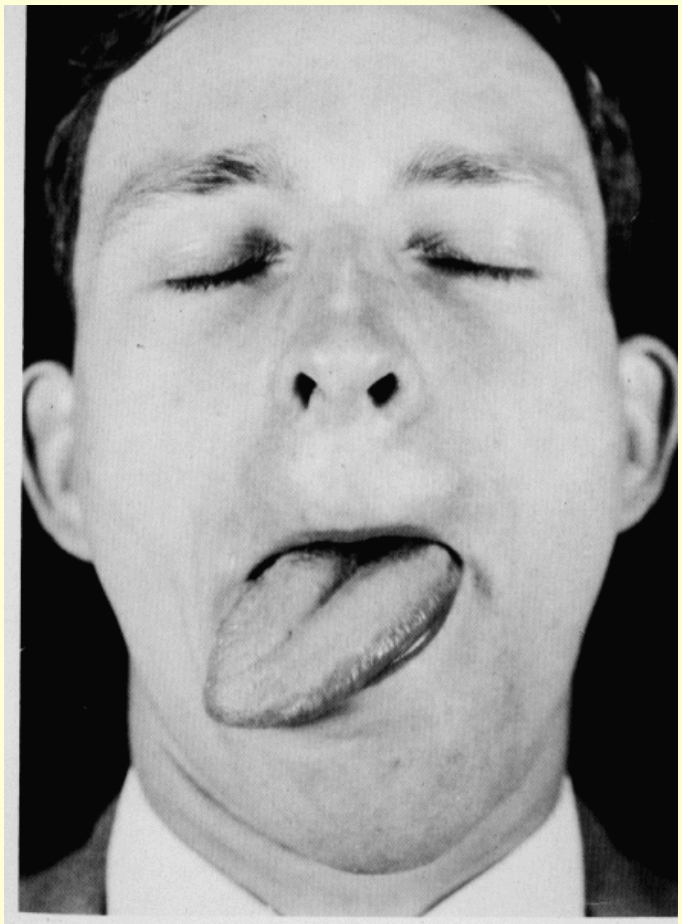


FIG. 17–3. Nuclear paralysis of muscles supplied by the hypoglossal nerve: atrophy and fasciculations of the tongue in a patient with amyotrophic lateral sclerosis.

Tongue atrophy

Bulbar and pseudobulbar palsy

- In both: **dysartria**
  dysphagia

- Differences:

	BULBAR	**PSEUDOBULBAR**
Lesion	**medulla oblongata**	**both hemispheres**
Pat. axial. rr	**absent**	**present**
Masseter.r.	**normal**	**increased**
Smiling, crying without cause	**absent**	**present**