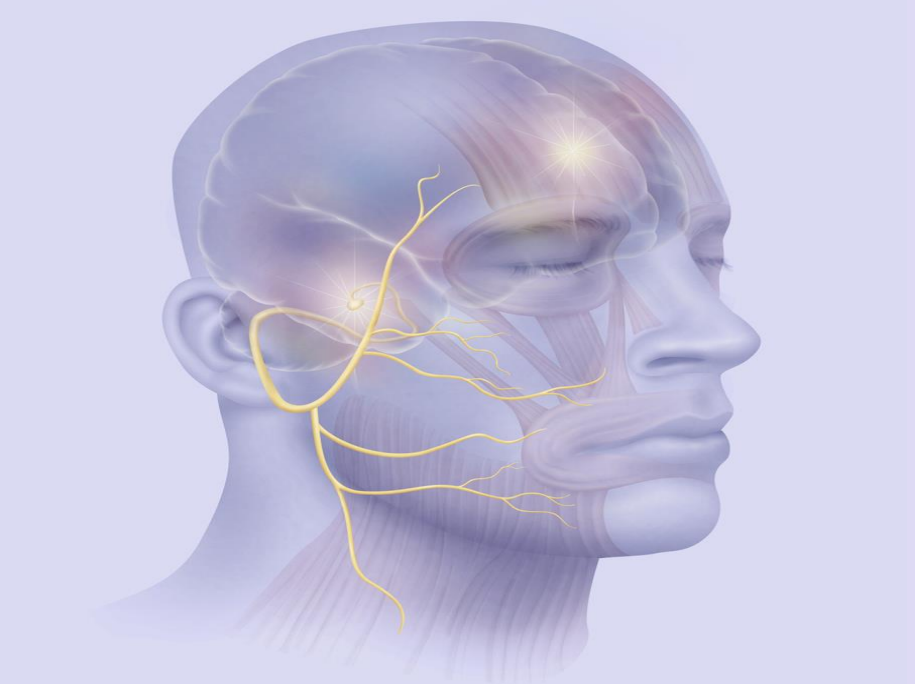
FACIAL NERVE & IT'S DISORDERS



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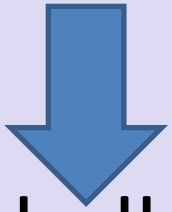
ANATOMY OF FACIAL NERVE

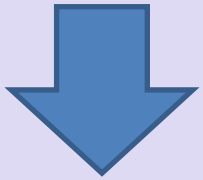
- The facial nerve contains approximately 10,000 fibers.
- 7000 myelinated fibers innervate the muscles of facial expression, stapedius muscle, postauricular muscles, posterior belly of digastric muscle, and platysma
- 3000 fibers form the nervus intermedius (Nerve of Wrisberg)
  - sensory fibers (taste) from the anterior 2/3 of the tongue
  - taste fibers from soft palate via palatine and greater petrosal nerve
  - parasympathetic secretomotor fibers to the parotid, submandibular, sublingual, and lacrimal gland

SUPRANUCLEAR SEGMENT

Cerebral cortex

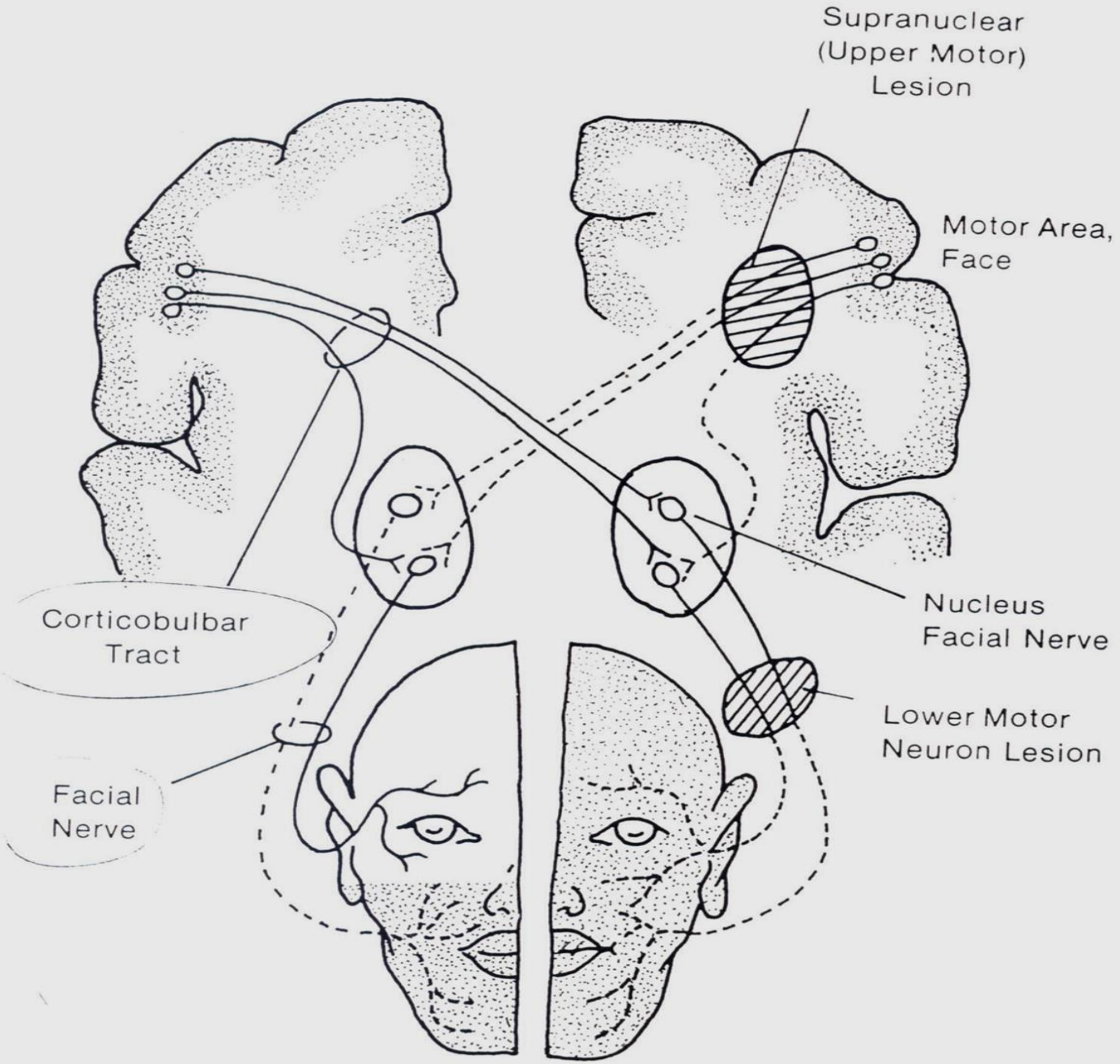


Corticobulbar tract



Facial nucleus (pons)

- Upper face → crossed & uncrossed
- Lower face → crossed only

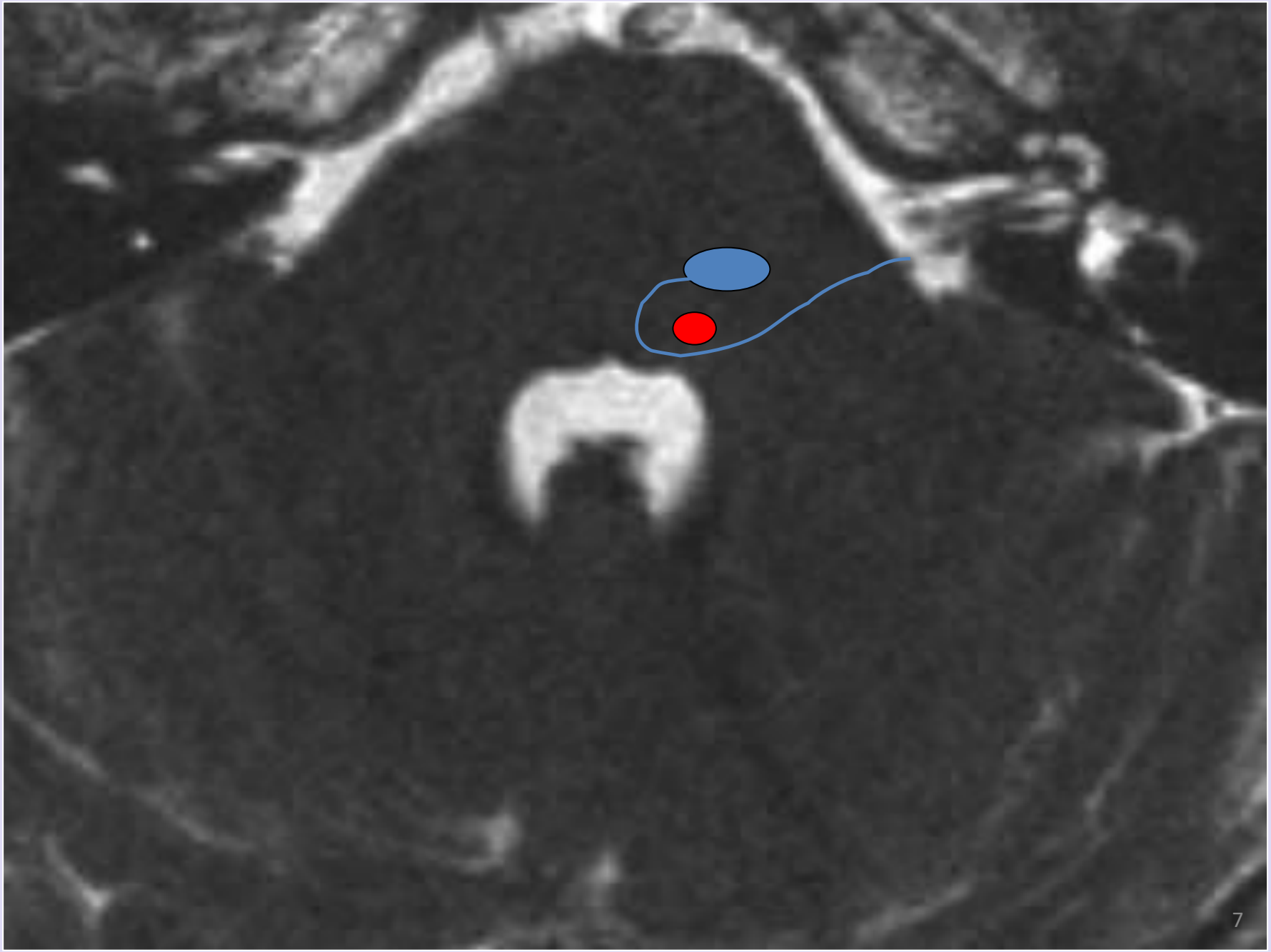

Supranuclear
(Upper Motor)
Lesion
Motor Area,
Face
Nucleus
Facial Nerve
Lower Motor
Neuron Lesion
Corticobulbar
Tract
Facial
Nerve

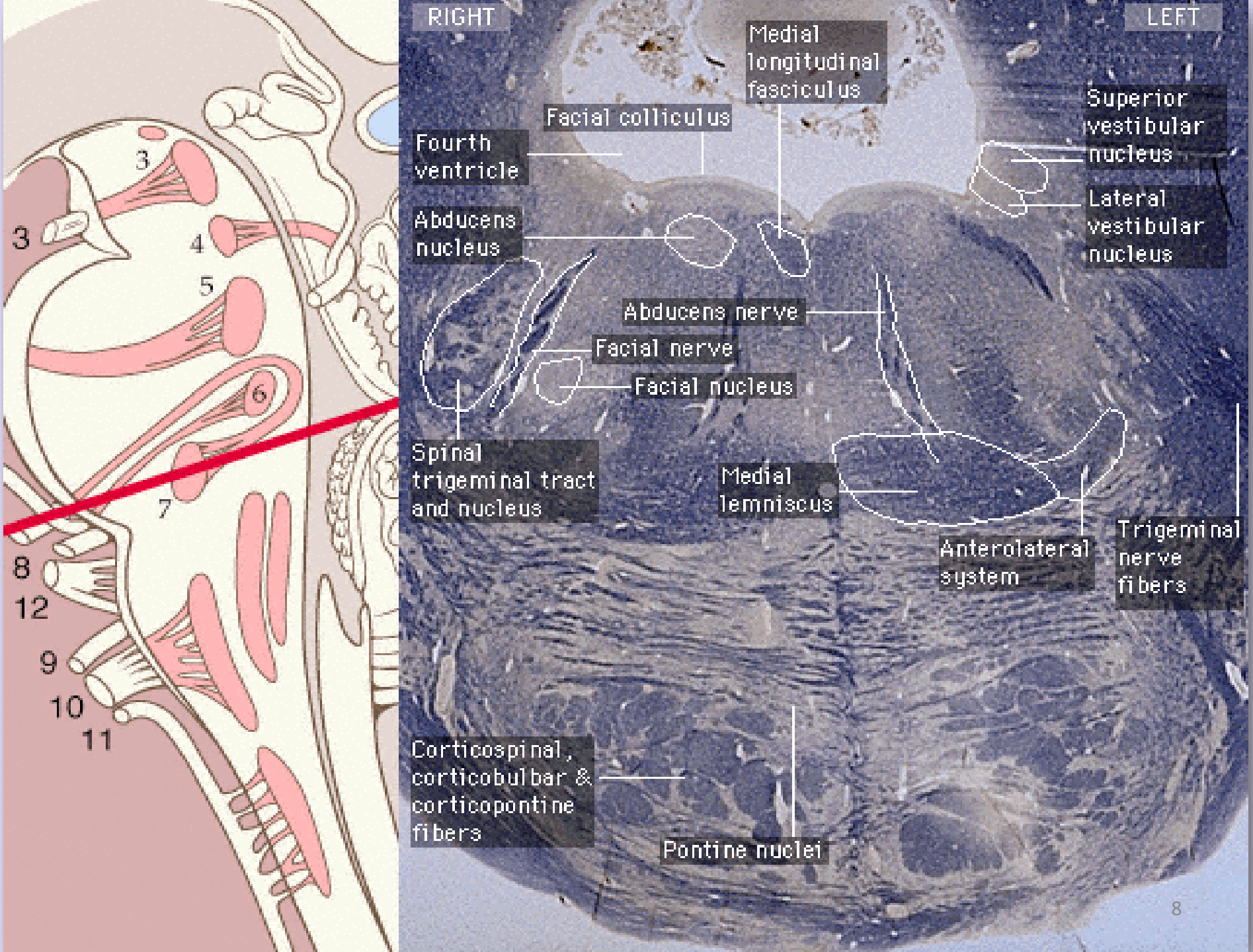
ANATOMY

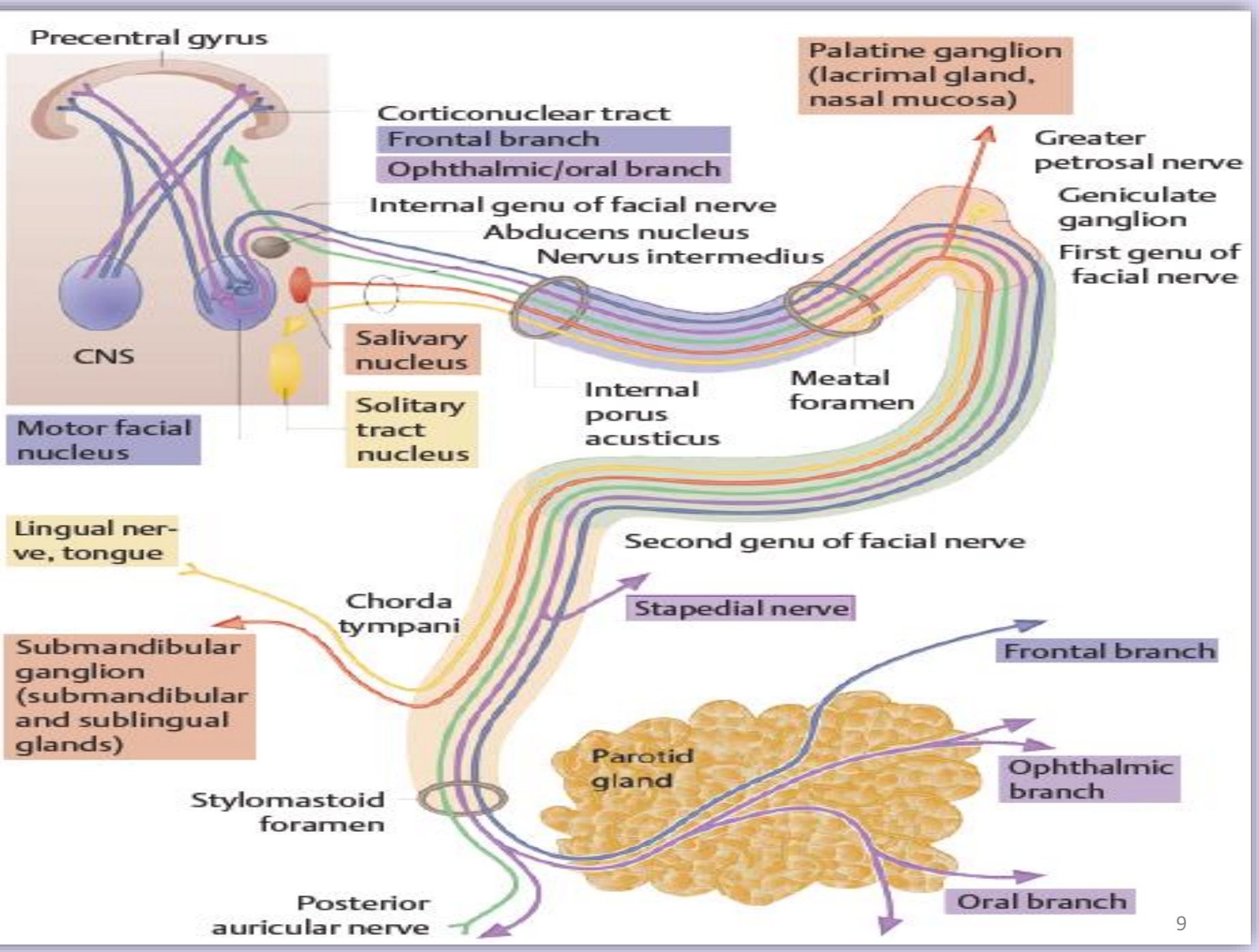
- Intracranial part (15-17 mm)
- Intratemporal part
  - Intrameatal segment
  - Labyrinthine segment
  - Tympanic segment
  - Mastoid segment
- Extracranial part

INTRACRANIAL PART

- Before the facial nerve leaves the brainstem, its motor fibers wind around the abducens nucleus and form the internal genu of the nerve.




RIGHT
LEFT
Medial longitudinal fasciculus
Facial colliculus
Fourth ventricle
Superior vestibular nucleus
Lateral vestibular nucleus
Abducens nucleus
Abducens nerve
Facial nerve
Facial nucleus
Spinal trigeminal tract and nucleus
Medial lemniscus
Anterolateral system
Trigeminal nerve fibers
Corticospinal, corticobulbar & corticopontine fibers
Pontine nuclei
3
4
5
6
7
8
12
9
10
11


Precentral gyrus
Corticonuclear tract
Frontal branch
Ophthalmic/oral branch
Internal genu of facial nerve
Abducens nucleus
Nervus intermedius
CNS
Salivary nucleus
Solitary tract nucleus
Motor facial nucleus
Internal porus acusticus
Meatal foramen
Palatine ganglion (lacrimal gland, nasal mucosa)
Greater petrosal nerve
Geniculate ganglion
First genu of facial nerve
Second genu of facial nerve
Lingual nerve, tongue
Chorda tympani
Submandibular ganglion (submandibular and sublingual glands)
Stapedial nerve
Frontal branch
Parotid gland
Ophthalmic branch
Oral branch
Stylomastoid foramen
Posterior auricular nerve

INTRAMEATAL (8-10 MM)

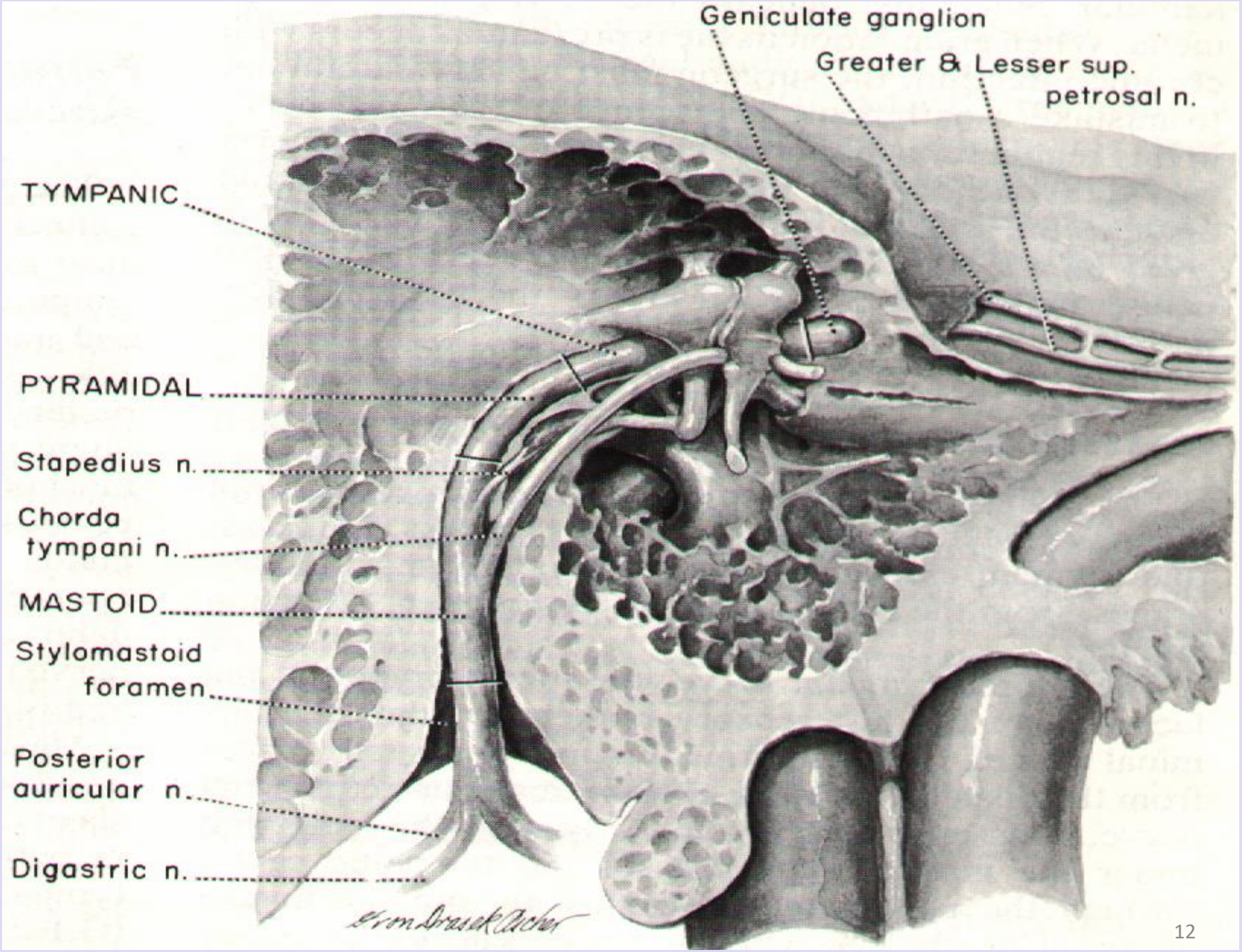
- Accompanied by cranial nerve VIII, the facial nerve travels through the internal auditory canal to the fundus;
- there it passes anterosuperiorly through the meatal foramen, leaving the meatus.
- This is the narrowest point in the bony fallopian canal (facial canal) and is the site where the nerve is most likely to become entrapped due to inflammatory swelling.

LABYRINTHINE

- After running a short distance (4 MM) anteriorly, the facial nerve gives off the greater petrosal nerve with its secretory fibers to the lacrimal glands and nasal mucosal glands.

- The facial nerve turns sharply downward and posteriorly at the geniculate ganglion, forming the first genu.

- Narrowest diameter of 0.61-0.68 mm


Geniculate ganglion
Greater & Lesser sup. petrosal n.
TYMPANIC
PYRAMIDAL
Stapedius n.
Chorda tympani n.
MASTOID
Stylomastoid foramen
Posterior auricular n.
Digastric n.

TYMPANIC

- This segment of the facial nerve runs horizontally through the middle ear, passing above the stapes, to the aditus ad antrum near the lateral semicircular canal.
- Length is 11 MM
- The tympanic nerve segment is covered by a thin bony sheath.

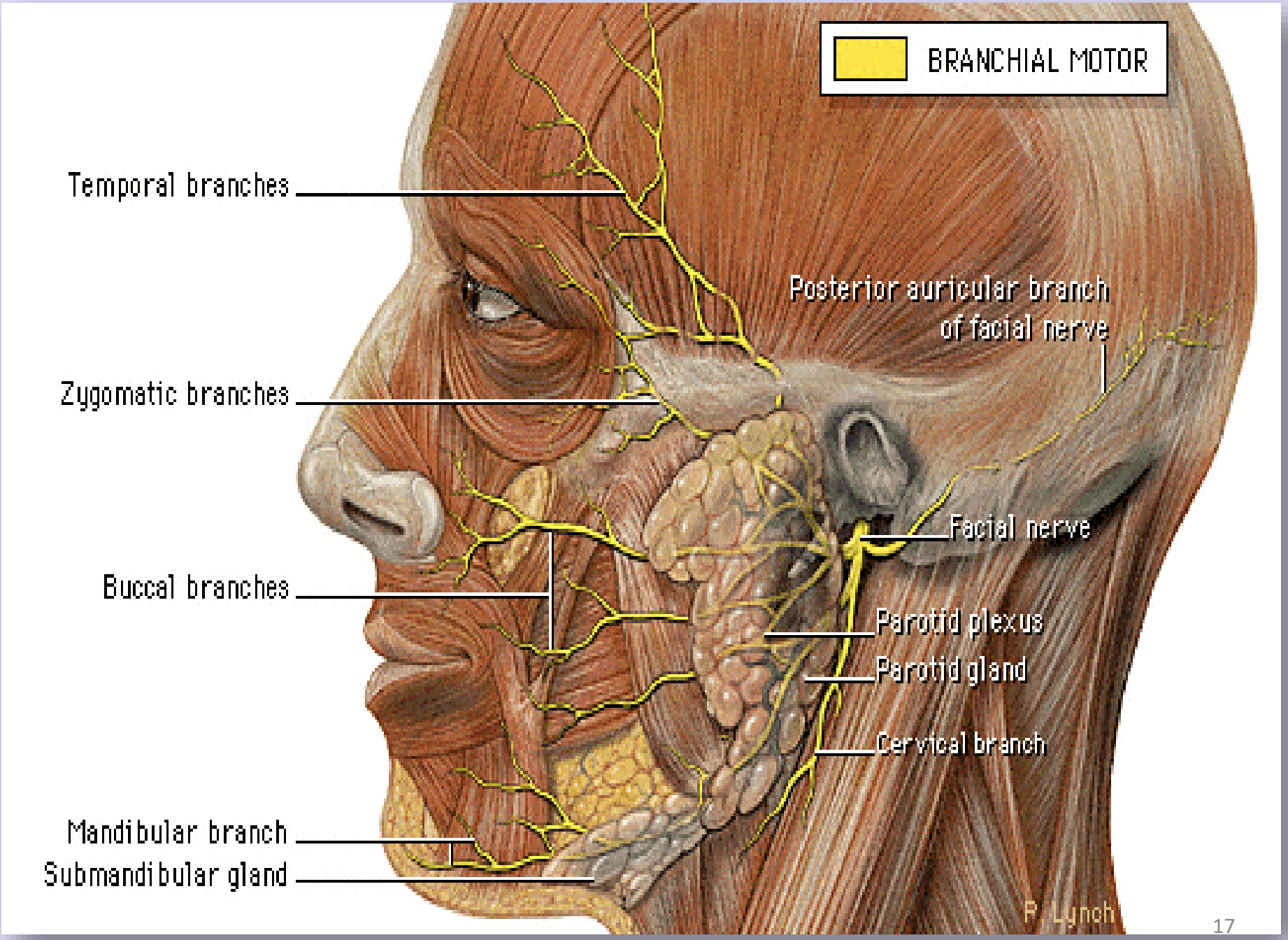
MASTOID

- The mastoid segment of the facial nerve forms the second genu by the aditus ad antrum, turning vertically downward at an approximately 90° angle.
- Length is 13 mm
- It courses through the mastoid and leaves its bony canal at the stylomastoid foramen. Just before exiting at this foramen, the facial nerve gives off the chorda tympani, which runs back to the middle ear and passes upward. Pass through middle ear. It contains sensory gustatory fibers.

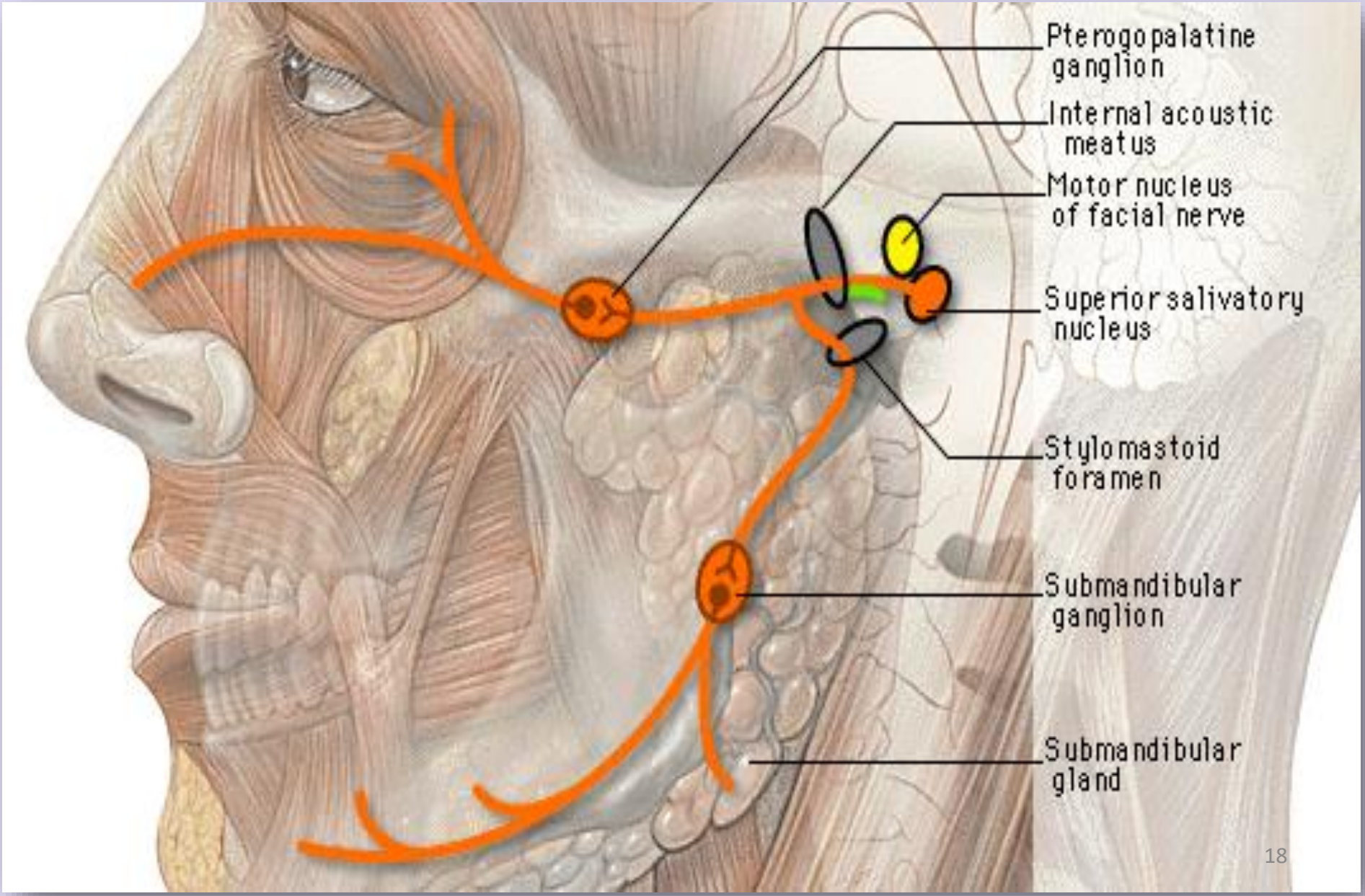
EXTRACRANIAL

- After emerging from the stylomastoid foramen, the facial nerve enters the parotid gland, where it branches at the **PES ANSERINUS.**
- The **Pes Anserinus** is the main bifurcation of the **facial nerve** into the upper (temporofacial) and lower (cervicofacial) branches.

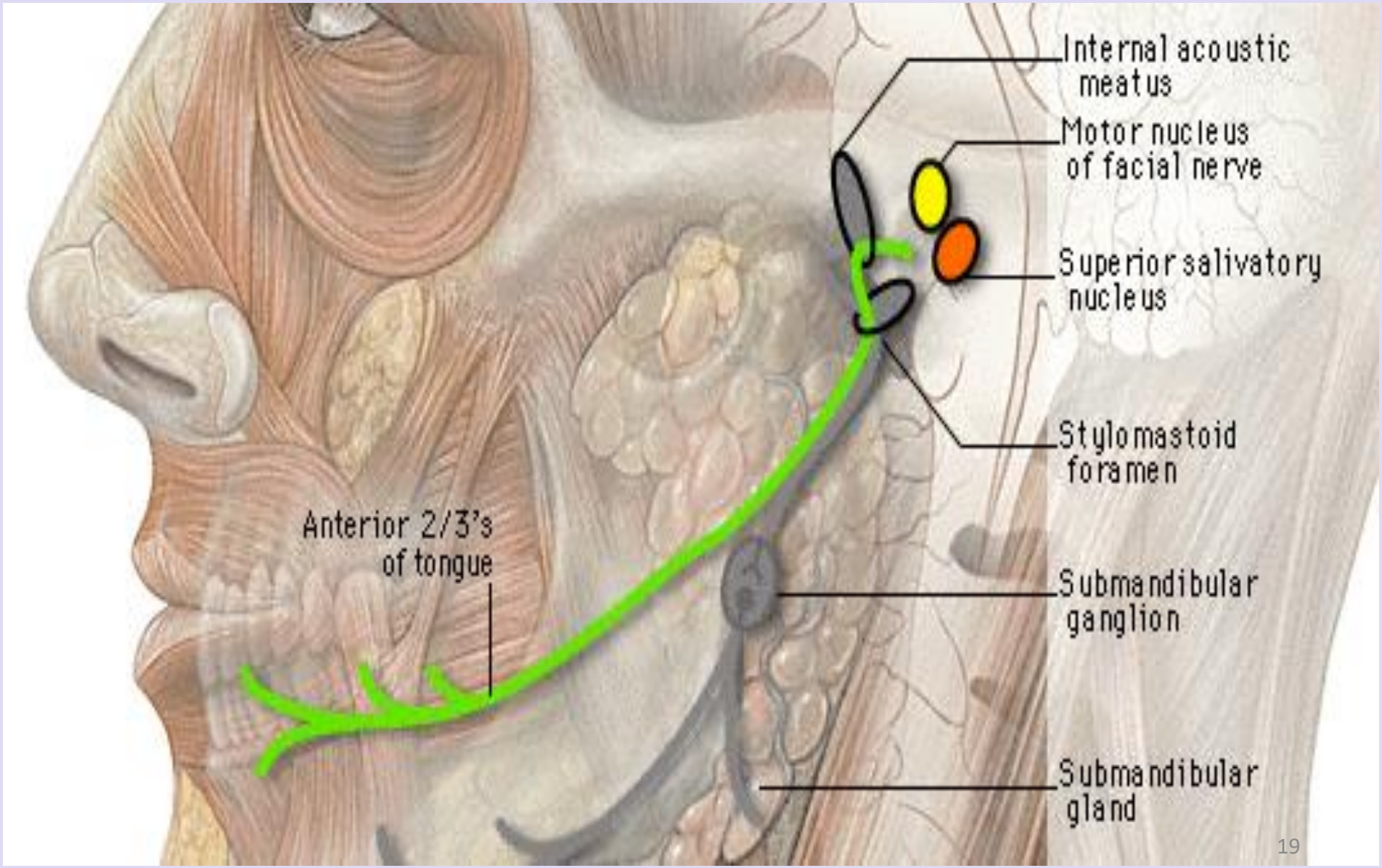

Temporal
Zygomatic
Buccal
Mandibular
Cervical


BRANCHIAL MOTOR
Temporal branches
Zygomatic branches
Buccal branches
Mandibular branch
Submandibular gland
Posterior auricular branch of facial nerve
Facial nerve
Parotid plexus
Parotid gland
Cervical branch
R. Lynch

PARASYMPATHIC FIBERS



SPECIFIC VISCERAL SENSATION



FUNCTION

- Contraction of the muscles of the face
- Production of tears from a gland (Lacrimal gland)
- Conveying the sense of taste from the front part of the tongue (via the Chorda tympani nerve)
- The sense of touch at retroauricular groove concha, post. Meatus & outer TM

CLINICAL EXAMINATION

complete clinical history

- The onset and course of facial nerve paralysis
- Otologic symptoms and diseases or previous ear surgery
- Trauma
- Neurologic disease
- Tick bites (Borreliosis) or evidence of other infections
- Systemic diseases such as diabetes mellitus, cancer, autoimmune diseases, or Sarcoidosis

SYMPTOMS

- Hyperacusis (paralysis of the stapedius muscle)
- Otalgia (irritation of the sensory fibers)
- Gustatory disturbances
- Disturbances of lacrimation (dryness, crocodile tears = gustatory lacrimation due to faulty neural regulation)
- Facial muscles paresis or paralysis (Motor paralysis is the most important and by far the most common symptom of facial nerve pathology.)

FRONTAL BRANCH

- Wrinkling the forehead or looking upward.

- Intact function of the frontal branch compared with the other facial nerve branches indicates a central or supranuclear lesion when paresis is present.

SYNKINESIS

- Involuntary associated movement of mimetic muscles accompanying the voluntary movement of other muscles.
- An unintended movement of the oral commissure induced by closing the eyes.
- This type of synkinesis generally persists as a residual defect following the complete degeneration of nerve fibers Incomplete eyelid closure due to idiopathic facial paralysis on (Neurotmesis).

LABORATORY EVALUATION

- Patients with facial paralysis should undergo laboratory undergo laboratory tests to screen for infectious diseases (borreliosis, herpes zoster, syphilis, human immunodeficiency virus [HIV], mononucleosis, toxoplasmosis).

- Audiometric testing (pure-tone, speech and immittance measurements) is necessary due to stapedius muscle involvement and the close proximity of cranial nerve VIII.

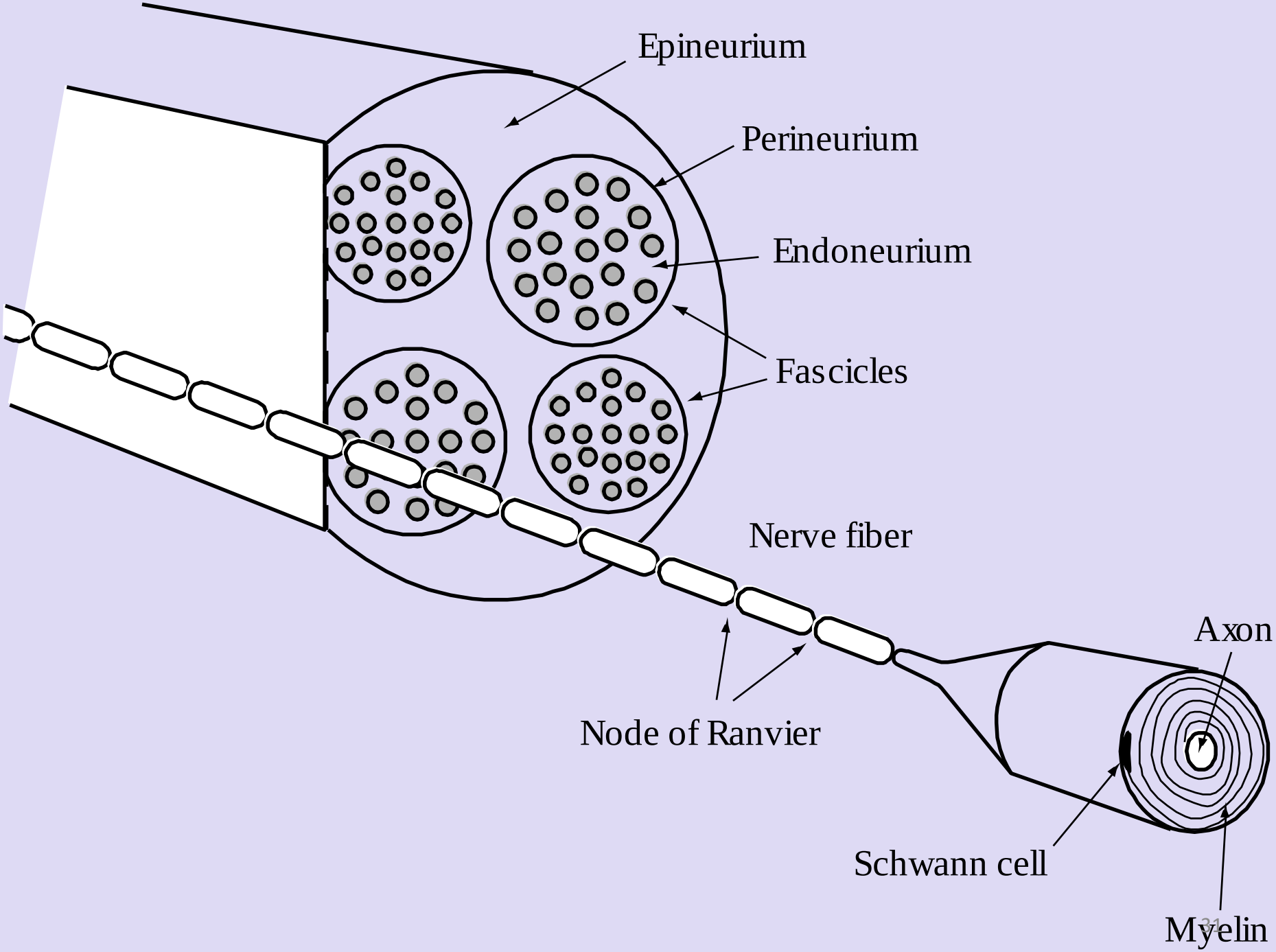
OTHERS

- Schirmer's test: (A 30% reduction in lacrimal secretion relative to the opposite side is considered abnormal.)
- Stapedial reflex test
- Gustometry: (A right-left discrepancy means that the lesion is proximal to the mastoid segment.)
- Sialometry

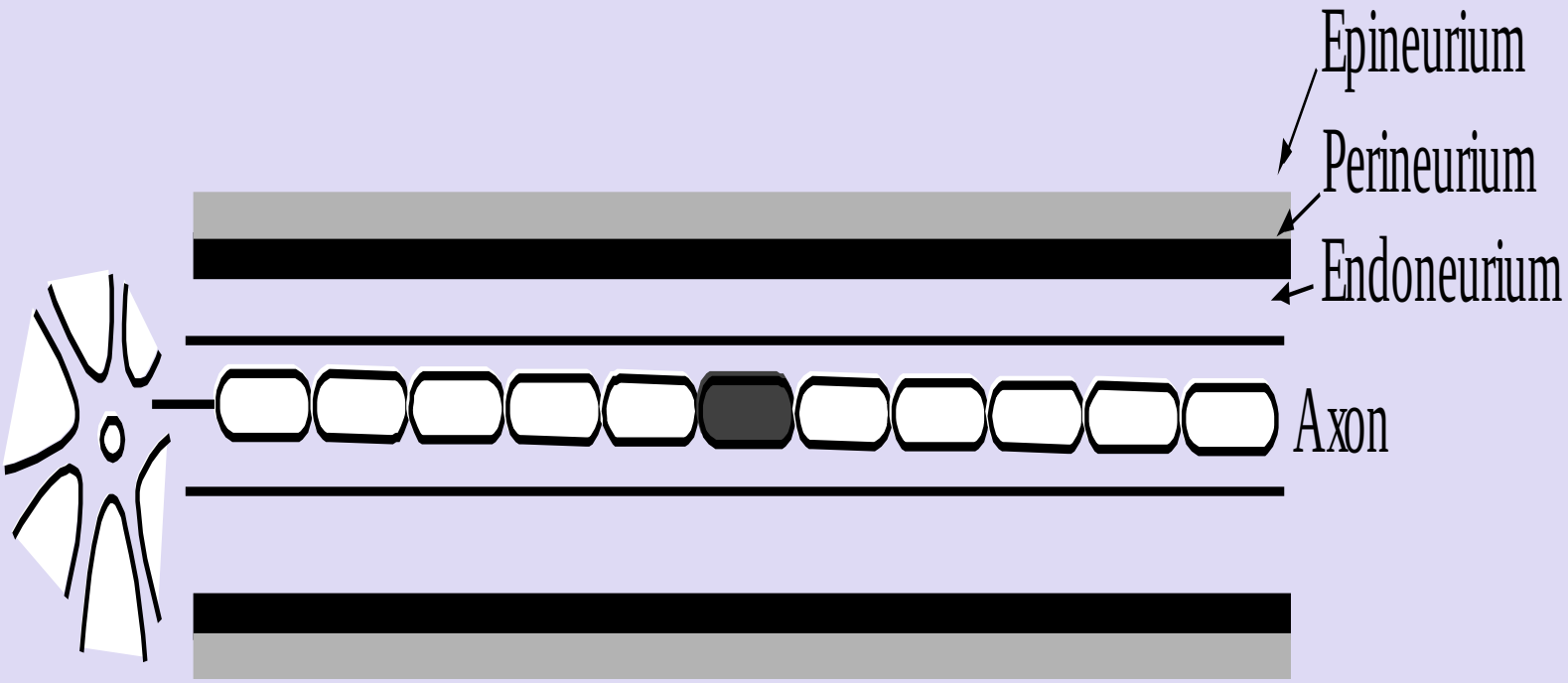
Inflammatory facial nerve lesions can be demonstrated by MRI after gadolinium contrast administration. Otogenic and traumatic facial paralysis should always be evaluated by thin-slice bone-window CT scanning of the temporal bone.

THREE DEGREES OF FACIAL NERVE FIBER INJURY:

- Neurapraxia
  - Without degeneration
- Axonotmesis
  - Wallerian degeneration of the myelin sheath
  - Intact perineurium
  - Compelete paralysis
  - Regeneration of the axon is also complete
- Neurotmesis
  - Regeneration is unpredictable
  - residual dysfunction with synkinesis and persistent palsy

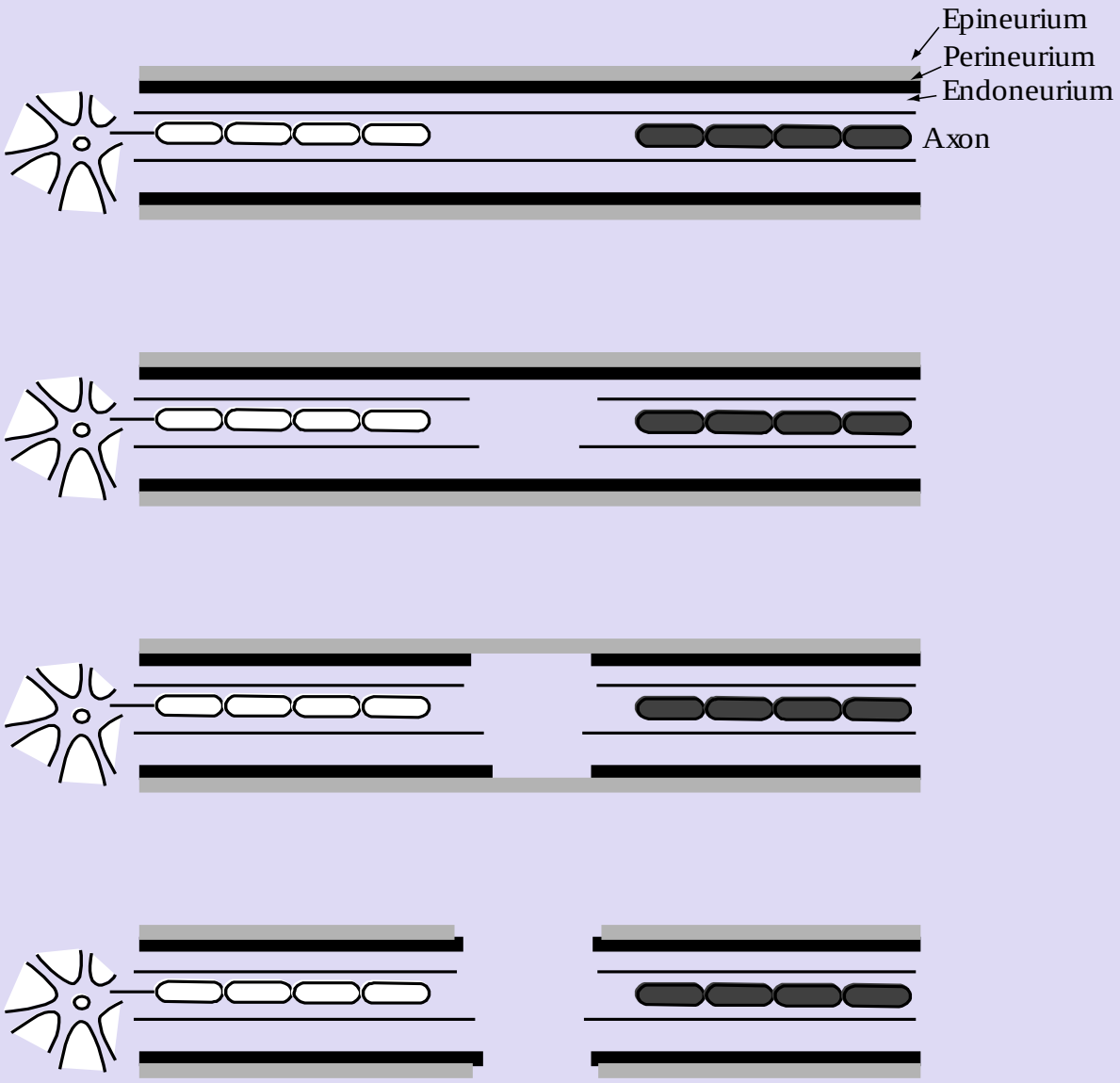

Epineurium
Perineurium
Endoneurium
Fascicles
Nerve fiber
Axon
Node of Ranvier
Schwann cell
Myelin

NEURAPRAXIA



Axonotmesis

Neurotmesis



❖Electroneurography (ENoG):

- ❖More than 90% degeneration of the nerve fibers is a poor prognostic sign in terms of complete recovery.

❖Electromyography (EMG):

- ❖EMG is also used for the intraoperative monitoring of facial nerve function during parotid and otologic surgery and intracranial operation.

❖Magnetic stimulation:

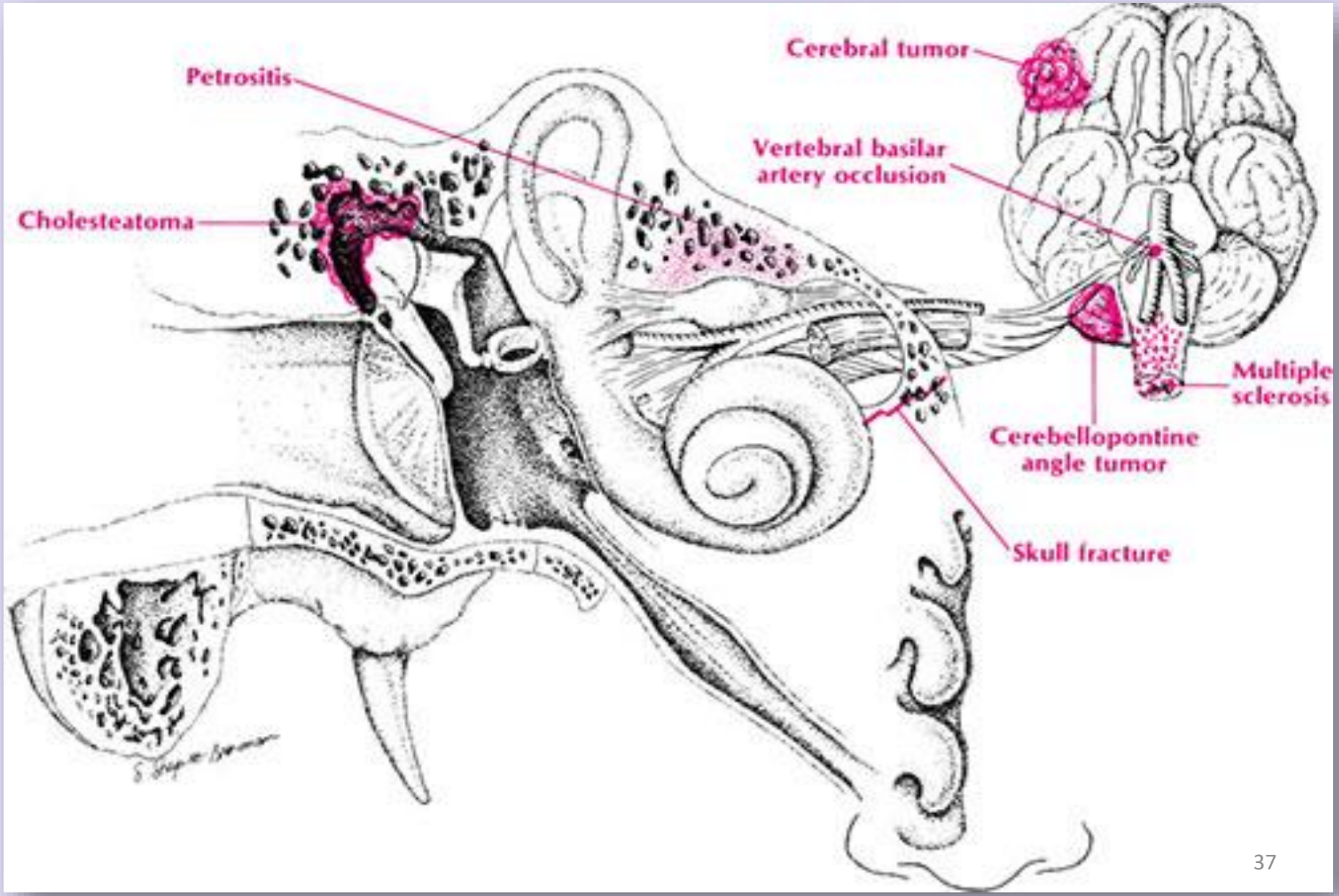
- ❖If the nerve is responsive to stimulation when facial paralysis is present, there is a good prognosis for recovery. If the nerve is unresponsive, a prognostic assessmen cannot be made.

Diagnosis and Management of Facial Paralysis

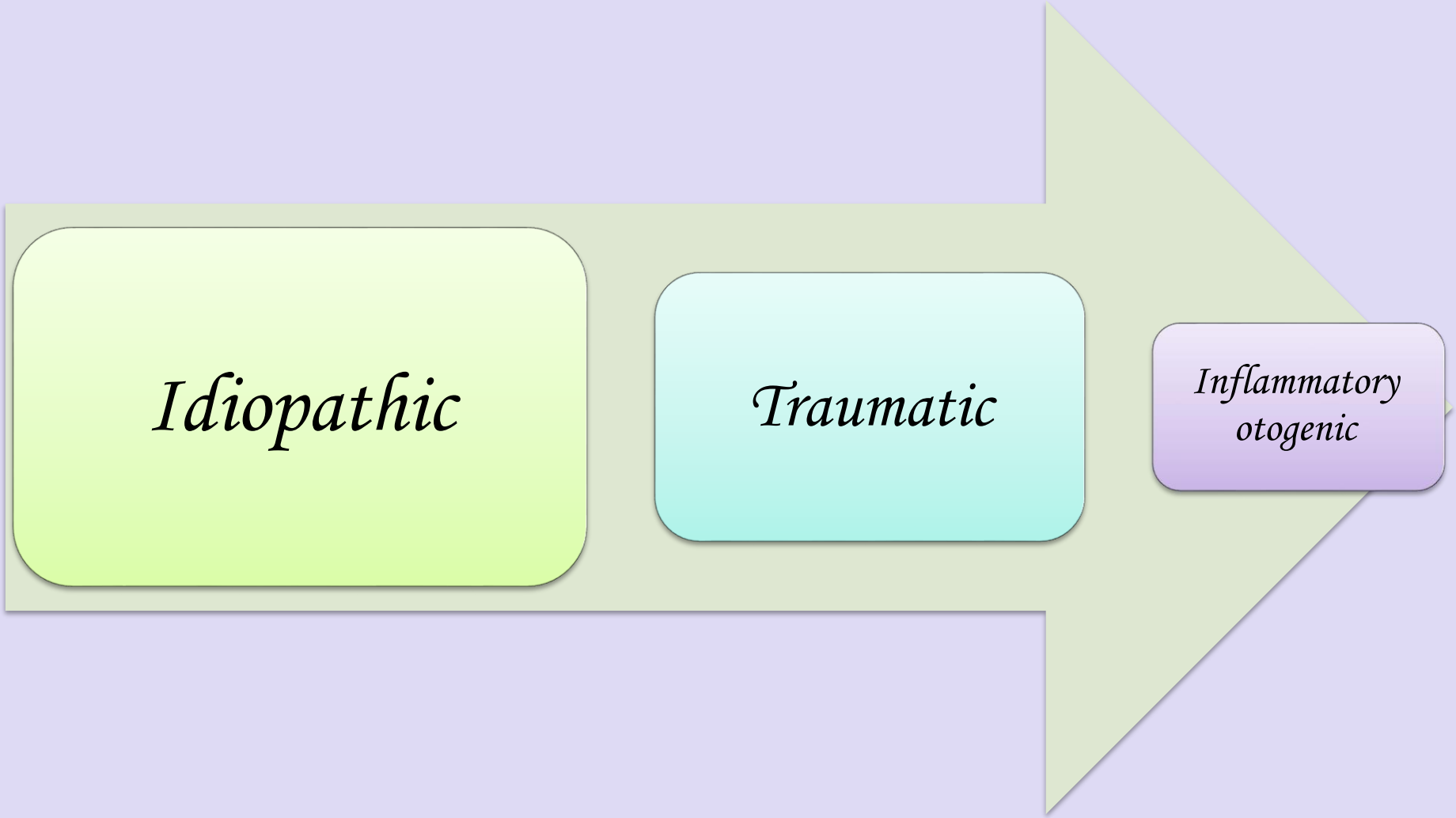
Central vs. Peripheral Facial Palsy

- *Frontal movement*
- *Spastic vs. flaccid paralysis*
- *Emotional reactions*

SITES OF LESION



FACIAL PARALYSIS



Bell's palsy is the most common form of facial paralysis.

BELL'S PALSY
IDIOPATHIC FACIAL PARALYSIS

Criteria:

- Unilateral
- Peripheral
- Acute onset
- No apparent cause
- Does not involve any other cranial nerves

SYMPTOMS

- Often the initial symptom is retroauricular pain.
- No systemic manifestations
- Hyperacusis (stapedius muscle paralysis),
- Dysgeusia
- Decreased lacrimation

- The paralysis is partial in 30% of cases and complete in 70% of cases.
- Idiopathic facial paralysis is more common in diabetic patients and in pregnancy (third trimester).

COURSE AND PROGNOSIS

- Partial paralysis always resolves completely within a few weeks.

- Recovery from complete paralysis takes longer (months) and is complete in only about 60-70% of cases.

- Approximately 15% of patients are left with troublesome residual palsy and or synkinesis.

COMPLICATIONS

- The most serious complication is corneal damage.

TREATMENT

- Corticostroid
- Anti- viral agents
- Corneal moisturization & protection
- Gold plate
- Facial nerve decompression

Inflammatory-- otogenic facial paralysis

- Cholesteatoma
- Subacute mastoiditis in pediatric patients
- Advanced necrotizing otitis externa

Symptoms

- Otologic symptoms are usually the dominant findings.
- Facial paralysis occurs as a complication.
- A chronic process (cholesteatoma)may have an insidious onset.

DIAGNOSIS:

- Otoscopy
- CT scan

DIFFERENTIAL DIAGNOSIS:

- Herpes zoster oticus
- Tumors of the lateral skull base
- Temporal bone tumors
- Parotid tumors

TREATMENT

- Surgical exposure of the nerve
- Appropriate antibiotic therapy
- Corticosteroids
- Exception: Acute Otitis Media (AOM)

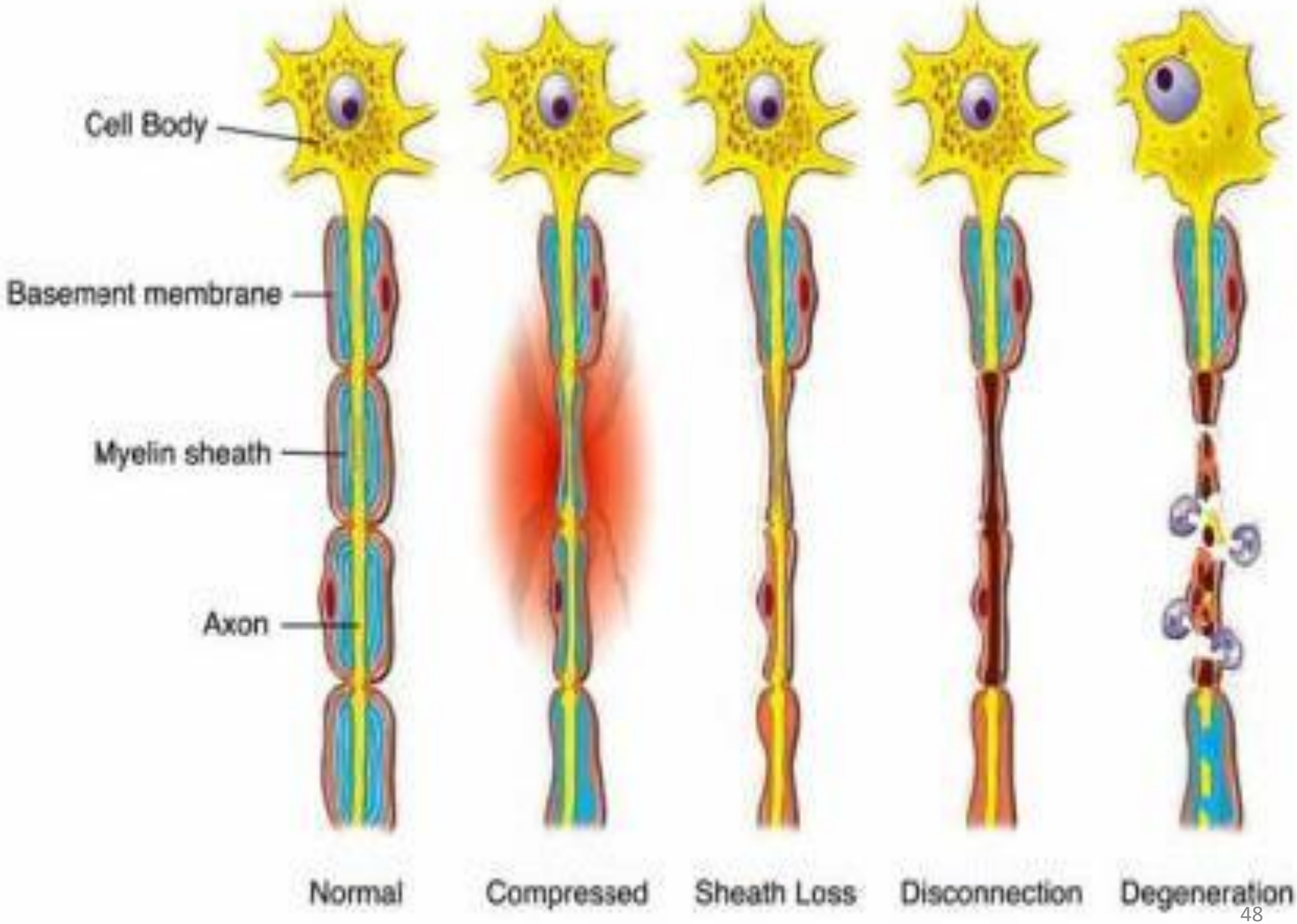
Antibiotic therapy ± Tympanotomy

PROGNOSIS

- The less complete and more acute the paralysis and the earlier treatment is initiated, the better the prognosis.

Traumatic facial paralysis

- Traumatic rupture
- Stretch injury
- Nerve compression (by hematoma or bone fragments)
- Trauma-induced swelling
- Thermal injury (from a drill during otosurgery)


Cell Body
Basement membrane
Myelin sheath
Axon
Normal
Compressed
Sheath Loss
Disconnection
Degeneration

DIAGNOSIS

- History (except comatose patients)
- Immediate vs. delayed
- Site of lesion (CT scan)

TREATMENT

- Every case of immediate paralysis should be surgically explored.

- Delayed paralysis is treated initially with corticosteroids to reduce edema. If neurography indicates more than 90 % degeneration or if CT indicates compression by bone fragments, the nerve is surgically explored.

- This is also done if other indications for temporal bone surgery exist (cerebrospinal fluid leak, ossicular chain disruption). It is usually sufficient to decompress the nerve.

RAMSAY HUNT SYNDROM

HERPES ZOSTER OTICUS

- Caused by reactivation varicella zoster virus (herpes virus type 3)
- Facial paralysis + hearing loss +/- vertigo
- Two-thirds of patients have rash around ear
- Other cranial nerves, particularly trigeminal nerves (5^{th} CN) often involved
- Worse prognosis than Bell's (complete recovery: 50%)
- Important cause of facial paralysis in children 6-15 years old

- 3rd most common of peripheral facial paralysis (10%)
- Aged > 60 yrs. or low immune (low CMIR)
- Virus travels to the dorsal root extramedullary cranial nerve ganglion
- Infected of HZV at auricular, external canal or face
- Prodromal symptoms very similar to those seen in Bell's palsy but usually more severe

- Symptoms include severe otalgia, facial paralysis, facial numbness, and a vesicular eruption on the concha, external auditory canal, and palate

- Facial paralysis + hearing loss + vertigo → "canal paralysis"

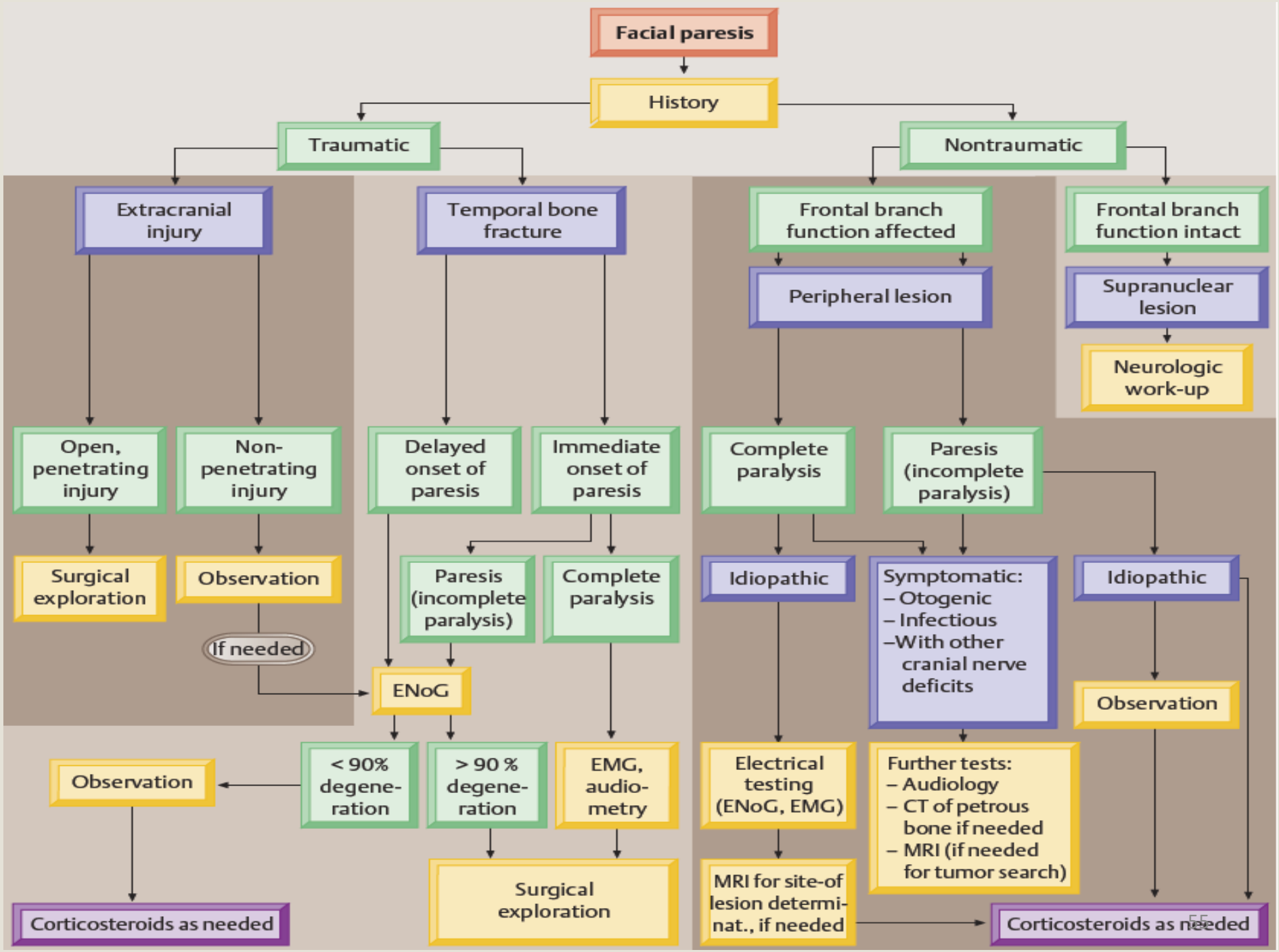
- Pathophysiology & treatment liked in Bell 's palsy

MELKERSSON'S SYNDROME

- Idiopathic

- Triad of symptoms
  - Facial paralysis
  - Swelling of the lips
  - Fissured tongue

- Treatment : like bell's palsy


Facial paresis
History
Traumatic
Nontraumatic
Extracranial injury
Temporal bone fracture
Frontal branch function affected
Frontal branch function intact
Peripheral lesion
Supranuclear lesion
Neurologic work-up
Open, penetrating injury
Non-penetrating injury
Delayed onset of paresis
Immediate onset of paresis
Complete paralysis
Paresis (incomplete paralysis)
Surgical exploration
Observation
If needed
Paresis (incomplete paralysis)
Complete paralysis
Idiopathic
Symptomatic:
– Otogenic
– Infectious
–With other cranial nerve deficits
Idiopathic
Observation
ENoG
< 90% degene-ration
> 90 % degene-ration
EMG, audio-metry
Electrical testing (ENoG, EMG)
Further tests:
– Audiology
– CT of petrous bone if needed
– MRI (if needed for tumor search)
Observation
Surgical exploration
MRI for site-of lesion determi-nat., if needed
Corticosteroids as needed
Corticosteroids as needed

Temporal bone fractures

- Longitudinal fracture
- Transverse fracture
- Mixed fracture

SIGNS

- bleeding from the external canal
- hemotympanum
- step-deformity of the osseous canal
- conductive hearing loss (longitudinal fracture)
- sensorineural hearing loss (transverse fracture)
- CSF otorrhea
- facial nerve involvement (20% of longitudinal fractures and 50% of transverse fractures)

Longitudinal VS Transverse

Type of injury	Longitudinal	Transverse
Incidence	70-90%	10-20%
Site of injury	Temporal , Parietal area	Occipital , Frontal area

Origin of fracture site	Temporal squama	Foramen magnum
Direction of injury	Posterosuperior of EAC cross roof of middle ear along carotid canal anterior to labyrinthine capsule	Between various foramen Jugular F. Hypoglosal F. Labyrinthine capsule

Insertion	middle cranial fossa	middle cranial fossa
Hearing loss	**CHL**	**SNHL**
Vertigo	No	**Common**

Facial paralysis **Onset**	20-25 % Delayed, transient	**50%** **Immediate, permanent**
Site of lesion	Tympanic segment , Perigeniculate ganglion	Labyrinthine segment
CSF otorrhea	No	Common

Cardinal S&S	1.Bleeding from ear 2.CHL 3.Battle's sign	1.Vertigo&Nystagmus 2.SNHL 3.Facial paralysis 4.Hemotympanum
CT-scan	Axial & sagital section	Coronal & 20degree coronal oblique section

PROGNOSIS

- Immediate onset paralysis : poor prognosis
- Delayed onset paralysis : good prognosis
- All case of paralysis → electrical testing

TREATMENT

- Surgery is treatment of choice

- Indications for facial nerve exploration
  - incomplete paralysis
  - iatrogenic paralysis

- Contraindications : any case have no poor prognostic factors

COMPLICATIONS

COMPLICATIONS OF FACIAL NERVE DECOMPRESSION

- dural tears
- conductive or sensorineural hearing loss
- vestibular function loss
- persistent CSF leaks
- meningitis
- injury to the anterior inferior cerebellar artery (AICA) or its branches