

HEAD AND NECK DISCUSSION SESSION 4: GROSS ANATOMY

ONN BLOCK

Feb 14, 2024

Discuss

**Branchial Arches. Pouches
Spinal and Cranial Nerve Reflexes**

DEVELOPMENT OF BRANCHIAL ARCHES

EMBRYOLOGICAL DEVELOPMENT

FORM GILLS IN FISH

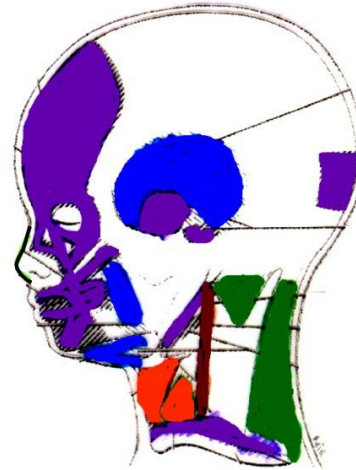


~4 weeks

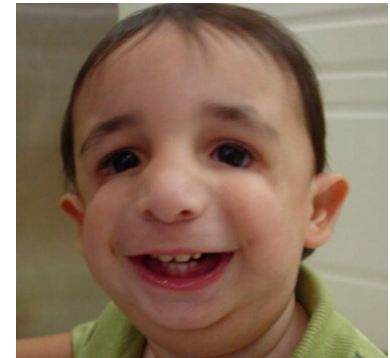


~11 weeks

ANATOMY



CLINICAL SYNDROMES



Know – Branchial cartilages, muscles, nerves, pouches

Clinical Branchial Cleft Syndromes

ALSO Abnormalities of Thyroid development - NOT DERIVED FROM BRANCHIAL ARCHES

GILLS HAVE ARTERIES, MUSCLES AND NERVES

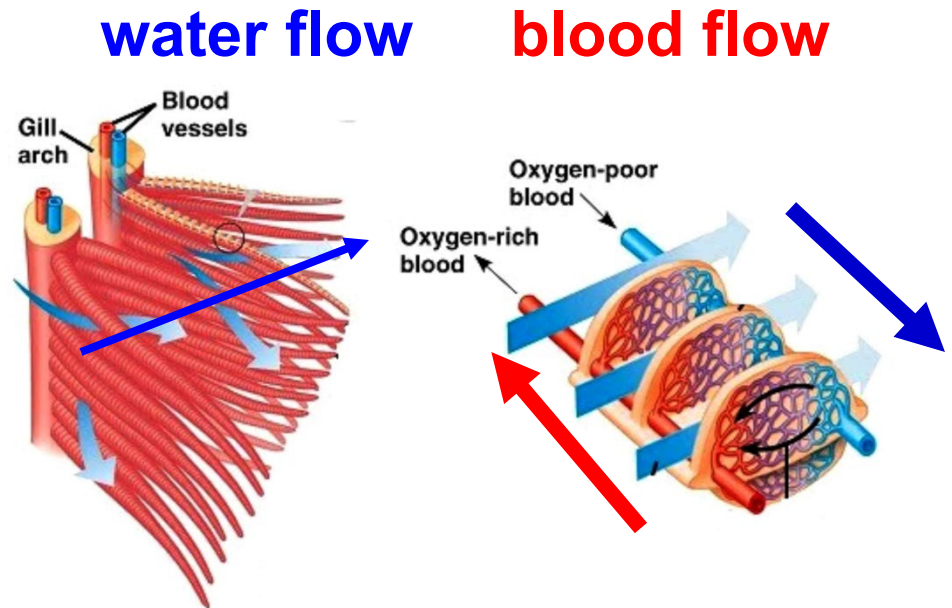
Gills have filaments attached to cartilages

- arteries pass through filaments for gas exchange

- Gills moveable (filter feeding) - each has skeletal muscle and nerve
(CRANIAL NERVE)



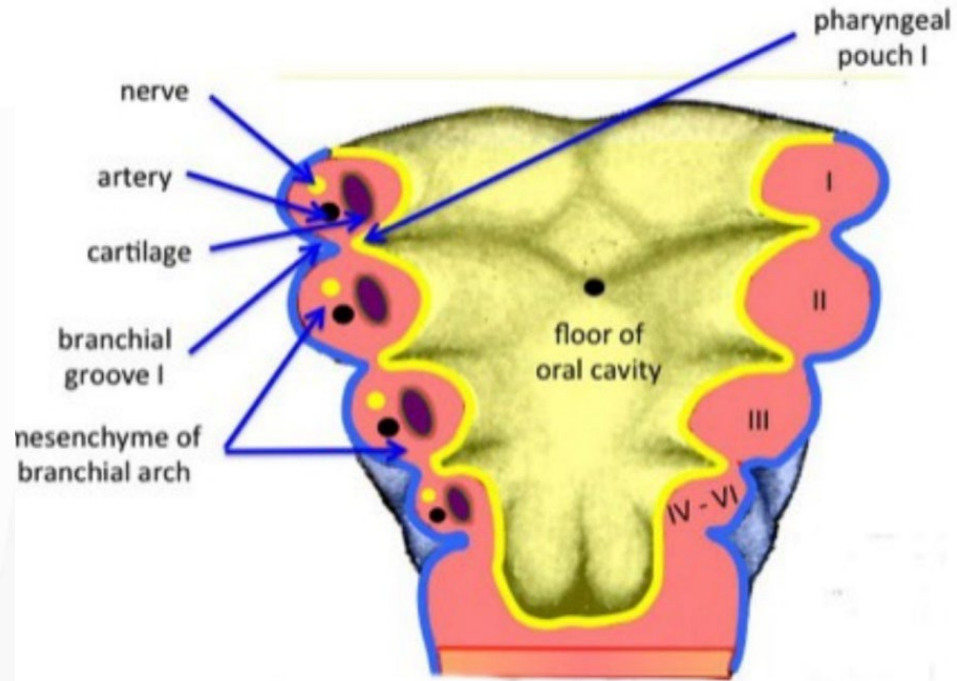
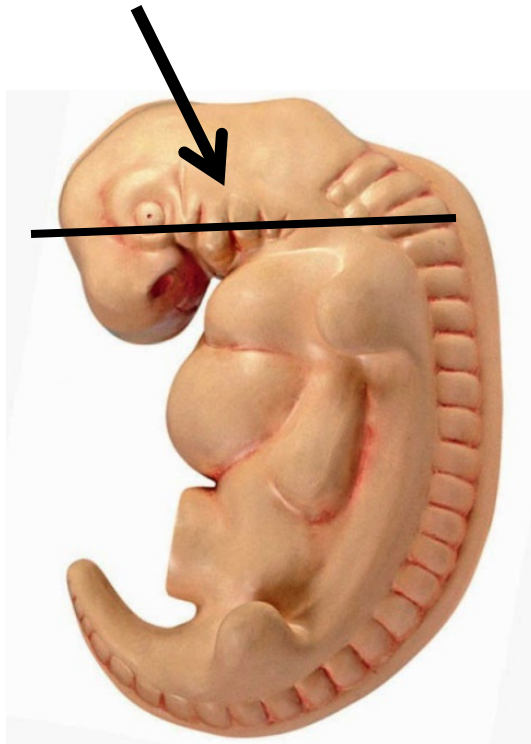
Gills



Large surface area - Mackerel (swim a lot) - surface of gills 10 times surface area of body

BRANCHIAL ARCHES HAVE CARTILAGES, MUSCLES, ARTERIES

BRANCHIAL ARCHES



**FORM - CLEFTS ON OUTSIDE (ECTODERM)
POUCHES ON INSIDE (ENDODERM)**

CHART OF BRANCHIAL ARCH DERIVATIVES FROM FIRST AID - MEMORIZE

Branchial arch derivatives

ARCH	CARTILAGE	MUSCLES	NERVES ^a	ABNORMALITIES/COMMENTS
1st branchial arch	<p>Maxillary process → Maxilla, zygomatic bone</p> <p>Mandibular process → Meckel cartilage → Mandible, Malleus and incus, sphenomandibular ligament</p>	<p>Muscles of Mastication (temporalis, Masseter, lateral and Medial pterygoids), Mylohyoid, anterior belly of digastric, tensor tympani, anterior 2/3 of tongue, tensor veli palatini</p>	CN V ₃ chew	<p>Pierre Robin sequence — micrognathia, glossoptosis, cleft palate, airway obstruction</p> <p>Treacher Collins syndrome — neural crest dysfunction → mandibular hypoplasia, facial abnormalities</p>
2nd branchial arch	<p>Reichert cartilage: Stapes, Styloid process, lesser horn of hyoid, Stylohyoid ligament</p>	<p>Muscles of facial expression, Stapedius, Stylohyoid, platysma, posterior belly of digastric</p>	CN VII (facial expression) smile	
3rd branchial arch	<p>Greater horn of hyoid</p>	<p>Stylopharyngeus (think of stylopharyngeus innervated by glossopharyngeal nerve)</p>	CN IX (stylopharyngeus) swallow stylishly	
4th–6th branchial arches	<p>Arytenoids, Cricoid, Corniculate, Cuneiform, Thyroid (used to sing and ACCCT)</p>	<p>4th arch: most pharyngeal constrictors; cricothyroid, levator veli palatini</p> <p>6th arch: all intrinsic muscles of larynx except cricothyroid</p>	<p>4th arch: CN X (superior laryngeal branch) simply swallow</p> <p>6th arch: CN X (recurrent/inferior laryngeal branch) speak</p>	<p>Arches 3 and 4 form posterior 1/3 of tongue; arch 5 makes no major developmental contributions</p>

KNOW THIS FOR STEP 1

BREAK DOWN TO COMPONENT IN LECTURE HANDOUT

Arch- Cranial Nerve

STRUCTURES DERIVED FROM BRANCHIAL ARCHES

1- V

2- VII

3- IX

4- X

6- XI

ARCH/NERVE	SKELETAL	LIGAMENTS	MUSCLES
First (V)	1) Malleus 2) Incus	1) Ant. ligament of malleus 2) Sphenomandibular ligament	1) Muscles of Mastication 2) Tensor tympani 3) Tensor palati 4) Mylohyoid 5) Ant. belly of Digastric
Second (VII)	1) Stapes 2) Styloid process 3) Hyoid bone - lesser horn, upper half of body	Stylohyoid ligament	1) Muscles of Facial Expression 2) Stapedius 3) Stylohyoid 4) Post. belly of Digastric
Third (IX)	Hyoid bone - greater horn, lower half of body	-----	Stylopharyngeus
Fourth (X)	Cartilages of Larynx	-----	1) All muscles of Larynx 2) All muscles of Pharynx (except Stylopharyngeus) 3) All muscles of Soft Palate (except Tensor palati)
Sixth (XI)	-----	-----	1) Sternocleidomastoid 2) Trapezius

CHART OF BRANCHIAL ARCH DERIVATIVES FROM FIRST AID - MEMORIZE

IDENTIFY ARCH/NERVE QUESTIONS

KAPLAN REVIEW QUESTION

A 43-year-old female is diagnosed with a condition that causes excruciating pain near her nose and mouth. The involved nerves innervates which of the following branchial arches?

- A. First**
- B. Second**
- C. Third**
- D. Fourth**

MUSCLES AND NERVES = BRANCHIOMOTOR MUSCLES FROM CRANIAL NERVES HANDOUT (INCANTATION)

10) BRANCHIOMOTOR - voluntary motor to skeletal muscles of face, ear, pharynx and neck that are derived from branchial arches.

Nerve

Innervates

**FIRST
ARCH**

V (Trigeminal)
(all in V3)

muscles of mastication
mylohyoid
tensor tympani
tensor palati
anterior belly of digastric

**SECOND
ARCH**

VII (Facial)

muscles of facial expression
stylohyoid
posterior belly of digastric
stapedius

**THIRD
ARCH**

IX (Glossopharyngeal)

stylopharyngeus

**FOURTH,
SIXTH
ARCH**

X (Vagus)

all muscles of pharynx (except stylopharyngeus)
muscles of larynx
all muscles of palate (except tensor palati)

XI (Accessory)

sternocleidomastoid
trapezius

CLINICAL: BRANCHIAL POUCHES, GROOVES, MEMBRANES

POUCH	FORMS	CLINICAL
First	1) Auditory tube 2) Tympanic cavity	First Branchial 'Cleft' cyst - tract linked to external auditory meatus
Second	Lining (crypts) of palatine tonsils	Second Branchial 'Cleft' cyst - tract linked to tonsillar fossa (palatine tonsils)
Third	1) Inferior parathyroid gland 2) Thymus	Third Branchial 'Cleft' cyst - tract at thyrohyoid membrane or piriform recess
Fourth	1) Superior parathyroid gland 2) C-cells of Thyroid	does not form
Sixth (XI)	-----	-----



Note: Cysts and fistuli - in lateral neck are **anterior to Sternocleidomastoid muscle**

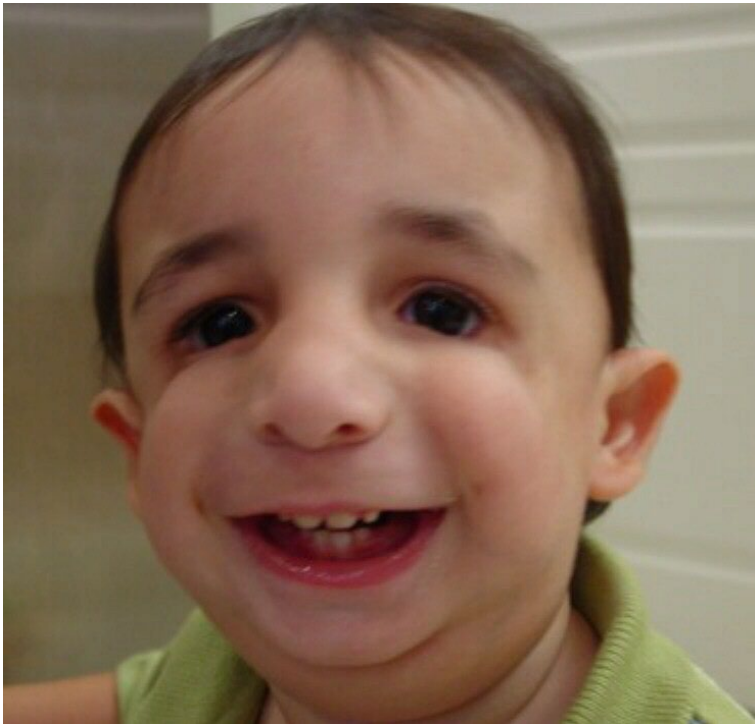
CLEFT	FORMS
First	External Auditory Meatus

MEMBRANE	FORMS
First	Tympanic membrane

NOTE:
CLEFT =
GROOVE

NOTE: INNERVATION OF BRANCHIAL POUCHES DOES NOT FOLLOW INNERVATION OF ARCH STRUCTURES (ex. muscles)

PRACTICE QUESTION CLINICAL VIGNETTE



Note: Questions about Branchial Pouches can be asked as Branchial Arches

A young child is brought to a pediatrician by his parents. The child (photo) shows micrognathia (small mandible) and downward slanting eyes. Tests of auditory function indicate a hearing loss. The physician suspects that the child has Treacher-Collins syndrome, a congenital disorder associated with malformation of structures that develop in association with the first branchial arch. Which of the following structures normally develops with the first branchial arch and, if malformed, could contribute to the hearing loss?

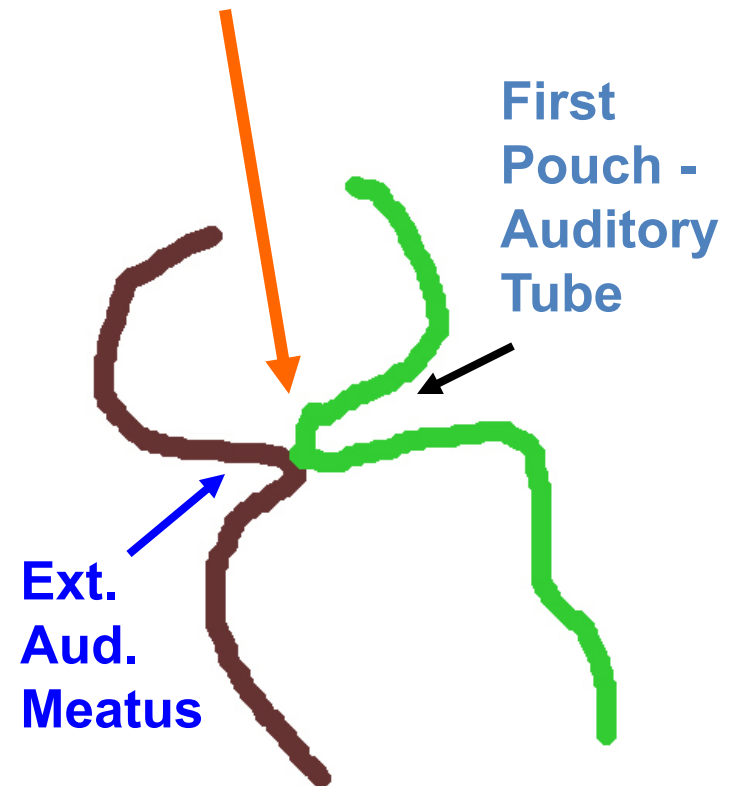
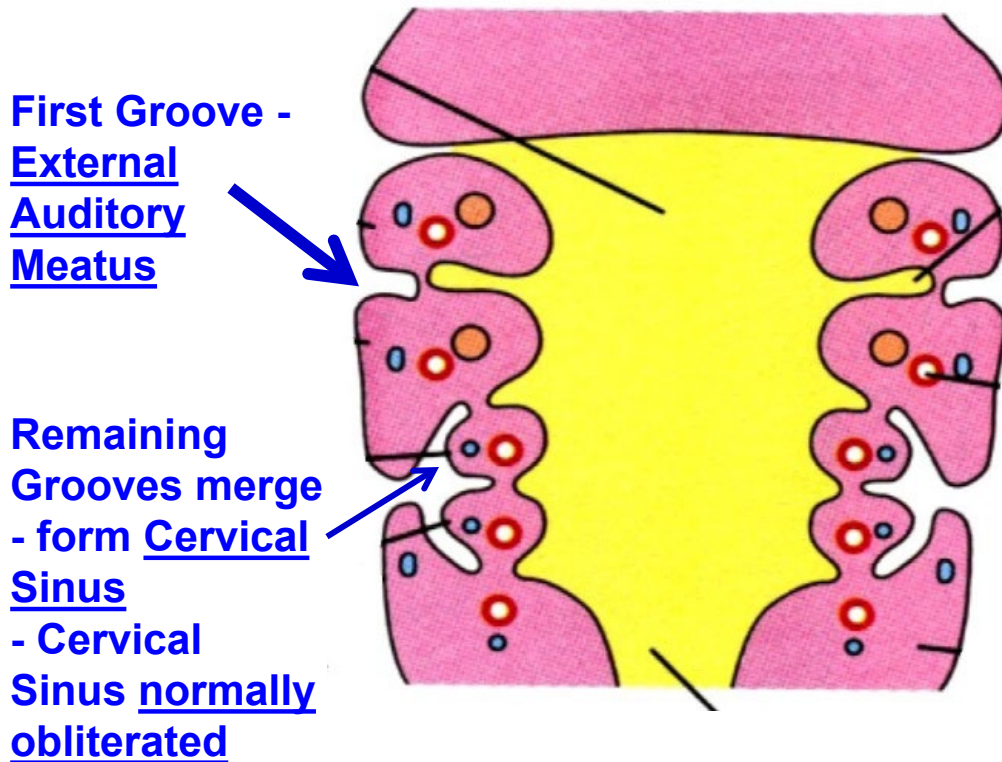
- A. Auditory tube
- B. Cochlea
- C. Malleus and Incus
- D. Vestibulocochlear nerve
- E. Stapes

BRANCHIAL GROOVES (CLEFTS) AND MEMBRANES

Only First Branchial Groove and Membrane Normally form Structures in Adult

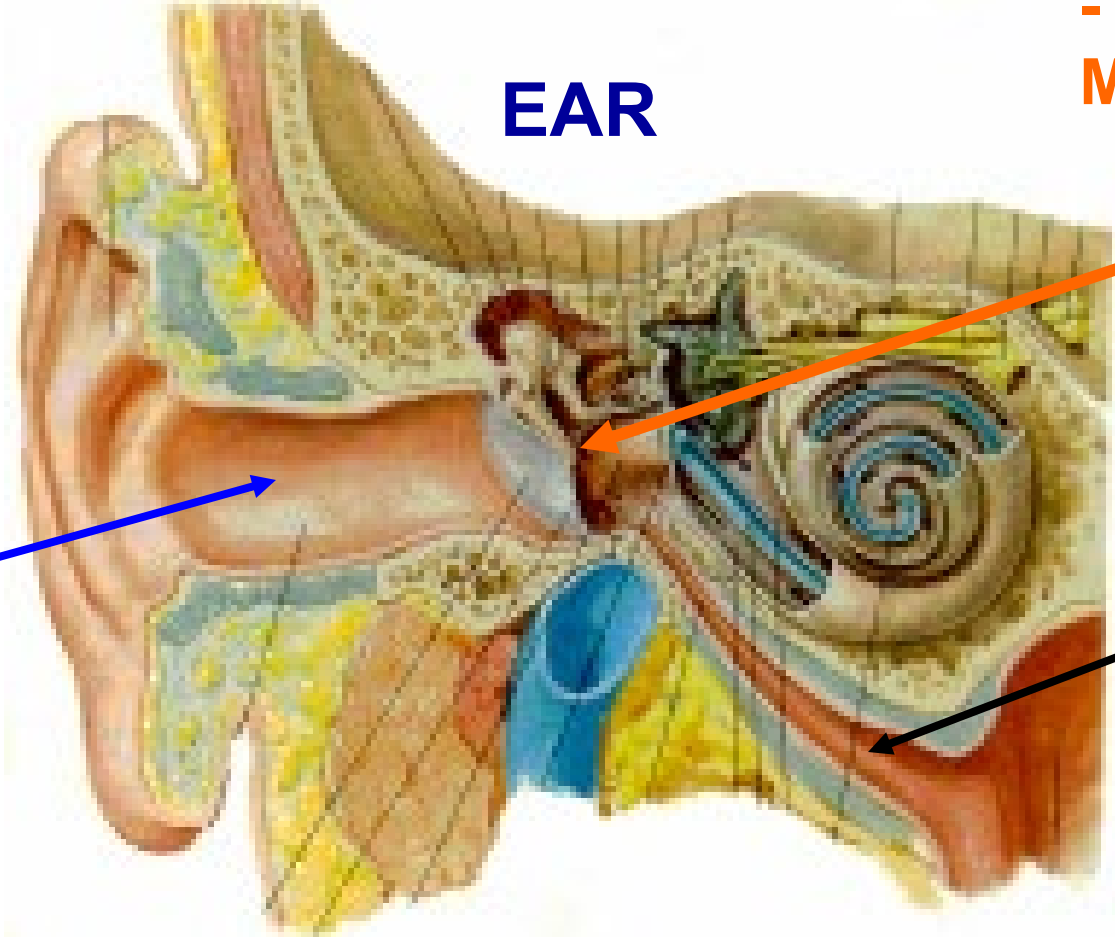
First Groove - External Auditory Meatus

First Membrane = Tympanic Membrane



EAR

First Membrane
- Tympanic
Membrane

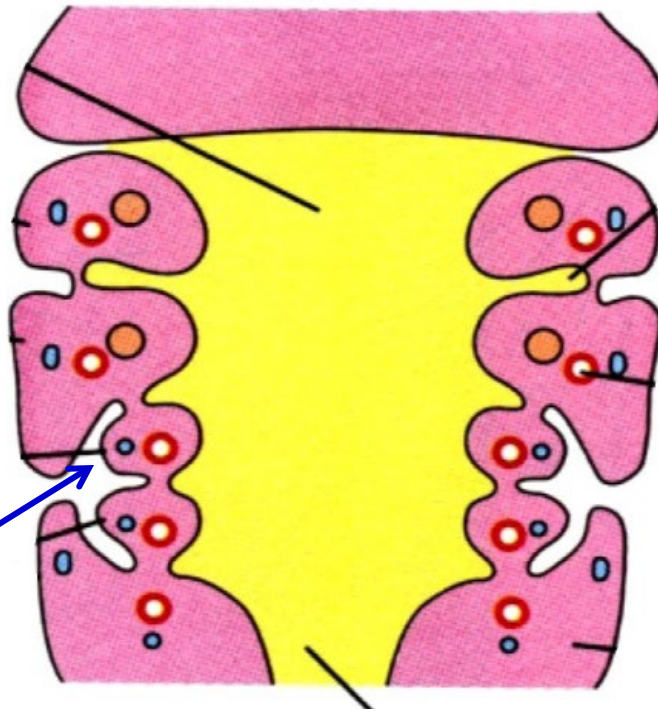


FIRST GROOVE -
Ext. Aud.
Meatus

FIRST POUCH -
Auditory
Tube,
Tympanic
Cavity

BRANCHIAL GROOVES

Other Grooves develop in longer depression
Cervical Sinus



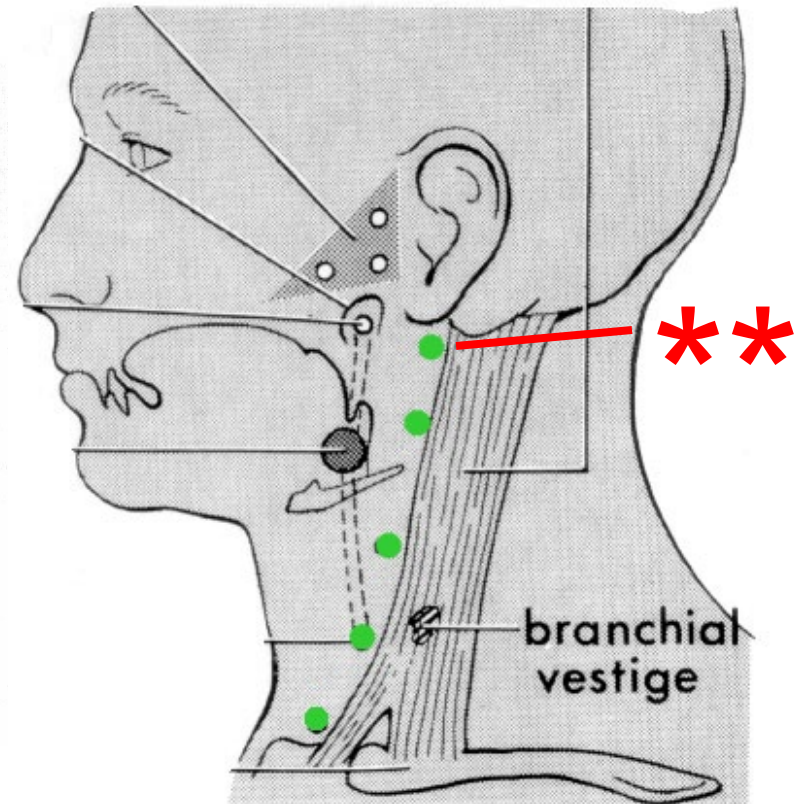
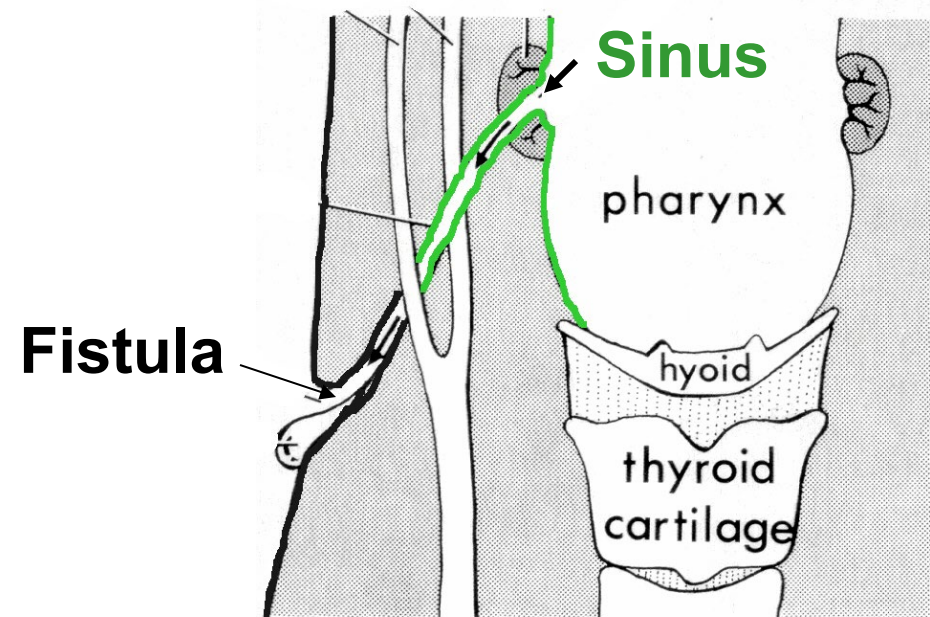
Remaining
Grooves merge
- form Cervical
Sinus
- Cervical
Sinus normally
obliterated

Note:
Cervical
sinus
normally
obliterated
but
can persist

BRANCHIAL ANOMALIES

Branchial Sinus = Blind pouch from Pharynx

Branchial Fistula = Channel, often connecting Pharynx to skin of neck; usually passes Anterior to Sternocleidomastoid, between Int. and Ext. Carotid A.



FIRST BRANCHIAL POUCH SYNDROME – channel to External Auditory Meatus

PRACTICE QUESTION CLINICAL VIGNETTE

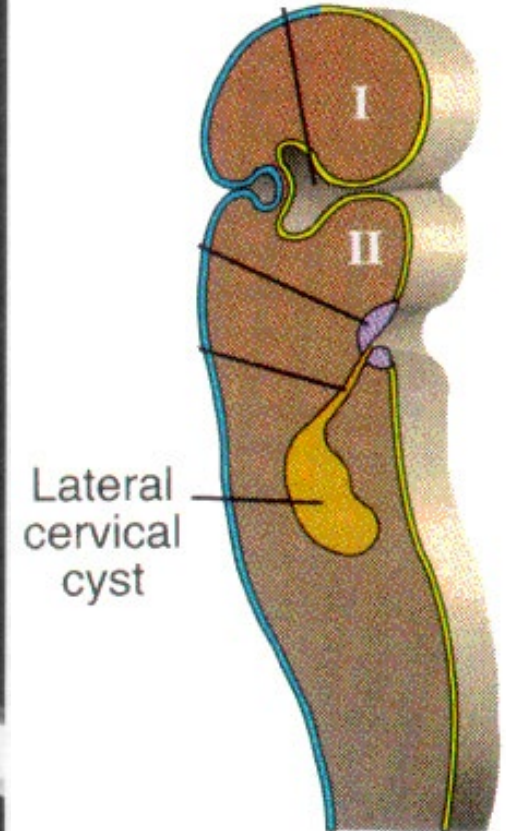
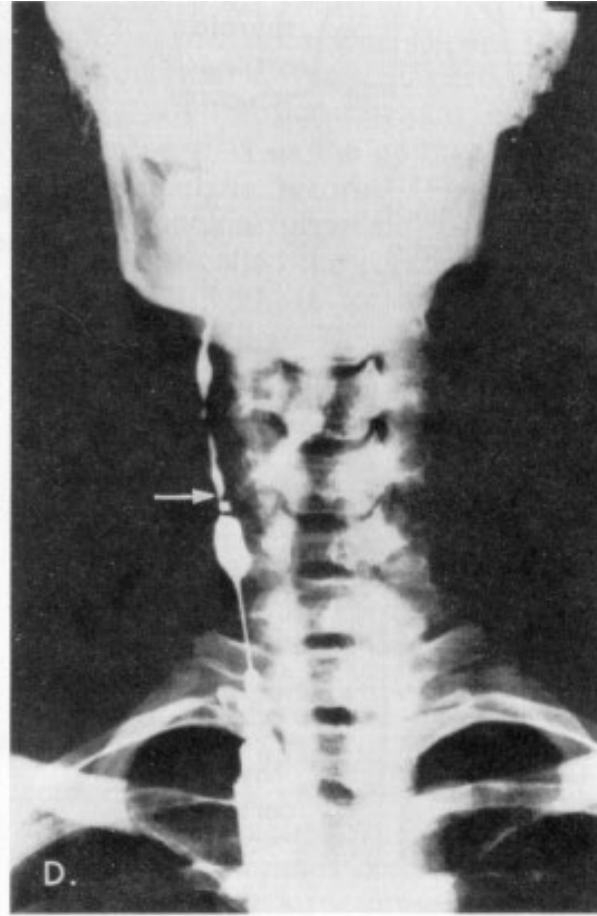


A 24 year old woman develops a mass in her neck (see photo above). The mass is located immediately anterior to the sternocleidomastoid muscle. The physician suspects that this condition has result from a branchial cyst. During surgery, the mass is found to be connected to a tract that extends superiorly and medially. The tract is most likely to be connected to which of the following structures?

- A. Middle meatus of the nasal cavity
- B. Pharyngeal tonsil
- C. Tonsillar fossa (palatine tonsils)
- D. Lingual tonsil
- E. Mandibular fossa

SECOND BRANCHIAL POUCH SYNDROME

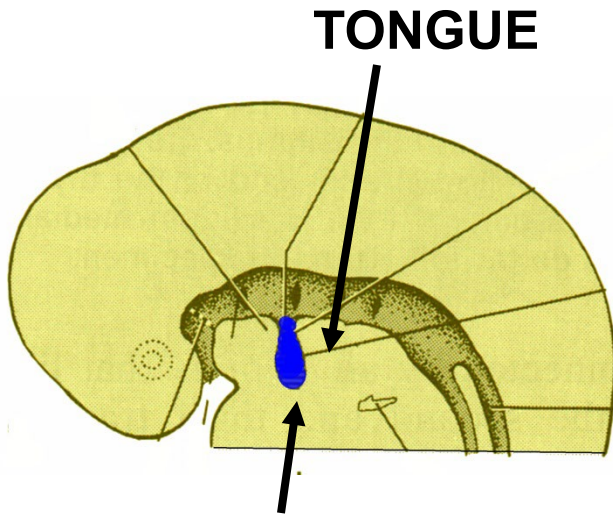
SECOND BRANCHIAL POUCH FORMS CRYPTS (LININGS)
OF PALATINE TONSILS



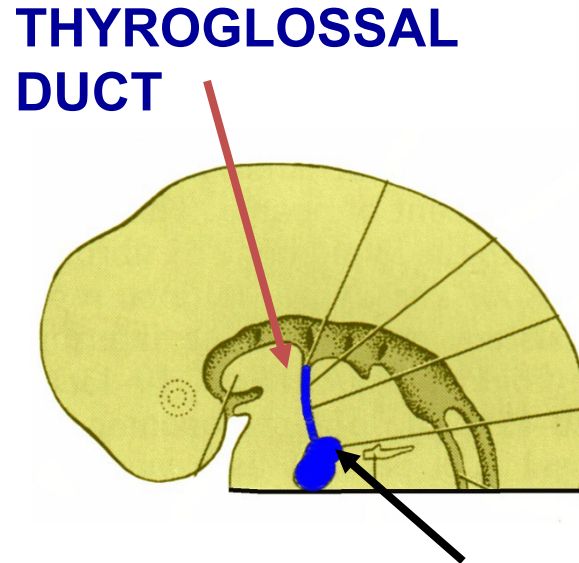
Branchial Fistula - drains to neck

Branchial Cyst
often remnant
of Cervical Sinus

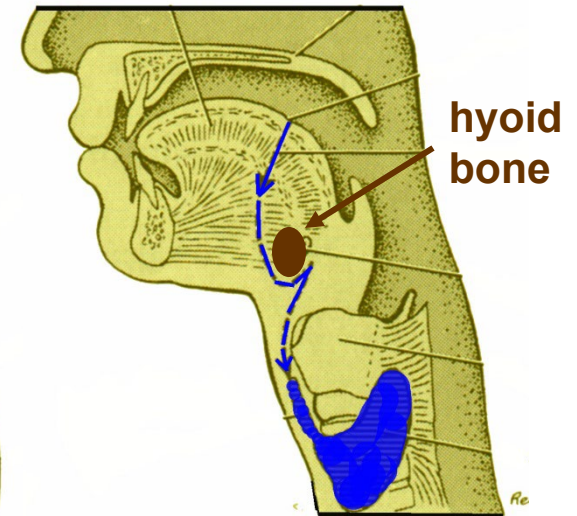
DEVELOPMENT OF THYROID



1) Thyroid start as Median endodermal Thickening on floor of pharynx at **future junction of anterior 2/3 and posterior 1/3 of tongue (marked by Foramen Cecum)**

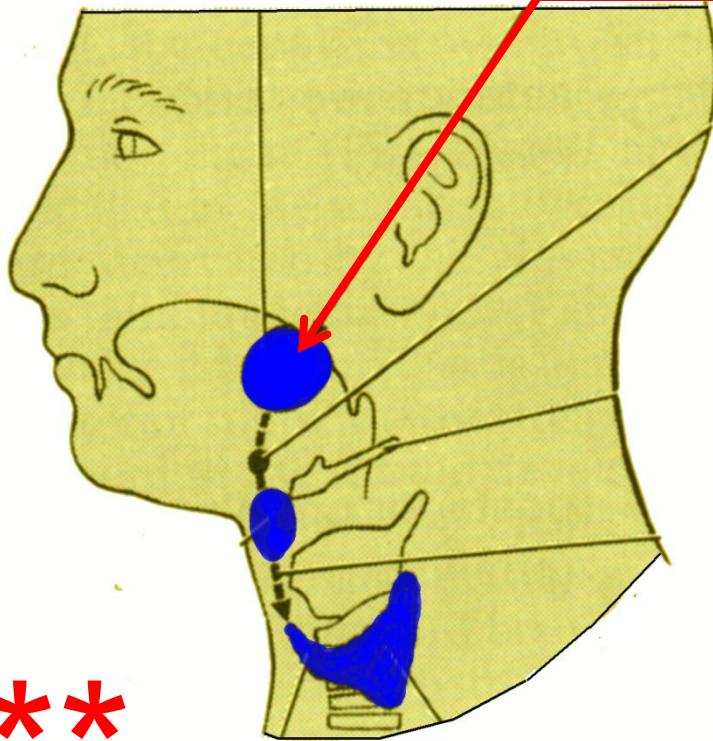


2) Elongates to form Thyroid Diverticulum; descends ant. to hyoid bone and larynx
3) Thyroglossal duct connects Diverticulum to Foramen cecum



CONGENITAL MALFORMATIONS

LINGUAL THYROID* - gland in tongue



Thyroglossal Duct Remnants - can form thyroid tissue (cysts) along path (midline, ant. to hyoid, larynx)

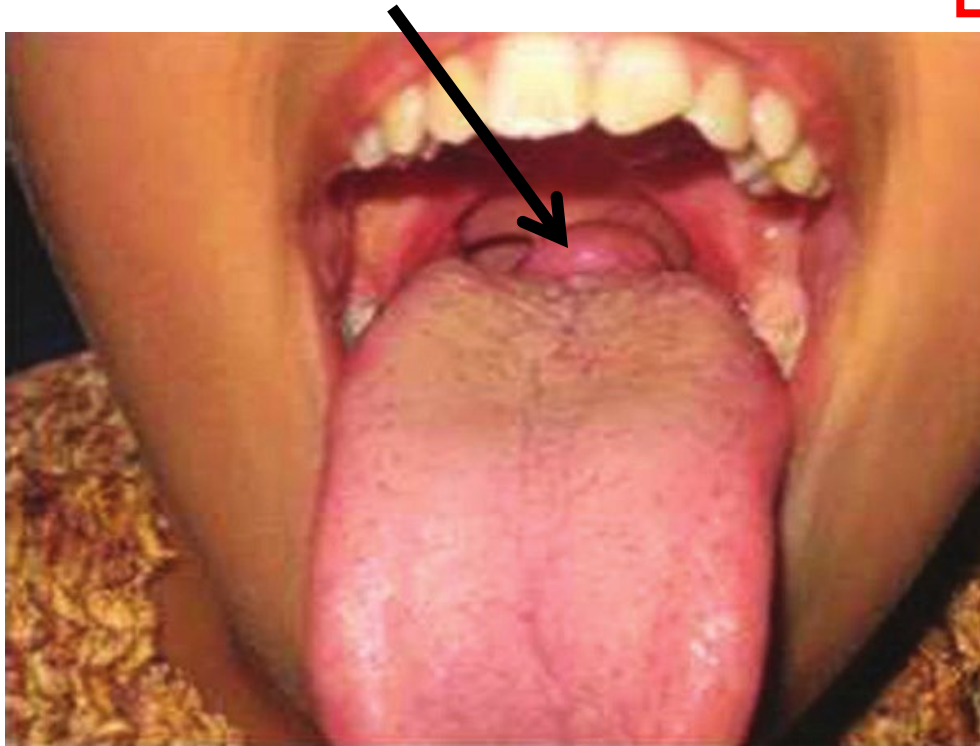
MIDLINE



C. PYRAMIDAL LOBE. ABSENCE OF ISTHMUS

Pyramidal Lobe - 50% of people; attached to hyoid by fibrous strand; no clinical problems

**LINGUAL THYROID* -
Thyroid gland in tongue**



AT: Junction of anterior 2/3 and posterior 1/3 of tongue

**THYROGLOSSAL DUCT
CYST *- midline of
neck, path of migration**



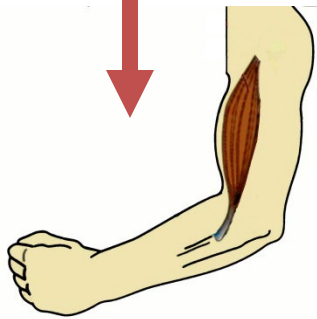
SPINAL REFLEXES

SPINAL REFLEXES AND DISORDERS

REFLEX	STIMULUS/SENSE ORGAN(S) EXCITED	NORMAL RESPONSE	UPPER MOTOR NEURON DISORDERS
Stretch (Myotatic, Deep Tendon) Reflex – Compensatory maintain position (ex. riding on moving bus)	Rapid Stretch of muscle (test: tap on muscle tendon) Excites Muscle Spindle Primary (Ia) and Secondary (II) sensory neurons (NOT Golgi Tendon Organ)	Stretched muscle contracts rapidly (monosynaptic connection); also Excite synergist and Inhibit antagonist Note: Gamma motor neurons can enhance stretch reflexes, tell patient to relax before test	<u>Hyperreflexia</u> - (increase) - characteristic of Upper Motor Neuron lesions (ex. spinal cord injury, damage Corticospinal tract); note: <u>Clonus</u> = hyperreflexia with repetitive or sustained contractions to single stimulus
Autogenic Inhibition - Limits Muscle Tension	Large force on tendon excites Golgi Tendon Organ Ib (test: pull on muscle when resisted)	Muscle tension decreases; Also inhibit synergist muscles; excite antagonist muscles	<u>Clasped Knife Reflex</u> - occurs in Upper Motor Neuron lesions - forceful stretch of muscle is first resisted then collapses
Flexor Reflex - Protective avoidance reflex	Sharp, painful stimulus, as in stepping on nail; Excites - Cutaneous and pain receptors (test: stroke foot with pointed object)	Limb is rapidly withdrawn from stimulus; protective reflex; also inhibit extensors of same limb and excite extensors of opposite limb (Crossed Extensor Reflex)	<u>Babinski sign</u> -toes extend (dorsiflex) to cutaneous stimulus of sole of foot (normally plantar flex); characteristic of Upper Motor Neuron lesion

STIMULUS

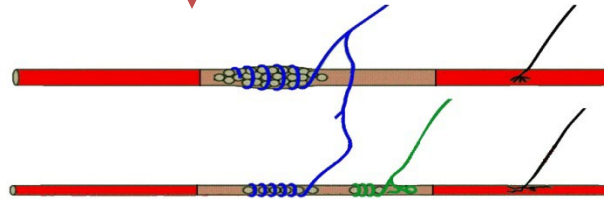
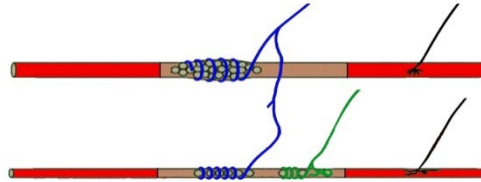
**BICEPS
MUSCLE
STRETCHED**



**1) Stimulus -
fast stretch
of muscle**

STRETCH REFLEX

BICEPS MUSCLE SPINDLE

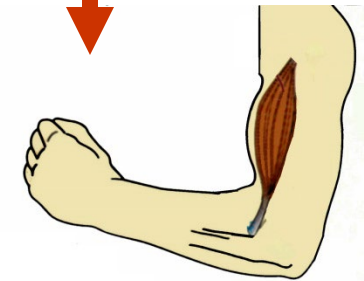


**2) Sense organ
excited - Muscle
spindle Ia and II
sensory neurons**

RESPONSE



**BICEPS
MUSCLE
CONTRACTS**



**3) Primary
response -
muscle that is
stretched
contracts rapidly**

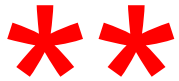
Ia



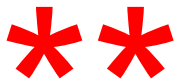
II



OTHER COMPONENTS OF STRETCH REFLEX

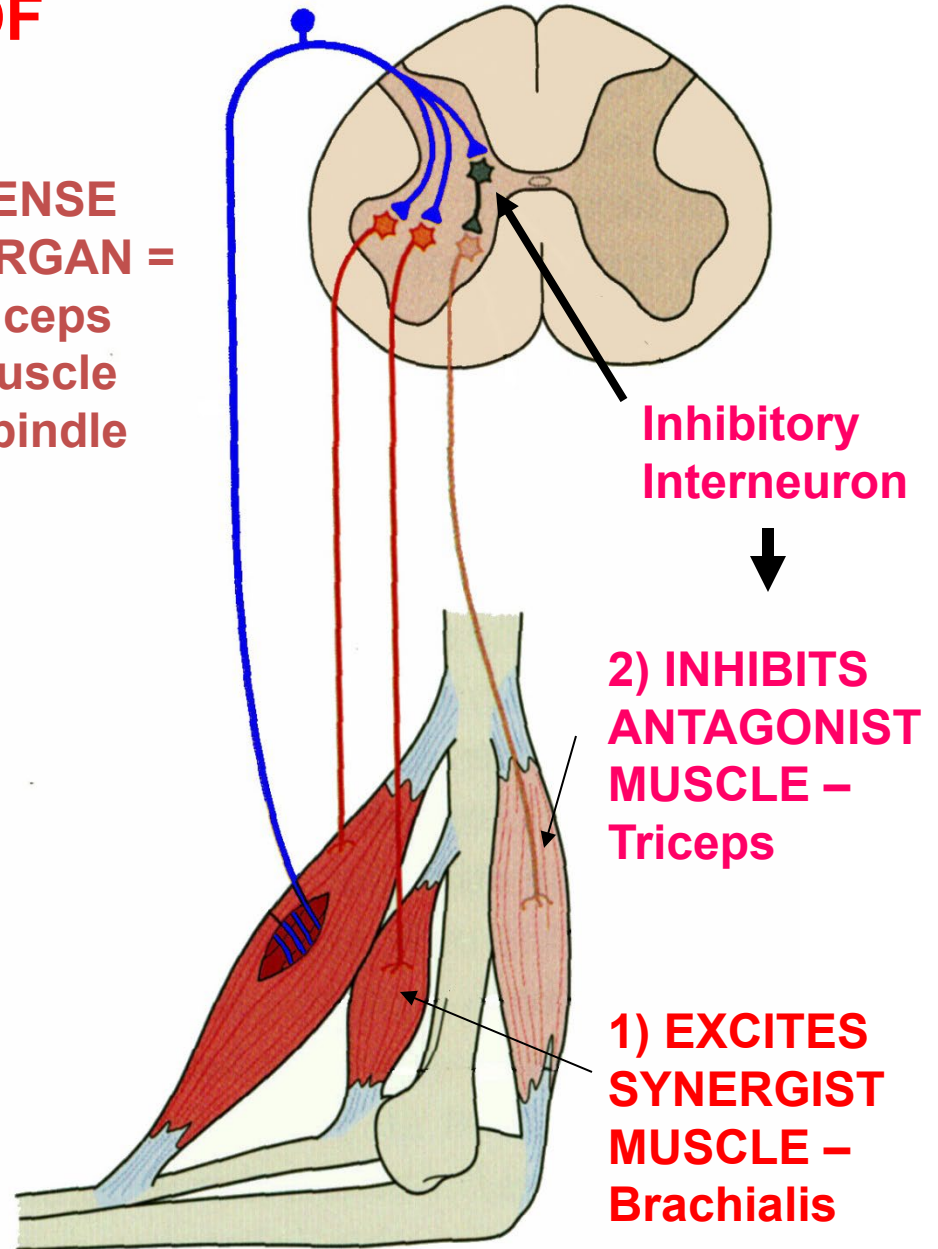


1) Excite synergist muscles - spindle afferents also make excitatory **monosynaptic** connections with synergist muscles



2) Inhibit antagonist muscles - **RECIPROCAL INHIBITION** - Spindle activity also excites **interneurons** that make **inhibitory synapses** on motor neurons to antagonist muscles (**polysynaptic**)

SENSE ORGAN =
Biceps
Muscle
Spindle

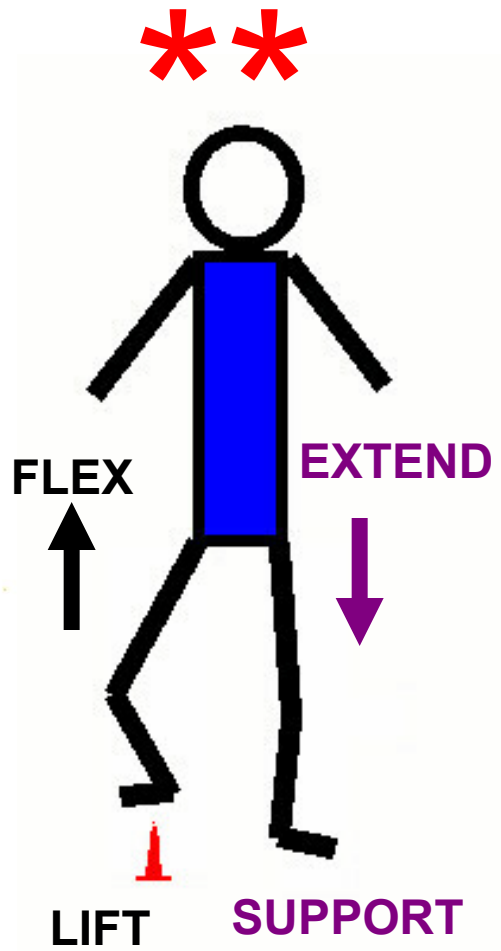
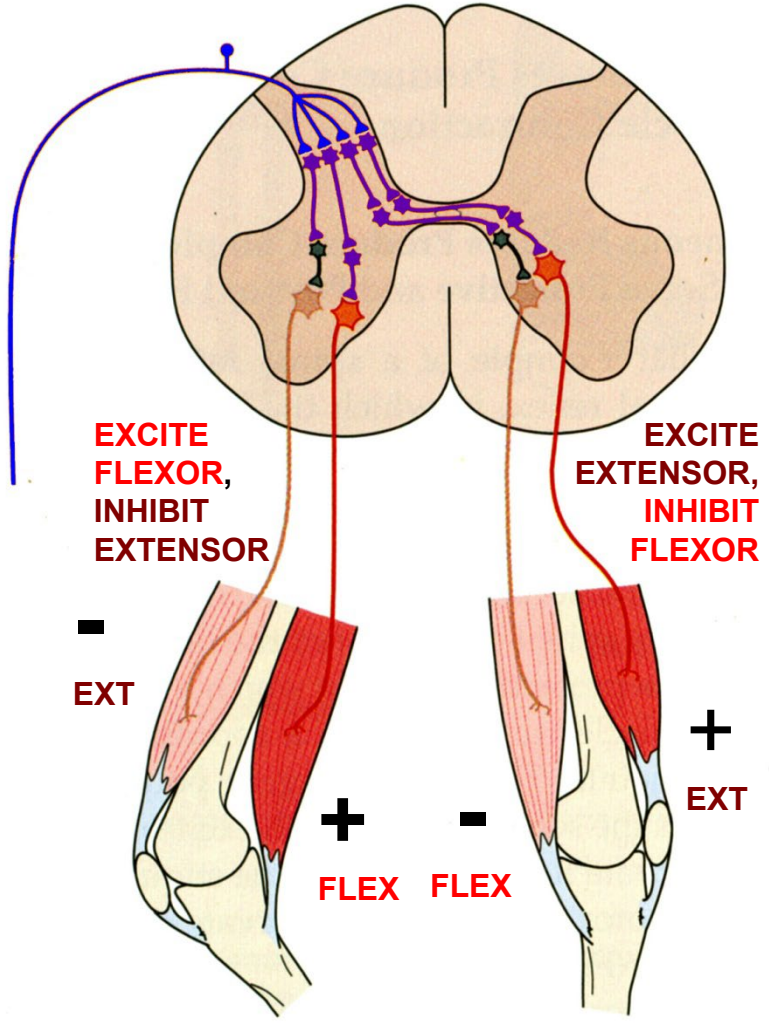


FLEXOR REFLEX: OTHER EFFECTS ALL ARE POLYSYNPAPTIC BY INTERNEURONS

1) Excite synergist muscles - **excite other flexors in same leg** (other joints)

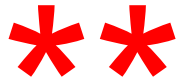
2) Inhibit antagonist muscles - **inhibit Extensors in same leg**

3) **CROSSED EXTENSION REFLEX - EXCITE EXTENSORS AND INHIBIT FLEXORS IN OPPOSITE LEG**



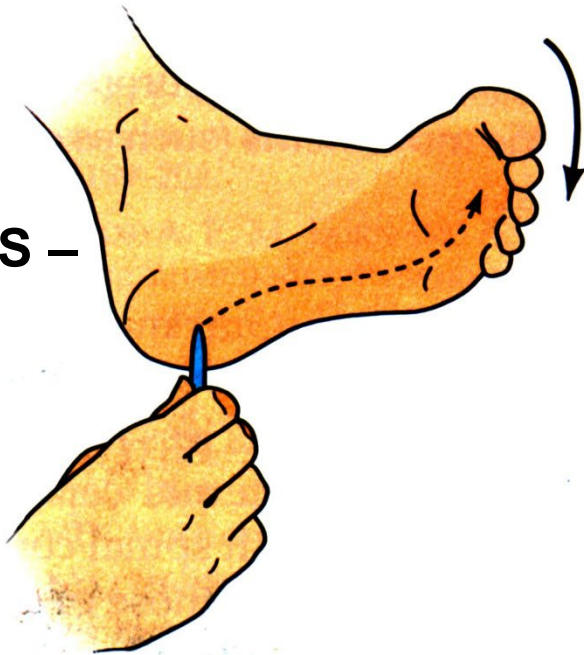
FUNCTION: OTHER LEG PROVIDES SUPPORT WHEN FIRST LEG IS LIFTED

FLEXOR REFLEXES CAN CHANGE AFTER LESIONS, DISEASE PROCESSES



NORMAL RESPONSE

**STIMULUS –
TO SKIN
OF SOLE
OF FOOT**



**BABINSKI SIGN –
(EXTENSOR PLANTAR
RESPONSE)**

**FLEX
TOES
(DOWN)**



**EXTEND BIG
TOE, FANNING
(ABDUCTION)
OF OTHER
TOES**



Babinski sign - seen after **Upper Motor neuron lesion** - direction of movement **changes from flexing toes to extending and fanning (abducting) toes**

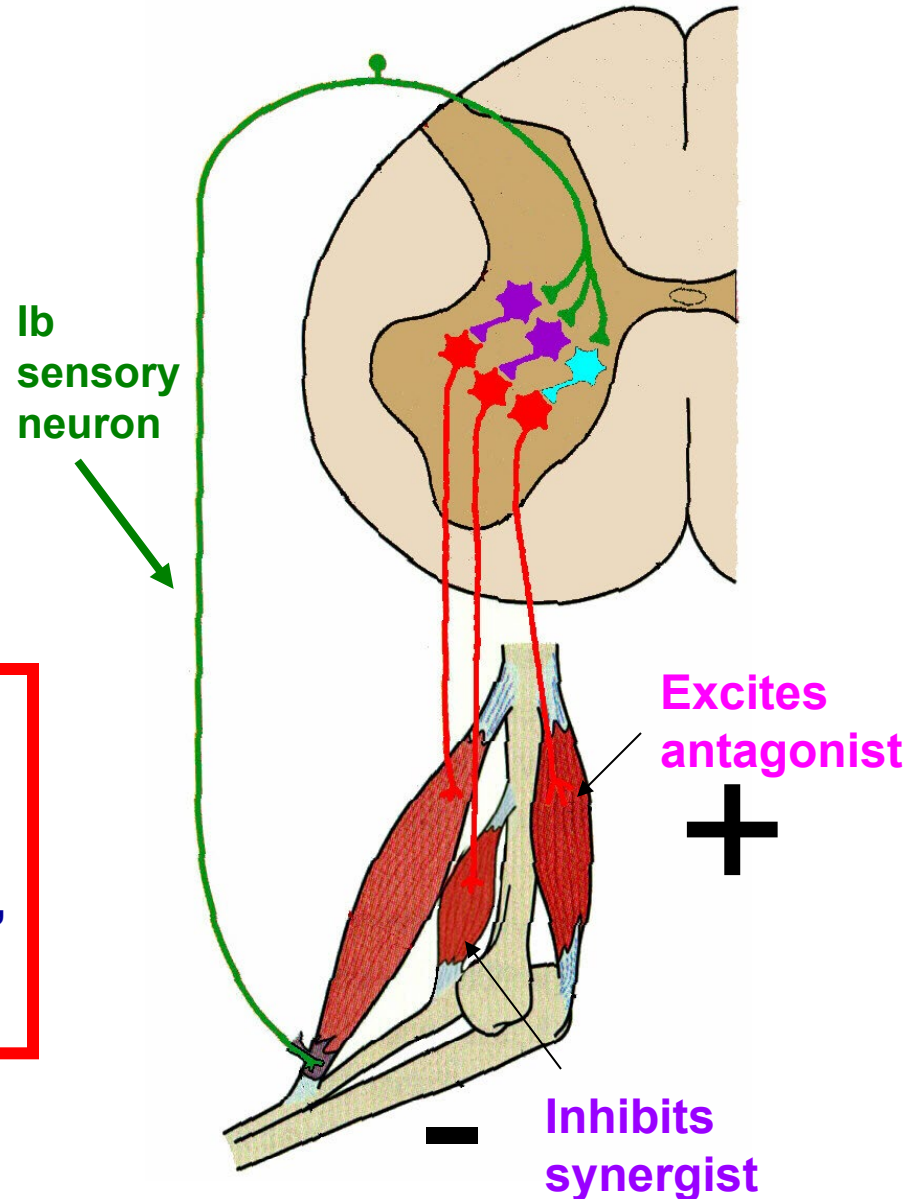
**EXTENSOR
PLANTAR
RESPONSE IS
NORMAL IN
NEWBORNS,
INFANTS TO
AGE 2**

AUTOGENIC INHIBITION

Other effects

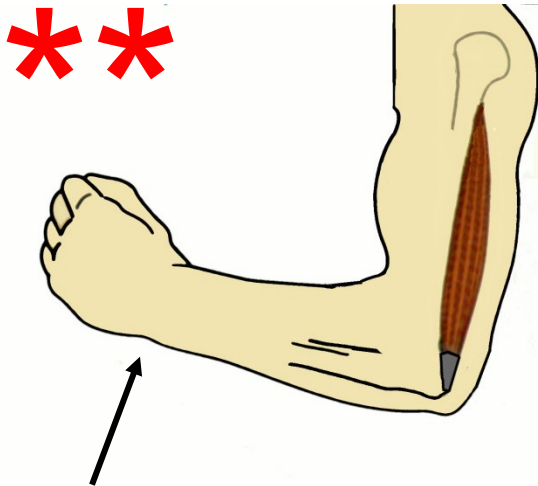
- a. Inhibit synergist muscles
- b. Excites antagonist muscles -

CLASPED KNIFE REFLEX: in Upper motor neuron lesions, tonus increases, resistance to stretch increases; if sufficient force is applied, limb resistance suddenly decreases (like pocket knife snapping shut)

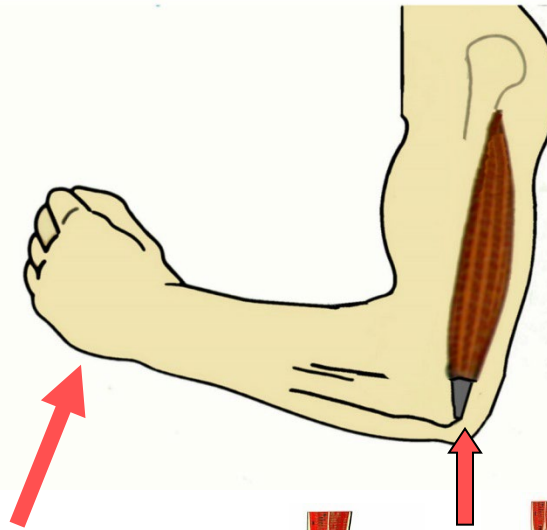


CLASPED KNIFE REFLEX: is an example of Autogenic inhibition. It is elicited in patients with Upper Motor neurons lesions due to high tonus in muscle.

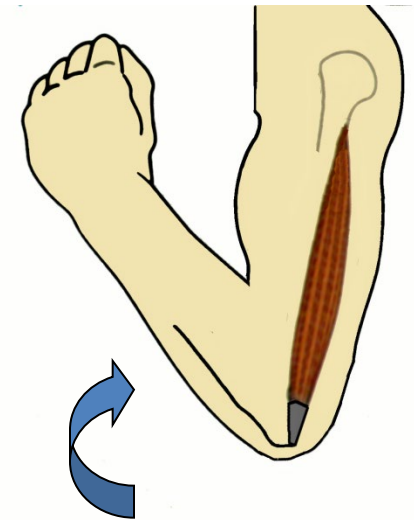
1) PHYSICIAN TRIES TO FLEX ELBOW JOINT OF PATIENT WITH UPPER MOTOR NEURON LESION



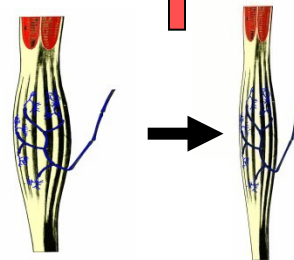
2) KEEP TRYING AND TENSION ON TRICEPS TENDON EXCITES GOLGI TENDON ORGANS



3) TRICEPS RELAXES AND RESISTANCE SUDDENLY DECREASES: ELBOW JOINT FLEXES



HIGH IMPOSED FORCE EXCITES GOLGI TENDON ORGANS IN TRICEPS TENDON WHICH INHIBITS MOTOR NEURONS TO TRICEPS MUSCLE



ELBOW JOINT SNAPS SHUT LIKE A POCKET KNIFE = CLASPED KNIFE REFLEX

REFLEXES OF CRANIAL NERVES

REFLEXES OF CRANIAL NERVES

REFLEX	STIMULUS	SENSORY	RESPONSE	CLINICAL
Pupillary Light Reflex (II to III)	Test: Shine light in eye	Light detected by Optic Nerve	Excite Constrictor of pupil of eye (III Short Ciliary nerves (Ciliary Ganglion, parasympathetic))	Extensively used to check CN II; Absence of Pupillary Light Reflex can indicate catastrophe (brain herniation)
Corneal Reflex (V to VII)	Touch cornea of eye with cotton	Touch detected by Long Ciliary nerves (V1), Somatic sensory	Close eye (VII to Orbicularis Oculi muscle) Branchiomotor	Absence of Corneal Reflex; Test for damage to V1 sensory, VII motor
Gag Reflex (IX to X)	Test: Touch posterior tongue, oropharynx;	Excites Visceral Sensory endings in Glossopharyngeal N. (IX)	Excite muscles of pharynx, palate; Vagus N. (X), Branchiomotor	Other symptoms of Vagus damage (X); Patient Say's Ahh: soft palate not elevated on ipsilateral side (paralyze Levator Palati); uvula deviated away from side of lesion
Jaw Jerk Reflex Stretch (Deep Tendon) Reflex (V to V)	Test: tap down on mandible; Stretch muscles of mastication (ex. Masseter)	Excites Muscle Spindle sensory neurons in Trigeminal nerve (V)	Contract muscles that elevate mandible Motor - V3	<u>Hyporeflexia</u> - indicates Trigeminal nerve damage

1. PUPILLARY LIGHT REFLEX - II TO III

AFFERENT ARM OF REFLEX

**SENSORY
STIMULUS**

**LIGHT IN
EYE**

EFFERENT ARM OF REFLEX

**MOTOR
RESPONSE**

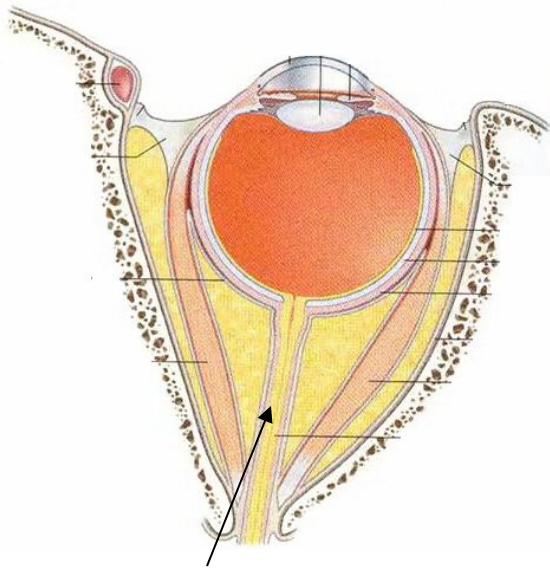
**CONSTRICT
PUPIL**



**REFLEX IS
CONSENSUAL –
LIGHT IN ONE EYE
CAUSES PUPILLARY
CONSTRICTION IN
BOTH EYES**

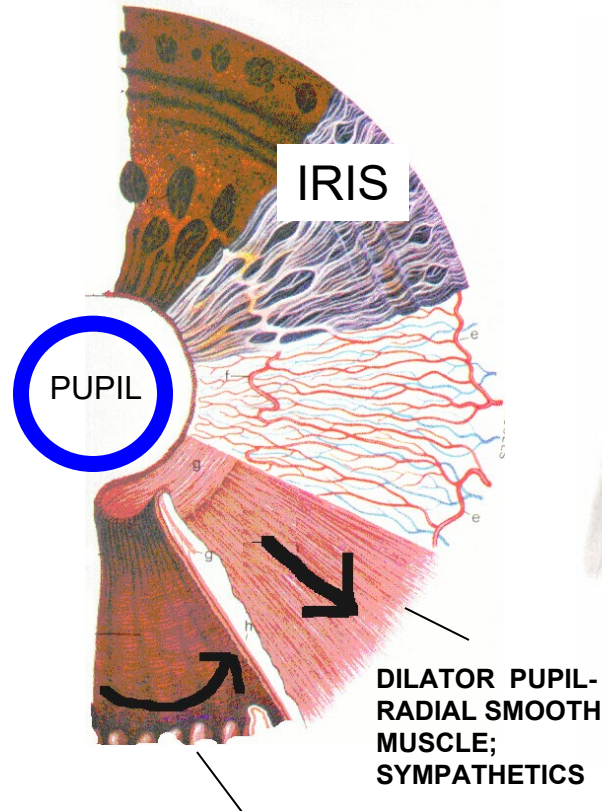
PUPILLARY LIGHT REFLEX

**CN II - OPTIC NERVE -
DETECTS LIGHT**

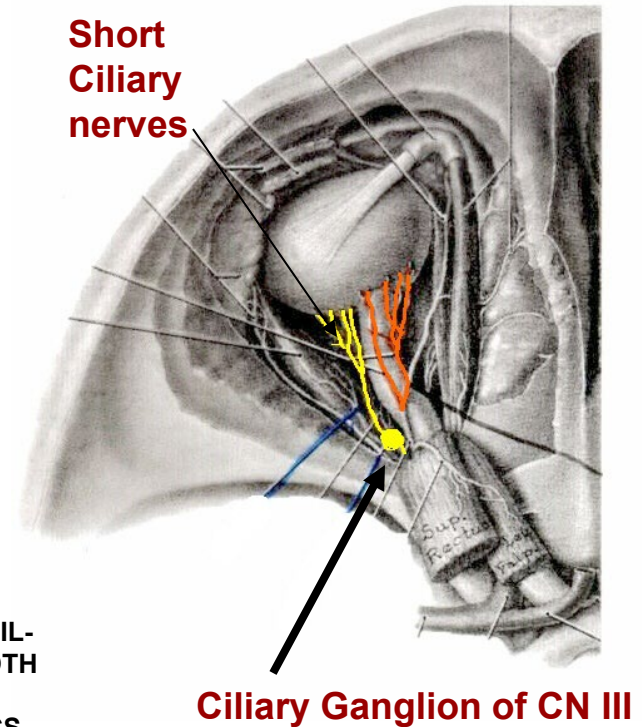


**OPTIC NERVE -
CN II VISION**

**CN III - OCULOMOTOR - parasympathetics
from Ciliary Ganglion in Short Ciliary nerves**



**CONTRACTOR PUPIL-
CIRCULAR SMOOTH MUSCLE;
PARASYMPATHETICS - CN III**



2. CORNEAL REFLEX - V TO VII

AFFERENT ARM OF REFLEX

**SENSORY
STIMULUS**

**TOUCH
CORNEA**

**TRIGEMINAL -
V1 - LONG
CILIARY NERVES
TO CORNEA**



EFFERENT ARM OF REFLEX

**MOTOR
RESPONSE**

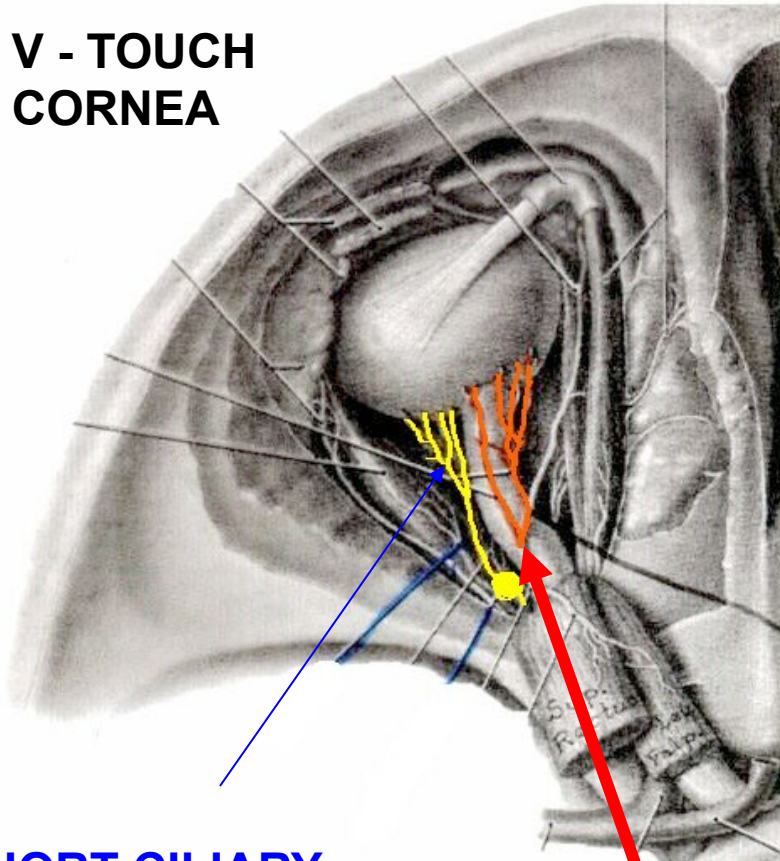
**CLOSE
EYELID**

**FACIAL -
VII - MOTOR TO
ORBICULARIS
OCULI
(Branchiomotor)**

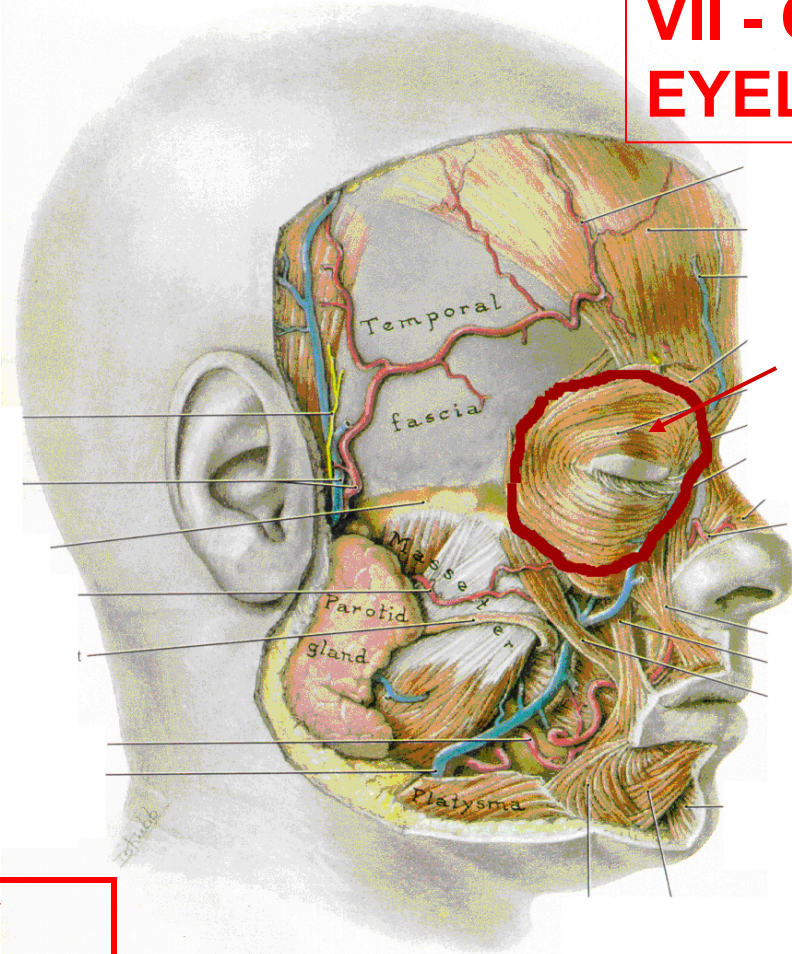
CORNEAL REFLEX - V to VII



V - TOUCH
CORNEA



VII - CLOSE
EYELID



ORBICULARIS
OCULI
M.

SHORT CILIARY
NERVES (III),
CILIARY GANGLION
PARASYMPATHETIC

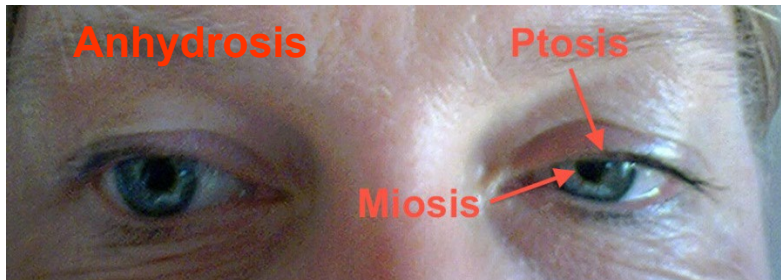
LONG CILIARY
NERVES (V1) -
SOMATIC
SENSORY TO
CORNEA

- Palpebral part - Close eyelids
- Orbital part - Buries eyelids, Ex. sandstorm
BRANCHIOMOTOR - VII

LESIONS OF SYMPATHETICS PRODUCE SYMPTOMS IN EYE: HORNER'S SYNDROME

HORNER'S SYNDROME - damage to Sympathetic pathways: symptoms involve structures of eye and head -

HORNER'S SYNDROME



SYMPTOMS -

- 1) **MIOSIS** - pupillary constriction;
PARALYSIS OF PUPILLARY DILATOR MUSCLE
- 2) **PTOSIS** - drooping eyelid;
PARALYSIS OF SMOOTH MUSCLE PART OF LEVATOR PALPEBRAE SUPERIORIS
- 3) **ANHYDROSIS** - lack of sweating;
LOSS OF INNERVATION OF SWEAT GLANDS

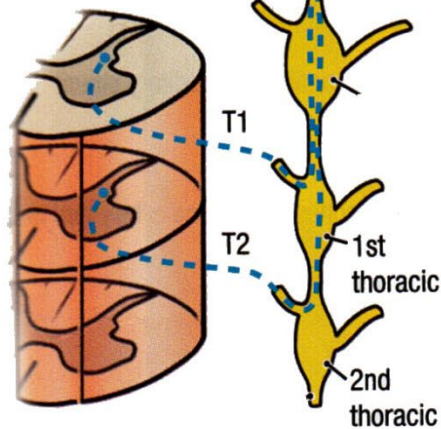
CLINICAL

CAN DAMAGE SYMPATHETIC CHAIN IN NECK; SHOW SYMPTOMS IN EYE AND FACE

PTOSIS - DAMAGE PATHWAY OF SYMPATHETICS TO EYE

2) **PRE-
GANGLIONIC
AXONS ASCEND
CHAIN AND
SYNAPSE
IN SUPERIOR
CERVICAL
GANGLION**

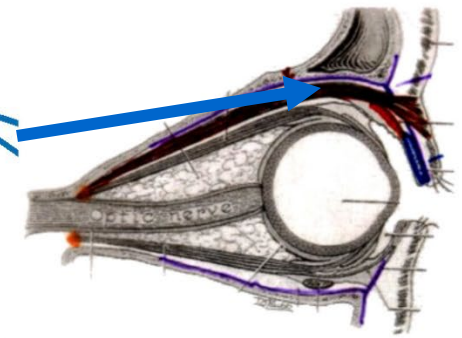
1) **OUT T1,
T2**



3) **POST-
GANGLIONIC
FIBERS
JOIN
PLEXUS
ON
INTERNAL
CAROTID
ARTERY**

4) **PARALYZE
SMOOTH
MUSCLE OF
LEVATOR
PALPEBRAE
SUPERIORIS**

**PTOSIS =
EYELID DROOP**



HYPOTHALAMUS

DIENCEPHALON

MIDBRAIN

POIS

MEDULLA

SPINAL CORD

T 1

L 2

White rami

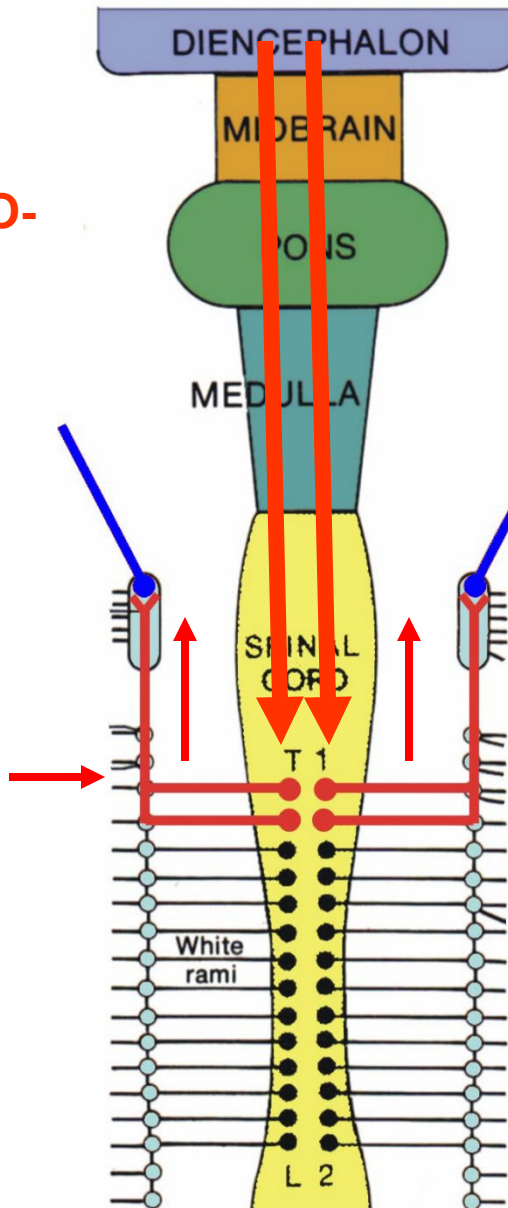
LESIONS CAN OCCUR IN MANY PLACES IN PATHWAY

HYPOTHALAMO-SPINAL TRACT

to Target Organ

2) Neuron 2
(Postganglionic neuron) In
Superior Cervical Ganglia

PATHWAY TO HEAD -
1) Neuron 1
(Preganglionic neuron) in
spinal cord at
T1, T2

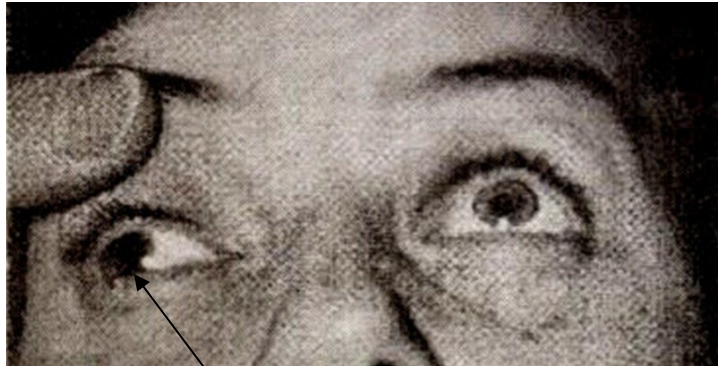


Ptosis (drooping of the eyelid)



PTOSIS = DROOPING EYELID; CAN BE SIGN OF DAMAGE TO OCULOMOTOR NERVE (III) OR SYMPATHETICS

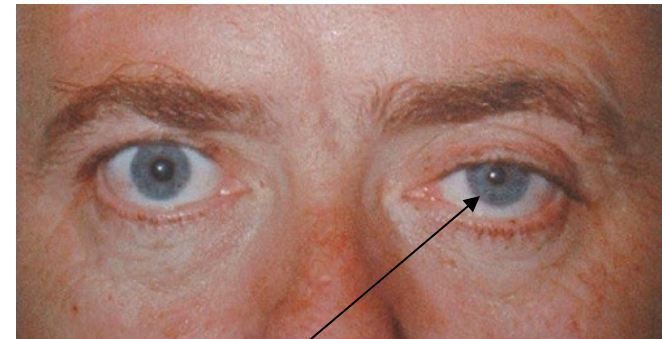
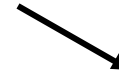
SKELETAL MUSCLE PART



OCULOMOTOR NERVE PALSY
other symptoms: - Pupil is dilated
- denervate Pupillary constrictor (Mydriasis) - Also affect **Eye movements** - Accommodation

CN III SYMPTOMS – EYELID DROOP + CONSTRICTED PUPIL

SMOOTH MUSCLE PART



SYMPATHETICS - HORNER'S SYNDROME -
- Miosis - denervate Pupillary dilator; constricted pupil
- Anhidrosis - lack of sweating

SYMPATHETIC SYMPTOMS – EYELID DROOP + CONSTRICTED PUPIL