DISCUSSION SESSION: GROSS ANATOMY

ONN BLOCK

Monday Feb 8, 2021

Discuss Spinal Reflexes, Cranial Nerve Reflexes (including testing), Autonomics (including Horner's syndrome)

SPINAL AND CRANIAL NERVE REFLEXES

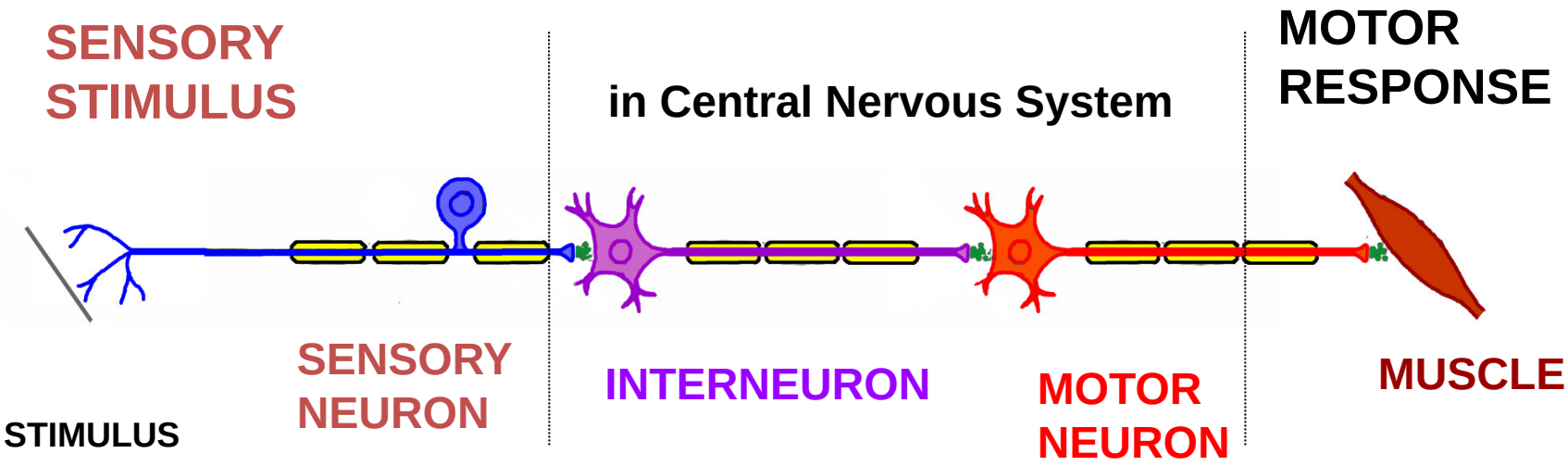
Review reflexes as clinical tools

Three basic Spinal Reflexes –

Stretch reflex – tap on tendon causes muscle to contract
Flexor reflex – aversive stimulus (ex. strong tactile stimulation of sole of foot) causes flexor muscles to contract
Autogenic inhibition – Large forces cause muscle to relax

Cranial nerve reflexes

TYPICAL REFLEX



Reflexes are clinical tools. For reflex to occur, all elements (sensory neuron, interneuron, muscle) must be functional:
If absent, diagnose where pathway is interrupted.
If abnormal, diagnose where pathway is compromised.

REFLEXES CAN BE USED TO TEST NERVOUS SYSTEM FUNCTION, LOCATE SITE OF LESION

SPINAL REFLEXES

SPINAL REFLEXES AND DISORDERS

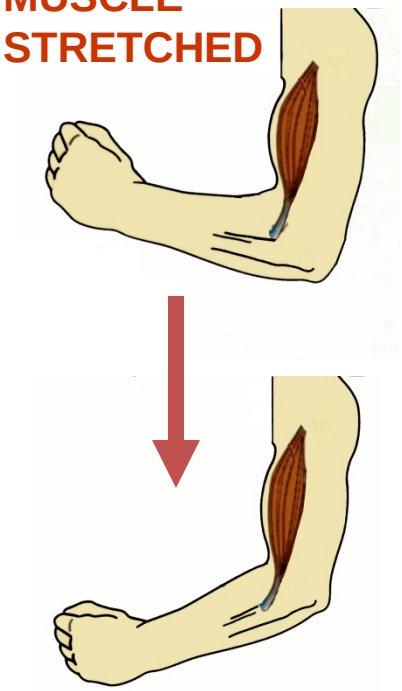
REFLEX	STIMULUS/SENSE ORGAN(S) EXCITED	NORMAL RESPONSE	UPPER MOTOR NEURON DISORDERS
Stretch (Myotatic, Deep Tendon) Reflex – Compensatory maintain position (ex. riding on moving bus)	Rapid Stretch of muscle (test: tap on muscle tendon) Excites Muscle Spindle Primary (Ia) and Secondary (II) sensory neurons (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	Hyperreflexia - (increase) - characteristic of Upper Motor Neuron lesions (ex. spinal cord injury, damage Corticospinal tract); note: Clonus = 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	Clasped Knife Reflex - 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)	Babinski sign- toes extend (dorsiflex) to cutaneous stimulus of sole of foot (normally plantar flex); characteristic of Upper Motor Neuron lesion

STRETCH REFLEX

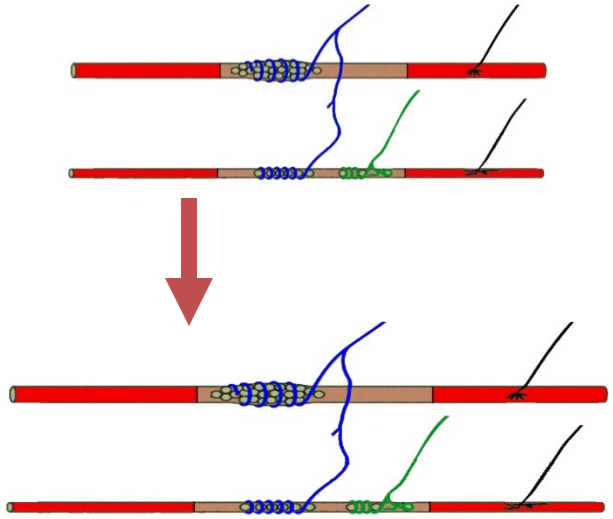
STIMULUS

RESPONSE

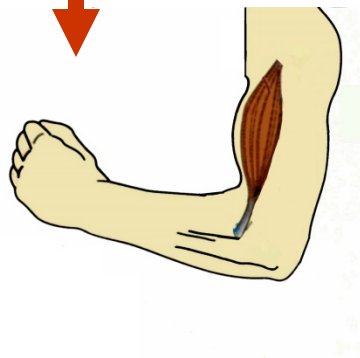
BICEPS MUSCLE STRETCHED



BICEPS MUSCLE SPINDLE



BICEPS MUSCLE CONTRACTS



1) Stimulus - <u>fast stretch</u> of muscle

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

3) Primary response - muscle that is stretched <u>contracts rapidly</u>

OTHER COMPONENTS OF STRETCH REFLEX

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

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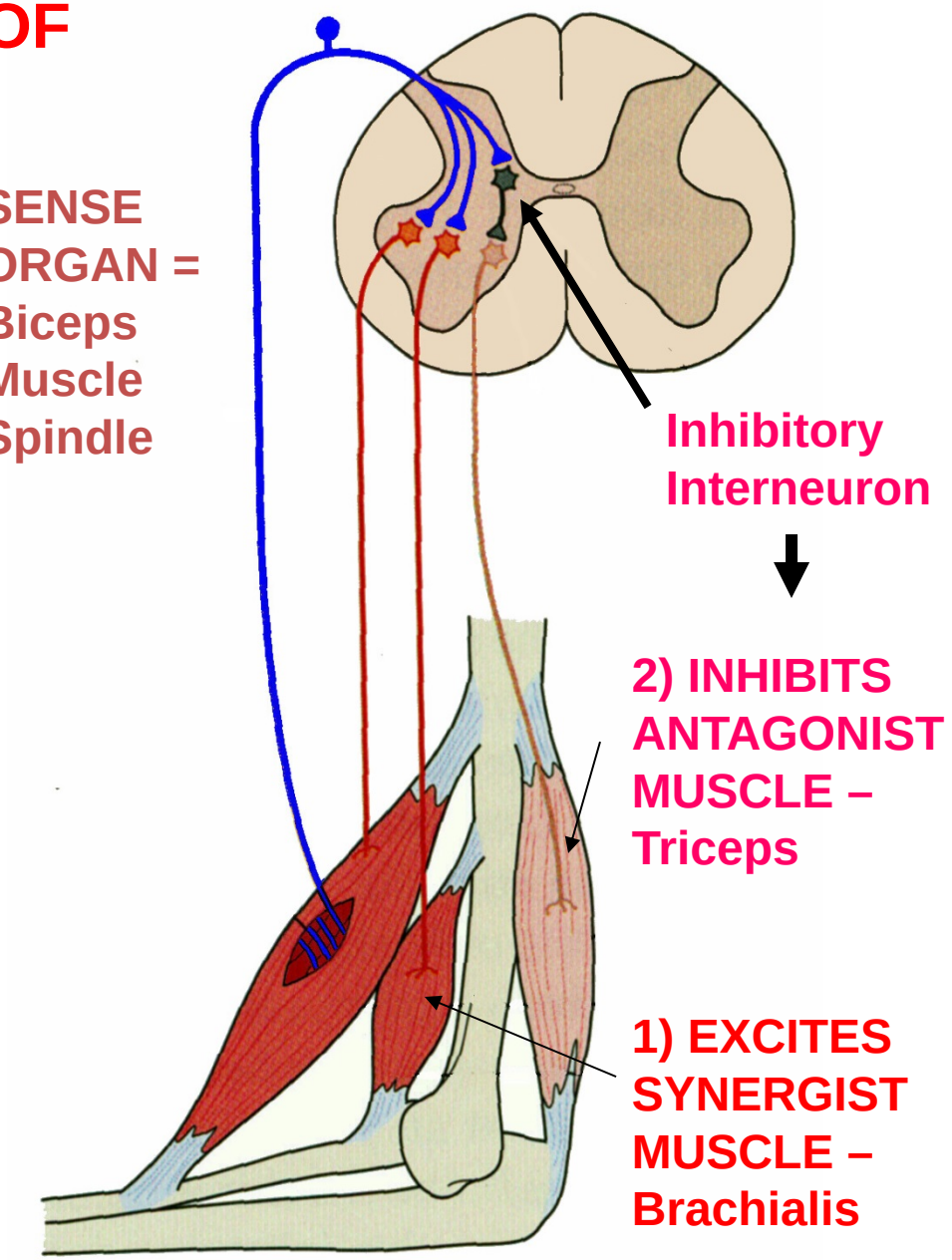
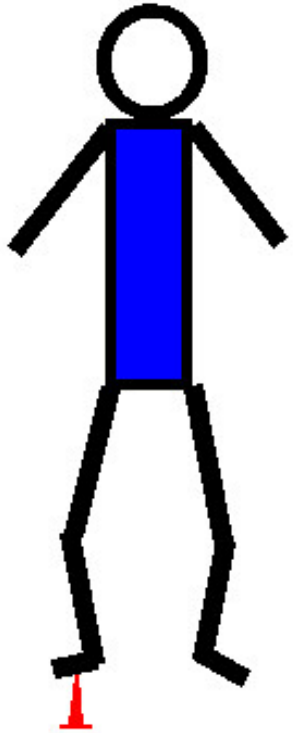
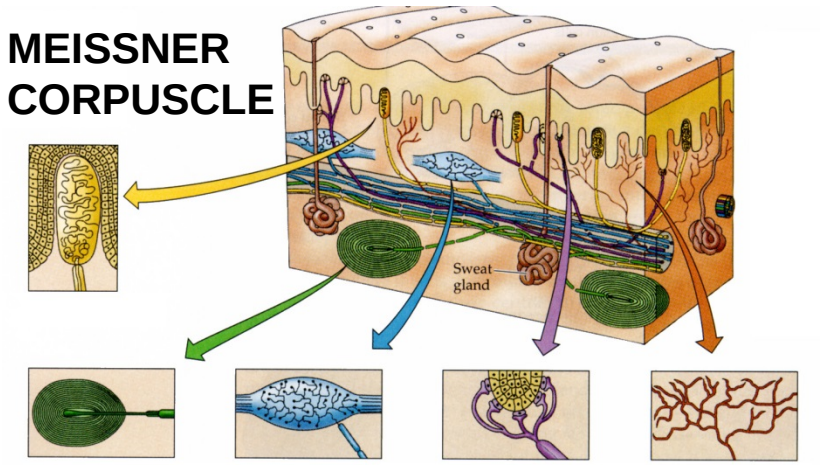
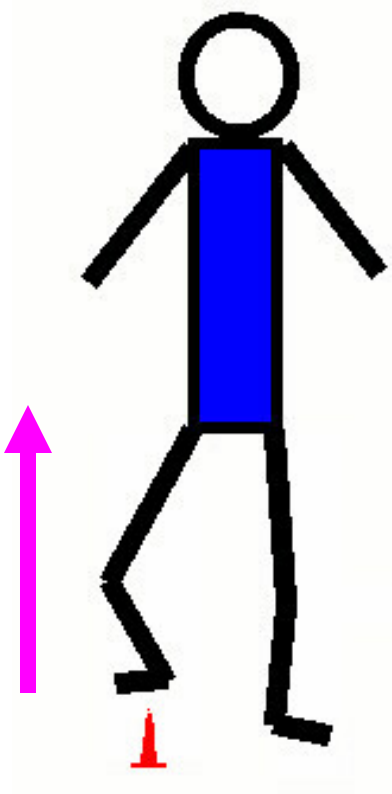
2) Inhibit antagonist muscles - RECIPROCAL INHIBITION - Spindle activity also excites interneurons that make inhibitory synapses on motor neurons to antagonist muscles (polysynaptic)



FLEXOR REFLEX





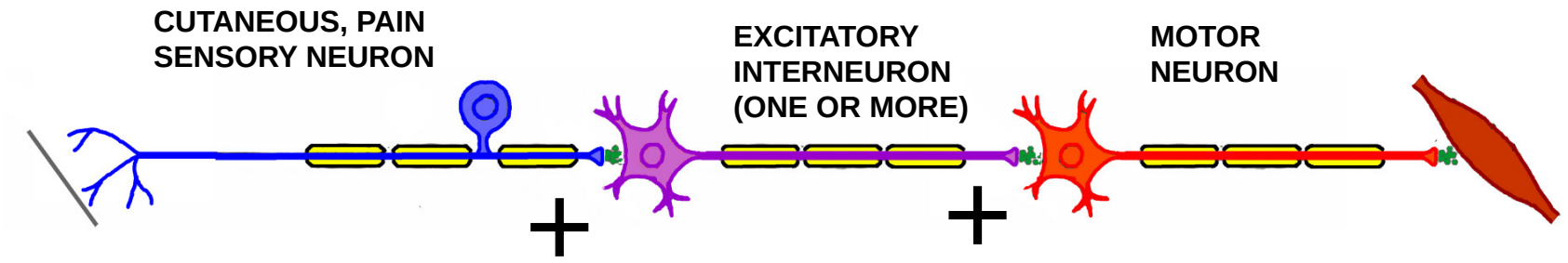


1) Stimulus - painful or noxious stimulus (stepping on nail)

2) Sense organ excited - Cutaneous receptors, Pain receptors (nociceptors)

3) Primary response - Protective withdrawal of limb

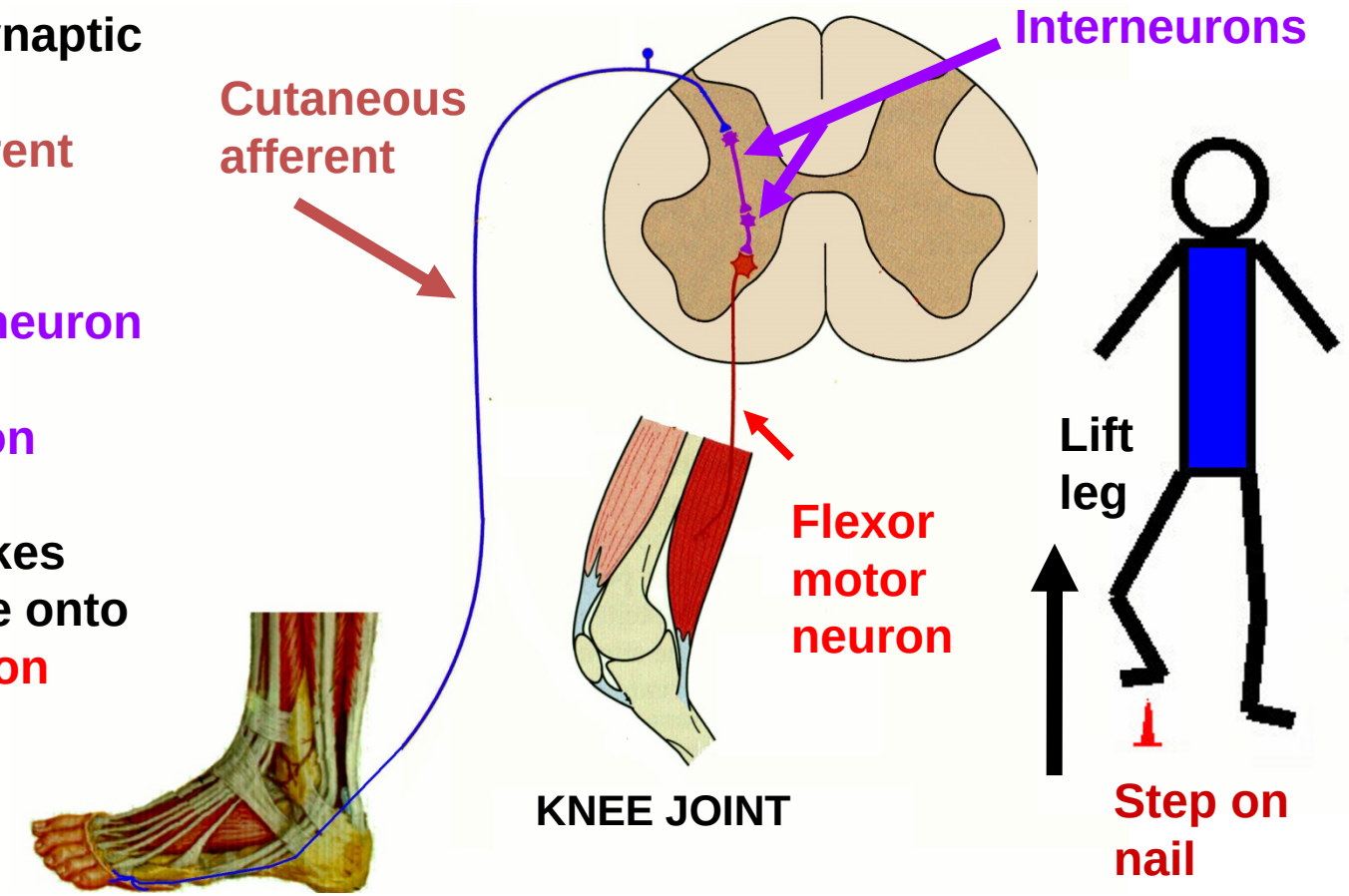
FLEXOR REFLEX: PATHWAYS



Synapses - Polysynaptic

1) Cutaneous afferent makes excitatory synapse onto Interneuron; Interneuron can synapse upon another interneuron

2) Interneuron makes excitatory synapse onto Flexor motor neuron



FLEXOR REFLEX: OTHER EFFECTS
ALL ARE POLYSYNAPTIC 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

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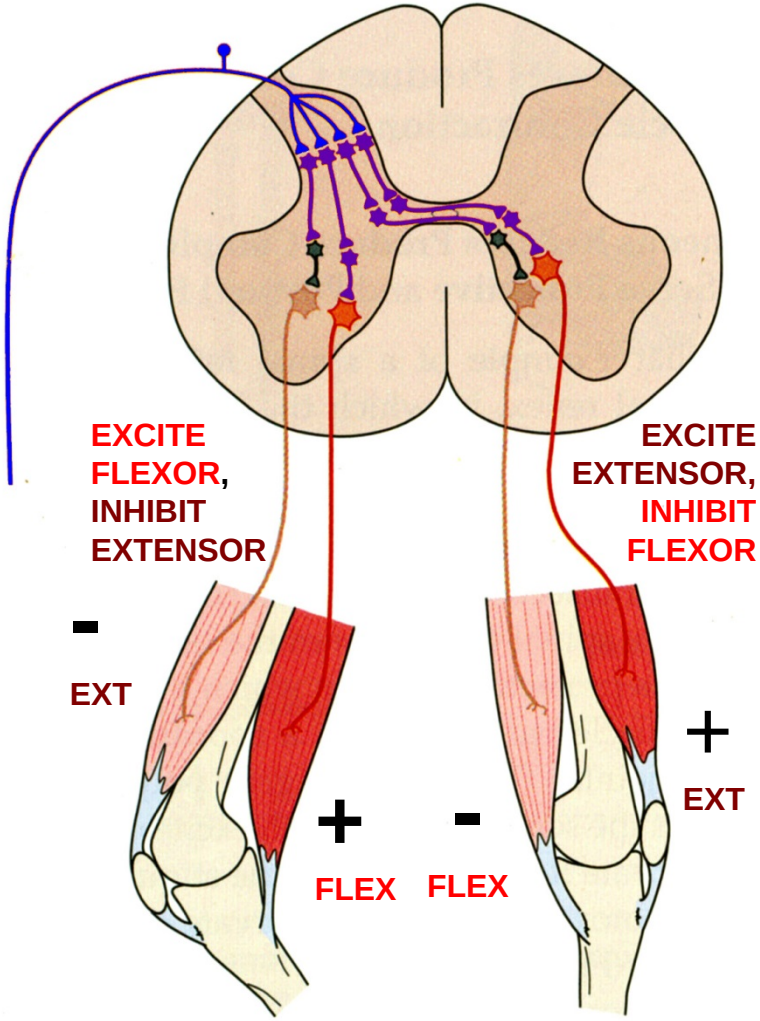

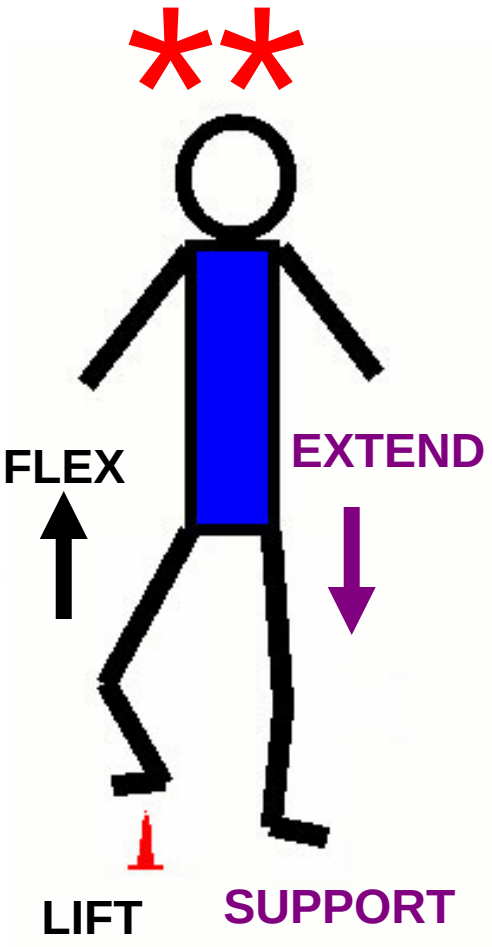

FUNCTION: OTHER LEG PROVIDES SUPPORT WHEN FIRST LEG IS LIFTED

FLEXOR REFLEXES CAN CHANGE AFTER LESIONS, DISEASE PROCESSES

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NORMAL RESPONSE

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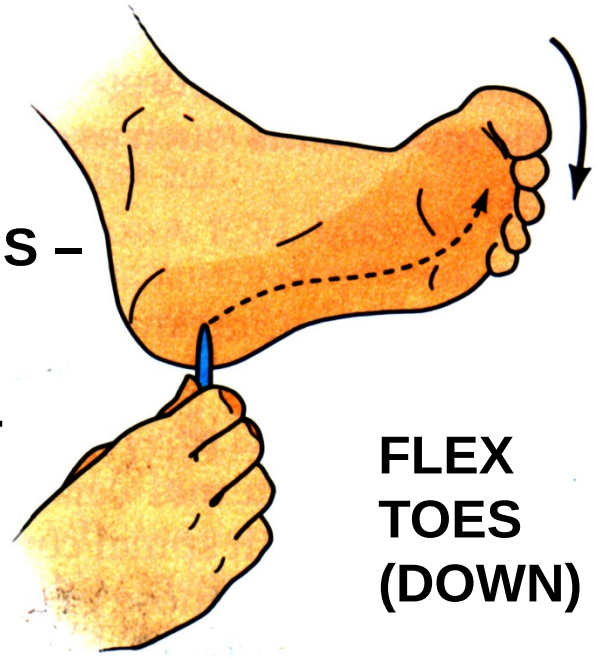
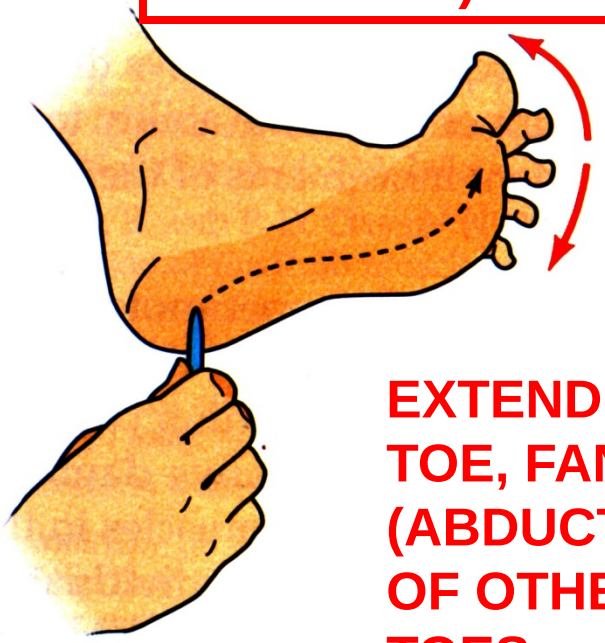
BABINSKI SIGN – (EXTENSOR PLANTAR RESPONSE)

STIMULUS – TO SKIN OF SOLE OF FOOT



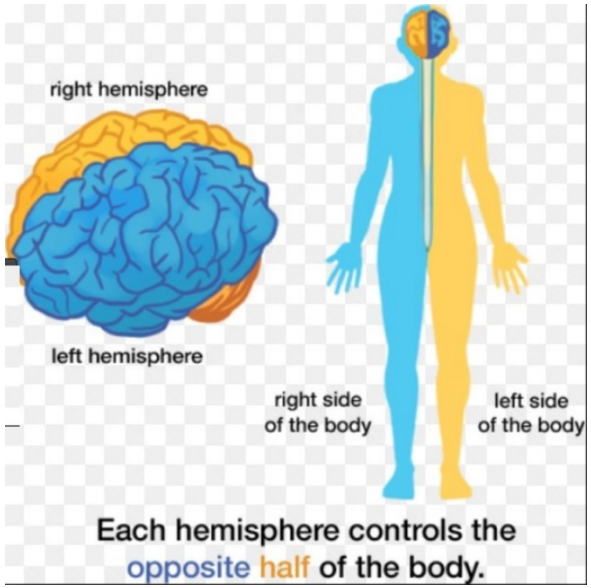
FLEX TOES (DOWN)

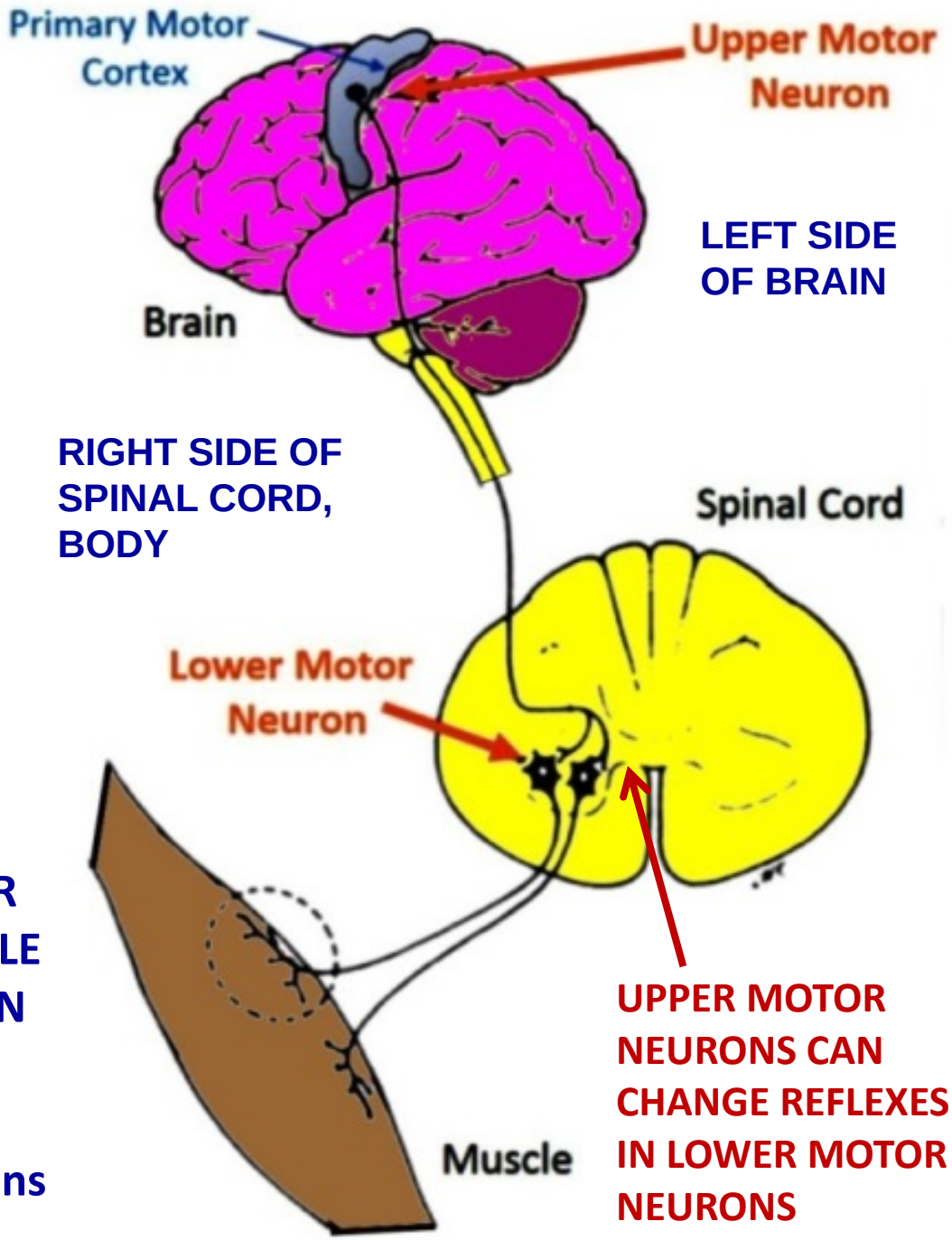


EXTEND BIG TOE, FANNING (ABDUCTION) OF OTHER TOES

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

UPPER VS LOWER MOTOR NEURON

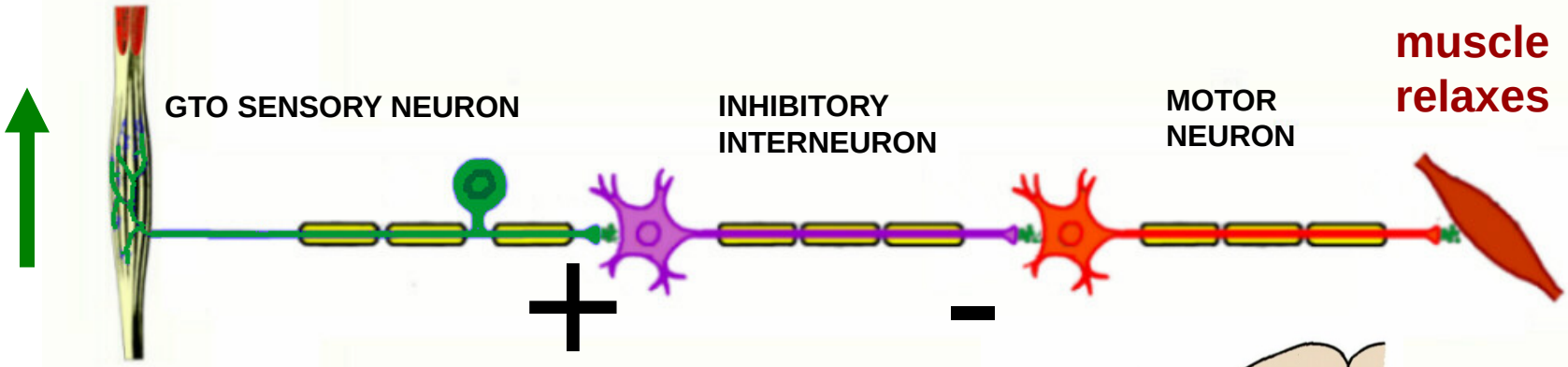




LOWER MOTOR NEURON = MOTOR NEURON THAT INNERVATES MUSCLE

UPPER MOTOR NEURON – NEURON IN CNS THAT CAN ACTIVATE OR INFLUENCE LOWER MOTOR NEURONS (ex. Corticospinal neurons in brain)

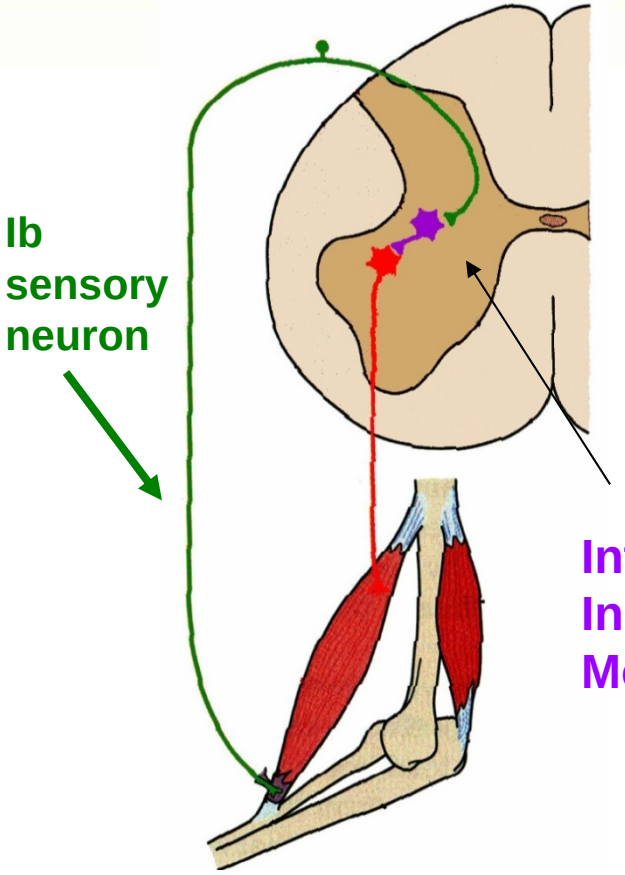
AUTOGENIC INHIBITION REFLEX: GOLGI TENDON ORGANS



PRIMARY RESPONSE
Synapses - polysynaptic

1) Ib sensory neuron (GTO) makes excitatory synapse onto interneuron
2) Interneuron makes inhibitory synapse onto motor neuron; Motor neuron decreases firing

Function of Autogenic inhibition - Regulating muscle tensions (protective, prevent damage to tendon)

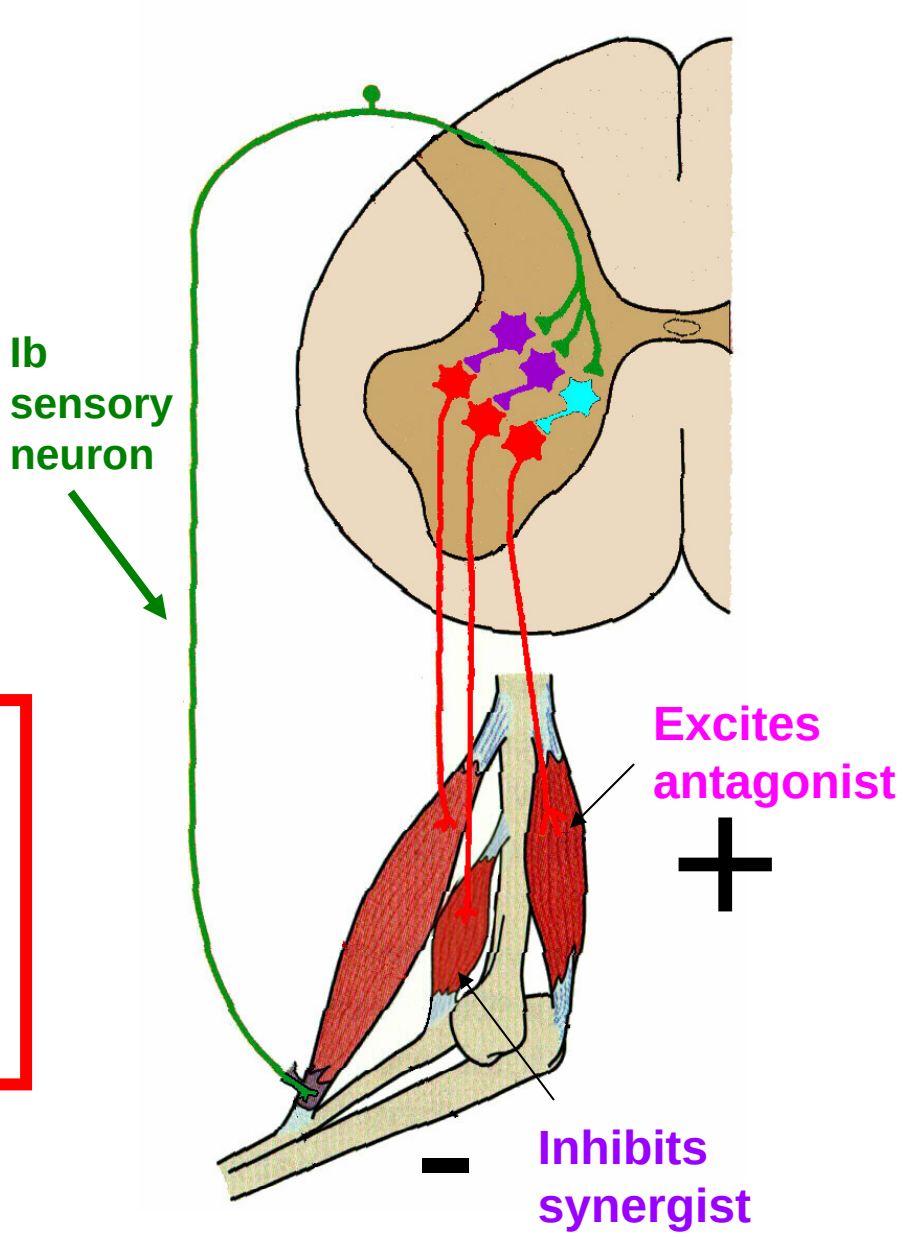


AUTOGENIC INHIBITION

Other effects

a. Inhibit synergist muscles
b. Excites antagonist muscles -

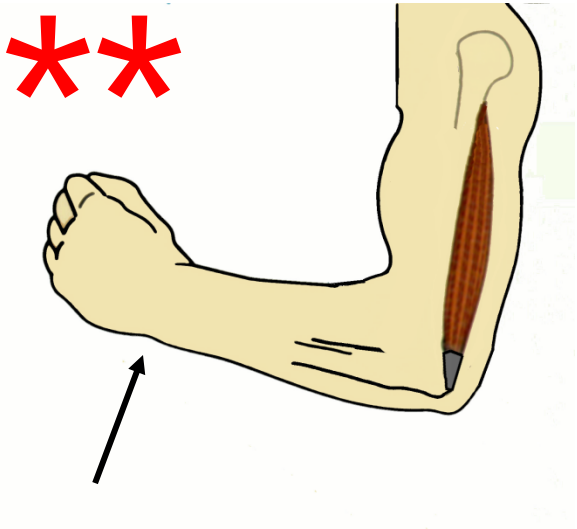
CLASPED KNIFE REFLEX: in Upper motor neuron lesions, tonus increases, resistance to stretch increases; if sufficient force is applied, limb resistance suddenly decreases (like pocket knife snapping shut)



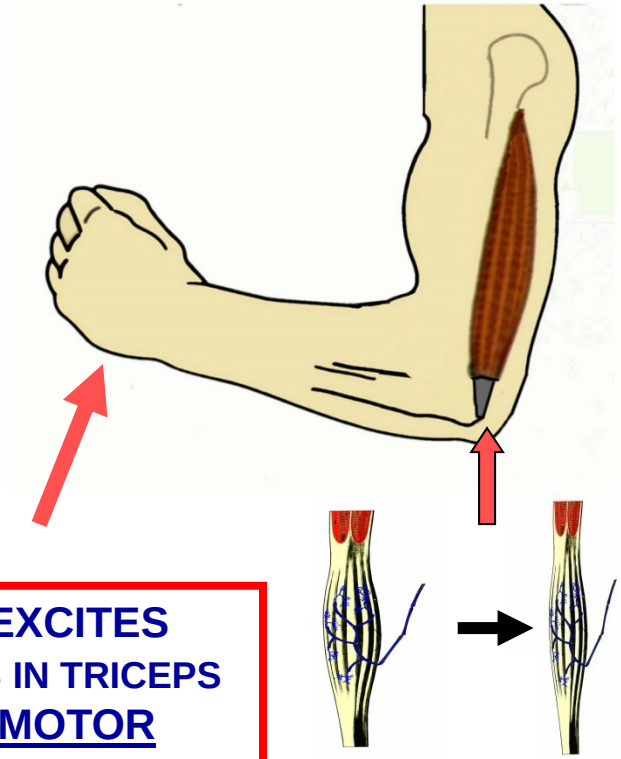
CLASPED KNIFE REFLEX: is an example of Autogenic inhibition.

It is elicited in patients with UMN lesions due to high tonus in muscle.

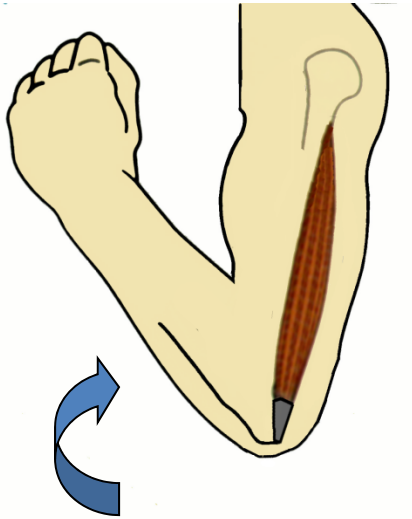
1) PHYSICIAN TRIES TO FLEX ELBOW JOINT OF PATIENT WITH UPPER MOTOR NEURON LESION



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



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



HIGH IMOSED 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	Hyporeflexia - 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

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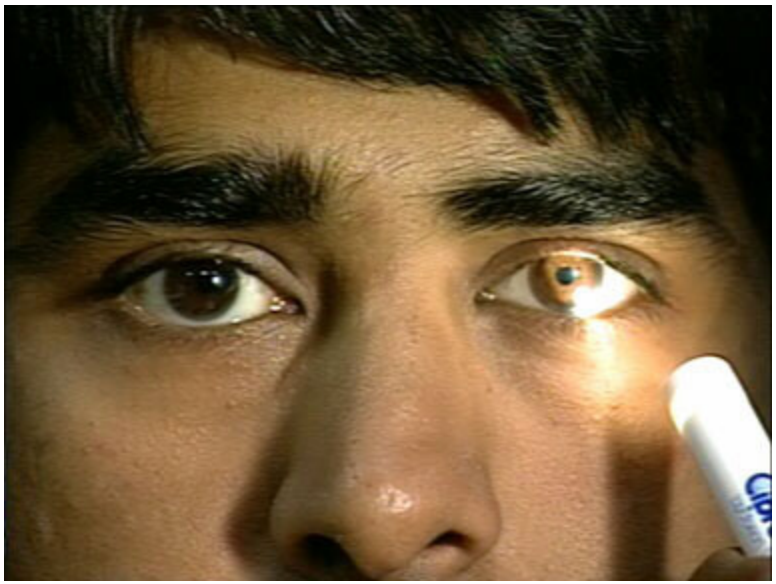
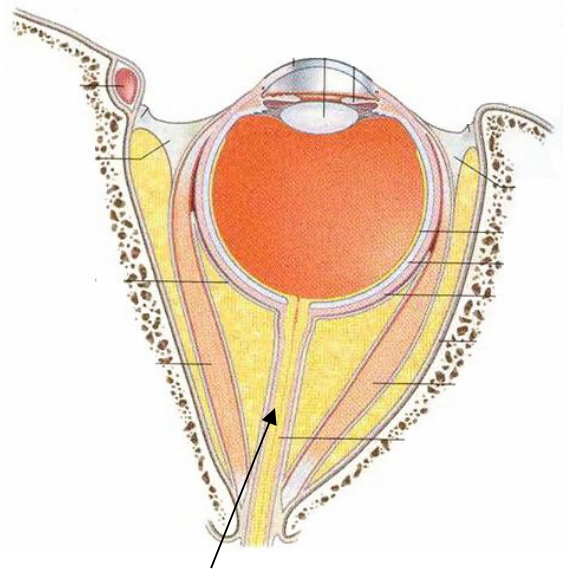


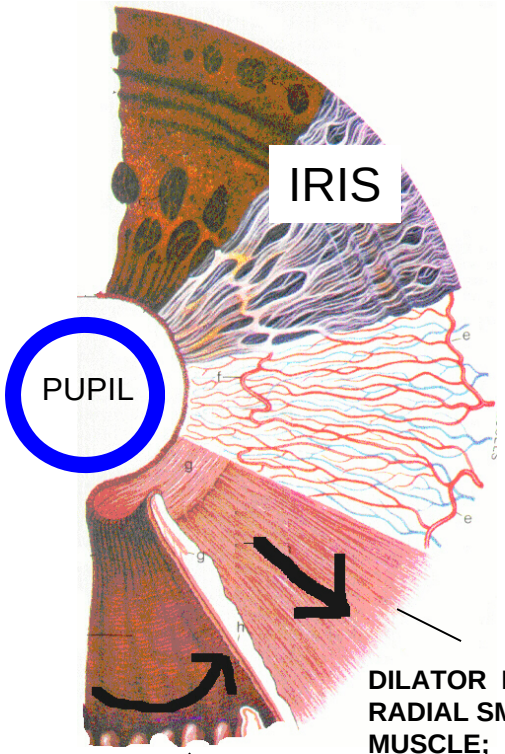
PUPILLARY LIGHT REFLEX

CN II - OPTIC NERVE - DETECTS LIGHT

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

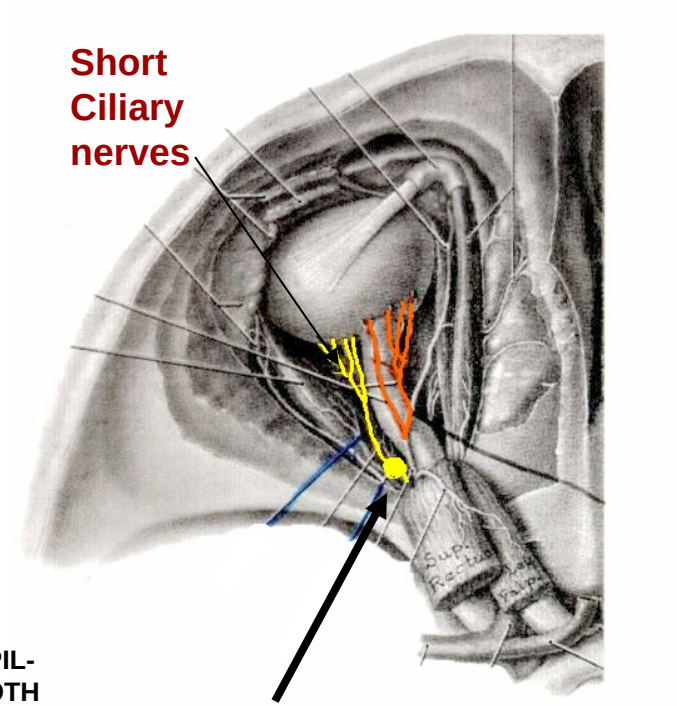


OPTIC NERVE - CN II VISION



DILATOR PUPIL- RADIAL SMOOTH MUSCLE; SYMPATHETICS

CONSTRICTOR PUPIL- CIRCULAR SMOOTH MUSCLE; PARASYMPATHETICS - CN III



Ciliary Ganglion of CN III

PUPILLARY LIGHT REFLEX

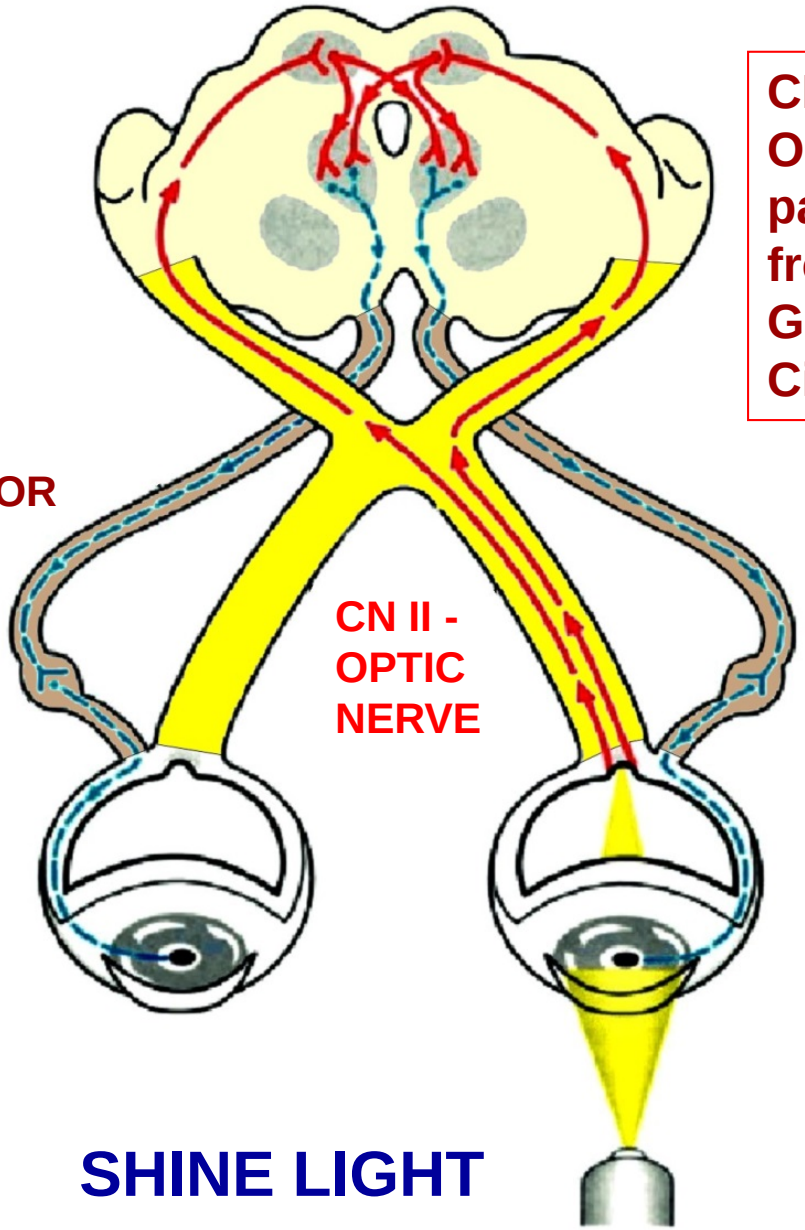
CN II - OPTIC NERVE - DETECTS LIGHT

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

CN III - OCULOMOTOR

CN III - OCULOMOTOR

CN II - OPTIC NERVE



CONSENSUAL REFLEX – PUPIL CONSTRICTS IN OPPOSITE EYE

DIRECT REFLEX – PUPIL CONSTRICTS IN SAME EYE

SHINE LIGHT

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 (SVE)

CORNEAL REFLEX - V to VII

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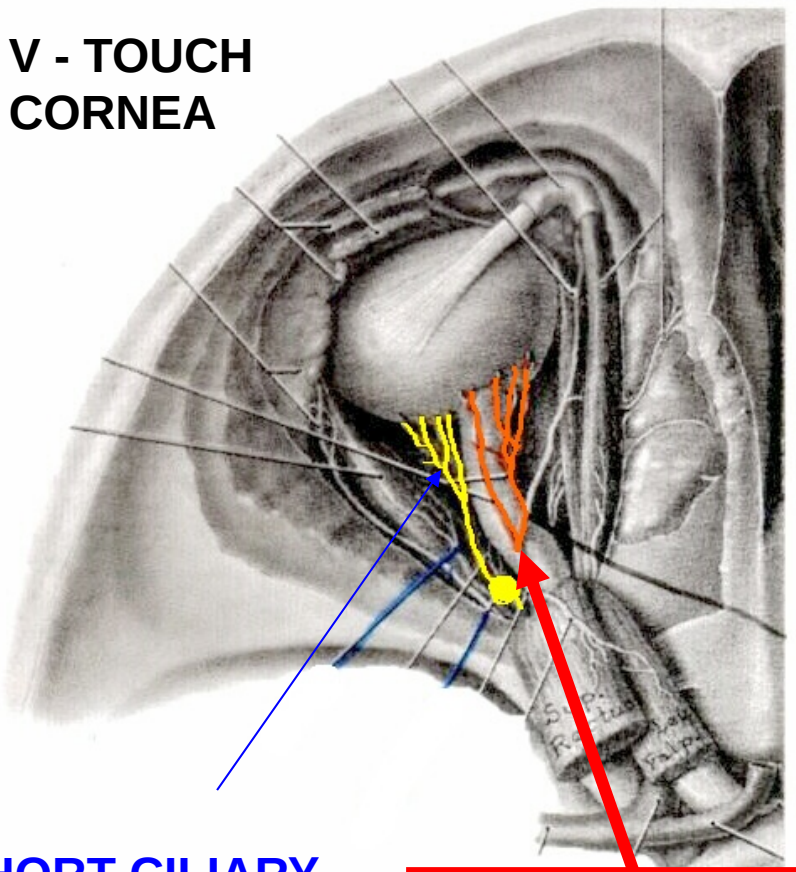
V - TOUCH CORNEA



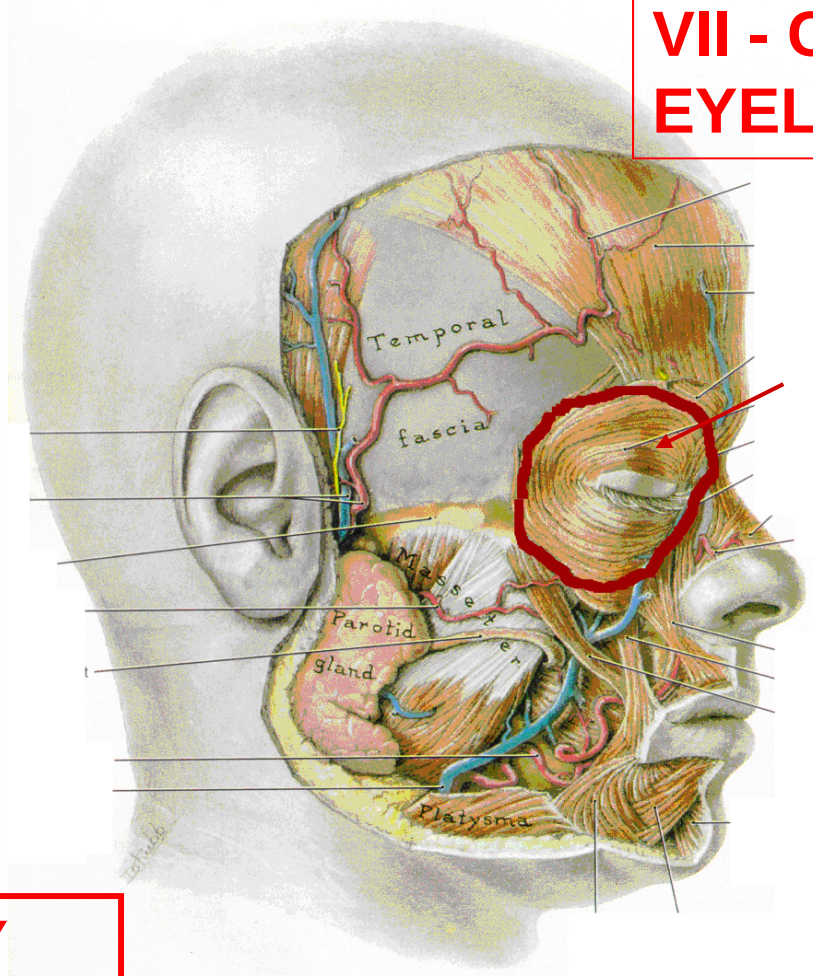
SHORT CILIARY NERVES (III),

CILIARY GANGLION

PARASYMPATHETIC

LONG CILIARY NERVES (V1) - SOMATIC SENSORY TO CORNEA

VII - CLOSE EYELID



ORBICU-LARIS OCULI M.

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

GAG REFLEX - IX to X

GO OVER NEXT BLOCK

AFFERENT ARM OF REFLEX

SENSORY STIMULUS

TOUCH ORO-PHARYNX

EFFERENT ARM OF REFLEX

MOTOR RESPONSE

PATIENT GAGS - CONTRACT PHARYNGEAL MUSCLES

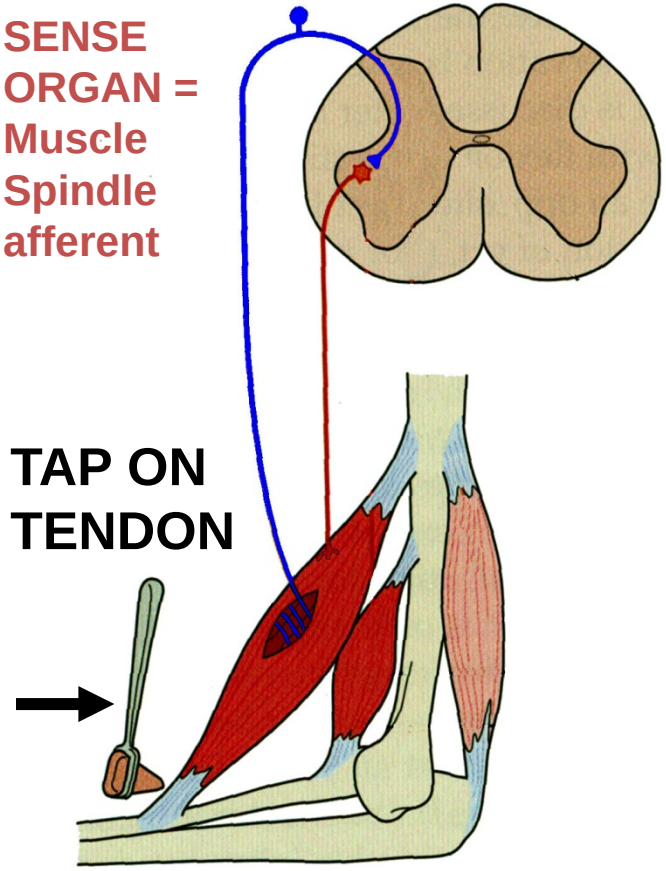
STRETCH REFLEX OF MUSCLES OF MASTICATION - JAW JERK REFLEX - sensory and motor in Trigeminal V3

GO OVER NEXT BLOCK

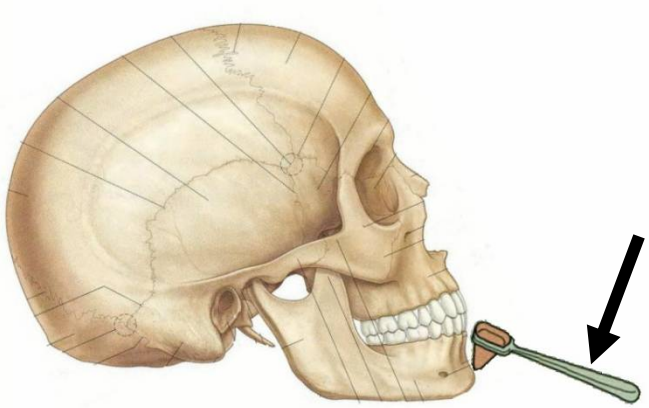
STRETCH REFLEX

SENSE ORGAN = Muscle Spindle afferent

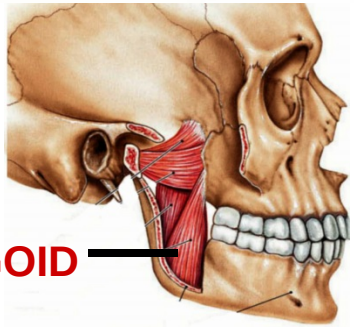
TAP ON TENDON



TAP DOWN ON CHIN

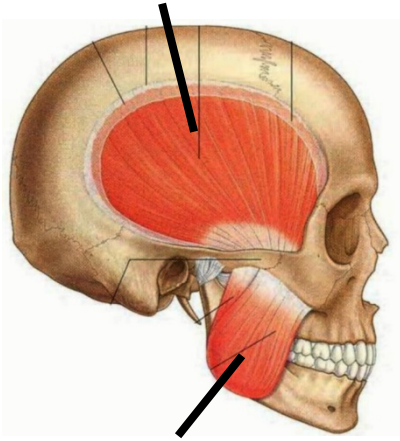


MEDIAL PTERYGOID



STRETCH MUSCLES THAT CLOSE MOUTH (ELEVATE MANDIBLE)

TEMPORALIS



MASSETER

REFLEX TESTING IN NEW BORNS/INFANTS – GO OVER NEXT BLOCK

PALMAR GRASP

MORO REFLEX - arm extend

STEPPING 'REFLEX' - actually eliciting motor pattern

PLANTAR GRASP

PLACING REFLEX

TONIC NECK REFLEX - extend ipsilateral arm, flex opposite arm

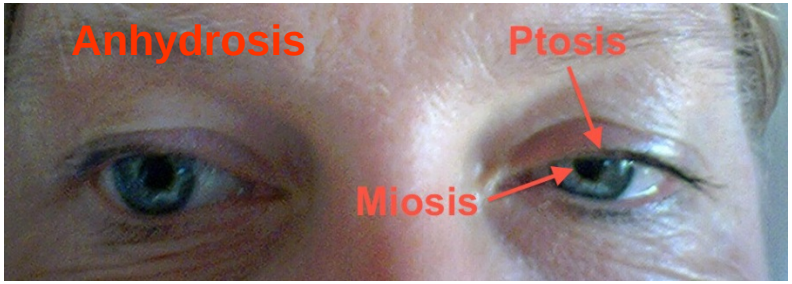
AUTONOMICS Horner’s Syndrome

AUTONOMICS

Horner’s Syndrome

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

HORNER'S SYNDROME



CLINICAL

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

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

SYMPTOMS -

1) MIOSIS - pupillary constriction;
PARALYSIS OF PUPILLARY DILATOR MUSCLE

2) PTOSIS - drooping eyelid;
PARALYSIS OF SMOOTH MUSCLE PART OF LEVATOR PALPEBRAE SUPERIORIS

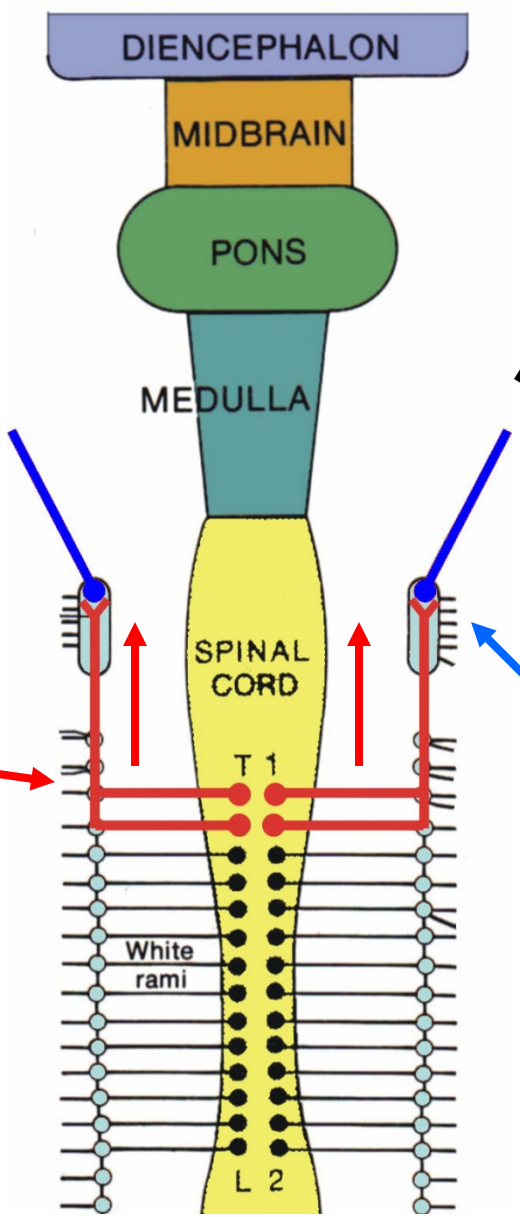
3) ANHYDROSIS - lack of sweating;
LOSS OF INNERVATION OF SWEAT GLANDS

SYMPATHETICS TO HEAD

PATHWAY TO HEAD -

1) Neuron 1 (Preganglionic neuron) in spinal cord at T1, T2

- leaves and ascends sympathetic chain

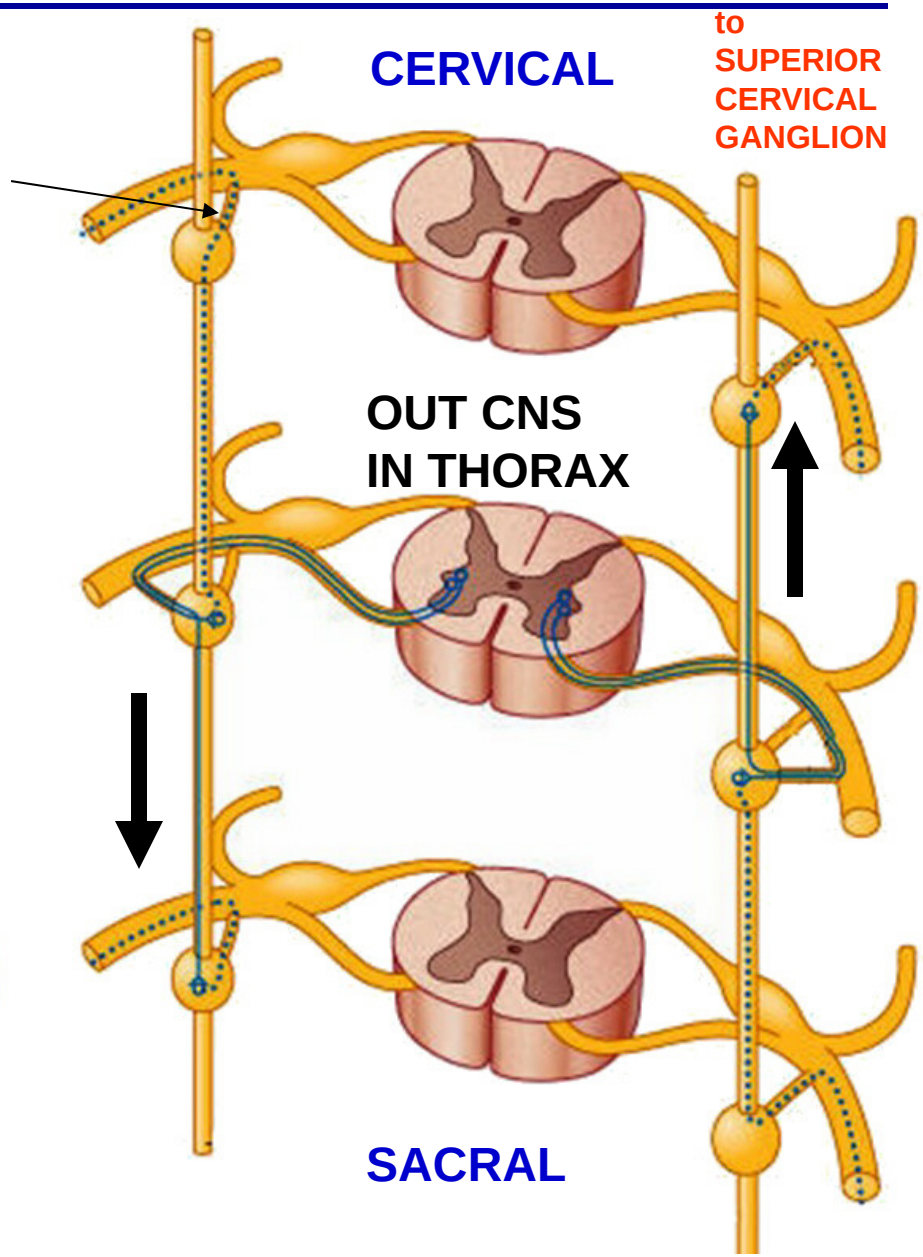


to Target Organ

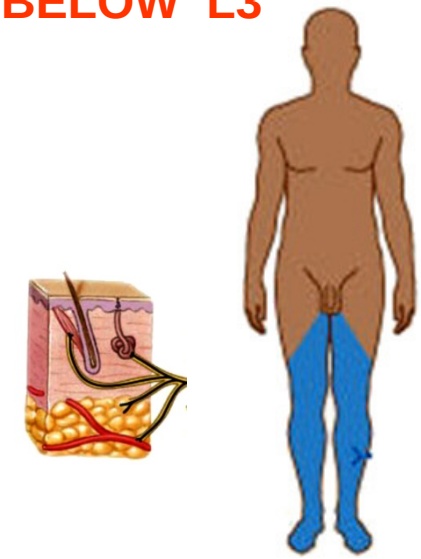
Joins Plexus on Internal and External Carotid Arteries in mostly Unnamed branches

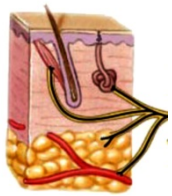
2) Neuron 2 (Postganglionic neuron) In Superior Cervical Ganglia

SYMPATHETICS TO SKIN - IN THORAX CAN COME OUT AND ASCEND OR DESCEND CHAIN OF GANGLIA



SYMPATHETICS TO SKIN, BLOOD VESSELS BELOW L3



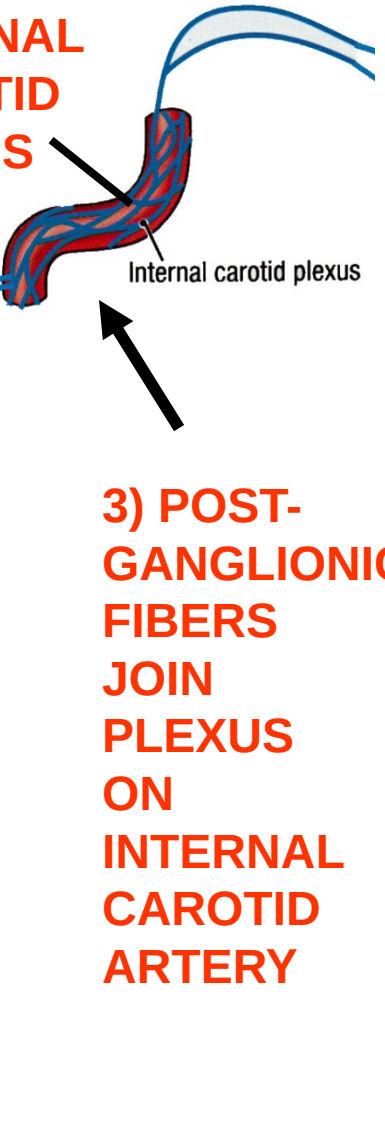


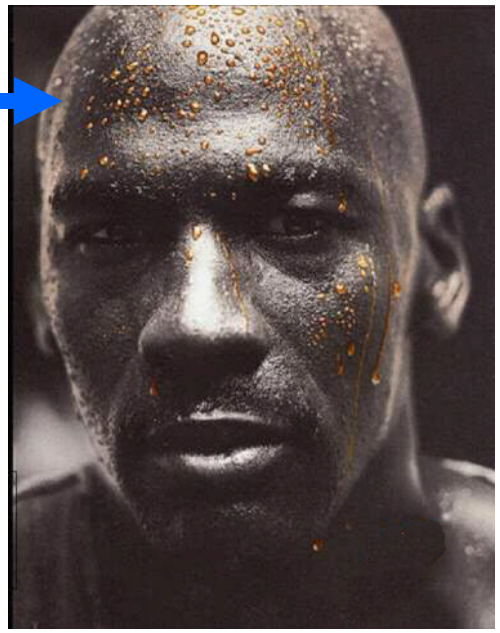
EX. join nerves of Brachial Plexus to Skin of Arm, Hand

SYMPATHETICS TO SKIN, BLOOD VESSELS ABOVE T1

SYMPATHETICS TO SKIN OF HEAD

INTERNAL CAROTID PLEXUS





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

1) OUT T1, T2

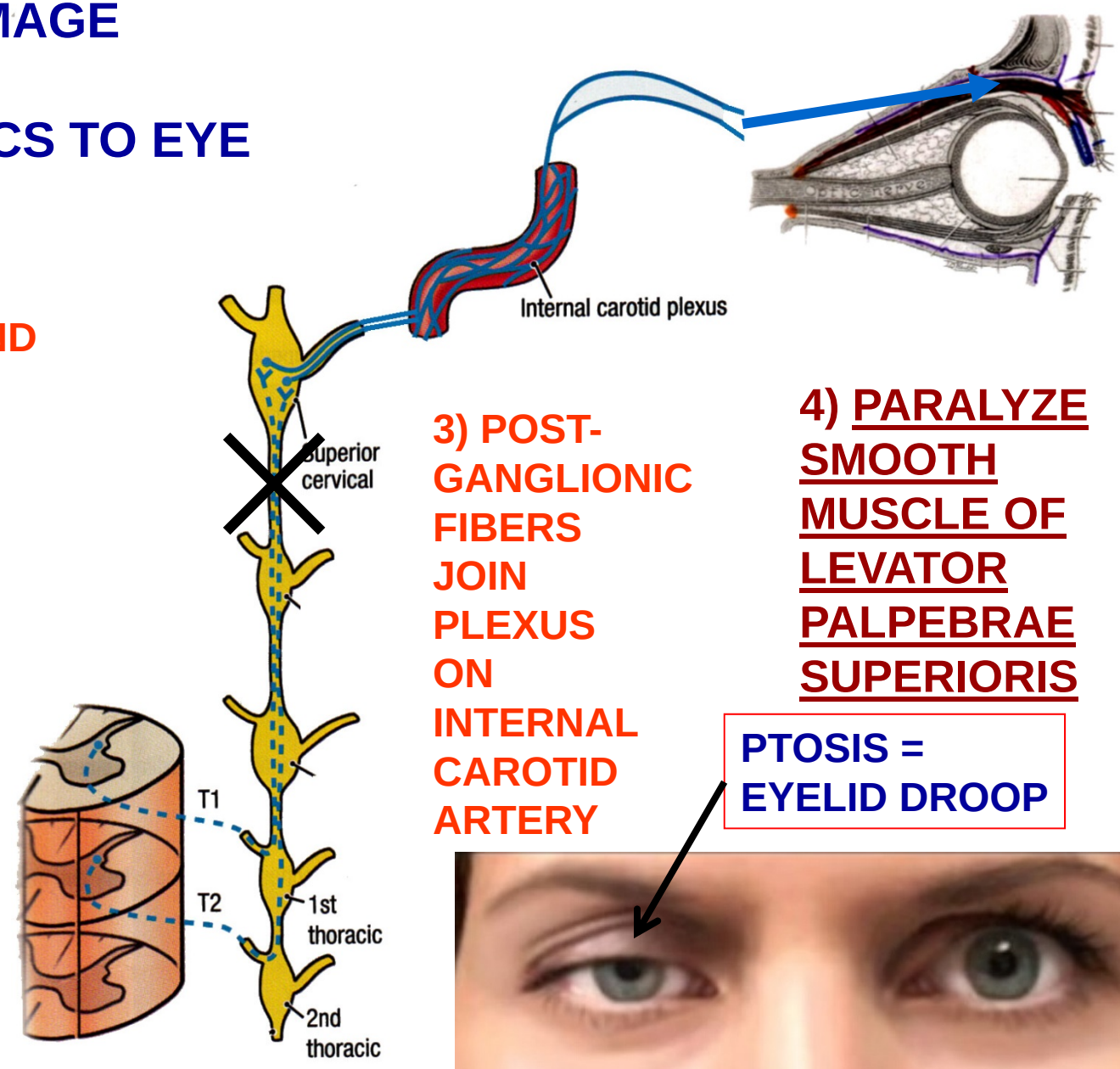
3) POST-GANGLIONIC FIBERS JOIN PLEXUS ON INTERNAL CAROTID ARTERY

4) POST-GANGLIONIC FIBERS END IN SKIN OF FACE; MICHAEL JORDAN SWEATS

BLOCK OR DAMAGE SYMPATHETICS - ANHYDROSIS = LACK OF SWEATING

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) <u>PARALYZE SMOOTH MUSCLE OF LEVATOR PALPEBRAE SUPERIORIS</u>

PTOSIS = EYELID DROOP

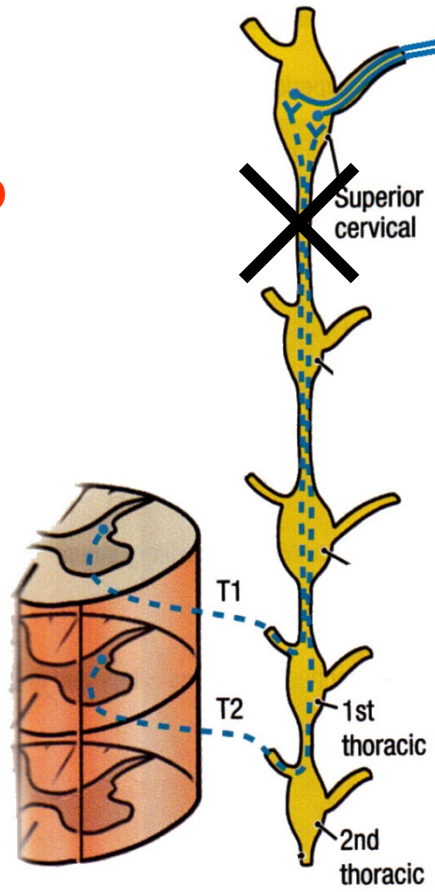
MIOSIS - DAMAGE PATHWAY OF SYMPATHETICS TO EYE

CN III - OCULOMOTOR CONSTRICTOR IS UNOPPOSED

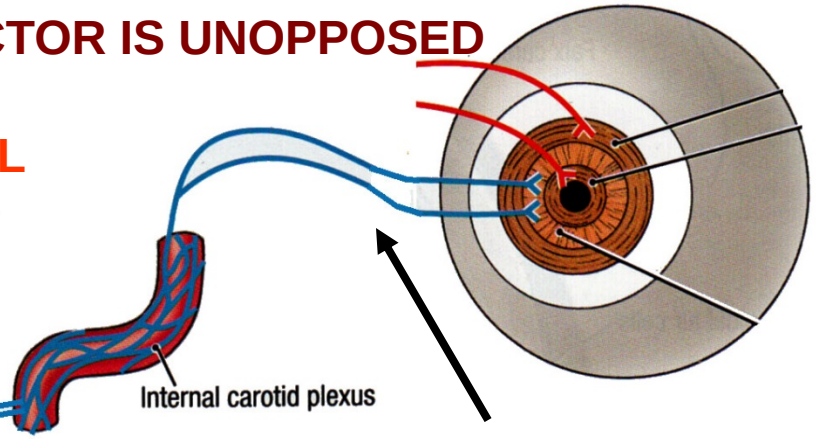
INTERNAL CAROTID PLEXUS

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 DILATOR PUPILLAE (RADIAL SMOOTH MUSCLE)

PUPIL IS CONSTRICTED (MIOSIS) - CONSTRICTOR INNERVATED BY OCULOMOTOR NERVE (III)

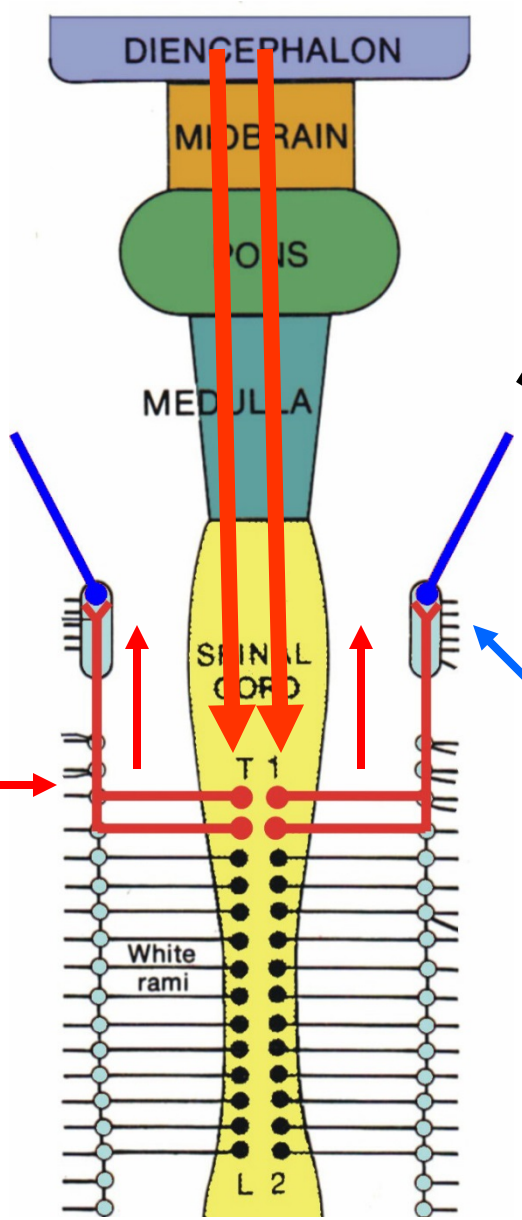
SUMMARY CHART: HORNER'S SYNDROME

Symptom	Structure innervated	Damage
Anhydrosis (lack of sweating)	Sweat glands in skin	lack of sweating in skin (ex. forehead)
Ptosis (eyelid droop)	Levator Palpebrae Superioris - sympathetics to Smooth muscle part	Levator lifts upper eyelid; damage produce eyelid droop
Miosis (constricted pupil)	Pupillary dilator muscle	Damage paralyzes Dilator muscle; pupil is constricted (Constrictor pupillae muscle is intact)

HYPOTHALAMUS

LESIONS CAN OCCUR IN MANY PLACES IN PATHWAY

HYPOTHALAMO-SPINAL TRACT



to Target Organ

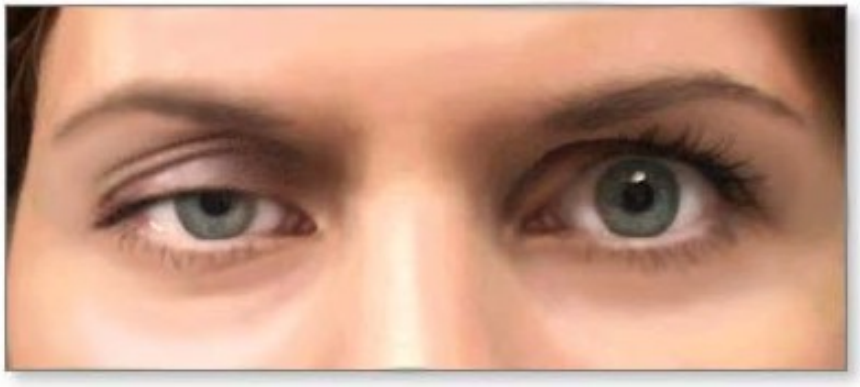
PATHWAY TO HEAD -

1) Neuron 1 (Preganglionic neuron) in spinal cord at T1, T2

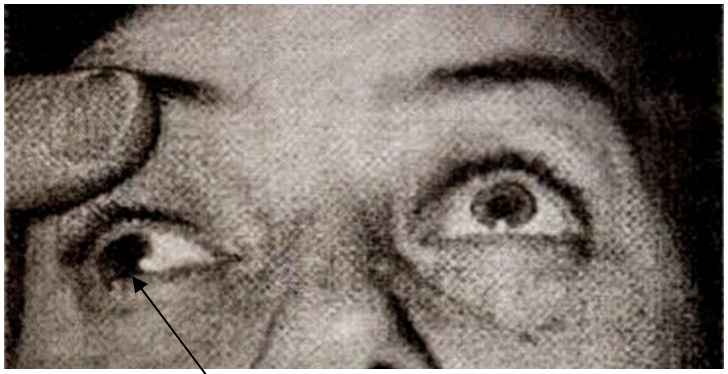
2) Neuron 2 (Postganglionic neuron) In Superior Cervical Ganglia

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

Ptosis (drooping of the eyelid)

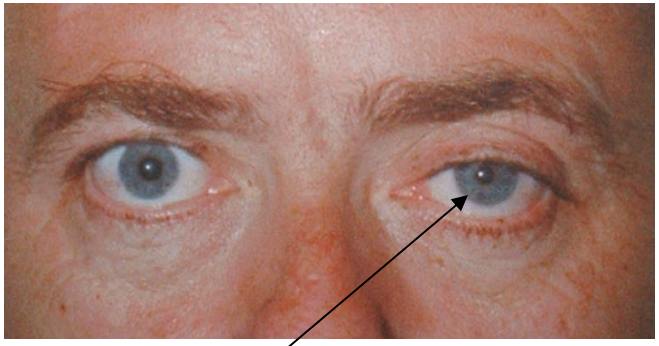


SKELETAL MUSCLE PART



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

SMOOTH MUSCLE PART



SYMPATHETICS - HORNER'S SYNDROME -
- <u>Miosis - denervate Pupillary dilator; constricted pupil</u>
- Anhydrosis - lack of sweating

**

SYMPTOM – EYELID DROOP + CONSTRICTED PUPIL

SUMMARY CHART: HORNER'S SYNDROME VS OCULOMOTOR PALSY **

Structure	Horner's Syndrome	Oculomotor Palsy (nerve damage)
Upper eyelid	Ptosis (eyelid droop) - paralyze Smooth muscle part of Levator Palpebrae Superioris	Ptosis (eyelid droop) - paralyze Skeletal muscle part of Levator Palpebrae Superioris
Pupil of eye	Pupil constricted (Miosis) - Pupillary Dilator muscle paralyzed; Pupillary constrictor muscle intact	Pupil dilated (Mydriasis) - pupilllary constrictor muscle paralyzed; Dilator muscle is intact
Sweat glands in skin	Anhydrosis - lack of sweating in skin (ex. forehead)	No effect (parasympathetics do not innervate skin)

also: Eye movements - affect by Oculomotor Palsy; no effect if damage Sympathetics.