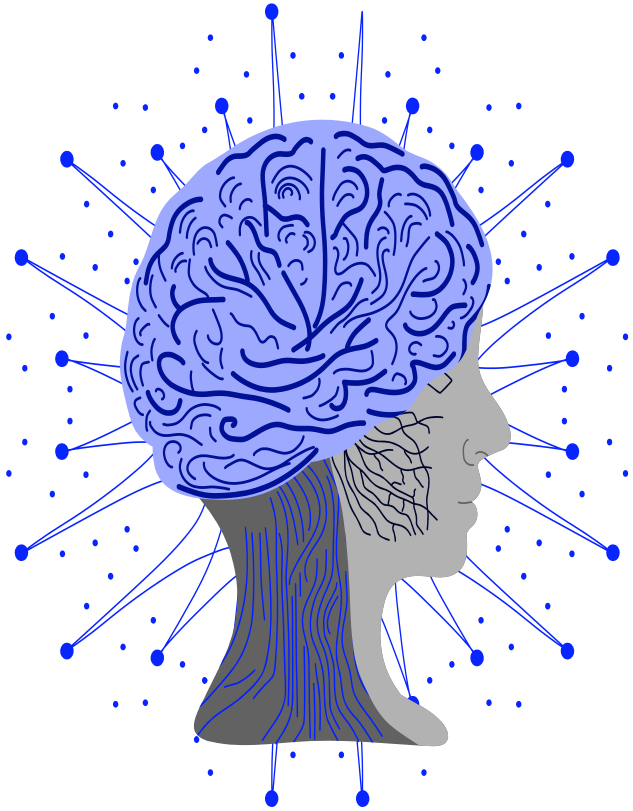
Neuromuscular Systems Lecture-Week 3



DRPT-630 Clinical Examination

October 20, 2025

Dr. Robin Baker, PT, DPT, NCS

Tone Assessment

Sensation Testing

Motor Testing

Deep Tendon Reflex Testing

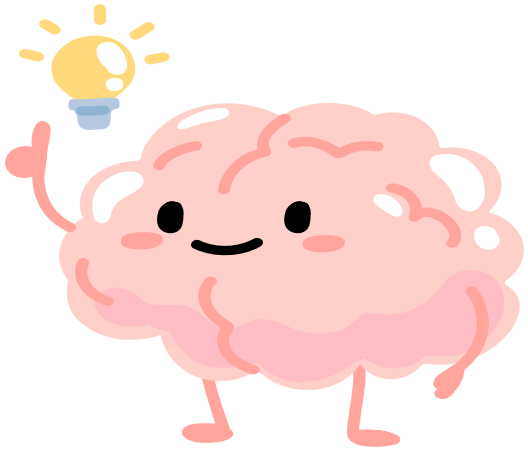
Coordination Testing

Balance Testing

Cranial Nerve Assessment

UMN Testing

Neuromuscular Systems



Objectives

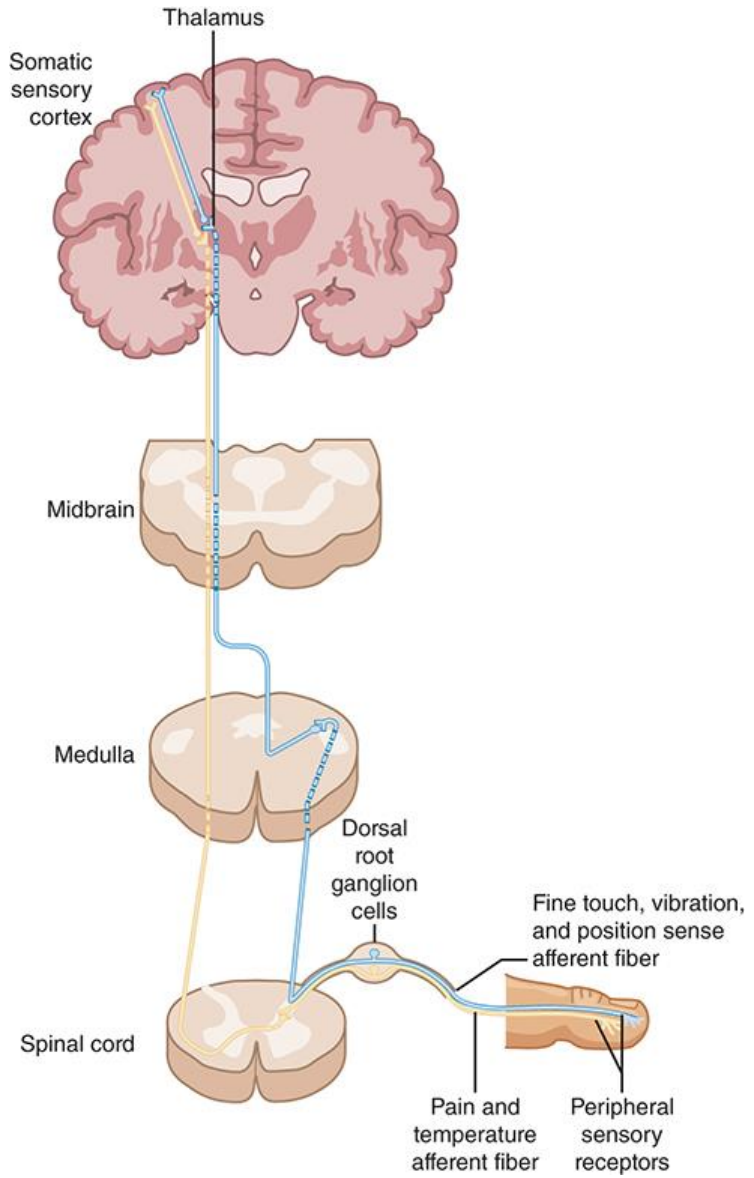
1. Describe the purpose and clinical significance of key neuromuscular tests and measures used to assess deep tendon reflexes, pathological reflexes, and cranial nerves.
2. Prioritize which tests and measures to include in a comprehensive neuromuscular examination based on patient presentation.
3. Select and administer age-appropriate tests and measures, including assessments of somatosensory function, cranial and peripheral nerve integrity, balance, coordination, dermatomes, myotomes, reflex integrity, and sensory integrity.
4. Integrate neuromuscular tests and measures into a clinical neuromuscular examination.
5. Complete accurate documentation of examination tests and measures.

1. Identify Neurologic Integrity
    - Confirms the functional status of sensory and motor pathways.
    - Helps determine if the nervous system is intact, impaired, or disrupted.
2. Localize Lesions or Dysfunction
    - Abnormal findings can indicate whether involvement is central (brain/spinal cord) or peripheral (nerve root, cranial nerve).
    - Guides further testing or medical referral.
3. Establish a Baseline and Monitor Change
    - Reflexes and CN findings provide objective data for comparison over time.
    - Useful for tracking recovery, progression, or response to treatment.
4. Support Clinical Reasoning and Safety
    - Informs decisions about examination depth, intervention selection, and need for collaboration/referral.
    - Ensures safe and appropriate patient management.

Why Examine Reflexes and Cranial Nerves?

1. During the neurological examination
    - When the nervous system is the primary system of concern
2. After Neurologic Injury or Illness (Hint: KNOWN diagnosis, primary system)
    - Stroke, traumatic brain injury, multiple sclerosis, spinal cord injury, or peripheral nerve injury.
    - Helps determine extent and pattern of involvement.
3. Unexplained Neurologic Symptoms
    - When the nervous system is **NOT** the primary system of concern, but subjective history or observation may prompt further examination beyond the review of systems (i.e. unexplained Weakness, numbness, dizziness, or vision changes)
    - Sudden changes in coordination, speech, or swallowing.
4. To Guide Further Testing or Referral
    - Unexpected abnormal findings, may indicate need for physician/specialist referral
    - Support hypothesis or clinical reasoning
    - Interprofessional communication

When to Examine Reflexes and Cranial Nerves?



Upper Motor Neurons

- Within the brain and spinal cord
- Affected by Central Nervous System diseases

Lower Motor Neurons

- Within spinal nerve roots
- Affected by Peripheral Nervous System diseases
  - Muscle weakness or atrophy
  - Hyporeflexia

Deep Tendon Reflexes

1

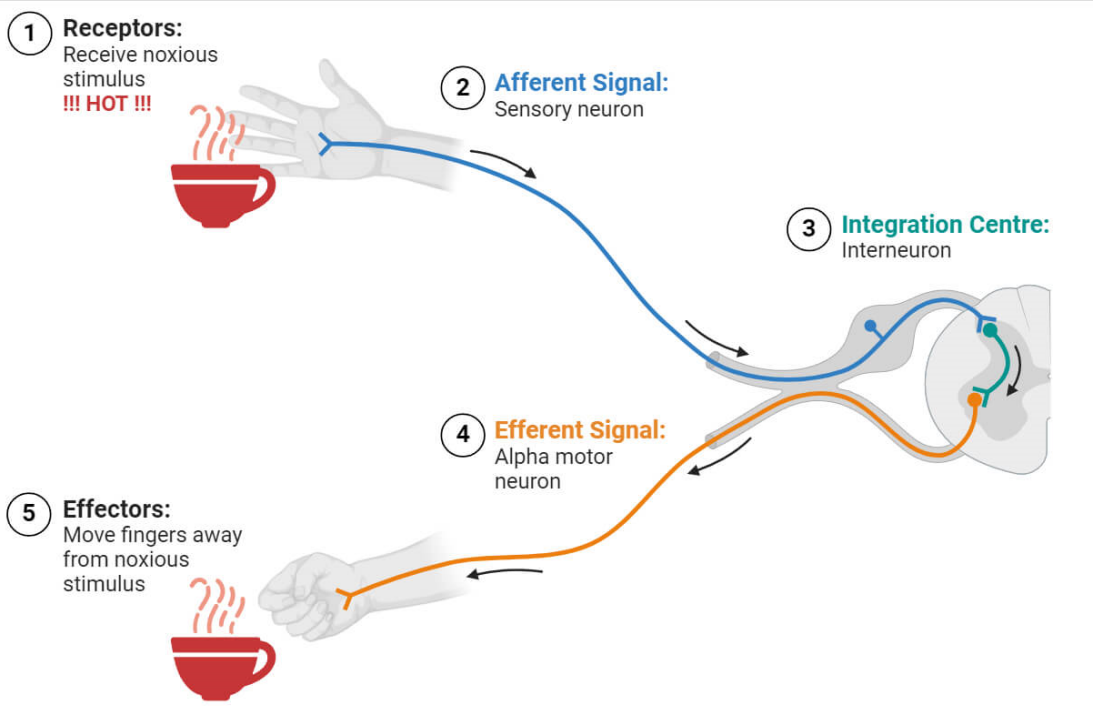
Basic Spinal Reflex Arc Overview

Parts of a Simple Reflex Arc:

1. Stimulus (stretch reflex in a DTR)
2. Receptor
3. Sensory Neuron
4. Motor Neuron
5. Interneuron
6. Effector

Definition

A pathway that a nerve impulse follows during a reflex action. Reflex arcs are highly beneficial in situations that require a quick response and do NOT involve conscious thought.



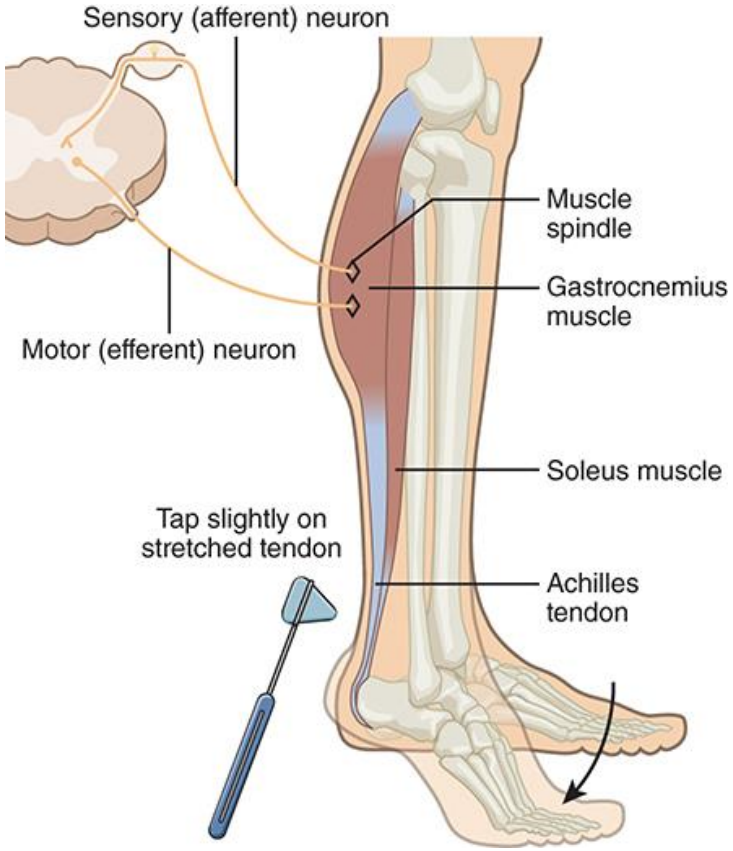
Source:: https://microbenotes.com/reflex-arc/

Deep Tendon Reflexes

Quick, involuntary muscle contraction in response to stretch

Elicited by tapping a tendon with a reflex hammer

Provides information on integrity of reflex arc and spinal segment



Deep Tendon Reflexes

Superficial Reflexes

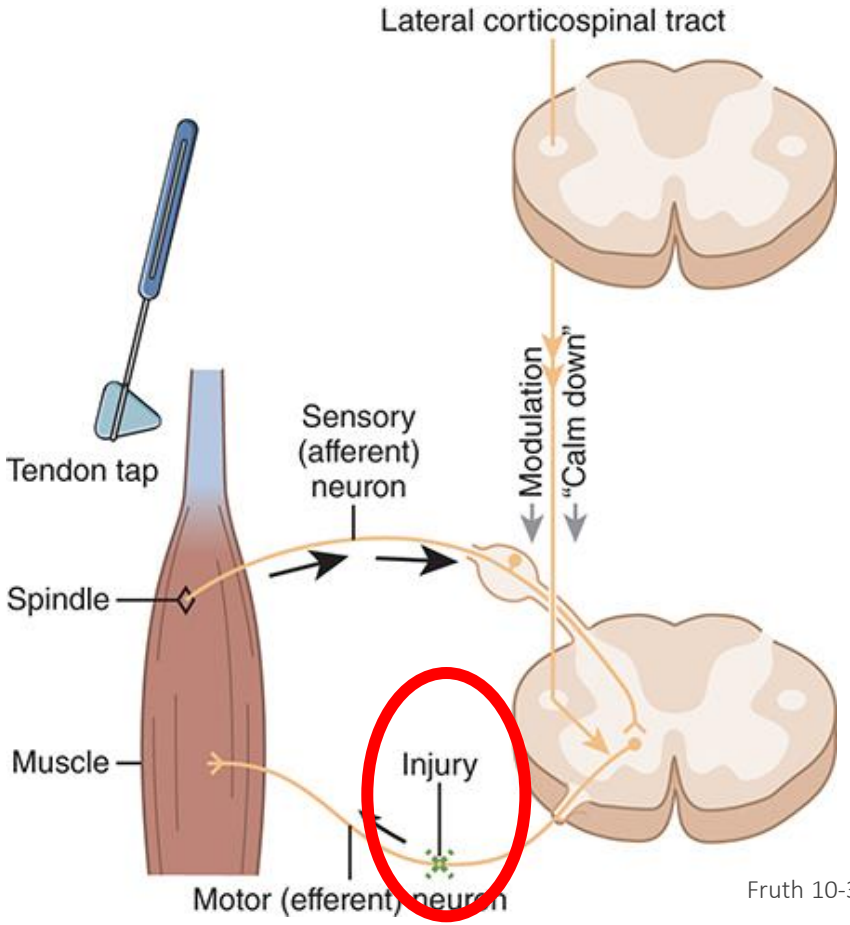
Pathological Reflexes

- Monosynaptic stretch reflex
  - Contains two neurons
    - Afferent → Sensory component
    - Efferent → Motor component
  - Communicate via one synapse within the anterior horn of the spinal cord

- DTRs provide insight into the integrity of the peripheral and central nervous systems

Deep Tendon Reflexes (DTR): Fundamental Concepts

- Hypotonic reflexes frequently result from injury or compression along the nerve pathway, including at the nerve root.
- Causes may include a bulging vertebral disc, advanced stenosis, peripheral nerve injury, or peripheral nervous system disorders.



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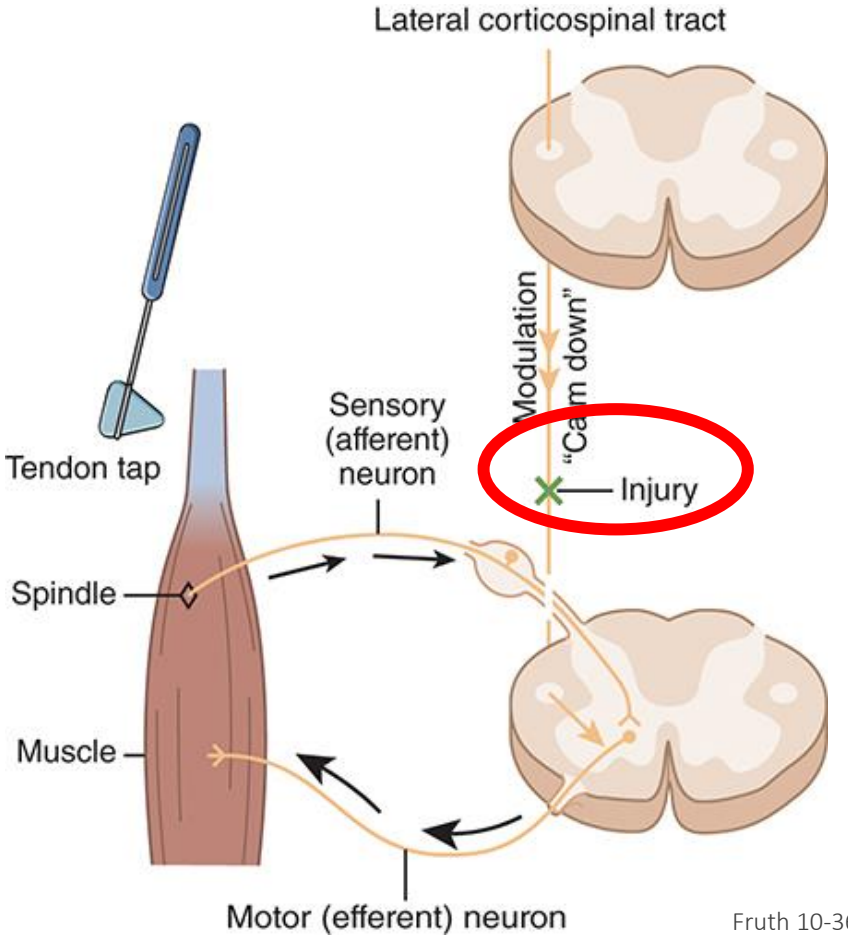
Fundamental Concepts: Hypotonic DTRs

Fundamental Concepts: Hypertonic DTRs

- Abnormally hypertonic DTRs are a sign of central nervous system pathology.
- Damage to the cerebral cortex or corticospinal tract above the reflex arc interrupts normal inhibitory control, resulting in an exaggerated reflex response.
  - *Corticospinal has a modulating influence on automatic reflexes*
- Hypertonic reflexes are commonly found in patients presenting with known brain or spinal cord pathology, and the findings are usually bilateral.



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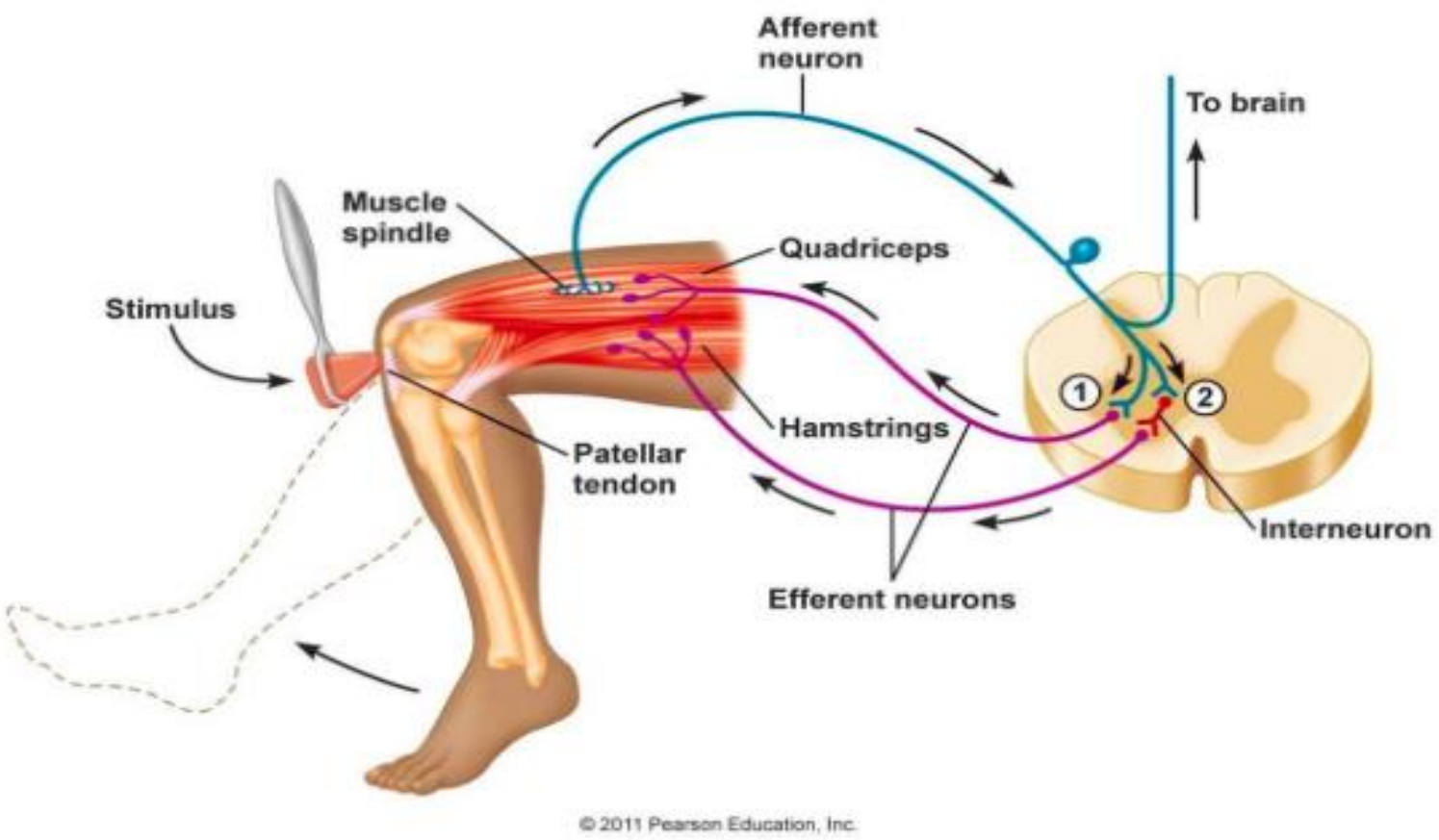
Deep Tendon Reflex Grading



- 0+ No Reflex
- 1+ Minimal or depressed response (Hypoactive)
- 2+ Normal Response
- 3+ Overly Brisk Response (Hyperactive)
- 4+ Very Brisk Response (Clonus)

***A score of a 1+ or 3+, does not necessarily indicate pathology, especially if the same bilaterally or without supportive evidence*

Purpose of Testing

Identify upper or lower motor neuron involvement

Assess symmetry between sides

Detect hypo- or hyperreflexia

Support localization of neurological dysfunction

Factors Influencing Reflexes

01

Anxiety or voluntary contraction

02

Positioning and relaxation

03

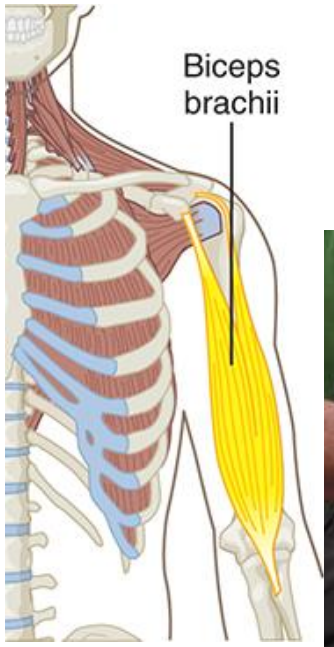
Sensory loss

04

Medication effects (i.e. muscle relaxants)

Biceps Brachii

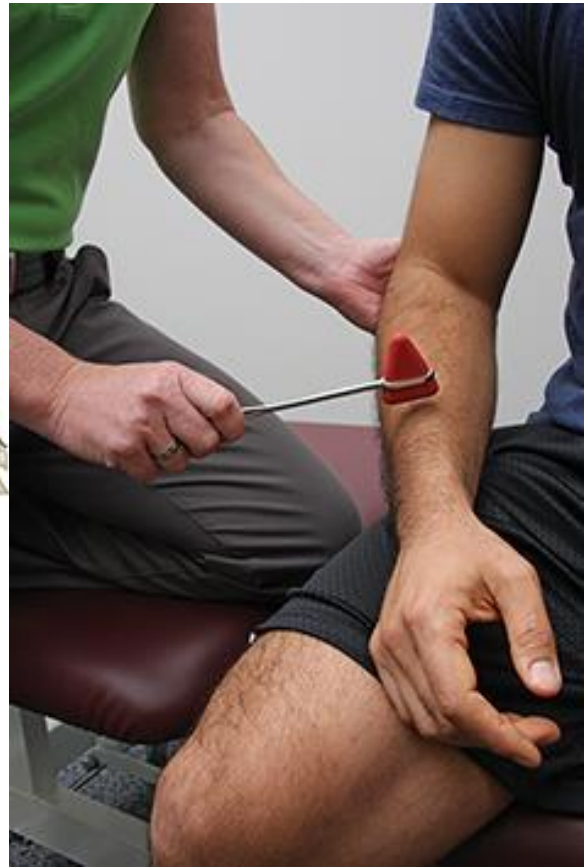
- **Patient position:** Seated, arm relaxed, partially flexed
  - *Alternate position: supine*
- Tap over distal biceps tendon
- **Normal response:** contraction of biceps, elbow flexion
- **Segmental level: C5**-C6



Brachioradialis

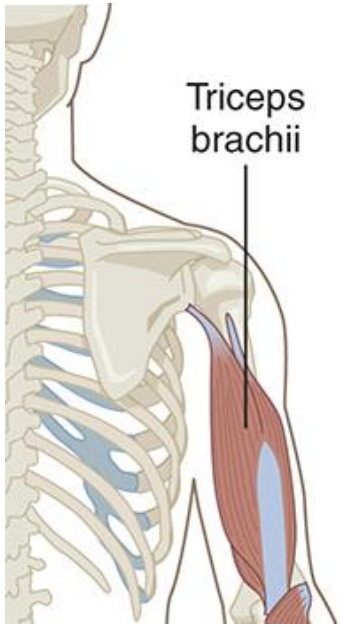
- **Patient position:** Seated, arm relaxed, partially flexed
  - *Alternate position: supine*
- Tap 1-2 inch. Proximal to the radial styloid
- **Normal response:** elbow flexion (slight forearm pronation/supination possible)
- **Segmental level:** C5-**C6**

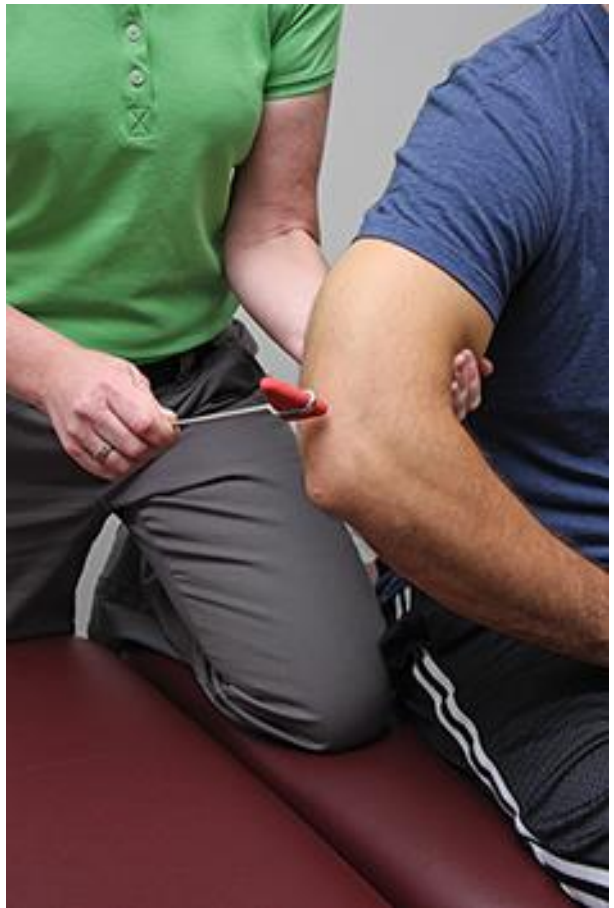
Brachioradialis



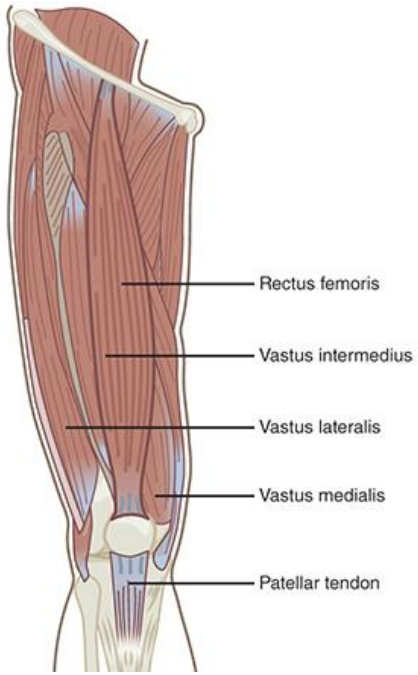
Triceps

- **Patient position:** Seated, arm relaxed and supported in abduction
  - *Alternate position: supine*
- Tap just proximal to olecranon process
- **Normal response:** elbow extension
- **Segmental level:** C6-**C7**



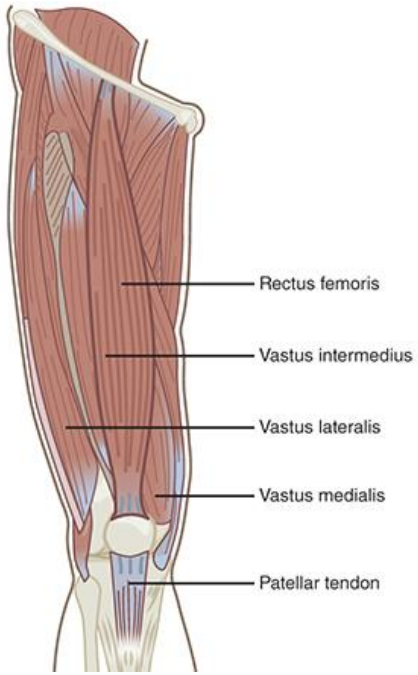


Patellar



- **Patient position:** Seated (short sitting)
  - *Alternate position: supine*
- Tap midway between distal patella and tibial tubercle
- **Normal response:** Knee extension
- **Segmental level:** L2, L3, **L4**

Achilles



- **Patient position:** Seated (short sitting)
  - *Alternate position: supine or prone*
- Tap on the Achilles tendon at level of malleoli
- **Normal response:** Ankle plantar flexion
- **Segmental level: S1,** S2

Integration With Other Systems

- Always interpret reflexes in context with tone, strength, and sensation findings
- Integrate with coordination testing for complete neuromuscular picture

Tips for Reliable DTR Testing

- Ensure full relaxation
- Compare sides
- Use appropriate hammer force
- Test in consistent order

Case A: A 35-year-old patient presents with absent right patellar reflex and diminished quadriceps strength. Sensation intact.

- *What spinal level is likely involved?*

Case B: A patient presents with wrist drop and absent triceps reflex following a humeral shaft fracture.

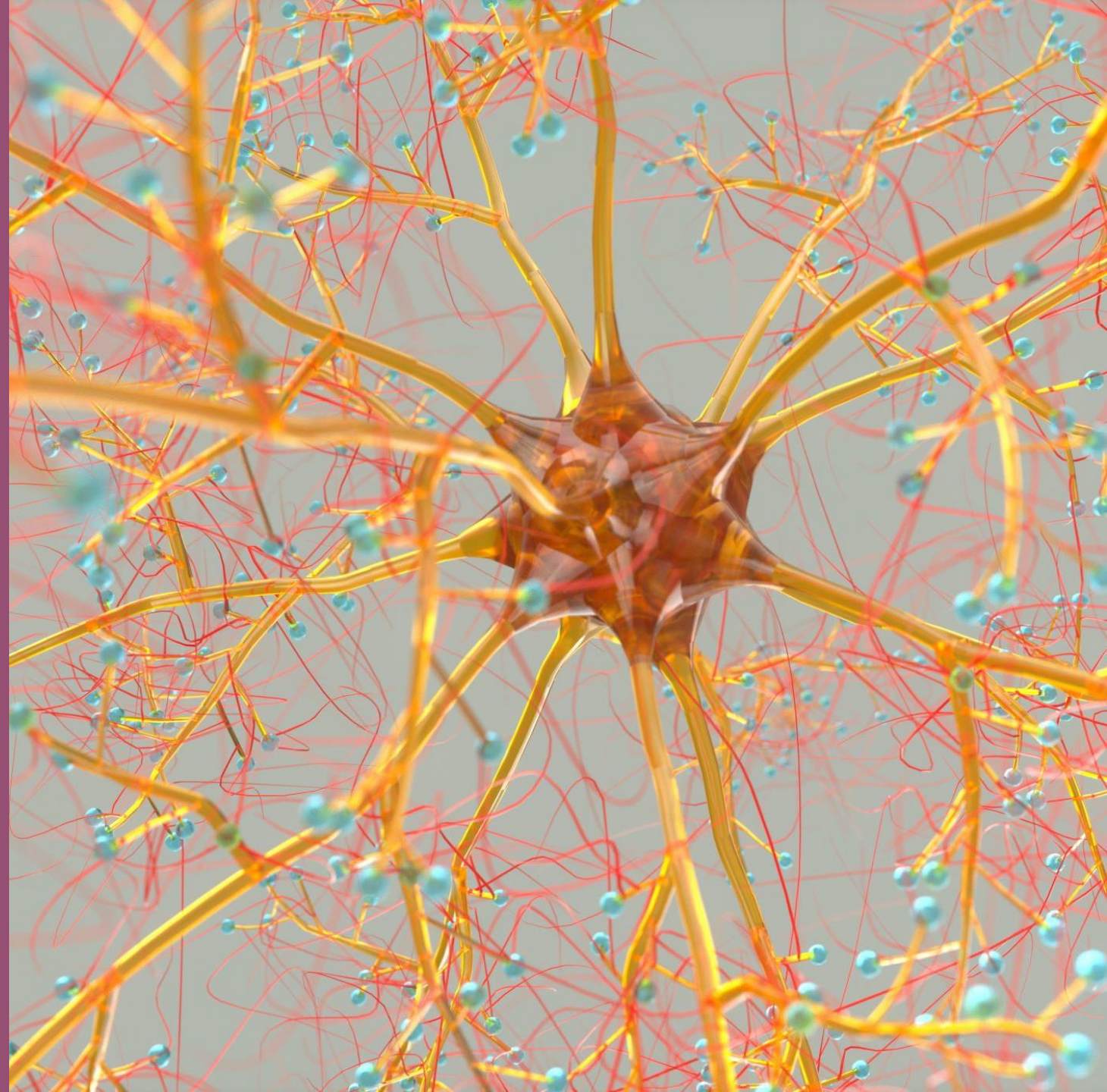
- *Is this more likely an UMN or LMN presentation?*

Case C: A 55-year-old patient with a right middle cerebral artery stroke demonstrates exaggerated left-sided patellar and Achilles reflexes

- *Is this more likely an UMN or LMN presentation?*
- *Would the lesion be in the peripheral nerve at the level of the DTR or above the level of the DTR in the spinal cord?*

Cases

Cranial Nerves



Fundamental Concepts

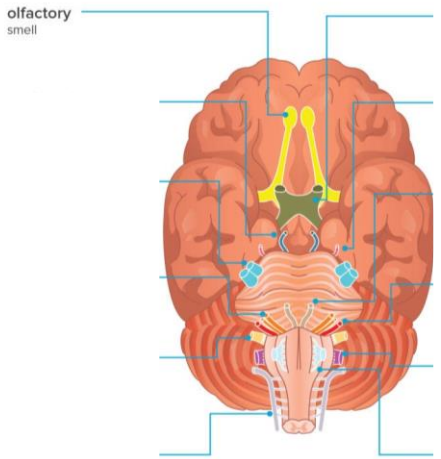
- 12 pairs of peripheral nerves originating from brain stem
- Motor, Sensory, or Mixed
- Integral part of neurologic screening
- Common causes of CN dysfunction: trauma (head injury), tumor, ischemic/vascular lesion (CVA), Neurological diseases (i.e. MS)
- In an *unknown diagnosis*, if a cranial nerve dysfunction is identified, the patient should be referred to a physician

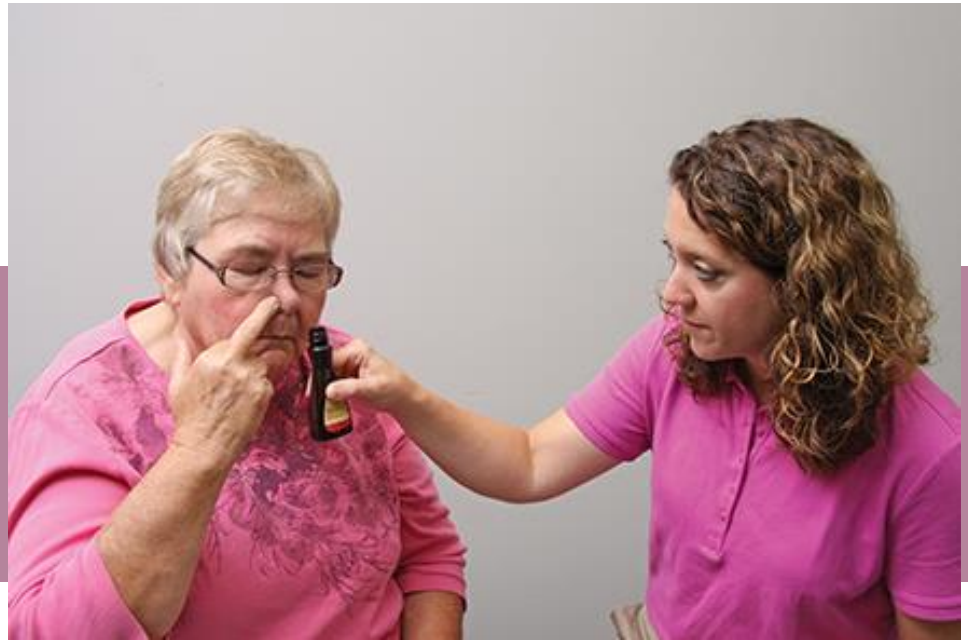
Classification of Cranial Nerves

Type	Nerves	Function
Sensory	I, II, VIII	Smell, Vision, hearing/balance
Motor	III, IV, VI, XI, XII	Eye, neck, tongue movement
Mixed	V, VII, IX, X	Facial sensation, taste, swallowing, speech

Cranial Nerve I: Olfactory

- Smell - Sensory
- Test each nostril with familiar scent (coffee, mint)
  - Patient should be able to identify the odor and the strength of the smell should be equal, bilaterally
    - *Loss = anosmia*
- Consider head trauma or COVID-related loss

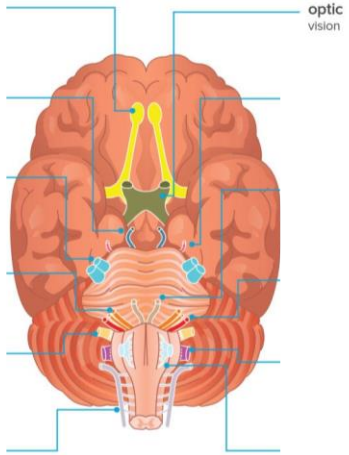




Cranial Nerve II: Optic

- Vision - Sensory
- Visual acuity and visual fields
- Contralateral pupillary reaction to light
  - With penlight-assess constriction of contralateral pupil
    - *Pupillary light reflex (afferent limb)*
- Common deficits: hemianopsia, blindness

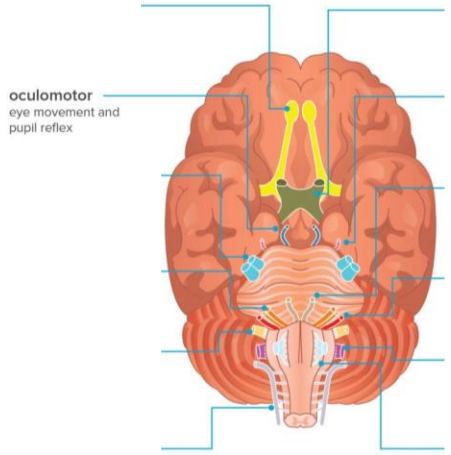
Testing CN II: Contralateral pupillary constriction



Cranial Nerve III: Oculomotor

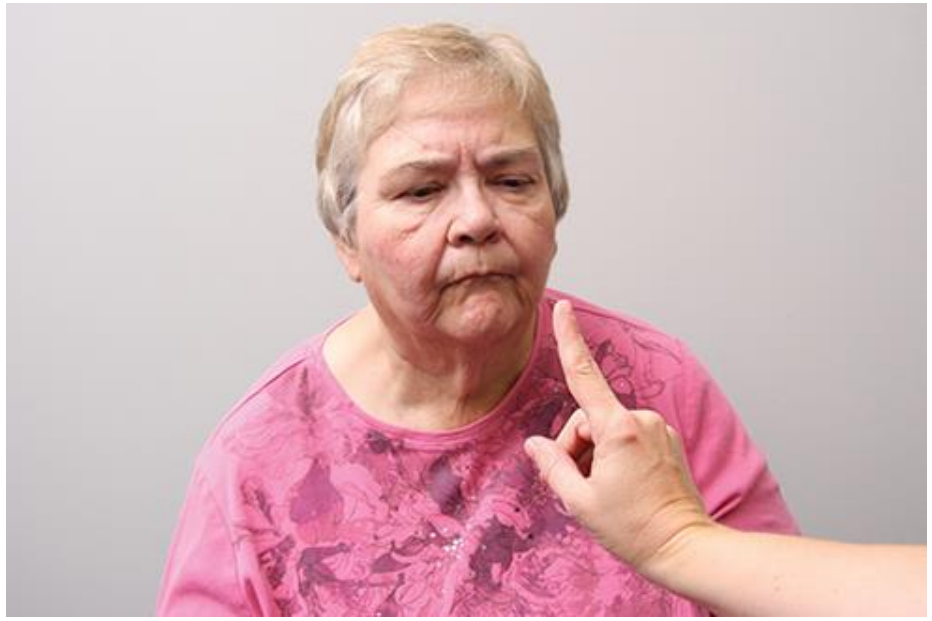
- Controls most extraocular movements Eyelid opening/elevation - Motor
  - With penlight-assess constriction of ipsilateral pupil
- Observe for ptosis, nystagmus, or diplopia
- Test smooth pursuit and saccades
  - H-Test

Testing CN III: Ocular motions

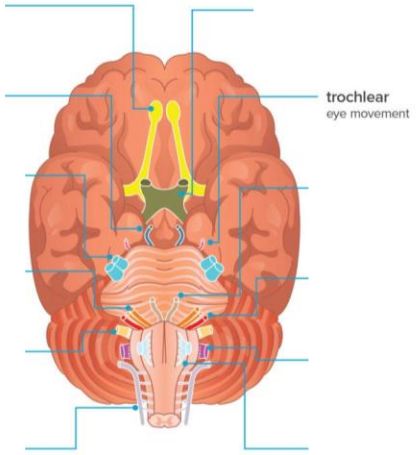


Cranial Nerve IV: Trochlear

- Diagonal downward-medial movement of eye
  - Motor
- Test smooth pursuit and saccades
  - Bring finger toward patient's nose and both eyes should converge (down & in)

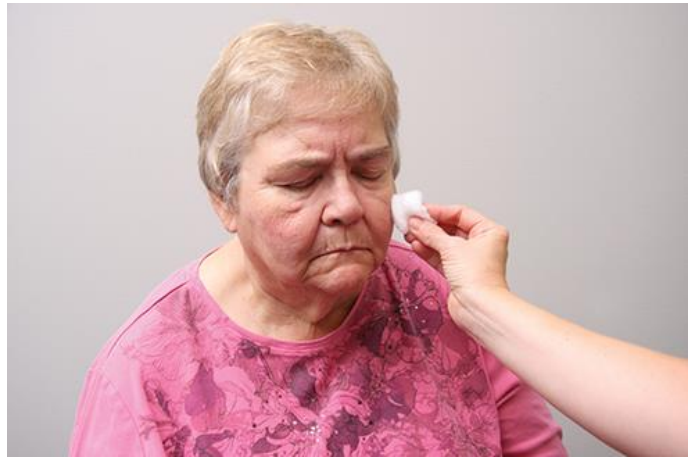


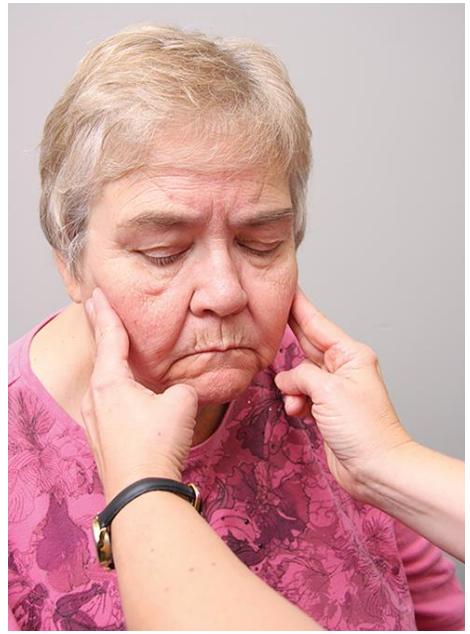
Testing CN IV: Ocular convergence



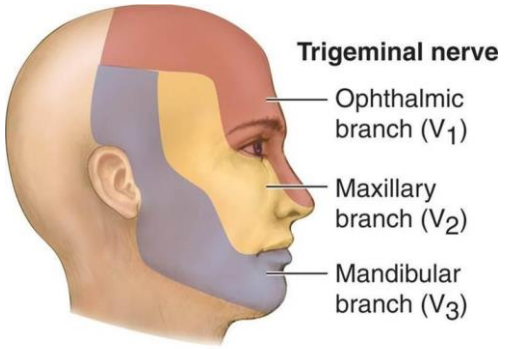
Cranial Nerve V: Trigeminal

- Mixed
  - Sensory – Sensation to face (V1 & V2)
    - 3 Sensory branches – ophthalmic (forehead), maxillary (cheeks), mandibular (lateral jaw)
  - Motor – Muscles of mastication (V3)
    - Palpate masseter & temporalis mm with patient clenching jaw
    - Apply resistance to jaw slightly open – mandibular closing

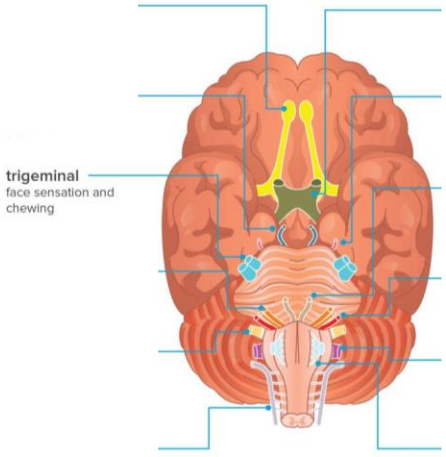




Testing CN V: Strength of muscles of mastication



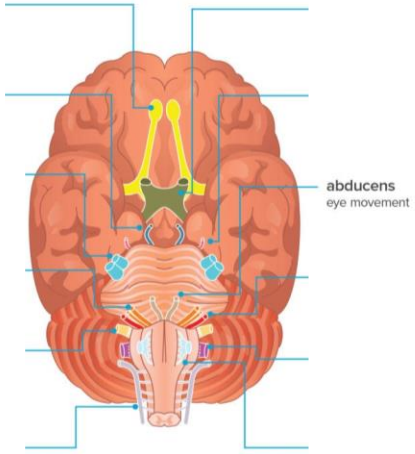
Sensory distribution of trigeminal nerve



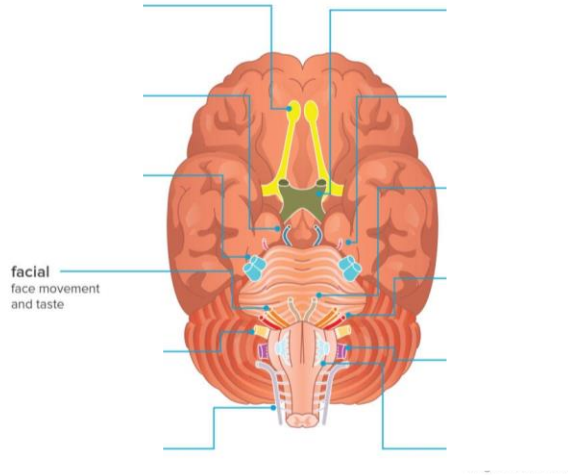
Cranial Nerve VI: Abducens

- Lateral deviation of the eye – Motor
- Test smooth pursuit and saccades
  - H-test – specifically watch for lateral (abduction) of the eye

Testing CN IV: Ocular movements – Lateral deviation



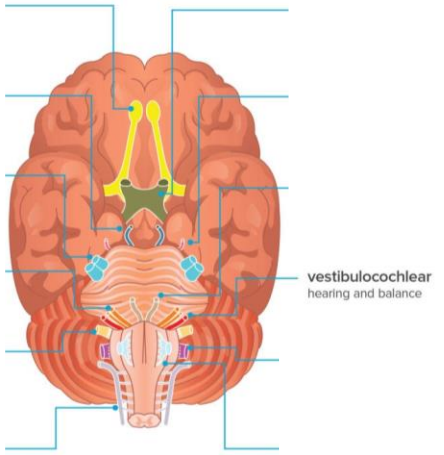
- Mixed
  - Sensory – Taste for salty, sweet, sour, on anterior 2/3 of tongue
  - Motor – Facial movements
    1. Facial expression
    2. Closing the eyelid
    3. Closing the mouth
- Saliva & tear production; nasal mucosa secretions
- Ask patient to smile, frown, puff out cheeks, elevate, depress eyebrows
  - Look for symmetry in facial expression
- Taste: place something sweet on anterior portion of tongue



Cranial Nerve VII: Facial

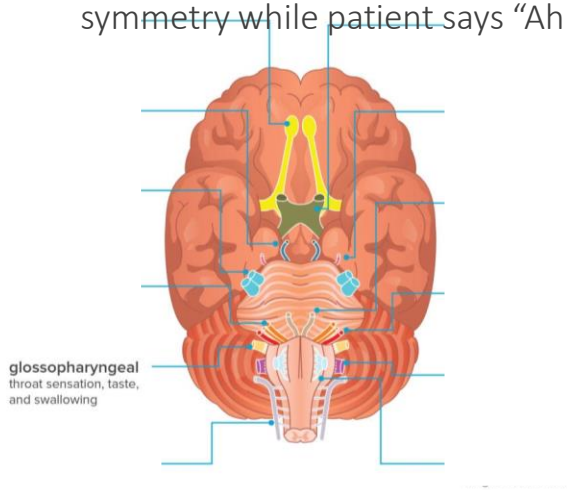
- Hearing - Sensory
- Testing: finger rub or tuning fork
  - Test one ear at a time
- Balance: dizziness, vertigo, nystagmus
  - Grossly assessed by having patient stand unsupported with eyes closed for 30 seconds
- Links to vestibular system

Cranial Nerve VIII: Vestibulocochlear



- Mixed
  - Sensory – Taste for sour & bitter on posterior 2/3 of tongue
  - Motor – Controls pharynx
  - Autonomic – Saliva production
- Ask patient to open mouth and say “ahh”. Observe uvula and listen for loss or decreased phonation (dysphonia)
  - No lateral deviation should be present.
- Have patient swallow several times, ask about difficulty
  - *Dysphagia – difficulty swallowing*
- Test gag reflex (afferent) – using a tongue depressor, gently move towards back of throat, until gag reflex is elicited

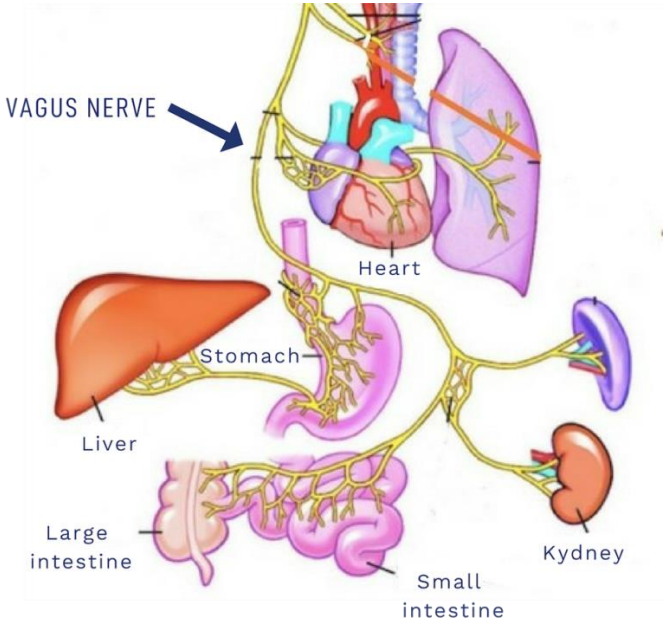
Testing CN IX & X: Phonation & Uvular symmetry while patient says “Ahhh”



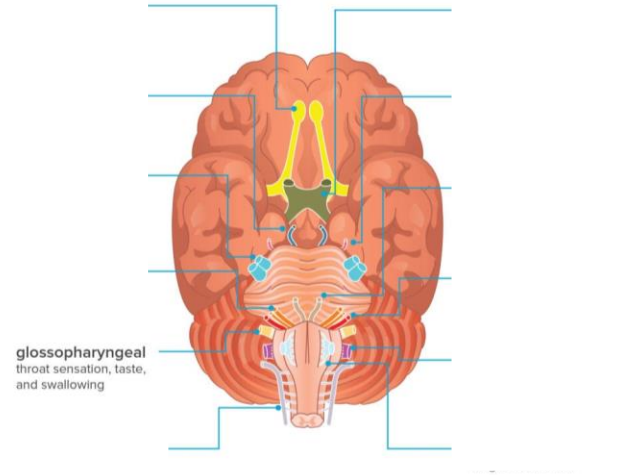
Cranial Nerve IX: Glossopharyngeal

Assessed with CN X

- Mixed
  - Sensory – Pharynx & larynx
  - Motor – Palate, pharynx & larynx
  - Autonomic – controls many thoracic and abdominal viscera
- Ask patient to open mouth and say “ahh”. Observe palate and listen for loss or decreased phonation (dysphonia)
  - No lateral deviation should be present.
- Have patient swallow several times, ask about difficulty
  - *Dysphagia – difficulty swallowing*
- Test gag reflex (efferent) – using a tongue depressor, gently move towards back of throat, until gag reflex is elicited



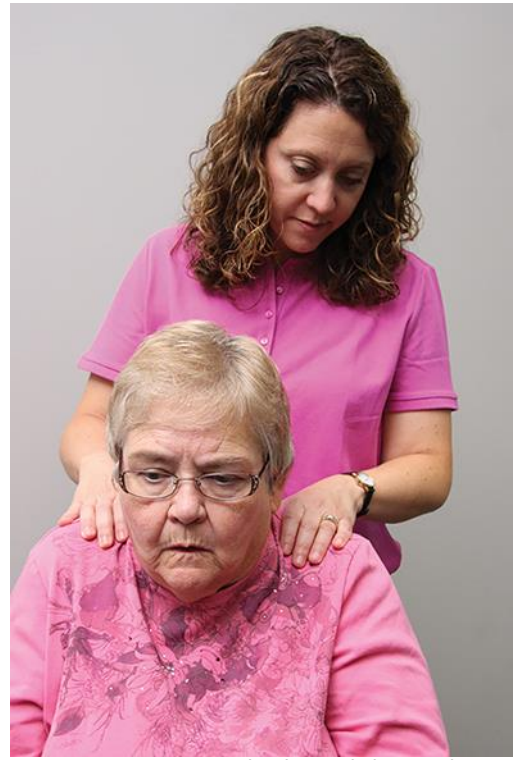
Cranial Nerve X: Vagus



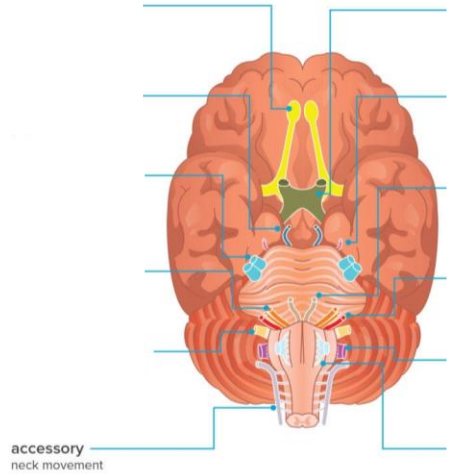
Assessed with CN IX

Cranial Nerve XI: Spinal Accessory

- Sternocleidomastoid (SCM) & Trapezius – Motor
  - *Trapezius: scapular elevation*
  - *SCM: head rotation to opposite side & ipsilateral lateral neck flexion (unilaterally)*
- Test shoulder shrug and head rotation
  - Note atrophy of trapezius or SCM – compare side to side

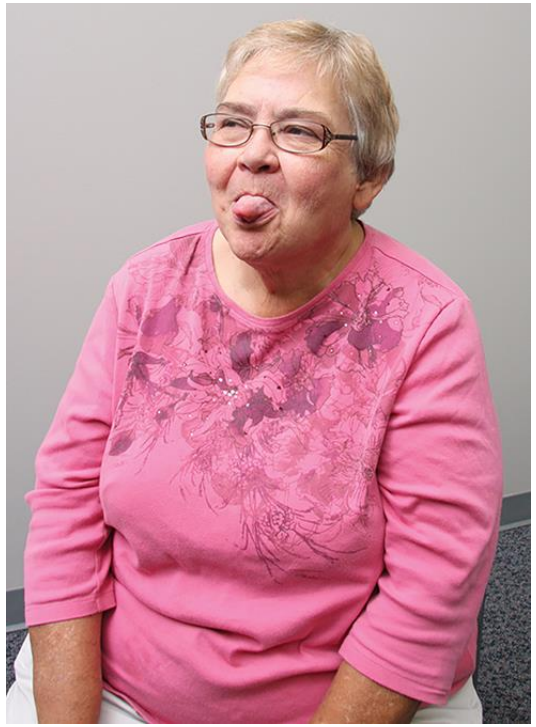


Testing CN XI: Resisted shoulder elevation

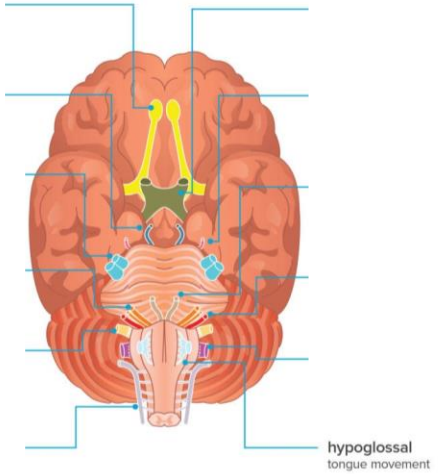


Cranial Nerve XII: Hypoglossal

- Tongue movement – Motor
- Ask patient to stick out tongue – observe for any side-to-side deviation or atrophy
  - Deviation towards side of lesion
  - Also observe for smooth movements



Testing CN XII: Tongue symmetry & Control



Case A: A 55-year-old with right facial droop, unable to close eye, normal forehead movement.

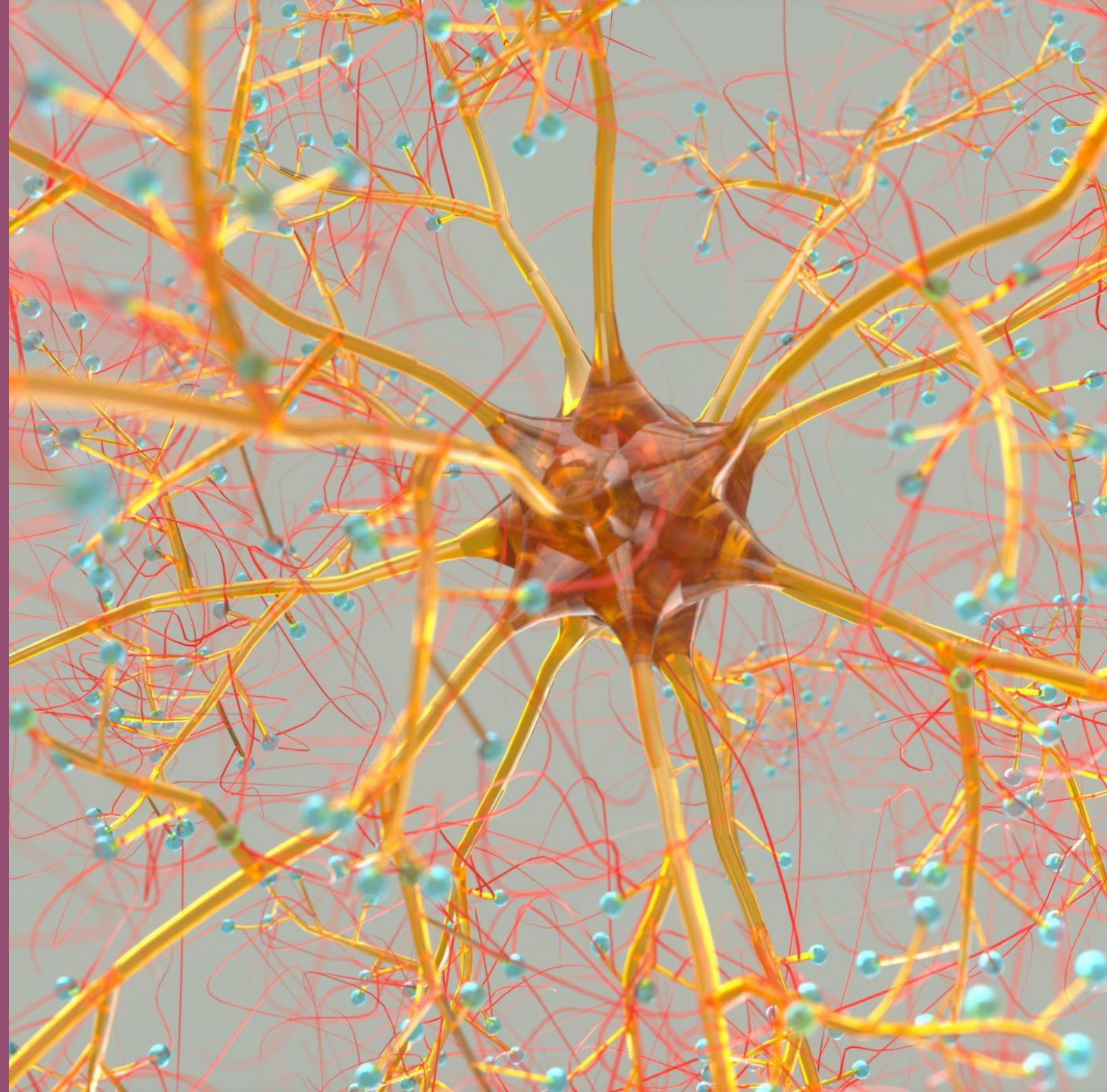
- *Which cranial nerve is most likely involved?*

Case B: Patient presents with dysarthria and weak tongue movement deviating right.

- *Which cranial nerve is most likely involved?*
- *Predict side of lesion*

Cases

Upper Motor Neuron Testing



Upper Motor Neuron Testing

Purpose

- Purpose: detect lesions in corticospinal tract.
- Indicates loss of inhibitory control from higher centers

Common Signs of UMN Lesion

- Spasticity
- Hyperreflexia
- Clonus
- Pathologic reflexes (Babinski, Hoffmann)

Clonus Testing

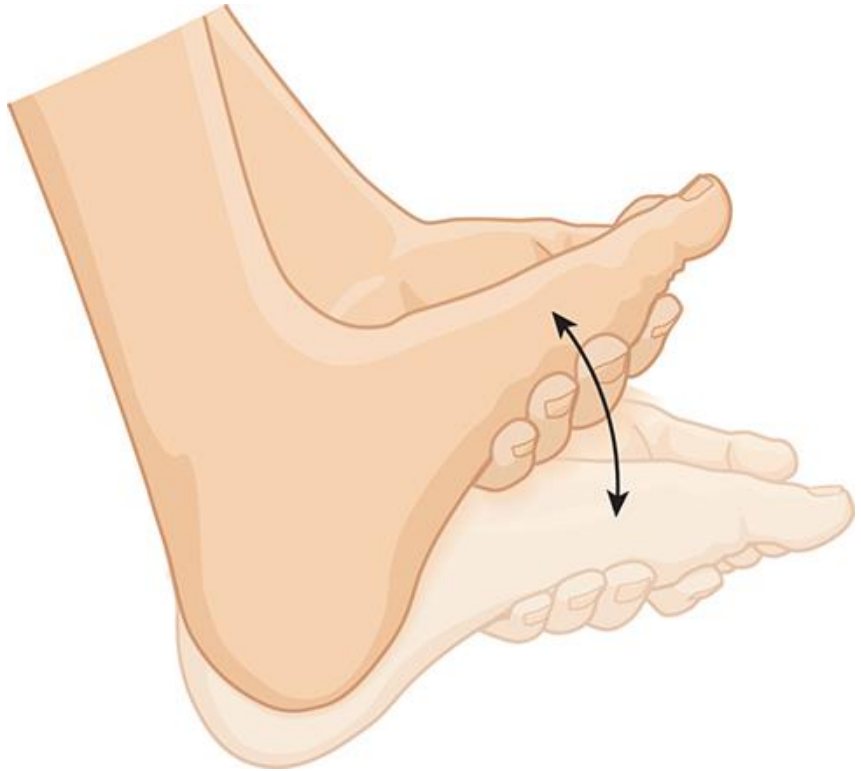


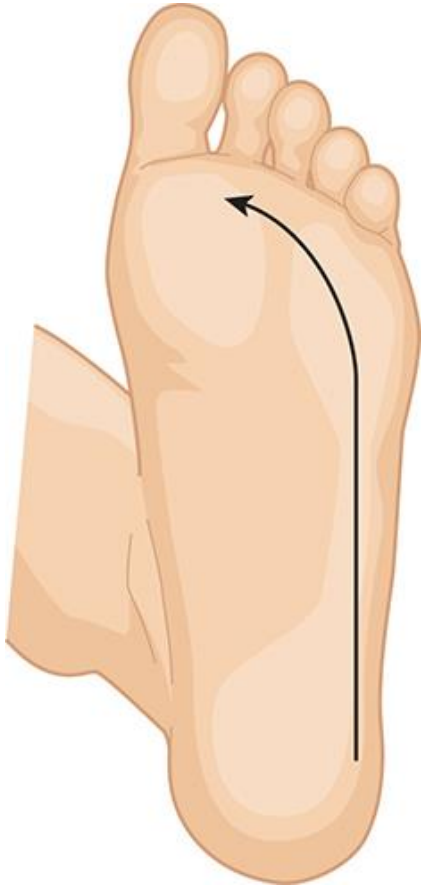
Figure 10.81 – motions felt during a positive clonus test at the ankle

- Rapid DF of ankle → Rhythmic contractions
- Sustained clonus = (+) for UMN lesion

4+ Very Brisk Response (Clonus)

Babinski Reflex

- Stroke lateral sole → extend great toe, fanning of toes = positive
- Normal in infants, abnormal in adults
- Indicates corticospinal tract lesion



Hoffman's Sign

- Flick distal phalanx of middle finger → thumb/index flexion = positive
- Suggests cervical cord involvement

- Unexplained weakness
- Hyperactive reflexes
- Postural asymmetry
- Suspicion of central nervous system involvement

When to Perform UMN Tests