

Neurological System & Mental Status Assessment

Chapter 16, 17

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1

Overview of Anatomy

- Central Nervous System
 - Brain
 - Spinal cord
- Peripheral Nervous System
 - 12 pairs of cranial nerves
 - Spinal and peripheral nerves

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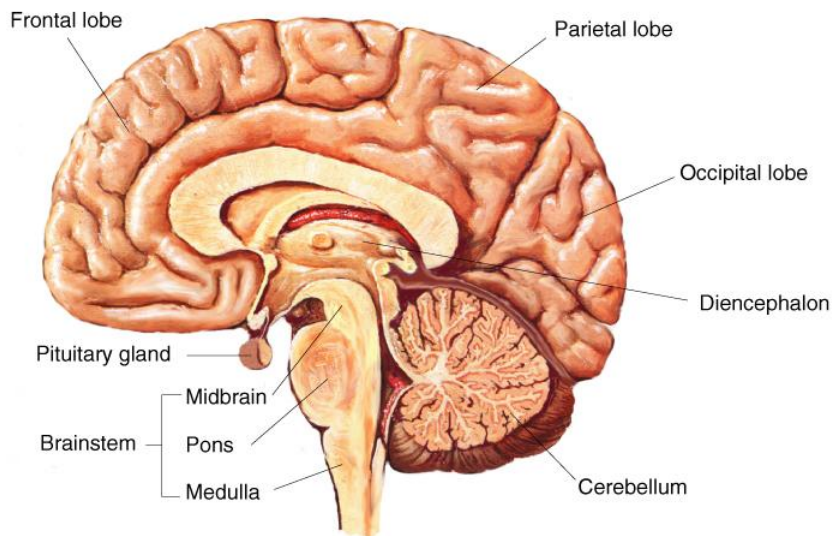
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4 Regions of The Brain:

- **Diencephalon:** regulates consciousness
- **Brainstem:** connects the upper part of the brain with the spinal cord, consist of (pons, medulla, midbrain)
- **Cerebellum:** gait and coordination
- **Cerebrum:** thinking and higher functions

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Anatomy of the brain - right half, medial view

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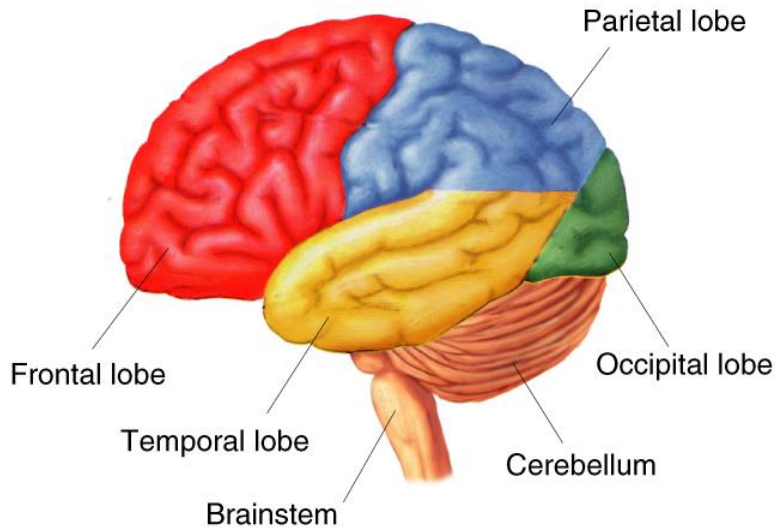
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Hemispheres Divided into 4 Lobes

- Frontal – personality, behaviour, emotions, intellectual function
- Parietal - primary centre for sensation
- Occipital– Primary visual receptor centre
- Temporal– Primary auditory reception centre.

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5



Anatomy of the brain - left half, lateral view

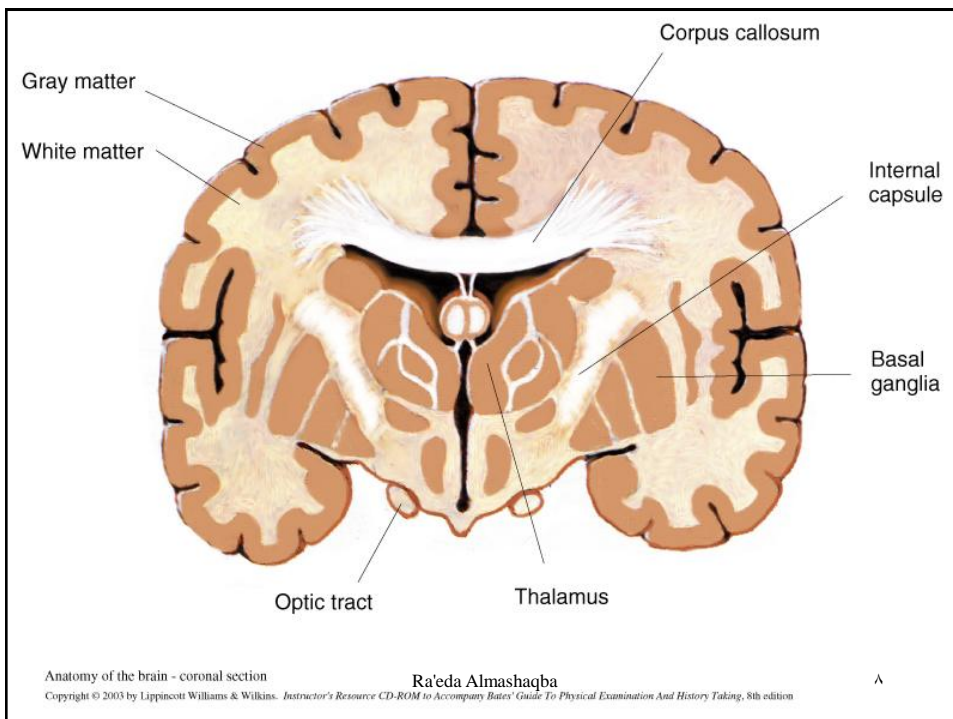
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Brain tissue (gray and white matter)

- Gray matter consists of aggregations of neuronal cell bodies
- White matter consists of the neuronal axons that are covered with myelin; the myelin sheets allow nerve impulses to travel more rapidly
- Additional clusters of gray matter deep in the brain
 - Thalamus: regulates sensory impulses
 - Hypothalamus: regulates body temperature, pulse, BP, endocrine function, and emotions
 - Basal ganglia: affect movement

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Sensory Pathways

- Receptors all over body
- Monitors conscious sensation, internal organ functions, body position, initiate motor reflexes
- Travels through *afferent* fibres of PNS
 - Spinothalamic tract – pain, temperature & crude or light touch
 - Posterior (Dorsal) columns – proprioception, vibration & finely localized touch.

Motor Pathways

Corticospinal or Pyramidal Tract

- Originate motor cortex, travel to brain stem, cross over, proceed down to synapse with lower motor neuron in spinal cord
- Mediate voluntary movement, particularly very skilled, discrete purposeful movements
- Higher, newer motor system
- Mapped in motor cortex in human looking pattern called somatotopic organization.

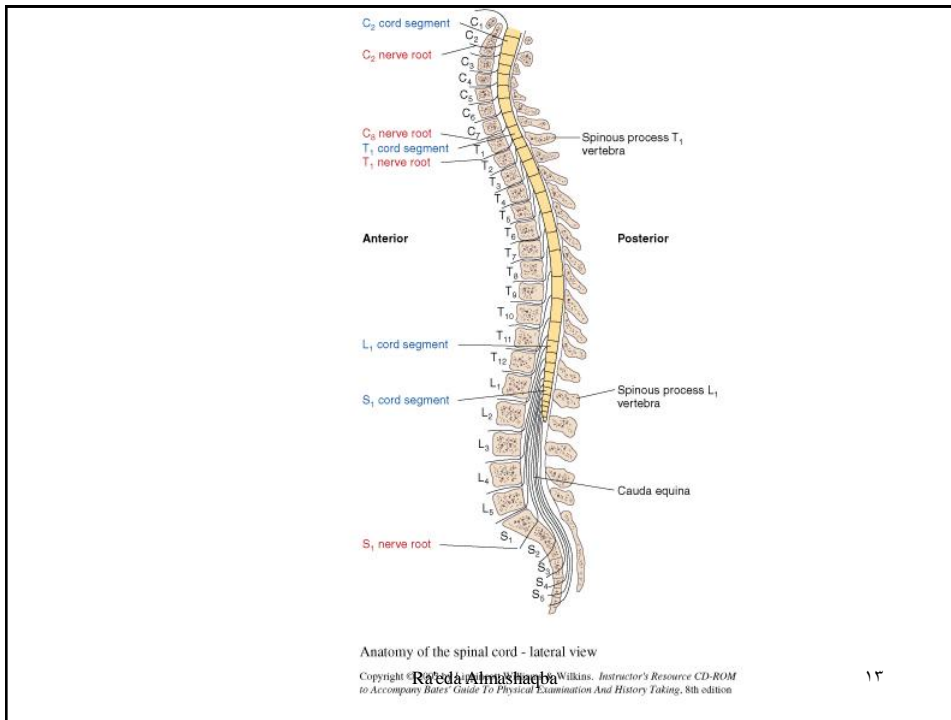
Motor Pathways

Extrapyramidal Tracts

- All motor nerve fibres originating in motor cortex, basal ganglia, brain stem & spinal cord that are outside pyramidal tract
- Lower, older motor system
- Maintain muscle tone & control automatic body movements like walking.

The Spinal Cord

- Cylindrical mass of nerve tissue encased within the bony vertebral column
- Contains important motor and sensory pathways that connect the peripheral muscles and nerves with the brain
- Also mediates reflex activity of deep tendon reflex
- divided into :cervical segments (C1-C8), thoracic segments (T1-T12), lumbar segments (L1-L5), sacral segments (S1-S5), and the coccygeal



PNS (Cranial and Peripheral Nerves)

- 12 pairs of cranial nerves that originate in the brain (diencephalons or brainstem) and exit the cranium
- Spinal nerves attach to the spinal cord; each nerve has an anterior (ventral) root containing motor fibers and a posterior (dorsal) root containing sensory fibers
- Most peripheral nerves contain both sensory (afferent) and motor (efferent) fibers
- Spinal cord contains both gray and white matter

Table 23-1 Cranial Nerves		
I: Olfactory	Sensory	Smell
II: Optic	Sensory	Vision
III: Oculomotor	Mixed	<u>Motor</u> : most EOM movement, raise eyelids. <u>Parasympathetic</u> : pupil constriction, lens shape.
IV: Trochlear	Motor	Down & inward movement of eye
V: Trigeminal	Mixed	<u>Motor</u> : muscles of mastication. <u>Sensory</u> : sensation of face/scalp, cornea, mucous memb. mouth/nose.
VI: Abducens	Motor	Lateral movement of eye
VII: Facial	Mixed	<u>Motor</u> : facial muscles, close eye, labial speech. <u>Sensory</u> : taste on anterior 2/3 of tongue. <u>Parasympathetic</u> : saliva & tear secretion.
VIII: Acoustic	Sensory	Hearing & equilibrium
IX: Glosso-pharyngeal	Mixed	<u>Motor</u> : pharynx (phonation & swallowing). <u>Sensory</u> : taste posterior 1/3 tongue, pharynx (gag reflex). <u>Parasympathetic</u> : parotid gland, carotid reflex.
X: Vagus	Mixed	<u>Motor</u> : pharynx & larynx (talking & swallowing). <u>Sensory</u> : sensation from carotid body/sinus, pharynx, viscera. <u>Parasympathetic</u> : carotid reflex.
XI: Spinal	Motor	Movement of trapezius & sternomastoid muscles
XII: Hypoglossal	Motor	Movement of tongue

Reflexes

- Spinal reflexes: An abnormal reflex helps us locate a pathologic lesion:
- **Deep tendon response**
 - ankle reflex (Sacral 1 primarily)
 - knee reflex (Lumbar 2,3,4)
 - Supinator (brachioradialis) reflex (Cervical 5, 6)
 - biceps reflex (Cervical 5, 6)
 - triceps reflex (Cervical 6, 7)
- **Superficial reflexes** by stimulating the skin: coetaneous reflexes
 - Abdominal reflexes —upper (thoracic 8, 9, 10)
—lower (thoracic 10, 11, 12)
 - Plantar responses (Lumbar 5, Sacral 1)

Subjective Data Collection

- Headache
- Head injury
- Dizziness/vertigo
- Seizures
- Tremors
- Weakness
- Incoordination
- Numbness or tingling
- Difficulty swallowing
- Difficulty speaking
- Significant past history
- Environmental/occupational hazards.

Sequence of Assessment

- Mental Status
- Cranial nerves
- Motor system
- Sensory system
- Reflexes.

Mental Status Exam

1. Appearance and behavior
2. Speech and language
3. Mood
4. Thoughts and perceptions
5. Cognitive Functions

1. Appearance and behavior

- **Level of consciousness:** alertness or state of awareness of the environment (awake, alert). Understanding questions,
- **Posture and motor behavior:** note body posture and patient's ability to relax
- **Dressing, grooming, personal hygiene:** look at pt dressed it is clean, fastened properly, how does it compare to other, are both side the same.
- **Facial expression:** observe face while pt at rest and during conversation or interacting with other, is there any variation or congruency with topics (anxiety, depression, apathy, anger, elation), immobile facial expression (Parkinson's)
- **Manner, affect, and relationship to persons and things**

Level of consciousness:

- **Alertness:** arousal intact, the person opens the eyes, looks at you, responds fully and appropriately to stimuli.
- **Lethargy:** speak in a loud voice. An abnormal response would be the patient appears drowsy, but opens the eyes and looks at you, responds to your questions, and then falls asleep.
- **Obtundation:** shake gently as if awakening a sleeper. An obtunded patient opens the eyes and looks at you, but responds slowly and somewhat confused
- **Stupor:** arouses from sleep only after painful stimulus, pinch a tendon, rub the sternum, and roll a pencil across a nail bed.
- **Coma:** repeated painful stimuli. Unarousable and with eyes closed.

Level of Consciousness (Arousal): Techniques and Patient Response

Level	Technique
Alertness	Speak to the patient in a normal tone of voice. An alert patient opens the eyes, looks at you, and responds fully and appropriately to stimuli (arousal intact).
Lethargy	Speak to the patient in a loud voice. For example, call the patient name or ask "How are you?"
Obtundation	Shake the patient gently as if awakening a sleeper.
Stupor	Apply a painful stimulus. For example, pinch a tendon, rub the sternum, or roll a pencil across a nail bed. (No stronger stimuli needed!)
Coma	Apply repeated painful stimuli.

- 2. Speech and language:** Note the characteristics, and if any disorders of speech: look for those affecting the voice, the articulation of words, the production and comprehension of language
- 3. Mood:** is a more sustained emotion that may color a person's view of the world.
- 4. Thought and perceptions:**
 - **Thought process** the logic, relevance, organization, coherence of the patient's thought as it leads to selected goals, or how people think.
 - **Perceptions:** sensory awareness of objects in the environment and their interrelationship (external stimuli); also internal stimuli, such as dreams or hallucinations

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5. Cognitive function

- **Orientation:** Being aware to person, place, and time.
- **Attention:** ability to focus on one task or activity.
- **Remote memory:** long term memory, refers to intervals of years.
- **Recent memory:** short term memory, refers to minutes, hours, or days.
- **New learning ability:** immediate repetition of material, followed by storage or retention of information.

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Cranial Nerve Assessments

I – Olfactory nerve – smell

- Test if: report loss of smell, had head trauma, with abnormal mental status or when suspect intracranial lesion
- Each nostril should identify odour – may ↓ with aging
- Occlude each & test with non-noxious smells: coffee, toothpaste, orange, vanilla, soap, peppermint

II – Optic nerve – vision

- visual acuity/visual fields, ophthalmoscopic exam– chpt 14

III, IV, VI – Oculomotor, Trochlear, & Abducens – Extra ocular eye movements

- Check pupil size, regularity, equality, direct & consensual light reaction & accommodation
- Check extraocular movements by cardinal positions of gaze
- Assess for nystagmus carefully chpt. 14.

25

Cranial Nerve Assessments

V – Trigeminal Nerve – mastication, sensation of face, corneal reflex

- Test motor component: Assess muscles of mastication - palpate temporal & masseter muscles as person clenches teeth, try to separate jaws by pushing down on chin; normally you cannot.
- Test sensory function: eyes closed test light touch sensation – touch cotton wisp to forehead, cheeks & chin
- Corneal reflex – omit unless clt has abnormal facial sensation or movement – remove contact lenses – bring wisp of cotton in from the side & lightly touch cornea not conjunctiva – person should blink bilaterally – tests sensory afferent neuron of cranial nerve V and motor efferent in cranial nerve VII.

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Assess the Muscles of Mastication by Palpating the Temporal and Masseter Muscles



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With the Person's Eyes Closed, Test Light Touch Sensation by Touching a Cotton Wisp to these Designated Areas on Person's Face: Forehead, Cheeks, and Chin.



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With the Person Looking Forward, Bring a Wisp of Cotton in from the Side (to Minimize Defensive Blinking) and Lightly Touch the Cornea—Not the Conjunctiva.



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29

Cranial Nerve Assessments

VII – Facial Nerve – facial muscle movement, taste

- Motor Assessment: Note mobility & facial symmetry as clt smiles, frowns, closes eyes tightly, lifts eyebrows, shows teeth & puffs cheeks
- Do not test taste routinely – only if suspect facial nerve injury — ask person to identify taste of sugar, salt lemon juice

VIII – Acoustic nerve – hearing acuity

- Test hearing in normal conversation, whispered voice test, Weber & Rinne – chpt. 15.

Note Mobility and Facial Symmetry as the Person: Smiles, Frowns, Closes Eyes Tightly, Lifts Eyebrows, Shows Teeth, and Puffs Cheeks.



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Cranial Nerves Assessments

IX & X – Glossopharyngeal & Vagus nerves

- Motor: Depress tongue with blade, note pharyngeal movement as person says “ahhhh” or yawns – uvula & soft palate should rise in midline, tonsillar pillars should move medially
- Touch posterior pharyngeal wall with blade & note ***gag reflex***
- Voice sounds should be smooth & not strained
- Sensory: IX mediates taste on posterior 1/3 of tongue but too difficult to test

XI – Spinal Accessory nerve – sternomastoid & trapezius muscle strength

- Ask person to turn head against resistance, shrug shoulders against resistance.

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Check Equal Strength by Asking the Person to Rotate the Head Forcibly Against Resistance



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34

Ask the Person to Shrug the Shoulders Against Resistance



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Cranial Nerves Assessment

XII – Hypoglossal nerve – tongue

- Inspect tongue – watch for wasting or tremors, should thrust midline as person protrudes
- Ask person to say “light, tight, dynamite” note lingual speech is clear & distinct.

Motor System Assessment

- Muscles – size, symmetry, strength, tone, involuntary movements
- Cerebellar Function – balance & coordination tests – gait, tandem walking, Romberg test, hop in place, rapid alternating movements, thumb to each finger, finger to finger test, finger to nose test, heel to shin tests.

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37

Motor system Examination

- Body position during movement and rest
- Watch for involuntary movements: note (location, quality, rate, rhythm, amplitude, relation to activity, posture)
- **Tics**: repetitive twitching of a muscle group at inappropriate time
- **Tremor**: involuntary contraction of opposing muscle group in a rhythmic movement as in Parkinson's disease
- **Chorea**: sudden, rapid jerky, purposeless movement as in Huntington's disease



Tics



Tremor



Chorea

– **Muscle Bulk**

- Compare size and contours of muscle (flat, concave? Unilateral or bilateral, proximal or distal). Look for:
 - **Atrophy**: abnormally small muscle with wasted appearance.
 - Happen in disuse, injury to lower motor neuron disease such as polio.
 - **Hypertrophy**: increased size and strength occur with isometric exercise
 - Look at the thenar and hypothenar muscle (convex and full)
 - Look at the space between metacarpals (full, slightly depressed)
- **Tone**: is the normal degree of tension (contraction) in voluntary relaxed muscle
 - Shows as mild resistance to passive stretch
 - Decreased resistance suggests peripheral disease in nervous system, cerebella, or spinal injury
 - Limited ROM, pain, flaccidity (decrease resistance or hypotonic); spasticity or rigidity (increased resistance).

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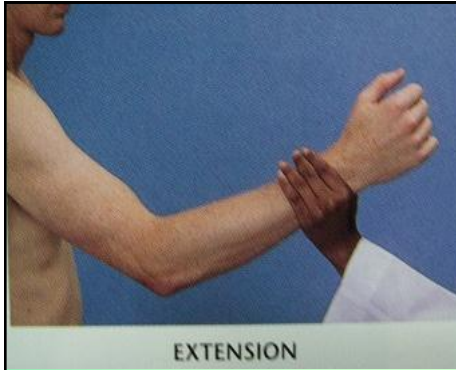
– **Strength: test muscle power**

Ask the pt to move against your resistance

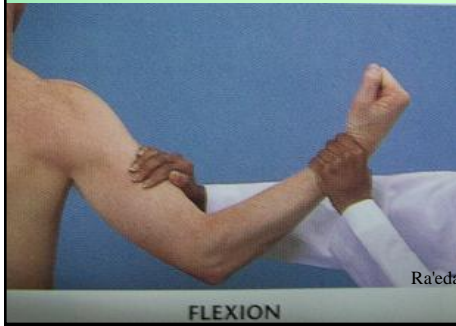
- **Paresis or weakness**: diminished strength
- **Paralysis or plegia**: is absence of strength
- **Hemiparesis or hemiplegia**: paralysis of one side of the body
- **Grading Muscle Strength**:
 - 5: Full ROM against gravity, full resistance.
 - 4: Full ROM against gravity, some resistance.
 - 3: Full active ROM with gravity.
 - 2: Full active ROM with gravity eliminated (Passive motion).
 - 1: Slight contraction barely detected
 - 0: No contraction.

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- Muscle strength of the upper trunk:
- Test flexion (biceps) and extension (triceps) at the elbow:



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- Test extension at the wrist (radial nerve):



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- Test the grip:



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- Test finger abduction(ulnar nerve)

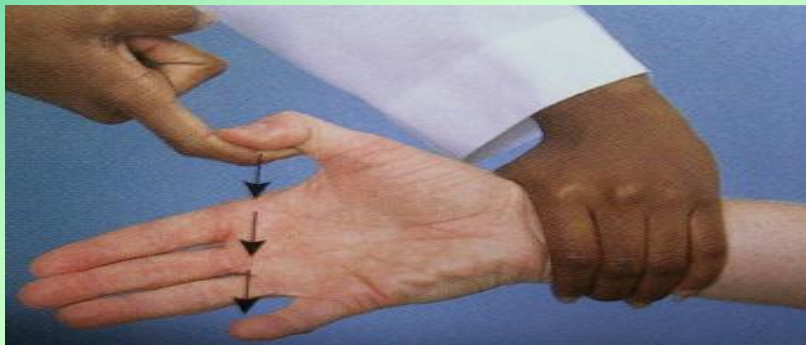


Finger abduction

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- Test opposition of the thumb (median nerve):

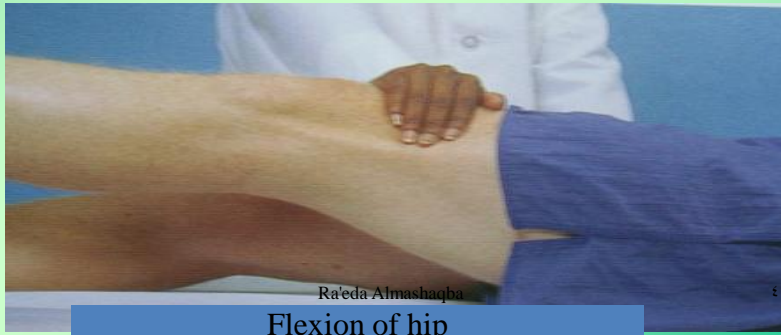


Opposition of thump

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- **Muscle strength of the lower trunk:**
 - flexion, extension, lateral bending of the spine
 - Thoracic expansion, diaphragmatic excursion during respiration
 - Test flexion at the hip:



Test adduction at the hip:

- Place your hand between pt knee
- Ask pt to bring his leg together against you

Test abduction at the hip:

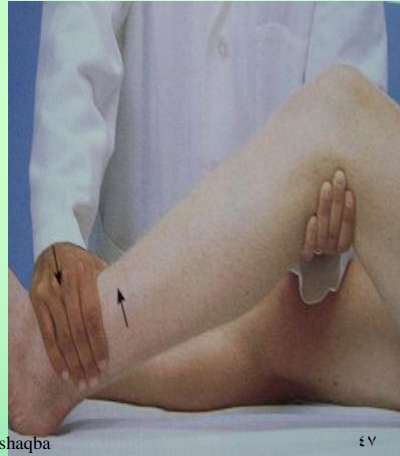
- Place your hand at the outer side of the knee
- Ask pt to spread legs against your hand

Test extension at the hips:

- Have the pt push the posterior thigh down against your hand

- Test flexion at the knee:
 - Flex pt knee, foot resting on the bed
 - Ask pt to keep the foot down as you try to straighten the leg

- Test extension at the knee



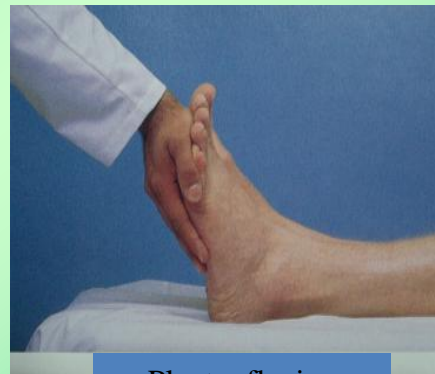
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- Test dorsiflexion and plantarflexion at the ankle



dorsiflexion



Plantar flexion

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Coordination

- Coordination requires that four areas of the nervous system function in an integrated way:
 - Motor system for motor strength
 - Cerebellar system for rhythmic movement and steady posture
 - Vestibular system for balance and coordinating eye, head, body
 - Sensory system, for position sense

• Rapid alternating movements (Cerebellar)

In Arms:

- Pat thigh alternating with palm and back of hand; tap sequential fingers
- Tap the distal joint of the thumb with tips of index finger as rapidly as possible

In Legs:

Ask pt to tap your hand as quickly as possible with the ball of each foot in turn note any slowness



Rapid alternate movement

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- Point to point movements (Cerebellar)
 - Check finger to nose and heel to shin
 - Observe accuracy and smoothness
 - Cerebellar incoordination gets worse with eyes closed



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Heel-to-shin

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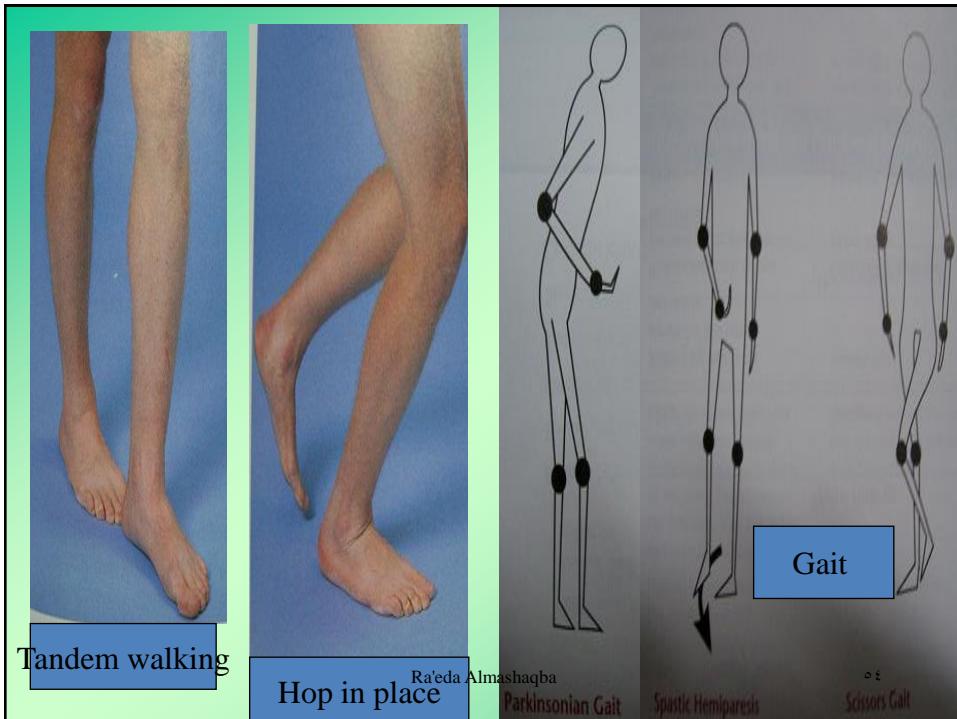
- **Gait**

- Ask the patient to walk across the room, turn around, and then come back
- walk heel to toe (tandem walking) (brings out subtle incoordination)
- Walk on toes, then on heels (tests strength and balance)
- Hop in place on each foot in turn
- Do shallow knee bend, in one leg then on the other
- Rising from a sitting position without arm support

Ataxia: uncoordinated or unsteady gait

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– Stance (posture):

- Romberg test: test of position sense, patient stand feet together, eyes closed, for 20-30 sec. dose patient able to maintain upright position
 - Positive: when lose balance, sways, widens base of feet to avoid falling
- Pronator drift test:
 - stand for 20-30 sec, arms up, palms up, eyes closed;
 - then instruct the patient to keep arms up, tap the arms briskly downward, the patient should be able to keep arms up back smoothly.
 - Abnormal finding: downward drift of arm with flexion of elbow and fingers; or pronation of one arm (Corticospinal tract lesion).

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Romberg Test

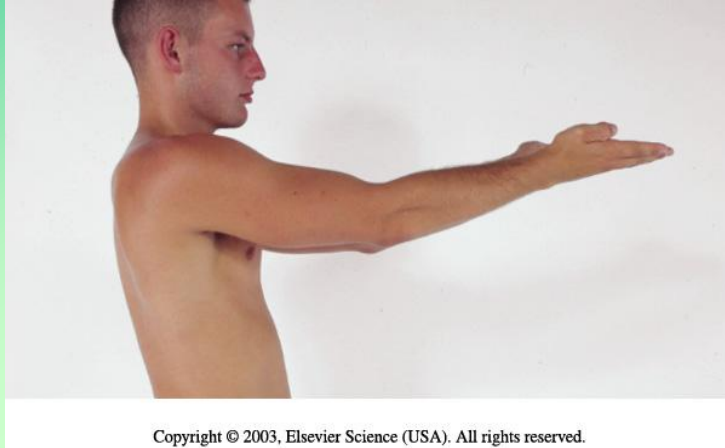


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Checking for Palmar Drift



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Assessment of the Sensory System

- Careful sensory assessment helps to establish the level of spinal cord lesion and determine peripheral lesions
- To evaluate the sensory system, several kinds of sensation are assessed:
 - Pain & Temperature (spinothalamic tracts)
 - Position and vibration (posterior columns)
 - Light touch (posterior columns and spinothalamic tracts)
 - Discriminative sensation (involve the cortex)

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- Sensory testing quickly fatigues many patients and then produces unreliable results
- Therefore:
 - Pay special attention to areas where there are symptoms such as numbness or pain
 - Where there are motor or reflex abnormalities that suggest a lesion of the spinal cord or PNS
 - Where there are trophic changes (such as absent or excessive sweating)
 - Repeated testing at another time is often required to confirm abnormalities

- The following patterns of testing allow one to identify sensory deficits accurately and efficiently
 - Compare symmetric areas (arms, legs, trunk)
 - Compare the distal with the proximal areas of the extremities
 - When testing position and vibration, first test fingers and toes; if ok, ok everywhere
 - Vary the pace of testing
 - When you detect an areas of sensory loss, map out boundaries in detail (start from point of decrease sensation then move up)

- **Pain: sharp or dull?, does this feel same as this?**
 - Analgesia: absence of pain sensation
 - Hypalgesia: decreased sensitivity to pain
 - Hyperalgesia: increased sensitivity to pain
- **Temperature:** not necessarily performed if pain sensation is normal.
 - Hot or cold sensation?
- **Light Touch:** with a “wisp of cotton” touch skin lightly; avoid pressure.
 - Anesthesia: absence of touch sensation
 - Hypesthesia: is a decreased sensitivity to touch
 - Hyperesthesia: increased sensitivity to touch.

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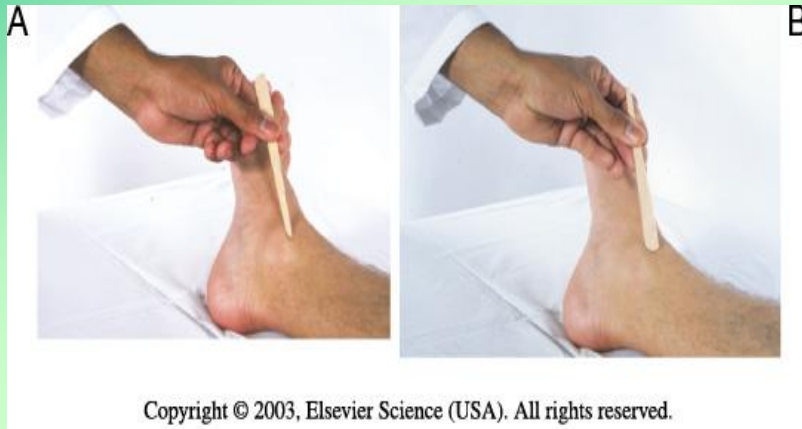
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- **Vibration:** using low pitch tuning fork 128 Hz
 - Start from distal interpharyngeal joints then at interpharyngeal joint of big toe
 - Be sure it is a vibration or pressure
 - If it is impaired proceed to more proximal bony prominences (wrist, elbow, medial malleolus)
 - Common causes of lost of sensation of vibration is (DM, alcoholism, vitamin B₁₂ deficiency, posterior column disease)
- **Position:** using your thumb and index finger pull big toe “up” and “down”.

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Testing Pain Sensation



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63

Testing Light Touch



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64

Assessing Vibration Sensation



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Kinesthesia (Position)



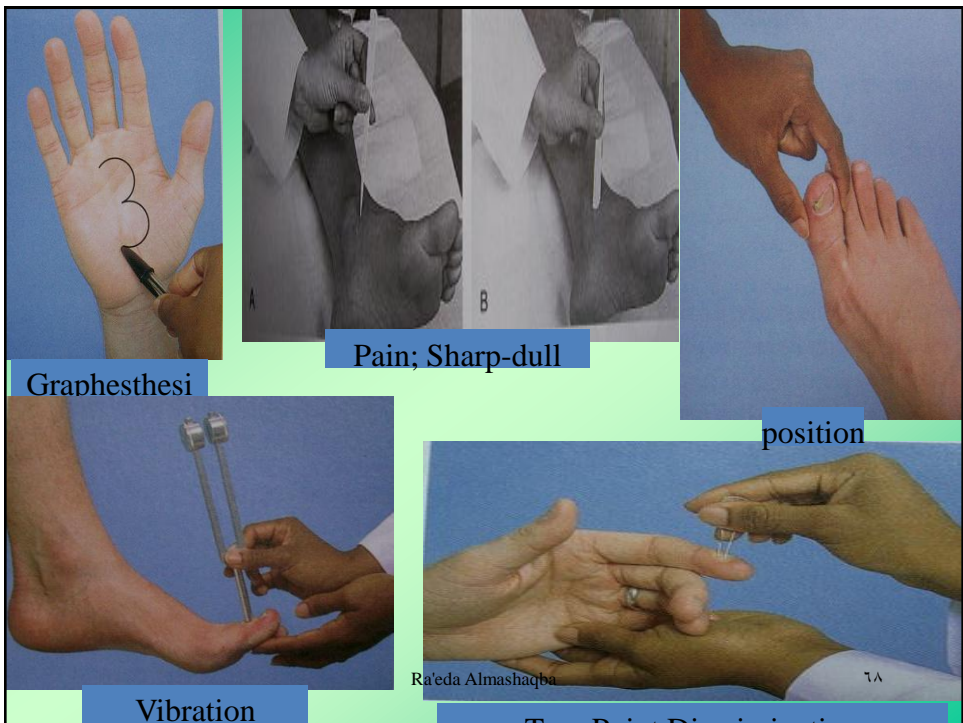
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66

- **Discriminative Sensations:** it is an additional technique test the ability of sensory cortex to correlate, analyze, interpret sensations.
- Performed while the **pt eyes are closing**
 - **Stereognosis** (object identification by feeling)
 - **Graphesthesia** (number identification by feeling)
 - **Two-point discrimination:** increase distance between 2 recognizable points indicate lesion of the sensory cortex
 - **Point localization**
 - **Extinction:** ask patient if feels your touch when you simultaneously stimulate areas on both sides of the body.

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Deep Tendon Reflexes

- To elicit:
 - Ask the patient to relax
 - Position the limbs properly
 - Hold reflex hammer between your thumb and index finger
 - Strike the tendon briskly, using a rapid wrist movement
 - You may use either the pointed or the flat end of the hammer
 - Note speed, force, and amplitude of reflex response and grade the response

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- Reflexes are graded 0 to 4+
 - 4+: Very brisk, hyperactive, with clonus
 - 3+: Brisker than average; possible by not necessarily indicative of disease
 - 2+: Average; normal
 - 1+: Somewhat diminished; low normal
 - 0 : No response
- Hyperactive reflex indicate CNS disease
- Absent or diminished of reflex indicate loss of sensation, relevant spinal segment damage, or PN damage

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Reinforcement:

- Used when the reflexes are symmetrically diminished or absent
 - It leads to isometric contraction of other muscles that may increase reflex activity
- e.g. to test arm reflex ask pt to clench teeth or squeeze one thigh with opposite hand
- if leg reflex are absent ask pt to lock fingers and pull one hand against the other (pull just before strike)



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Deep tendon reflexes

- Biceps reflexes (C5,6)
- Tested while pt is sitting or lying down
- Observe flexion at elbow, watch and feel the contraction of biceps muscle

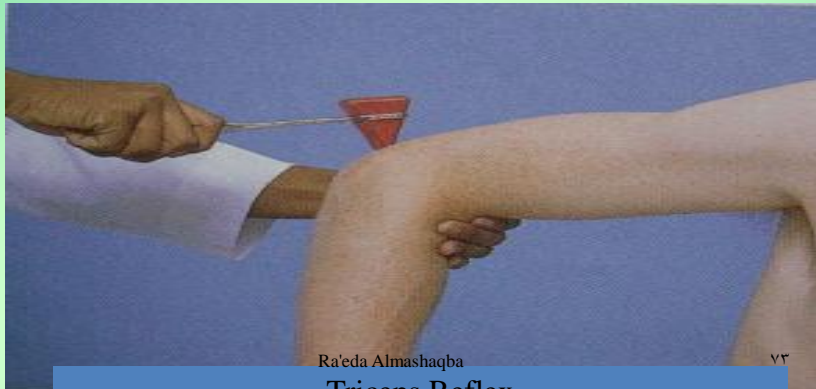


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Biceps Reflex

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- **Triceps reflexes (C6,7):**

- Pt may be sitting or supine
- Watch for contraction of the triceps muscle and extension at elbow



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Triceps Reflex

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- **Supinator or Brachioradialis(C5,6):**

- Strike the radius with the flat edge, 1-2 inch above the wrist
- Watch for flexion and supination of the forearm

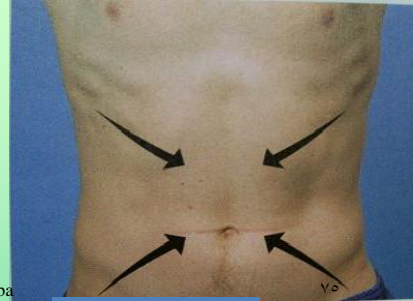


Brachioradialis Reflex Ra'eda Almashaqba

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- **Abdominal reflex**

- Above umbilicus (T8,9,10), below umbilicus (T10,11,12)
- Use wooden end of a cotton tipped applicator or the back of the hammer
- Note contraction of Abd muscle and deviation of the umbilicus toward stimulus
- May be absent in PN or CN disorder

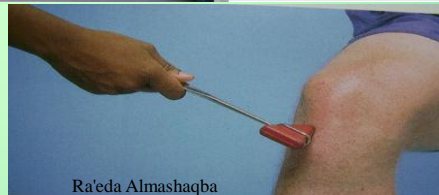


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Abdominal Reflex

- **Knee reflex (L2,3,4):**

- Pt sitting or lying down
- Tap patellar tendon under the patella
- Note contraction of quadriceps and extension at the knee (placing your hand at the anterior thigh lets you feel this reflex)



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٧٦

Knee Reflex

- Ankle reflex (primarily S1):
 - If pt in sitting position, dorsiflex the foot at the ankle
 - Strike the Achilles tendon
 - Watch and feel planter flexion at the ankle and the speed of relaxation after muscle contraction



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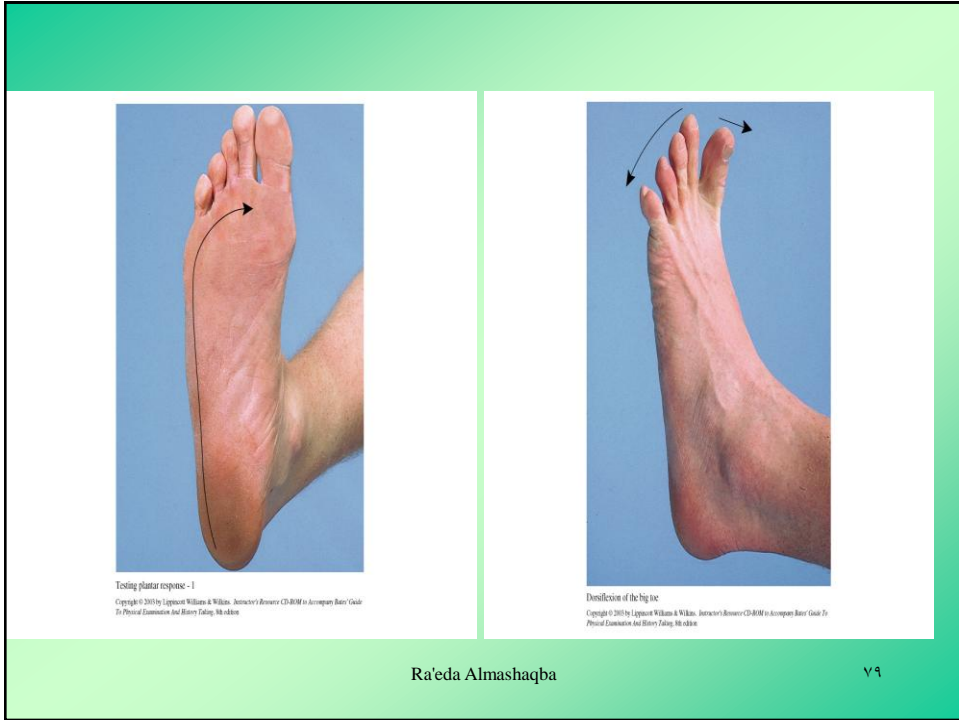
Ankle Reflex

Plantar Reflex

- Also known as the Babinski response
- Take key or end of the hammer and stroke the lateral aspect of the foot, curving medially against the ball
- Normal response planter flexion of the toes
- Upward motion of the toe is abnormal.
- +ve Babinski: the big toe dorsiflex, other toes fanning.

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- **Ankle clonus:**
 - Used when reflexes are hyperactive
 - Support knee in a partly flexed position
 - The other hand dorsiflex and plantarflex the foot for a few times
 - Encourage pt to relax. Then sharply dorsiflex the foot and maintain position.
 - Look and feel for rhythmic oscillation between dorsiflexion and plantarflexion
 - In normal people ankle does not react to this stimulus
 - Sustained clonus indicate CNS disease
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Testing for Clonus



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81

Meningeal Signs

- **Neck Mobility:** pain in the neck and resistance to flexion indicate meningeal inflammation, arthritis, or neck injury
- **Brudzinski's Sign:** positive if flexion of hip and knees as you flex the neck.
- **Kernig's Sign:** Positive if pain and increased resistance to extending the knee when flex leg at the hip and knee and then straighten the knee.
 - Both Brudzinski's and Kernig's sign suggest meningeal inflammation/irritation

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