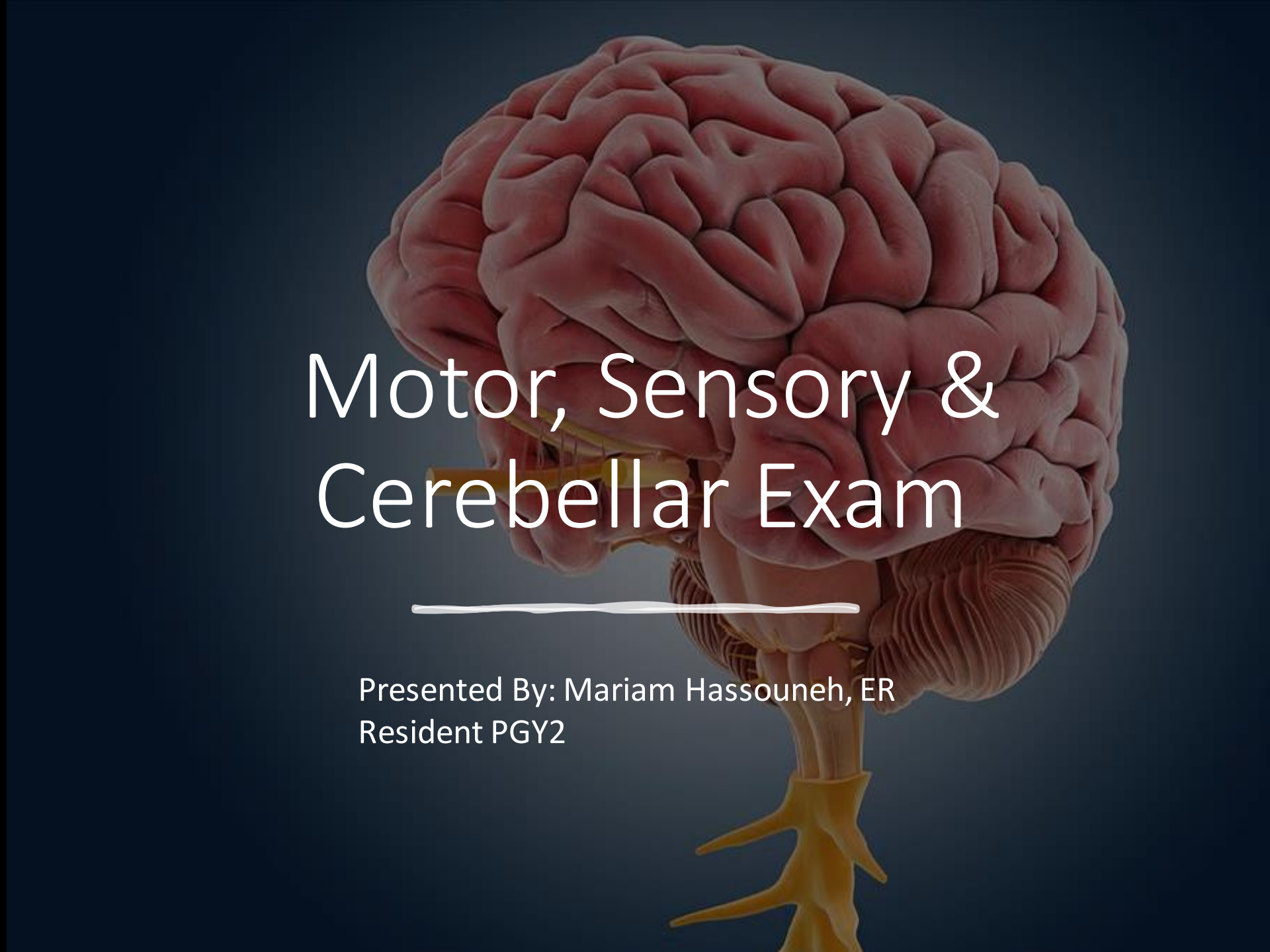
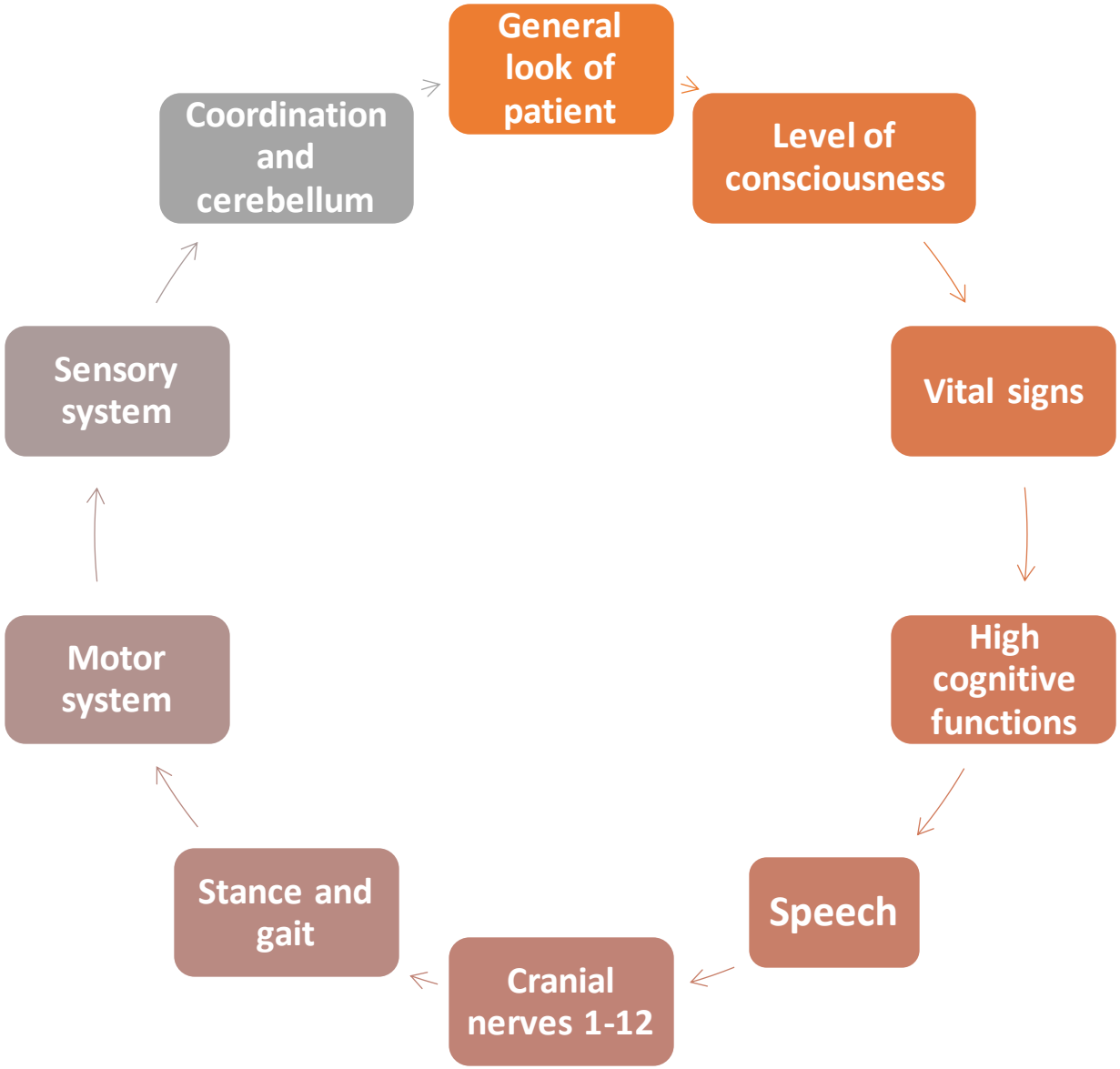


Motor, Sensory & Cerebellar Exam

Presented By: Mariam Hassouneh, ER Resident PGY2

Remember from the previous lecture!

General Approach to Neurological Examination

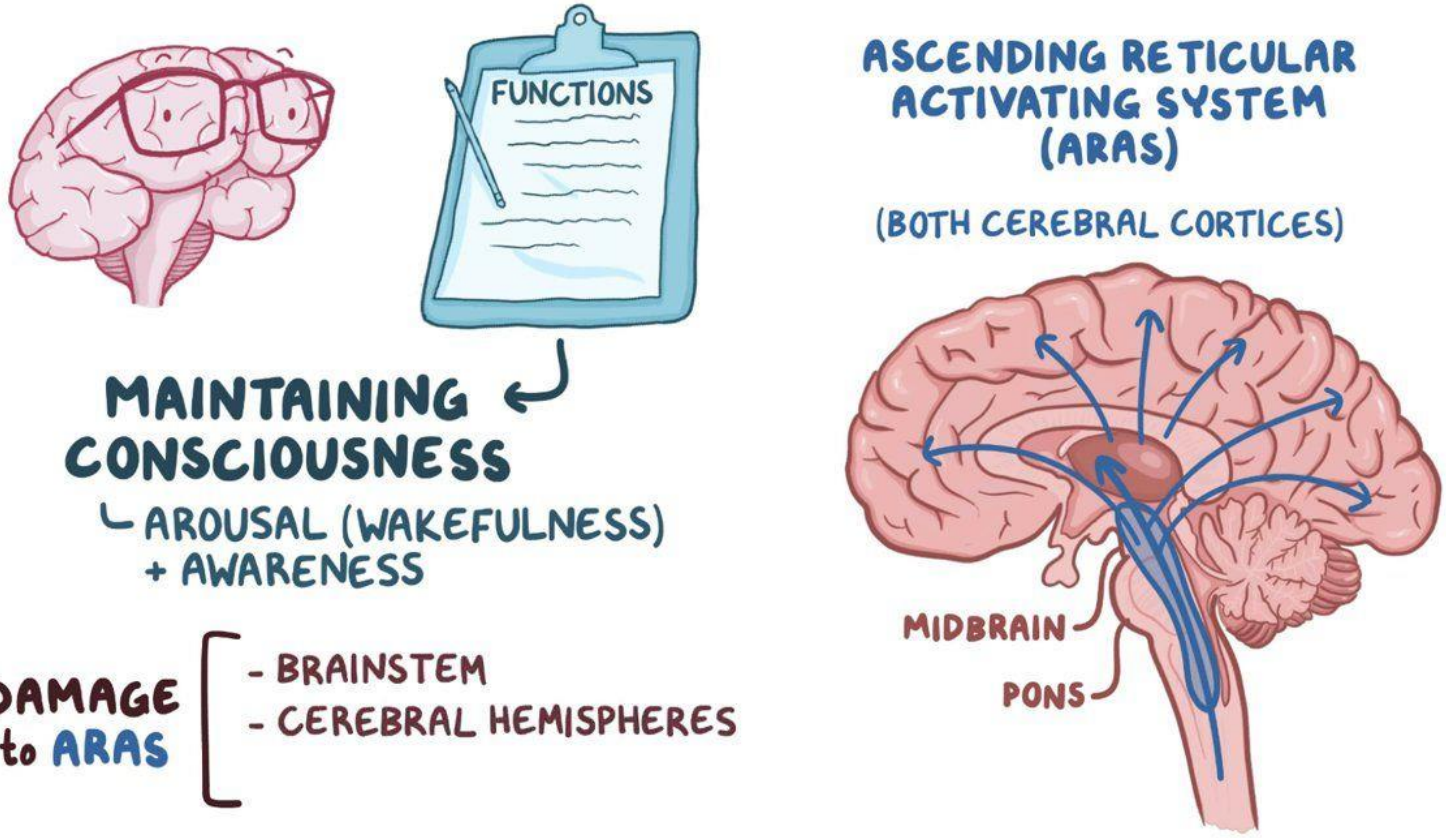


General look of the patient

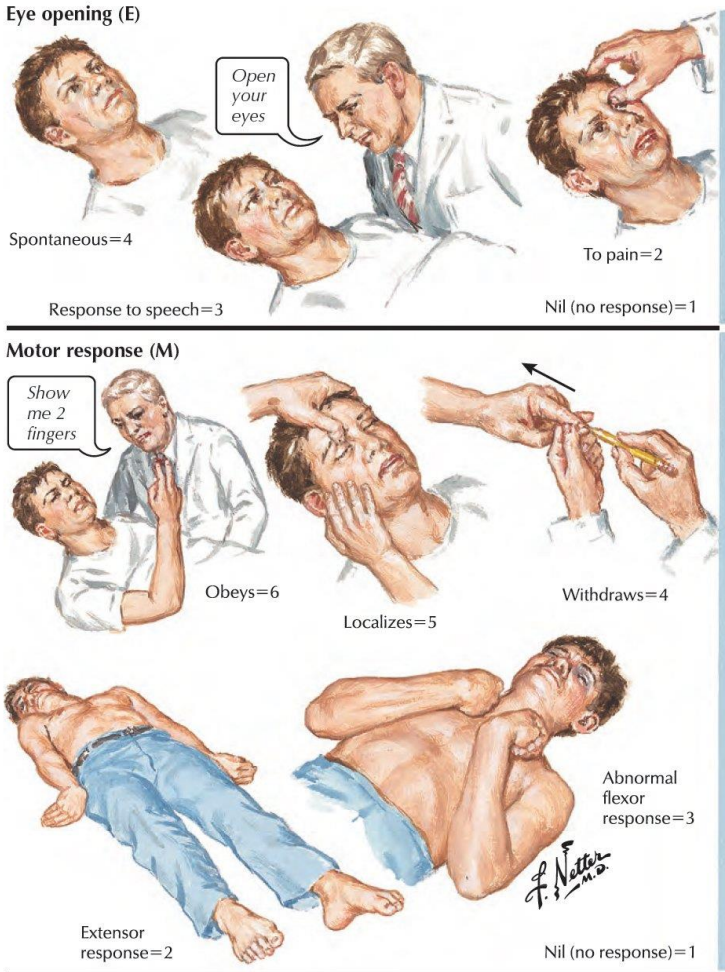
Begins with your first contact with the patient and continues during history taking!

- Facial expression
- General demeanor
- Posture
- Gait
- Speech
- Involuntary movements

Assessment Of Consciousness Level



Glasgow Coma Scale



E	
Spontaneous	4
To speech	3
To pain	2
Nil	1

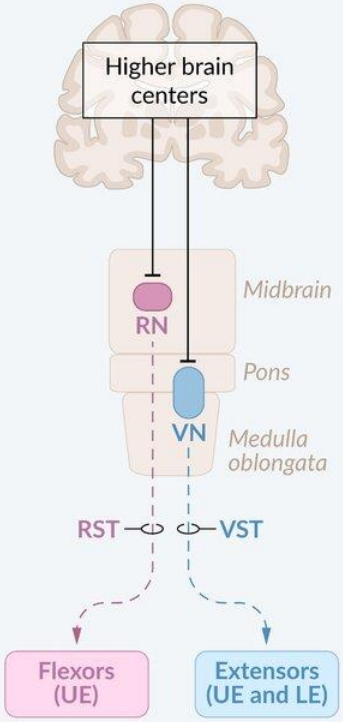
M	
Obeys	6
Localized	6
Withdraws	4
Abnormal flexion	3
Extensor response	2
Nil	6

V	
Orented	5
Confused conversation	4
Inappropriate words	3
Incomprehensible sounds	2
Nil	1

Coma score (E+M+V)=3 to 15

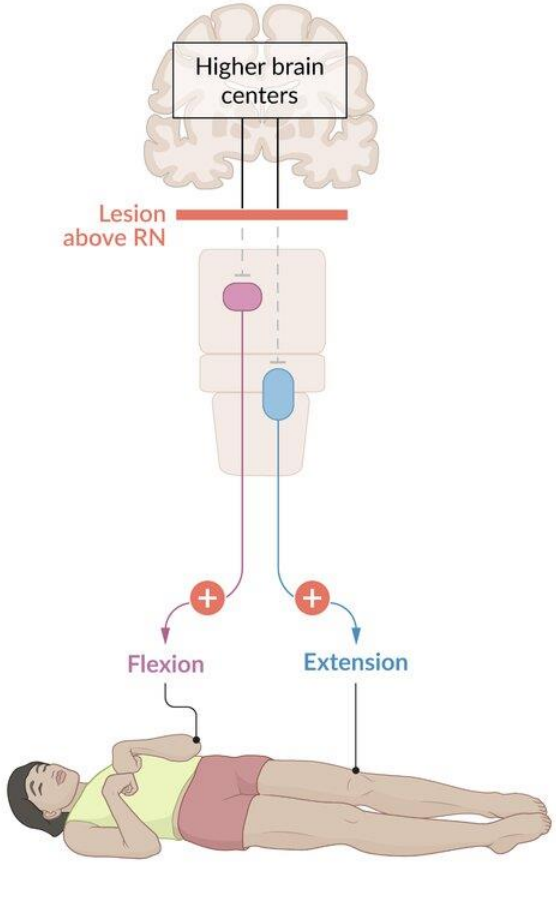
How to calculate a Glasgow Coma Scale (GCS) score.

Normal physiology

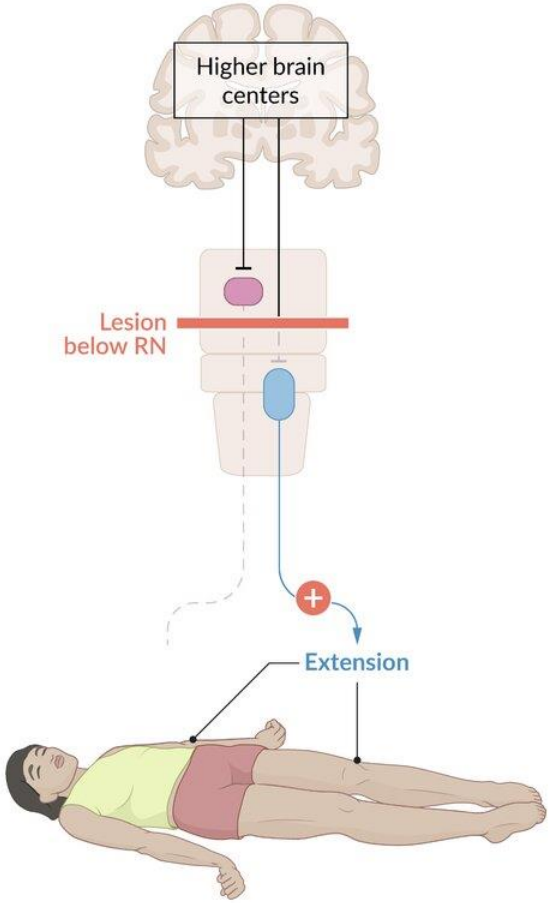


RN	Red nuclei	UE	Upper extremity
VN	Vestibular nuclei	LE	Lower extremity
RST	Rubrospinal tract	⊣	Inhibitory effect
VST	Vestibulospinal tract	→	Excitatory effect

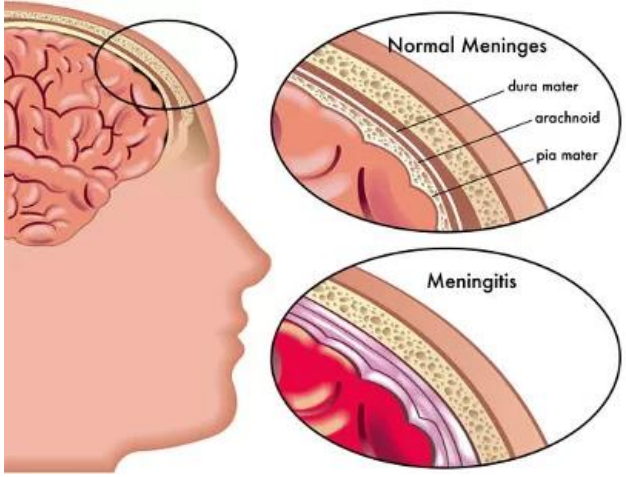
Decortication

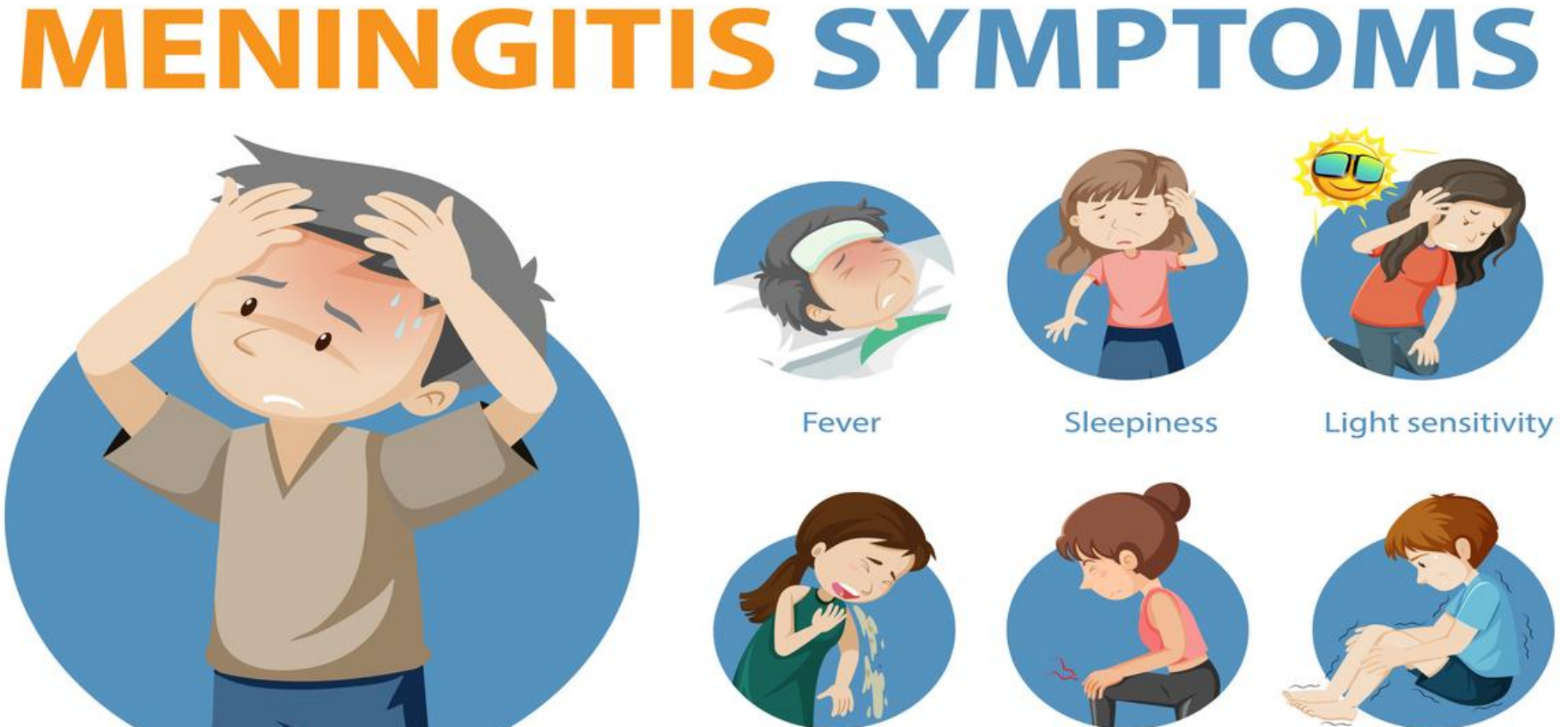


Decerebration



Meningeal irritation signs

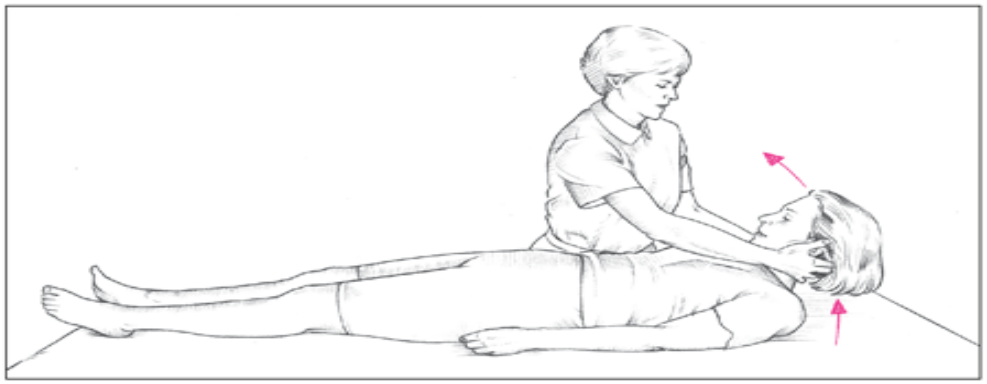




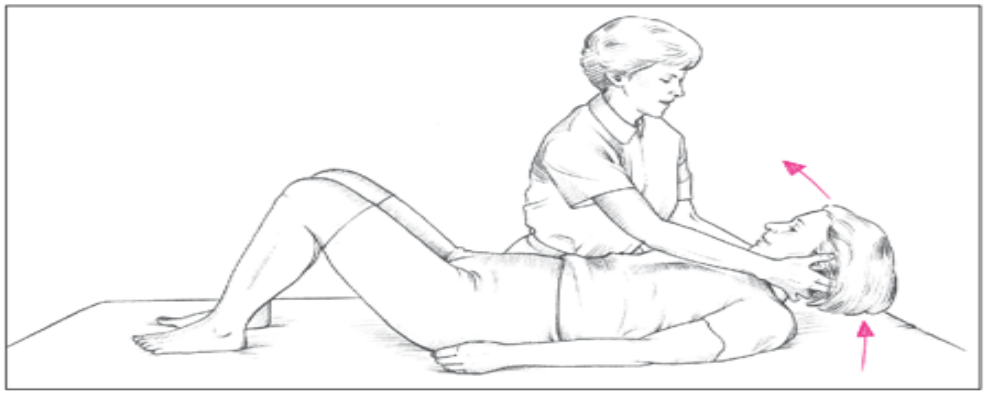
Testing for Brudzinski's sign

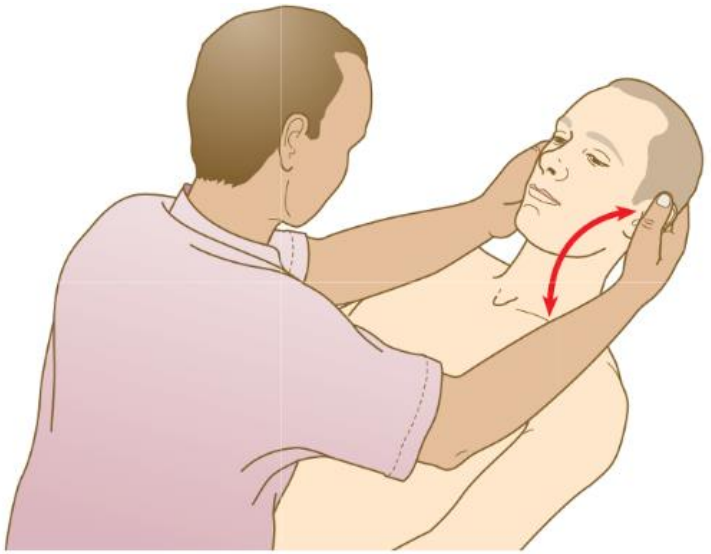
Here's how to test for Brudzinski's sign when you suspect meningeal irritation:

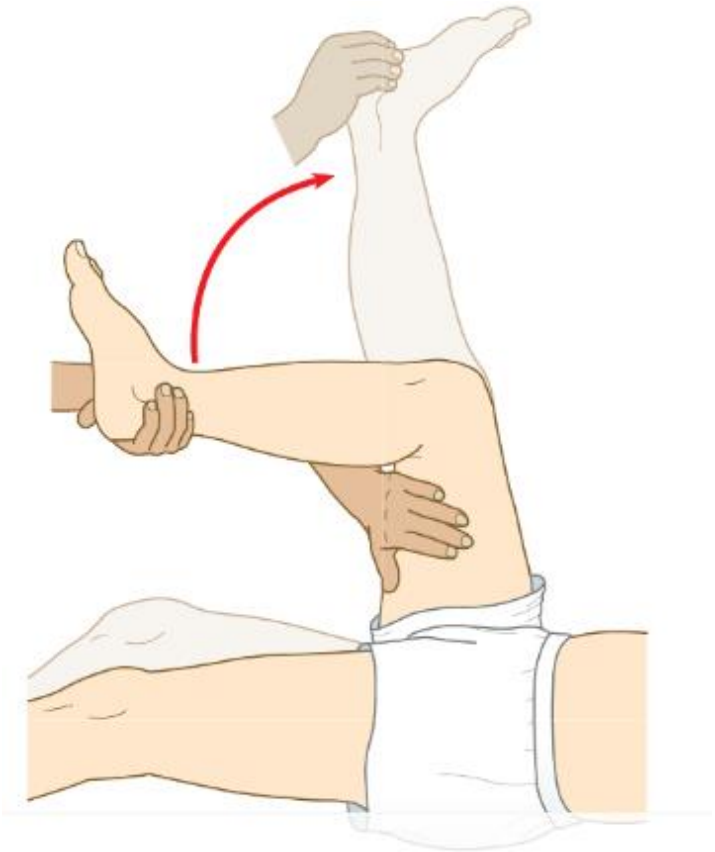
With the patient in a supine position, place your hands behind her neck and lift her head toward her chest.



If your patient has meningeal irritation, she'll flex her hips and knees in response to the passive neck flexion.

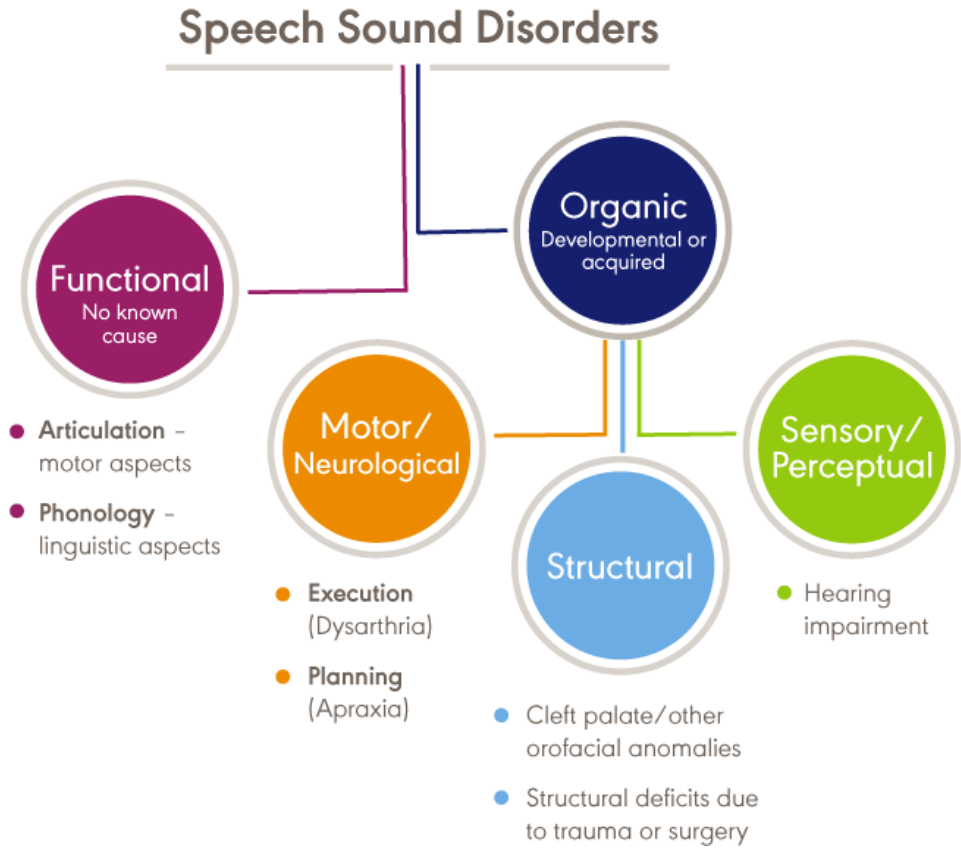


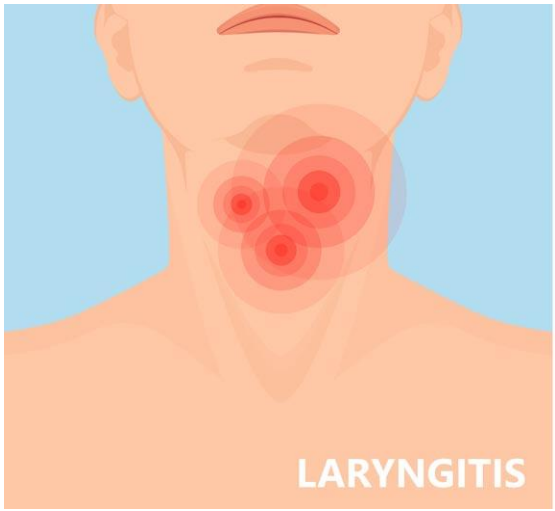


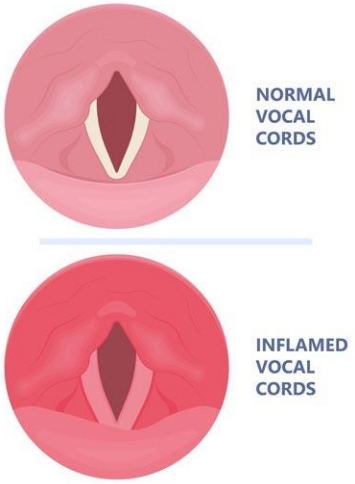


Show me how you talk!

Dysarthria & Dysphonia







Speech Abnormalities

- Dysarthria:
  - articulation problems
  - localized lesions in the tongue, lips, or mouth,
  - ill fitting dentures,
  - neurological motor deficit
- Dysphonia:
  - loss of volume caused by laryngeal disorders
  - laryngitis or vagal nerve supply to the vocal cords (recurrent laryngeal nerve)
  - Inability to abduct one of the cords leads to a bovine (ineffective) cough.

Speech Examination

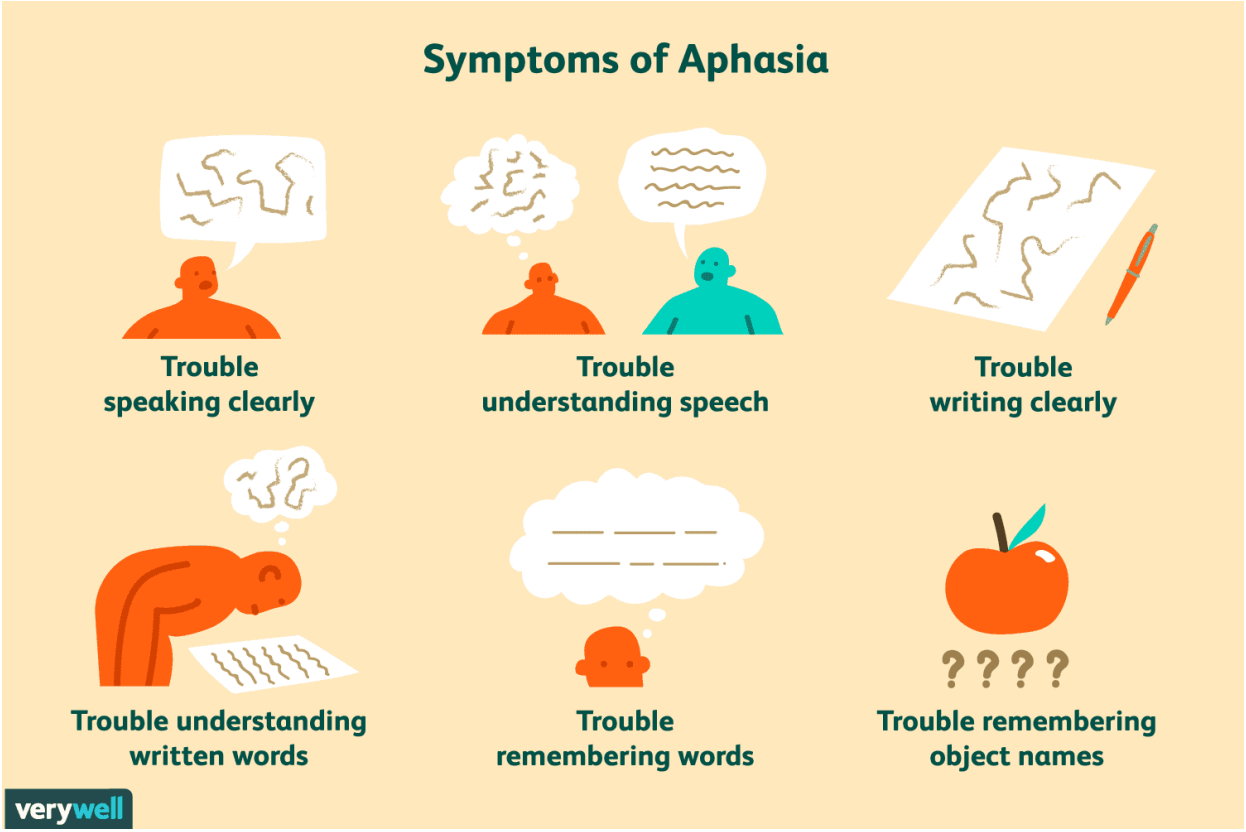
- Listen to the patient's spontaneous speech, noting volume, rhythm and clarity.
- Ask the patient to repeat phrases such as 'yellow lorry' to test lingual (tongue) sounds and 'baby hippopotamus' for labial (lip) sounds, then a tongue twister, e.g. 'the Leith police dismisseth us'.
- Ask the patient to count steadily to 30 to assess fatigue.
- Ask the patient to cough and to say 'Ah'; observe the soft palate rising bilaterally.

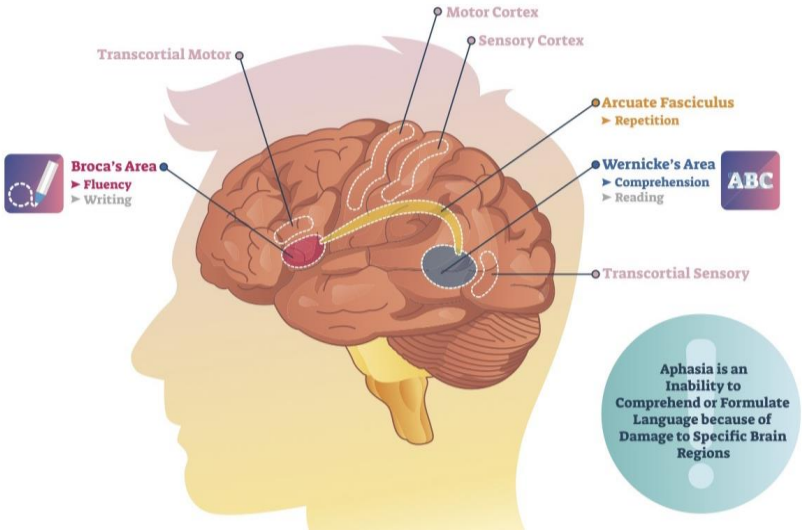
Dysarthria

- Pseudobulbar palsy; Bilateral UMN lesion
  - contracted, spastic tongue and difficulty pronouncing consonants;
- Bulbar palsy; Bilateral LMN lesion
  - Weakness of the tongue results in difficulty with lingual sounds, while palatal weakness gives a nasal quality to the speech.
- Cerebellar dysarthria:
  - slow and slurred, similar to alcohol intoxication.
- Myasthenia gravis:
  - fatiguing speech, becoming increasingly nasal and may disappear altogether
- Parkinsonism:
  - dysarthria and dysphonia, with a low-volume, monotonous voice

Show me how you talk!

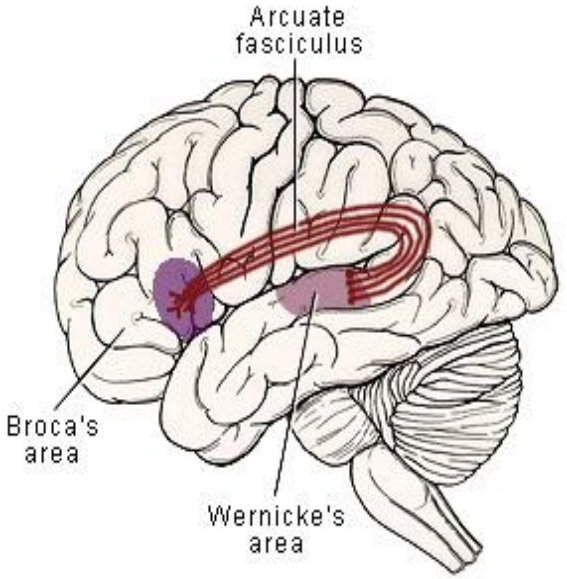
Receptive (Fluent, Wernick'es) vs Expressive (Non fluent, Broca's) Aphasia





Dysphasia

- Dysphasia:
  - disturbance of language resulting in abnormalities of speech production and/or understanding
  - may also involve other language symptoms, e.g. writing and reading.
- Expressive (motor) dysphasia; nonfluent speech, grammar and syntax errors. Comprehension is intact
- Receptive (sensory) dysphasia; fluent speech, meaningless, paraphrasias and neologism. Comprehension is poor.
- Conduction dysphasia
- Global dysphasia
- Dyslexia
- Dyscalculia
- Dysgraphia



Dysphasia examination

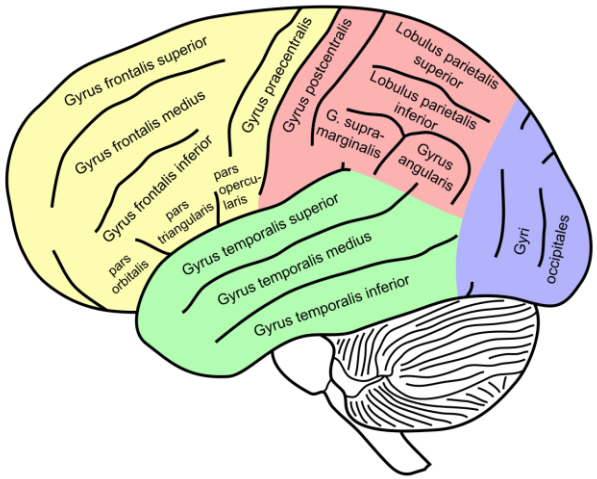
- listen to the fluency and appropriateness of the content during speech.
- Ask the patient to name a common object
- Give a simple three-stage command
- Ask the patient to repeat a simple sentence
- Ask the patient to read a passage from a newspaper.
- Ask the patient to write a sentence; examine his handwriting.

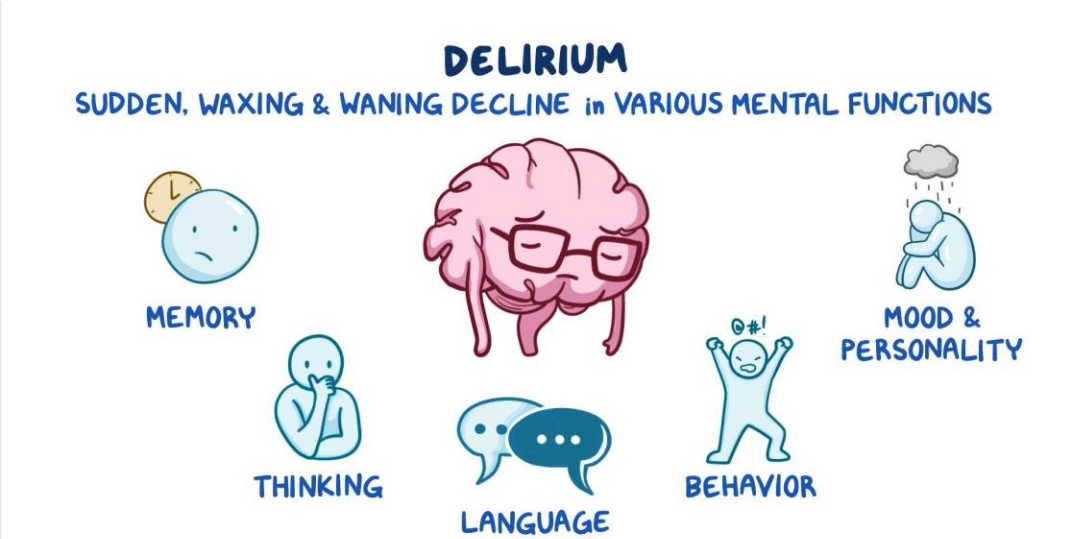
Speech Abnormalities; Live!

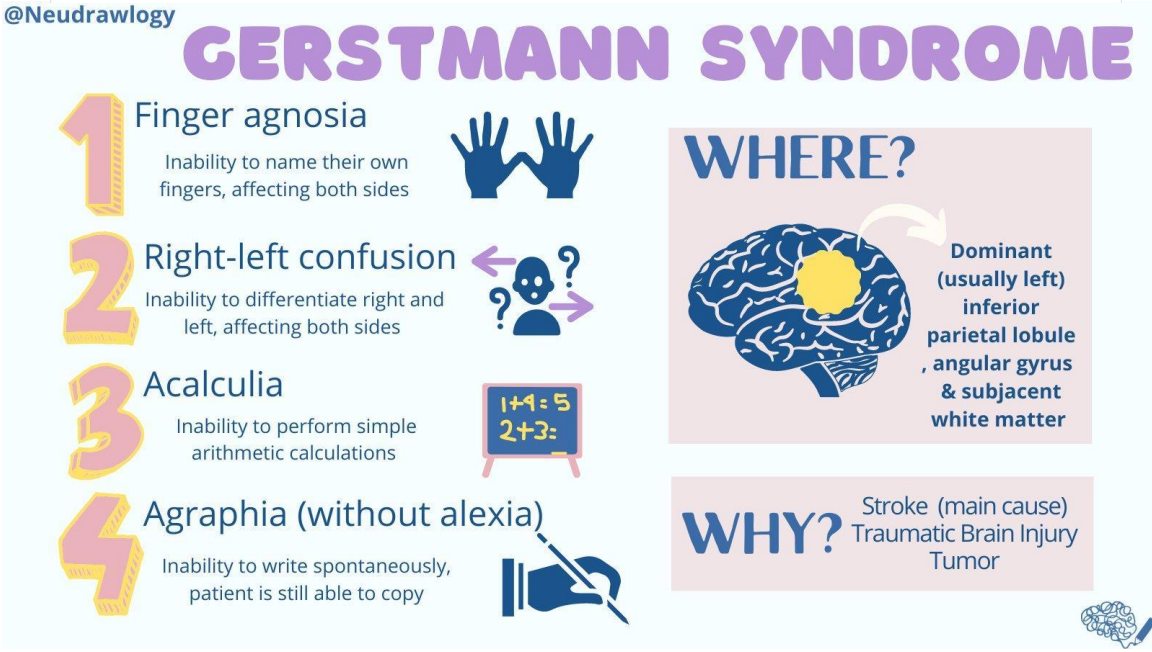
- https://youtu.be/IXxruuFwue8
- https://www.youtube.com/watch?v=dy8WvykiLto&ab_channel=emtgoodboy
- https://youtube.com/shorts/s-5gFaUJbT8?feature=share
- https://youtu.be/JWC-cVQmEmY
- https://youtu.be/3oef68YabD0

Note that!

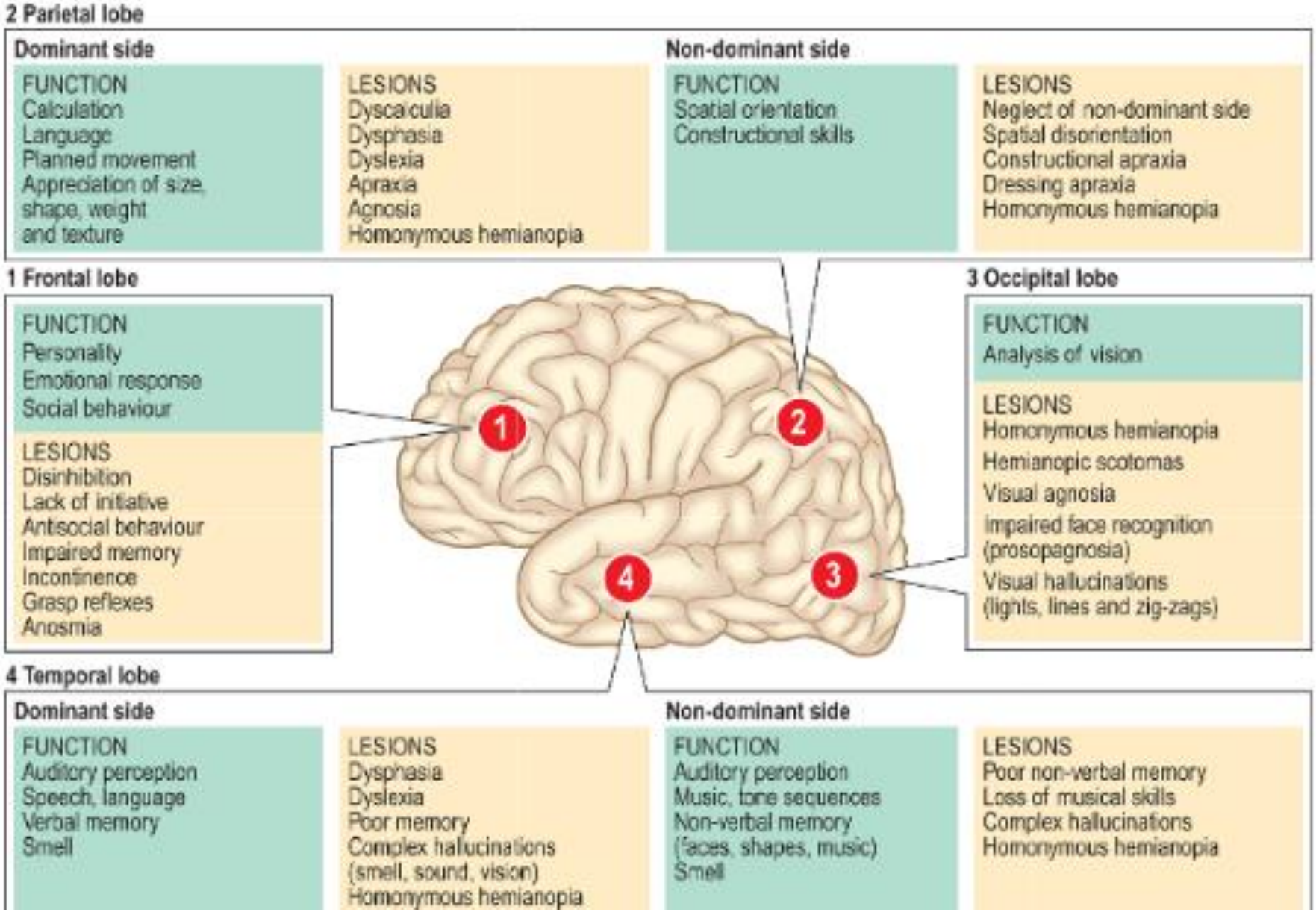
- Dysphasia vs confusion
- Gerstmann syndrome







Cortical Function



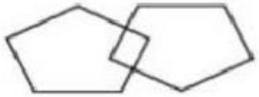
Assessing higher cognitive functions

- Thinking, emotion, language, behavior, planning, and initiation of movements, perception of sensory information
- Time-consuming!!
- Very imp in patients who display cognitive symptoms
- MMSE, MoCA are quick screening tools
- Addenbrooke's cognitive examination is more detailed

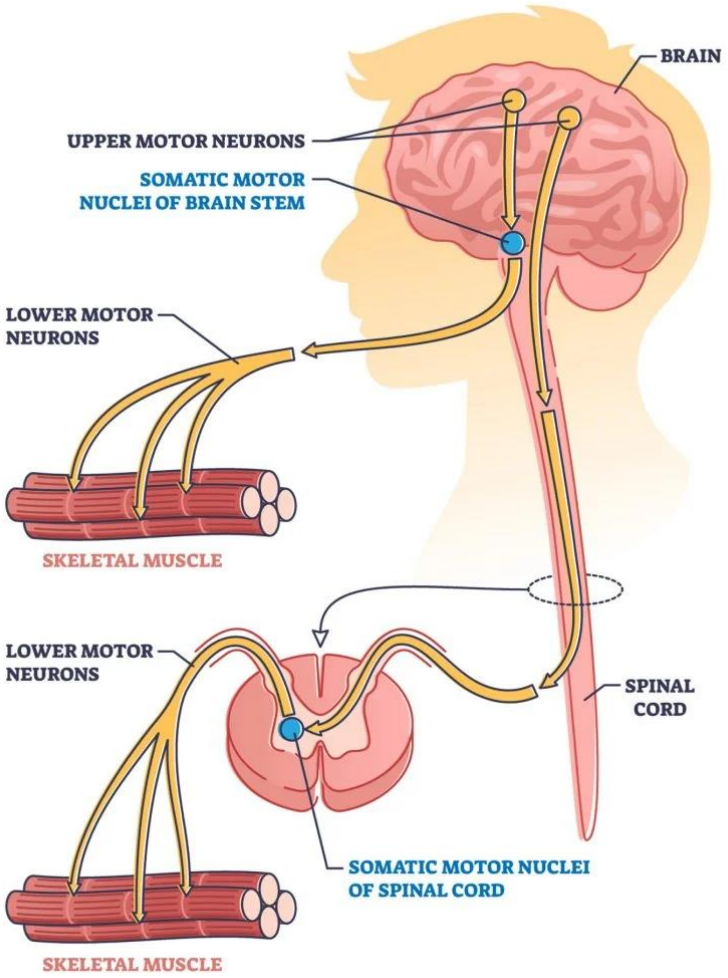
Mini-Mental State Examination (MMSE)

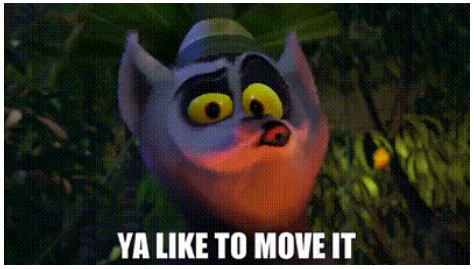
Patient's Name: _____ Date: _____

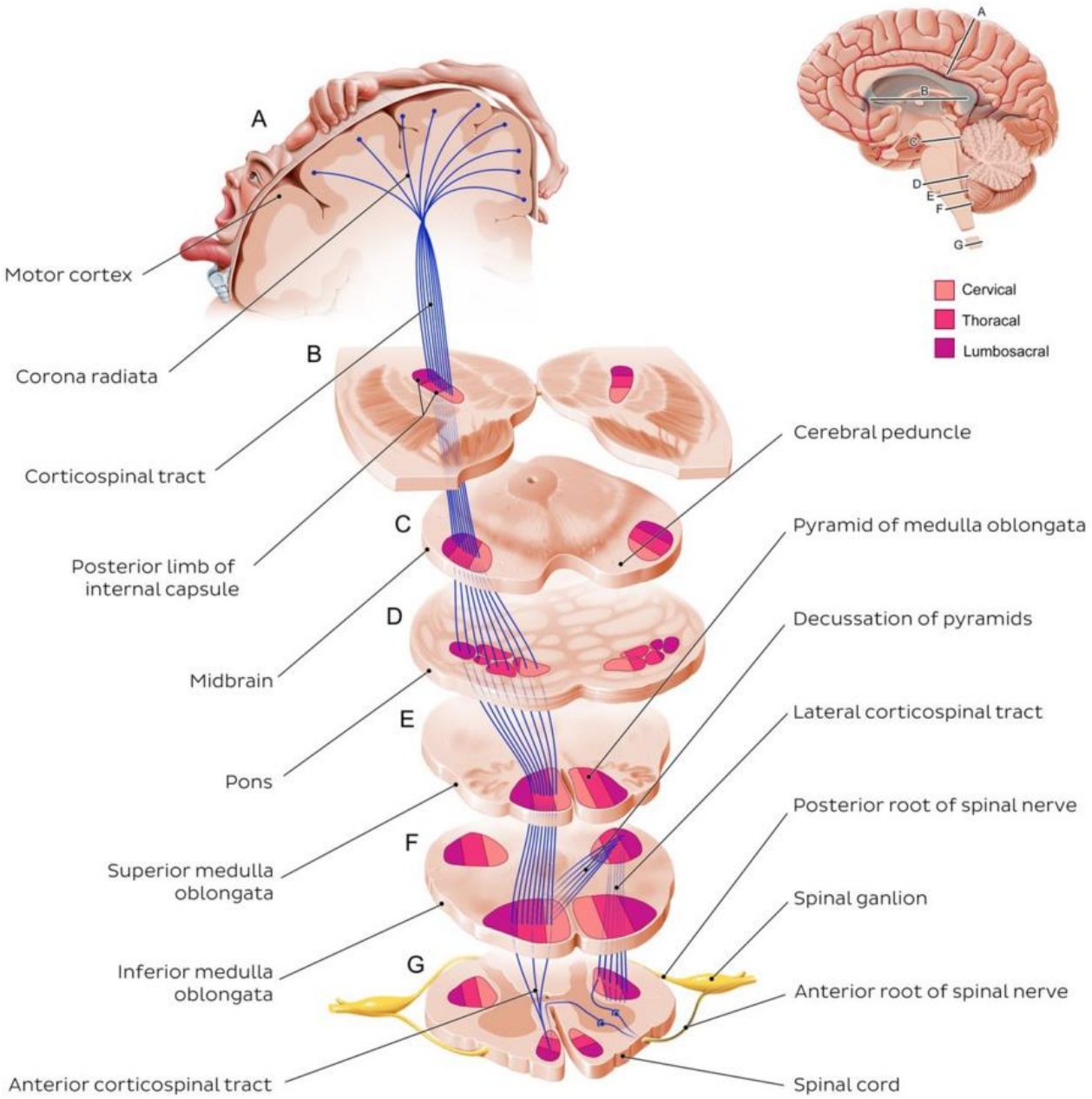
Instructions: Score one point for each correct response within each question or activity.

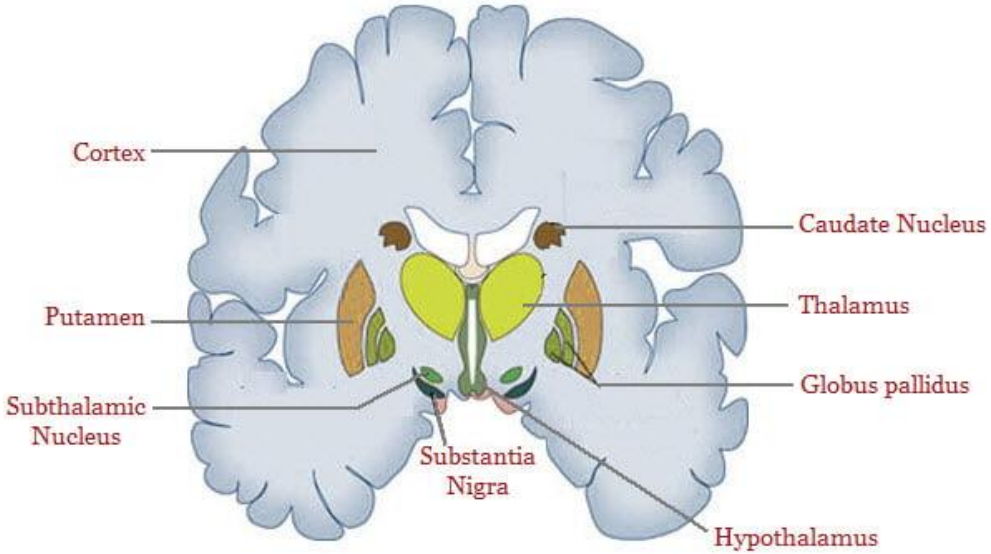
Maximum Score	Patient's Score	Questions
5		"What is the year? Season? Date? Day? Month?"
5		"Where are we now? State? County? Town/city? Hospital? Floor?"
3		The examiner names three unrelated objects clearly and slowly, then the instructor asks the patient to name all three of them. The patient's response is used for scoring. The examiner repeats them until patient learns all of them, if possible.
5		"I would like you to count backward from 100 by sevens." (93, 86, 79, 72, 65, ...) Alternative: "Spell WORLD backwards." (D-L-R-O-W)
3		"Earlier I told you the names of three things. Can you tell me what those were?"
2		Show the patient two simple objects, such as a wristwatch and a pencil, and ask the patient to name them.
1		"Repeat the phrase: 'No ifs, ands, or buts.'"
3		"Take the paper in your right hand, fold it in half, and put it on the floor." (The examiner gives the patient a piece of blank paper.)
1		"Please read this and do what it says." (Written instruction is "Close your eyes.")
1		"Make up and write a sentence about anything." (This sentence must contain a noun and a verb.)
1		"Please copy this picture." (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.) 
30		TOTAL

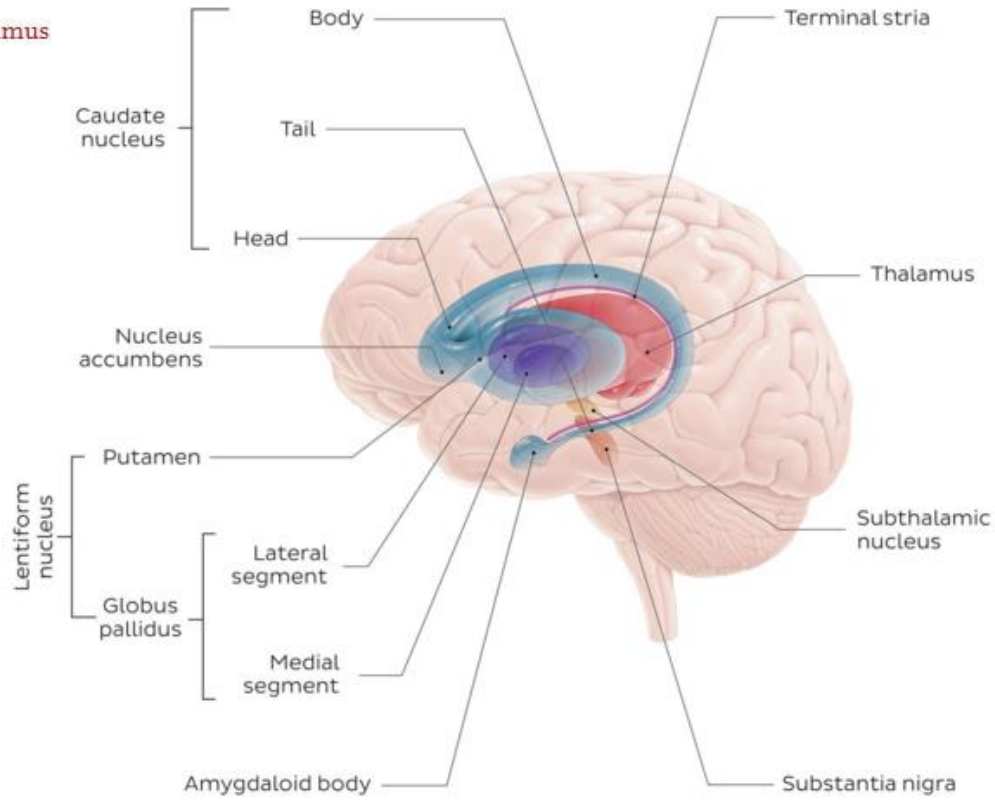
The motor system







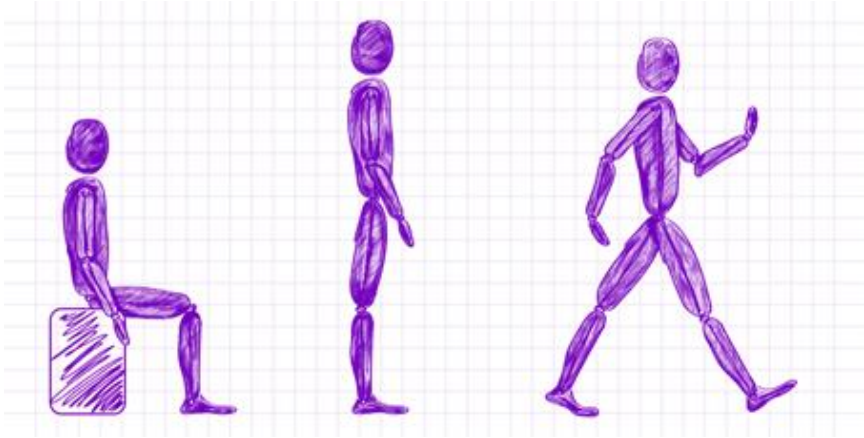

Cortex
Caudate Nucleus
Putamen
Thalamus
Globus pallidus
Subthalamic Nucleus
Substantia Nigra
Hypothalamus


Body
Terminal stria
Caudate nucleus
Tail
Head
Thalamus
Nucleus accumbens
Putamen
Lentiform nucleus
Subthalamic nucleus
Lateral segment
Globus pallidus
Medial segment
Amygdaloid body
Substantia nigra

Stance and gait

- Stance:
  - Narrow base while eyes are open and closed

- Gait:
  - slapping sound of a foot drop gait?
  - tiptoes, then on the heels.
  - Tandem gait



Abnormal stance

IS IT WHEN OPENING AND CLOSING EYES? CEREBELLAR!

IS IT MORE WHEN EYES ARE CLOSED???? SENSORY!

Abnormal Gait

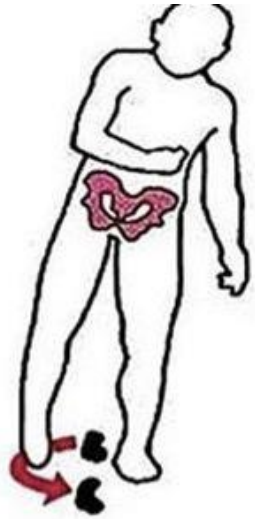
- Hemiplegic gait.
- Scissors-like gait.
- Ataxic gait.
- Foot drop.
- Parkinsonian gait
- Waddling gait.
- Bizarre gaits.

Abnormal Gait

Parkinsonian gait

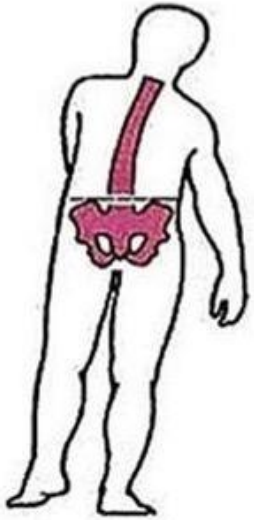
Paraspastic gait

Spastic–atactic gait



gait with circumduction in a patient with right hemiparesis

Trendelenburg gait



Duchenne gait

Quadriceps weakness

Steppage gait with foot drop

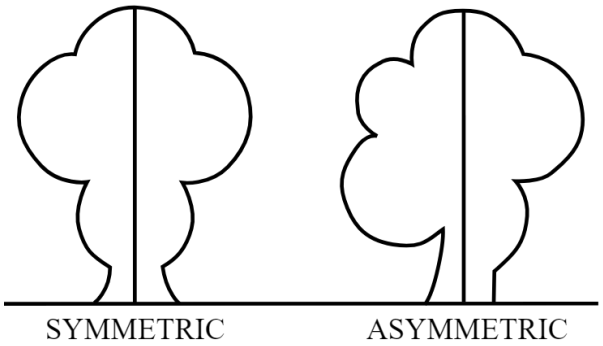
The motor system

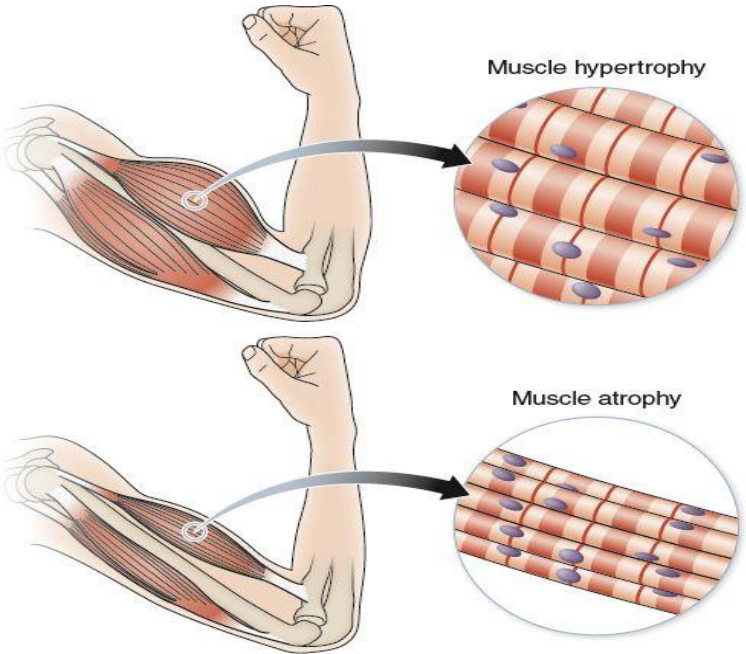
- Inspection and palpation of muscles
- Assessment of tone
- Testing movement and power
- Examination of reflexes
- Testing coordination

Inspection and palpation of muscles

- Completely expose the patient while keeping the patient's comfort and DIGNITY.

1. Look for asymmetry, inspecting both proximally and distally.
2. Note deformities
3. Examine for wasting or hypertrophy, fasciculation, and involuntary movement.





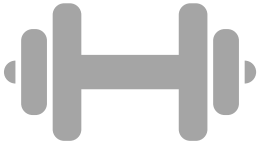
Muscle Bulk

Muscle wasting

Lower motor neuron lesions

Upper motor neuron lesions? Acute vs long standing

Muscle disorders usually result in proximal wasting



Muscle hypertrophy

Physiological muscle hypertrophy e.g. Those body builders!!!

Pseudohypertrophy may occur in muscular dystrophy but the muscles are weak.

What if you suspect, but cannot see?

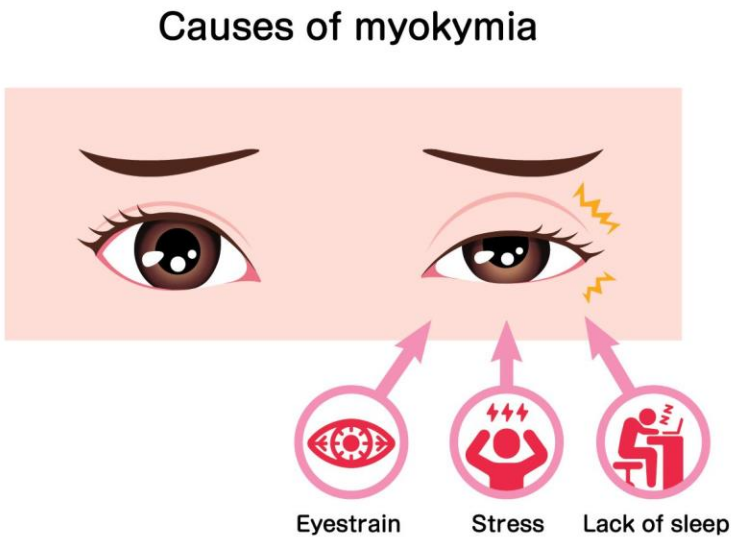
Ask the patient and whether he has also noticed this, as minor asymmetry in muscle bulk is often normal.

Abnormal Movements

- Fasciculation
- Myoclonic jerks
- Tremor
- Dystonia
- Chorea
- Athetosis
- Ballism
- Tics

Fasciculation

- Irregular twitches under the skin overlying resting muscles caused by individual motor units firing spontaneously
- Occurs in LMN lesions, usually in wasted muscles.
- Seen, not felt.
- Physiologically is common, especially in the calves
- Myokymia: eyelid or first dorsal interosseus and is rarely pathological



Myoclonic jerks

- These are sudden shock-like contractions of one or more muscles that may be focal or diffuse and occur singly or repetitively.

- Healthy people commonly experience these when falling asleep (hypnic jerks).

- They may also occur pathologically in association with epilepsy, diffuse brain damage and dementia.

Tremor

- Tremor is an oscillatory movement about a joint or a group of joints resulting from alternating contraction and relaxation of muscles.

- Classified according to their frequency, amplitude, position, and body part affected.

INTENTION TREMOR

* INVOLUNTARY TREMORS during INTENTIONAL MOVEMENT
* MOST COMMONLY AFFECTS LIMBS (especially UPPER) and SPEECH MUSCLES

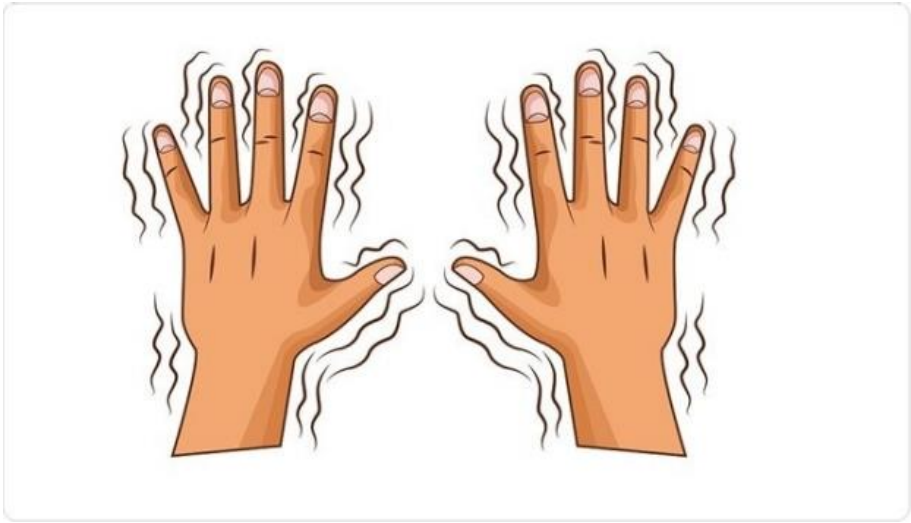
ESSENTIAL TREMOR

* CAN OCCUR without INTENTIONAL MOVEMENT
* CAN BE WORSENED with ANXIETY or INTENTIONAL MOVEMENT

PARKINSONIAN TREMOR

* MORE EVIDENT at REST
* ASSOCIATED with PARKINSON DISEASE

- Fine, fast postural tremor:
  - Physiological tremor seen with anxiety
  - Hyperthyroidism
  - Excess alcohol or caffeine intake
  - Adverse effect of β-agonist



- Essential tremor :
  - The most common pathological cause of tremor
  - AD pattern of inheritance
  - Affecting the upper limbs and head
  - With postural and action components
  - It may be improved by alcohol

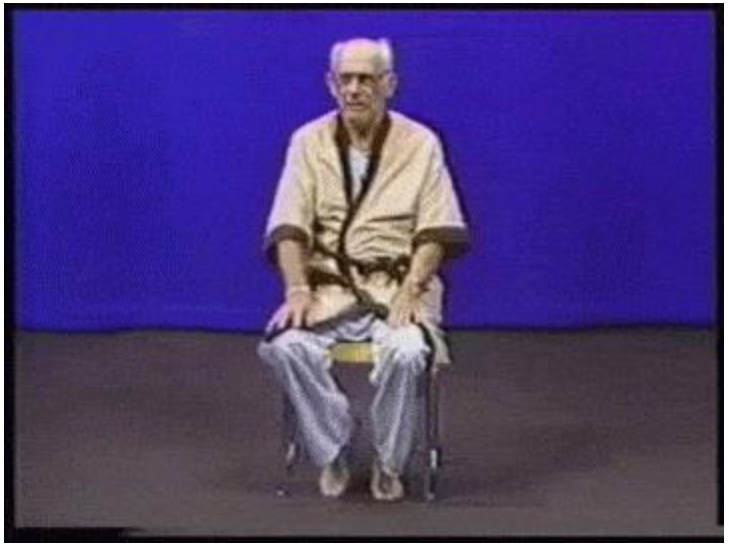
- Parkinson's disease
  - slow, coarse tremor
  - worse at rest but reduced with voluntary movement
  - Mc in the upper limbs, usually asymmetrical

- Cerebellar damage:
  - Intention tremor is absent at rest but maximal during movement
  - finger-to-nose test

- Functional tremors:
  - inconsistent
  - varying frequencies and amplitudes
  - may be associated with other signs

- Dystonia
  - caused by sustained muscle contractions, leading to twisting, repetitive movements, and sometimes tremor.
- Chorea
  - brief, random, purposeless movements which may affect various body parts, but commonly the arms.
- Athetosis
  - slower, writhing movement, more similar to dystonia than chorea.
- Ballism
  - refers to violent flinging movements sometimes affecting only one side of the body (hemiballismus).
- Tics
  - repetitive, stereotyped movements which can be briefly suppressed by the patient.


spasmodic torticolis



The motor system

- Inspection and palpation of muscles
- Assessment of tone
- Testing movement and power
- Examination of reflexes
- Testing coordination

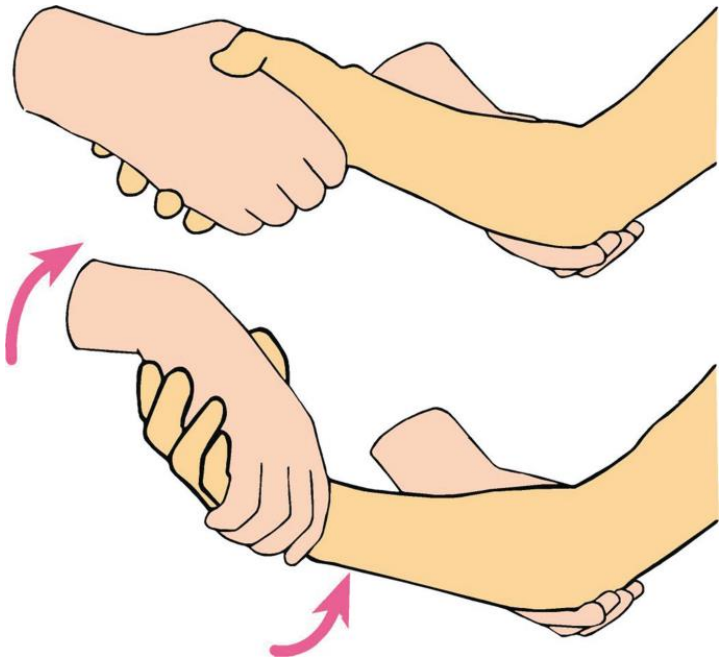
Assessment of tone

Tone is the resistance felt by the examiner when moving a joint passively.

- Ask the patient to lie supine and relax.
- Any pain or limitation?
- Passively move each joint tested through as full a range as possible, both slowly and quickly in all anatomically possible directions.
- Be unpredictable, both in direction and speed, why?

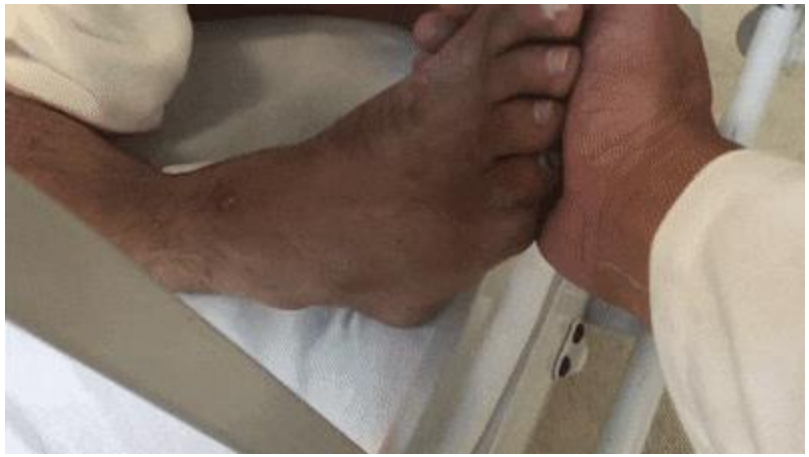
- **Upper limb**
  - **Hold the patient's hand as if shaking hands, using your other hand to support his elbow. Assess the tone at the wrist and elbow.**

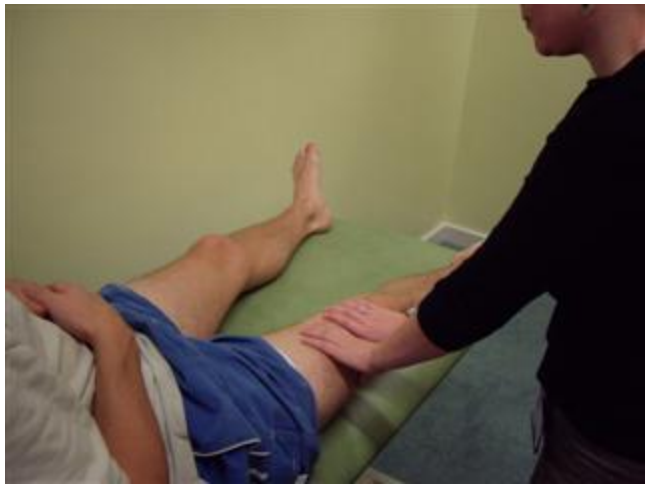
- **Activation**
  - **a technique used to exaggerate subtle increase in tone and is particularly useful for assessing extrapyramidal tone increase.**
  - **Ask the patient to describe circles in the air with the contralateral limb while assessing tone. A transient increase in tone with this maneuver is normal.**



- ***Lower limb***
  - Roll the leg from side to side, then briskly lift the knee into a flexed position, observing the movement of the foot .
  - Typically the heel moves up the bed, but increased tone may cause it to lift off the bed due to failure of relaxation.

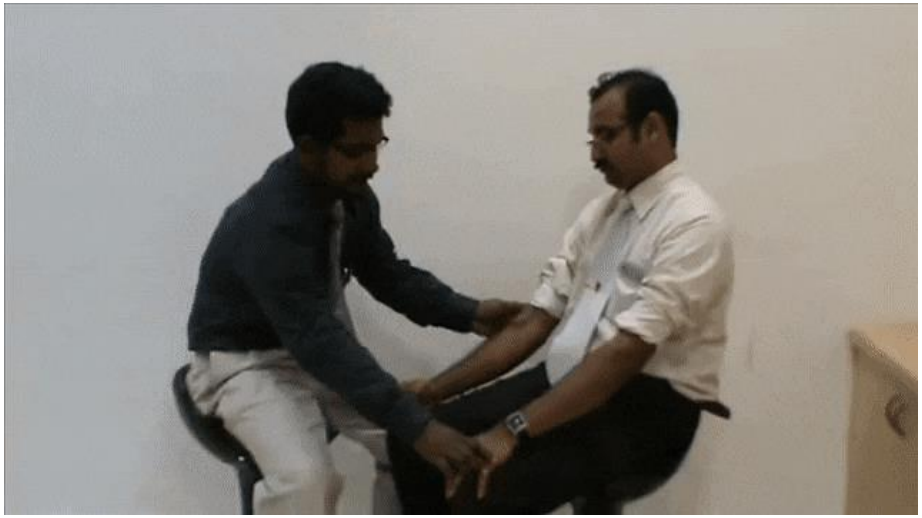
- ***Ankle clonus***
  - Support the patient's leg, with both the knee and ankle resting in 90° flexion.
  - Briskly dorsiflex and partially evert the foot, sustaining the pressure.
  - Clonus is felt as repeated beats of dorsiflexion/plantar flexion.

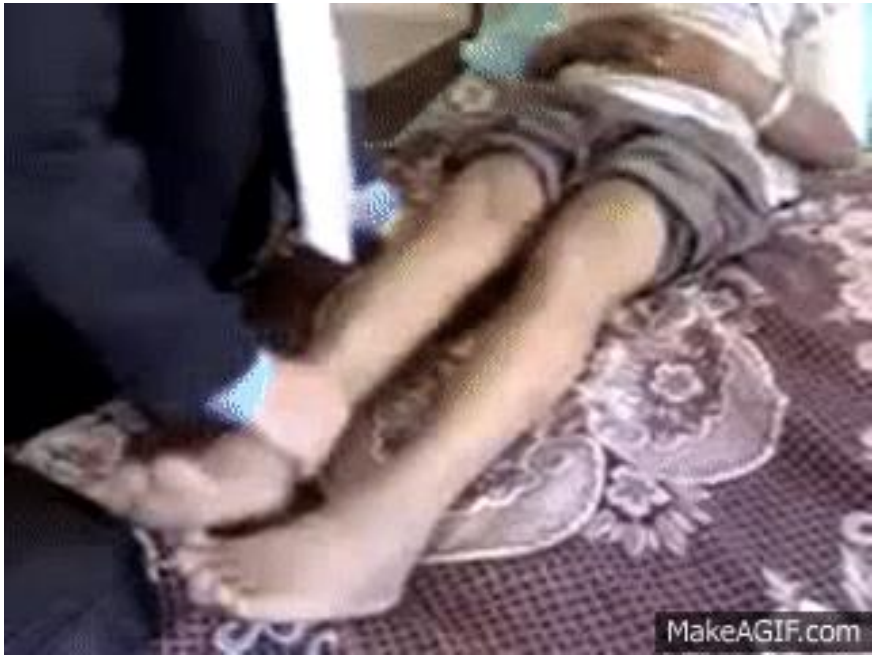




Tone Abnormalities

- Hypotonia
  - LMN: muscle wasting, weakness, and hyporeflexia.
  - In the early phases of cerebral or spinal shock
- Hypertonia
  1. Spasticity:
     - velocity-dependent resistance, with quick movements
     - In mild forms: 'catch' at the beginning or end of passive movement.
     - In severe cases: it limits the range of movement and may be associated with contracture.
     - In the upper limbs : on extension; in the legs: on flexion.
  2. Rigidity
     - Sustained resistance throughout the range of movement , with slow movement
     - In parkinsonism this is classically described as 'lead pipe rigidity'. In the presence of a Parkinsonian tremor there may be a regular interruption to the movement, giving it a jerky feel ('cog wheeling').
- Clonus
  - Rhythmic series of contractions evoked by a sudden stretch of the muscle and tendon.
  - Unsustained (<6 beats) clonus may be physiological.
  - When sustained, it indicates UMN damage

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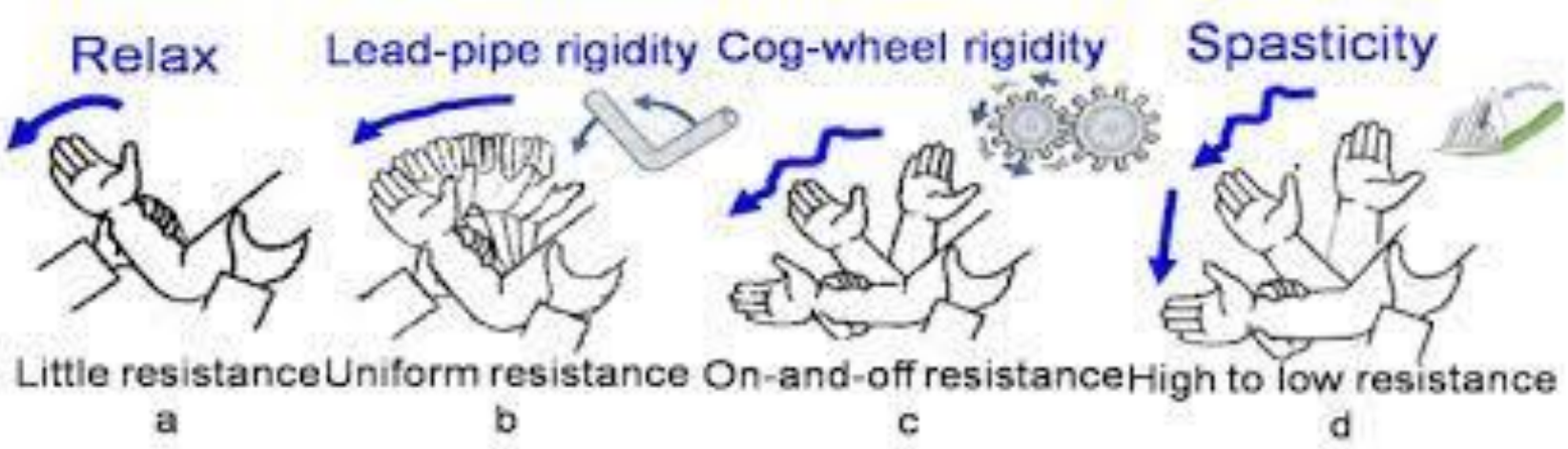

Relax
Lead-pipe rigidity
Cog-wheel rigidity
Spasticity
Little resistance
Uniform resistance
On-and-off resistance
High to low resistance
a
b
c
d

The motor system

- Inspection and palpation of muscles
- Assessment of tone
- Testing movement and power
- Examination of reflexes
- Testing coordination

Testing movement and power

1. Test upper limb power with the patient sitting on the edge of the couch.
2. Test lower limb power with the patient reclining.
3. Any pain?
4. Assess whether he can overcome gravity first
5. Then apply resistance to this movement testing across a single joint

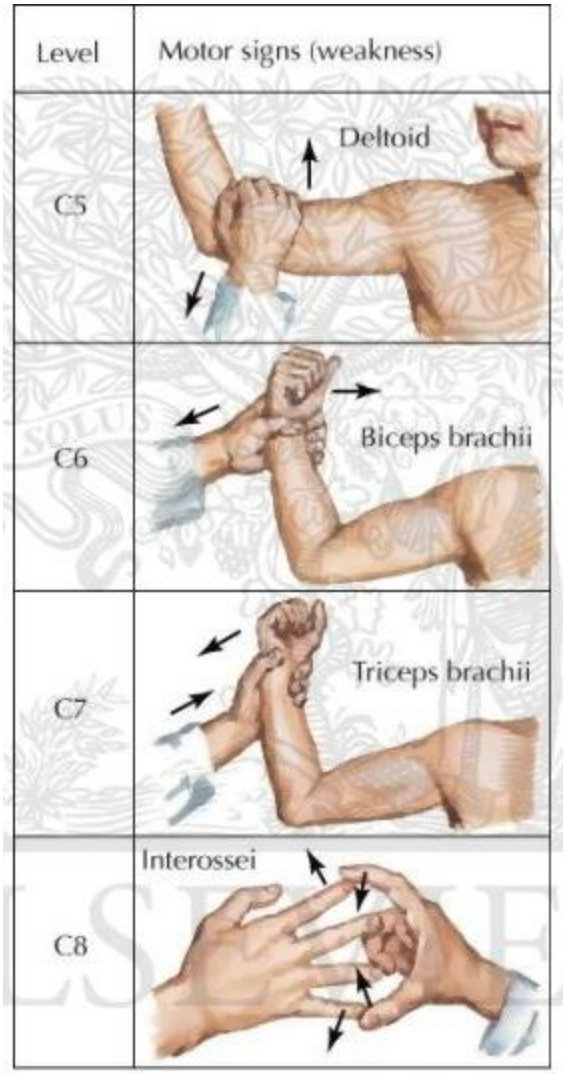
Truncal strength

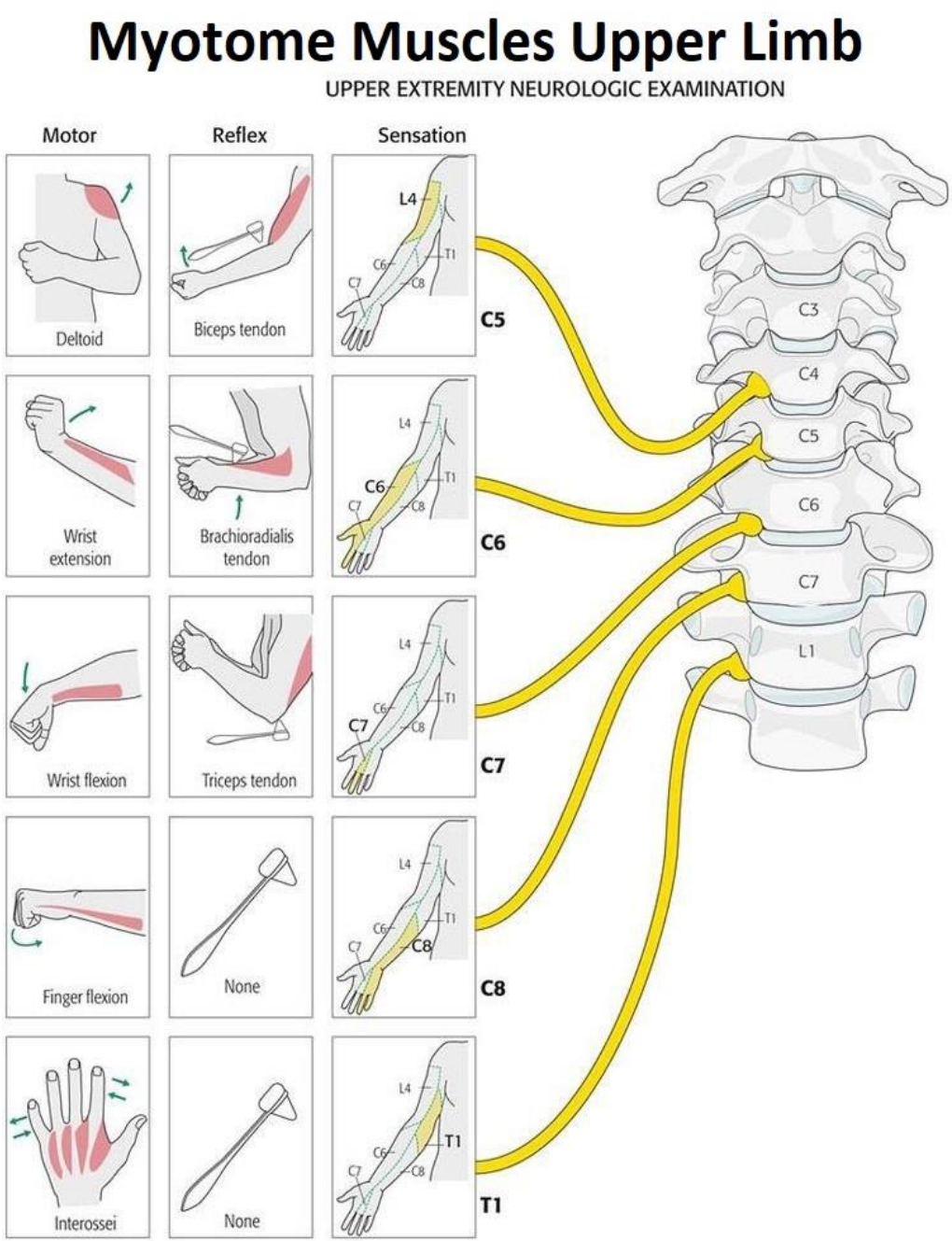
- Sit up from the lying position, or rise from a chair, without using the arms.

Commonly tested movements in upper limb

Movement	Muscle	Nerve / Root
Shoulder abduction	deltoid	Axillary C5
Elbow flexion	Biceps Brachioradialis	Musculocutaneous C5,6 Radial C6
Elbow extention	Triceps	Radial C7
Wrist extension	Extensor carbi radialis longus	Posterior interosseous nerve (radial) C6
Finger flexion	Flexor pollicis longus Flexor digitorum profundus	Anterior interosseous (median) C8 Ulnar C8
Finger extension	Extensor digitorum communis	Posterior interosseous nerve (radial) C7
Finger abduction	First dorsal interosseous	Ulnar T1
Thumb abduction	Abductor pollicis previs	Median T1

Commonly tested movements in the upper limb

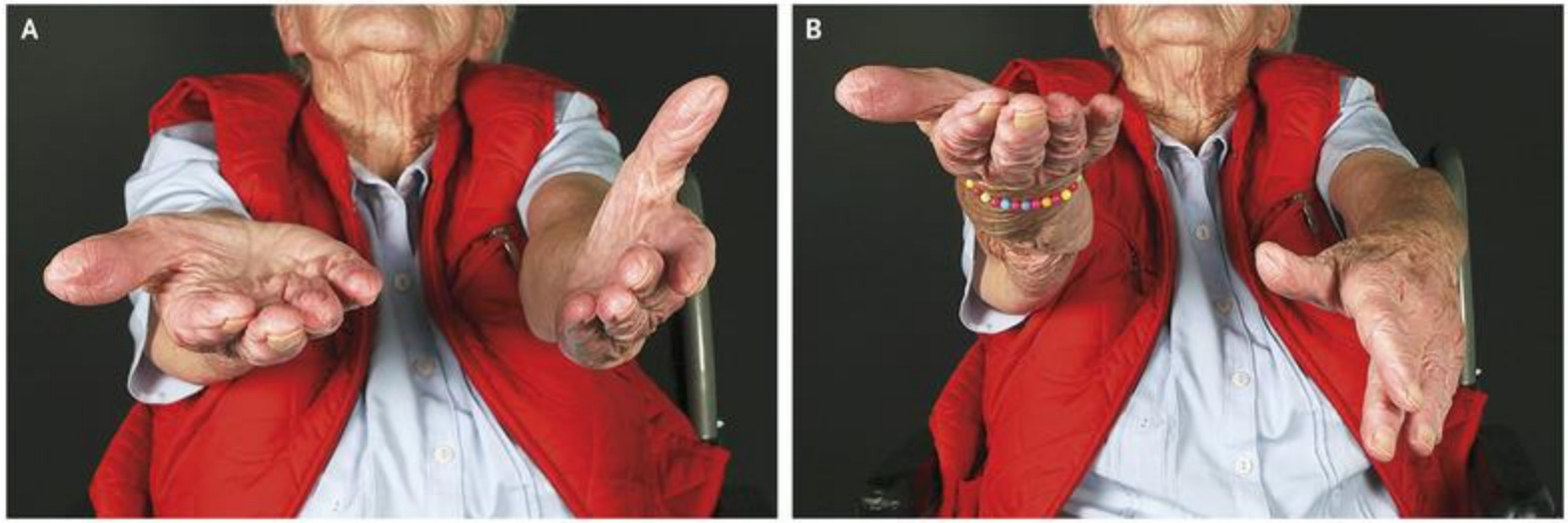




Pronator drift

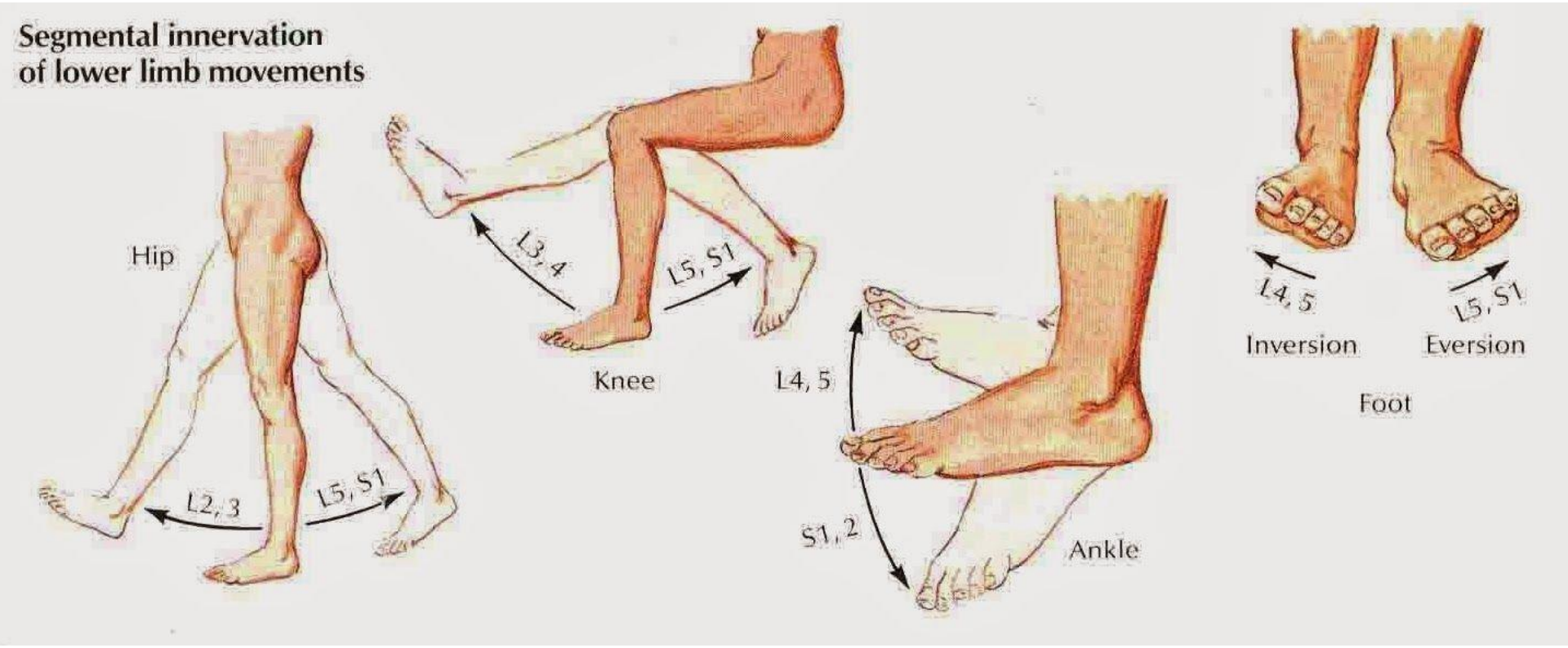
- Observe the patient with his arms outstretched and supinated (palms up) and eyes closed for ‘pronator drift’, when one arm starts to pronate

- It is an early feature of upper motor neuron lesions, and it has good sensitivity and specificity



Commonly tested movements in lower limb

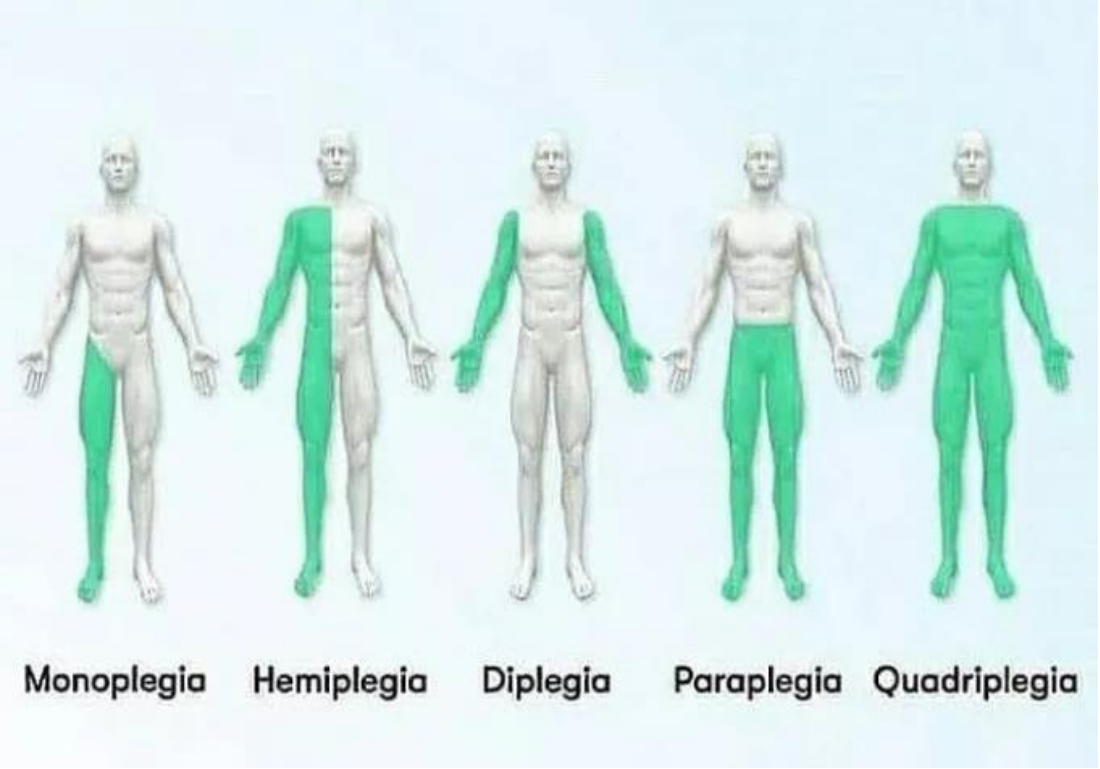
Movement	Muscle	Nerve / Root
Hip flexion	iliopsoas	Femoral L2- L3
Hip extension	Gluteus maximus	Sciatic L5,S1
Knee flexion	Hamstrings	Sciatic S1
Knee extention	Quadriceps Femoris	Femoral L3,L4
Ankle dorsiflexion	Tibialis anterior	Deep peroneal L4,5
Ankle plantar flexion	Gastrocnemius and soleus	Tibial nerve S1,2
Great toe extension	Extensor hallucis longus	Deep peroneal L5
Ankle eversion	Peroneus	Superficial peroneal L5,S1
Ankle inversion	tibialis posterior	Tibial nerve L4,5


Segmental innervation
of lower limb movements
Hip
L2, 3
L5, S1
L3, 4
L5, S1
Knee
L4, 5
S1, 2
Ankle
L4, 5
L5, S1
Inversion
Eversion
Foot

How to scale muscle power?

11.18 Medical Research Council scale for muscle power	
0	No muscle contraction visible
1	Flicker of contraction but no movement
2	Joint movement when effect of gravity eliminated
3	Movement against gravity but not against examiner's resistance
4	Movement against resistance but weaker than normal
5	Normal power

How many types of Paralysis?

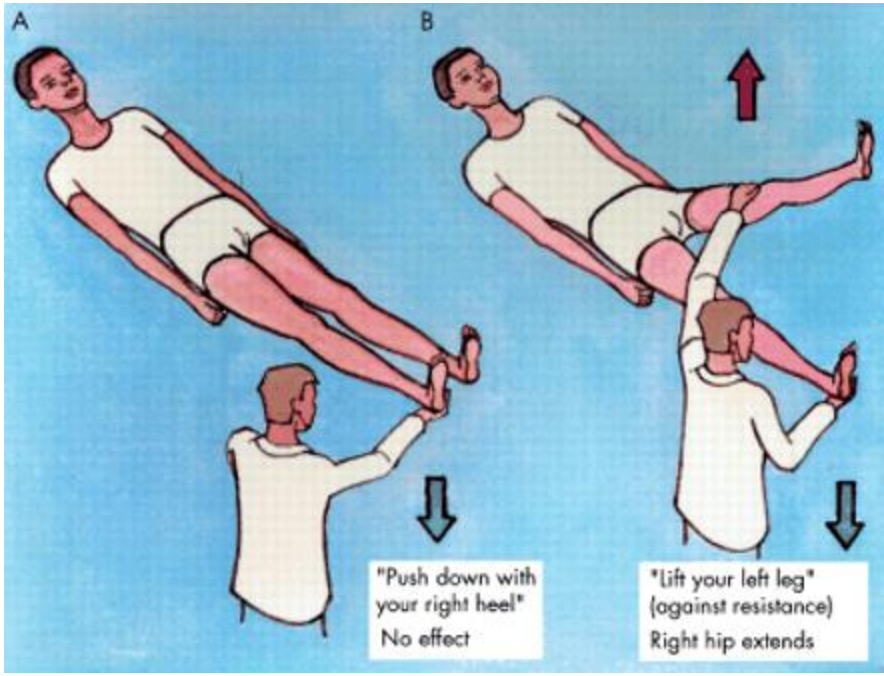


11.20 Definitions of paralysis

Term	Definition
Paresis	Partial paralysis
Plegia	Complete paralysis
Monoplegia	Involvement of a single limb
Hemiplegia	Involvement of one-half of the body
Paraplegia/diplegia	Paralysis of the legs
Tetraplegia	Paralysis of all four limbs

Hints!

- Weakness of a relatively large group of muscles >>> UMN
- Paresis of an individual and specific muscle >>> LMN
- You need only to show that the patient can achieve maximum power briefly
- Functional weakness:
  - Wildly fluctuating or sudden ‘give way’ weakness
  - Hoover’s sign “ WHO IS LYING?”

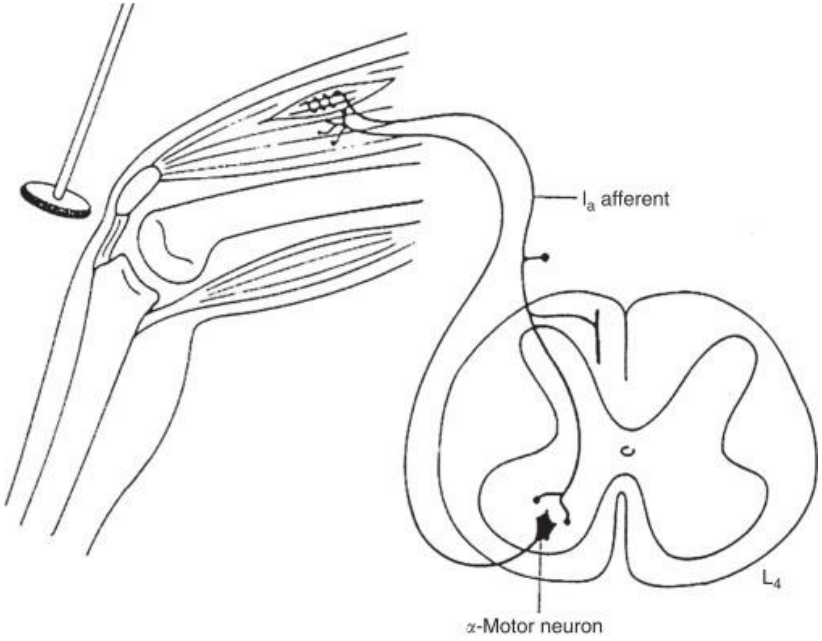


The motor system

- Inspection and palpation of muscles
- Assessment of tone
- Testing movement and power
- Examination of reflexes
- Testing coordination

Examination of reflexes

- Involuntary contraction of a muscle in response to stretch.
- It is mediated by a reflex arc consisting of an afferent (sensory) >>>> efferent (motor) neuron with one synapse between (a monosynaptic reflex)
- These stretch reflex arcs are served by a particular spinal cord segment which is modified by descending upper motor neurons.



How to examine?

Position: supine on the examination couch with the limbs exposed.

Setting: relaxed and comfortable as possible, as anxiety and pain can cause an increased response.

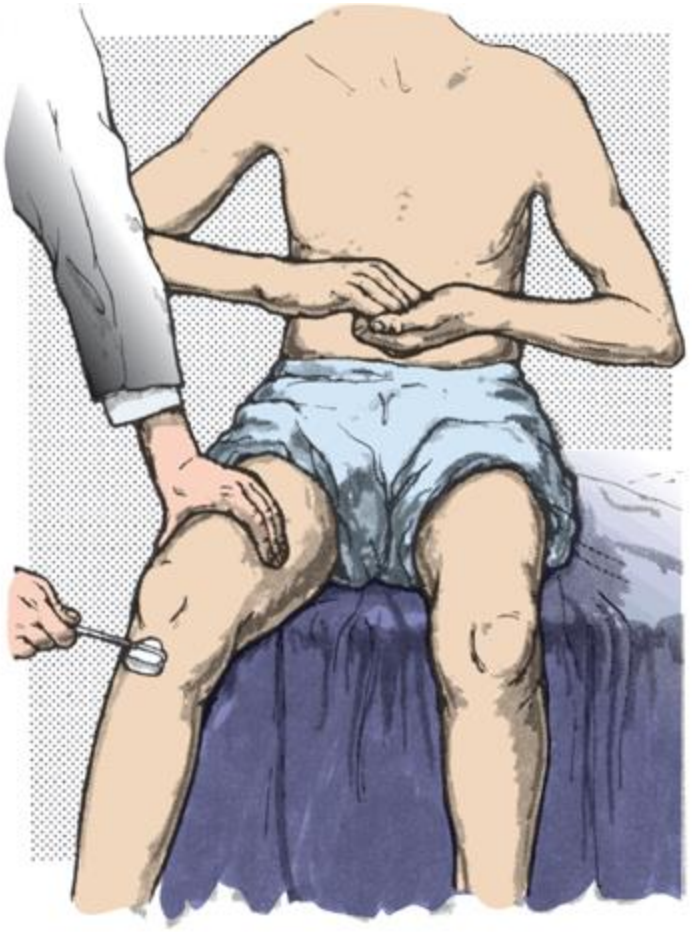
Techniques: Flex your wrist and allow the weight of the tendon hammer head to determine the strength of the blow..

Strike the tendon, not the muscle or bone

Compare each reflex with the other side; check for symmetry of response

Reinforcement

- Use whenever a reflex appears absent
- Never conclude a reflex is absent until you have used reinforcement!!!
- The patient should relax between repeated attempts
- Strike the tendon immediately after your command to the patient
- upper limb reflexes:
  - clench the teeth or to make a fist with the contralateral hand.
- Lower limb reflexes:
  - interlock the fingers and pull one hand against the other (Jendrassik maneuver)

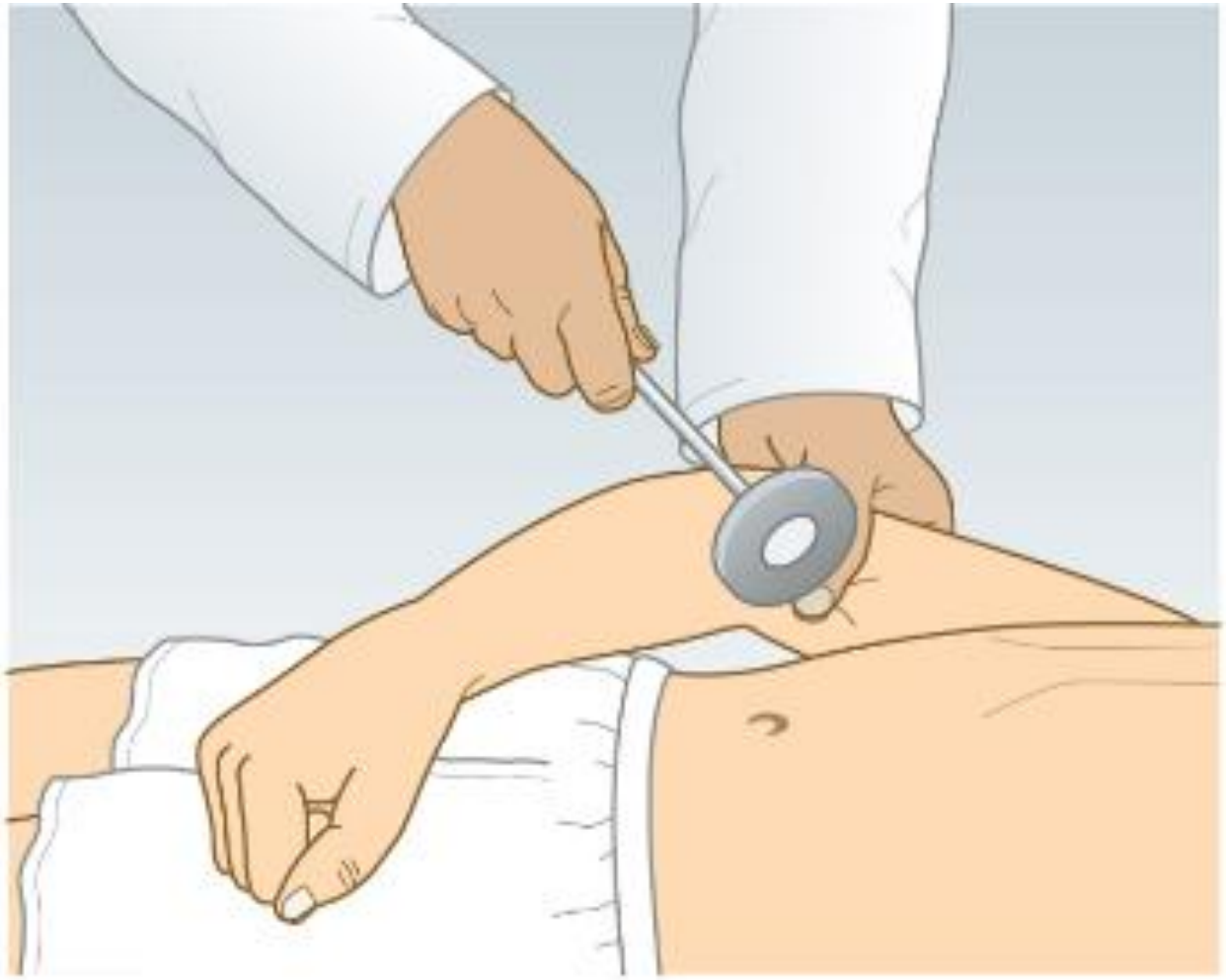


Examined DTRs

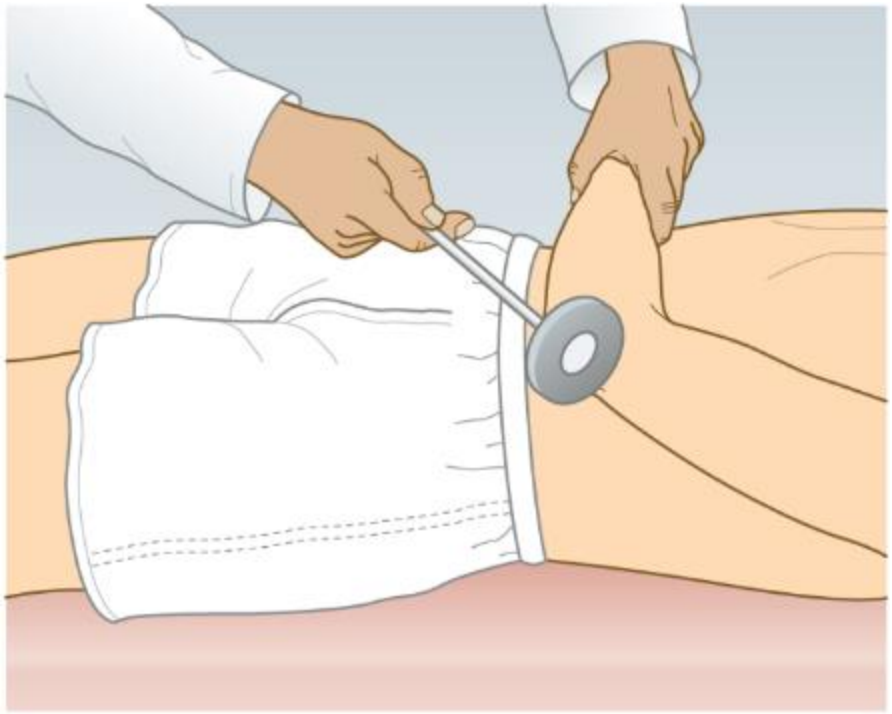
11.24 Monosynaptic (deep tendon) reflexes and root innervation

Reflex (muscle)	Nerve root
Biceps	C5
Supinator (brachioradialis)	C6
Triceps	C7
Knee (quadriceps)	L3, 4
Ankle (gastrocnemius, soleus)	S1

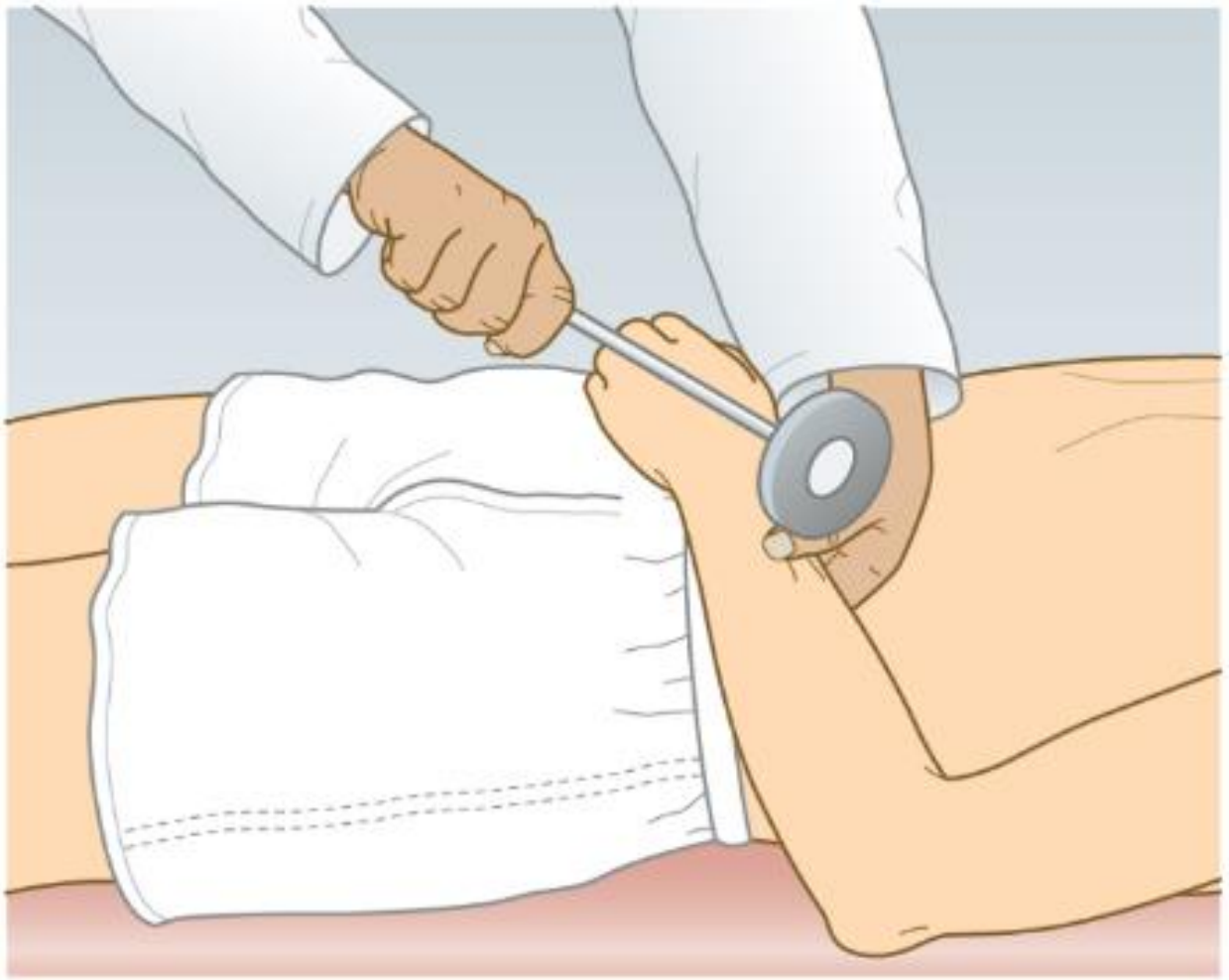
Biceps Jerk



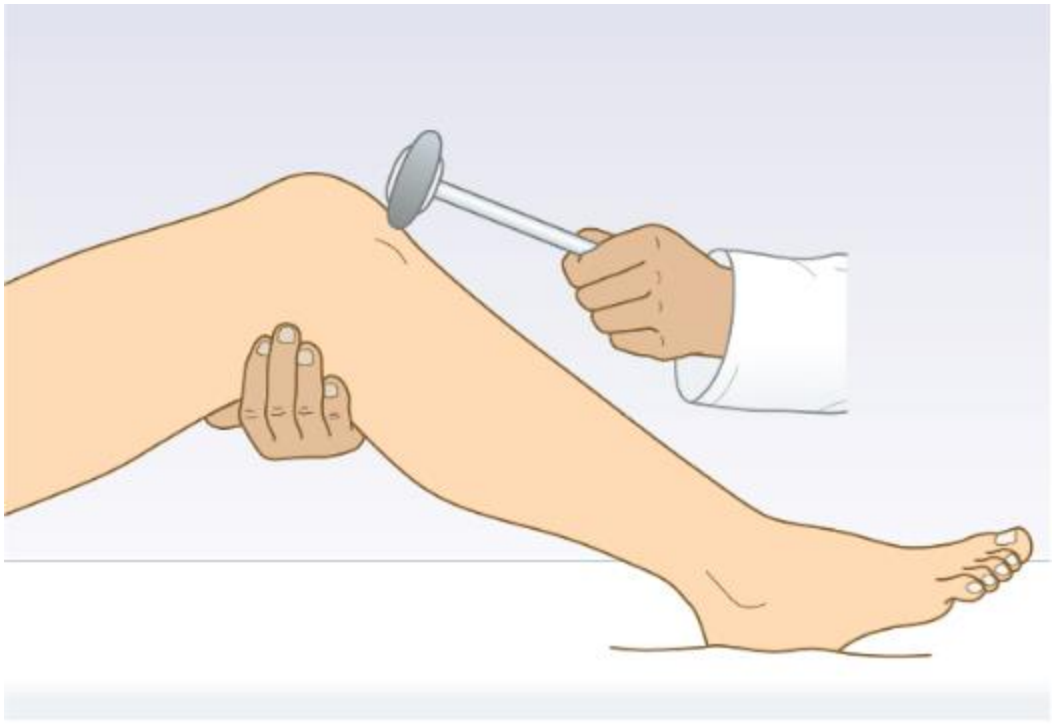
Triceps Jerk



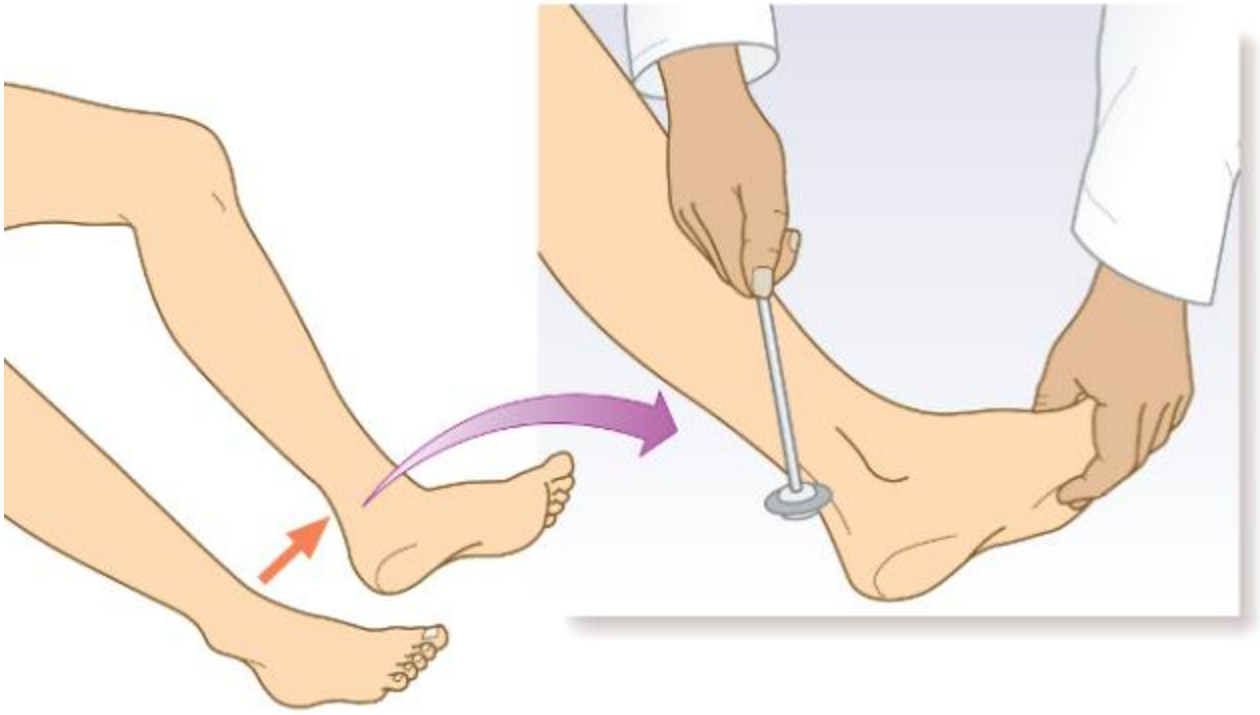
Supinator Jerk



Knee Jerk



Ankle Jerk

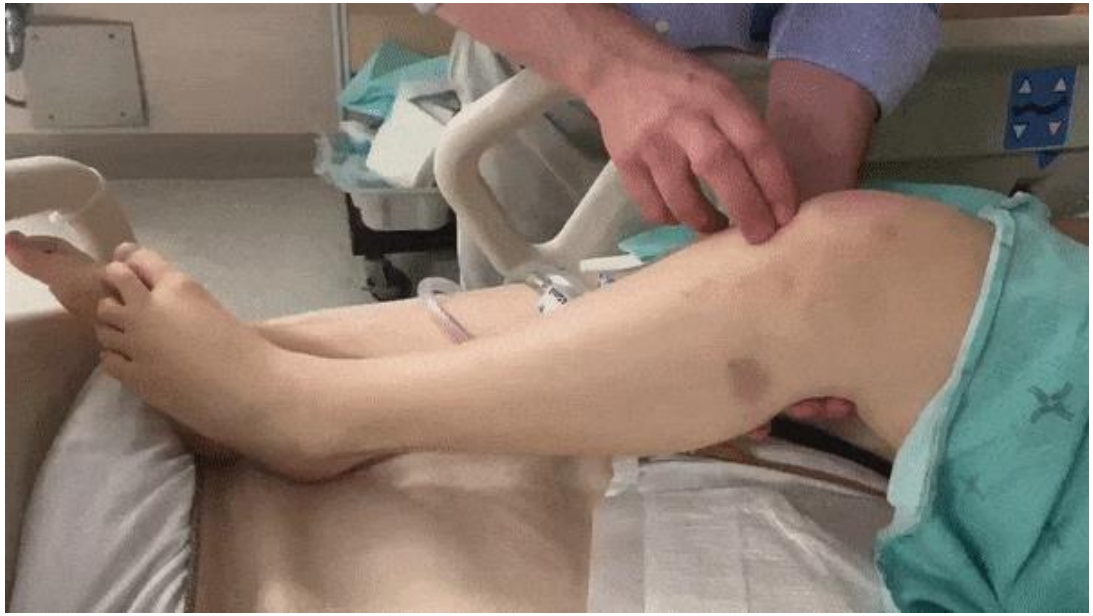


Recording responses

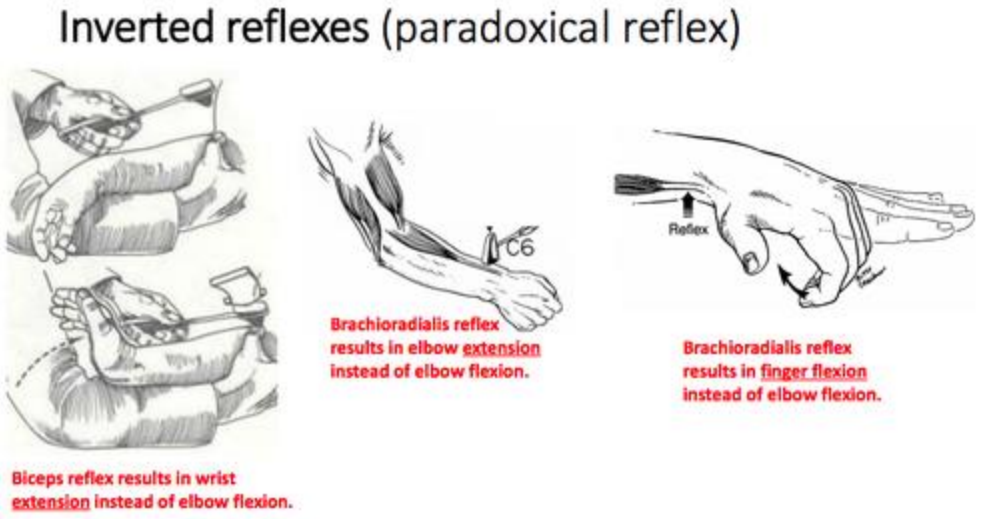
- Increased
- Normal
- Diminished
- present only with reinforcement
- Absent

Variation in response

- Hyper-reflexia >>> UMN!!!!
- Diminished or absent jerks
  - LMN Lesions
  - In healthy elderly people the ankle jerks may be reduced or lost
  - Isolated loss of a reflex suggests a mononeuropathy or radiculopathy



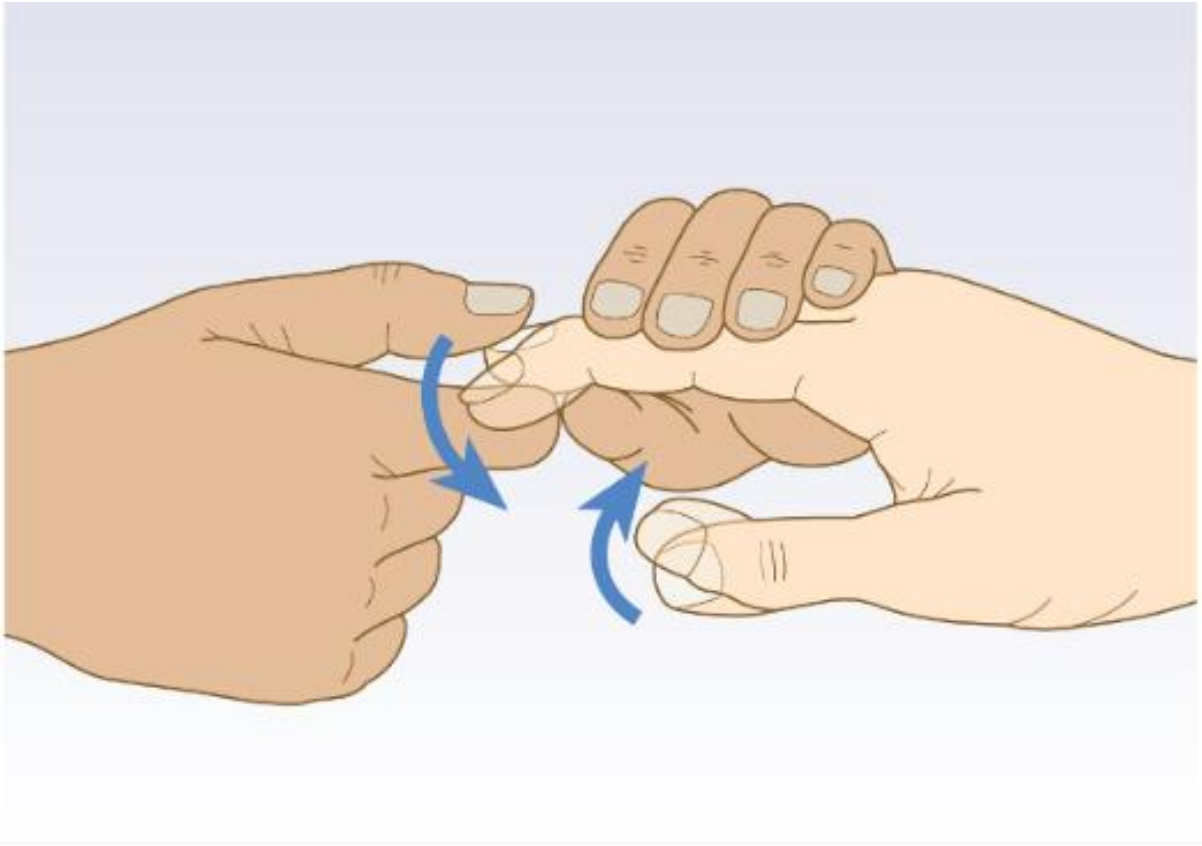
- An ‘inverted’ Supinator reflex
  - caused by combined spinal cord and root pathology localizing to a specific spinal level.
  - It is most common at the C5/6 level.
  - When elicited, the biceps reflex is absent or reduced but finger flexion occurs. This is because the lesion at the C5/6 level affects the efferent arc of the biceps jerk (C5 nerve root), causing it to be reduced or lost, and also the spinal cord increasing reflexes below this level (including the finger jerks).
  - It is most commonly seen in cervical spondylotic myeloradiculopathy.



- In cerebellar disease
  - the reflexes may be pendular
  - muscle contraction and relaxation tend to be slow
  - these are not sensitive or specific cerebellar signs.

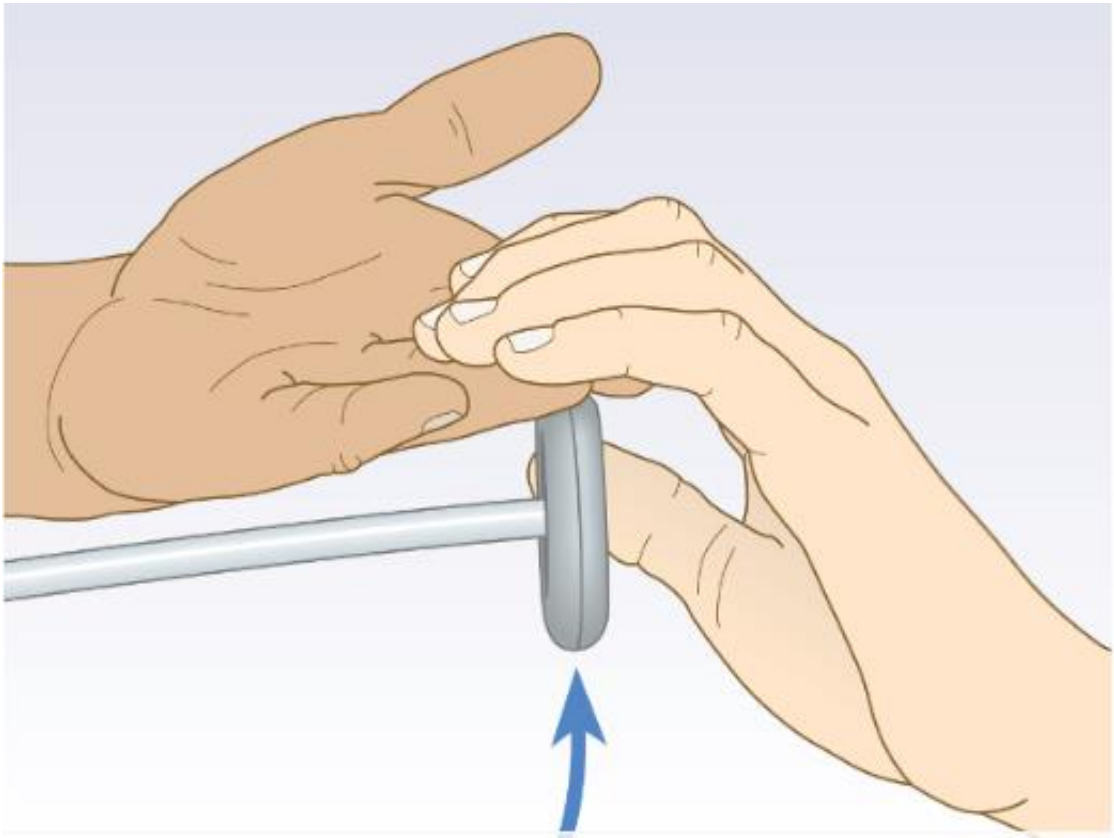
Hoffmann's reflex

- Place your right index finger under the DIPJ of the patient's middle finger.
- Use your right thumb to flick the patient's finger downwards.
- Look for any reflex flexion of the patient's thumb



Finger Jerk

- Place your middle and index fingers across the palmar surface of the patient's proximal phalanges.
- Tap your own fingers with the hammer.
- Watch for flexion of the patient's fingers



What if they yield positive??

- suggest hypertonia
- can occur in healthy individuals, and are not useful signs in isolation

Inverted Supinator Test (Positive Test)

Ortho Eval Pal with Paul Marquis PT
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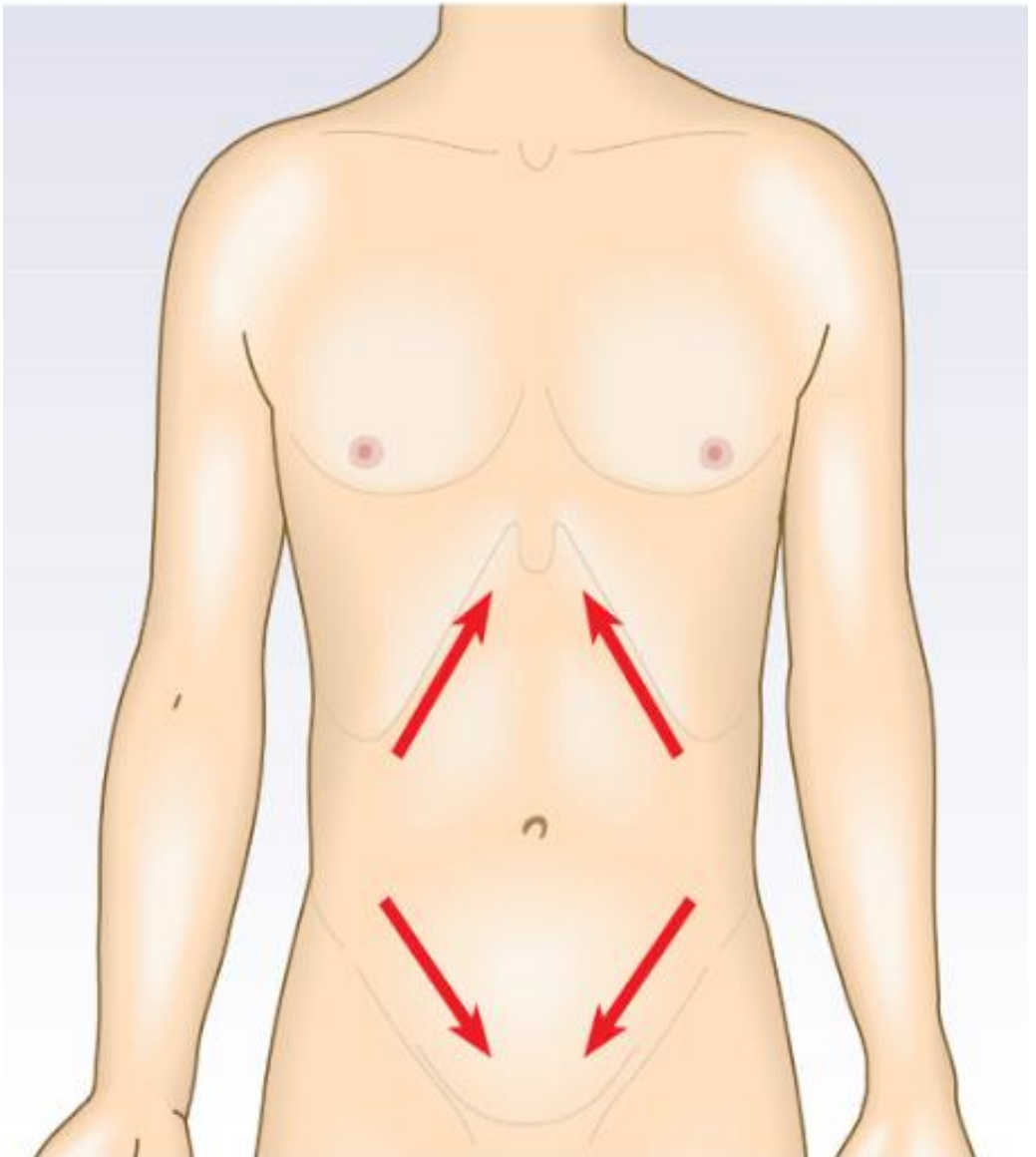
GENTLY

Superficial reflexes

- This group of reflexes is polysynaptic and elicited by cutaneous stimulation rather than stretch.
- With the exception of the plantar response, they are not part of the routine examination and have poor sensitivity and specificity.
- The cremasteric reflex applies only in males.

Abdominal reflexes (T8–12)

- Position: Supine and relaxed.
- Technique: With an orange stick and briskly, but lightly, stroke the upper and lower quadrants of the abdomen in a medial direction
- Normally, contraction of the underlying muscle, with the umbilicus moving laterally and up or down depending upon the quadrant tested.



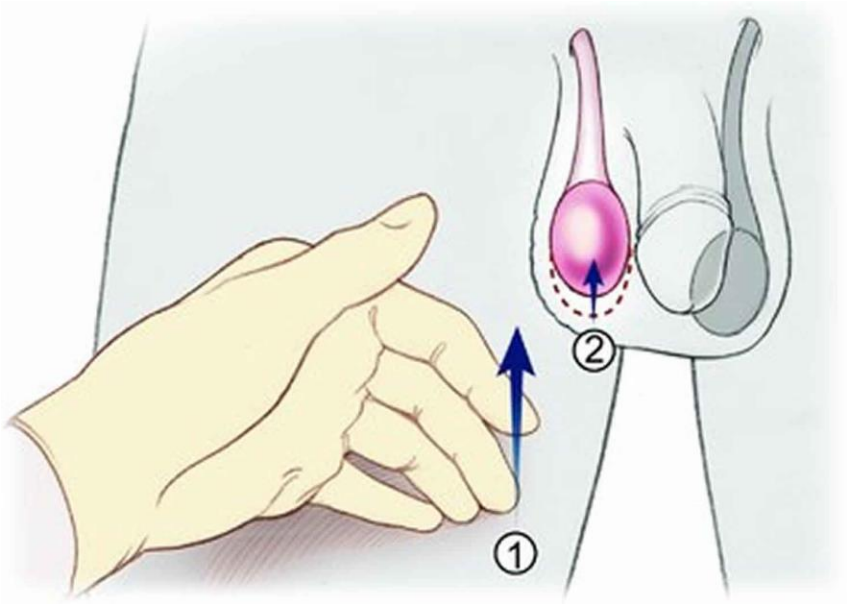
Abnormal findings

- Superficial abdominal reflexes (T8–12) are lost in UMN lesions but are also affected by LMN damage affecting T8–12.

- They are usually absent in the obese, the elderly, or after abdominal surgery.

Cremasteric reflex (L1–2)

- Explain what you are going to do and why it is necessary.
- Abduct and externally rotate the patient's thigh.
- Use an orange stick to stroke the upper medial aspect of the thigh.
- Normally the testis on the side stimulated will rise briskly.
- The cremasteric reflex in males (L1 and L2) is rarely elicited
- Typically, is lost in spinal cord or root lesions.

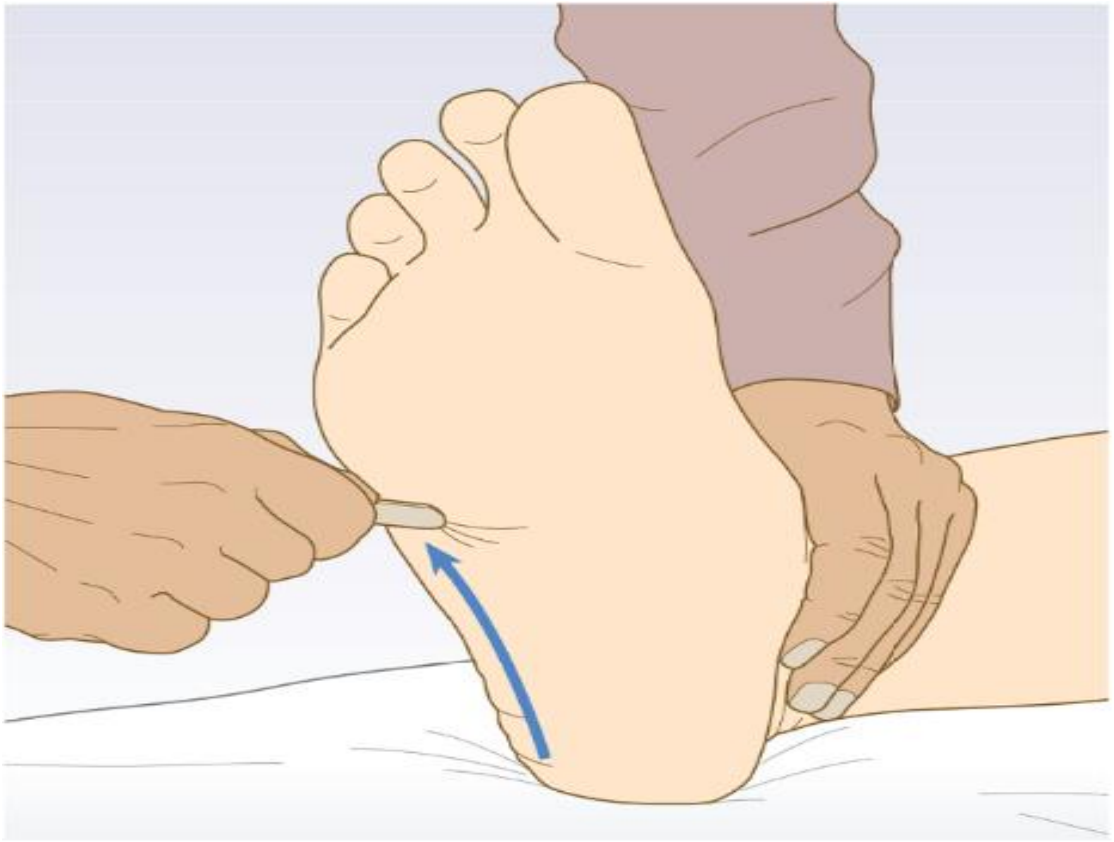


Plantar response (S1–2)

- Run a blunt object along the lateral border of the sole of the foot toward the little toe

- Watch both the first movement of the great toe and the other leg flexor muscles.

- The normal response is flexion of the great toe with flexion of the other toes.



Abnormal findings

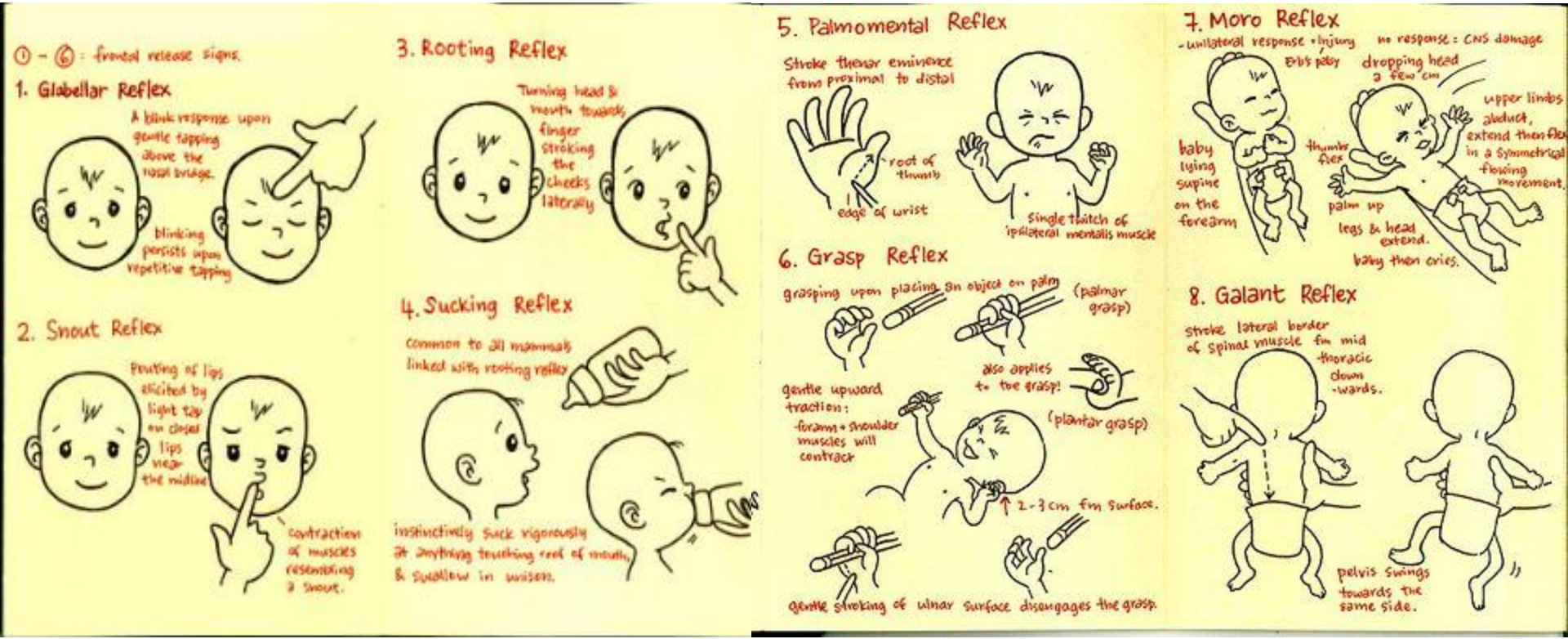
- A true Babinski sign:
  - involves activation of the extensor hallucis longus tendon (not movement of the entire foot, a common 'withdrawal' response to an unpleasant stimulus)
  - coincides with contraction of other leg flexor muscles
  - is reproducible.

- This is a sign of UMN lesion
- Fanning of the toes is normal and not pathological.

Primitive reflexes

- These are present in normal neonates and young infants but disappear as the nervous system matures.

- Their return after early childhood is often associated with brain damage or degeneration.



11.25 Primitive reflexes

Snout reflex

- Lightly tap the lips. An abnormal response is lip pouting

Grasp reflex

- Firmly stroke the palm from the radial side. In an abnormal response, your finger is gripped by the patient's hand

Palmomental reflex

- Apply firm pressure to the palm next to the thenar eminence with a tongue depressor. An abnormal response is ipsilateral puckering of the chin

Glabellar tap

- Stand behind the patient and tap repeatedly between his eyebrows with the tip of your index finger. Normally the blink response stops after three or four taps

Abnormal findings

- The primitive reflexes have little localizing value and in isolation are of little significance, but in combination suggest diffuse or frontal cerebral damage

- Unilateral grasp and palmomental reflexes may occur with contralateral frontal lobe pathology

- The glabellar tap is an unreliable sign of Parkinson's disease(Myerson sign)

The motor system

- Inspection and palpation of muscles
- Assessment of tone
- Testing movement and power
- Examination of reflexes
- Testing coordination

Testing coordination

- Performing complex movements smoothly and efficiently
- Depends upon intact sensory and motor function and an intact cerebellum.

- In general, cerebellar midline structures, e.g. vermis, influence body equilibrium, while each hemisphere controls ipsilateral coordination.

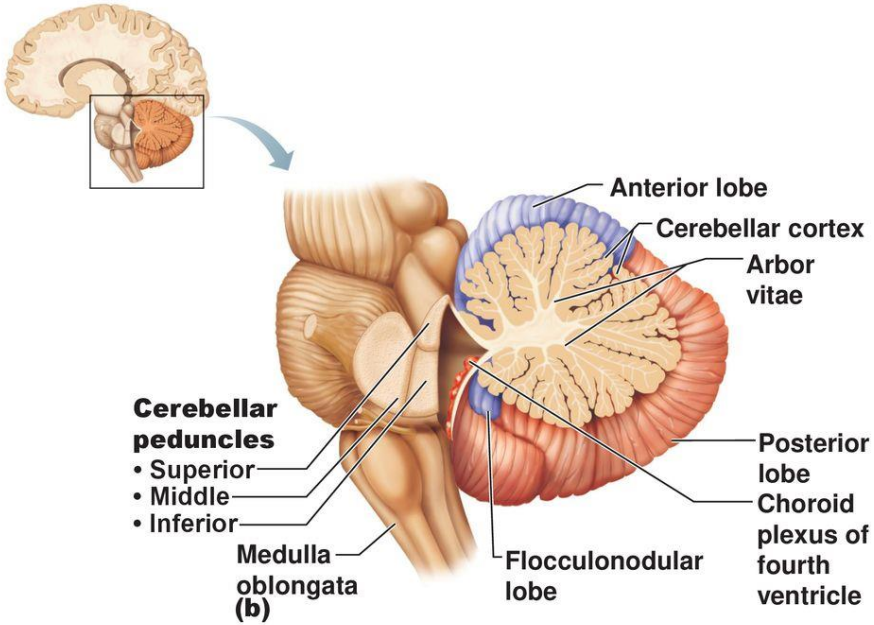
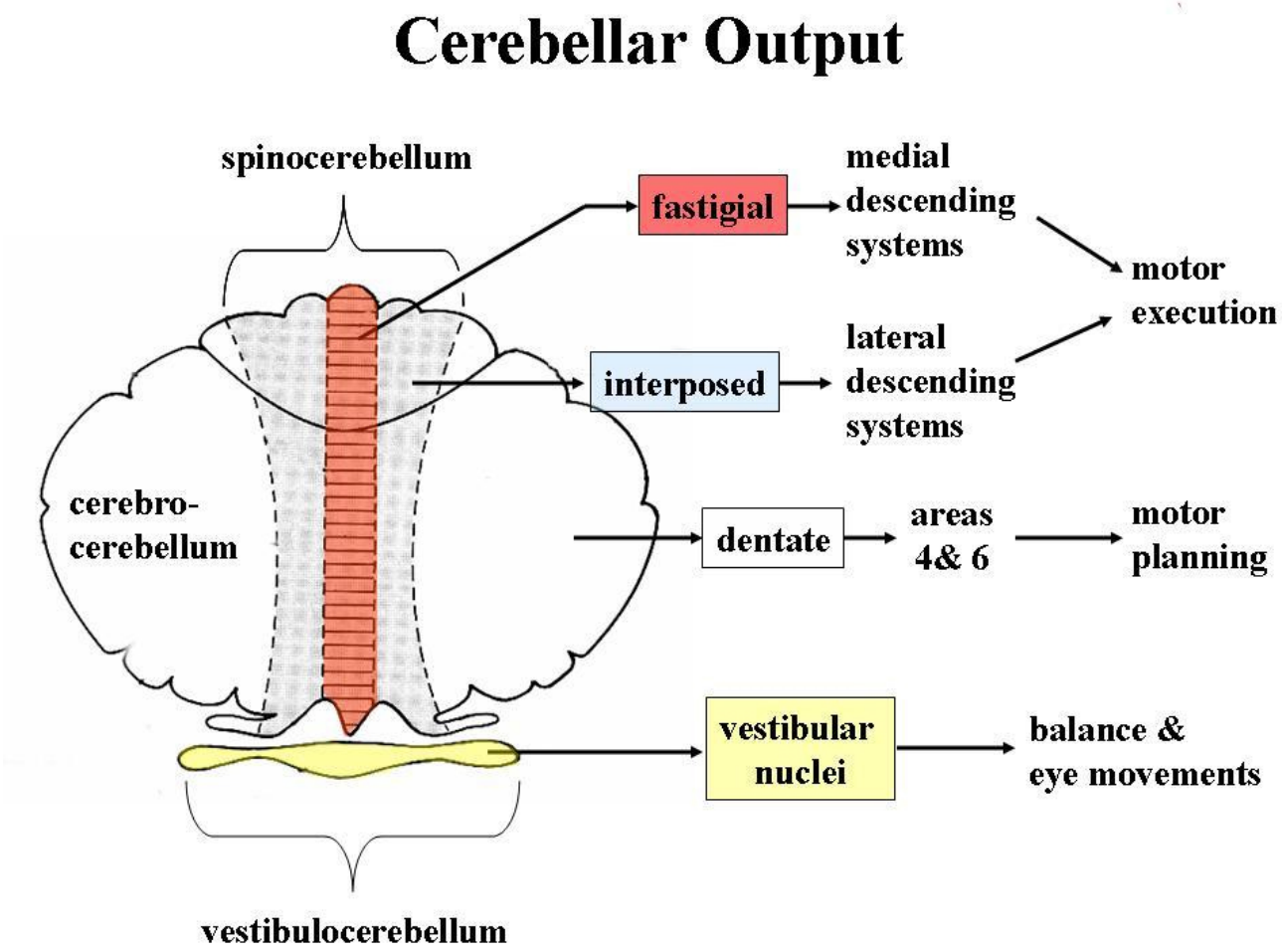


Figure 12.17b

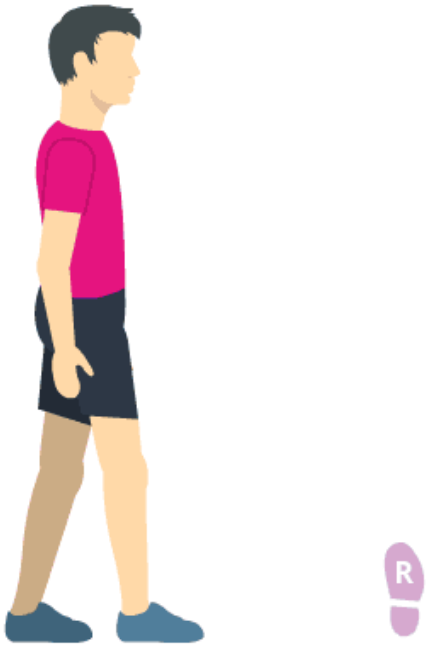
What to examine?

- Stance and gait
- Limb coordination
- Dysarthria
- Nystagmus
- Power
- Tone
- Reflexes



Stance and gait

- In disorders predominantly affecting midline cerebellar structures, truncal ataxia may be the only finding.
  - In the most severe cases, this may mean the patient cannot sit unsupported.
  - Tandem gait (heel–toe walking) may be impaired in less severe cases.



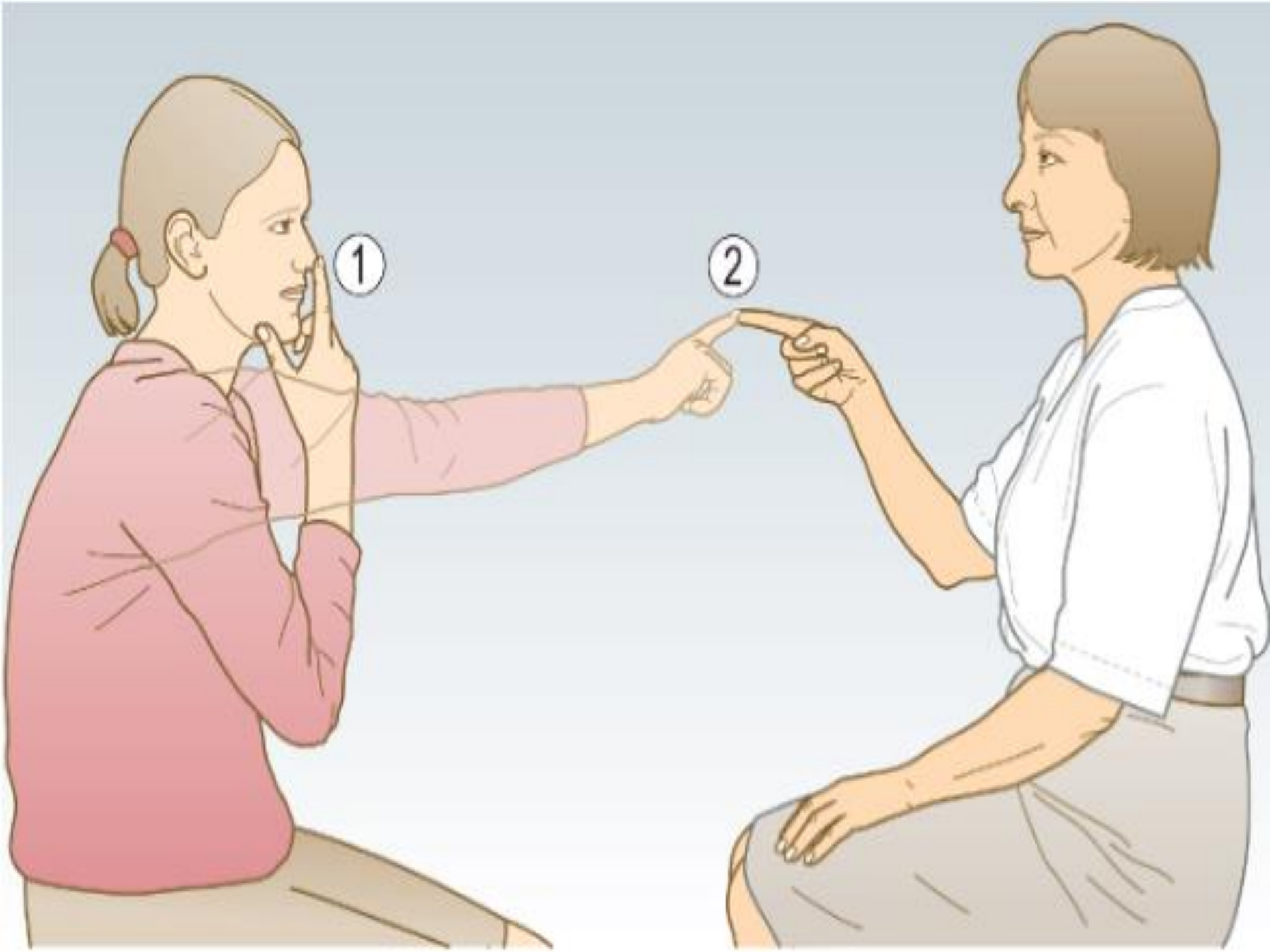
Limb coordination

- Upper limbs:
  - Finger-to-nose test
  - Rapid alternating movements
  - Rebound phenomenon (rarely useful)

- Lower limbs:
  - Heel-to-shin test

Finger-to-nose test

- Ask the patient to touch his nose with the tip of his index finger and then touch your fingertip.
- Hold your finger just within the patient's arm's reach
- Ask him to repeat the movement between nose and target finger as quickly as possible.
- Make the test more sensitive by changing the position of your target finger.
- Move your finger just as the patient's finger is about to leave his nose, otherwise you will induce a false-positive finger-to-nose ataxia.
- Some patients are so ataxic that they may injure their eye/face with this test. If so, use your two hands as the targets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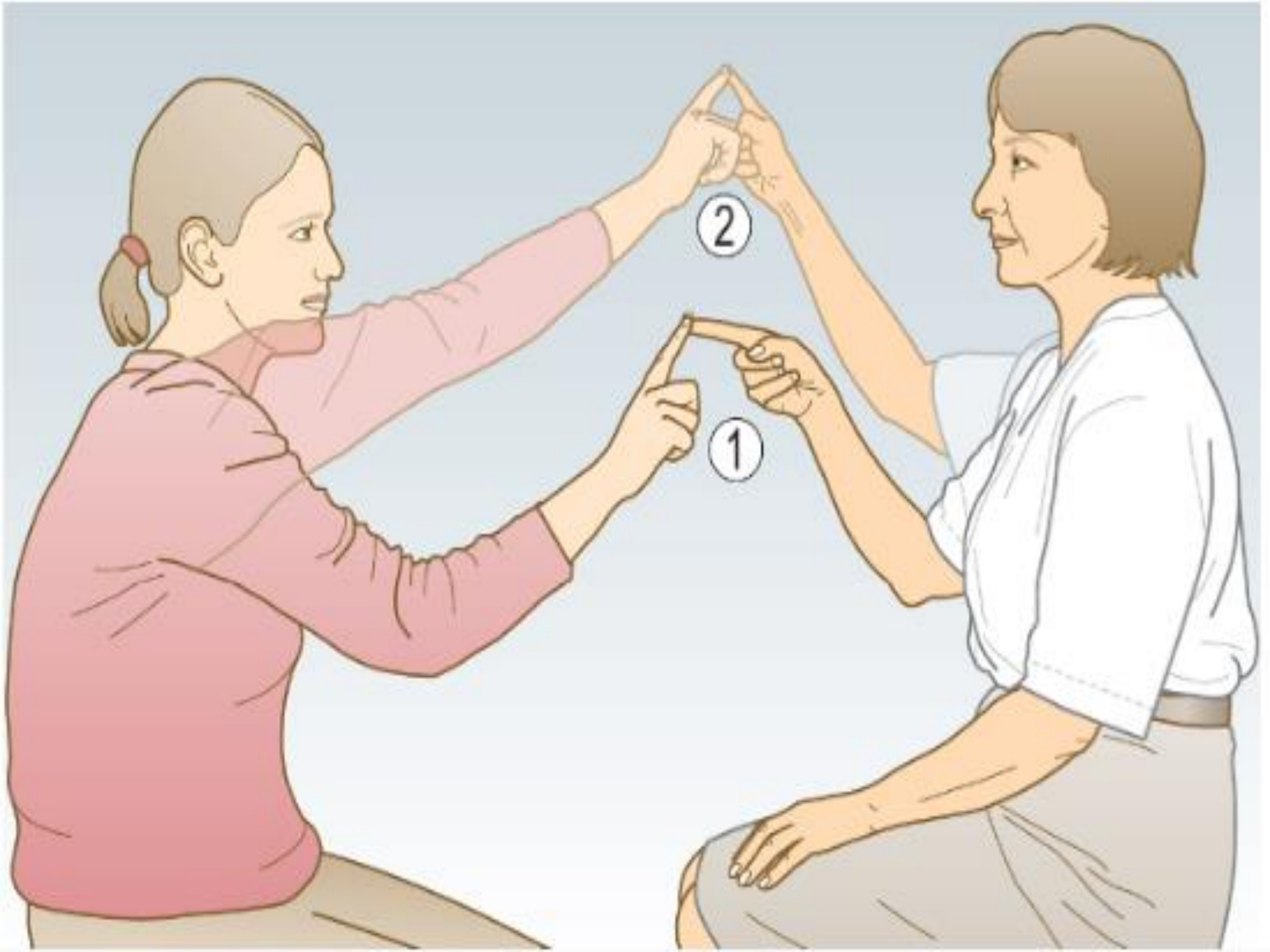
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Abnormal findings

- Weakness may produce false-positive finger-to-nose test, so demonstrate that power is normal first.

- Dysmetria or past-pointing:
  - tendency to fall short or overshoot the examiner's finger

- Intention tremor:
  - In more severe cases there may be a tremor of the finger as it approaches the target finger and the patient's own nose

- Dys-synergia:
  - The movement may be slow, disjointed, and clumsy

Rapid alternating movements

- First method:
  - Demonstrate repeatedly patting the palm of your hand with the palm and back of your opposite hand as quickly and regularly as possible.
  - Ask the patient to copy your actions.
  - Repeat with the opposite hand.

- Second method:
  - ask the patient to tap a steady rhythm rapidly with his hand on the other hand or table,
  - ‘listen to the cerebellum’
  - ataxia makes this task difficult, with a slower, irregular rhythm than normal.

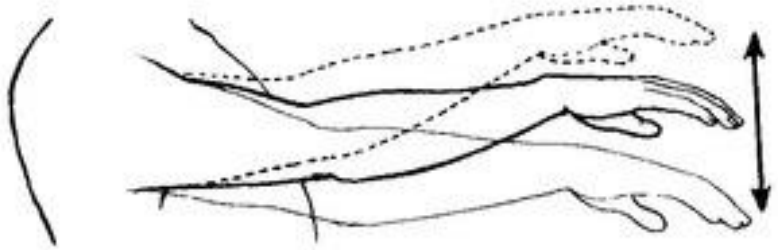
Abnormal findings: Dysdiadochokinesis

- Impairment of rapid alternating movements
- Evident as slowness, disorganization, and irregularity of movement

Rebound phenomenon

- Ask the patient to stretch his arms out and maintain this position.
- Push the patient's wrist quickly downward and observe the returning movement.
- Normally: Arm return to the original position
- Abnormally: The displaced outstretched arm may fly up past the original position

Arm bounce



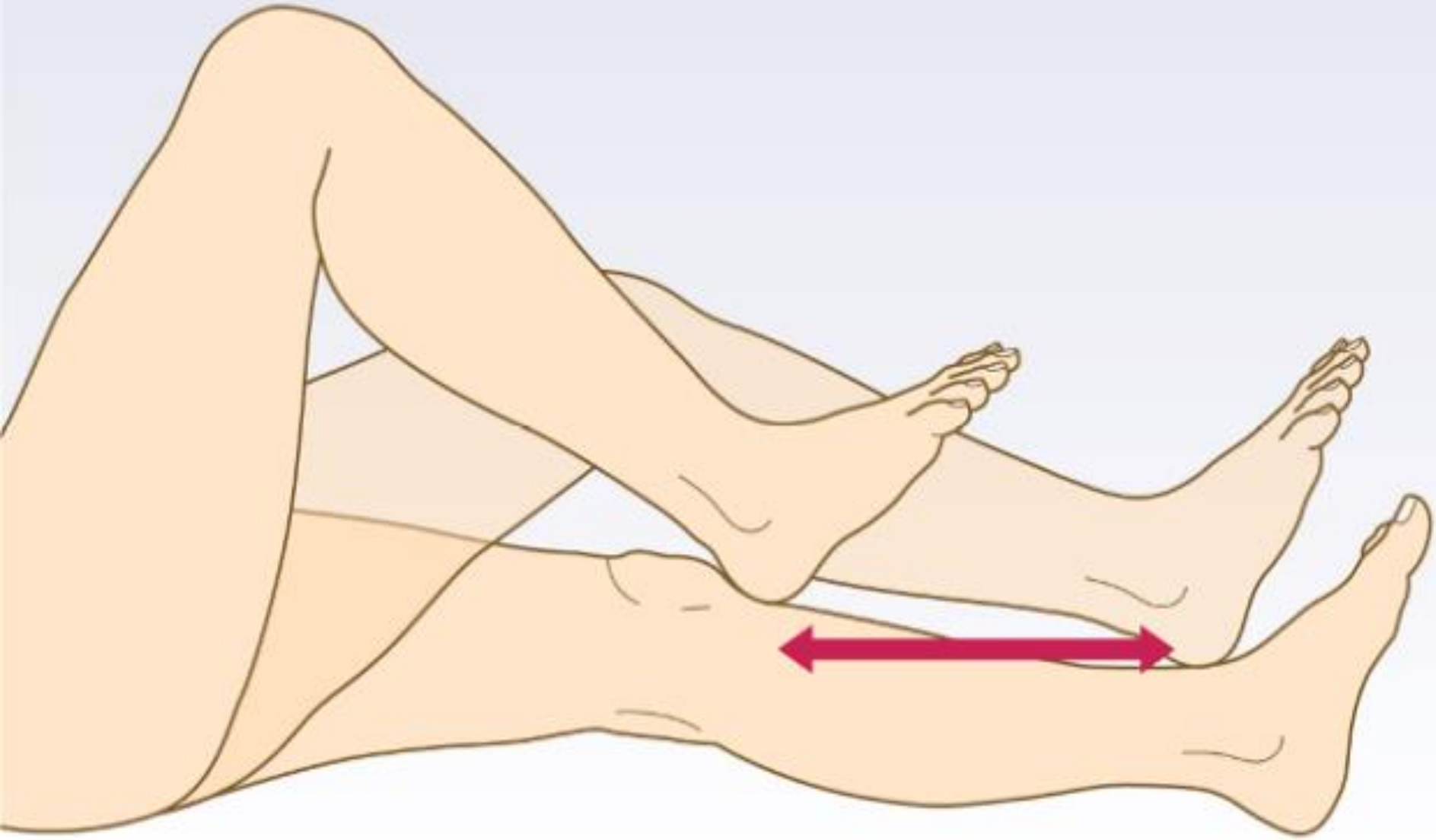
Downward pressure and sudden release of the patient's outstretched arm causes excessive swinging.

Rebound phenomenon

Ask the patient to flex elbow against resistance. Sudden release may cause the hand to strike the face due to delay in triceps contraction.

Heel-to-shin test

- With the patient lying supine, ask him to place his heel on his opposite knee, and then slide his heel up and down the shin between the knee and ankle
- Same as finger-to-nose test
- Abnormal: if the heel wavers away from the line of the shin.
- Weakness may produce a false-positive heel-to-shin test, so demonstrate that power is normal first.



Apraxia

- Dyspraxia or apraxia is difficulty or inability to perform a task, despite no impairment of the necessary individual functions.

- It is a sign of higher cortical dysfunction, usually localizing to the non-dominant frontal or parietal lobes.

How to examine for apraxia?

- Ask the patient to perform an imaginary act
- Ask the patient to copy movements you make with your fingers
- Ask the patient to copy a geometrical figure
- Ask the patient to put on a pajama top or dressing gown, one sleeve of which has been pulled inside out

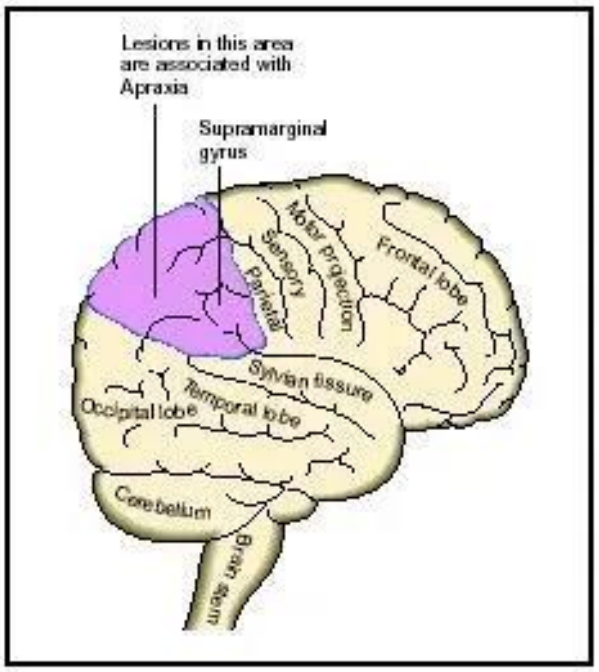
Apraxia	Score
Drawing of the pentagon	1 point
Drawing of the spiral	1 point
Drawing the house	1 point
Drawing a clock	3 points
Putting a sheet of paper in an envelope	3 points
"Goodbye" – correct movement	1 point
Scissors – correct movement	1 point
Brushing teeth – correct movement	1 point
Total	12 points

Cambridge Cognitive Examination (CAMCOG)

Abnormal findings

- Constructional apraxia:
  - Difficulty drawing a figure
  - Is a feature of parietal disturbance.

- Dressing apraxia:
  - Often associated with spatial disorientation and neglect
  - is usually due to non-dominant hemisphere parietal lesions.



11.12 Features of motor neurone lesions

	Upper motor neurone lesion	Lower motor neurone lesion
Inspection	Usually normal (wasting in longstanding lesions)	Wasting, fasciculation
Tone	Increased with clonus	Normal or decreased, no clonus
Weakness	Preferentially affects extensors in arms, flexors in leg	Usually more focal, in distribution of nerve root or peripheral nerve
Deep tendon reflexes	Increased	Decreased/absent
Plantar response	Extensor	Flexor


IM SO TIRED
ME

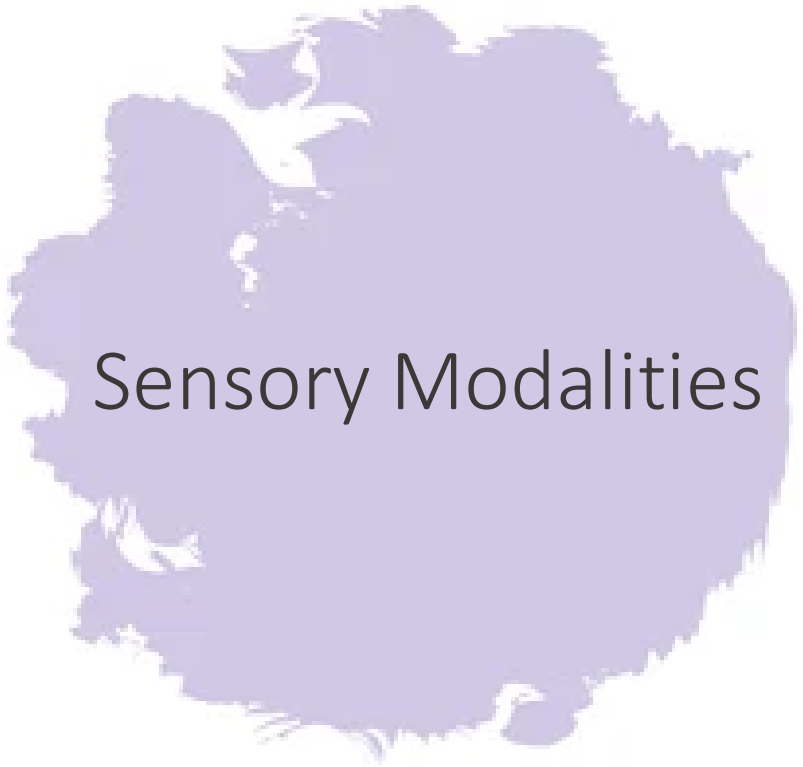

Take a rest

The sensory system

A small tip!

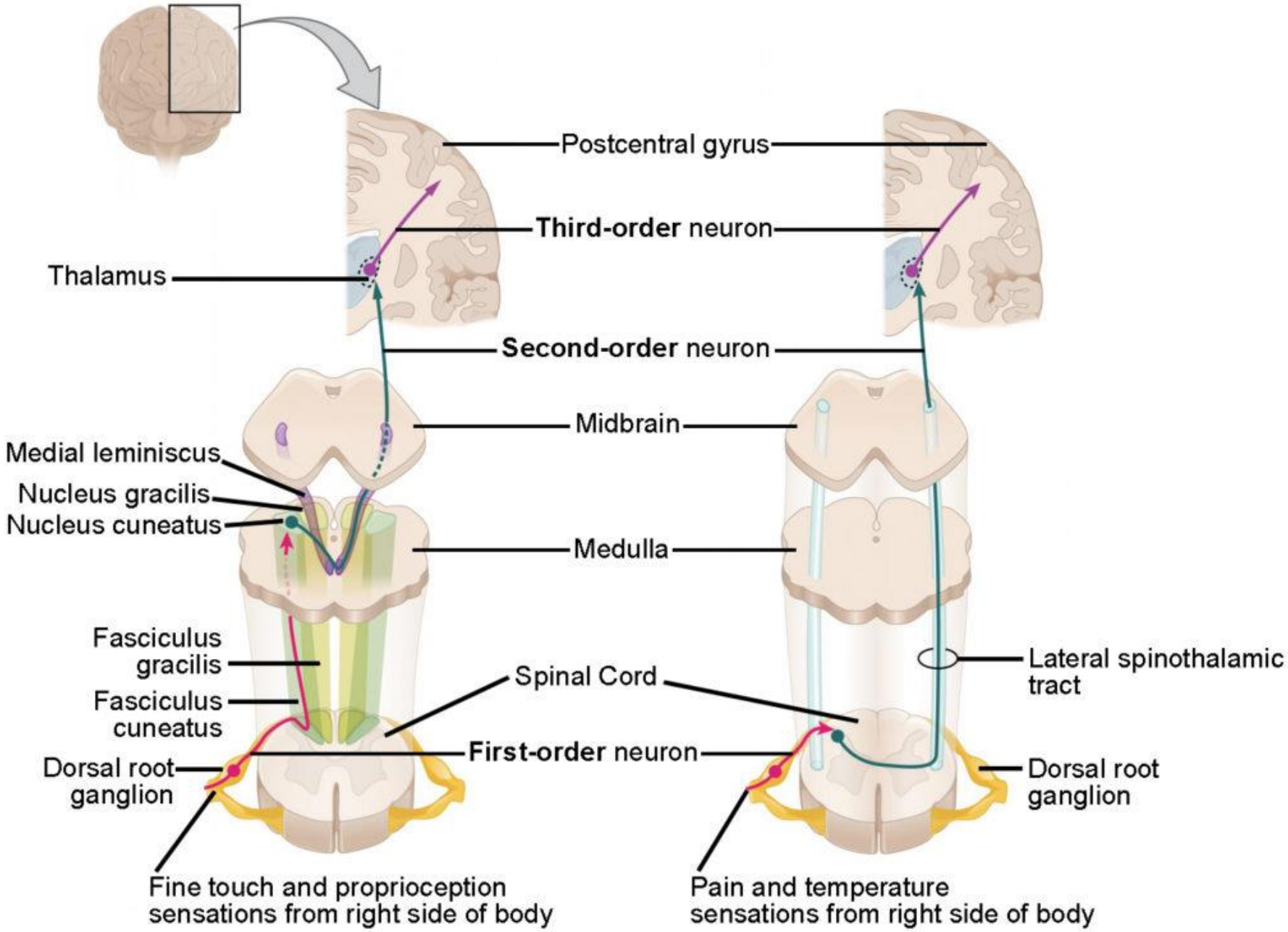
Detailed examination of sensation is time-consuming and unnecessary unless the patient demonstrates sensory symptoms, or you suspect a specific pathology

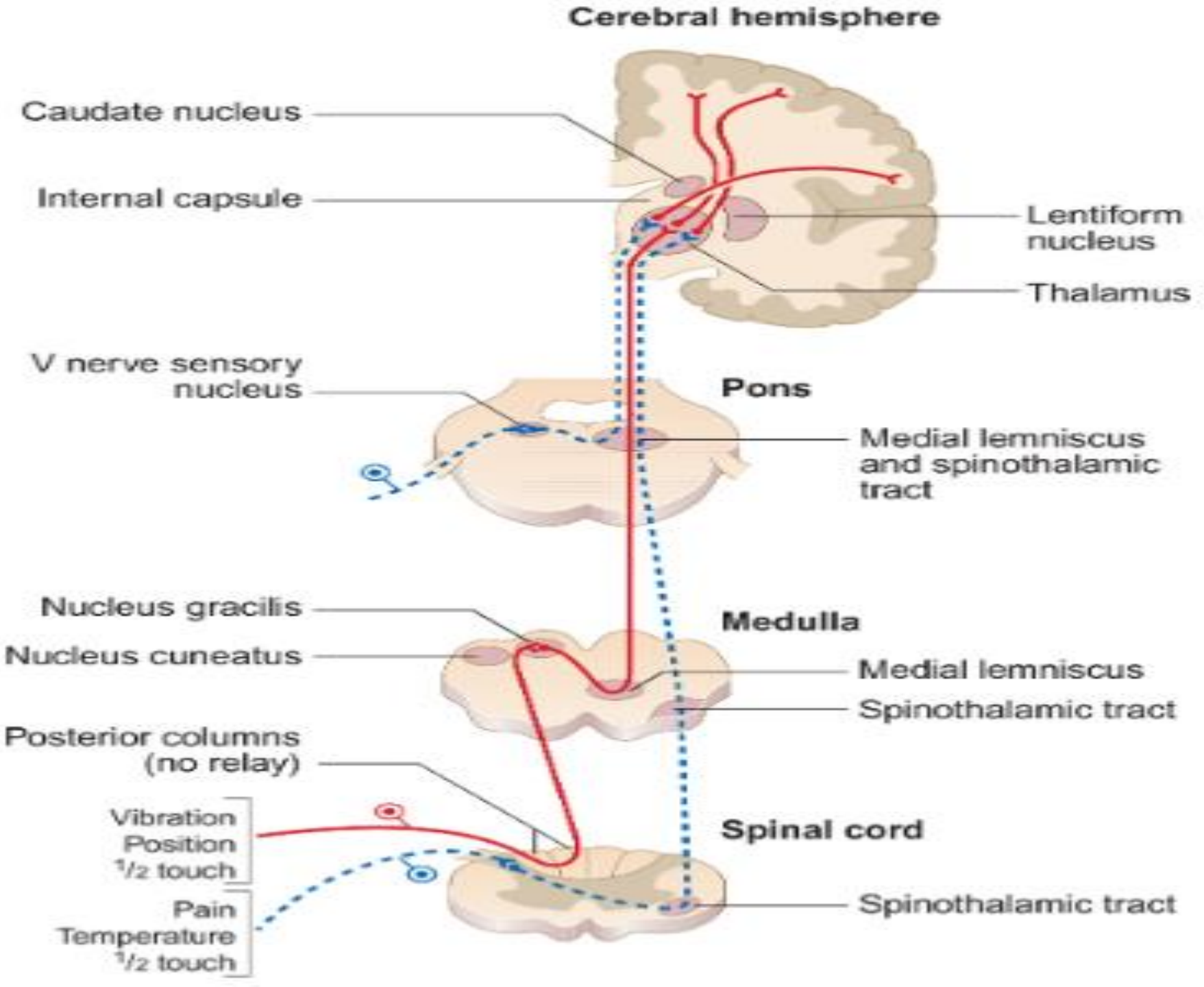
Sensory Modalities



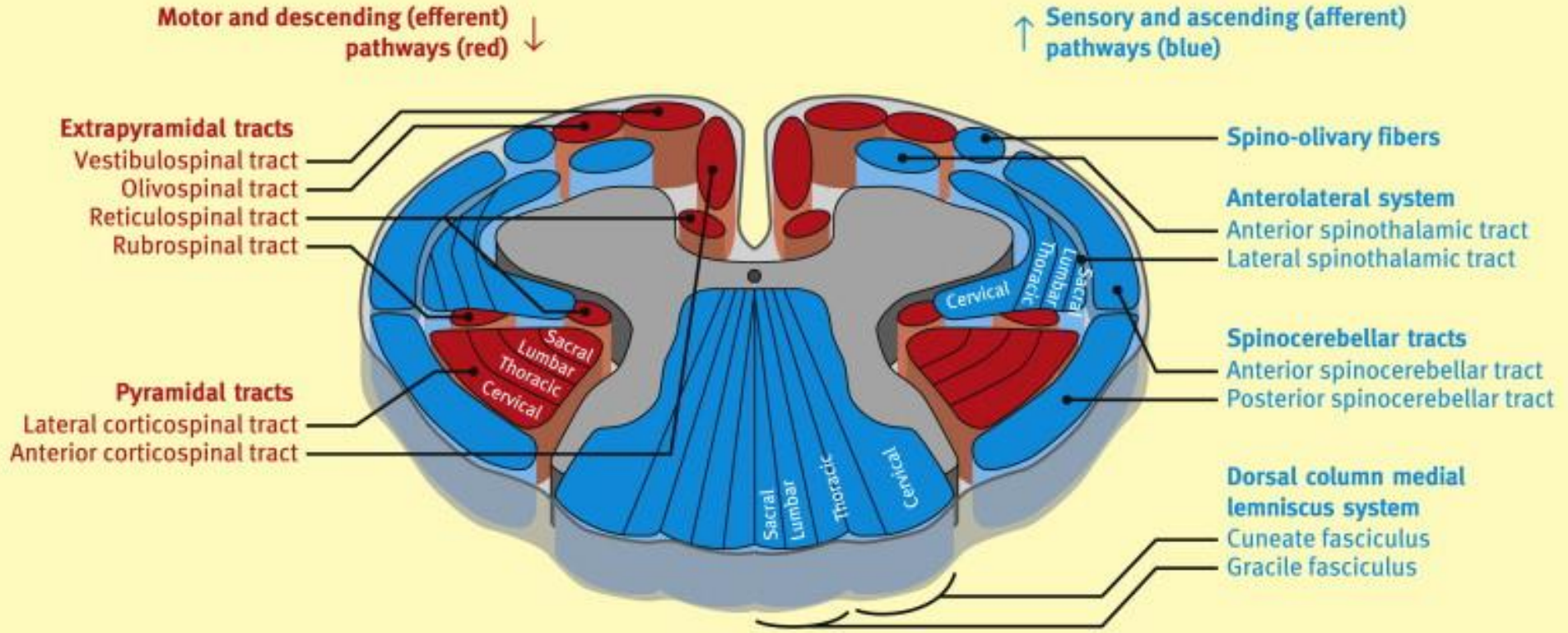
- Light Touch
- Superficial pain
- Temperature
- Vibration
- Proprioception
- Stereognosis and graphaesthesia

Let’s review some anatomy!


Postcentral gyrus
Third-order neuron
Thalamus
Second-order neuron
Midbrain
Medial leminiscus
Nucleus gracilis
Nucleus cuneatus
Medulla
Fasciculus gracilis
Fasciculus cuneatus
Spinal Cord
First-order neuron
Dorsal root ganglion
Fine touch and proprioception sensations from right side of body
Lateral spinothalamic tract
Dorsal root ganglion
Pain and temperature sensations from right side of body
Dorsal column system
Spinothalamic tract


Cerebral hemisphere
Caudate nucleus
Internal capsule
Lentiform nucleus
Thalamus
V nerve sensory nucleus
Pons
Medial lemniscus and spinothalamic tract
Nucleus gracilis
Nucleus cuneatus
Medulla
Medial lemniscus
Spinothalamic tract
Posterior columns (no relay)
Vibration
Position
1/2 touch
Spinal cord
Pain
Temperature
1/2 touch
Spinothalamic tract

Anatomy of the spinal cord

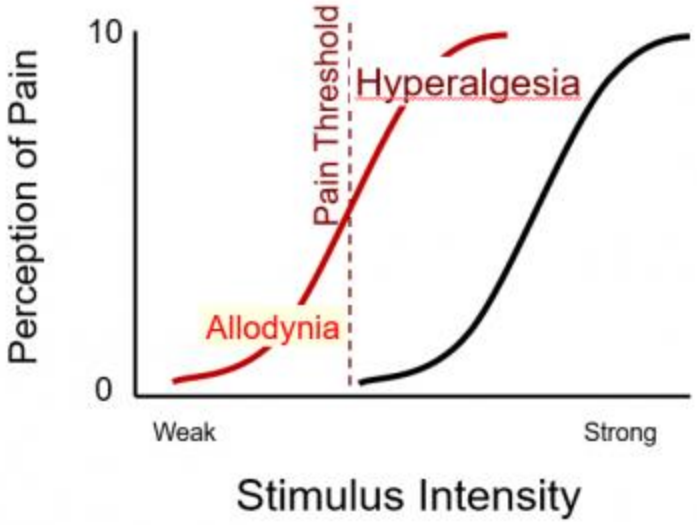


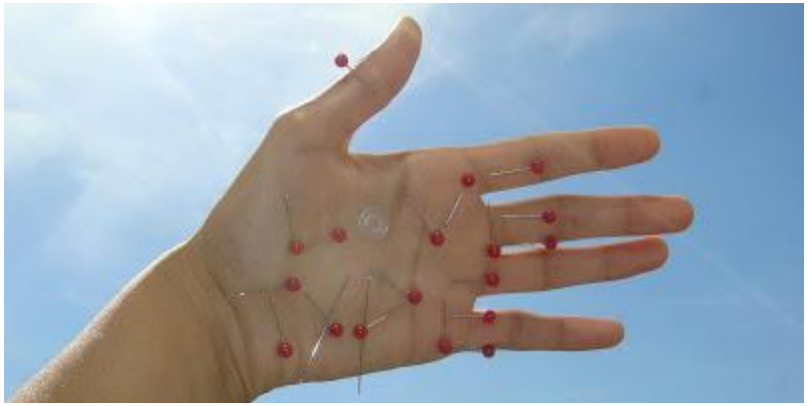
So, Let's Recap on the Diagrams

- Proprioception and vibration sensation:
  - Conveyed in large, myelinated fast-conducting fibers in the peripheral nerves and in the posterior columns of the spinal cord
  - The posterior column remains ipsilateral from the point of entry up to the medulla.
- Pain and temperature sensation
  - Carried by small, slow-conducting fibers of the peripheral nerves and the spinothalamic tract of the spinal cord.
  - Most pain and temperature fibers cross to the contralateral spinothalamic tract within one or two segments of entry to the spinal cord.
- All sensory fibers relay in the ***thalamus*** before sending information to the sensory cortex in the ***parietal lobe***

Symptoms and definitions

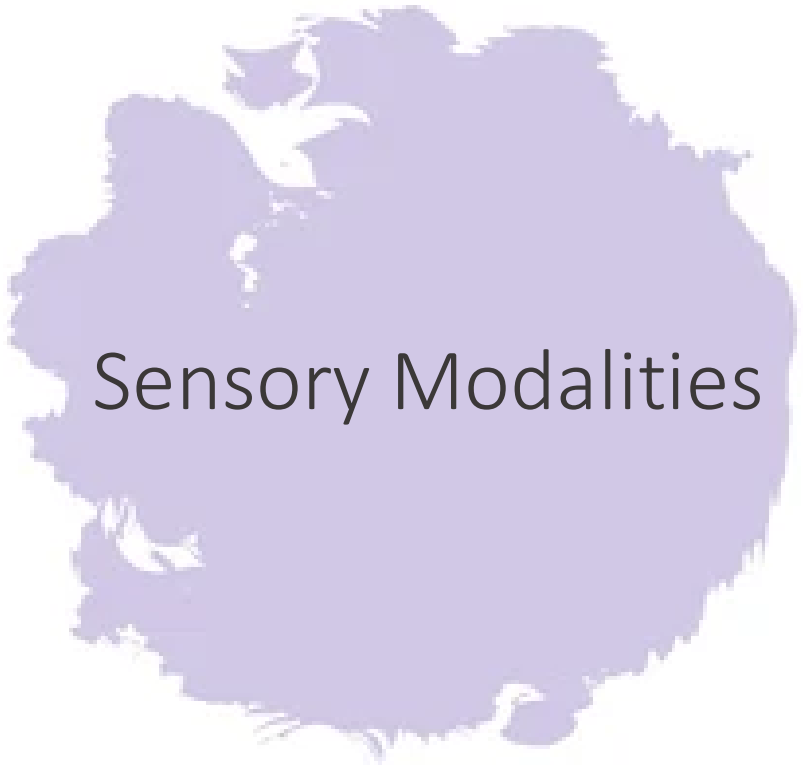
Paraesthesia	Tingling, or pins and needles Spontaneous or provoked Not unduly unpleasant or painful
Dysaesthesia	Unpleasant paraesthesia
Hypoaesthesia	Reduced sensation to a normal stimulus
Analgesia	Numbness or loss of sensation
Hyperaesthesia	Increased sensitivity to a stimulus
Allodynia	Painful sensation resulting from a non-painful stimulus
Hyperalgesia	Increased sensitivity to a painful stimulus


Perception of Pain
10
0
Pain Threshold
Hyperalgesia
Allodynia
Weak
Strong
Stimulus Intensity




Congenital
Insensitivity to Pain
Some People Can't
Feel Pain

Sensory Modalities

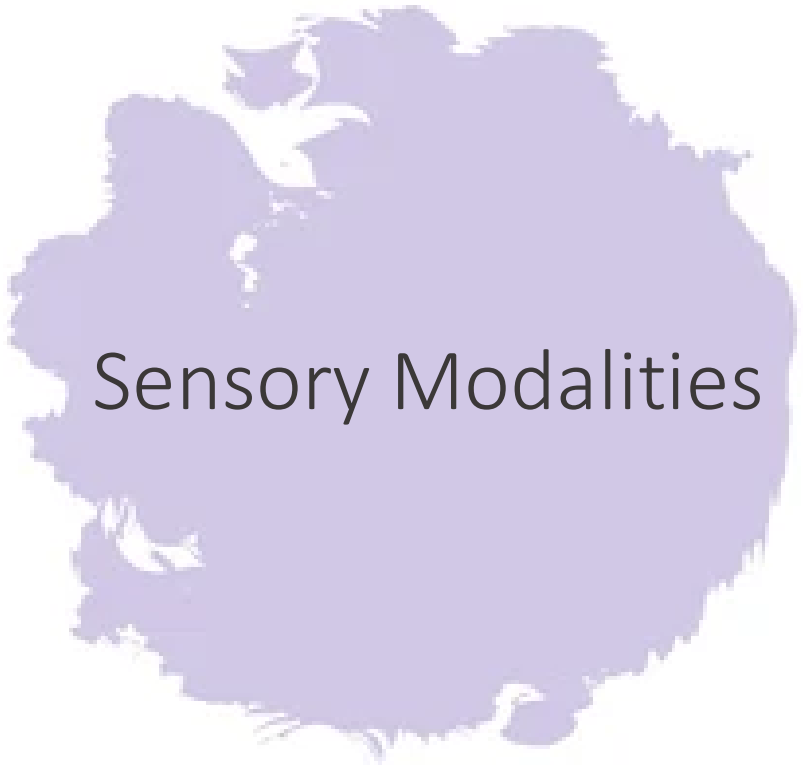


- Light Touch
- Superficial pain
- Temperature
- Vibration
- Proprioception
- Stereognosis and graphaesthesia

Light Touch

- While the patient looks away or closes his eyes, use a wisp of cotton wool (or lightly apply your finger) and ask the patient to say yes to each touch.
- Time the stimuli irregularly and make a dabbing rather than a stroking or tickling stimulus.
- Compare each side for symmetry.

Sensory Modalities

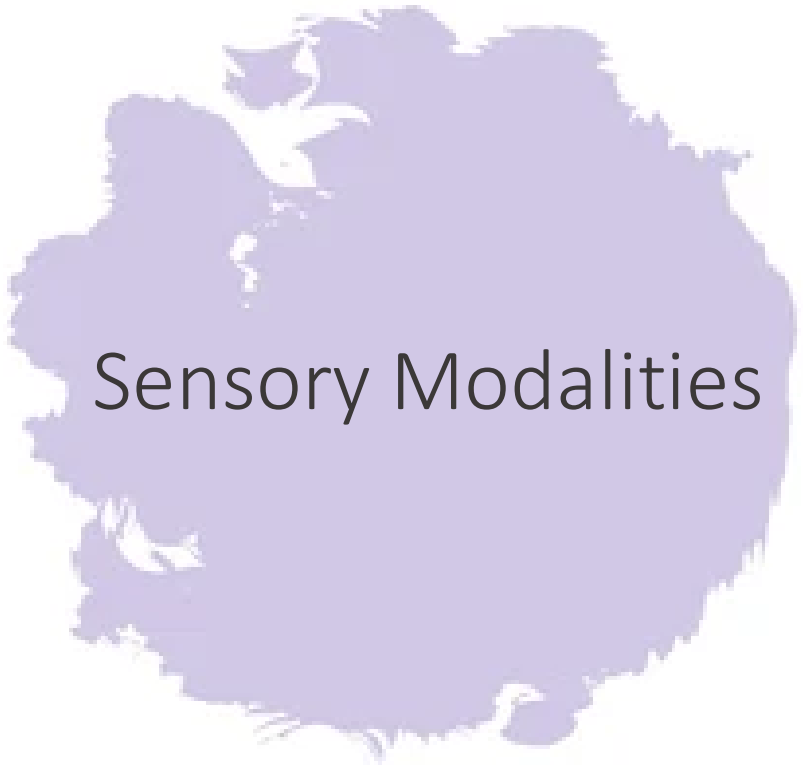


- Light Touch
- Superficial pain
- Temperature
- Vibration
- Proprioception
- Stereognosis and graphaesthesia

Superficial pain

- Use a fresh neurological pin
- Explain and demonstrate that the ability to feel a sharp pinprick is being tested.
- Map out the boundaries of any area of reduced, absent or increased sensation and compare with.
- Move from reduced to higher sensibility: i.e. from hypoaesthesia to normal, or normal to hyperaesthesia.

Sensory Modalities



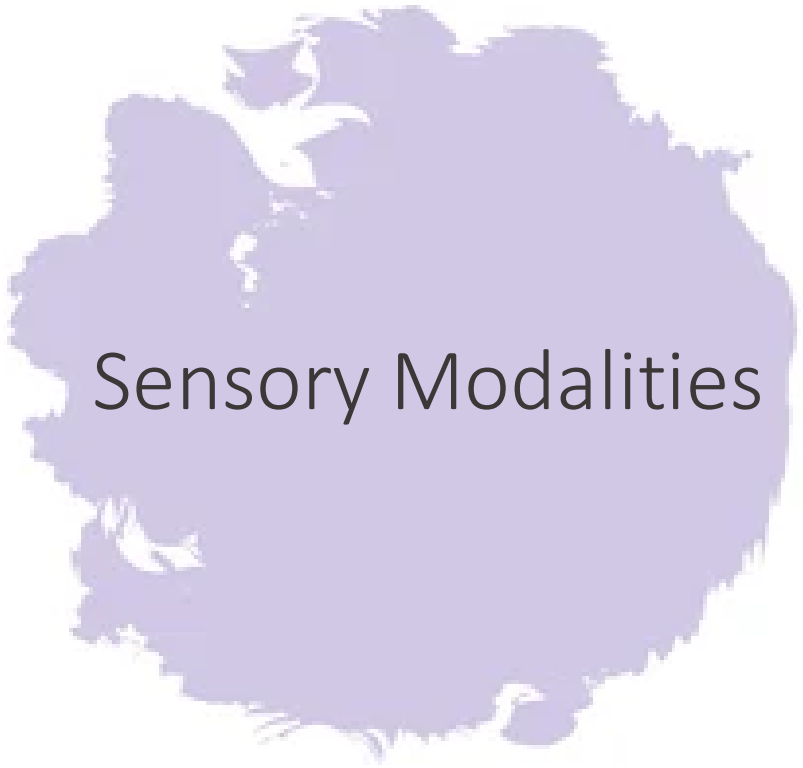
- Light Touch
- Superficial pain
- Temperature
- Vibration
- Proprioception
- Stereognosis and graphaesthesia

Temperature

- Touch the patient with a cold metallic object, e.g. tuning fork, and ask if it feels cold.

- More sensitive assessment requires tubes of hot and cold water at controlled temperatures but is seldom performed.

Sensory Modalities



- Light Touch
- Superficial pain
- Temperature
- Vibration
- Proprioception
- Stereognosis and graphaesthesia

Vibration

- Teach your patient what to fell?
  - Place a vibrating 128 Hz tuning fork over the sternum.
  - Ask the patient, ‘Do you feel it buzzing?’

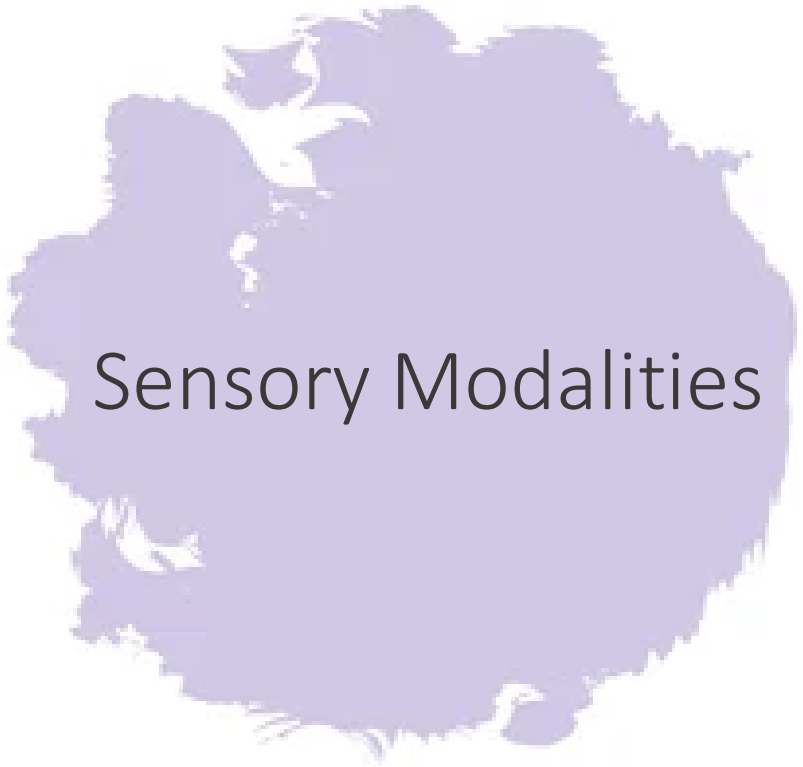
- Lower limb:
  - Place it on the tip of the great toe
  - If sensation is impaired, place the fork on the interphalangeal joint and progress proximally, to the medial malleolus, tibial tuberosity and anterior iliac spine, depending upon the response.

Vibration

- The upper limb:
  - Start at the distal interphalangeal joint of the forefinger, and if sensation is impaired, proceed proximally.

- If in doubt as to the accuracy of the response, ask the patient to close his eyes and to report when you stop the fork vibrating with your fingers.

Sensory Modalities

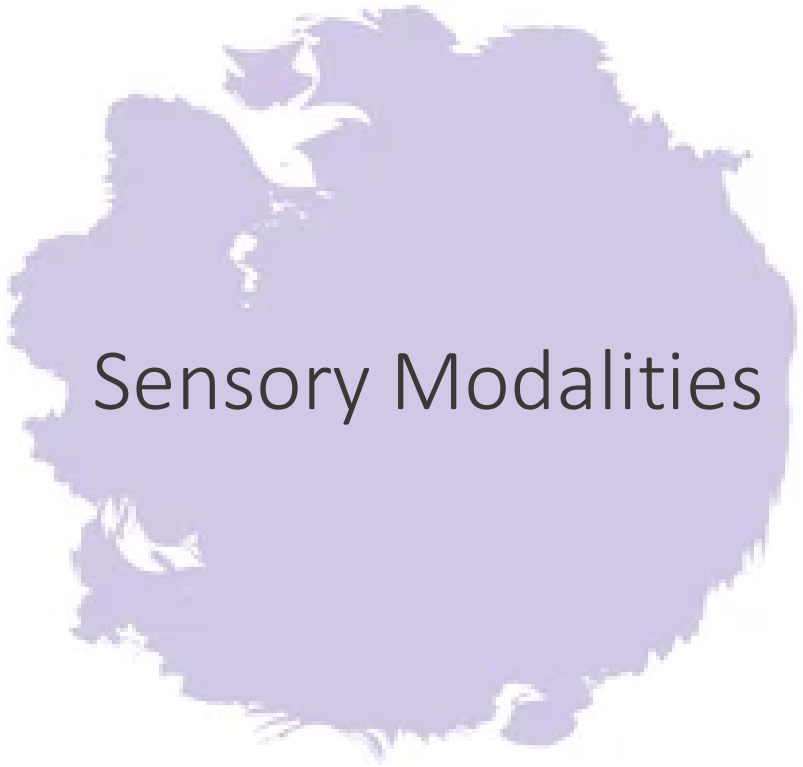


- Light Touch
- Superficial pain
- Temperature
- Vibration
- Proprioception
- Stereognosis and graphaesthesia

Proprioception

- With the patient's eyes open, demonstrate the procedure.
  - Hold the distal phalanx of the patient's great toe at the sides.
  - Tell the patient you are going to move his toe up or down, demonstrating as you do so
- Ask the patient to close his eyes and to identify the direction of small movements in random order.
- Test both great toes (or middle fingers). If impaired, move to more proximal joints in each limb.

Sensory Modalities



- Light Touch
- Superficial pain
- Temperature
- Vibration
- Proprioception
- Stereognosis and graphaesthesia

Stereognosis and graphaesthesia

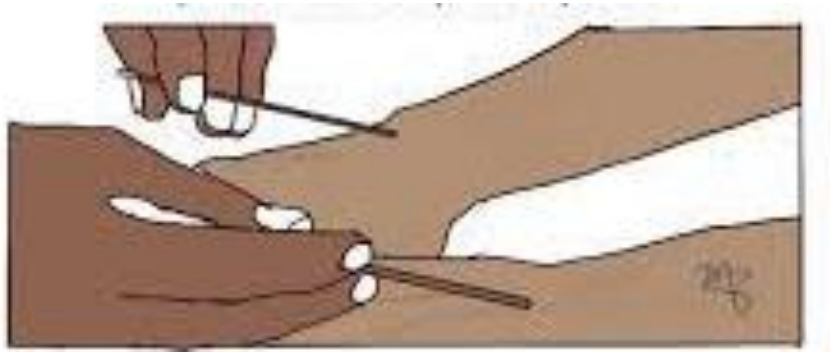
- A so-called Cortical sense!
- Ask the patient to close his eyes.

- Stereognosis:
  - Place a familiar object, e.g. coin or key, in his hand and ask him to identify it.

- Graphaesthesia:
  - Use the blunt end of a pencil or orange stick and trace letters or digits on the patient's palm.
  - Ask the patient to identify the figure

Sensory inattention
(If sensory pathways are otherwise intact)

- Ask the patient to close his eyes.
- Touch his arms/legs in turn and ask which side has been touched.
- Now touch both sides simultaneously and ask whether the left, right or both sides were touched.



The sensory modalities (Identifying the lesion level)

- Peripheral nerve and dorsal root
- Spinal cord
- Intracranial

>> Interpretation of sensory signs requires knowledge of the relevant anatomy of sensory nerves and dermatomes

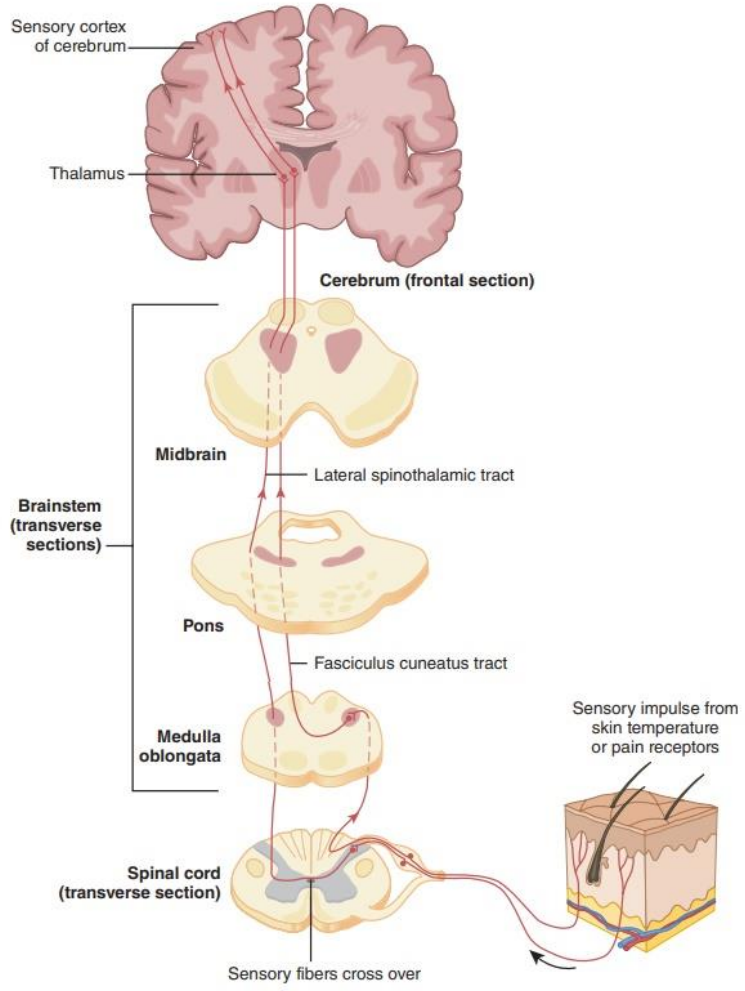
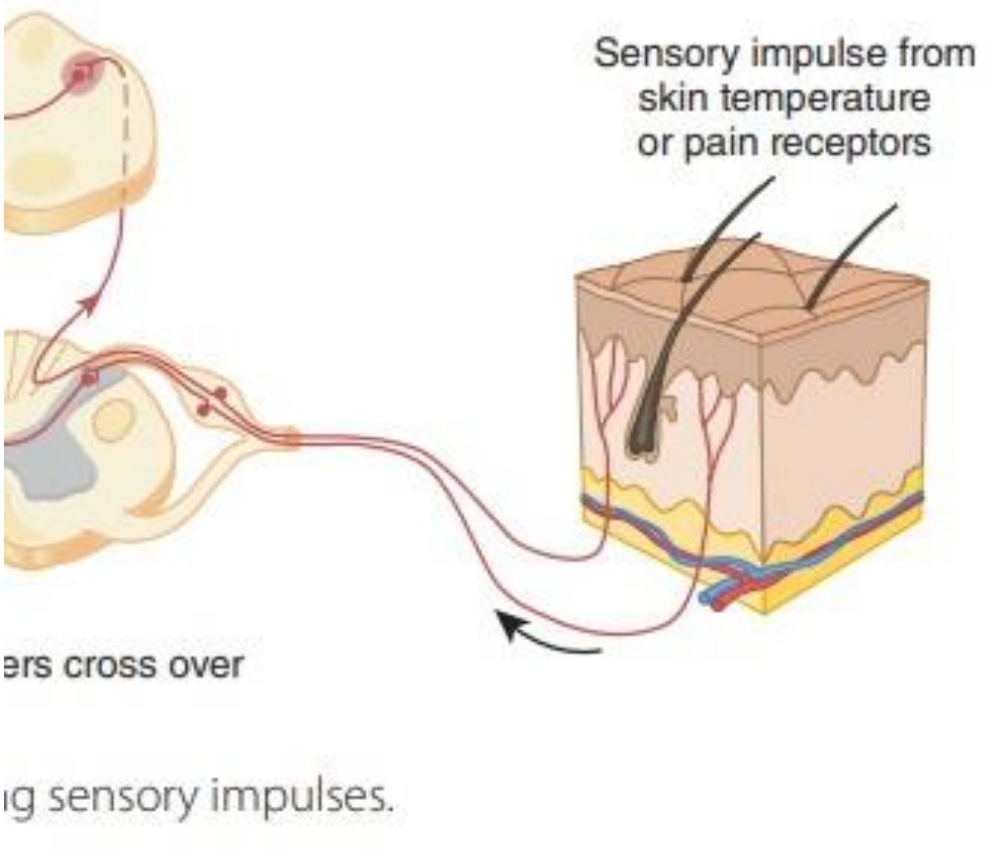


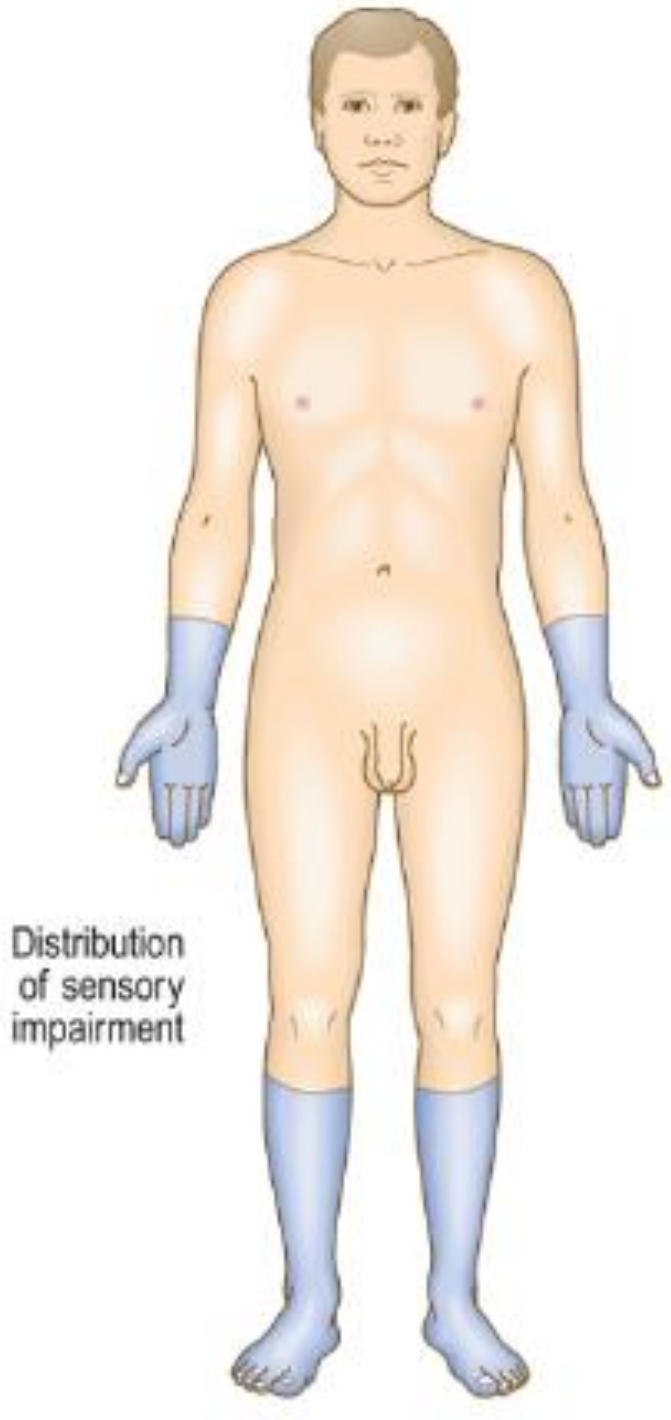
FIGURE 12-16 The path of ascending sensory impulses.

Peripheral nerve and dorsal root

- Many diseases affect peripheral nerves, generally resulting in peripheral neuropathies or polyneuropathies
- Peripheral neuropathies tend to affect the lower limbs first (length-dependent).
- Symptoms affecting the upper limbs first suggest a demyelinating rather than axonal neuropathy or a disease process in the spinal cord.

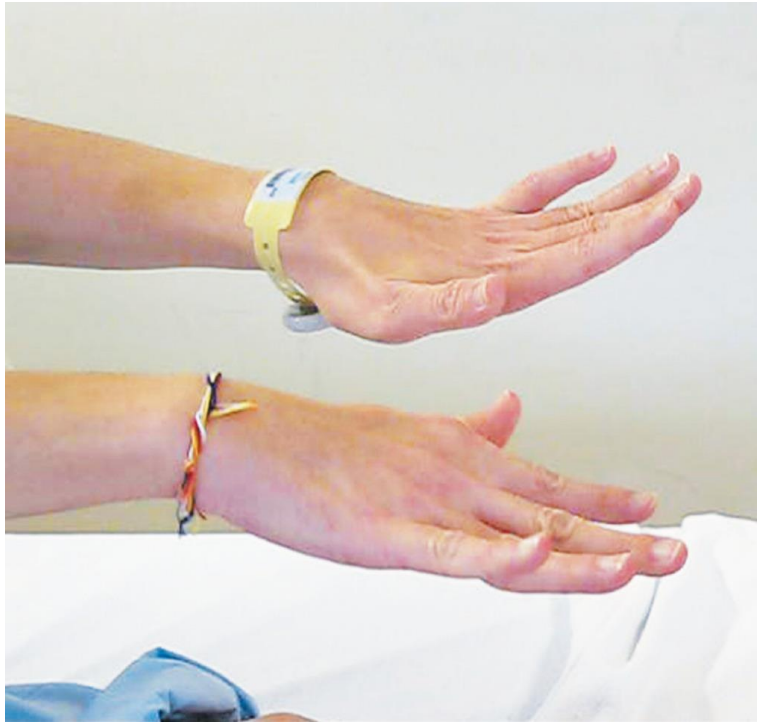


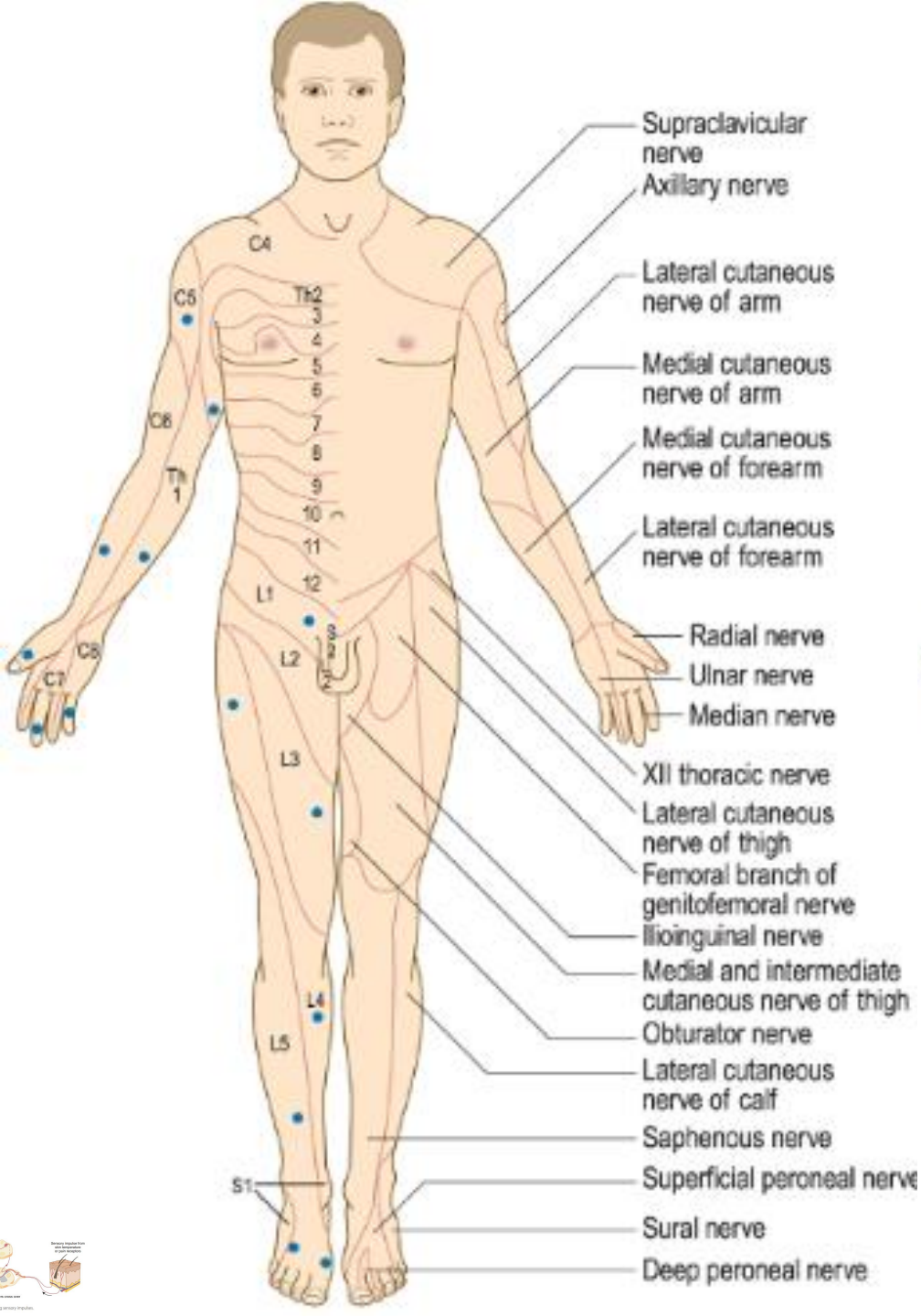
Gloves and Stockings (Diabetic Neuropathy)

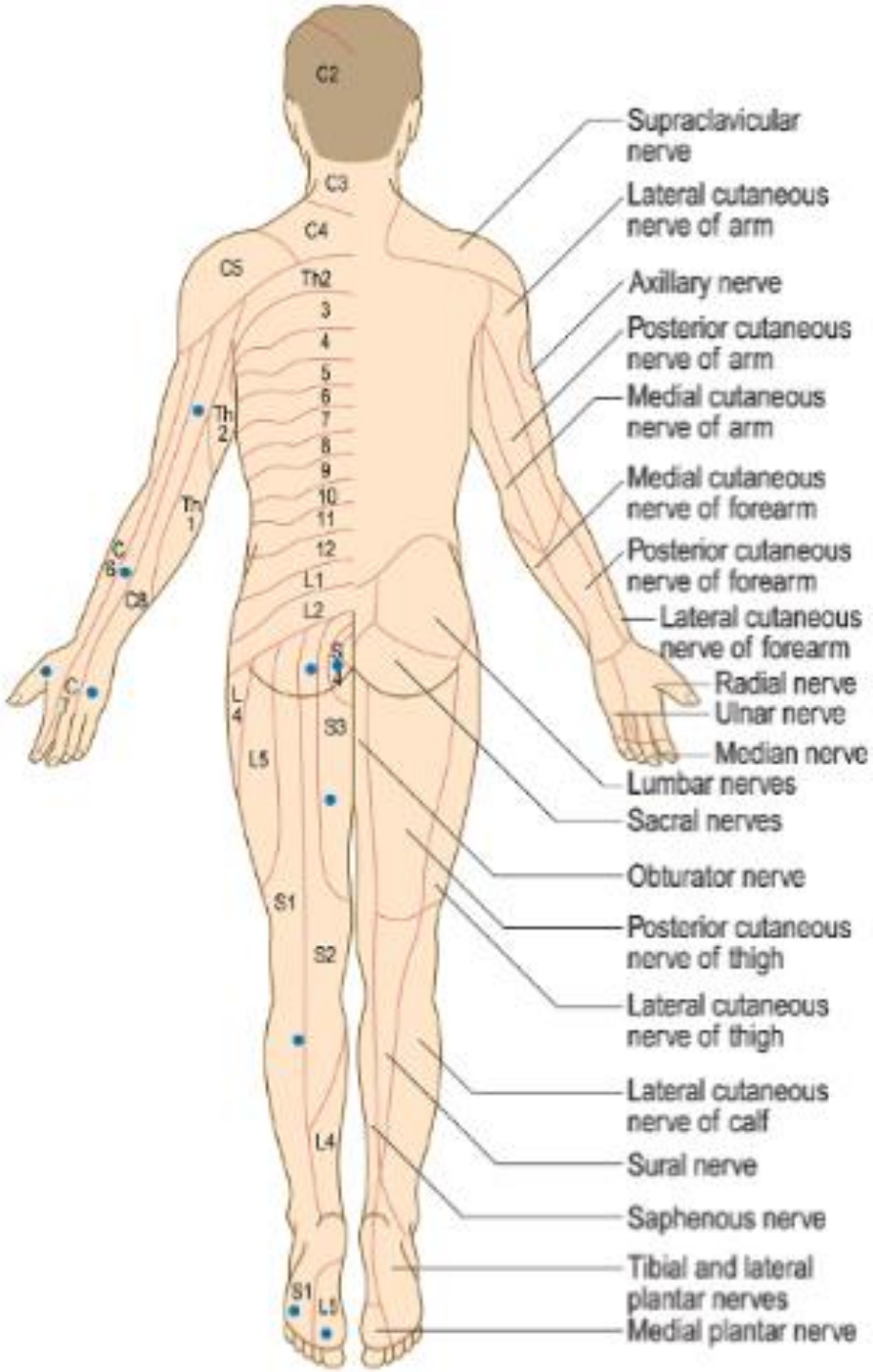


Loss of Proprioception (Pseudoathetosis)

- May be demonstrated by asking the patient to close his eyes and hold his hands outstretched: the fingers will make involuntary, slow wandering movements, mimicking athetosis.



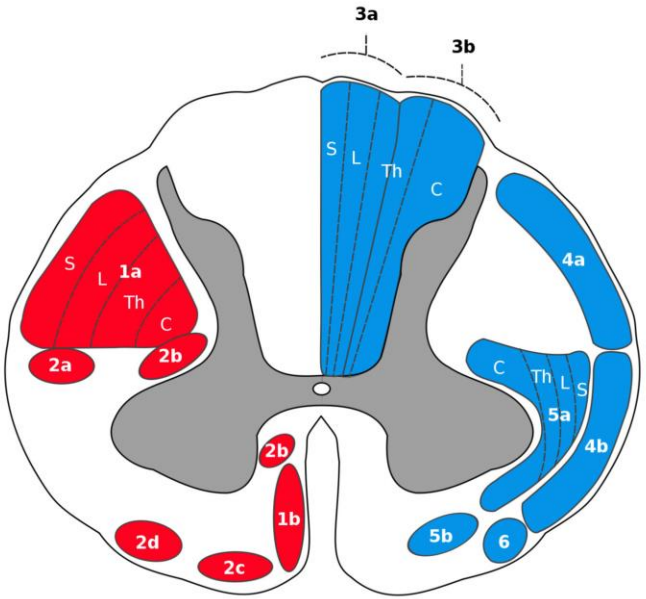

C4
C5
Th2
3
4
5
6
7
8
9
10
11
12
L1
L2
L3
L4
L5
S1
C6
Th 1
C8
C7
Supraclavicular nerve
Axillary nerve
Lateral cutaneous nerve of arm
Medial cutaneous nerve of arm
Medial cutaneous nerve of forearm
Lateral cutaneous nerve of forearm
Radial nerve
Ulnar nerve
Median nerve
XII thoracic nerve
Lateral cutaneous nerve of thigh
Femoral branch of genitofemoral nerve
Ilioinguinal nerve
Medial and intermediate cutaneous nerve of thigh
Obturator nerve
Lateral cutaneous nerve of calf
Saphenous nerve
Superficial peroneal nerve
Sural nerve
Deep peroneal nerve


C2
C3
C4
C5
Th2
3
4
5
6
7
8
9
10
11
12
L1
L2
L4
L5
S1
S2
S3
Th 2
Th 1
C 6
C8
Supraclavicular nerve
Lateral cutaneous nerve of arm
Axillary nerve
Posterior cutaneous nerve of arm
Medial cutaneous nerve of arm
Medial cutaneous nerve of forearm
Posterior cutaneous nerve of forearm
Lateral cutaneous nerve of forearm
Radial nerve
Ulnar nerve
Median nerve
Lumbar nerves
Sacral nerves
Obturator nerve
Posterior cutaneous nerve of thigh
Lateral cutaneous nerve of thigh
Lateral cutaneous nerve of calf
Sural nerve
Saphenous nerve
Tibial and lateral plantar nerves
Medial plantar nerve

Spinal cord

- Traumatic and compressive spinal cord lesions cause loss or impairment of sensation in a dermatomal distribution below the level of the lesion.

- A zone of hyperaesthesia may be found immediately above the level of sensory loss.



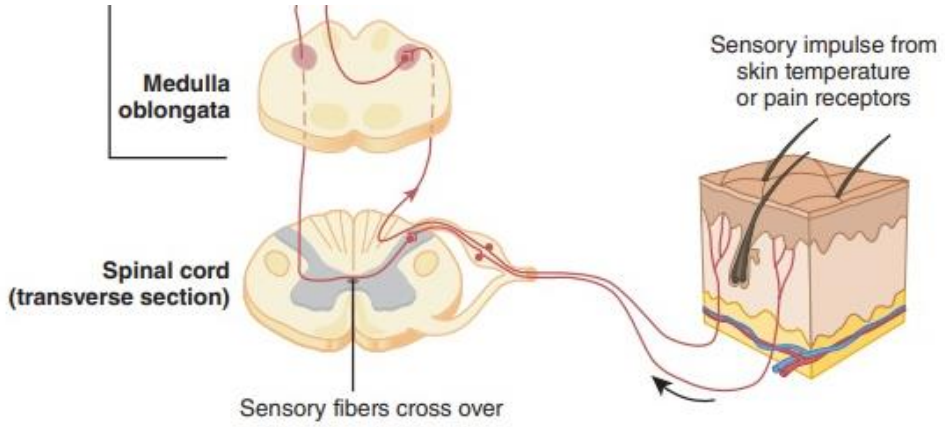


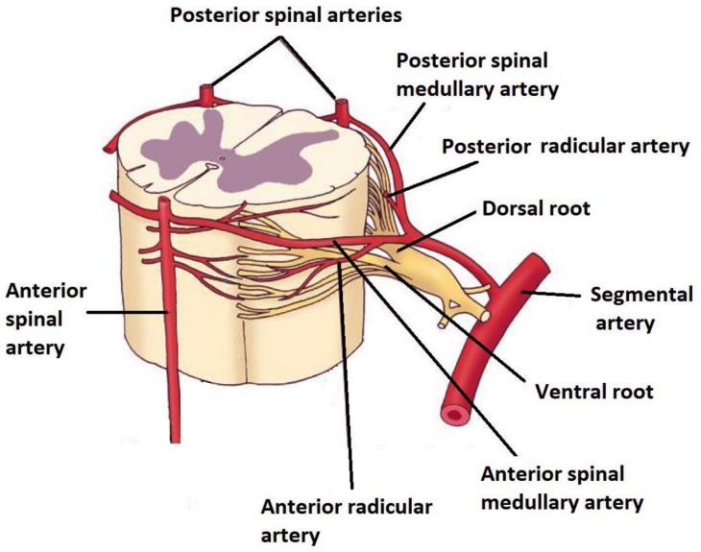
FIGURE 12-16 The path of ascending sensory impulses.

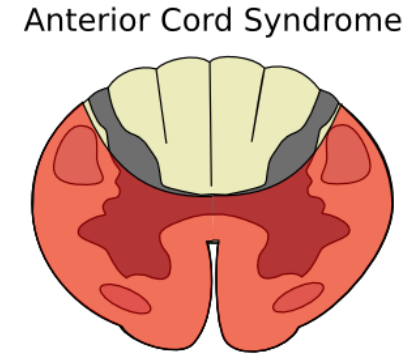
Spinal cord lesions

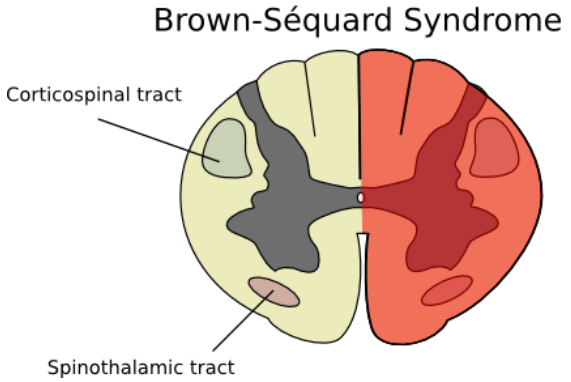
- Anterior spinal artery syndrome:
  - Results in loss of spinothalamic sensation and motor function, with sparing of dorsal column sensation.

- A similar dissociated pattern of pain and temperature loss and sparing of dorsal column sensation occurs in syringomyelia.

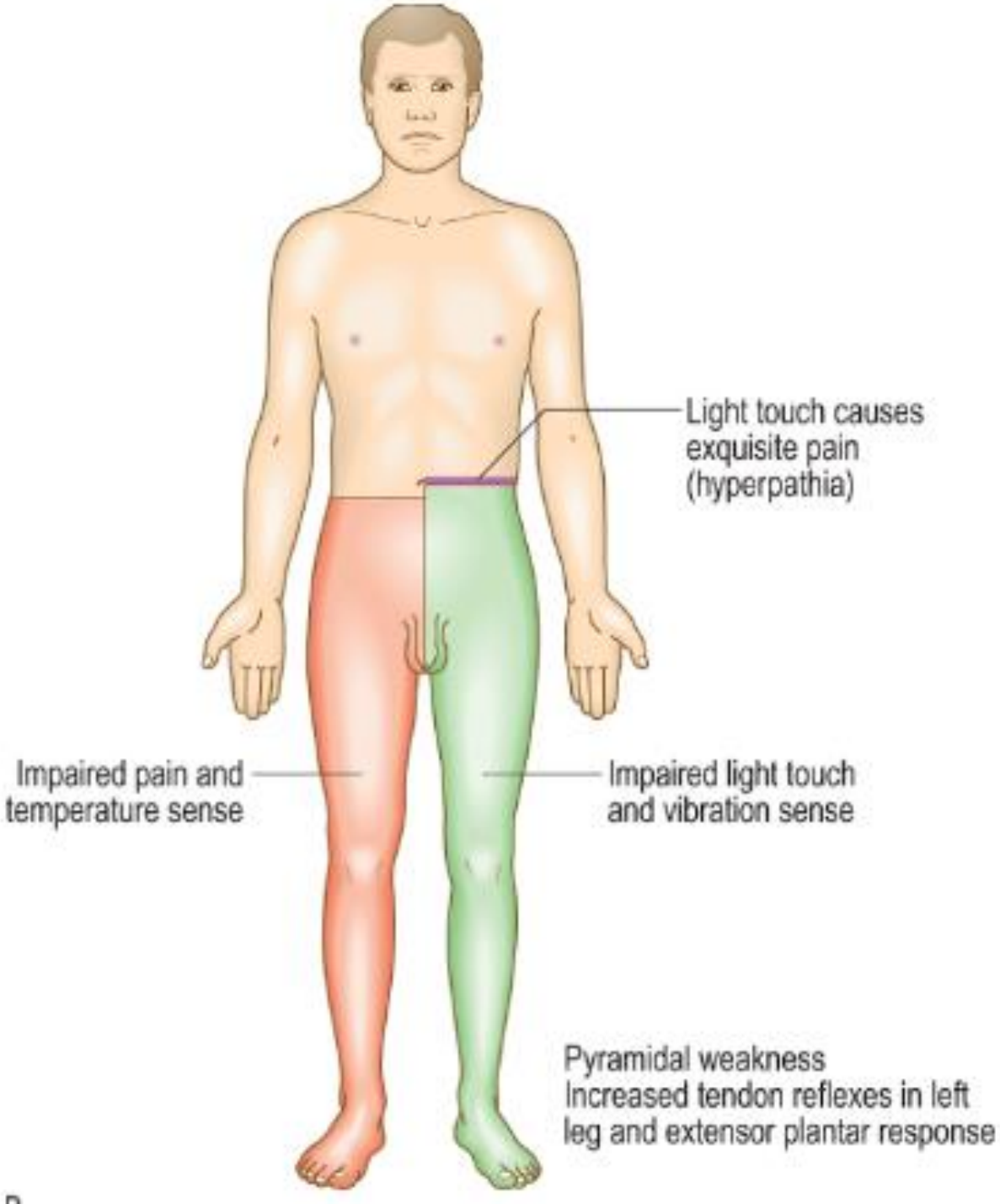
- Brown-Séquard syndrome
  - When one-half of the spinal cord is damaged.
  - This is characterized by ipsilateral motor weakness and loss of vibration and joint position sense, with contralateral loss of pain and temperature







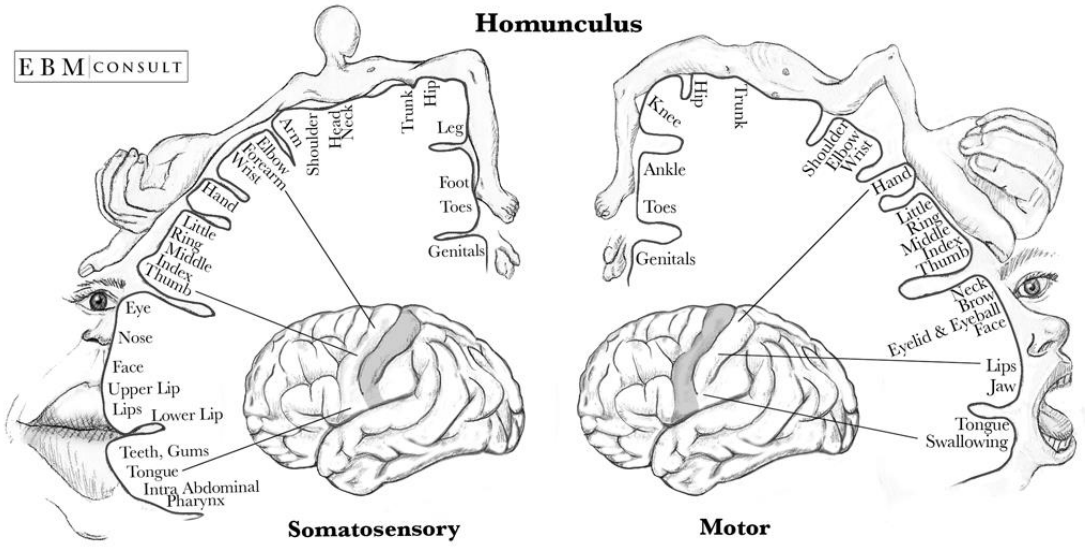
Brown-Séquard syndrome

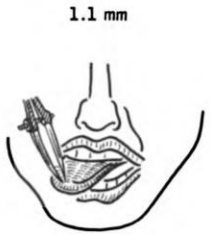


Intracranial

- Thalamic lesions may cause a patchy sensory impairment on the opposite side with unpleasant, poorly localized pain, often of a burning quality

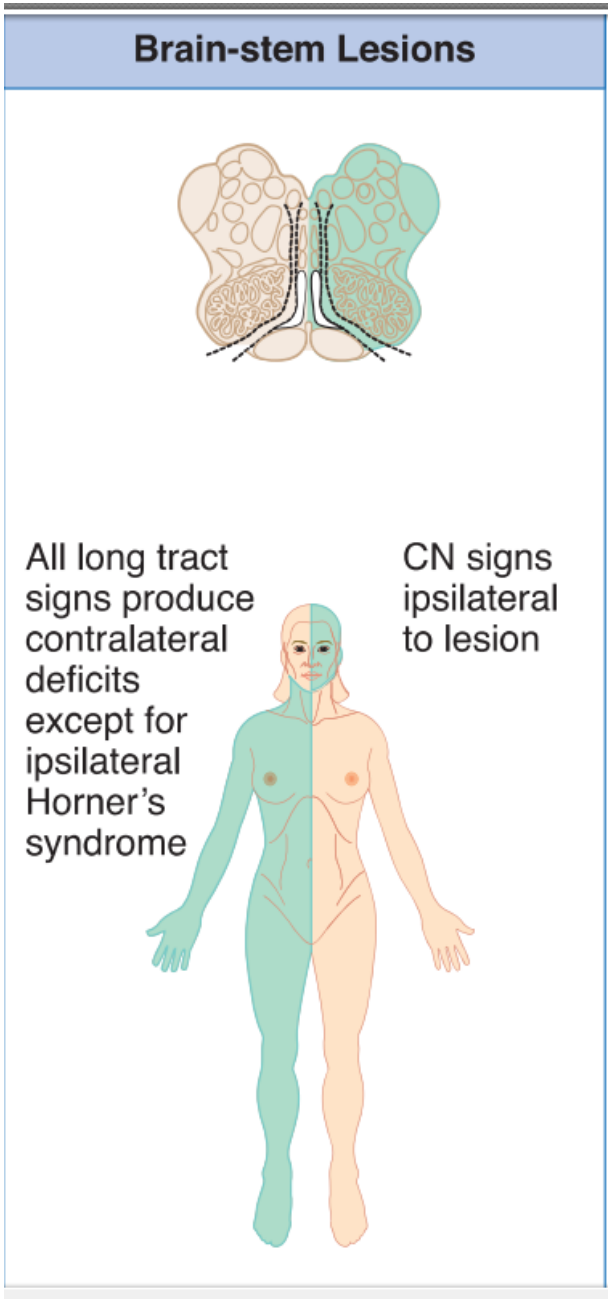
- Cortical parietal lobe lesions typically cause sensory inattention but may also affect joint position sense, two-point discrimination, stereognosis (tactile recognition) and localization of point touch.





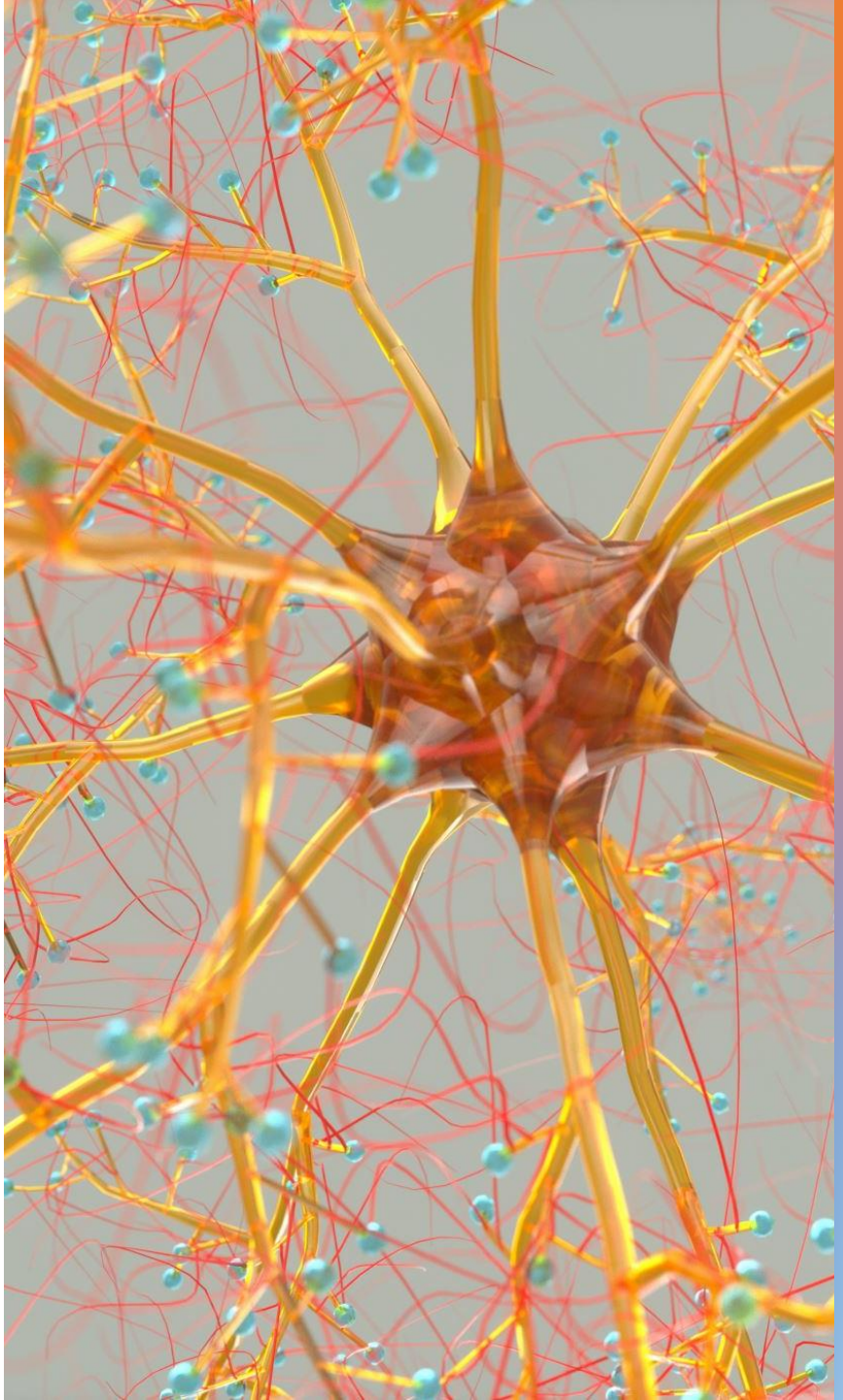
Brain stem lesions

- Lower brainstem lesions may cause ipsilateral numbness on one side of the face (V nerve nucleus) and contralateral body numbness (spinothalamic tract).



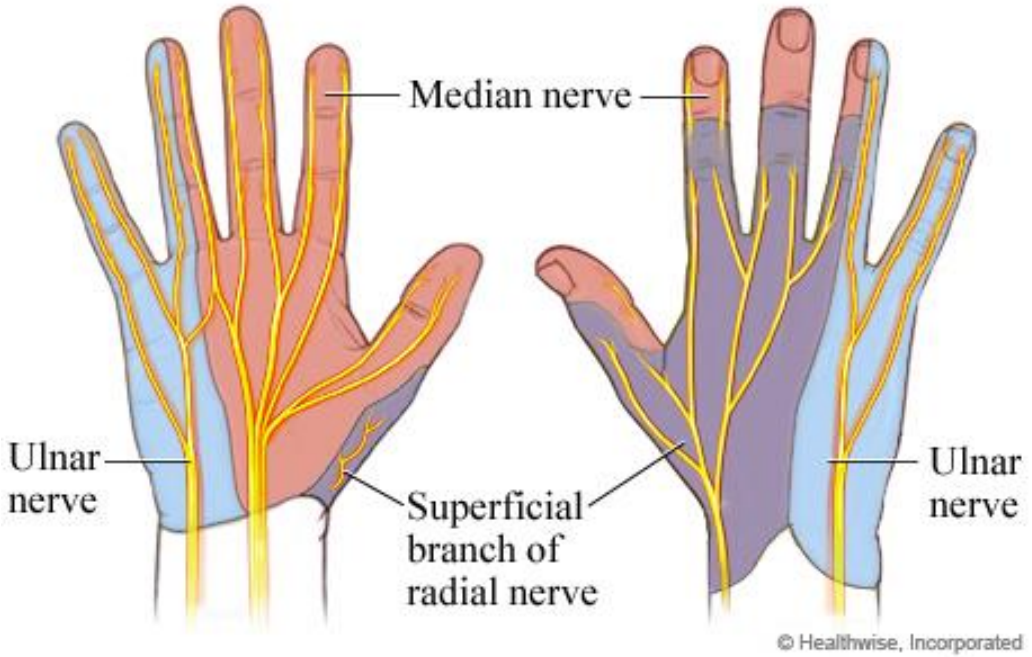
Peripheral nerves Examination

Your Famous Rock, Paper, Scissors!

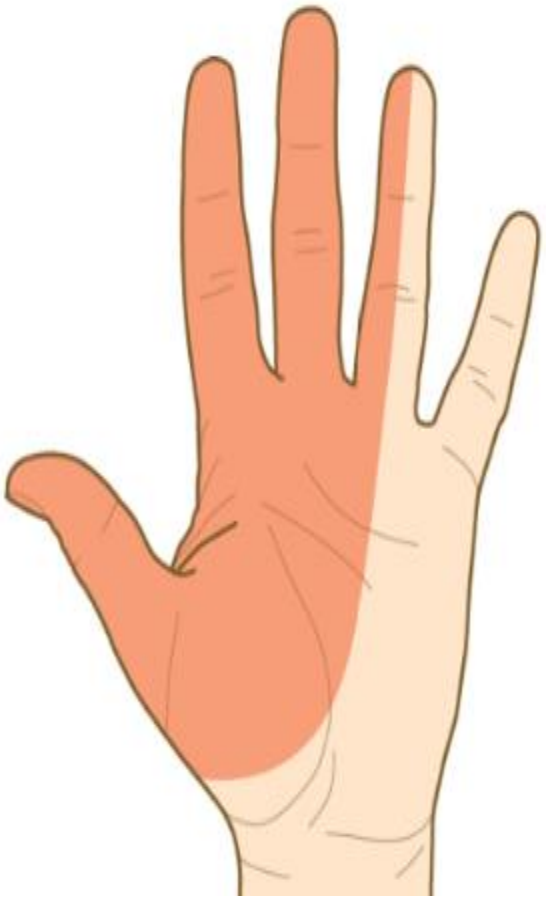


Sensory examination of the hand

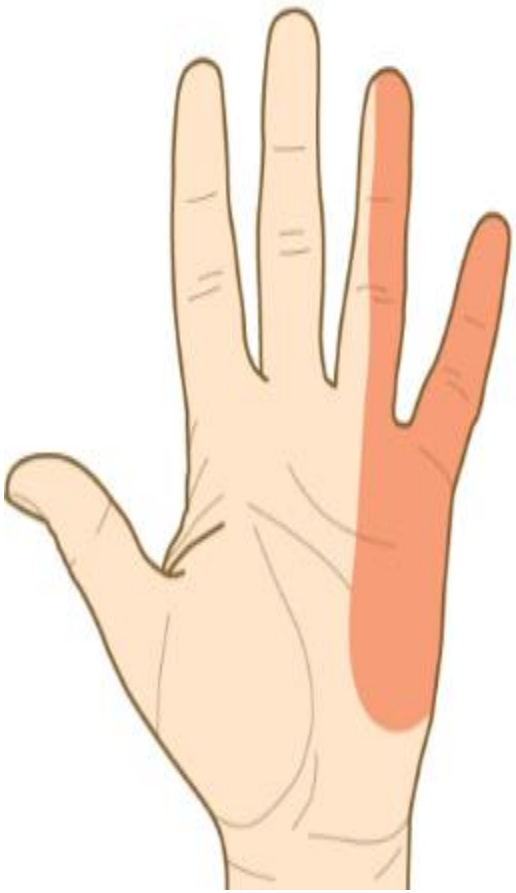
- Test for altered sensation over the hand involving:
  - The thumb
  - Index and middle fingers
  - The lateral half of the ring



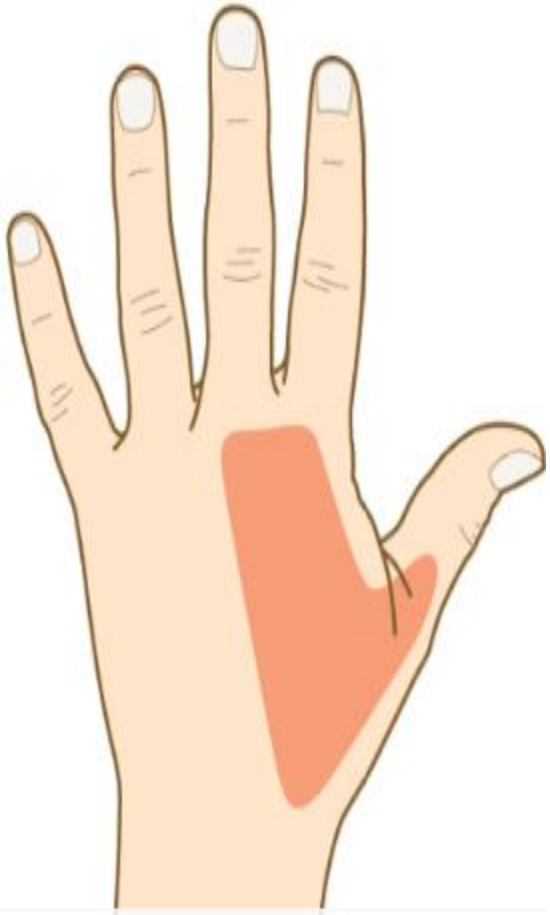
Median



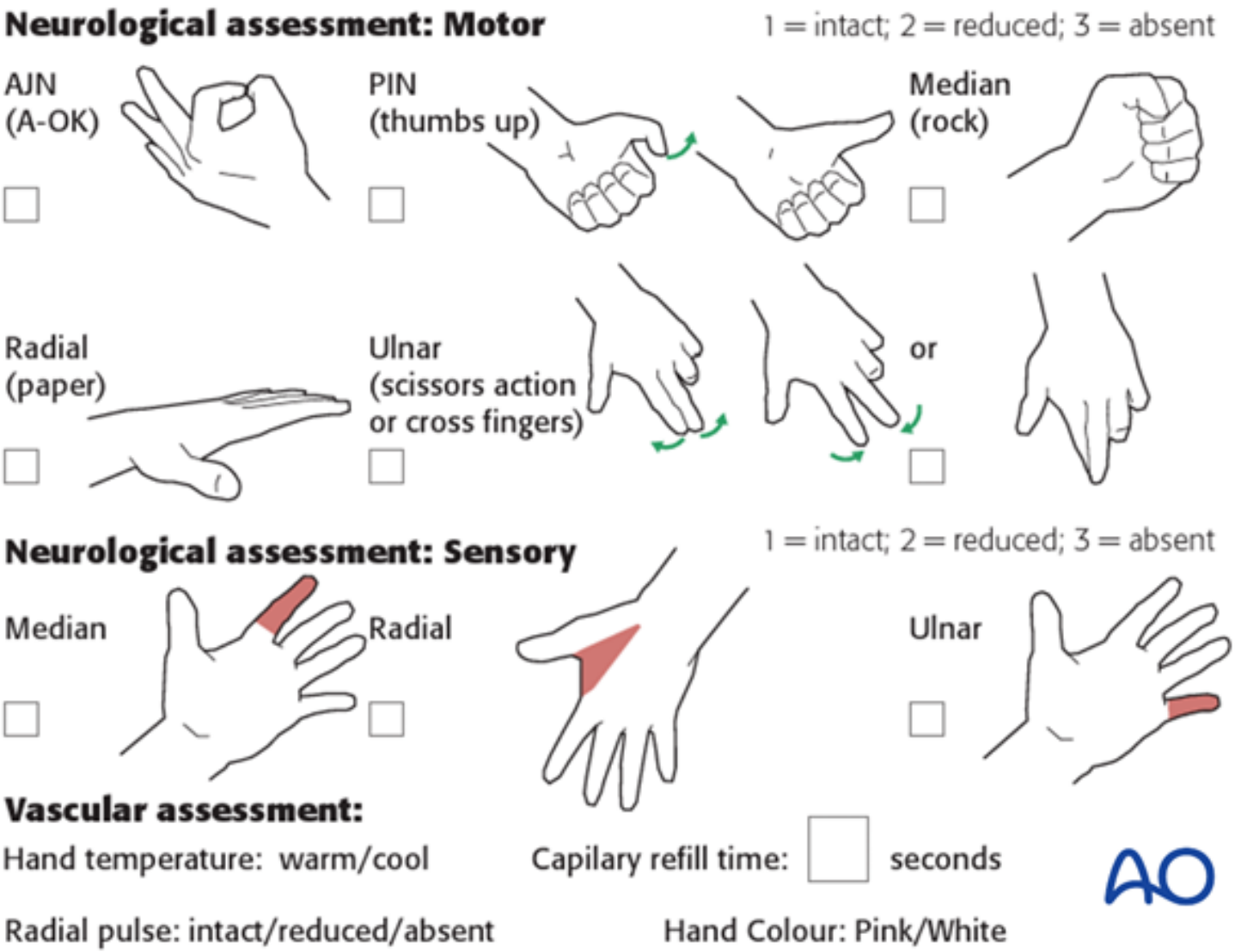
Ulnar



Radial

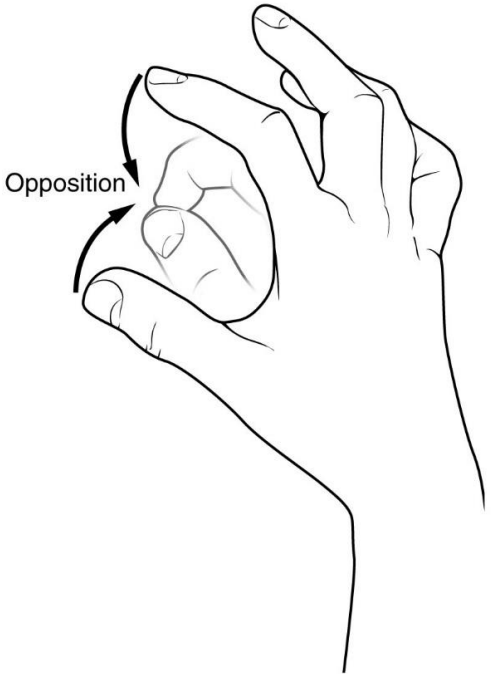


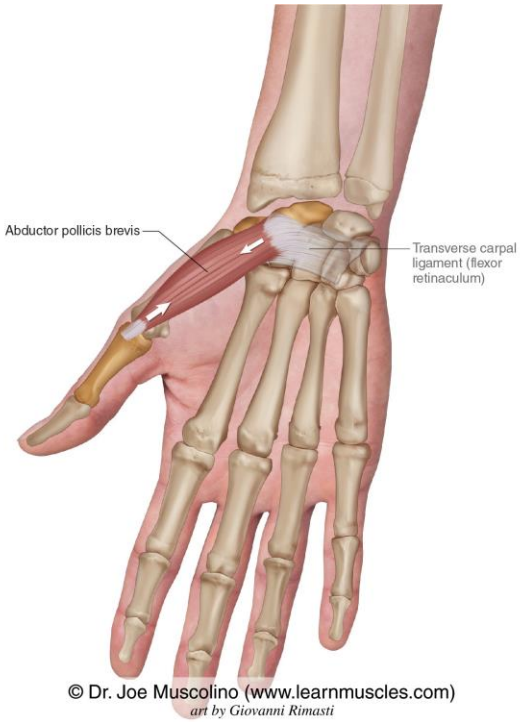
Motor examination of the hand

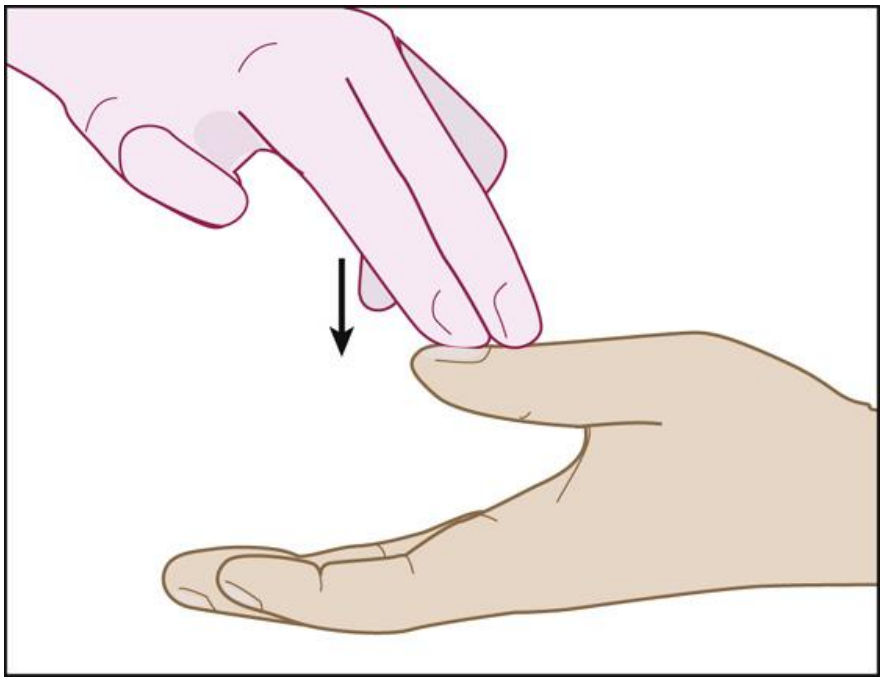


Median nerve

- Wasting of the thenar eminence
- Testing thumb abduction (abductor pollicis brevis): patient's palm up on a flat surface. Ask him to move the thumb vertically against your resistance
- Testing opposition (opponens pollicis): Ask him to touch the thumb and ring finger together while you attempt to pull them apart

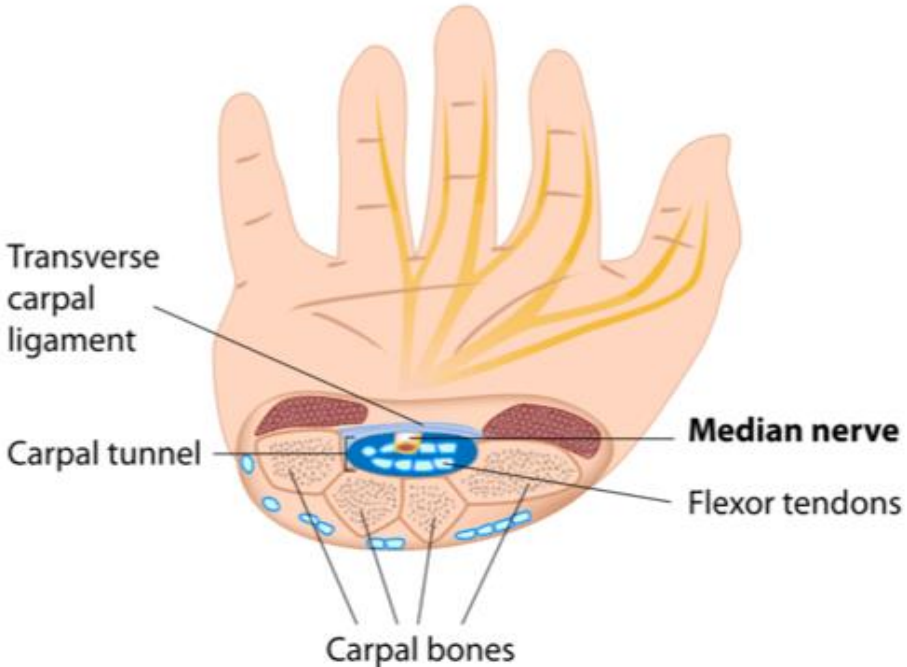






Carpal Tunnel Syndrome (CTS)

- It is the most common entrapment neuropathy
- This may be compressed as it passes between the flexor retinaculum and the carpal bones at the wrist
- Initially produces sensory symptoms

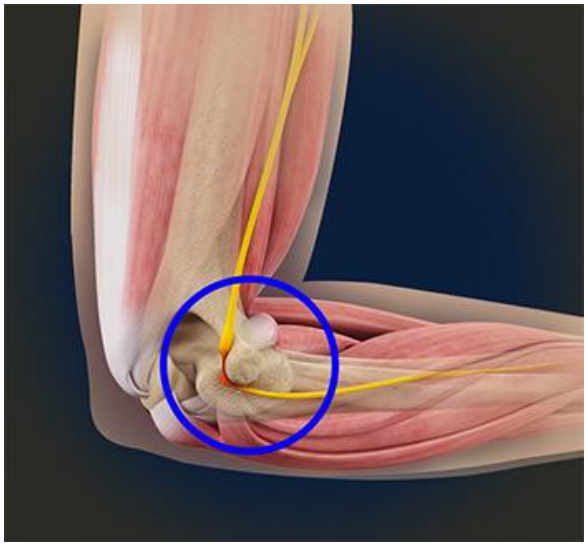


11.30 Common features of carpal tunnel syndrome

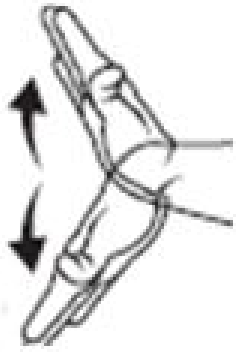
- More common in women
- Unpleasant tingling in the hand
- May not observe anatomical boundaries, radiating up the arm to the shoulder
- Weakness uncommon, but affects thumb abduction if occurs
- Symptoms commonly occur at night, wakening patient from sleep
- The patient may hang the hand and arm out of the bed for relief
- Thenar muscle wasting (in longstanding cases)
- Associated with pregnancy, diabetes and hypothyroidism

Ulnar nerve

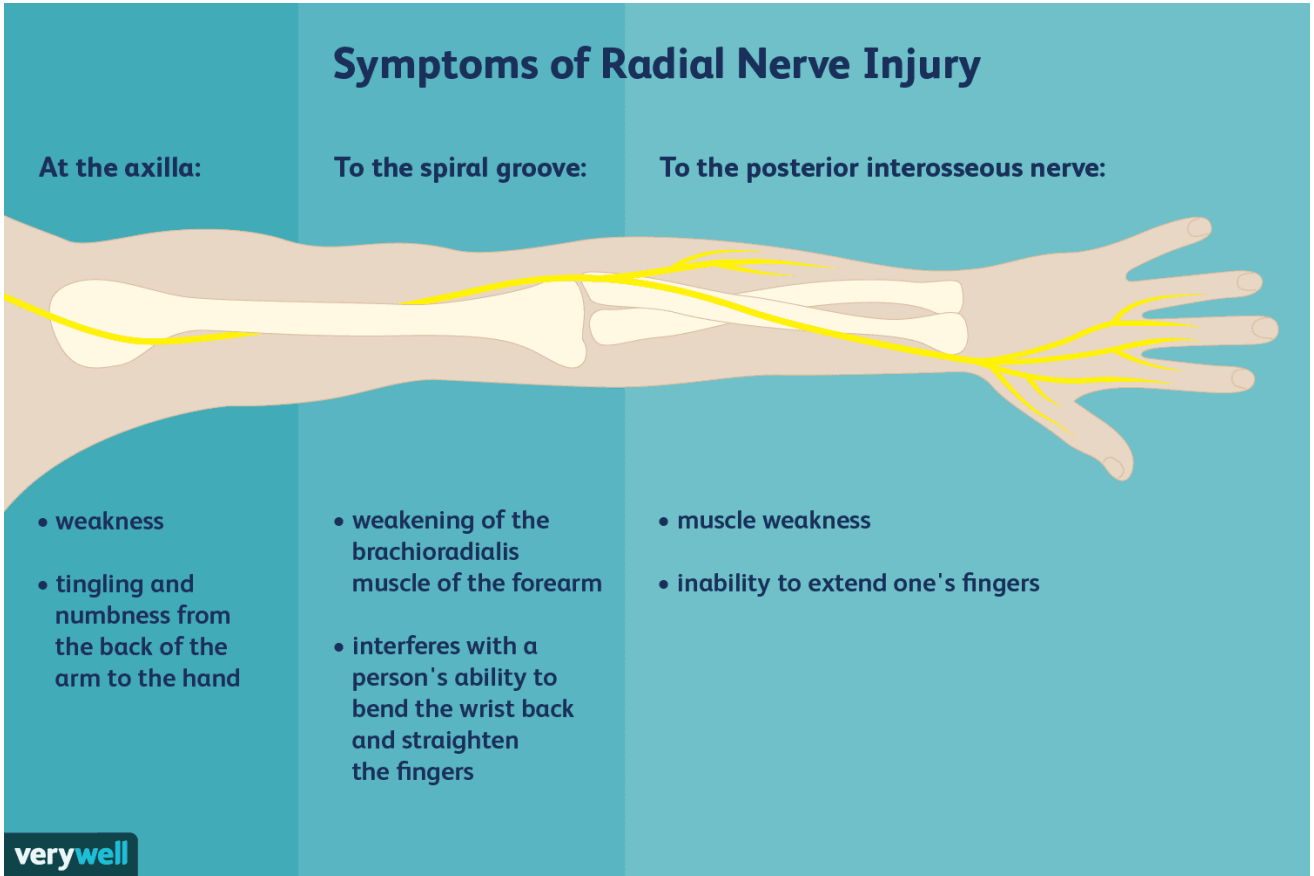
- Look for wasting of interossei (dorsal guttering).
- Fingers abduction: Patient's fingers on a flat surface and ask him to spread the fingers against resistance from your fingers.
- Fingers adduction: Placing a card between the patient's fingers and pulling it out using your own fingers.
- Examine the elbow (the commonest place of entrapment)
- Note any scars or other signs of trauma.
- feel for the nerve in the ulnar groove.



Radial nerve



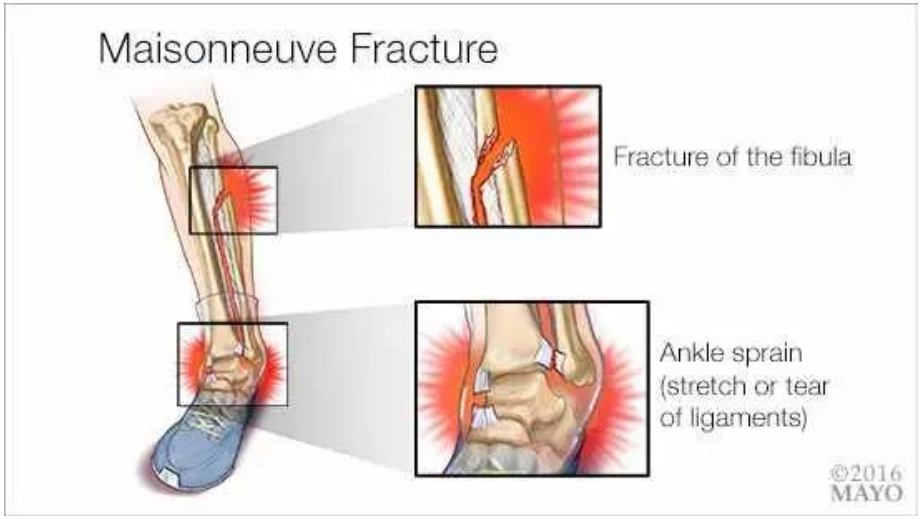
- Test for weakness of arm and forearm extensors (triceps, wrist, and fingers)
- Look for sensory loss over the dorsum of the hand
- loss of triceps tendon jerk.

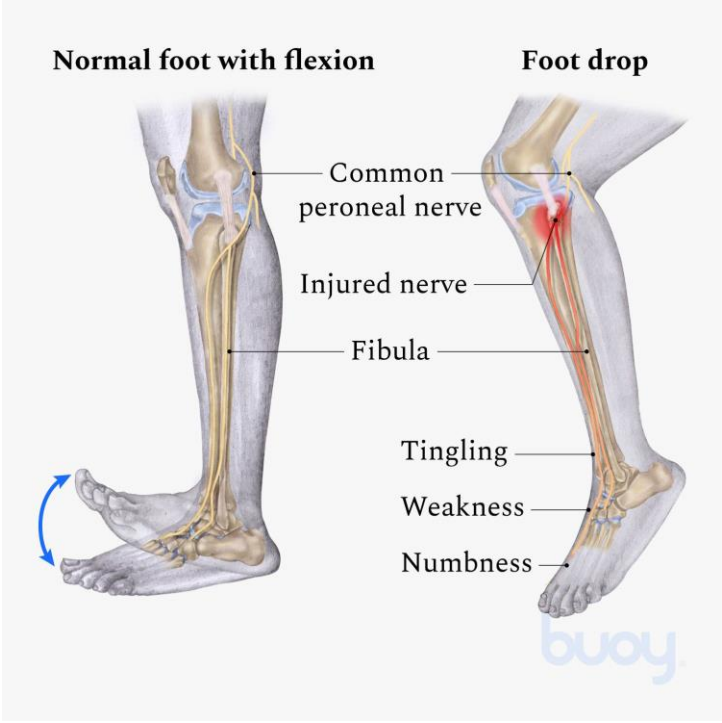


Common Peroneal Nerve

- This typically presents with foot drop.

- It may be damaged in fibular head fractures, or compressed particularly in immobile patients, or as a result of repetitive kneeling or squatting.

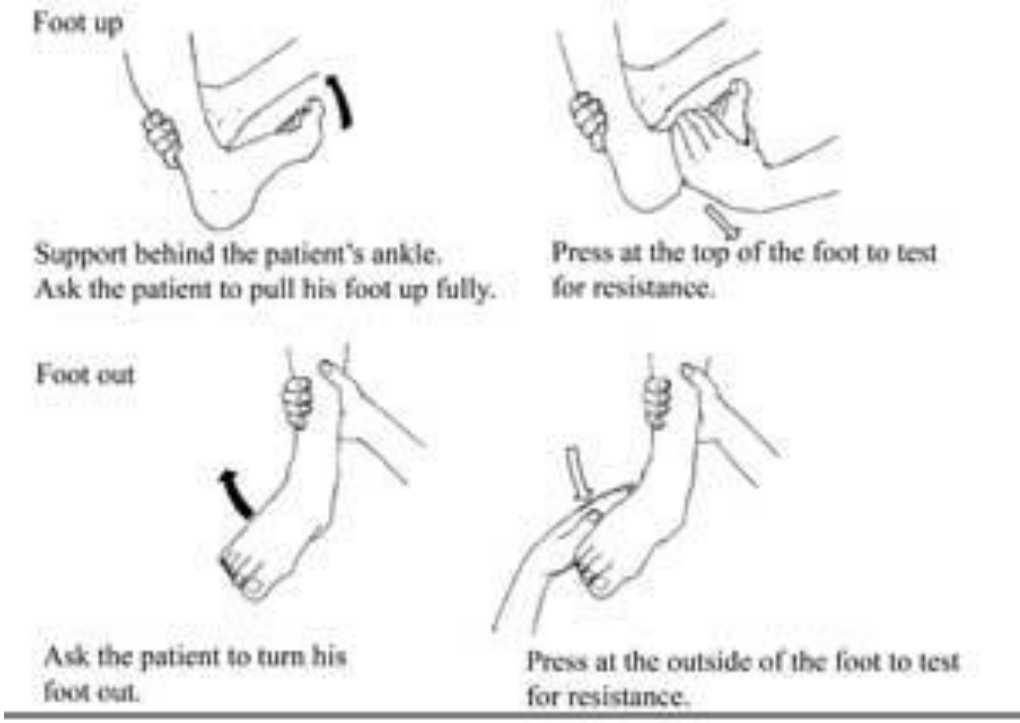


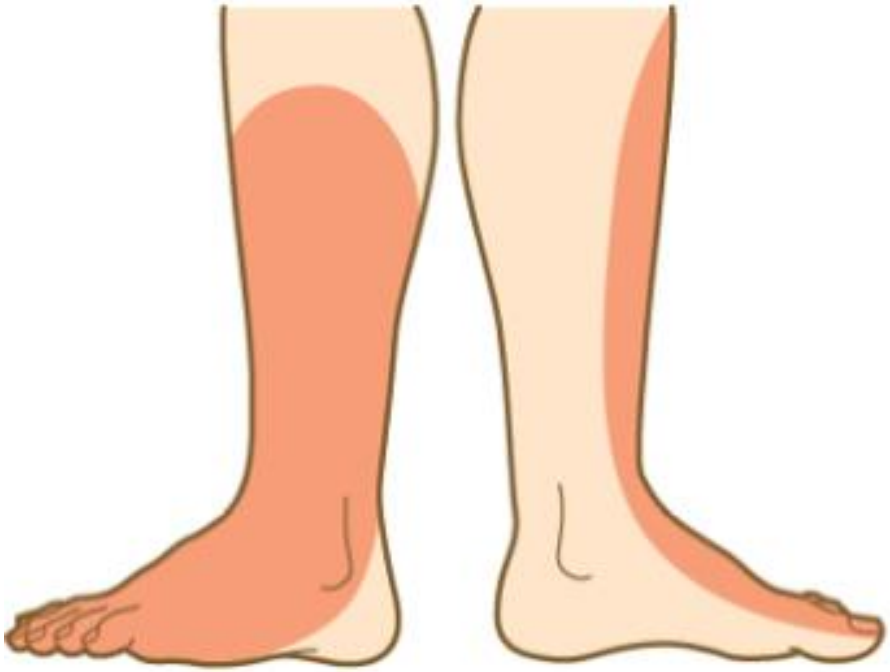


Examination

- Test for weakness of ankle dorsiflexion and eversion. Inversion will be preserved.

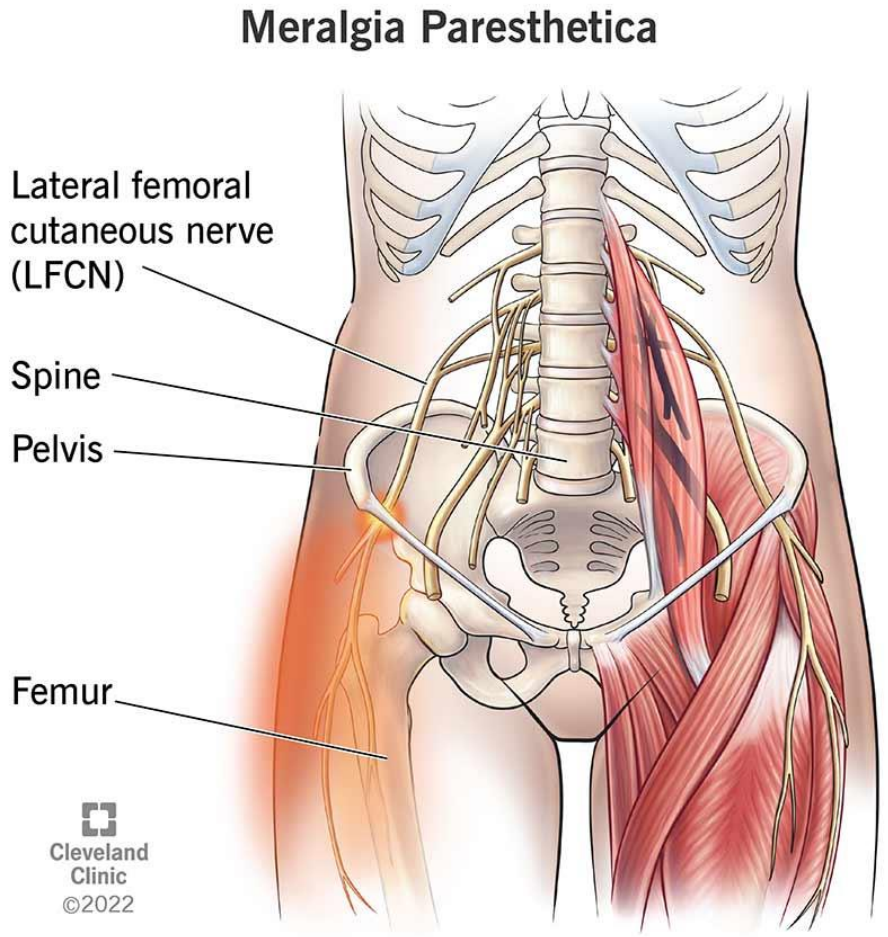
- Test for sensory loss over the dorsum of the foot

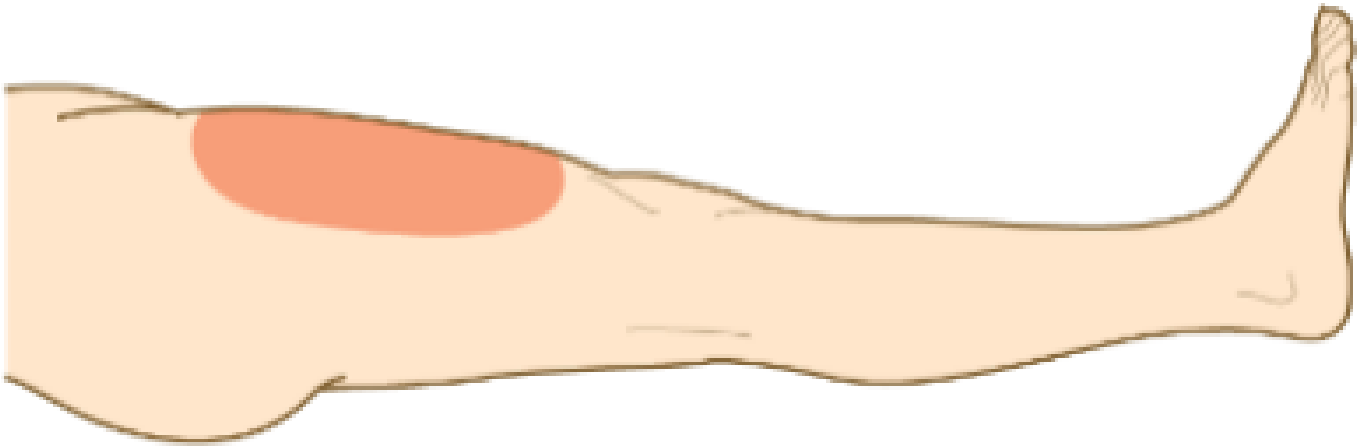




Lateral cutaneous nerve of thigh

- This purely sensory nerve may be compressed as it passes under the inguinal ligament, producing paraesthesia in the lateral thigh (meralgia paraesthetica





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