

NERVOUS SYSTEM

Physical Examination

Examination of the cranial nerves

CRANIAL NERVES

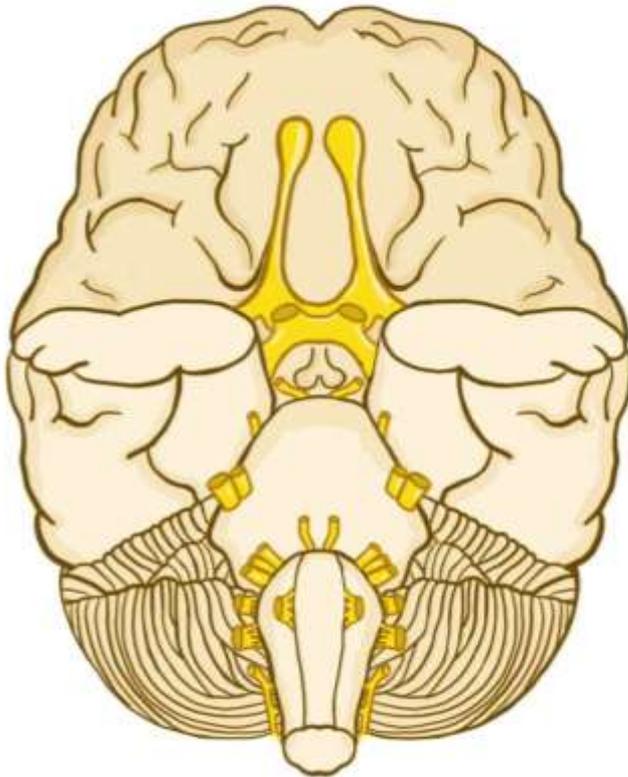
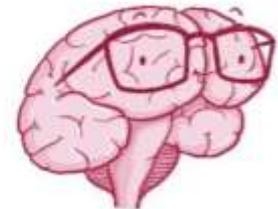
~ 12 PAIRS

↳ NUMBERED BASED ON ORDER THEY ARISE FROM NUCLEI IN THE BRAIN → EXIT THROUGH FORAMINA
(EXCEPT FOR XI & XII → INVERTED)

- (S) I - OLFACTORY
- (S) II - OPTIC
- (M) III - OCULOMOTOR
- (M) IV - TROCHLEAR
- (B) V - TRIGEMINAL
- (M) VI - ABDUCENS
- (B) VII - FACIAL
- (S) VIII - VESTIBULOCOCHLEAR
- (B) IX - GLOSSOPHARYNGEAL
- (B) X - VAGUS
- (M) XI - ACCESSORY
- (M) XII - HYPOGLOSSAL

"ON OLD OLYMPUS' TOWERING
TOP, A FINN VAN GERMAN
VIEWED A HOP"

"SOME SAY MARRY MONEY, BUT
MY BROTHER SAYS BIG BRAINS
MATTER MORE"



Examination of the cranial nerves

□ The Olfactory nerve

- You can ask patients if they think their sense of smell is normal, although self-reporting can be surprisingly inaccurate.
- Patients often note hypogeusia/ageusia (altered taste) with anosmia too, as taste is crucially influenced by the sense of smell.
- Check the nasal passages if they are clear.
- Ask the patient to differentiate between different known odors while the eyes are closed. 'Scratch and sniff' test cards.
- Examine each side.

The optic nerve

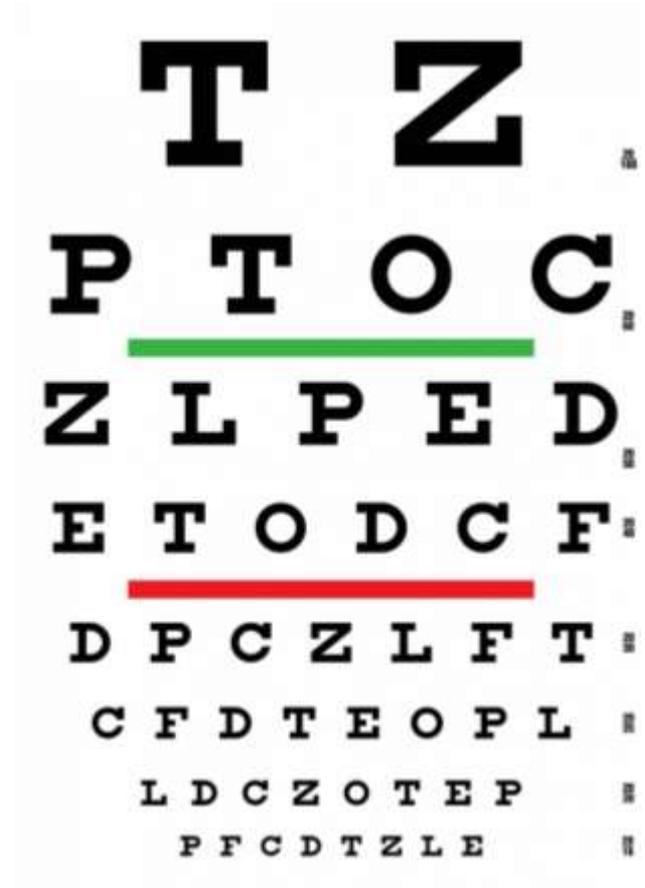
- Visual acuity: for the neurological exam, ask the patient to count fingers only.

Detailed examination of the eye is done by the ophthalmologist by special and proper instruments. However, you should inspect the for the following:

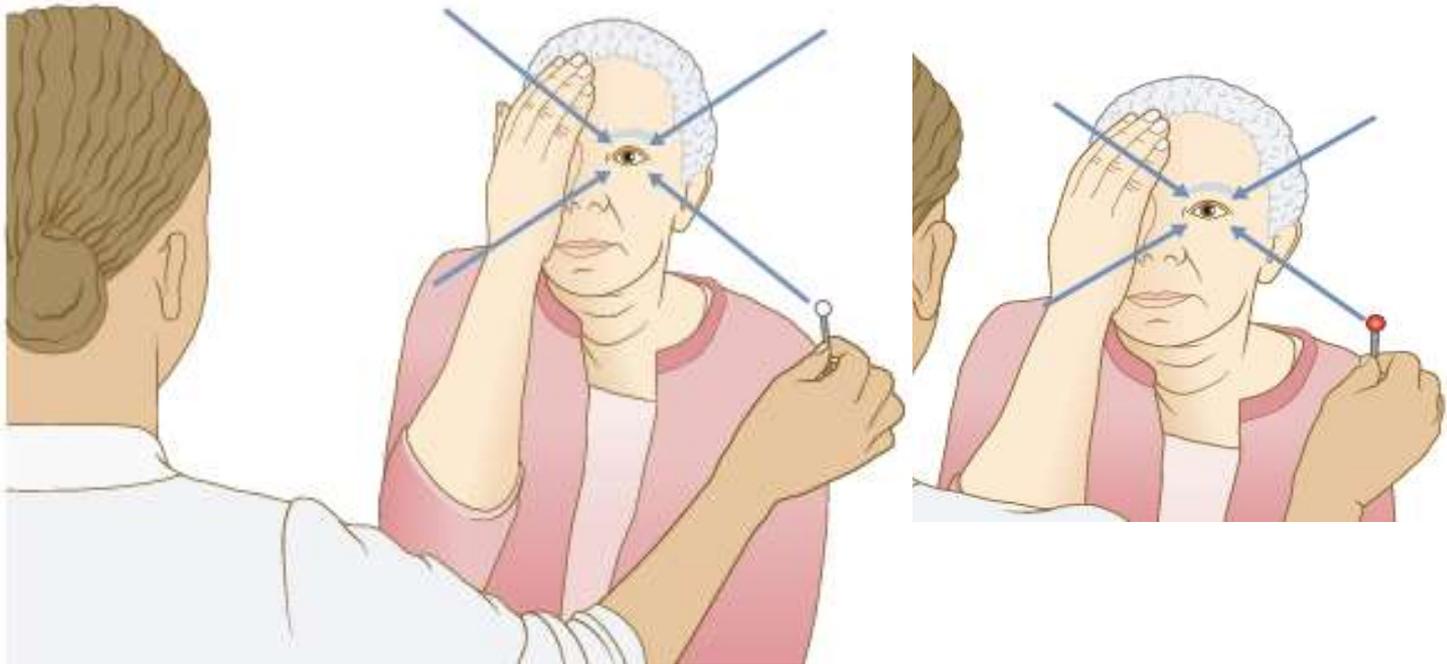
1. Visual Acuity
2. Colour vision
3. Visual fields
4. Pupillary reflex
5. Fundoscopy

The optic nerve

- For **acuity**, you can use Snellen or LogMar chart .



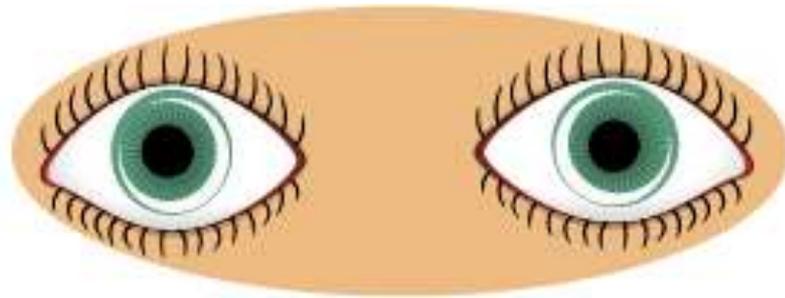
- The visual fields examination (homonymous defects, sensory inattention, peripheral visual fields, central visual field (red desaturation test), and the blind spot).



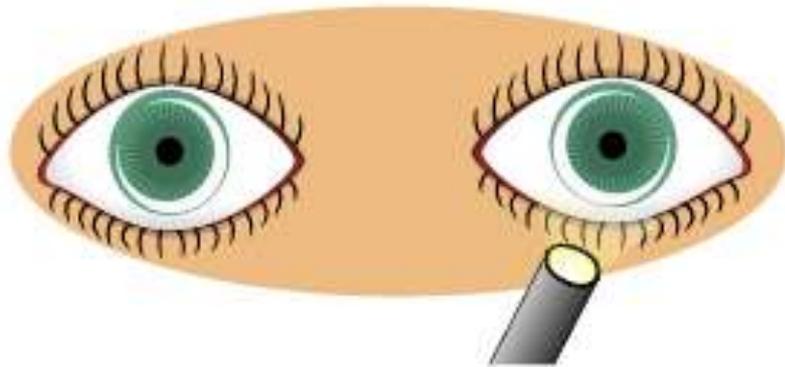
The optic nerve

- **Pupillary examination:**
 1. Direct light reflex
 2. Consensual light reflex
 3. Relative afferent pupillary defect (RAPD)
 4. Accommodation reflex.

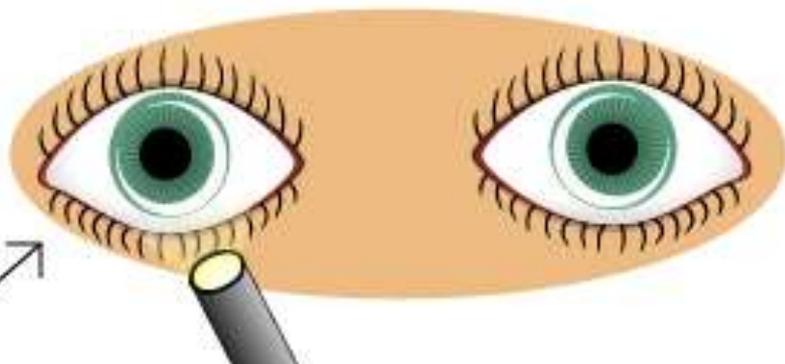
No Light



**Normal
Response
to Light**



**Positive
RAPD of
Right Eye** ↗



Optic nerve

- Accommodation (for optic and oculomotor nerves):

Ask the patient to focus on an object and gradually bring the object closer.

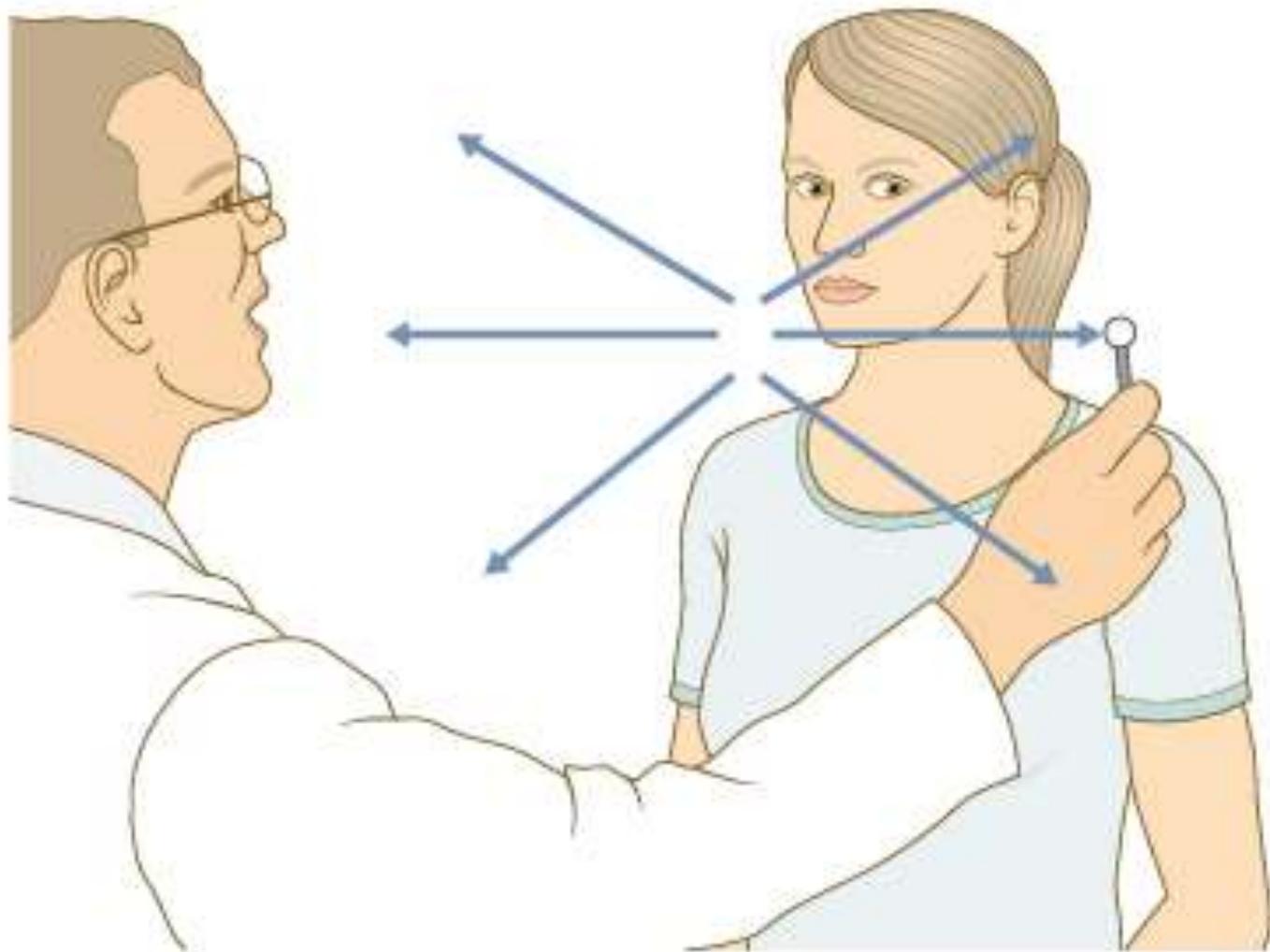
Accommodation: convergence, pupils constrict, lens convexity increases.

- Ophthalmoscopic examination:

The see the red reflex, optic disc (swelling, paleness, hemorrhage), and the macula.

Oculomotor nerve, trochlear, and abducens

- Look for ptosis
- Mydriasis
- On looking at the eyes, if the eye is depressed and abducted (third nerve palsy). If the eye elevated and adducted (fourth nerve palsy)
- Examine the gaze (Horizontal, vertical) for any ophthalmoplegia.
- Ask the patient if he sees double vision during the gaze examination
- Look for nystagmus during movement
- Pupillary reflex
- Accommodation reflex





A

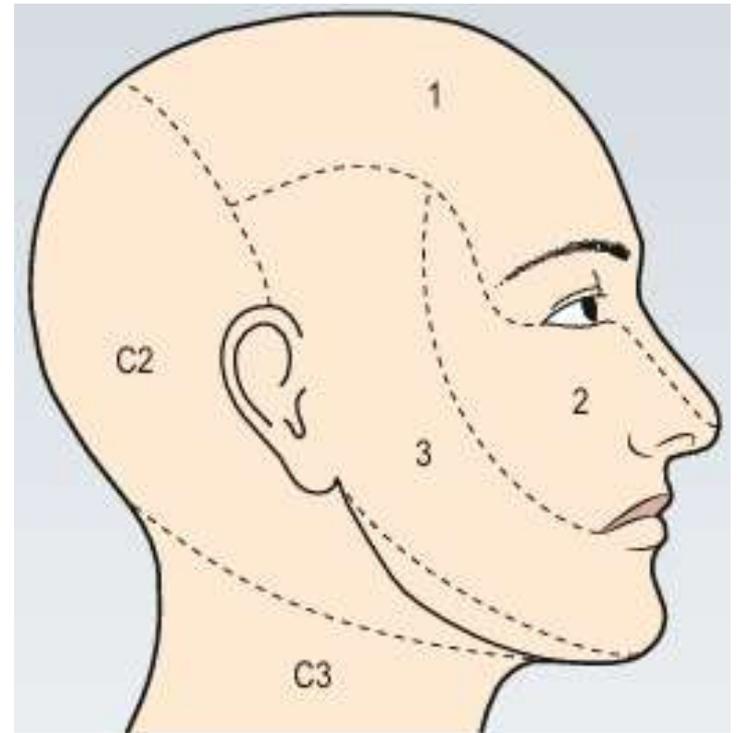


B

The trigeminal nerve

There are three major branches of V:

- Ophthalmic (V1): sensory
- Maxillary (V2): sensory
- Mandibular (V3): sensory and motor (provides motor supply to the muscles of mastication.)



The trigeminal nerve

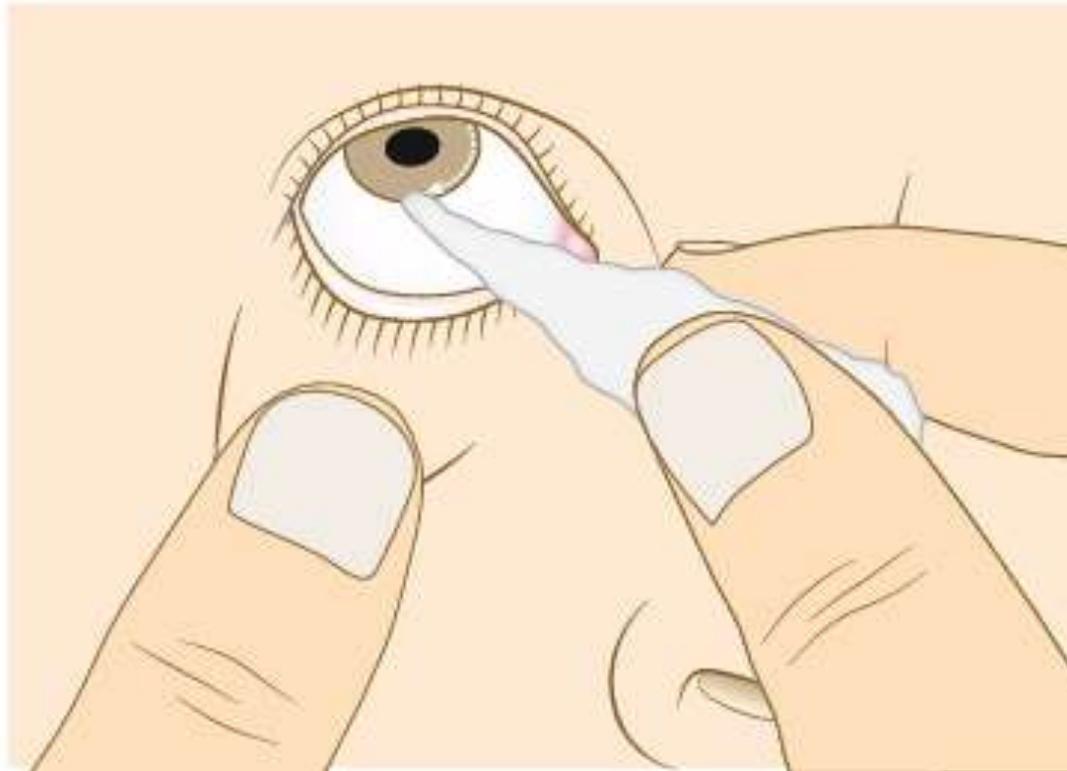
Sensory: examine the three divisions:

- Light touch
- Pain
- Crude touch, 'Nasal tickle' test.

Motor:

- Inspect for wasting of the muscles of mastication.
- Ask the patient to clench his teeth and feel the masseter. Ask the patient to open their jaw and note any deviation; the jaw may deviate to the paralysed side due to contraction of the intact contralateral pterygoid muscle.
- Corneal reflex
- Jaw jerk

Corneal reflex



Jaw jerk



The facial nerve

- First you should inspect for asymmetry, look at the nasolabial fold, differences in blinking or eye closure on one side.
- Watch for any involuntary movements.
- Inspect the ear for vesicles in case of facial shingles
- Ask the patient to wrinkle the forehead, raise their eyebrows (frontalis muscle).
- Ask the patient to screw their eyes tightly shut and resist you opening them (orbicularis oculi).
- Ask patient to show the teeth (orbicularis oris).
- Ask the patient to blow out their cheeks with their mouth closed (buccinators and orbicularis oris).
- You can examine for power

Facial nerve

- Taste examination:

By using a cotton buds dipped in different tastes, ask the patient to identify the taste when applied to the anterior 2/3 of the tongue.

Please try to differentiate between upper and lower motor neuron facial nerve lesion.

7.5 Comparison of bulbar and pseudobulbar palsy		
	Bulbar palsy	Pseudobulbar palsy
Level of motor Lesion	Lower motor neuron	Upper motor neuron
Speech	Dysarthria	Dysarthria and dysphonia
Swallowing	Dysphagia	Dysphagia
Tongue	Weak, wasted and fasciculating	Spastic, slow-moving
Jaw jerk	Absent	Present/brisk
Emotional lability	Absent	May be present
Causes	Motor neuron disease	Cerebrovascular disease, motor neuron disease, multiple sclerosis

Vestibulocochlear nerve

- **Hearing loss:**

Whispered voice test:

stand behind the patient and whisper at 15 cm on one ear while rubbing the tragus of the opposite ear ('masking'). Then repeat it at longer distance, if he can hear you whispering from 60 cm distance, then this is normal. Repeat it for the other side.

Weber's Test:

Put the tuning fork on the midline of the forehead and ask the patient where does he hear the sound?

Normally the sound would be expected to be heard in the middle, or equally in both ears; however, **up to 40% of people with normal hearing will lateralise on Weber's test.**

Pathologically, the sound would be heard in the middle when there is bilateral symmetrical hearing loss, if it is better on the right (lateralises to the right): right conductive hearing loss or left sensorineural hearing loss (same thing applies for the left side)



Rinne's Test:

Put the vibrating fork on the mastoid process of the ear, then after the patient can no longer hear it, place it near to his external auditory meatus, and ask if he still can hear it and which is better (when it was on the mastoid or when it is near the ear).

Normally, the patient should be able to hear it again when it is near the meatus (after it has been stopped being heard at the mastoid). This is a normal observation because **air conduction is better than bone conduction** and this is reported as positive Rinne's Test.



- The tuning fork will lateralise to the affected ear in conductive hearing loss before Rinne's test becomes abnormal (negative).
- A false-negative Rinne's test may occur if there is profound hearing loss on one side. This is due to sound being conducted through the bone of the skull to the other 'good' ear.

Weber and Rinne's Tests

9.5 Tuning fork tests		
	Weber's test	Rinne's test
Bilateral normal hearing	Central	AC > BC, bilateral
Bilateral symmetrical sensorineural loss	Central	AC > BC, bilateral
Unilateral or asymmetrical sensorineural loss LEFT	Louder right	AC > BC, bilateral ^a
Unilateral conductive loss LEFT	Louder left	BC > AC, left AC > BC, right
Bilateral conductive loss (worse on LEFT)	Louder left	BC > AC, bilateral
<p>^aPatients with a severe sensorineural loss may have BC > AC due to BC crossing to the other better-hearing cochlea that is not being tested (false-negative Rinne's test). AC, Air conduction; BC, bone conduction.</p>		

Weber and Rinne's Tests

	Weber without lateralization	Weber lateralizes left	Weber lateralizes right
Rinne both ears AC>BC	Normal/bilateral sensorineural loss	Sensorineural loss in right	Sensorineural loss in left
Rinne left BC>AC		Conductive loss in left	Combined loss: conductive and sensorineural loss in left
Rinne right BC>AC		Combined loss : conductive and sensorineural loss in right	Conductive loss in right
Rinne both ears BC>AC	Conductive loss in both ears	Combined loss in right and conductive loss on left or bilateral conductive loss; worse on left.	Combined loss in left and conductive loss on right or bilateral conductive loss; worse on right.

The Vestibulocochlear nerve

(Nystagmus)

- Nystagmus is an involuntary rhythmic oscillation of the eyes, which can be horizontal, vertical, rotatory or multidirectional.
- It may be continuous, paroxysmal, or evoked by manoeuvres such as gaze or head position. **It can be spontaneous or gaze evoked.**
- The most common form, ' **jerk nystagmus**', consists of alternating phases of a slow drift in one direction with a corrective saccadic ' **jerk**' in the opposite direction. The direction of the fast jerk is used to define the direction of nystagmus.
- **Pendular nystagmus**, in which there is a sinusoidal oscillation without a fast phase, is less common.
- Nystagmus may be caused by disorders of the vestibular, visual or cerebellar pathway. **Central nystagmus** is caused by lesions in the brain stem or cerebellum (not fatigable). **Peripheral nystagmus** is caused by lesions of the vestibular nerve or the semicircular canal (fatigable).

The Vestibulocochlear nerve (Nystagmus)

- Patients should be tested with spectacles or contact lenses for best corrected vision.
- With the patient seated, ask them to fixate on a stationary target in a neutral gaze position and observe for spontaneous nystagmus.
- Stand about 1 meter away from the patient, then move your finger from the midline upward, downward, left, and right. Wait for 5 seconds at each position.
- Avoiding extremes of gaze where physiological nystagmus may occur. Do not move more than 30 degrees from the Medline.

If any oscillations are present, note:

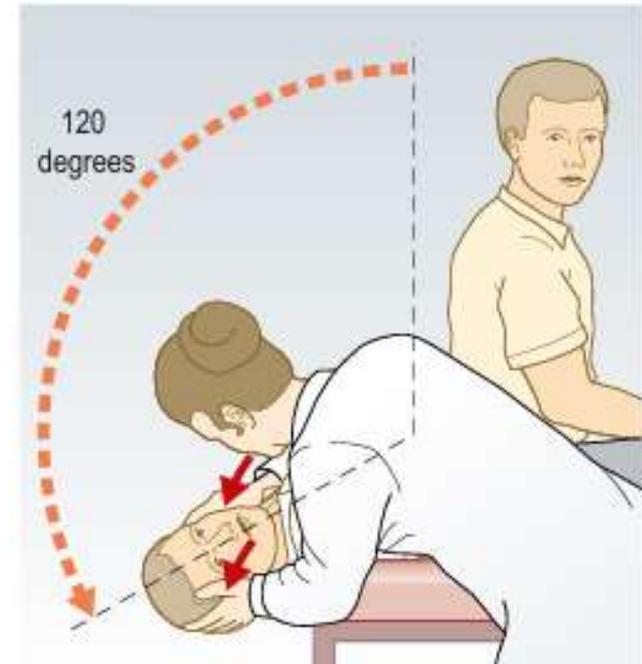
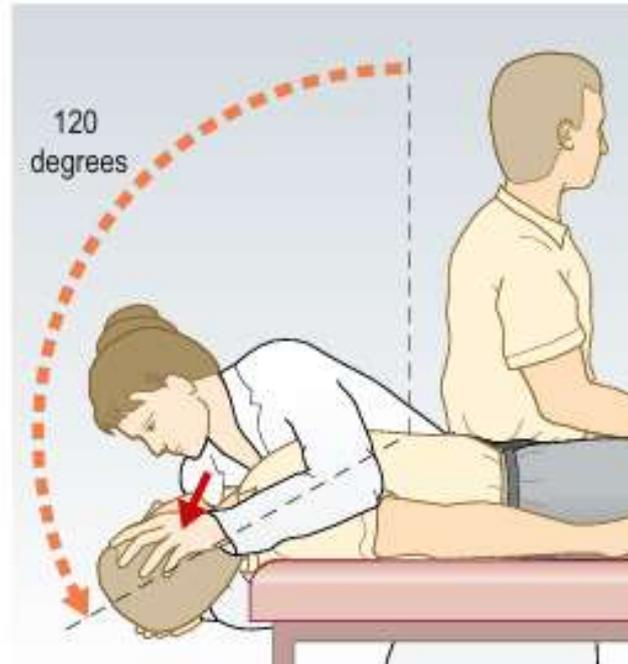
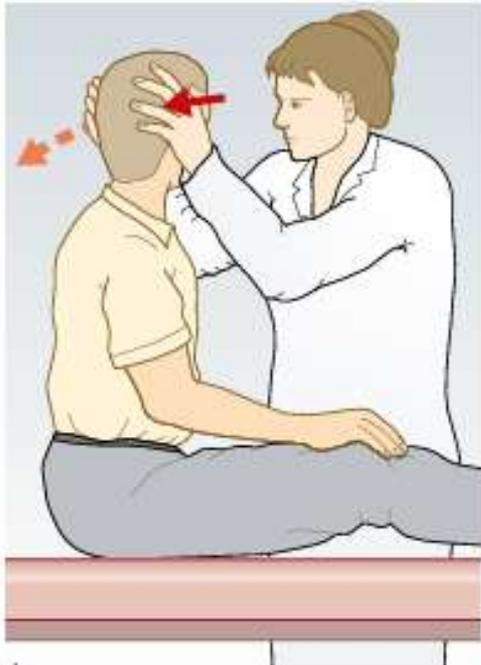
- whether they are horizontal, vertical or rotatory
- which direction of gaze causes the most marked nystagmus
- in which direction the fast phase of jerk nystagmus occurs

The Vestibulocochlear nerve testing for positional nystagmus

- **Dix-Hallpike positional test**

While the patient seated, ask him to turn the head 45 degrees to one side and rapidly lower him so that his head is lower than the body at the edge of the table. Wait 30 seconds to watch for Nystagmus in case of positional vertigo. Repeat the test on the other side.

Dix-Hallpike positional test



9.4 Characteristics of nystagmus

Nystagmus type	Clinical pathology	Characteristics	
		Fast phase	Maximal on looking
Jerk:			
Peripheral	Semicircular canal, vestibular nerve	Unidirectional Not suppressed by optic fixation Patient too dizzy to walk Dix–Hallpike fatigues on repetition	Away from affected side
Central	Brainstem, cerebellum	Bidirectional (changes with direction of gaze) Suppressed by optic fixation Patient can walk (even with nystagmus) Dix–Hallpike persists	To either side
Dysconjugate (ataxic)	Interconnections of III, IV and VI nerves (medial longitudinal bundle)	Typically affects the abducting eye	To either side
Pendular	Eyes, e.g., congenital blindness	No fast phase	Straight ahead

Physiological nystagmus

- Optokinetic
- End point
- Vestibular caloric test

Warm water: eyes contralateral, nystagmus ipsilateral

Cold water: eyes ipsilateral, nystagmus contralateral.

In comatose: No fast phase (correction)

Brain stem lesion: No eye movement and no nystagmus

The glossopharyngeal and vagus nerves

- The glossopharyngeal (IX) nerve mainly carries sensation from the pharynx and tonsils, and sensation and taste from the posterior one-third of the tongue. The IX nerve also supplies the carotid chemoreceptors.
- The vagus (X) nerve carries important sensory information but also innervates upper pharyngeal and laryngeal muscles.
- **The main functions of IX and X that can be tested clinically are swallowing, phonation/articulation and sensation from the pharynx/larynx.**
- In the thorax and abdomen, the vagus (X) nerve receives sensory fibres from the lungs and carries parasympathetic fibres to the lungs, heart and abdominal viscera.

The glossopharyngeal and vagus nerves

- Ask the patient to say AAH, look at the movements of the palate and uvula using a torch, and then to cough.
- Ask the patient to puff the cheeks out, while the lips are close. If air escape through the nose, then the palatal movement is weak. If air escaped from the mouth, then this is facial nerve.
- In fully conscious patients only, use the swallow test. Administer 3 teaspoons of water and observe for absent swallow, cough or delayed cough or change in voice quality after each teaspoon. If there are no problems, observe again while the patient swallows a glass of water.
- Examine both sides in gag reflex. (Testing pharyngeal sensation and the gag reflex is unpleasant and has poor predictive value for aspiration).

The accessory nerve

- Inspect the sternomastoid muscles and the trapezius.
- Ask the patient to shrug their shoulders, then apply down ward pressure with your hands to assess the power.
- Test power in the left sternomastoid by asking the patient to turn their head to the right while you provide resistance with your hand placed on the right side of the patient's chin. Reverse the procedure to check the right sternomastoid.
- Test both sternocleidomastoid muscles simultaneously by asking the patient to flex their neck. Apply your palm to the forehead as resistance.

The hypoglossal nerve

- Inspect the tongue for:
 - At rest: fasciculations, tremor (Parkinson) wasting or hypertrophy.
 - Asking them to put out their tongue: deviation (deviates to the affected side) or involuntary movement.
- Ask the patient to move the tongue quickly from side to side.
- Test power by asking the patient to push against the cheeks.

Examination of the motor system

- Inspection and palpation
- Assess the tone
- Reflexes
- Movement and power
- Co-ordination

Inspection

- Muscle Bulk
- Fasciculations
- Myoclonic jerks
- Tremor :
 1. **Physiological** (fine and fast, seen with anxiety, hyperthyroid, alcohol and caffeine excess, and as a side effect of Beta agonists)
 2. **Essential Tremor**: Fine and can be coarse in advanced cases. The most common pathological cause of tremor; it is typically symmetrical in the upper limbs and may involve the head and voice.
 3. **Action tremor**: coarse and violent. Can be seen in CVA and MS
 4. **Resting tremor** that is slow and coarse is typical of Parkinson
 5. **Intention tremor**: absent at rest and increases with movement. It is typical of cerebellum damage.

Assessment of the Tone

- Tone is the resistance felt by the examiner when moving a joint passively.
- Hypotonia (flaccid) or hypertonic (spastic)
- Rigidity :
 1. **Lead-pipe**: constant through the movement (parkinson without obvious tremor)
 2. **Cog-wheel rigidity**: when it is associated with tremor (parkinson with tremor)
 3. **Clasp-knife rigidity**: seen on attempting flexion of the limb in strokes, MS or any other type of UMNL.

Examination of tone

- The room should be warm.
- Ask the patient to lie supine on the examination couch and to relax and 'go floppy.' Enquire about **any pain or limitations** of movement before proceeding.
- Passively move the joints through full range of movement, try slow and fast movements.

- **Test for Ankle clonus.**

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

- **Myotonia.**

- Ask the patient to make a fist and then to relax and open their hand; watch for the speed of relaxation.
- Using the tendon hammer, percuss the belly of the thenar eminence; this may induce contraction of the muscles, causing the thumb to adduct, and you may witness dimpling of the muscle belly



Deep tendon reflexes

- Record the response as:
 - increased (++++)
 - normal (++)
 - decreased (+)
 - present only with reinforcement (+/-)
 - absent (0).
- Compare each reflex with the other side; check for symmetry of response.
- Use reinforcement whenever a reflex appears to be absent. For knee and ankle reflexes, ask the patient to interlock their fingers and pull one hand against the other. To reinforce upper limb reflexes, ask the patient to make a fist with the contralateral hand and squeeze tightly immediately before you strike the tendon.

Deep tendon reflexes

- Brachioradialis tendon reflex (The supinator reflex)
- Biceps tendon reflex
- Triceps tendon reflex
- Knee jerk
- Ankle jerk
- Hoffman reflex
- Finger jerk
- Jaw jerk

Biceps jerk C5



Supinator jerk C6



Triceps jerk C7



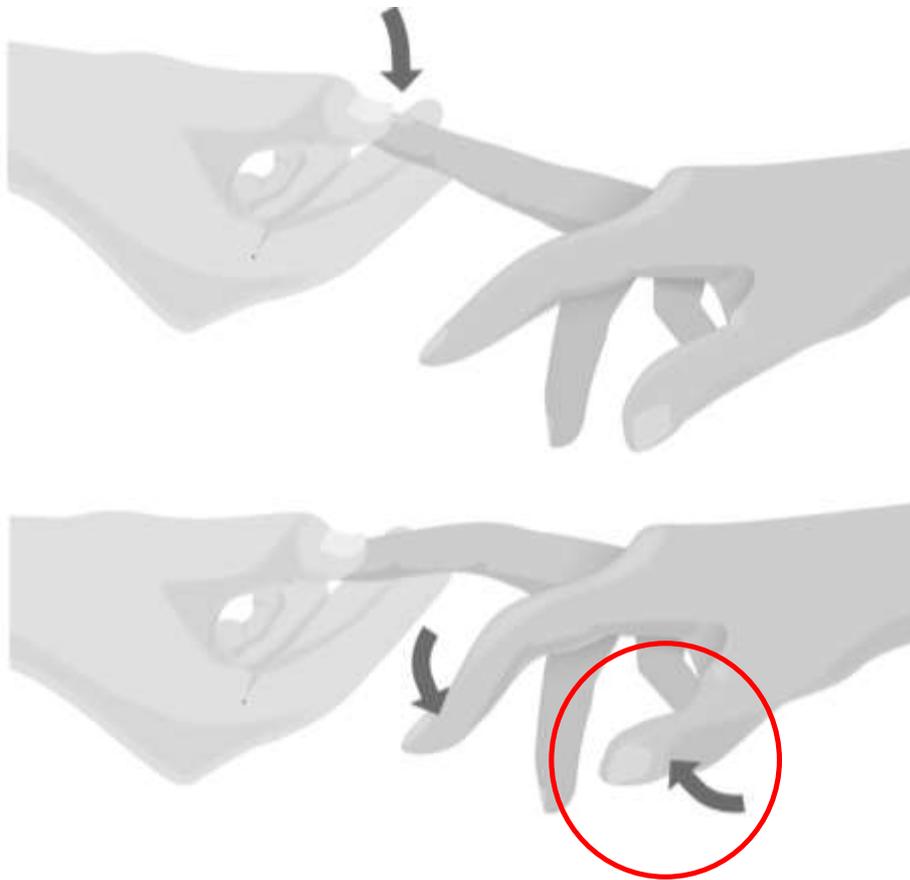
Knee jerk L3, L4



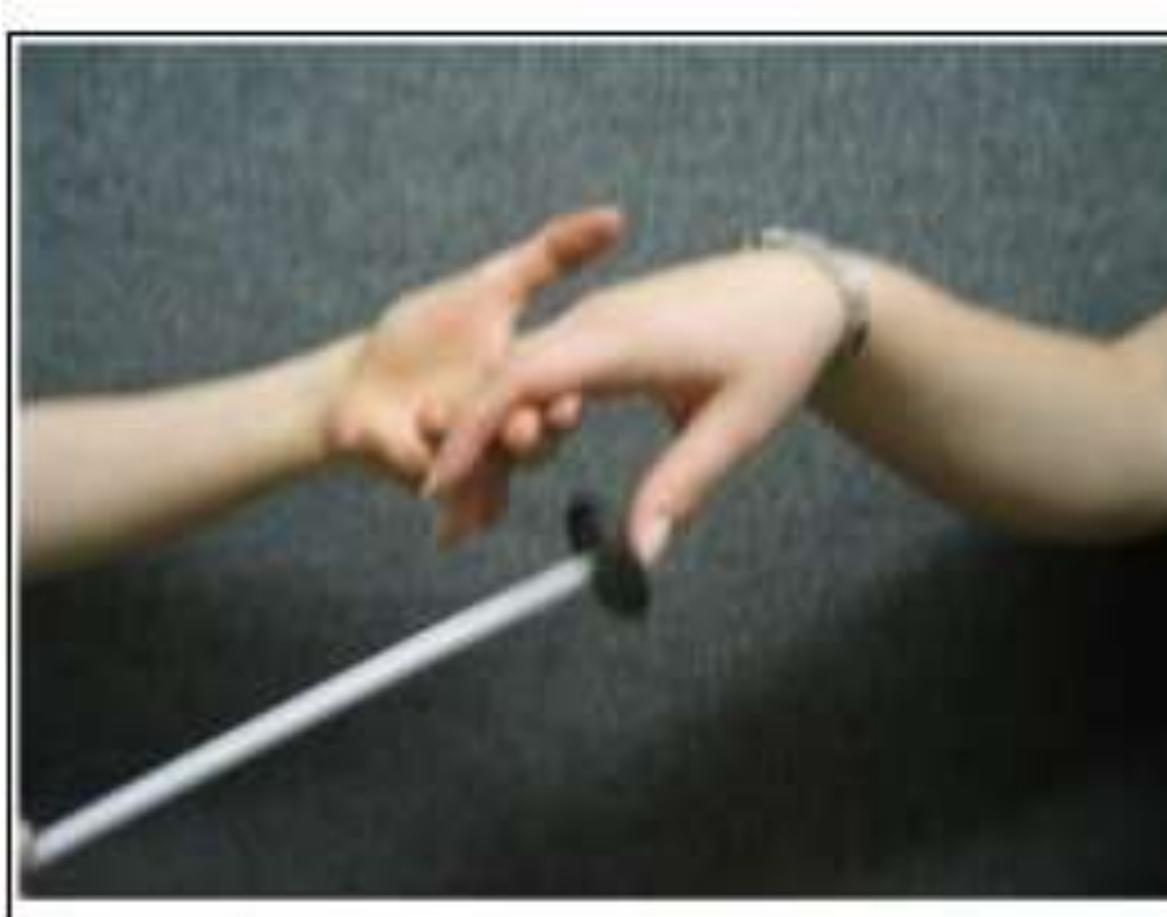
Ankle jerk, S1



Hoffman reflex



Finger jerk (C8)



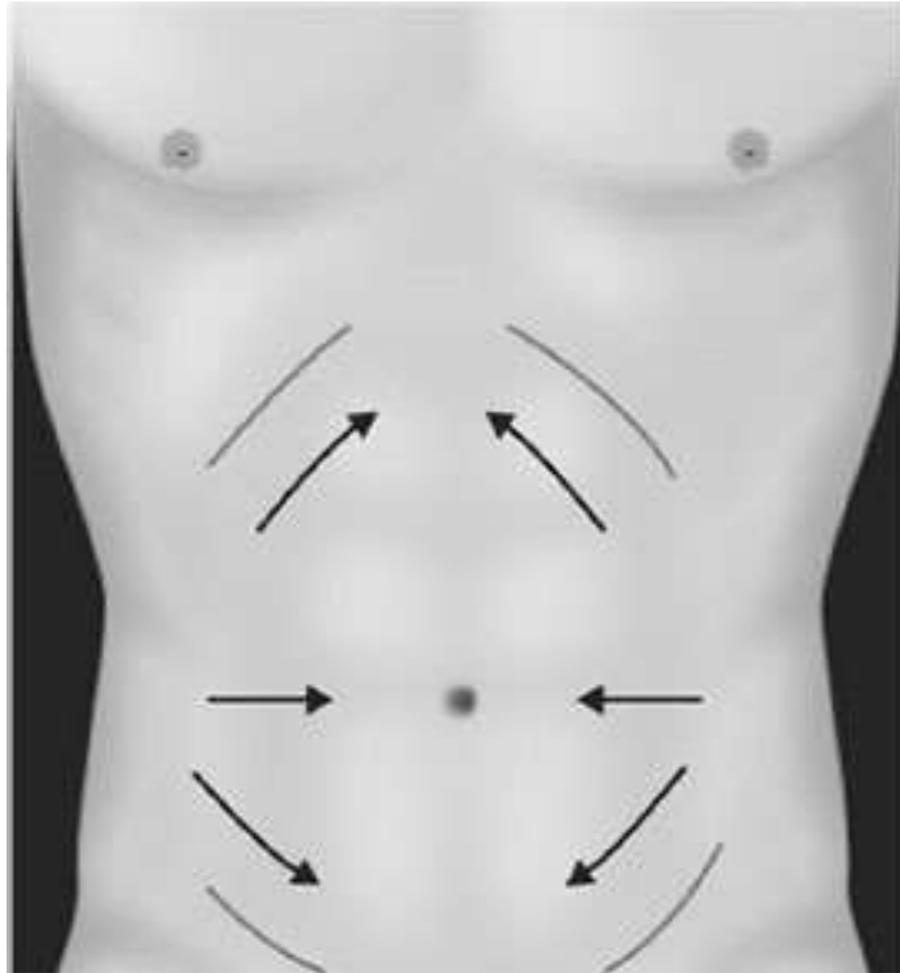
Superficial reflexes

- Plantar reflex (Bibinski sign)
- Abdominal reflex
- The cremasteric reflex

Plantar response (S1–2)



Abdominal reflexes (T8–12)



Power

- Make sure the patient is not in pain
 - You can examine the power of all muscles
 - Give it score from 0-5
- 0 No muscle contraction
 - 1 Fasciculations with no movement
 - 2 Movement when gravity is eliminated
 - 3 Movement against gravity but not against the resistance
 - 4 Movement against resistance but weaker than normal
 - 5 Normal

Power

- Ask about **pain** that might interfere with testing.
- Observe the patient getting up from a chair and walking.
- Ask the patient to lift their arms above their head.
- Ask them to 'play the piano.'
- Observe the patient with their arms outstretched and supinated (palms up) " pronator drift
- Ask the patient to undertake a movement. First assess whether they can overcome gravity. Then apply resistance to this movement, testing across a single joint.
- To test truncal strength, ask the patient to sit up from a lying position

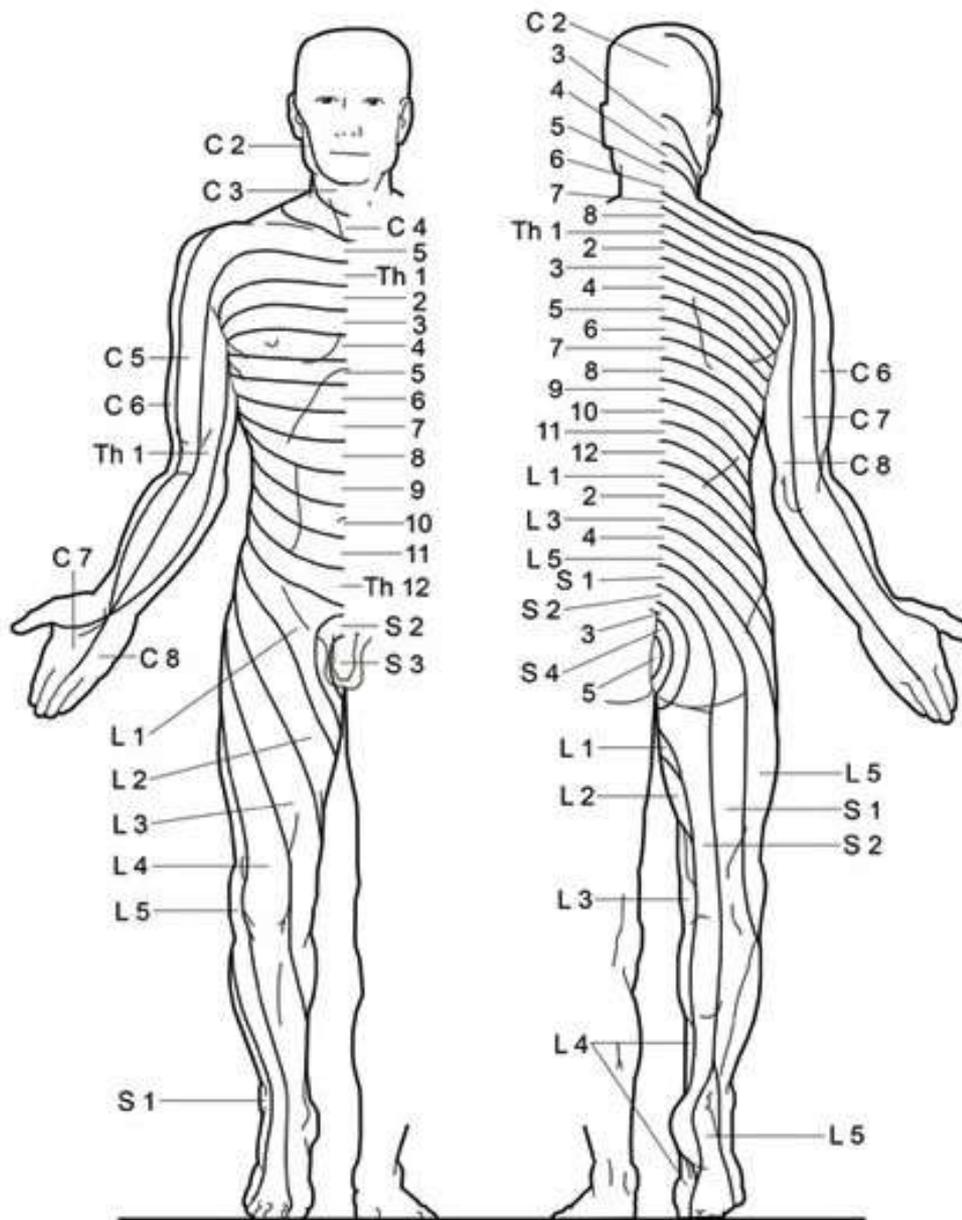
Coordination

- Stance and gait, including tandem gait (walking in a straight line, heel to toe)
- Eye movements (looking for nystagmus)
- Speech (dysarthria)
- Limb coordination.
- Finger nose test (dysmetria)
- Heel-shin test
- Rapid alternating movement (Dysdiadochokinesia)

Sensory modalities

- Touch
- Pain (superficial and deep)
- Temperature
- Vibration
- Joint position sense (proprioception)
- Two point discrimination
- Stereognosis, and graphesthesia
- Sensory inattention

Dermal Segmentation (Dermatomes)



Specific nerve lesions

Median nerve: carpal tunnel syndrome

- It is more common in women.
- The patient presents with parasthesia and pain of the hand associated with weakness.
- Symptoms may wake the patient at night.
- Thenar muscle wasting may be seen.

Specific nerve lesions

The radial nerve

- It may be injured at the shaft of the humerus.
- Please test for wrist drop and loss of sensation at the dorsum of the hand.

The ulnar nerve usually injured at the elbow .

- Please test for weakness in the abduction and adduction of the hand and loss of sensation on the ulnar side of the hand.

Specific nerve lesions

Lateral cutaneous nerve of the thigh

- It can be trapped at the inguinal ligament.
- It causes meralgia paraesthetica, in which paraesthesia affects the area on the lateral aspect of the thigh.
- It is related to obesity and pregnancy.

Specific nerve lesions

Common peroneal nerve

- Relate to the fracture or trauma of the head of the fibula
- It results in foot drop.
- Test for loss of dorsiflexion, and eversion.
- Test also for loss of sensation over the dorsum of the foot and the lateral aspect of the leg.