

# Neurologic Examination

Professor Yasser Metwally

[www.yassermetwally.com](http://www.yassermetwally.com)

**INDEX** [Click to view my video channel](#) [www.yassermetwally.info](http://www.yassermetwally.info)

- [Equipment Needed](#) [Click to view important online video clips](#)
- [General Considerations](#)
- [Mental Status](#)
- [Cranial Nerves](#)
- [Observation](#)
  - [I - Olfactory](#)
  - [II - Optic](#)
  - [III - Oculomotor](#)
  - [IV - Trochlear](#)
  - [V - Trigeminal](#)
  - [VI - Abducens](#)
  - [VII - Facial](#)
  - [VIII - Acoustic](#)
  - [IX - Glossopharyngeal](#)
  - [X - Vagus](#)
  - [XI - Accessory](#)
  - [XII - Hypoglossal](#)
- [Motor](#)
  - [Observation](#)
  - [Muscle Tone](#)
  - [Muscle Strength](#)
  - [Pronator Drift](#)
- [Coordination and Gait](#)
  - [Rapid Alternating Movements](#)
  - [Point-to-Point Movements](#)
  - [Romberg](#)
  - [Gait](#)
- [Reflexes](#)
  - [Deep Tendon Reflexes](#)
  - [Clonus](#)
  - [Plantar Response \(Babinski\)](#)
- [Sensory](#)
  - [General](#)
  - [Vibration](#)
  - [Subjective Light Touch](#)
  - [Position Sense](#)
  - [Dermatomal Testing](#)
  - [Pain](#)
  - [Temperature](#)
  - [Light Touch](#)
  - [Discrimination](#)
- [Meningeal signs](#)
- [Decerebrate & Decorticate posturing](#)
- [Notes](#)

[Click to download the publication " CNS examination" in PDF format](#)



## Equipment Needed

### Equipment Needed

- Reflex Hammer
- 128 and 512 (or 1024) Hz Tuning Forks
- A Snellen Eye Chart or Pocket Vision Card
- Pen Light or Otoscope
- Wooden Handled Cotton Swabs
- Paper Clips

## General Considerations

- Always consider left to right symmetry
- Consider central vs. peripheral deficits
- Organize your thinking into seven categories:
  1. Mental Status
  2. Cranial Nerves
  3. Motor
  4. Coordination and Gait
  5. Reflexes
  6. Sensory
  7. Special Tests

## Mental Status

The [Mini Mental Status Examination](#) is a useful screening tool.

## Cranial Nerves

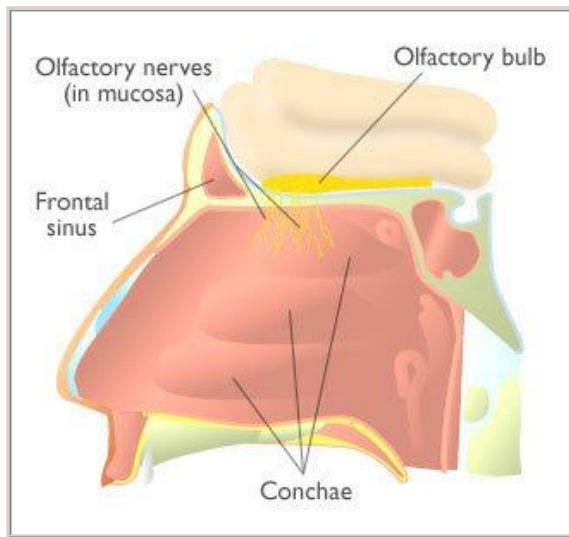
### Observation

- Ptosis (III)
- Facial Droop or Asymmetry (VII)
- Hoarse Voice (X)
- Articulation of Words (V, VII, X, XII)
- Abnormal Eye Position (III, IV, VI)
- Abnormal or Asymmetrical Pupils (II, III)

### I - Olfactory [1]

Evaluate the patency of the nasal passages bilaterally by asking the patient to breath in through their nose while the examiner occludes one nostril at a time. Once patency is established, ask the patient to close their eyes. Occlude one nostril, and place a small bar of soap near the patent nostril and ask the patient to smell the object and report what it is. Making certain the patient's eyes remain closed. Switch nostrils and repeat. Furthermore, ask the patient to compare the strength of the smell in each nostril.





The olfactory nerve is part of our ability to smell. Loss of the sense of smell is called anosmia. Most patients with anosmia can still smell harsher smells (sweet and sour) but have difficulty with flavors like cinnamon and peppermint. Patients with anosmia often complain that they've lost their sense of taste. Much of the pleasure derived from eating is due to smell, not taste (think of sniffing a glass of fine wine before drinking it). There are many causes for anosmia:

1. Trauma
2. Surgery
3. Masses affecting the orbitofrontal region or cribriform plate
4. Destruction of the neuroepithelium due to inflammation, as in chronic rhinitis or viral infection

## II - Optic

- Examine the Optic Fundi
- Test Visual Acuity
  1. Allow the patient to use their glasses or contact lens if available. You are interested in the patient's best corrected vision.
  2. Position the patient 20 feet in front of the Snellen eye chart (or hold a Rosenbaum pocket card at a 14 inch "reading" distance).
  3. Have the patient cover one eye at a time with a card.
  4. Ask the patient to read progressively smaller letters until they can go no further.
  5. Record the smallest line the patient read successfully (20/20, 20/30, etc.) [2]
  6. Repeat with the other eye.
- Screen Visual Fields by Confrontation
  1. Stand two feet in front of the patient and have them look into your eyes.
  2. Hold your hands about one foot away from the patient's ears, and wiggle a finger on one hand. [3]
  3. Ask the patient to indicate which side they see the finger move.
  4. Repeat two or three times to test both temporal fields.
  5. If an abnormality is suspected, test the four quadrants of each eye while asking the patient to cover the opposite eye with a card. ++ [4]
- Test Pupillary Reactions to Light
  1. Dim the room lights as necessary.
  2. Ask the patient to look into the distance.
  3. Shine a bright light obliquely into each pupil in turn.
  4. Look for both the direct (same eye) and consensual (other eye) reactions.
  5. Record pupil size in mm and any asymmetry or irregularity.
  6. If abnormal, proceed with the test for accommodation.
- Test Pupillary Reactions to Accommodation [5] ++
  1. Hold your finger about 10cm from the patient's nose.
  2. Ask them to alternate looking into the distance and at your finger.
  3. Observe the pupillary response in each eye.



Figure 1. Examination of the light reflex

## III - Oculomotor (Click for an online video clip) (Click for an online video clip)

- Observe for Ptosis

- Test Extraocular Movements
  1. Stand or sit 3 to 6 feet in front of the patient.
  2. Ask the patient to follow your finger with their eyes without moving their head.
  3. Check gaze in the six cardinal directions using a cross or "H" pattern.
  4. Pause during upward and lateral gaze to check for [nystagmus](#). [6]
  5. Check convergence by moving your finger toward the bridge of the patient's nose.
- Test Pupillary Reactions to Light ([See Above](#))

### Examination of ocular motility

1. Observe for ptosis.
2. Test Extraocular Movements

Stand or sit 3 to 6 feet in front of the patient. Ask the patient to follow your finger with their eyes without moving their head. Check gaze in the six cardinal directions using a cross or "H" pattern. Pause during upward and lateral gaze to check for nystagmus.

1. Check convergence by moving your finger toward the bridge of the patient's nose.



## IV - Trochlear

Test Extraocular Movements (Inward and Down Movement, [See Above](#))

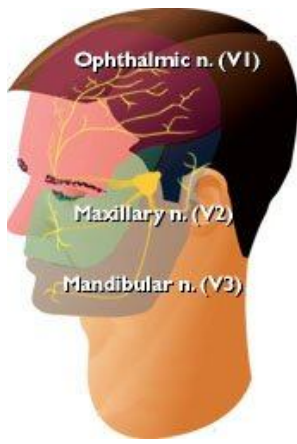
## V - Trigeminal [\(Click for an online video\)](#)

- Test Temporal and Masseter Muscle Strength
  1. Ask patient to both open their mouth and clench their teeth.
  2. Palpate the temporal and masseter muscles as they do this.
- Test the Three Divisions for Pain Sensation
  1. Explain what you intend to do.
  2. Use a suitable sharp object to test the forehead, cheeks, and jaw on both sides. [7]
  3. Substitute a blunt object occasionally and ask the patient to report "sharp" or "dull."
- If you find an abnormality then:
  1. Test the three divisions for temperature sensation with a tuning fork heated or cooled by water. ++
  2. Test the three divisions for sensation to light touch using a wisp of cotton. ++
- Test the Corneal Reflex ++
  1. Ask the patient to look up and away.
  2. From the other side, touch the cornea lightly with a fine wisp of cotton.
  3. Look for the normal blink reaction of **both** eyes.
  4. Repeat on the other side.
  5. Use of contact lens may decrease this response.



### Examination of the motor part of the trigeminal nerve

1. Test Temporalis and Masseter Muscle Strength
2. Ask the patient to open their mouth and clench their teeth.
3. Palpate the temporalis and masseter muscles as they do this.



**Figure 2. Examination of the sensory part of the trigeminal nerve**

**Table 1. Examination of the sensory part of the trigeminal nerve**

- **Test the Three Divisions for Pain Sensation**

- Explain what you intend to do then ask the patient to close their eyes.
- Use a clean, slightly sharp, disposable object to test the forehead, cheeks, and jaw on both sides.
- Substitute a blunt object (cotton swab) occasionally and ask the patient to report "sharp" or "dull."
- The ophthalmic, maxillary, and mandibular divisions of the fifth cranial nerve are usually denoted as V1, V2, and V3.
- Test for Temperature and Light Touch
- If an abnormality is suspected, proceed with more detailed testing.
- Test the three divisions for temperature sensation with a tuning fork heated or cooled by water.
- Test the three divisions for sensation to light touch using a wisp of cotton.

- **Test the Corneal Reflex**

- The Corneal Reflex is not necessary unless an abnormality of the trigeminal (V) or facial (VII) nerve is suspected.
- Remove contact lenses, if present, as these may decrease this response.
- Ask the patient to look up and away.
- From the other side, touch the cornea lightly with a fine wisp of cotton.
- Look for the normal blink reaction of both eyes.
- Repeat on the other side.

## VI - Abducens [Click for online video](#)

Test Extraocular Movements (Lateral Movement, [See Above](#))

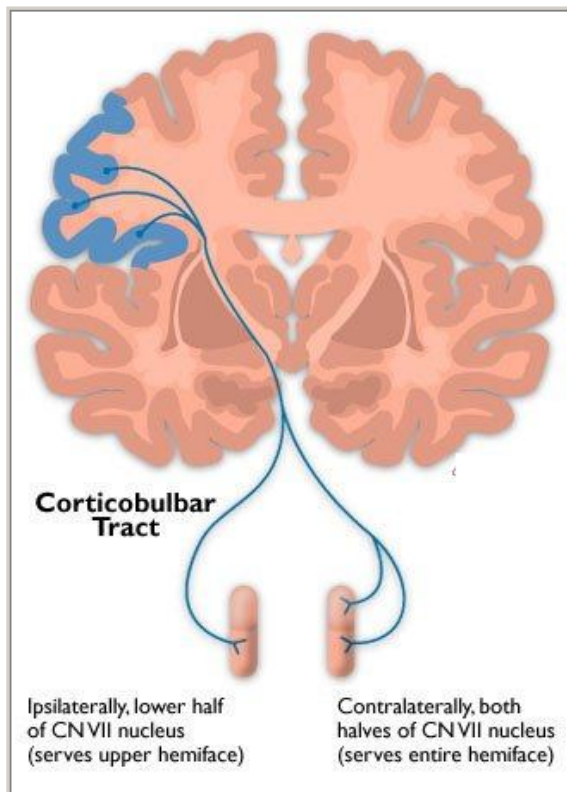
## VII - Facial [Click for the online topic "examination of the facial nerve"](#)

- Observe for Any Facial Droop or Asymmetry
- Ask Patient to do the following, note any lag, weakness, or asymmetry:
  1. Raise eyebrows [8]
  2. Close both eyes to resistance
  3. Smile

4. Frown
  5. Show teeth
  6. Puff out cheeks
- Test the Corneal Reflex ([See Above](#)) ++



**Figure 3. A, Examination of the facial nerve. B,C, Facial palsy**



**Figure 4. Intracranial facial nerve connection**

**Table 2. Principle of facial nerve examination**

Observe for any facial droop or asymmetry.

Ask the patient to do a few of the following. (It is not necessary to do them all.):

- Raise eyebrows
- Close both eyes to resistance
- Smile
- Frown
- Show teeth

- Puff out cheeks
- Note any lag, weakness, or asymmetry.
- Test the Corneal Reflex

The Corneal Reflex is not necessary unless an abnormality of the trigeminal (V) or facial (VII) nerve is suspected. Tease out a fine wisp from the end of a cotton ball or swab. Warn the conscious patient what you are about to do. If necessary, hold the patient's eyelid open to expose the cornea. Touch the cornea with the wisp by approaching from the side and avoiding the area of central vision. The patient should spontaneously shut both eyes in response to corneal stimulation. This is a monosynaptic reflex between the sensation to the cornea provided by the ophthalmic nerve (V1) and the muscles of the eyelids, innervated by the facial nerve (VII).

With CN VII recall that the type of finding relates to the presence of a central versus a peripheral nervous system lesion. With a unilateral central nervous system lesion (e.g., stroke), recall this would involve the corticobulbar pathway. Function is preserved over the upper part of the face (forehead, eyebrow, eyelid). If the lesion involves the peripheral seventh nerve (Bell's palsy), the entire face is involved.

## VIII - Acoustic

- Screen Hearing [9]
  1. Face the patient and hold out your arms with your fingers near each ear.
  2. Rub your fingers together on one side while moving the fingers noiselessly on the other.
  3. Ask the patient to tell you when and on which side they hear the rubbing.
  4. Increase intensity as needed and note any asymmetry.
  5. If abnormal, proceed with the Weber and Rinne tests.
- Test for Lateralization (Weber) ++
  1. Use a 512 Hz or 1024 Hz tuning fork.
  2. Start the fork vibrating by tapping it on your opposite hand.
  3. Place the base of the tuning fork firmly on top of the patient's head.
  4. Ask the patient where the sound appears to be coming from (normally in the midline).
- Compare Air and Bone Conduction (Rinne) ++
  1. Use a 512 Hz or 1024 Hz tuning fork.
  2. Start the fork vibrating by tapping it on your opposite hand.
  3. Place the base of the tuning fork against the mastoid bone behind the ear.
  4. When the patient no longer hears the sound, hold the end of the fork near the patient's ear (air conduction is normally greater than bone conduction).
- Vestibular Function: Use the past pointing test

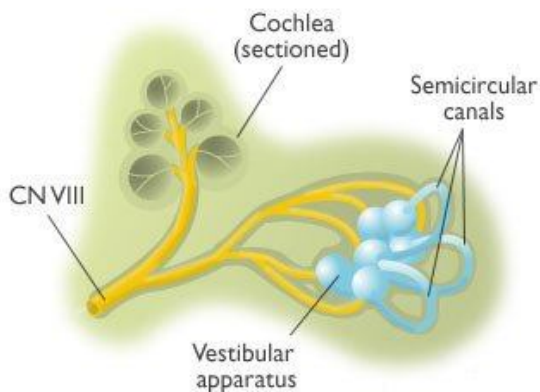


Figure 5. Examination of the acoustic nerve

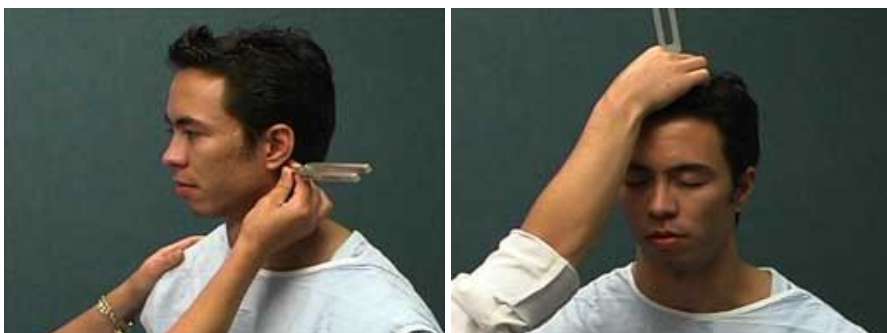


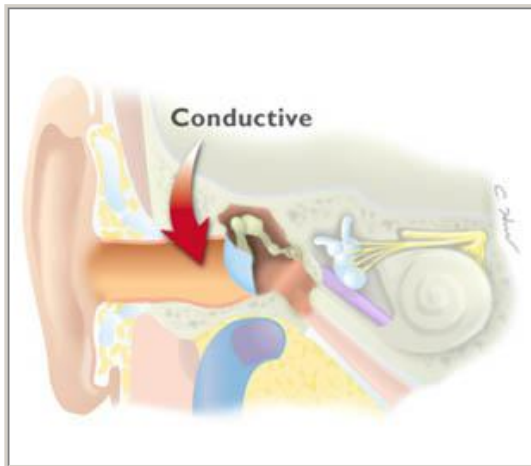
Figure 6. A, Rinne test, B, Weber

**Table 3. Principle of Rinne test and Weber tests****Compare Air and Bone Conduction (Rinne)**

1. Start with a 512 Hz tuning fork vibrating by tapping it on your hand.
2. Place the base of the tuning fork against the mastoid process on one side.
3. Ask the patient to tell you when the sound goes away.
4. When the patient no longer hears the sound, bring the end of the tuning fork near the patient's ear.
5. Air conduction is normally greater than bone conduction so they should hear the sound again for several more seconds.

**Test for Lateralization (Weber)**

1. Start with a 512 Hz tuning fork vibrating by tapping it on your hand.
2. Place the base of the tuning fork firmly in the center on top of the patient's head.
3. Ask the patient where they hear the sound.
4. They should hear the sound "in the center" if they have normal hearing.

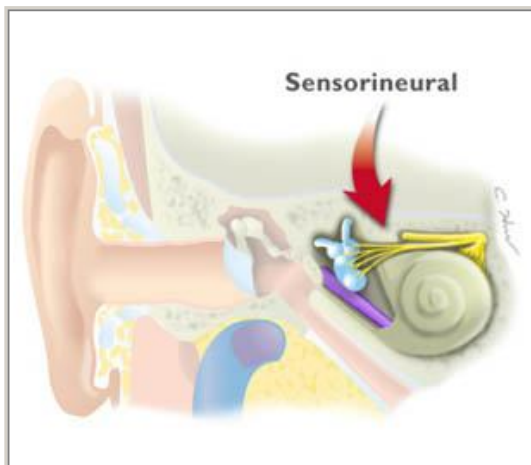


**The Weber and Rinne tests are used to differentiate conductive from sensorineural hearing loss.**

- **Conductive Hearing Loss (Middle Ear Deafness)**

The finger rubbing test is abnormal on the affected side. The Rinne test will indicate bone conduction better than air on that side. The sound is transmitted to the cochlea through bone rather than through the middle ear. Paradoxically the Weber test will lateralize to the affected ear. This is because sounds arriving via bone conduction appear louder when air conduction is decreased (masking effect).

**Etiology:** Usually due to a structural defect (blocked canal, trauma, scarred or torn tympanic membrane. Otosclerosis occurs when the stapes bone in the middle ear is scarred and immobile inhibiting the transfer of sound vibrations.



- **Sensorineural Hearing Loss**

The finger rubbing test is abnormal on the affected side. The Rinne test would indicate that air conduction better than bone (normal if heard at all). The Weber test would lateralize to the unaffected ear. Due to the damage to the auditory neural pathway neither bone or air will conduct well and for this reason the sound lateralizes to the unaffected (better) ear.

**Etiology:** Caused by damage to the nerve transmitting the sound (VIII) or its associated neurons and receptors (hair cells). This can be caused by tumors (acoustic neuromas, meningiomas), stroke, trauma, children born to mothers who had Rubella during pregnancy, aminoglycoside toxicity, atrophy of the cochlea seen in aging and various genetic causes.

**IX - Glossopharyngeal**

[See Vagus Nerve](#)

**X - Vagus** Click for online video clips

- Listen to the patient's voice, is it hoarse or nasal?



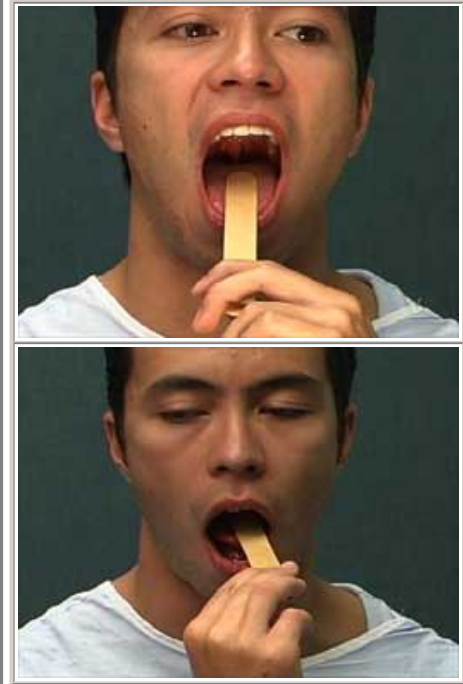
- Ask Patient to Swallow
- Ask Patient to Say "Ah"
  - Watch the movements of the soft palate and the pharynx.
- Test Gag Reflex (Unconscious/Uncooperative Patient) ++
  1. Stimulate the back of the throat on each side.
  2. It is normal to gag after each stimulus.

### Principle of vagus nerve examination

- Listen to the patient's voice, is it hoarse or nasal?
- Ask the patient to swallow.
- Ask the patient to say "Ah".
  - Do the soft palate and the other pharyngeal structures move? Is the movement symmetrical?

### Gag Reflex

- It is usually not necessary to perform this test on a conscious, cooperative patient. It is very useful in cases of coma.
- Stimulate the back of the throat on each side.
- It is normal to gag after each stimulus.
- This reflex protects the lungs from food and liquid contamination. A diminished gag reflex greatly increases the risk of aspiration.



## XI - Accessory

- From behind, look for atrophy or asymmetry of the trapezius muscles.
- Ask patient to shrug shoulders against resistance.
- Ask patient to turn their head against resistance. Watch and palpate the sternomastoid muscle on the opposite side.



### Examination of the accessory nerve

- From behind, look for atrophy or asymmetry of the trapezius muscle.
- Ask the patient to shrug their shoulders against resistance.
- Ask the patient to turn their head against resistance. Watch and palpate the sternocleidomastoid muscle on the opposite side.

## XII - Hypoglossal [Click for an online video](#)

- Listen to the articulation of the patient's words.
- Observe the tongue as it lies in the mouth
- Ask patient to:
  1. Protrude tongue [10]
  2. Move tongue from side to side

### Examination of the hypoglossal nerve

1. Listen to the articulation of words as the patient speaks.



2. Observe the tongue as it lies in the mouth.
3. Ask the patient to:
  1. Stick out their tongue.
  2. Move their tongue from side to side.
4. In an infant, pinching the nostrils causes the mouth to open and the tongue to rise. Observe for symmetry.

## Motor

### Observation

- Involuntary Movements
- Muscle Symmetry
  - Left to Right
  - Proximal vs. Distal
- Atrophy
  - Pay particular attention to the hands, shoulders, and thighs.
- Gait

### Muscle Tone

1. Ask the patient to relax.
2. Flex and extend the patient's fingers, wrist, and elbow.
3. Flex and extend patient's ankle and knee.
4. There is normally a small, continuous resistance to passive movement.
5. Observe for decreased (flaccid) or increased (rigid/spastic) tone.

### Muscle Strength

- Test strength by having the patient move against your resistance.
- Always compare one side to the other.
- Grade strength on a scale from 0 to 5 "out of five":

Grading Motor Strength	
Grade	Description
0/5	No muscle movement
1/5	Visible muscle movement, but no movement at the joint
2/5	Movement at the joint, but not against gravity
3/5	Movement against gravity, but not against added resistance
4/5	Movement against resistance, but less than normal
5/5	Normal strength

- Test the following:
  1. Flexion at the elbow (C5, C6, biceps)
  2. Extension at the elbow (C6, C7, C8, triceps)
  3. Extension at the wrist (C6, C7, C8, radial nerve)
  4. Squeeze two of your fingers as hard as possible ("grip," C7, C8, T1) [10]
  5. Finger abduction (C8, T1, ulnar nerve)
  6. Opposition of the thumb (C8, T1, median nerve)
  7. Flexion at the hip (L2, L3, L4, iliopsoas)
  8. Adduction at the hips (L2, L3, L4, adductors)
  9. Abduction at the hips (L4, L5, S1, gluteus medius and minimus)

10. Extension at the hips (S1, gluteus maximus) [12]
11. Extension at the knee (L2, L3, L4, quadriceps) [10]
12. Flexion at the knee (L4, L5, S1, S2, hamstrings)
13. Dorsiflexion at the ankle (L4, L5)
14. Plantar flexion (S1) [12]

**Table 4.**

Muscle Action	Major Muscles Involved	Nerves/Roots Involved
Hip flexion	Iliopsoas	L2-L4
Hip extension	Gluteus maximus	S1
Hip adduction	Adductors	L2-L4
Hip abduction	Gluteus medius and minimus	L4, L5, S1
Knee extension	Quadriceps	L2-L4
Knee flexion	Hamstrings	L4, L5, S1, S2,
Ankle dorsiflexion	Anterior and lateral leg muscles	L4, L5

### Pronator Drift

1. Ask the patient to stand for 20-30 seconds with both arms straight forward, palms up, and eyes closed.
2. Instruct the patient to keep the arms still while you tap them briskly downward.
3. The patient will not be able to maintain extension and supination (and "drift into pronation) with upper motor neuron disease.

## Coordination and Gait

### Rapid Alternating Movements

1. Ask the patient to strike one hand on the thigh, raise the hand, turn it over, and then strike it back down as fast as possible.
2. Ask the patient to tap the distal thumb with the tip of the index finger as fast as possible.
3. Ask the patient to tap your hand with the ball of each foot as fast as possible.

### Point-to-Point Movements [Click for the video-enriched online topic "Classification of tremors"](#)

1. Ask the patient to touch your index finger and their nose alternately several times. Move your finger about as the patient performs this task.
2. Hold your finger still so that the patient can touch it with one arm and finger outstretched. Ask the patient to move their arm and return to your finger with their eyes closed.
3. Ask the patient to place one heel on the opposite knee and run it down the shin to the big toe. Repeat with the patient's eyes closed.



#### Finger to Nose [Click for online video](#) [Click for online video](#)

- Ask the patient to touch your index finger and their nose alternately several times.
- Move your finger to a new position each time the patient returns to their nose.
- Hold your finger still so that the patient can touch it with one arm and finger outstretched.
- With their eyes closed, ask the patient to touch their nose and return to your finger twice.

#### Heel to Shin



- Ask the patient to place one heel just below the opposite knee and run it down the shin to the big toe.
- Repeat with the patient's eyes closed.
- Repeat on the other side.



### Rapid alternating movement is used to assess cerebellar function in the upper and lower extremities.

- Ask the patient to strike one hand on the thigh, raise the hand, turn it over, and then strike it back down as fast as possible.
- Ask the patient to tap their thumb with the tip of the index finger as fast as possible.
- Ask the patient to tap your hand with the ball of each foot as fast as possible.
- Slow or uncoordinated alternating movement is known as dysdiadochokinesis.

## Romberg

1. Be prepared to catch the patient if they are unstable.
2. Ask the patient to stand with the feet together and eyes closed for 5-10 seconds without support.
3. The test is said to be positive if the patient becomes unstable (indicating a vestibular or proprioceptive problem).



### Romberg Test

- Be prepared to catch the patient if they are unstable.
- First, test when the patient's eyes are open to get a general sense of balance and proprioception.
- Ask the patient to stand with their feet together and eyes closed for five to ten seconds without support.
- The test is said to be positive if the patient becomes unstable (indicating a vestibular or proprioceptive problem).

## Gait [\(Click for an online video clip\)](#) [\(Click for an online video clip\)](#) [\(Click for an online video clip\)](#)

Ask the patient to:

1. Walk across the room, turn and come back
2. Walk heel-to-toe in a straight line
3. Walk on their toes in a straight line
4. Walk on their heels in a straight line
5. Hop in place on each foot
6. Do a shallow knee bend
7. Rise from a sitting position

## Reflexes

### Deep Tendon Reflexes

- The patient must be relaxed and positioned properly before starting.

- Reflex response depends on the force of your stimulus. Use no more force than you need to provoke a definite response.
- Reflexes can be reinforced by having the patient perform isometric contraction of other muscles (clenched teeth).
- Reflexes should be graded on a 0 to 4 "plus" scale:

Tendon Reflex Grading Scale	
Grade	Description
0	Absent
1+ or +	Hypoactive
2+ or ++	"Normal"
3+ or +++	Hyperactive without clonus
4+ or ++++	Hyperactive with clonus

- Biceps (C5, C6)
  1. The patient's arm should be partially flexed at the elbow with the palm down.
  2. Place your thumb or finger firmly on the biceps tendon.
  3. Strike your finger with the reflex hammer.
  4. You should feel the response even if you can't see it.
- Triceps (C6, C7)
  1. Support the upper arm and let the patient's forearm hang free.
  2. Strike the triceps tendon above the elbow with the broad side of the hammer.
  3. If the patient is sitting or lying down, flex the patient's arm at the elbow and hold it close to the chest.
- Brachioradialis (C5, C6)
  1. Have the patient rest the forearm on the abdomen or lap.
  2. Strike the radius about 1-2 inches above the wrist.
  3. Watch for flexion and supination of the forearm.
- Abdominal (T8, T9, T10, T11, T12)
  1. Use a blunt object such as a key or tongue blade.
  2. Stroke the abdomen lightly on each side in an inward and downward direction above (T8, T9, T10) and below the umbilicus (T10, T11, T12).
  3. Note the contraction of the abdominal muscles and deviation of the umbilicus towards the stimulus.
- Knee (L2, L3, L4)
  1. Have the patient sit or lie down with the knee flexed.
  2. Strike the patellar tendon just below the patella.
  3. Note contraction of the quadriceps and extension of the knee.
- Ankle (S1, S2)
  1. Dorsiflex the foot at the ankle.
  2. Strike the Achilles tendon.
  3. Watch and feel for plantar flexion at the ankle.

### Classical tendon jerk reflexes in the upper limb



### The Biceps tendons reflex

#### Biceps reflex (C5, C6)

- The patient's arm should be partially flexed at the elbow with the palm down resting on their lap.
- Place your thumb or finger firmly on the biceps tendon.
- Strike your finger with the reflex hammer.
- You should feel the response even if you can't see it.

#### Brachioradialis reflex (C5, C6)

- Have the patient rest the forearm on the abdomen or lap.
- Strike the brachioradialis tendon where it passes over the radius about two to four centimeters above the wrist.



- Watch for flexion and supination of the forearm.
- Triceps reflex (C6, C7)**
- The patient's arm should be partially flexed at the elbow with the palm down resting on their lap. Alternatively, support the upper arm and let the patient's forearm hang free.
  - Strike the triceps tendon above the elbow with the broad side of the hammer.
  - Watch for extension of the forearm.

**The Triceps tendons reflex**

**Classical tendon jerk reflexes in the lower limb**



- Knee reflex (L2, L3, L4)**
- Have the patient sit or lie down with the knee flexed.
  - Strike the patellar tendon just below the patella.
  - Note contraction of the quadriceps and extension of the knee.

**The knee reflex**

- Ankle reflex (S1, S2)**
- Dorsiflex the foot at the ankle.
  - Strike the Achilles tendon.
  - Watch and feel for plantar flexion at the ankle.

**Clonus** [Click for an online video](#)

If the reflexes seem hyperactive, test for ankle clonus: ++

1. Support the knee in a partly flexed position.
2. With the patient relaxed, quickly dorsiflex the foot.
3. Observe for rhythmic oscillations.



**Eliciting clonus**

- Eliciting clonus**
- Clonus occurs when there is a lack of normal cortical inhibition of a deep tendon reflex, resulting in rapid, strong, oscillating muscular contractions. This occurs when sustained tension is placed on one of the muscles controlling a joint, such as the wrist or ankle.
  - If the reflexes seem hyperactive, test for ankle clonus:
  - Support the knee in a partly flexed position.
  - With the patient relaxed, quickly dorsiflex the foot.
  - Observe for rhythmic oscillations.
  - Up to 8-10 contractions of ankle clonus is considered normal in newborns, but contractions sustained beyond this are evidence of a central nervous system deficit.

**Plantar Response (Babinski)**

1. Stroke the lateral aspect of the sole of each foot with the end of a reflex hammer or key.
2. Note movement of the toes, normally flexion (withdrawal).
3. Extension of the big toe with fanning of the other toes is abnormal. This is referred to as a positive Babinski.



Normal



Positive Babinski

### Plantar response [Click for an online video](#)

- This test is used to assess upper motor neuron lesions.
- Stroke the lateral aspect of the sole of each foot with the blunt end of a reflex hammer or key.
- Note movement of the toes, normally flexion (withdrawal).
- Extension of the big toe with fanning of the other toes is abnormal. This is referred to as a positive plantar response.
- Symmetry is particularly important for interpretation. A positive Babinski on one side and not the other is an important clue to the location of a lesion.
- The other plantar tests are equivalent.
- The term "Babinski reflex" is the abnormal response to plantar stimulation. Therefore, it is incorrect to make the statement that a patient has a "normal" or "down-going Babinski." Rather, if the response is normal, one should simply state that the "plantar reflex is normal" or that the "toes are down-going."
- The presence of a Babinski response in infants may be normal (sometimes up to 2 years of age), and should not be taken as conclusive evidence of neurological disease.



Eliciting abdominal reflex

### Abdominal reflex (T8, T9, T10, T11, T12)

- Use a blunt object such as a key or tongue blade.
- Stroke the abdomen lightly on each side in an inward and downward direction above (T8, T9, T10) and below the umbilicus (T10, T11, T12).
- Note the contraction of the abdominal muscles and deviation of the umbilicus towards the stimulus.
- Babies do not exhibit the abdominal reflex until about 6 months, but if spinal cord lesions are suspected the anal reflex is present at birth and can be tested.

## Sensory

### General

- Explain each test before you do it.
- Unless otherwise specified, the patient's eyes should be closed during the actual testing.
- Compare symmetrical areas on the two sides of the body.
- Also compare distal and proximal areas of the extremities.
- When you detect an area of sensory loss map out its boundaries in detail.

### Vibration

- Use a low pitched tuning fork (128Hz).
  1. Test with a **non-vibrating** tuning fork first to ensure that the patient is responding to the correct stimulus.
  2. Place the stem of the fork over the distal interphalangeal joint of the patient's index fingers and big toes.
  3. Ask the patient to tell you if they feel the vibration.
- If vibration sense is impaired proceed proximally: ++

1. Wrists
2. Elbows
3. Medial malleoli
4. Patellas
5. Anterior superior iliac spines
6. Spinous processes
7. Clavicles



**Examination of vibration sense**

#### **Examination of vibration sense**

- Use a low pitched (128 Hz) tuning fork.
- Test with a non-vibrating tuning fork first to ensure that the patient is responding to the correct stimulus.
- Place the stem of the fork over the distal interphalangeal joint of the patient's index fingers and great toes.
- Ask the patient to tell you if they feel the vibration.
- If the patient consistently detects vibration at these four points their vibratory sensation is intact.
- If vibration sense is impaired proceed proximally:
- Wrists, Elbows, Medial malleoli, Patellae, Anterior superior iliac spines, Spinous processes, Clavicles
- Vibratory sensation uses the same receptors as proprioception. These receptors are only sensitive to lower frequencies. Your exam will be inaccurate if you use a tuning fork with a pitch higher than 128 Hz.

#### **Subjective Light Touch**

- Use your fingers to touch the skin lightly on both sides simultaneously. [13]
- Test several areas on both the upper and lower extremities.
- Ask the patient to tell you if there is difference from side to side or other "strange" sensations.

#### **Position Sense**

1. Grasp the patient's big toe and hold it away from the other toes to avoid friction. ++
2. Show the patient "up" and "down."
3. With the patient's eyes closed ask the patient to identify the direction you move the toe.
4. If position sense is impaired move proximally to test the ankle joint. ++
5. Test the fingers in a similar fashion.
6. If indicated move proximally to the metacarpophalangeal joints, wrists, and elbows. ++



#### **Examination of sense of position**

- Use this test when an abnormality is suspected, for instance if a patient has an uncoordinated gait or positive Romberg Test.
- Grasp the patient's big toe on the sides and hold it away from the other toes to avoid friction.
- Move the distal joint with your other hand.
- Demonstrate "up" and "down" while the patient watches.
- With the patient's eyes closed ask the patient to identify the direction you move the toe.
- If position sense is impaired move proximally to test the ankle joint.



## Examination of sense of position

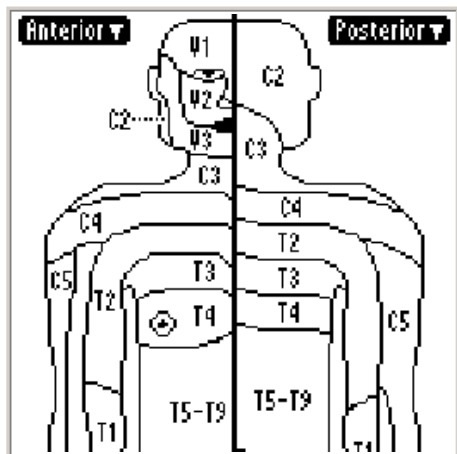
- Test the index finger in a similar fashion.
- If indicated move proximally to the metacarpophalangeal joints, wrists, and elbows.

## Dermatomal Testing

If vibration, position sense, and subjective light touch are normal in the fingers and toes you may assume the rest of this exam will be normal. ++

## Pain

- Use a suitable sharp object to test "sharp" or "dull" sensation. [7]
- Test the following areas:
  1. Shoulders (C4)
  2. Inner and outer aspects of the forearms (C6 and T1)
  3. Thumbs and little fingers (C6 and C8)
  4. Front of both thighs (L2)
  5. Medial and lateral aspect of both calves (L4 and L5)
  6. Little toes (S1)



## Dermatomal map landmarks:

- T4: nipple
- C6: thumb, index finger
- C7: middle finger
- T10: umbilicus
- L3: knee
- S1: sole
- S5: anus

## Temperature

- Often omitted if pain sensation is normal. ++
- Use a tuning fork heated or cooled by water and ask the patient to identify "hot" or "cold."
- Test the following areas:
  1. Shoulders (C4)
  2. Inner and outer aspects of the forearms (C6 and T1)
  3. Thumbs and little fingers (C6 and C8)
  4. Front of both thighs (L2)
  5. Medial and lateral aspect of both calves (L4 and L5)
  6. Little toes (S1)

## Light Touch

- Use a fine whip of cotton or your fingers to touch the skin lightly.
- Ask the patient to respond whenever a touch is felt.
- Test the following areas:
  1. Shoulders (C4)
  2. Inner and outer aspects of the forearms (C6 and T1)
  3. Thumbs and little fingers (C6 and C8)
  4. Front of both thighs (L2)
  5. Medial and lateral aspect of both calves (L4 and L5)
  6. Little toes (S1)

## Discrimination

Since these tests are dependent on touch and position sense, they cannot be performed when the tests above are clearly abnormal. ++

- Graphesthesia
  1. With the blunt end of a pen or pencil, draw a large number in the patient's palm.
  2. Ask the patient to identify the number.
- Stereognosis
  1. Use as an alternative to graphesthesia. ++
  2. Place a familiar object in the patient's hand (coin, paper clip, pencil, etc.).
  3. Ask the patient to tell you what it is.
- Two Point Discrimination
  1. Use in situations where more quantitative data are needed, such as following the progression of a cortical lesion. ++
  2. Use an opened paper clip to touch the patient's finger pads in two places simultaneously.
  3. Alternate irregularly with one point touch.
  4. Ask the patient to identify "one" or "two."
  5. Find the minimal distance at which the patient can discriminate.



**Graphesthesia**



**Tactile localization**

### Graphesthesia

- With the blunt end of a pen or pencil, draw a large number in the patient's palm.
- Ask the patient to identify the number.

### Stereognosis

- Use as an alternative to graphesthesia.
- Place a familiar object in the patient's hand (coin, paper clip, pencil, etc.).
- Ask the patient to tell you what it is.

### Tactile localization

- Use in situations where more quantitative data are needed, such as following the progression of a cortical lesion.
- Use an opened paper clip to touch the patient's finger pads in two places simultaneously.
- Alternate irregularly with a one point touch.
- Ask the patient to identify "one" or "two."
- Find the minimal distance at which the patient can discriminate.

## Meningeal signs

Signs of meningeal irritation indicate inflammation of the dura; these signs are as follows:

1. Nuchal rigidity or neck stiffness is tested by placing the examiner's hand under the patient's head and gently trying to flex the neck. Undue resistance implies diffuse irritation of the cervical nerve roots from meningeal inflammation.
2. Brudzinski sign is flexion of both knees during the maneuver to test nuchal rigidity. This indicates diffuse meningeal irritation in the spinal nerve roots.
3. Kernig sign is elicited by flexing the hip and knee on one side while the patient is supine, then extending the knee with the hip still flexed. Hamstring spasm results in pain in the posterior thigh muscle and difficulty with knee extension. With severe meningeal inflammation, the opposite knee may flex during the test.
4. Lasegue or straight leg raising (SLR) sign is elicited by passively flexing the hip with the knee straight while the patient is in the supine position. Limitation of flexion due to hamstring spasm and/or pain indicates local irritation of the lower lumbar nerve roots. Reverse SLR is elicited by passively hyperextending the hip with the knee straight while the patient is in the prone position. Limitation of extension due to spasm and/or pain in the anterior thigh muscles indicates local irritation of the upper lumbar nerve roots.



**Straight leg raising test**



**Brudzinski's Sign**



**Kernig's Sign**

### **Straight leg raising test**

- This is a test for nerve root compression in the lower back.
- Ask the patient to lie supine on the exam table with knees straight.
- Grasp the leg near the heel and raise the leg slowly towards the ceiling.
- Pain in an L5 or S1 distribution suggests nerve root compression or tension (radicular pain).
- Dorsiflex the foot while maintaining the raised position of the leg.
- Increased pain strengthens the likelihood of a nerve root problem.
- Repeat the process with the opposite leg.
- Increased pain on the opposite side (a positive crossed straight leg raise) indicates a high probability of nerve root compression on that side.

### **Brudzinski's Sign**

- Flex the patient's neck and observe the hips and knees.
- If the hips and knees flex in response, this suggests meningeal irritation.

### **Kernig's Sign**

- With the patient supine, flex the leg 90 degrees at the hip and knee.
- Keeping the hip flexed, straighten the leg slowly at the knee.
- Some discomfort is normal, but bilateral pain and increased resistance to extension suggest meningeal irritation.

## **Decerebrate & Decorticate posturing** [\(Click for an online video clip\)](#)

These are often assessed in patients who present comatose and non-responsive, often requiring respiratory support. There are two classic reflexive postures: decorticate and decerebrate.



**Decerebrate posturing**

### **Decerebrate posturing**

- Decerebrate posturing is seen in patients with lesions of the brainstem itself. These patients will exhibit extension of the arms, flexion of the wrists, jaw-clenching, back-arching, plantar flexion, and neck extension, either spontaneously or in response to a sternal rub.
- A way to remember the difference between the two postures is that in the decorticate posture, the patient's arms will point to the cortex.

### **Decorticate posturing**

- Decorticate posturing is seen when there is a lesion of the corticospinal tract superior to the level of the brainstem. This is indicated in the comatose patient who responds to a sternal rub by full flexion of the elbows, wrists, and fingers, as well as plantar flexion of the feet with



## Decorticate posturing

## Notes

1. For more information refer to *A Guide to Physical Examination and History Taking, Sixth Edition* by Barbara Bates, published by Lippincott in 1995.
2. Visual acuity is reported as a pair of numbers (20/20) where the first number is how far the patient is from the chart and the second number is the distance from which the "normal" eye can read a line of letters. For example, 20/40 means that at 20 feet the patient can only read letters a "normal" person can read from twice that distance.
3. You may, instead of wiggling a finger, raise one or two fingers (unilaterally or bilaterally) and have the patient state how many fingers (total, both sides) they see. To test for **neglect**, on some trials wiggle your right and left fingers simultaneously. The patient should see movement in both hands.
4. Additional Testing - Tests marked with (++) may be skipped unless an abnormality is suspected.
5. PERRLA is a common abbreviation that stands for "Pupils Equal Round Reactive to Light and Accommodation." The use of this term is so routine that it is often used incorrectly. If you did not specifically check the accommodation reaction use the term PERRL. Pupils with a diminished response to light but a normal response to accommodation (Argyll-Robertson Pupils) are a sign of neurosyphilis.
6. Nystagmus is a rhythmic oscillation of the eyes. Horizontal nystagmus is described as being either "leftward" or "rightward" based on the direction of the **fast** component.
7. Testing Pain Sensation - Use a new object for each patient. Break a wooden cotton swab to create a sharp end. The cotton end can be used for a dull stimulus. Do **not** go from patient to patient with a safety pin. Do **not** use non-disposable instruments such as those found in certain reflex hammers. Do **not** use very sharp items such as hypodermic needles.
8. Central vs Peripheral - With a unilateral central nervous system lesion (stroke), function is preserved over the upper part of the face (forehead, eyebrows, eyelids). With a peripheral nerve lesion (Bell's Palsy), the entire face is involved.
9. The hearing screening procedure presented by Bates on page 181 is more complex than necessary. The technique presented in this syllabus is preferred.
10. Deviation of the tongue or jaw is **toward** the side of the lesion.
11. Although it is often tested, grip strength is **not** a particularly good test in this context. Grip strength may be omitted if finger abduction and thumb opposition have been tested.
12. The "anti-gravity" muscles are difficult to assess adequately with manual testing. Useful alternatives include: walk on toes (plantarflexion); rise from a chair without using the arms (hip extensors and knee extensors); step up on a step, once with each leg (hip extensors and knee extensors).
13. Subjective light touch is a quick survey for "strange" or asymmetrical sensations only, not a formal test of dermatomes.