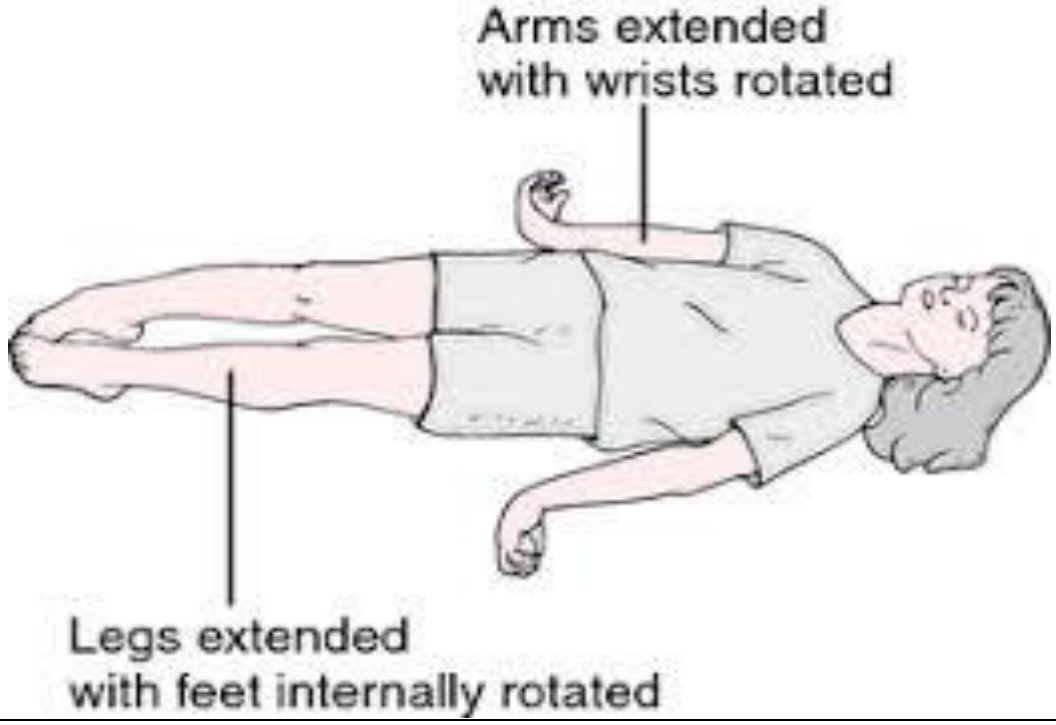
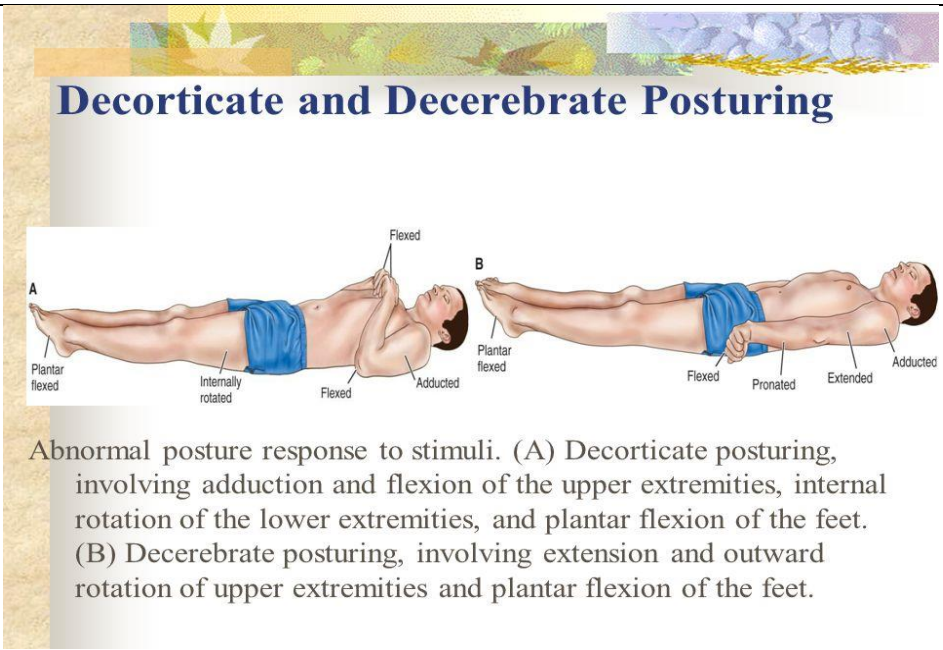
Neurological Assessment

General Considerations	
1. Always consider left to right symmetry 2. Consider central vs. peripheral deficits	
3. Organize your thinking into seven categories:	
a. Mental Status b. Cranial Nerves c. Motor d. Coordination and Gait e. Reflexes f. Sensory g. Special Tests	
Steps to Neurological Assessment	
1. Assess mental status/higher function:	
A. Conscious patient:	
1) Talk to patient and ask questions that avoid yes/no answers if possible.	
• Evaluate orientation, attention, coherence, comprehension, memory/recall	
• Screen for delirium	
• Identify symptoms such as headache, nausea or visual problems	
2) Determine Glasgow Coma Scale (GCS)	
B. Altered patient:	
1) Assess for response to:	
a) Normal voice	
b) Loud voice	
c) Light touch	
d) Central pain	
Differentiate between higher function of "awareness" (e.g., purposeful movement, recognition of family) versus arousability (grimacing to pain only).	
2) Determine Glasgow Coma Scale (GCS)	
Ascertain the patient acuity of hearing	
Check patient note for any medical condition that may affect accuracy of GCS, e.g. previous stroke affect movement of patient arm.	
Check the neurological observation chart for GCS documentation	
GCS composed of three responses: eyes response=4, verbal response=5 and motor response=6, total of them= 15 at best. The least total score = 3.	
Eyes opening	
Assessment of eye opening involves the evaluation of arousal (being aware of the environment.	
Score 4	Eye opens spontaneously.
Score 3	Eye opens to speech
Score 2	Eye opens in response to pain only, for example trapezius squeeze (caution if applying painful stimuli).
Score 1	Eye don't open to verbal painful stimuli
Record "C" if the patient is unable to open his eyes because of swelling, ptosis (drooping of the upper eye lid) or a dressing.	

Verbal response	
Assessment involving evaluating awareness	
Score 5	Oriented
Score 4	Confused
Score 3	Inappropriate words
Score 2	Incomprehensible sounds
Score 1	No response. This is despite both verbal and physical stimuli
Record "D" if the patient is dysphasic and "T" if the patient has a tracheal or tracheostomy tube.	
Motor response	
Assessment of motor response is designed to determine the patient's ability to obey a command and to localize, and to withdraw or assume abnormal body positions, in response to a painful stimulus.	
Score 6	**Obeys commands.** The patient can perform two different movements.
Score 5	**Localizes to central pain.** The patient does not respond to a painful stimulus but purposely moves an arm to remove the cause of a central painful stimulus.
Score 4	**Withdraws from pain.** The patient flexes or bends the arm towards the source of the pain but fails to locate the source of the pain (no wrist rotation)
Score 3	**Flexion to pain.** The patient flexes or bends the arm; characterized by internal rotation and adduction of the shoulder and flexion of the elbow, much slower than the normal flexion **(decorticate)**
Score 2	**Extension to pain.** The patient extends the arm by straightening the elbow and may be associated with internal shoulder and wrist rotation **(Decerebrate).**
Score 1	**No response to painful stimuli.**
Painful stimulus: a true localizing of pain involves the patient bringing an arm up to chin level using trapezius squeeze, supra orbital ridge pressure (not recommended in suspected facial fracture)	





Abnormal posture response to stimuli. (A) Decorticate posturing, involving adduction and flexion of the upper extremities, internal rotation of the lower extremities, and plantar flexion of the feet. (B) Decerebrate posturing, involving extension and outward rotation of upper extremities and plantar flexion of the feet.

2. Consider whether seizures could be present

Look for evidence of seizures (non-convulsive seizures should be considered in patients with unexplained decrease in level of consciousness or failure to awaken, especially after TBI or stroke).

3. Test Cranial Nerves

- In rapid neurologic examination, pupil assessment is the primary CN examination.

Light Reflex (CN II [Optic and CN III [Oculomotor]): Conduct 4 point assessment:

Pupillary Reactions: PERRLA is a common abbreviation that stands for **"Pupils Equal Round Reactive to Light and Accommodation."**

a. Direct light response in L eye;
b. Direct light response in R eye;
c. Consensual light response in L eye; and
d. Consensual light response in R eye.

1. **Consensual light response:** If an individual's right eye is shielded and light shines into the left eye, constriction of the right pupil will occur, as well as the left.
2. **Both pupils should constrict to light** shone in either eye; true CN III compression should cause decreased responsiveness to both direct and consensual testing.
3. Look for direct and **consensual responses**.
4. **In a normal response,** the eye which the light is shined has pupillary constriction (direct reflex) AND the other pupil also constricts (indirect or consensual reflex).
5. An abnormal response (no pupillary constriction) can help to localize the lesion, particularly when interpreted with the result of vision testing.
6. While observing the pupillary light response one should also check that the pupils are the same size.
7. Observe Accommodation to light.

- **Accommodation to light.**

If the pupillary reactions to light are diminished or absent, check the reaction to accommodation (near reaction):

a) Hold your finger about 10cm from the patient's nose.
b) Ask them to alternate looking into the distance and at your finger.
c) Observe the pupillary response in each eye.

- Loss of reactivity to direct and consensual light with pupillary dilation suggests compression of CN III (top of brainstem).
- Fixed and pinpoint pupil suggests lower brainstem dysfunction in the area of the pons.
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Extra ocular Movement (EOM)

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. Check convergence by moving your finger toward the bridge of the patient's nose.
5. Pause during upward and lateral gaze to check for nystagmus (involuntary eye movement which differs in each eye)

Facial Sensation (CN V [Trigeminal]; test 3 branches [V1, V2 and V3] independently): light touch test

- Preferably done with patient's eyes closed. Touch each side of the forehead (V1), cheek (V2) and jaw (V3) with a whisp of tissue (**light touch**). Repeat with a blunt needle (pin).
- Ask patient to identify when they perceive the stimulus; assess for symmetry of sensation.
- **Motor:** Place two fingers on each of the patient's cheeks and ask him/her to raise them.

Light Touch

1. Test several areas on both the upper and lower extremities.
2. Use your fingers to touch the skin lightly on both sides simultaneously. Ask the patient to tell you if there is difference from side to side or other "strange" sensations.
3. Use a fine wisp of cotton or your fingers to touch the skin lightly. Ask the patient to respond whenever a touch is felt.
4. **Test the following areas:**
   a) Shoulders (C4)
   b) Inner and outer aspects of the forearms (C6 and T1)
   c) Thumbs and little fingers (C6 and C8)
   d) Front of both thighs (L2)
   e) Medial and lateral aspect of both calves (L4 and L5)
   f) Little toes (S1)

Temperature

1. Often omitted if pain sensation is normal.

2. Uses a tuning fork heated or cooled by water and asks the patient to identify "hot" or "cold."

3. Test the following areas:

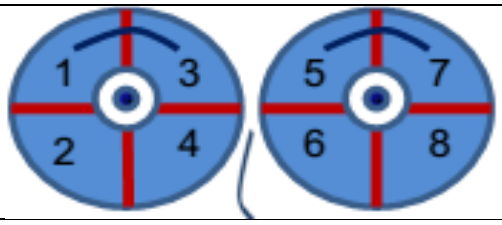
- Shoulders (C4)
- Inner and outer aspects of the forearms (C6 and T1)
- Thumbs and little fingers (C6 and C8)
- Front of both thighs (L2)
- Medial and lateral aspect of both calves (L4 and L5)
- Little toes (S1)

4. Assess motor function (look for asymmetry).

- Evaluate movement in response to command, with and without resistance if possible.
- Observe spontaneous movement or response to pain if unable to obey.

5. Assess sensory function (look for asymmetry).
Test response to pin and light tough; patient must be able to obey; important part of spinal cord testing for at risk patients (ASCI,).
6. Assess cerebellar function.
Patient must be able to obey; cerebellum responsible for ipsilateral (belonging to or occurring on the same side of the body). Coordination of movement.
• Tests of rapid alternating movement can be performed in ICU. **Examples:**
○ Examiner holds finger up and asks patient to touch his/her own nose, then the examiner's finger.
○ Have patient touch each fingertip to thumb tip in succession.

Cranial Nerves (CN) assessment: Awake Patient

1. Sense of smell (CN I [Olfactory]):
• Block one nare after another and test ability to smell a strong aroma such as cloves قرنفل or coffee. • Use different smell object for each nostril.
• Assess for symmetrical sensation (testing omitted in most critical care assessments)
• Smell (may be injured with anterior basal skull #fracture) • Dysfunction causes anosmia
2. Vision (CN II [Optic]):
• If patient wears glasses, test with glasses on.
• Can patient identify objects / people or the number of digits held up by examiner? Can they read?
• Does patient recognize family members?
• Observe response to visual stimulation from either side of bed; occipital lobe stroke causes loss of vision to the opposite visual field of one or both eyes (e.g., a left occipital lobe stroke can cause blindness to all or part of the right visual field of the right and/or left eye).
• With patient looking ahead, ask patient to indicate when he/she can see a pen that is randomly wiggled into each of the 8 visual fields, shown below. Deficits will need to be confirmed at a later
• Recognition of objects or people. • If alert, ability to see objects in all 8 fields.

• Eye chart, Reading
• Light reflex tests CN II and III
• Remember to test with glasses on
Inspection 1. Observe the patient for ptosis, exophthalmos, lesions, deformities, or asymmetry. 2. Ask the patient to look up and pull down both lower eyelids to inspect the conjunctiva and sclera. 3. Next spread each eye open with your thumb and index finger. Ask the patient to look to each side and downward to expose the entire bulbar surface. 4. Note any discoloration, redness, discharge, or lesions. Note any deformity of the iris or lesion cornea.

5. If you suspect the patient has conjunctivitis, be sure to wash your hands immediately. Viral conjunctivitis is very contagious, so protect your self

Visual acuity:

- **In cases of eye pain, injury, or visual loss, always check visual acuity before proceeding with the rest of the exam or putting medications in your patient's eyes.**

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 an opaque 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.)
6. Repeat with the other eye.

Unexpected/unexplained loss of acuity is a sign of serious ocular pathology.

7. Ask pt. to cover Rt. Eye & tell you how many fingers you are holding up.
8. Uncover Rt. Eye & cover Lt. Eye. Again ask pt. the same question.

3. Light Reflex (CN II [Optic and CN III [Oculomotor]):

Pupillary Reactions: PERRLA is a common abbreviation that stands for **"Pupils Equal Round Reactive to Light and Accommodation."**

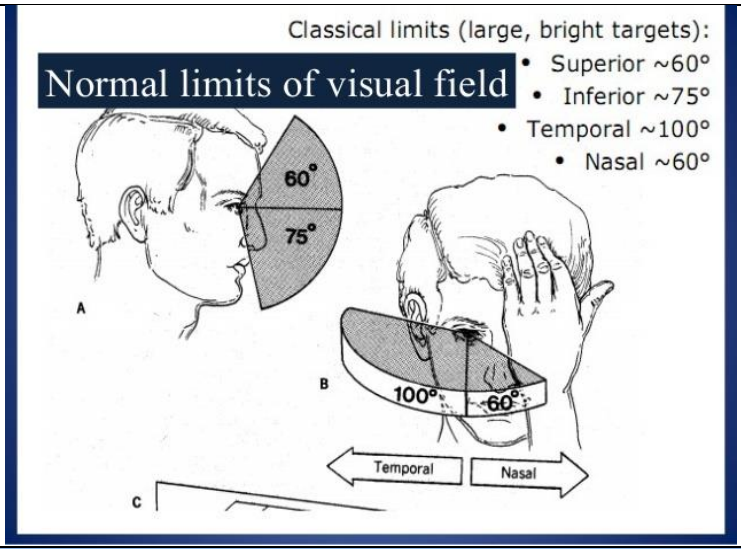
4. Eye Opening (CN III [Oculomotor]):

- Ask patient to open eyes wide; observe for upward movement of lids.
- Look at the white portion of each eye. Ptosis (eyelid droop) may be present if there is less white showing on the affected side.

5. Eye Movement (EOM) (CN III [Oculomotor], IV [Trochlear] and VI [Abducens]):

- Hold a pen in front of the patient. Stand at least a couple of feet away.
- Ask patient to follow the pen as you **SLOWLY** move it horizontally, vertically and diagonally, in both directions. Follow eye movements into extreme vertical and horizontal gaze.
- Eye movements should be **conjugate** (together). **Dysconjugate gaze** causes **diplopia**. It may be due to CN III, IV or VI dysfunction, or disorders of one of the muscles involved in eye movement.
- Observe for **nystagmus** (extra eye movements). Nystagmus can be normal in the extreme horizontal gaze but never in vertical gaze.

a. **Test visual acuity** and pupillary constriction.
b. Move the patient's eyes through the six cardinal positions of gaze.
c. Ask the patient to smile, frown, wrinkle forehead, and puff out cheeks.



6. Facial Sensation (CN V [Trigeminal]; test 3 branches [V1, V2 and V3] independently):

- Preferably done with patient's eyes closed. Touch each side of the forehead (V1), cheek (V2) and jaw (V3) with a whisp of tissue **(light touch). Repeat with a blunt needle (pin).**
- Ask patient to identify when they perceive the stimulus; assess for symmetry of sensation.
- **Motor:** Place two fingers on each of the patient's cheeks and ask him/her to raise them.

7. Facial Movement (CN VII [Facial]):

Mixed: (A) Motor: muscles used for facial expressions, close eye and mouth;
(B) Sensory (sense of taste in the front 2/3 of tongue;
(C) Parasympathetic: saliva and tear secretion

- Sense of taste not usually checked unless specific concerns
- Observe for Any Facial Droop or Asymmetry

- Ask Patient to do the following, note any lag, weakness, or asymmetry: Raise eyebrows
- Have patient **smile**, show teeth and wrinkle forehead / Frown
- Observe nasal labial fold. Assess symmetry.
- Show teeth
- Puff out cheeks
- Close both eyes to resistance
- Ask patient to close eyelids tightly; assess ability to keep eyes closed against resistance.

8. Hearing Acoustic (CN VIII [Auditory]):

- Comprehensive testing requires an audiology examination. ICU screening includes response to voice or loud noise; each ear can be assessed.
- Identify symptoms of tinnitus.
- Vertigo with upright positioning or impaired horizontal eye movement may indicate CN VIII disorders.

1. **Sensory:** Hearing and Equilibrium
2. **Initial test:**

a) Face the patient and hold out your arms with your fingers near each ear.
b) Rub your fingers together on one side while moving the fingers noiselessly on the other.
c) Ask the patient to tell you when and on which side they hear the rubbing.
d) Increase intensity as needed and note any asymmetry.
e) Test hearing with normal voice and whispers

3. If abnormal, proceed with the Weber and Rinne tests

9. Gag Reflex (CN IX [Glossopharyngeal] and X [Vagus]).

Touch back of throat (on each side) and assess for gag.

- Touching the posterior pharynx with the tongue depressor. Explain to patient that this may be uncomfortable.

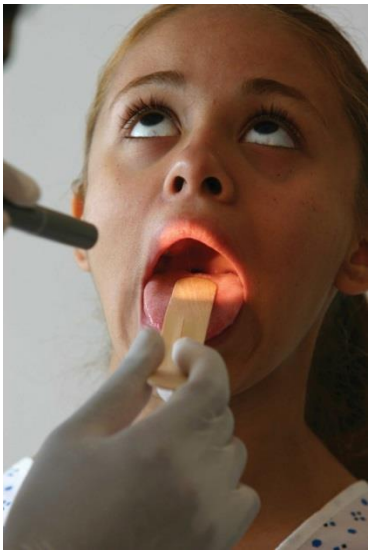


Figure 26.13 Testing cranial nerves IX and X.

10. Shoulder Shrug and Face Turning (CN XI [Accessory]).

- Place your hands on the patient's shoulders while he or she shrugs against resistance.
- Ask patient to raise both shoulders and hold up against resistance; observe symmetry.
- Then place your hand on the patient's left cheek, then the right cheek, and have the patient push against it.
- Have patient turn head side-to-side. Repeat while you apply resistance to cheek.

Figure 26.16 Testing the strength of the trapezius muscle against resistance.

Figure 26.17 Testing the strength of the sternocleidomastoid muscle against resistance.

11. Tongue Movement (CN XII [Glossopharyngeal]).

Ask patient to stick out tongue and move it side to side, can test against resistance.

12. Corneal reflex (V1 branch of CN V [Trigeminal] and CN VII [Facial]):

- **Touching the cornea causes both eyes to blink.**
- Ask the patient to look up. Approaching from the side and avoiding his eyelashes, touch the cornea (not the conjunctiva) lightly with a fine wisp (thread) of cotton.
- The sensation is detected by the first branch of CN V (V1 branch), which stimulates CN VII to protect the eyes; **nasal tickle tests** دغدغة the same pair.

- Be careful to "sneak in يتسلل from the side" when touching the cornea (with a whisp of tissue).
- If the patient blinks because they see you, you have tested CN II and VII.
- If they blink because they hear you, you have tested CN VIII (Acoustic) and VII.

- Blinking of only one eye suggests weakness on the side of the face with the absent blink

13. Coughing and Breathing (CN X and Medulla): comatose patient

- Assess for cough reflex during suctioning.
- Elevated PCO 2 must be confirmed before apnea can be verified.

14. Sensory Function

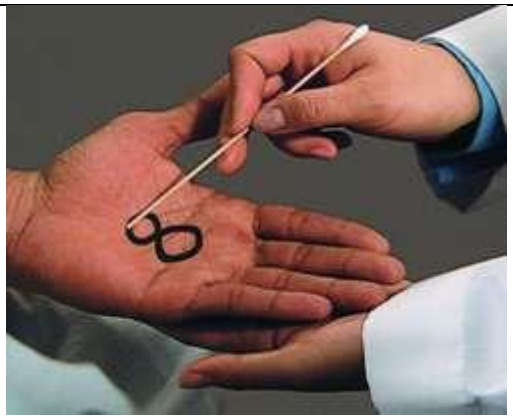
- **Proprioception** (or kinesthesia) is the sense though which we perceive the position and movement of our body, including our sense of equilibrium and balance, senses that depend on the notion of force.
- Proprioception is defined as the conscious or unconscious awareness of joint position, whereas neuromuscular control is the efferent motor response to afferent (sensory) information.

- Observation of light touch identification
- Sharp, dull, temperature, and vibration determination

Graphesthesia:

Graphesthesia: Higher-order aspects of sensation, or cortical sensation, should be tested as well. To test graphesthesia,

- Ask the patient to close his/ her eyes and identify letters or numbers that are being traced using your finger or applicator onto patient's palm or the tip of his/ her finger.
- Then ask him or her to identify the number.
- Repeat on the other hand with a different number.




Stereognosis:

Stereognosis: the mental perception of depth or three-dimensionality by the senses, usually in reference to the ability to perceive the form of solid objects by touch (and identify various objects by touch using one hand at a time).

a. **Ask the patient to close his or her eyes.**
b. Place a familiar object, such as a key, in the patient's hand and ask him or her to identify the object.
c. Repeat using another object for the other hand.

Test also for **tactile extinction (loss)** on double simultaneous tactile stimulation. Note that graphesthesia, stereognosis, and extinction or death cannot reliably be tested for unless primary sensation is intact bilaterally.

- **Topognosis:** recognition of the location of a stimulus on the skin.

Two-point discrimination

Two-point discrimination measures the individual's ability to perceive two points of stimuli presented simultaneously. The health care practitioner is interested in the smallest distance between the points that can still be perceived as two points by the individual being tested.

Expected findings - The measured distance will vary depending on the body part being tested and should be compared to normative data. Reflect how finely innervated an area of skin is. In clinical settings, two-point discrimination is a widely used technique for assessing tactile perception.

Equipment Two-point discrimination **aesthesiometer.**

Testing procedure

1. Explain the procedure to the patient with his/her eyes open. For example, "I am going to touch various parts of your arms (or other body part) with this instrument. I will touch you with either one or two points, and tell me if you feel one or two points when you feel the touch."
2. Demonstrate the procedure with the patient's eyes open until the patient understands the procedure.
3. The patient closes his/her eyes, or vision is otherwise occluded.
4. Begin the test with the points of the anesthesiometer opened greater than the mean value for the body part being tested.
5. Provide the stimulus by applying light and equal pressure across the two points.
6. Have the patient identify if they feel one or two points.
7. Move the two points closer together across consecutive trials until the patient cannot distinguish the two points as separate.
8. Measure the distance between the two points using the aesthesiometer ruler.
9. Repeat throughout suspected areas and document findings.

Position sense:

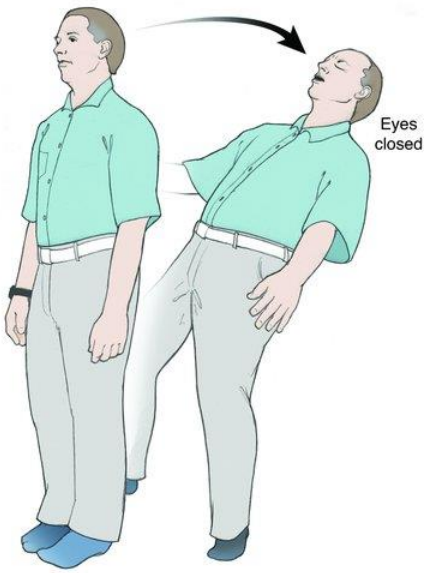
Clinically, joint position sense is often referred to as proprioception. Expected findings - The individual will be able to replicate the joint position accurately with the opposite extremity or describe the position verbally.

b. Grasp the patient's big toe and hold it away from the other toes to avoid friction. Show the patient "up" and "down."
c. 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.
d. Test the fingers in a similar fashion.
e. If indicated move proximally to the **metacarpophalangeal** joints, wrists, and elbows.

Motor Function

- Observation of gait and balance
- Administration of the **Romberg test**
- Administration of the **finger-to-nose test**
- Observation of rapid alternating action movements
- Administration of the heel-to-shin test

A. 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.
B. Point-to-Point Movements
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.
Coordination and Gait
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.
3. Ask the patient to move their arm and return to your finger with their eyes closed.
4. Ask the patient to place one heel on the opposite knee and run it down the shin to the big toe.
5. Repeat with the patient's eyes closed.
Gait
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
Romberg
1. Be prepared to catch the patient if they are unstable.
2. Ask the patient to stand upright with the feet together and eyes closed for 5-10 seconds without support. 3. Wait 20 seconds and observe for patient swaying and ability to maintain balance.
4. The test is said to be positive if the patient becomes unstable (indicating a vestibular or proprioceptive problem).
5. Remain close at hand in case the patient begins to sway or fall.
6. A patient who has a problem with **Proprioception (Somatosensory)** can still maintain balance by compensating with vestibular function and vision.
7. A loss of balance is interpreted as a positive **Romberg sign**.



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 in other than a young child. This is referred to as a positive Babinski
4. Positive Babinski is normal to age 24 months

Dermatomes 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

1. Use a suitable sharp object to test "sharp" or "dull" sensation.
2. **Test the following areas:**
    a. Shoulders (C4)
    b. Inner and outer aspects of the forearms (C6 and T1)
    c. Thumbs and little fingers (C6 and C8)
    d. Front of both thighs (L2)
    e. Medial and lateral aspect of both calves (L4 and L5)
    f. Little toes (S1)