

Sensory System Examination (on General Somatic Sensory System)

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A. The Pearls:

1. The integrity of sensory system (anatomical and functional) is vital to human daily functioning. The sensory system plays an important role in reflex activity, calibrating body position, regulating internal autonomic function such as blood pressure, heart rate, and respiratory, as well as **giving rise to conscious sensation**.
2. Some fundamental knowledge such as: dermatome, receptors, sensory modality, anatomy of the nervous system, functional anatomy, homunculus of conscious sensations, physiology of sensory system is required prior to the clinical examination sessions.
3. As part of a neurological examination, the (general somatic) sensory system examination (if done correctly and properly) will enable clinicians to:
 - a. Find the pattern of sensory abnormality (such as: proximal, distal, symmetric, asymmetric, dermatomal or peripheral nerve distribution).
 - b. Determine which of any components of the sensory system are damaged (peripheral, central, spinothalamic tracts, posterior columns).
 - c. Establish the diagnosis.
4. Sensory testing may quickly fatigue patients, resulting in unreliable results. So it is important to examine patient in efficient way. Rescheduling for the sensory testing may be needed in order to confirm abnormalities. In general, there are tips on how to conduct the examination of the sensory system:
 - a. When appropriate, enliven the procedures (games or curiosity matter)..... Let us see whether you can feel the buzz of this tuning fork).
 - b. Demonstrates and describe the test, ask patient to answer “yes” or “no”; “same” or “different”.
 - a. Apply the lightest pressure needed for the stimulus to feel sharp, and try not to draw blood.
 - b. Avoid other cues.
 - c. **Always** do comparing distal – proximal; left and right.
 - d. Vary the pace of testing.
5. According to **The International Standards for the Neurological Classification of Spinal Cord Injury** (ISNCSCI) by American Spinal Injury Association (ASIA):
 - a. There are **28** specific skin locations (table 01), referred to as **key sensory points***** (which representing dermatomes), to be tested on each side of the body for pin-prick and light touch appreciation.

No.	Dermatome	Key point
1	C2	<i>One cm lateral to the occipital protuberance at the base of the skull. An alternate key point is at least 3 cm behind the ear.</i>
2	C3	<i>At the apex of the supra-clavicular fossa.</i>
3	C4	<i>Over the acromio-clavicular joint.</i>
4	C5	<i>On the radial side of the antecubital fossa just proximal to the elbow.</i>
5	C6	<i>On the dorsal surface of the proximal phalanx of the thumb.</i>
6	C7	<i>On the dorsal surface of the proximal phalanx of the middle finger.</i>
7	C8	<i>On the dorsal surface of the proximal phalanx of the little finger.</i>

8	T1	<i>On the ulnar side of the antecubital fossa, just proximal to the medial epicondyle of the humerus.</i>
9	T2	<i>At the apex of the axilla.</i>
10	T3	<i>At the MidClavicular Line (MCL) and the third intercostal space, found by palpating the anterior chest to locate the third rib and the corresponding third intercostal space below it.</i>
11	T4	<i>At the MCL and the fourth intercostal space, located at the level of the nipples.</i>
12	T5	<i>At the MCL and the fifth intercostal space, located midway between the level of the nipples and the level of the xiphisternum.</i>
13	T6	<i>At the MCL, located at the level of the xiphisternum.</i>
14	T7	<i>At the MCL, located at one quarter the distance between the level of the xiphisternum and the level of the umbilicus.</i>
15	T8	<i>At the MCL, located at one half the distance between the level of xiphisternum and the level of the umbilicus.</i>
16	T9	<i>At the MCL, located at three quarters of the distance between the level of xiphisternum and the level of the umbilicus.</i>
17	T10	<i>At the MCL, located at the level of the umbilicus.</i>
18	T11	<i>At the MCL, midway between the level of the umbilicus and the inguinal ligament.</i>
19	T12	<i>At the MCL, over the midpoint of the inguinal ligament.</i>
20	L1	<i>Midway between the key sensory points for T12 and L2.</i>
21	L2	<i>On the anterior-medial thigh, midway on a line between the midpoint of the inguinal ligament and the medial femoral condyle above the knee.</i>
22	L3	<i>At the medial femoral condyle above the knee.</i>
23	L4	<i>Over the medial malleolus.</i>
24	L5	<i>On the dorsum of the foot at the third metatarsal phalangeal joint.</i>
25	S1	<i>On the lateral side of the heel.</i>
26	S2	<i>In the popliteal fossa of the knee at the midpoint.</i>
27	S3	<i>Over the ischial tuberosity.</i>
28	S4/5	<i>In the perianal area, less than one cm lateral to the mucocutaneous junction.</i>

Table 01: Key Sensory Points (Adapted from The **International Standards for the Neurological Classification of Spinal Cord Injury** (ISNCSCI), produced by American Spinal Injury Association (ASIA).

- b. The method for testing light touch appreciation:
 - i. The recommended testing instruments are a **tapered wisp of cotton, pulled off a cotton ball or off a cotton-tipped applicator stick**. If the instruments above are not available, the substitute instruments are: a finger tip, piece of tissue or dull end of safety pin. However, the use of any of the substitute instruments should be noted accordingly.
 - ii. The cotton is applied by **lightly and briefly stroking it across the skin, moving over a distance not exceed 1 cm**.
- c. The method for testing pin-prick appreciation:
 - i. The recommended testing instrument is a **standard safety pin**. The pin is to be opened and straightened out. The pointed end is used for sense of sharpness and the rounded end for the sense of dullness.
 - ii. Whether using the dull or pointed end, **light pressure is applied without moving the pin after point of contact**.
- d. When segmental sensory impairment is suspected, start sensory testing with pin-prick discrimination in a cephalad direction.
- e. **Joint movement appreciation** has not been observed to be present in the absence of any light touch appreciation or sharp/ dull discrimination.

- f. Testing for **deep anal sensation** is required when patients have absent sharp/dull discrimination and light touch appreciation in the perirectal area (S4-5 dermatome). Deep anal sensation test is done by inserting examiners index finger into anus and applying gentle pressure to the anorectal wall (innervated by the somatosensory components of the pudendal nerve S4/5). Alternately pressure can be applied by using the thumb to gently squeeze the anus against the inserted index finger.

Case Illustration:

A 61-year-old woman complains of imbalance, numbness and tingling in her hands and legs. She also having trouble buttoning her clothes. She thinks nothing wrong with her muscle strength. Symptoms started with very slight tingling sensations, which she noticed about 4 years ago. During this last 2 months, walking became increasingly difficult and unstable.

On examination, her vision is normal, normal mental status, normal muscle strength, normal tendon reflexes. Gait is moderately ataxic and she has to reach out for support by touching the walls of the hallway at times. Fine movements of the fingers are performed poorly. Sensation, particularly to vibration and joint position, is severely impaired in the distal upper and lower limbs.

B. Steps of Examination*:

(perform every clinical examination with practicing the necessary standard precautions)

1. *Greet the patient*
2. *Introduce yourself*
3. *Explain intension and procedure briefly*
4. *Chaperone*
5. *Exposure*
6. *Positioning (supine or sitting)*
7. *Perform the pin prick examination*
8. *Perform the light touch examination*
9. *Perform the proprioception/ vibration sense examination*
10. *Perform the examination of discriminative sensations/ function of sensory cortex*
11. *Conclude the session.*



Fig. 01: Tools for sensory testing.

C. Sensory Examination in General Health Screening:

Neurological system:

- **Mental status:**
Alert, relaxed and cooperative. Thought coherent, oriented to person, place and time.
- **Cranial nerves:**
I–XII intact.
- **Motor:**
Good muscle bulk and tone. Strength 5/5 except for both hands - flexors and extensors are non testable (NT) due to joint inflammation!
- **Cerebellar:**
Point - to - point movements, rapid alternating movements intact.
- **Sensory:**
Pin-prick, light touch, position sense, vibration and graphesthesia intact.
- **Reflexes:**

	Biceps	Triceps	Brachioradialis	Patellar	Achilles	Plantar
Right	2+	2+	2+	2+	2+	-
Left	2+	2+	2+	2+	2+	-

Spinothalamic

DCML

Cortical level

- Two-point discrimination
- Tactile extinction
- Point localization
- Stereognosis
- Graphesthesia

Fig. 02: Example of neurological examination notes (Medical Record).

Figure 02 shows medical notes on neurological system examination.

****** A reliable sensory system examination can only be achieved when the patient is able to comprehend the instructions given by the clinician (in this case, the patient was alert and cooperative).

In the examination of the (general somatic) sensory system, a clinician will test several kinds of sensations:

1. Pain and temperature (allowing clinicians to get the impression on the integrity of spinothalamic tracts).
2. Position and vibration (posterior columns/ DCML)
3. Light touch (both of these pathways).
4. Discriminative sensations, which depend on some of the above sensations but also involve the cortex.

There are 2 common terms used for light touch sensation:

1. **Crude touch** for less discriminative light touch; a sensation that is modulated through spinothalamic tracts.
2. **Fine touch** for more discriminative light touch; a sensation that is modulated through posterior columns (DCML: Dorsal Column Medial Lemniscus).

C.1. Examining Pain, Light Touch (crude touch) and Temperature (Spinothalamic tracts)

- PI see "*B. Steps of Examination (point 1 to 6)*". Supine is preferred and standard position for spinal cord injury cases.
- Select and use proper tool for pin-prick examination: **standard safety pin**.
- Briefly explain on how you would like to touch the patient's body with the safety pin. Then on reference point (the predicted normal area e.g. face or sternum), make sure that the patient is able to differentiate between sharp and dull sensation. The test cannot be continued (and labelled as NT / Not Testable) if patient shows no ability to reliably distinguish sharp/dull ends of the pin when tested on the reference point (in most of the case is on the face/ cheek).
- Do proper way of stimulation on the 28 key points*** (touch lightly with the sharp tip of safety pin, omit unnecessary cues such as through requesting the subject's eyes closed when needed).
 - Test and touch with the sharp end of the safety pin in all dermatomes of both sides of the body (at the key points). Alternately and irregularly in unpredictable way, touch with the dull end of the safety pin, and the patient is asked to state when he/ she has been touched and whether the feeling is sharp or dull.
 - If you have concluded that a patient can reliably discriminate at a location, then again you have to ensure that there is **no differences in the sensation of sharpness** between left and right side of the body, between proximal (reference point) and distal.

A client comes for a general medical checkup. Please do "pin-prick" sensory examination! (total mark: 5; 5 minutes time)

Answer Key:

The student/ examinee has to do the following:

Component to assess	Awarded mark
Greet the patient Introduce self & chaperone (if needed) Preparing subject for adequate exposure & proper positioning.	.5
Explain intension and procedure briefly On <u>reference point</u> (the predicted normal area e.g. face or sternum), student explains and make sure patient able to differentiate between sharp and dull sensation.	1 or 0
Proper examination: Proper tool selection (correct choice: safety pin) Next marks only be awarded if student use the right tool! Proper way of stimulation (touch lightly with the sharp tip of safety pin, omit unnecessary cues such as through requesting the subject's eyes closed when needed). The student must ensure whether patient is able to differentiate between sharp and dull (at a random dermatomal area, student has to substitute pin with the dull tip of safety pin). Student should check the pin sensation at all key sensory points. Student should ask patient if there is any different feeling between the pin stimulations , and then again, to be sure, the student has to test again whether there is any differences in pin sensations between left and right, proximal and distal.	.5 or 0 2, 1 or 0 (2 if done perfectly; 1 if done partly; and 0 if doing major mistake or severely inadequate)
Concluding the session.	1 or 0

SUB TOTAL

5

○ Total Mark :...../ 5; Examiner:; Signature:

Fig. 03: Example of OSCE question with the mark scheme.

- Temperature testing is often omitted if pain sensation is normal. In performing this test, you will use two test tubes, filled with hot and cold water, or a tuning fork heated or cooled by water. Touch the skin and ask the patient to identify "hot" or "cold."

C.2. Examining fine touch, proprioception and vibration sense (Posterior Columns)

- Pl see "*B. Steps of Examination (point 1 to 6)*". Supine is preferred and standard position for spinal cord injury cases.
- Select and use proper tool for light touch (fine touch) examination: a **tapered wisp of cotton**.
- Briefly explain on how you would like to touch the patient's body with the cotton. Then on reference point (the predicted normal area e.g. face or sternum), make sure that the patient is able to respond adequately. Ask the patient to promptly respond with "yes" when the cotton tip touches his/ her face (cheek). The test cannot be continued (and labelled as NT / Not Testable) if patient shows no ability to reliably respond to stimulation.
- Do proper way of stimulation on the 28 key points*** (touch lightly with the cotton, omit unnecessary cues such as through requesting the subject's eyes closed when needed).
- If the patient do appreciate the light touch, then you have to assess whether there are differences in feeling to the touch (with cotton) on both sides of the body, and also between the proximal (the reference point) and distal parts.

With reference to "Figure 3" above, you can train yourself by answering the following challenges:

- **A healthy client come for general medical checkup.... practice the examination for "light touch" sensory examination (in 5 minutes).**
- **An elderly patient with uncontrolled chronic diabetes, come for medical check to your clinic. Examine the "light touch" sense. What is the expected sensory loss pattern?**

- Test for **vibration sense**.
 - Pl see "*B. Steps of Examination (point 1 to 6)*".
 - **Tuning fork of low frequency 128 Hz** is used as the tool for vibration modality.
 - Briefly explain on how you would like to touch the patient's body with the tuning fork. Then on reference point (the predicted normal area e.g. Glabella or chin), ask patient whether he/ she can appreciate the vibrating and the non vibrating tuning fork. Make sure that the patient is able to respond adequately.
 - By avoiding visual cues, do the test on both sides of the body. For upper extremities, test the vibration sense on the distal interphalangeal joint of the patient's finger. For the lower extremities, test the vibration sense over the interphalangeal joint of the big toe.
 - If vibration sense is impaired, proceed to more proximal bony prominences (e.g., wrist, elbow, medial malleolus, patella, anterior superior iliac spine, spinous processes, and clavicles), and note where the vibration sense is normal.

- Test for **Proprioception (joint position sense)**.
 - Pl see "*B. Steps of Examination (point 1 to 6)*".
 - Briefly explain on how you would like to move the patient's finger-joint. Let the patient see when his finger is moved up and down and ask him to state the direction of the movement (e.g. "Up" or "down").
 - By avoiding visual cues, do the test. Grasp the patient's big toe, holding it by its sides between your thumb and index finger, and then pull it away from the other toes. This prevents extraneous tactile stimuli from affecting position testing. Do the movement in small arc and in irregular directions, and ask the patient to state the direction of movement (e.g. "Up" or "down"). Perform the test until you get the impression of patient's proprioception status on that particular joint. Proceed with the other side and also the fingers of the upper extremities.
 - If position sense is impaired, move proximally to test it at the ankle joint.
 - In a similar fashion, do the test for the fingers, and if indicated, to the metacarpophalangeal joints, wrist, and elbow; and
 - Note where the proprioception is normal.

C.3. **Examination of discriminative sensations (cortical sensations); e.g.:** stereognosis, graphesthesia, two-point discrimination, point localization, extinction.

- **Stereognosis** refers to the ability to identify an object by feeling it. Place in the patient's hand a familiar object such as a coin, paper clip, key, pencil, or cotton ball, and ask the patient to tell you what it is. Normally a patient will manipulate it skillfully and identify it correctly within **5 seconds**. Asking the patient to distinguish "heads" from "tails" on a coin is a sensitive test of stereognosis.
- **Graphesthesia** refers to the ability to recognize writing on the skin purely by the sensation of touch. This test can be done to replace stereognosis testing when motor impairment, arthritis, or other conditions prevent the patient from manipulating an object well enough to identify it. You may test the patients' ability to recognize number which is written on patients' palm and plantar of foot. Before the test, let the patient sees his palm and or foot and tell him/ her which is upper and which is lower part. With the blunt end of a pen or pencil, draw a large number in the patient's palm. A normal person can identify most such numbers.

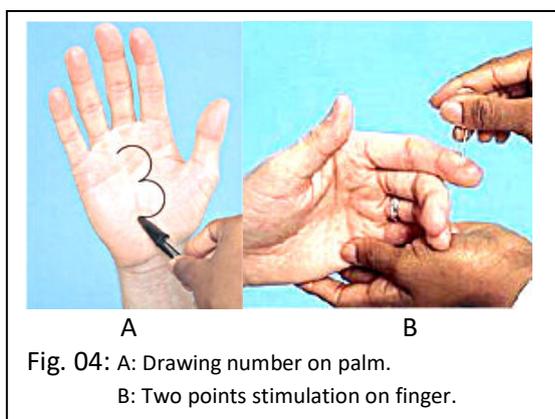


Fig. 04: A: Drawing number on palm.

B: Two points stimulation on finger.

- **Two-point discrimination** refers to the ability to discern that two nearby objects touching the skin are truly two distinct points, not one. This examination will use the two ends of an opened paper clip. Screening examination is done by touching the patients' finger pad/ plantar of the big toe in one or "two points simultaneously". Alternate the double stimulus irregularly with a one-point touching and assess the patients' ability to sense the stimulus as one or two points. Be careful not to cause pain. Find the minimal distance at which the patient can discriminate one from two points (normally <5 mm on the finger pads). This test may be used on other parts of the body, but normal distances vary widely from one body region to another.
- **Point localization** refers to the ability to locate a point on the skin that is stimulated. With avoiding clues from vision or as patient to close eyes, briefly touch a point on the patient's skin. Then ask the patient to open both eyes and point to the place touched. Normally a person can do so accurately. This test, together with the test for extinction, is especially useful on the trunk and the legs.
- **(Tactile) Extinction** refers to disorder that impairs the ability to perceive multiple stimuli of the same type simultaneously. This test is done by simultaneously stimulate corresponding areas on both sides of the body. Ask where the patient feels your touch. Normally both stimuli are felt.

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