



**Neurophysiology I Module
Physiology Lab 1**



**Sensory Examination
&
Sensory Lesions**

Presented by:
Dr.Shaimaa Nasr Amin
Associate Professor of Medical Physiology

1

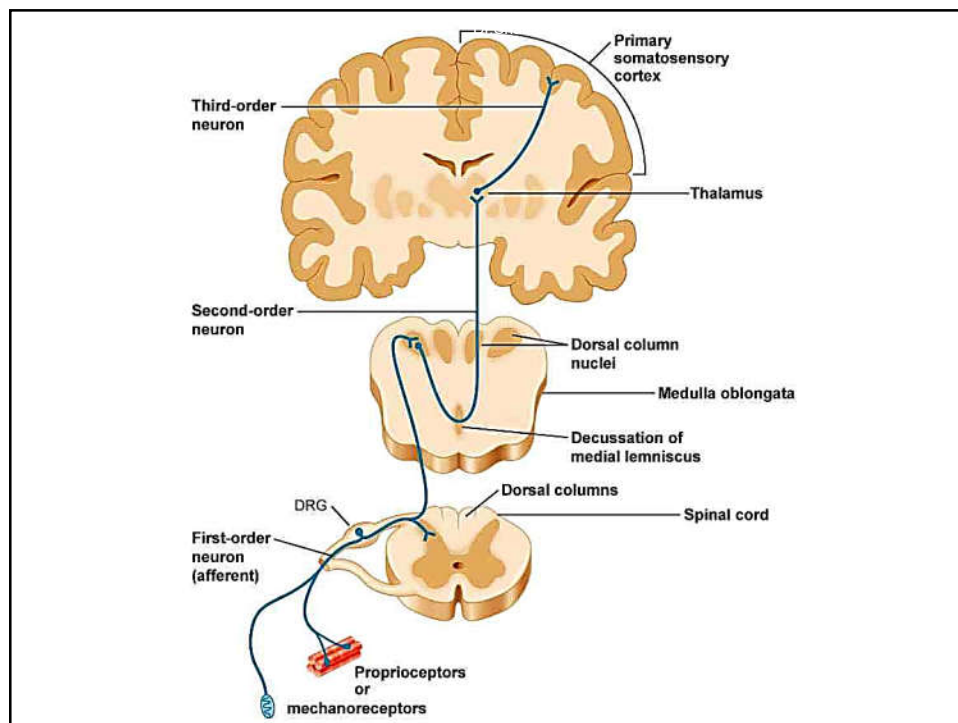
Sensory Examination

2

General rules for testing any sensation:

- 1- Work in pairs, one student acting as a subject and the other as observer
- 2- Examine the subject while closing his eyes
- 3- Start examination from periphery then proceed inwards
- 4- Compare the results of both side
- 5- The observer should ensure that the subject's answers are honest and based on the actual sensation felt.
- 6- Do not suggest the response either verbally or by allowing him to see the stimulus.

3



4

Sensations carried by dorsal column		
Sensation	Receptor	Afferent fiber
Fine touch	Meissner's & Merkels.	A β
Stereognosis	mixture	A β
Pressure	Pacinian & spray	A β
Vibration S.	Pacinian & Me.	A β
Position S.	Pacinian Muscle spindles , Ruffini endings Golgi tendon organs in tendons	A α -A β

5

<p>Fine touch: Touch which is highly discriminative and sharply localized Receptors: Meissner's and Merkels Pathway: Dorsal column It includes:</p> <p>a- Tactile Localization: Definition: The subject is able to localize accurately the site of stimulation while closing his eyes Procedure:</p> <ol style="list-style-type: none"> 1. Ask the subject to close his eyes. 2. Touch different parts of the body with blunt, non sharp object. 3. Ask him to locate the exact area touched. 4. Compare corresponding points on both sides of the body

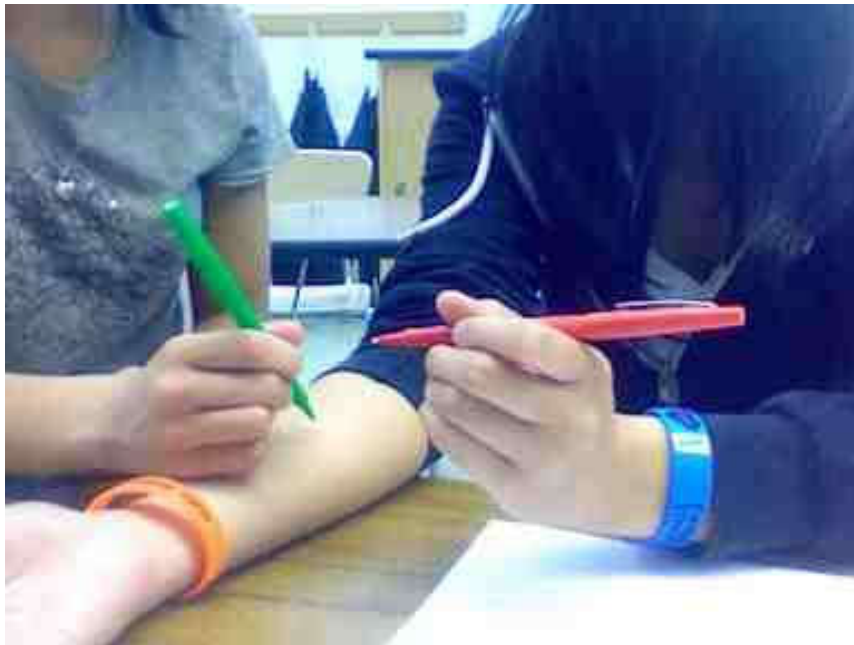
6

Tactile Localization



- Have pt close eyes
- Touch pt on R cheek & L arm
- Ask patient where touch was felt

7



8

b- Two-point discrimination

Definition: The ability to feel 2 touched points simultaneously as 2 separate points supposing that they are separated by a threshold distance.

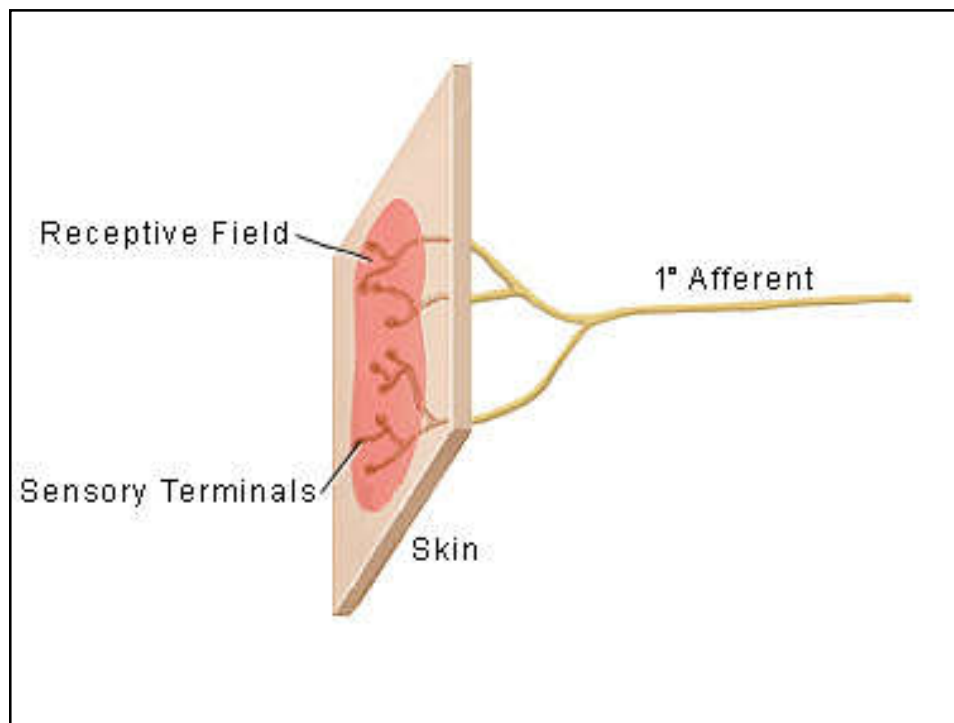
Materials:

1- Weber's compass: It has 2 points and a scale to read the distance between the 2 points.

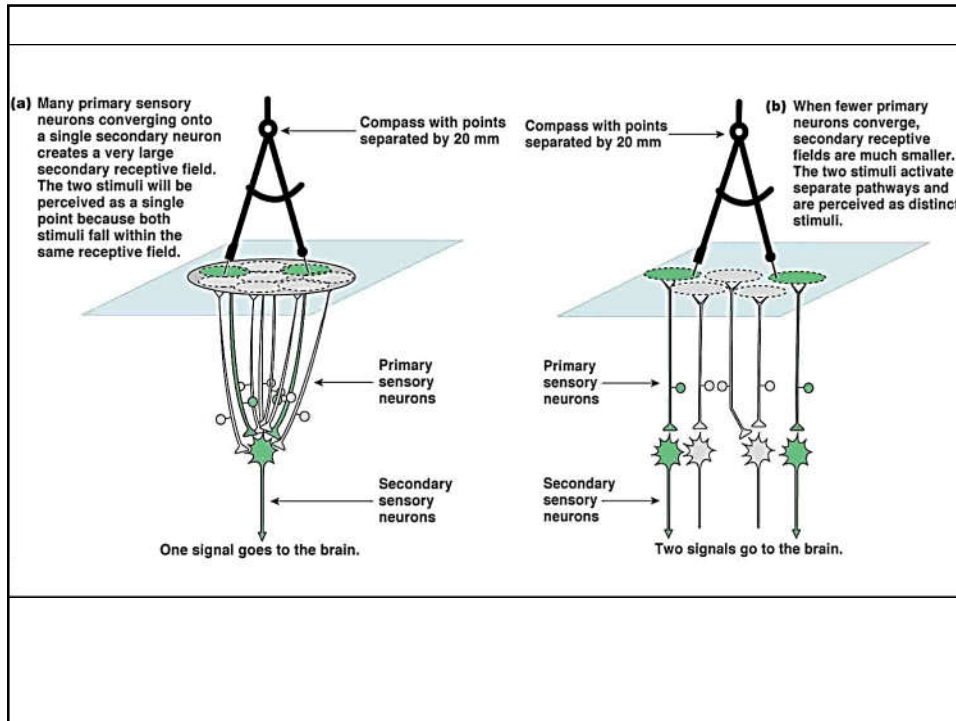
Procedure:

1. Ask the subject to close his eyes.
2. With the calipers of the compass wide apart, touch two areas at the back of the hand.
3. Ask the subject to say whether he feels two points of touch or a single point. The subject should report one, two or don't know

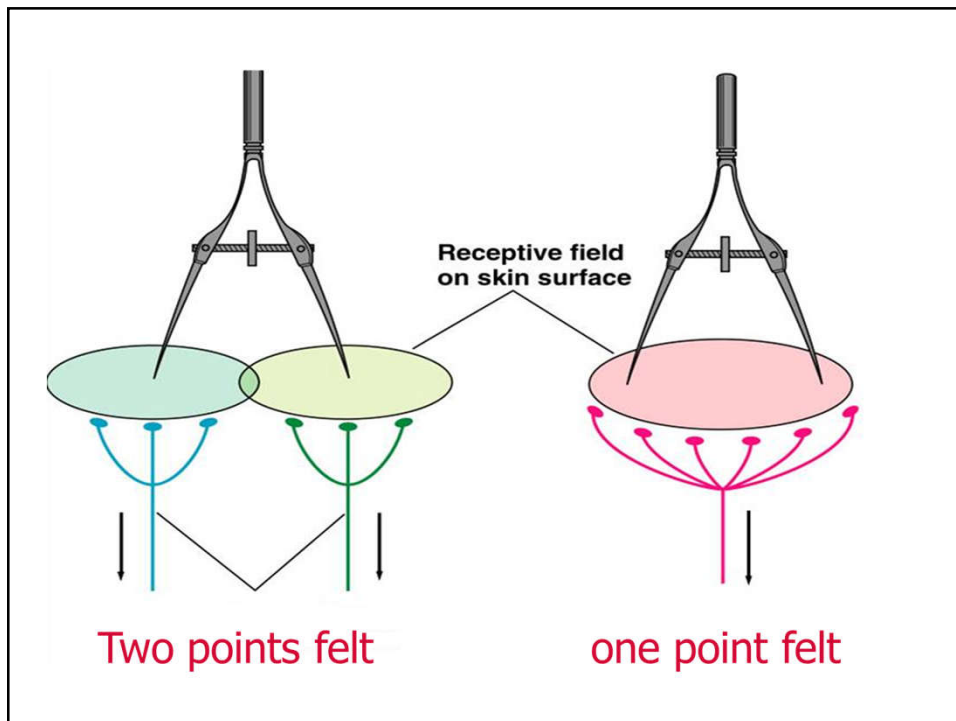
9



10



11



12

Shorter threshold distance:

↑ No of receptors

↓ Receptive field

↓ degree of convergence

↑ Area of representation

13

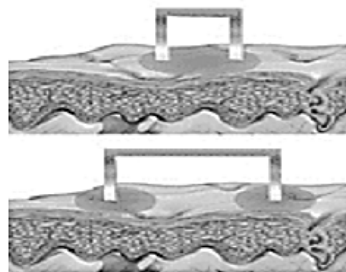
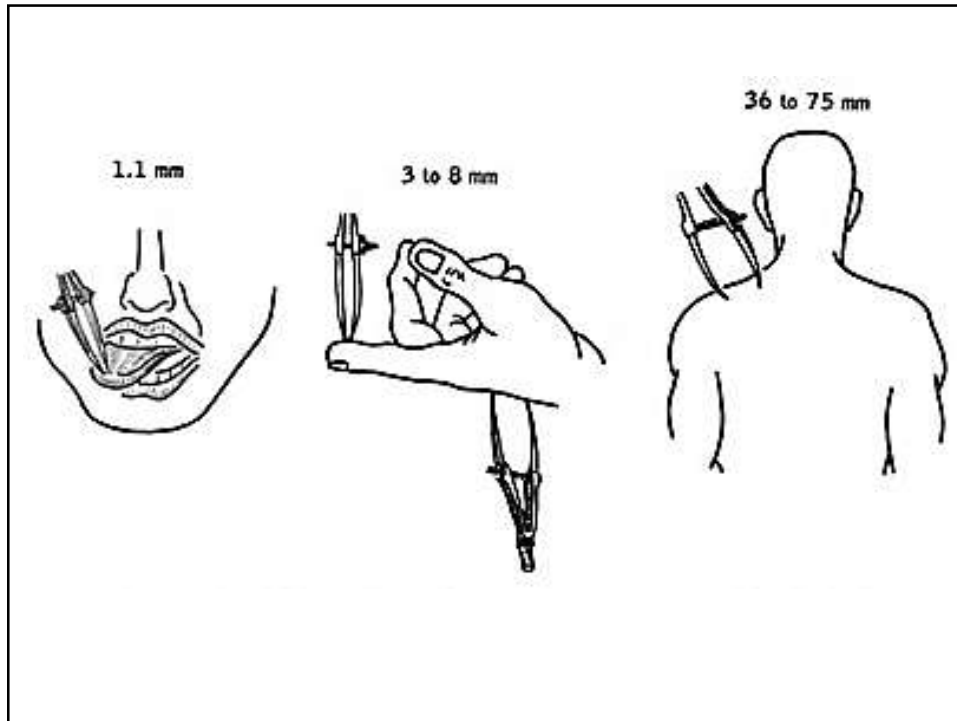


Fig (1): 2 point discrimination distance

4. Now decrease the distance between two limbs of the caliper and measure in millimeters the minimum distance that he can feel the points as two distinct points.
5. Determine the two-point threshold distance in the following areas: lips, back of hand, palm of hand, fingertips, back of neck and forearm.

14



15

7- Record your results in a table and compare to the normal values below:

Area	Normal Distance	Results obtained
Fingertips, lips	2 mm
Palm of hand	5 mm
Dorsum of hand	7 mm
forearm	9 mm
Back of neck	30-40 mm

16

Stereognosis:

It is the ability to recognize the familiar objects (needs previous experience) placed in the hand by touch while both eyes are closed

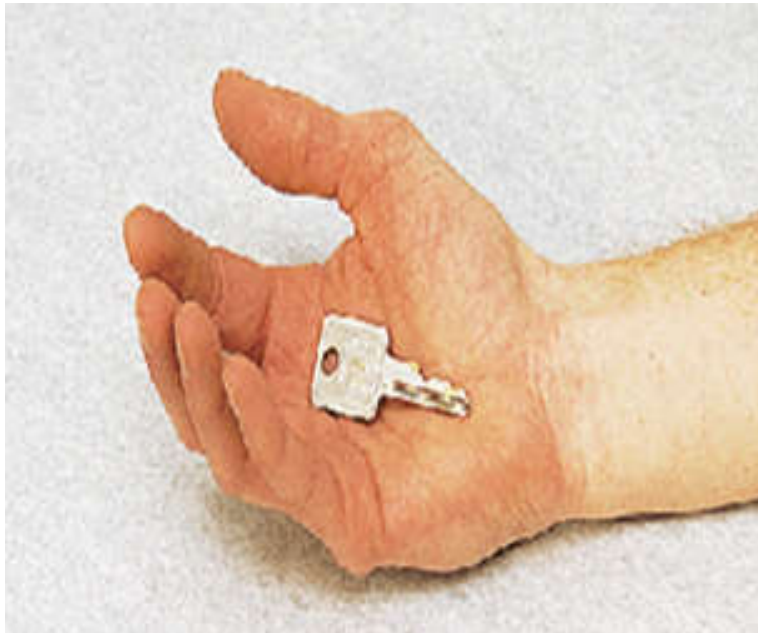
Receptors: mixture of touch, pressure, stretch and temperature

Pathway: dorsal column

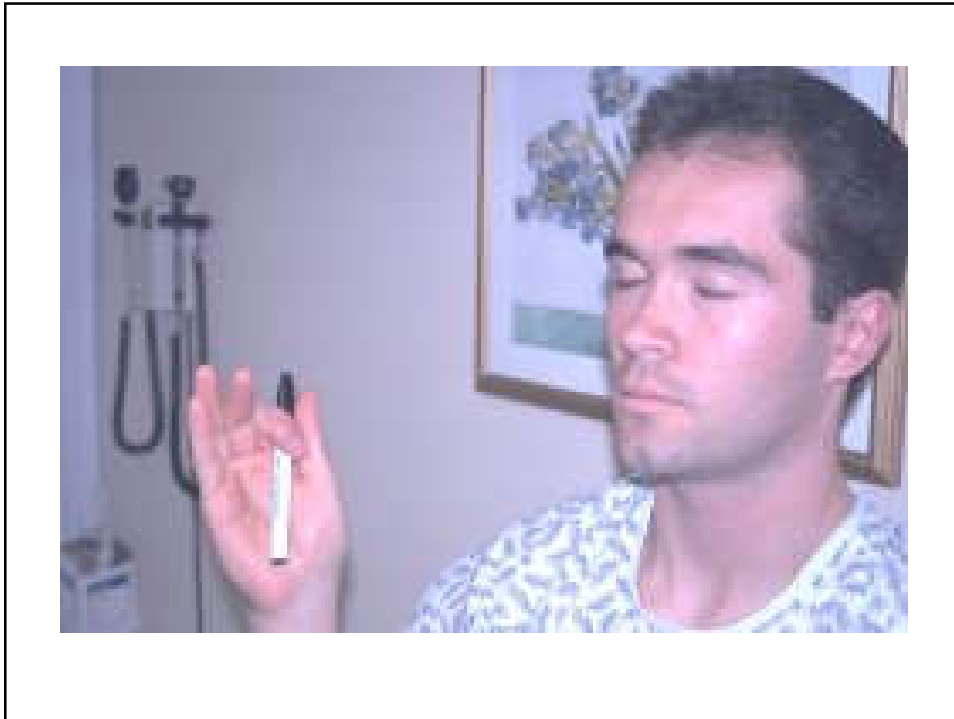
Procedure:

1. Ask the subject to close his eyes.
2. Place any common object like coins, keys, pen etc. in his palm and ask him to identify the object without looking at it.

17



18



19

Texture of Material:

It is the ability of the person to know the type of a piece of clothes (silk, cotton, ect) by feeling it with eyes closed.

-It is a type of stereognosis.

Weight discrimination:

It is the ability to discriminate between different weights (fine pressure)

Receptors: Paccinian corpuscles and spray type endings.

Pathway: dorsal column

Procedure:

1. Ask the subject to close the eyes and place his hand on the table.
2. Place different weights in his hands.
3. Ask him to indicate if he could identify the variations in the weights placed on his hand.

20

-Light pressure:

- Pressure touch
 - Sensed by cutaneous receptors.

Vibration sense:

It is the ability to feel the vibrations of a tuning fork put on any part of the body, but more prominently on bony eminences (Magnify the stimulus)

Receptors: Paccinian c/sec – Meissner 80 c/sec

Pathway: dorsal column

Tools needed:

Tuning fork: low frequency (128-250 c/s) and long arms

Procedure:

- 1-Ask the subject to close his eyes.
- 2- Strike the tuning fork and place its foot successively over identical bony prominences on each side of the body such as knuckles, head of radius, elbow, patella, malleoli, styloid process, iliac crest, etc.
- 3- Ask the subject to acknowledge whether he feels the vibration and whether it is of the same intensity on the two sides. The normal subject feels a vibratory tremor not just sensation of touch.
- 4- Test if the subject can accurately identify when the vibration stops

21



22

-Proprioceptive sensation:

Proprioception is the sensation of the position of different parts of the body relative to each other and the position of the body in space as well as the movements of each other.

Pathway: Grail & cunuate tracts.

There are two types:-

(1)Static proprioception (sense of position).

(2)Dynamic proprioception (sense of movement).

(A)Sense of Position =Static proprioception:

It is the sense of the position of different parts of the body relative to each other.

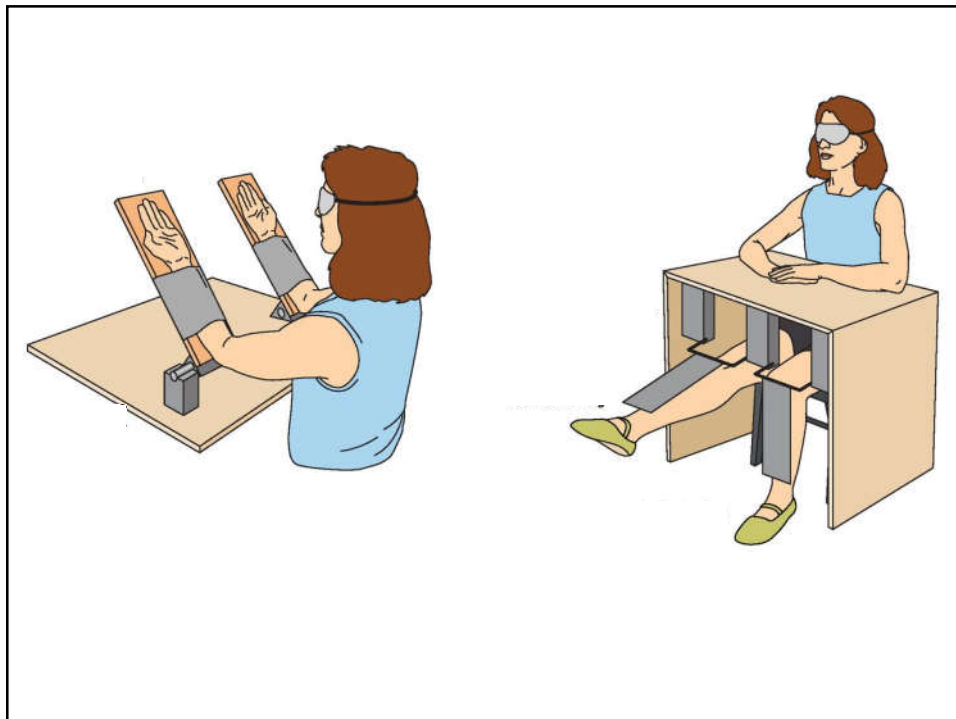
Receptors are muscle spindles, Golgi tendon organs and Ruffini end ending.

(B)Sense of Movements = Dynamic proprioception:

It is the sense of Joint movements.

Receptors: Pacinian corpuscles & Golgi tendon organ.

23



24



25



26

Positive Romberg's sign



27

EXAMINATION OF SPINOTHALAMIC SENSATIONS

28

Sens. carried by Spinothalamic Tract

Sensation	Receptor	Afferent fiber
Crude Touch	FNE & Hair F.	A δ (VST)
Tickle & itch	FNE	C (VST)
Warm	FNE	C (LST)
Cold	FNE	C & A δ (LST)
Pain	FNE	C & A δ (LST)

29

Crude touch:

Touch with poor intensity discrimination and localization

Receptors: Free nerve endings and hair end organs

Pathway: ventral spinothalamic tract

Procedure:

- a- It is examined by a piece of cotton.
- b- Ask the person if he feels touch or not
- c- Compare both right and left sides of the body

30



31

Pain Sensation:

This sensation can be tested either with a cutaneous stimulus, such as the prick of a pin, or by pressure on deeper tissues, such as muscles and bone

Receptors: Free nerve endings

Pathway: lateral spinothalamic tract

Procedure:

(a) Superficial Pain

1- Ask the person to close his eyes

2- Elicit the sensation of pain on the nailbed, pulp of fingers, palms and back of the hands and arms using an ordinary pin.

(b) Pressure Pain

Put pressure on deep structures such as calf muscles, tendoachilis or wrist bones and ask him whether he feels pain.

(c) Referred pain:

Place the elbow in ice water, at first pain is felt in the region of elbow, then pain is felt along distribution of ulnar nerve (ring finger, little finger and inner side of the hand)

32

Testing Pain Perception



33

Temperature sense:

Receptors: Free nerve endings

Pathway: lateral spinothalamic tract

Procedure:

1. With two test-tubes containing warm (not hot) and cold water, touch at different sites of the body of your subject.
2. Ask him to report "cold" or "warm"
3. The tubes should be interchanged at random



34

MAJOR SENSORY ABNORMALITIES:

Hypoesthesia, Anaesthesia: reduced or absent touch sensation.

Hyperesthesia: lowered threshold to tactile stimuli.

Paresthesia: tingling or numbness sensation (pins and needles).

Hypoalgesia, Analgesia: reduced or absent pain sensation.

Hyperalgesia: exaggerated response to painful stimuli.

a- Primary hyperalgesia: occurs in the injured area and is caused by sensitization of local nociceptors by inflammatory mediators, e.g. in sunburned skin.

b- Secondary hyperalgesia: occurs in uninjured area due to facilitation of sensory transmission, e.g. in thalamic syndrome.

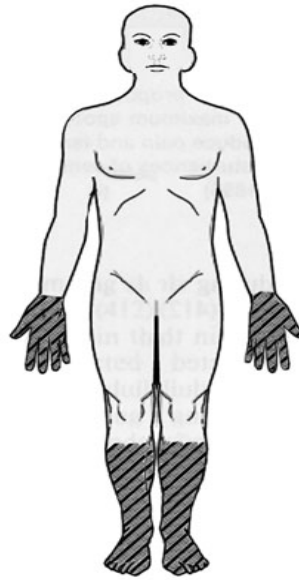
Allodynia: exaggerated pain response to non-painful stimuli, e.g. light touch.

35

SENSORY LESIONS

36

Peripheral nerve lesions



Polyneuropathy
("glove and stocking" deficits)

37

POLYNEURITIS (PERIPHERAL NEURITIS)

This disease is also called *polyneuropathy or peripheral neuropathy*. It is characterized by widespread bilateral symmetrical degeneration of the peripheral nerves in the limbs (including both sensory and motor nerves), and some cranial nerves may also be affected.

Causes of polyneuritis

1. Vitamin B deficiency, particularly vitamin B₁ (thiamine).
2. Certain metabolic disturbances (e.g. diabetes mellitus).
3. Toxic causes whether endogenous (e.g. uremia) or exogenous (e.g. lead, mercury and arsenic poisoning).
4. Nerve infection by certain viruses or bacteria (e.g. leprosy and tetanus).
5. Some endocrine diseases (e.g. hyperthyroidism and acromegaly).
6. Certain allergic conditions.

Dr.Shaimaa N.Amin, CNS 2021

38

Manifestations of polyneuritis

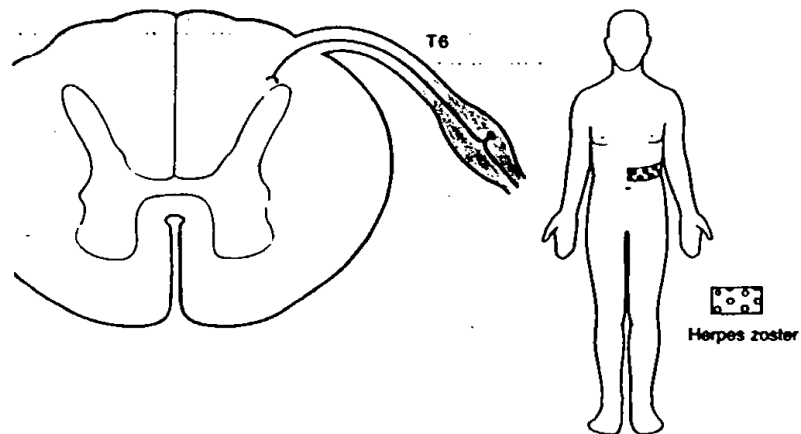
(1) **Sensory disturbances** : At first, there is *paraesthesia* (= sensation of pin-pricking, burning, numbness or tingling) in the fingers and toes. Later, *anesthesia* occurs in the peripheral parts of the limbs, taking a *glove and stocking distribution*. The superficial and deep sensations are also lost, and the latter leads to *sensory ataxia* (see above).

Dr.Shaimaa N.Amin, CNS 2021

39

Spinal cord lesions

Herpes zoster



Dr.Shaimaa N.Amin, CNS 2021

40



41



42



Dr.Shaimaa N.Amin, CNS 2021

43

Herpes Zoster:

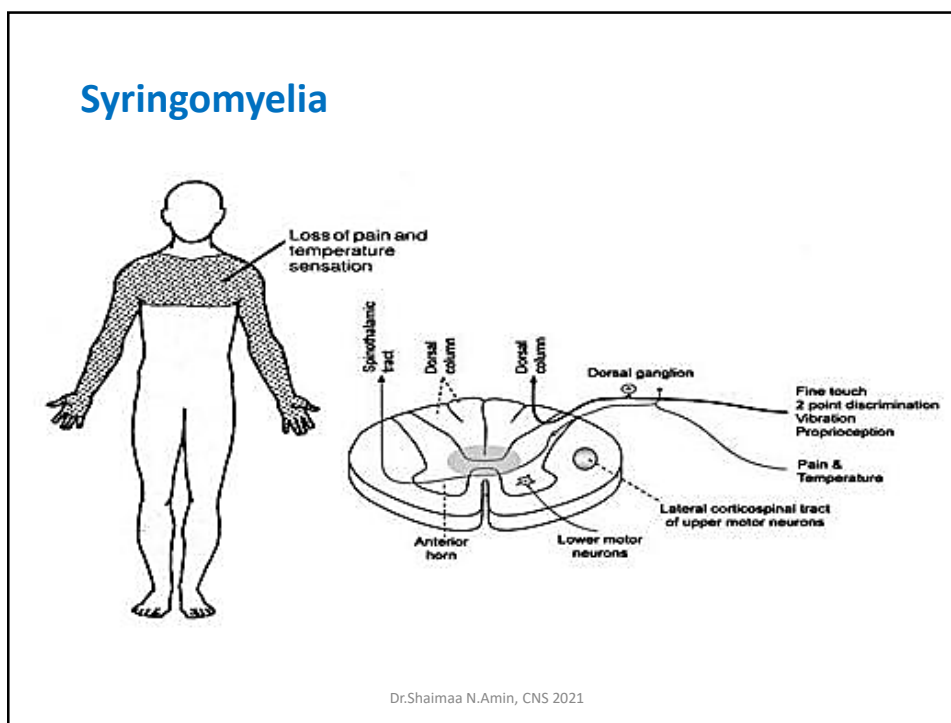
-It is a viral infection, in which the herpes virus attacks a dorsal root ganglion (DRG) in patients with history of varicella (chicken pox) infection.

-Virus starts to reproduce causing irritation of pain afferents in the DRG leading to severe pain felt in the dermatomal segment supplied by the infected ganglion.

-The virus also migrates with neuronal cytoplasmic flow towards the peripheral axons to their cutaneous terminals, where it reproduces leading to painful skin rash and vesicular formation.

Dr.Shaimaa N.Amin, CNS 2021

44



45

SYRINGOMYELIA

This is a slowly progressive disease that is probably congenital in origin. It occurs in middle ages and *females are more affected*. There is an *abnormal overgrowth of neuroglial tissue (= gliosis) associated with cavitation around the central canal of the spinal cord*. The lesion may extend upwards in the brain stem, resulting in *syringobulbia*.

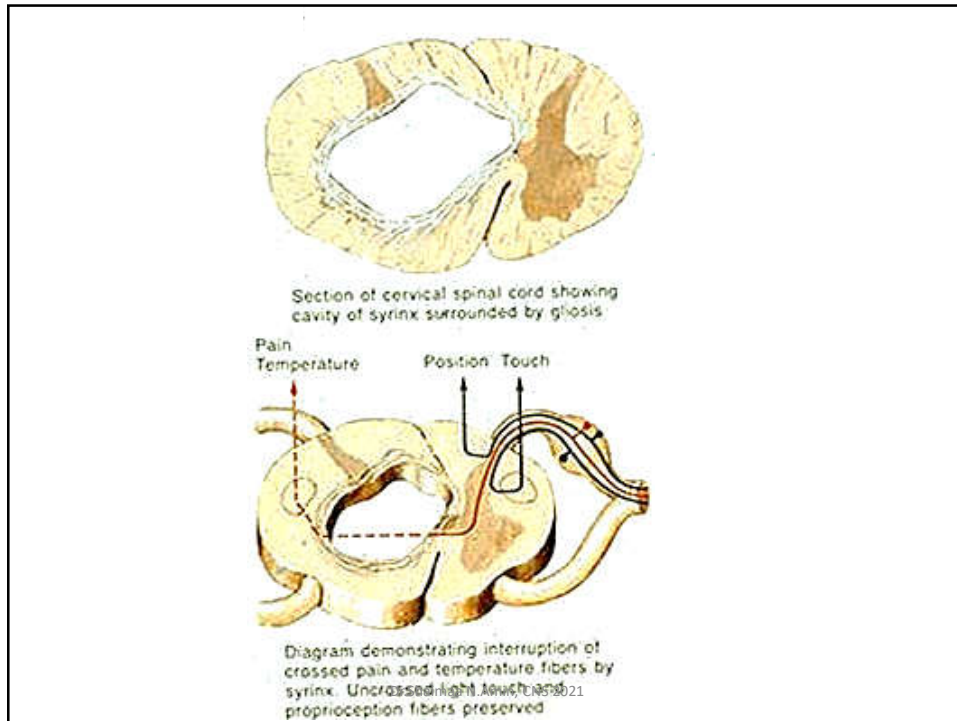
Manifestations (symptoms) of syringomyelia

(1) **Dissociated sensory loss** (= loss of some sensations and preservation of others). Because the lesion damages the crossing fibres of the lateral spinothalamic tracts in front of the central canal, there is *bilateral loss of pain and temperature sensations at the level of the lesion*. On the other hand, fine tactile and proprioceptive sensations are preserved because the *dorsal columns are not affected*.

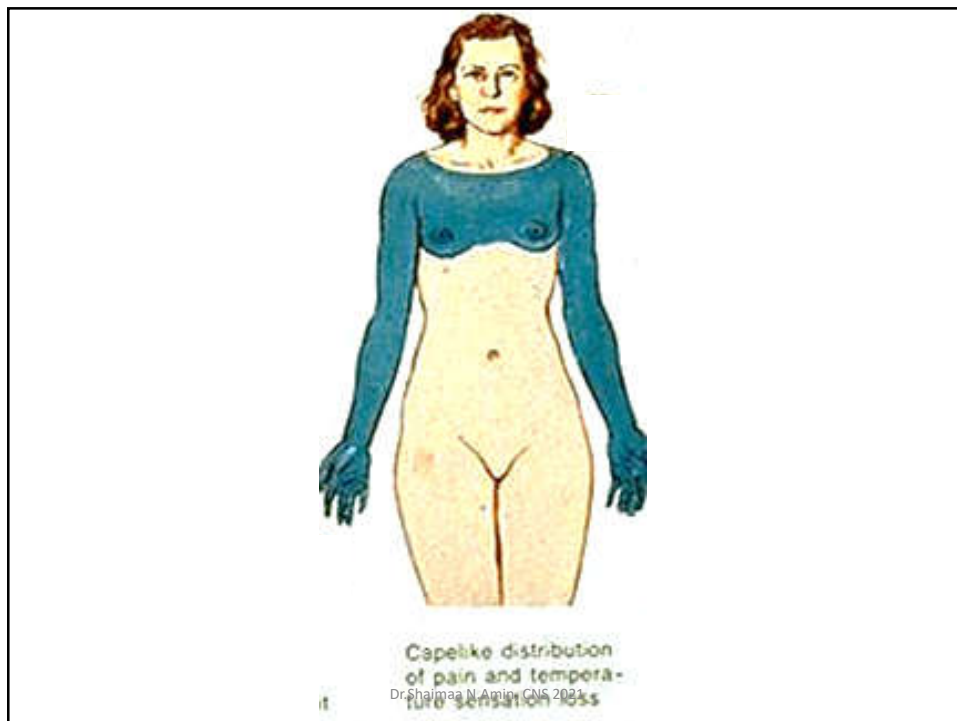
The lesion usually affects the *lower cervical and upper thoracic segments* of the spinal cord, so its manifestations often have a *"jacket distribution"*.

Dr.Shaimaa N.Amin, CNS 2021

46

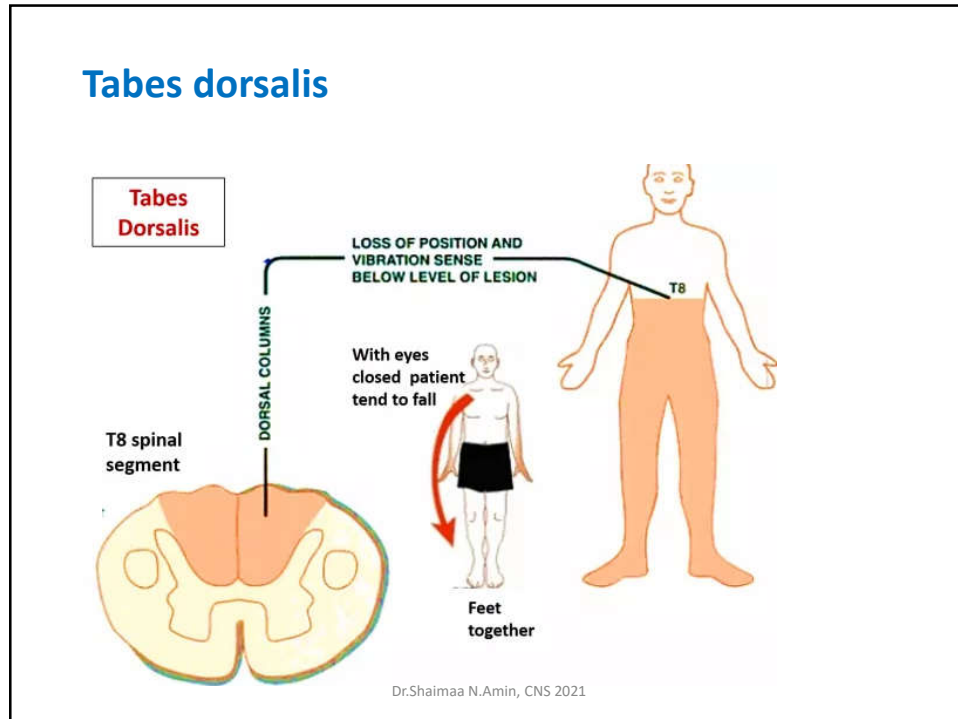


47



48

Tabes dorsalis



49

TABES DORSALIS

This is a disease that occurs in the late stage of *neurosyphilis* as a result of inflammation of the posterior (or dorsal) nerve roots (which is commonly *bilateral at the lower thoracic or lumbosacral regions of the spinal cord*).

Dr.Shaimaa N.Amin, CNS 2021

50

Manifestations (symptoms) of tabes dorsalis

(A) Early manifestations

(1) **Attacks of severe sharp pain** (= *lightning pain*) due to irritation of the pain-conducting afferent nerve fibres by the inflammatory process.

(2) **Degeneration of the gracile and cuneate tracts** (because their thick nerve fibres are readily affected by compression and *regeneration cannot occur because these nerve fibres lack neurolemma*). This causes atrophy of the dorsal column of spinal cord (**tabes = atrophy**) and leads to :

1- Loss of the fine tactile sensations and the vibration sense.

2- Loss of the conscious proprioceptive (kinesthetic) sensations (i.e. the senses of position and movement) as well as the subconscious proprioceptive information to the cerebellum. This leads to incoordination of voluntary movements called **sensory ataxia** (page 113) which is characterized by :

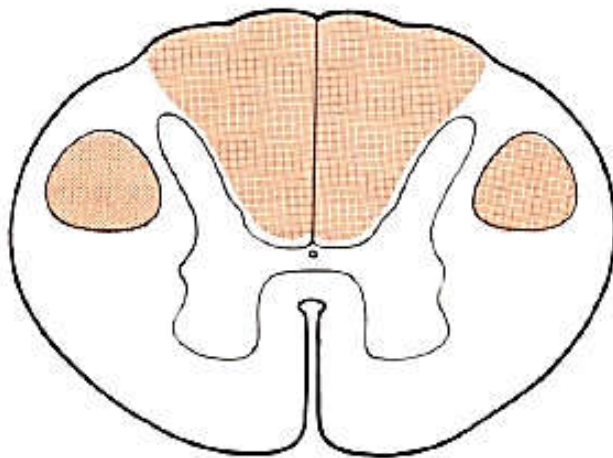
a- The patient walks at a broad base and finds difficulty in walking.

b- **Equilibrium disturbances** : On closing his eyes, the patient sways and may fall (e.g. during washing his face). This is called **Romberg's sign**, and it is due to loss of the main mechanisms that maintain equilibrium (i.e. vision and the proprioceptive sensations).

c- **Stamping gait** : During walking, the patient raises his legs too high then drops them forcefully (because he is unaware of their position).

51

Sub-acute combined degeneration



Dr.Shaimaa N.Amin, CNS 2021

52

SUBACUTE COMBINED DEGENERATION (SCD)

This is a slowly-progressive disease due to **deficiency of vitamin B₁₂** (so it is often associated with pernicious anemia). It is characterized by *poly-neuropathy* together with *bilateral degeneration of the dorsal and lateral columns* of the spinal cord.

Manifestations of SCD

These occur *mainly in the lower limbs*, and include the following :

- (1) *Loss of deep sensations and sensory ataxia* due to degeneration of the gracile and cuneate tracts.

Dr.Shaimaa N.Amin, CNS 2021

53



54