

**Gomel State Medical University**  
**Department of Neurology and neurosurgery**

**Lecture**

**SENSORY SYSTEM AND  
DISTURBANCES OF SENSATION**

**Lecturer: Serebrova E.V.**

## **TYPES OF SENSATION**

- **Exteroceptive**
- **Proprioceptive**
- **Interoceptive**
- **COMBINED SENSATION**

## **TYPES OF RECEPTORS**

### **DISTANT RECEPTORS -**

in eyes and ears

### **EXTEROCEPTORS:**

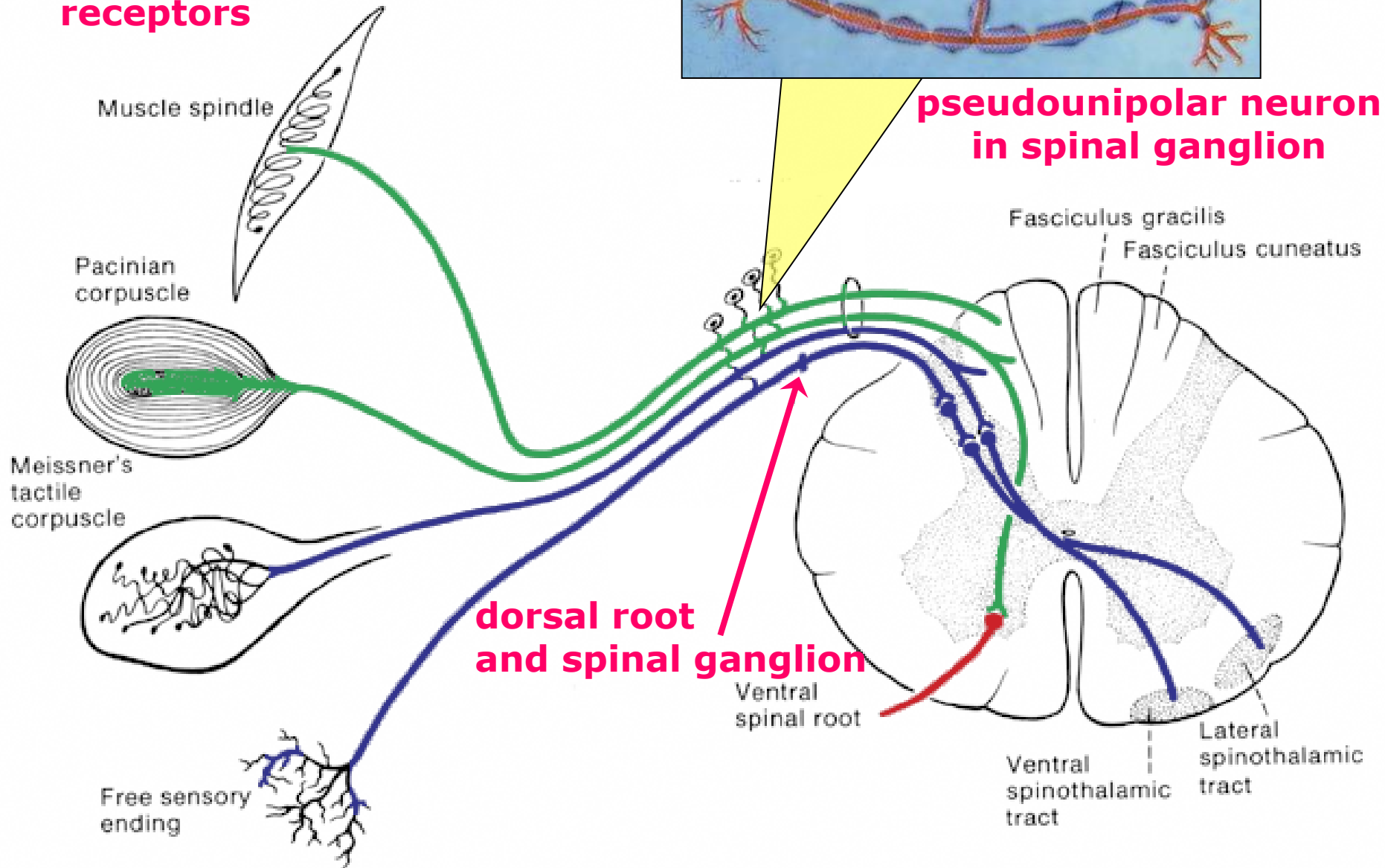
- free endings (nociceptors)
- mechanoreceptors
- thermoreceptors:

### **PROPRIOCEPTORS**

### **INTERO(VISCERO)CEPTORS**

# SENSORY PATHWAYS OVERVIEW

## receptors

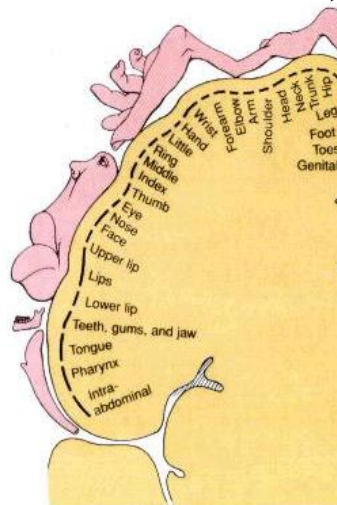


# THE EXTEROCEPTIVE SENSATION

**PAIN SENSATION**

**TEMPERATURE SENSATION**

**TACTILE SENSATION**



*tactile and pressure sensations -*

*anterior spinothalamic tract*

*pain and temperature sensations -*

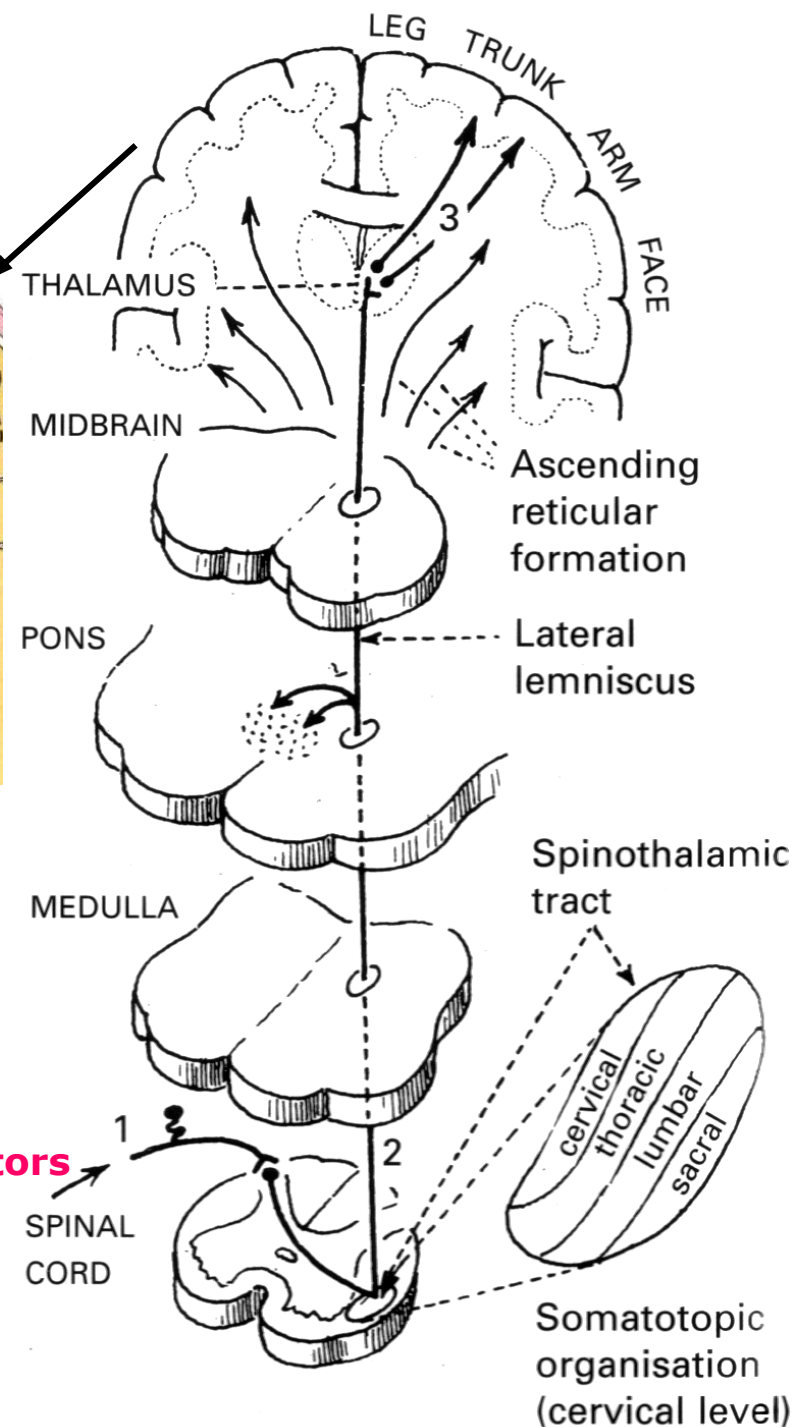
*lateral spinothalamic tract*

**1<sup>st</sup> neuron** – spinal ganglion

**2<sup>nd</sup> neuron** - nerve cells in posterior horns

**3<sup>rd</sup> neuron** – thalamic posterolateral ventral nucleus

**exteroceptors**



# THE PROPRIOCEPTIVE SENSATION

SENSE OF MOTION AND POSITION

SENSE OF VIBRATION

PRESSURE SENSATION

**fasciculus gracilis (Goll's tract):**

*perineal saddle region, legs, and lower trunk*

**fasciculus cuneatus**

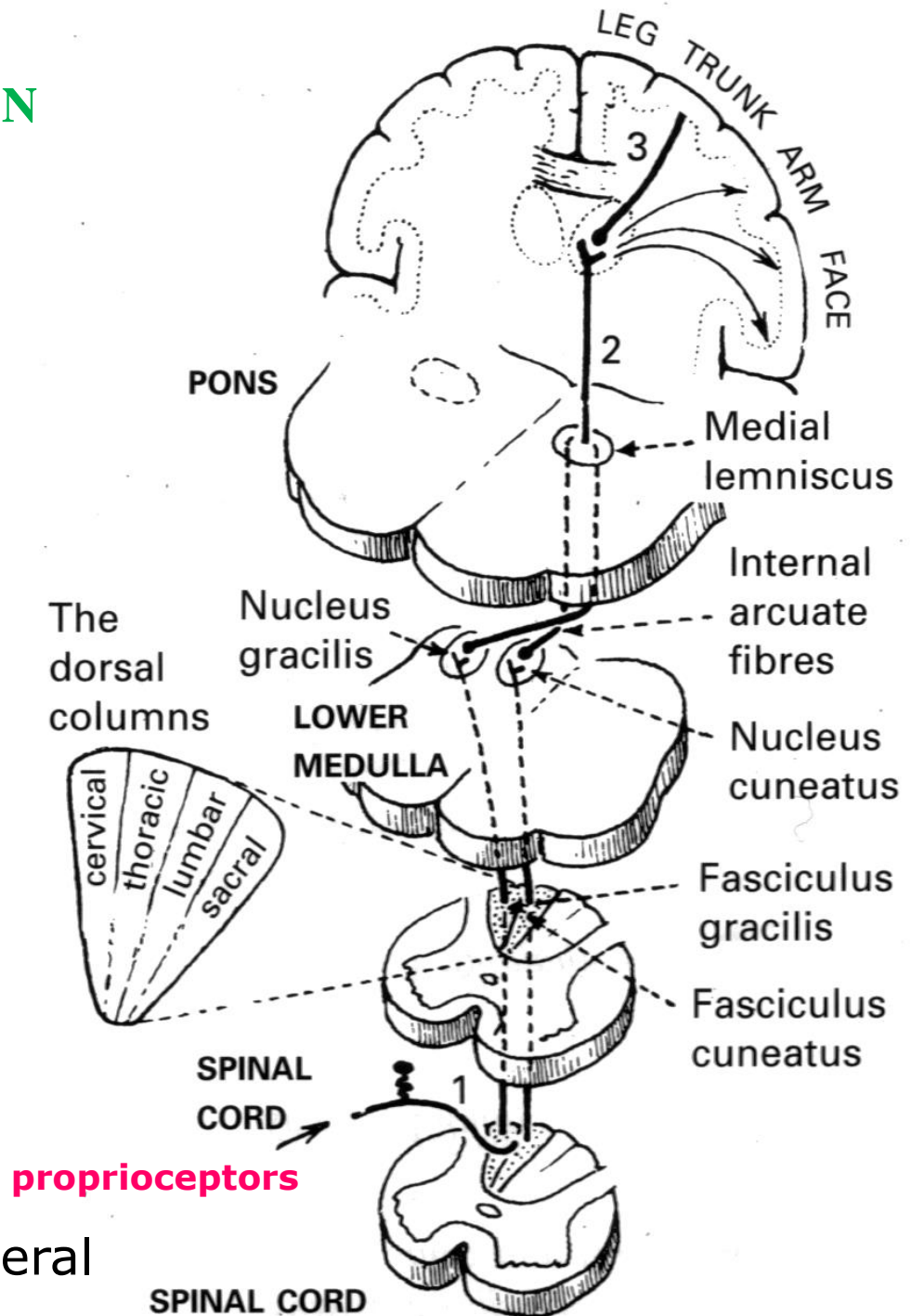
**(Burdach's tract) :**

*chest, arms, and neck*

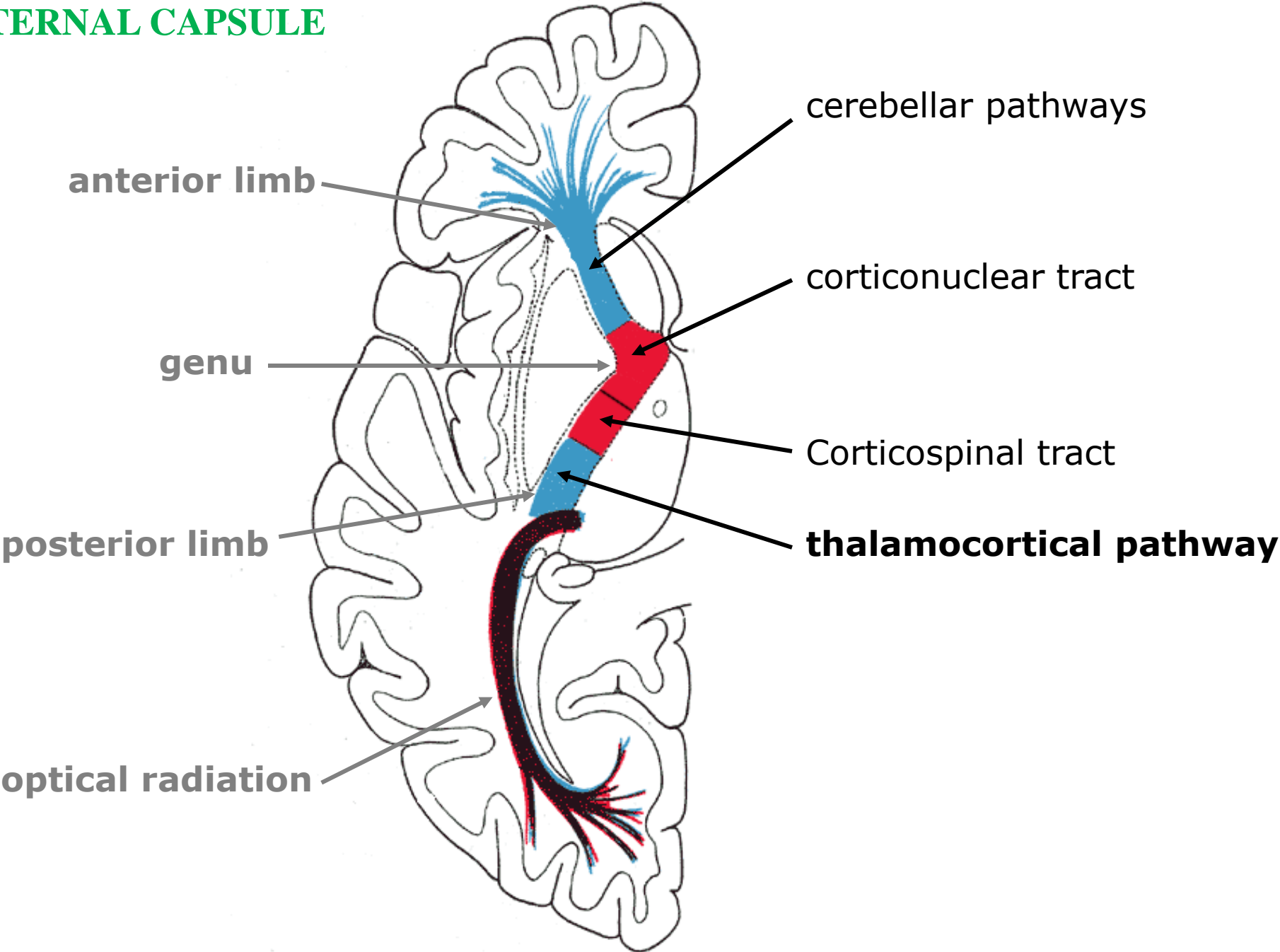
**1<sup>st</sup> neuron** – spinal ganglion

**2<sup>nd</sup> neuron** - nerve cells in the nuclei gracilis and cuneatus

**3<sup>rd</sup> neuron** - thalamic posterolateral ventral nucleus



**INTERNAL CAPSULE**



# Examination Of Sensory System

## The Exteroceptive Sensations

### Superficial pain sensation

*analgesia*

*hypalgesia*

*hyperalgesia*

### Temperature sensations

*thermanesthesia*

*thermhypesthesia*

*thermhyperesthesia*

### Tactile sensations

*anesthesia*

*hypesthesia*

*hyperesthesia*



*Sharp or dull?*





# Examination Of Sensory System

## Proprioception Sensations Testing

Proprioceptive sensations arise from the deeper tissues of the body, principally from the muscles, ligaments, bones, tendons, and joints.

### Senses of motion and position



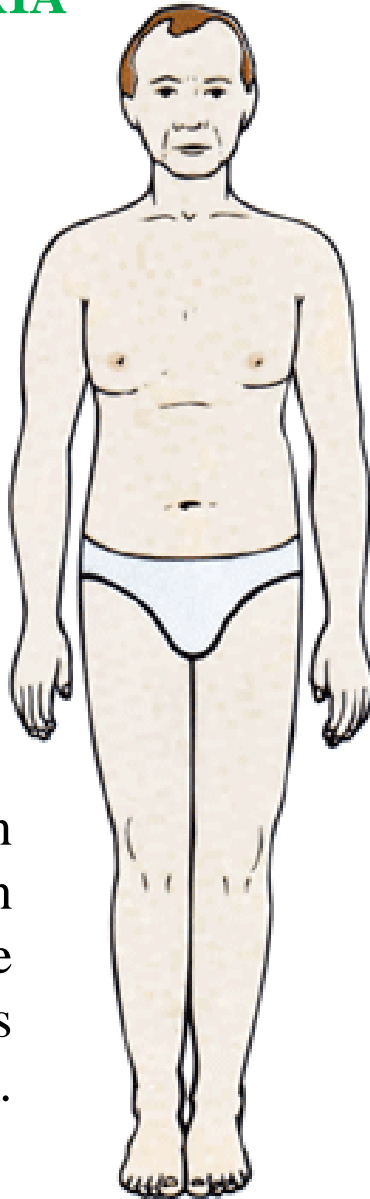
+ tests for ataxia: *finger-to-nose test* and *the heel-to-knee test*, executed while the eyes are closed, assuming the tests are normal when the eyes are open –

+ *the Romberg sign* is positive when the patient is able to stand with his feet together while his eyes are open, but sways or falls when they are closed; it is one of the earliest signs of posterior column disease

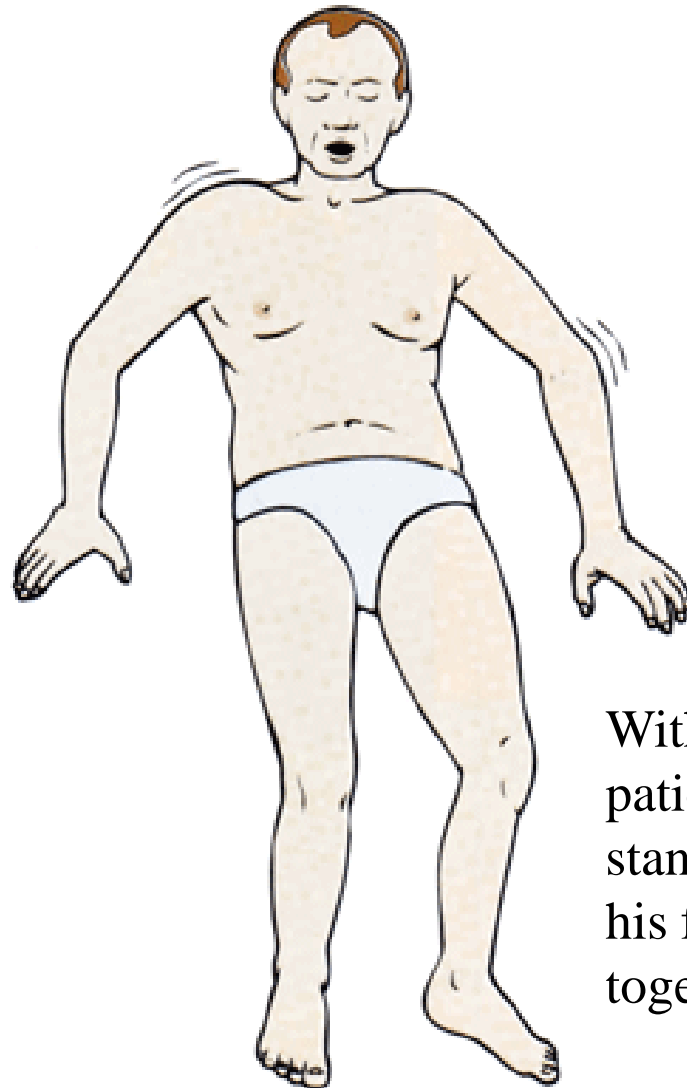
- ***sensory ataxia***



# SENSORY ATAXIA



With eyes open  
the patient can  
compensate  
greatly for the loss  
of deep esthesias.



With eyes closed the  
patient is not able to  
stand securely when  
his feet are put  
together.

**Positive Romberg's sign**

# Examination Of Sensory System

## Proprioception Sensations Testing

### Sense of vibration (Pallesthesia)

Pallesthesia is the ability to perceive the presence of vibration when an oscillating tuning fork is placed over certain bony prominences. Sensation is tested on:

- the great toe
- the medial and lateral malleoli of the ankle
- styloid processes of the radius and ulna
- the finger joints

The tuning fork is placed in vibration and held until the patient no longer feels it vibrate.



# Examination Of Sensory System

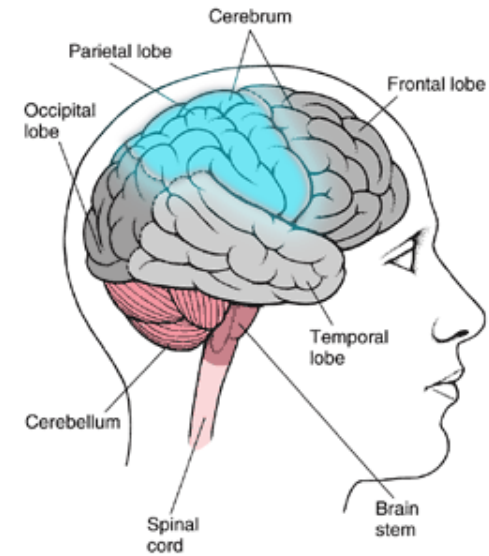
## CEREBRAL SENSORY FUNCTIONS

*Combined sensation* - those varieties of sensation for the recognition of which more than one of the previously discussed senses is used.

A cortical component is necessary for the final perception of them. This cortical component is a function of the parietal lobes

*Stereognosis* is an ability of perceiving and understanding the form and nature of objects by touch, and of identifying and recognizing them. When this ability is lost, the patient has *astereognosis*, or *tactile agnosia*.

Astereognosis can be diagnosed only if cutaneous and proprioceptive sensations are present, for if these are significantly impaired, the primary impulses cannot reach consciousness for interpretation



# Syndroms Of Interruption Of Sensory Pathways

*lesions of the peripheral nerves (peripheral neural type of sensory loss):*

- loss or diminution in all types of sensation, **OR**
  - paresthesias or pain
- that is either constant or lancinating in character

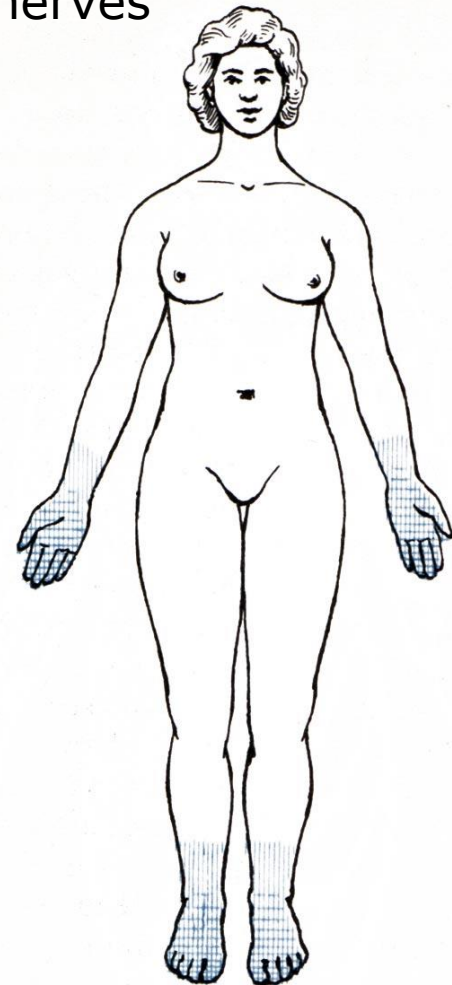
} in the distribution  
of the affected  
nerves

## Peripheral polyneritical (distal) type of sensory loss

Sensory loss involves the distal segments of extremities - *a glove and socking distribution of altered sensation.*

The margins of area are poorly demarcated with no sharp border between the normal and hypesthetic areas.

**Causes:** polyneuropathis (diabetic, toxic)



# Localization Of Sensory Disorders

## **disease of the dorsal root ganglia:**

lancinating pain (herpes zoster)  
~ trophic changes

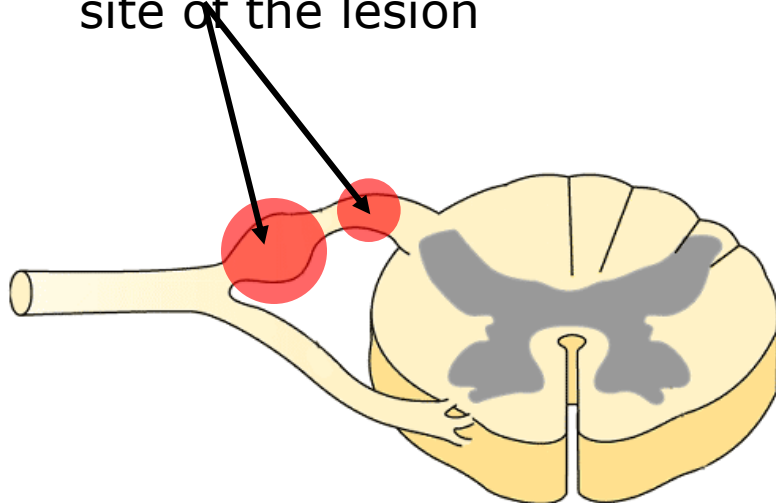
Injury to several adjacent **posterior roots** (*peripheral radicular type of sensory loss*)

- radicular paresthesias and pain;
- a decrease in or loss of all sensory qualities in the respective segment of the body.

} the distribution is segmental in type

If the injured roots supply the nerves for arm or leg, there will also be hypotonia or atonia, areflexia, and ataxia.

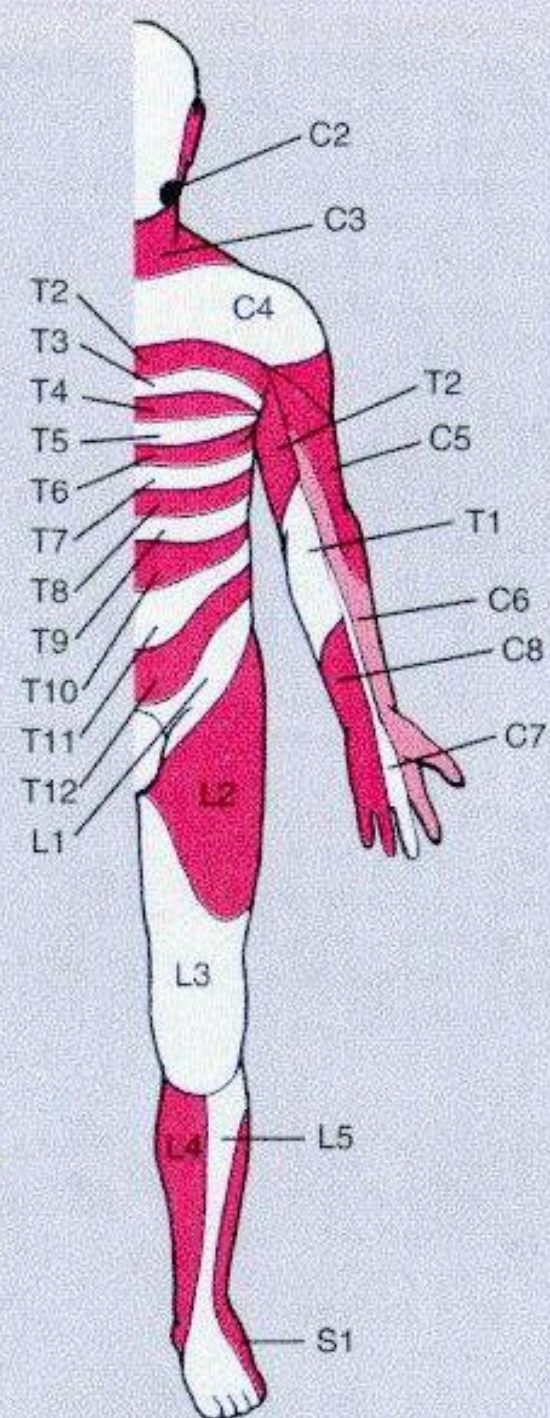
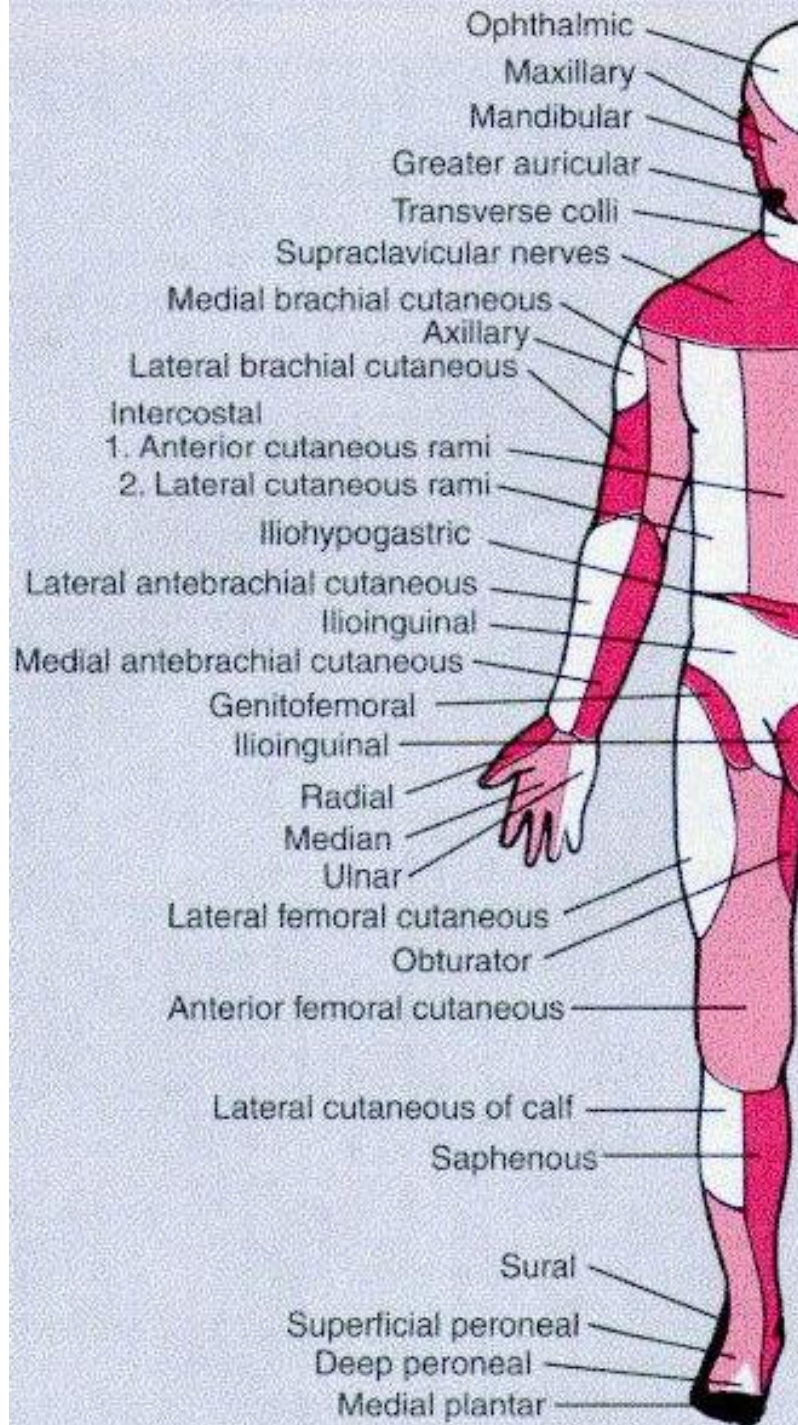
site of the lesion



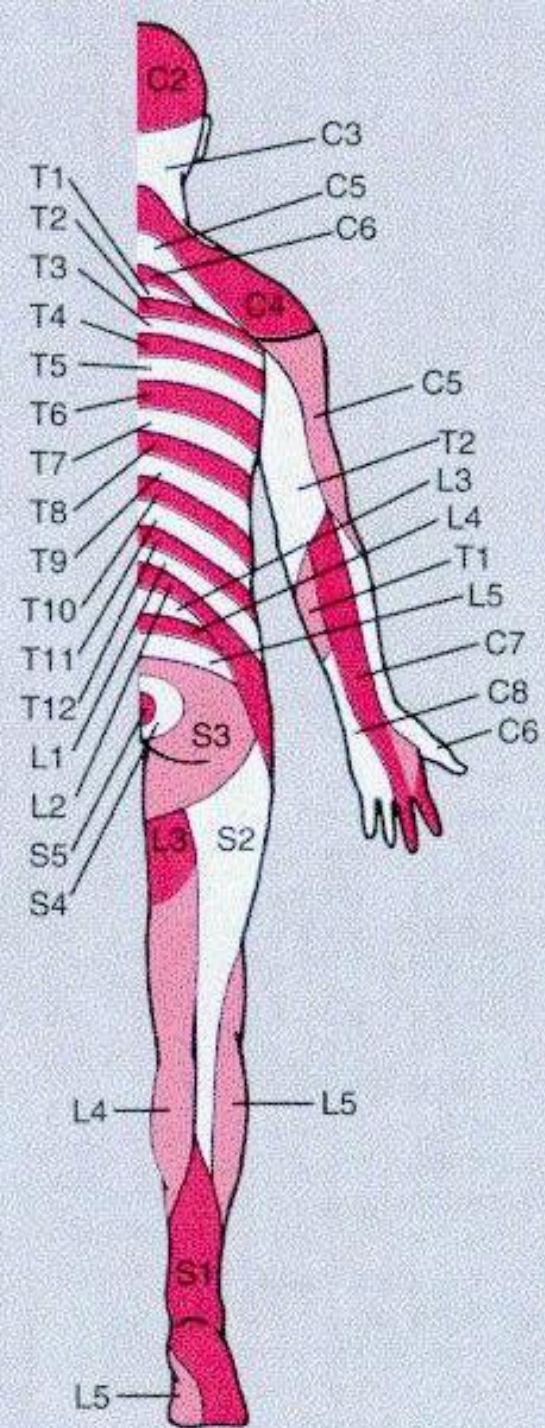
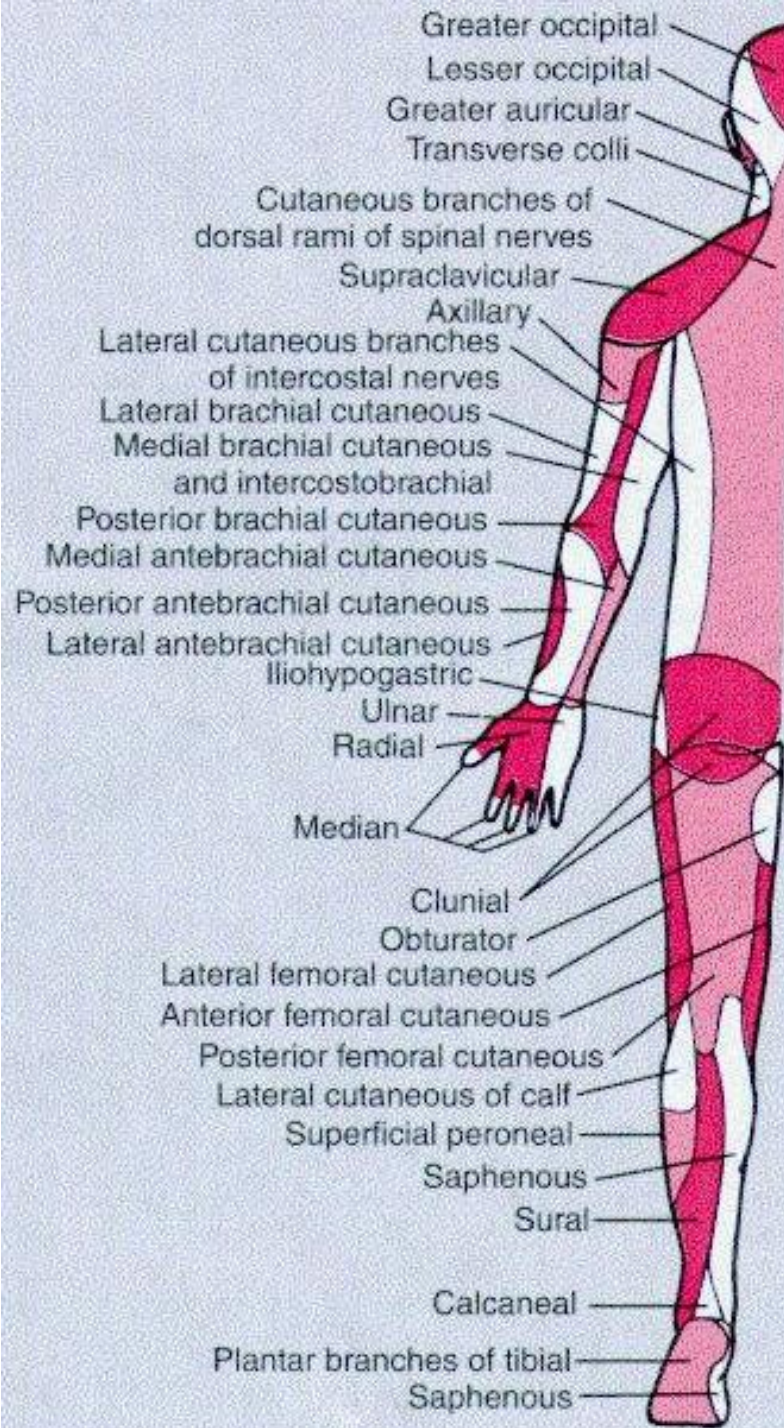
**Herpes zoster**













# Localization Of Sensory Disorders

*Lesions of the spinal cord and brain stem*

## **Spinal conductive type of sensory loss**

Lesion may be *complete transverse* and *incomplete transverse*, e.g.:

- Brown-Sequard syndrome  
(lateral hemisection of the cord)
- posterior funiculi lesion

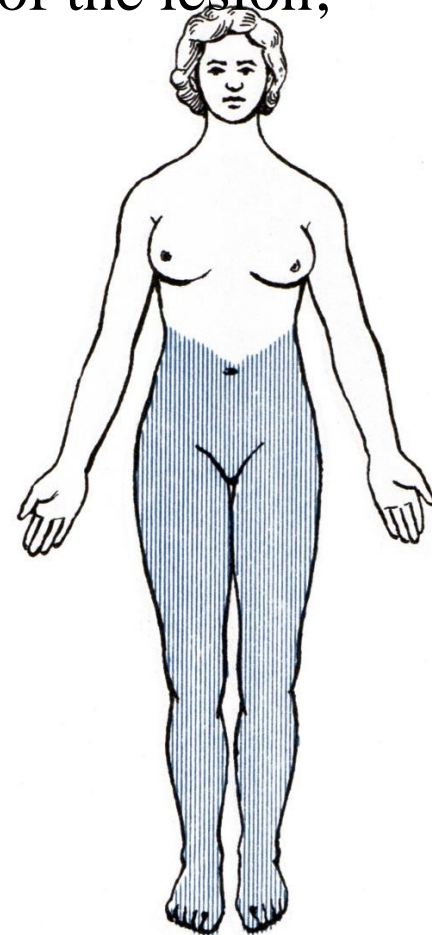
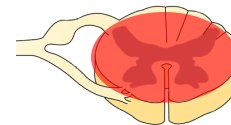
# Localization Of Sensory Disorders

**Complete transection of the spinal cord induces:**

- spastic tetra- or paraparesis;
- loss of all types of sensation below the uppermost level of the lesion;
- bladder, bowel and genital dysfunction.

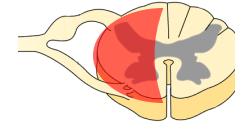
## **Conductive type of sensory loss**

Paraesthesia  
below T9 level  
due to complete  
cord transection



# Localization Of Sensory Disorders

**Brown-Sequard syndrome** follows the lateral hemisection of the spinal cord.



## **Ipsilateral signs are the following:**

- spastic paralysis below the level of the lesion;
- loss of tactile discrimination, vibratory and position sensation below the level of the lesion;
- segmental hypesthesia.

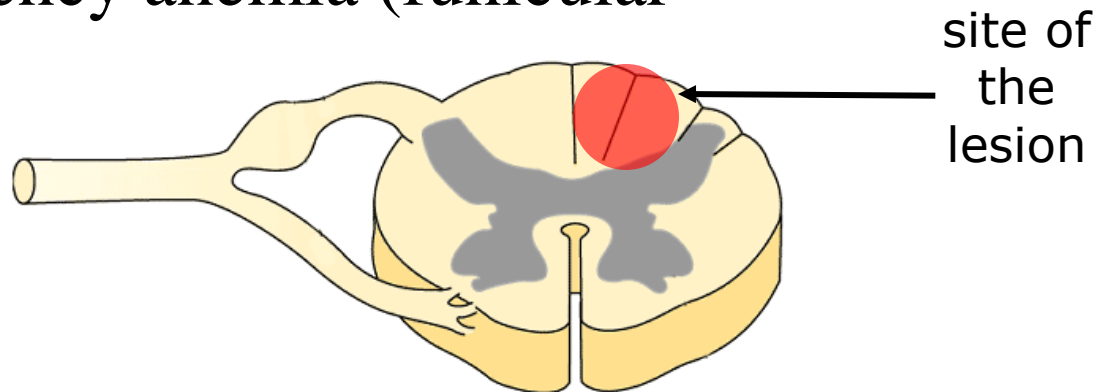
## **The major contralateral feature:**

- loss of pain and temperature sensation 2-3 segments below the level of the lesion (because of crossing of the spinothalamic tracts which mediate these modalities).

# Localization Of Sensory Disorders

- Loss of posture and locomotion sensation*
- Astereognosis*
- Loss of vibratory sense*
- Positive Romberg's sign* with closed eyes

**The most frequent causes:** neurosyphilis (tabes dorsales) and B12 deficiency anemia (funicular myelosis).



# Localization Of Sensory Disorders

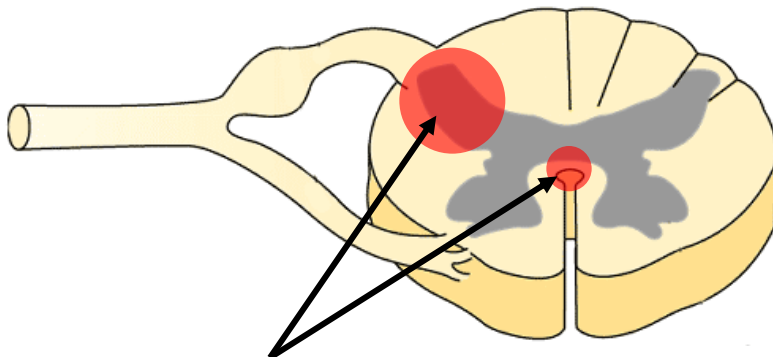
## Spinal segmental type of sensory loss

Lesion within the posterior horn or anterior white commissure

-Abolishes pain and temperature sensations ipsilaterally;  
all other qualities remain intact (**dissociated disorder** of sensibility).

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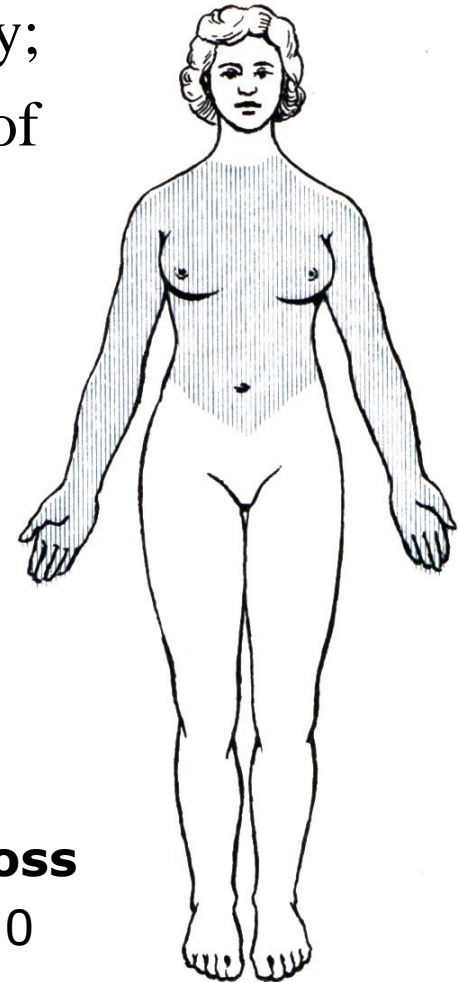
Causes: syringomyelia, tumors



site of the lesion

### Segmental type of sensory loss

Dissociated anesthesia in C4-T10 segments ("jacket")



# Localization Of Sensory Disorders

## *Lesions of the thalamus:*

- A lesion involving **all sensory pathways just beneath the thalamus** abolishes all sensory qualities in the contralateral half of the body.

~ may be associated with paresthesias and hyperesthesias, or *painful hyperpathias*

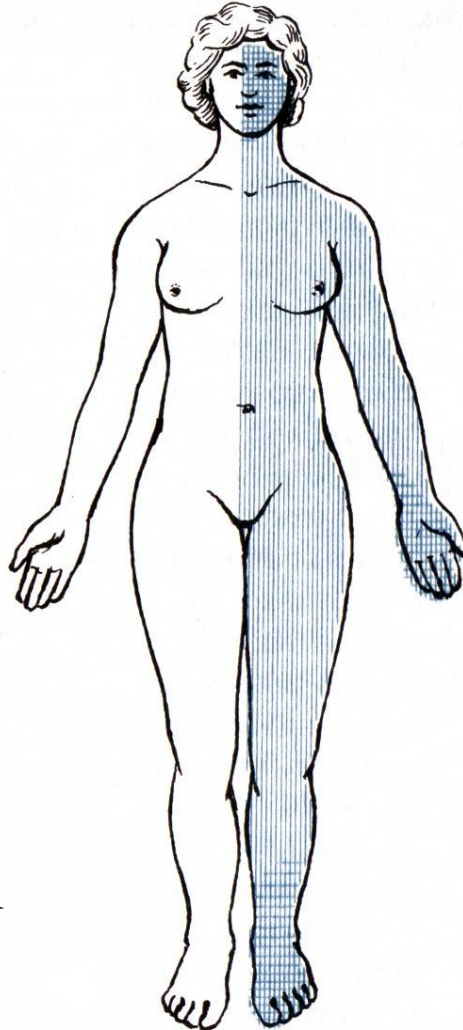
Also the thalamus lesion induces **hemianopsia and hemyataxia**.

*Cortical or subcortical lesion in the sensorimotor area:* paresthesias (tingling, formication, etc.) and numbness in the respective extremity of the opposite side, most pronounced distally (*cerebral cortical type of sensory loss*). The paresthesias may occur as focal sensory seizures (Jacksonian attack).

# Localization Of Sensory Disorders

## Cerebral conductive type of sensory loss

Lesion within the cerebrum involving afferent fibers (e.g., in the internal capsule) results in contralateral hemianesthesia.



## Contralateral hemianesthesia

Lesion in the internal  
capsule

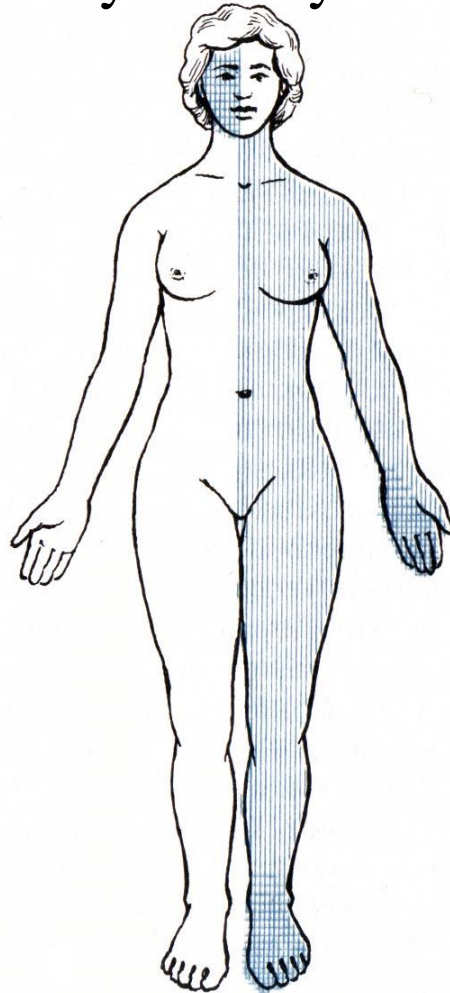


# Localization Of Sensory Disorders

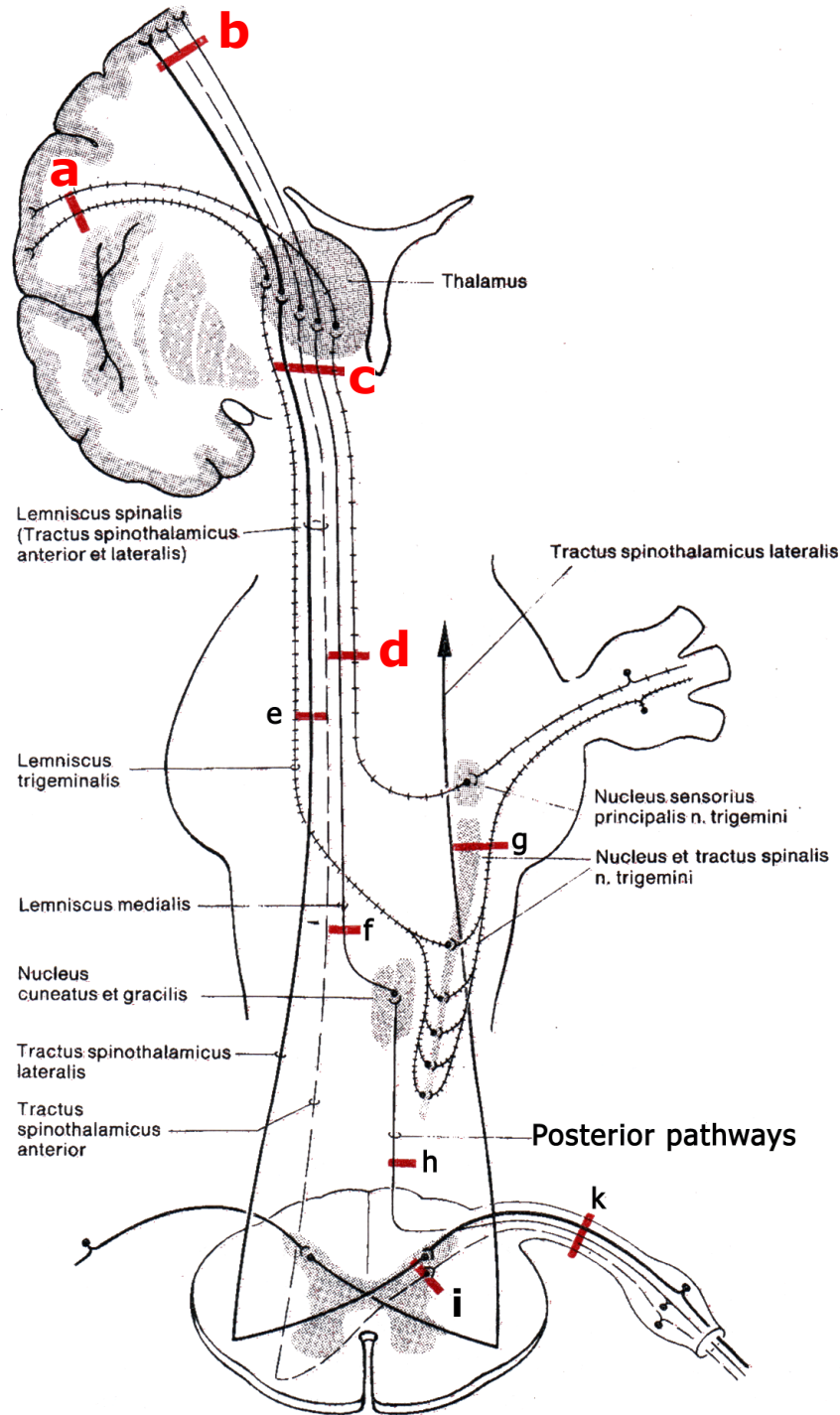
Damage of the **spinal trigeminal nucleus and tract and of the lateral spinothalamic tract** produces loss of pain and temperature sensation ipsilaterally in face and contralaterally in body.

**Contralateral  
alternating  
hemianesthesia**

Lesion in the medulla  
involving V cranial  
nerve nucleus



# Syndromes Of Interruptions Of Sensory Pathways



**Location a or b. Cortical or subcortical lesion in the sensorimotor area:**

paresthesias (tingling, formication, etc.) and numbness in the respective extremity of the opposite side, most pronounced distally. The paresthesias may occur as focal sensory seizures.

**Location c. All sensory pathways just beneath the thalamus:** abolishes all sensory qualities in the contralateral half of the body.

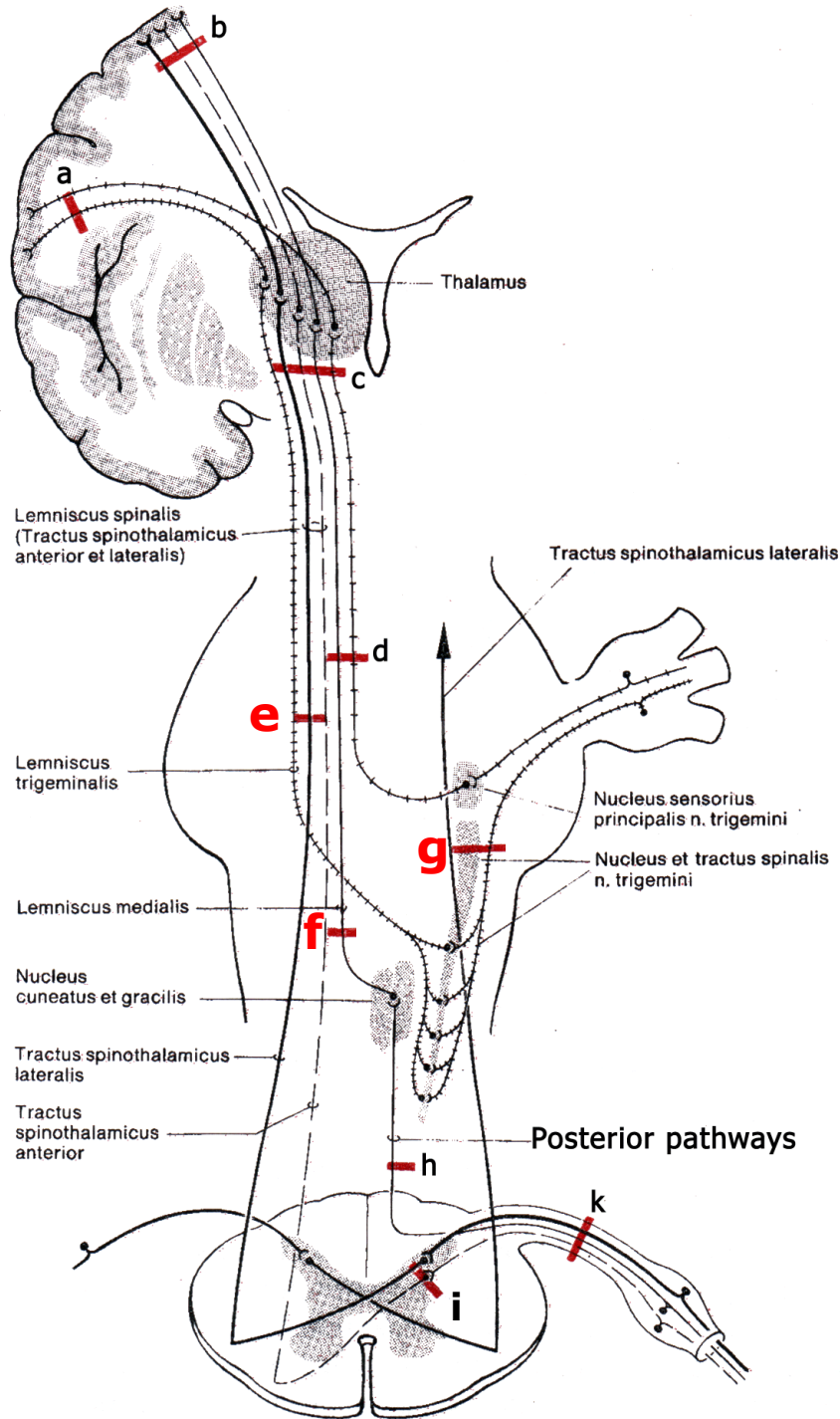
**Location d. Sensory pathways other than those for pain and temperature:** hypesthesia is noted contralaterally in face and body. Pain and temperature sensations remain intact.

## Syndromes Of Interruptions Of Sensory Pathways

**Location e.** The damage is limited to the **trigeminal lemniscus and the lateral spino-thalamic tract in the brainstem**: absence of pain and temperature sensation in the contralateral face and body; all other sensory qualities remain undisturbed.

**Location f:** Involvement of the **medial lemniscus and the anterior spinothalamic tract**: abolishes all sensory qualities in the contralateral portion of the body except pain and temperature.

**Location g:** Damage to the **spinal trigeminal nucleus and tract and to the lateral spinothalamic tract**: loss of pain and temperature sensation ipsilaterally in face and contralaterally in body.



## Syndromes Of Interruptions Of Sensory Pathways

**Location h. Damage to the posterior funiculi:** loss of posture, vibration, discrimination and other sensations associated with ipsilateral ataxia.

**Location i. A lesion in the posterior horn:** abolishes pain and temperature sensations ipsilaterally; all other qualities remain intact (dissociated disorder of sensibility).

**Location k: Injury to several adjacent posterior roots:** radicular paresthesias and pain; a decrease in or loss of all sensory qualities in the respective segment of the body. If the injured roots supply the nerves for arm or leg, there will also be hypotonia or atonia, areflexia, and ataxia.

