



3- Somatic sensation; tactile and proprioceptive sensation.

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Touch sensation

Touch receptors can also detect vibration and pressure sensations. Types of touch receptors :

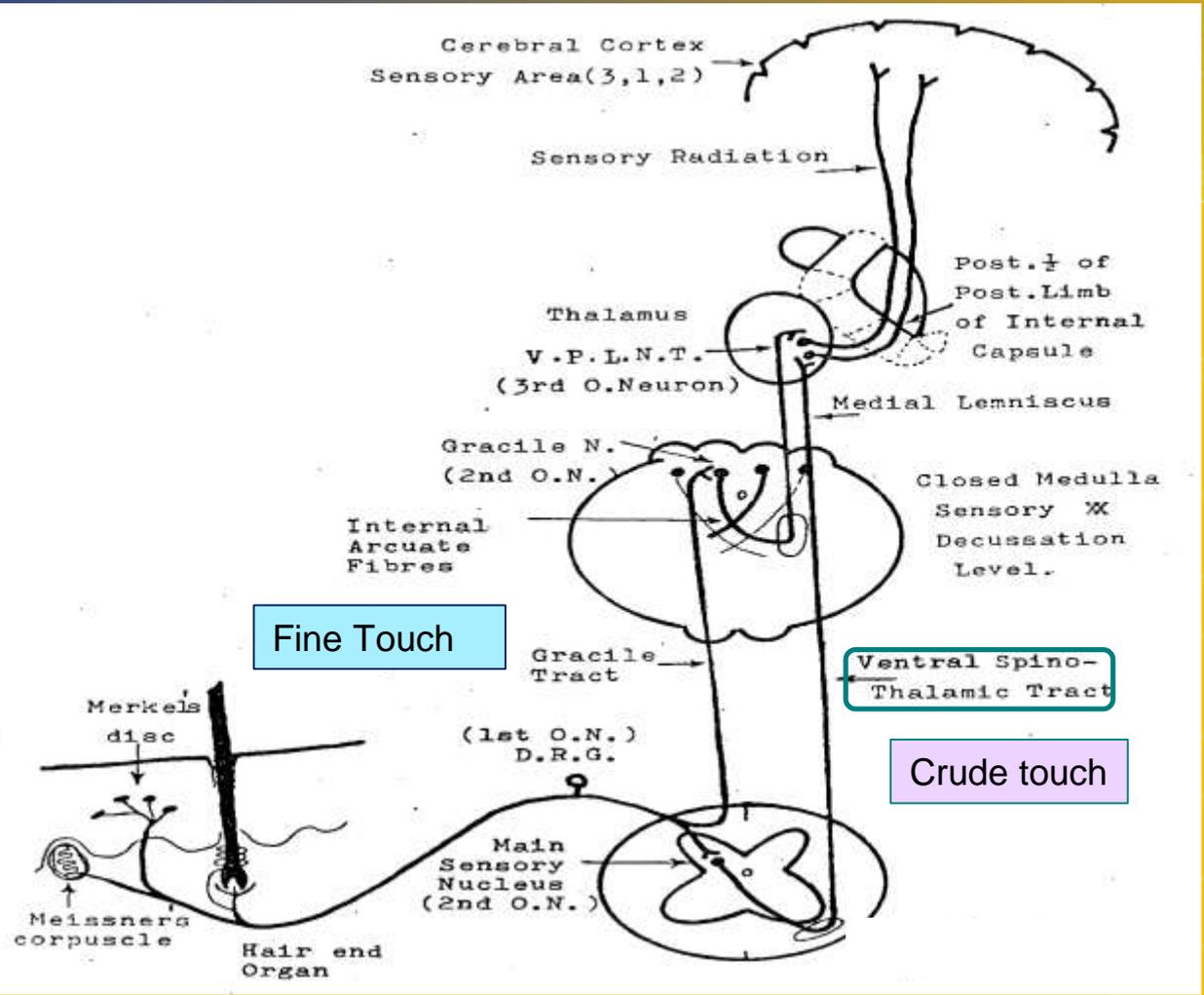
1. Free nerve endings.
2. Meissner's corpuscles.
3. Merckels discs.
4. Hair end organ.
5. Ruffini's corpuscles.
6. Pacinian corpuscles.
7. Spray type endings, these are multi-branched structures present in deeper tissues (adapted very slowly).

-Meissner's corpuscles, hair end organ and Pacinian corpuscles adapt **very rapidly**.

Types of touch :

A. Crude (rough) touch :

Poorly localized, its receptors are free nerve ending and hair end organ, Transmission occurs in **A delta fibers** (1-5 μ , 5-15 m/sec.). **1st order neuron** (DRG) ,**2nd order neuron** (Main sensory nucleus) and **3rd order neuron** (PVLNT) to pass through posterior half of the posterior limb of internal capsule to **sensory radiation** to end in **opposite side** sensory cortex area **3,1,2**.



B. Fine touch:

1) Tactile localization (Topognosis):

Means ability of the **closed eye** person to determine the previously touched point on skin.

2) Tactile discrimination : two point discrimination ;

This means the ability of a closed eye person to differentiate between touch in one point or simultaneous touch in two separate points. This type of sense is most accurate in **tips of the fingers, face, lips, tongue** (up to 2 mm) while it is less accurate in back (15 mm). Point to point discrimination is most accurate in retina of the eye. The parts of the body in which tactile discrimination is very sensitive have wide area of representation in sensory cortex, beside sensory nerves carry sensations from small areas thus each point touched reaches the cord in a separate nerve fiber and reaches sensory cortex in a separate point. The receptors also are very crowded and impulses are conducted by group "A" beta fibers (8 - 15 μ) and velocity of 30-60 m/second.

-Pathway of fine touch:

The same as the pathway of **proprioception** carried by the **gracile and cuneate** tracts but the receptors are different they are: Merkel's, Meissner's and Basket hair endings.

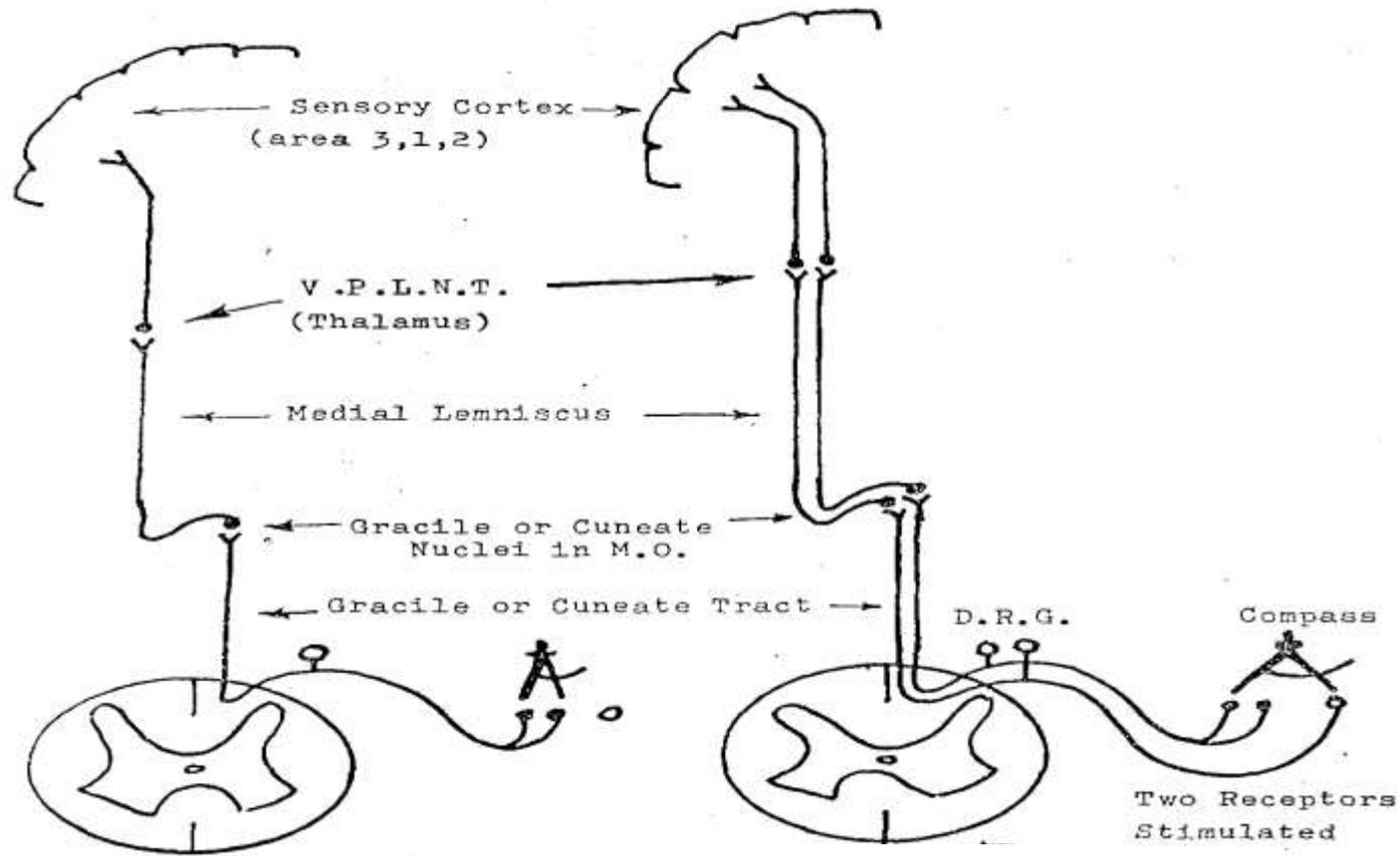
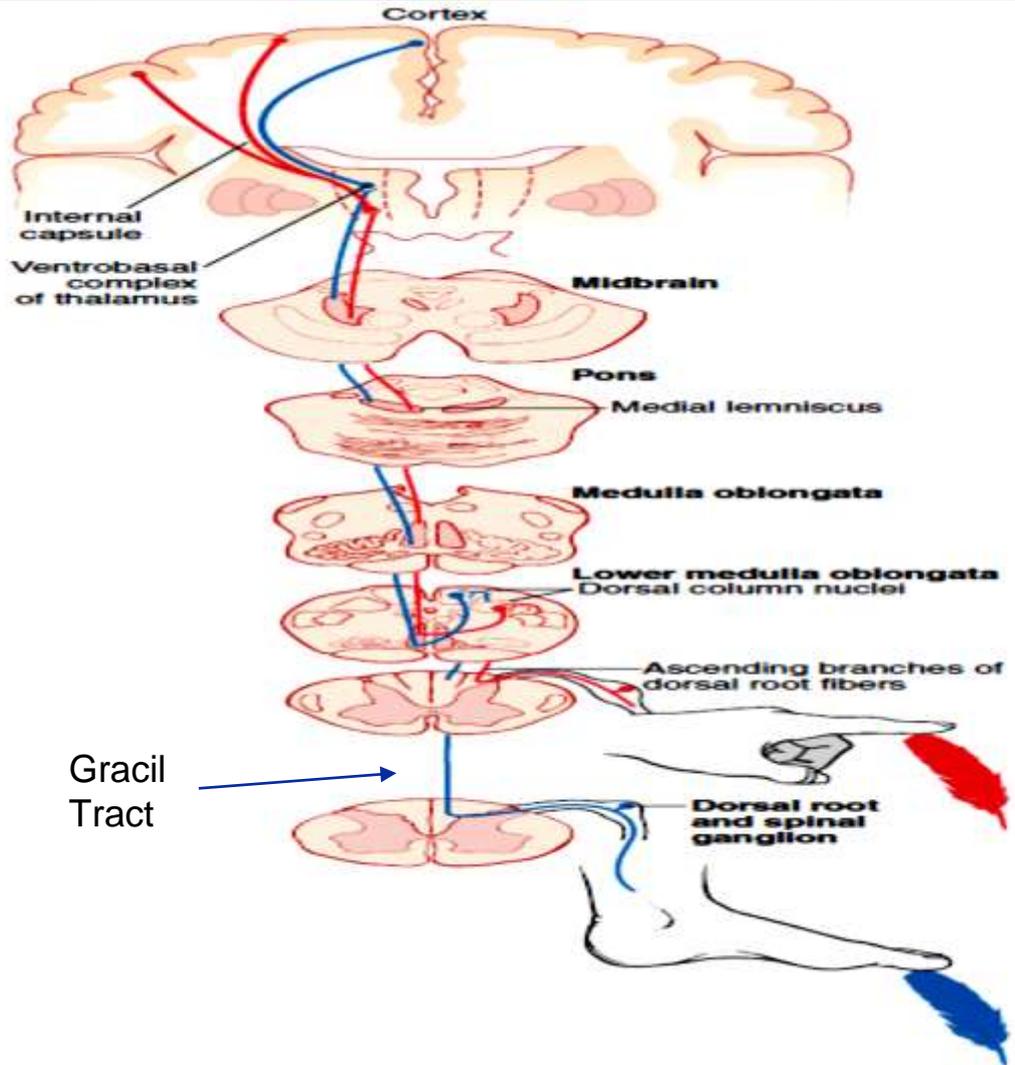


Figure : Mechanism of the two point discrimination.



B- Proprioceptive (deep) or Kinesthetic Sensations

They include the sense of position, movements, deep pressure, muscle tension and relation of parts of body to each other and to the space.

-Most important receptors are :

Golgi - tendon organ, muscle spindle spray type ending (all these are slowly adapting receptors), pacinian corpuscles are rapidly adapting, all proprioceptive sensations are carried to the sensory cortex by rapid dorsal column system (Gracile and cuneate).

I. Conscious proprioceptive sensation : are carried by the dorsal column system (Gracile & Cuneate tracts):

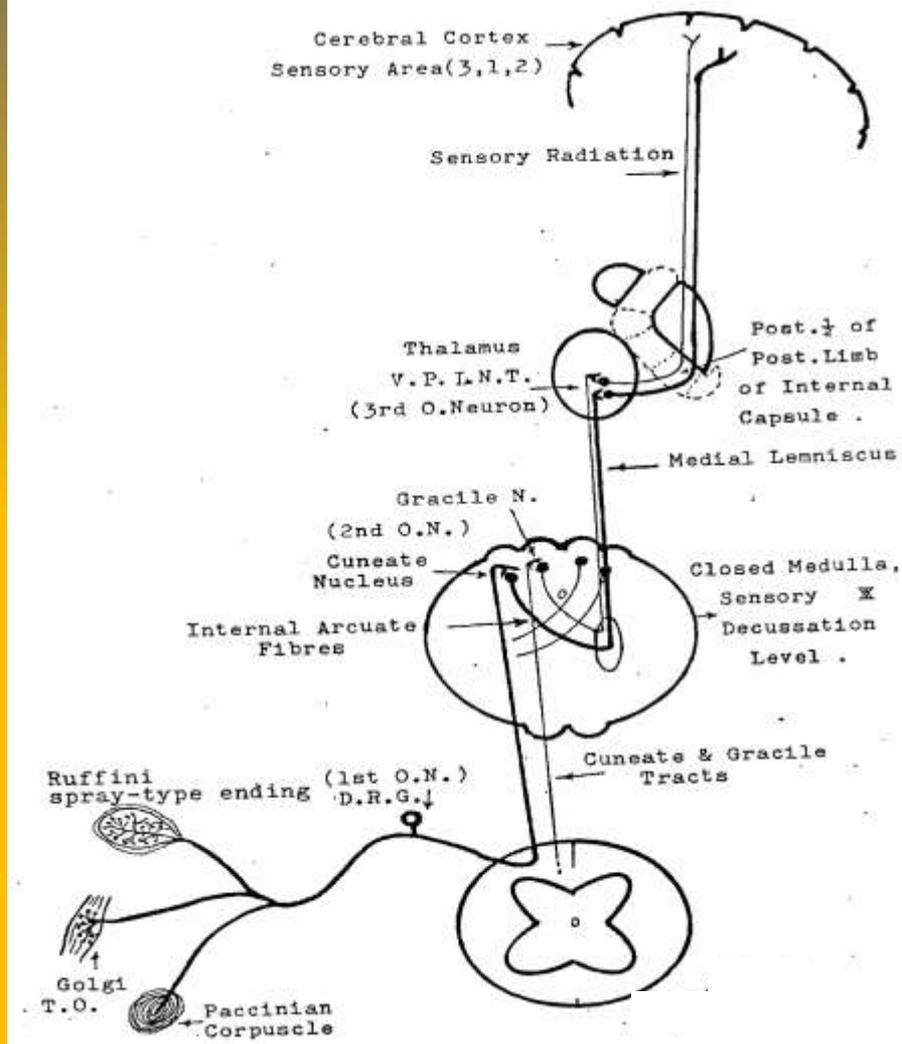
1-Thickly myelinated branches of **the dorsal root ganglion** cells which form its 1st order neurons, these fibers are groups **A α** and **A β** .

2-On entering the spinal cord, it ascends directly **without crossing** and it does not enter the gray matter (occupies lateral margin of the dorsal white matter).

3-Some lateral fibers from this system enter the dorsal horn of spinal cord and synapse with many neurons in several layers in the cord. Some of these neurons are sensory and their axons form the **spino-cervical tract**, while the other neurons are motor and they elicit **local spinal reflexes**, third neurons join the spino-cerebellar tract.

4-The medial or the main bulk of the dorsal column system ascend to the medulla oblongata where it synapses with the **2nd order neuron** in the gracile & cuneate nuclei. Axons of the second order neuron **decussate** immediately to **opposite side** (forming internal arcuate fibers), ascend in brain stem as **medial lemniscus** and join the **trigeminal lemniscus** and reach **3rd order neuron** in the ventro-postero-lateral nucleus of the thalamus (PVLNT).

-Axons of third order neuron ascend to reach sensory areas in the cerebral cortex (area 3, 1, 2 and area 5,7)

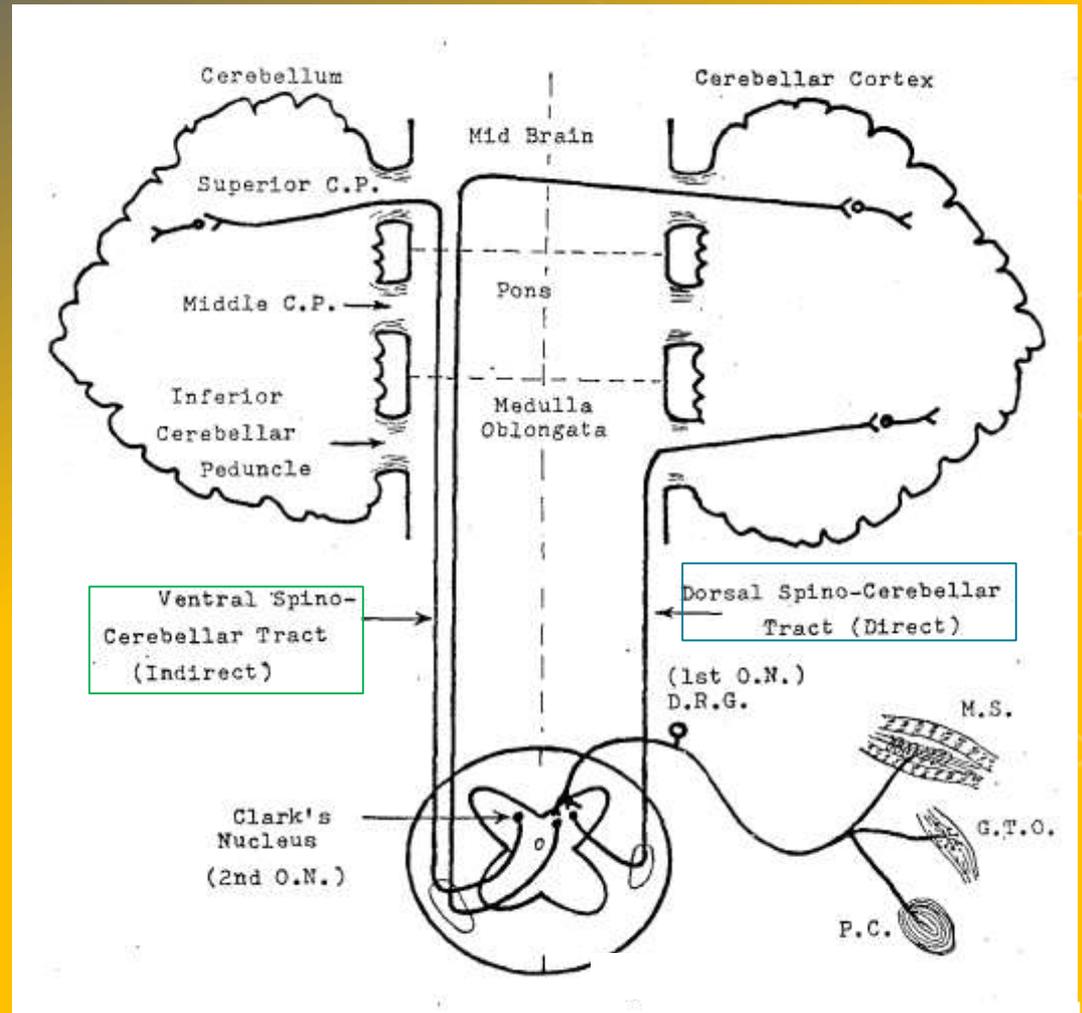


II. Unconscious proprioceptive sensation:

Unconscious proprioceptive sensations (joint and muscle movements during walking, running, swimming) are so called because most of them do not reach the sensory cortex, but they are coordinated by the cerebellum, basal ganglia and other nuclei in brain stem like reticular formation and vestibular nuclei. They are carried by:

1- Dorsal (direct) and ventral (indirect) spino-cerebellar tracts: Carries unconscious proprioceptive sensations (do not reach the cerebral cortex as the person is unaware of them like joint movements during running or swimming), fibers are group "**A**" **beta** which is the most rapid tracts in the body (100 m/second). **1st order neurons** are the dorsal root ganglion cells. Axons of the **Clark's nucleus** (2nd order neurons), ascend directly in the same side of spinal cord and enter the cerebellum through the **inferior peduncle** of the **same side** where they synapse in deep nuclei of cerebellum (**dorsal spinocerebellar tract**), in case of the **Ventral (indirect)** spino cerebellar tract, axons of Clark's nucleus **cross to the opposite side** in front central canal, then ascend in the spinal cord and enter the cerebellum in the **superior peduncles** of both sides.

2- Spino-Reticular and Spino-olivary Tracts ; Both tracts carry unconscious proprioceptive sensations, impulses end in the reticular formation and olivary nuclei respectively.



C- Combined superficial and deep sensations

1) Stereognosis : Means ability to recognize the previously educated objects present **in palms** of hand without vision. This type of fine touch needs both cutaneous and deep receptors, it reaches to certain area in brain (**area 5, 7**) called **center of stereognosis** or sensory association area.

Astereognosis (loss of this sense) occur in lesion in the sensory area, tabes dorsalis which is caused by **syphilis** and destroys the dorsal roots, cutting.-Gracile and Cuneate tracts which carry fine touch or in pernicious anemia (**decreased Vit. B₁₂**), because it causes demyelination in the ascending tract in the spinal cord.

2) Vibration sense: Also it needs both cutaneous and deep receptors. Vibration is better felt on **bone** because bone only magnify sensation. It is transmitted by rapidly conducting gracile and cuneate tracts. Bone does contain special receptors for vibration sense, and vibration can be felt on soft tissues.

-Pathway of combined sensations :

The same as the pathway of proprioception carried by the **gracile and cuneate tracts** .

Thank You

