MEDICINE
KING SAUD UNIVERSITY

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Physiology Team 436

# CNS PHYSIOLOGY

- Text
- Important
- Formulas
- Numbers
- Doctor notes
- Notes and explanation

Lecture No.14

"Only Those Who Dare To Fail Greatly Can Ever Achieve Greatly"

# Physiology of Proprioception in Balance

**Objectives:**

1. Identify the major sensory receptors & pathways.
2. Describe the components, processes and functions of the sensory pathways.
3. Appreciate the dorsal column system in **conscious proprioception (anatomy and functions).**
4. Describe the spinocerebellar tract pathway in **unconscious proprioception** from muscles, tendons, and joints.
5. Defferentiate between sensory and motor **ataxia**.

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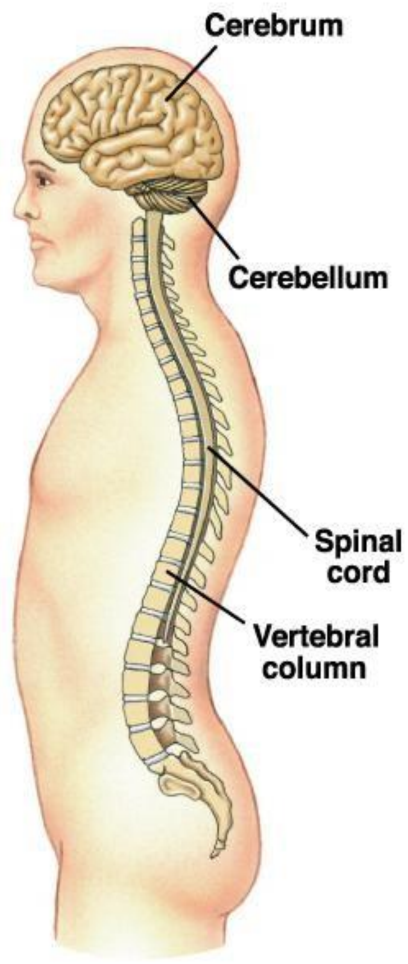
# Organization of the Nervous System (introduction)

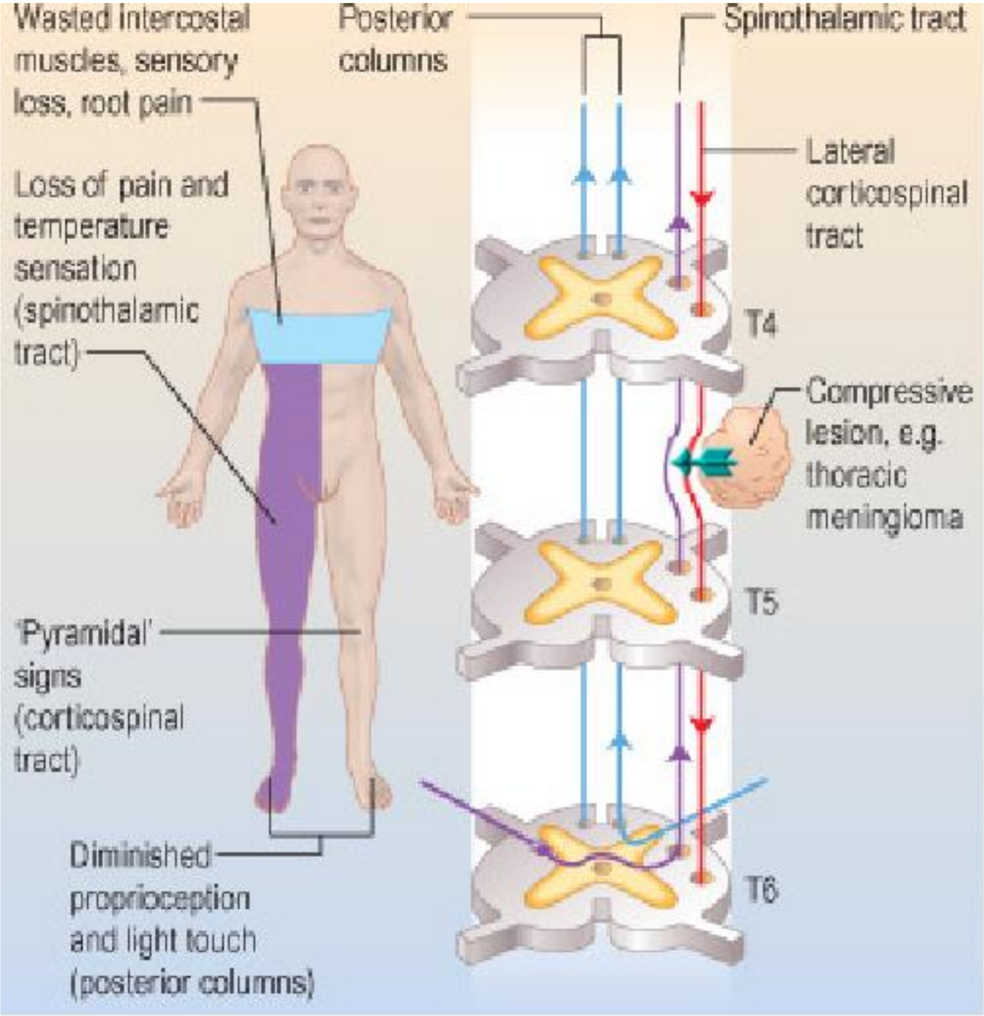
Two big initial divisions:

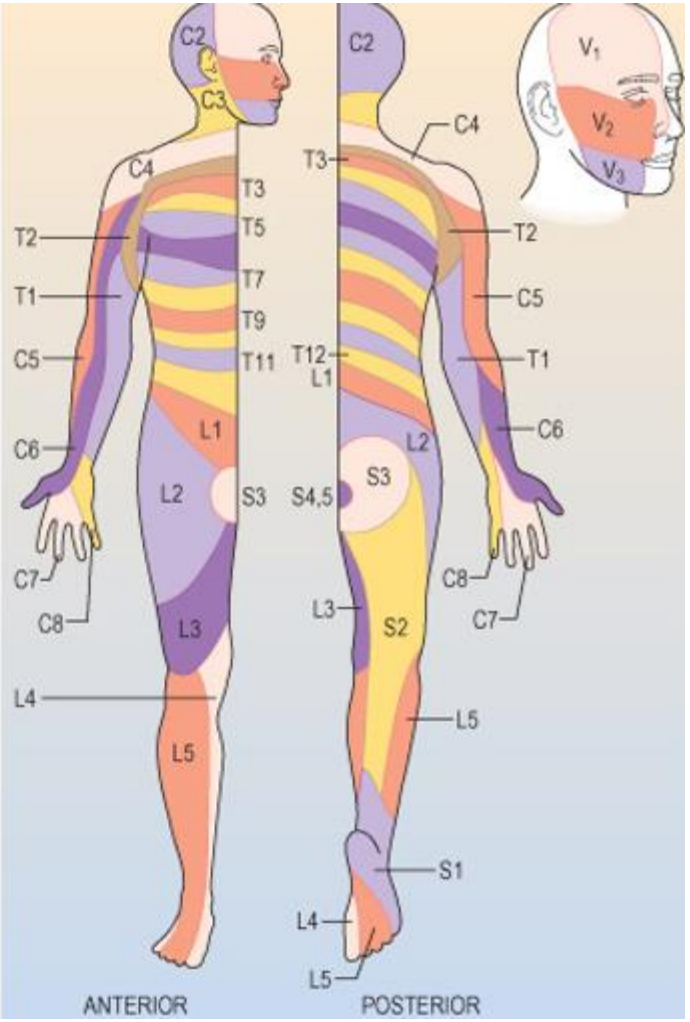
- Central Nervous System (the center of integration and control)
  - The brain
  - The spinal cord
- Peripheral Nervous System (the nervous system outside of the brain and spinal cord)
  - 31 Spinal nerves: carry info to and from the spinal cord.
  - 12 Cranial nerves: carry info to and from the brain.



# Dermatomes

- Dermatome is an area on skin supplied by a single spinal nerve.



# What is Proprioception ?

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- Proprioception stems from the latin word proprius which means "one's own" or "individual".
- It is the sense of one`s own body position.
- It is also called proprioceptive / position sense.
- It is the awareness of body position and of movements of body parts.
- Strength of effort being employed in movements.

- It can be divided into:

1. Static proprioception: conscious perception of the orientation of the different parts of the body with respect to one another.
2. Dynamic proprioception: rate of movement sense (also called kinesthesia).

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- Encapsulated Nerve Endings.
- Monitor stretch in locomotory organs.

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- types of proprioceptors:

1. Exteroception: By which one perceives the outside world.
2. Interoception: By which one perceives pain, hunger, and the movement of internal organs.

# Cont.

- Proprioception informs us about:
  - The location of a body part in relation to other parts.
  - The rate of movement of a body part when it is moving.
  - The degree to which our muscle are being contracted or stretched.
  - The amount of tension created in our tendons.
  - The head orientation in relation to the ground and in response to movement.

Proprioceptive information is carried from periphery to the CNS by proprioceptors and other somatic receptors.

# Types of Proprioceptors

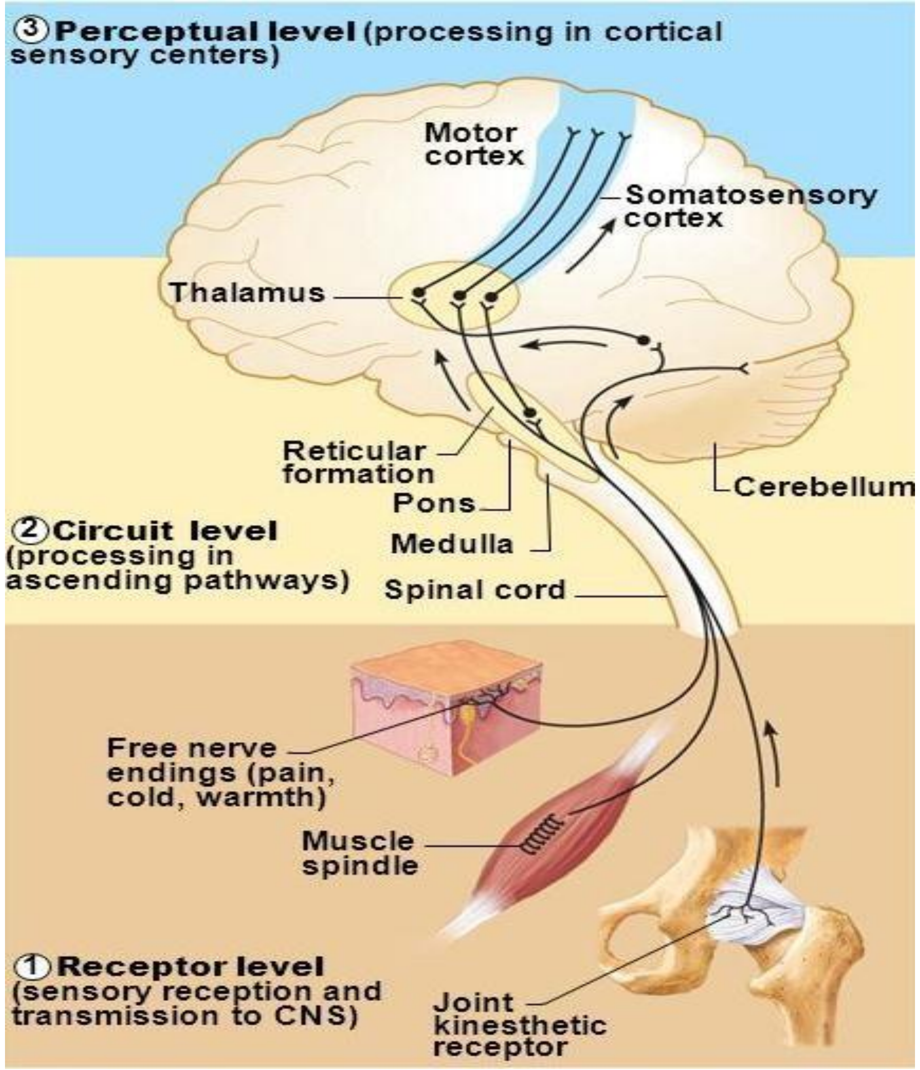
# This slide is important

- Muscle spindles also detect the degree of strength on the muscles and rate of change of movement.
- Golgi tendon is stimulated when there is overstretch : a stretch that may tear the muscle or separate it from it's tendon.

- Proprioceptors include the muscle spindles, Golgi tendon organs, and joint receptors.
- These provide a sense of body position and allow fine control of skeletal movements.

1. Muscle spindles:
    - Detect how much a muscle is stretched.
    - Imbedded in the perimysium between muscle fascicles.
2. Golgi tendon organs:
    - Located near the muscle-tendon junction.
    - Detect tension of a muscle on its tendon.
    - Provide information about the strength of contraction & tension.
3. Joint Kinesthetic receptors:
    - Are mechanoreceptors + sensory (nerve endings) in the joint capsules, they detect angle and movement of the joints.

- N.B: Cutaneous & deep receptors also contribute to proprioception



# Cont.

- There are two types: These are main ascending sensory pathways for proprioception.

| Types of Proprioception | |
|---|---|
| Conscious proprioception | Unconscious proprioception |
| It reaches the level of sensory cerebral cortex (cerebrum) via the dorsal column tract. | • is communicated to the cerebellum primarily via:<br>1. The dorsal spino-cerebellar tract (dSCT).<br>2. The ventral spino-cerebellar tract (vSCT). |

# Sensory receptors types

- Mechanoreceptors: which detect mechanical compression or stretching of the receptor or of tissues adjacent to the receptor, ex: proprioceptors.
- Thermoreceptors: which detect changes in temperature, some receptors detecting cold and others warmth.
- Nociceptors (pain receptors): which detect damage occurring in the tissues, whether physical damage or chemical damage, ex: free nerve endings.
- Electromagnetic receptors: which detect light on the retina of the eye, ex: rods and cones.
- Chemoreceptors: which detect taste in the mouth, smell in the nose, oxygen level in the arterial blood, osmolality of the body fluids, carbon dioxide concentration, and perhaps other factors that make up the chemistry of the body, ex: chemo R in carotid bodies

# Classification of sensory receptors

Classification of Sensory Receptors

ALL this smart art is extra

- B-Based on their adequate stimulus
  - Mechanoreceptors
  - Thermoreceptors (cold & heat)
  - Chemoreceptors (ex: taste receptors)
  - Photoreceptors (in the retina).
  - Nociceptors (pain receptors)
- A-Based on their location (Sherrington 1906)
  - Exteroceptors: concerned with the external environment -Found on the the surface of the body -Monitor changes in the external environment
  - Interoceptors: concerned with the internal environment (visceral)
  - Proprioceptors: concerned with one`s own body position -Are those relating to the physical state of the body, including joint position, and sate of tendons and muscles.

Sensory receptors classified according to:

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- Location
- Type of stimulus detected
- Structure

# Cont.

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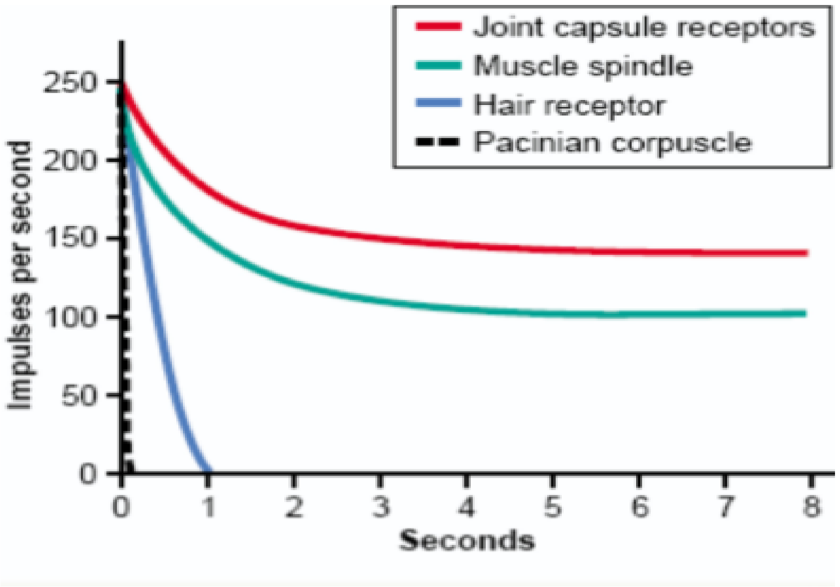
Extra

## Adaptation of receptors:

When a continuous sensory stimulus is applied, the receptor responds at a high impulse rate at first and then at a progressively slower rate until finally the rate of action potentials decreases to very few or often to none at all.




Based on their speed of adaptation

| Slowly adapting (SA) | Rabidly adapting (RA) |
| --- | --- |
| • Fire as long as the stimulus is there (tonic receptors).<br>• Nociceptors and proprioceptors show no or very little adaptation. | • Fire upon stimulus and cease firing when the stimulus remains constant (phasic receptors).<br>• Getting used to the bad smell in a room.<br>• Being aware of a ring or a watch only when putting them on or taking them off (onset and offset). |

# Cont. Adaptation of receptors

- Rapid adapting or phasicreceptors.

Ex: meissner's corpuscles(touch), pacinian corpuscles(vibration)

- Slowly adapting or tonic receptors.

Ex: ruffini's (pressure ,skin stretch ) krause's end bulbs, and merkel's disks.

- Non adapting receptors.

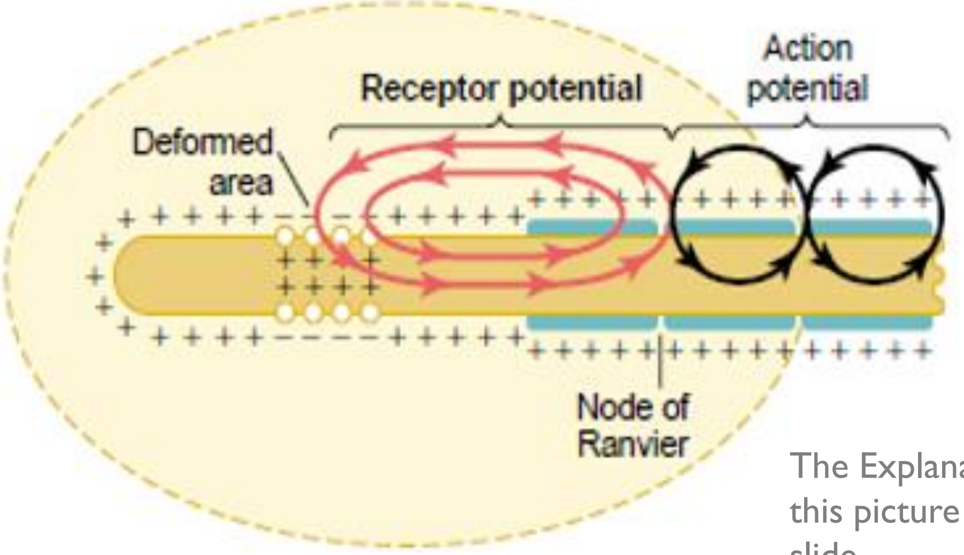
Ex: free nerve endings for pain sensation.

## Mechanisms by which receptors adapt:

- First, the pacinian corpuscle is a viscoelastic structure so that after stimulation within few hundredths of a second, the fluid within the corpuscle redistributes, so that the receptor potential is no longer elicited.
- The second mechanism of adaptation of the pacinian corpuscle, but a much slower one, results from accommodation , which occurs in the nerve fiber itself. This probably results from progressive "inactivation" of the sodium channels in the nerve fiber membrane.

## Receptor potential of the pacinian corpuscle:

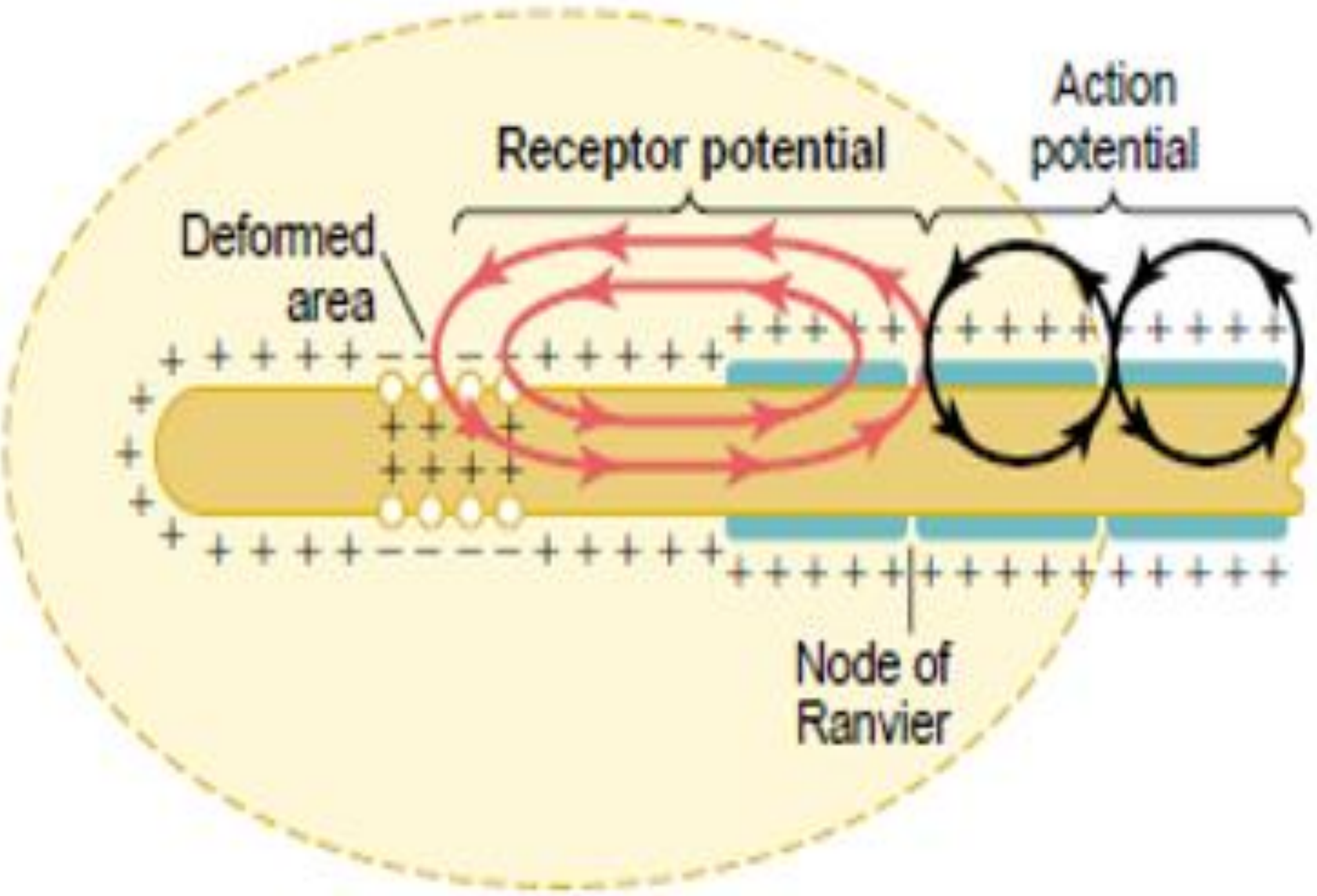
- For joint position and vibration sensation (Also Ruffini's endings).
- The receptor potential produced by compression induces a local circuit of current flow that spreads along nerve fiber.
- The frequency of repetitive action potentials transmitted from sensory receptors increases approximately in proportion to the increase in receptor potential.




The Explanation of this picture next slide.

# Doctors' explanation

- when deformed area is compressed it cause a receptor potential if this receptor potential is enough it causes action potential.
- receptor potential is localized graded and doesn't spread.
- AP: it's either yes or no ( not graded ) and spreads.
- If you want to stimulate them in a continuous state you increase the strength of stimulus.
- Pain receptors don't adapt and proprioceptors also.



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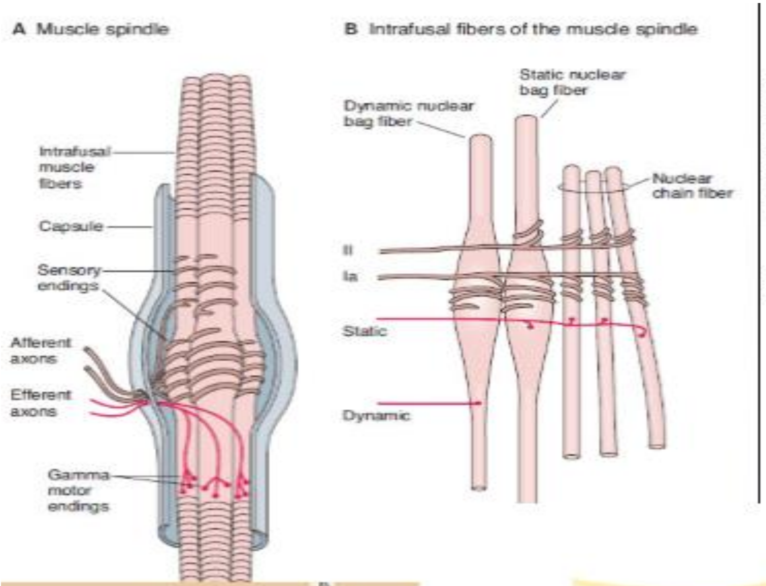
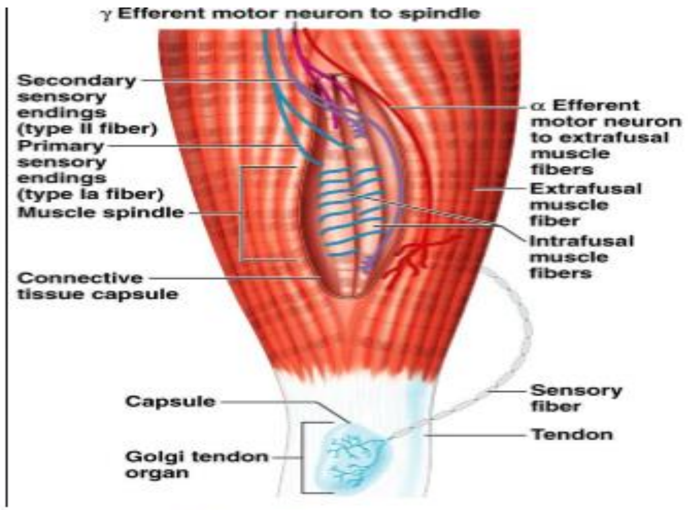
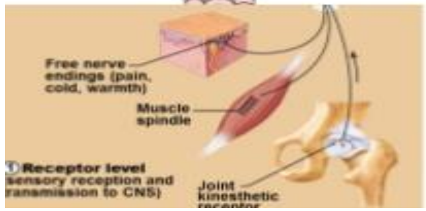
# Structure of proprioception

- Structures concerned with proprioception:
  - Proprioceptors (spatial orientation, four inputs).
  - Brain Stem (Cortico, Rubro, Vestibulo, Reticulo, Olivo, Tectospinal).
  - vestibular system (apparatus, nuclei).
  - Ascending Tracts.
  - Visual system.
  - Cerebellum (flocculonodular lobe → dynamic equilibrium, Uvula → Static equilibrium).
  - Cerebral cortex (primary cortical center for equilibrium located in the parietal lobe deep in the sylvian fissure).



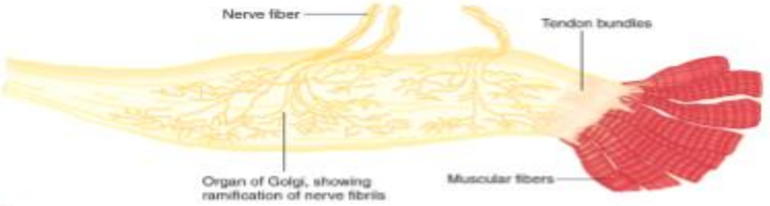




FIGURE 12–5 Golgi tendon organ. This organ is the receptor for the inverse stretch reflex and consists of a netlike collection of knobby nerve endings among the fascicles of a tendon. The innervation is the Ib group of myelinated, rapidly conducting sensory nerve fibers. (Reproduced with permission from Gray H [editor]: Gray's Anatomy of the Human Body, 29th ed. Lea & Febiger, 1973.)

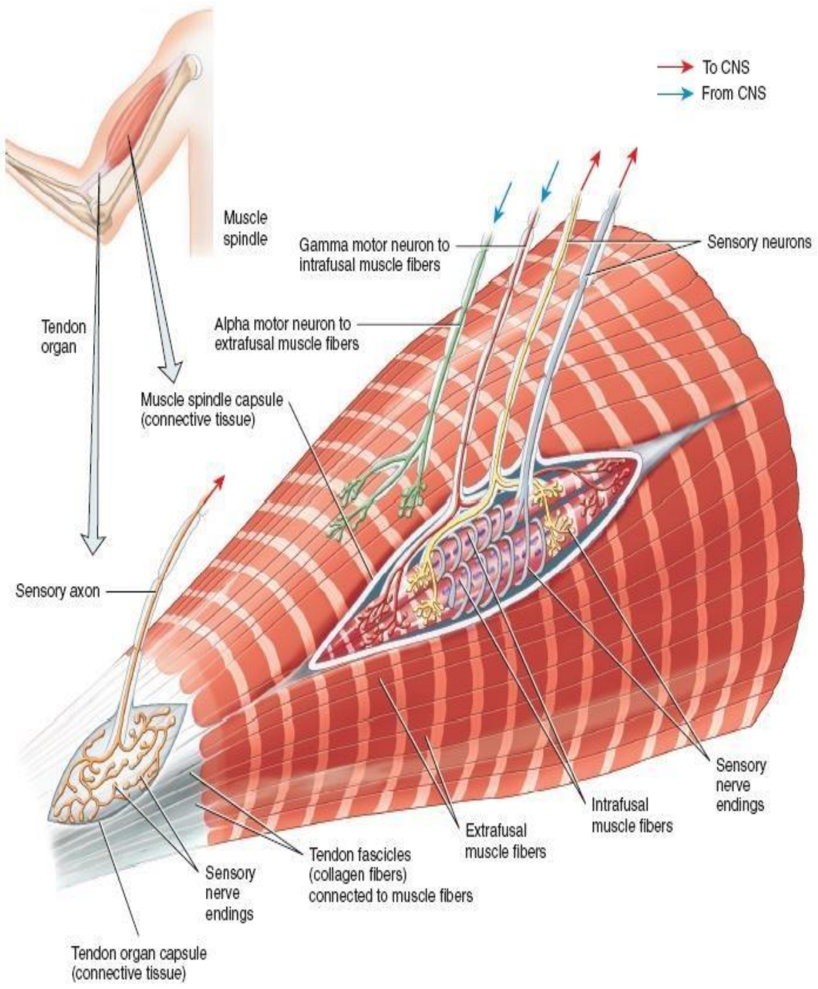
- Conscious perception will be perceived by cortex so impulses passes through brain stem.
- Reticulo: you must be awake to perceive the perception.
- Olivo: because it's connected to cerebellum.
- When all equilibrium contributers are damaged the person still can stand and maintain balance because of visual clues if this person closes his eyes he falls.
- Uvula responsible for static equilibrium and flocculonodular for dynamic.

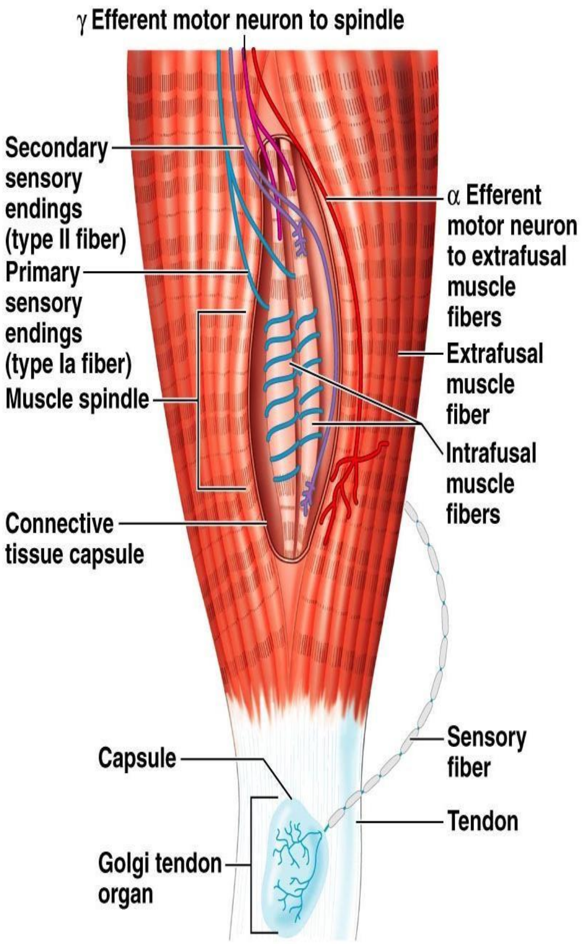
The doctor was explaining this

# Muscle Spindles & Golgi Tendon Organs

1. ## Muscle spindles:
   - They detect changes in the length of muscle.
   - They convey length information to the CNS via group I and II afferent neurons.
   - This information is important for determining the position of body part.

2. ## Golgi tendon organs
   - They detect changes in muscle tension.



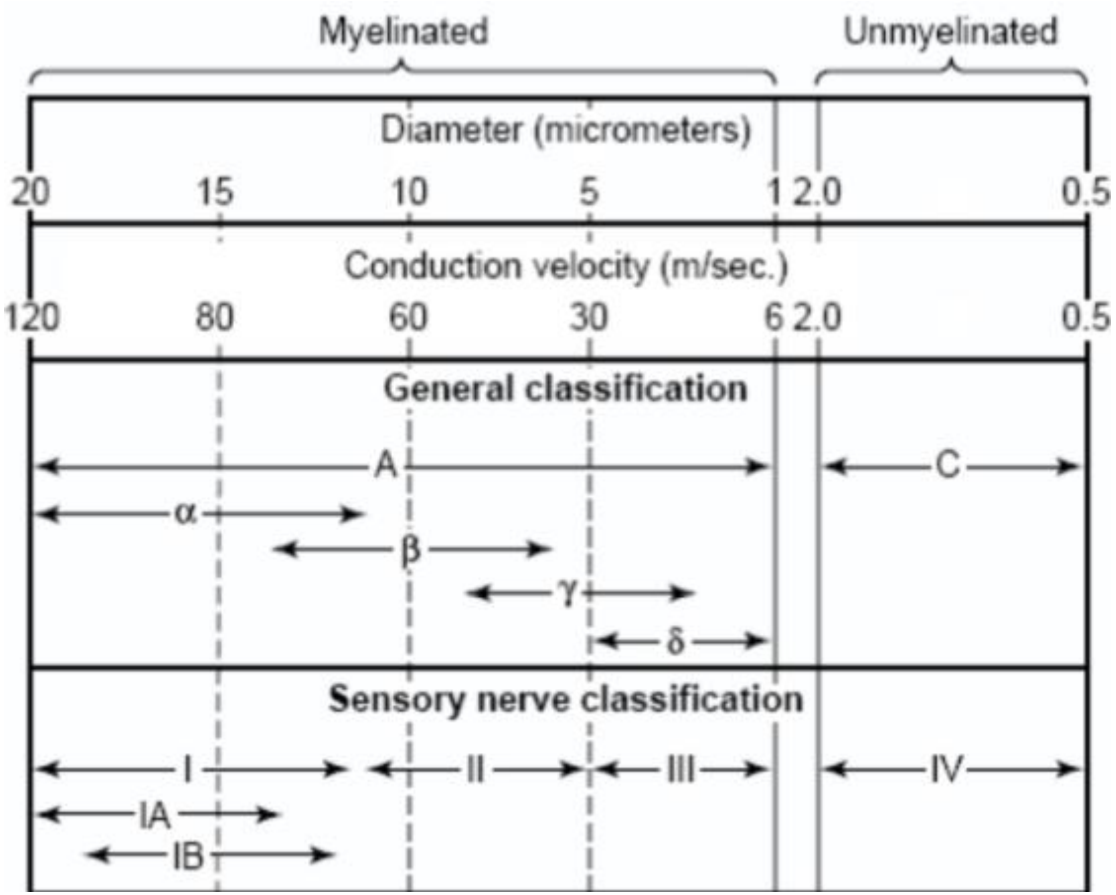



# Classification of nerve fibers

- An Overview of Sensory Pathways and the Somatic Nervous System.

- **Neural pathways:**

  - Afferent pathways: Sensory information coming from the sensory receptors through peripheral nerves to the spinal cord and to the brain .
  - Efferent pathways: Motor commands coming from the brain and spinal cord, through peripheral nerves to effecter organs.

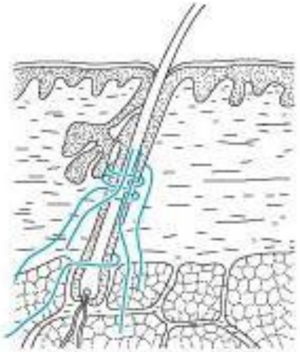


# Encapsulated

- Encapsulated Nerve Endings:
  - Consist of one or more end fibers of sensory neurons.
  - Enclosed in connective tissue.
- Include four main types:
  1. Meissner's corpuscles
  2. Pacinian corpuscles
  3. Ruffini's corpuscles
  4. Proprioceptors

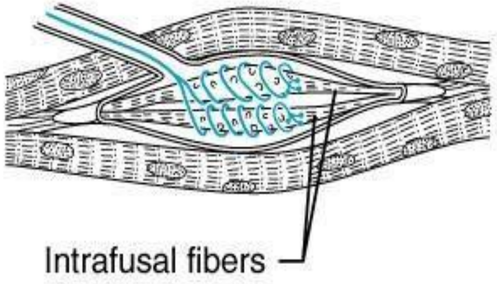
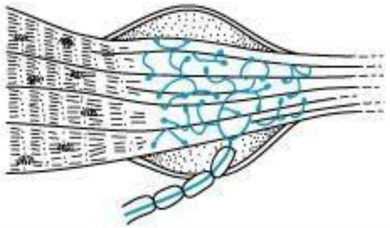
# Unencapsulated nerve endings

**Table 14.1** General Sensory Receptors Classified by Structure and Function (1 of 3)

| Anatomical Class (structure) | Illustration | Functional Class According to Location (L) and Stimulus Type (S) | Body Location |
|---|---|---|---|
| **UNENCAPSULATED** | | | |
| Free nerve endings of sensory neurons |  | L: Exteroceptors, interoceptors, and proprioceptors<br>S: Nociceptors (pain), thermoreceptors (heat and cold), possibly mechanoreceptors (pressure) | Most body tissues; densest in connective tissues (ligaments, tendons, dermis, joint capsules, periostea) and epithelia (epidermis, cornea, mucosae, and glands) |
| *Modified free nerve endings:* Merkel discs |  | L: Exteroceptors<br>S: Mechanoreceptors (light pressure) | Basal layer of epidermis |
| Hair follicle receptors |  | L: Exteroceptors<br>S: Mechanoreceptors (hair deflection) | In and surrounding hair follicles |

# Cont. Encapsulated nerve endings
# This slide is important

## 14.1 General Sensory Receptors Classified by Structure and Function *(continued)*

| Structural Class | Illustration | Functional Class According to Location (L) and Stimulus Type (S) | Body Location |
|---|---|---|---|
| **PROPRIOCEPTORS** | | | |
| Muscle spindles |  | L: Proprioceptors<br>S: Mechanoreceptors (muscle stretch) | Skeletal muscles, particularly those of the extremities |
| Golgi tendon organs | | L: Proprioceptors<br>S: Mechanoreceptors (tendon stretch) | Tendons |
| Joint kinesthetic receptors (Pacinian and Ruffini endings, free nerve endings, and receptors resembling Golgi tendon organs) |  | L: Proprioceptors<br>S: Mechanoreceptors and nociceptors | Joint capsules of synovial joints |

# Sensory modalities

**TABLE 8–1 Principle sensory modalities.**

| Sensory System | Modality | Stimulus Energy | Receptor Class | Receptor Cell Types |
|---|---|---|---|---|
| Somatosensory | Touch | Tap, flutter 5–40 Hz | Cutaneous mechanoreceptor | Meissner corpuscles |
| Somatosensory | Touch | Motion | Cutaneous mechanoreceptor | Hair follicle receptors |
| Somatosensory | Touch | Deep pressure, vibration 60–300 Hz | Cutaneous mechanoreceptor | Pacinian corpuscles |
| Somatosensory | Touch | Touch, pressure | Cutaneous mechanoreceptor | Merkel cells |
| Somatosensory | Touch | Sustained pressure | Cutaneous mechanoreceptor | Ruffini corpuscles |
| Somatosensory | Proprioception | Stretch | Mechanoreceptor | Muscle spindles |
| Somatosensory | Proprioception | Tension | Mechanoreceptor | Golgi tendon organ |
| Somatosensory | Temperature | Thermal | Thermoreceptor | Cold and warm receptors |
| Somatosensory | Pain | Chemical, thermal, and mechanical | Chemoreceptor, thermoreceptor, and mechanoreceptor | Polymodal receptors or chemical, thermal, and mechanical nociceptors |
| Somatosensory | Itch | Chemical | Chemoreceptor | Chemical nociceptor |
| Visual | Vision | Light | Photoreceptor | Rods, cones |
| Auditory | Hearing | Sound | Mechanoreceptor | Hair cells (cochlea) |
| Vestibular | Balance | Angular acceleration | Mechanoreceptor | Hair cells (semicircular canals) |
| Vestibular | Balance | Linear acceleration, gravity | Mechanoreceptor | Hair cells (otolith organs) |
| Olfactory | Smell | Chemical | Chemoreceptor | Olfactory sensory neuron |
| Gustatory | Taste | Chemical | Chemoreceptor | Taste buds |

# Reflex arc

Stimulus → Receptor → Afferent → Center → Efferent → Effector → Effect

## Stretch reflex

- Muscle stretch → Muscle spindle → Afferent Ia
- Afferent Ia → Spinal cord (center)
- Spinal cord (center) → Efferent α motor → Extrafusal fibers
- Extrafusal fibers → Muscle contraction
- Muscle contraction → Reciprocal inhibition of antagonist

## Inverse stretch reflex

- Over stretch → Golgi organ tendon → Afferent Ib
- Afferent Ib → Spinal cord (center)
- Spinal cord (center) → Inhibitory interneuron → Efferent α Motor
- Efferent α Motor → Extrafusal fibers
- Extrafusal fibers → Muscle relaxation → Reciprocal inhibition of antagonist

# Types of mammalian fibres

**TABLE 4-1 Types of mammalian nerve fibers.**

| Fiber Type | Function | Fiber Diameter (μm) | Conduction Velocity (m/s) | Spike Duration (ms) | Absolute Refractory Period (ms) |
|---|---|---|---|---|---|
| Aα | Proprioception; somatic motor | 12–20 | 70–120 | | |
| Aβ | Touch, pressure | 5–12 | 30–70 | 0.4–0.5 | 0.4–1 |
| Aγ | Motor to muscle spindles | 3–6 | 15–30 | | |
| Aδ | Pain, temperature | 2–5 | 12–30 | | |
| B | Preganglionic autonomic | <3 | 3–15 | 1.2 | 1.2 |
| C, Dorsal root | Pain, temperature | 0.4–1.2 | 0.5–2 | 2 | 2 |
| C, Sympathetic | Postganglionic sympathetic | 0.3–1.3 | 0.7–2.3 | 2 | 2 |

# Classification of sensory nerve fibres

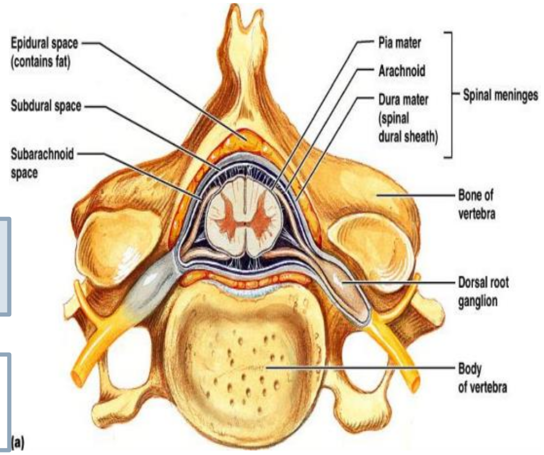
**TABLE 4–2 Numerical classification of sensory nerve fibers.**

| Number | Origin | Fiber Type |
|---|---|---|
| Ia | Muscle spindle, annulo-spiral ending | Aα |
| Ib | Golgi tendon organ | Aα |
| II | Muscle spindle, flower-spray ending; touch, pressure | Aβ |
| III | Pain and cold receptors; some touch receptors | Aδ |
| IV | Pain, temperature, and other receptors | Dorsal root C |

# Spinal cord tracts

- Sensory information from receptors throughout most of the body is relayed to the brain by means of ascending tracts of fibers that conduct impulses up the spinal cord.
- When the brain directs motor activities, these directions are in the form of nerve impulses that travel down the spinal cord in descending tracts of fibers.

Spinal cord tracts
- Ascending tracts (sensory)
- Descending tracts (motor)




- A Cross-section view of spinal cord- wider laterllay than anteroposteriorly. In the middle on the dorsal side is a shallow groove called the posterior median sulcus and on the ventral side is the anterior median fissure (deeper).
- center consist of gray matter shaped like a butterfly and there is an opening at the center.
- Spinal cord is protected by three layers of meninges. The only difference from the brain is that the dural matter does not attach to bone. The dural matter is surrounded externally by a layer of cushioning fat called epidural space.

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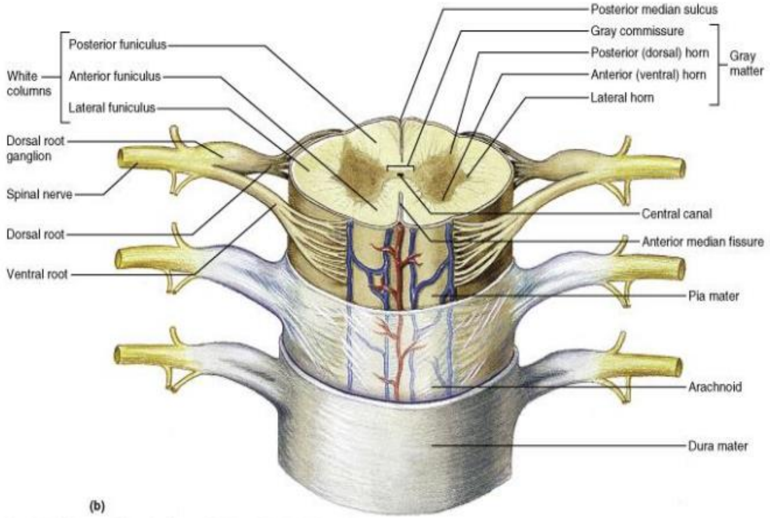
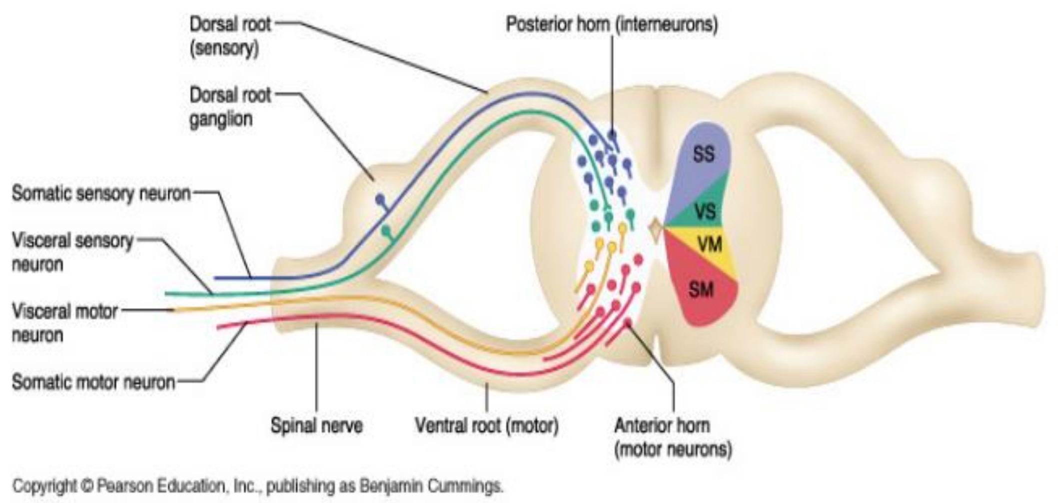


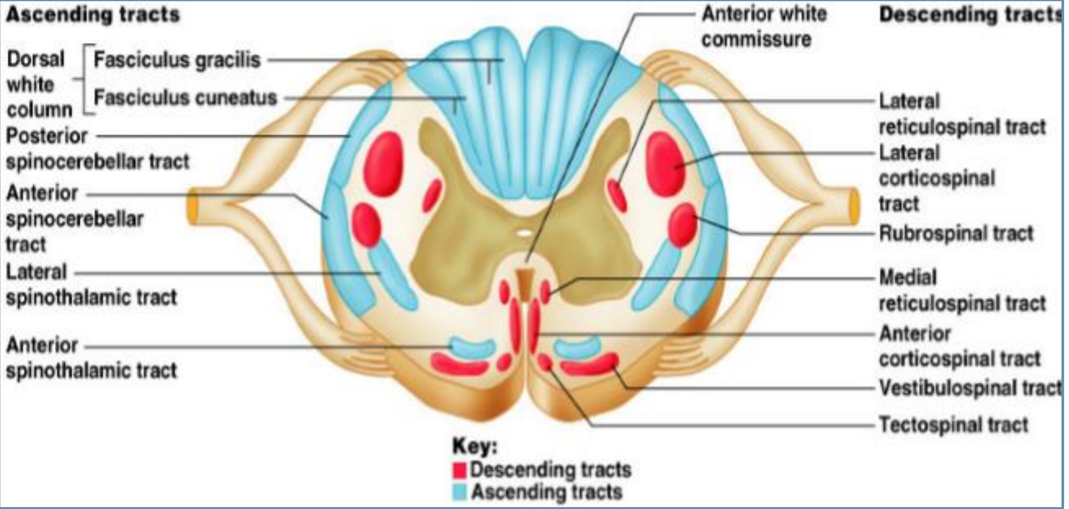
# Organization of spinal cord

## Grey matter: organization




- Dorsal half – sensory roots and ganglia.
- Ventral half – motor roots.
- Dorsal and ventral roots fuse laterally to form spinal nerves.
- Four zones are evident within the gray matter –somatic sensory (SS), visceral sensory (VS), visceral motor (VM), and somatic motor (SM).

## White matter in the spinal cord




- Fibers run in three directions, ascending, descending and transversely.
- Divided into three funiculi (columns), posterior, lateral and anterior.
- Each funiculus contains several fiber tracks.
- Fiber tract names reveal their origin and destination.
- Fiber tracts are composed of axons with similar functions.

# Ascending sensory tracts

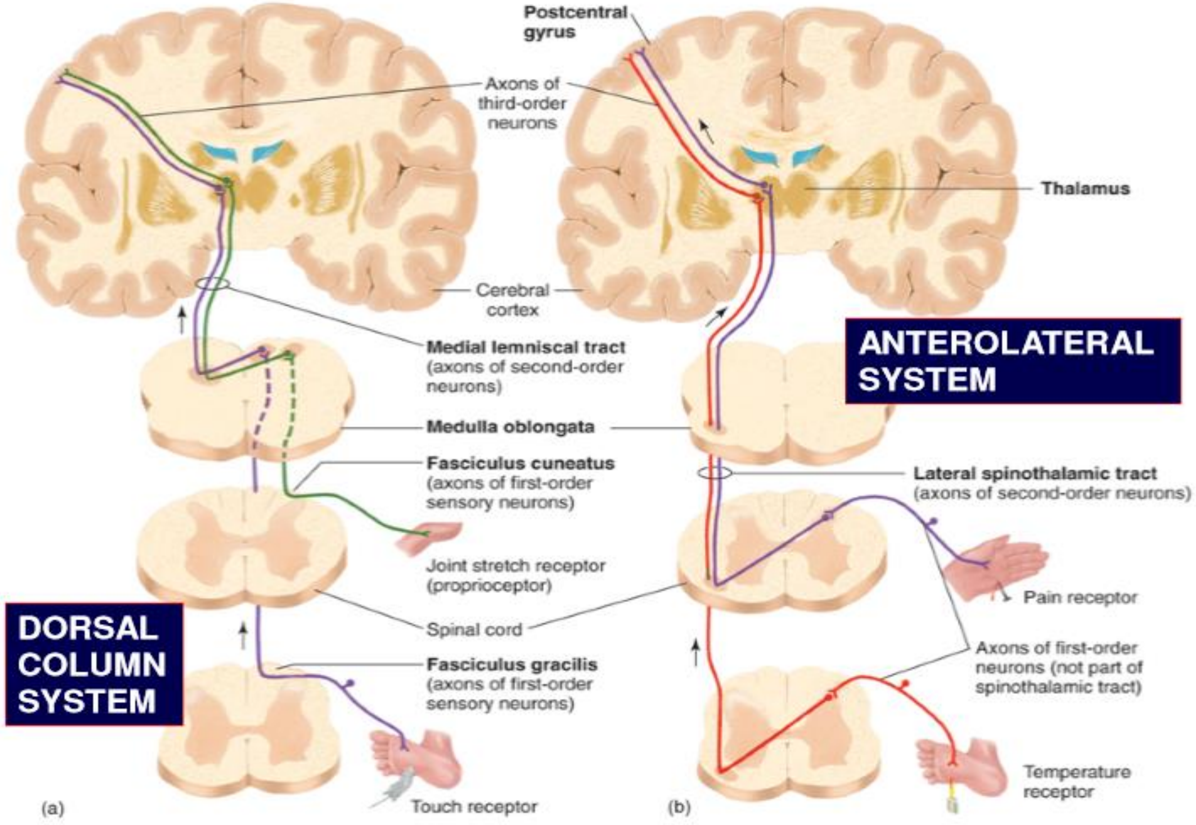
- There are several ascending sensory systems.
- Dorsal column system & Anterolateral system.
- Each system carries different types of sensations or modalities proprioception, pain, temperature, fine touch, crude touch, vibration.
- Sensory systems allow us to detect, analyze and respond to our environment .
- Ascending pathways carry information from sensory receptors to the brain.
- Conscious: reach cerebral cortex.
- Unconscious: do not reach cerebral cortex.
- Sensations from body reach the opposite side of the brain.
- Stereognsis 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.
- Conscious feeling always relayed to cerebral cortex so if only cerebellar tracts are intact you won't feel any thing.

- Sensory pathways: 3 neurons:
  - 1st: enters spinal cord from periphery.
  - 2nd: crosses over (decussates), ascends in spinal cord to thalamus.
  - 3rd: projects to somatosensory cortex.
- Spinal tracts:
  - These are known as sensory and motor pathways consisting of multineuron pathways connecting the CNS to the PNS. At some point most pathways crossover (decussate),
  - Ascending (sensory) Pathways :

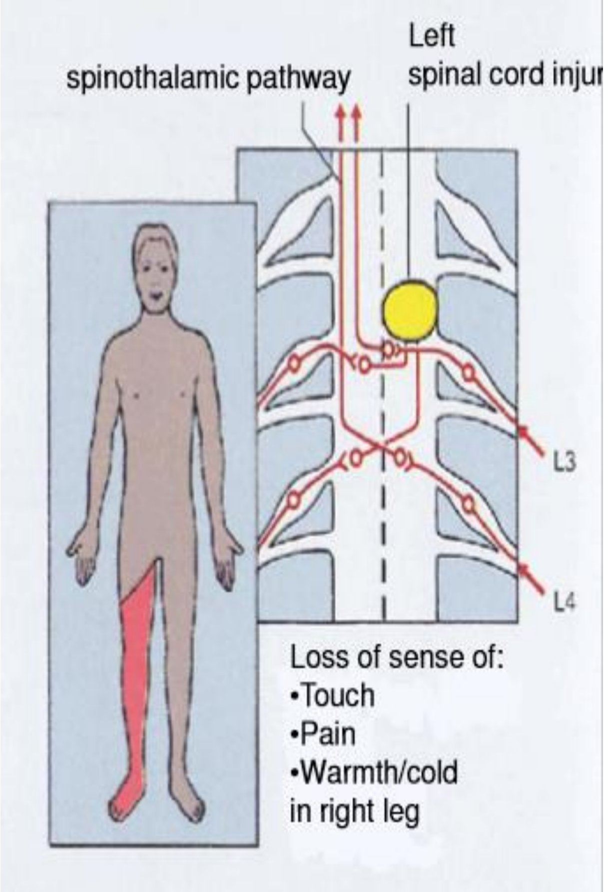
1. Dorsal column pathway: carries signal of fine touch, pressure, vibration , stereognosis and concious proprioception, ascends up dorsal white column in fasciculus gracilis or cutaneatus to medulla oblongata to the thalamus to primary somatosensory cortex (post central gyrus).
2. Posterior and anterior spinocerebellar pathways: carry subsconcious proprioception. Dorsal gray horn to lateral column to medulla oblongata to pons to cerebellum.
3. Spinothalamic pathway: carries signals of pain, temperature, deep pressure, and course touch. From psterior gray horn decussate into lateral and anterior funiculi up to the thalamus to primary somatosensory cortex (postcentral gyrus).

# Cont. Anterolateral system

- Ventral and lateral spinothalamic tracts.
- Pain.
- Thermal sensations, (warmth & cold).
- Crude touch and pressure sensations capable only of crude localizing ability on the surface of the body.
- Tickle and itch sensations.
- Sexual sensations.




Spinothalamic lesion



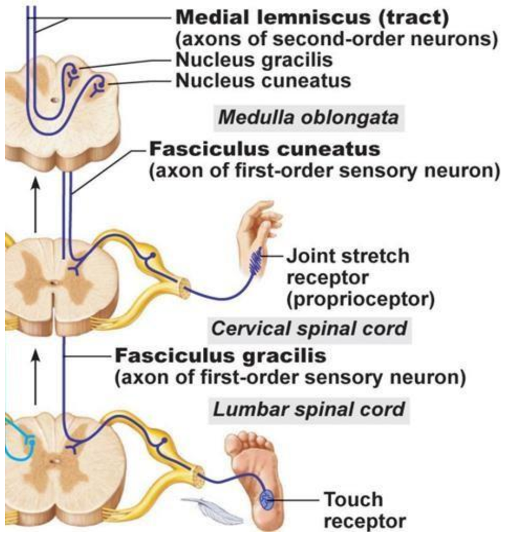
# Dorsal column–medial lemniscal system

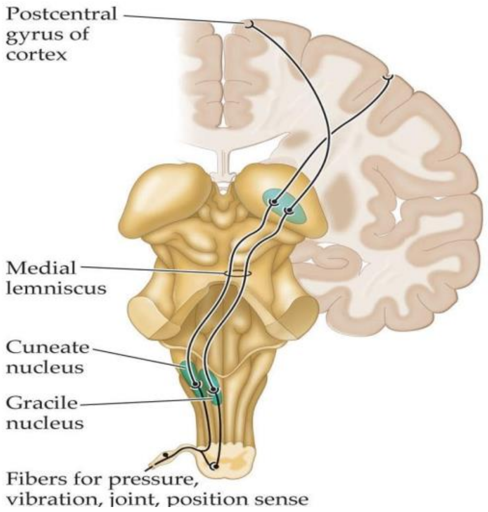
- Touch sensations requiring a high degree of localization of the stimulus.
- Touch sensations requiring transmission of fine gradations of intensity.
- Carries fine touch, tow point discrimination, pressure, vibration and conscious proprioception signals.
- Phasic sensations like vibratory sensations.
- Sensations that signal movement against skin.
- Joints Position sensations (Proprioception).
- Pressure sensations requiring fine degrees of judgment of intensity.
- Strereognosis.

**1st neuron**
- Enters spinal cord through dorsal root, ascends to medulla (brain stem).

**2nd neuron**
- Crosses over in medulla, ascends to thalamus.

**3rd neuron**
- Projects to somatosensory cortex.



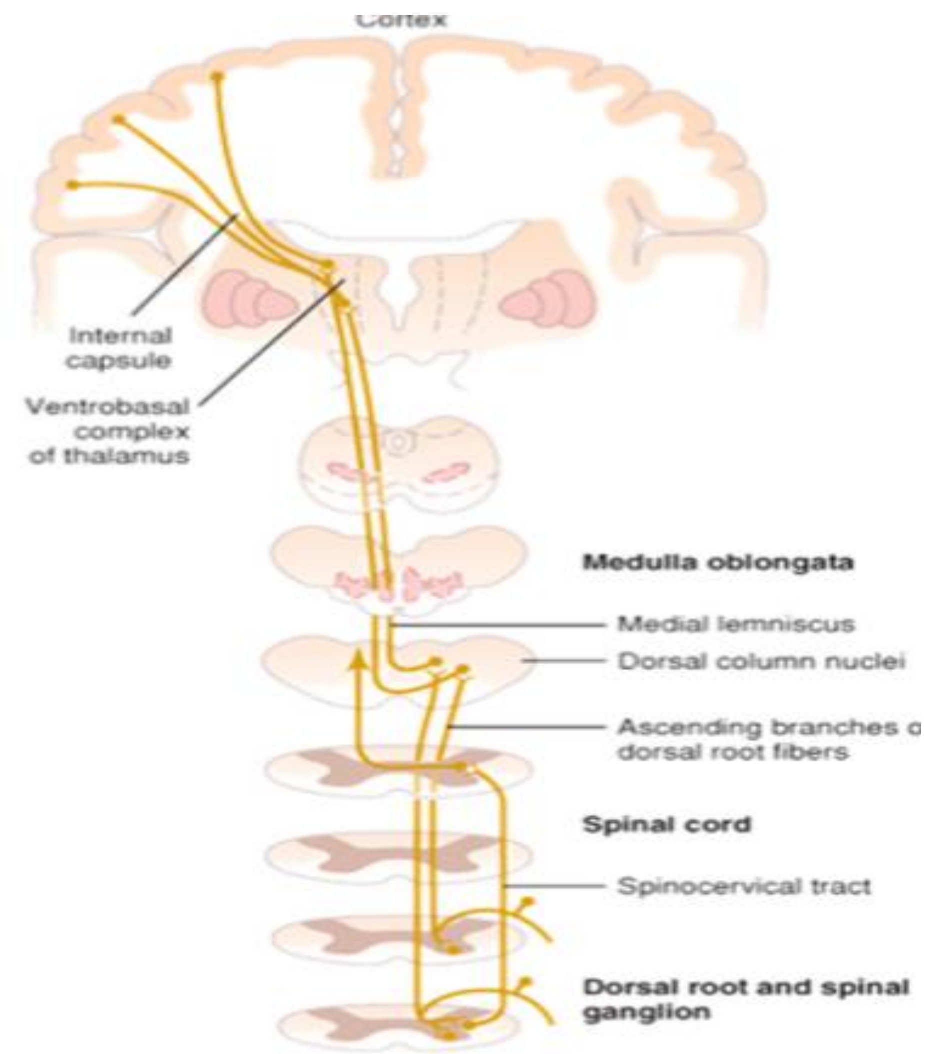




- Fine Touch
- Pressure
- Vibration
- Position
- Movement

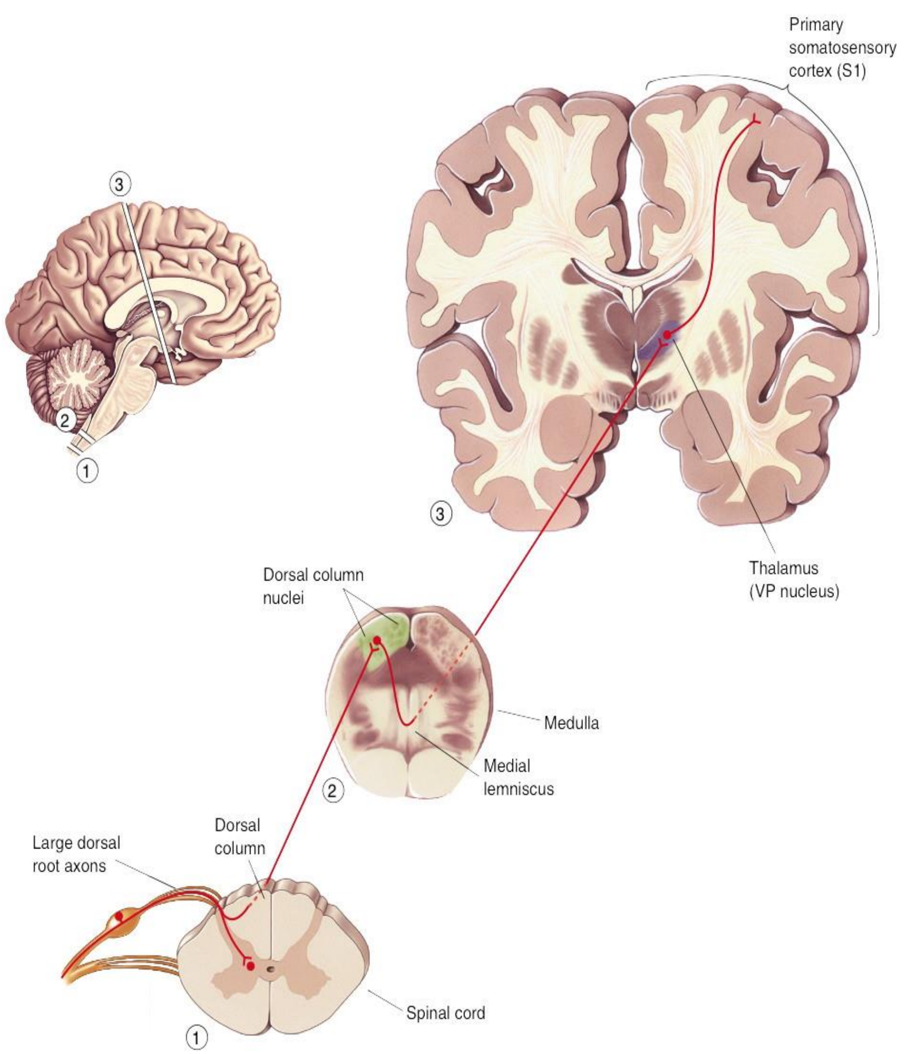
Fact conducting A α/β-fiber neurons

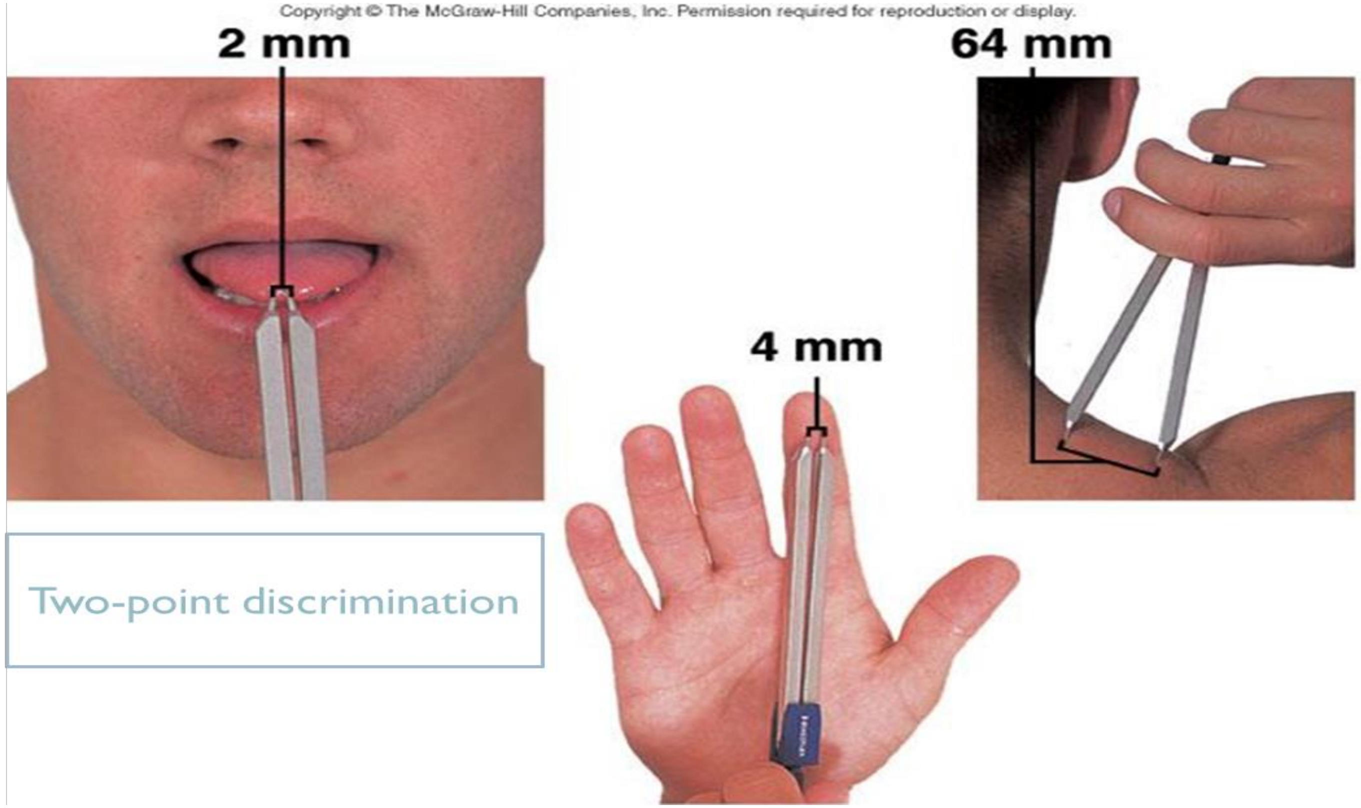
# Proprioception from head

- In this pathway through the brain stem, each medial lemniscus is joined by additional fibers from the sensory nuclei of the trigeminal nerve, these fibers subserve the same sensory functions for the head that the dorsal column fibers subserve for the body.



# Dorsal column pathway

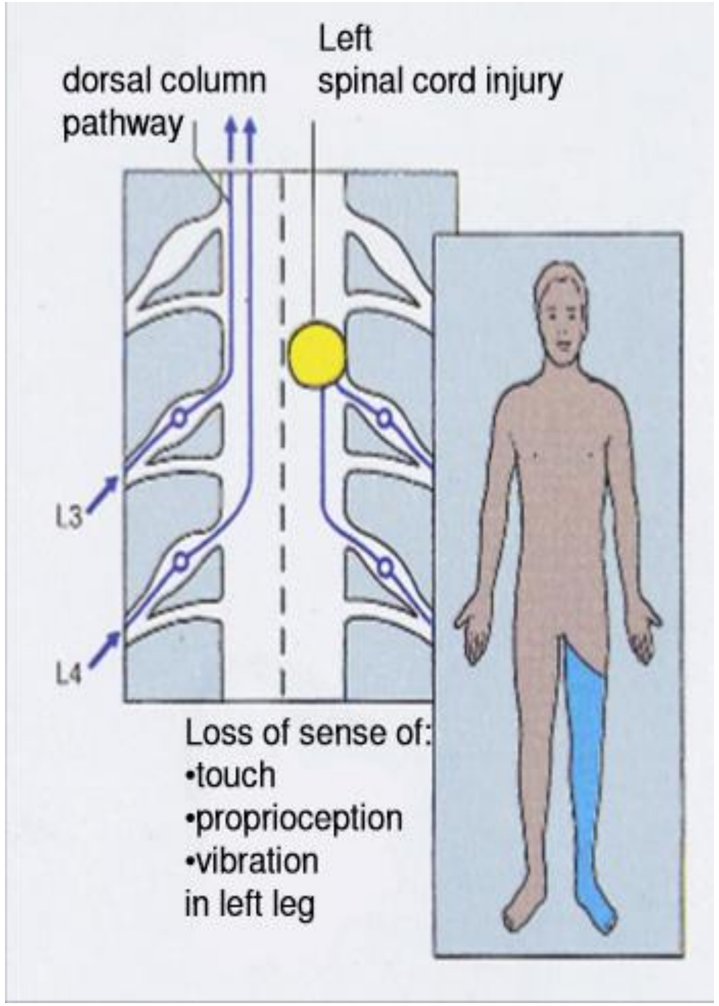



- Two point discrimination: is the ability to detect a small distance between two objects in contact with the skin.
- In the face and the hands the sense of two point discrimination is better than other areas of the body why is that? Its because of two reasons: 1.there are more sensory receptors in our face and hands.
  2. the lips face and tongue are represented by larger areas in the somatic cortex

# Dorsal column damage

- Sensory ataxia.
- Patient staggers; cannot perceive position or movement of legs.
- Visual clues help movement.
- In spinothalamic lesion decussation in spinal cord so lesion may be manifested contralaterlly.
- Control of rate (slow or fast) range(distance ) force and direction of movement is lost duo to loss of perception in sensory ataxia.
- If eyes closed they fall.
- The damage here (picture) will be on the same side because it is at the level of the spinal cord, if the damage was above the medulla it would be on the opposite (contralateral) side.




Positive romberg test the test depends on the integrity of proprioception from the joints of the legs.

# Role of cerebellum in proprioception

Functional division of cerebellum

## Vestibulocerebellum (flocculonodular lobe)

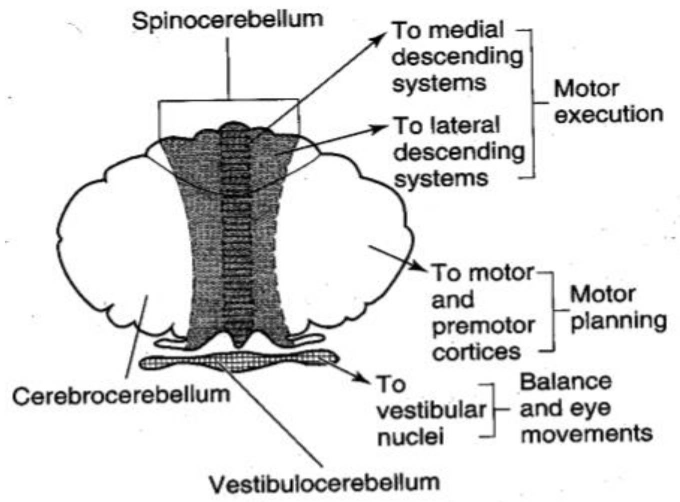
- In association with the brain stem and spinal cord control equilibrium and postural movements.
- During performance of rapid motions specially with changes in direction controlling balance between agonist and antagonist muscle contractions of the spine, hips, and shoulders during rapid changes in body positions as required by the vestibular apparatus.

## Spinocerebellum (vermis + intermediate zone)

- Feedback control of distal limb movements by way of the intermediate cerebellar cortex and the interposed nucleus.
- Feedback information from the peripheral parts of the body, especially from the distal proprioceptors of the limbs, telling the cerebellum what actual movements result.

## Cerebrocerebellum

- Function of the large lateral zone of the cerebellar hemisphere to plan, sequence, and time complex movements.



# Function of afferent system to the cerebellum

**TABLE 12–2 Function of principal afferent systems to the cerebellum.**[a]

| Afferent Tracts | Transmits |
|---|---|
| Vestibulocerebellar | Vestibular impulses from labyrinths, direct and via vestibular nuclei |
| Dorsal spinocerebellar | Proprioceptive and exteroceptive impulses from body |
| Ventral spinocerebellar | Proprioceptive and exteroceptive impulses from body |
| Cuneocerebellar | Proprioceptive impulses, especially from head and neck |
| Tectocerebellar | Auditory and visual impulses via inferior and superior colliculi |
| Pontocerebellar | Impulses from motor and other parts of cerebral cortex via pontine nuclei |
| Olivocerebellar | Proprioceptive input from whole body via relay in inferior olive |

[a]The olivocerebellar pathway projects to the cerebellar cortex via climbing fibers; the rest of the listed paths project via mossy fibers. Several other pathways transmit impulses from nuclei in the brain stem to the cerebellar cortex and to the deep nuclei, including a serotonergic input from the raphé nuclei to the granular and molecular layers and a noradrenergic input from the locus coeruleus to all three layers.

- Sustained movement is touch.
- Rapid repetitive movement is considered vibration.
- Pressure is deep touch.

# The dorsal & ventral spinocerebellar tracts

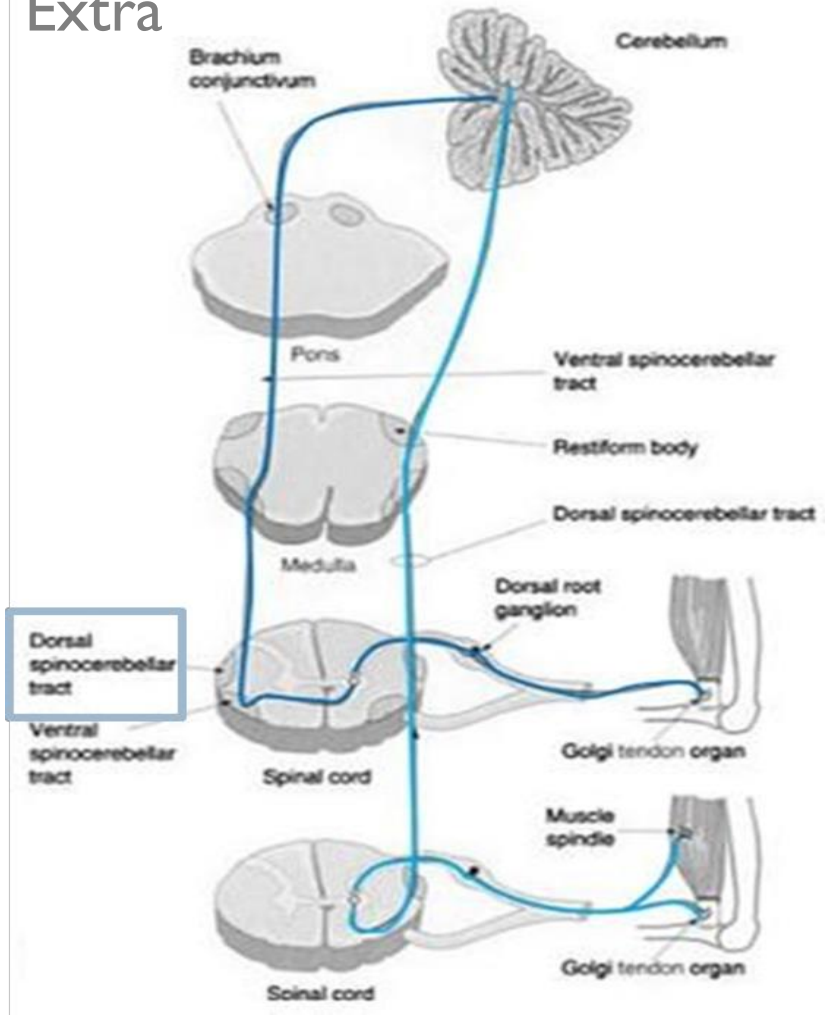
- They carry subconscious proprioception signals.
  - Receptors in muscles and joints.

| 1st neuron: | → | 2nd neuron: | → | 3rd neuron: |
|---|---|---|---|---|
| • Enters spinal cord through dorsal root. | | • Ascends to cerebellum. | | • Ascends to cortex. |

  - Spinocerebellar tract damage leads to cerebellar ataxia.

- Function of dSCT, informs the cerebellum about:
  - Muscle length and contraction.
  - Degree of tension on tendons.
  - Position of body parts & their movement  Forces acting on the body surfaces.

Extra



# Ataxia and gait disturbances

- Ataxia: inability to coordinate voluntary muscular movements that is due to nerve damage (CNS or PNS) and not due to muscle weakness (called also incoordination).

Types of Ataxia

Sensory ataxia

Motor ataxia

Failure of proprioceptive information to the CNS. May be due to disorders of spinal cord or peripheral nerves. Can be compensated for by visual inputs.

PNS lesions

- (Ex: polyneuropathy) injury to sensory receptors and afferent neurons.
- Cause ataxia because there is loss of the sense of joint position proprioception. Broad-based, high-stepping, stamping gait develops.

- This ataxia is made worse by removal of additional sensory input (e.g. vision)
- Ataxia is made worse in the dark or no vision. First described in sensory ataxia of tabes dorsalis, this is the basis of Romberg's test.

- Romberg's test. Ask the patient to close the eyes while standing with feet together.
- The affected patient becomes unstable (Romerg`s test).

# Cont.

- Motor ataxia: caused by cerebellar disorders.

- Intact sensory receptors and afferent pathways.
- Integration of proprioception is faulty.
- Midline cerebellar lesions cause truncal ataxia.
- Lateral cerebellar lesions cause limb ataxia.
- Thalamic infarcts may cause contra lateral ataxia with sensory loss.

- Motor ataxia = cerebellar ataxia.
- Control of rate (slow or fast) range(distance ) force and direction of movement is lost duo to loss of motor control.

- Features of cerebellar ataxia:

- Clumsy movements.
- Incoordination of the limbs (intention tremor).
- Reeling gait (wide-based, unsteadiness, and irregularity of steps, often with a tendency to fall to one or other side, forward or backward).
- Alcoholic intoxication produces similar effects.

- How can we differentiate between cerebellar or dorsal column ataxia? If it was cerebellar or motor ataxia the imbalance would be there whether the patient closed his eyes or had them opened if it was in the dorsal coloumn or a sensory ataxia the patient will loose balance when his eyes are closed (positive romberg test).

ONLY IN MALES' SLIDES

# Brown-séquard syndrome

- Is an incomplete spinal cord lesion.
- Hemisection injury often in cervical region.
- May be caused by **trauma**, tumor, multiple sclerosis.

| Ipsilateral loss | Contralateral Loss |
| --- | --- |
| - Fine touch, Vibration, Proprioception (injury to dorsal Column).<br>- Leg ataxia (injury to dorsal spinocerebellar tract).<br>- Spastic paresis below lesion (lateral corticospinal).<br>- Patients also suffer from ipsilateral **upper motor neuron paralysis** (see lecture of Upper motor lesion).<br>- Flaccid paralysis (Ventral horn destruction).<br>- Dermatomal anesthesia (Dorsal horn destruction). | - Loss of pain and temp (injury of lateral spinothalamic tract).<br>- Loss of crude touch and pressure (ventral spinothalamic).<br>- Minor contralateral muscle weakness (Ventral corticospinal tract).<br>- Leg ataxia (injury to V. spinocerebellar). |

# Thank you!

اعمل لترسم بسمة، اعمل لتمسح دمعة، اعمل و أنت تعلم أن الله لا يضيع أجر من أحسن عملا.

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QUIZ

اقتراحات وشكاوي

**References:**

- Females' and Males' slides.
- Guyton and Hall Textbook of Medical Physiology (Thirteenth Edition.)