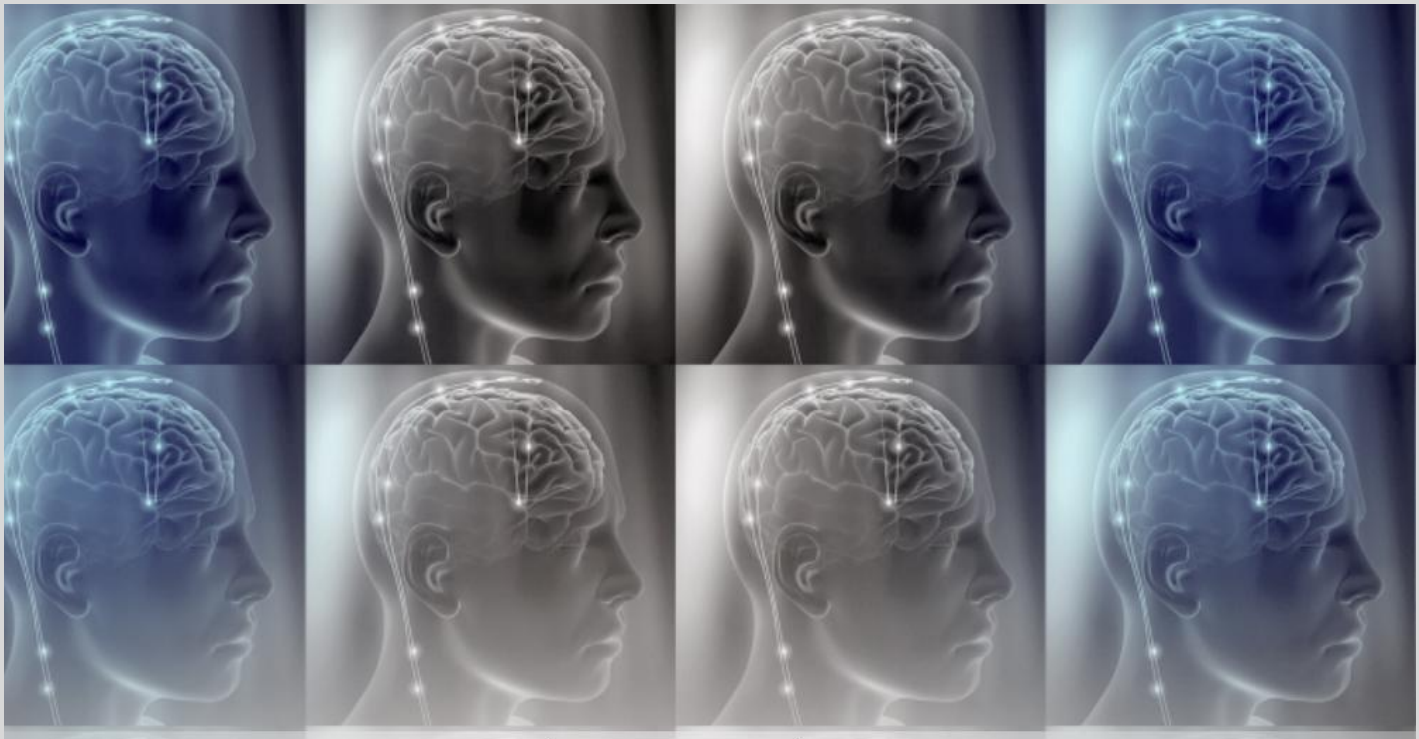


431

CNS Central Nervous System

Block

Physiology Team

	Female Side	Male side
Done By :	Sara Al-Anazy	Al-Waleed Khaled
Revised By:	Ala'a Al-Oqail	Mohammed Asiri

CNS central Nervous System

Block

Slide No.(1)

Proprioceptors & Balance

by

Prof. Ashraf / Dr. Faten
College of Medicine
Physiology Dept

Team Notes :

CNS Central Nervous System

Block

Slide No.(2)

Receptor

- Receptor is a transducer that convert any external or internal stimulation into electrical signal (generator potential then action Potential)

Team Notes :

(Additional info) :

What is the differences between Generator Potential and Action Potential?

A generator potential is a **Localized ,graded** response to a stimulus and if it becomes large enough it produces an action potential. These generator potentials "add" together which is called **summation** and allows an action potential to fire.

An action potential is not graded and is **all or nothing**. Also an action potential travels along a nerve fiber where as a generator potential localized.

CNS Central Nervous System

Block

Slide No.(3)

What is Proprioception?

It is the ability that provide information concerning the position of joints, position of body in space & position of each part in body in relation to other parts(specialy when eyes closed)

Team Notes :

Nothing else was mentioned about this slide.

CNS Central Nervous System

Block

Slide No.(4)

What are the Proprioceptors?

-These are receptors of proprioception (concerned with information about the position of body in space&position of each part in body in relation to other parts)

Team Notes :

Properiocetive sensations are the feeling of body movement and position, including motion of the arms and legs, resulting from stimuli received by Proprioceptors found in many locations in the body . For Example: in the muscles, tendons, joints, and inner ear. The stimuli may be produced by changes in muscle tension or stretching and reaction to the pull of gravity on the body .

CNS Central Nervous System

Block

Slide No.(5)

Proprioceptor Locations:-

1:Muscle Spindle or Stretch Receptors

This is present in muscles,this provides information about change in muscle length

2:Golgi tendon organ

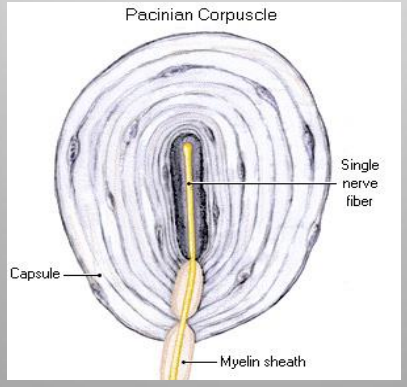
It is located in tendons of muscles and is sensitive to change in muscle tension

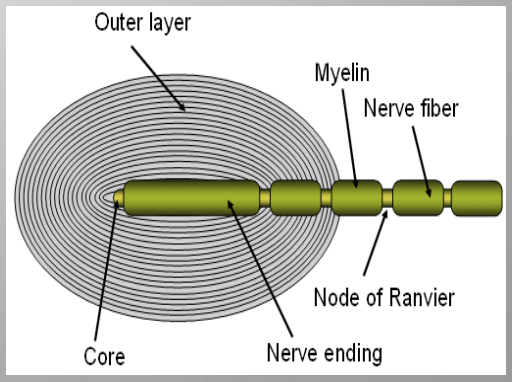
3:Pacinian Corpuscle

it is a laminated capsule and is pressure sensitive nerve ending situated in the centre of laminated (like onion skin) capsule. It responds to high velocity changes in joint position& sensitive to deep pressure

Team Notes :

Pacinian corpuscles (Lamellar corpuscles) are one of the four major types of mechanoreceptor. They are nerve endings in the skin responsible for sensitivity to pressure.





CNS Central Nervous System

Block

Slide No.(5)

Proprioceptor Locations:-

1:Muscle Spindle or Stretch Receptors

This is present in muscles,this provides information about change in muscle length

2:Golgi tendon organ

It is located in tendons of muscles and is sensitive to change in muscle tension

3:Pacinian Corpuscle

it is a laminated capsule and is pressure sensitive nerve ending situated in the centre of laminated (like onion skin) capsule. It responds to high velocity changes in joint position& sensitive to deep pressure

Team Notes :

There are three low-threshold Proprioceptors :

1:Muscle Spindle (or Stretch Receptors): present(in parallel) in skeletal muscles. They are especially numerous in extraocular muscles(eye movement) and intrinsic muscles of the hand and neck because we use them frequently . It provides information about change in muscle length

2:Golgi tendon organ: It is located(in series) in collagen fibers that form tendons of muscles and is sensitive to change in muscle tension

3:Pacinian Corpuscle(sensitive to vibration and pressure): it is a laminated capsule and it is pressure sensitive nerve ending situated in the centre of laminated (like onion skin) capsule. It is rapidly adapting and responds to high velocity changes in joint movement, position& sensitive to deep pressure.

CNS Central Nervous System

Block

Team Notes :

Muscle spindle :-

Consist of modified muscle fibers(intrafusal & extrafusal fibers). Have three types of nerve fibers :

1. Both contain Primary afferent nerve fibers which end in annulospiral fibers coil around middle that respond to muscle stretch.
2. Secondary afferent nerve fibers wrap around the ends of nuclear chain fibers, respond to prolonged stretch
3. Gamma motor neuron fibers which innervate the ends of intrafusal fibers (about 1/3 of fibers in spinal nerves)

Only the two ends of an intrafusal fiber have sarcomeres and are able to contract.

CNS Central Nervous System

Block

Slide No.(6)

- a- Neck Proprioceptors:-
- detect head position in relation to trunk
- b- Body Proprioceptors proprioceptors of anti-gravity muscles
- c- pressure receptors as in sole of feet initiate positive supporting reaction (magnet reflex)

Team Notes :

Anti-Gravity Muscles are:

- Extensor of Lower limps , Extensor of neck and back muscles
- Flexors of upper limp
- Abdominal wall muscles
- Elevator of mandible

(magnet reflex)

- If light pressure with the thumb is applied to the sole of the foot of a newborn lying in a supine position, the baby pushes back against the pressure.

CNS Central Nervous System

Block

Slide No.(7)

Types of proprioception:-

1- conscious proprioception reach the level of cerebral cortex sensory area via dorsal column system

2- Unconscious proprioception reach the level of cerebellum via spinocerebellar tracts

Team Notes :

Nothing else was mentioned about this slide.

CNS Central Nervous System

Block

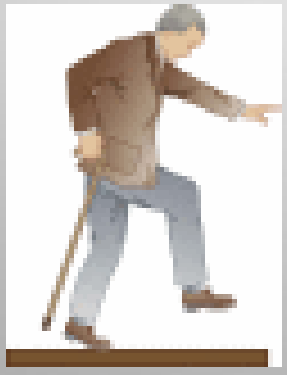
Slide No.(8)

---**Lesion of dorsal column system** as in diabetic polyneuropathy & tabes dorsalis causes:-

1- **Sensory ataxia**(incoordinated sensations)
2-Positive rombergism(romberg sign) in which patient is unable to stand when closing his eyes
3-Stamping gait(raise his legs then drop suddenly as stamp)

Team Notes :

Stamping gait:



Sensory ataxia presents itself with an unsteady "stamping" gait with heavy heel strikes

CNS Central Nervous System

Block

Slide No.(9)

Postural reflexs that depend on proprioceptors are :-

1- Stretch reflex & muscle tone :- is required for maintenance of body tone which is essential to balance the body

2- Golgi tendon reflex (inverse stretch reflex) It senses the pull on the tendon and monitors muscle tension & prevents muscle rupture

3- Crossed extensor reflex

4- Positive & negative supporting reaction (magnet reflex). Initiated by proprioceptors of flexors, cutaneous pressure receptors as in sole of feet

5- Neck postural reflexes

Neck proprioceptors detect head position in relation to trunk & initiate neck postural reflexes

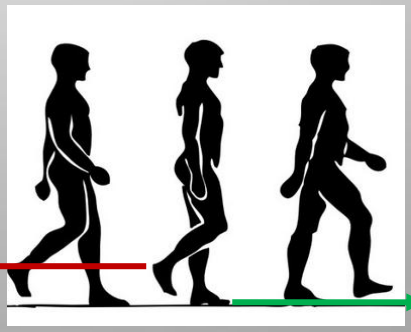
6- -Righting reflexes by Body Proprioceptors proprioceptors of neck and anti-gravity muscles

Team Notes :

Magnet Reflex:

Both Extensor and flexors of the lower limp are contracted. This will make the leg a rigid column to support the body during standing and walking. **It is the only reflex without Reciprocal inhibition**. (because both flexors and extensors are contracted)

At this leg the Reflex is negative because the flexors are contracted and extensors are relaxed



At this the leg the reflex is positive because the leg is a rigid column and both extensor and flexor are contracted

CNS Central Nervous System

Block

Slide No.(10)

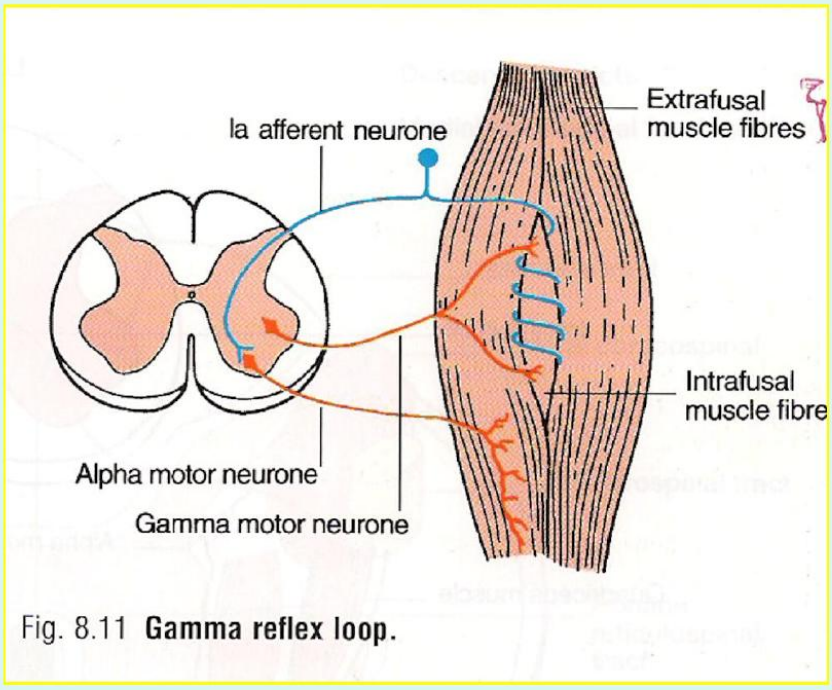


Fig. 8.11 **Gamma reflex loop.**

Team Notes :

Somatic reflex employ a reflex arc :-

1. Somatic receptors (in the skin, muscle or a tendon)
2. Afferent nerve fibers (carry information from receptors into the dorsal horn of the spinal cord)
3. Interneurons (integrate information) lack in some reflexes
4. Efferent nerve fibers (carry motor impulses to the skeletal muscles)
5. Skeletal muscle (the somatic effectors that carry out the response)

CNS Central Nervous System

Block

Slide No.(11)

-Component of stretch reflex

1. **1-Dynamic stretch reflex (dynamic or phasic response)**

- **Sudden rapid stretch of a muscle >> Nuclear bag fibers respond to rate or velocity of stretch>>>>discharge Synchronous strong impulses from spindles >>>>primary ending >>>alpha motor neuron >>>motor nerve>>>>causing sudden contraction of muscle extrafusal fibers synchronously (jerk movement)**
- -

-Basis of tendon jerk (contraction followed by (relaxation) (knee,biceps,triceps)

Team Notes :

Stretch Reflex : is mediated primarily by the brain, therefore, is not strictly a spinal reflex.

- Patellar reflex (monosynaptic) : tapping the patellar ligament suddenly stretches the quadriceps femoris. This stimulate numerous of muscle spindles in the quads and sends signals to the spinal cord.
- Withdrawal reflex (polysynaptic)
- Flexor and crossed extensor reflex

CNS Central Nervous System

Block

Slide No.(12)

2- Static stretch reflex(static response)

- **Maintained** stretch of muscle>>> **Nuclear chain fibers** discharge with increased rate >>>Impulses in the **secondary sensory nerve** >>>>alpha motor neuron >>> motor nerve>>> contraction of muscle fibers **Asynchronously**(not all together discharge of motor units)>>>>>> resulting in **mild sustained** contraction of muscle extrafusal fibers as long as it is stretched

-Basis of **muscle tone**

Team Notes :

Nothing else was mentioned about this slide.

CNS Central Nervous System

Block

Slide No.(13)

Muscle Tone(Static stretch reflex)

Dif/ resistance of muscle to stretch

-Stimuli for muscle tone / Stretch of skeletal muscle between origin and insertion

-Present in antigravity muscle (extensors of LL, back, neck, flexor of UL, muscle of abdominal wall and elevator of mandible

-if lost by low gamma efferent discharge>>>>>hypotonic or flacidity

-if increased by high gamma efferent discharge>>>>>>hypertonic,spastic muscle

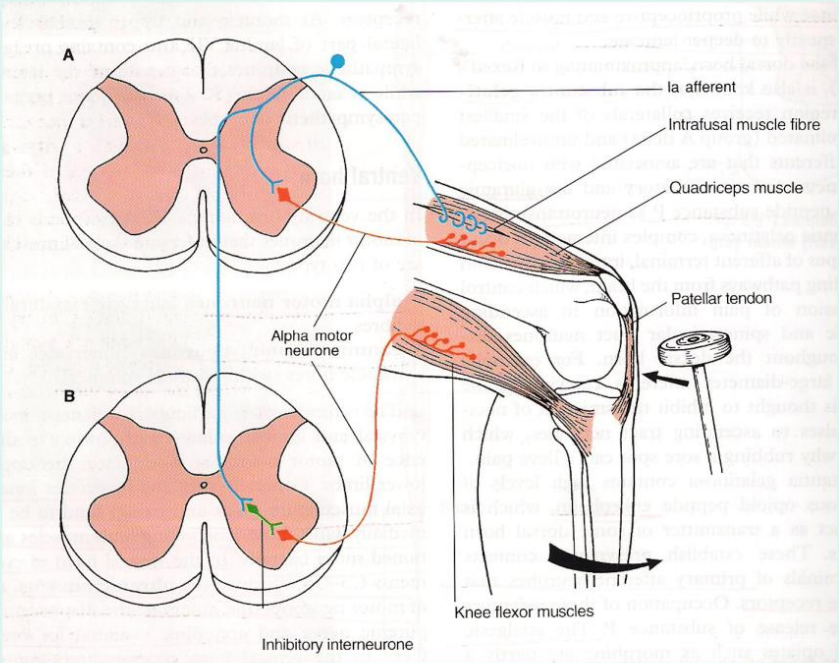
Team Notes :

Nothing else was mentioned about this slide.

CNS Central Nervous System

Block

Slide No.(14)



Team Notes :

CNS Central Nervous System

Block

Slide No.(15)

The Golgi tendon reflex (inverse stretch reflex)

-Deep & polysynaptic reflex

-(opposite response to stretch reflex).

-Excessive tension in the muscle (by passive over-stretch of tendon or active muscle contraction) >>> muscle relaxes

-The receptors are Golgi tendon organs (3-25) present in tendons

-stimulated golgi tendon organ>>> impulses via fast Aα fibers >>>> SC >>> excitation of inhibitory interneuron secrete Glycine >> inhibit alpha motor neuron >>> muscle relaxation

- Also stim excitatory interneuron to antagonist.

Value/Protect muscle from rupture

Team Notes :

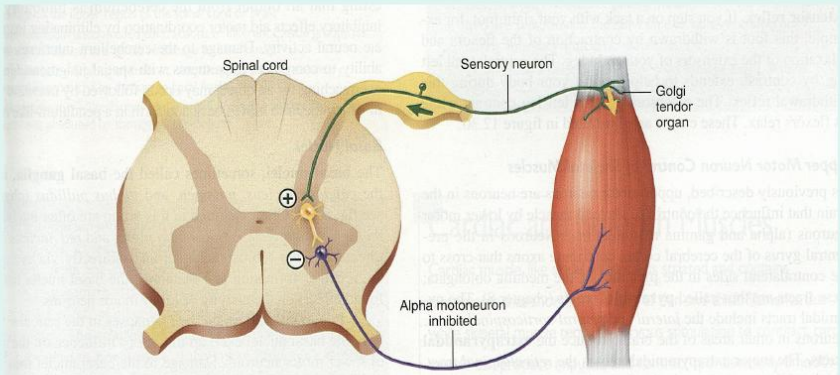
Nothing else was mentioned about this slide.

CNS Central Nervous System

Block

Slide No.(16)

The Golgi tendon reflex (inverse stretch reflex)



ure 12.28 **The action of the Golgi tendon organ.** An increase in muscle tension stimulates the activity of sensory nerve endings in the Golgi organ. This sensory input stimulates an interneuron, which in turn inhibits the activity of a motor neuron innervating that muscle. This is therefore a tic reflex.

Team Notes :

CNS Central Nervous System

Block

Slide No.(17)

Crossed extensor reflex:-

Flexion and withdrawal of the stimulated limb by painful stim >> causes flexion of that limb & extension of the opposite limb >> occurs with strong stimulus why?

Reciprocal innervations occurs in crossed extensor reflex. How?
flexors in the opposite limb are inhibited while extensors are excited pushing the body away from the injurious agent and supporting the body weight against gravity
- hence it is an Antigravity Reflex

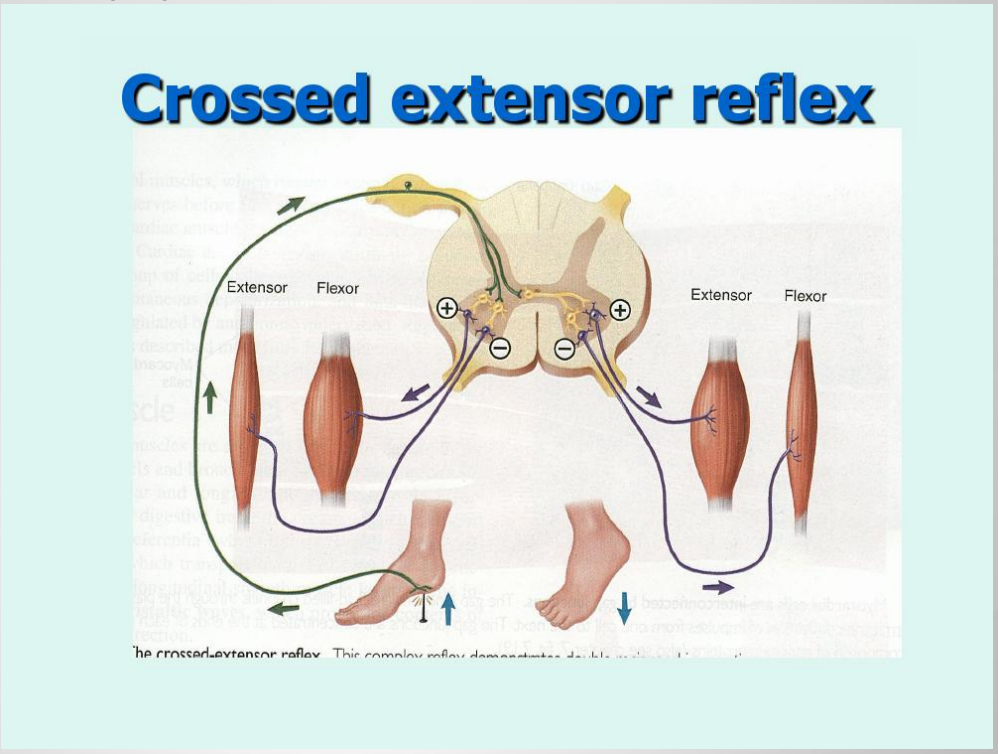
Team Notes :

Nothing else was mentioned about this slide.

CNS Central Nervous System

Block

Slide No.(18)



Team Notes :

Useful Video :

http://www.youtube.com/watch?v=iaXVUtS8Y4I

CNS Central Nervous System

Block

Slide No.(19)

- Positive supporting reaction (magnet reflex) (Initiated by proprioceptors of flexors & cutaneous pressure receptors as in sole of feet – no reciprocal inhibition both flexors& extensors are contracted.

-Negative supporting R (which release +ve supporting reaction -(receptors are proprio of extensors of the released limb)

Team Notes :

Nothing else was mentioned about this slide.

CNS Central Nervous System

Block

Slide No.(20)

- -**Neck postural reflexes:-**
- **Neck proprioceptors detect head position in relation to trunk & initiate neck postural reflexes**
- **-Stimulus is :-changing head position stimulates neck proprioceptors**
- **-Righting reflexes :- by Body Proprioceptors mainly proprioceptors of neck and anti-gravity muscles**
- **-Phasic reflexes**

Team Notes :

Nothing else was mentioned about this slide.

Questions:

1. **In positive supporting reaction (magnet reaction):**
   A. Both flexors and Extensor relaxed
   B. Both flexors and Extensor Contrated
   C. Flexor contracted and extensor relaxed
2. **The only reflex without Reciprocal inhibition:**
   A. Crossed Extensor reflex
   B. Magnet Reflex
   C. Righting Reflex
3. **Inability to stand when closing the eyes is called:**
   A. Romberg sign
   B. Ataxia
   C. Stampin gait
4. **Pacinian corpuscle is** :
   A. rapidly adapting and sensitive to vibration and pressure.
   B. carry pain sensation
   C. carry thermal sensation
5. **muscle tone is**:-
   A. Dynamic stretch reflex
   B. Phasic stretch reflex
   C. Static stretch reflex
6. **It provides information about <u>changes in muscle length</u>:**
   A. Muscle spindle
   B. Golgi tendon organ
   C. Pacinian corpuscle
7. **If the patient is rombergism, the lesion would be related to:**
   a. **Cerebellum**
   b. **Spinal nerves**
   c. **Dorsal column system**

Answers :-

1	2	3	4	5	6	7
B	B	A	A	C	A	C