
بسم الله الرحمن الرحيم

Proprioceptors & Balance

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Receptor

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

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)

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)

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

- **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)**

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

---**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)

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

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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

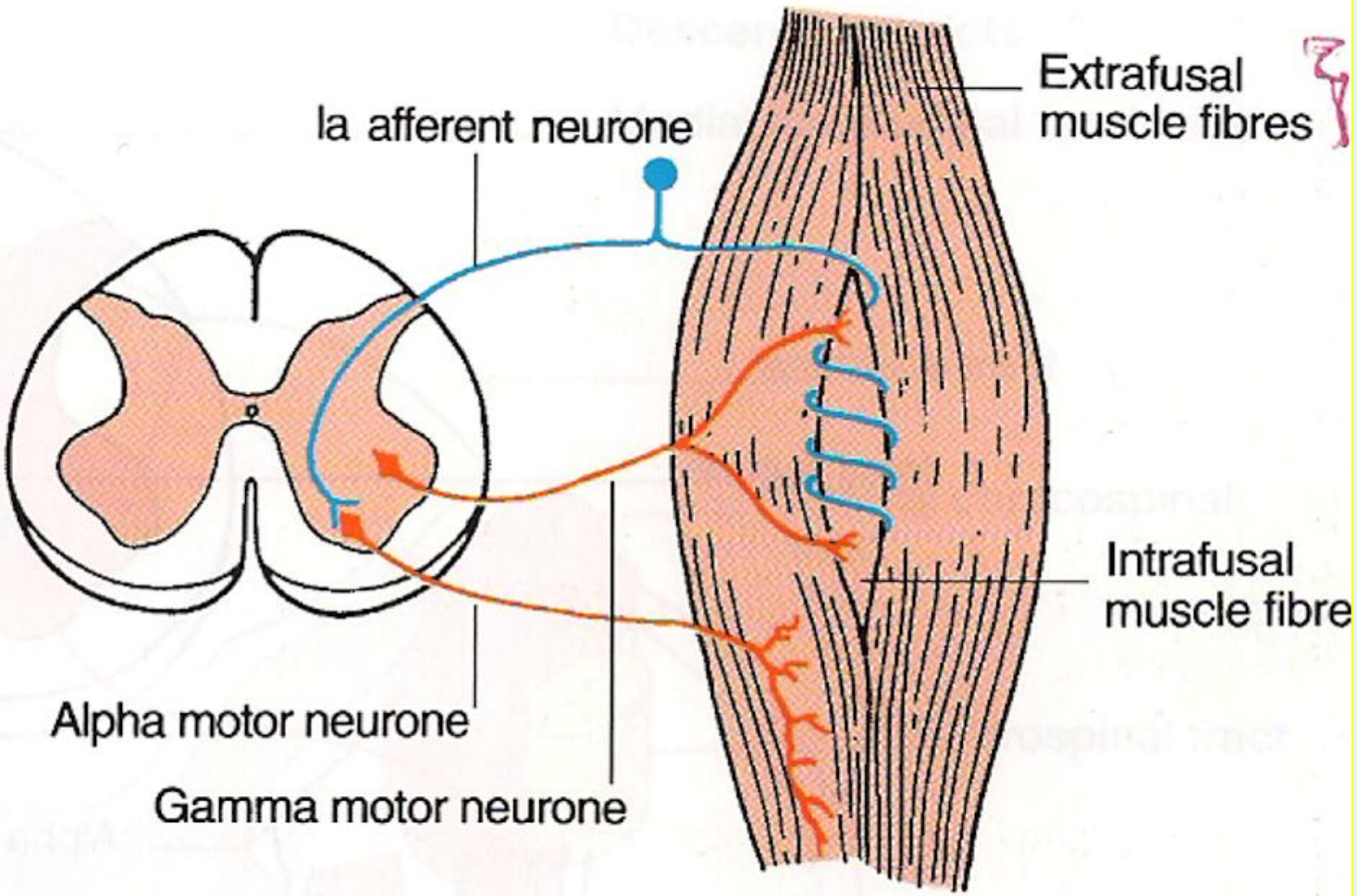


Fig. 8.11 **Gamma reflex loop.**

-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)

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**

Muscle Tone(Static stretch reflex)

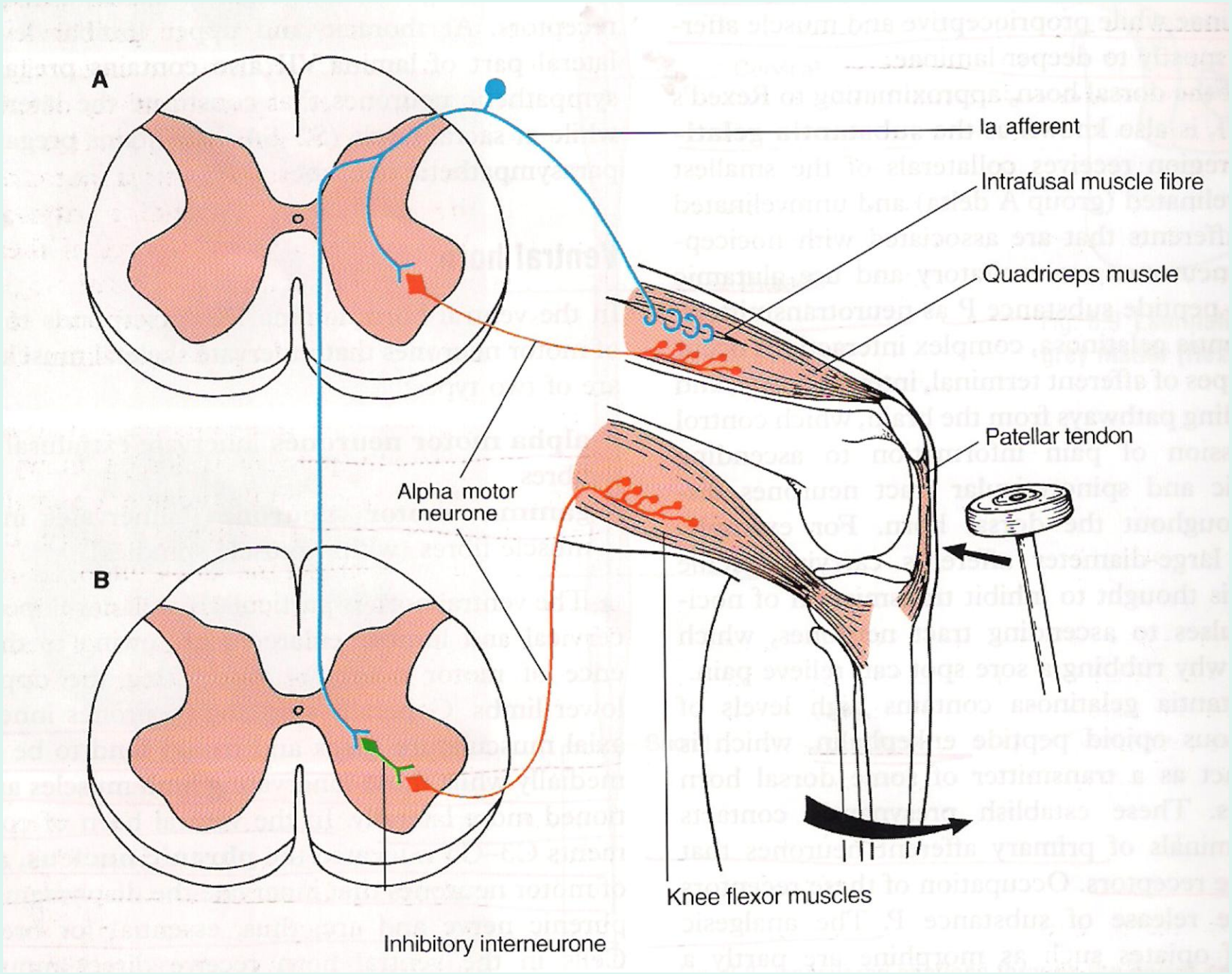
Dif/ resistance of muscle to stretch

- 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


A
B
Ia afferent
Intrafusal muscle fibre
Quadriceps muscle
Patellar tendon
Alpha motor neurone
Knee flexor muscles
Inhibitory interneurone

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

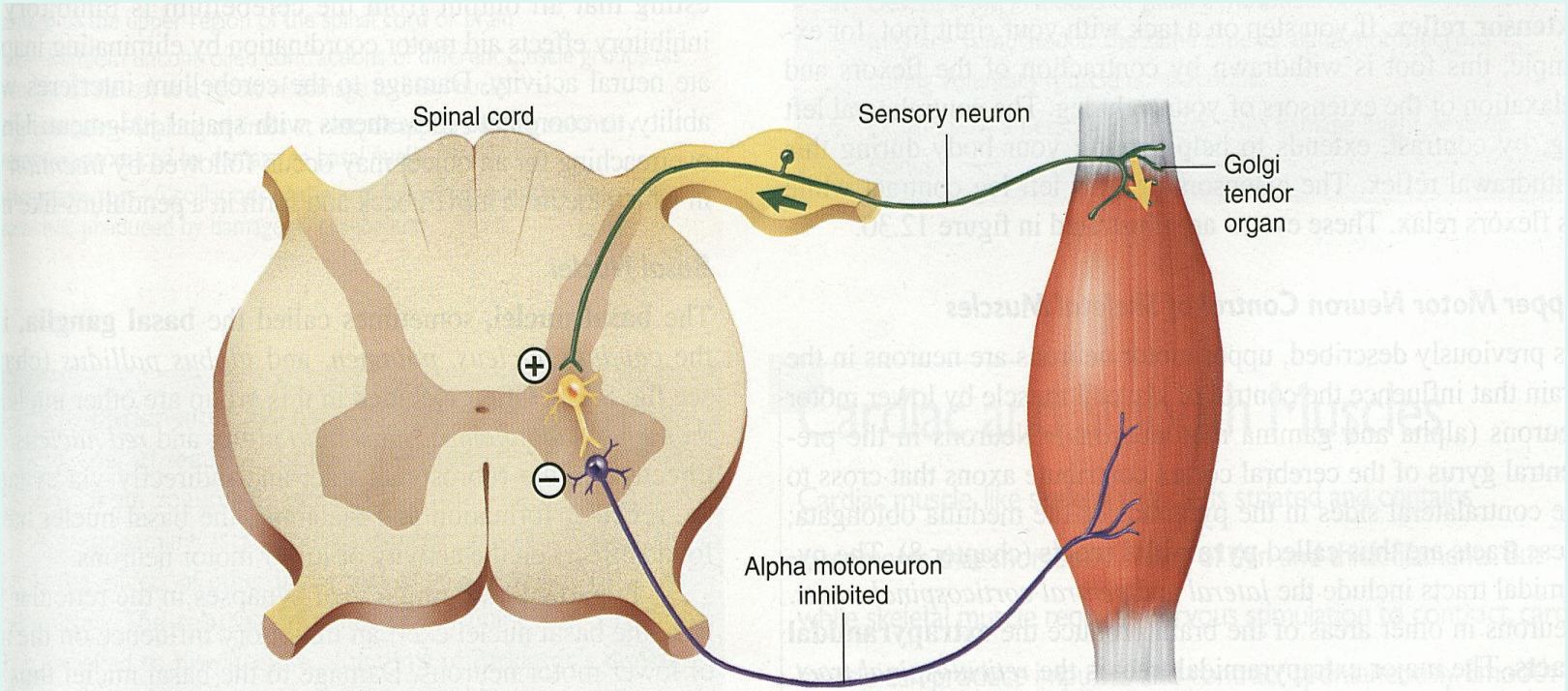
-The receptors are Golgi tendon organs (3-25) present in tendons

-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

The Golgi tendon reflex (inverse stretch reflex)



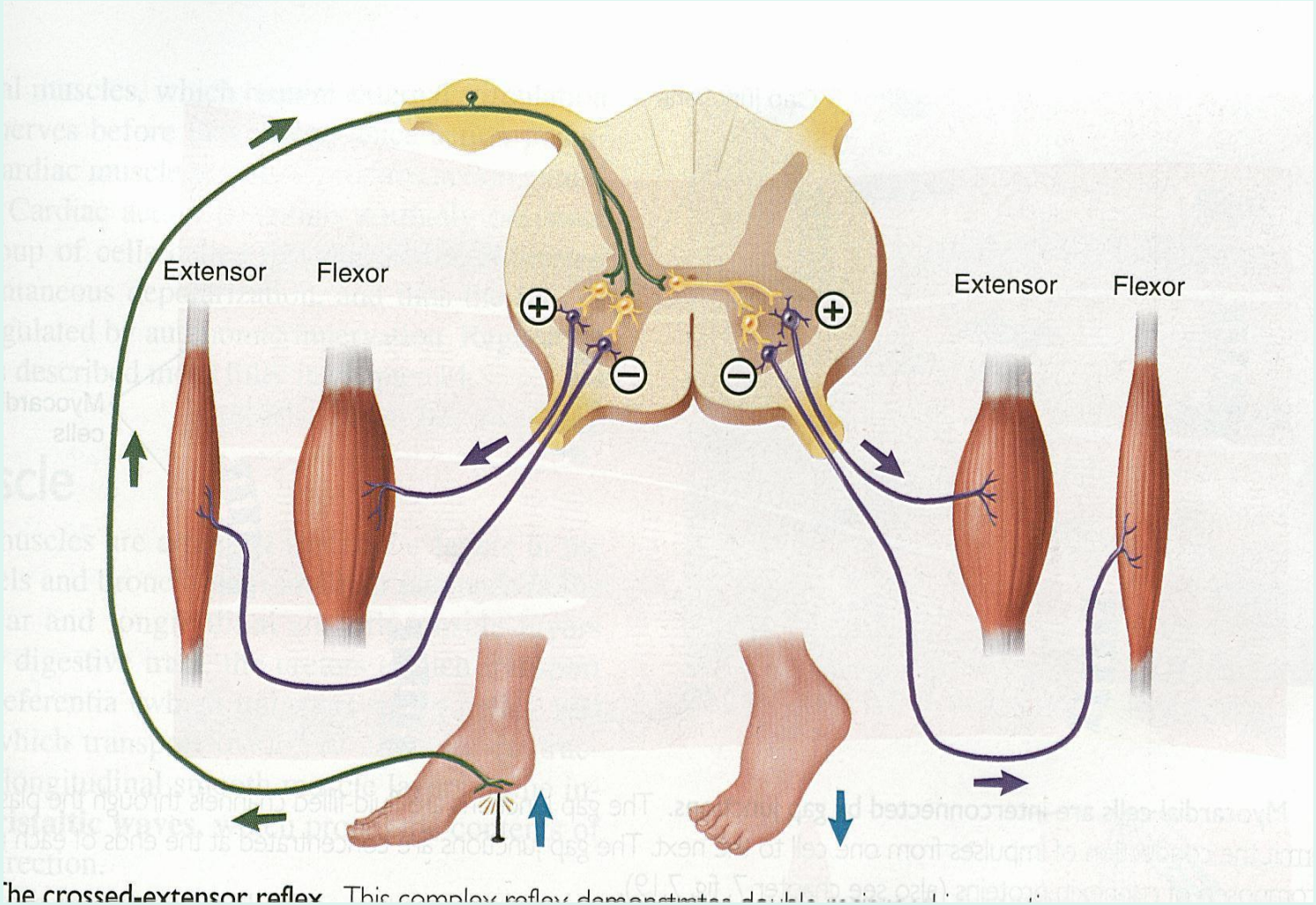
ure 12.28 **The action of the Golgi tendon organ.** An increase in muscle tension stimulates the activity of sensory nerve endings in the Golgi organ. This sensory input stimulates an interneuron, which in turn inhibits the activity of a motor neuron innervating that muscle. This is therefore a tic reflex.

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

Crossed extensor reflex



The crossed-extensor reflex. This complex reflex demonstrates double

- **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)**

- **-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**