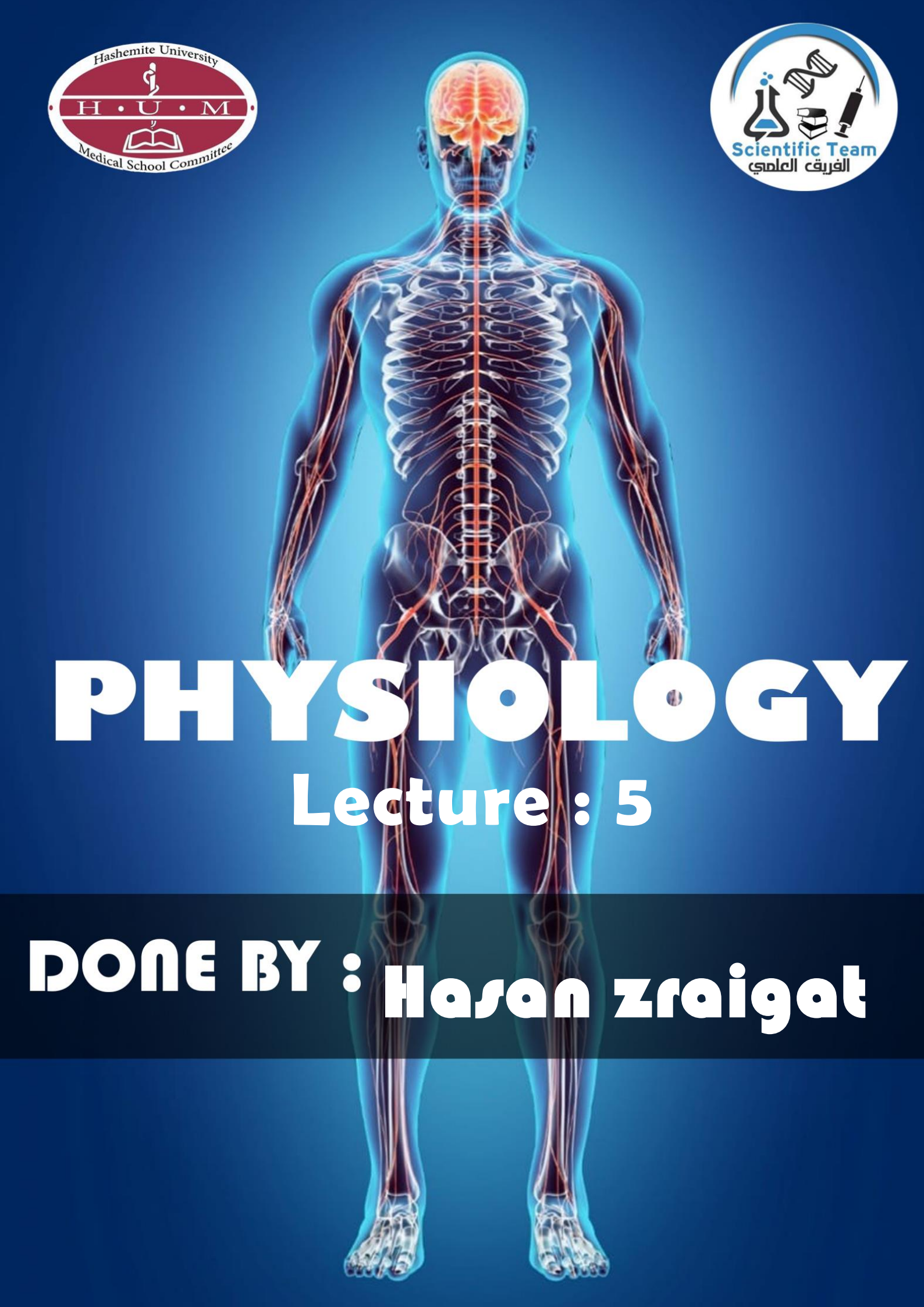


PHYSIOLOGY

Lecture : 5

DONE BY : Hasan zraigat

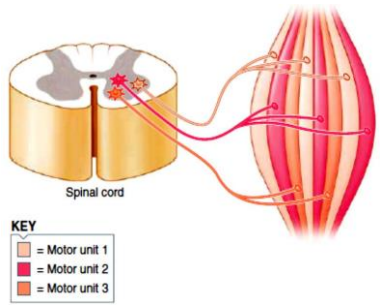
Spinal cord & somatic sensations

Muscle tone does not cause fatigue because:

1- It is due to **alternate** contraction of different musclefibres.

2- Contraction is **subtetanic.**

3- Muscle fibres involved in muscle tone are the **red muscle fibres**, which contract slowly and can sustainforce in muscle for a long time.



This picture shows us ..motor units that alternating so they will not get fatigue

Muscle tone does not cause fatigue ?

Why muscles do not get fatigue?

1-sub tetanic ⟹ *never reach maximum level*

2-muscle fiber structure (red type muscle fibers) that contract slowly and resist fatigue

Functions of muscle tone

1-Maintain the body posture against the effect ofgravity.

2-provides a background for voluntarymovements.

3- helps in regulation of body temperature.

4- helps venous and lymph.

-muscle tone function:

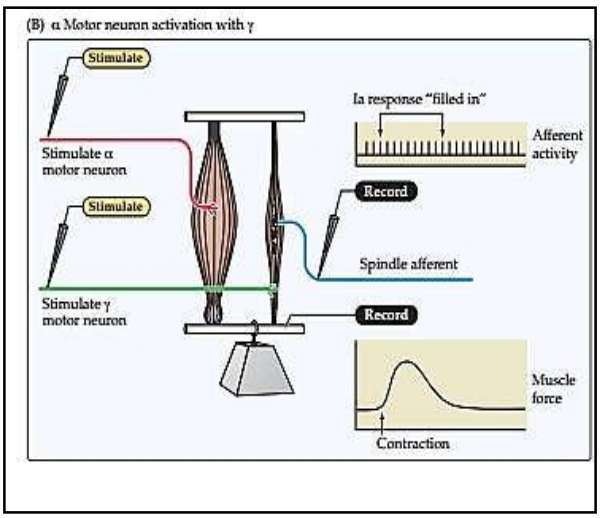
1-manitain erect position

2-keep continuous sub tetanic contraction

3-role in basal body temperature

4-increase pump activity

Contraction of skeletal muscles will press on the blood and lymph vessels so increase venous and lymph return. you can increase pump activity even more (by adding voluntary muscle contraction(exercise) to the reflex contraction)



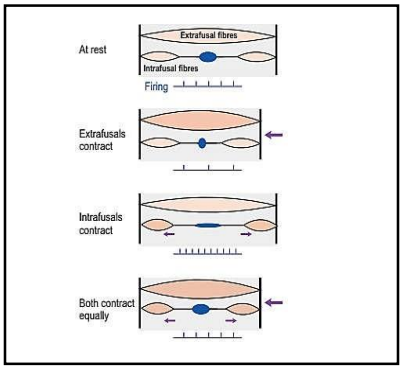
We have here e.f fibers that are able to contract and also we have the nonparallel embedded i.f fibers If extrafusal (e.f) muscle fibers were the only one contract (no intrafusal (i.f) fiber contraction) = e.f are shortened while i.f not (remain relaxed and cannot detected the muscle length nor send signal about that to cns)

When e.f stimulated, it will have an order contract. Either reflex contract or voluntary contract

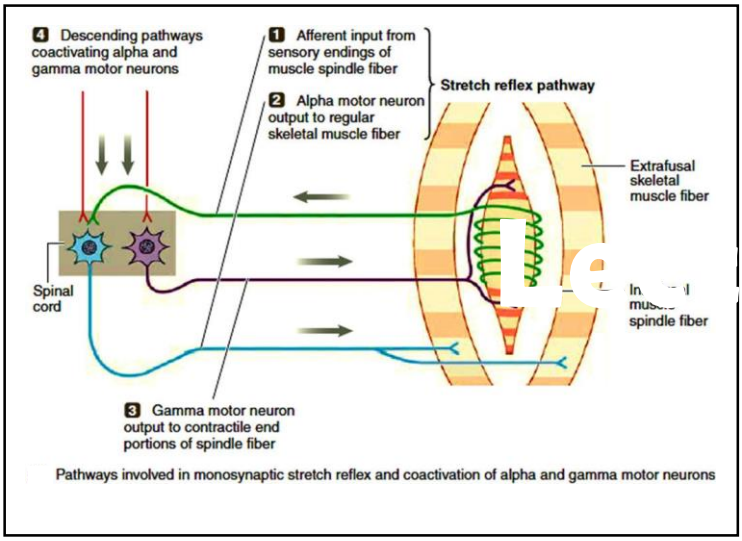
Skeletal muscle can be target to reflex contract or voluntary contract voluntary contract like writing or move your hand

ANY MOVEMENT IN OUR BODY SHOULD PASS IN THREE STAGES

Idea initiation then planning then movement performing pathway voluntary or reflex -any impulse comes to activate e.f, must stimulate gamma motor neuron too. the central part of i.f will stretched◊Whenever peripheral i.f contract and send signal to cns with the current situation of the muscle length



Monitoring of muscle length and ready for any feedback whenever needed



اسم العمل̈ية اللي شرحناها Alpha – gamma co- activation

‘load’ means the force against which a musclehas to operate.

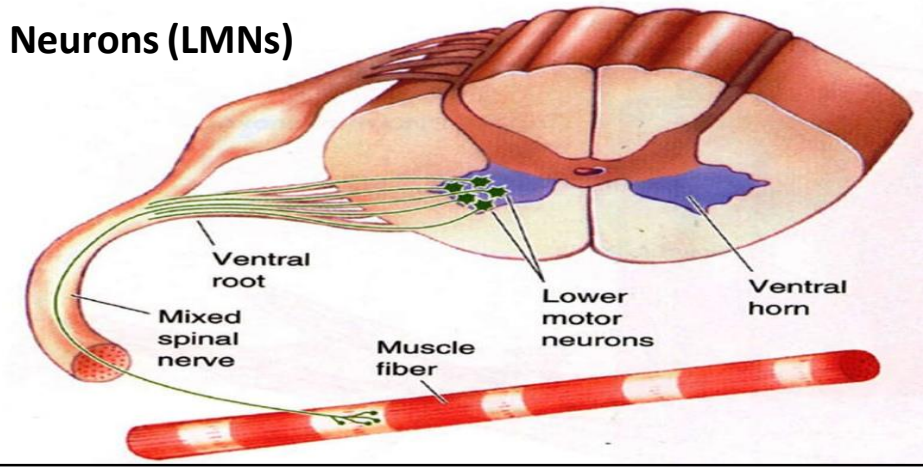
Load

Stretch reflex can help in voluntary movement too not in maintain muscle length only, HOW???

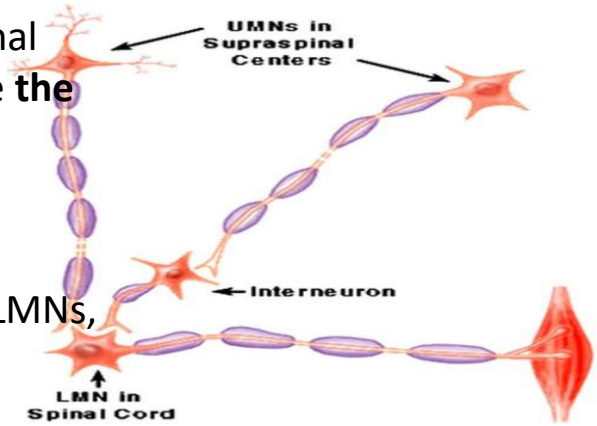
1-muscle tone ⇨ as we have said muscle tone act as a background of voluntary movement

2-servo assistant function (we will talk about it later)

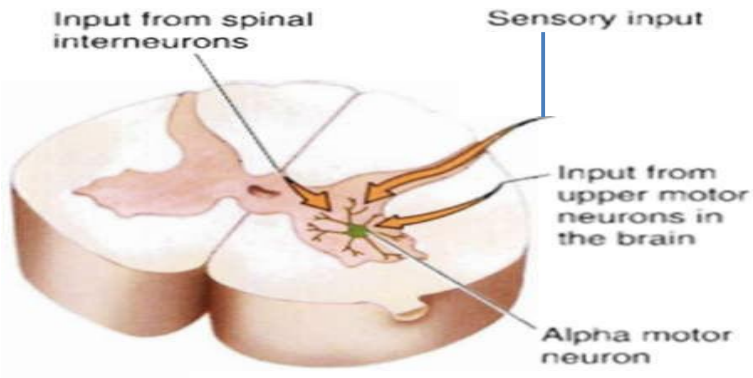
Lower Motor Neurons (LMNs)



- Cells that carry signals from supraspinal centers to LMNs of the spinal cordare **the Upper Motor Neurons (UMNs).**



-**<u>UMNs</u>** carry **<u>motor</u>** **<u>commands</u>** to the LMNs, which **<u>execute them</u>** by causing muscle contraction.



UMN Signals from supra spinal area to

LMN Signals from AHC to the muscles

AHC can receive signals from different inputs.For example, it can receive from

-Sensory input (as result from muscle stretch stimuli)

-from UMN like to do voluntary contraction

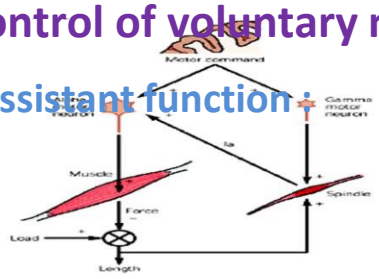
-interneuron within spinal cord

AHC = LMN = FINAL COMMON PATHWAY = final result that affect the muscle

Final=because of the final destination to deliver the message to the muscles COMMON = because it receives stimuli from more than one recourse as we mentioned above

Physiological significance of the stretch reflex2- Control of voluntary movements.

a-Servo-assistant function :



When load is larger than expected and don't move that

1- will exert ⇒ so central receptor area sense the change ⇒stretch to the muscle ultimately that will activate circuit of stretch reflex

2-supra spinal will also send to gamma motor neuron centre to increase the stretch reflex

So to sum up: stretch reflex is a result of

1-load exerted stretch on muscle HIGHER CENTER UMN Stretch circuit

2-gamma motor neuron (peripheral part first then affect the central part)

So AHC receive stimuli from (double stimulations)

1-reflex arc stimuli

2-voulantory movement access So AHC is affected by two things so muscle tension can increase and then we can move the load

The stretch reflex is controlled by supraspinal areas that manipulate it ,either to facilitate or to inhibit it

The supraspinal areas manipulate either: -

Gamma motor neurons (most of them)

- Alpha motor neurons (few of them)

Supraspinal asreas are divided to:

1) Facilitating areas 2) Inhibitory areas

Facilitatory areas:

1)Facilitating reticular formation.

Reticular formation: network of neurons found in the brain stem. Part of reticular formation in the pons is called (pontine reticular formation)

the special thing about (Pontine Reticular Formation) is that it has intrinsic activity i.e. it works automatically to stimulate Gamma motor neurons and other areas depend on it to stimulate stretch reflex . *it will reach the spinal cord through ventral reticulo-spinal tract (VRST).

2)Primary motor area 4 Found in the cerebral cortex. Send tract called (cortecospinal tract) to the spinal cord.

3)Neocerebellum (cerebrocerebellum):

*the cerebellum is divided to more than one part one of them is stimulatory which is (neocerebellum) and it forms the lateral/ peripheral portion of the cerebellum.

4)Lateral vestibular nucleus:

It facilitates the stretch reflex in two pathways:

a) Direct pathway: it gives vestibule-spinal tract which stimulate the alpha motor neurons

b) Indirect pathway: send stimulation through pontine reticular formation to stimulate gamma motor neurons

5)Caudate nucleus: The stimulatory part of the basal ganglia.

Supraspinal inhibitory areas

1)Inhibitory reticular formation:

*Found in the medulla

*Unlike the stimulatory part it doesn't have intrinsic activity

*to make an inhibitory effect on gamma motor neurons it needs to be activated by other inhibitory areas.

* It reaches to the spinal cord through Lateral reticulo-spinal tract.

2)Red nucleus: Inhibits alpha motor neurons through rubro-spinal tract *Rubro=Red

3)Paleocerebellum (spinocerebellum) : The central part of the cerebellum which has inhibitory effect

4)Lentiform nucleus The inhibitory part of basal ganglia

5)Cortical suppressor area (4s)& area 6

Now we will talk about another type of reflexes

(inverse stretch reflex)

*excessive stretch/ contraction of the muscle will be followed by its relaxation The difference between this type and the stretch reflex is the force of the contraction i.e. if the contraction was normal this will be followed by contraction (stretch reflex) but, if the contraction was severe this will be followed by relaxation (inverse stretch reflex)

Why it's important?

Because if the stretch was so severe this might lead to tear and rupture of the tendon.

*receptors for this reflex are found in the tendon and are called the GTO (Golgi tendon organs)

*GTO are arranged in series with muscle fibers unlike intrafusal receptors which are arranged parallel to muscle fibers

* another difference is that they monitor muscle tension not muscle length

*it has efferent fiber of type 1b It is bisynaptic reflex i.e.

(1) afferent fiber will synapse with inhibitory interneuron

(2) inhibitory interneuron will synapse with alpha motor neuron

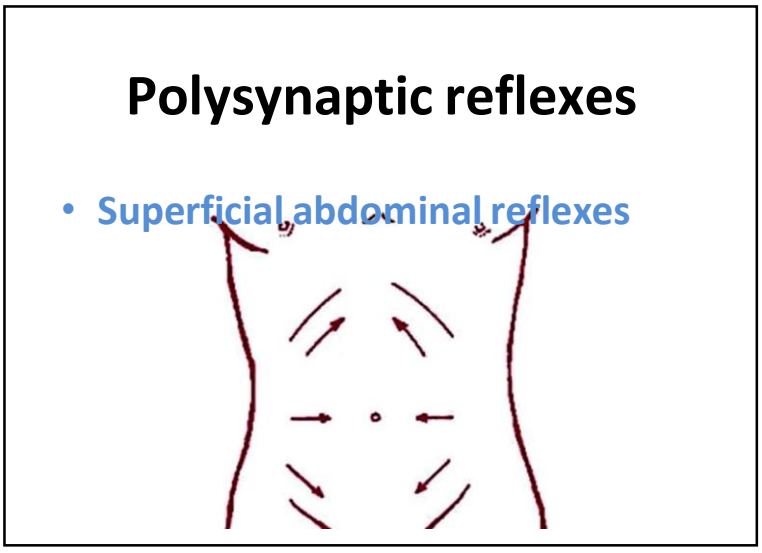
Polysynaptic reflexes:more than one synapse between the afferent and efferent neuron

*there are many of them but, we will take the most important ones for now

1)Superficial abdominal reflex: Its center extends from T7-T12 Divided into 3 parts:

a) upper abdominal b) middle abdominal c) lower abdominal

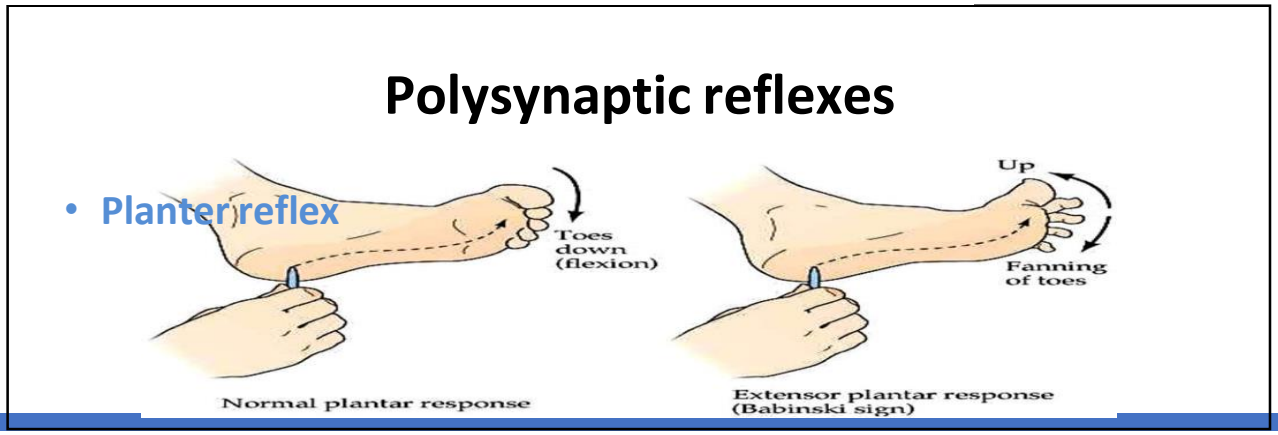
The test procedure: I make a stroke with sharp item on the skin in the direct seen in the picture down. As result for this stroke in normal person there will be contraction for muscles under the skin & the umbilicus will be pulled toward the stimulus. (Can be considered as example for the withdrawal reflex)



2)Planter reflex:

I make stroke with sharp item on the sole of the foot from heel toward the toes until I reach the base of the big toe In normal person ill see planter flexion.

- In person with upper motor neuron lesion ill see dorsiflexion
- of big toe and fanning of the other toes (Babinski sign)



I *if

apply that test to a baby under 1 year old ill see Babinski sign also!! Why is that?

Because this reflex is the reflex we were be born with and it stays until first year of age. So what happens after one year? The upper motor neuron is responsible for inhibition of this reflex and in the first year it won't be myelinated and after the first year when it gets myelinated enough it will start to inhibit the (Babinski sign)

-so in adults any defect in upper motor neuron like (upper motor neuron lesion) will lead to end the inhibition control and the reappearance of the sign again This is called (release phenomena)

3)Withdrawal reflex: weve already talked about this one a hundred times before but just to remind

- When I get stimulated by annoying stimulus in one side of the body this will lead to reflexion of all the muscles in this side to protect the body from it This reflex is also example for neuronal diversion i.e. one

- stimulus in the skin will lead to activation of great number of neurons and muscle fibers. Crossed extensor reflex: associated to withdrawal effect.

*When I touch something hot in one side of the body for example the muscles of the same side will reflex to protect the body while muscles on the other side will extend to provide support for the body and prevent you from falling.

4)Scratch reflex:

Rhythmic scratch movement to remove irritant stimulus and protect the body

5)Positive supporting reflex:

When you are standing which muscles will be more active (flexors /extensors)?

Both of them will be stretched same.

- There is receptors in the sole of the foot & as result for pressure of body weight on them there will be stimulation of this reflex to which will lead to contraction of both flexors and extensors muscles of lower limb.

*the importance of this reflex is to make the lower limbs rigid billers to be able to carry the body weight.

* This reflex break a physiological rule which is (reciprocal innervation) which says that: when any muscle contract its antagonist muscle should relax