Stretch Reflex & tendon jerks

Color index

- Important
- Further Explanation

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Contents

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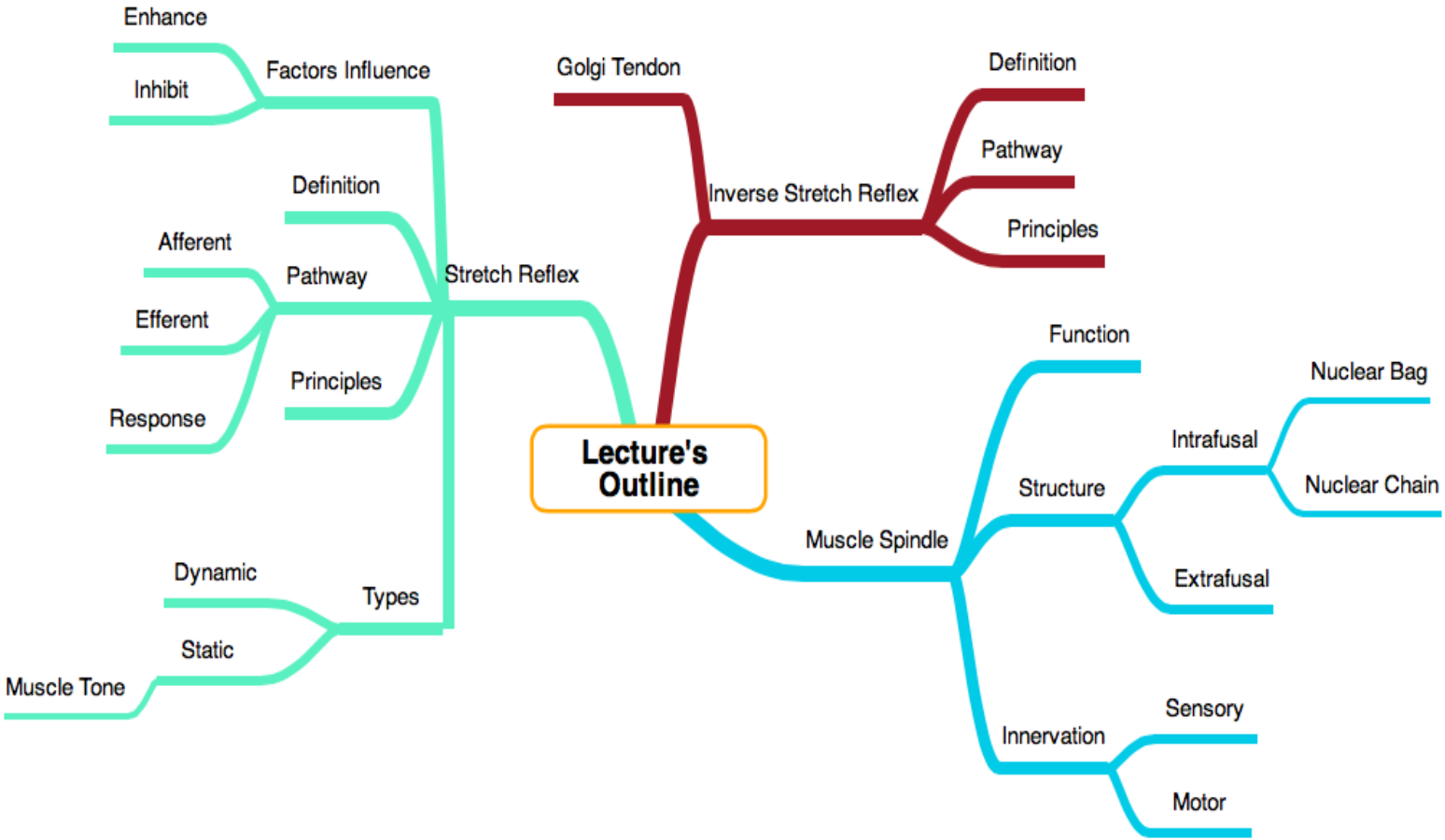
Mind Map


Lecture's Outline
Stretch Reflex
Factors Influence
Enhance
Inhibit
Definition
Pathway
Afferent
Efferent
Principles
Response
Types
Dynamic
Static
Muscle Tone
Golgi Tendon
Inverse Stretch Reflex
Definition
Pathway
Principles
Muscle Spindle
Function
Structure
Intrafusal
Nuclear Bag
Nuclear Chain
Extrafusal
Innervation
Sensory
Motor

The Stretch reflex

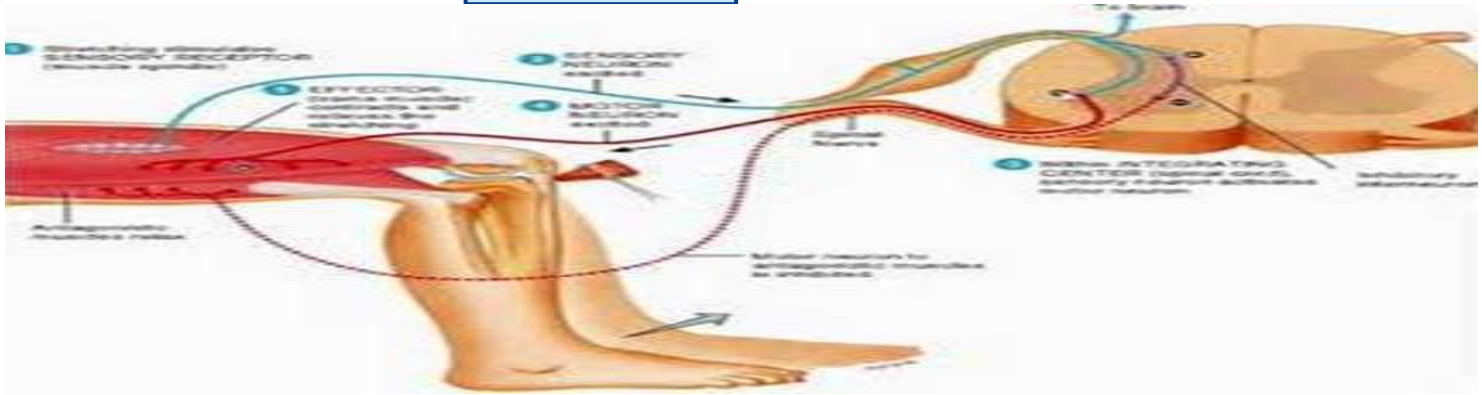
Defintion	it”s reflex contraction of muscle resulting from stimulation of muscle spindle by stretch
Number of synsapses	only one (monosynaptic)
response	stretch of muscle (lengthening)
Sensory fibers	Ib
motor fiber	α Motoneurons
effects	contraction of muscle

Princepls of Stretch reflex

When the muscle is stretched, group Ia afferent fibers in the muscle spindle are activated These group Ia afferents enter the spinal cord and synapse *directly* on and activate α motoneurons.

When these α motoneurons are activated, they cause contraction of the muscle that was originally stretched and leads decreasing of stretch on the muscle spindle to back to normal

Simultaneously, information is sent from the spinal cord to cause contraction of synergistic muscles and relaxation of antagonistic muscles.



Muscle Spindle

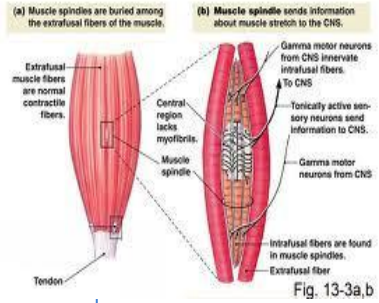


Fig. 13-3a,b

Strecture

Muscle spindles are distributed among the extrafusal muscle fibers Muscle spindles are spindle-shaped organs composed of intrafusal muscle fibers and innervated by sensory and motor nerve fibers and parallel to extrafusal fiber

Types of *Intrafusal Muscle Fibers of Muscle Spindles*

1-Nuclear bag
fibers are larger, and their nuclei are accumulated in a central ("bag") region. ratio 2/spindle

Nuclear chain
fibers are smaller, and their nuclei are arranged in rows ("chains"). ratio 4 to 5 / spindle

Innervation of Muscle spindle

Sensory innervation

1- group Ia afferent nerve (annulospiral)
- the largest nerves in the body; thus, they have among the fastest conduction velocities (70-120) , diameter 17 micometer and innervates the central region of both the nuclear bag fibers and the nuclear chain fibers
-discharge rapidly in suddunly stretched than sustaind stretch

2-group II afferent nerves (flower spray)
- Group II fibers have intermediate diameters and intermediate conduction velocities , diameter 8 micrometer and innervate the nuclear chain fibers.

Motor innervation

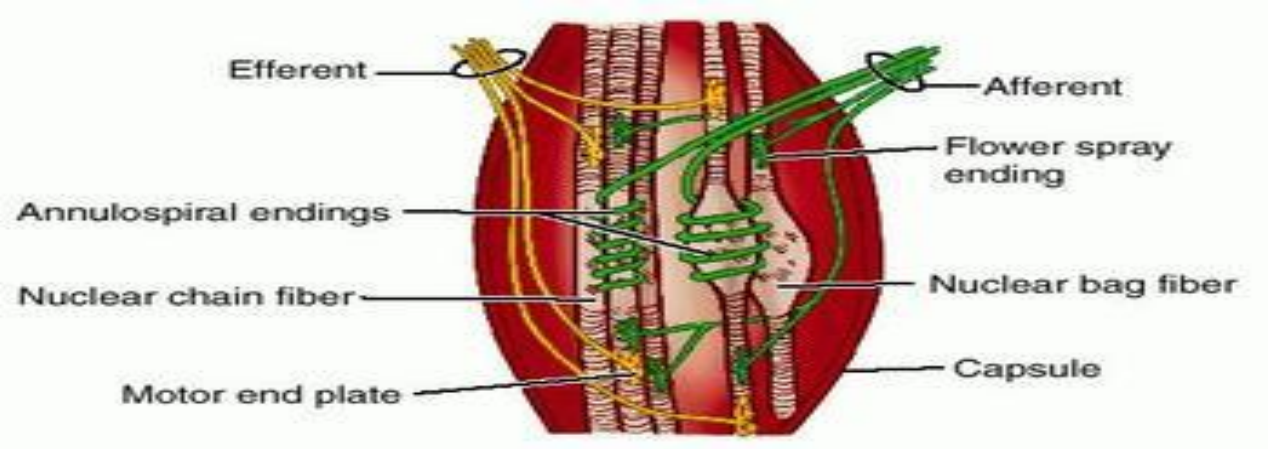
1-Dynamic γ motoneurons (plate endings.,) **;** synapse on nuclear bag fibers

2-**Static γ motoneurons (**trail endings,) synapse on nuclear chain fibers

Function of Muscle spindels

1-keep CNS informed about muscle length & rate or • velocity of change in muscle length & the spindles can send to the spinal cord either positive signals—that is, increased numbers of impulses to indicate stretch of a muscle—or negative signals—below- normal numbers of impulses to -indicate that the muscle is unstretched•

2-muscle spindle act to maintain • muscle length against rupture



How the muscle spindle is activated

When a muscle is stretched, the extrafusal muscle fibers are lengthened and the intrafusal muscle fibers also are lengthened.

The group Ia afferent fibers (innervating the central region of nuclear bag and nuclear chain fibers) detect the *velocity* of length change, and the group II afferent fibers (innervating the nuclear chain fibers) detect the *length* of the muscle fiber.

Activation of group Ia afferent fibers stimulates α motoneurons in the spinal cord.

Types of responses Component of stretch reflex

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

Sudden rapid stretch of a muscle >> stimulate Nuclear bag fibers which respond to rate or velocity of stretch>>>> discharge Synchronous strong impulses from spindles >>>>primary ending (annulospiral) send potent dynamic signals>>> alpha motor neuron >>>motor alpha 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>>> stimulates Nuclear chain fibers to discharge with increased rate >>>Impulses in the secondary sensory nerve (flower- spray)>>>>alpha motor neuron >>> motor nerve>>> contraction of muscle fibers Asynchronously(motor units not discharge all together)>>>>>> resulting in mild sustained contraction of muscle extrafusal fibers as long as it is stretched . Basis of muscle tone

Muscle Tone(Static stretch reflex)

Difention: resistance of muscle to stretch
stimulated by :sustained 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
lost by low gamma efferent discharge to muscle >>>>>hypotonic or flacidity . and increased by high gamma efferent discharge to muscle >>>>>>hypertonic , spastic muscle .

Damping

is the stretch reflex ability to prevent oscillation or jerkiness of body movements.

Signals from the spinal cord are transmitted to a muscle in an unsmooth form, with increasing or decreasing in intensity for few milliseconds, the muscle contraction will be jerky such signals.
-Muscle spindle reflexes make the contraction is relatively smooth, because the motor nerve to the muscle is excited at slow frequency.

SUPRASPINAL REGULATION OF THE STRETCH REFLEX

Stretch reflexes are subject to strong regulation by supraspinal centres, especially certain motor centres in the brainstem and cerebral cortex. changes in reflex threshold, amplitude, and/or pattern are common following supraspinal lesions that affect these centres or their fibre tracts.
the stretch reflex is controlled by supraspinal centres through their connections to the several types of neuron. gamma motor neurons are mainly controlled by inputs from descending fibres from supraspinal centres e.g., reticulospinal and vestibulospinal

Factors influence stretch

Enhances

1-Suprspinal ,-Primary motor area4
-Vestibular N , -Pontine RF(bulboreticular) -Neocerebellum
2-Anxiety
3-Noxious painful stimuli
4-Jendrassik-manuver

Inhibits

1-Supraspinal -Cortical (suppressor area4&Area 6) -Basal ganglia -Medullary RF -Red nucleus -paleocerebellum
2-Excessive stretch of muscle(golgi tendon reflex)

THE INVERSE STRETCH REFLEX (golgi tendon reflex)

Number of synapse	two (disynaptic)
response	contraction (shotening) of muscle
sensory affrent	Ib
response	relaxation of muscle
receptor	golgi tendon organ
motoneuron	α Motoneurons

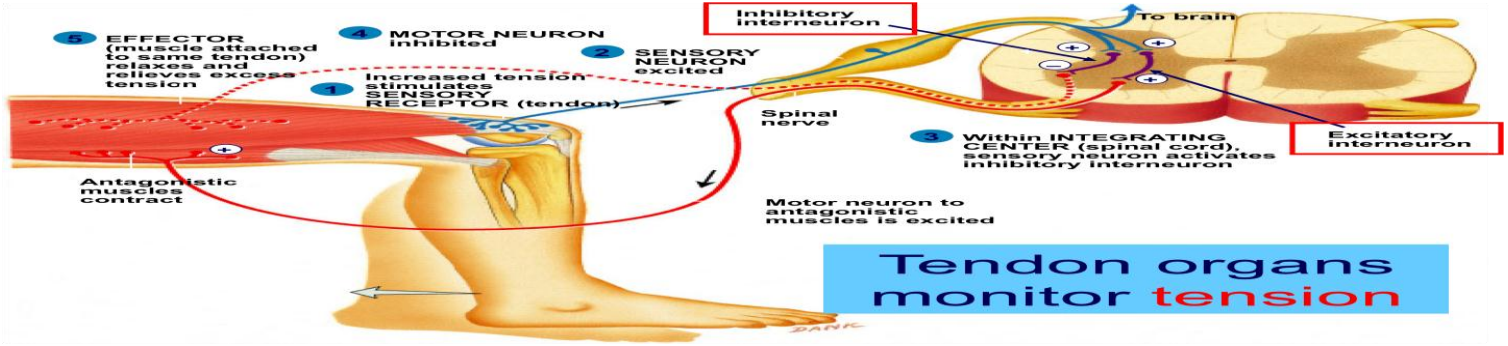
The Golgi tendon organ is a stretch receptor found in tendons, which senses contraction and activates group Ib afferent nerves. Golgi tendon organs are arranged in series with the extrafusal muscle fibers (contrasting the parallel arrangement of muscle spindles in the stretch reflex)

Princepls of golgi tendon reflex

When the muscle contracts, the extrafusal muscle fibers shorten, activating the Golgi tendon organs attached to them. In turn, the group Ib afferent fibers that synapse on inhibitory interneurons in the spinal cord are activated.

When the inhibitory interneurons are activated (i.e., activated to *inhibit*), they inhibit firing of the α motoneurons, producing relaxation of the homonymous muscle (the muscle that originally was contracted).

As the homonymous muscle relaxes, the reflex also causes synergistic muscles to relax and antagonistic muscles to contract.



1- The number of synapses in the stretch reflex are:
A. One (monosynaptic)
B. Two (disynaptic)
C. Three (trisynaptic)
D. A&B

2-Ia are :
A. motoneurons
B. Afferent fibers
C. Efferent fibers
D. B&C

3-Nuclear chain nuclei arranged in
A. Clusters
B. Chains
C. Rows
D. central

4- Static γ motoneurons synapse on
A. nuclear bag fibers
B. nuclear chain fibers
C. golgi tendon organ
D. B&C

5- the spindles can send to the spinal cord in
A. Positve signals
B. Negative signals
C. No signal
D. A&B

6- Which of the following is NOT a factor enhance the stretch :
A. anxiety
B. Jendrassik-manuver
C. Excessive stretch of muscle
D. Noxious painful stimuli

7- Golgi tendon organ activates group
A. Ib afferent nerves
B. II Afferent nerves
C. Ia afferent nerves
D. B&A

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

MCQs

1- motor fibres of stretch reflex are :

. α Motoneurons

2- muscle spindle act to maintain

. muscle length against rupture

3- define Muscle Tone

. resistance of muscle to stretch

4- The response of golgi tendon reflex is

. relaxation of muscle

5- Activation of group Ia afferent fibers stimulates

. α Motoneurons in spinal cord

SAQs

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK

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