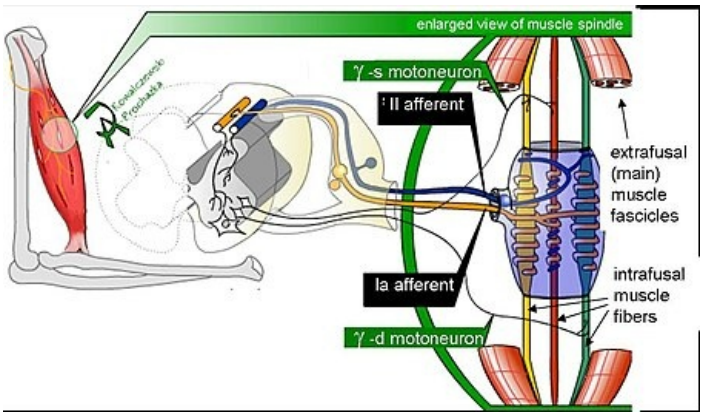
Muscle spindle



Muscle spindle - wiring diagram

A **muscle spindle** is a group of modified muscle fibres. They are present in all muscles, more abundantly in those that control fine motor skills (e.g.m. abductor pollicis brevis). The spindle is composed of a connective sheath and about ten intrafusal fibres. Sensory nerve endings are attached to the central part of the fibres and the peripheral part is contractile. The spindle is embedded in the interstitial septa of the muscle. It is involved **in parallel** with the intrinsic (extrafusal) fibres of the skeletal muscle.

Function and connection

Muscle spindles are receptors of the stretch (spindle) reflex, which means that they **register stretching and shortening of the muscle**. A stimulus induced by gravity, pulling of antagonistic muscles, or an external stimulus (e.g., a blow from a neurological hammer) triggers signal transmission to the corresponding spinal segment and to higher CNS levels. The spindle is innervated in two ways:

1. Sensory (reflex pathway) When the muscle is stretched, the muscle spindle is also stretched. This stimulus will increase the frequency of signals in the centrifugal fibres. After passing through the posterior spinal root, the centrifugal fibres are reconnected to α-motoneurons in the anterior spinal cord. Motor fibers emanating from the α-motoneuron cause contraction of the muscle in which the stretch was registered. During muscle contraction, the spindles relax and the frequency of centripetal signals decreases.

2. Motor from γ-motoneurons Gamma-motoneurons receive information from the CNS, on the basis of which they **adjust the sensitivity** of the spindle (maintain its excitability). This connection is very important for the **regulation of muscle tone** and is referred to as the γ-loop. It begins with the transfer of a signal from the brain (reticular formation) to the γ-motoneurons of the anterior spinal cord horn. The gamma-motoneuron then sends information to the spindle, which contracts. The contraction of the receptor itself, again triggers the activation of the reflex pathway to the corresponding spinal segment. Muscle spindles sense both static and dynamic changes within muscles.

Type of change	Fibre type	Ending in the muscle	Reconnection in the spine	Signal frequency
Static (permanent tension)	II	branch-like ending	γ-motoneurons	constant
Dynamic	Ia	anulospiral	α-motoneurons	high when stretching the muscle

References

Related articles

- Muscle
- Examination of tendon-muscle reflexes and skin sensitivity
- Golgi tendon body
- Muscle inervation

Literature used

- KITTNAR, Otomar. *Lékařská fyziologie.* 1. edition. Praha : Grada, 2011. ISBN 978-80-247-3068-4.
- MYSLIVEČEK, Jaromír. *Základy neurověd.* 2. edition. Praha : Triton, 2009. 390 pp. ISBN 978-80-7387-088-1.