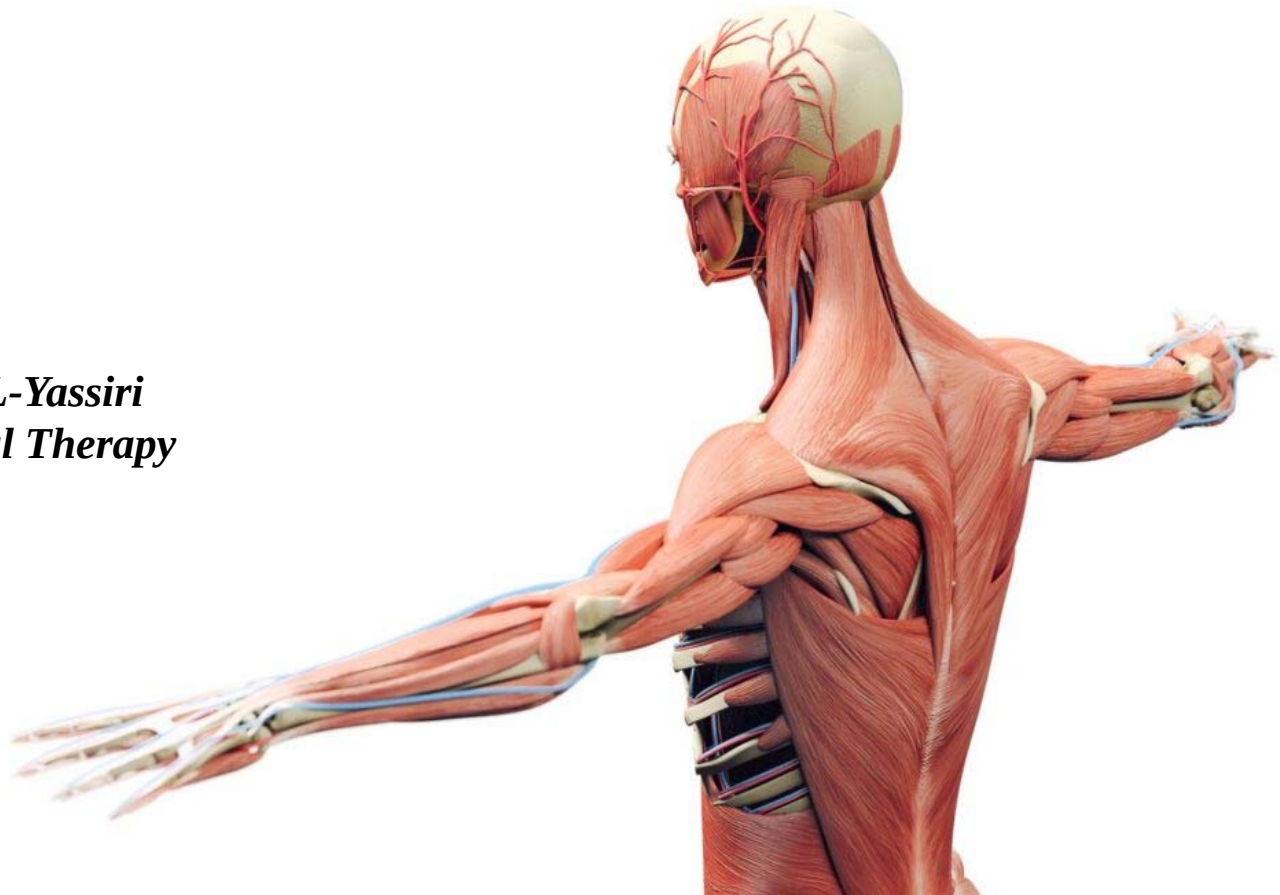


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Techniques
muscular system



About 40% of the body is skeletal muscle, and perhaps another 10% is smooth and cardiac muscle. Some of the same basic principles of contraction apply to all these muscle types. The muscular system is like a machine that converts chemical energy from food into mechanical energy.

The 5 main functions of the muscular system are movement, support, protection, heat generation, and blood circulation:

1. Movement

- Skeletal muscles pull on the bones causing movements at the joints.
- Skeletal muscles pull on the soft tissues of the face causing facial expressions.
- Movement caused by the respiratory muscles enables breathing.

2. Support

- Muscles of the body wall support the internal organs.
- As these muscles lose their tone, the internal organs of the abdominal-pelvic cavity may bulge outward as seen in some individuals as they age.

3. Protection

- Skeletal muscles, particularly of the body wall, cushion the body's internal organs (abdominal cavity) from force applied to the exterior of the body.

4. Heat generation

- Heat is a waste product of muscle metabolism, which helps maintain an internal body temperature.
- Shivering is a mechanism of the muscular system that generates heat to warm an overly cooled body.

5. Blood circulation

- Cardiac muscles aid pumping action of the heart by aiding blood circulation.

Structure of skeletal muscle:

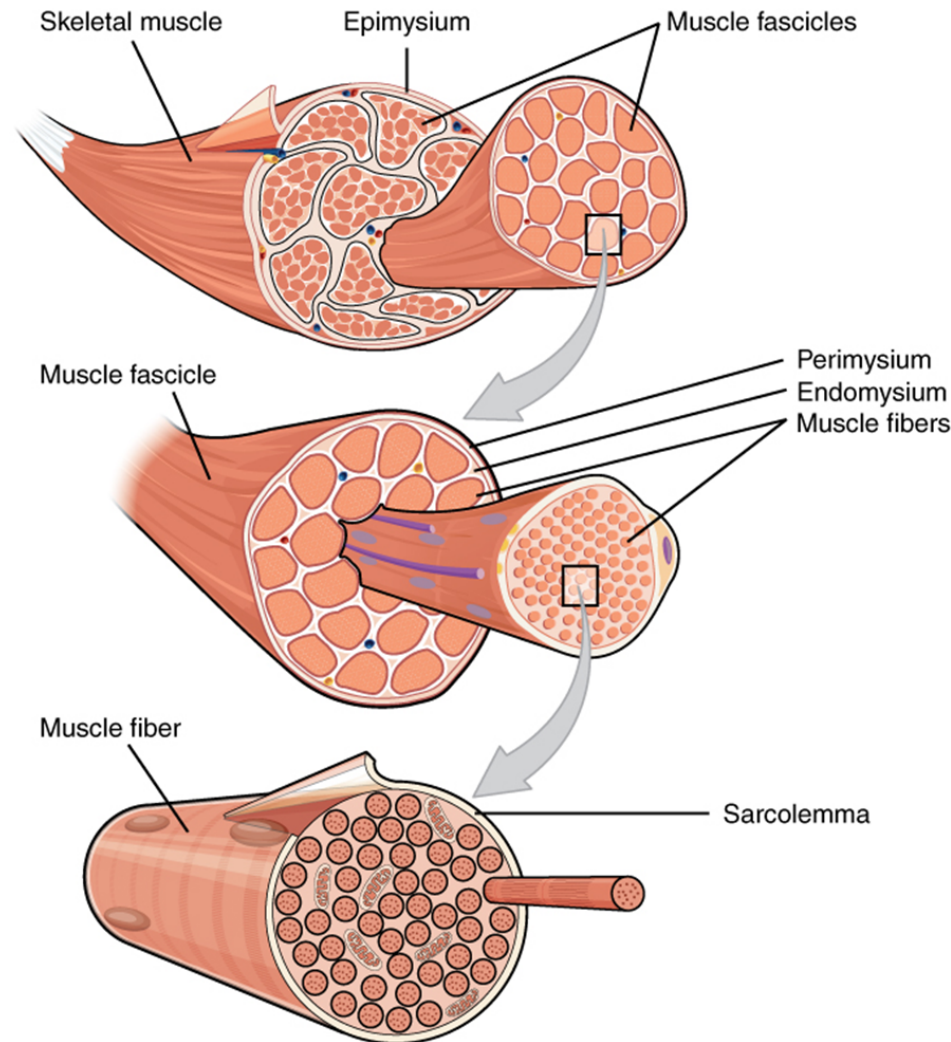
Skeletal muscle is a specialized contractile tissue connected to the skeleton which enables to move the body. The skeletal muscle consists of muscle tissue, connective tissue, nerve tissue and vascular tissue.

❖ Fascia

Fascia is connective tissue outside the epimysium that surrounds and separates the muscles.

❖ Epimysium

Outermost connective tissue covering the entire muscle, providing strength and protection. It protects the skeletal muscle from friction against other muscles and bones.



❖ Fascicles

Portions of epimysium project inward to divide the muscle into compartments. Each of these compartments contains a bundle of fibers. This is called a fascicle (fasciculus).

❖ Perimysium

Perimysium is the layer of connective tissue that surrounds the fasciculus with resistance to traction.

❖ Muscle fiber (cell)

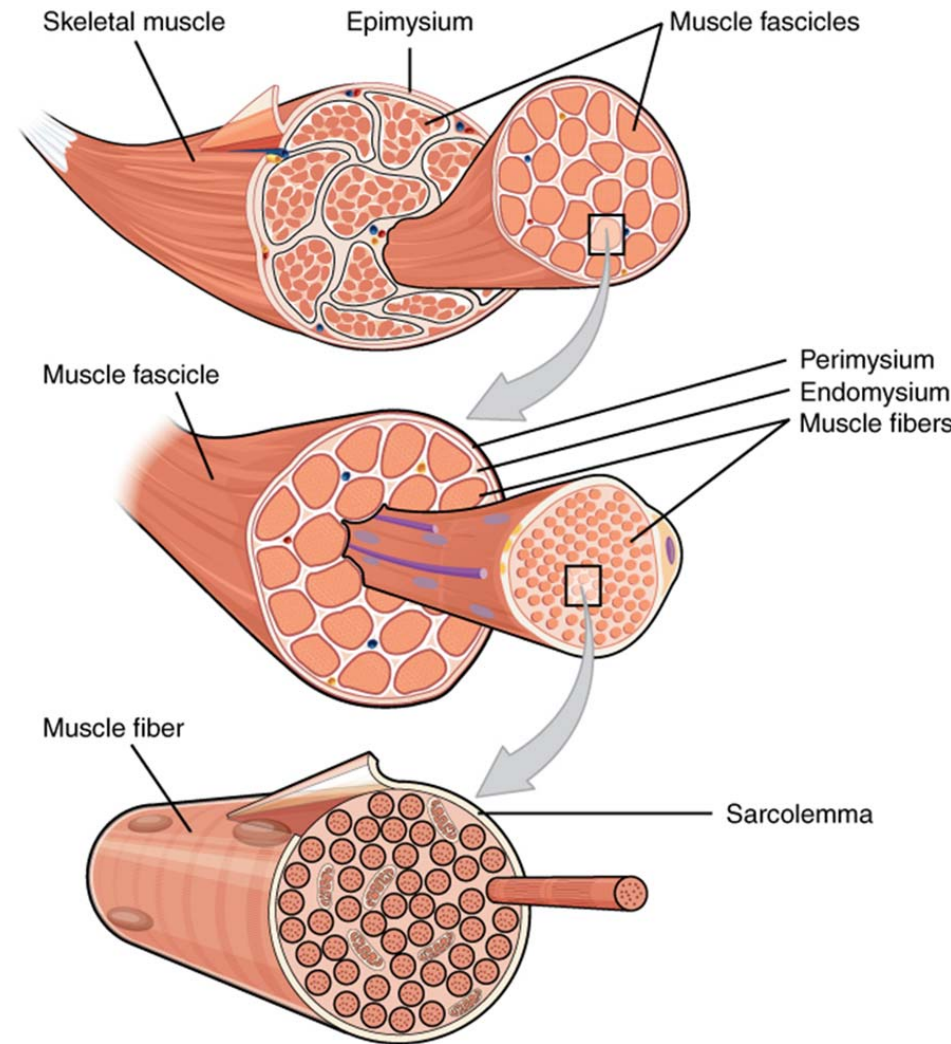
long cylindrical cell containing myofibrils (Thread like structure inside the fibers made of actin and myosin) that perform contraction.

❖ Endomysium

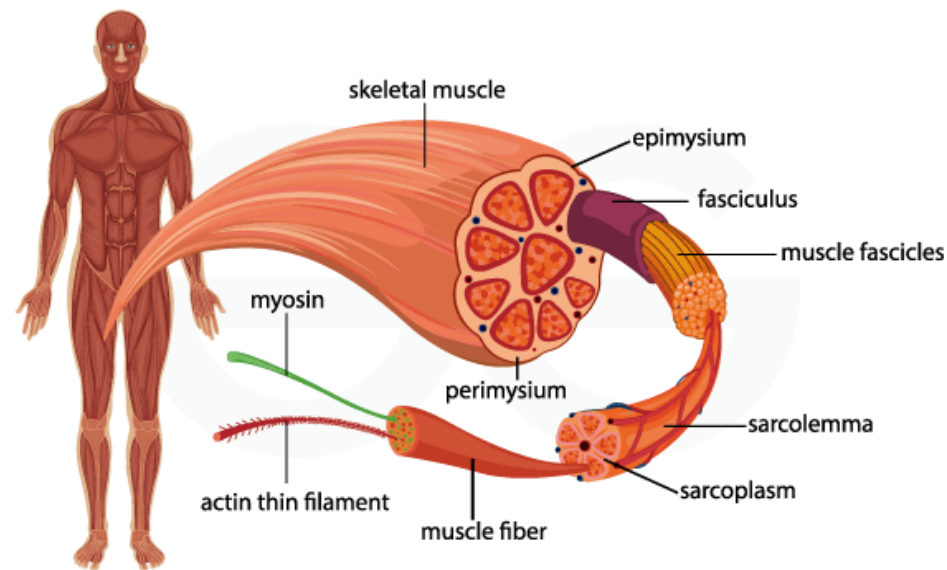
Thin connective layer surrounding individual muscle fibers, the endomysium contains minute blood vessels (capillaries) and nerves. It provides an appropriate chemical environment for calcium, sodium and potassium to be exchanged, this makes the muscles contract.

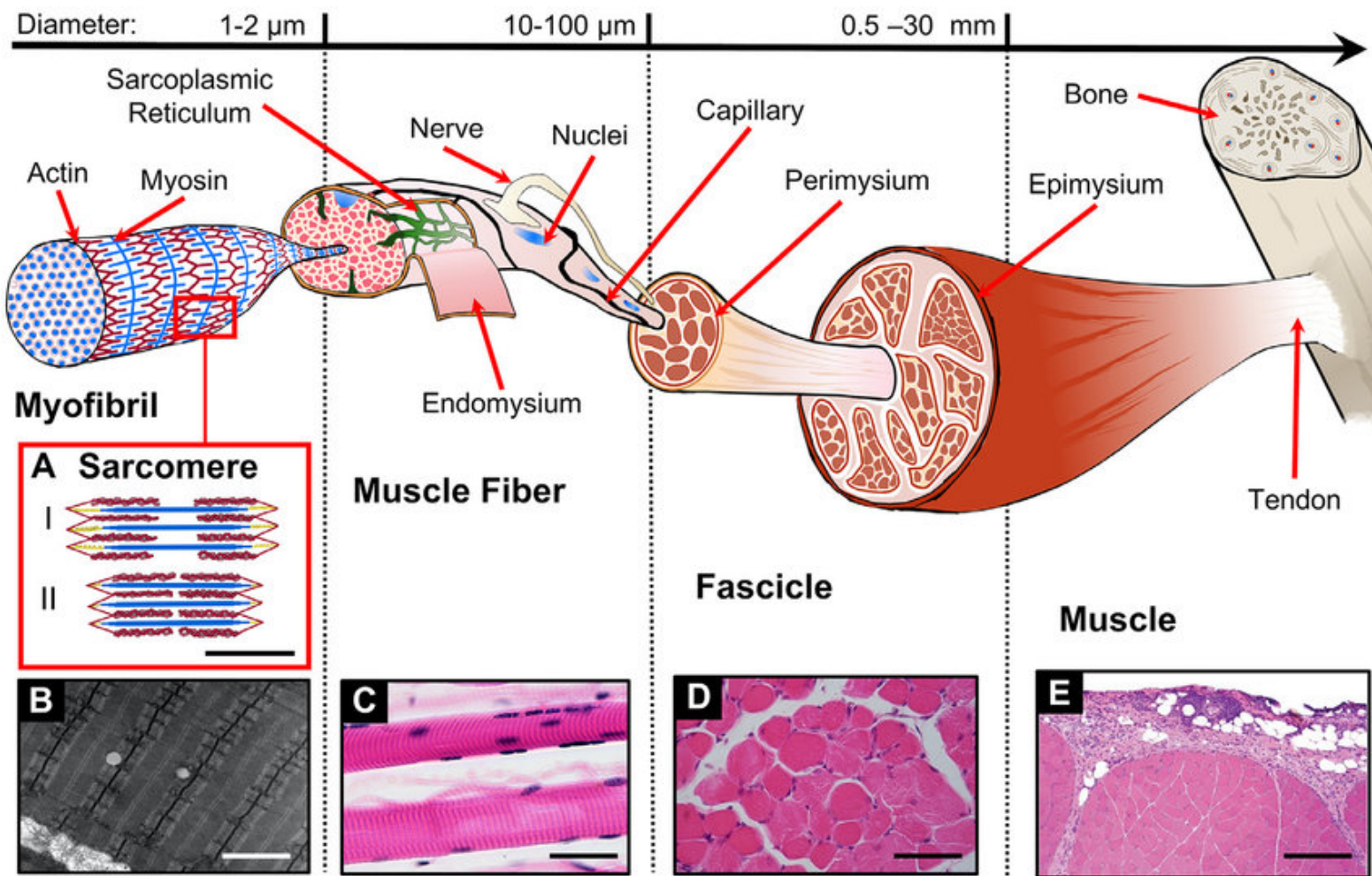
❖ Myofibrils

Thread like structure inside the fibers made of actin and myosin filaments that generate force.



Each muscle fiber is lined by plasma membrane namely sarcolemma. It encloses a cytoplasm called sarcoplasm which has the endoplasmic reticulum. The muscle fibers consist of myofibrils, which have two important proteins, namely actin and myosin in it.

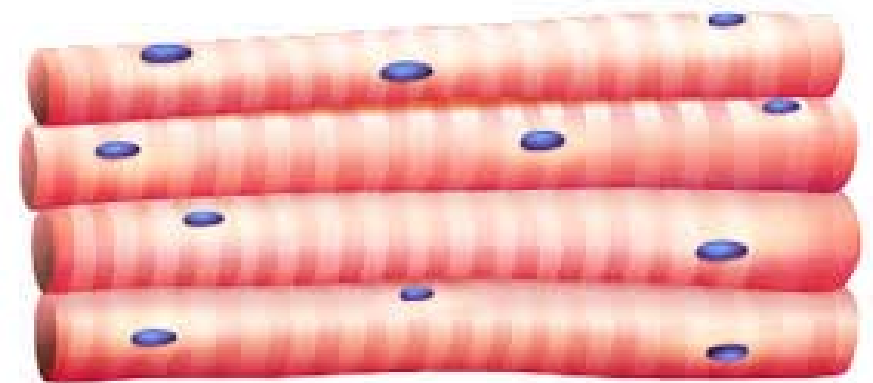




Properties of skeletal muscle

The skeletal muscles have the following properties:

- ❑ **Extensibility:** It is the ability of the muscles to extend when it is stretched.
- ❑ **Elasticity:** It is the ability of the muscles to return to its original structure.
- ❑ **Excitability:** It is the ability of the muscle to respond to a stimulus.
- ❑ **Contractility:** It is the ability of a muscle to contract when in contact with a stimulus.



Skeletal muscle

Muscle tone: is the resistance of muscles to passive stretch during a relaxing state. and also the low-level contraction or rigidity of muscles when they are at rest.

Control of Muscle Tone:

- **Muscle spindles** is the main regulator of muscle tone , a small sensory unit that is closely associated with and lies parallel to a muscle.
- Connecting to the endomysium of a muscle fiber, muscle spindles are composed of nuclear bag fibers and nuclear chain fibers. Both are similar to muscle fibers in that they contain actin and myosin myofilaments that allow them to stretch with the muscle.
- Both cells of the muscle spindle contain sensory neurons. When stretched, muscle spindles become activated, triggering impulses to the spinal cord that can generate an immediate reflex. Spindles can also trigger impulses to the cerebral cortex providing information about the degree of stretch within the muscle.
- To maintain tone, spindles also operate a feedback loop by directly triggering motor neurons linked to their associated muscles.

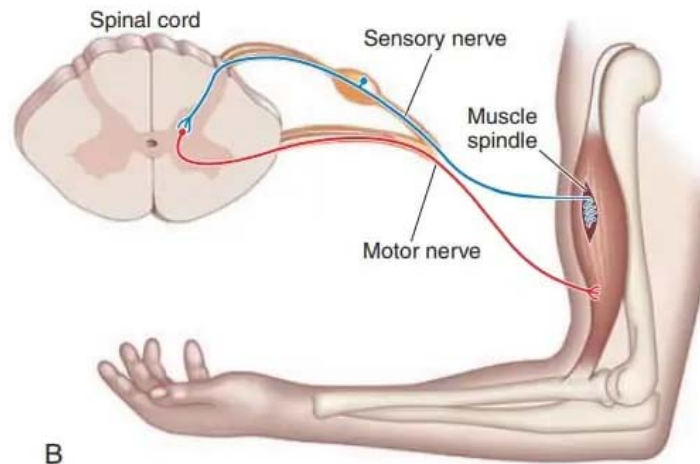
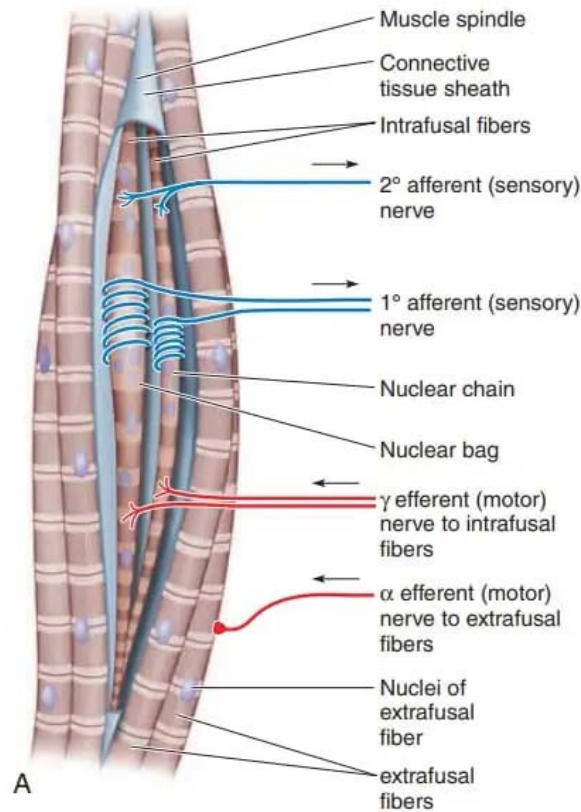


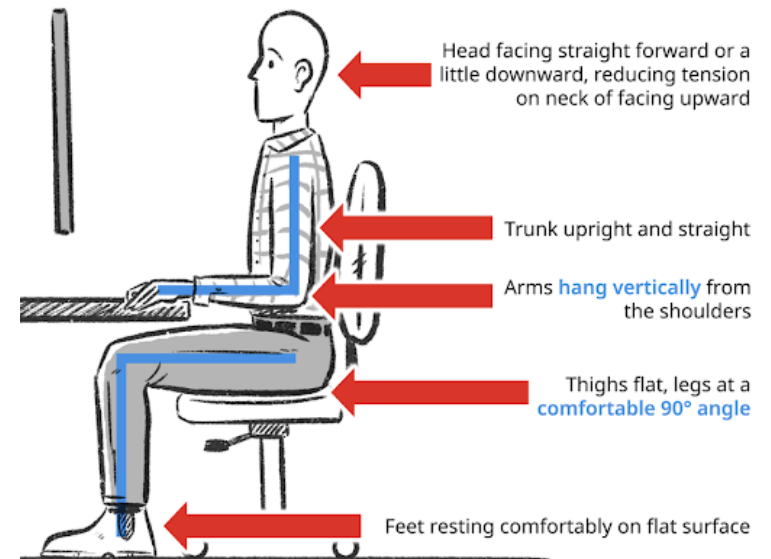
FIGURE Muscle Spindle. **A**, Structure of the Muscle Spindle; **B**, Schematic Representation of Stretch Reflex Regulation of Muscle Length

Muscle spindles: are stretch receptors within the body of a skeletal muscle that primarily detect changes in the length of the muscle. They convey length information to the central nervous system via afferent nerve fibers. This information can be processed by the brain as proprioception. The responses of muscle spindles to changes in length also play an important role in regulating the contraction of muscles.

- ❖ Except during certain stages of sleep, most of our muscles are in a state of slight contraction; this is what is known as muscle tone.
- ❖ When sitting upright, for example, the tone of neck muscles keeps head up, and the tone of the back muscles keeps the back straight. This is an important function of muscle tone for human beings, because it helps us to maintain an upright posture.
- ❖ For a muscle to remain slightly contracted, only a few of the muscle fibers in that muscle must contract. Alternate fibers contract so that the muscle as a whole does not become fatigued.
- ❖ This contraction of alternate fibers, muscle tone, is also regulated by the cerebellum of the brain.
- ❖ Muscle fibers need the energy of ATP (adenosine triphosphate) in order to contract.
- ❖ When they produce ATP in the process of cell respiration, muscle fibers also produce heat. The heat generated by normal muscle tone is approximately 25% of the total body heat at rest.

Upright sitting

Useful for common office work



Important of muscle tone:

1. Helps maintain balance and posture.
2. Generate heat that keeps the muscles healthy and ensures efficient flow of blood to them.
3. Allows for quick unconscious response to any sudden internal or external stimuli.



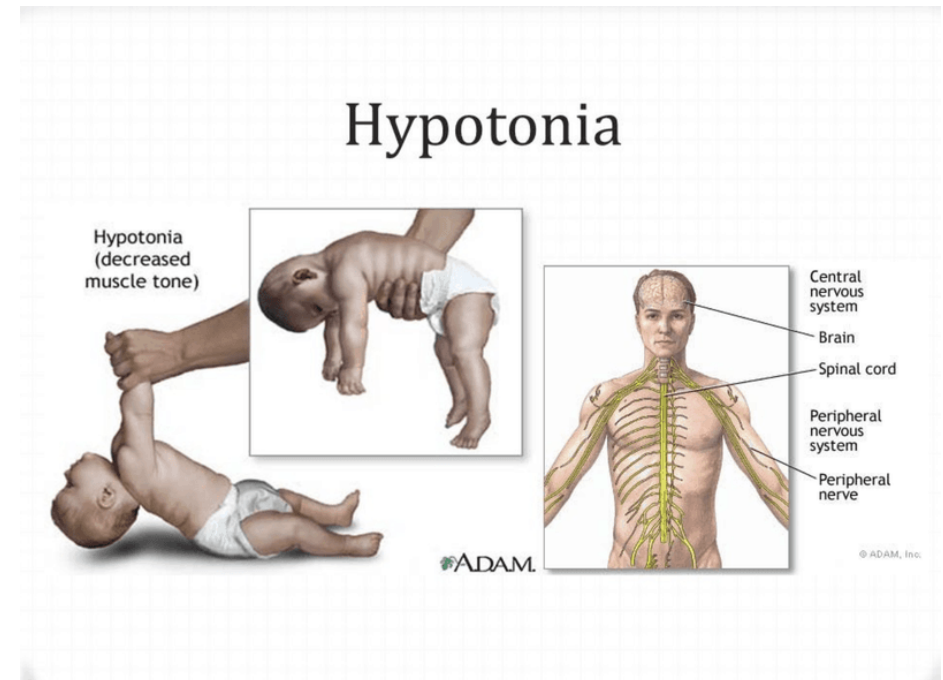
Changes in muscle tones can also lead to diseases which include hypotonia and hypertonia:

- ❑ **Hypotonia:** also known as a floppy baby syndrome, is a condition that involves low muscle tone with reduced muscle strength. Hypotonia is not a specific health sickness, but a possible sign of various disorders that affect muscle strength or motor nerve control by the brain.

- ❖ Low muscle tone mainly affects children who need a lot of effort to move their muscles properly during activities. Maintaining good posture is a significant problem when they sit or stand.

- ❖ Many children experiencing low muscle tone have slow gross motor development such as walking, sitting, and rolling.

- ❖ it is a symptom of an underlying issue, not a disease itself. Potential causes include genetic conditions (e.g., Down syndrome, Prader-Willi syndrome), nervous system disorders (e.g., cerebral palsy and spinal muscular atrophy), muscular diseases (e.g., muscular dystrophy) or birth trauma.



- ❑ **Muscle hypertonia:** is an increase in the rigidity of muscle tone and reduced capacity of the muscle to stretch brought by injury to the CNS (brain and spinal cord) causing disruptions in the nerve pathways in charge of muscle tone.
- ❑ In children under the age of two, when the injury occurs, the most common term used for hypertonia is (cerebral palsy). Common types include spasticity and rigidity.

The symptoms associated with hypertonia include;

- ❖ Stiffness in muscles
- ❖ Loss of function
- ❖ Tenderness and pain in the affected muscles
- ❖ Decreased range of movement
- ❖ Spasticity of muscles
- ❖ Deformity
- ❖ An involuntary crossing of legs
- ❖ Rapid muscle contractions
- ❖ Fixed joints

