

UNIT 6**MUSCULAR SYSTEM**

Muscular system is the system of human body that provides motor power for all movements of the body parts or organs. The muscular system consists of large number of muscles (about 639) and composed of special tissue known as muscular tissue.

Functions of Muscular System

1. It helps in movements of the body parts and organs.
2. It helps in stability and posture of the body.
3. It helps in production of heat.
4. It is helps in blood circulation.
5. It helps in digestion of food by peristalsis movements.

MUSCLE

Muscle is a type of tissue composed of the contractile cells or fibers, which by contraction causes the movement of an organ or part of the body. The study of muscles is known as myology.

Types of Muscles

The muscles are of three types:

- a. Skeletal muscle
- b. Smooth muscle
- c. Cardiac muscle

SKELETAL MUSCLES

- Skeletal muscle works as a lever system, in which muscles are attached to bone and contract to move the bone in any direction.
- It is also known as voluntary muscle, striped muscle, striated muscle or somatic muscles.
- The skeletal muscles form most of the body weight (about 40% to 50% of body mass).
- They are under the voluntary control i.e., they are subjected to conscious control.
- The somatic nervous system supplies these muscles.
- The skeletal muscles are present in the body walls, limbs, tongue and pharynx. Examples include muscles of body walls such as serratus anterior, latissimus dorsi etc; muscles of limbs such as triceps, biceps, deltoid, brachialis, brachioradialis, coracobrachialis etc.

Composition of Skeletal Muscle

Skeletal muscle is formed by:

- 75% = Water
- 25% = Solids.

Solids are 20% of proteins and 5% of organic substances other than proteins and inorganic substances.

Structure of Skeletal Muscle

- Under the electron microscope, the skeletal muscle is made up of a large number of individual muscle cells known as myocytes.
- The muscle cells are commonly known as muscle fibers because these cells are long and slender in appearance.
- The skeletal muscle fibers are seen in rough cylindrical in shape, lying parallel to one another.
- The individual muscle fibers are very long about 35 cm in length (longest muscle) and 10μ to 100μ in diameter.
- Each muscle fiber contains contractile proteins called myofibrils.

- Longitudinally, myofibrils are divided into contractile units known as a sarcomere.
- Each muscle fiber has multinucleated (several nuclei, because the cells are so large), found just under the cell membrane known as sarcolemma.
- The cytoplasm of muscle cell is known as sarcoplasm. There are also many mitochondria, essential for producing adenosine triphosphate (ATP) from glucose and oxygen to power the contractile mechanism.
- Also present is a specialized oxygen-binding substance called myoglobin, which is similar to the haemoglobin of red blood cells and stores oxygen within the muscle.

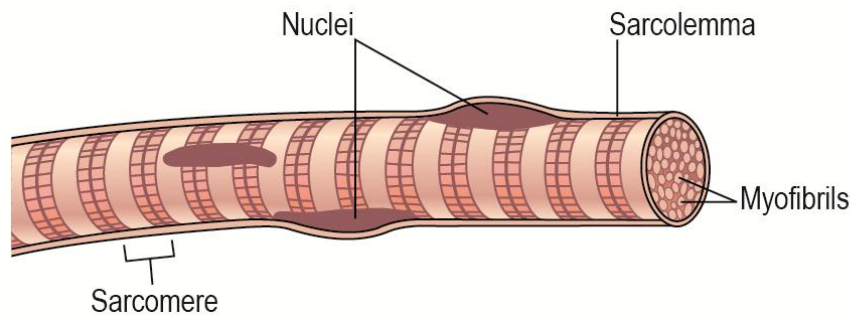


Fig: Structure of skeletal muscle

Functions of Skeletal Muscle

The skeletal muscles are the vital part of the musculoskeletal system. They serve a variety of functions, includes:

1. Chewing and swallowing which are the first parts of digestion.
2. Maintaining body posture and body position.
3. Produce body movements by moving the bones in different parts of the body.
4. Protecting joints and holding them in place.
5. Gives shape and appearance (outlook) to the body by attaching to the bone.
6. Protects the vital organs of the body.
7. Helps in venous return and lymphatic drainage by supplying blood vessels and lymph vessels.

SMOOTH MUSCLES

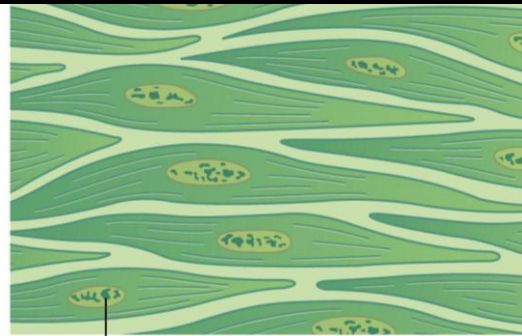
The muscle that contract without conscious control (involuntary control) is known as smooth muscles. It is also known as unstriated muscles, plain muscles, involuntary muscles or non skeletal muscles. Examples: It is present in the:

- Wall of internal organs like esophagus, stomach and intestine in the gastrointestinal tract
- Ducts of digestive glands.
- Trachea, bronchial tube and alveolar ducts of respiratory tract.
- Ureters, urinary bladder and urethra in excretory system.
- Wall of the blood vessels in circulatory system.
- Arrector pilorum of skin.
- Mammary glands, uterus, genital ducts, prostate gland and scrotum in the reproductive system.
- Iris and ciliary body of the eye.

Structure of Smooth Muscle

- The smooth muscle is made up of thin-elongated muscle cells.
- The muscle fibers are covered by plasma lemma.
- The nucleus is single, elongated and centrally placed. Normally, two or more nucleoli are present in the nucleus.
- The smooth muscle fibers are very small, measuring about 2 to 5 microns in diameter and 55 to 200 microns in length.

- Each muscle fiber contains myofibrils. The myofibrils are made up of muscles proteins, but there are no dark and light bands present.
- The smooth muscle contraction is very slow, involuntary under the control of autonomic nervous system.



Nucleus

Fig; Structure of smooth muscle

Functions of Smooth Muscle

Smooth muscles are concerned with very important functions in different parts of the body.

- In cardiovascular system:** The smooth muscles present in the blood vessels regulate blood pressure and blood flow through different organs and regions of the body.
- In respiratory system:** The contraction and relaxation of smooth muscle of the respiratory tract regulate the inflow and outflow of air.
- In digestive system:** The smooth muscles in digestive tract help in movement of food substances, mixing of food substance with digestive juices, absorption of digested material and elimination of unwanted substances.
- In Urinary system:** The smooth muscles in renal blood vessels regulate renal blood flow and glomerular filtration. The smooth muscles in the ureters expel (propel) urine from kidneys to urinary bladder through ureters. The smooth muscles present in urinary bladder help voiding urine to the exterior.
- In reproductive system:** In males, smooth muscles facilitate the movement of sperms and secretions from accessory glands along the reproductive tract. In females, these muscles accelerate the movement of sperm through genital tract after sexual act, movement of ovum into uterus through fallopian tube, expulsion of menstrual fluid and delivery of the baby.

CARDIAC MUSCLE

The cardiac muscle is a type of muscle (muscular tissue) present in the middle layer of heart wall. It is also known as heart muscle or myocardium.

Structure of Cardiac Muscle

- The cardiac muscle cells are short, cylindrical and branched structure.
- The muscle cell contains centrally situated nucleus.
- The muscle cells are inter connected with each other by special zigzag junctions known as inter calated disc.
- The cardiac muscle consists of cylindrical fibers interconnected by oblique bridge and forming continuous contractile network.
- The cardiac muscles are myogenic and these muscles are not initiated by nervous system. But, the heart rate, force of contraction and blood pressure are regulated by autonomic nervous system.
- The cardiac muscles have power of rhythmic contraction and relaxation throughout the life and do not get tired.

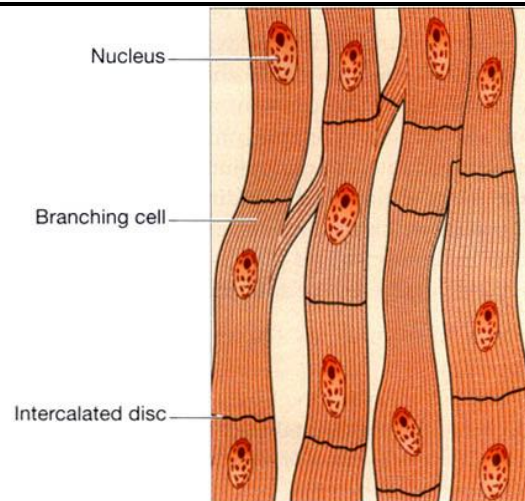


Fig: Structure of Cardiac Muscle

Functions of Cardiac (heart) Muscle

- It plays role in contraction of atrium and ventricles of the heart.
- It plays role in circulating the blood and its contents throughout the body as a consequence.

Differences between Skeletal, Smooth and Cardiac muscle

| No. | Skeletal muscle | Smooth muscle | Cardiac muscle |
|-----|---|---|---|
| 1. | It is present in limbs, body walls, tongue and pharynx. | It is present in wall of internal organs such as stomach, intestine, urinary bladder, blood vessels, ureter, gastrointestinal tract, respiratory tract etc. | It is present in middle layer of heart wall. |
| 2. | It is rough cylindrical in shape. | It is spindle in shape. | It is cylindrical in shape. |
| 3. | It is multinucleated. | It is uninucleated. | It is uninucleated. |
| 4. | It is covered by sarcolemma. | It is covered by plasma lemma. | It is covered by plasma lemma. |
| 5. | The nerve supply from somatic nervous system. | The nerve supply from autonomic nervous system. | The nerve supply from autonomic nervous system. |
| 6. | It has rapid contraction. | It has slow sustained contraction. | It has rhythmic (Automatic) contraction. |
| 7. | The mode of working is voluntary. | The mode of working is involuntary. | The mode of working is myogenic (automatic or rhythmic.). |
| 8. | The blood supply is rich. | The blood supply is poor. | The blood supply is rich. |
| 9. | The energy demand is high and at a time. | The energy demand much less and constantly. | The energy demand is high and constantly. |
| 10. | Get tired easily. | Don't get tired easily. | Do not get tired. |

ACTION OF SKELETAL MUSCLE

Each movement at a joint is brought about by a coordinated activity of different groups of muscles. These muscle groups are classified and named according to their function.

1. **Prime movers (agonists):** It is a group of muscles which is required to perform a particular movement. Example: Brachialis is prime mover of elbow joint flexion.
2. **Antagonists (opponents):** It is a group of muscles which oppose the agonist. Examples: In elbow flexion triceps work as antagonist.
3. **Synergist:** It is a group of muscles which helps agonist. Example: Front thigh muscle which helps in hip flexion.
4. **Fixator:** These are muscles work to stabilize the bones of origin of agonist to increase.