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Human Anatomy and Physiology
Chapter 10 : Skeletal Muscles

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Chapter 10

Skeletal Muscles

→ The contractile tissue derived from the mesodermal (middle) layer of germ cells during embryonic development is known as a muscle. Muscles are basically of three types:

1. Skeletal muscles (voluntary),
2. Smooth muscles (involuntary), and
3. Cardiac muscles (involuntary).

→ Skeletal muscles are a type of striated muscle tissues which are under the control of somatic nervous system. A bundle of collagen fibres, which act as a link between bone and skeletal muscles, is known as tendon.

→ Individual components of a skeletal muscle are known as muscle fibres which are formed by the fusion ofdevelopmental myoblasts.

→ Long, cylindrical, and multinucleated cells made up of actin and myosin myofibrils are known as myofibres.

→ A sarcomere forms the basic functional unit of the cell and gives a striped appearance to the skeletal muscles. It also acts as machinery, and is essentially required for muscle contraction.

Physiology of Muscle Contraction

- The contraction of muscles is also called muscle twitch or twitch.
- Twitch takes place with change in the length of a muscle fibre, i.e., the fibre either increases or decreases in length.
- Central nervous system, comprising of brain and spinal cord, controls the process of muscle contraction.
- The muscle contractions which are voluntary in nature are controlled by the brain, while the Involuntary reflexes are controlled by the spinal cord.
- The simple implication of the term contraction is a shortening or reduction in the length of the muscle fibre.

The following steps are involved in muscle contraction

- A stimulus for muscle contraction is generated in CNS either as voluntary activity froup the brain or as a reflex activity from the spinal cord.
- The motor neuron within the ventral born of the spinal cord is activated and an action potential is produced which passes outward into the ventral root of the spinal cord A motor unit is formed by the aggregation of a number of muscle fibres. An action potential is carried to a motor end plate on every muscle fibre.
- The electrical resting potential under the motor end plate changes by the action of Ach. This generates an action potential that passes along the surface of muscle fibre in both the directions
- The action potential spreads inside the muscle fibre at the site where each transverse tubule opens onto the surface of the muscle fibre.
- Ca ions are released by the sarcoplasmic reticulum at every point where a transverse tubule comes in contact with a part of the sarcoplasmic reticulum
- The Ca+2 ions cause movement of troponin and tropomyosin on their thin filament. In be d
- This allows movement of myosin molecule head along the thin filament to generate a driving force of contraction.

Sliding Filament Theory

→ Sliding filament theory describes the contraction of skeletal muscles at molecular level. According to this theory, skeletal muscle contraction causes shortening of the length of muscle fibres due to the sliding of the thick and thin filaments over one another.

Steps Involved Sliding Filament Theory

- The myosin heads have ATP-binding sites and ATPase enzyme, an enzyme that hydrolyses the present the thick filament.
- The conversion of ATP into ADP releases energy and inorganic phosphate.
- In case, Ca2+ ions have been taken back by the calcium pump into the Sarcoplasmic Reticulum (SR), the myosin cross-bridges detach from the actin receptors causing relaxation.
- In case Ca2+ ions are still present in SR then the whole process repeats itself causing further contraction.
- This theory of contraction of skeletal muscles is known as sliding filament theory of skeletal muscle contraction.

DISORDER OF SKELETAL MUSCLES

→ Musculoskeletal disorders (MSDs) are the condition in which the muscles, bones, and joints of the body are influenced.

Types

- **Tendinitis:** It is a condition that affects the thick cords that connect the muscles to the bones. It occurs when tendons become irritated or inflamed. It causes severe discomfort and tenderness in the affected joint resulting in inability to move.
- **Carpal tunnel syndrome:** It occurs when the median nerve is compressed while passing through the hand. On the palm side of the hand, the median nerve is found (also called the carpal tunnel). The median nerve gives the thumb, index finger. long finger. and part of the ring finger sensibility (the ability to feel) and sends an impulse to the muscle that moves the thumb. This syndrome can affect either one or both the hands,
- **Osteoarthritis:** It is the most common chronic joint problem. A joint is the point where two bones meet. The ends of these bones are protected by cartilage. which is a type of connective tissue. This cartilage breaks down as a result of OA, causing the bones of the joint to rub together, resulting in pain,stiffness, and other side effects.
- **Rheumatoid arthritis (RA):** It is an autoimmune disease that causes joint pain and damage throughout the body. It commonly affects both sides of the body, causing joint deterioration.
- **Fibromyalgia:** It is a chronic (long-term condition. Even healthcare providers may find it difficult to comprehend this disease. Its symptoms are similar to those of other diseases, and there are no true tests available to confirm the diagnosis. Therefore it is frequently misdiagnosed.
- **Bone fractures :** Sometimes, they are also known as shattered bones. These are painful injuries, which are commonly caused by sports injuries, vehicle accidents, or falls, take time to recover. They can be treated in a variety of ways depending on the severity of the fracture.

Symptoms

- Symptoms of MSDs are:
  - Persistent pain
  - Rigid joints
  - Swelling
  - Dull aches
- They can have an impact on any major part of the musculoskeletal system, including:
  - Neck
  - Shoulders
  - Wrists
  - Back
  - Hips
  - Legs
  - Knees
  - Feet

- MSD symptoms might make it difficult to do things like walk or type in some cases. An affected person might develop a limited range of motion or find it difficult to complete routine tasks.

Causes

- Risk factors for developing MSDs are:
  - Age
  - Lifestyle
  - Occupation
  - Family history
  - Activity level
- MSDs can be caused by wear and tear musculoskeletal system caused due to some activities. These are some of the activites causing MSDS:
  - Constantly sitting in the same position at a computer.
  - Performing repetitive motions.
  - Exercising using high weights.
  - Maintaining a bad posture at work

Diagnosis

- The treatment plan will vary depending on the cause of the symptoms. Therefore it is important to get an accurate diagnosis.
- Following symptoms are diagnosed:
  - Pain
  - Redness
  - Muscle weakness
  - Swelling
  - Muscle atrophy

Treatment

- ✓ Based on the diagnosis and the severity of the symptoms, the doctor will propose a treatment plan.
- ✓ They may recommend several exercises and over-the-counter pain relievers like ibuprofen or acetaminophen to treat minor aches and pains.
- ✓ They may prescribe drugs to lessen inflammation and pain if the symptoms are severe.
- ✓ They may recommend physical therapy, occupational therapy or both in some circumstances.
- ✓ These therapies can assist in learning how to cope with pain and discomfort, maintain strength and range of motion, and adapt daily activities and settings.

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