38.4A: Structure and Function of the Muscular System

The muscular system controls numerous functions, which is possible with the significant differentiation of muscle tissue morphology and ability.

Learning Objectives

• Describe the three types of muscle tissue

Key Points

• The muscular system is responsible for functions such as maintenance of posture, locomotion, and control of various circulatory systems.
• Muscle tissue can be divided functionally (voluntarily or involuntarily controlled) and morphologically (striated or non-striated).
• These classifications describe three distinct muscle types: skeletal, cardiac and smooth. Skeletal muscle is voluntary and striated, cardiac muscle is involuntary and striated, and smooth muscle is involuntary and non-striated.

Key Terms

• myofibril: A fiber made up of several myofilaments that facilitates the generation of tension in a myocyte.
• myofilament: A filament composed of either multiple myosin or actin proteins that slide over each other to generate tension.
• myosin: A motor protein which forms myofilaments that interact with actin filaments to generate tension.
• **actin**: A protein which forms myofilaments that interact with myosin filaments to generate tension.

• **striated**: The striped appearance of certain muscle types in which myofibrils are aligned to produce a constant directional tension.

• **voluntary**: A muscle movement under conscious control (e.g. deciding to move the forearm).

• **involuntary**: A muscle movement not under conscious control (e.g. the beating of the heart).

• **myocyte**: A muscle cell.

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**The Musculoskeletal System**

The muscular system is made up of muscle tissue and is responsible for functions such as maintenance of posture, locomotion and control of various circulatory systems. This includes the beating of the heart and the movement of food through the digestive system. The muscular system is closely associated with the skeletal system in facilitating movement. Both voluntary and involuntary muscular system functions are controlled by the nervous system.
The muscular system: Skeletal muscle of the muscular system is closely associated with the skeletal system and acts to maintain posture and control voluntary movement.

Muscle is a highly-specialized soft tissue that produces tension which results in the generation of force. Muscle cells, or myocytes, contain myofibrils comprised of actin and myosin myofilaments which slide past each other producing tension that changes the shape of the myocyte. Numerous myocytes make up muscle tissue and the controlled production of tension in these cells can generate significant force.

Muscle tissue can be classified functionally as voluntary or involuntary and morphologically as striated or non-striated. Voluntary refers to whether the muscle is under conscious control, while striation refers to the presence of visible banding within myocytes caused by the organization of myofibrils to produce constant tension.

Types of Muscle

The above classifications describe three forms of muscle tissue that perform a wide range of diverse functions.

Skeletal Muscle

Skeletal muscle mainly attaches to the skeletal system via tendons to maintain posture and control movement. For example, contraction of the biceps muscle, attached to the scapula and radius, will raise the forearm. Some skeletal muscle can attach directly to other muscles or to the skin, as seen in the face where numerous muscles control facial expression.

Skeletal muscle is under voluntary control, although this can be subconscious when maintaining posture or balance. Morphologically skeletal myocytes are elongated and tubular and appear striated with multiple peripheral nuclei.

Cardiac Muscle Tissue

Cardiac muscle tissue is found only in the heart, where cardiac contractions pump blood throughout the body and maintain blood pressure.

As with skeletal muscle, cardiac muscle is striated; however it is not consciously controlled and so is classified as involuntary. Cardiac muscle can be further differentiated from skeletal muscle by the presence of intercalated discs that control the synchronized contraction of cardiac tissues. Cardiac myocytes are shorter than skeletal equivalents and contain only one or two centrally located nuclei.

Smooth Muscle Tissue

Smooth muscle tissue is associated with numerous organs and tissue systems, such as the digestive system and respiratory system. It plays an important role in the regulation of flow in such systems, such as aiding the movement of food through the digestive system via peristalsis.

Smooth muscle is non-striated and involuntary. Smooth muscle myocytes are spindle shaped with a single centrally
located nucleus.

image

Figure \(\PageIndex{1}\): **Types of muscle**: The body contains three types of muscle tissue: skeletal muscle, smooth muscle, and cardiac muscle, visualized here using light microscopy. Visible striations in skeletal and cardiac muscle are visible, differentiating them from the more randomised appearance of smooth muscle.