24. Introduction to Skeletal Muscles

Introduction

Muscle is one of the four primary tissue types in the human body, along with epithelial tissue, connective tissue, and nervous tissue. Muscle tissue itself comes in three sub-types: (1) **skeletal muscle** is generally associated with movement of the skeleton, (2) **cardiac muscle** forms the heart, and (3) **smooth muscle** is found in various places in the body, including the digestive tract, blood vessels, and the eyes. These three types of muscle tissue all have the same general function, which is to contract and cause movement. The cells of all three types contain the proteins, **actin** and **myosin**, which are ultimately responsible for contraction. On the other hand, these three types of muscle tissue are distinctly different in terms of their appearance and how they are controlled. When viewed through a microscope, cells of skeletal and cardiac muscle tissue have a **striated** (striped) appearance. Cells of smooth muscle lack these striations and appear smooth. Skeletal muscle cells are said to be **voluntary**, since they may be stimulated consciously by the somatic nervous system. Cardiac and smooth muscle cells are innervated by the autonomic nervous system, and they are **involuntary**.

I. The microscopic anatomy of muscle tissues

**Objective 1:** Identify skeletal, cardiac, and smooth muscle tissues, and describe their appearance.

Skeletal muscle cells are long and thin; thus they are often referred to as **skeletal muscle fibers**. The individual fibers typically extend from one end of a muscle all the way to the other end. In the sartorius muscle, which is the longest muscle in the body, the muscle fibers may be well over a foot in length. Skeletal muscle fibers are also typically quite large in diameter, the result of the fact that each skeletal muscle fiber develops from the fusion of hundreds of smaller cells. This is evident from the observation that skeletal muscle fibers are **multinucleate**, containing the nuclei of the many cells that fused together. Each fiber also contains numerous **myofibrils**, which are bundles of actin and myosin. It is the orderly arrangement of actin and myosin in the myofibrils that gives skeletal muscle its striated appearance.

Cardiac muscle cells are much shorter in length than skeletal muscle fibers, and each contains one or two nuclei. They are joined end-to-end at structures called **intercalated discs**, which contain **desmosomes** and **gap junctions**. The gap junctions allow action potentials to spread rapidly from one cell to the next, the importance of which will be studied in detail in A&P II. Cardiac muscle cells are branched, and this helps to rapidly spread an action potential moving across the heart. As in skeletal muscle, it is the arrangement of actin and myosin in myofibrils that results in visible striations.

Smooth muscle cells also are much smaller than skeletal muscle fibers, and each has a single nucleus. Actin and myosin are not arranged in myofibrils, thus there are no striations.
ACTIVITY 1

• Use your computer to view images of skeletal, cardiac, and smooth muscle tissues. Refer to the images in Table 9.3 of *Marieb* and Plates 28, 31, and 32 of *Lab Atlas*. Draw a picture of each type of tissue in the spaces below. You should be able to identify the following structures in the appropriate images: **striations, nuclei, fibroblasts, intercalated discs**.

![Diagram of skeletal muscle](image1)

![Diagram of cardiac muscle](image2)

![Diagram of smooth muscle](image3)

• Examine a plastic model of a skeletal muscle fiber. The **sarcolemma** is the plasma membrane of a muscle fiber. Like the axolemma of a neuron, the sarcolemma is excitable and capable of conducting action potentials. The connective tissue wrapping of the muscle fiber is the **endomysium**. Identify the following structures on the model: **sarcolemma, endomysium, myofibrils, striations**, and **nuclei**.
QUESTIONS

1. Use the terms striated or smooth, and voluntary or involuntary to describe the three types of muscle tissue:

   skeletal
   cardiac
   smooth

2. Both axons and skeletal muscle cells are often referred to as “fibers.” What do both of these structures have in common that leads to them being called fibers?