Different types of muscle and their structures

1.Smooth Muscle:

Smooth muscle is sometimes known as ***visceral muscle*** because it is a major component of many internal (visceral) organs. Smooth muscle is widely distributed throughout the body, being found in the walls of hollow internal organs and other internal structures such as our digestive, reproductive, and urinary tracts, tubes such as blood vessels and airways, and in other locations, such as the inside of the eye. When smooth muscles contract, they help the organs and vessels carry out their functions. The many muscles that line your digestive tract work together to move food through the digestive system. When smooth muscles in the stomach wall contract, for example, they squeeze the food inside the stomach, helping to mix and churn the food and break it into smaller pieces. This is an important part of digestion.

Unlike skeletal and cardiac muscle, smooth muscle is ***not striated***. This is because the individual muscle cells are not perfectly aligned into sarcomeres. Instead, they are displaced throughout the fibers. Smooth muscle cell is spindle-shaped and has one central nucleus. This gives smooth muscle the ability to contract for longer, although the contraction happens more slowly and rhythmically. Consider the muscle that contracts the sphincter on your bladder. This muscle may need to stay clamped shut for hours at a time and only gets a minute of relief when you go to the bathroom. Many other smooth muscles operate in the same manner. Muscles attach to your hair follicles that all your hairs to stand up when it's cold. Smooth muscle is almost everywhere in your body and aids in everything from circulation to digestion. Contractions of smooth muscles are **involuntary**, so they are not under

conscious control. Instead, they are controlled by the autonomic nervous system, hormones, neurotransmitters, and other physiological factors.

Like cardiac muscle, smooth muscle is mostly controlled by the autonomous nervous system.

♣ Structure of Smooth Muscle:

The cells that make up smooth muscle are generally called **myocytes.** Unlike the muscle fibers of striated muscle tissue, the myocytes of smooth muscle tissue do not have their filaments arranged in sarcomeres. Therefore, smooth tissue is not striated. However, the myocytes of smooth muscle do contain myofibrils, which in turn contain bundles of myosin and actin filaments. The filaments cause contractions when they slide over each other.

Bundles of protein filaments form a myofibril, and bundles of myofibrils make up a single muscle fiber. I and A bands refer to the positioning of myosin and actin fibers in a myofibril. Sarcoplasmic reticulum is a specialized type of endoplasmic reticulum that forms a network around each myofibril. It serves as a reservoir for calcium ions, which are needed for muscle contractions. H zones and Z discs are also involved in muscle contractions, which you can read about in the concept of Muscle Contraction.

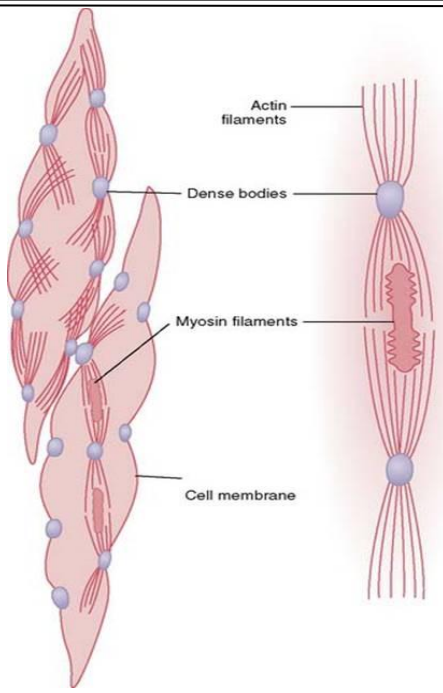

Figure 6: Physical structure of smooth muscle. The upper left-hand fiber shows actin filaments radiating from dense bodies. The lower left-hand fiber and the right-hand diagram demonstrate the relation of myosin filaments to actin filaments.

♣ Functions of Smooth Muscle

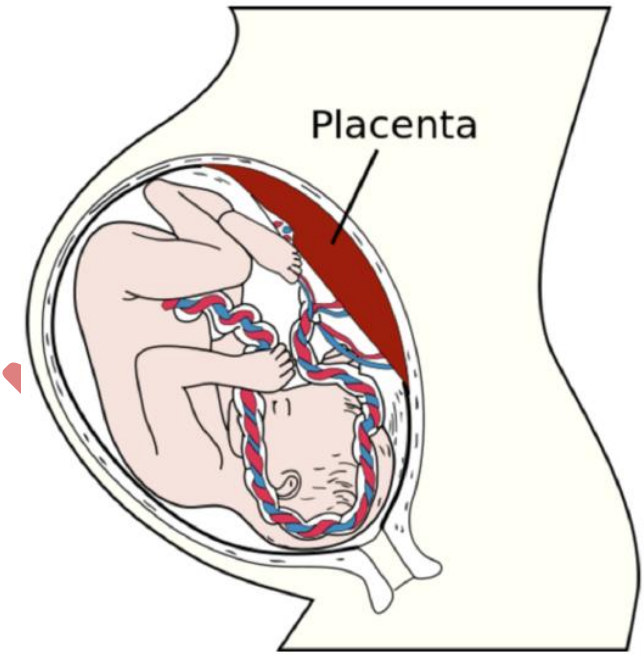

Figure 7: The muscular uterine wall stretches to a great extent to accommodate a growing fetus, yet it can still contract with great force during the labor that precedes childbirth. At that time, it can exert up to 100 pounds of force.

Unlike striated muscle, smooth muscle can sustain very long-term contractions. Smooth muscle can also stretch and still maintain its contractile function, which striated muscle cannot. The elasticity of smooth muscle is enhanced by an extracellular matrix secreted by myocytes. The matrix consists of elastin, collagen, and other stretchy fibers. The ability to stretch and still contract is an important attribute of smooth muscle in organs such as the stomach and uterus, both of which must stretch considerably as they perform their normal functions.

The following list indicates where many smooth muscles are found, along with some of their specific functions.

- Walls of organs of the gastrointestinal tract (such as the esophagus, stomach, and intestines), moving food through the tract by peristalsis.
- Walls of air passages of the respiratory tract (such as the bronchi), controlling the diameter of the passages and the volume of air that can pass through them.
- Walls of organs of the male and female reproductive tracts; in the uterus, for example, pushing a baby out of the uterus and into the birth canal.
- Walls of structures of the urinary system, including the urinary bladder, allowing the bladder to expand so it can hold more urine, and then contract as urine is released.
- Walls of blood vessels, controlling the diameter of the vessels and thereby affecting blood flow and blood pressure.
- Walls of lymphatic vessels, squeezing the fluid called lymph through the vessels.
- Iris of the eyes, controlling the size of the pupils and thereby the amount of light entering the eyes.
- Arrector pili in the skin, raising hairs in hair follicles in the dermis.

2. Cardiac Muscle:

Cardiac muscle is found only in the wall of the heart. It is also called myocardium. The cardiac muscle is striated, like skeletal muscle. The cardiac muscle cell is rectangular in shape. The contractions of cardiac muscle is **involuntary**, strong, and rhythmical. They are controlled by electrical impulses from specialized cardiac muscle cells in an area of the heart muscle called the **sinoatrial node**. Cardiac muscle contains a great many mitochondria, which produce ATP for energy and help the heart resist fatigue. However, Cardiac muscle is highly specialised. Cardiac muscle is under the control of the autonomic nervous system, however, even without a nervous input contraction can occur due to cells called pacemaker cells. Cardiac muscle is highly resistant to fatigue due to the presence of a large number of mitochondria, myoglobin and a good blood supply allowing continuous aerobic metabolism.

♣ Structure of cardiac muscle:

Cardiac muscle, found only in the wall of the heart, is also called myocardium. As shown in the figure below, the myocardium is enclosed within connective tissues, including the endocardium on the inside of the heart and pericardium on the outside of the heart. The cardiac muscle cell has one central nucleus, like smooth muscle, but it also is striated, like skeletal muscle. The cardiac muscle cell is rectangular in shape. Cardiac muscle contains a great many mitochondria, which produce ATP for energy.

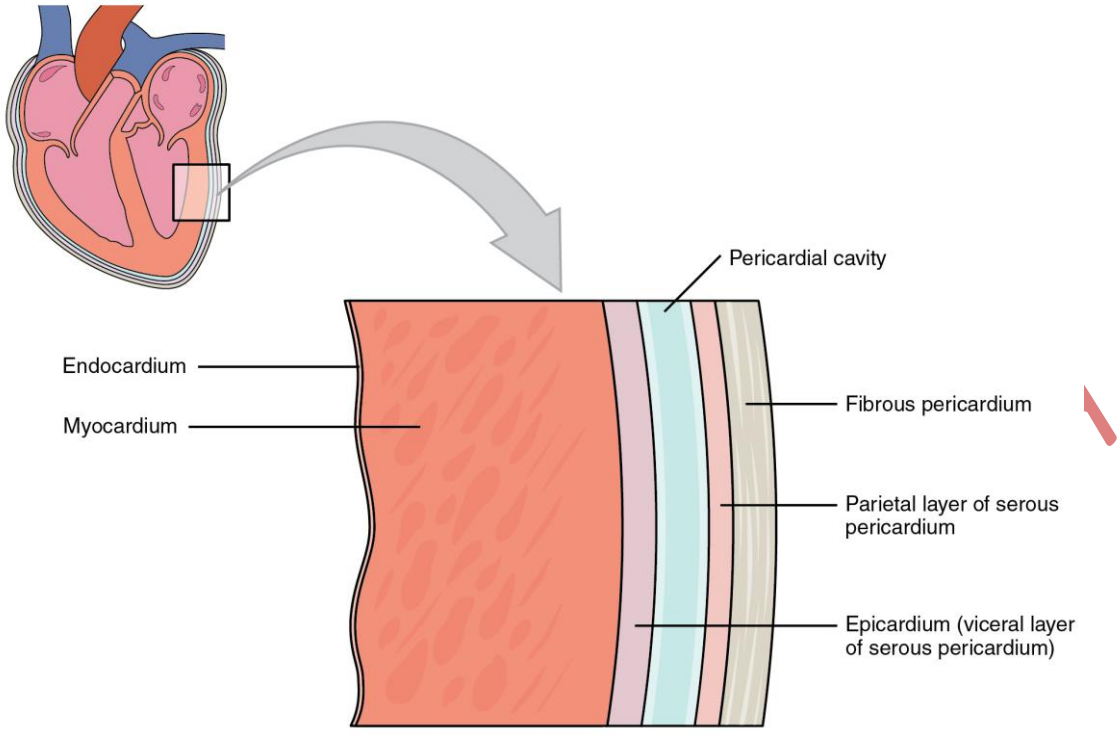

Figure 8: The thick wall of the heart consists mainly of cardiac muscle tissue called myocardium. (OpenStax College [CC BY 3.0)

Like skeletal muscle, cardiac muscle is **striated** because its filaments are arranged in sarcomeres inside the muscle fibers. However, in cardiac muscle, the myofibrils are arranged in a branching pattern (irregular angles) instead of a linear pattern (or parallel rows as they are in skeletal muscle). This explains why cardiac and skeletal muscle tissues look different from one another. Both skeletal muscle and cardiac muscle need to contract quickly and often, which is why the striations can be seen.

The cells of cardiac muscle tissue are arranged in interconnected networks. This arrangement allows rapid transmission of electrical impulses, which stimulate virtually simultaneous contractions of the cells. This enables the cells to coordinate contractions of the heart muscle.

♣ Functions of Cardiac muscle:

The heart is the muscle that performs the greatest amount of physical work in the course of a lifetime. Although the power output of the heart is much less than the maximum power output of some other muscles in the human body, the heart does its work continuously over an entire lifetime without rest. Cardiac muscle surrounds the chambers of the heart and is used to pump blood through the body.