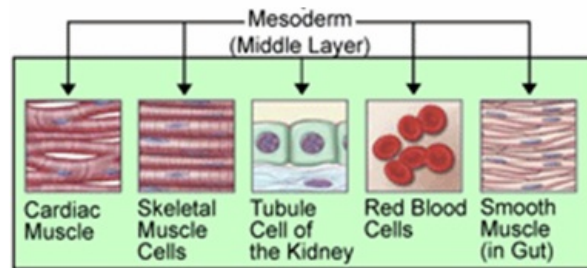


Embryonic Development of Muscles

Origin

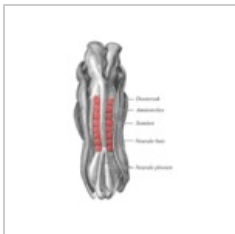
With the exception of some smooth muscle tissue, the muscular system develops from the mesodermal germ layer

and consists of skeletal, smooth and cardiac muscle.



Skeletal

Skeletal muscle is derived from **paraxial mesoderm** (http://en.wikipedia.org/wiki/Paraxial_mesoderm), which forms **somites** from the occipital to the sacral regions and somitomeres in the head.



Highlighted
somites
(=somieten)

Smooth

Smooth muscle differentiates from **visceral splanchnic mesoderm** (<http://medical-dictionary.thefreedictionary.com/Splanchnic+mesoderm>) surrounding the gut and its derivatives and some parts also from ectoderm (in pupillary, mammary gland and sweat glands).

Cardiac

Cardiac muscle is derived from **visceral splanchnic mesoderm** surrounding the heart tube.

Skeletal muscle

Head musculature is derived from seven somitomeres, which are partially segmented whorls of mesenchymal cells derived from paraxial mesoderm. Musculature of the axial skeleton, body wall and limbs is derived from somites. These somites and somitomeres undergo a process of epithelization and form a "ball" of epithelial cells with a small cavity in the center. Cells in the upper region of the somite form the dermatome (giving rise to skin precursor cells) and two muscle-forming areas at the **ventrolateral (VLL)** and **dorsomedial (DML)** lips form. Cells from these two areas migrate and proliferate to form progenitor muscle cells ventral to the dermatome, thereby forming the **dermomyotome**. Some cells from the VLL region also migrate into the adjacent parietal layer of the lateral plate mesoderm. Here they form **infrahyoid, abdominal wall (rectus abdominis, internal and external oblique and transversus abdominis), and limb muscles**. The remaining cells in the myotome form **muscles of the back, shoulder girdle and intercostal muscles**.

Myogenesis

Myogenesis is the formation of muscle fibers, called myotubes. These fibers are multinucleated and are capable of contraction. First step in their formation is alignment of the myoblasts into the myotubes and the second stage is the fusion itself.

Mesodermal domains

Initially, there is a well-defined border between each somite and parietal layer of lateral plate mesoderm called the lateral somitic frontier. This frontier separates two mesodermal domains in the embryo:

1. The **primaxial domain** that comprises the region around the neural tube and contains only somite-derived (paraxial mesoderm) cells.
2. The **abaxial domain** that consists of the parietal layer of lateral plate mesoderm together with somite cells that have migrated across the lateral somitic frontier.

Muscle cells that cross this frontier (those from the VLL edge of the myotome) and enter the lateral plate mesoderm comprise the abaxial muscle cell precursors; those that remain in the paraxial mesoderm and do not cross the frontier (the remaining VLL cells and all of the DML cells) comprise the primaxial muscle cell precursors.

Innervation

1. Epaxial muscles (above the axis) - **back muscles** - are innervated by dorsal primary rami
2. Hypaxial muscles (below the axis) - **body wall and limb muscles** - are innervated by ventral primary rami

Cardiac Muscle

Cardiac muscle develops from splanchnic mesoderm surrounding the endothelial heart tube. Myoblasts adhere to one another by special attachments that later develop into **intercalated discs**. Myofibrils develop as in skeletal muscle, but myoblasts do not fuse. During later development, a few special bundles of muscle cells with irregularly distributed myofibrils become visible. These bundles, **Purkinje's fibers** (http://en.wikipedia.org/wiki/Purkinje_fibers), form the conducting system of the heart.

Smooth Muscle

Smooth muscle for the dorsal aorta and large arteries is derived from lateral plate mesoderm and neural crest cells. In the coronary arteries smooth muscle originates from proepicardial cells and neural crest cells. Smooth muscle in the wall of the gut derivatives is derived from the splanchnic layer of lateral plate mesoderm that surrounds these structures. Only the sphincter and dilator muscles of the pupil and muscle tissue in mammary and sweat glands are derived from **ectoderm**.

Links

- Muscular system (http://en.wikipedia.org/wiki/Muscular_system)

Bibliography

- SADLER, T. W. *Langman's Medical Embryology*. 12th edition. Lippincott Williams & Wilkins, 2012. Chapter 11: Muscular System. ISBN 978-1-4511-4461-1.
- WIKIPEDIA. *Muscular system* [online]. [cit. 2012-12-04]. <http://en.wikipedia.org/wiki/Muscular_system>.