

# Skeletal muscle structure

The basic building unit is the **muscle fibre**.

## Developmental stages=

1. **Myoblast** - mononuclear formation; myoblasts fuse
2. **Myotube** - multinucleated formation, nuclei located in the axis
3. **Muscle fiber** - multinucleated formation, nuclei in the periphery

## Description

The nuclei are oval, located on the periphery just below the surface. The plasma membrane, here called the **sarcolemma**, forms tubular invaginations - **T-tubules**. On the surface of the filament is a complex of *lamina basalis* and a network of reticular filaments = **endomysium**; the whole complex follows the sarcolemma and into the lumina of the T-tubules. The cytoplasm, the **sarcoplasm**, is filled with longitudinally arranged myofibrils that form the contractile apparatus of the cell.

### Arrangement of myofibrils

1. longitudinal section - transverse striations are visible
2. transverse section - transverse striations cannot be observed, we observe bundles of myofibrils separated by a layer of sarcoplasm, the so-called Conheim's fields

**Mitochondria** are located between myofibrils (long axes parallel), are rod-shaped and bulky. In the sarcoplasm we also find **polysomes, gER, GK, glycogen stores**.

Perpendicular to the interface between the light (I) and dark (A) stripes of the myofibrils, the T-tubules of the sarcolemma protrude. They form a meshwork, the meshes surrounding each myofibril.

The smooth endoplasmic reticulum - **sarcoplasmic reticulum** - is highly developed. It represents a *reservoir of calcium ions* that are crucial for the initiation and progression of myofibril contraction. It is tubular in nature. The tubules form a network around the myofibrils. At the interface of the A and I strips of myofibrils, the tubules terminate in a wide terminal cisterna (a hoop encircling the entire myofibril). The cisterna inserts on the side away from the reticulum tubule insertion towards the perpendicular T-tubule of the sarcolemma. To each T-tubule 2 cisternae (one on each side) insist = the complex structure (cisterna-T-tubule-cisterna) forms a **triad**. Close relationship between the sarcoplasmic reticulum and the T-tubule membrane → formation of specialized precincts - **couplings**. These are important in the process of coupling excitation and contraction. The end of the muscle fibre is conical.

At the transition into the tendon, the sarcolemma forms deep invaginations ← ingrowth of bundles of collagen fibers of the tendon + anchoring into the basement membrane.

## Types of muscle fibers

**Red fibers** contain many myoglobin = oxygen-binding protein (similarity to hemoglobins), cytochrome → red color of muscle. Fibers work continuously for long periods of time. Energy by oxidative phosphorylation → many mitochondria. They contract more slowly but persistently.

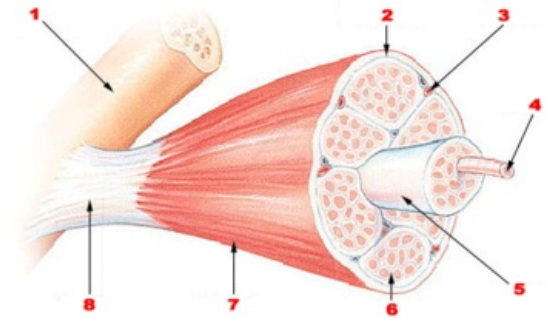
**White fibers** have low myoglobin, cytochrome, few mitochondria. They are bulkier, capable of rapid contraction but not persistent. They are subdivided into subtypes A (fast, moderately fatiguable), B and C (very fast, rapidly fatiguable).<sup>[1]</sup>

**Intermediate filaments** - intermediate type

## Muscle structure

Skeletal muscle tissue is arranged into muscles. Muscles are attached to skeletal components via ligamentous structures. Through their contractions they provide movement = **active component of the musculoskeletal system**.

1. **Muscle fibre** - surrounded by **endomysium (lamina basalis + network of ret. fibres)**. Fiber network embedded in lamina structures → mediator of transmission of forces generated during contraction to the ligamentous structures of the muscle. The forces exerted by the contraction of individual fibres are added together. The resulting force acts in the direction of the axis of the tendon attachment. Richly vascularised.



**Skeletal muscle structure:** 1) bone, 2) perimysium, 3) blood vessel, 4) muscle fiber, 5) fascicle, 6) endomysium, 7) epimysium, 8) tendon

2. **Bundles of fibres** - surrounded by **perimysium** = connective tissue layer reinforced by networks of collagen fibres. Between the bundles are **vascular and nerve networks**. The perimysium is **ductile**, allowing the bundles to move relative to each other during muscle activity.
3. **Muscle** - encased by **epimysium** = layer of **dense collagen connective tissue**.

## Linked articles

### Related articles

- Bone
- Muscle

### Literature used

- {JARKOVSKÁ, Daniela – MARTÍNEK, Jindřich. *Histologie. 1.* 1. edition. Karolinum, 1997. ISBN 80-7184-388-1.
1. VAJNER, Luděk – UHLÍK, Jiří – KONRÁDOVÁ, Václava. *Lékařská histologie I. : Cytologie a obecná histologie.* - edition. Univerzita Karlova v Praze - Nakladatelství Karolinum, 2012. ISBN 978-80-246-1860-9.