MED438

King saud university
Histology team med438

MUSCLE

Color code: Doctor notes extra Important

Editing file

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Objectives:

Identify and describe the histological structure of the three types of muscle cells and list the differences between them.

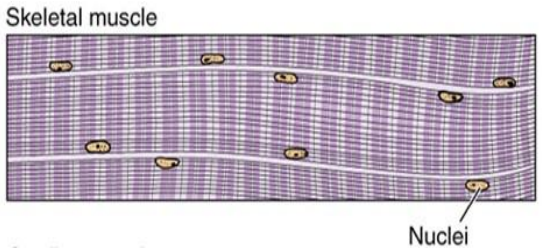
Muscular Tissue

- Made of elongated muscle cells (fibers)
- There are 3 types of muscles (muscle fibers):

muscle fibers

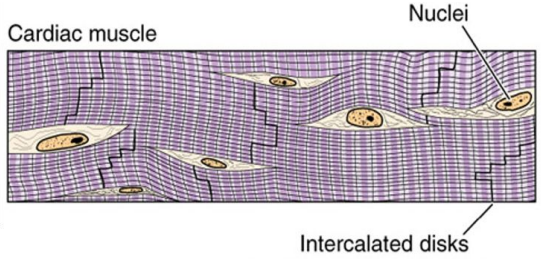
Skeletal

striated, voluntary.



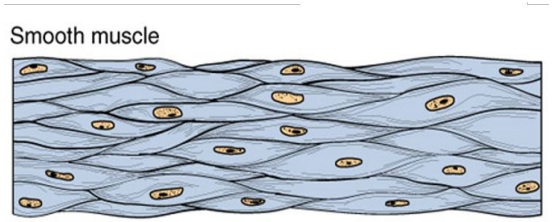
Cardiac

striated, involuntary.



Smooth

Non-striated, involuntary

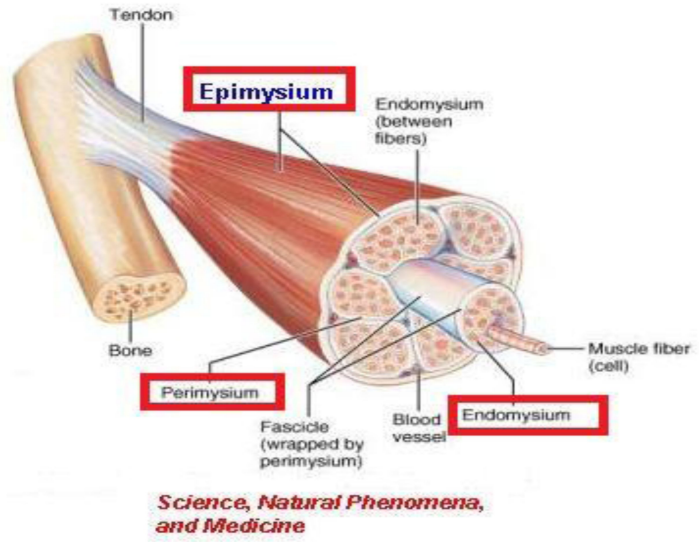


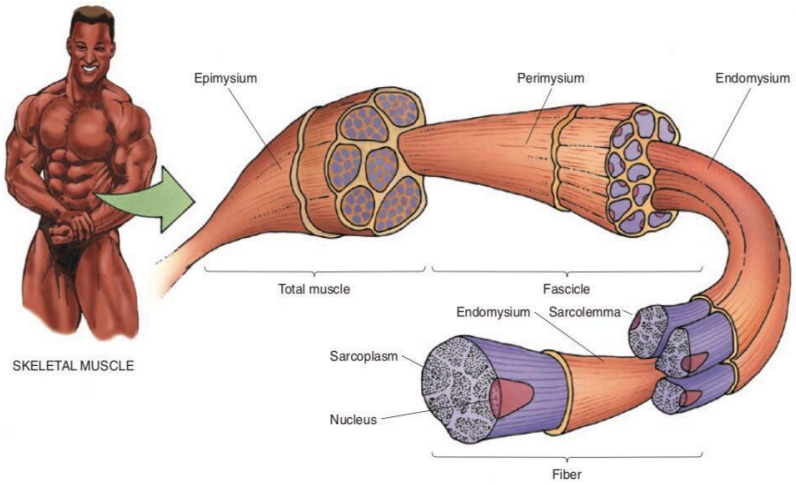
Skeletal Muscle

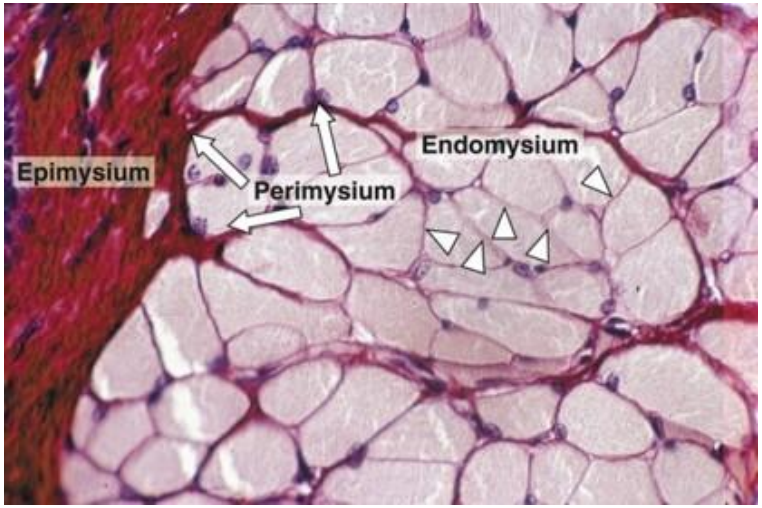
- The whole muscle is covered by a C.T (dense irregular collagenous) covering, the **epimysium.**
- Consists of parallel skeletal muscle fibers, arranged in bundles, separated by C.T (dense irregular collagenous) septa, the **perimysium.**
- The individual fibers are separated by C.T (reticular fibers), **endomysium**.

Epi=out , Peri=around , Endo=inside

Sarco=fleshy , Mysium=flesh , Myo=muscle





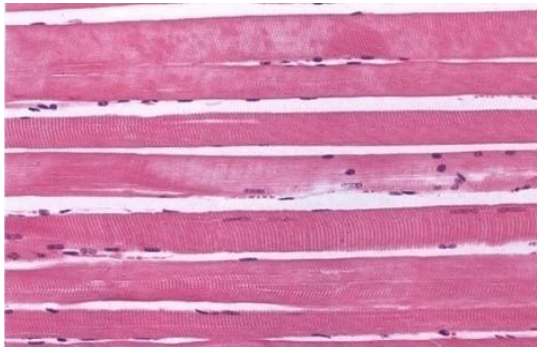


Skeletal Muscle Fibers under microscope

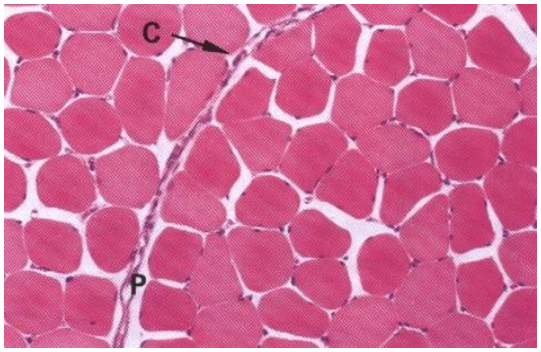
L.M. Picture:

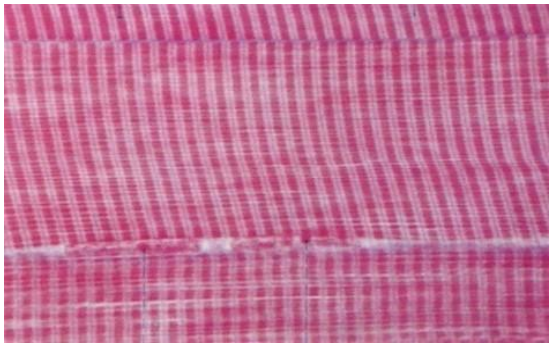
- Cylindrical in shape.
- Non-branched.
- Covered by a clear cell membrane, the **sarcolemma.**
- Multinucleated: nuclei are multiple and are peripherally located (close to the sarcolemma).
- Cytoplasm **(sarcoplasm)** is acidophilic and shows clear transverse striations.

Longitudinal section



Transverse section





In normal cell	In muscle fiber
Cell membrane	sarcolemma
Cytoplasm	sarcoplasm
Smooth endoplasmic reticulum-SER	Sarcoplasmic reticulum -SR
Mitochondria	sarcosomes

Skeletal Muscle Fibers under microscope

E.M. Picture:

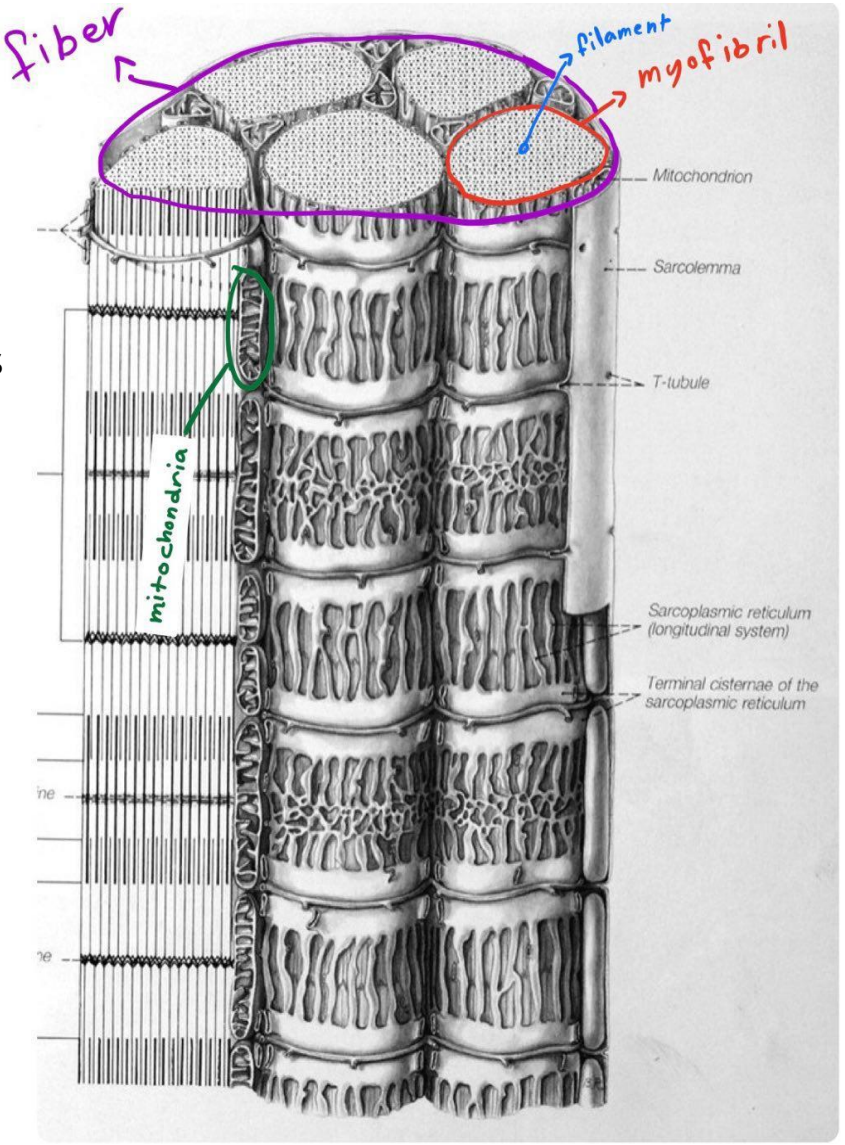
Sarcoplasm contains:

- Parallel myofibrils (thousands of filaments)
- Numerous mitochondria, arranged in rows between the myofibrils.
- Well developed smooth endoplasmic reticulum **(sarcoplasmic reticulum-SR).**
- Myoglobin pigment.

  *myoglobin carrying of oxygen molecules to muscle tissues

- Glycogen

  *Glycogen provides energy for the muscle

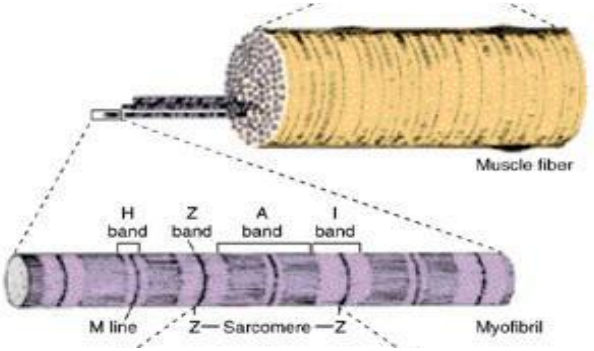


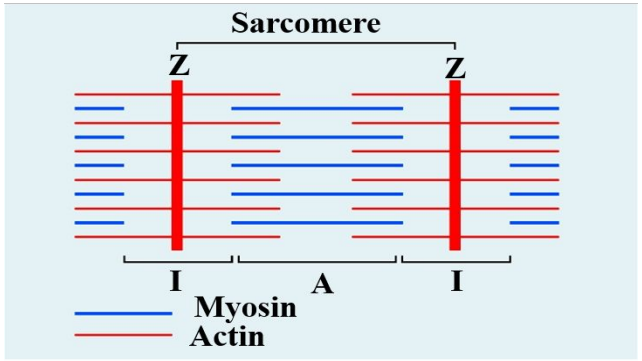
Skeletal Muscle Fibers (Myofibrils)

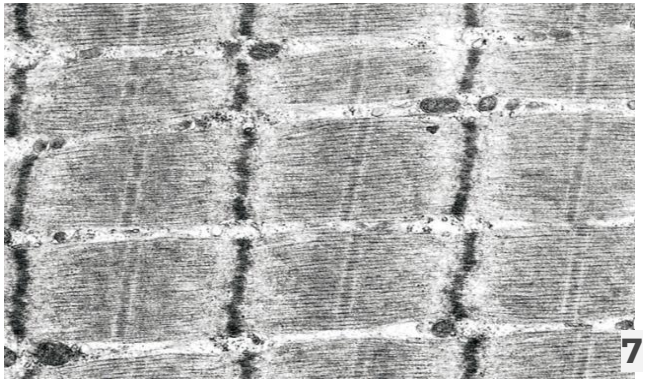
E.M. Picture of Myofibrils:

- Contractile threads (organelles), arranged longitudinally in the sarcoplasm.
- Each myofibril shows alternating **dark (A) and light bands (I)**.
- The A band shows a pale area in the middle **(H band)** which is divided by a dark line **(M line).**
- The **(I) band** shows a dark line in the middle **(Z line).**
- The sarcomere is the segment between 2 successive **Z lines**. It is the contractile unit of a myofibril.
- The myofibrils are formed of myofilaments (thick myosin and thin actin).
- The **(A) band** is formed of myosin myofilaments mainly and the terminal ends of actin myofilaments.
- The **(I) band** is formed of actin myofilaments.

*Good picture in the next slide

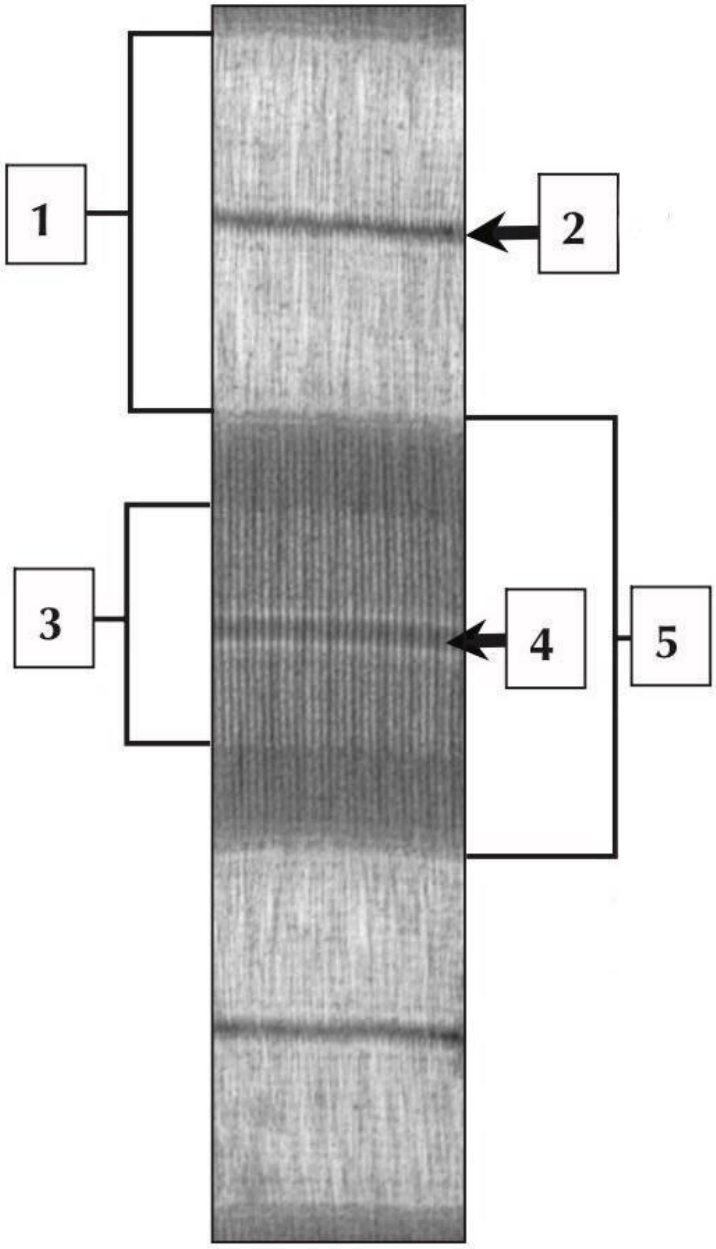






*The **(A) band** is dark because it contains both myosin and actin. **The (I) band and the (H) zone** are light because they have only one type of myofilaments (actin in I and myosin in H).

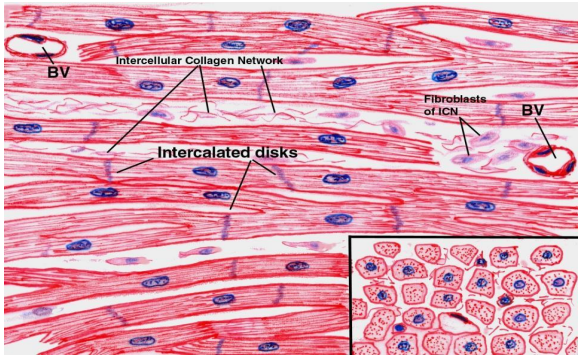
1. **I band**
2. **Z band**
3. **H zone**
4. **M band**
5. **A band**



Cardiac Muscle

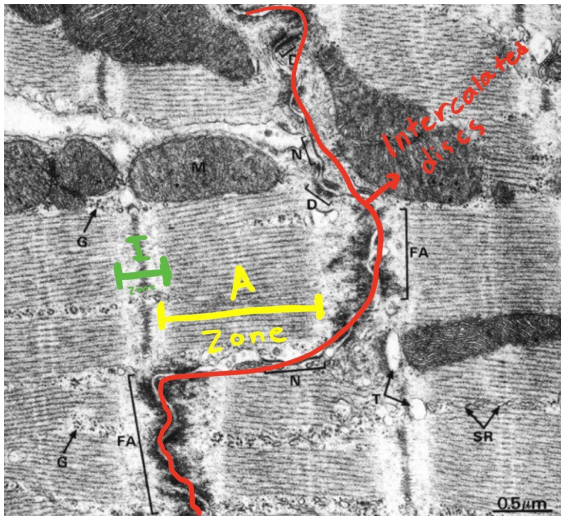
- Found in the myocardium.
- Striated and involuntary.

L.M. Picture of Cardiac Muscle Fibers:



- Cylindrical in shape.
- Intermediate in diameter between skeletal and smooth muscle fibers.
- Branch and anastomose.
- Covered by a thin sarcolemma.
- Mononucleated. Nuclei are oval and central.
- Sarcoplasm is acidophilic and shows non-clear striations (fewer myofibrils).
- Divided into short segments (cells) by the intercalated discs.

E.M. Picture:

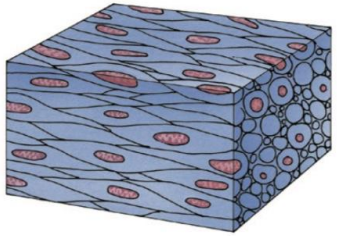


- Few myofibrils.
- Numerous mitochondria.
- Less abundant sarcoplasmic reticulum-SR.
- Glycogen & myoglobin.
- **Intercalated discs:** are formed of the two cell membranes of 2 successive cardiac muscle cells, connected together by junctional complexes (desmosomes and gap junctions).

*Gap junctions allow communication and passage between cardiac muscle cells

Smooth Muscle

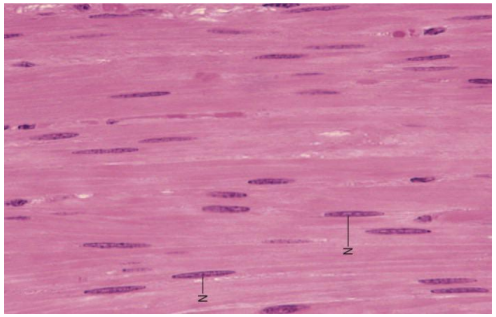
- Present in walls of blood vessels and viscera (internal organ) (digestive, urinary, genital .... etc).
- Non-striated and involuntary.



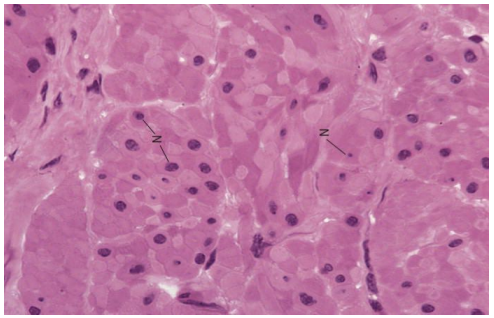
L.M. Picture of Smooth Muscle Fibers:

- Fusiform in shape (spindle-shaped).
- Small diameter and Non-branched.
- Thin sarcolemma.
- Mononucleated. Nuclei are oval & central in position.
- Sarcoplasm is non-striated and acidophilic.

Longitudinal section



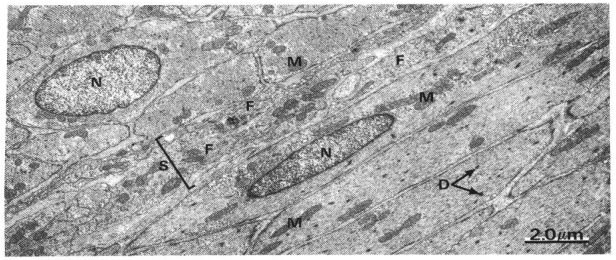
Cross section

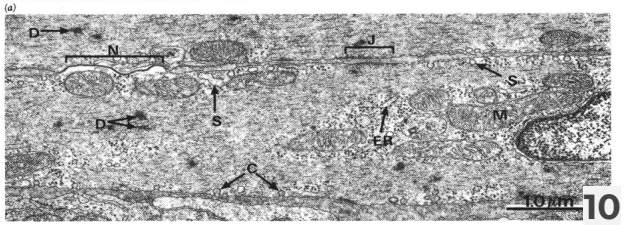


E.M. Picture:

- Sarcoplasm contains mitochondria and sarcoplasmic reticulum.
- Myosin & actin filaments are irregularly arranged (that's why no striations could be observed).
- Cells are connected together by gap junctions for cell communication.

"Question: Gap junction can be seen in .....?
A:Smooth muscles and cardiac muscles (involuntary muscles)"

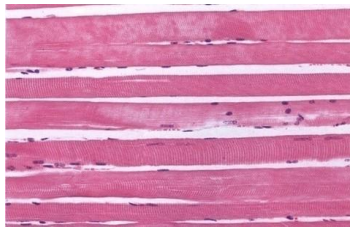
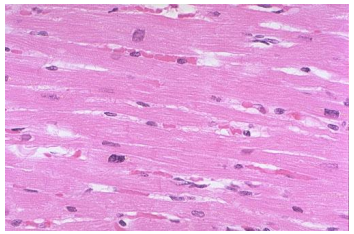
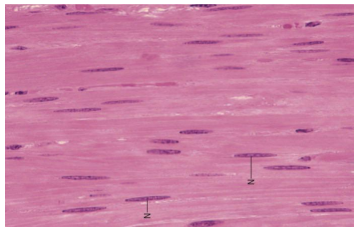




REGENERATION OF MUSCLE

(1) Skeletal muscle cells: Can not divide. **Limited** regeneration by satellite cells (stem cells on the muscle cell's surface)	**(2) Cardiac muscle cells:** **No** regenerative capacity.	**(3) Smooth muscle cells:** Can divide. Regenerate from pericytes. **active** regenerative response.

Comparison between different types of muscle fibers

	Skeletal	Cardiac	Smooth
Site	Muscle attached to skeleton	Myocardium of the heart	Viscera e.g. stomach
Shape	Cylindrical	Cylindrical	Fusiform
Diameter	Largest	Medium-sized	Smallest
Branching	Non-branched	Branched	Non-branched
Striations	Clear	Not clear	Absent
Intercalated discs	Absent	Present	Absent
Nuclei	Numerous and peripheral	One central nucleus	One central nucleus
Action	Voluntary	Involuntary	Involuntary
Regeneration	Limited	No	active
L.M Picture			

*This table is very important and useful for OSPE

Quiz

1. Which one of the following muscular tissue is Fusiform in shape
   a. Skeletal
   b. Cardiac
   c. Smooth
   d. nerves

2. What is the name of the dark line in the middle of The (I) band
   a. A line
   b. M line
   c. Z line
   d. H line

3. An entire skeletal muscle is invested by a connective tissue element known as
   a. Endomysium
   b. Epimysium
   c. Perimysium
   d. Intercalated discs

4. Intercalated discs is present in which of the following type of muscle fibers?
   a. Cardiac muscle
   b. Skeletal muscle
   c. Smooth muscle
   d. All of them

5. The **(A) band** is dark because it contains ?
   a. Myosin
   b. Actin and tubulin
   c. Actin
   d. Myosin and actin

6. Which one of the following muscle fibers can divide?
   a. Cardiac muscle
   b. Skeletal muscle
   c. Smooth muscle
   d. All of them

1-c 2-c 3-b 4-a 5-d 6-c

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