Muscular Tissue

Lecture 2 – Musculoskeletal Block

Objectives:

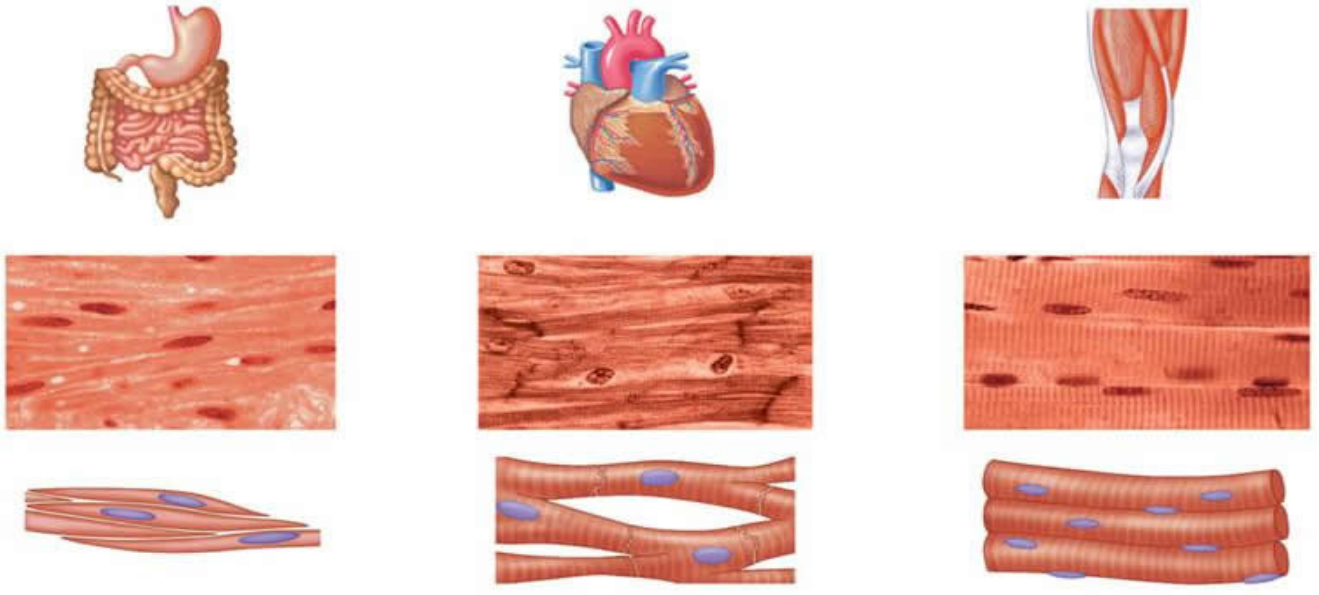
By the end of this lecture you should be able to:

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

Muscular Tissue

- It is made of elongated muscle cells "fibers"

Types of Muscles



Smooth muscle
- has narrow, tapered rod-shaped cells.
- has nonstriated, uninucleated fibers.
- occurs in walls of internal organs and blood vessels.
- is involuntary.

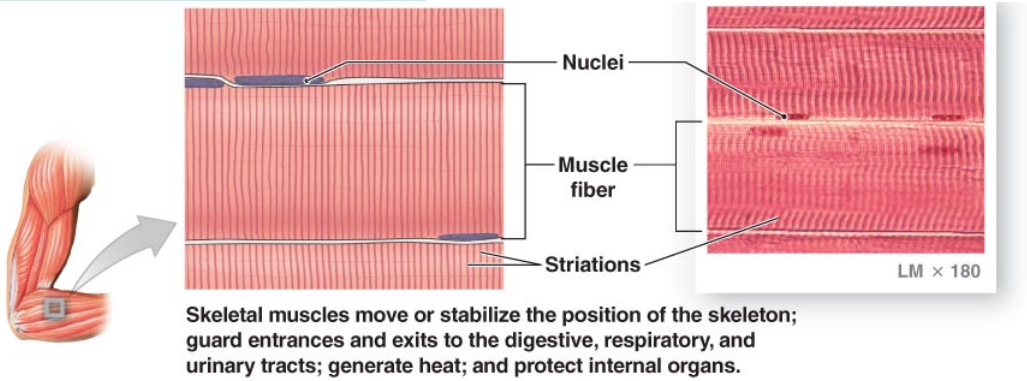
Cardiac muscle
- has striated, tubular, branched, uninucleated fibers.
- occurs in walls of heart.
- is involuntary.

Skeletal muscle
- has striated, tubular, multinucleated fibers.
- is usually attached to skeleton.
- is voluntary.

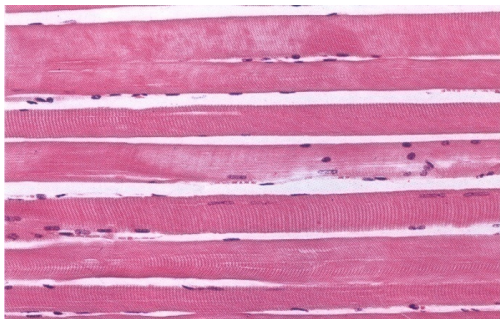
Skeletal Muscle

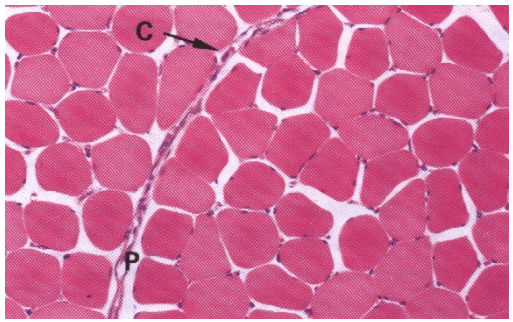
L.M Picture

- 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.



Skeletal muscles move or stabilize the position of the skeleton; guard entrances and exits to the digestive, respiratory, and urinary tracts; generate heat; and protect internal organs.

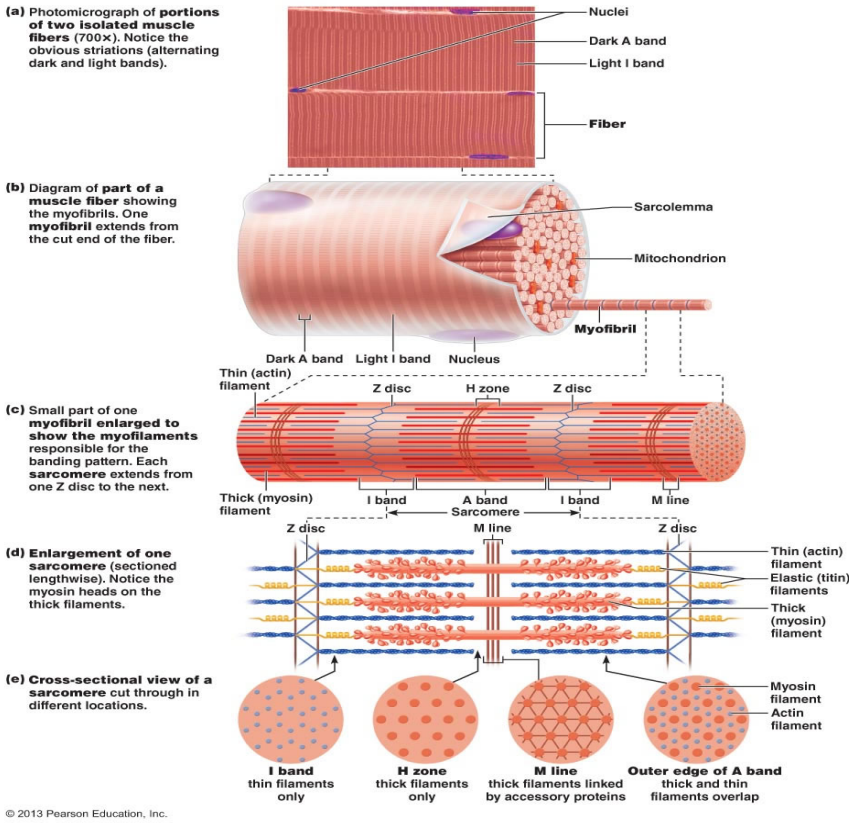




Skeletal Muscle

E.M Picture

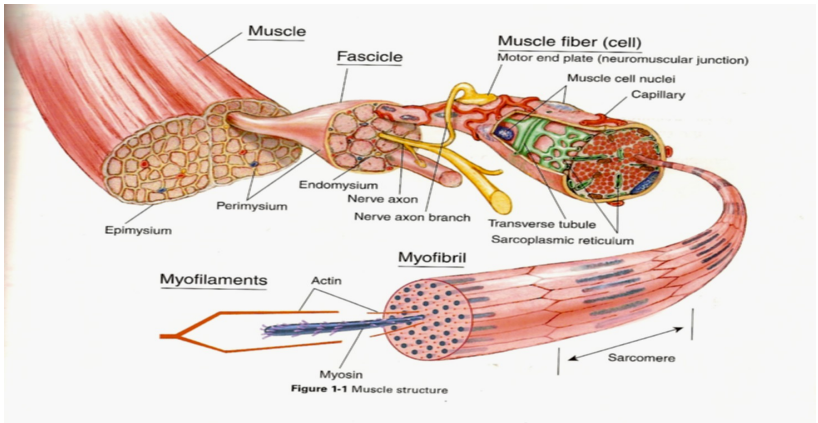
- Contractile threads (organelles), arranged longitudinally in the sarcoplasm.
- Each myofibril shows alternating dark (A) and light bands (I).
- The **A band** shows a pale area in the middle (H band) which is divided by a dark line (M line).
- The **(I) band** shows a dark line in the middle (Z line).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

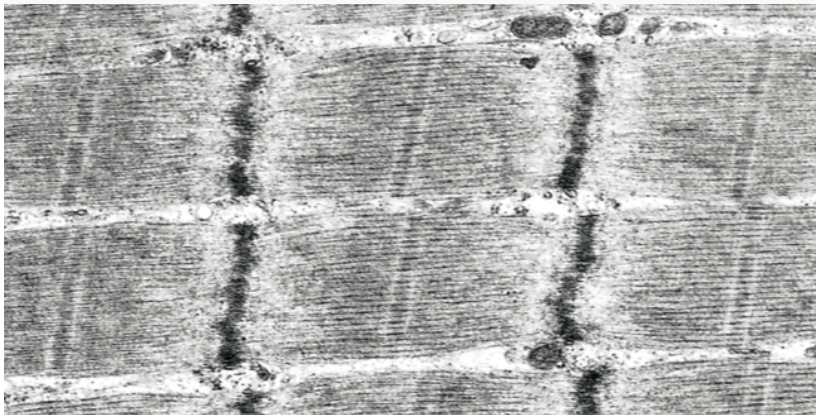


Skeletal Muscle

E.M Picture

- 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.

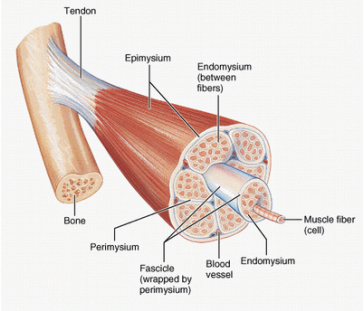




To make this easier.. Let's start with the tiniest unit of the skeletal muscle (i.e. the myofibril) and follow up the progress until we reach the skeletal muscle: But before that, I suggest you to watch this "6-minutes" video:

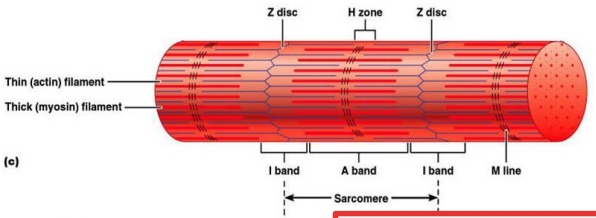
http://www.youtube.com/watch?v=f_tZne9ON7c

Skeletal muscle



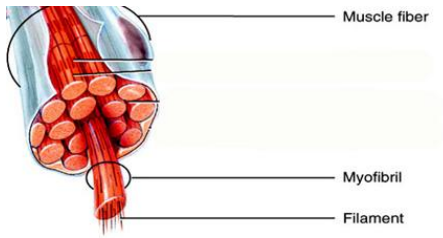
The whole muscle is covered by a C.T. covering called: **Epimysium**

Myofibril



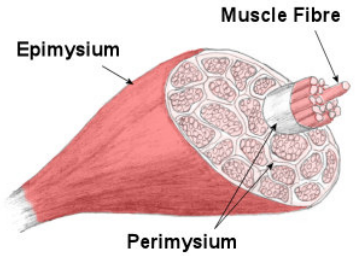
Bundles of myofibrils form the muscle fiber

Muscle fiber



Each muscle fiber is separated by C.T. called: **Endomysium**

Muscle fiber bundle

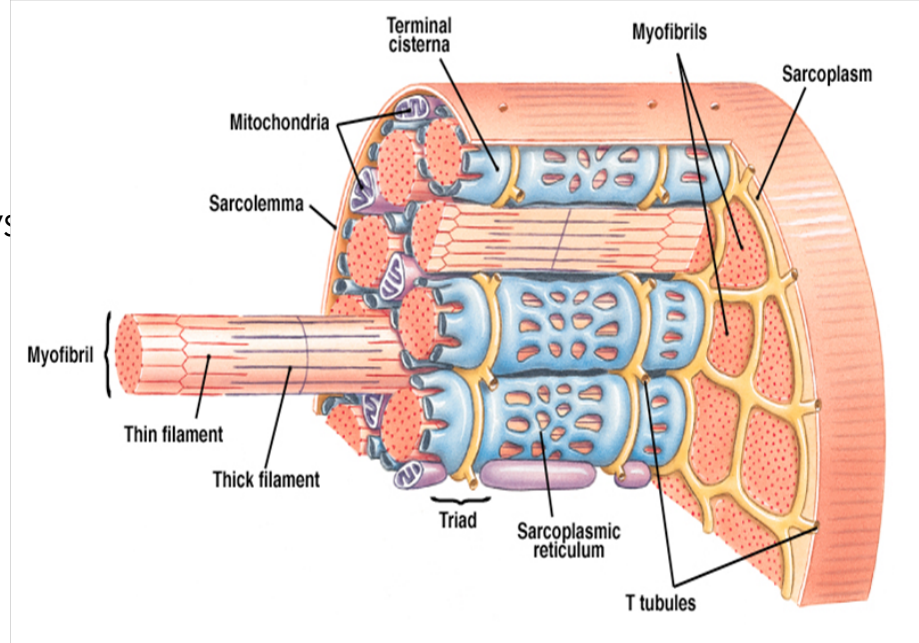


Each muscle fiber bundle is separated by C.T. called: **Perimysium**

Skeletal Muscle Fiber

Sarcoplasm (cytoplasm) of the skeletal muscle fiber contains:

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



The TRIAD tubular system:

- The sarcolemma sends transverse invaginations into the sarcoplasm, the **T-tubules**. They form collars around the myofibrils at the level of the A - I junctions.
- The SR forms transverse wider cisternae (**terminal cisternae**) on either side of the T-tubule.
- The 2 terminal cisternae of the SR and the T-tubule in-between form the **triad tubular system**, which plays an important role during muscle contraction.

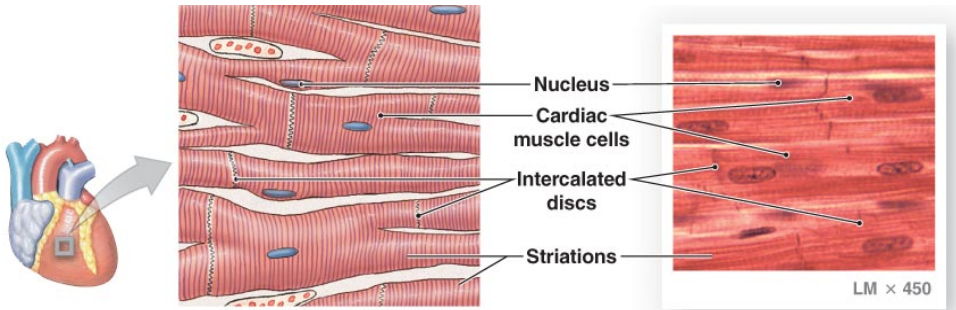
Cardiac Muscle

L.M Picture

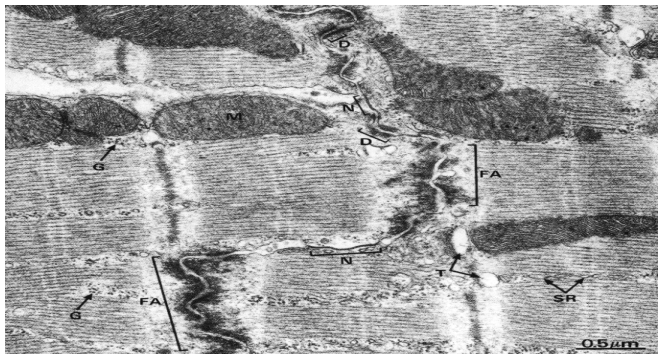
- **Cylindrical** in shape.
- Intermediate in diameter between skeletal and smooth muscle fibers.
- **Branch** and **anastomose.**
- Covered by a thin **sarcolemma**.
- Mononucleated. Nuclei are oval and central.
- **Sarcoplasm** is acidophilic and shows non-clear striations (fewer myofibrils).
- Divided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

E.M Picture

- Few myofibrils.
- Numerous mitochondria.
- Less abundant SR.
- T-tubules come in contact with only one cisterna of SR forming "**Diads**" (not triads).
- 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).



Cardiac muscle moves blood and maintains blood pressure.



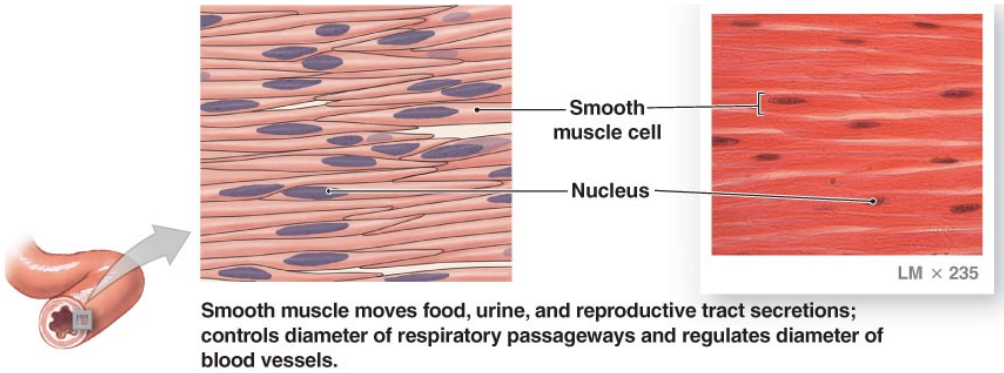
Smooth Muscle

L.M Picture

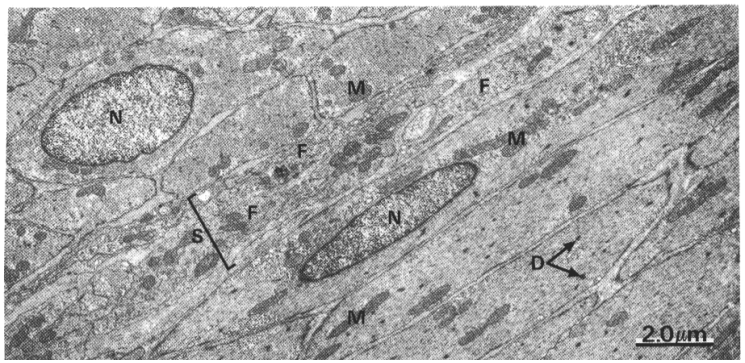
- **Fusiform** in shape (spindle-shaped).
- Small diameter.
- **Non-branched**.
- Thin **sarcolemma**.
- **Mononucleated**. Nuclei are oval & central in position.
- **Sarcoplasm** is non-striated and acidophilic.

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.



Smooth muscle moves food, urine, and reproductive tract secretions; controls diameter of respiratory passageways and regulates diameter of blood vessels.



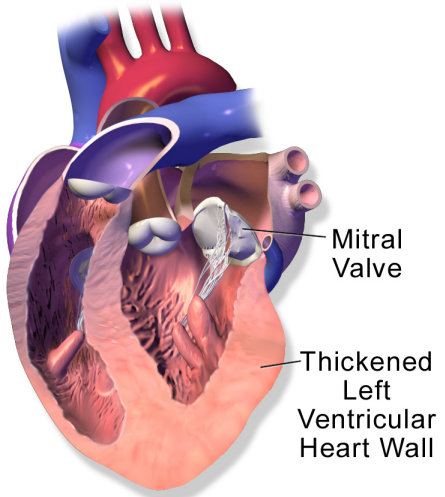
Comparison
Between Muscle Fibers

	Skeletal	Cardiac	Smooth
Site	Muscle attached to skeleton	Myocardium of the heart	Viscera, e.g. stomach
Shape	Cylindrical	Cylindrical	Fusiform (spindle-shaped)
Diameter	Largest	Medium-sized	Small
Branching	Non-branched	Branched	Non-branched
Striations	Clear	Not clear	Absent
Intercalated discs	Absent	Present	Absent
Nuclei	Numerous and peripheral	One oval and central nucleus	One oval and central nucleus
Action	Voluntary	Involuntary	Involuntary
Regeneration & Division	Limited	No	Active

Clinical Application

Cardiac hypertrophy:

- During cardiac hypertrophy the number of cardiac muscle cells is not increased; instead, they become longer and larger in diameter.



Hypertrophic Cardiomyopathy

MCQ's

Q1) Which of the following C.T. separates each individual skeletal muscle fibres:

A-epimysium.

B –endomysium.

C-perimysium.

D-sarcoplasm.

Q2) Cytoplasm (sarcoplasm) of skeletal muscles fibres is basophilic:

A-True.

B-False.

Q3) Sarcomere is the distance between two …….

A- M lines.

B-H bands.

C-Z lines.

D- I bands.

Q4) I band is formed of actin myofilaments

A-True.

B-False.

Q5) Triad tubular system plays an important role during muscle relaxation.

A-True.

B-False.

Q6) Intercalated discs is present in which of the following type of muscle fibres.

A-cardiac muscle.

B-smooth muscle.

C-skeletal muscle.

Q7) Which one of the following muscle fibres can divide:

A-cardiac muscle.

B-smooth muscle.

C-skeletal muscle.

1-B
2-B
3-C
4-A
5-B
6-A
7-B

Motivation Corner

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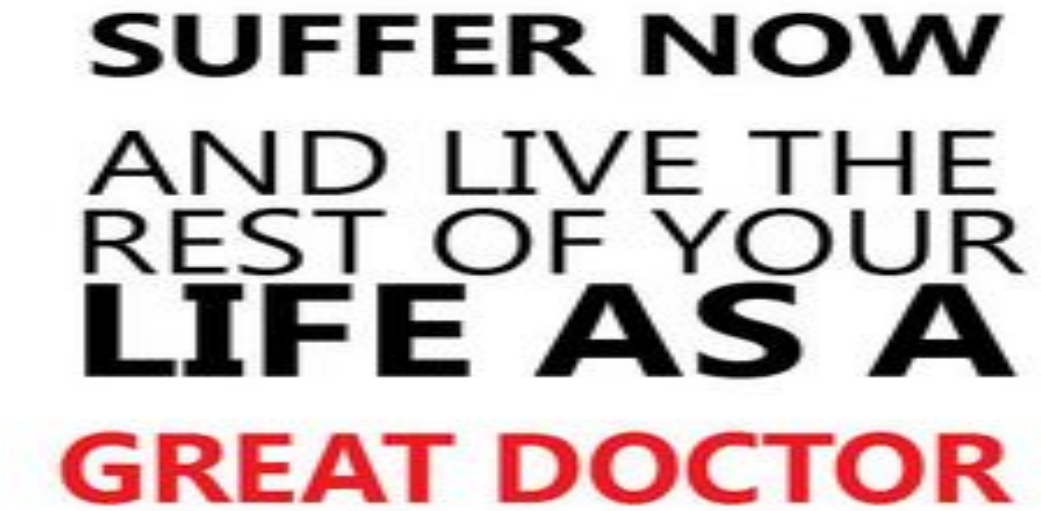

YouTube http://www.youtube.com/watch?v=8rsk2Xzejnc

Thank you for Checking our Work

For any correction, suggestion or any useful information do not hesitate to contact us: Histology434@gmail.com