

Musculoskeletal system

Muscles

Lesson (3)

Dr / Shimaa Essa

*Lecturer of physical therapy , faculty of community,
King Khalid university*





Objectives

Upon successful completion of this lesson you would be able to:

- 1) Recognize types of muscles.
- 2) Identify structures of muscles.
- 3) Identify the basic behavioral properties of the muscles.
- 4) Delineate functions of muscles.
- 5) Identify classifications of muscles.

Introduction

- Muscular system consists of three muscle types: cardiac, smooth, and skeletal
- Skeletal muscles form (40-45% of total body weight)
- Human body has more than 430 pairs of skeletal muscle; most vigorous movement produced by 80 pairs

Introduction (continued)

- Skeletal muscles provide strength (production of muscle tension) and protection for the skeleton, enable bones to move, provide the maintenance of body posture against gravity
- Skeletal muscles perform both dynamic and static work
 - ✦ Dynamic: locomotion & positioning of segments
 - ✦ Static: maintains body posture





SKELETAL

Muscles



Skeletal Muscles

- *Definition:*

Skeletal muscles are voluntary muscles which are attached to the bones of the skeleton (appendicular and axial), forming the muscles of limbs, abdomen, head, neck, face, eye, diaphragm and tongue. The number of skeletal muscles in the human body is about 640 muscles

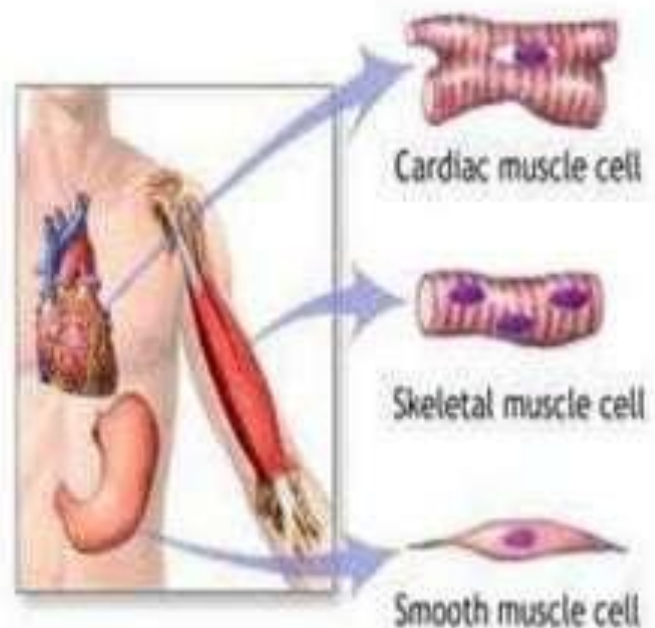


Skeletal Muscles

Types of muscles

There are **three** types of muscles:

- 1- Cardiac (in the heart).
- 2- Skeletal (around the skeleton).
- 3- Smooth (in the viscera).



Skeletal Muscles

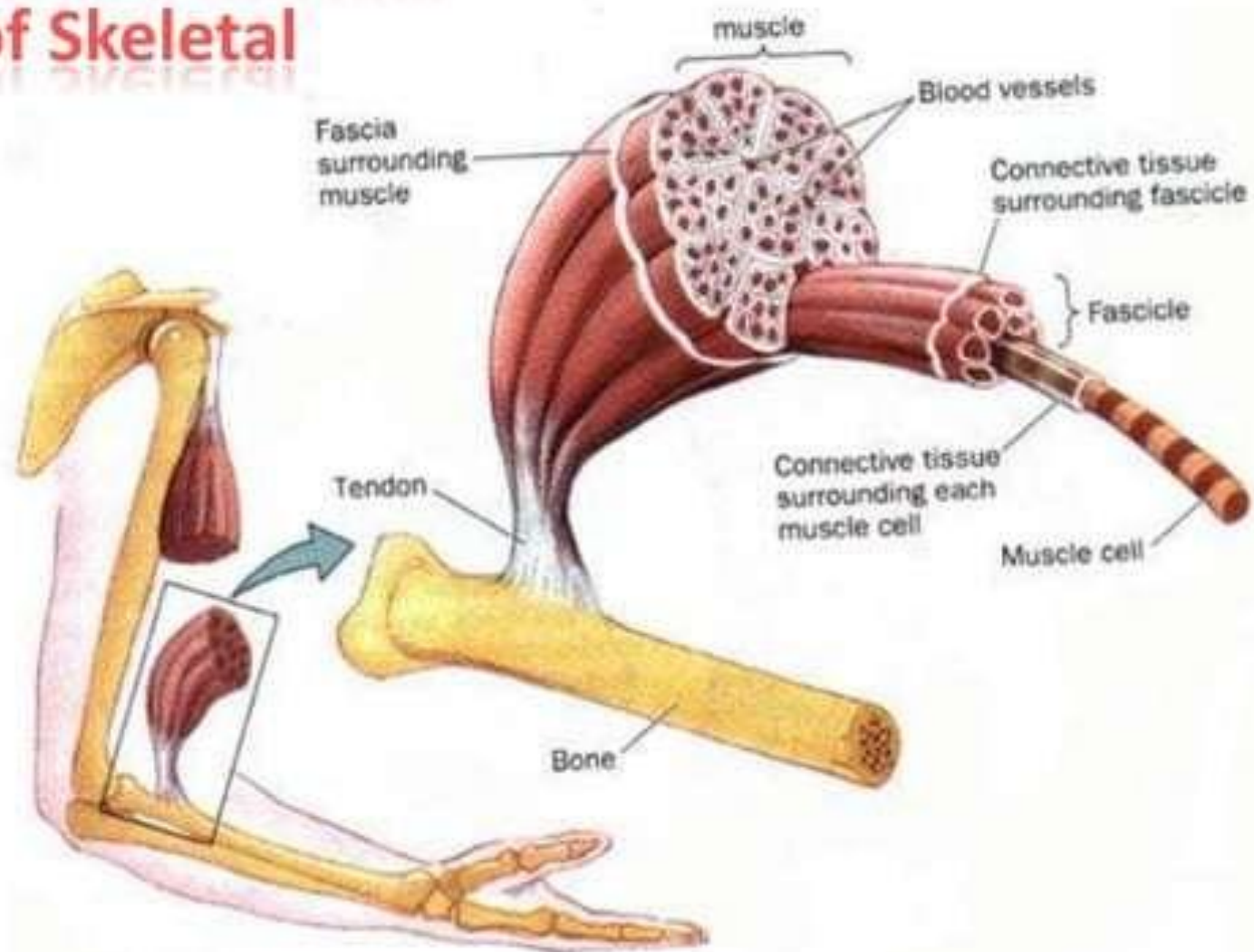
Structure of Skeletal Muscle

- Structural unit of skeletal muscle is the multinucleated muscle cell or fiber.
- Muscle fibers consist of myofibrils (sarcomeres in series: basic contractile unit of muscle).
- Myofibrils consist of myofilaments (actin and myosin).



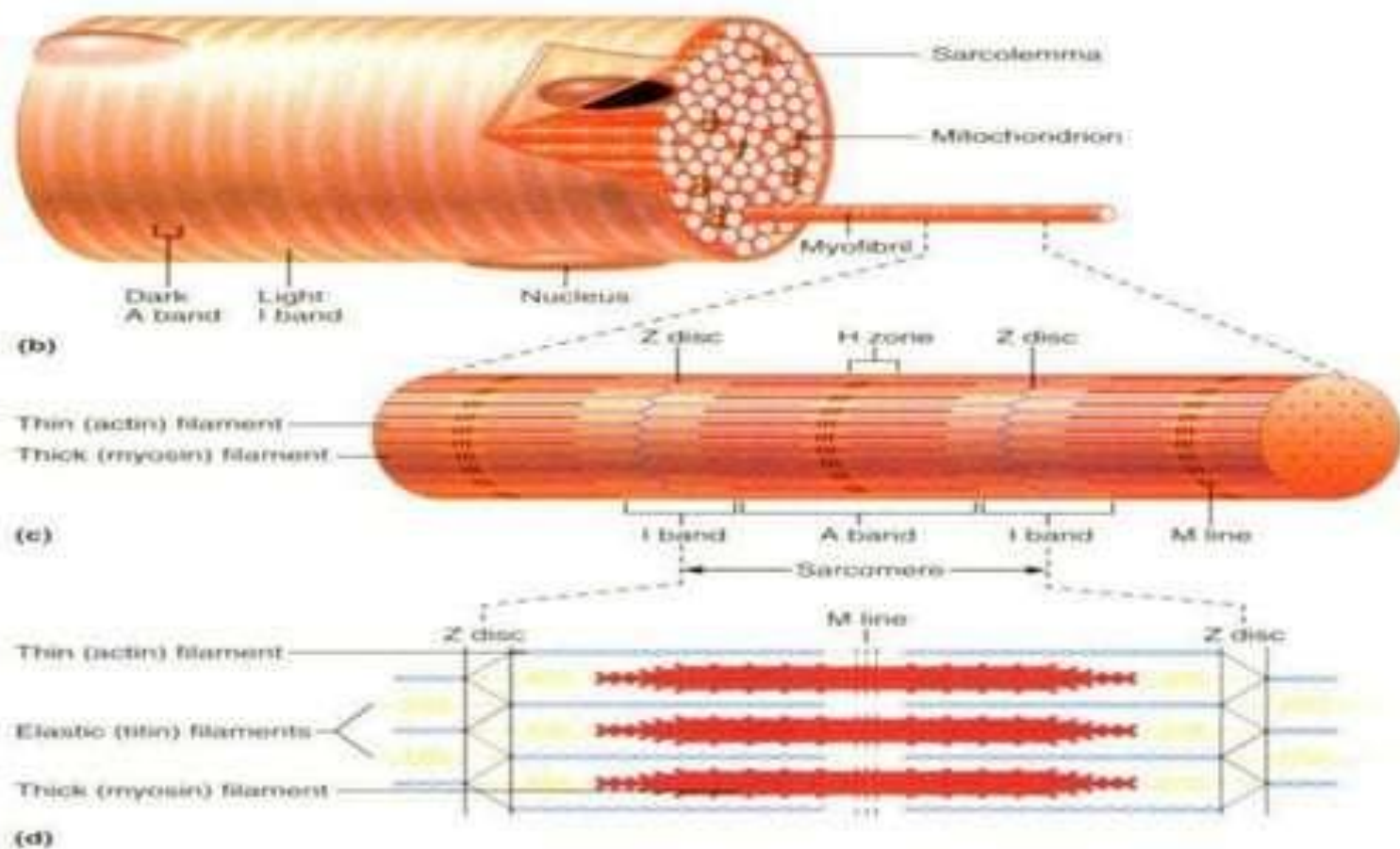
Skeletal Muscles

Microscopic-Macroscopic Structure of Skeletal Muscle



Skeletal Muscles

Microscopic-Macroscopic Structure of Skeletal Muscle

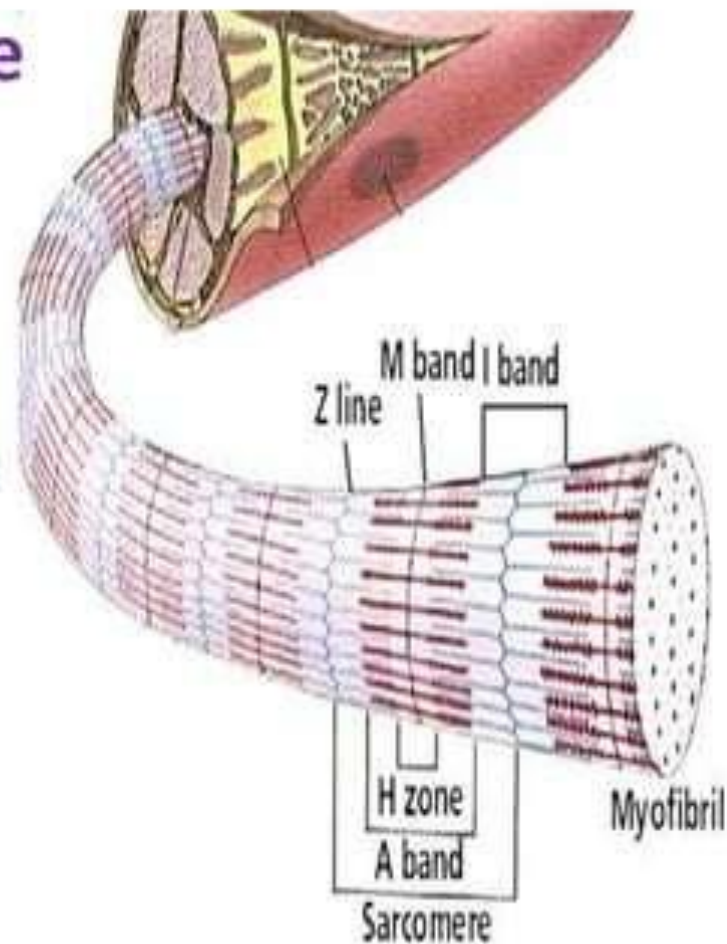


Skeletal Muscles

Structure of Skeletal Muscle

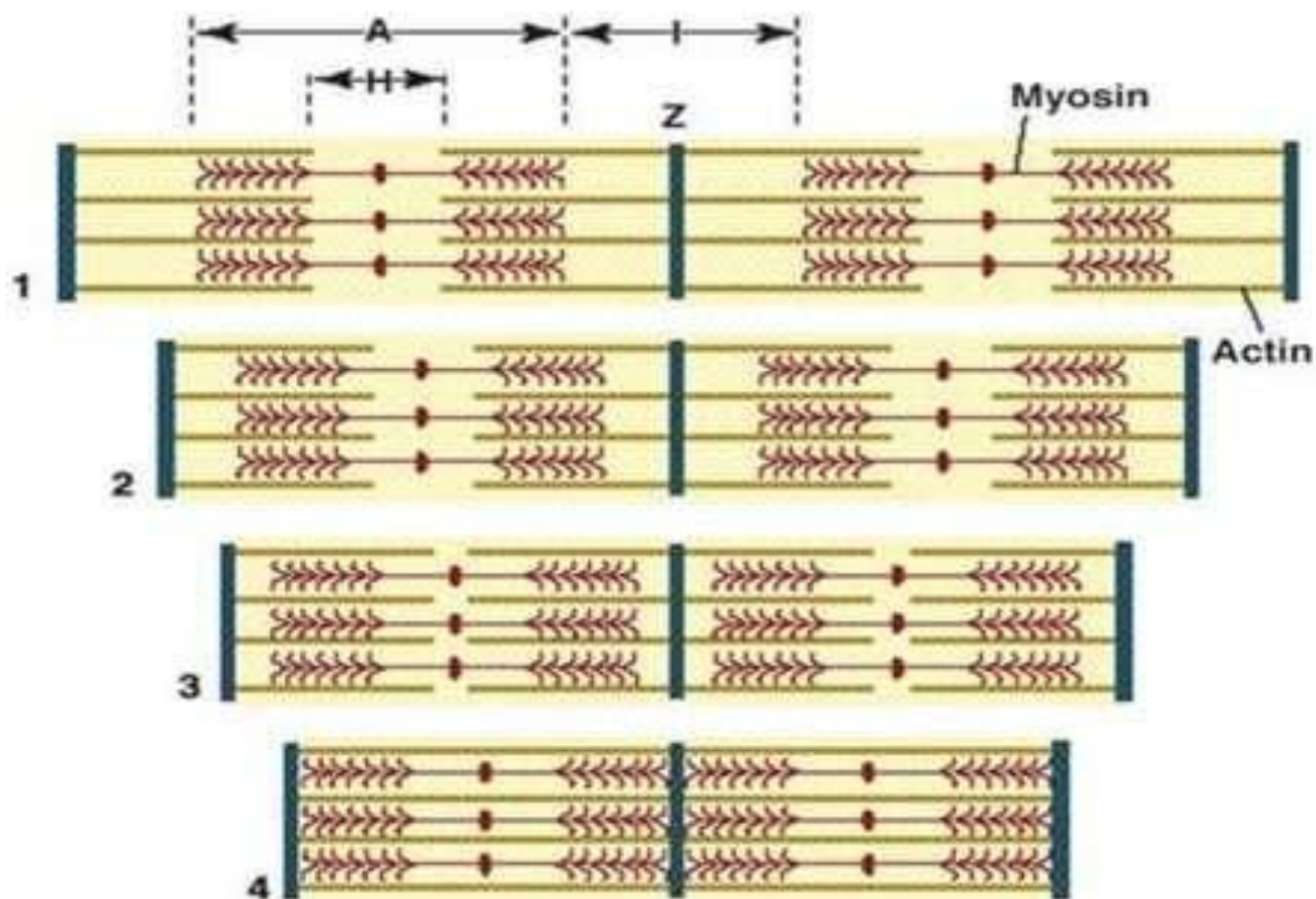
Composition of sarcomere

1. Z line to Z line.
2. Thin filaments (Actin)
3. Thick filaments (Myosin)
4. Myofilaments in parallel with sarcomere
5. Sarcomeres in series within myofibrils



Skeletal Muscles

The Sliding Filament Model of Muscle Contraction



Skeletal Muscles

Functions of skeletal muscles

1. They produce tension.
2. They are responsible for body movement.
3. They provide power either to mobilize bones or to stabilize them so, skeletal muscle can be considered as "*force generator system*".
4. They maintain posture.





Properties of Skeletal muscles

Skeletal Muscles

Properties of skeletal muscles

1- Irritability:

It is the ability of the muscle to respond to stimulus either mechanical, electrical, or thermal.

2- Contractility and relaxation:

It is the capacity of the muscle to develop tension between its ends "in contraction" and can release its tension "in relaxation".

3- Distensibility: It is the ability of the muscle to be lengthened or stretched when an outside force is applied to it up to certain limit (physiological limit).

- **N.B.** The muscle does not suffer from stretch so long as it is not stretched beyond its physiological limits.

4- Elasticity: It is the ability of the muscle to recoil to its original length when an outside force is released or removed.

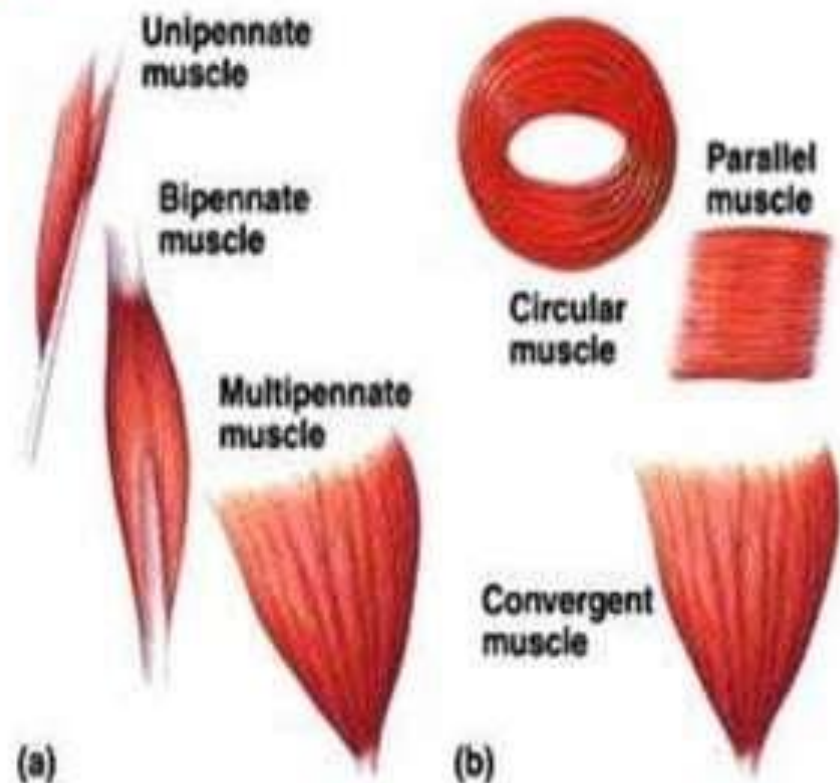
- ** The muscle is still elastic unless it has been overstretched and it will recoil from a distended length.



Classifications of **Skeletal muscles**

A. Classification of the Muscle according to arrangement of muscle fibers and shape:

- 1- Fusiform type.
- 2- Parallel type.
- 3- Pennate type.
- 4- Triangular type.
- 5- Sphincter.



Skeletal Muscles

Classifications of skeletal muscles

1- Fusiform type "spindle":

The muscle fibers are arranged in the form of a spindle as a belly and 2 tendons.

■ Subdivisions:

1- *One head muscle*

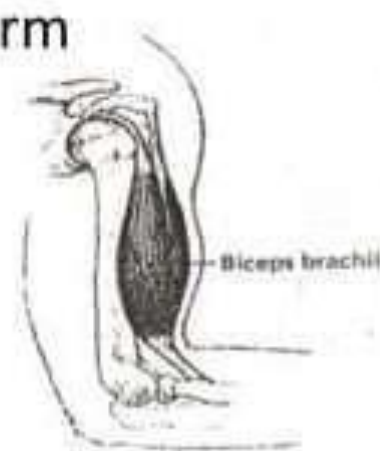
2- *Two-heads muscle*

3- *Three heads muscle*

4- *One belly muscle*

5- *Two-bellies:*

6- *Multiple bellies*



Two-headed



Two bellies



Multiple bellies

Skeletal Muscles

Classifications of skeletal muscles

1- Fusiform type "spindle":

The muscle fibers are arranged in the form of a spindle as a belly and 2 tendons.

■ Subdivisions:

1- *One head muscle*

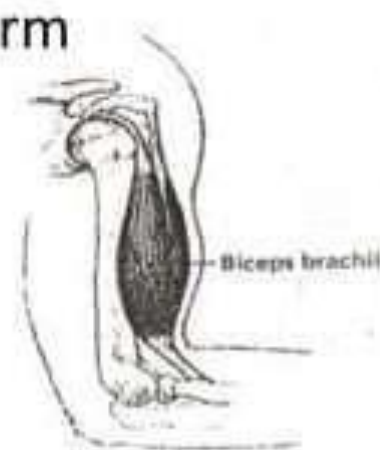
2- *Two-heads muscle*

3- *Three heads muscle*

4- *One belly muscle*

5- *Two-bellies:*

6- *Multiple bellies*



Two-headed



Two bellies



Multiple bellies

2- Parallel type:

The muscle fibers are parallel to each other in a longitudinal direction and they are extending along the whole length of the muscle.

- **Subdivisions:**

- a- Rectangle

- Fibers are parallel to each other and have equal length Abdomen.

- b- Rhomboid

- Fibers are parallel in sides while the adjacent sides are not equal in length.

- c- Quadrangle



Rectangular



Rhomboidal

3- Penniform or pennate type:

The muscle fibers are short parallel fibers lying obliquely to a Central axial tendon. In this type; the fibers are arranged in a feather like pattern.

- **Subdivisions:**

- 1- **Unipennate:**

The muscle fibers are attached to one side of the tendon like = **Half of a feather.**

- 2- **Bipennate:**

The muscle fibers are attached to both sides of the tendon like = **A complete feather.**

- 3- **Multipennate:**

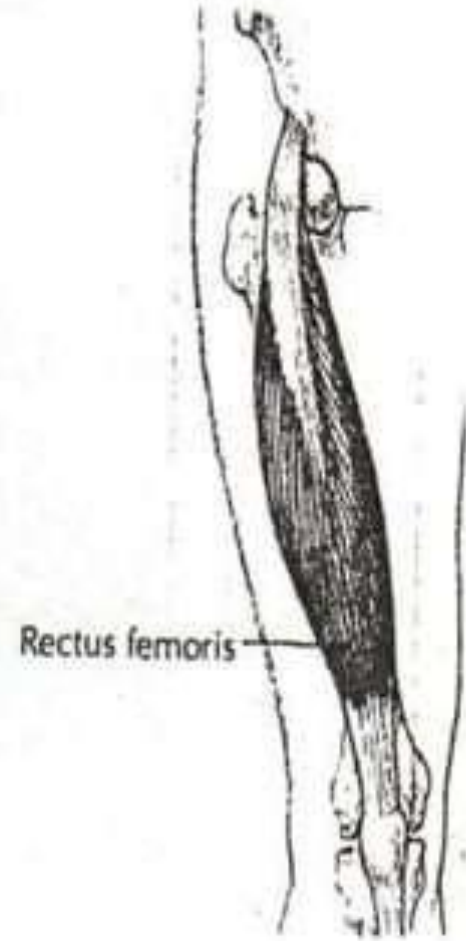
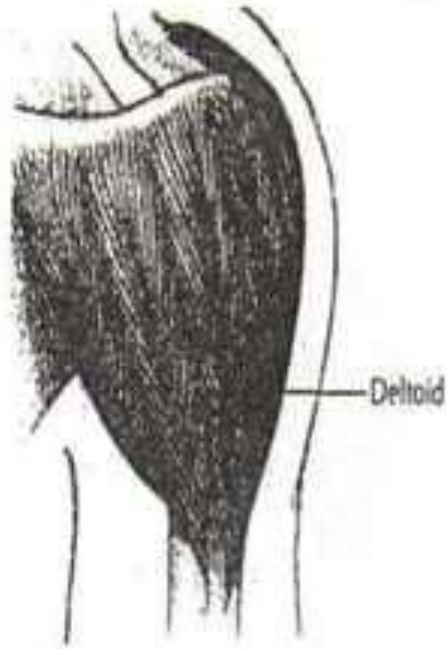
It consists of many bipennate structures set together on the muscle.

- 4- **Circumpennate:** The muscle fibers are attached to all sides of the tendon



Skeletal Muscles

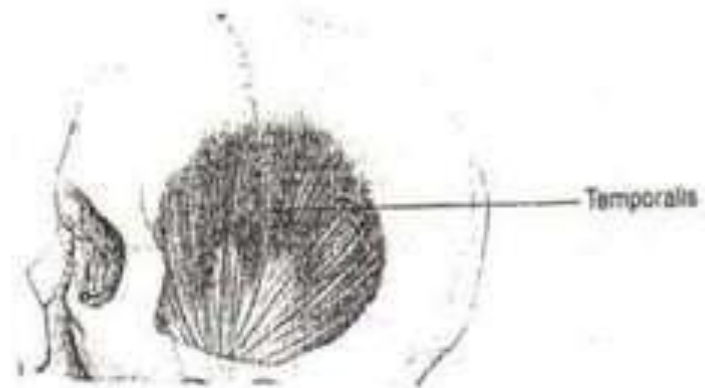
Classifications of skeletal muscles



4- Triangular type "Fan - shaped"

- **Subdivisions:**

1- Fan-shaped: one side triangle:



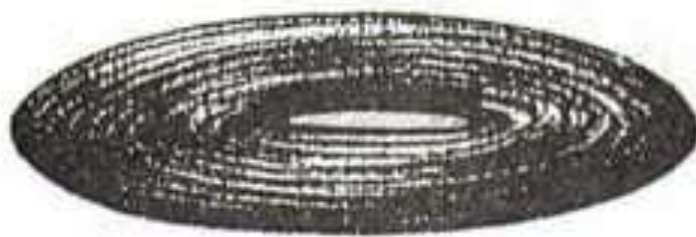
2- Trapezoid: (Triangle on two sides)



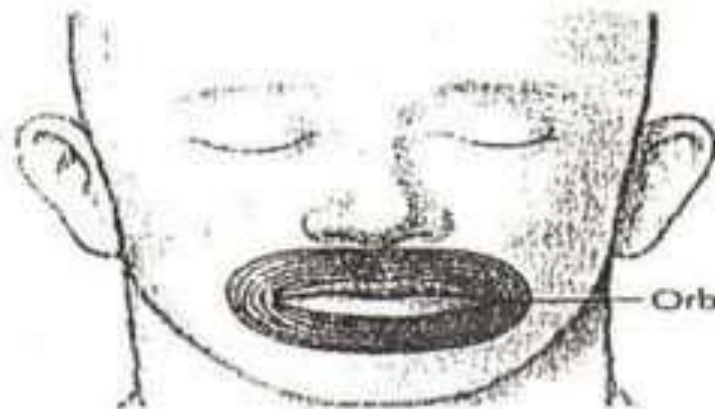
Triangular

5- Sphincter type

Muscle fibers are arranged in a circular manner.



Sphincter



Orbicularis oris

Skeletal Muscles

Classifications of skeletal muscles

Muscle shapes.



Fusiform



Rhomboidal



Rectangular



Triangular



Penniform (pennate)



Bipenniform (bipennate)



Multiple bellies



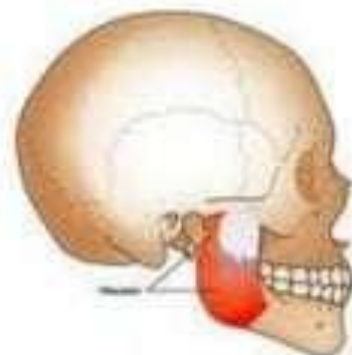
Two-headed



Two bellies

B. Classification of muscle according to the **number joints** over which the **muscle passes**:

- 1- **One joint muscle**
- 2- **Two joint muscle**
- 3- **Multi-joint muscle**



C. Classification of muscles according to the type of muscle action or function:

One action of the joint is not only the responsibility of one muscle but it is the responsibility of different groups of muscles.

1-AGONISTS:

They are muscles which contract to perform certain action and they include;

a- Prime movers:

They are muscles which make the major contribution in any contraction as the movement is produced by their contraction.

b- Secondary movers:

They are muscles which cross the same joint but make less contribution in the movement. They are also called "accessory or assisted movers".

2- ANTAGONISTS:

They are muscles which oppose the prime movers as they relax and lengthen progressively to allow agonist to move.

- **3- SYNERGISTS:** (Syn = together + ergon = work)
Synergists are muscles which work together in a close cooperation as they either contract or relax to modify the action of 1 agonist. They aim to:
 - Make the agonist stronger.
 - Eliminate the action of undesired movement.



D. Classification of muscles according to myoglobin

Content:

1- Red muscles (Slow twitch muscle fiber):

They are muscles which contain more red fibers and they are responsible for movement which requires slow action for a long time.

They contract slowly and relax slowly and don't suffer from fatigue easily.

Example; (as neck extensors) Muscles which maintain posture or antigravity muscles.

2- White muscles (Fast twitch muscle fiber):

They are muscles which contain less red fibers and they are responsible for movement which requires rapid action for a short time.

They contract rapidly and relax rapidly and suffer from fatigue easily.

Example; (as ocular muscles).



E. Classification of muscles according to **type muscle contraction**:

There are different types of muscle contraction according to the type of load applied to the muscle.

1- **Isometric** contraction:

(Iso = equal + metric = length.)

2- **Isotonic** contraction:

(Iso = equal + tonic = tone or tension)

a- Concentric contraction.

b- Eccentric contraction.



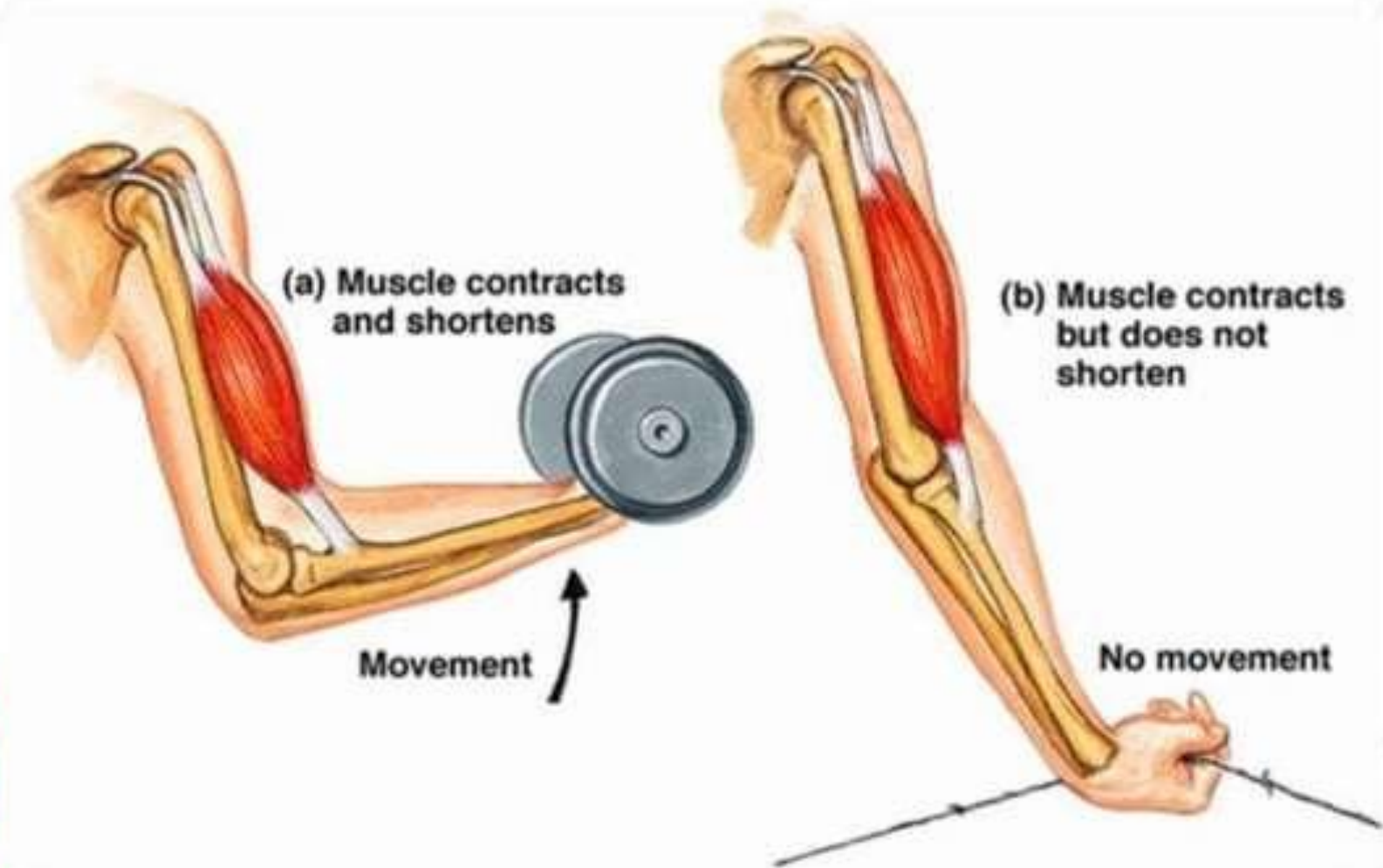
Skeletal Muscles

Classifications of skeletal muscles

- **Concentric contraction:** (Con = towards + centric = center)
It is a contraction in which the origin and insertion of the contracting muscle are brought closer together due to the action of the muscle.
- **Eccentric contraction:** (Ecc = away from + centric = center)
It is a contraction in which the origin and insertion of the contracting muscle are moved away from each other by an external force, even though the muscle is contracting.
- **Isokinetic contraction:** (Iso = equal + kinetics = motion).

Isokinetic movement is a **popular type of exercises** and not contraction with a constant force through the range of motion at a constant angular velocity so muscles maintain maximum tension throughout the range of motion.

Isotonic and Isometric Contractions



F. Classification according to Orientation of line of pull in relation to the joint :

➤ Flexors:

If the line of pull passes anterior to the joint axis; the muscle is called Flexor.

➤ Extensors:

If the line of pull passes posterior to the joint axis; the muscle is called Extensor.

➤ Abductors:

If the line or pull passes lateral to the joint axis, the muscle is called Abductor.


➤ Adductors:

If the line of pull passes medial to the joint axis; the muscle is called Adductor.





Summary of Muscles

- 
- There are **3** types of muscles, Cardiac, Skeletal and Smooth muscles.
 - Skeletal muscles are muscles attached to the skeleton and responsible for body movement.
 - Skeletal muscles have **6** different Classifications, and each classification has its own sub-classifications.

Thank you

