

## 7. MUSCULAR SYSTEM

!!JAY AMBE!!

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*PREPARED BY*

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### MUSCULAR SYSTEM

#### INTRODUCTION:

- The body contains **3 types of muscle tissue**.
- The differences in these types of muscle are due to their microscopic structure, their location in the body and their function and how their functions are controlled: either voluntary or involuntary (autonomic).

#### A) Skeletal muscles:

- Attach to the skeleton and are responsible for voluntary body movements.
- The fibers are multi-nucleated and transversely striated and are grouped in parallel bundles called **fasciculi**.
- The skeletal muscles are the only voluntary muscles in the body.

#### B) Smooth muscles:

- Occur mainly in blood vessels and tubular organs of the GI tract, reproductive, urinary and respiratory systems.
- The muscle fibers are unstriated and contain a single nucleus.
- These muscles are under autonomic control- they are involuntary.

#### C) Cardiac muscle:

- It is found only in the wall of the heart and has the unique property of autorhythmicity.
- Its contractions are involuntary and have an intrinsic rhythm.
- No external stimuli are needed to make it contract.
- It has intercalated discs that help hold adjacent cells together and transmit the force of contraction from cell to cell.
- It is also striated.

### SKELETAL MUSCLE SYSTEM

- When referring to the muscular system, we are referring to skeletal muscle only.
- The body has more than 600 skeletal muscles.
- Technically speaking, each one of these muscles is an organ. It is composed of muscle tissue, nerve and connective tissue.

#### ➤ FUNCTIONS OF THE MUSCULAR SYSTEM:

#### A) Movement:

- The primary function of skeletal muscle in the body is movement.
- Even the smallest areas such as the eyeball and the ear have associated muscles responsible for their movements.
- The contraction of skeletal muscle is also important in functions such as breathing and movement of bodily fluids.
- The stimulation of individual muscle fibers maintains a state of muscle contraction known as tonus. This is important in maintaining the movement of blood and lymph throughout the body.

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- When muscle is cut off from nerve supply, a condition that occurs when spinal nerves are severed, and the muscles lose tonus and become flaccid and eventually atrophy (shrink).
- The involuntary contraction of smooth muscle is also essential for movement of fluids and material through the body. Likewise the involuntary pumping of the cardiac muscle keeps blood flowing through the body.

### B) Body heat production:

- The body maintains a fairly constant temperature. Physiologically this is one of the principles of homeostasis - the body's ability to regulate its functions. Muscle metabolism produces heat as an end product.
- Because muscles constitute about 40-45% of the body's weight and are in a constant state of fiber activity, they are the primary source of body heat.
- The rate of heat production rises with increased muscle activity. This also explains why emaciated (thin) and elderly people, who have reduced muscle mass have difficulty staying warm.

### C) Posture and Support of body:

- The skeletal system provides a framework for body support but the muscles do all the heavy lifting.
- Skeletal muscles maintain posture (position), stabilize the joints and support the viscera (internal organ). Postural muscles of the head, neck and trunk are working even when you think you are relaxed. The head, in particular is constantly being held at the atlanto-occipital joint up by the muscles of the neck. When you start to get drowsy, these muscles will relax and your head nods forward.

## ➤ PROPERTIES OF MUSCLE

### A) Irritability (Electrical Excitability):

- Muscle responds to electrical stimulation from nerve impulses.

### B) Contractility:

- Muscle responds to stimuli by contracting lengthwise, or shortening.

### C) Extensibility:

- Once stimulus has subsided and the muscle fiber is relaxed it is capable of being stretched beyond its resting length by the contraction of an opposing muscle.
- Muscle can be stretched up to 30% of its resting length. The fibers are then prepared for another contraction.

### D) Elasticity:

- Muscle fibers, after being stretched, have a tendency to recoil to their original resting length.

## ➤ STRUCTURE OF SKELETAL MUSCLE:

### A) Muscle attachments:

#### Tendons:

- These are dense connective tissue that attaches the muscle to bone.

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- When a muscle contracts, it shortens and puts tension on the tendon and the bone.
- The muscle tension causes movement of the bone at a synovial joint.

### Origin:

- The less moveable attachment of the muscle is called the **origin**.
- At the girdles and appendages the most proximal muscle attachment is the **origin**.

### Insertion:

- Movement of the bone at the synovial joint causes one of the attached bones to move more than the other.
- The more moveable bony attachment of the muscle is called the insertion.
- In muscles associated with girdles and appendages the more distal attachment is the insertion.

### Belly:

- The fleshy thick part of the muscle. It is also called the **gaster**.

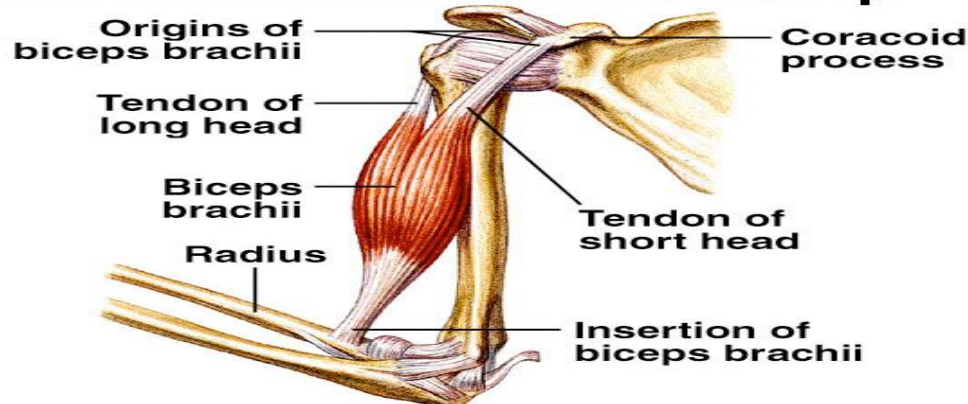
### Aponeuroses:

- It is a flattened sheet like tendon

### Retinaculum:

- It is a strong band of connective tissue that covers entire groups of tendons and keeps the tendons from bowing during muscle contraction.
- They are attached to articulating bones and are found at the wrist and the ankle.

## Skeletomuscular Relationship



### B) Associated Connective Tissue:

#### Endomysium:

- The outer covering of individual muscle fibers.
- It binds individual fibers together and supports capillaries and nerve endings serving the muscle.

#### Perimysium:

- Another sheath covering that binds groups of muscle fibers together into bundles called **fasciculi**.
- The perimysium supports the nerves and blood vessels that serve the surrounding fasciculi.

#### Epimysium:

- The entire muscle is covered by a sheath called the **Epimysium**, which in turn is part of a tendon

#### Fascia:

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- It is a fibrous connective tissue that covers the muscle and attaches to the skin.

### a) Superficial fascia:

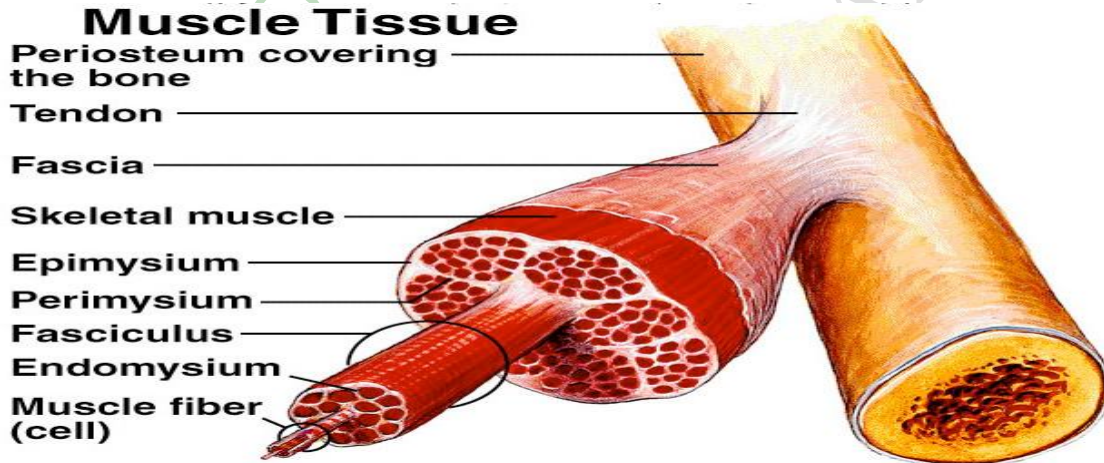
- It secures skin to the underlying structures.
- In areas such as the abdomen, buttocks the fascia is thick and is laced with adipose tissue.
- In areas such as the back of the hand, around the face and the elbows, ankles and wrists, the superficial fascia is very thin.

### b) Deep fascia:

- It is an extension of the superficial fascia to deeper surfaces. It lacks adipose tissue and blends with the epimysium.
- It is composed of dense connective tissue. Deep fascia surrounds adjacent muscle, compartmentalizing and binding them into functional groups.

### c) Subserous fascia:

- It extends between deep fascia and serous membranes. It is composed of loose connective tissue.



## ➤ MUSCLE GROUPS BASED ON THEIR ACTIONS:

### A) Synergistic:

- Muscle groups that contract together to accomplish a particular movement.
- Most large movements of the body require several synergistic muscles to accomplish the task.

#### a) Prime movers:

- Muscles that are primarily responsible for a movement are called **prime movers**.

#### b) Fixators:

- Muscles that aid and allow prime movers to act efficiently by stabilizing the joint to prevent unwanted movements.
- Synergists that stabilize a joint are known as **fixators**.

### B) Antagonistic:

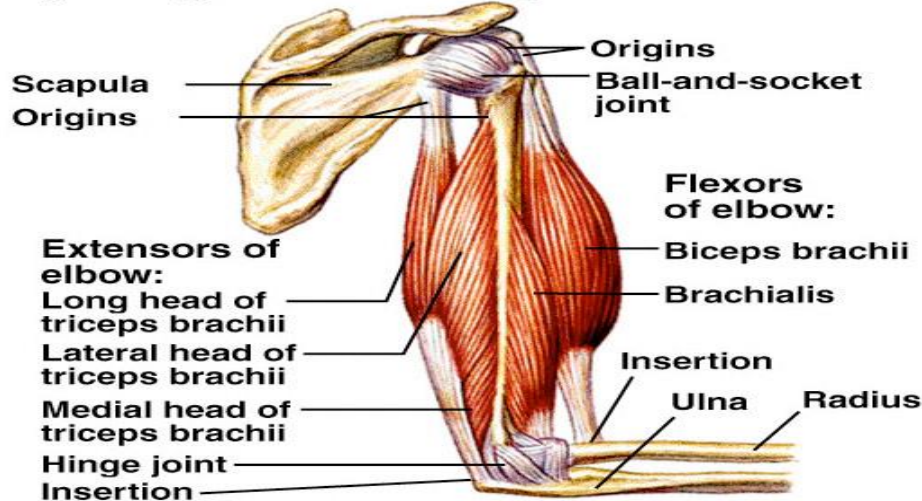
- Muscles that have opposing actions and are located on opposite sides of a joint.
- An example would be the biceps brachii together with the brachialis which flex the elbow.



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- The antagonist is the triceps muscle which extends the elbow when contracted. Antagonists are needed because the fibers in a contracted muscle are shortened and need to be elongated (stretched) before they can cause movement via contraction again.

### Synergistic/Antagonistic Muscles



#### ➤ MUSCLE TYPES BY FIBER ARRANGEMENT

##### Parallel (Longitudinal):

- It is strap-like long excursion, contracts over a long distance.
- Good endurance (stamina), not especially strong.
- Examples: Sartorius, rectus abdominus

##### Convergent (Radiate):

- Fan shaped, force of contraction focused on a single point of attachment.
- It is Stronger than parallel.
- Examples: Pectoralis muscles.

##### Sphincter (Circular):

- Fibers concentrically arranged around an orifice.
- Act as a sphincter (constrictor) when contracted.
- Examples: Orbicularis oris, orbicularis oculi

##### Pennate (feather):

- In this type one or more tendons run through the body of the muscle.
- Because the muscle fibers pull at an angle the tendons don't move as far as parallel types do.
- Pennate muscles contain more fibers than parallel types and are capable of generating more tension (are stronger).

##### Unipennate:

- It has one extended tendon. All the muscle fibers are found on the same side of the tendon.
- Example: gluteus maximus

##### Bipennate:

- It has 2 tendons.

##### Multipennate:

- It has more than 2 tendons that branch within the muscle.

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- Example: Deltoid

### ➤ BLOOD AND NERVE SUPPLY TO THE MUSCLE

- Muscles have a high rate of metabolic activity and require an extensive blood supply to receive nutrients and eliminate wastes.
- Skeletal muscle cannot contract without stimulation by a nerve impulse.
- The muscle requires extensive innervation to ensure the connection of each muscle fiber with a nerve cell.

There are 2 neural pathways for each muscle fiber:

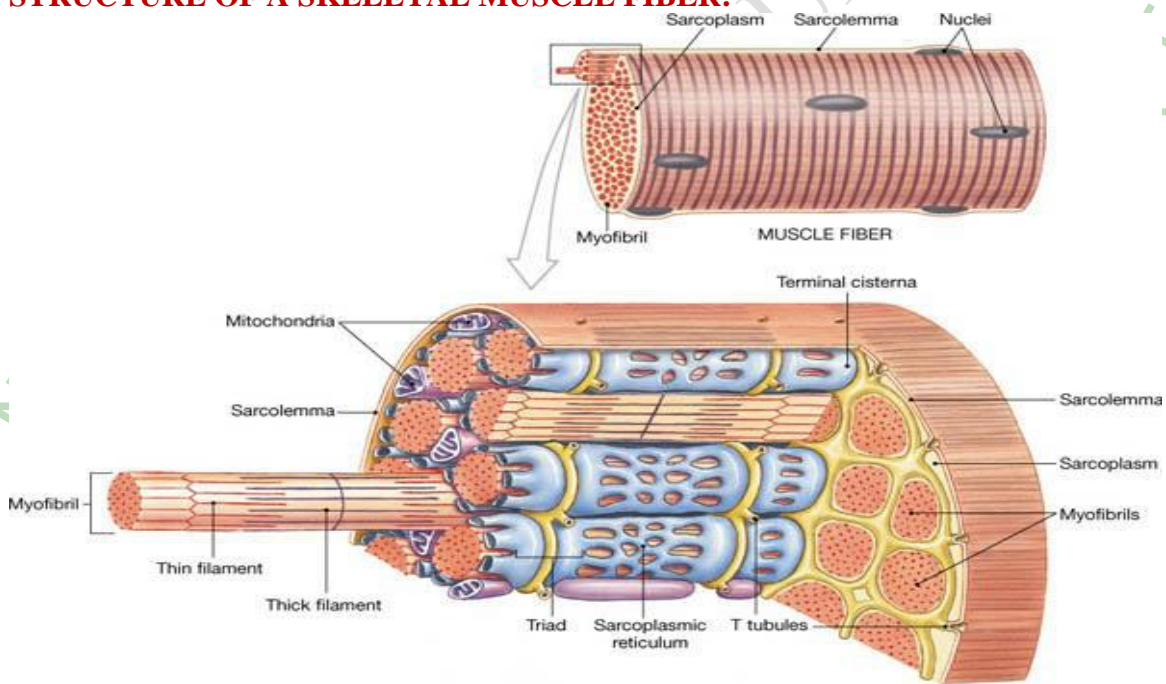
#### a) Motor (efferent) neurons:

- It is a nerve cell that conducts impulses **to the muscle fiber, stimulating it to contract.**

#### b) Sensory (afferent) neurons:

- Nerve cells that conduct **impulses away from the muscle to the CNS**, which responds to the activity of the muscle fiber.
- Muscle fibers will atrophy (weaken) if not periodically stimulated to contract.

### ➤ STRUCTURE OF A SKELETAL MUSCLE FIBER:



a) **Sarcolemma:** Cell membrane of the muscle fiber

b) **Sarcoplasmic reticulum:** It is a network of membranous channels that extends through the cytoplasm of the cell

c) **Sarcoplasm:** The cytoplasm of the fiber

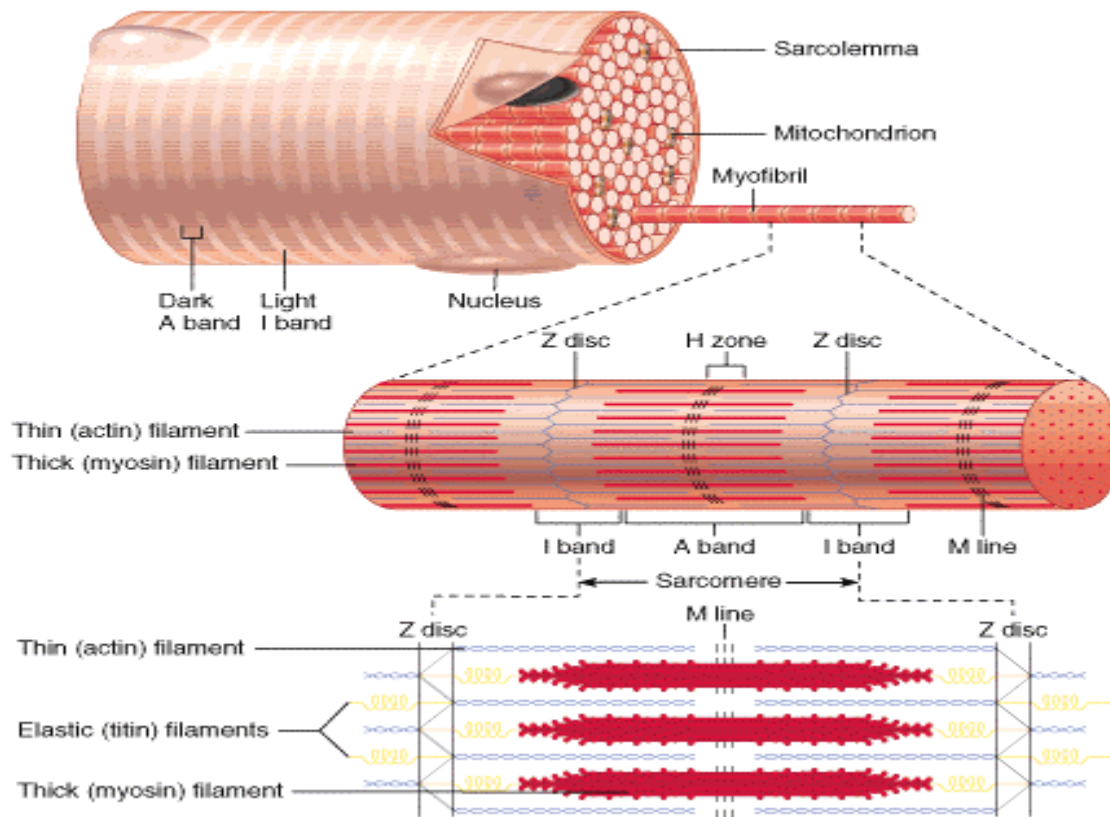
d) **T tubules** (transverse tubules): It is a system of tubules that run perpendicular to the sarcoplasmic reticulum.

e) **Myofibrils:**

- It is a contractile element of the skeletal muscles.
- They are 1-2  $\mu\text{m}$  in diameter and contain three smaller structures which are known as myofilament:

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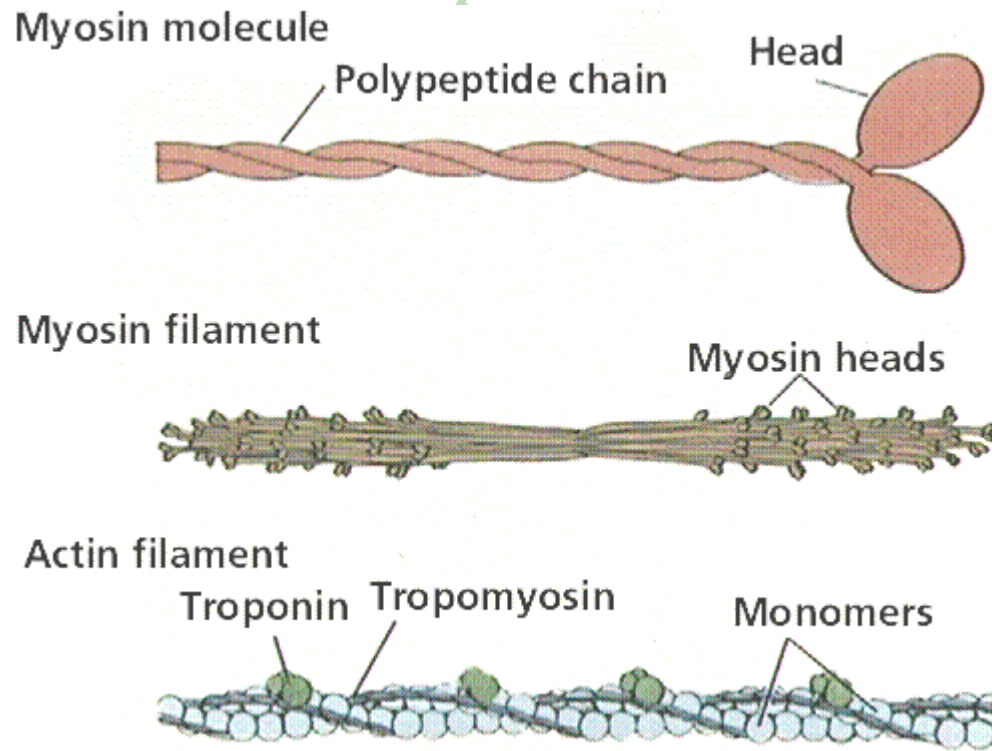
- i) Thin filament
- ii) Thick filament
- iii) Elastic filament



- During the muscles contraction and relaxation, the thin and thick filaments overlap on one another.
- Inside the myofibril, the filament is not extent the entire length of muscles fiber but it produce compartment known as sarcomeres which are the basic functional units of straight muscles fiber.
- Between two filaments narrow plate shaped regions of dense material is known as Z-disc which separate one sarcomere to next.
- Within the sarcomere is a dark area called A-band, it consist the thick filament overlap by thin filaments.
- Lighter and less dense area are called the I-band, it consist only thin filament.
- In the centre of each A-band consist only thick filament so it is known as H-band.
- Each H-band is centrally divided by M-line.
- The Z-disc passes from the centre of each I-band.
- The thick filament is made up by myosin protein and thin filament is made up by actin protein, tropomyosin and troponin.
- Myosin proteins look like as two golf clubs twisted together or head and tail like portion.
- Actin has myosin binding side where myosin head are attached during the contraction and relaxation process.



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Structure of & myosin (thick filament) & actin (thin filament)

### ➤ **PHYSIOLOGY OF MUSCLES CONTRACTION AND RELAXATION:**

#### **a) Contraction of Muscles:**

- It is well described by sliding filament model.

During the muscles contraction, myosin head attaches with the thin filaments (actin)

It slide the muscles inward toward the H-zone at the centre of Sarcomere

As the thin filament slide inward Z discs come toward each other

And the sarcomeres shorten

But the length of thin and thick filament do not change

The sliding of the filaments and shortening of the sarcomeres cause shortening of the whole muscles fiber

#### **i) Role of the calcium in contraction:**

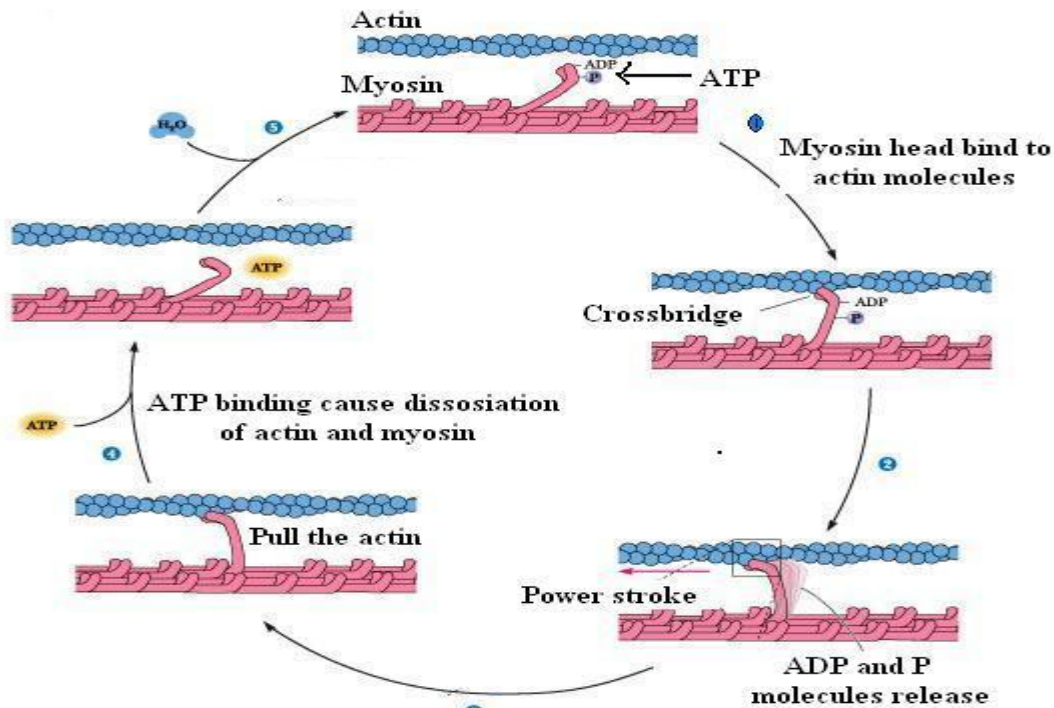
- An increase concentration of  $\text{Ca}^{+2}$  increase the contraction.
- While decreasing concentration of  $\text{Ca}^{+2}$  decrease the sliding means contraction.

#### **ii) Role of ATP in contraction:**

- In the relaxed condition ATP is attached with the head of Myosin.
- Due to hydrolysis ATP release one phosphate molecules and convert in to ADP and gives energy to myosin.

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- At the same time sarcoplasmic reticulum release the  $\text{Ca}^{+2}$  which release the tropomyosin from actin side for the binding of myosin means it open the actin block for myosin
- So myosin head by the help of energy bind with the actin.
- The head of the myosin produce power stroke means pull the actin or thin filament and contract the muscles.
- Once the power stroke is complete again ATP bind to myosin head for another attachment.



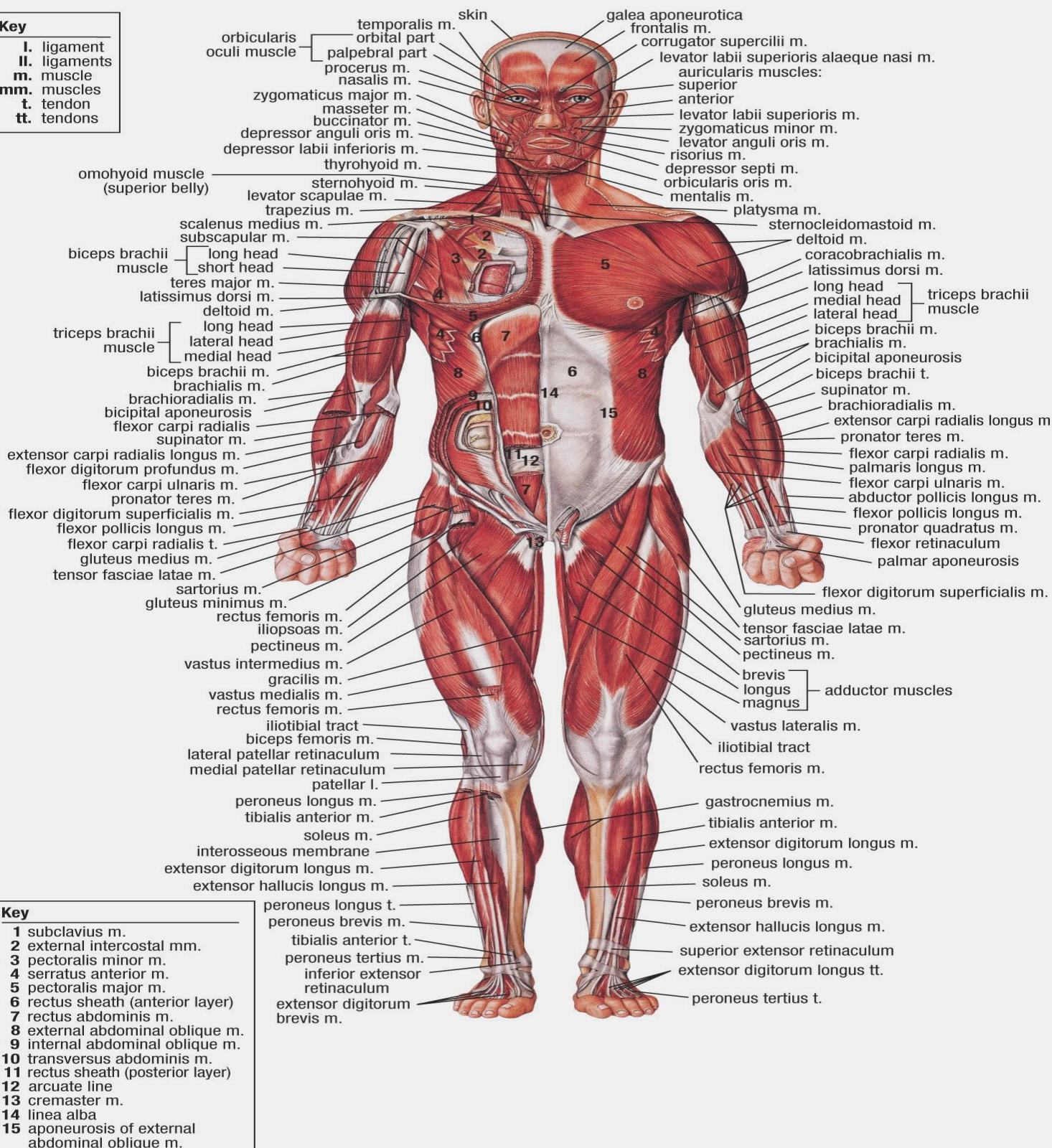
### b) Relaxation of muscles:

- $\text{Ca}^{+2}$  is the main mediator for muscles contraction
- So in the relaxation the concentration of  $\text{Ca}^{+2}$  is 10,000 low in sarcoplasm.
- This concentration is decrease by two ways
  - a) Ach (acetyl choline) is the main mediator who releases the  $\text{Ca}^{+2}$ , so in the relaxation acetyl choline esterase enzyme degrades or breaks down the Acetyl choline and lower the concentration of  $\text{Ca}^{+2}$ .
  - b) Sarcoplasmic membrane consist the  $\text{Ca}^{+2}$  pump which flows the out side  $\text{Ca}^{+2}$  in to inside the sarcoplasm, so during the relaxation calsequestrin bind to  $\text{Ca}^{+2}$  pump and remove the  $\text{Ca}^{+2}$  from the sarcoplasm.

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### MUSCULAR SYSTEM (ANTERIOR VIEW)

Key
I. ligament
II. ligaments
m. muscle
mm. muscles
t. tendon
tt. tendons



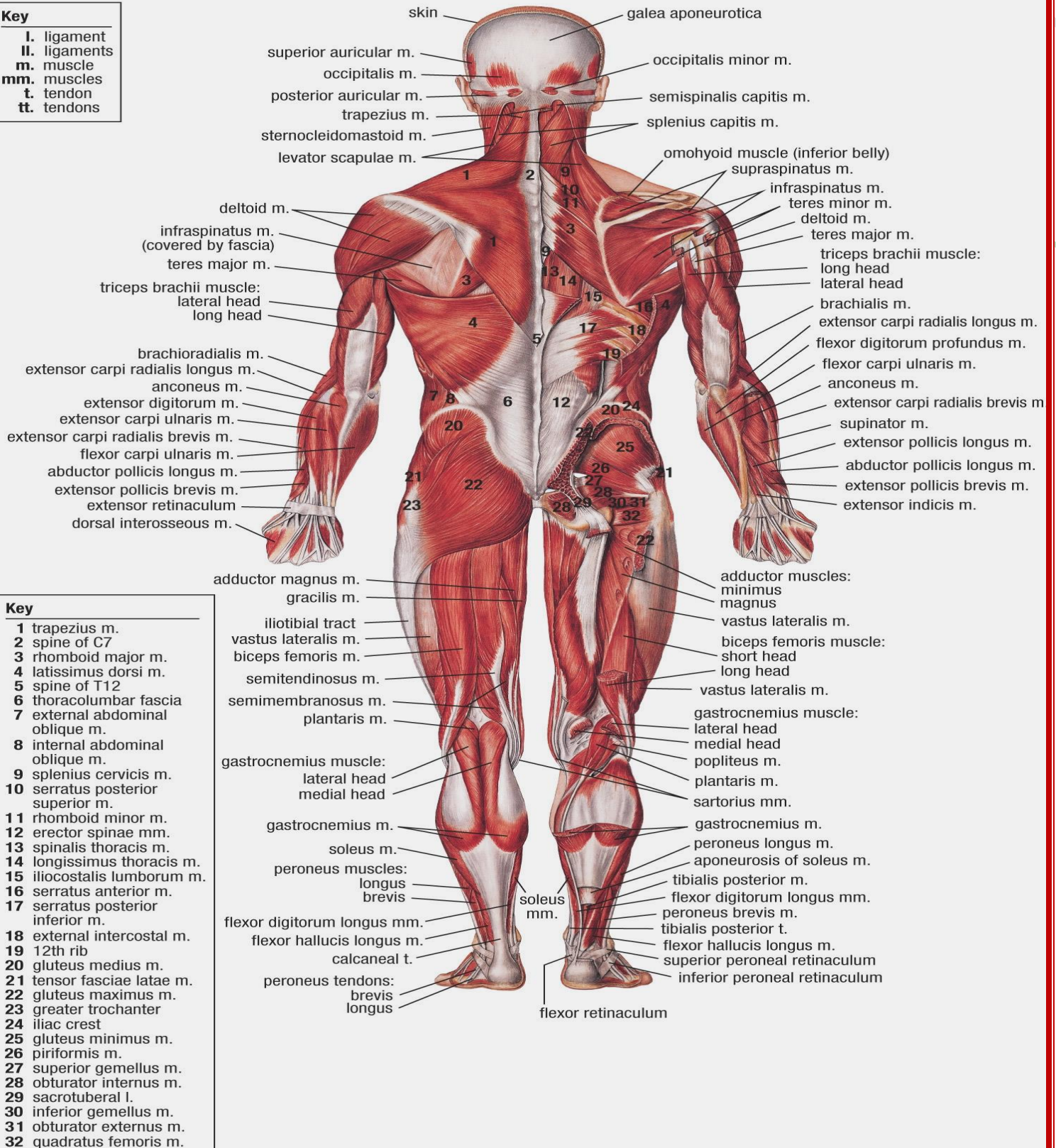


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### MUSCULAR SYSTEM (POSTERIOR VIEW)

#### Key

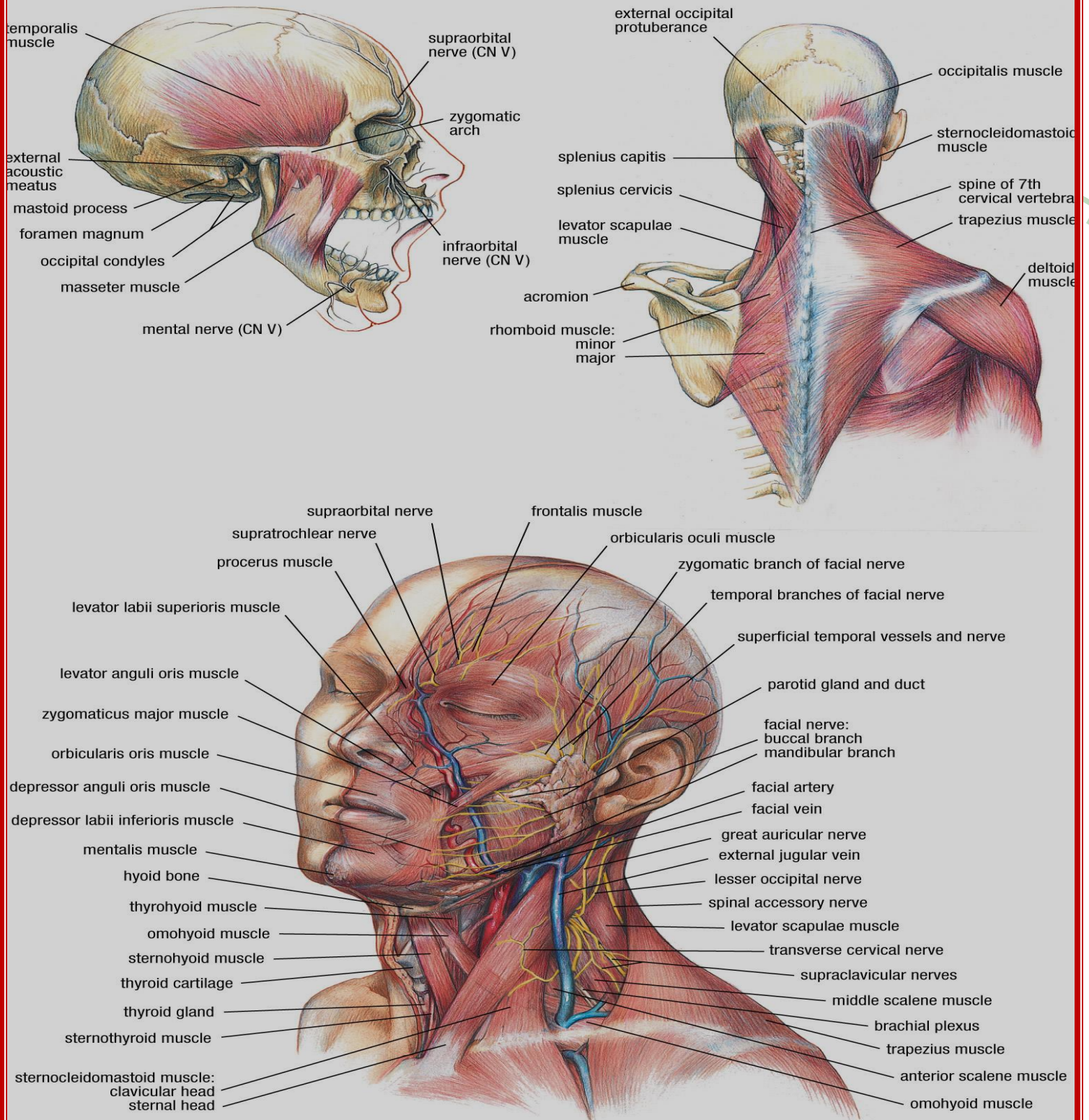
- I. ligament
- II. ligaments
- m. muscle
- mm. muscles
- t. tendon
- tt. tendons





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### MUSCULAR ANATOMY OF HEAD AND NECK

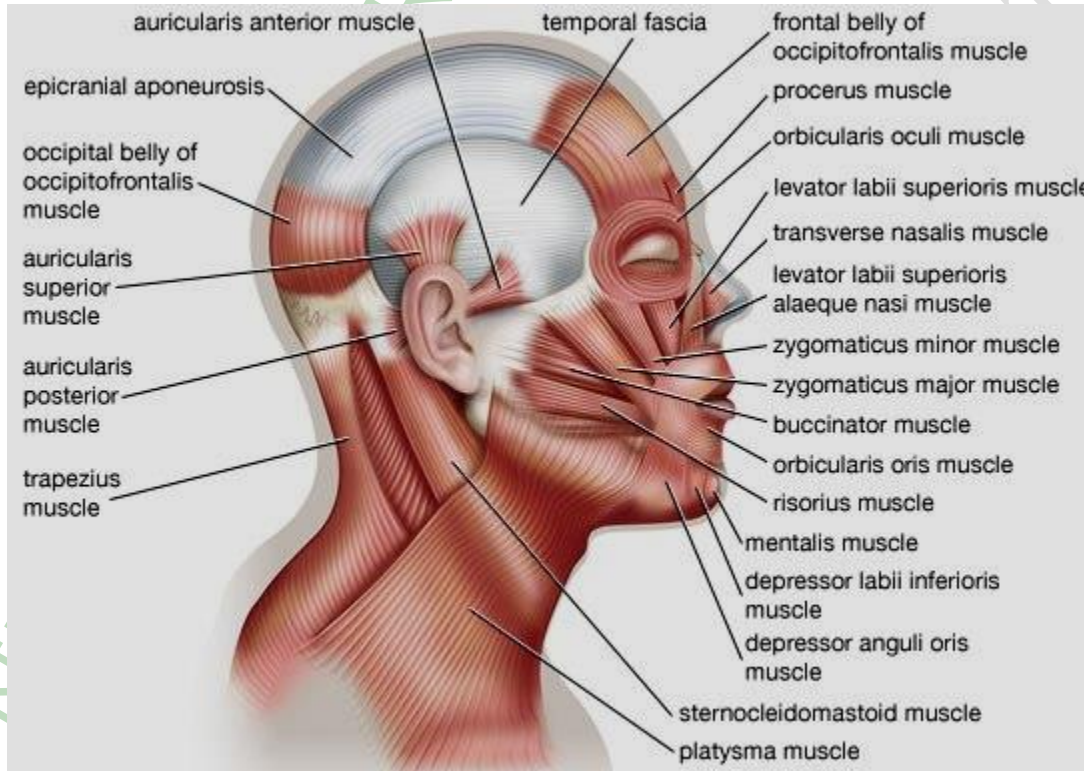




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### ➤ MUSCLES OF FACIAL EXPRESSION:

- The muscles in this group provide humans with the ability to express a wide variety of emotions, including surprise, fear and happiness.
- The muscles themselves lie within the layers of superficial fascia (face or out look).
- They usually originated in the fascia or bones of the skull and insert in to the skin.
- Because of their insertion, the muscles of facial expression move the skin rather than a joint when they contract.



#### a) Occipitofrontalis muscle:

- The **occipitofrontalis** or **epicranius** is a muscle which covers parts of the skull.
- It consists of two parts or bellies:
  - The occipital belly, near the occipital bone, and
  - The frontal belly, near the frontal bone.
- Occipital and frontal connected by a flat tendon which is a cord like shining endpart of the muscles.
- The frontalis muscles are situated under the skin in the region of the forehead.
- The occipital muscles are situated under the skin in the region of the occipital bone.
- It helps in raising the eyebrow and forms transverse wrinkles on the forehead on contraction.

#### b) Orbicularis oris:

- It is situated at a corner of mouth.

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- Its close lips, compresses lips against teeth and gives shapes during speech to the lips.

### c) Orbicularis oculi:

- It is present around the palpebral fissure.
- Its contraction closes the eye lids.
- The orbicularis oculi and orbicularis oris are some of the few muscles which are not attached to the bone.

### d) Zygomaticus:

- Insert in skin at angle of mouth and orbicularis oris.
- It pulls the corner of mouth upward and outward as in smiling and laughing.

### e) Levator labii superioris:

- Insert in skin at angle of mouth and orbicularis oris.
- It helps for the elevation of upper lips.

### f) Depressor labii inferioris:

- It is present in skin of lower lips.
- It depresses (lowers) lower lips.

### g) Buccinator:

- It is situated in the cheek.
- It contracts the cheeks.
- Adipose tissue covers the buccinators of the cheeks.

### h) Mentalis:

- It present in the skin of chin.
- It elevates and protrudes lower lips and pulls the skin of chin up as in pouting.

### i) Platysma:

- These are present around angle of mouth and skin of lower face.
- Draws outer parts of lip inferiorly and posteriorly as in pouting.

### j) Risorius:

- Present in skin at an angle of mouth.
- Draws angle of mouth laterally as in tenseness.

### k) Corrugator supercilli:

- It is present in skin of eyebrow.
- It draws eyebrow inferiorly as in frowning.

### l) Levator palpebrae superioris:

- It is present in skin of upper eye lids.
- It elevates upper eyelids (open eye).

## ➤ MUSCLES THAT MOVE THE MANDIBLE (LOWER JAW):

- Muscles that move the mandible are also known as muscles of mastication because they are involve in biting and chewing.
- These muscles are attached to the skull and bone.
- There are four mastication muscles:

### a) Masseter:

- It is situated between the process and external surface of the corner of the lower jaw.
- It gives side to side movements of mandibles.

### b) Temporalis:

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- It is present in temporal part.
  - It raises (move up) the lower jaw.
  - c) **Medial pterygoid:**
    - Elevate and moves mandible side to side
  - d) **Lateral pterygoid:**
    - It protract (prolong or extend) and moves side to side mandible and open mouth.
- **MUSCLES THAT MOVES THE EYEBALLS-EXTRINSIC MUSCLES**
- There are two types of the muscles present in to the eyeballs:
    - i) **Extrinsic muscles:** It originates outside the eyeballs and insert on their outer surface.
    - ii) **Intrinsic muscles:** It originates and insert within the eye ball.
  - Movements of the eyeballs are controlled by three pairs of extrinsic muscles.
  - Two pairs of rectus muscles according to movement or rotation it is known as:
    - Superior
    - Inferior
    - Lateral
    - Medial
  - One pair of oblique muscles according to movement or rotation it is known as:
    - Superior
    - Inferior
- a) **Superior rectus:**
- It is present in superior and central part of eyeball.
  - It rolls the eyeball superiorly.
- b) **Inferior rectus:**
- It is present in inferior and central part of eyeball.
  - Rolls eyeball inferiorly
- c) **Lateral Rectus:**
- It is present in lateral side of eyeball.
  - Rolls eyeball laterally.
- d) **Medial Rectus:**
- It is present in medial side of eyeball.
  - It rolls eyeball medially.
- e) **Superior oblique:**
- It is present in eyeball between superior and lateral recti.
  - It rotates eyeball on its axis.
  - It direct cornea inferiorly and laterally.
- f) **Inferior oblique:**
- It is located between inferior and lateral recti.
  - It rotates eyeball on its axis.
  - It direct cornea superiorly and laterally.
- **MUSCLES THAT MOVES THE TONGUE-EXTRINSIC MUSCLES:**
- The tongue is divided in to lateral halves by a median fibrous septum.

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- The septum extends through out the length of tongue and is attached inferiorly to the hyoid bone.
- It is also divided in to two types:
  - i) **Extrinsic muscles:**
    - It originates outside the tongue and insert in to it.
    - They move the entire tongue in anteriorly, posteriorly and laterally.
  - ii) **Intrinsic muscles:**
    - It originates and insert within the tongue.
    - These muscles alter the shape of tongue rather than moving the entire tongue.

**a) Genioglossus:**

- It is present undersurface of tongue and hyoid bone.
- It depresses (lower) tongue and thrusts (push) it anteriorly.

**b) Styloglossus:**

- It is present side and undersurface of tongue.
- Elevates tongue and draws it posteriorly.

**c) Palatoglossus:**

- It is present in side of tongue.
- It elevates tongue posteriorly and draws soft palate inferiorly on tongue.

**d) Hyoglossus:**

- It is present in side of tongue.
- It depresses tongue and draws its sides inferiorly.

➤ **MUSCLES OF THE FLOOR OF THE ORAL CAVITY:**

- These muscles are referred to as suprahyoid muscles because they lie superior to the hyoid bone.

- It consists:

**a) Digastric:**

- Elevate hyoid bone and depresses mandible as in opening the mouth.

**b) Stylohyoid:**

- Elevates hyoid bones and draws it posteriorly.

**c) Mylohyoid:**

- Elevate hyoid bone and floor of mouth and depresses mandible.

**d) Geniohyoid:**

- Elevate hyoid bone and, draws hyoid bones and tongue anteriorly and depresses mandible.

➤ **MUSCLES THAT ACT ON THE ABDOMINAL WALLS:**

**a) anterolateral abdominal wall:**

- The anterolateral abdominal wall is composed of skin, fascia and four pairs of flat and sheet like muscles:
  - Rectus abdomens
  - External oblique
  - Internal oblique
  - Transversus abdominis
- The rectus abdominus muscles are interrupted by three transverse fiber bands of tissue called as tendinous intersections.

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- It compresses the abdomen and provides help in to urination, forced expiration and childbirth.

### b) Posterior abdominal wall

- Posterior abdominal wall is formed by lumbar vertebrae, hip bone, quadratus lumborum muscles.
- Quadratus lumborum muscles give help in forceful expiration and deep inspiration.

### ➤ MUSCLES USED IN BREATHING:

- These muscles are attached to the ribs.
- Their contraction and relaxation alter the size of the thoracic cavity during breathing.
- The muscles helps in inspirations are diaphragm and internal intercostals
- The muscles helps in expiration is external intercostals.

### ➤ MUSCLES THAT MOVE THE PECTORAL (SHOULDER) GIRDLE:

- These muscles depresses, rotate or elevate the clavicle or scapula
- Muscles that move the pectoral girdle can be divided in to:

#### a) Anterior groups: It consist

- Subclavius
- Pectoralis minor
- Serratus anterior

#### b) Posterior groups: it consist

- Trapezius
- Levator scapulae
- Rhomboideus major
- Rhomboideus minor

### ➤ MUSCLES THAT MOVE THE HUMERUS (ARM):

- It consist the nine muscles.
- It rotates, extends, adducts and flexes the arms.
- Out of nine only two muscles are not originate from the scapula so it is known as axial muscles while other seven muscles are known as scapular.

#### a) Axial muscles are:

- Pectorals major
- Latissimus dorsi

#### b) Scapular muscles are:

- Deltoid
- Subscapularis
- Supraspinatus
- Infraspinatus
- Teres major
- Coracobrachialis

### ➤ MUSCLES THAT MOVE THE RADIUS AND ULNA (FOREARM):

- The muscles which move the radius and ulna are divided into:

#### a) Flexor: It consist

- Biceps brachii
- Brachialis



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- Brachioradialis
- It flexes forearm
- b) **Extensors:** It consists
  - Triceps brachii
  - Anconeus
  - It flexes and extends forearm

### ➤ **MUSCLES THAT MOVES THE WRIST, HAND AND FINGER:**

- On the basis of location and function, the muscles are divided in to two groups.

#### a) **Anterior compartment muscles:**

- It originates on the humerus and insert on the carpals, metacarpals and phalanges.
- Anterior compartment muscles are flexors.
- It is further divided in to superficial and deep muscles.

#### b) **Posterior compartment muscles:**

- It is arise on the humerus and insert on the metacarpals and phalanges.
- It is further divided in to superficial and deep muscles.
- Posterior compartment muscles are extensor.

#### a) **Anterior compartment muscles (Flexors):**

##### i) **Superficial:**

- Flexor carpi radialis
- Palmaris longus
- Flexor carpi ulnaris
- Flexor digitorum superficialis

##### ii) **Deep :**

- Flexor digitorum profundus.
- Flexor pollicis longus.

#### b) **Posterior compartment muscles (Extensor):**

##### i) **Superficial:**

- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor digitorum
- Extensor digit minimi
- Extensor carpi ulnaris

##### ii) **Deep:**

- Abductor pollicis longus
- Extensor pollicis brevis
- Extensor pollicis longus
- Extensor indicis

- Superficial muscles of anterior compartment mostly flex and adduct wrist or thumb.
- Deep muscles of anterior compartment mostly flex the finger or thumb.
- Superficial muscles of posterior compartment mostly extend and adduct wrist or thumb.
- Deep muscles of posterior compartment mostly extend the finger or thumb.

### ➤ **INTRINSIC MUSCLES OF THE PALM:**

- The muscles present in the palm are known as the intrinsic muscles of palm.
- It gives help to moves the digits.
- These muscles origins and insertion are both within the hand.
- It provides the help for flexion, extension, abduction, adduction and opposition
- It is divided in to three principal groups

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- Thenar
- Hypothenar
- Intermediate.

### ➤ **Muscles of thigh:**

The muscles of the thigh can be classified into three groups according to their location:

#### **a) Anterior (extensor) compartment :**

- These muscles extend the leg and some also flex the thigh.
- It is innervated by femoral nerve.
- It is composed by

##### **i) Quadriceps femoris:**

- It includes the four distinct part means four separate muscles which are:
  - Rectus Femoris
  - Vastus Lateralis
  - Vastus Intermedius
  - Vastus medialis
- The common tendon for the four muscles is known as quadriceps tendon, which attach to the patella.
- These muscles provide help in extension of leg and flexion of thigh.

##### **ii) Sartorius muscles:**

- It is contact when you sit in the cross legged position.
- It is longest muscles of the body.
- It flexes the thigh and leg.

#### **b) Posterior (flexor) muscles:**

- It mostly flexes the leg but some time extends the thigh.
- It is innervated by branch of sciatic nerve.
- A collective designation of three muscles of posterior or flexor muscles are known as hamstring, it includes:
  - Biceps femoris
  - Semitendinosus
  - Semimembranosus
- It provides helps in extension and flexion of legs and thigh.
- The hamstrings are so named because their tendons are long.

#### **c) The adductors (on the medial side):**

- The medial compartment is so named because its muscles adducts thigh.
- It is innervated by the obturator nerve.
- It consists:
  - Adductor magnus
  - Adductor longus
  - Adductor brevis
  - Pectineus
- These four muscles act on the femur.
- While gracilis the outer muscles in the medial compartment not only adduct the thigh but also flex the leg.

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### ➤ MUSCLES OF HIP:

- There are several ways of classifying the muscles of the hip:
  - By location or innervation (ventral and dorsal divisions of the plexus layer);
  - By development on the basis of their points of insertion (a posterior group in two layers and an anterior group); and
  - By function (i.e. extensors, flexors, adductors, and abductors).

#### a) The anterior dorsal hip muscles:

- It helps to rotate or extend the thigh laterally.
- It includes:
  - Psoas major
  - Psoas minor
  - Iliacus

#### b) Posterior dorsal hip muscles:

- It helps to rotate or abduct the thigh medially.
- It includes:
  - Gluteus maximus
  - Gluteus minimus
  - Gluteus medius

#### c) The ventral hip muscles:

- It functions as lateral rotators and plays an important role in the control of the body's balance.
- Because they are stronger than the medial rotators, in the normal position of the leg, the apex of the foot is pointing outward to achieve a better the support.
- It helps in to abducts and rotate the thigh laterally.
- It includes:
  - Obturator internus
  - Obturator externus
  - Superior Gemellus
  - Inferior Gemellus
  - Quadratus Femoris

### ➤ MUSCLES THAT MOVE THE FOOT AND TOES:

- All muscles in the leg are attached to the foot and, based on location, can be classified into an anterior and a posterior group separated from each others by the tibia, the fibula, and the interosseous membrane.
- These two groups can be subdivided into subgroups or layers:

#### a) The anterior group consists:

##### i) Extensors:

- Three of the anterior muscles are extensors.
  - Tibialis anterior
  - Extensor Digitorum Longus
  - Extensor Hallucis Longus

##### ii) Peroneals

- Peroneus Longus
- Brevis

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b) The posterior group consists:

- i) Superficial
  - Of the posterior muscles three are in the superficial layer.
    - Triceps Surae
    - Soleus
    - Gastrocnemius
- ii) Deep layer.
  - Tibialis Posterior
  - Flexor Hallucis Longus
  - Flexor Digitorum Longus
- Functionally, the muscles of the leg are either extensors, responsible for the dorsiflexion of the foot, or flexors, responsible for the plantar flexion.

NAME	ACTION	EXAMPLE
FLEXOR	Decrease angle at a joint	Flexor Carpi Radialis
EXTENSOR	Increase angle at a joint	Extensor Carpi Ulnaris
ABDUCTOR	Move bone away from midline	Abductor Pollicis Longus
ADDUCTOR	Move bone toward midline	Adductor Longus
LEVATOR	Produce upward movement	Levator Scapulae
DEPRESSOR	Produce downward movement	Depressor Labii Inferioris
SUPINATOR	Turn palm upward/anterior	Supinator
PRONATOR	Turn palm downward/posterior	Pronator Teres

### DISORDERS OF MUSCLES:

#### Cramp:

- Cramp is the term associated with the painful sensation caused by either prolonged or sudden extreme contraction of a muscle.
- The condition may be connected with electrolyte imbalance and is often associated with fatigue, stress and poor posture.

#### • Muscular Dystrophy:

- The term muscular dystrophy refers to a group of inherited diseases where fiber degenerate muscles and replaced by fatty tissue.
- Increasing weakness and loss of ability result.
- The severity of the condition varies from slight weakness through to damage to the intercostals muscles or myocardium, with eventual fatal consequences.

#### Poliomyelitis:

- Poliomyelitis is actually an infectious viral disease of the central nervous system.
- It is often attribute to the muscular system as it can lead muscular stiffness, weakness and eventual paralysis.

#### Strain:

- A strain is occur when there is excessive use or stretching of muscles.
- This may damage the muscles fibers or tendons by tearing them and generally leads to pain and swelling.

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- In an extreme case, the tissue is completely torn apart with extensive hemorrhage, swelling, pain and loss of function.

### **Tendinitis:**

- Tendinitis occurs when excessive use of a particular muscle leads to a painful inflammation of the associated tendon sheath.
- The condition may also be caused by bacterial infection or rheumatic disease.
- Tension Headache:
  - A tension headache is probably the most common form of headache.
  - It occurs when muscular contraction in the back of neck caused by emotional stress or other factor leads to pain.
  - Muscular spasm may then constrict blood vessels and increase the problem which can be compounded by a build up of toxic waste substance in the scalp.

### **Migraine:**

- Migraine is a condition similar to the tension headache but with much more severe symptoms.
- Often a migraine is initiated by a trigger factor and may occasionally be preceded by an “aura” or warning symptoms.
- Blood vessels supplying the brain constrict.
- At a some point later, they dilate causing an intense headache and perhaps including other problems like visual disturbance, dizziness, vertigo and vomiting.

### **RELATED TERMINOLOGY:**

**ATROPHY:** Wasting away of muscle due to lack of use.

**HYPERTROPHY:** An increase in the size of the muscle cell.

**INTRAMUSCULAR INJECTION:** Medication injected into skeletal muscle – usually the deltoid in the arm, vastus lateralis in the thigh, or gluteus medius in the buttocks.

**STRAIN:** Tear in the muscle resulting from excessive use. Bleeding inside the muscle can result in pain and swelling. Ice packs will help stop bleeding and reduce swelling.

**MUSCLE SPASM (cramp):** Sustained contraction of the muscle, usually because of overuse.

**MYALGIA:** Muscle pain

**HERNIA:** Organs can protrude through this weak muscle. A hiatal hernia occurs when the stomach pushes through the diaphragm.

**FLAT FEET (TALIPES):** Weakening of leg muscles that support the arch, downward pressure on the foot eventually flattens out the arches. Condition can be helped by exercise, massage and corrective shoes.

**TETANUS (lockjaw):** Infectious disease, continuous spasms of voluntary muscles, caused by a toxin from the bacillus clostridium tetani, enters the body through puncture wound. Prevented by an anti-toxoid vaccine.

**TORTICOLLIS (wry neck):** May be due to an inflammation of the trapezius and/or sternocleidomastoid muscle.

**MUSCULAR DYSTROPHY:** Group of diseases in which muscle cells deteriorate. Most common is Duchenne Muscular Dystrophy, caused by a genetic defect.

**MYASTHENIA GRAVIS:** Progressive muscular weakness and paralysis, sometimes death. Cause unknown. Fatal when respiratory muscles are paralyzed.



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**TENNIS ELBOW:** Occurs at the lateral epicondyle on the sides of the elbow. Tendon that connects arm muscle to elbow becomes inflamed due to overuse. Treated with pain relief and ice.

**SHIN SPLINTS:** Injury to the muscle tendon in the front of the shin. Caused by jogging. Choose correct running shoes with proper arch support.

**ROTATOR CUFF DISEASE:** Inflammation of tendons around shoulder joint. Due to repetitive overhead swinging, pain in top and front of shoulder, increase in pain when arm lifted over head. Treated with rest and physical therapy.

**CUMULATIVE TRAUMA DISORDERS:** Also called repetitive motion disorders – caused by repeated muscle use, such as using a keyboard.

**ERGONOMICS:** Study of the application of biology and engineering to the relationship between workers and their environment.

**TENDONITIS:** Inflammation of a tendon

**BURSITIS:** Inflammation of a bursa between bony prominence and muscles or tendons. Common in the shoulder or knee.

**CONTRACTURE:** Tightening or shortening of a muscle.

### IMPORTANT QUESTION:

1. WRITE DOWN THE FUNCTION OF MUSCLES.
2. WRITE DOWN THE PHYSIOLOGY OF MUSCLES CONTRACTION.
3. EXPLAIN THE STRUCTURE OF A SKELETAL MUSCLE FIBER.

“To acquire knowledge, one must study;  
but to acquire wisdom, one must observe.”

— Marilyn Vos Savant