

# Skeletal Muscle

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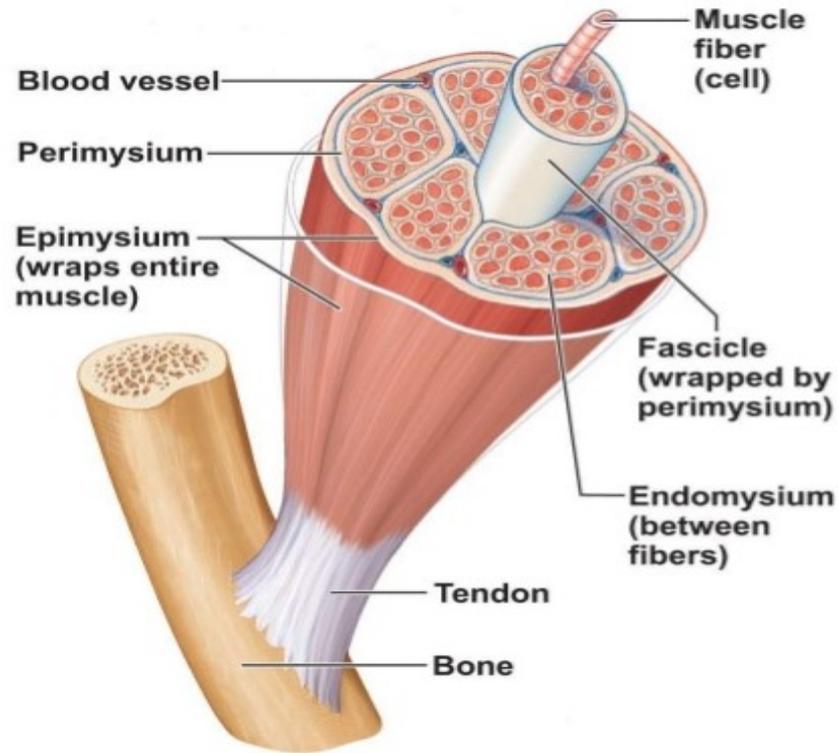
## Skeletal muscle tissue

Forty percent of your body mass is made up of skeletal muscle. Skeletal muscle (also called striated voluntary muscle in that microscopic bands or striations can be seen) attaches to bone and is responsible for the following functions:

- Produce skeletal movement , Skeletal muscle is attached to bones and its contraction makes possible locomotion, facial expressions, posture, and other voluntary movements of the body.
- Maintain posture and body position
- Support soft tissues
- Guard entrances and exits
- Store nutrient reserves
- Maintain body temperature , skeletal muscles generate heat as a byproduct of their contraction and thus participate in thermal homeostasis. Shivering is an involuntary contraction of skeletal muscles in response to lower than normal body temperature.

## Skeletal Muscle Structure

Skeletal muscle is comprised of a series of muscle fibers made of muscle cells. These muscle cells are long and multinucleated. At the ends of each skeletal muscle a tendon connects the muscle to bone. This tendon connects directly to the epimysium, or collagenous outer covering of skeletal muscle. Underneath the epimysium, muscle fibers are grouped into bundles called fascicles. These fascicles are surrounded by another protective covering formed from collagen perimysium.



The perimysium, as it is called, allows nerve and blood vessels to make their way through the muscle. Each fascicle is formed from tens to hundreds of bundled muscle fibers. Each skeletal muscle fiber( cells) contain many myofibrils – these are shaped like long cylinders and extend along the full length of the muscle fibre/cell. Each myofibril consists of many types of protein filaments like myosin filament (thick filaments) and actin (thin filaments). as well as a number of associated helper proteins like troponin and tropomyosin The thick filaments and the thin filaments within myofibrils overlap, and the sections where they overlap and occur together are called sarcomeres. When muscle contraction occurs, the thin filaments and the thick filaments slide past each other.

## **The Neuromuscular Junction(NMJ)**

Every skeletal muscle fiber is supplied by a motor neuron at the NMJ, it is the site where a motor neuron's terminal meets the muscle fiber. Every skeletal muscle fiber in every skeletal muscle is innervated by a motor neuron at the NMJ. Excitation signals from the neuron are the only way to functionally activate the fiber to contract.

### **Excitation-Contraction Coupling**

The term **Excitation-Contraction Coupling** involve the procedure by which electrical activity in somatic neuron initiate excitation of the skeletal muscle fiber then its contraction.

#### **Steps in excitation-contraction coupling**

For a skeletal muscle fiber to contract

1. Neuronal Signal( **action potential**) travels along the axon of a motor neuron, and terminate at the NMJ. At the NMJ, the axon terminal releases a chemical messenger, or **neurotransmitter**, called **acetylcholine (ACh)**.
3. The ACh molecules diffuse across a minute space called the **synaptic cleft** and bind to ACh receptors located within the **motor end-plate** of the muscle membrane at the NM, causing it to **depolarize**, and initiation of muscle fiber action potential
- 4.the action potential sweeps along the muscle membrane as a wave, is "coupled" to the actual contraction through the release of calcium ions (Ca<sup>++</sup>) from the SR.
- 6.then immediately Ca<sup>++</sup> ions removed from the media this will initiate muscle relaxation.

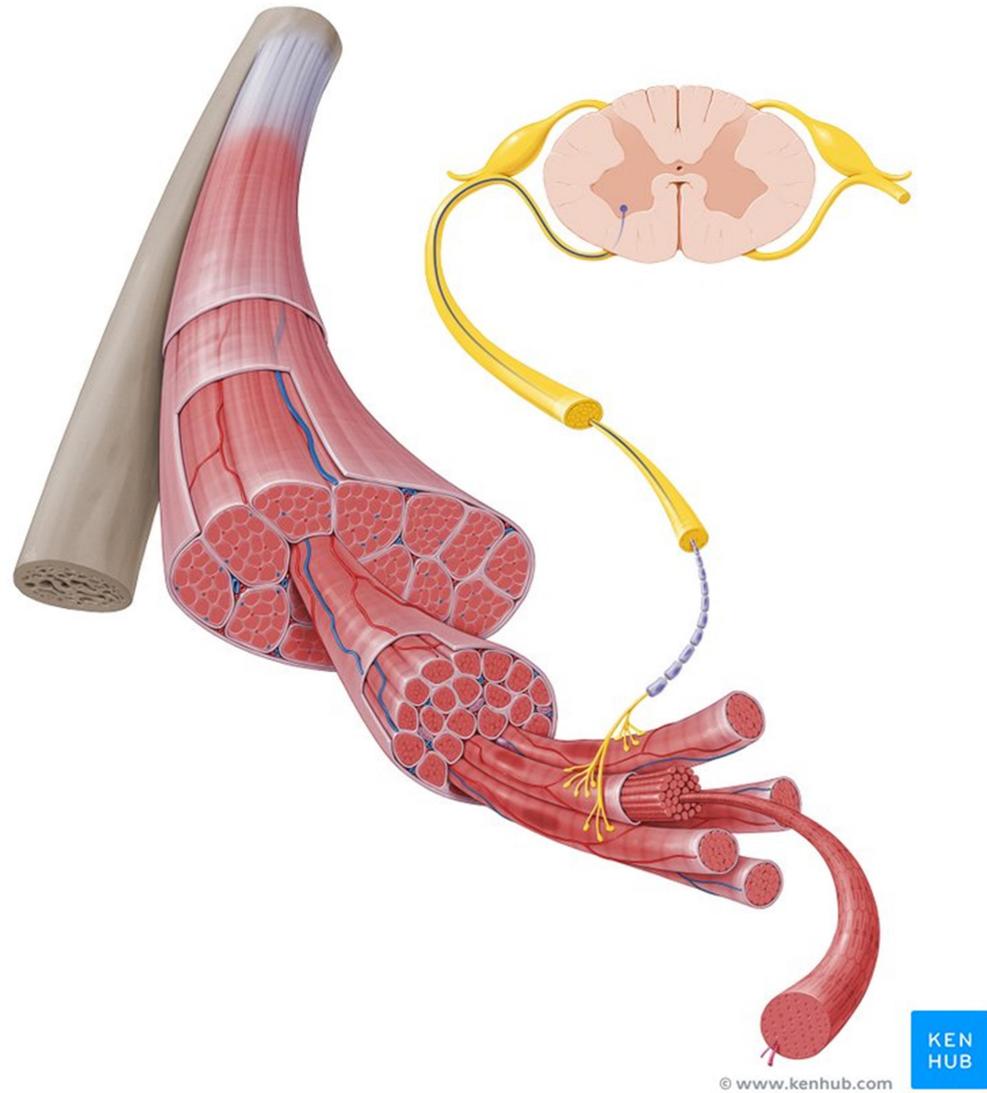


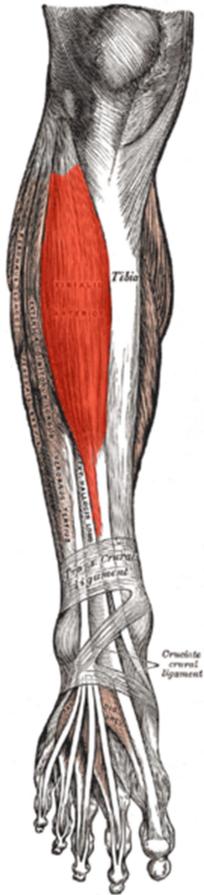
Figure: The Neuromuscular Junction(NMJ).

## Origin and Insertion

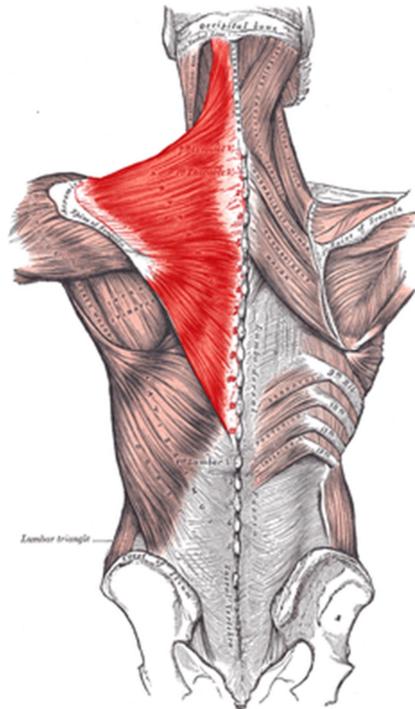
Most **skeletal muscle** is attached to bone on its ends by way of what we call tendons. As the muscles contract, they exert force on the bones, which help to support and move our body along with its appendages. The **origin** is the attachment site that doesn't move during contraction, while the **insertion** is the attachment site that does move when the muscle contracts. The insertion is usually **distal**, or further away, while the origin is **proximal**, or closer to the body, relative to the insertion. Muscular contraction produces an **action**, or a movement of the appendage.

### Naming Skeletal Muscles

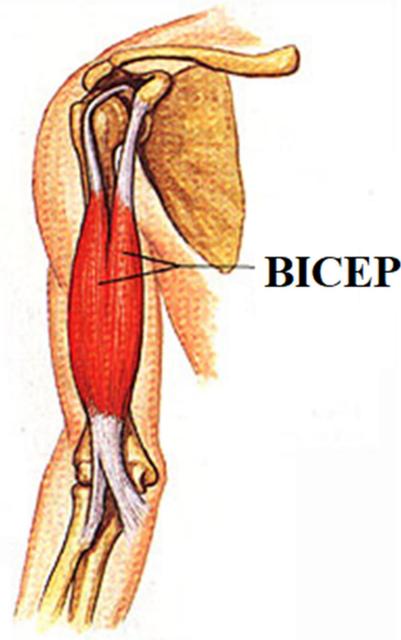
1. Terms Indicating Position or location (tibialis anterior) For example, the pectoralis major is found in the chest region and the rectus femoris is found near the femur.
2. Terms Indicating Direction, The term rectus implies that the fibers or muscle is oriented straight with respect to the longitudinal axis. The term oblique means that the orientation is at an angle to the longitudinal axis.
3. Terms Indicating shape Many muscles are named according to their shape. For example, deltoid means triangular in shape. trapezius



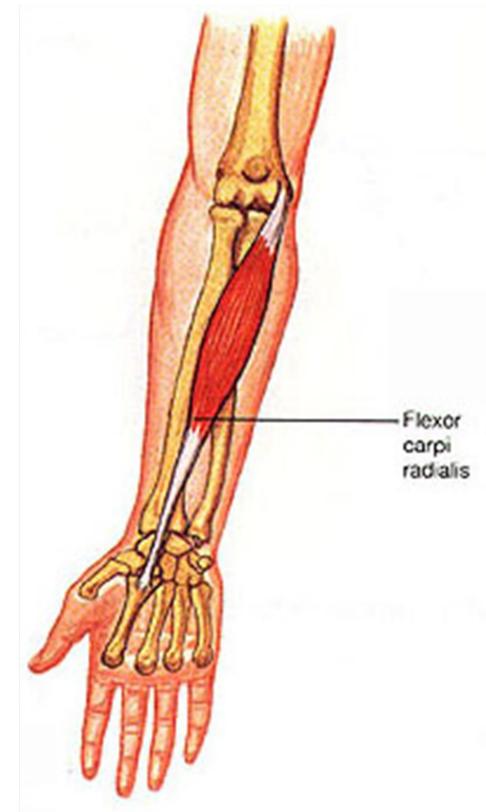
**tibialis anterior**



**trapezius**



**bicep**



**flexor**

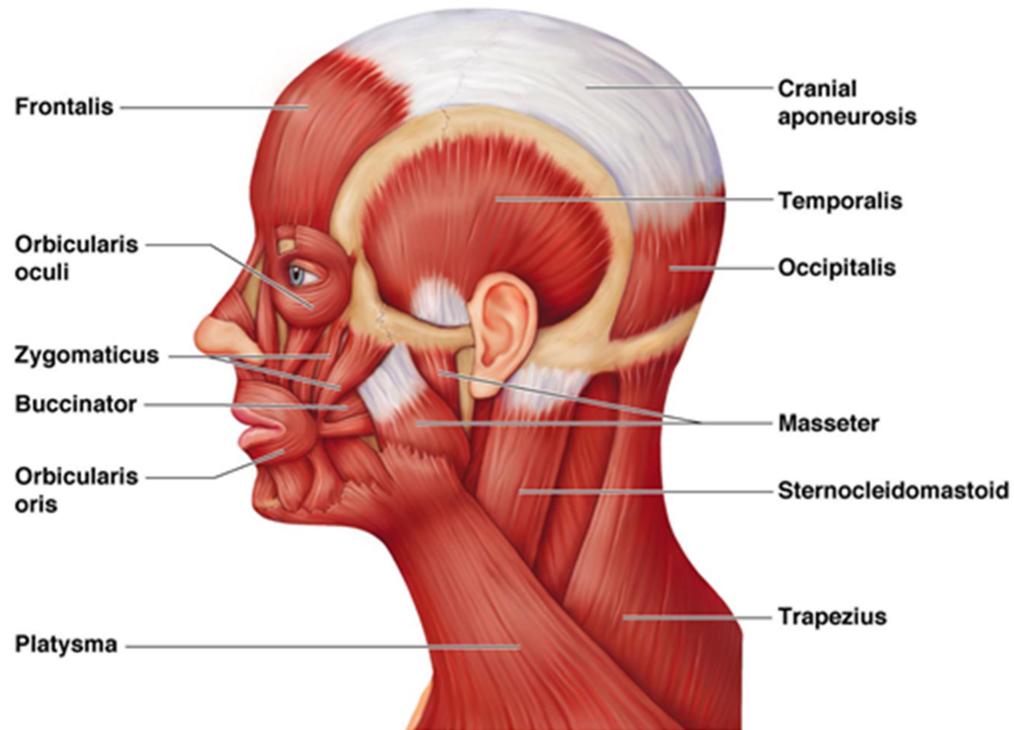
**4. Terms Indicating size**, major for bigger and minor for smaller; maximus for biggest, intermedius for middle and minimus for smallest

**5. Terms Indicating number of origin**, The term biceps means two heads; the term triceps means three heads; and the term quadriceps means four heads.

**6. Terms Indicating Action**, Muscles are often named for their primary action. For example, flexor, extensor, adductor and abductor are names associated with the action of the muscle.

## The facial muscles

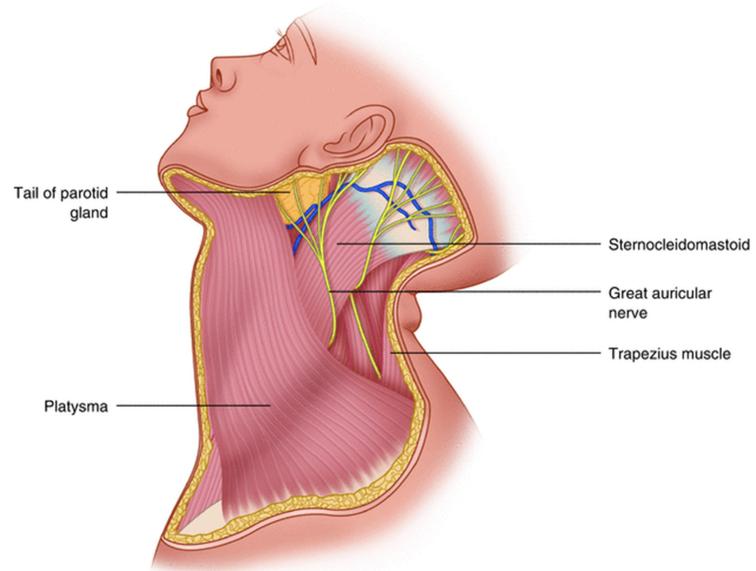
The facial muscles are a group of about 20 flat skeletal muscles lying under the facial skin. Most of them originate from the skull or fibrous structures and radiate to the skin through an elastic tendon.



### The main fascial muscles are

- Occipitofrontalis, Elevates eyebrows & wrinkles forehead
- orbicularis oculi, Closes eye
- temporalis
- orbicularis oris, Brings lips together, kissing
- Auricular muscles
- zygomaticus Elevates sides of mouth, smiling

- buccinator, Compresses cheeks inward-- wistling
- platysma



## MUSCLES OF MASTICATION AND TONGUE MOVEMENT

### Four pairs:

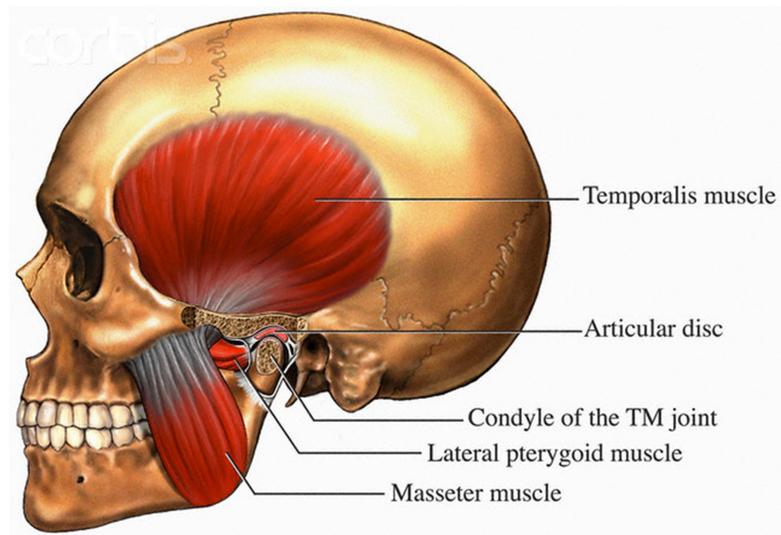
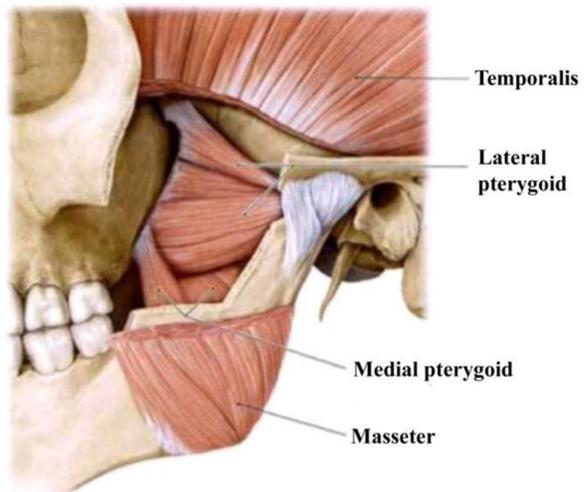
#### 1. Prime movers of jaw closure

##### a) Temporalis and masseter

- Cranial Nerve VII, Facial

#### 2. Grinding movements

##### b) Medial and lateral pterygoids Cranial nerve V (trigeminal nerve)



## **Muscles of the Neck that move Head**

### **FLEXION**

a) Sternocleidomastoid—

- If both sides contract together causes head flexion
- If one side contracts only, causes lateral rotation

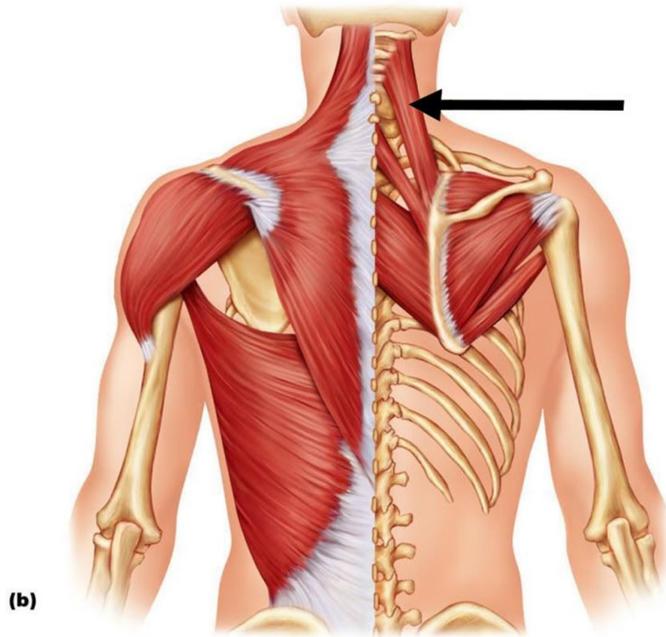
b) Scalenes—

- deep to Sternocleidomastoid
- Cause lateral head rotation

### **EXTENSION**

Trapezius: upper back muscle that extends to back of head

- Extends head and other movements (will do later)

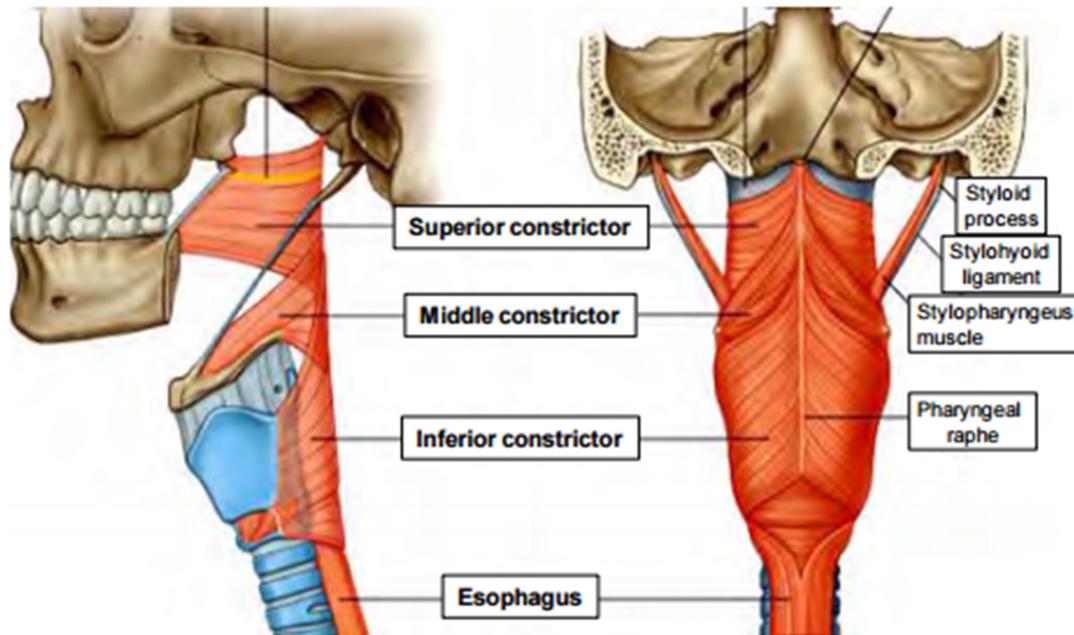


**Levator scapulae,**

When the shoulder is fixed, levator scapulae rotates to the same side and flexes the cervical spine laterally

## Muscles of Pharynx

- three pairs pharyngeal constrictors, the superior, middle and inferior constrictor , their function are:
  - encircle pharynx forming a muscular funnel
  - during swallowing drive food into the esophagus



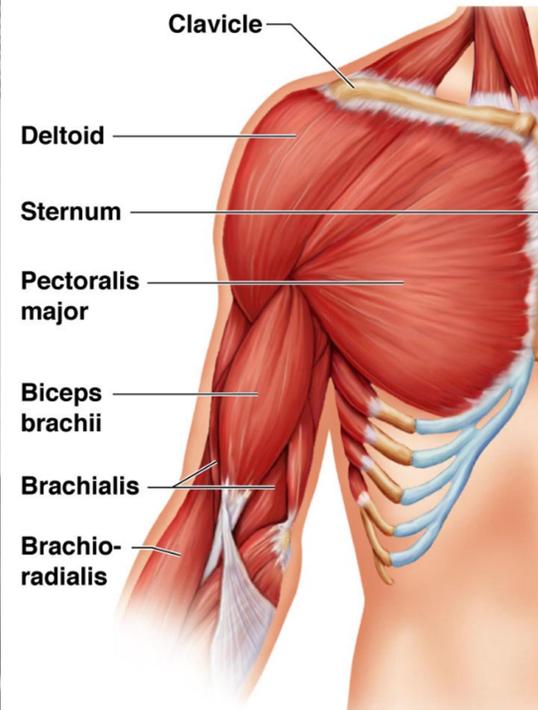
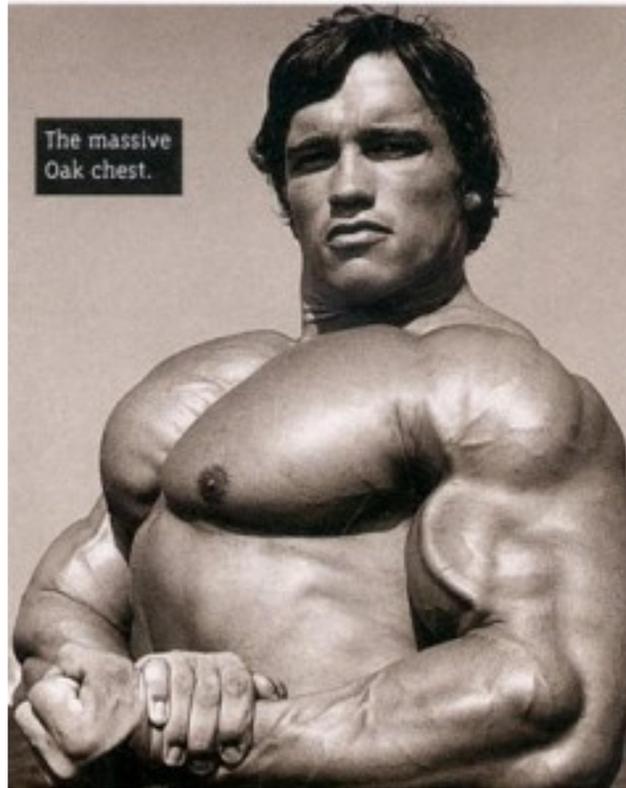
### **Muscles of the shoulder and upper limb**

Muscles of the shoulder and upper limb can be divided into four groups:

1. muscles that stabilize and position the pectoral girdle,
2. muscles that move the arm,
3. muscles that move the forearm,
4. muscles that move the wrists, hands, and fingers.

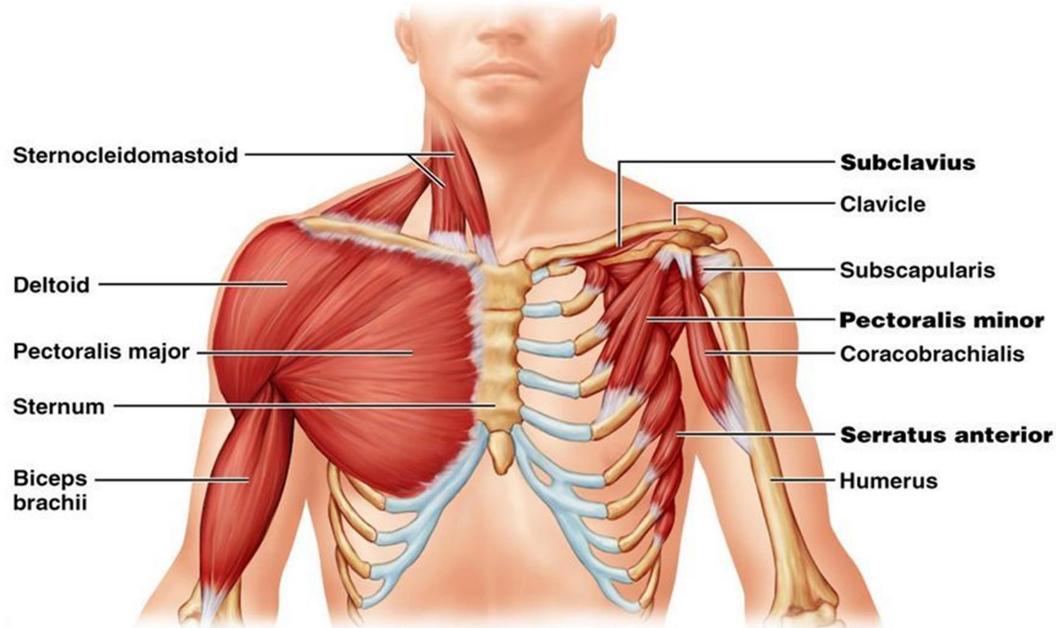
### **Muscles That Position the Pectoral Girdle**

Muscles that position the pectoral girdle are located either on the anterior thorax or on the posterior thorax. The anterior muscles include the subclavius, pectoralis minor, and serratus anterior. The posterior muscles include the trapezius, rhomboid major, and rhomboid minor.



### **Muscles That Move the Humerus.**

- 1.The muscles that move the humerus anteriorly : e.g., pectoralis major , subscapularis).
- 2.The muscles that move the humerus superiorly e.g., deltoids.
- 3.The muscles that move the humerus inferiorly e.g., latissimus dorsi.
- 4.The muscles that move the humerus posteriorly are generally located on the posterior side of the body and insert into the scapula (e.g., infraspinatus).



### Muscles That Move the Forearm

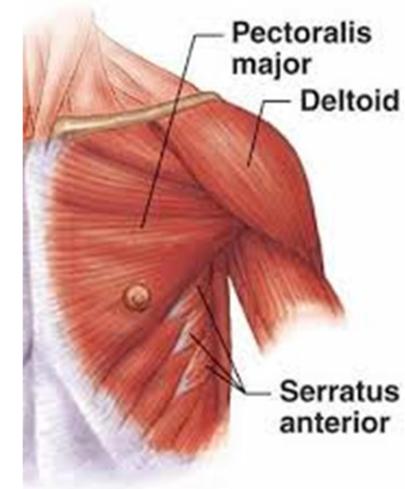
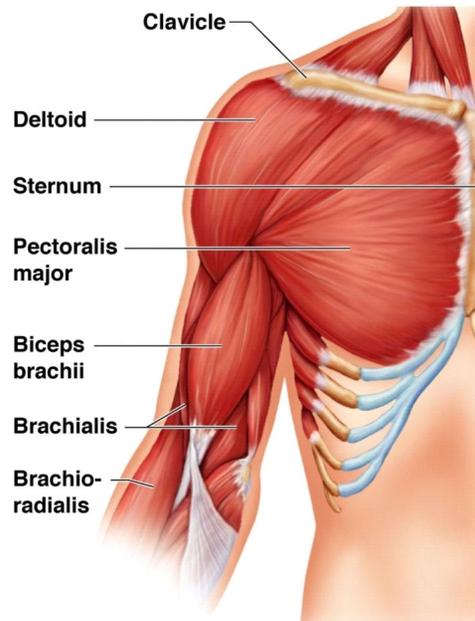
The forearm, made of the radius and ulna bones, has four main types of action at the hinge of the elbow joint: flexion, extension, pronation, and supination. **The forearm flexors include**

- the biceps brachii,
- brachialis,
- brachioradialis.

The extensors are the **triceps brachii** and **anconeus**.

The pronators are the **pronator teres** and the **pronator quadratus**,

The **supinator** is the only one that turns the forearm anteriorly. When the forearm faces anteriorly, it is supinated. When the forearm faces posteriorly, it is pronated.



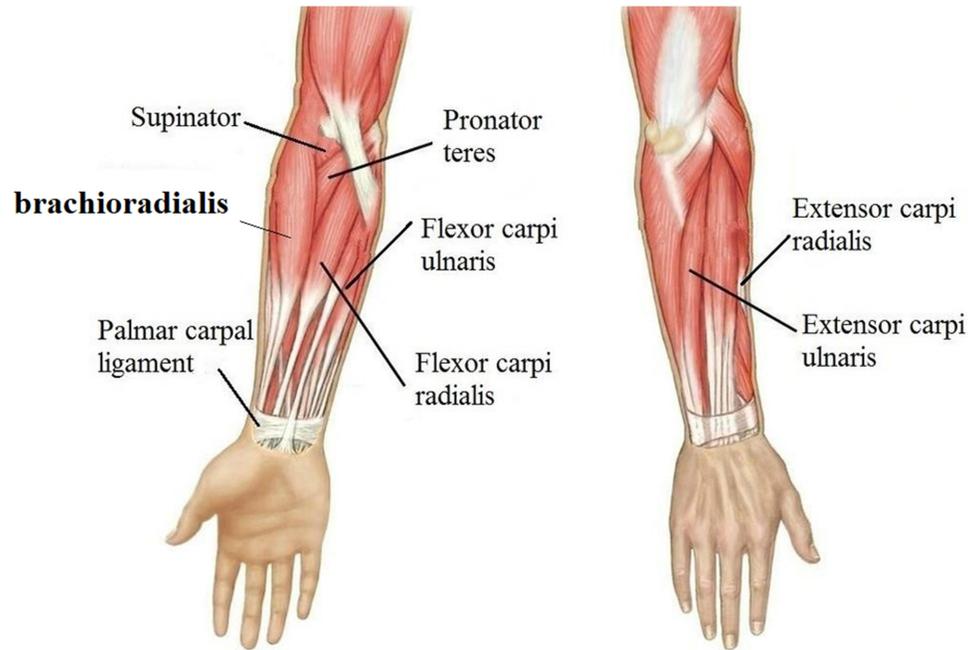
### Muscles of the Arm That Move the Wrists, Hands, and Fingers

The muscles in the **anterior compartment of the forearm** (anterior flexor compartment of the forearm) originate on the humerus and insert onto different parts of the hand. These make up the bulk of the forearm:

- **flexor carpi radialis,**
- **palmaris longus,**
- **flexor carpi ulnaris,**
- **flexor digitorum superficialis.**

The muscles in the **superficial posterior compartment of the forearm** (superficial posterior extensor compartment of the forearm) originate on the humerus. These are

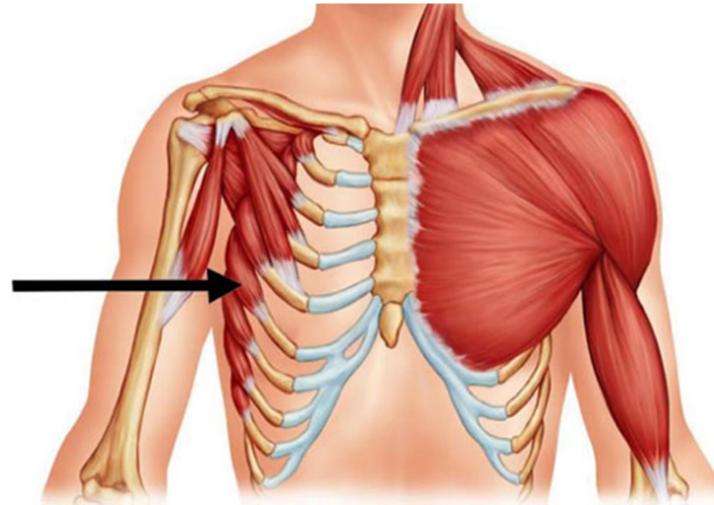
the **extensor radialis longus**, **extensor carpi radialis brevis**, **extensor digitorum**, **extensor digiti minimi**, **extensor carpi ulnaris**.



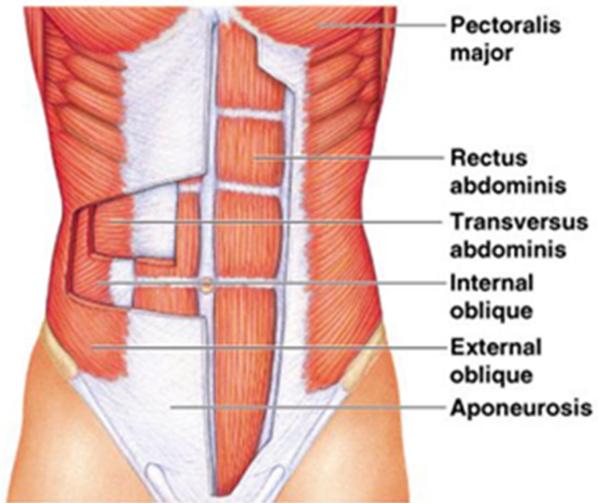
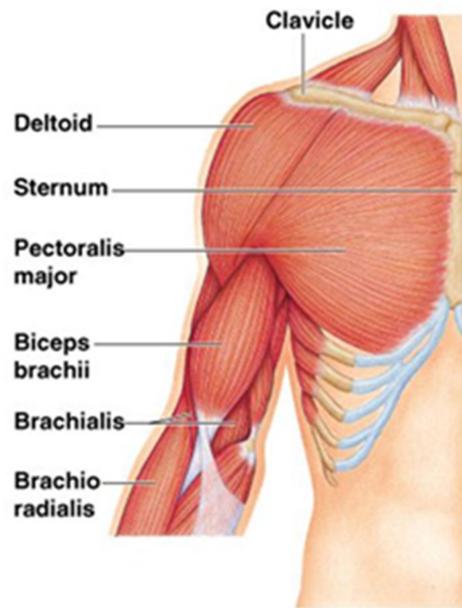
## The muscles of the trunk

The muscles of the trunk include those that move the vertebral column, the muscles that form the thoracic and **abdominal** walls, and those that cover the pelvic outlet. The erector spinae group of muscles on each side of the vertebral column is a large muscle mass that extends from the sacrum to the skull.

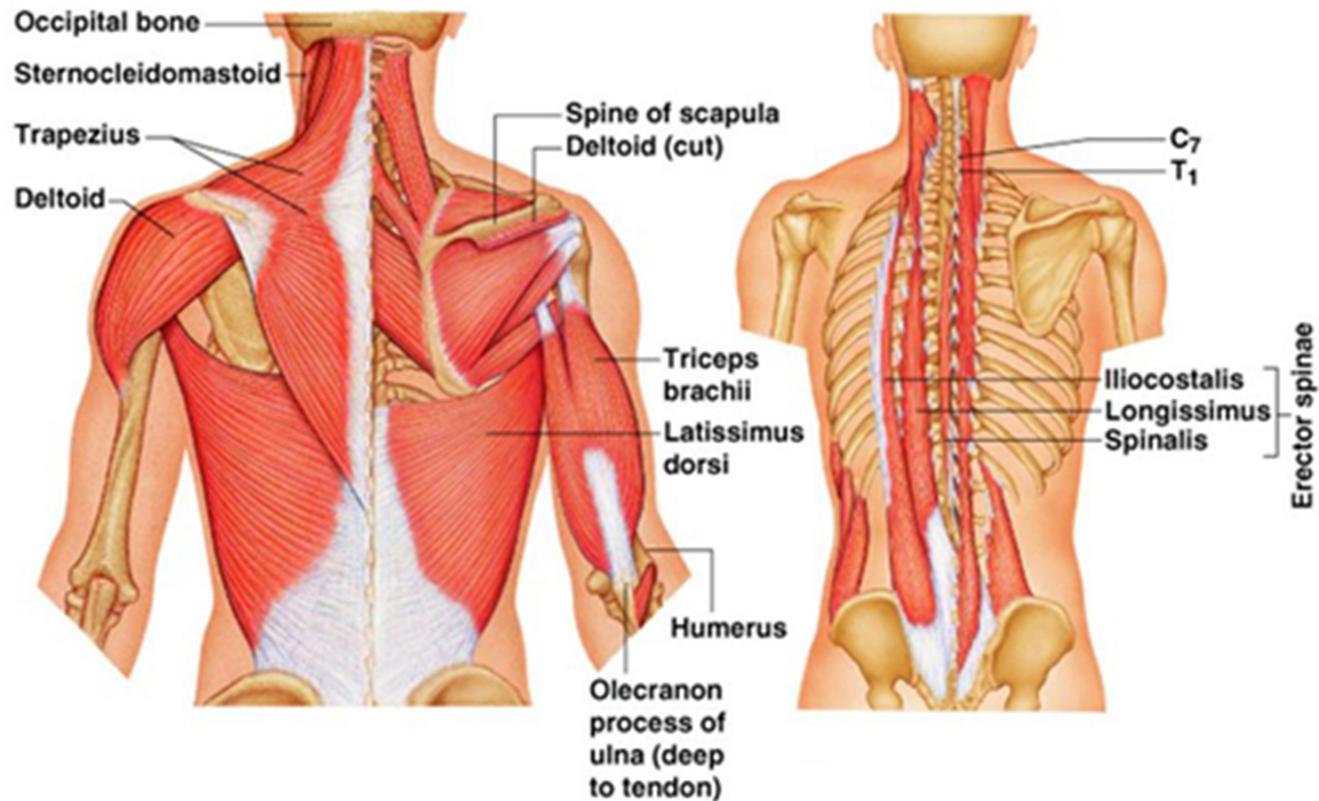
1. The main muscles of the trunk are the **pectoralis major** muscles at each breast.
2. The **latissimus dorsi** muscle that covers most of the lower back with its lateral fibers.
3. Extending from the back and wrapping around the sides of the rib cage is the **serratus anterior** muscle. This muscle's anterior edges are serrated like the teeth of a saw because this muscle's origins are on ribs 1 through 8 and each serration is the attachment point to another rib.
4. The upper back is covered by the large **trapezius** muscle that is almost diamond-shaped as it extends from the neck, out to the shoulders, then tapers in midway down the back.
5. There are three layers of muscle that sit over the abdomen. These layers are
  - outer layer is the **external oblique** muscle, with its aponeurosis covering the medial abdomen.
  - Under the external oblique are the **internal obliques** on the sides of the abdomen
  - the **rectus abdominis** muscle in-between the internal obliques.
  - The deepest layer has the **transverse abdominis** muscle, whose fibers run laterally.



Serratus anterior, extending from the back and wrapping around the sides of the rib cage is the **serratus anterior** muscle. This muscle's anterior edges are serrated like the teeth of a saw because this muscle's origins are on ribs 1 through 8 and each serration is the attachment point to another rib.



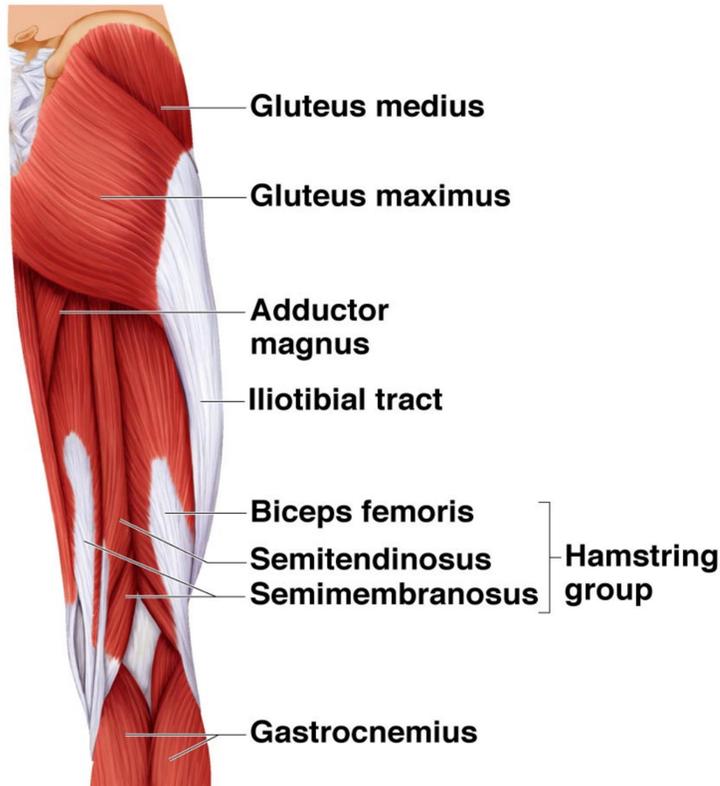
The **erector spinae muscles** are a large, disorganized group of **muscles** that run essentially vertically on either side of the spine, roughly one hand's width from the spinous processes. As a group, these **muscles** extend and stabilize the entire vertebral column and craniocervical region.



## Muscles that move the thigh and lower leg

The muscles of the lower limb include those acting on the hip or pelvic girdle, as well as muscles located in the thigh, leg, and foot.

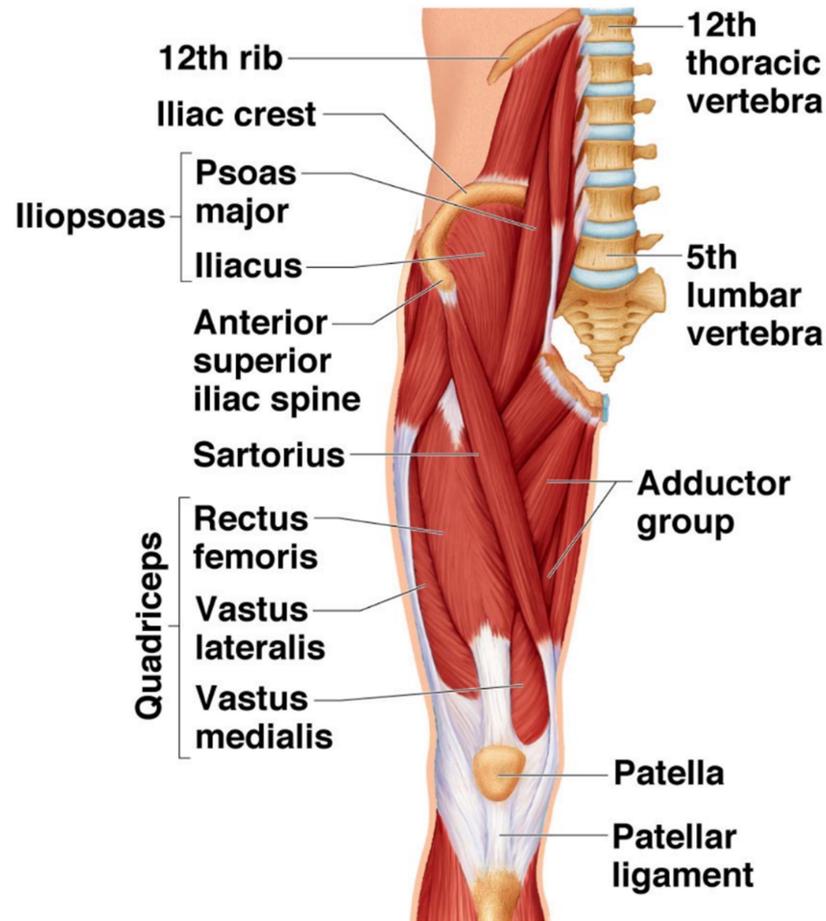
**Gluteus maximus** This muscle contributes to most of the flesh of the buttocks. It is a powerful **extensor of the thigh**. It is used primarily when the hip is already flexed as when rising from a sitting position or climbing up stairs.



The hamstring muscles are a group of three muscles, the **biceps femoris**, **semitendinosus** and **semimembranosus**. These muscles form the fleshy posterior part of the thigh. These muscles are **flexors of the leg** at the knee joint but also contribute to extension of the thigh at the hip joint.

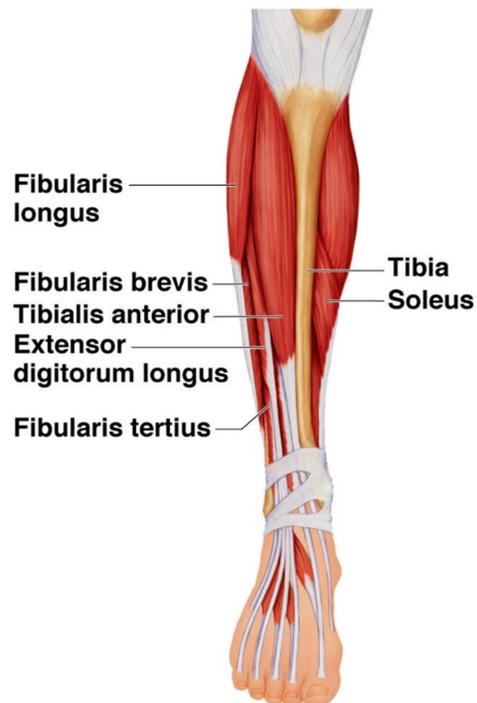
## Quadriceps femoris

This muscle has four heads each with their own name. The rectus femoris attaches to the hip bone and the vastus lateralis, vastus intermedius and vastus medialis attach to the femur. All four heads fuse and insert on the proximal tibia. The patella or knee cap forms in the tendon of this muscle. The quadriceps femoris is a powerful extensor of the leg at the knee joint. The rectus femoris also contributes to flexion of the thigh at the hip joint.



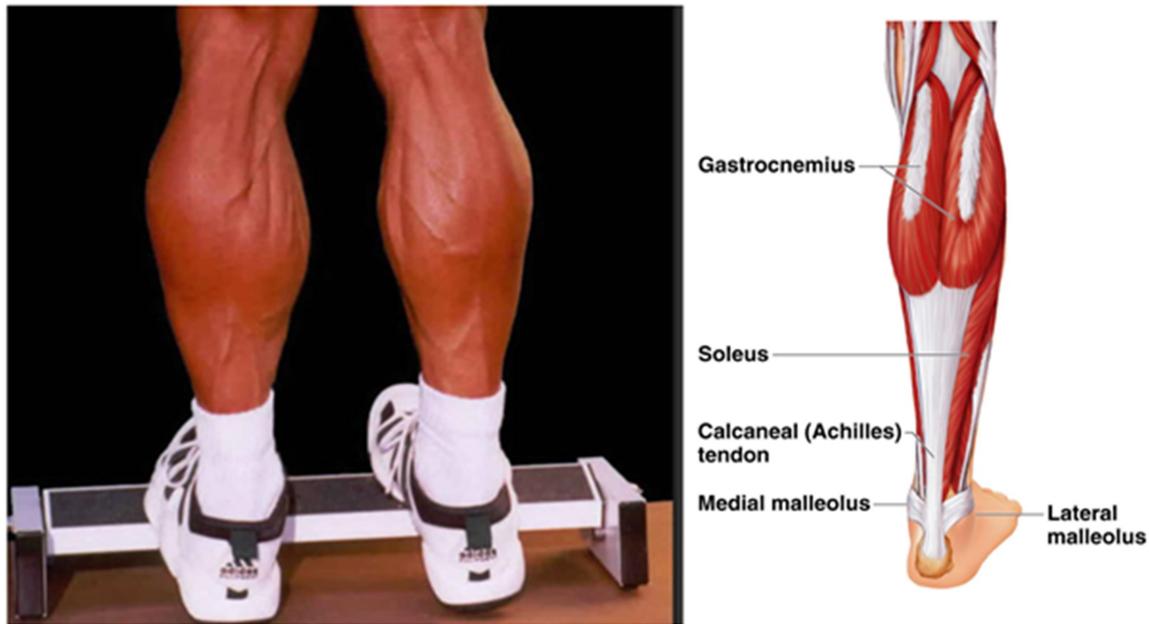
## The leg muscles divided into three compartments:

- anterior compartments, this compartment lies in front of the tibia and fibula and is surrounded by fascia. The anterior muscles dorsiflex the foot at the ankle and extend the toes, like tibialis anterior, extensor digitorum longus and extensor hallucis longus.
- lateral compartments, the lateral compartment contains two muscles: the fibularis (peroneus) longus and fibularis (peroneus) brevis. They originate on the lateral surface of the fibula. The fibularis longus inserts on the base of the first metatarsal and medial cuneiform, and the fibularis brevis inserts on the base of the fifth metatarsal. They're innervated by the superficial fibular (peroneal) nerve and help to plantarflex and evert the foot
- posterior compartments, which plantarflex the ankle and flex toes. like gastrocnemius ,this muscle has two heads and forms the curved calf of the posterior leg. like gastrocnemius



## The gastrocnemius

This muscle has two heads and forms the curved calf of the posterior leg. The gastrocnemius attaches to the distal end of the femur and inserts onto the heel bone by way of the **calcaneal (Achilles) tendon**. It is a **plantar flexor of the foot** but because it crosses the knee joint, also contributes to **flexion of the leg** at the knee joint.



**Sciatica** refers to back pain caused by a problem with the **sciatic** nerve. This is a large nerve that runs from the lower back down the back of each leg. When something injures or puts pressure on the **sciatic** nerve, it can cause pain in the lower back that spreads to the hip, buttocks, and leg.

## **Extensor digitorum longus**

This muscle is a superficial muscle on the anterior leg. It attaches to the tarsal bones on the medial side of the foot and dorsiflexes and inverts the foot. Extensor digitorum longus .The name of this muscle says its action. It is an extensor of the toes (2-5) but also dorsiflexes the foot.

