

Human Anatomy & Embryology

Lecture: Muscular System (1)

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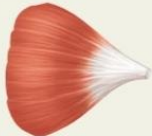





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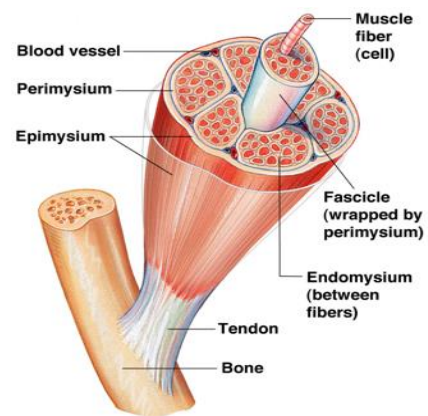
Introduction to Muscular System

Muscles are arranged in groups to move joints or other structures

- Very rarely a single muscle does a single action.
- Muscles have the power of pulling (they pull bones around joints).
- Each muscle has main function, and many have minor one or two.
- Always remember that muscle action is a force that has directions.
- We have 608 muscles in our body and that arranged in different shape and structure.

| TABLE 11.1 Arrangement of Fascicles | | |
|--|--|---|
| <p>PARALLEL</p> <p>Fascicles parallel to longitudinal axis of muscle; terminate at either end in flat tendons.</p>  <p><i>Example: Sternohyoid muscle (see Figure 11.8a)</i></p> | <p>FUSIFORM</p> <p>Fascicles nearly parallel to longitudinal axis of muscle; terminate in flat tendons; muscle tapers toward tendons, where diameter is less than at belly.</p>  <p><i>Example: Digastric muscle (see Figure 11.8a)</i></p> | |
| <p>CIRCULAR</p> <p>Fascicles in concentric circular arrangements form sphincter muscles that enclose an orifice (opening).</p>  <p><i>Example: Orbicularis oculi muscle (see Figure 11.4a)</i></p> | <p>TRIANGULAR</p> <p>Fascicles spread over broad area converge at thick central tendon; gives muscle a triangular appearance.</p>  <p><i>Example: Pectoralis major muscle (see Figure 11.3a)</i></p> | |
| <p>PENNATE</p> <p>Short fascicles in relation to total muscle length; tendon extends nearly entire length of muscle.</p> | | |
| <p>Unipennate</p> <p>Fascicles are arranged on only one side of tendon.</p>  <p><i>Example: Extensor digitorum longus muscle (see Figure 11.24b)</i></p> | <p>Bipennate</p> <p>Fascicles are arranged on both sides of centrally positioned tendons.</p>  <p><i>Example: Rectus femoris muscle (see Figure 11.3a)</i></p> | <p>Multipennate</p> <p>Fascicles attach obliquely from many directions to several tendons.</p>  <p><i>Example: Deltoid muscle (see Figure 11.17d)</i></p> |

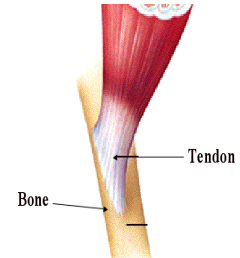
- Each muscle is a system on its own, and a system made of several types of tissues.
- **Fascicle**: groups of muscle fibers form bundles wrapped in a thicker Layer of connective tissue
- **Perimysium**: dense irregular connective tissue covers the fascicle.
- Surrounding each muscle fiber is a thin wrapping of mostly reticular fibers called the **endomysium**.
- **Epimysium**: thicker dense irregular connective tissue covers the periphery of the muscles



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- **Tendons** are a continuous mass of connective tissue that runs through the muscle as the endomysium, perimysium, and epimysium and emerges from the belly of the muscle (this is what makes your muscles so incredibly strong)

- ☒ Now let's see what happens when a tendon reaches a bone, a muscle as it comes near the bone forms a tendon, when the tendon touches the bone the tendon's fibers mix with the outer connective layer of the periosteum and the result is a very strong attachment of a tendon to the bone.



There are 2 types of muscles:

- **ON basis of contraction**
 - **Fast:** Glycolytic (use glycogen)
 - **Slow:** Slow oxidation
- **ON basis of types of myoglobin contents**
 - **Red** (has myoglobin)
 - **White** (less than red)

Naming of muscles is based on (because we have many muscles) :

- **Pattern of fascicle**
- **Size**
- **Shape**
- **Action**
- **Number of origins**
- **Location**
- **Combination (2 or 3 of these basis)**

Coordination of muscles :

- **Agonist (prime mover) :** does an action
- **Antagonist :** does opposite action
- **Synergist :** prevents unwanted movements
- **Fixator :** fix origin of prime mover
- **Helper :** weak prime mover

- ☒ Now muscular tissue is an excitable tissue and this excitability happens when a nerve impulse comes and change the electricity of the cell wall of the muscle cells so it comes through an Axon and this axon is a single process of the neuron as we know and this axon is going to divided into what is called the **axon terminals** and these are having dilated ends called the **end bulbs** of the axon Terminals and they synapse with the cell wall of that muscle cells and the neurotransmitters will stimulate the muscle, now when large number of muscle fibers are supplied by an axon this is called a **large motor unit** usually these muscles they do not produced skilled movements like the muscles at the back when an axon terminal supplies a small number of muscle fibers then this is called a **small motor unit** and these muscles are going to produce very skilled movement like the muscles of the hand and muscles of the orbit moving the eye therefore we have large motor units and small motor unit
- ☒ The blood supply of muscles they are usually very well supplied with blood vessels and they are supplied by more than one blood vessel and there is connection between these arteries these connections are called **anastomosis**

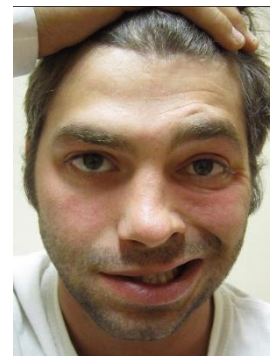
Some terminology

- Where the fixed (unmoving) end of a muscle attaches to bone is called **origin**
- The site where the movable end of a muscle attaches to bone is called **insertion**
- The muscle whose contraction is responsible for the desired action is called **agonist**
- The muscle whose action is the opposite of the desired action is called **antagonist**
- The muscle whose contraction aids the prime mover is called **synergist**

The muscular system

The facial muscles:

- The face is full with muscles and these muscles usually concentrated around the openings of the face mainly the two orbits and the mouth.
- All facial muscles are supplied by the facial cranial nerves (2), one supplies the left side and one supplies the right side.
- Note: Facial cranial nerves are the number 7 cranial nerves.
- **Facial palsy:** a common disease in the societies, it is a paralysis or severe weakness of the **facial** muscles on one side of the face, duo to disorder of the facial nerve supplies that side.
- Diagnose: if you look at the picture this is the facial palsy, there is a difference in appearance between the right and left sides.
- On the left side here, the muscles are working as you can see the mouth is **pulled** towards the left and there are lines on the forehead also the eyebrow is raised and we can see a prominent fold between the nose and the angle of the mouth called the **nasolabial fold**.
- One the right the muscles are not working (paralysis mode) the mouth is not moving there is no lines on the forehead also there is no nasolabial fold.

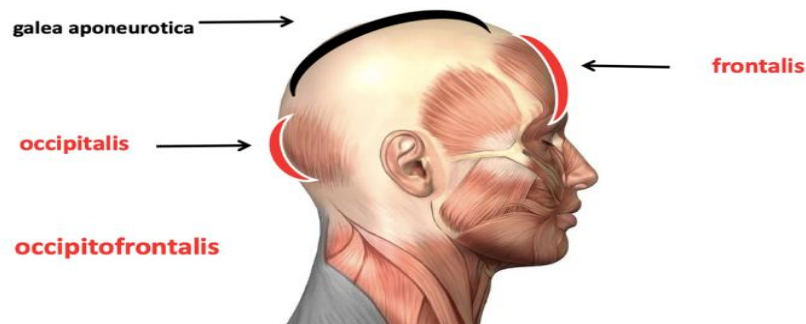


facial expression muscles:

1. **Occipitofrontalis muscle:** which made up of two parts, the two parts unite together by an **aponeurosis** (flat tendon) over the skull called **galea aponeurotica**.

- **Frontalis(anterior):** covers the forehead, originates from the galea aponeurotica and inserts into the skin of the forehead.
- **Occipitalis(posterior):** which is a fleshy muscle attached to the external surface of the occipital bone, originates from the occipital bone and insrets into the galea aponeurotica.

✓ **Action:** when this muscle contracts it raises eyebrows and shows lines on the forehead as a look of surprise.



2. **Orbicularis oris muscle:** it is a circular muscle like a sphincter around the mouth, you can test it by asking someone to whistle.

✓ **Action:** closes the mouth, whistling and speaking.



3. **Corrugator supercillii muscle:** it is in the middle and just superior to the nose.

✓ **Action:** when it contracts it wrinkles skin of forehead between eyebrows (vertically) as a look of discust.



4. **Zygomaticus major (inferior):** originates from the zygomatic bone and inserts into skin at angle of mouth.

✓ **Action:** pulls angle of mouth superiorly and laterally as in smiling.



5. **Zygomaticus minor (superior):** originates from the zygomatic bone and inserts into upper lip.

✓ **Action:** raises upper lip.

6. **Risorius:** pulls angle of the mouth laterally as in grimacing or smiling when conjunct with other muscles



- 7. **Levator labii superioris:** raises upper lip
- 8. **depressor labii inferioris:** depresses lower lip

when smiling with showing teeth we use 3 facial muscles:

- risorius
- levator labii superrioris
- depressor labii inferioris



- 9. **Depressor anguli oris:** pulls angle of the mouth laterally and inferiorly (pulled down the lower lip).



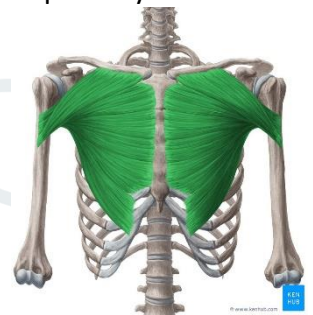
- 10. **orbicularis oculi:** circular muscle that surrounds the opening of the orbit.
✓ **Action:** closes the eye.



Muscles of Thorax and shoulder

- 1. **pectoralis major:** big muscle in the pectoral region and a good accessory inspiratory muscle.

- **Accessory inspiratory muscle:** a muscle that attaches to one or more thoracic bones, and accessory means it used when it is needed (forceful breathing) it is not used in normal breathing.
- Pectoral = chest or thorax
- **origin:**
 - clavicular head (upper fibers) from the medial end of the clavicle.
 - Sternal head (lower fibers) from the manubrium sterni, body of sternum, costal cartilages of ribs (2-6) and sometimes the rectus sheath of the upper anterior abdominal wall.
 - all these fibers converge as they come from a wide origin.
- **Insertion:** crest of the greater tubercle of the humerus.
- **Note:** The Upper fibers are inserted inferiorly to the lower fibers (the tendons twisted).
- Greater tubercle it is a large structure in the upper end of humerus and as its lower end goes down the upper part of shaft it creates an elevation called the crest of greater tubercle.
- **Innervation:** medial and lateral pectoral nerves (C5-T1).
- ✓ **Action:** flexes and adducts the arm, medially rotates the arm and flexes the shoulder joint (pulls the humerus anteriorly).



2. **Pectoralis minor:** a muscle in the pectoral region behind the pectoralis major, it is an accessory inspiratory muscle.

- It is smaller than the pectoralis major.
- **Origin:** ribs from (3-5)
- **Insertion:** the fibers go up and insert into the coracoid process of the scapula.
- ✓ **Action:** draws(brings) the scapula forward, medialward (because it is an oblique muscle) and downward.

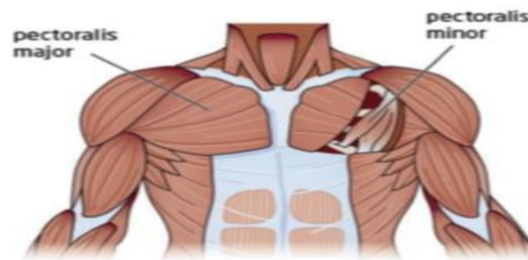
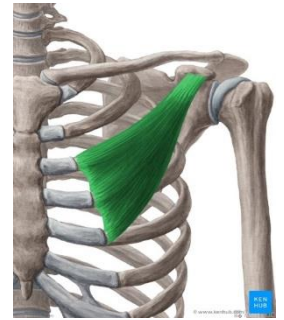
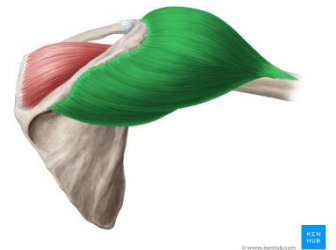


Figure 1

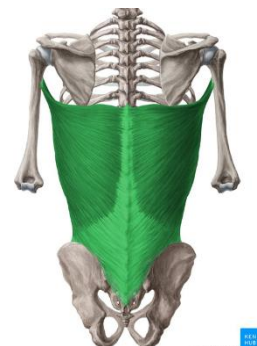
3. **Deltoid muscle:** it is triangular in shape and covers the shoulder joint, made up of 3 parts, each part has an origin but they all share the same insertion.

- **Part 1 (anterior part) origin:** lateral end of the clavicle
- **Part 2 (lateral part) origin:** acromion process of the scapula
- **Part 3 (posterior part) origin:** spine of scapula.
- **Insertion:** deltoid tuberosity
- **Note:** The deltoid tuberosity is the only feature of the humerus shaft .
- And we say that the deltoid is made up of 3 parts because each part has its own function in producing movement of the shoulder joint.
- **lateral part:** abducts upper limb (abduction).
- **Anterior part:** flexes upper limb (shoulder flexion).
- **Posterior part:** extends upper limb (shoulder extension).



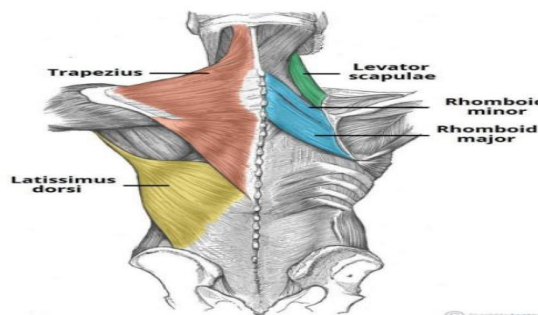
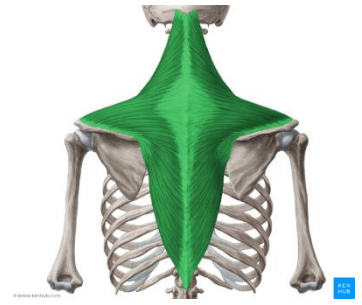
4. **Latissimus dorsi:** very powerful extender of the shoulder joint, located in the back of the trunk (back of thorax and lumbar regions), also called **swimmers** muscle because the swimmer uses it to extend the shoulder joint.

- **Origin:** lower 3 or 4 ribs, vertebral spines from T7 down to the sacrum, the posterior 1/3 of the iliac crest.
- **Insertion:** floor of the intertubercular sulcus (bicipital groove).
- ✓ **Action:** extends the arm, rotates the arm medially and fixes (stabilizes) the humerus, moves the ribs attached to them.



5. **Trapezius:** a large paired muscle, trapezoid in shape and made up of two halves one on the left and one on the right each half is triangular in shape.

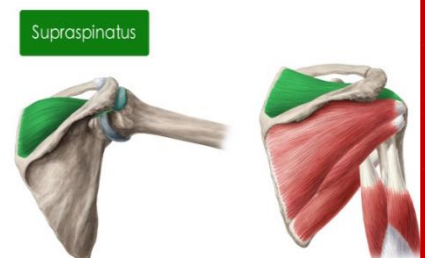
- **Origin:** medial third of superior nuchal line (a transverse line on the external surface of occipital bone), external occipital protuberance (a bony elevation on the external surface of occipital bone and you can feel it at the back of your head), ligamentum nuchae (a ligament of the upper part of the neck connecting spinal processes of cervical vertebrae), vertebral spines from (C7-T12).
- **Insertion:** lateral third of the clavicle, medial side of acromion process, superior border of scapular spine.
- **Innervation:** spinal accessory cranial nerve (XI).
- ✓ **Action:**
 - **Upper fibers:** elevate the scapula and rotate the scapula superiorly.
 - **Middle fibers:** adduct (retract) scapula.
 - **Lower fibers:** depress the scapula.



6. The rotator cuff muscles: 4 deep muscles of the shoulder

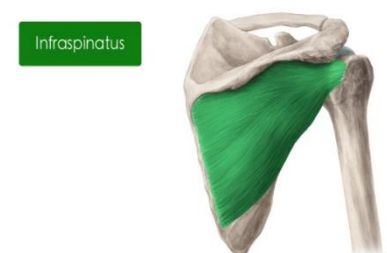
1. **Supraspinatus:** deep to trapezius.

- **Origin:** supraspinous fossa of scapula.
- **Insertion:** the top of the greater tubercle.
- **Action:** stabilizes the shoulder joint (pulls the head of humerus towards glenoid cavity), helps the deltoid muscle in abduction of the shoulder.



2. **Infraspinatus (posterior view):** some portions of it are deep to trapezius and deltoid muscles and other portions are superficial.

- **Origin:** infraspinous fossa of scapula.
- **Insertion:** lateral side of greater tubercle
- **Action:** stabilizes shoulder joint and laterally rotates the arm at shoulder joint.



3. **Subscapularis (anterior view):** large triangular muscle and very powerful.

- **Origin:** subscapular fossa of scapula.
- **Insertion:** lesser tubercle
- **Action:** stabilizes the shoulder joint and produces adduction.

Subscapularis



4. **Teres minor (posterior view):** cylindrical, elongated muscle.

- **Origin:** inferior lateral border of scapula.
- **Insertion:** greater tubercle
- **Action:** stabilizes the shoulder joint, laterally rotates and extends the arm at shoulder joint.
- Teres means when you cut it the cross section looks circular.

Teres major



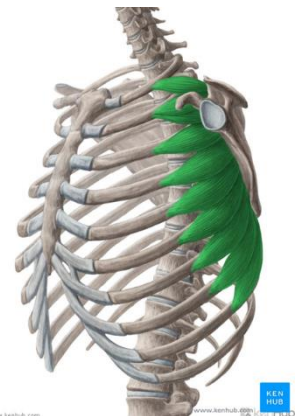
7. Some Muscles deep to trapezius:

1. **levator scapulae:** named according to its function.

- **origin:** the neck.
- **insertion:** medial superior angle of scapula.
- **Action:** pulls the scapula up.

2. **Rhomboids muscles:** two muscles, rhomboid major and rhomboid minor, rhomboid in shape.

- **Origin:** vertebral column
- **Insertion:** run obliquely and insert into medial border of scapula.
- **Action:** elevate and adduct the scapula.



8. Other muscles:

1. **Serratus anterior:** beside the chest.

- **Origin:** upper 8 or 9 ribs
- **Insertion:** medial border of scapula.
- **Action:** abducts the scapula and rotates the scapula superiorly.

2. **Serratus posterior inferior:** made up of several parts.

3. **Teres major:** inferior to the teres minor.

- **Origin:** dorsal surface of the inferior angle of the scapula.
- **Insertion:** intertubercle sulcus of humerus.
- **Action:** helps in adduction and medial rotation of arm, extends the arm.

Teres minor

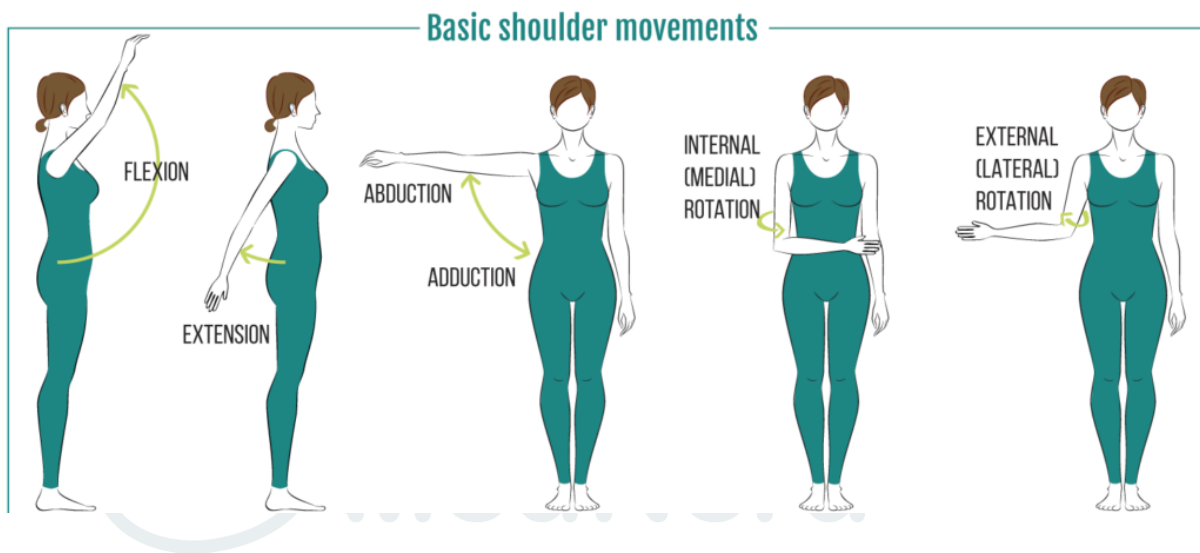


Note: The muscles that move the scapula:

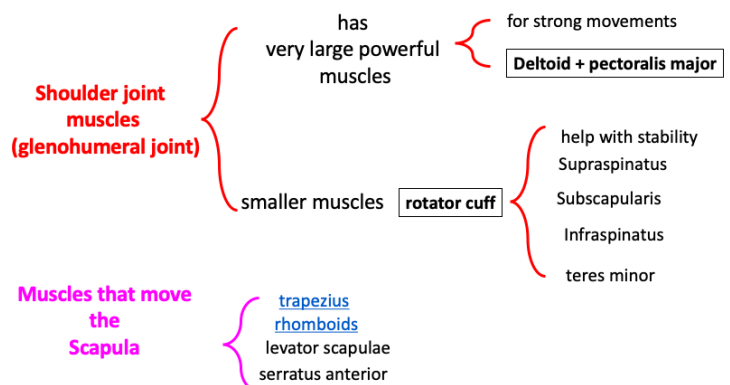
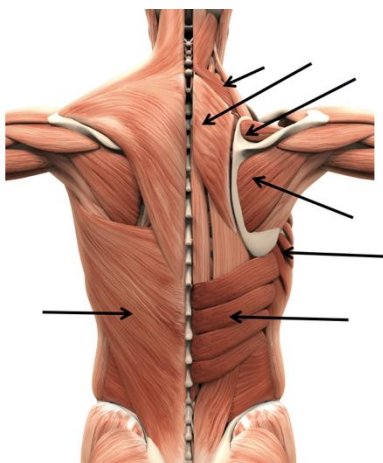
- ✓ Trapezius
- ✓ Rhomboid muscles
- ✓ Levator scapulae
- ✓ Serratus anterior
- ✓ Pectoralis minor

Basic shoulder movements:

- **Flexion:** lifting the upper limb up away from the trunk, but in a sagittal section.
- **Extension:** moving the upper limb backward.
- **Hyperextension:** moving the upper limb more backward
- **Abduction:** moving the upper limb away from the body.
- **Adduction:** moving the upper limb towards the body.
- **Internal(medial) rotation:** making the arm at the side of the body and the forearm in front of the abdomen, so the humerus axis move medially and its anterior parts become medial.
- **External(lateral) rotation:** making the arm at the side of the body and the forearm away from the trunk, so the humerus axis move laterally and its anterior parts become lateral.



Test you self:



Good Luck