لجان الدفعات

ANATOMY

MORPHINE ACADEMY

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8.3 9.9 12 15.6 19.66 25.66

Colors

Grid Spectrum Sliders

OPACITY

100%

Syste

Dr. Mustafa Saad
(2021)

فقرة اختيار لونين
أصعب من التفريغ
نفسه

The Muscular System

Dr. Mustafa Saad
(2021)

Muscular Tissue

Muscular tissue is the type of tissue whose cells are differentiated to optimally use the contractile ability of the cells.

بتحلوا تمايز

ومنهم بيشكلوا الـ smooth

ومنهم بيشكلوا الـ cardiac

الـ skeletal

Cell membrane = Sarcolemma (ح يعيراسمه ساركوليما)

Cytoplasm = Sarcoplasm (ساركوبلازم)

Smooth endoplamsic reticulum = Sarcoplasmic reticulum

ساركوبلازمك ريتيكيولر

Types of Muscle Cells

- Muscle cells are relatively long, therefore, they're called *muscle fibers* لل muscle cells لانو شكلها بكون elongated (طويل)
- There are three types of muscle cells:

muscular cells الفنكشن لل يحملوا contraction انكماش/انقباض

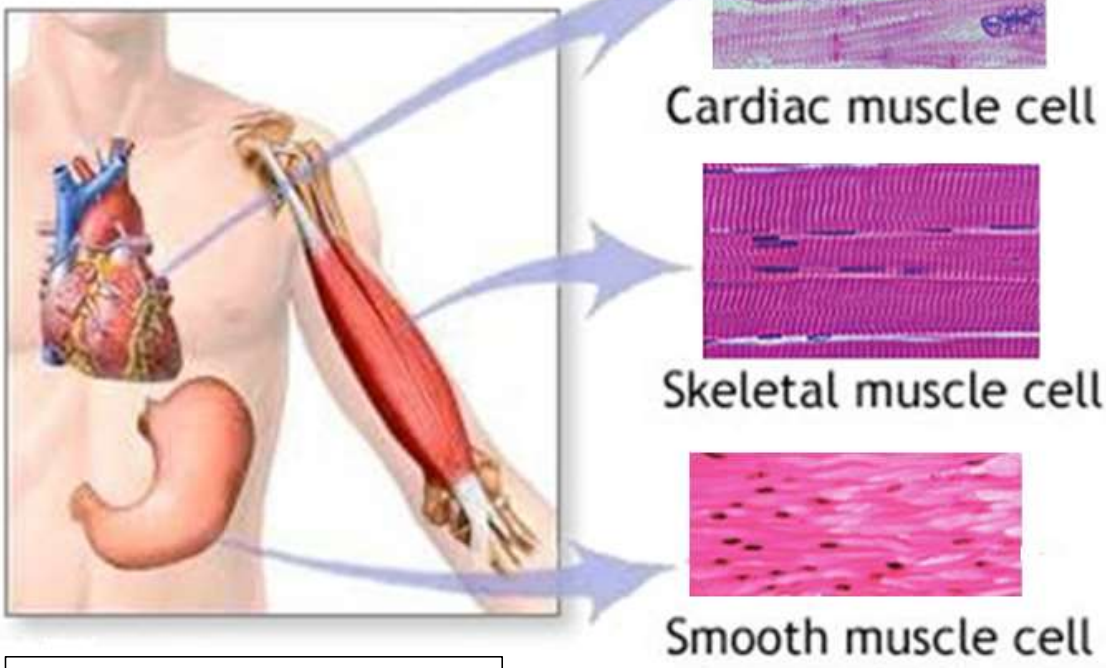
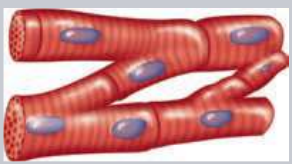


Fig.1: Types of muscle cells.

Comparison between the three types of muscle cells:

	Skeletal	Cardiac	Smooth
Location	Attached to bones	The heart	Internal organs and skin
Shape	Elongated and cylindrical 	Branched 	Spindle 
Nucleus	Several peripherally located nuclei	Single centrally located nucleus	Single centrally located nucleus
Striation	Striated	Striated	Non-striated
Function	• Movement of bone • Heat production	Beating of the heart	Movement of the viscera
Control	Voluntary	Involuntary	Involuntary

Notes

- Smooth muscle cells are held together by desmosomes. Also, gap junctions are present between the cells to allow the spread of Ca^{2+} (and thus contraction) rapidly between them.

- The branches of cardiac muscle cells meat each other at specialized structures called the ***intercalated discs*** which also contain desmosomes and gap junctions.

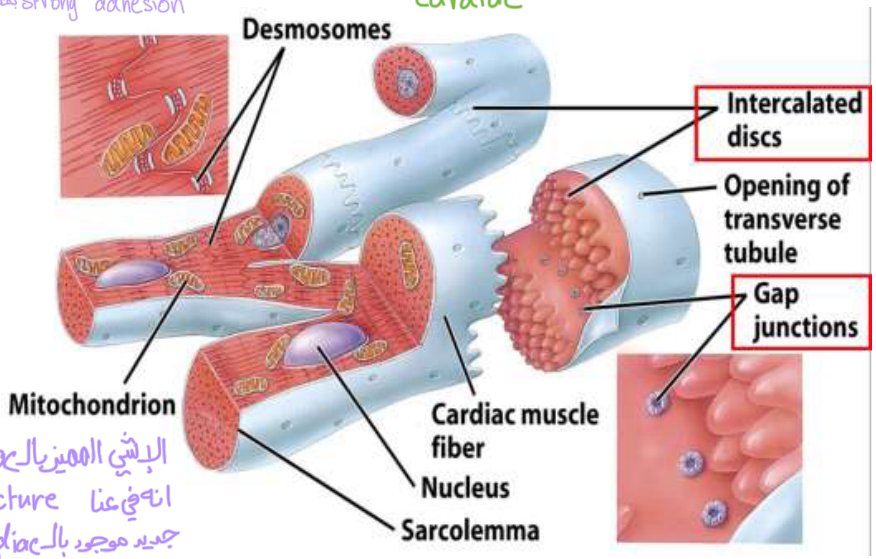


Fig.2: Cardiac muscle cells.

هو اذا متذكرين كيف كان شكل الـ nerve : عبارة عن مجموعة من bundles وكل واحد من هدول الـ bundles هو
بحتوي على مجموعة من neurons وكل واحد من هدول الـ neurons ممكن يكون عليه myelin sheath فهون نفس الاشي لكن
بكون more complex / بكون عنا هون الـ muscle عبارة عن مجموعة من bundles وكل واحد منهم عبارة عن مجموعة من cells

- Skeletal muscles are formed of several bundles of skeletal muscle cells. They are attached by tendons to bones.
- When a skeletal muscle contracts, the tendon will be pulled and this will pull the bone resulting in Movement. لما يصير عنا contra. هاض الاشي رح يسمح لل bone انها تتحرك
- The **belly** of the muscle is the fleshy (wide) part between the tendons. (أربطة) tendon كل جزء أو طرف من الـ muscle بكون الها ؟ muscle هو الـ bone كيف رح ترتبط بال

فهي الي بتربطها بالبون فلما تعمل contra. الـ muscle رح تشد ورح تسحب معاها الـ tendon وبالتالي رح تحرك معاها البون

- Muscles have more than one bony attachment:
  - the attachment of a tendon to the relatively stationary bone is called the **origin**.
  - the attachment of the muscle's other tendon to the relatively movable bone is called the **insertion**.
  - the **action/s** of a muscle are the main movements that occur during contraction (e.g., flexion or extension).

الجزء الي بكون بين الـ 2 tendons (بين الطرفين) والي هو رح يصير فيه contract..
هاض بنسميه بطن العضلة belly الي هو الجزء الطري من العضلة fleshy part

هو حكينا انه كل muscle الها طرفين وكل طرف فيه tendon وهاض رح يوصله مع وحدة من العظمات

هو في ٣ مصطلحات لازم نكون عارفينهم بال muscles : ① Origin ② Insertion ③ action

يعني الـ origin هو المكان الي طلعت منه العضلة ، بدي افترض انه هو نقطة البداية ، والـ inser. هي نقطة النهاية يعني واحد من الـ tendon واصل نقطة Ⓐ والثاني واصل Ⓑ والـ action تجيب Ⓑ الى Ⓐ

شو يعني هاض الاشي؟

الـ action بتحت اي muscle بتحمل Bring الـ inse ← to the ori.

أنا على أي اساس بحدد هاض ori/inse

المكان الي رح توصل فيه هاي الـ tendon ممكن يكون origin وممكن يكون insertion.

Organization of Skeletal muscles:

- Skeletal muscles are formed of several bundles of muscle fibers.

- Each fiber is surrounded by **Endomysium**: a loose areolar connective tissue layer. Each bundle is surrounded by connective tissue **Perimysium**. The whole muscle is surrounded by **Epimysium**: a dense connective tissue layer.

- The collagen fibers in these three connective tissue layers will extend beyond the fleshy part of the muscle to form the cord-like tendons or the broad aponeuroses that attach muscles to bones.

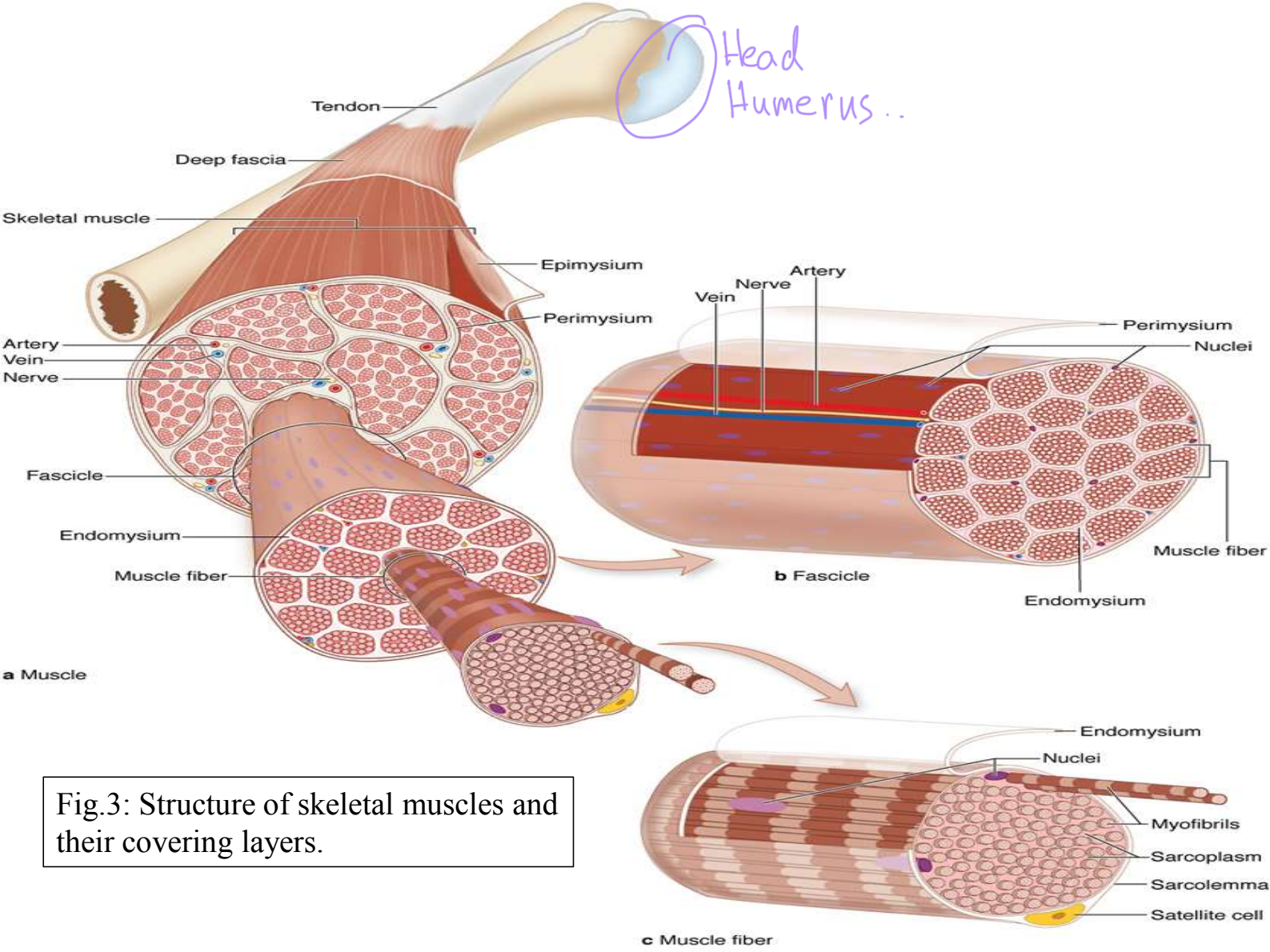


Fig.3: Structure of skeletal muscles and their covering layers.

Cross-Striation of skeletal and cardiac muscle cells:

- ✓ Skeletal and cardiac muscle fibers, under the LM, appear to have alternating dark and light areas. These are called the A and I bands respectively. The banding is due to the regular arrangement of the thin myofilament Actin and the thick myofilament Myosin.

Fig.4: Striation under light microscope.

- ✓ Under the EM, this arrangement proves to be more complex.

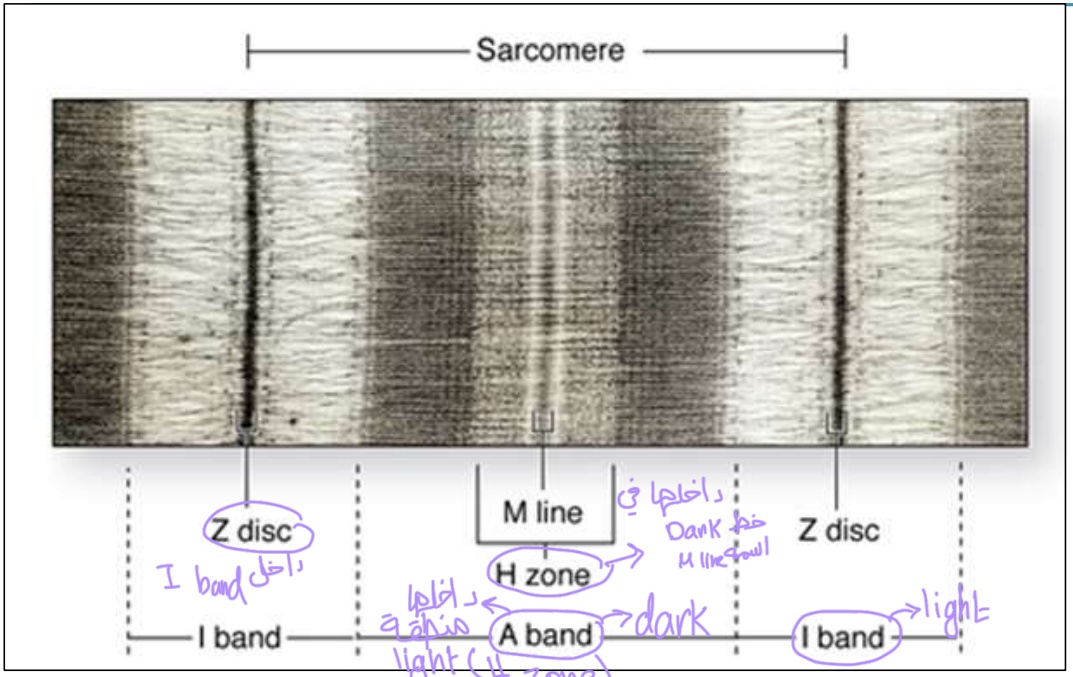
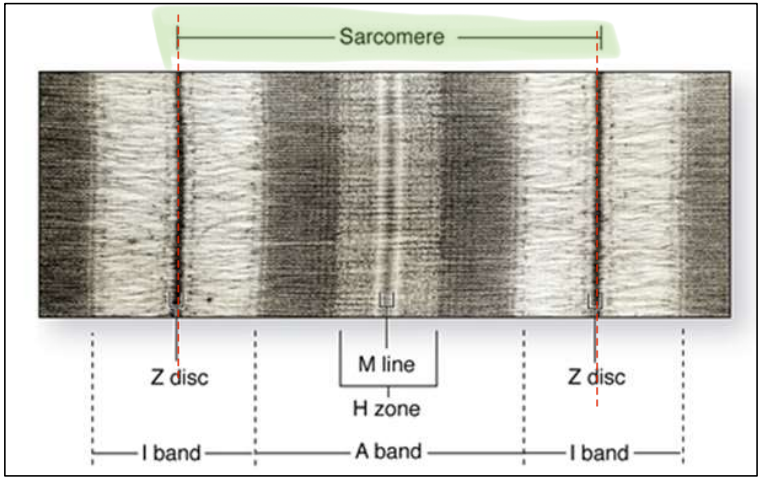
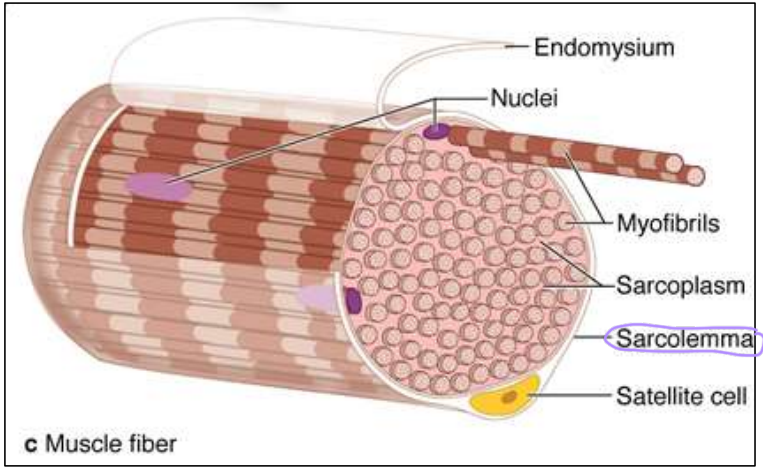


Fig.5: Striation under electron microscope.

- ✓ ***H Zone***: a lighter colored area within the A band.
- ✓ ***M Line***: darker colored line in the middle of the H zone.
- ✓ ***Z Disc (Line)***: a dark line in the middle of the light I band.



✓ ***The Sarcomere***: is the repetitive functional subunit of the contraction apparatus. It extends from one Z-line to the next Z-line.



✓ Several sarcomeres arranged end-to-end form the cylindrical myofibrils. Each muscle fiber contain several myofibrils.

Fig.6: Sarcomeres and myofibrils.

Muscle Regeneration

- Skeletal muscle cells cannot divide. Inactive ***Satellite cells*** are present close to the muscle fibers. When injury occurs, the satellite cells become active, divide and form new skeletal muscle fibers. This is also thought to be the mechanism by which skeletal muscles hypertorphy after exercise.

- Cardiac muscles cannot divide and they lack satellite cells. After injury, the damaged muscles are replaced by a connective tissue scar.

- Smooth muscle cells can divide, and, therefore, can easily replace damaged cells.

Muscles Of The Head

Muscles Of Facial Expression

تعابير الوجه

- Muscles of facial expression:
  - Lie within the subcutaneous layer. (الطبقة الثالثة من skin)
  - Usually originate from skull bones & insert into the skin.
  - Are all supplied by the Facial nerve. (الـ nerve اللي بتتحكم فيه اسمه)
- Because of their insertions, the muscles of facial expression move the skin rather than a joint when they contract. Because of this, these muscle produce the wide variety of facial expressions that humans have.

Zygomaticus major – The muscle of true smile

Risorius – The muscle of false smile (probably present only in humans and gorillas)

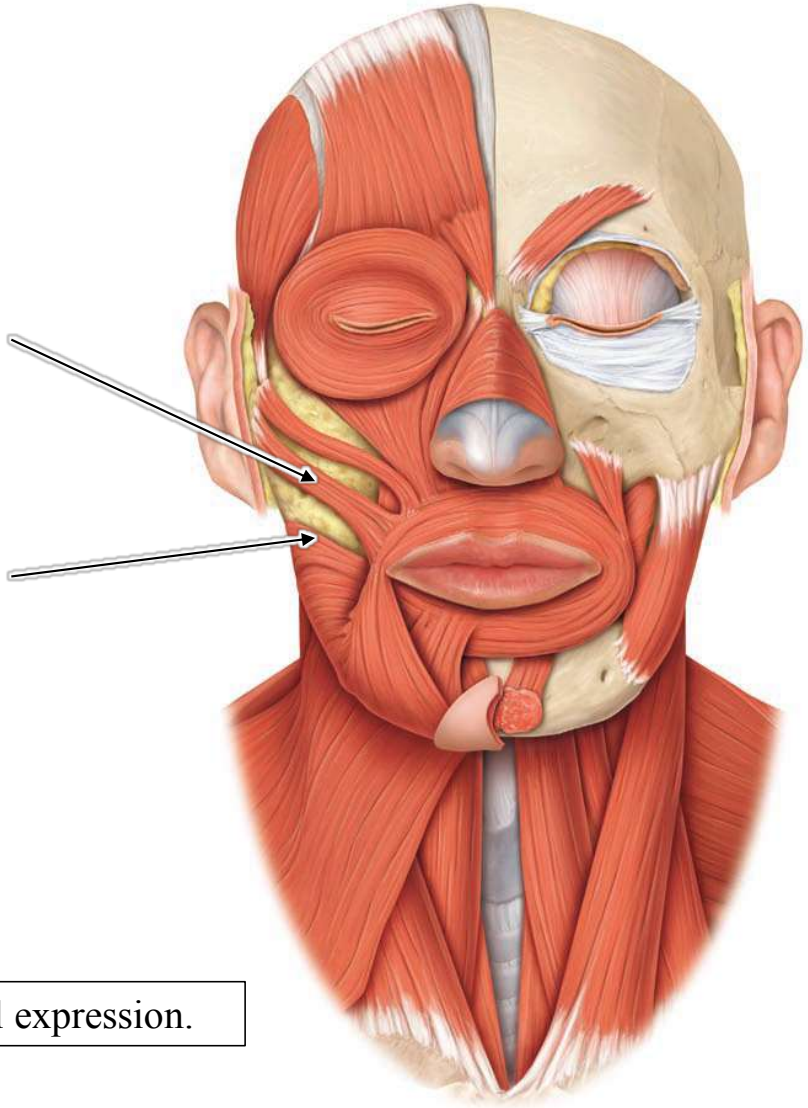


Fig.7: Muscles of facial expression.

Muscles of Mastication (Chewing)

- Four pairs of muscles move the mandible, and are known as 'muscles of mastication'.
- They are all supplied by the **mandibular branch of the trigeminal nerve.**
- The **masseter, temporalis,** and **medial pterygoid** close the mouth and account for the strength of the bite.
- The medial and **lateral pterygoid** muscles help to chew by moving the mandible from side to side.
- The lateral pterygoid is also the main depresseser of the mandible as in opening the mouth. Note that **Gravity** assists in depressing the mandible (plus other muscles).

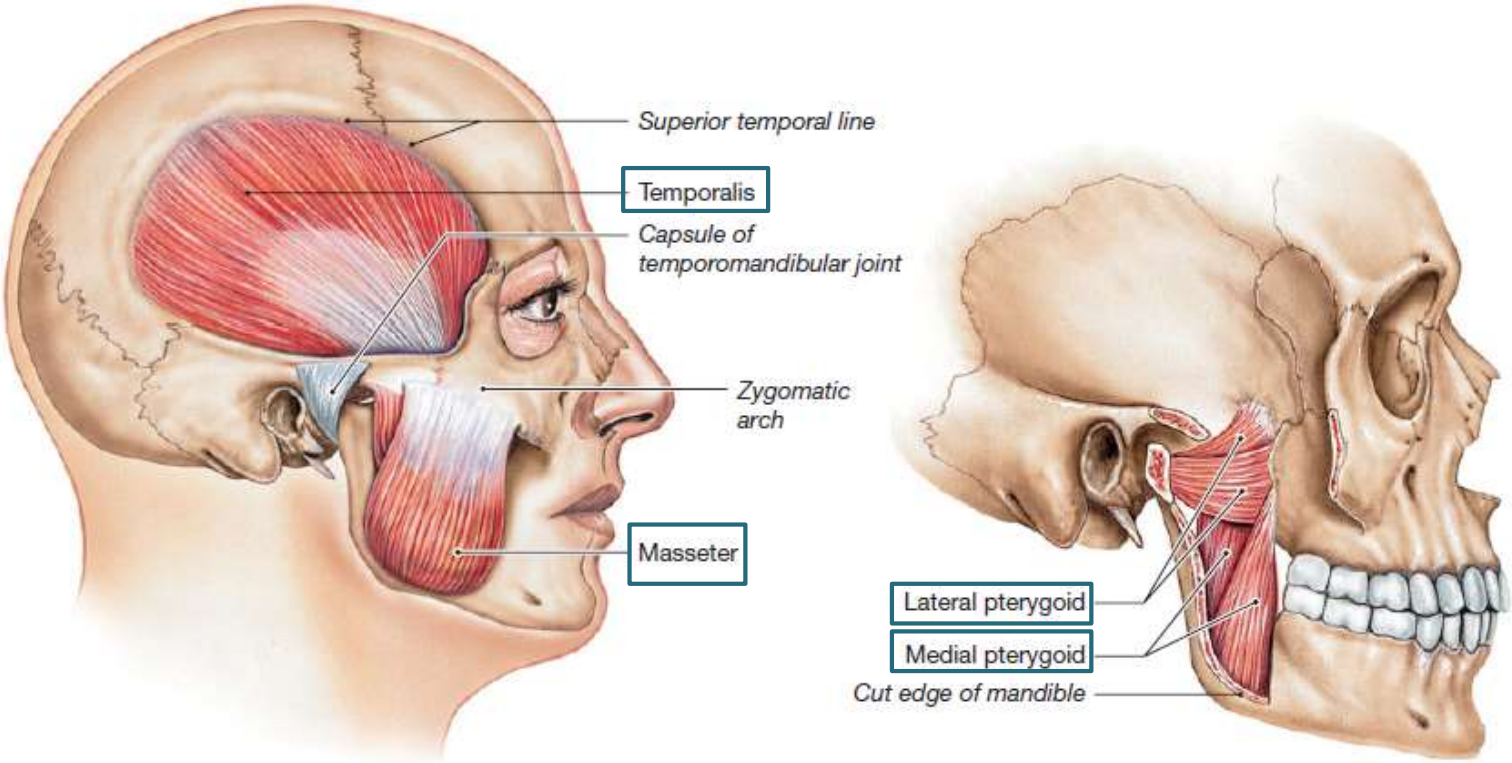


Fig.8: Muscles of mastication.

Muscles Of The Tongue

- Muscle of the tongue include:
  - Intrinsic muscles (originate and insert within tongue). These are responsible for changing the shape of the tongue.
  - Extrinsic muscles (originate outside the tongue, insert into tongue). These are responsible for moving the tongue.
- Genioglossus is one of these extrinsic muscles. It moves the tongue forwards.
- All muscles of the tongue are supplied by the Hypoglossal nerve, except the palatoglossus.

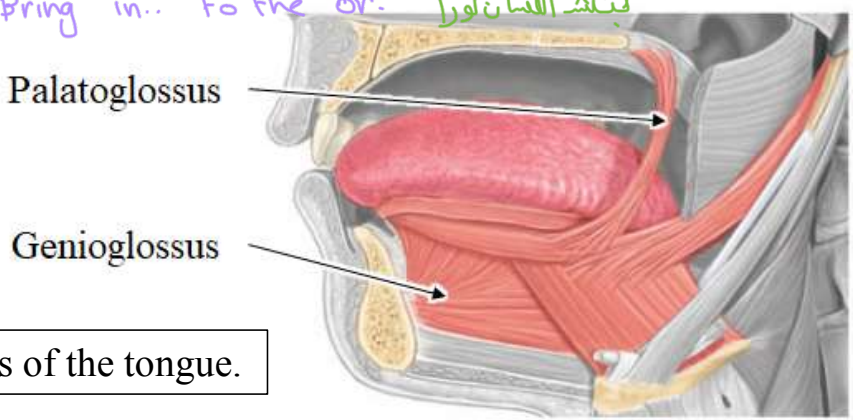


Fig.9: Muscles of the tongue.

Muscles Of The Neck

- The **Sternocleidomastoid** (SCM) muscle is an important anatomical landmark in the neck. It divides the neck into an anterior and a posterior triangle.

- The SCM muscle arises from the sternum and clavicle and is inserted into the mastoid process and the occipital bone. Its motor supply is by the accessory (XI) nerve. If the muscles on both sides contract, they'll flex the head. If the SCM muscle of one side contracts, it'll rotate the head to the opposite side.

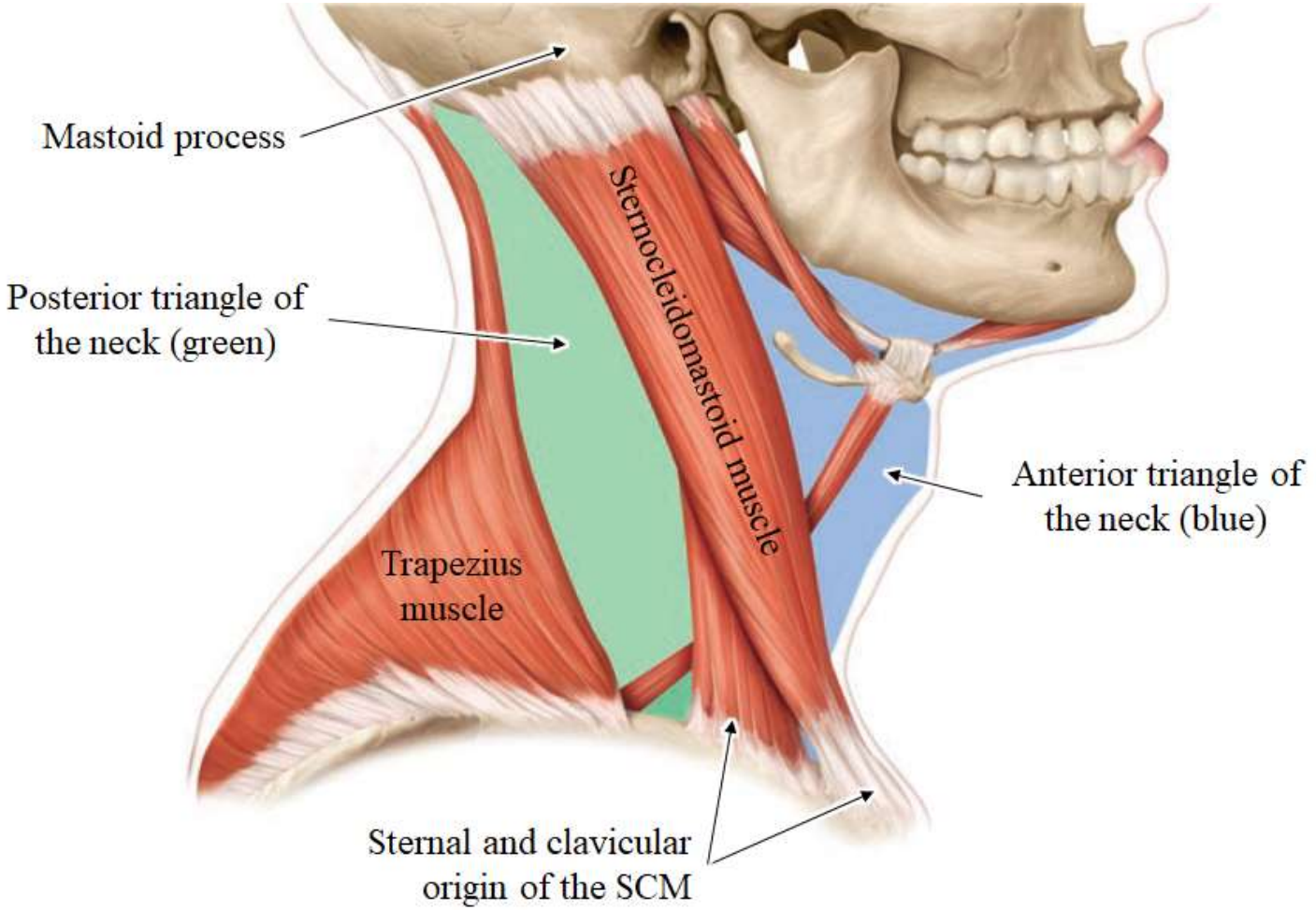


Fig.10: The sternocleidomastoid muscle.

A. *Anterior Triangle:*

1. **Anterior border**: midline
2. **Posterior border**: SCM muscle
3. **Superior border**: Mandible

B. *Posterior Triangle:*

1. **Anterior border**: SCM muscle
2. **Posterior border**: Trapezius muscle
3. **Inferior border**: Clavicle

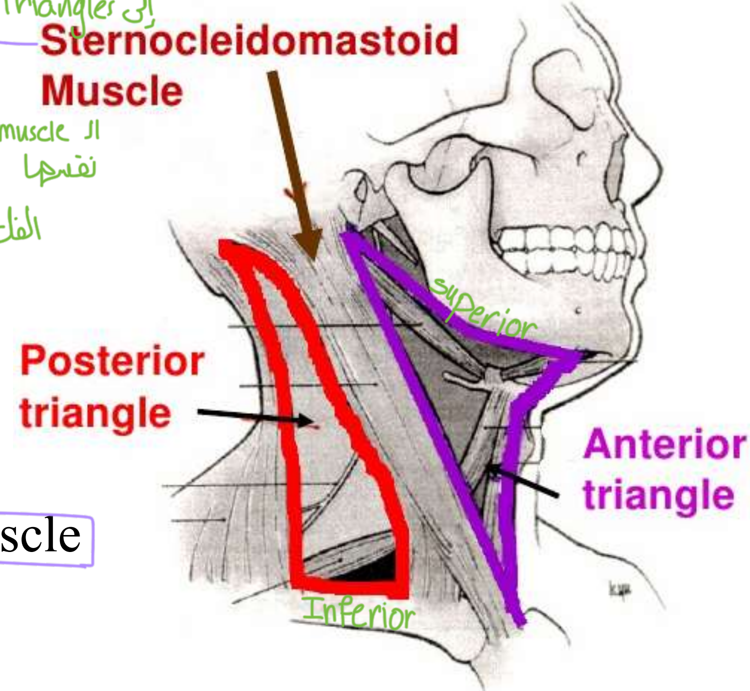


Fig.11: Boundaries of the triangles of the neck.

- In the ***anterior part of the neck***, we have the *suprahyoid* and *infrahyoid* muscles. These muscles move the hyoid bone and perform other functions.

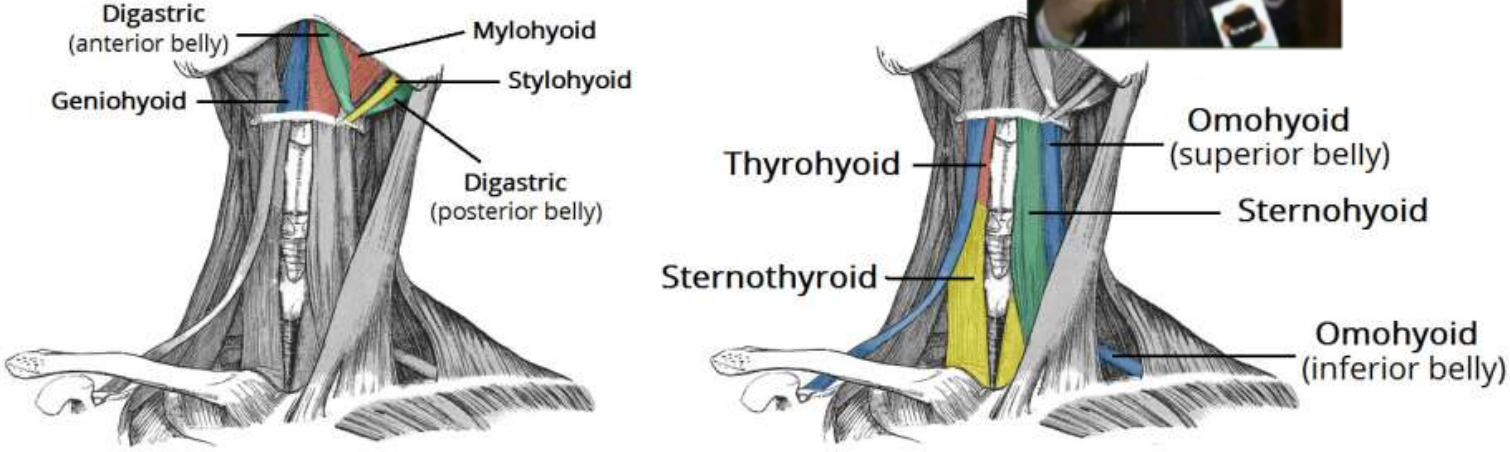


Fig.12: The suprahyoid (left) and infrahyoid muscles (right).

- In the ***lateral part of the neck***, we have the *scaleni* muscles. *Scalenus anterior* is an important landmark in the neck with several important relations. Among these relations we have: the subclavian artery and vein and the trunks of the brachial plexus.

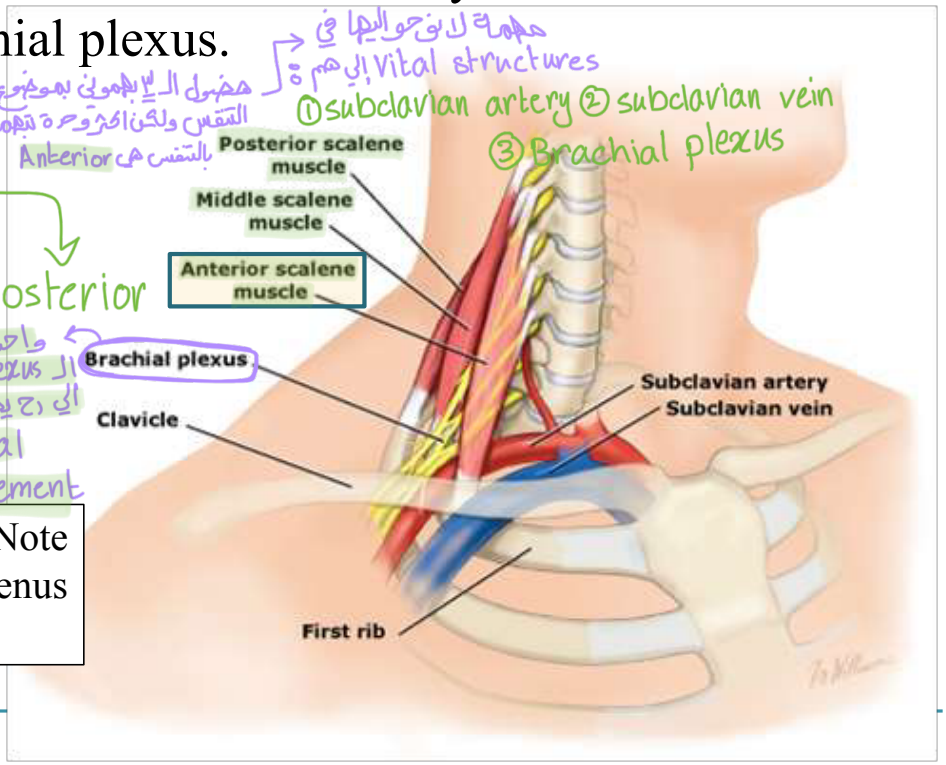


Fig.13: The scaleni. Note the relations of the scalenus anterior muscle.

Respiratory Muscles Of The Thorax

- Respiratory muscles alter the size of the thoracic cavity which affects the pressure in the lungs, and that determines whether we inhale or exhale.

- Between the ribs we have the intercostal muscles arranged in three layers: the **external, internal, and innermost intercostal muscles.** Between the internal and innermost intercostal muscles, we have the intercostal nerve and vessels.

- There are also a number of accessory muscles useful in forced breathing: SCM and the scaleni muscles.

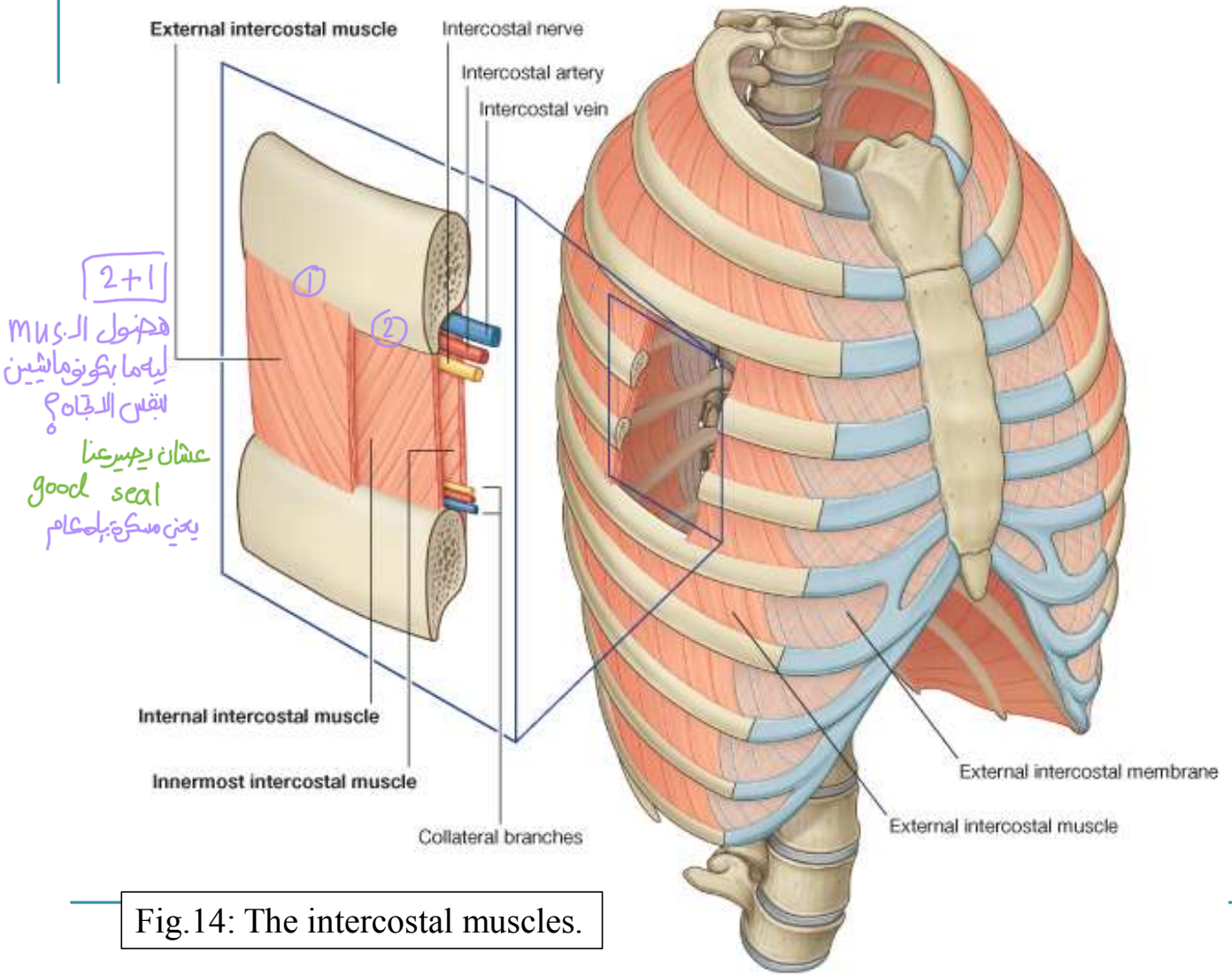


Fig.14: The intercostal muscles.

The Diaphragm

The diaphragm is the most important muscle of respiration

Muscle	Origin	Insertion	Nerve	Action
Diaphragm	1) **Sternal part**: Xiphoid process 2) **Costal part**: Lower 6 costal cartilages and adjacent ribs 3) **Vertebral part**: Upper 3 lumbar vertebrae and their discs	All muscle fibers converge to be inserted into a centrally located tendon	Phrenic nerve	Contraction of the diaphragm increases vertical diameter of thoracic cage causing inhalation. Its relaxation leads to exhalation.

فيها ٣ ثقوب :-

① ثقب رح يمر فيه Esophagus اي هالمري ؛ عشان يدخل للمعدة

② الثقب الثاني رح يمر فيه Abdominal Aorta

③ الثالث رح يمر فيه (IVC) Inferior Vena Cava

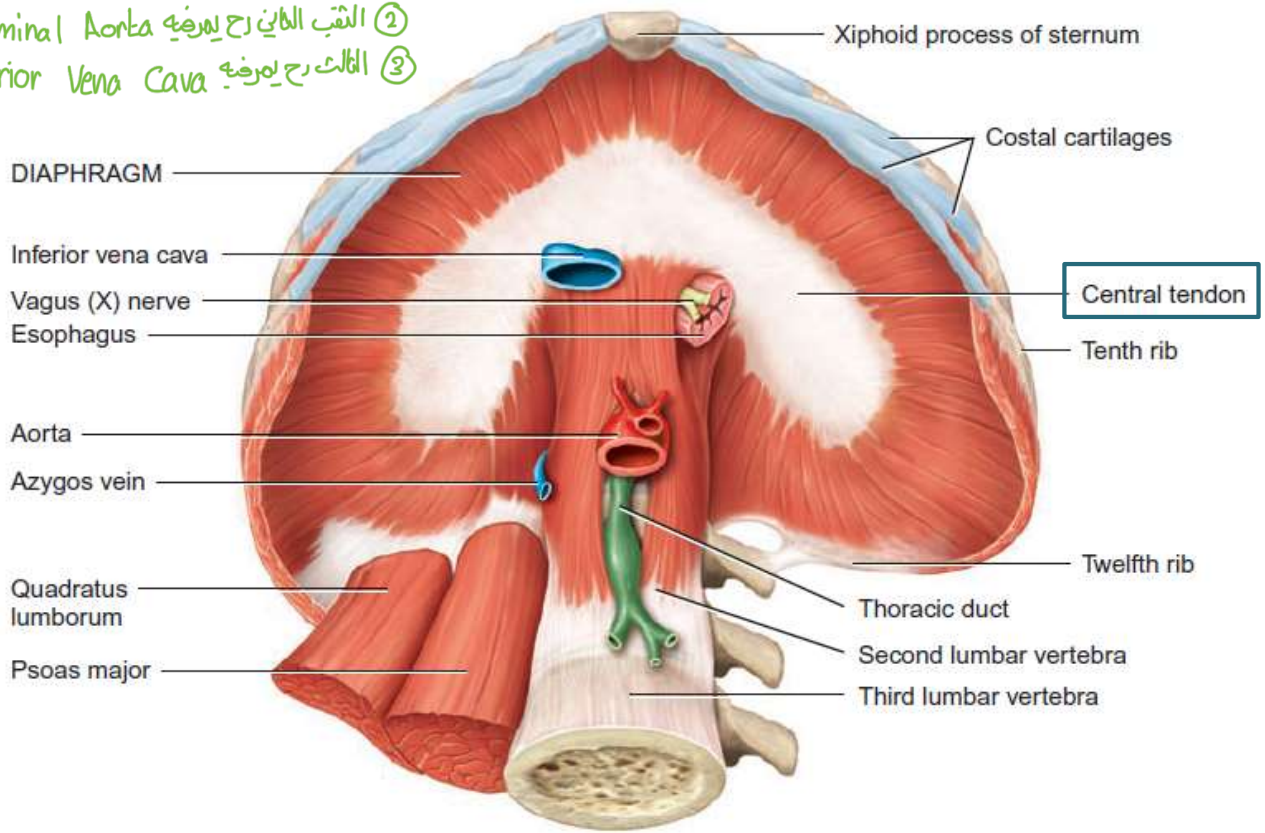


Fig.15: The diaphragm.

Anterolateral Abdominal Wall Muscles

- Include the **external oblique, internal oblique, and transversus abdominis.**

- The aponeurosis (broad tendon) of the external oblique forms the thick **inguinal ligament** inferiorly.
- The aponeuroses of these 3 muscles form the **rectus sheaths** which enclose the **rectus abdominis muscles**. The sheaths meat each other in the midline to form the **linea alba**, a connective tissue band extending from the xiphoid process to the pubic symphysis.

- **Actions:**
  1. They retain the organs within the abdominal cavity.
  2. The rectus abdominis flexes the lumbar vertebrae.
  3. They assist in micturition, defecation, vomiting, and labor.
  4. They assist in expiration.

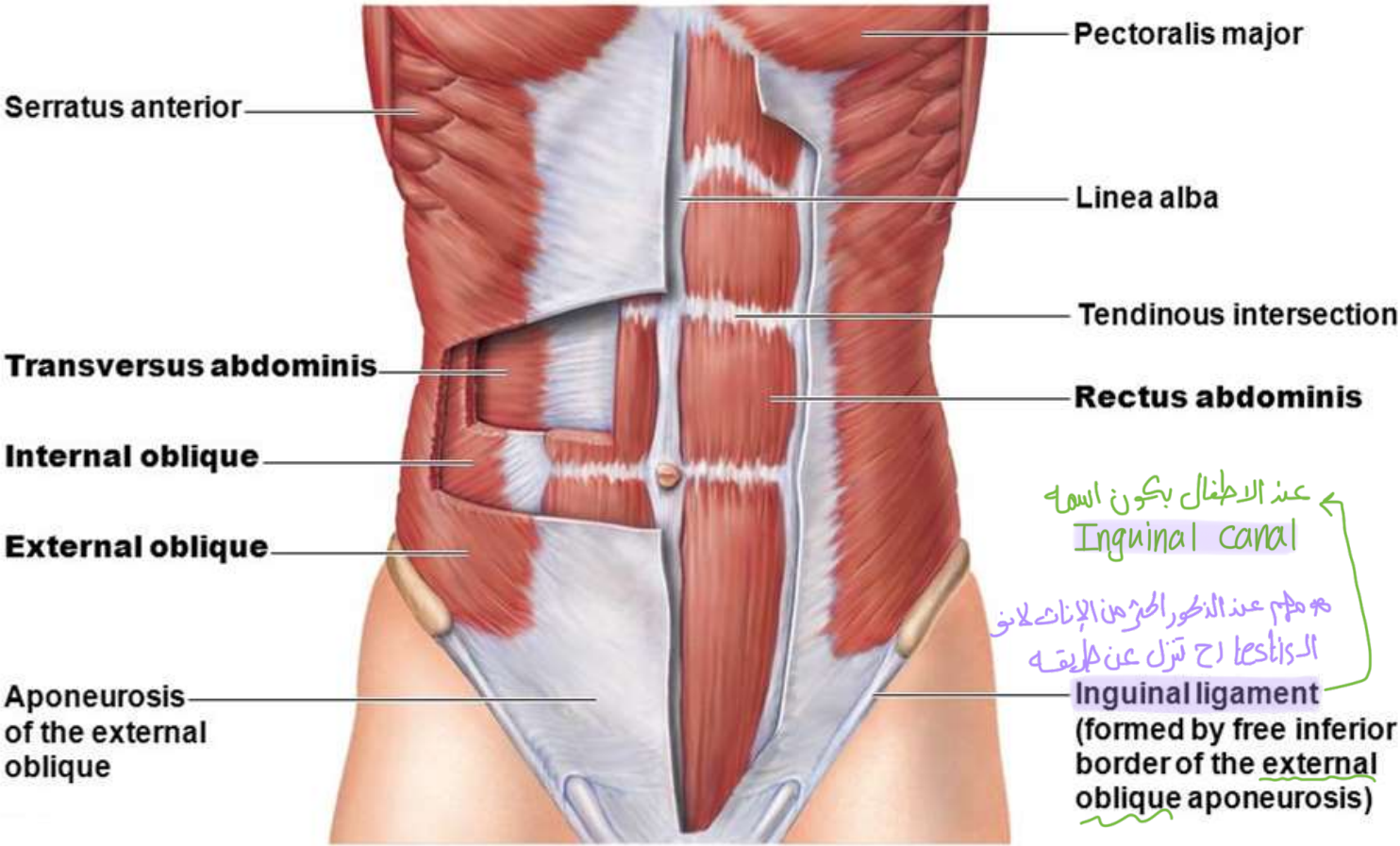


Fig.16: Anterior abdominal wall muscles.

Posterior Abdominal Wall Muscles

- Muscles of the posterior abdominal wall perform different functions.

- The most important are the ***psoas major*** and ***iliacus*** muscles. They are inserted by a common tendon into the thigh. When they contract, they flex the thigh on the trunk; if the thigh is fixed, they flex the trunk on the thigh.

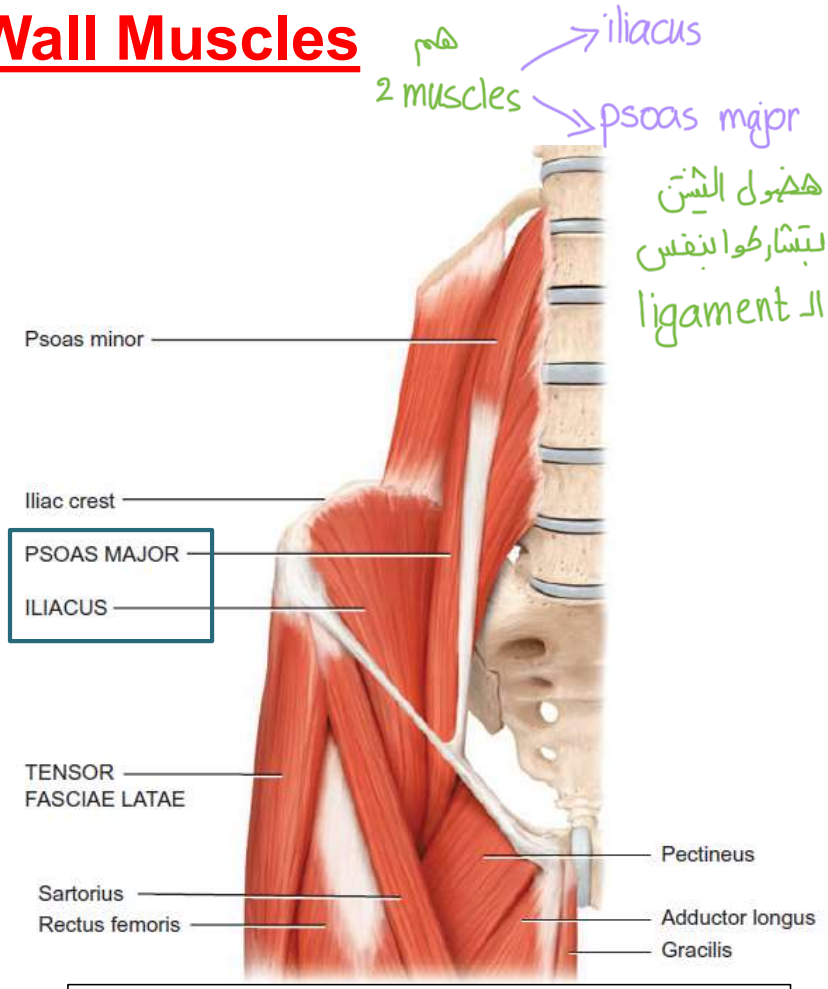


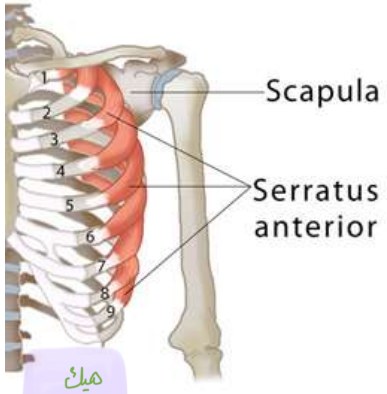
Fig.17: Posterior abdominal wall muscles.

Muscles Of The Upper Limb

Muscles that move the Pectoral Girdle

- Several muscles move and stabilize the pectoral girdle.
- The ***serratus anterior*** (punching) muscle fixes the scapula in position.
- ***Trapezius*** is a large muscle seen on the back. With the serratus anterior muscle, it rotates the scapula so that its glenoid cavity is raised. This allows the arm to be abducted above the head.

Trapezius



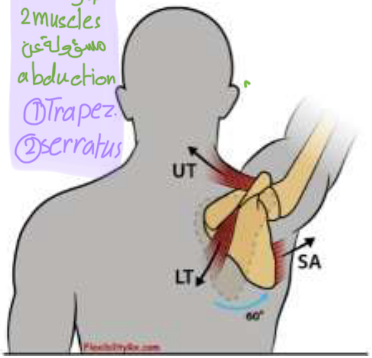
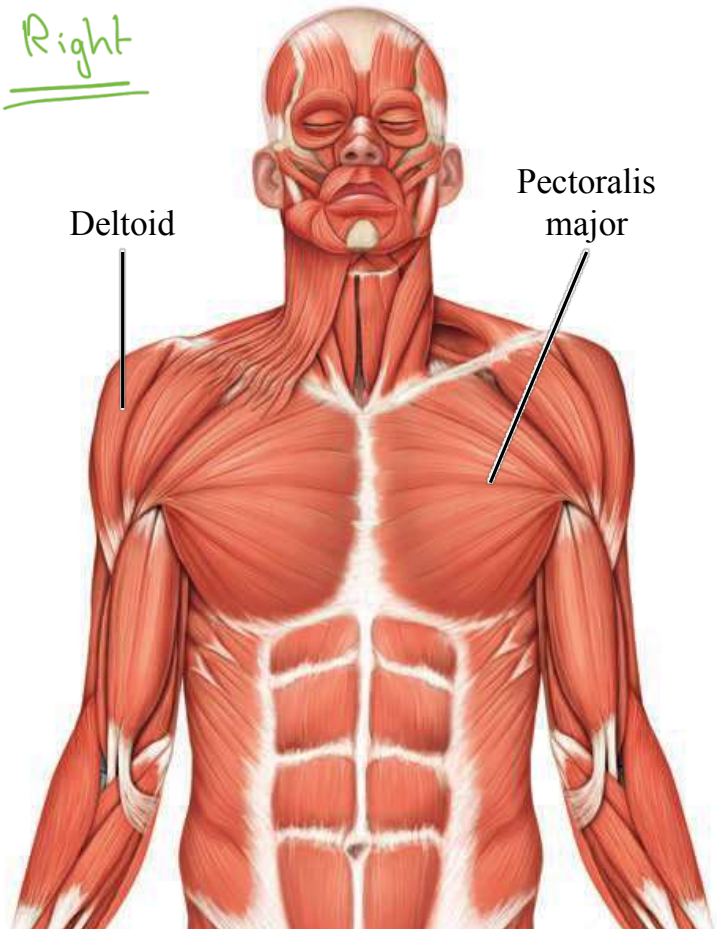


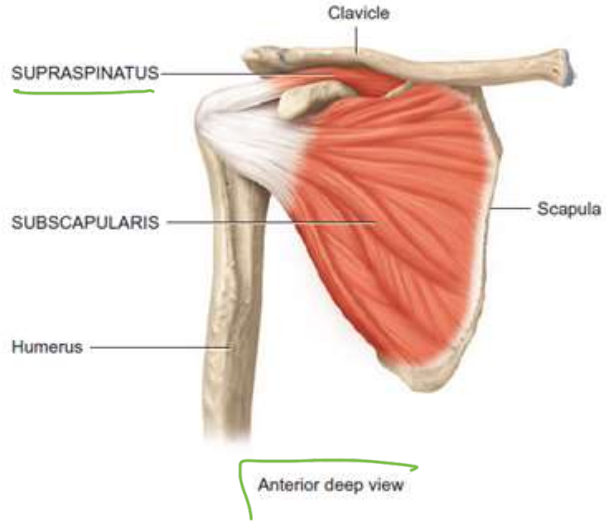
Fig.18 anteric trapezi action

Muscles of shoulder and thorax that move the humerus

- The ***deltoid*** muscle arises from the clavicle and scapula and is inserted into the shaft of the humerus. It flexes, abducts, and extends the humerus.
- The ***rotator cuff*** muscles (***subscapularis***, ***supraspinatous***, ***infraspinatous***, and ***teres minor***) arise from the scapula. Their tendons blend with the capsule of the shoulder joint stabilizing it. In addition, the supraspinatous initiates abduction of the arm.
- The ***pectoralis major*** is a big anterior muscle that arises from the clavicle, sternum, and costal cartilages to be inserted into the humerus. It flexes, adducts, and medially rotates the arm. It's one of the main muscle used in swimming.

Right





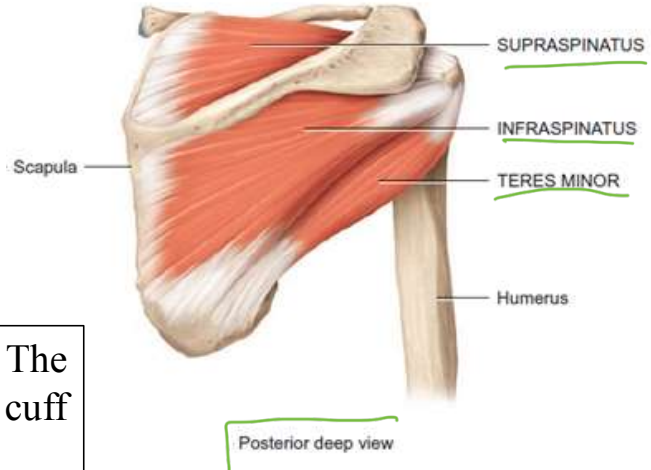


Fig.19: Deltoid and pectoralis major muscle. The two views of the scapula show the rotator cuff muscles.

Muscles of the arm (that move the forearm)

- The **biceps brachii, brachialis, and brachioradialis** are flexors. The **triceps brachii** extends the forearm.
- The biceps has two heads of origin. The long head passes through the intertubercular sulcus of the humerus. The biceps inserts into the radial tuberosity.
- It also forms an aponeurosis that inserts medially into fascia and that protects the underlying brachial artery and median nerve as they pass in the cubital fossa.

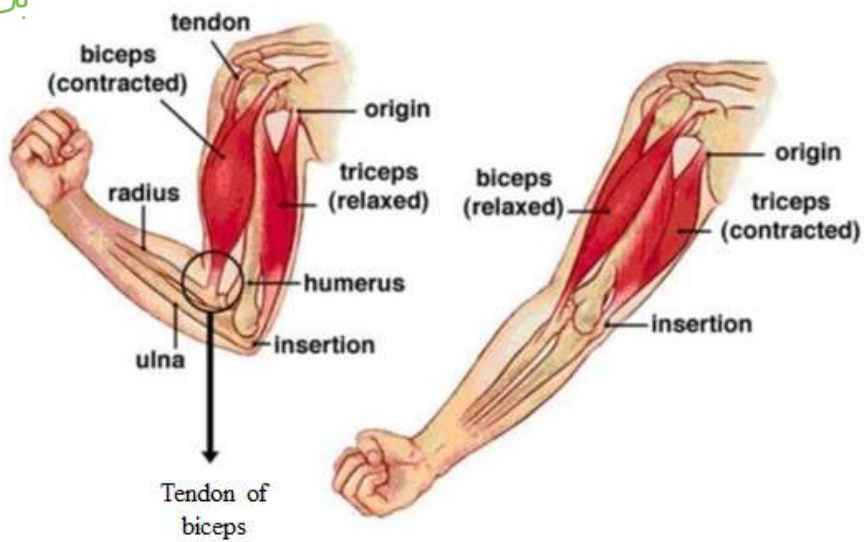


Fig.20: The biceps and triceps muscles.

The Cubital Fossa:

تجويف على شكل مثلث

- Shallow triangular depression anterior to elbow joint.
- Tendon of biceps, brachial artery and median nerve pass through it.
- Site of measuring brachial artery pulse and taking blood pressure.

هاي المنطقة بقيسوا منها الضغط بتيع الدم وكمان بسحب الدم وقياس النبض

- The superficial veins passing in the skin overlying this fossa can be used to take blood samples.

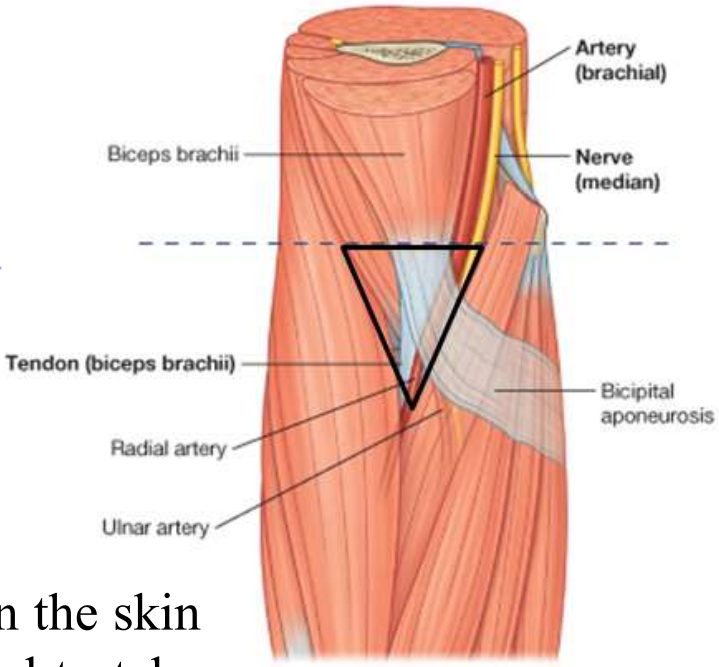


Fig.21: The cubital fossa.

Muscles of the Forearm

- Muscles in this group that act on the wrist and fingers are known as **extrinsic muscles of the hand** because they originate *outside* the hand and *insert* within it.
- Based on location and function, these muscles are divided into an **anterior (flexor) compartment** and a **posterior (extensor) compartment**.
- Anconeus, supinator and pronator quadratus are muscles in the forearm that act on the forearm.

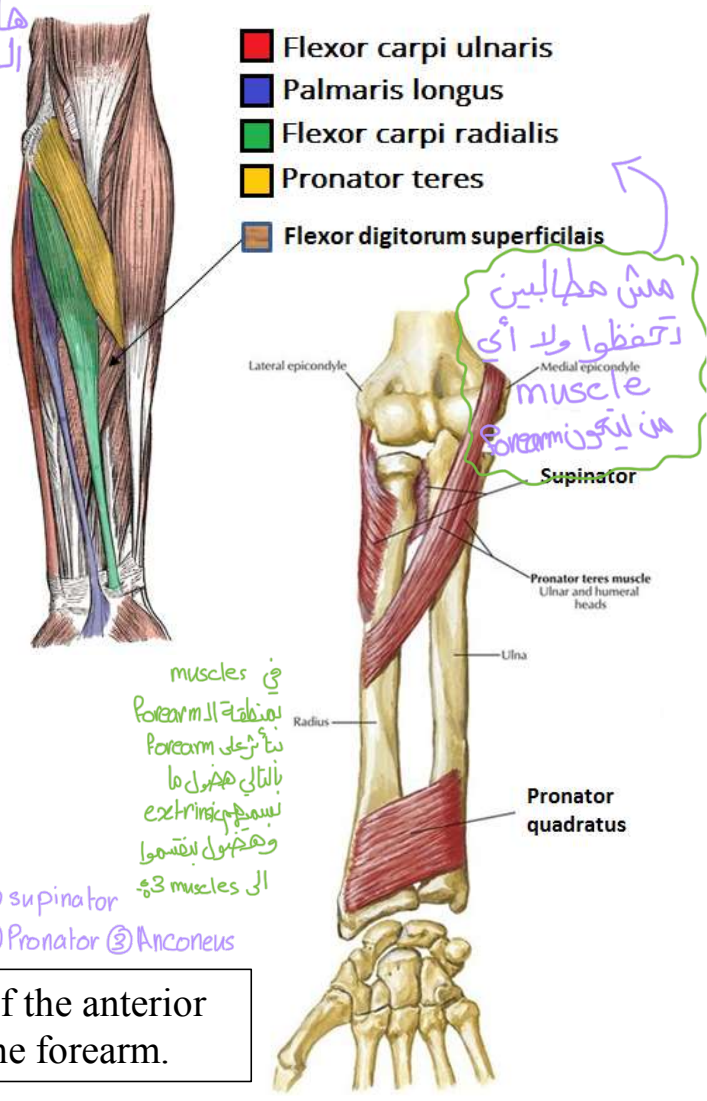


Fig.22: Muscles of the anterior compartment of the forearm.

- As the long muscles of the anterior forearm pass over the carpal bones, they are held in place by a thick band of connective tissue called the ***flexor retinaculum (transverse carpal ligament)***. This band with the carpal bones form a tunnel called the ***carpal tunnel***.
- Also passing through this tunnel is the median nerve.
- Certain conditions may affect this tunnel (like inflammation of the tendons or the joints) leading to compression of the median nerve. This is called ***Carpal Tunnel Syndrome***.

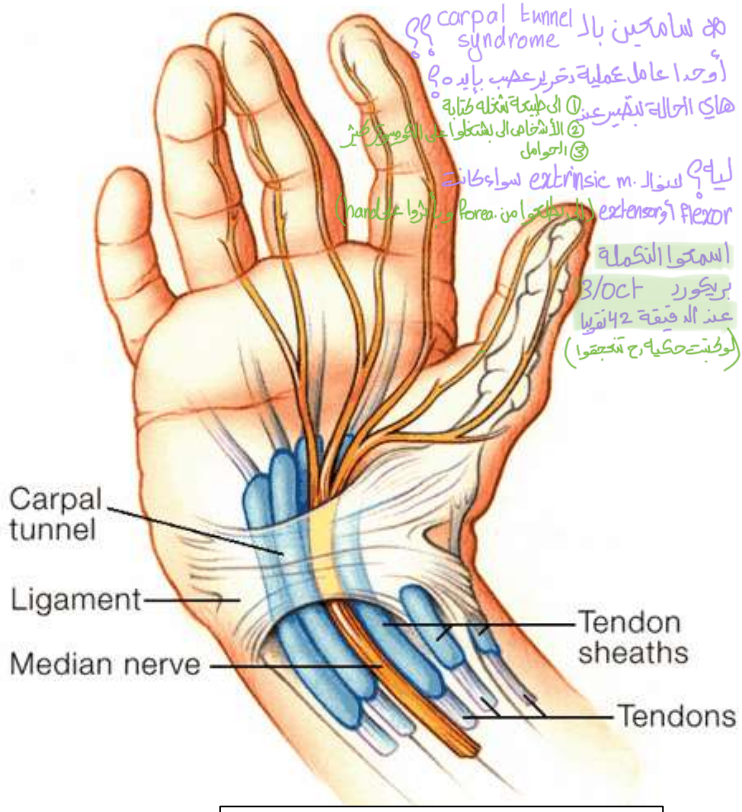
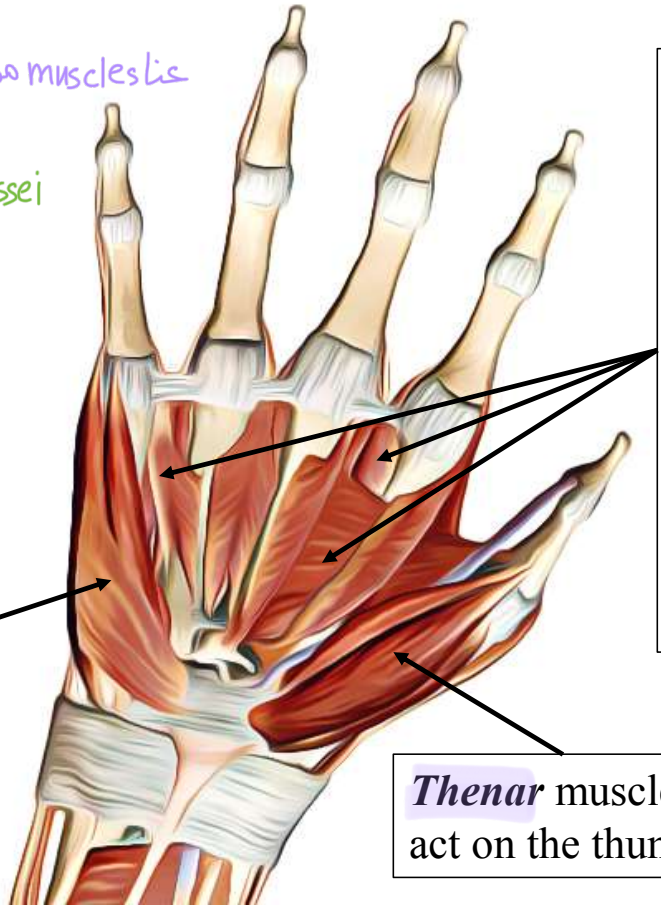


Fig.23: The carpal tunnel.

- The affected person may have pain in the hand, change in sensations and even weakness in the hand muscles supplied by the median nerve.

Movement of Forearm	Muscles that produce them
Flexion	Biceps Brachialis Brachioradialis
Extension	Triceps (Forearm) بمنطقة Anconeus (arm) بمنطقة
Supination	Biceps Supinator
Pronation	Pronator teres Pronator quadratus

Intrinsic Muscles of the Hand (3 groups)



- The intermediate group include the **lumbricals, the palmar and dorsal interossei**.
- The palmar interossei adduct the fingers towards the middle finger. The dorsal interossei abduct the fingers away from the middle finger

Hypothenar muscles act on the little finger

Thenar muscles act on the thumb

Fig.24: Intrinsic muscles of the hand.

Muscles Of The Lower Limb

- Lower limb muscles function in stability, locomotion, and maintaining posture. In contrast, upper limb muscles are characterized by versatility of movement.
- Muscles of the lower limbs often cross two joints and can act equally on both.
- Most muscles that move the femur originate from the pelvic girdle and insert on the femur.

Muscles of the Gluteal region (Buttocks)

Muscle	Action	Notes
Gluteus maximus	Extends thigh	With fat forms the buttocks
Gluteus medius	1. Abduct thigh 2. Medial rotation of thigh 3. Tilt hip	These muscles are essential in initiating walking, because they allow the legs to be lifted off the ground
Gluteus minimus		
Piriformis	1. Abduct thigh 2. Lateral rotation of the thigh	Between the piriformis and gemellus superior muscles is a small space through which pass the big Sciatic nerve
Gemellus superior		
Obturator internus		
Gemellus inferior		
Quadratus femoris		

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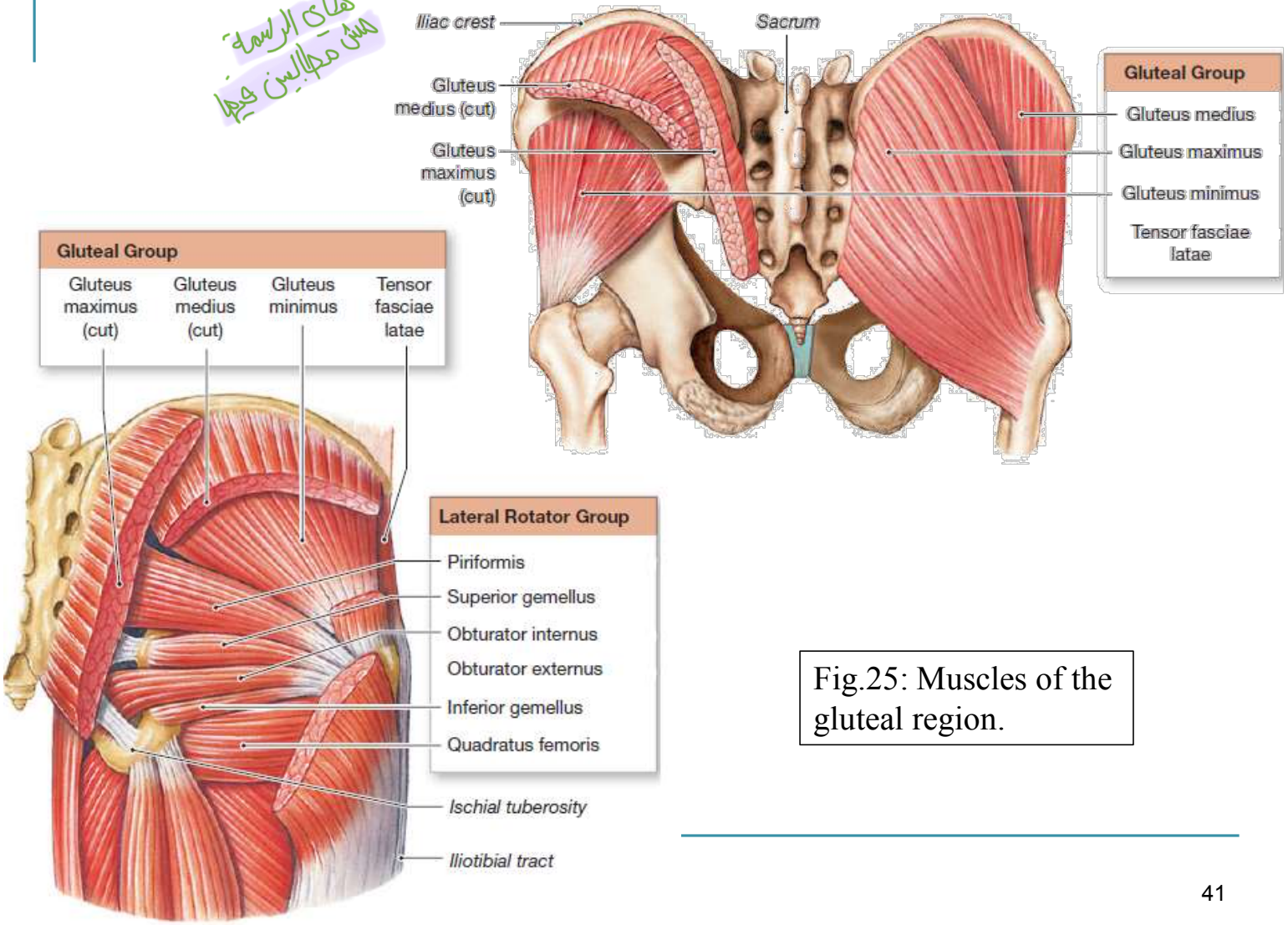

Fig.25: Muscles of the gluteal region.

Muscles of the Thigh

- Divided into anterior, medial, and posterior compartments.
  - **Anterior (extensor) compartment** of the thigh extend the leg (and flex the thigh). Supplied by the femoral nerve.
  - **Medial (adductor) compartment** of the thigh adduct the femur at the hip joint. Supplied by the obturator nerve.
  - **Posterior (flexor) compartment** of the thigh flex the leg (and extend the thigh). Supplied by the sciatic nerve.

- The **anterior compartment** of the thigh is divided into 2 triangles by the Sartorius muscle. The **sartorius** (cross-leg, tailor's) muscle is the longest muscle in the body. It originates from the anterior superior iliac spine and is inserted into the medial surface of the upper part of the shaft of tibia. It flexes, abduct and laterally rotates the thigh, it also flexes the leg.

- Below the sartorius, we have the **quadriceps femoris** muscle which is formed of the *rectus femoris, vastus medialis, vastus intermedius and vastus lateralis*. The tendon of the quadriceps inserts into the patellar base. The patellar ligament arises from the apex of the patella and inserts into the tibial tuberosity.
- The quadriceps extends the leg at the knee joint. The rectus femoris muscle also flexes thigh at the hip joint.

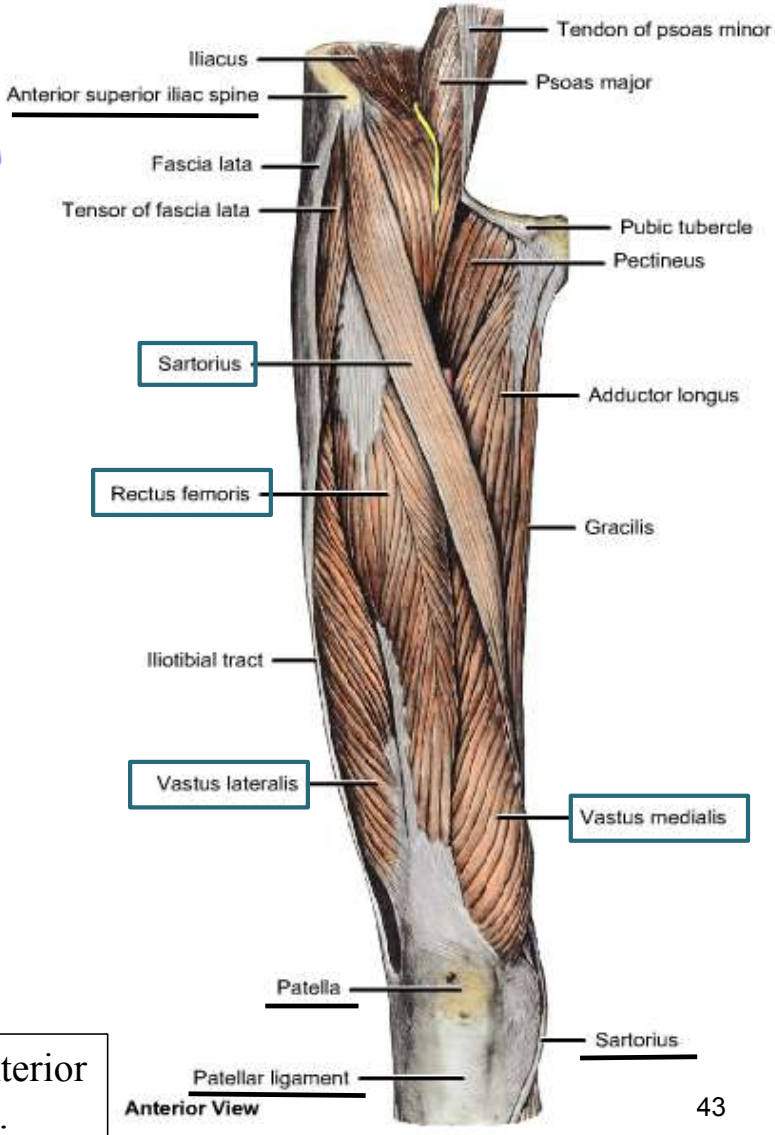

Fig.26: Muscles of the anterior compartment of the thigh.

Muscles of the Leg

- Leg muscles, like those of the thigh, are divided into three compartments: anterior, lateral, and posterior.
  - **Anterior compartment** muscles dorsiflex the foot.
  - **Lateral compartment** muscles plantar flex & evert the foot.
  - **Posterior compartment** muscles are split into a superficial group: the gastrocnemius, soleus and plantaris; and a deep group (e.g., tibialis posterior). The superficial muscles share a common tendon of insertion, the **calcaneal tendon (Achilles tendon** – the largest and strongest tendon in the body). They plantar flex the foot and the gastrocnemius also flexes the leg.

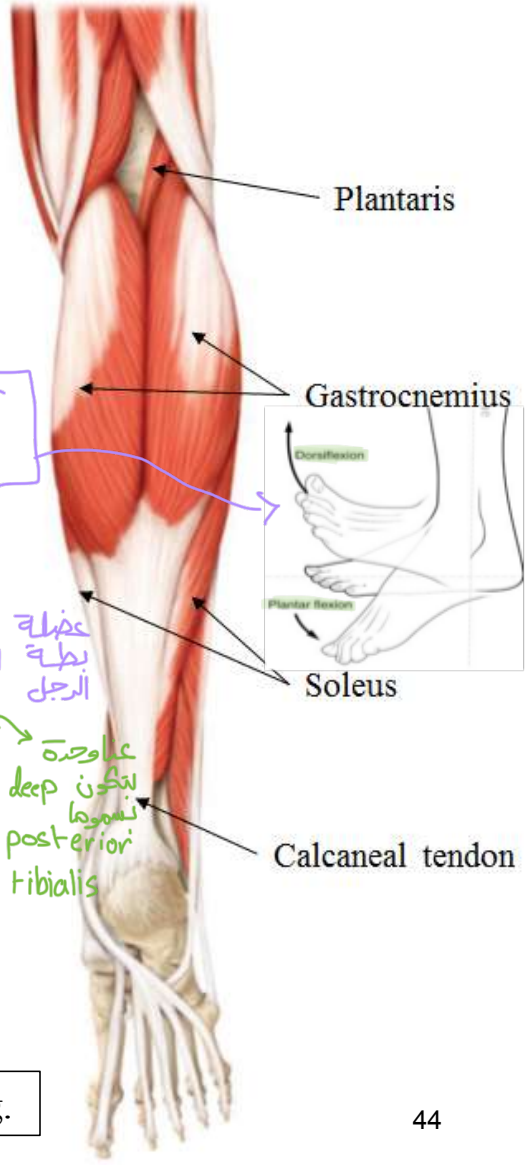

Fig.27: Muscles of the posterior compartment of the leg.

Intrinsic Muscles of the Foot

- These muscles are termed **intrinsic** because they originate & insert *within* the foot.
- These muscles are limited in action. They're designed for locomotion and support (of the arches).
- They include **dorsal** and **plantar groups**.

Fig.28: Intrinsic muscle of the foot (plantar group).