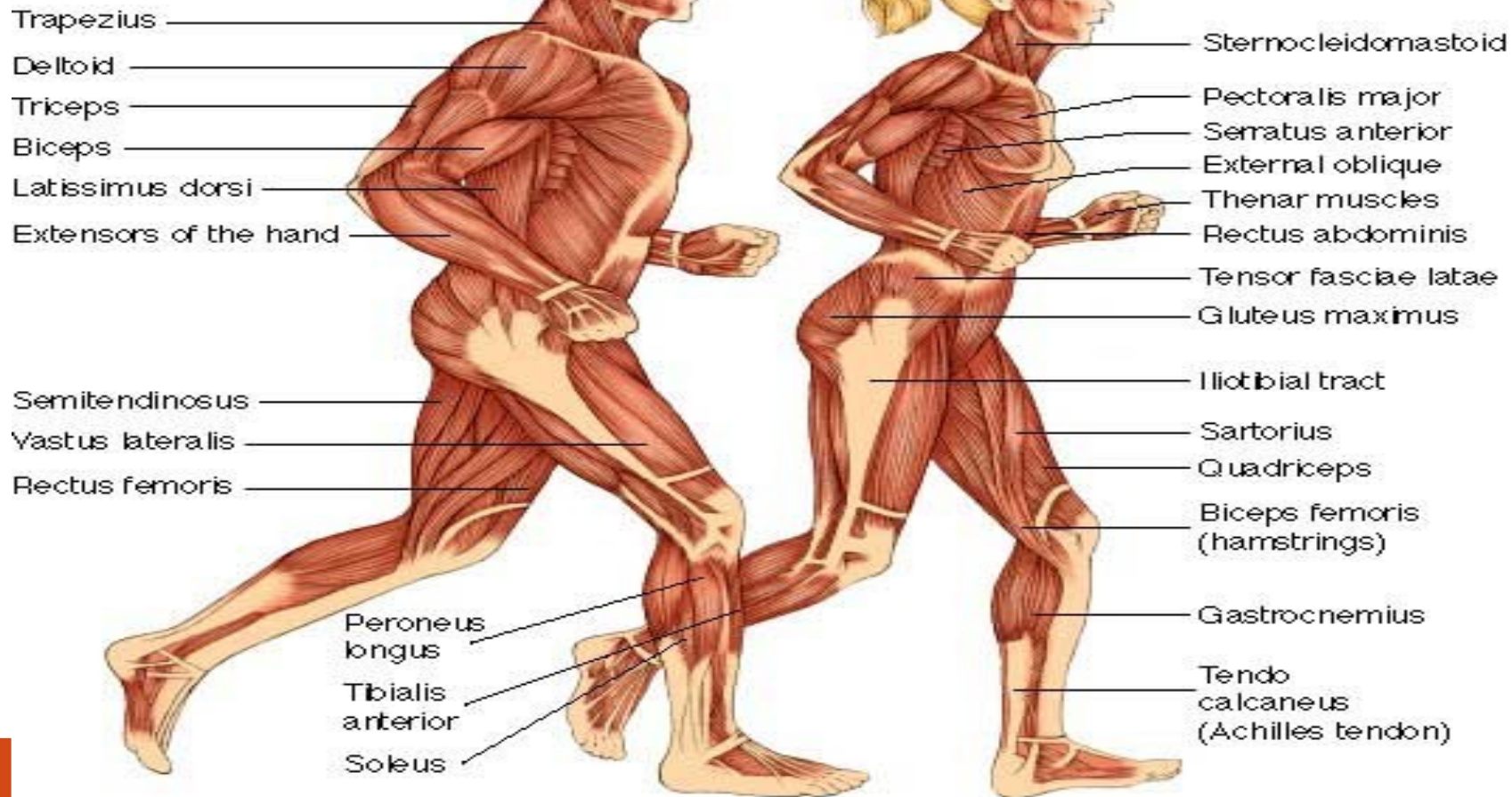


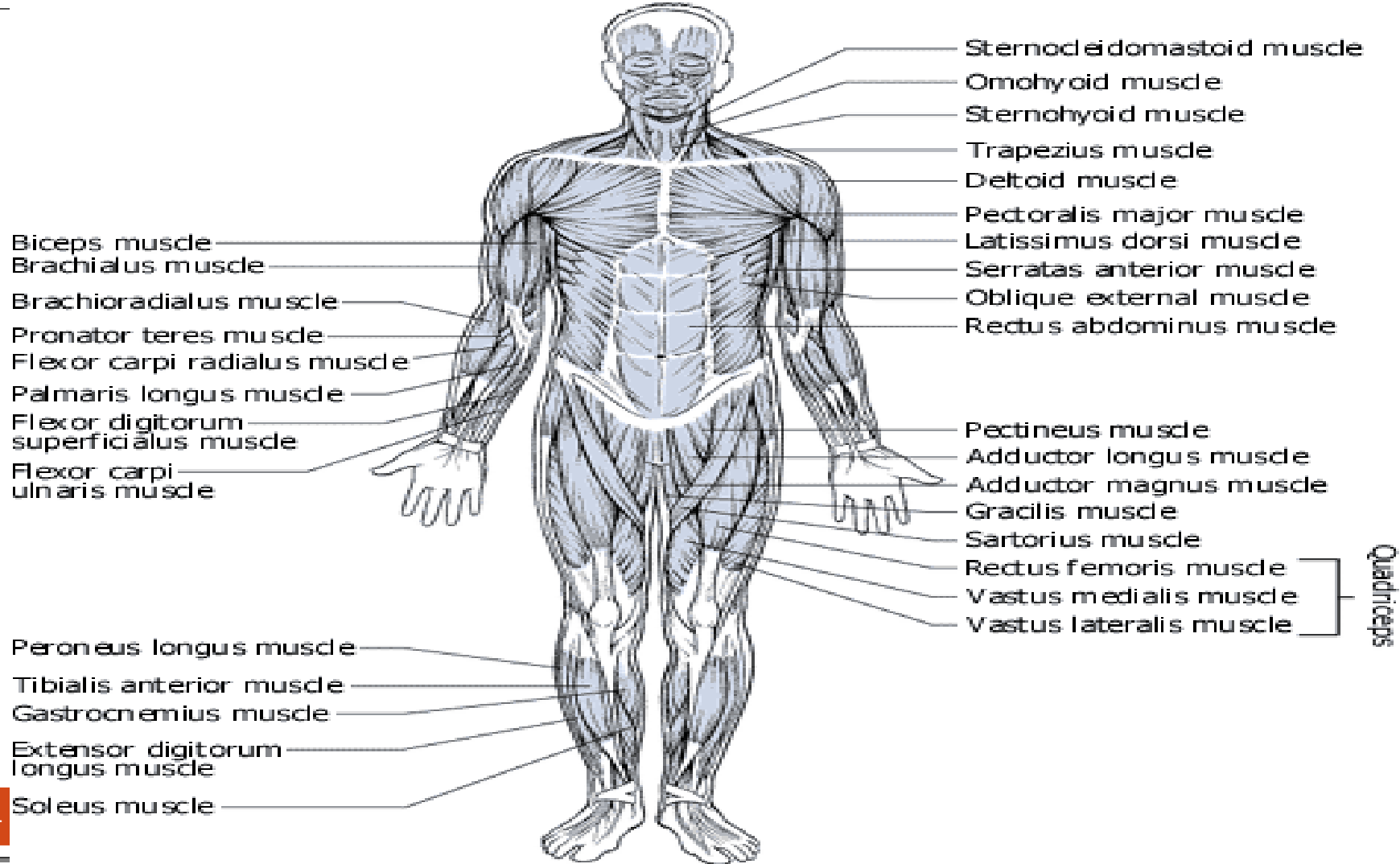


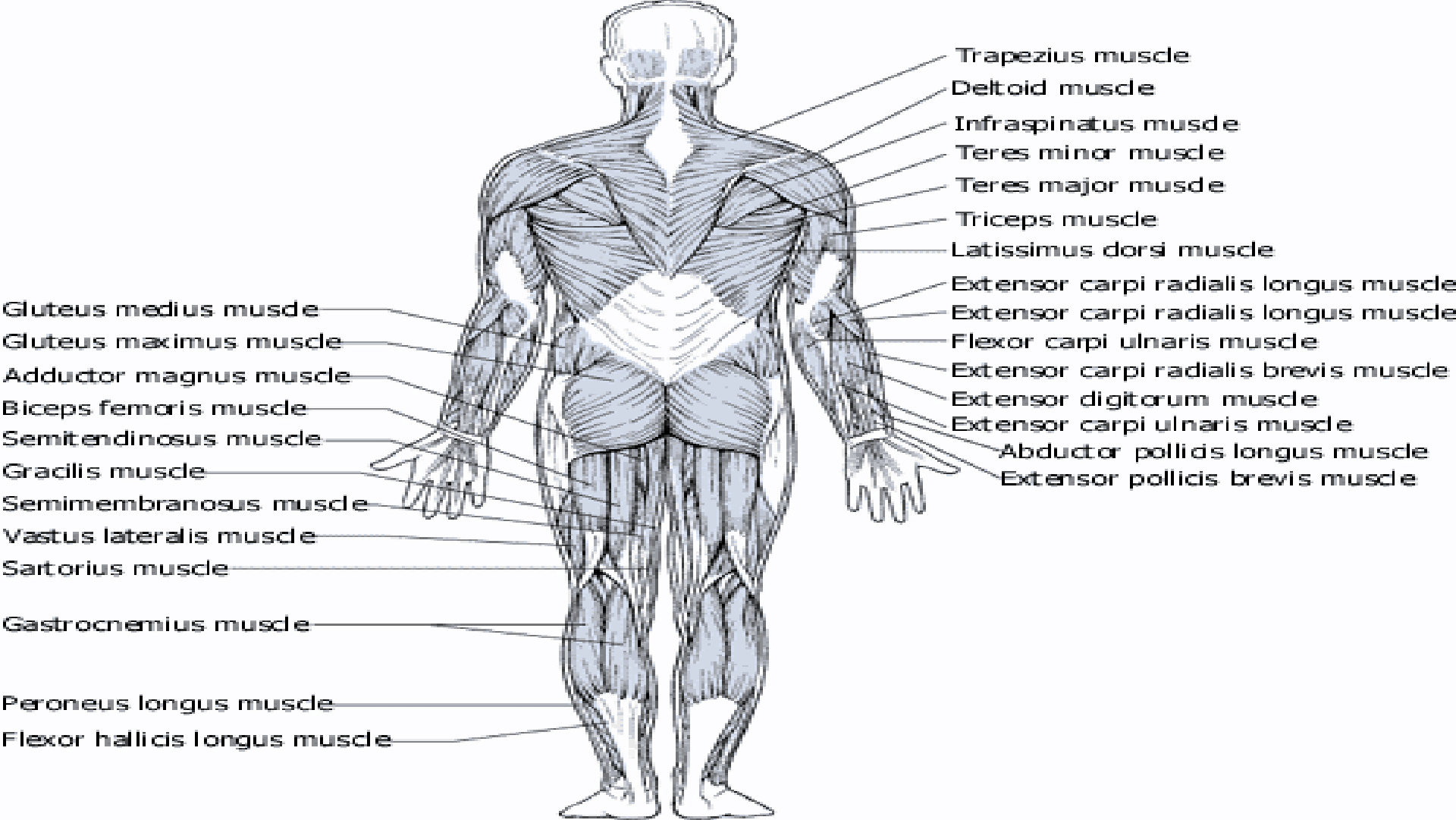
Muscular system

Outline

- ❖ Introduction
- ❖ Functions of skeletal system
- ❖ Common Properties of muscular tissue
- ❖ Structural organization of muscle cells
- ❖ Types of muscles tissue
 - Skeletal muscles
 - Cardiac muscles
 - Smooth muscles
- ❖ Naming of muscles
 - ❖ According to shape, size, no of head origin, location, etc.
- ❖ Muscles the body compartments
 - ❖ Head and neck, abdomen, thorax, thigh, back, upper and lower limbs
- ❖ Diseases of muscle







INTRODUCTION

- comprises the largest group of tissues in the human body
- Muscles which make up **40–50%** of total adult body weight.
- Consists of over **600-700** individual muscles

❖ **Basic functions of muscles:**

- ✓ **Body Movement**
- ✓ **Maintenance of posture**
- ✓ **Heat production (maintain Temp)**
- ✓ **Storing and moving substances within the body.**
- ✓ **Control the openings (sphincters)**

❑ **Properties of the muscular tissue**

❖ All muscles have 4 common properties

1. Excitability;

- ability to **respond to a stimulus** (i.e.: nerve impulse) by producing electrical signals called action Potentials (AP) two main types of stimuli trigger action potentials.
- One is auto rhythmic electrical signals arising in the muscular tissue itself, as in the heart's **pacemaker**.
- The other is chemical stimuli such as **neurotransmitters**, released by neurons, hormones distributed by the blood

2. Contractibility;

- is the ability of muscular tissue to **contract** forcefully when stimulated by an action potential.

...cont'd

3. Extensibility

- **is the ability of muscular tissue to stretch without being damaged.**
- Extensibility allows a muscle to contract forcefully even if it is already stretched.

Normally, **smooth muscle** is subject to the greatest amount of stretching.

E.g. each time your stomach fills with food, the muscle in its wall is stretched, Cardiac muscle also is stretched each time the heart fills with blood
ability to be stretched

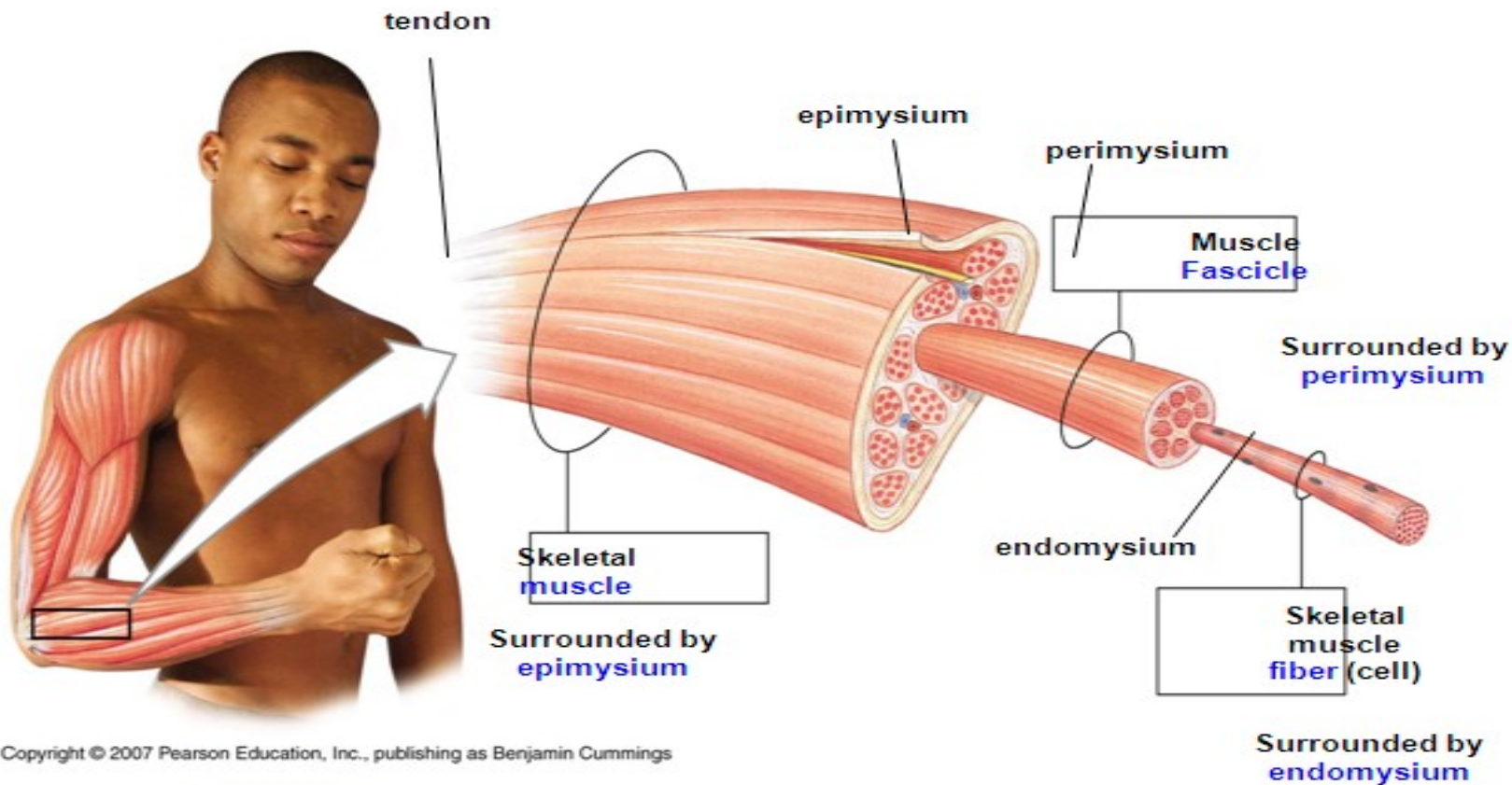
4. Elasticity

- **allows the muscle to return to its original shape after it has been stretched**

❖ **Connective tissue components**

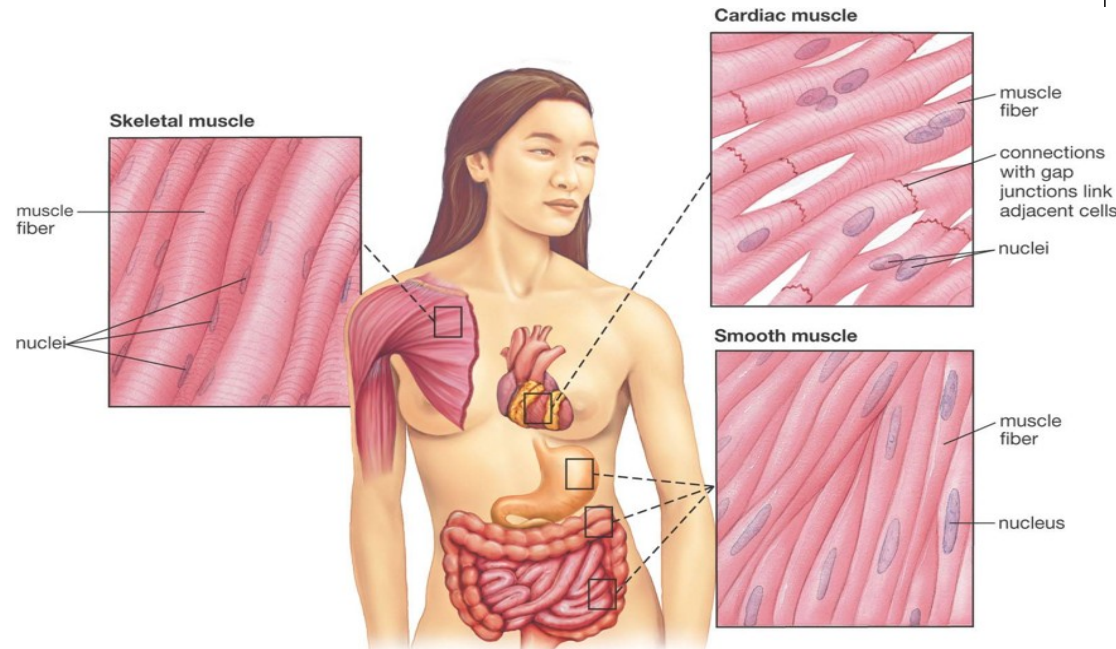
- Three layers of connective tissue extend from the fascia to protect and strengthen skeletal muscle
- **Fascia** is a dense sheet or broad band of irregular connective tissue that lines the body wall and limbs and supports and surrounds muscles and other organs
- The outermost layer, encircling the entire muscle, is the **epimysium**
- **Perimysium** (surrounds groups of 10 to 100 or more muscle fibers, separating them into bundles called **fascicles** (little bundles).
- Surrounds the separating individual muscle fibers from one another is **endomysium** (within), a thin sheath of areolar connective tissue.

connective tissue components



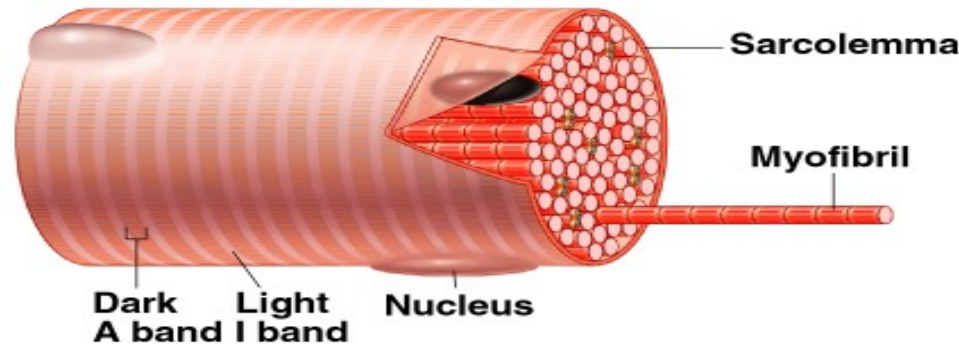
TYPES OF MUSCLES TISSUE

- ❖ Classified into **three** categories according to
 - morphology and
 - cross striations
 - location
 - functions



Microscopic Anatomy of Skeletal Muscle

- Sarcolemma – specialized plasma membrane
- Sarcoplasmic reticulum – specialized smooth endoplasmic reticulum



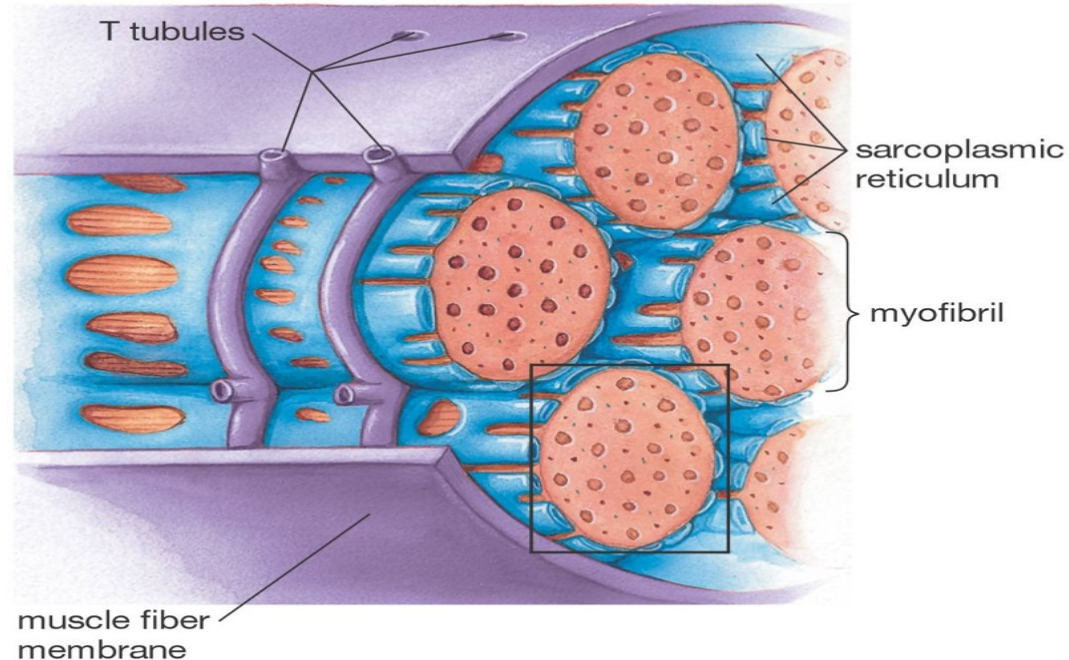
(a) Segment of a muscle fiber (cell)

Figure 6.3a

- A muscle cell is a “fiber.”
- Fibers are multinucleated and contain myoglobin. (Similar to hemoglobin —
- Myofibrils contain the contractile fibers.

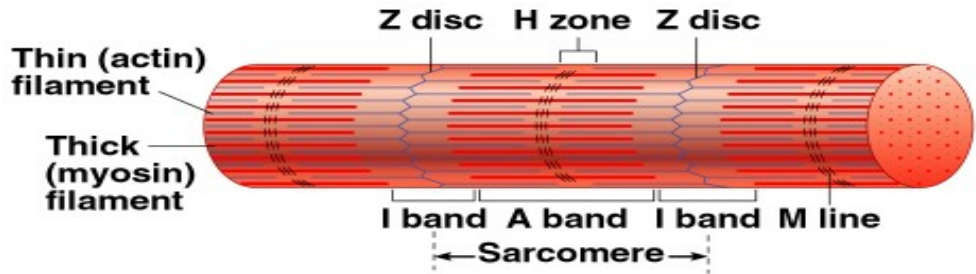
Muscle fibers

(a) Cross section of fiber



Microscopic Anatomy of Skeletal Muscle

- Myofibril
 - Bundles of myofilaments
 - Myofibrils are aligned to give distinct bands
 - I band = light band
 - A band = dark band

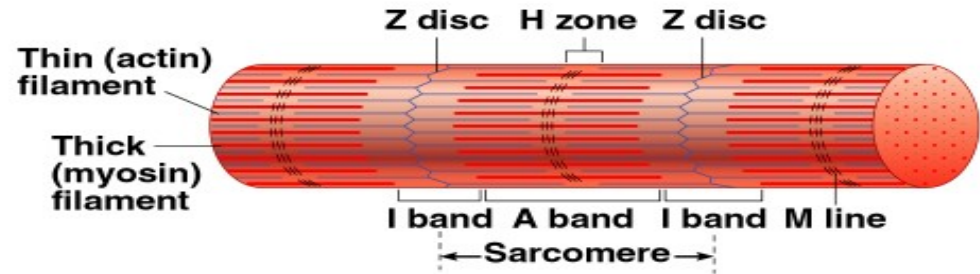


(b) Myofibril or fibril
(complex organelle composed of bundles of myofilaments)

Figure 6.3b

Microscopic Anatomy of Skeletal Muscle

- **Sarcomere**
 - Contractile unit of a muscle fiber



(b) Myofibril or fibril
(complex organelle composed of bundles of myofilaments)

Figure 6.3b

Microscopic Anatomy of Skeletal Muscle

- Organization of the sarcomere
 - Thick filaments = myosin filaments
 - Composed of the protein myosin
 - Has ATPase enzymes

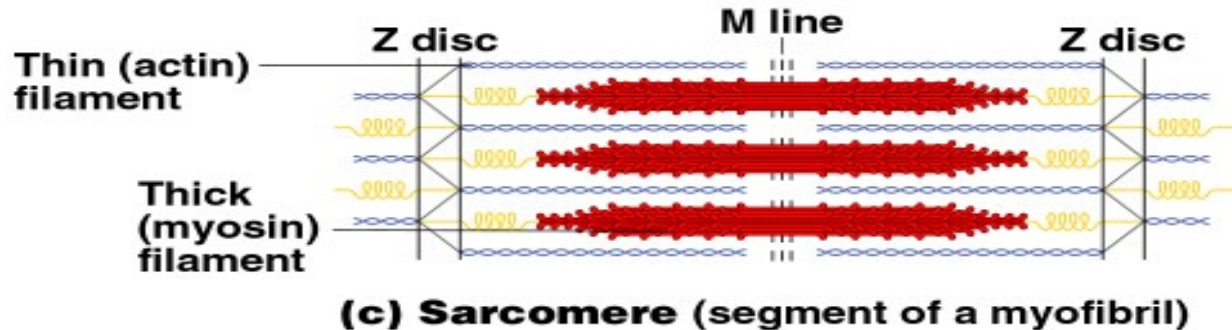


Figure 6.3c

Microscopic Anatomy of Skeletal Muscle

- Organization of the sarcomere
 - Thin filaments = actin filaments
 - Composed of the protein actin

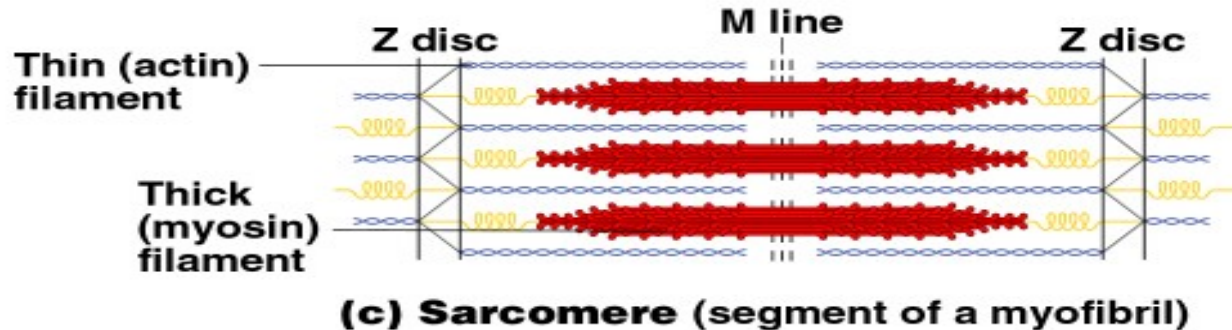
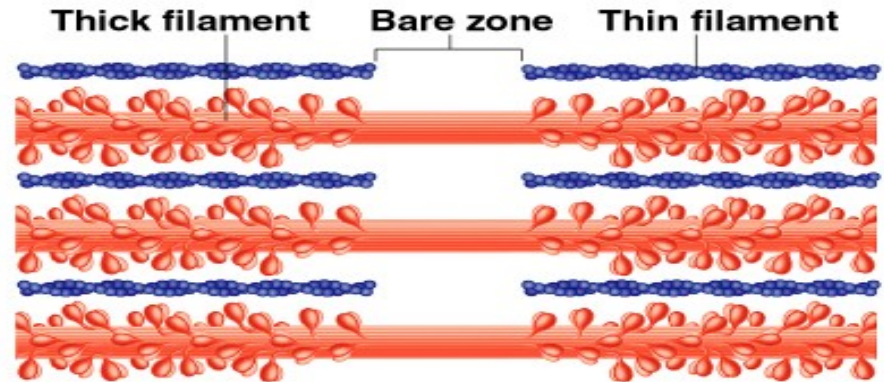


Figure 6.3c

Microscopic Anatomy of Skeletal Muscle

- Myosin filaments have heads (extensions, or cross bridges)
- Myosin and actin overlap somewhat



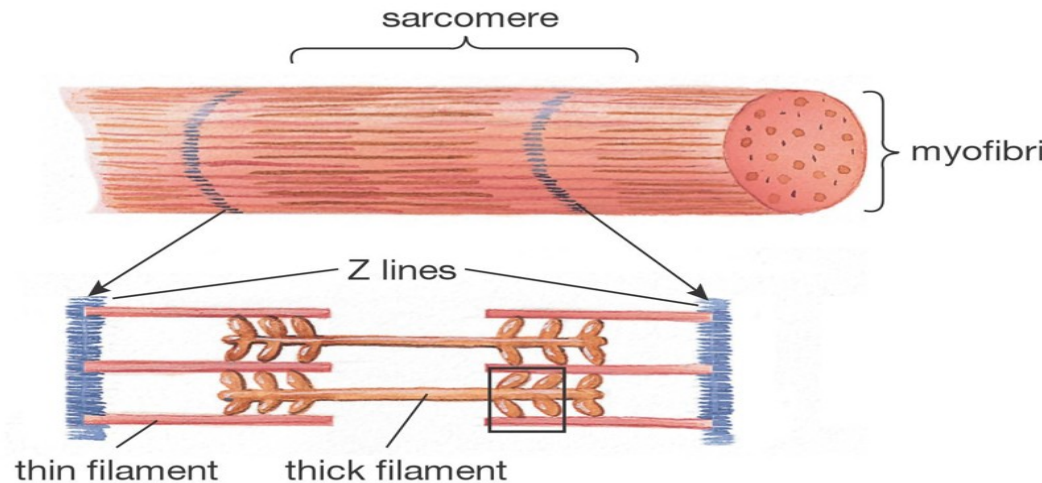
(d) Myofilament structure (within one sarcomere)

Figure 6.3d

Myofibril

- The myofibril is composed of “thick” and “thin” filaments.
- Each of these filaments is made up of strands of protein.
- The contractile unit is called **Sarcomere** between the consecutive Z-discs/lines

(b) Myofibril and sarcomere

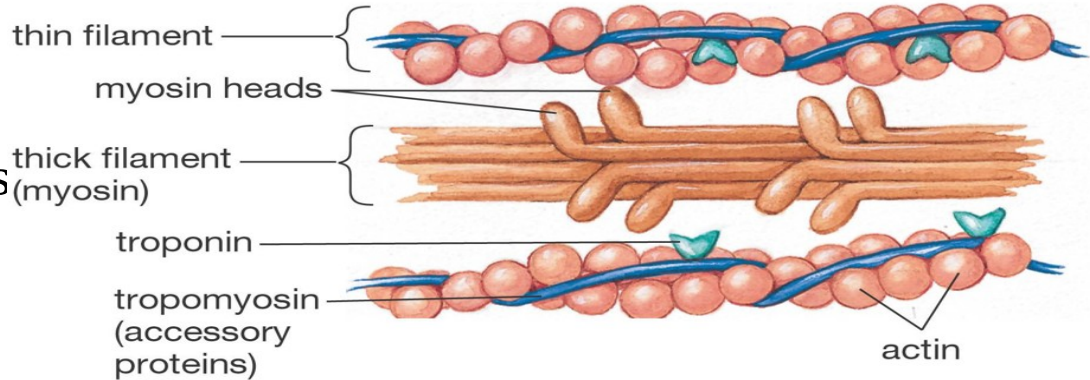


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Thick and thin filaments

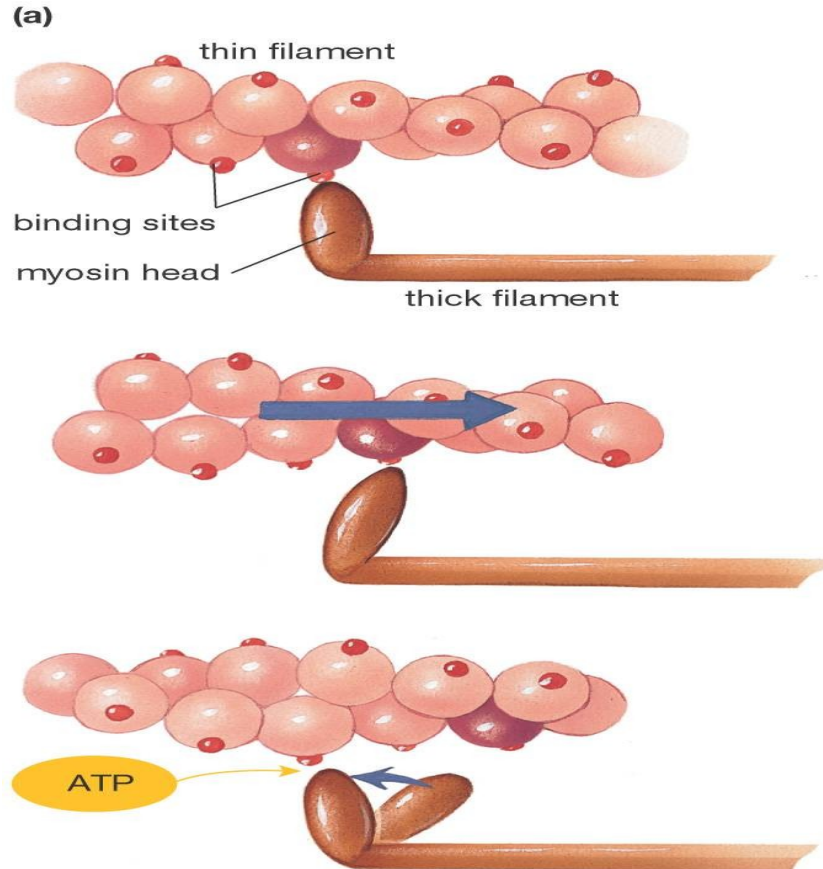
- **The thick filaments**, made mostly of **myosin**, have small “heads” that move.
- **The thin filaments** have points to which the myosin heads temporarily attach.

(c) Thick and thin filaments

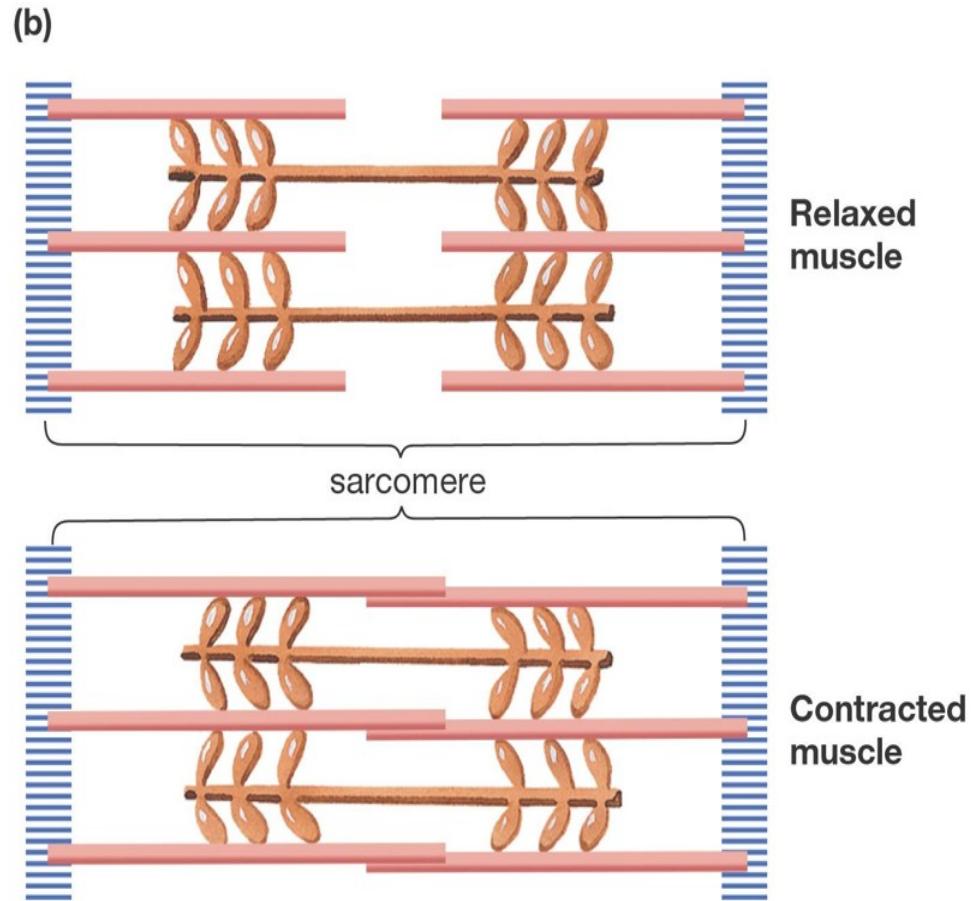


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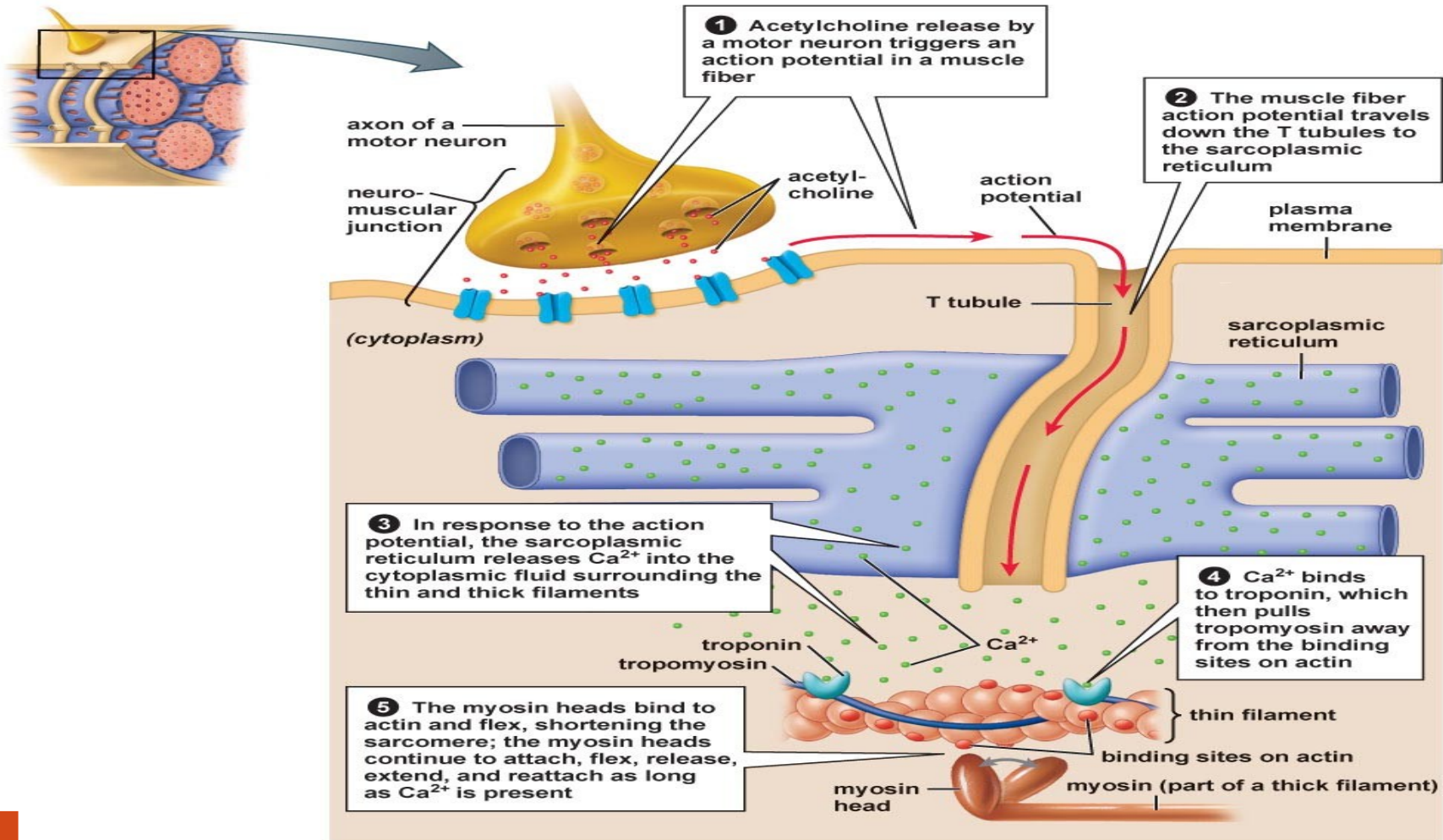
Muscle fiber action



- Fibers are either “on” (contracted) or “off” (relaxed).
- When lifting light weights, only a few fibers may be “on.” For heavy weights, many more may be “on,” and may take turns to prevent fatigue.



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1. Skeletal muscle

- is so named because most skeletal muscles move bones of the skeleton.
- Each skeletal muscle cell is known as **muscle fiber**
- They're so large because a single skeletal muscle cell results from the fusion of hundreds of embryonic precursor cells called **myoblasts**.

Cont'd

Function of Skeletal muscles

- Attach to bones to provide voluntary movement
- Produce heat and energy for the body
- Help maintain posture
- Protect internal organs
 - **Tendons:** strong, tough connective cords
 - **Fascia:** tough, sheet-like membrane

Cont'd

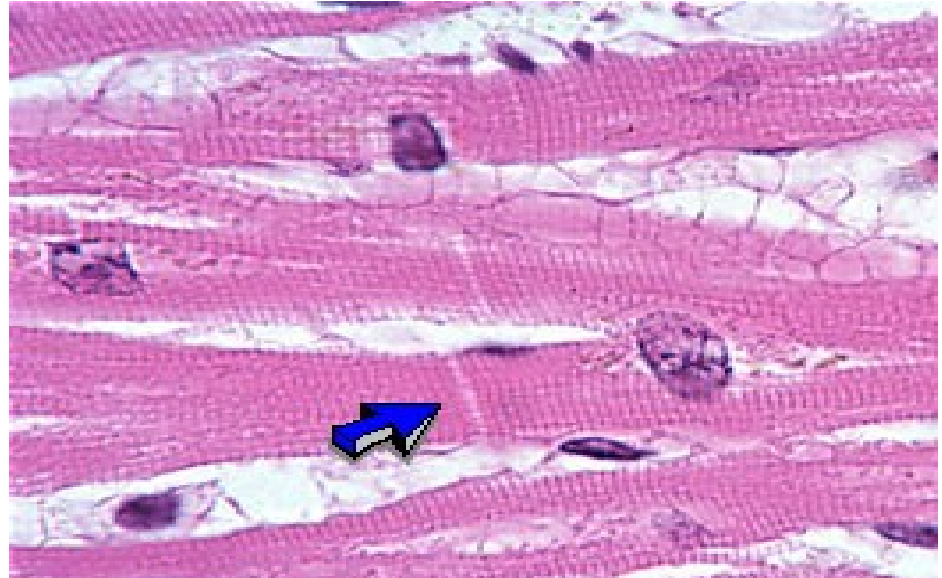
- muscle tissue is **striated**:

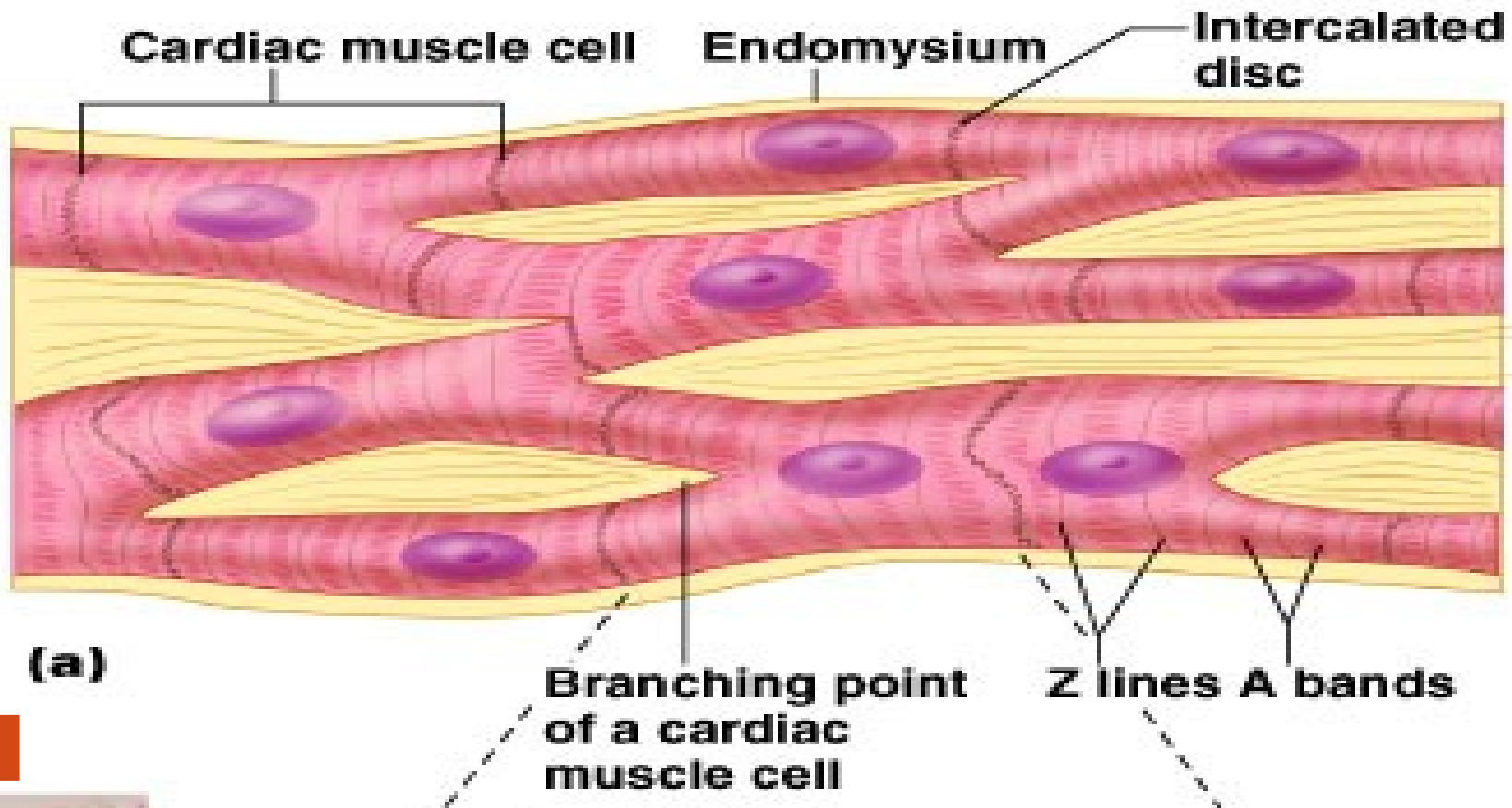
Alternating light and dark bands (striations) are seen when the tissue is examined with a microscope

- Skeletal muscle tissue works mainly in a **voluntary manner**.
- Its activity can be consciously controlled by neurons (nerve cells) that are part of the somatic (voluntary) division of the nervous system.

2. Cardiac muscle tissue

- It is only found in the heart wall
- Striated,
- involuntary muscle
- branching
- Uni- or binucleate.





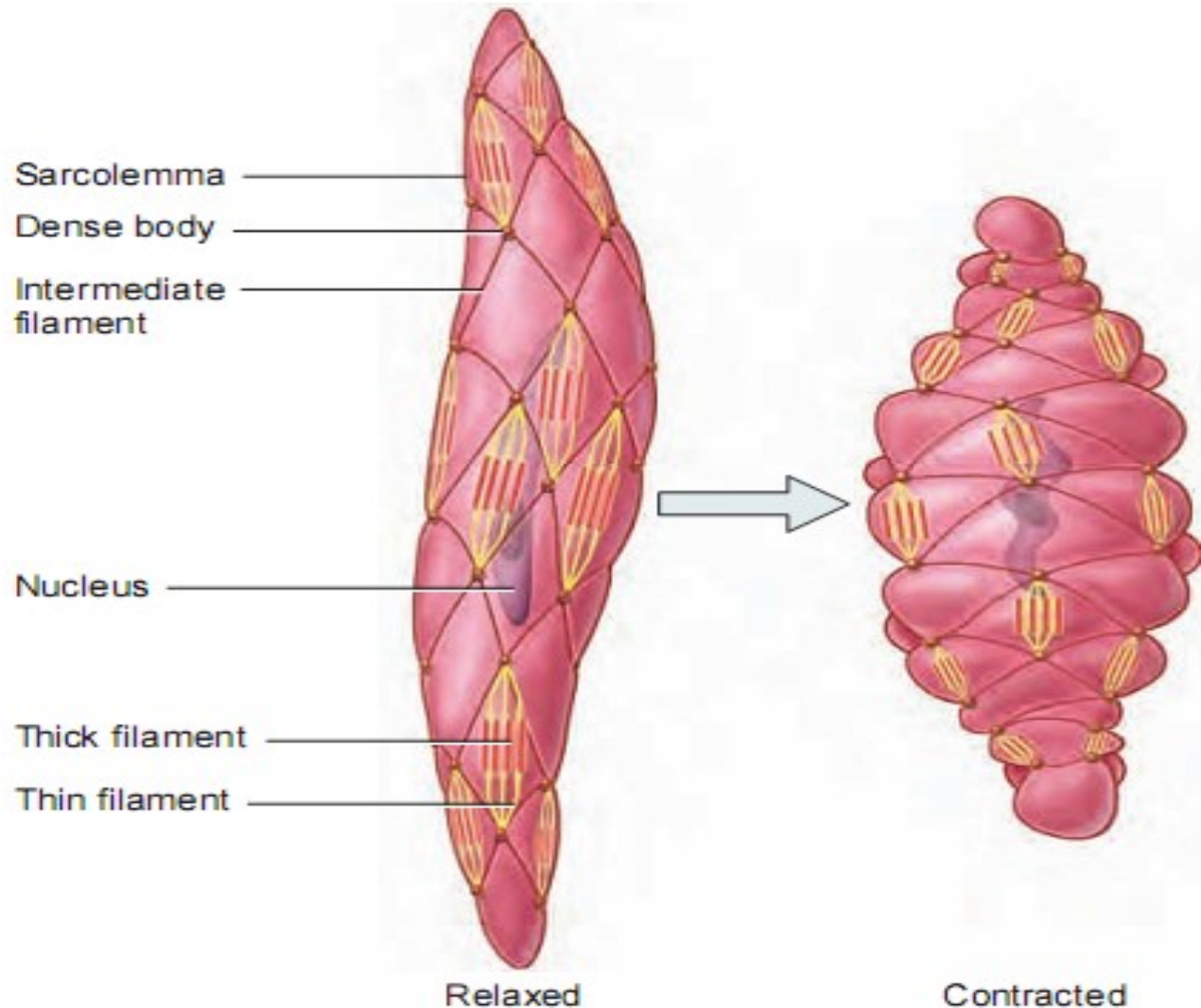
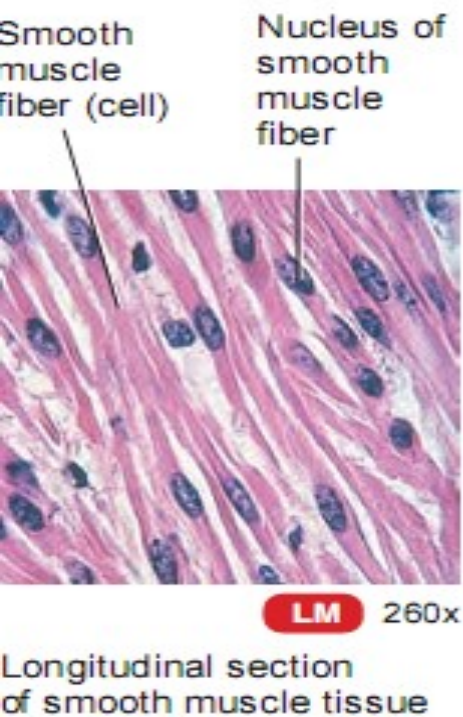
3. Smooth muscle tissue

❖ Cells

- Single cells, uninucleated, spindle(Fusiform) shaped
- No striations(non -striated)

❖ Smooth Muscle-Involuntary

- It has layers-opposite orientation (peristalsis)
- Lines of hollow organs
- found in walls of internal organs (intestines, bladder, stomach, uterus, blood vessels)



...cont'd

- Involuntary, non-striated muscle tissue
- Occurs with in almost every organ, forming sheets, bundles, or sheaths around other tissues.

❖ **Cardiovascular system:**

- Smooth muscle in blood vessels regulates blood flow through vital organs.
- Smooth muscle also helps regulate blood pressure

❖ **Digestive systems:**

- Rings of smooth muscle, called ***sphincters***, regulate movement along internal passageways.
- Smooth muscle lining the passageways alternates contraction and relaxation to propel matter through the alimentary canal.

...cont'd

❖ **Integumentary system:**

- Regulates blood flow to the superficial dermis
- Allows for piloerection - raising up of hairs

❖ **Respiratory system**

- Alters the diameter of the airways and changes the resistance to airflow

❖ **Urinary system**

- Sphincters regulate the passage of urine
- Internal (involuntary) & external sphincter(voluntary)
- External sphincter is type of skeletal muscle
- Smooth muscle contractions move urine into and out of the urinary bladder

...cont'd

❖ Reproductive system

▪ Males

- Allows for movement of sperm along the male reproductive tract.
- Allows for secretion of the non-cellular components of semen
- Allows for erection and ejaculation

▪ Females

- Assists in the movement of the egg (sperm) through the female reproductive tract
- Plays a large role in childbirth

Type	Skeletal muscle	Cardiac muscle	Smooth muscle
Location	Skeleton bone associated	Heart	visceral organs
Sheath	epi-, peri-, and endomysium	Endomysium & peri	Endomysium
Cell shape	long cylinders	Short branching anastomising cells	small spindles Tapered at the end
Number of nuclei and location of nuclei	many per cell peripheral	usually one per cell, central	one per cell central
Cross-striations	present	present	absent
Intercalated discs	absent	present	absent
Function	voluntary	involuntary	involuntary
Growth and regeneration response	limited	limited	unlimited from other

Naming of skeletal muscles

- on the basis of shape, location, attachment orientation of fibers, relative position, or function..

1. **Shape:**

- Rhomboideus= diamond
- Trapezius= trapezoid
- Quadratus =Square
- Orbicularis= Circular

2. **based on number of heads of origin:**

- Triceps it has three heads
- biceps it has two heads

3. **Location:**

- Pectoralis= chest
- Intercostal= between the ribs
- brachium = arm
- Temporalis=temporal bone and Frontalis= frontal bone

4. **Attachment:**

- Zygomaticus= attachment on zygomatic bone
- Temporalis= temporal bone
- Nasalis= nasal bone
- Femoris= attaches on femur
- tibialis= attachment on tibia
- Sternocleidomastoid= origin from sternum and clavicle ; inserted on mastoid process of temporal bone

5. **Size:**

- Maximus=largest
- medius
- Minimus=smallest
- Longus=longest
- Brevis=shorter

6. Orientation of fibers:

- Rectus =straight parallel to the mid line
- Transversus =horizontal perpendicular to the mid line
- Obliquus =diagonal muscle fascicles
- Orbicularis =circular muscle fibers

7. Relative position:

- lateral,
- medial,
- internal, and
- external.

8. Action

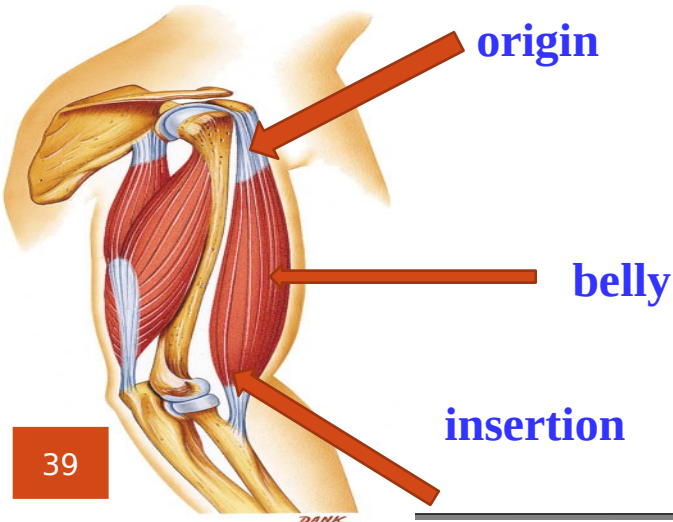
- adductor
- flexor
- pronator
- extensor

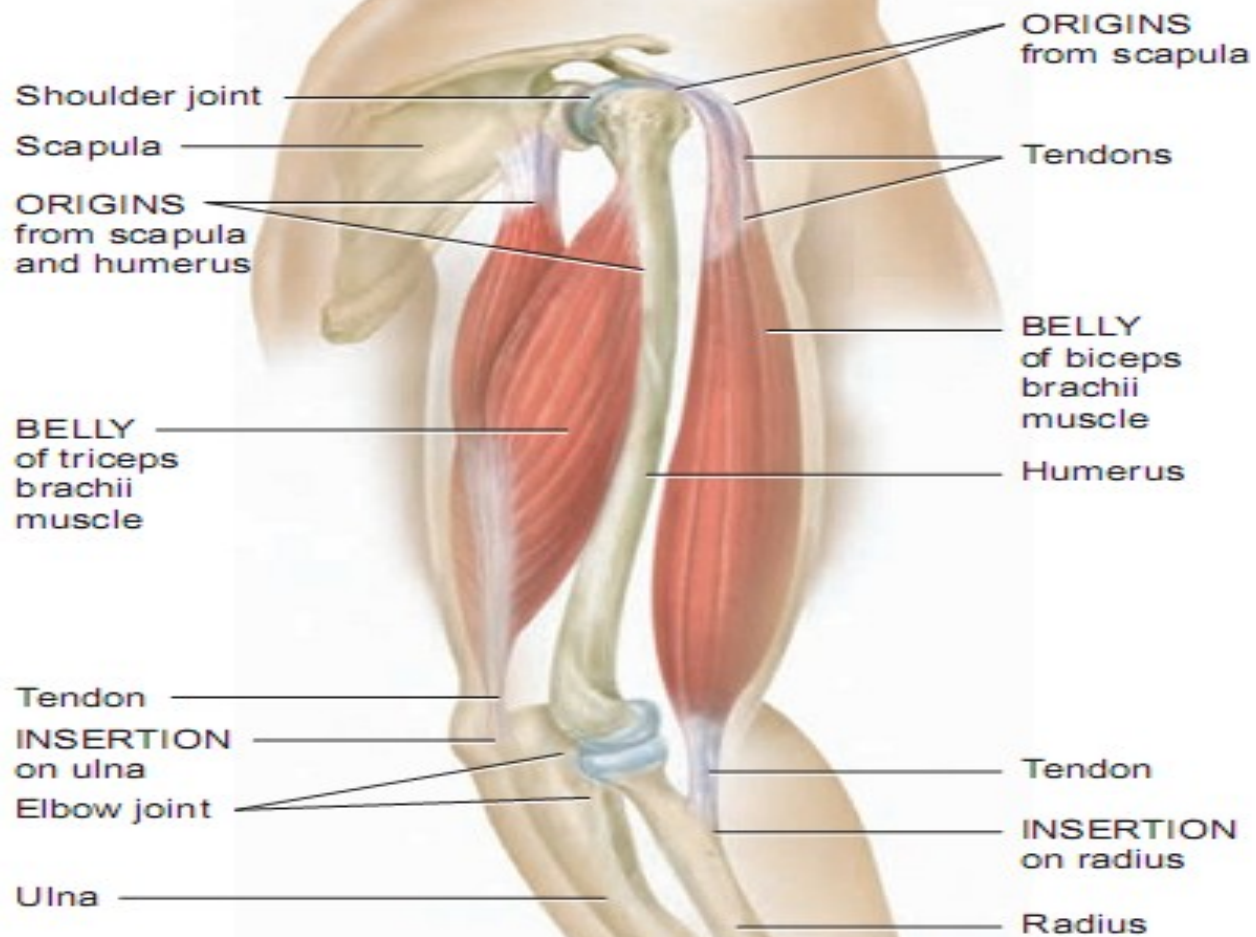
Size: Relative size of the muscle

- Maximus = Largest -Gluteus maximus
- Minimus =Smallest -Gluteus Minimus
- Longus =Longest -Adductor longus
- Latissimus =Widest -Latissimus dorsi
- Longissimus = Longest -Longissimus muscles
- Magnus = Large -Adductor magnus
- Major =Larger -Pectoralis major
- Minor = Smaller- Pectoralis minor
- Vastus = Great -Vastus lateralis

Skeletal Muscle Attachments

- there are two attachment site
- **Origin**- the stationary end of the muscle attachment
- **Insertion**- the relatively moveable end of the skeletal muscle attachment
- **Belly(gaster)**- the thick & flesh region between two attachments (origin & insertion)

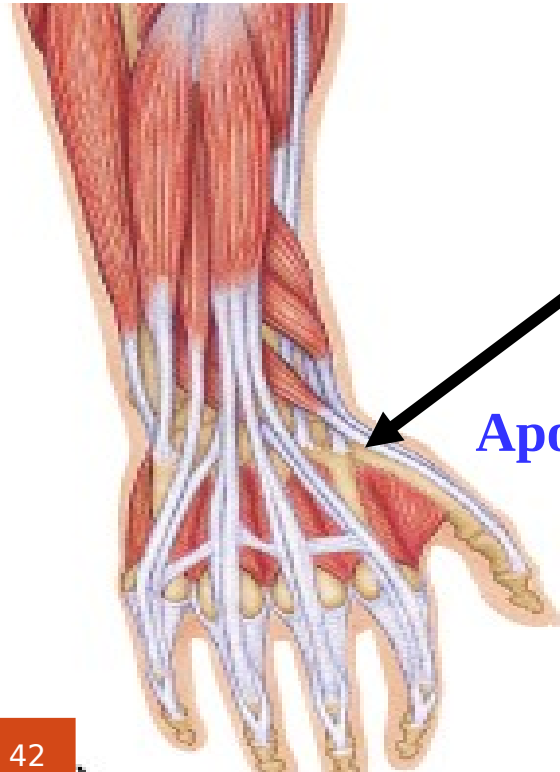




Muscle attachment Cont'd

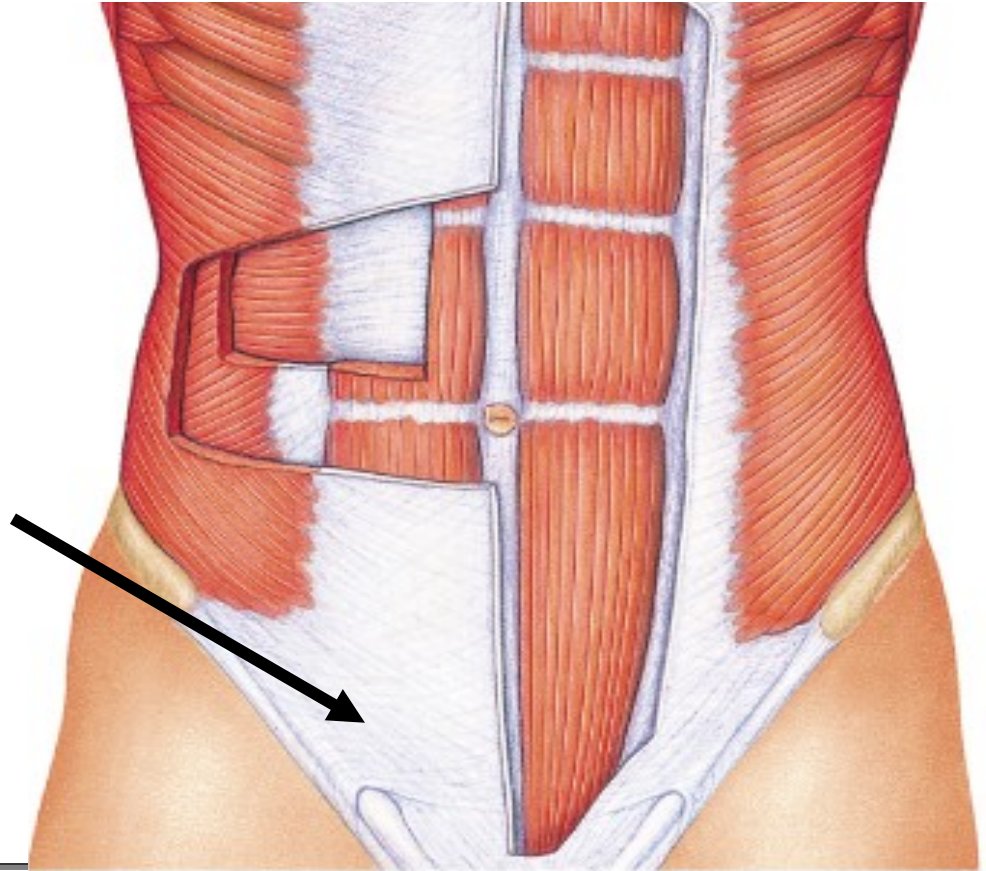
- Muscle attachments may be *direct* or *indirect*.
- **Direct** – the **epimysium** part directly attached to the bone or other soft tissues without a tendon
- Skeletal muscle doesn't attach directly to the bone
- **Indirect**
 - either a cordlike structure= **tendon** or
 - abroad sheet like structure= **aponeurosis**

Indirect attachments



Tendon

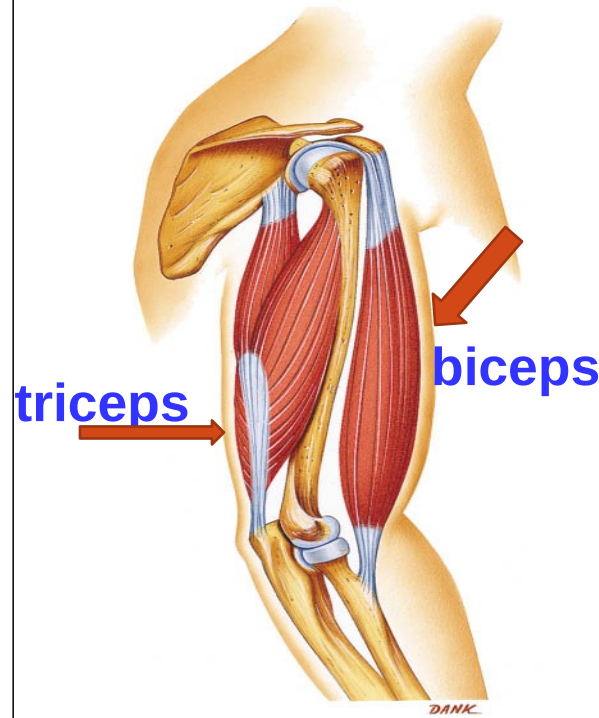
Aponeurosis



Coordinated action of muscle groups

- Muscles that perform opposite actions are *antagonistic muscles*
e.g, Biceps brachii & triceps brachii
- **Synergistic Muscles**- are muscles that perform similar actions
- **Agonist (prime mover)** – muscles which perform great action or a muscle that causes a desired action is referred to as the prime mover or agonist (leader).
- When you bend(flex) your elbow, the biceps brachii is prime mover while the triceps brachii is antagonist

- Muscles in the body rarely work alone, & are usually arranged in groups surrounding a joint
- A muscle that contracts to create the desired action is known as an **agonist** or **prime mover**
- A muscle that helps the agonist is a **synergist**
- A muscle that opposes the action of the agonist, therefore undoing the desired action is an **antagonist**



Intrinsic & extrinsic muscles

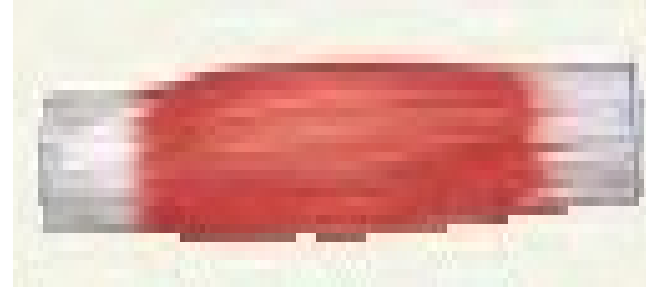
- **Intrinsic muscles** -has both insertion and origin within the same region
 - ▬ e.g. Intrinsic muscle of tongue which alter the shape of the tongue rather moving the entire tongue
- **Extrinsic muscles** -muscles which has origin from other body regions
 - ≡ e.g. extrinsic tongue muscles
 - Genioglossus
 - Styloglossus
 - Palatoglossus
 - hypoglossus

Arrangement of Fascicles

❖ parallel

- Fascicles parallel to longitudinal axis of muscle; terminate at either end in flat

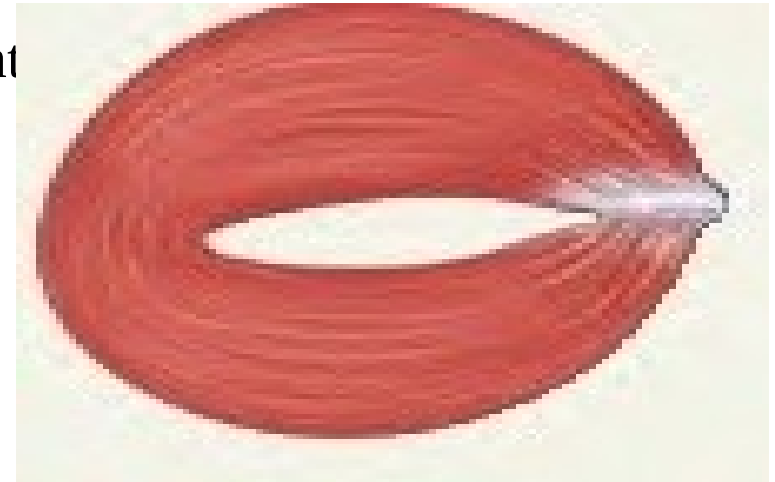
☐ e.g. Stylohyoid muscle



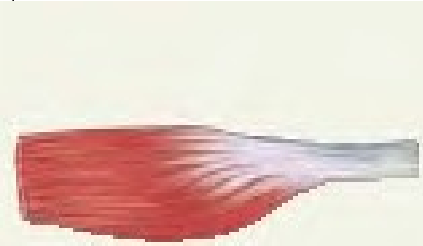
❖ circular

- Fascicles in concentric circular arrangement form sphincter muscles that enclose an orifice (opening).

☐ e.g. Orbicularis oculi & oris muscles



- ❖ **Pennate** - Short fascicles in relation to total muscle length; tendon extends nearly entire length of muscle.
- ❖ **unipennate**
 - Fascicles are arranged on only one side of the tendon
 - ⇨ e.g. *Extensor digitorum longus muscle (EDL)*
- ❖ **bipennate**
 - Fascicles are arranged on both sides of centrally positioned tendons
 - ⇨ E.g. *Rectus femoris muscle*
- ❖ **multipennate**
 - Fascicles attach obliquely from many directions to several tendons. E.g. *Deltoid muscle*



Example: Extensor digitorum longus muscle



Example: Rectus femoris muscle (see

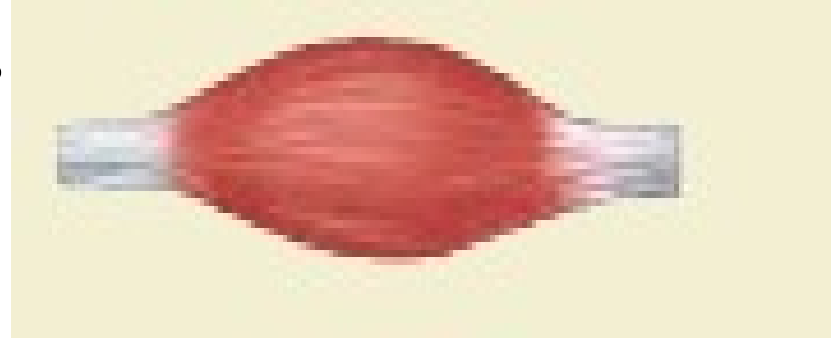


Example: Deltoid muscle (see

❖ fusiform

- Fascicles nearly parallel to longitudinal axis of muscle; terminate in flat muscle tapers toward tendons, where diameter is less than at belly.

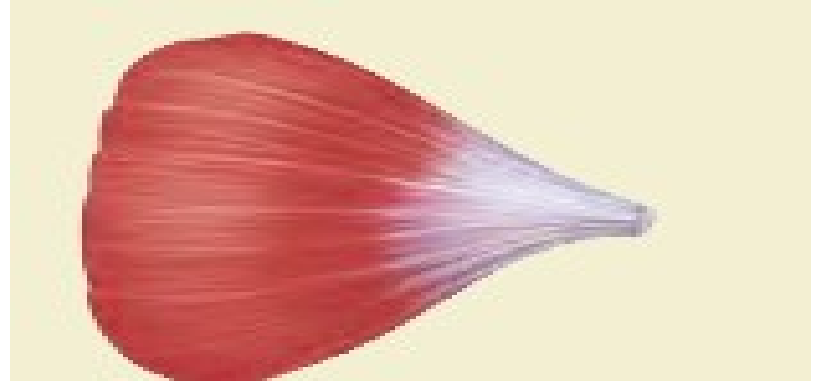
≡ e.g. *Digastric muscle*

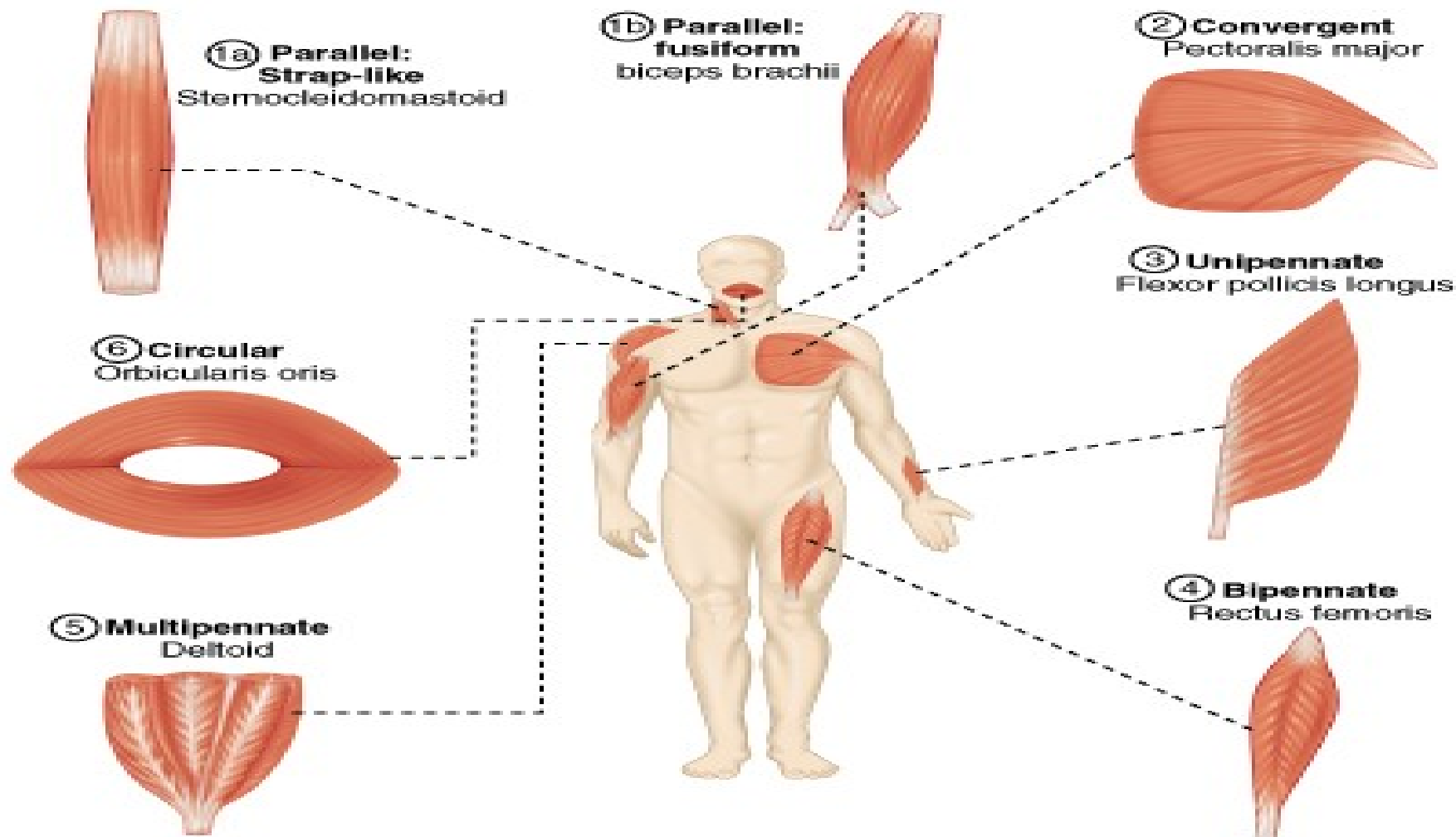


❖ triangular

- Fascicles spread over broad area converge at thick central tendon; gives muscle a triangular appearance.

≡ e.g. *Pectoralis major muscle*





Muscle of the tongue

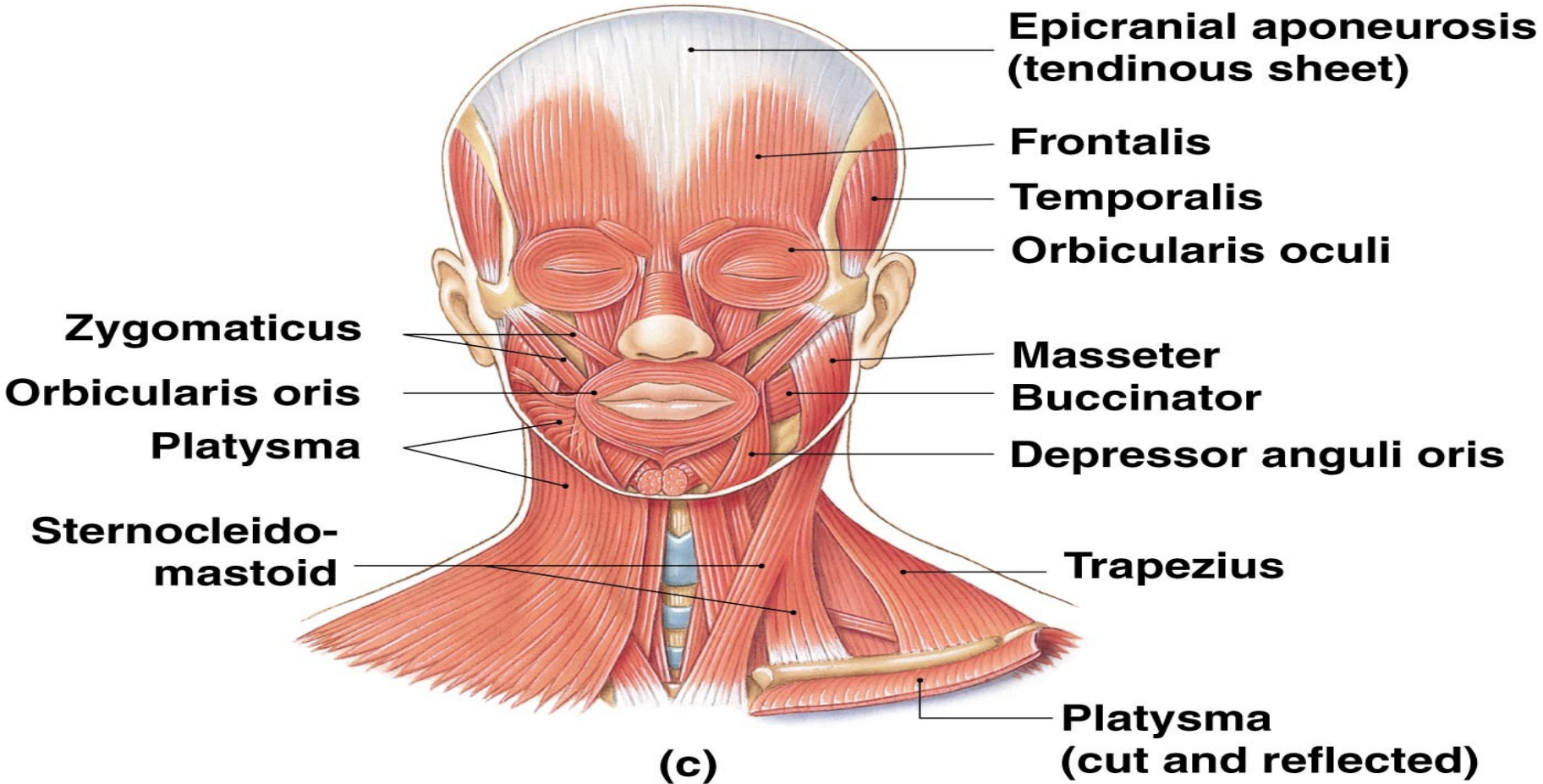
muscle	origin	insertion
▪ Genioglossus	mandible	hyoid bone & tongue
▪ Styloglossus	temporal bone	tongue
▪ Palatoglossus	soft palate	tongue
▪ Hypoglossus	G.H of hyoid bone	tongue

NB: All are innervated by **Hypoglossal (XII) nerve**.

1. MUSCLES OF THE HEAD & NECK

a) *Muscles of the facial expressions*

- Frontalis . Platysma
 - Orbicularis oculi . Temporalis
 - Nasalis . Occipitalis
 - Levator labii superioris . Buccinator
 - Zygomaticus major & minor
 - Orbicularis oris
 - Masseter
 - Depressor labii inferioris
 - Depressor anguli oris
- All are innervated by **facial nerve (VII)**



Muscles of Facial Expression

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Depressor anguli oris
(frown)



Orbicularis oculi
(blink/close eyes)



Frontal belly of occipitofrontalis
(wrinkle forehead, raise eyebrows)



Platysma
(tense skin of neck)



Zygomaticus major
(smile)



Orbicularis oris
(close mouth/kiss)



Occipitofrontalis



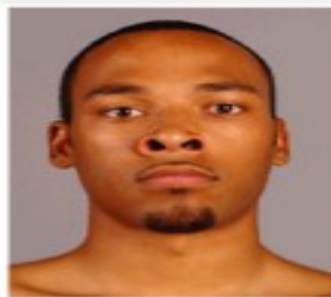
Corrugator supercilii



Procerus + transverse
part of nasalis



Orbicularis oculi



Lev. labii sup. alaeque nasi +
alar part of nasalis



Buccinator + orbicularis oris



Zygomaticus major + minor



Risorius



Risorius + depressor
labii inferioris



Levator labii superioris +
depressor labii



Dilators of mouth:
Risorius plus levator labii superioris
+ depressor labii inferioris



Orbicularis oris



Depressor anguli oris



Mentalis



Platysma

b) **Muscles of chewing & Swallowing**

- **Function:** Food manipulation, tongue movement , chewing and swallowing.

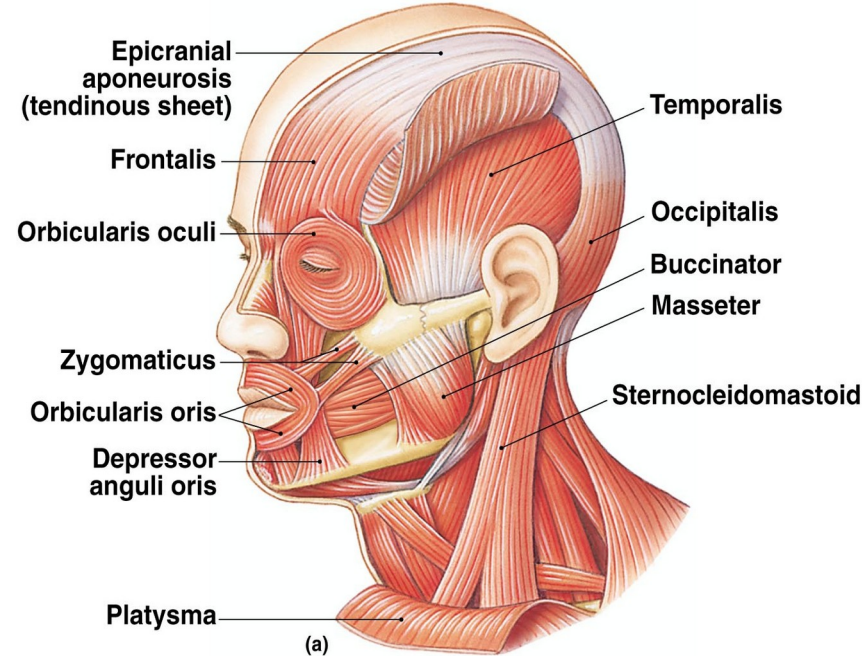
a) Extrinsic muscles of the tongue

The tongue is a very unique organ; both intrinsic and extrinsic muscles control its complex movements.

- **Intrinsic muscles** - consists of variable numbers of
 - vertical
 - transverse
 - longitudinal fascicles.

Muscles of chewing

- Produce the biting and chewing movements of mandible .
 - temporalis
 - masseter
 - pterygoid (2 pairs)
 - medial & lateral pterygoid
- All are innervated by **mandibular branch of trigeminal nerve(CN V)**.



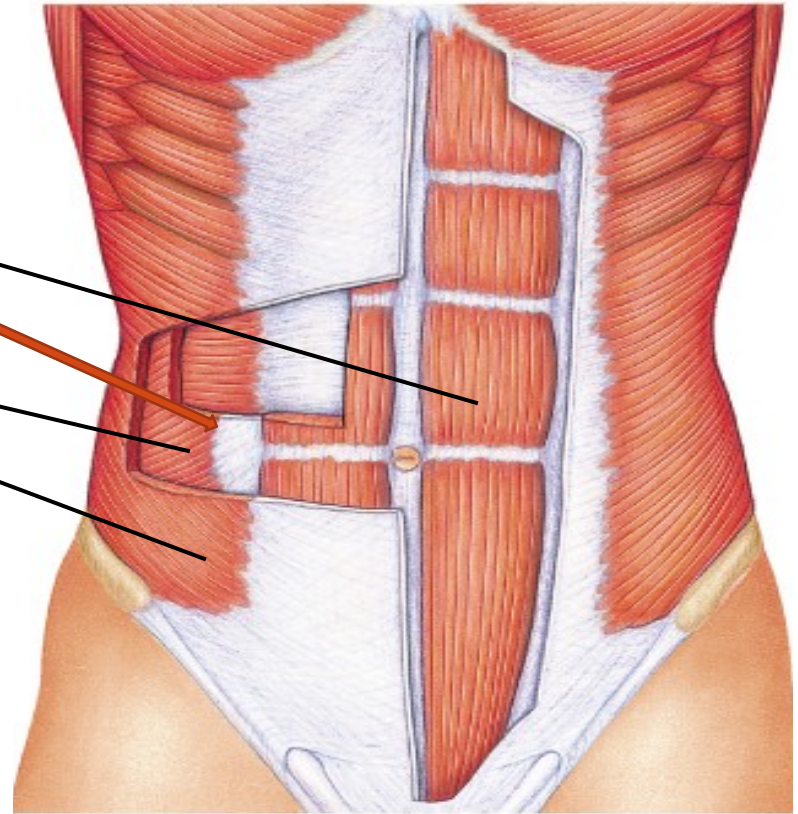
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❖ Abdominal wall muscles

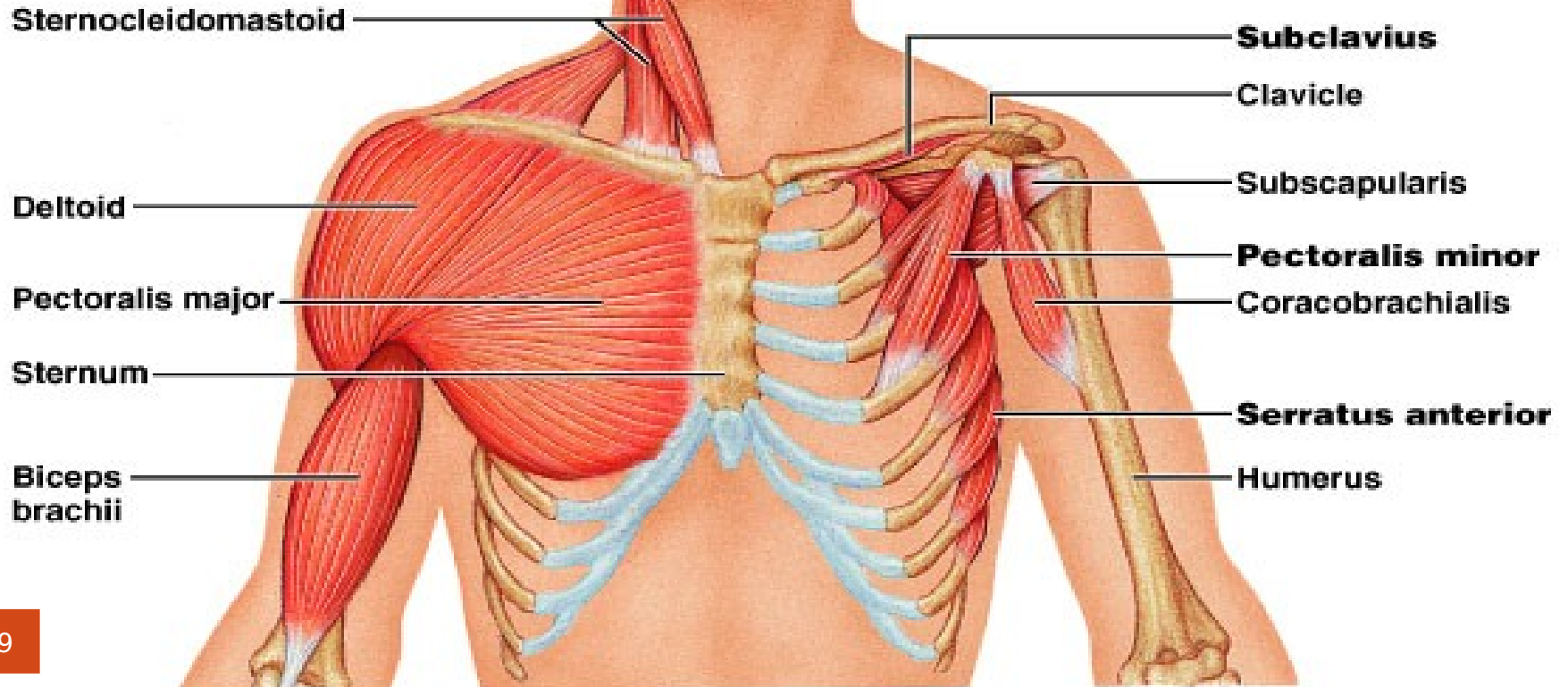
- Rectus abdominis
- Transverse abdominis
- Internal and
- external oblique abdominis

Action: flex & rotate lumbar vertebrae, fix & depress ribs, stabilize pelvis during walking, increase intra abdominal pressure

II All are innervated by **thoracic spinal nerve**



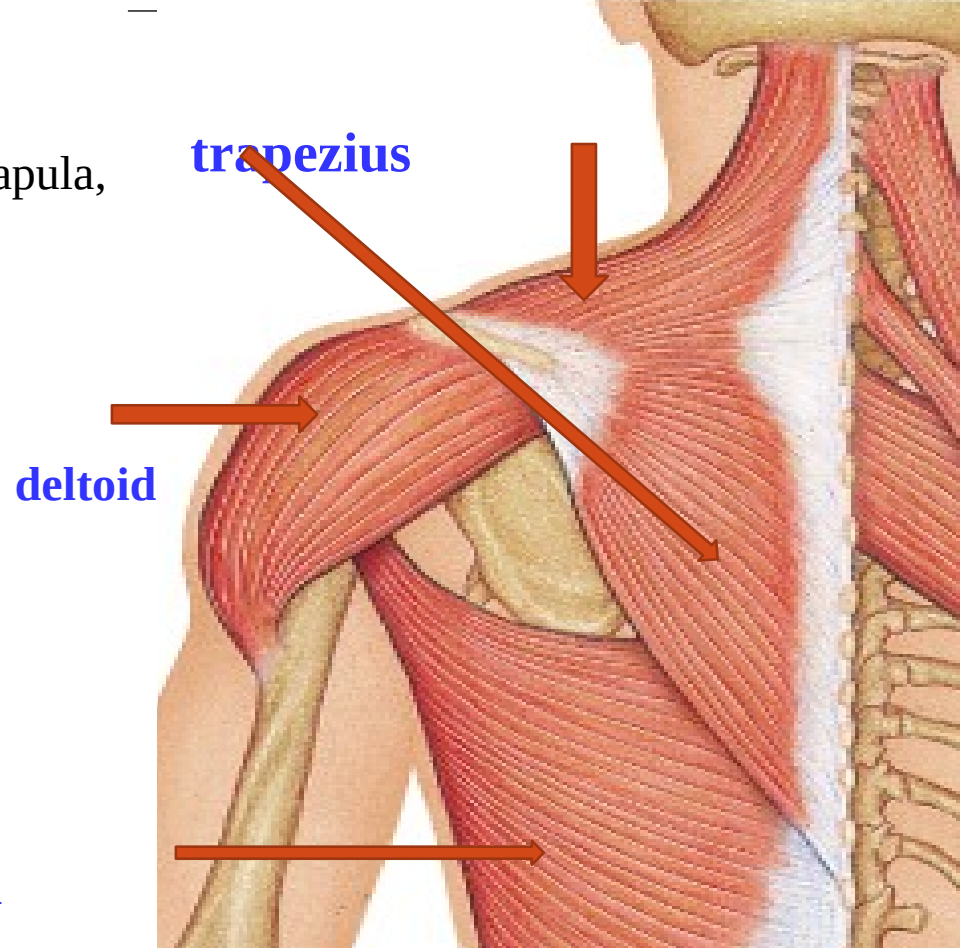
Superficial thorax muscles



Superficial thorax muscles

❖ Trapezius muscle

- Action: stabilize, elevate, adduct, depress scapula, extend head
- Trapezius by **accessory nerve**
- Deltoid by **axillary nerve**
- Latissimus dorsi by **Thoracodorsal nerve**



Muscles of the Back

➤ Their action is primarily extending , rotating, and laterally flexing the vertebral column.

- latismus dorsi
- trapizius
- serratus muscles

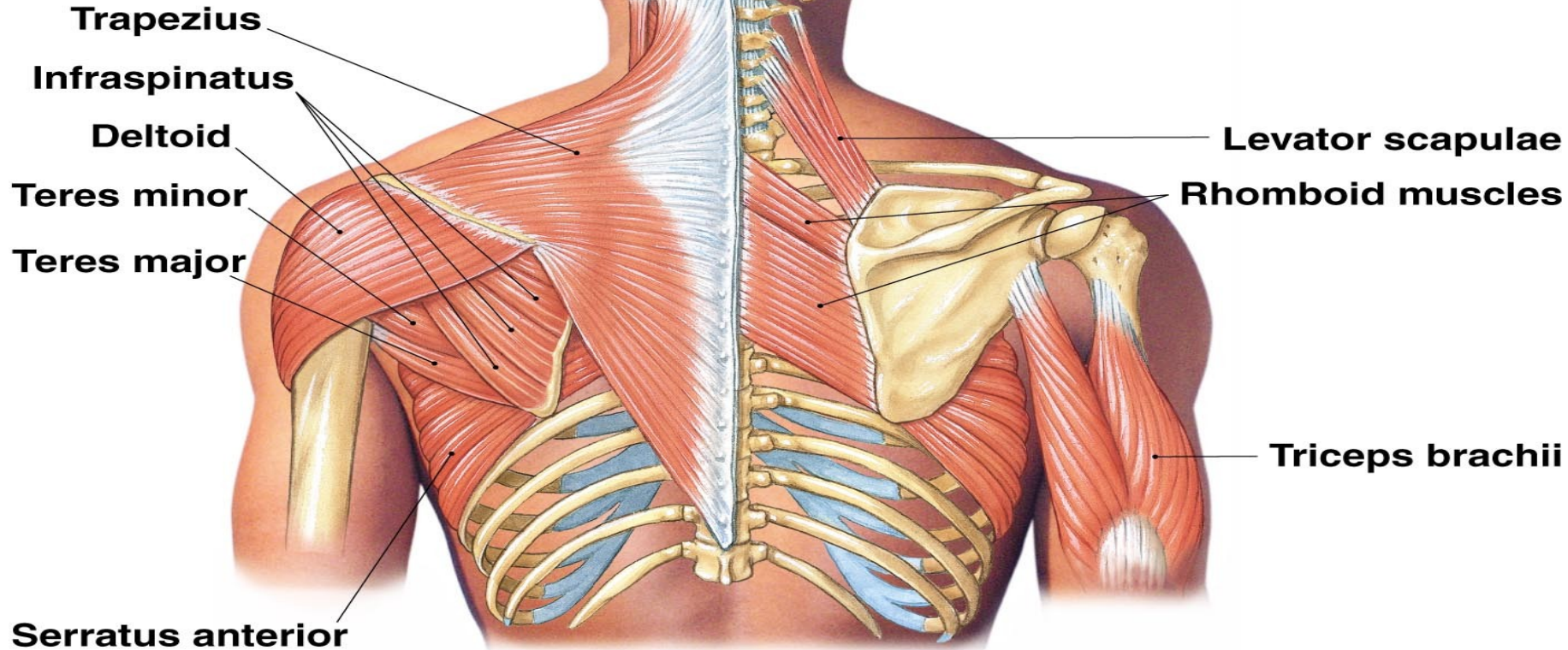
} **Superficial muscle**

- erector spine
- illiocostalis
- longismus and spinalis muscle

} **Deep muscle**

SUPERFICIAL

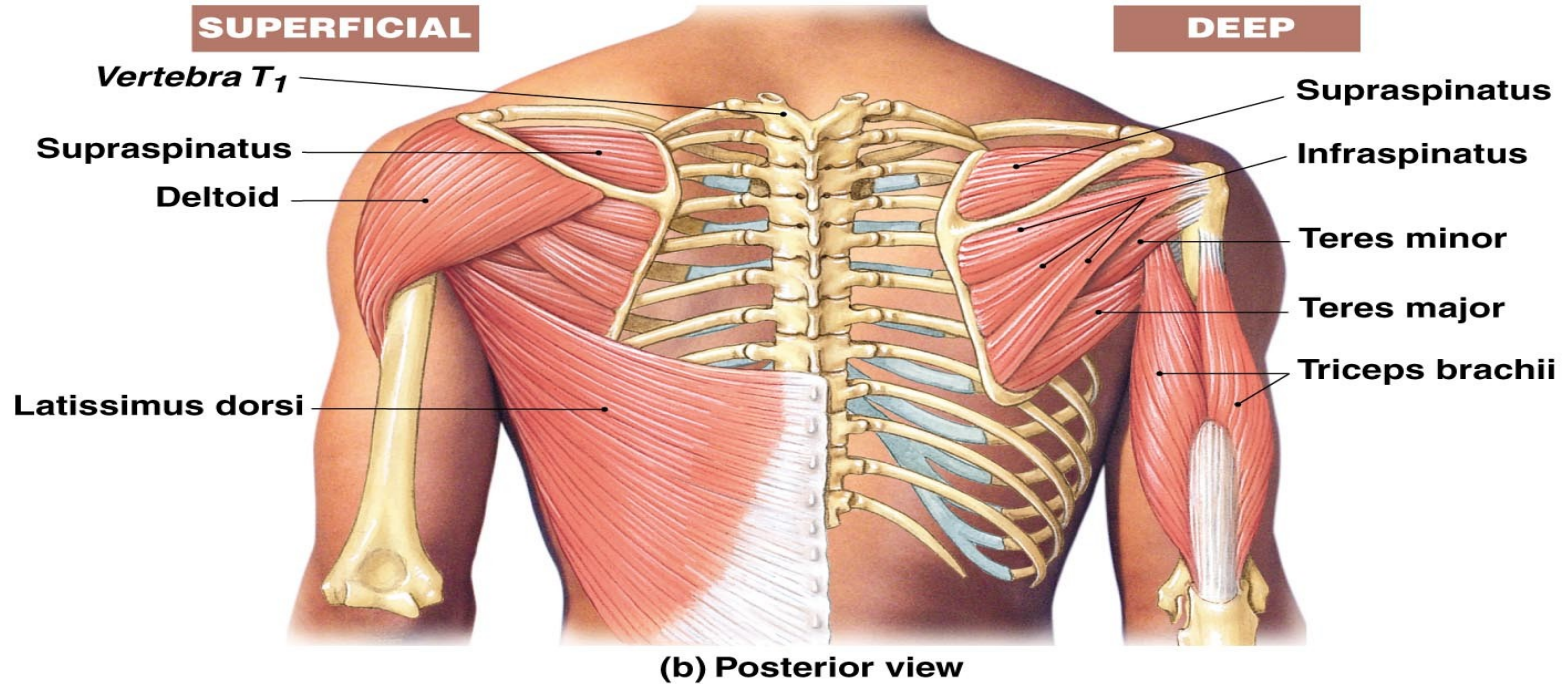
DEEP



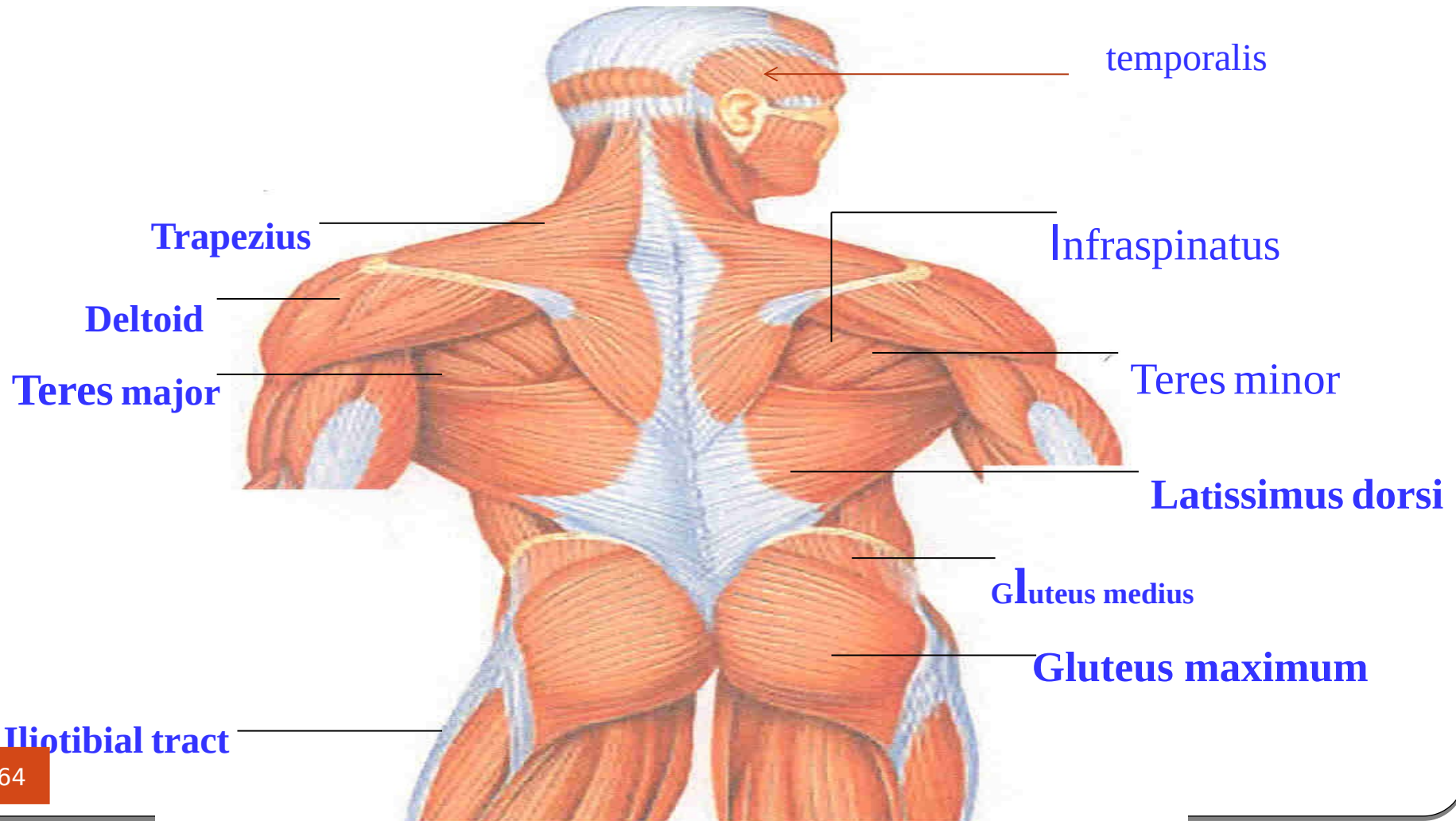
(a) Posterior view

Latissimus Dorsi muscle

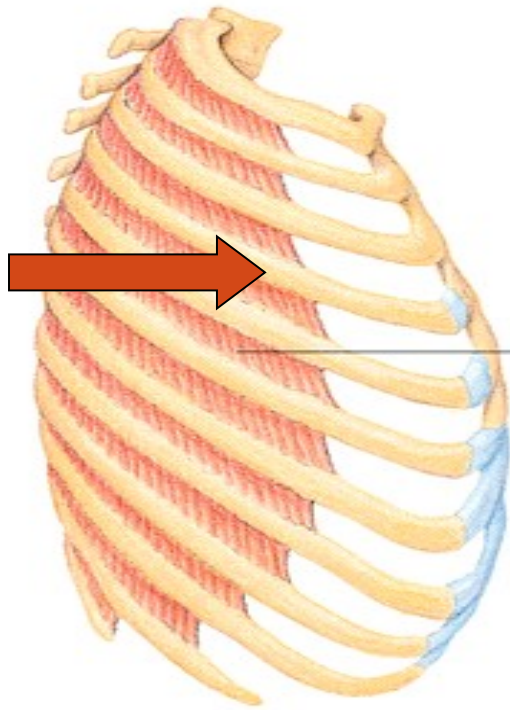
Action: *Extend, Adduct & Rotate Arm Medially*



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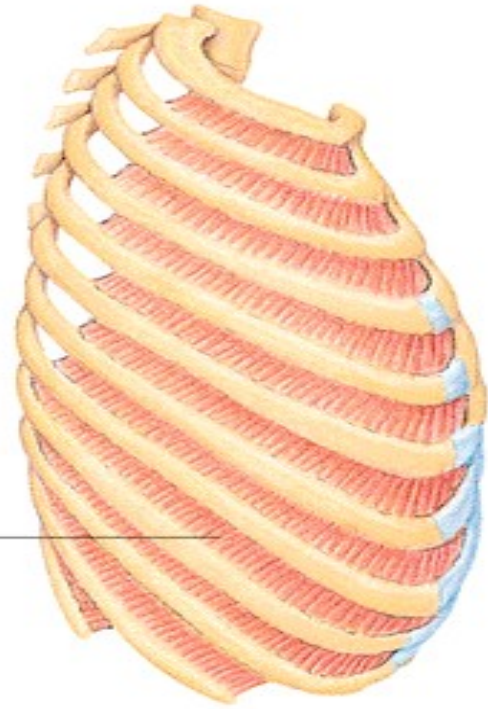
External Intercostals



Elevate ribs

External
intercostal

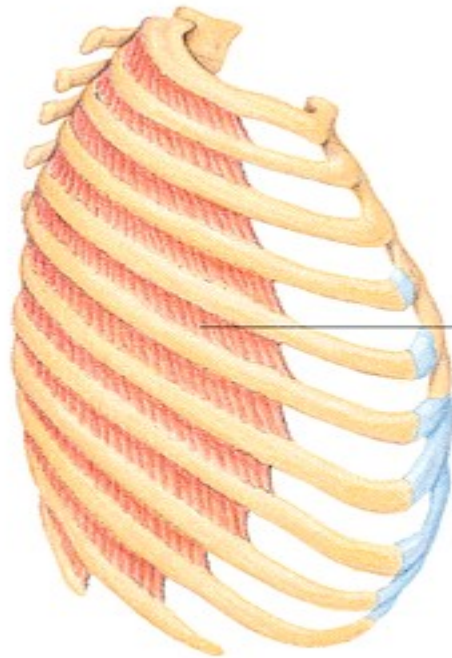
Internal
intercostal



(a)

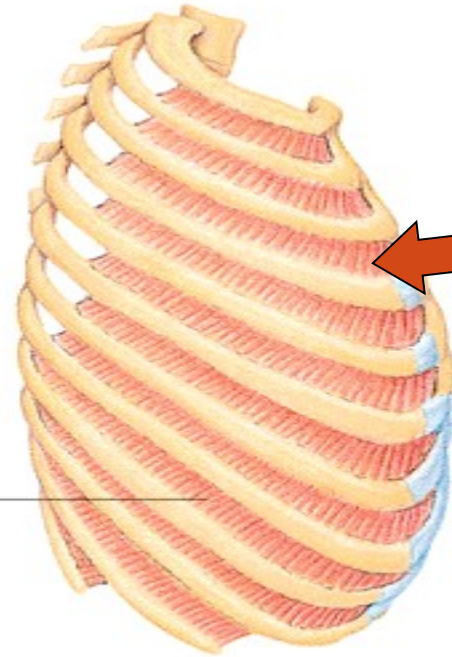
Internal Intercostals

Depress ribs



External
intercostal

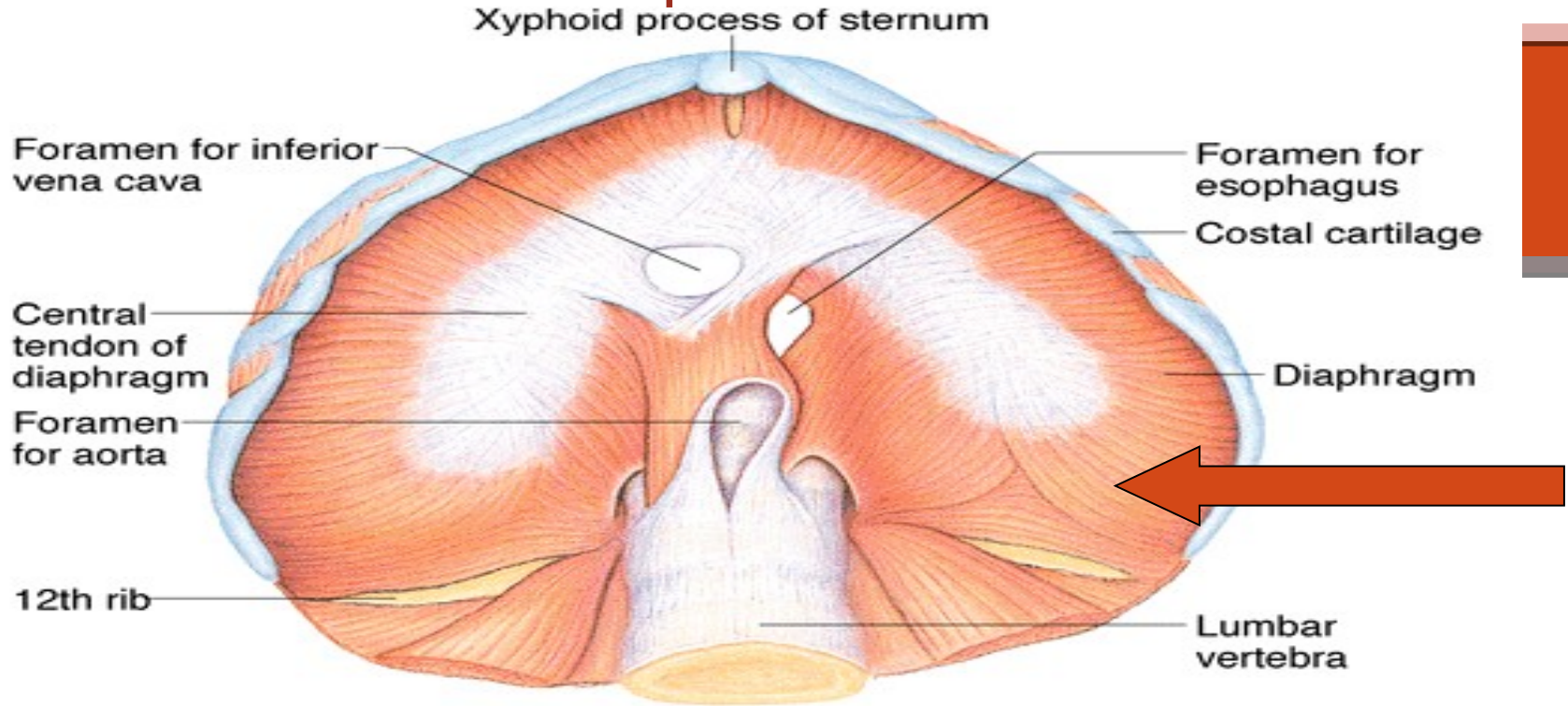
Internal
intercostal



(a)

Diaphragm

Inspiration

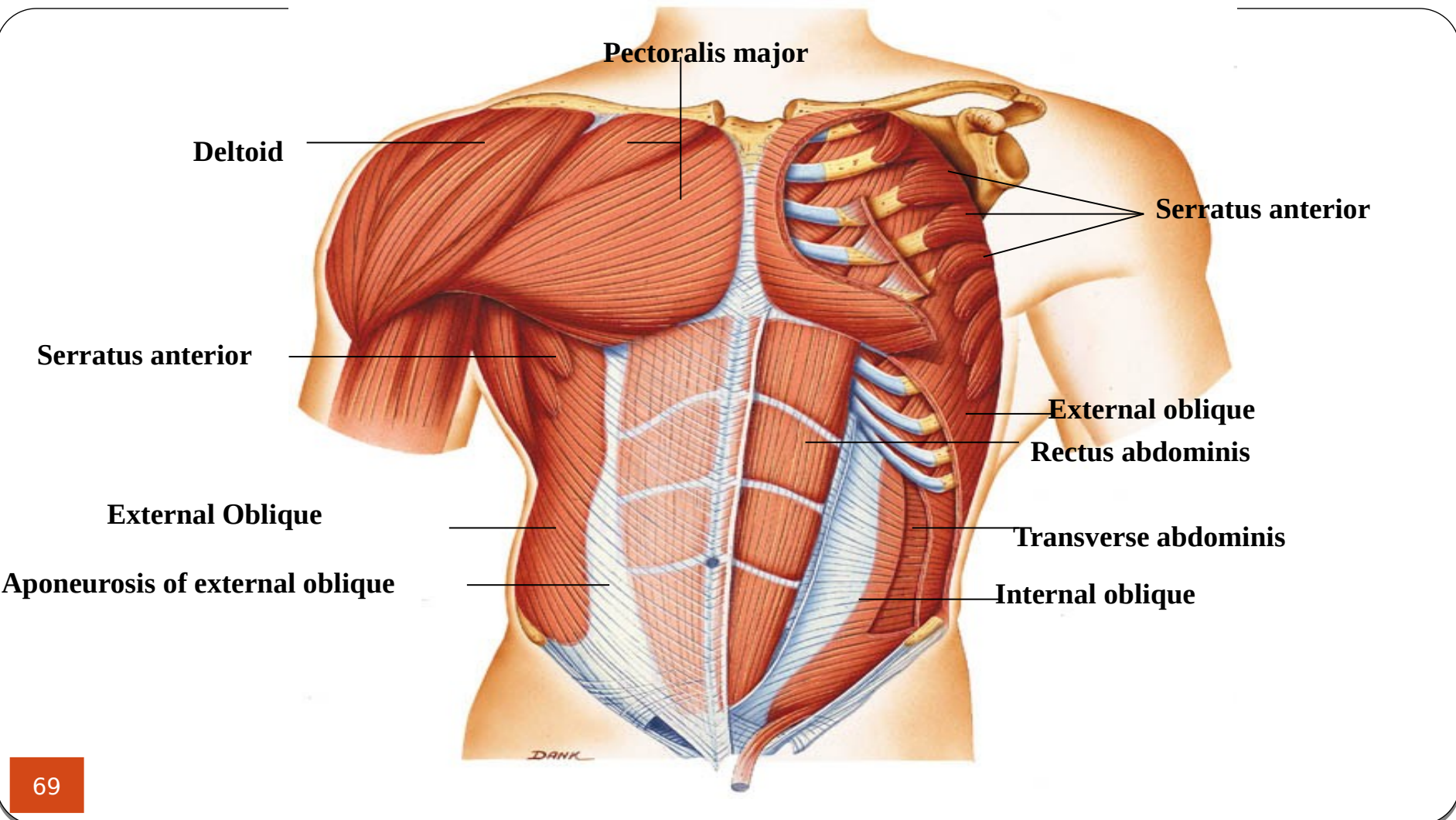


(b)

❖ **Muscles of the shoulder & upper limb**

➤ These muscles are used for the rotation, elevation, depression, protraction , flexion ,extension, adduction and abduction of pectoral girdle and upper limbs.

- trapizius
- serratus muscle
- pectoralis
- levator scapulae
- rhomboidus
- deltoid etc
- triceps brachii
- Biceps brachii
- Brachialis



Pectoralis major

Deltoid

Serratus anterior

Serratus anterior

External oblique

Rectus abdominis

External Oblique

Transverse abdominis

Aponeurosis of external oblique

Internal oblique

❖ Muscles of Arm

➤ four major arm muscles, *three flexors*

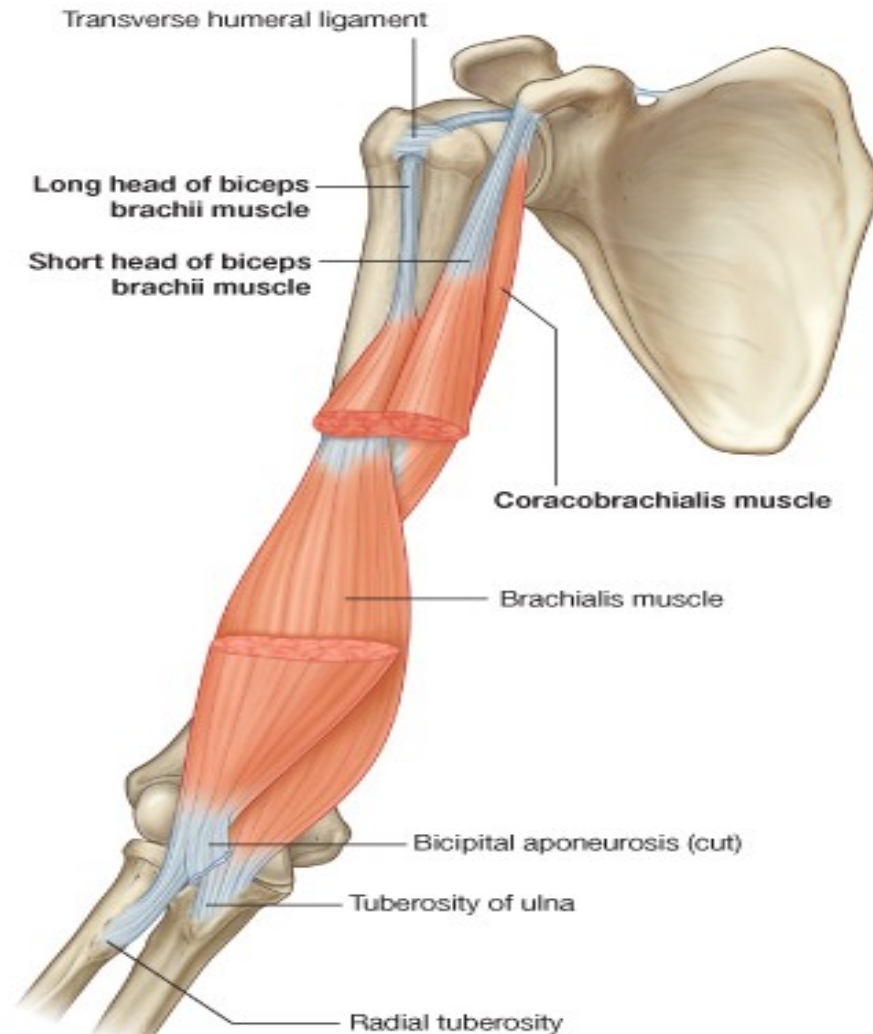
➤ **biceps brachii**

➤ **brachialis**

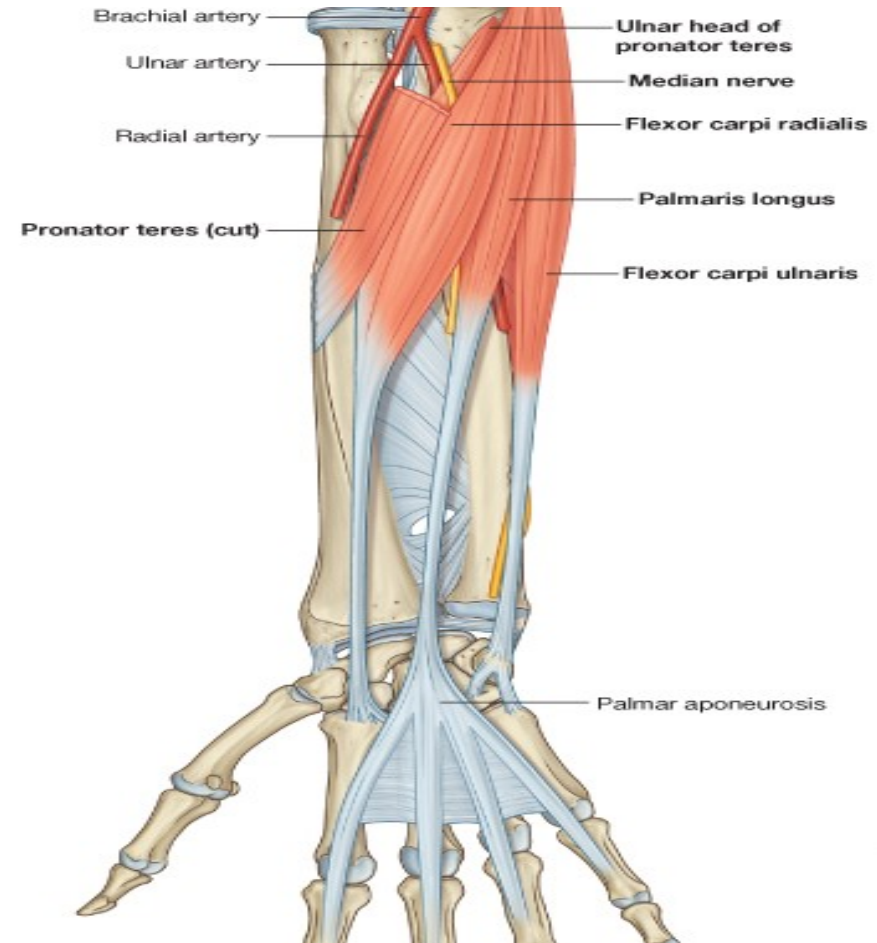
➤ **Coracobrachialis**

are in the anterior (flexor) compartment,
supplied by **the musculocutaneous
nerve**

➤ **extensor** (triceps brachii) is in the
posterior compartment, supplied by the
radial nerve



- ❖ **muscle of the forearm**
- **The anterior(flexor)
=(pronator)compartment**
- The flexor muscles are arranged in three layers or groups
- **A superficial layer** or group of **four muscles**
- *pronator teres*
- *flexor carpi radialis*
- *palmaris longus*
- *flexor carpi ulnaris*
- All are innervated by **median & ulnar nerve**

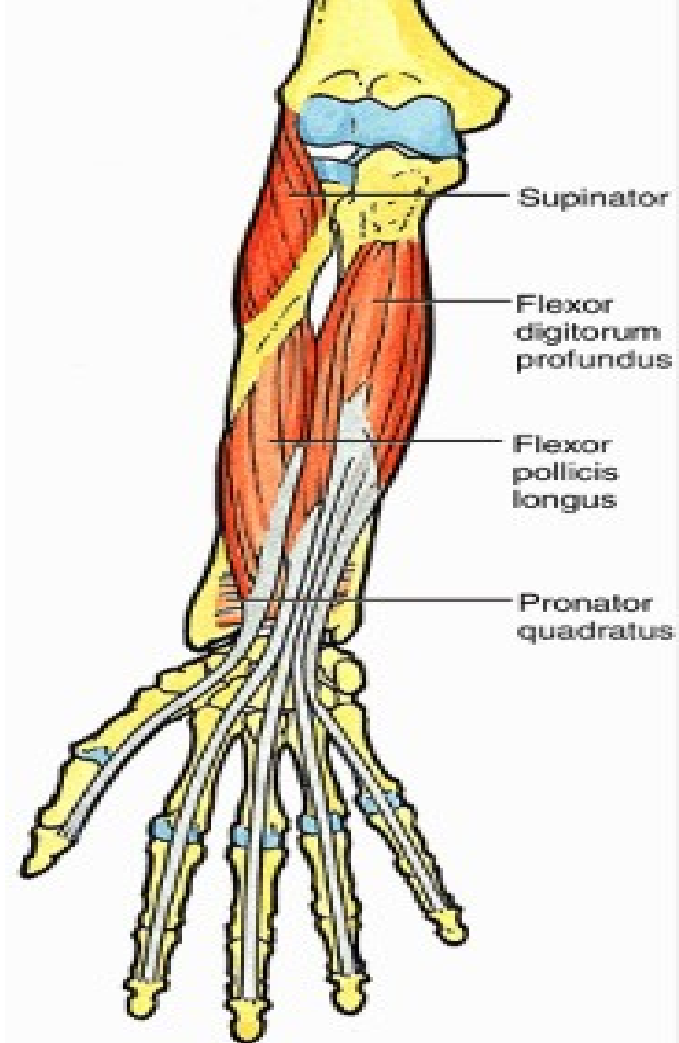


Intermediate (second layer)of anterior compartment of fore arm

Only one muscle , flexor digitorum superficialis(FDS)

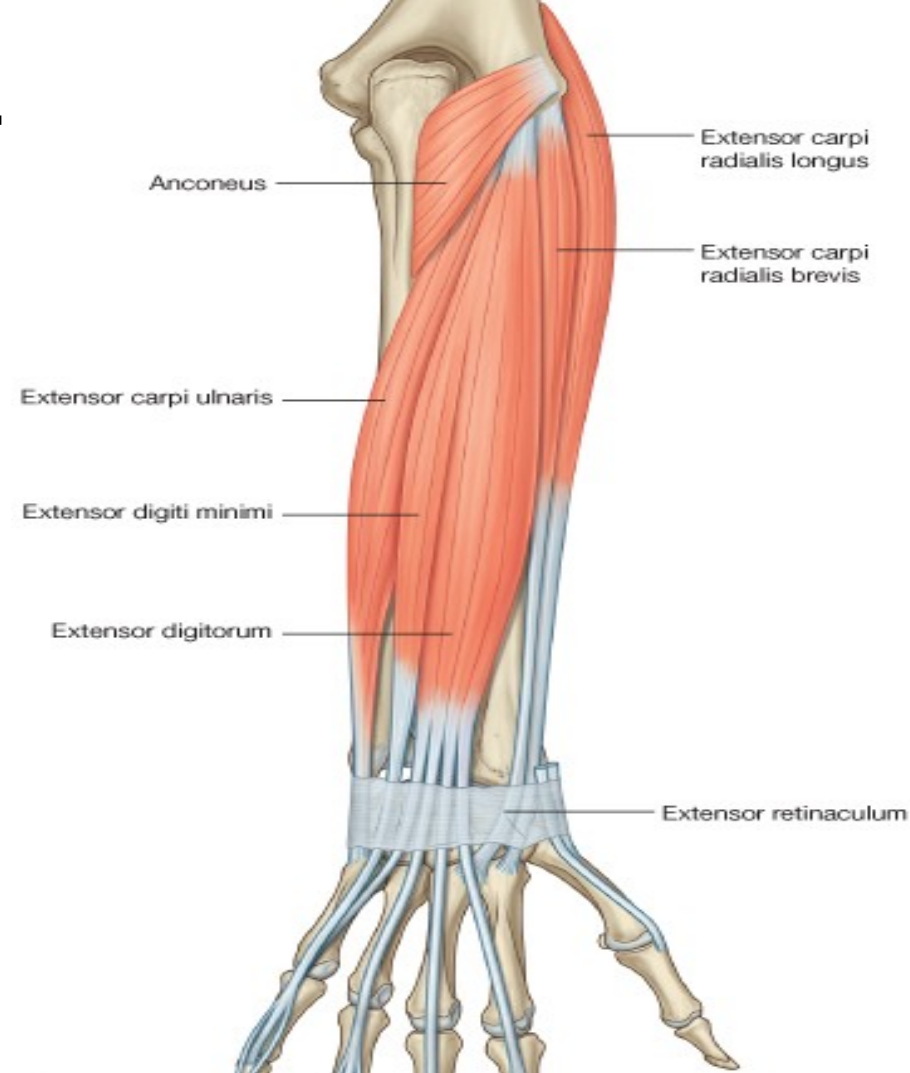
Which is innervated by **median nerve**

- **deep layer of forearm flexor muscles.**
- The following **three muscles** form the
- Flexor Digitorum Profundus
- Pronator Quadratus
- Flexor Pollicis Longus
- All are innervated by **median nerve**



❖ Extensor muscles of forearm

- The extensor muscles are in the **posterior** (**extensor-supinator**) compartment of the forearm, and **all** are innervated by branches of the **radial nerve**
- Extensor digitorum
- Extensor Carpi radialis longus
- Extensor Carpi radialis Brevis
- Extensor digiti minimi
- Extensor Indicis
- Adductor pollicis longus
- Extensor pollicis brevis



Muscles of lower limbs

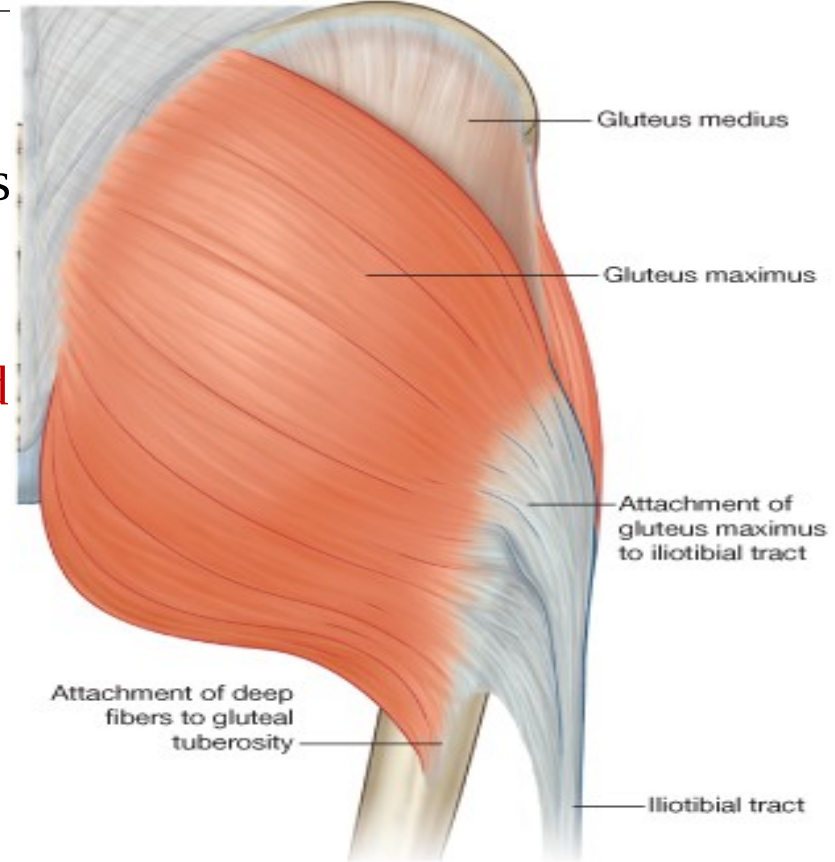
Gluteal region

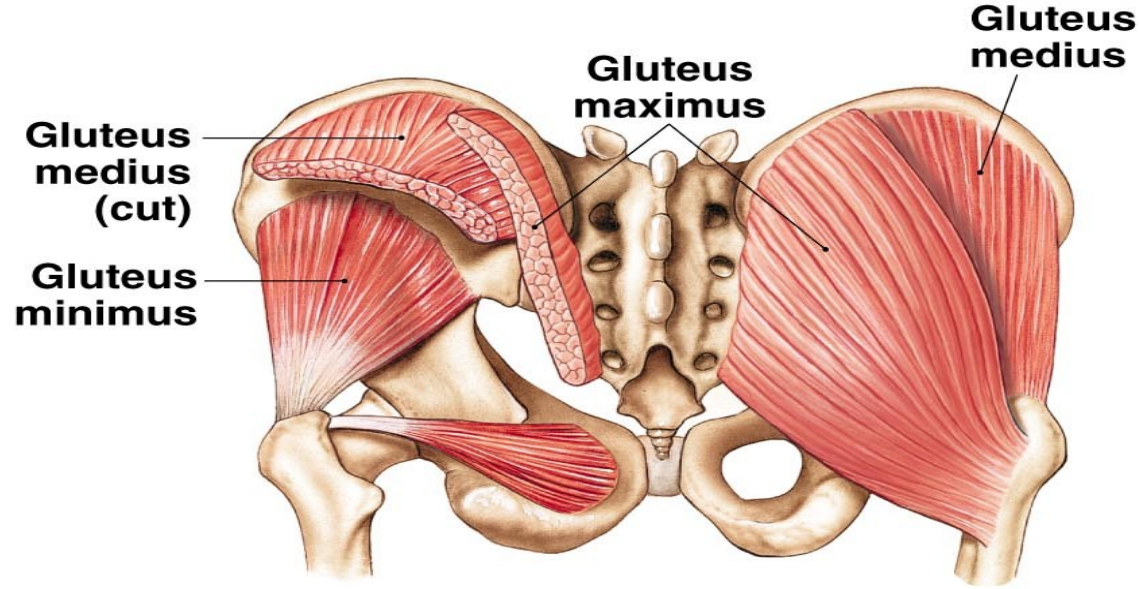
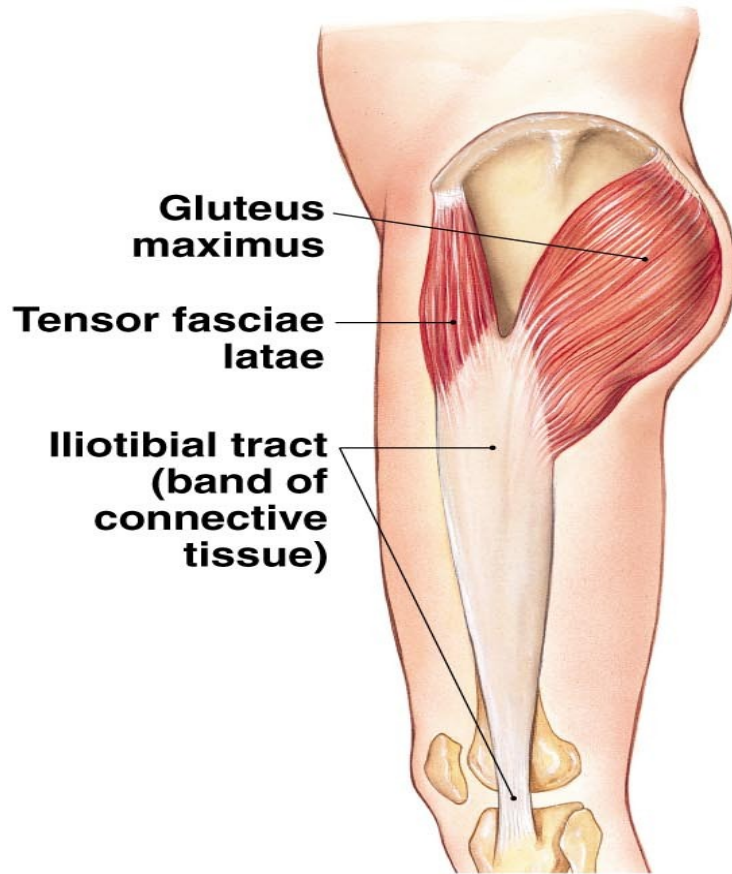
There are superficial and deep gluteal muscles

Superficial group

It consists of the three large overlapping glutei (**maximus, medius, and Minimus**) and **the tensor fasciae latae**

The deep layer consists of smaller muscles (**piriformis, obturator internus, superior and inferior gemelli, and quadratus femoris**)



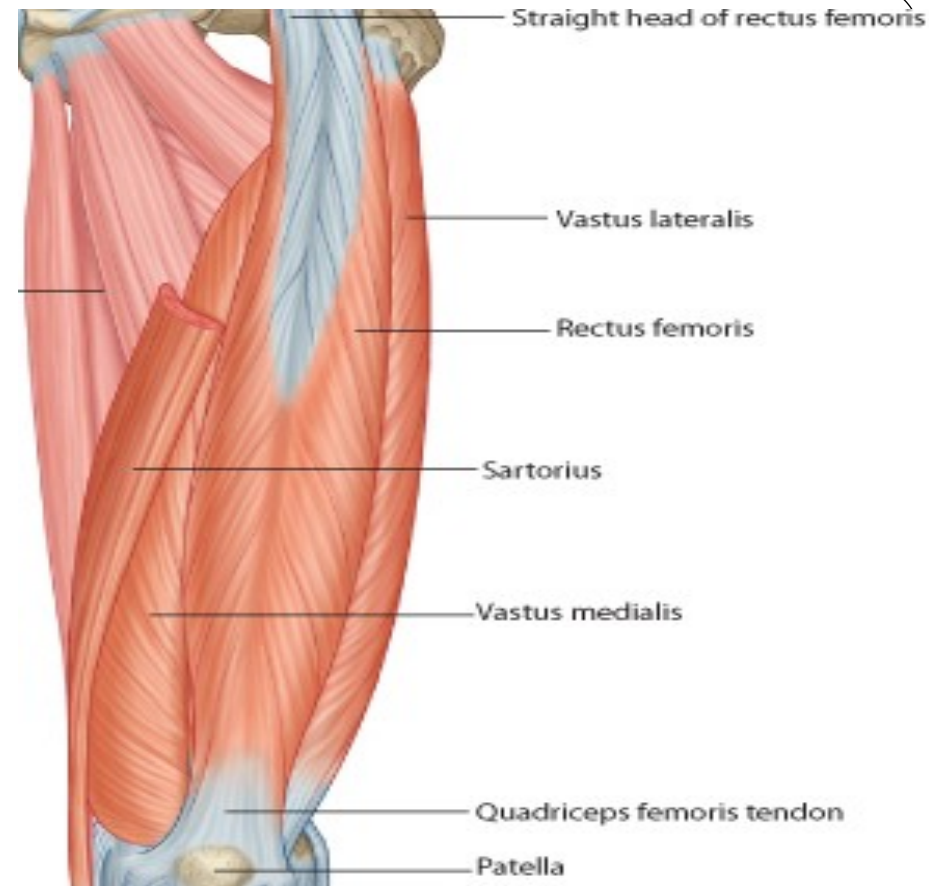


(a) The gluteal muscle group

Anterior (Extensor) Compartment of thigh muscle

Quadriceps femoris quadriceps four heads of origin

- Rectus femoris straight; fascicles
- Vastus lateralis
- Vastus medialis ;medialis medial)
- Vastus intermedius
- Sartorius ;S shape anterior muscle of the thigh
- Innervated by femoral nerve



Medial (Adductor) Compartment

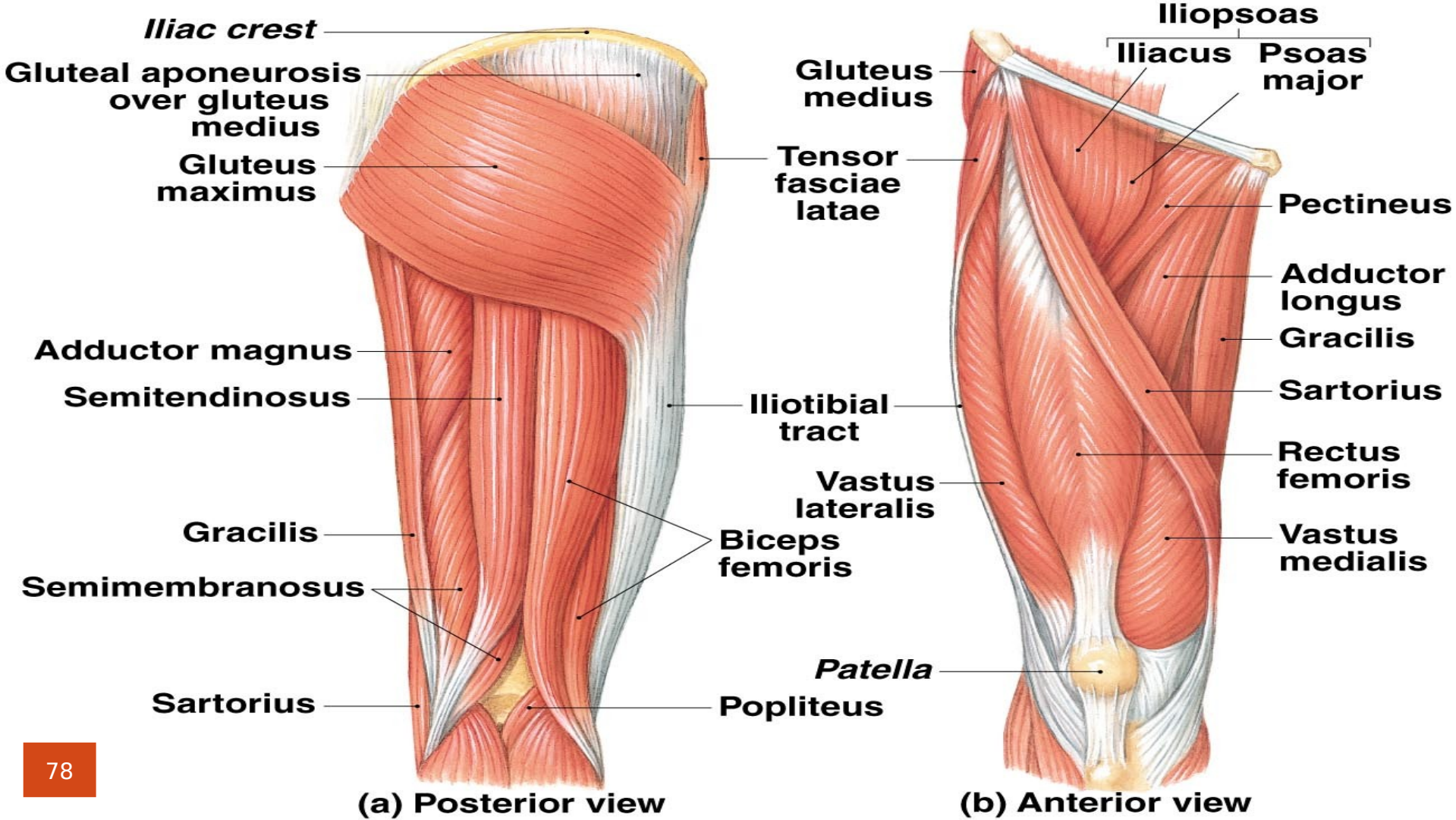
- Adductor magnus
- Adductor longus
- Adductor brevis
- Pectineus
- Gracilis

☞ All are innervated by **obtrator nerve**

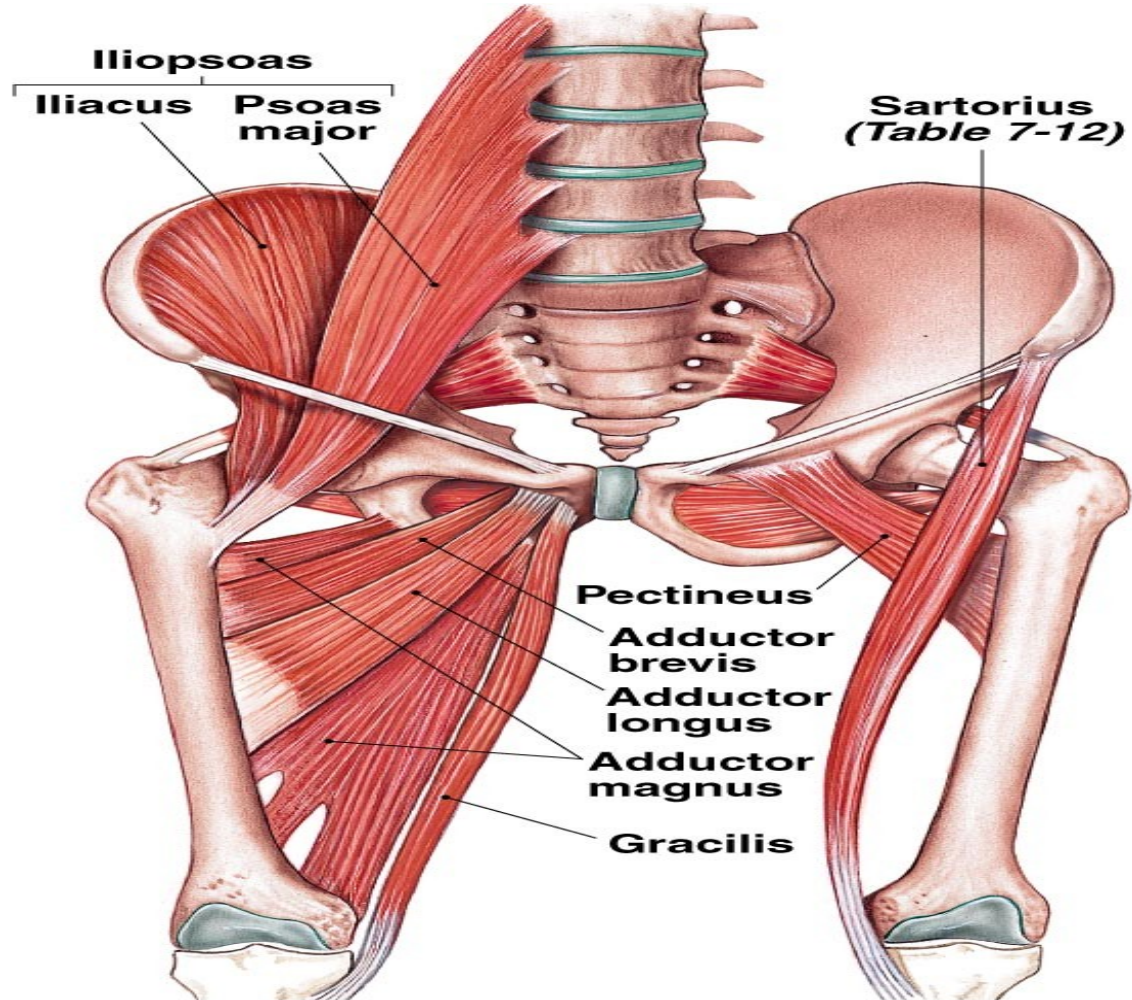
Muscles acting on the Thigh posterior compartment

- Biceps femoris
- Semitendinosus
- Semimembranosus

☞ These 3 muscles are used to **flex the knee joint** and innervated **by tibial branch of sciatic nerve**



Muscles That Move the Thigh



(b) The iliopsoas muscle and the adductor group

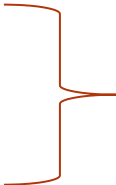
❖ Muscle of the leg

❖ Anterior compartment (extensor compartment)

- Tibialis anterior
 - Extensor digitorum longus (EDL)
 - Extensor hallucis longus (EHL)
 - Fibularis teritus ,
- By deep fibular nerve
- 

❖ Posterior compartment(flexor compartment)

➤ Superficial compartment

- Gastrocnemus
 - Soleus
 - Plantaris
- By tibial nerve
- 

SUPERFICIAL MUSCLES

Gastrocnemius

Soleus

Calcaneal tendon

SECOND LAYER

Popliteus

Soleus

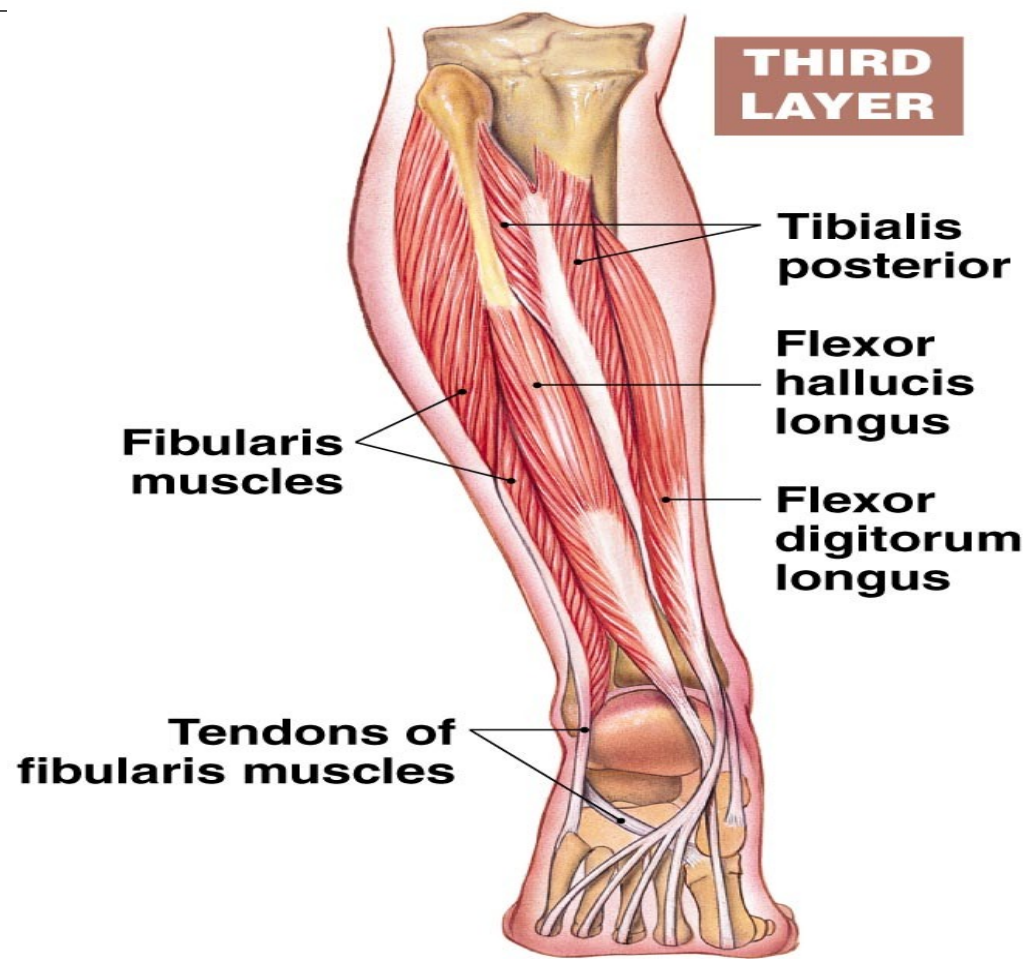
Gastrocnemius,
cut and removed

(a) Posterior view

Deep posterior compartment(flexor compartment)

- Tibialis posterior
- popliteus
- Flexor hallucis longus(FHL)
- flexor digitorum longus(FDL)

all are innervated by **tibial nerve**



(b) Posterior view, left leg

❖ **Lateral compartment**

➤ There are only two muscles in the lateral compartment

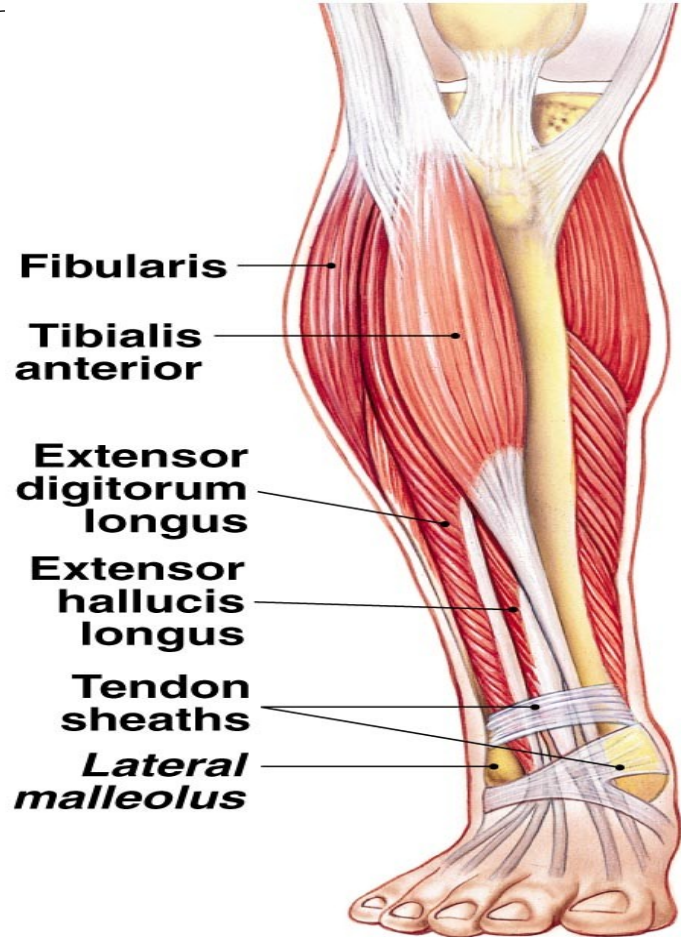
➤ **Fibularis longus**

➤ Its name is due to long tendon and superficial to the brevis

➤ **fibularis brevis**

➤ gives the name because it has short tendon ,deep to fibularis longus

≡ the lateral compartment of leg muscle are innervated by **superficial fibular nerve** and the anterior compartment is by **deep fibular nerve**



Fibularis

**Tibialis
anterior**

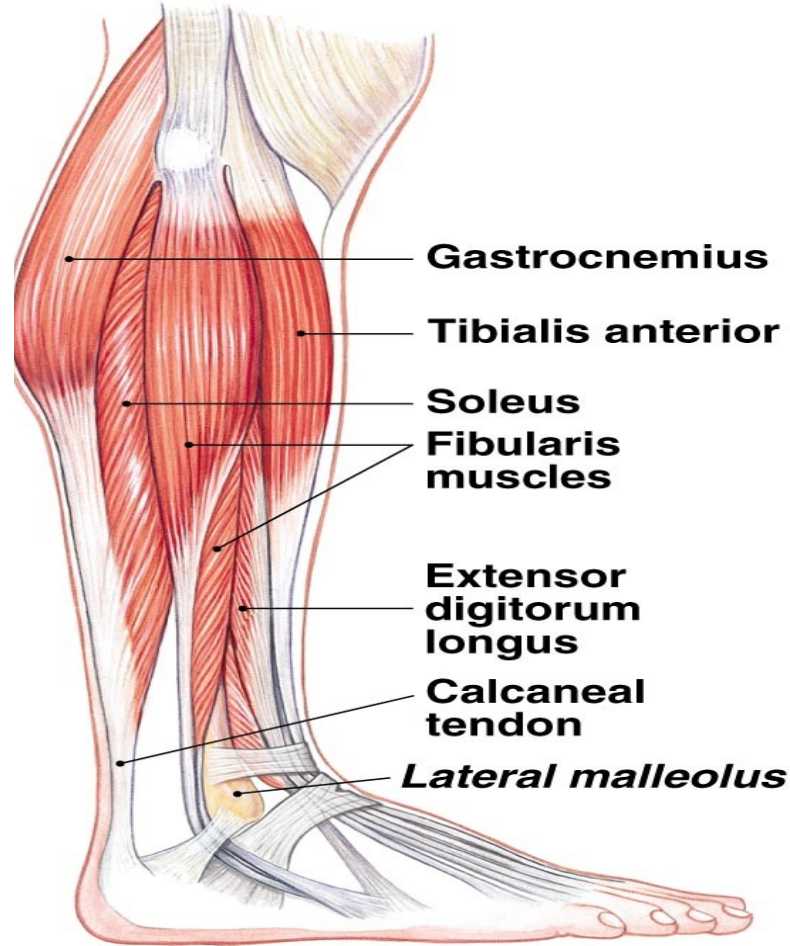
**Extensor
digitorum
longus**

**Extensor
hallucis
longus**

**Tendon
sheaths**

**Lateral
malleolus**

(c) Anterior view, right leg



Gastrocnemius

Tibialis anterior

Soleus

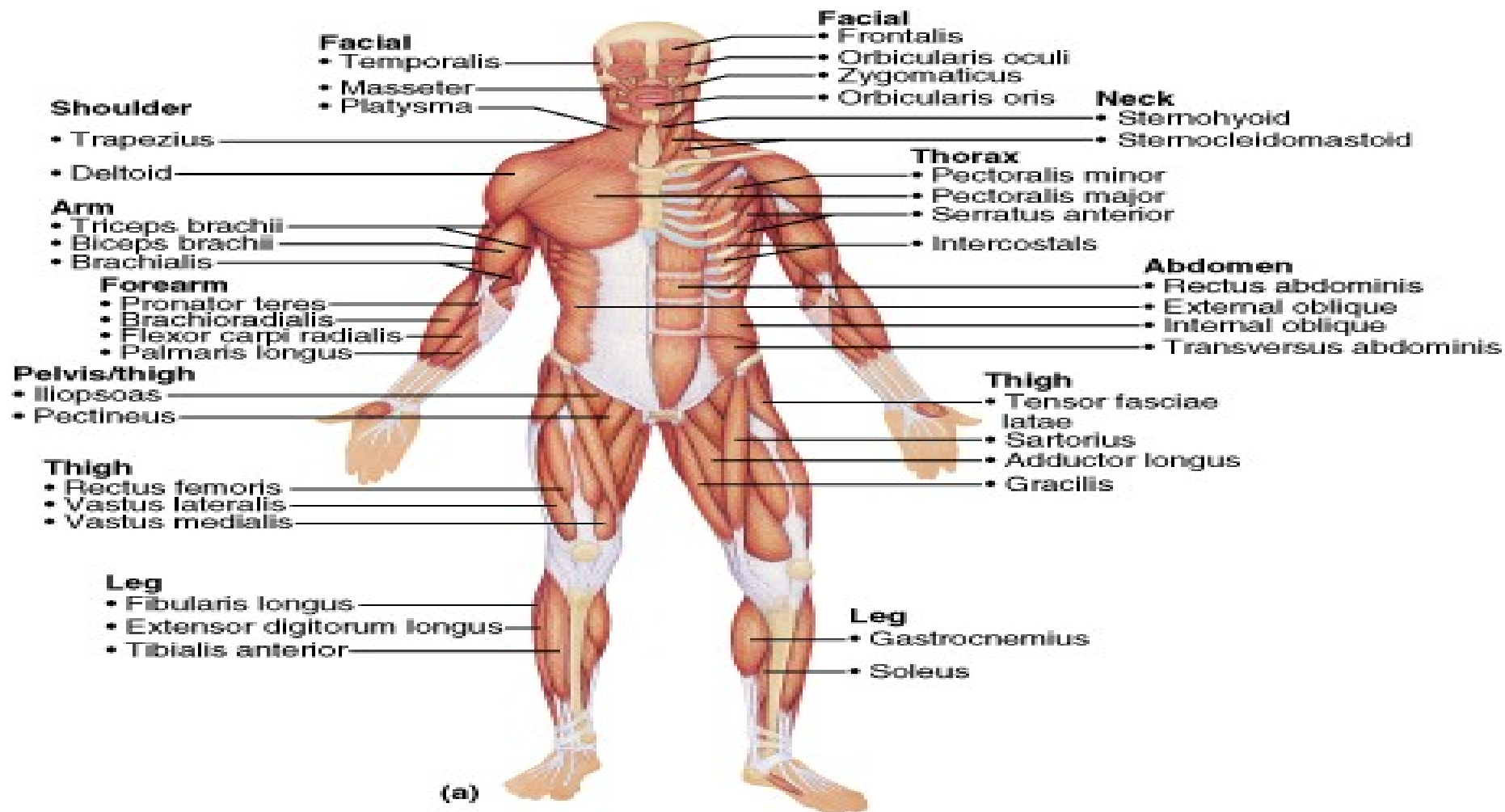
**Fibularis
muscles**

**Extensor
digitorum
longus**

**Calcaneal
tendon**

Lateral malleolus

(d) Lateral view



❖ Intramuscular Injection

- Site where free from nerves and important of injection of drugs

❖ The gluteal region

- The gluteal region is a common injection site because the muscles are thick and large; consequently, they provide a substantial volume for absorption of injected substances by intramuscular veins.
- It is important to be aware of the extent of the gluteal region of **Upper outer quadrant** and the safe region for giving injections

❖ Deltoid

❖ Vastus lateralis

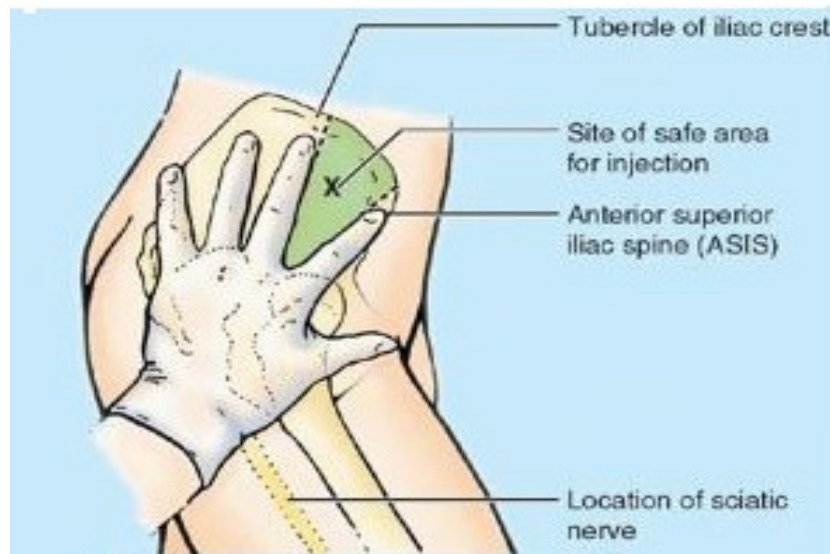
❖ umbilicus

Are the common site for intramuscular injection





(A) Posterior view



(B) Lateral view

Effects of Exercise on Muscle

❖ Results of increased muscle use

- Increase in muscle size
- Increase in muscle strength
- Increase in muscle efficiency
- Muscle becomes more fatigue resistant

Disorders relating to the Muscular System

- **Muscular Dystrophy:** inherited, muscle enlarge due to increased fat and connective tissue, but fibers degenerate and atrophy
- **Poliomyelitis(Polio):** actually a viral disease of the nervous system that cause paralysis of muscles.
- **Myasthenia Gravis:** progressive weakness due to a shortage of acetylcholine receptors

*Thank
you*

