The Muscular System (5)

CHAPTER 11

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Principles of
Human Anatomy
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Overview of Muscular Tissue

- There are three types of muscular tissue:
  - Skeletal
  - Cardiac
  - Smooth

Functions of Muscular Tissue

- Producing body movements
- Stabilizing body positions
- Storing and moving substances
- Producing heat

Properties of Muscular Tissue

- Electrical excitability
- Contractility
- Extensibility
- Elasticity

The Muscular System

Characteristics of muscle tissue:

1. Electrical excitability: the ability to respond to certain stimuli by producing electrical signals called action potentials (impulses)

2. Contractility: the ability to shorten & developing tension (force of contraction)

3. Extensibility: the ability of the muscle to be stretched without being damaged

4. Elasticity: the ability to return to its original shape after contraction

Structure of a Skeletal Muscle

- A skeletal muscle bundle consists of a body (belly) connected by tendons to the skeleton.
- Tendons
- Aponeuroses

The Muscular System

Each muscle consists of numerous muscle fibers

Muscle belly (body) is attached to bones by tendons(tendon is a cord of dense connective tissue that attaches a muscle to a bone)

some tendons are aponeuroses(a broad flat sheet of connective tissue that attaches a muscle to the periosteum of a bone/ another muscle/ or the skin)

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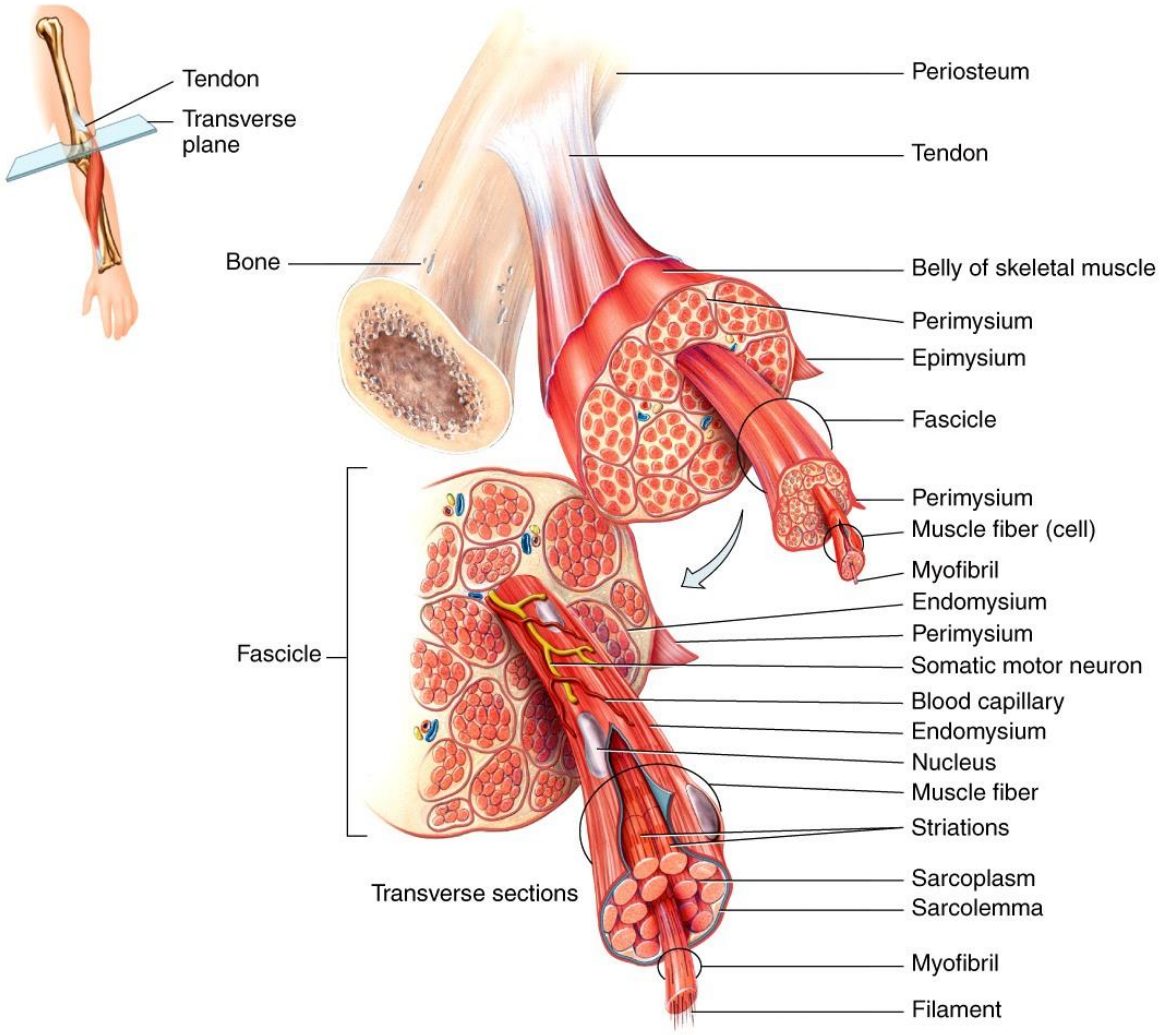
Organization of Skeletal Muscle and Connective Tissue Coverings



Components of a skeletal muscle

The Muscular System

Various skeletal muscles are grouped together and protected by large connective tissue sheets called fascia.

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The Muscular System

Nerve and Blood Supply:

- Nerves typically enter a muscle with the main blood vessels of the muscle as a unit called a neurovascular bundle.
- Somatic motor neurons send impulses down their axons to stimulate muscle fibers to contract.
- Blood vessels called capillaries deliver nutrients and oxygen to muscle fibers and carry wastes and heat away from muscle fibers.

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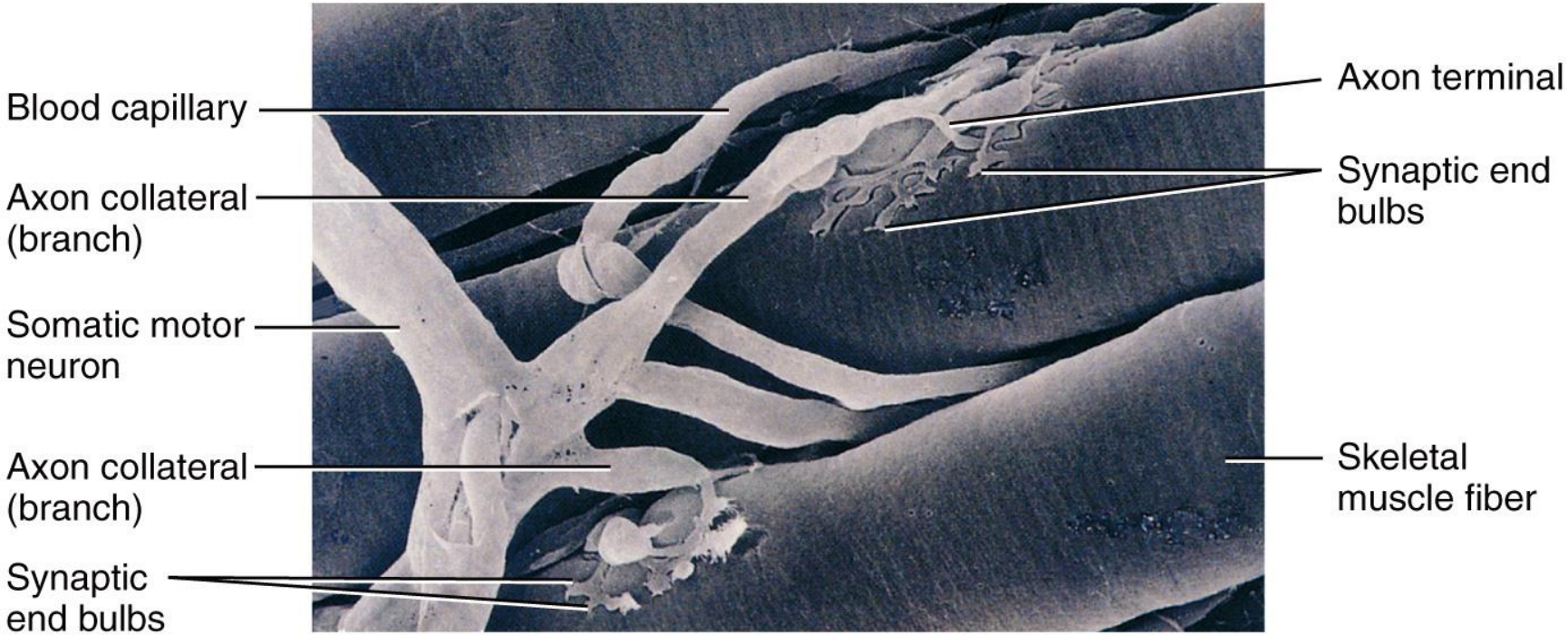
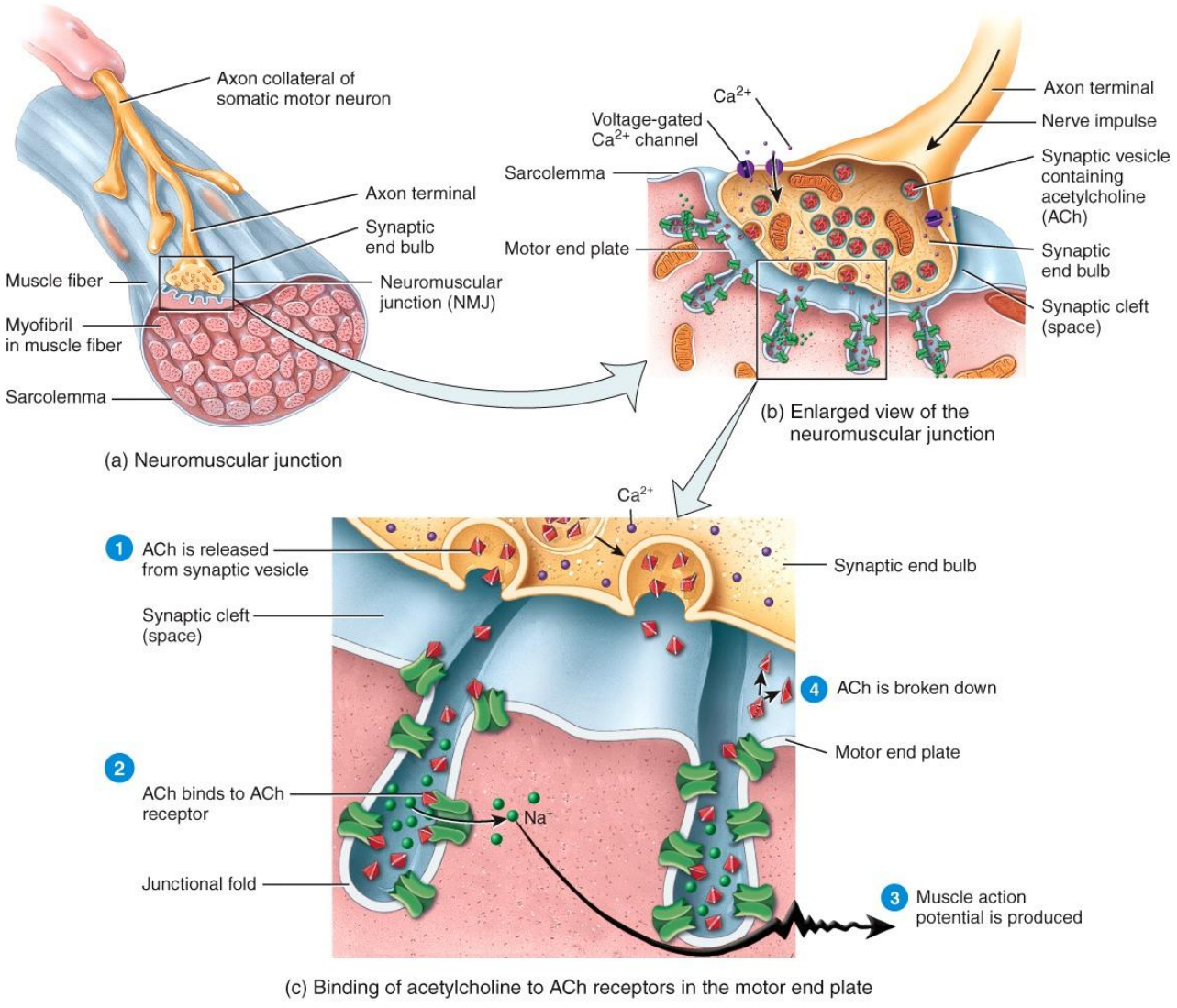
Structure of Neuromuscular Junction (NMJ)



(d) Neuromuscular junction

Structure of Neuromuscular Junction (NMJ)



The Muscular System

Movement is produced by action of bones, muscles & joints

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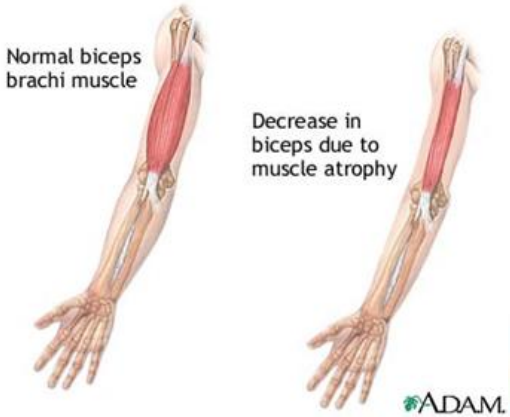
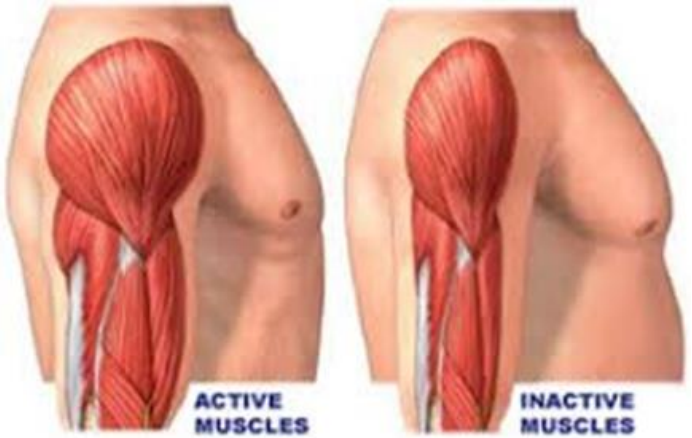
The Muscular System

Muscles can undergo atrophy/ hypertrophy

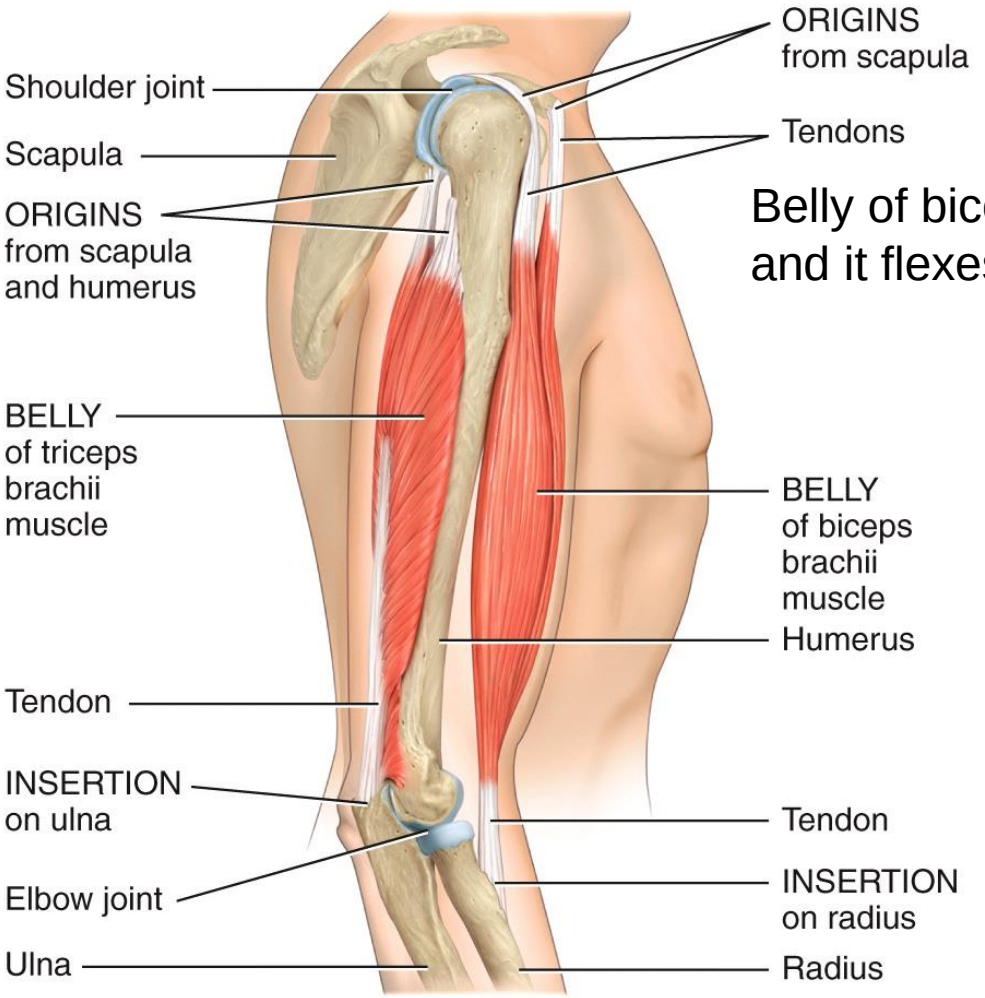




Muscle Attachment Sites: Origin and Insertion

- Contraction of muscle fibers(cells) produce movements
- Skeletal muscles cause movements by exerting force on tendons, which pull on bones or other structures.
- Articulating bones usually do not move equally in response to contraction.
  - Origin: stationary bone/ proximal
  - Insertion: movable
  - Action(s)

Relationship of Skeletal Muscles to Bones



Belly of biceps is on the arm, and it flexes the forearm

Origin and insertion of a skeletal muscle

Effects of Fascicle Arrangement

- All muscle fibers are parallel to one another within a single fascicle.
- Fascicle arrangement is related to power & rang of motion: Long fibers gives greater range of motion
- Strength is related to total number of fibers(more fibers…… stronger muscle)

Effects of Fascicle Arrangement

- Fascicles form patterns with respect to the tendons:
  - Parallel
  - Fusiform
  - Circular
  - Triangular
  - Pennate: unipennate, bipennate, and multipennate

Arrangement of Fascicles

TABLE 11.1

Arrangement of Fascicles

PARALLEL

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

Example: Sternohyoid muscle (see Figure 11.8a)

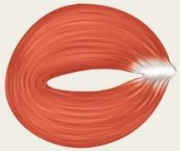
FUSIFORM

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

Example: Digastric muscle (see Figure 11.8a)

CIRCULAR

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



Example: Orbicularis oculi muscle (see Figure 11.4a)

TRIANGULAR

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

Example: Pectoralis major muscle (see Figure 11.3a)

PENNATE

Short fascicles in relation to total muscle length; tendon extends nearly entire length of muscle.

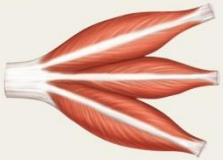
Unipennate
Fascicles are arranged on only one side of tendon.

Example: Extensor digitorum longus muscle (see Figure 11.24b)

Bipennate
Fascicles are arranged on both sides of centrally positioned tendons.

Example: Rectus femoris muscle (see Figure 11.3a)

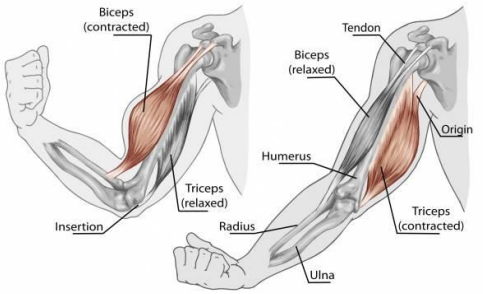
Multipennate
Fascicles attach obliquely from many directions to several tendons.



Example: Deltoid muscle (see Figure 11.17d)

Coordination Among Muscles

- It is common to attribute a specific action at a joint to a single muscle bundle, but remember that muscles do not work in isolation.
- Movements usually result from several skeletal muscles acting as a group:
  - Prime mover or agonist (ex: biceps)
  - Antagonist(triceps)
  - Synergist
  - Fixator: stabilize origin of primary mover



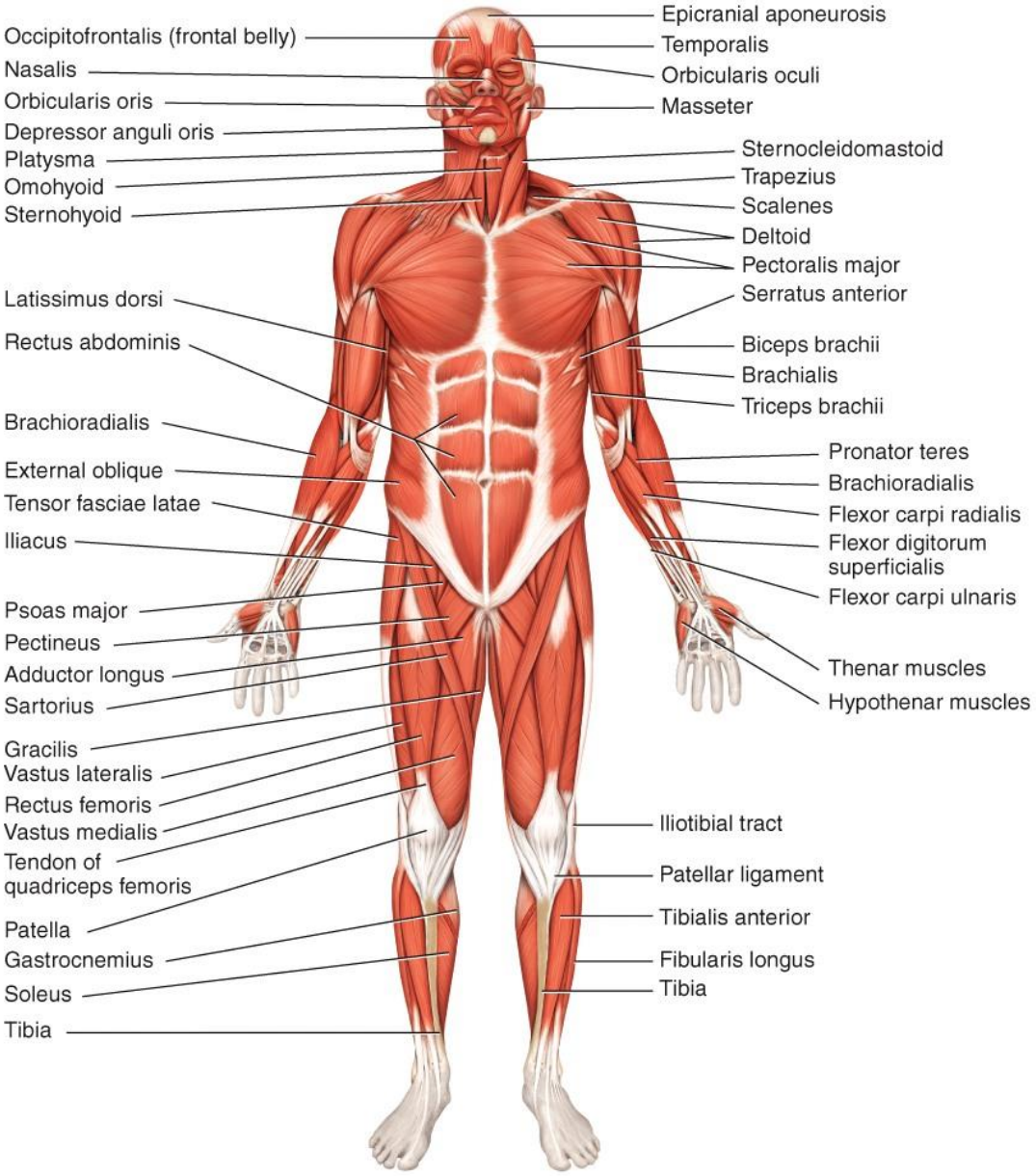
Structure and Function of Muscle Groups

- Muscle bundles arise from common masses of embryonic tissue. The limbs, trunk, and head each have a distinct pattern of muscle development.
- Muscle compartment
- Nerves and blood vessels develop along with muscles in a particular compartment.

How Skeletal Muscles Are Named

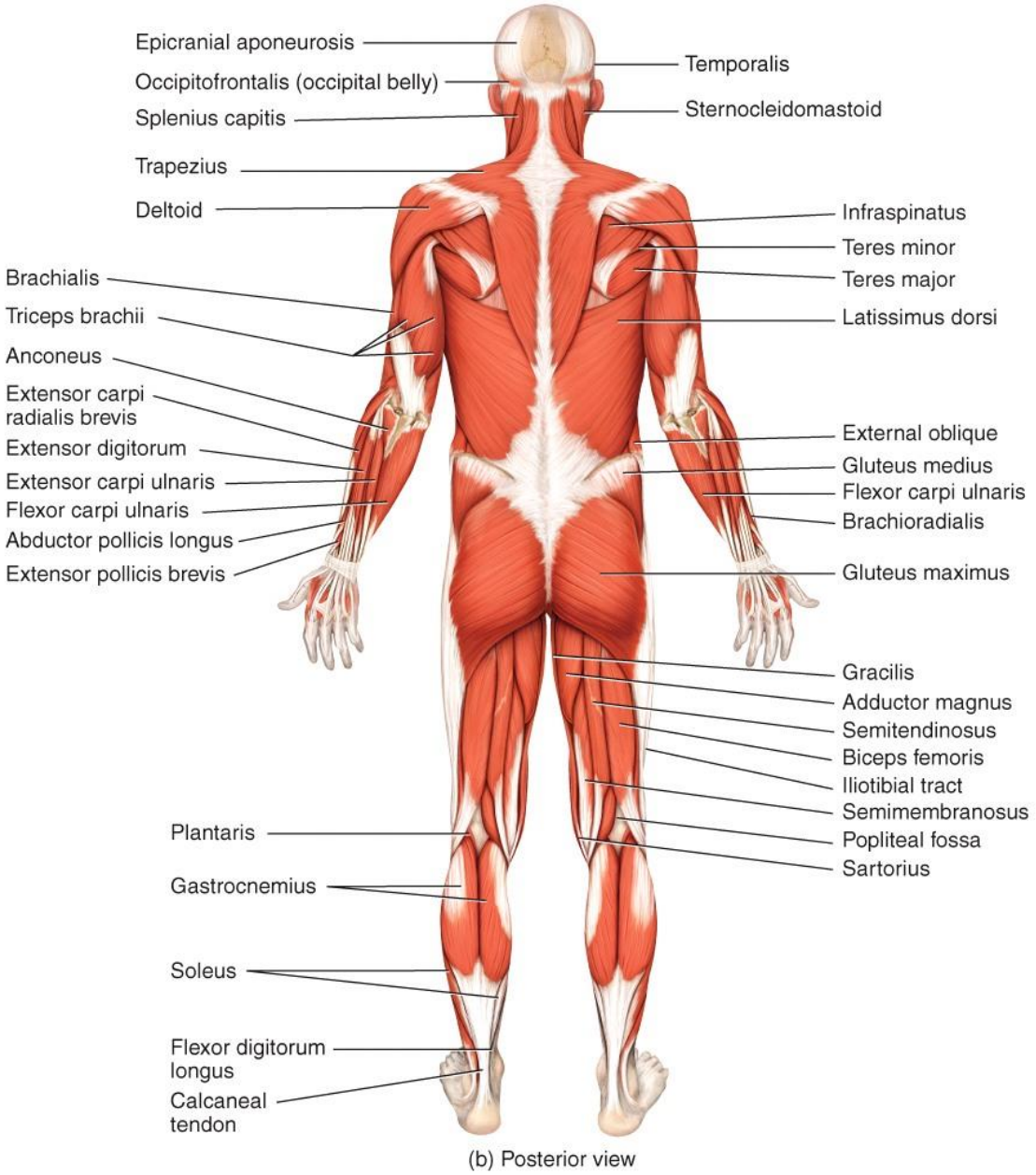
- Orientation of muscle fascicles relative to body's midline
- Size(pectoralis major), shape(trapezius), and action of muscles(flexors)
- Origin and insertion(thyrohyoid)

Principal Superficial Skeletal Muscles



(a) Anterior view

Principal Superficial Skeletal Muscles



(b) Posterior view

Characteristics Used to Name Muscles

NAME	MEANING
DIRECTION: Orientation of muscle fascicles relative to the body's midline	
Rectus	Parallel to midline
Transverse	Perpendicular to midline
Oblique	Diagonal to midline
SIZE: Relative size of the muscle	
Maximus	Largest
Minimus	Smallest
Longus	Long
Brevis	Short
Latissimus	Widest
Longissimus	Longest
Magnus	Large
Major	Larger
Minor	Smaller
Vastus	Huge

ACTION: Principal action of the muscle	
Flexor	Decreases a joint angle
Extensor	Increases a joint angle
Abductor	Moves a bone away from the midline
Adductor	Moves a bone closer to the midline
Levator	Raises or elevates a body part
Depressor	Lowers or depresses a body part
Supinator	Turns palm anteriorly
Pronator	Turns palm posteriorly
Sphincter	Decreases the size of an opening
Tensor	Makes a body part rigid
Rotator	Rotates a bone around its longitudinal axis

NUMBER OF ORIGINS: Number of tendons of origin	
Biceps	Two origins
Triceps	Three origins
Quadriceps	Four origins

LOCATION: Structure near which a muscle is found. Example: temporalis, a muscle near the temporal bone

ORIGIN AND INSERTION: Sites where muscle originates and inserts. Example: sternocleidomastoid, originating on the sternum and clavicle and inserting on mastoid process of temporal bone

TABLE 11.2

Characteristics Used to Name Muscles

NAME	MEANING
SHAPE: Relative shape of the muscle	
Deltoid	Triangular
Trapezius	Trapezoid
Serratus	Saw-toothed
Rhomboid	Diamond-shaped
Orbicularis	Circular
Pectinate	Comblike
Piriformis	Pear-shaped
Platys	Flat
Quadratus	Square, four-sided
Gracilis	Slender

Clinical Connection

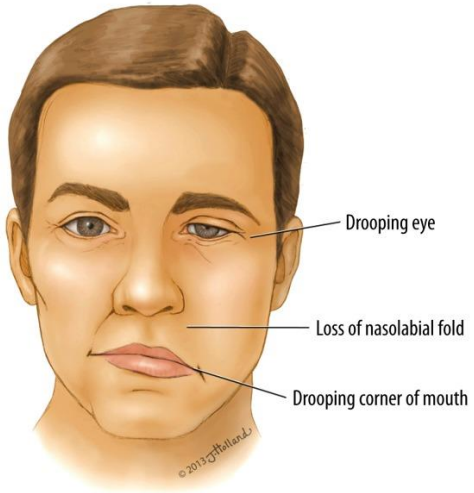
- Bell's palsy

Unilateral paralysis of muscles of facial expression: face droping, pt. cannot wrinkle forehead, difficulty in swallowing

Facial nerve is diseased/ affected

Etiology: infection/ surgery

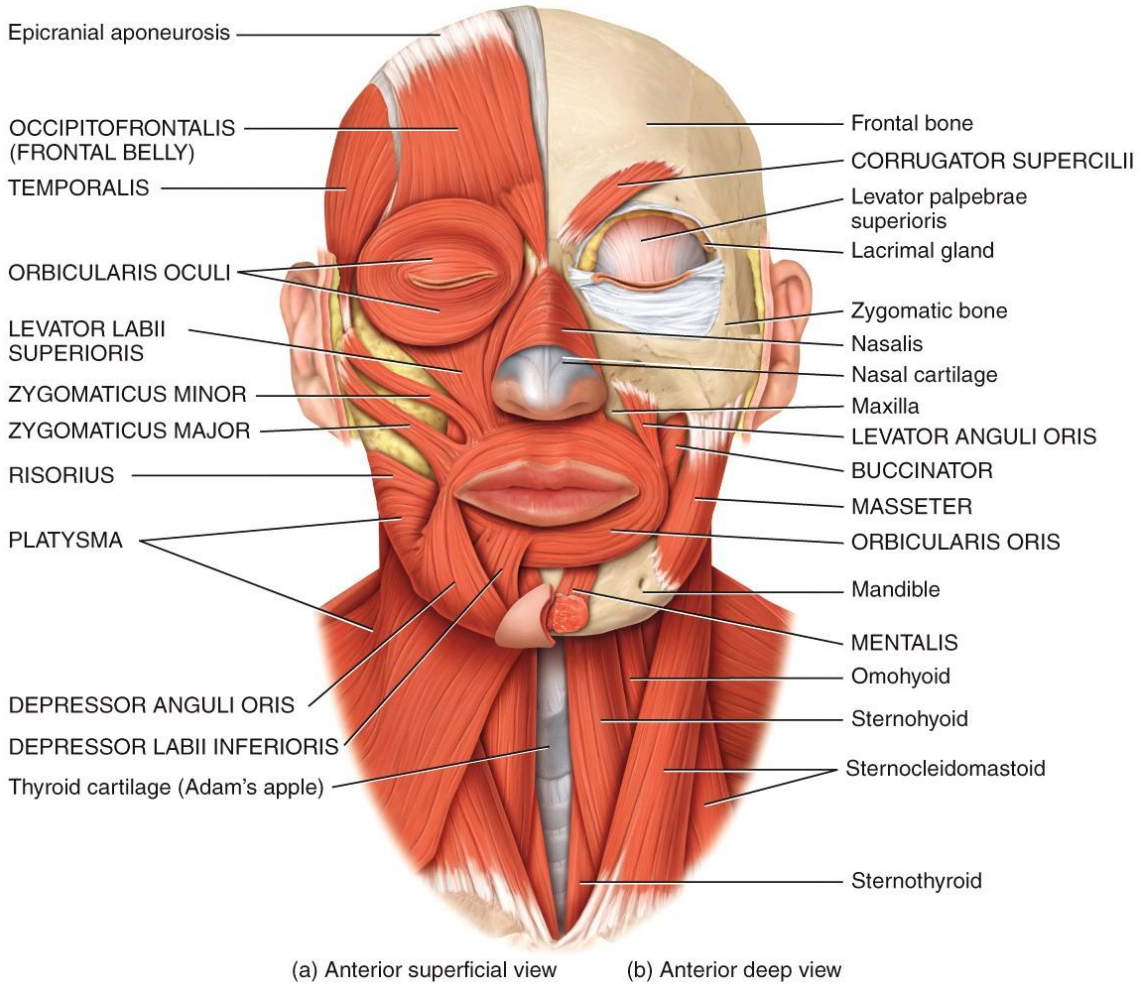
Prognosis: 80% recover completely



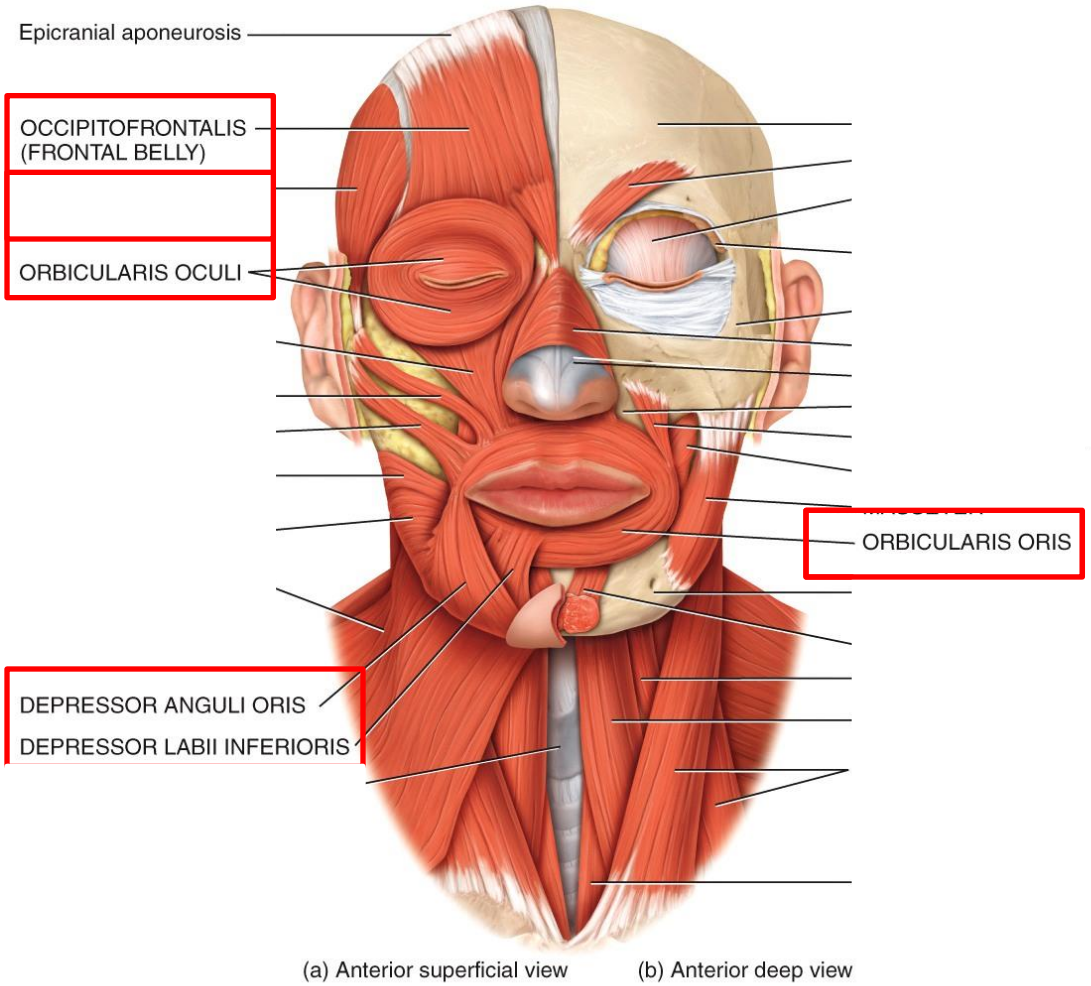
Muscles of the Head That Produce Facial Expressions

- Because of their insertions, the muscles involved in facial expression move the skin rather than a joint when they contract.
- Origin: fascia/ skull bones
- Insertion: skin
- Move skin not a joint
- Act on eye/ mouth
- Nerve supply: Facial VII

Muscles of the Head That Produce Facial Expressions



Muscles of the Head That Produce Facial Expressions



MUSCLE	ORIGIN	INSERTION	ACTION	INNERVATION
SCALP MUSCLES				
Occipitofrontalis (ok-sip′-i-tō-frun-TĀ-lis)				
Frontal belly (frontalis)	Epicranial aponeurosis	Skin superior to supraorbital margin	Draws scalp anteriorly, raises eyebrows, and wrinkles skin of forehead horizontally as in a look of surprise	Facial (VII) nerve
Occipital belly (occipitalis) (*occipit-*=back of the head)	Occipital bone and mastoid process of temporal bone	Epicranial aponeurosis	Draws scalp posteriorly	Facial (VII) nerve

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MUSCLE	ORIGIN	INSERTION	ACTION	INNERVATION
MOUTH MUSCLES				
Orbicularis oris (or-bi′-kū-LAR-is OR-is; *orb-*=circular; *oris*=of the mouth)	Muscle fibers surrounding opening of mouth	Skin at corner of mouth	Closes and protrudes lips, as in kissing; compresses lips against teeth; and shapes lips during speech	Facial (VII) nerve
Zygomaticus major (zī-gō-MA-tī-kus; *zygomatic*=cheek bone; *major*=greater)	Zygomatic bone	Skin at angle of mouth and blends with fibers of orbicularis oris	Draws angle of mouth superiorly and laterally, as in smiling	Facial (VII) nerve
Zygomaticus minor (*minor*=lesser)	Zygomatic bone	Upper lip	Raises (elevates) upper lip, exposing maxillary (upper) teeth	Facial (VII) nerve
Levator labii superioris (le-VĀ-tor LĀ-bē-ī soo-per′-ē-OR-is; *levator*=raises or elevates; *labii*=lip; *superioris*=upper)	Maxilla superior to infraorbital foramen	Skin at angle of mouth and blends with fibers of orbicularis oris	Raises upper lip	Facial (VII) nerve
Depressor labii inferioris (de-PRE-sor LĀ-bē-ī; *depressor*=depresses or lowers; *inferioris*=lower)	Mandible	Skin of lower lip	Depresses (lowers) lower lip	Facial (VII) nerve
Depressor anguli oris (ANG-ū-lī; *angul*=angle or corner; *oris*=of the mouth)	Mandible	Angle of mouth	Draws angle of mouth laterally and inferiorly, as in opening mouth	Facial (VII) nerve
Levator anguli oris	Maxilla inferior to infraorbital foramen	Skin of lower lip	Draws angle of mouth laterally and superiorly	Facial (VII) nerve
Buccinator (BUK-si-nā′-tor; *bucc-*=cheek)	Alveolar processes of maxilla and mandible and pterygomandibular raphe	Blends with fibers of orbicularis oris	Presses cheeks against teeth and lips, as in whistling, blowing, and sucking; draws corner of mouth laterally	Facial (VII) nerve
Risorius (ri-ZOR-ē-us; *risor*=laughter)	Fascia over parotid (salivary) gland	Skin at the angle of mouth	Draws angle of mouth laterally, as in grimacing	Facial (VII) nerve
Mentalis (men-TĀ-lis; *ment-*=the chin)	Mandible	Skin of chin	Elevates and protrudes lower lip and pulls skin of chin up as in pouting	Facial (VII) nerve
Platysma (pla-TIZ-ma; *platys*=flat, broad)	Fascia over deltoid and pectoralis major muscles	Mandible, blends with muscles around angle of mouth, and skin of lower face	Draws outer part of lower lip inferiorly and posteriorly as in pouting; depresses mandible	Facial (VII) nerve

Muscles of Mastication

MUSCLE	ORIGIN	INSERTION	ACTION	INNERVATION
Masseter (MA-se-ter=chewer) (see Figure 11.4b, c)	Maxilla and zygomatic arch	Angle and ramus of mandible	Elevates mandible, as in closing mouth	Mandibular division of trigeminal (V) nerve
Temporalis (tem′-pō-RĀ-lis; *tempor-*=time or temples)	Temporal bone	Coronoid process and ramus of mandible	Elevates and retracts mandible	Mandibular division of trigeminal (V) nerve
Medial pterygoid (TER-i-goyd; *medial*= closer to midline; *pterygoid*=wing-like)	Medial surface of lateral portion of pterygoid process of sphenoid bone; maxilla	Angle and ramus of mandible	Elevates and protracts (protrudes) mandible and moves mandible from side to side	Mandibular division of trigeminal (V) nerve
Lateral pterygoid (TER-i-goyd; *lateral*= farther from midline)	Greater wing and lateral surface of lateral portion of pterygoid process of sphenoid bone	Condyle of mandible; temporomandibular joint (TMJ)	Protracts mandible, depresses mandible as in opening mouth, and moves mandible from side to side	Mandibular division of trigeminal (V) nerve

Nerve supply: trigeminal n.

The Neck
(The Cervical Region)

Divided into 2 portions:

Anterolateral aspect:

ant. & post.

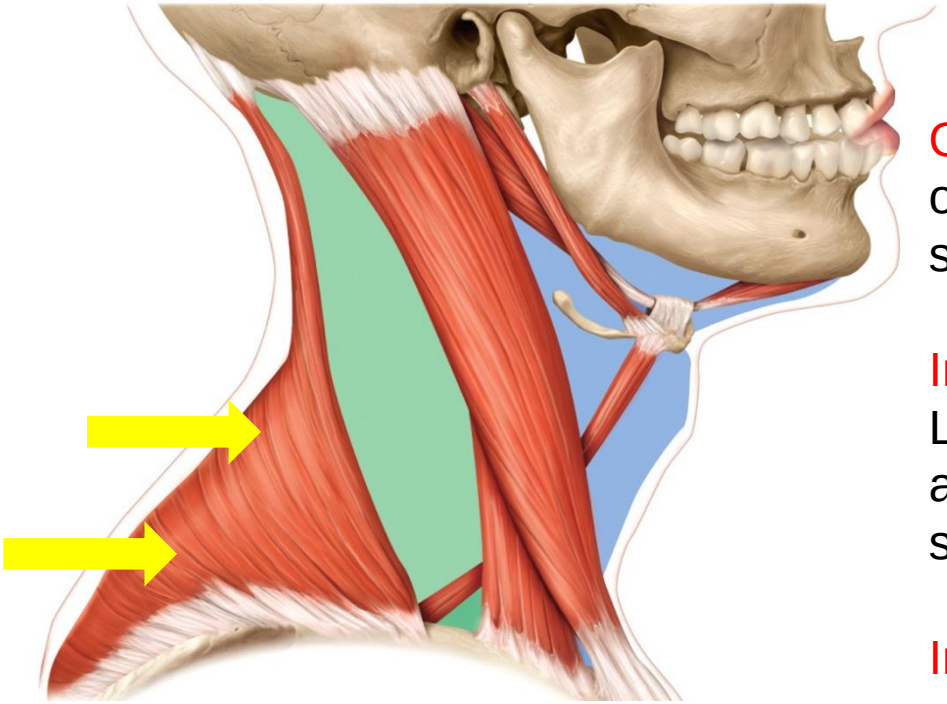
Post. aspect:

covered by trapezius

part of the back

△

Muscles of the Neck: triangles



Trapezius Muscle

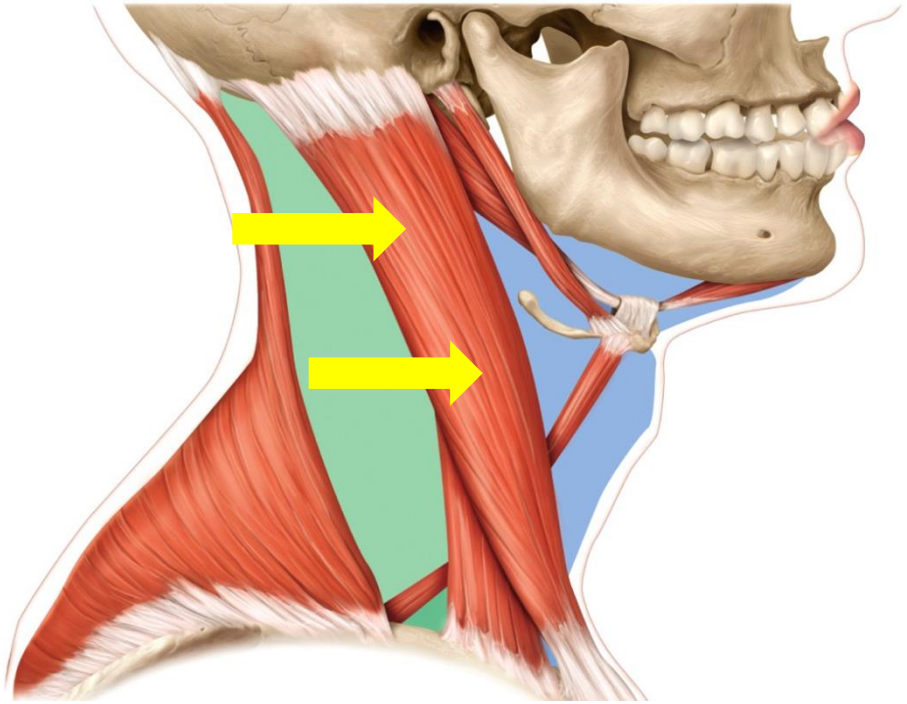
Origin:
occipital bone
spinous processes (C7-T12)

Insertion:
Lat. 1/3 of clavicle
acromion/ scapula
spine of scapula

Innervatio:n
spinal part of XI

Actions:
3 actions?

Muscles of the Neck: triangles



sternocleidomastoid

Origin:
Manubrium (sternal head) & clavicle

Insertion:
Mastoid process of temporal

Innervation:
spinal part of XI

Action:
single: tilts head to opposite side
Both: flex the neck

The Neck
(The Cervical Region)

Divided into 2 portions:

Anterolateral aspect:

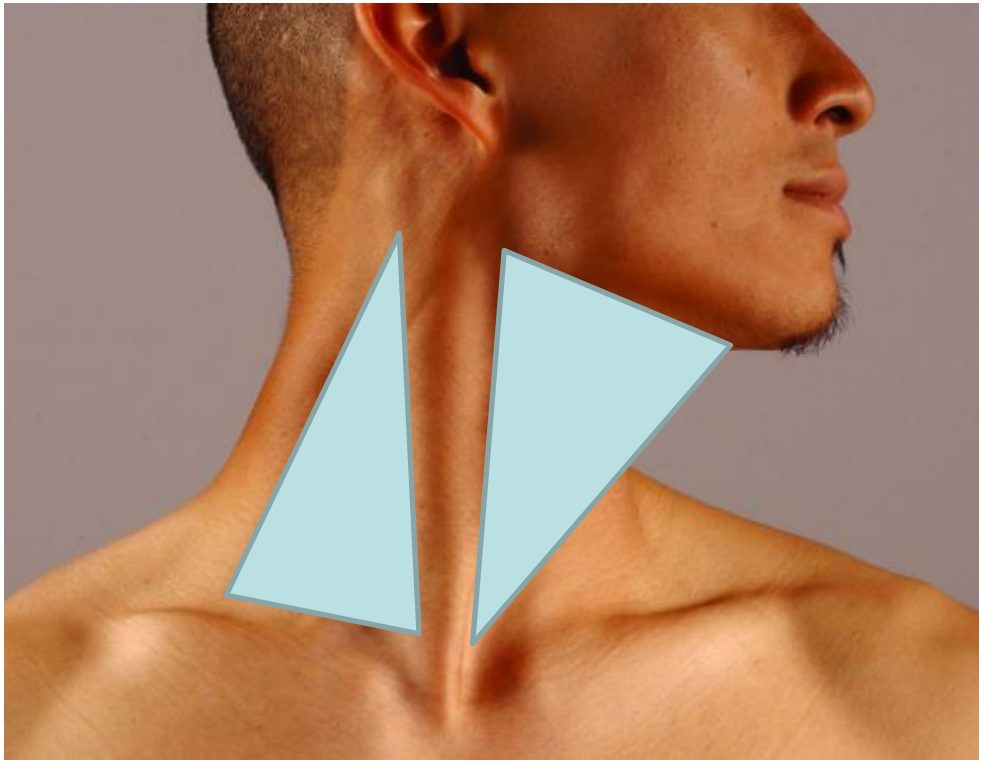
ant. & post.

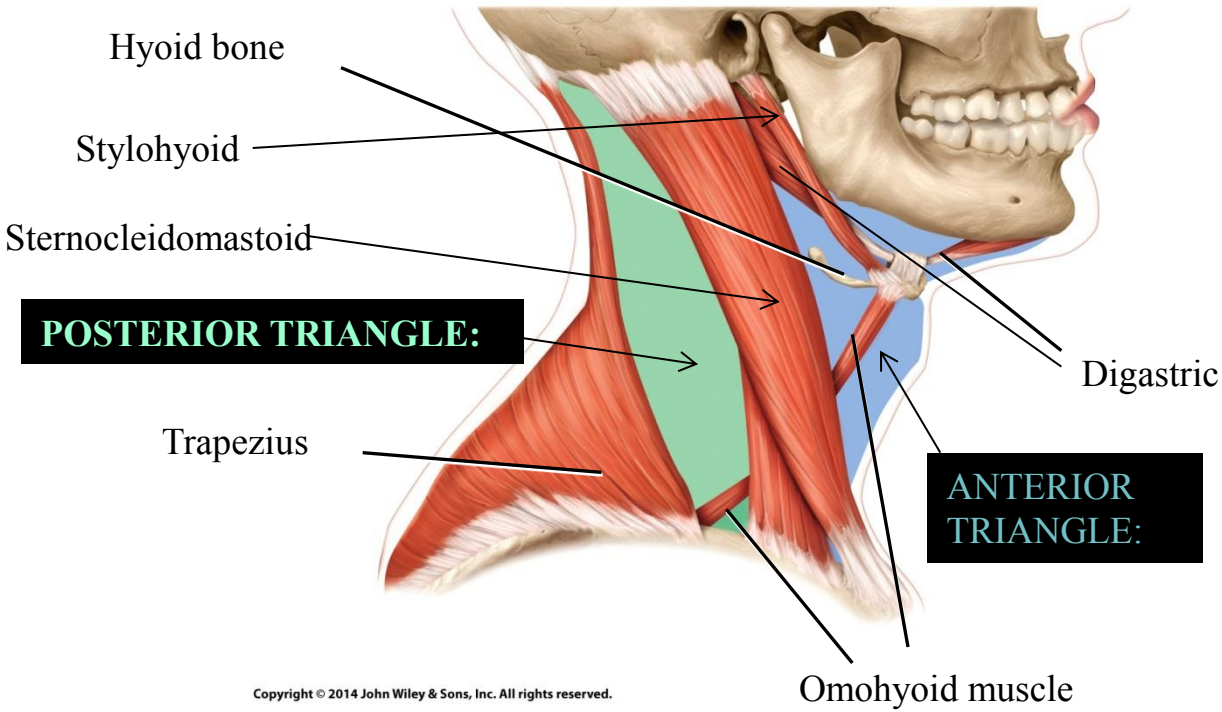
Post. aspect:

covered by trapezius

part of the back

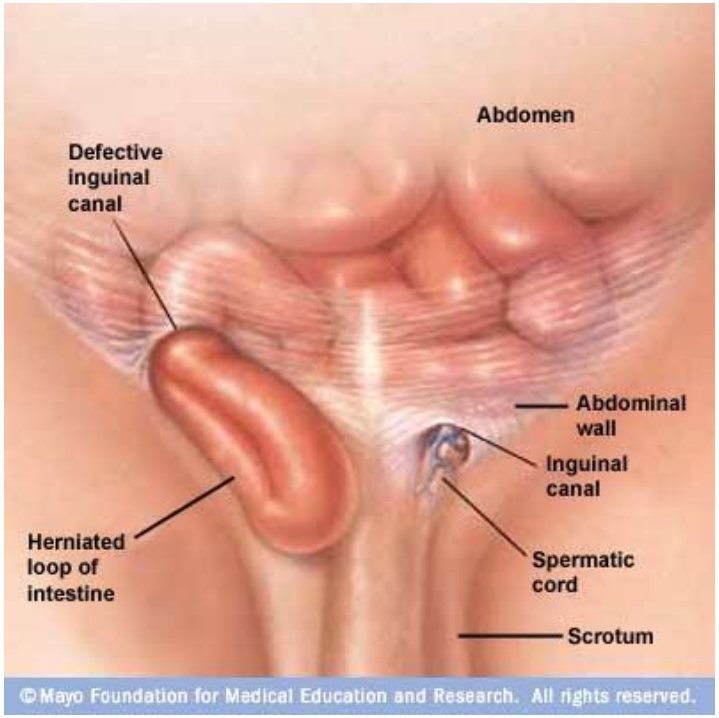
△





(d) Right lateral view of triangles of neck

Inguinal Hernia



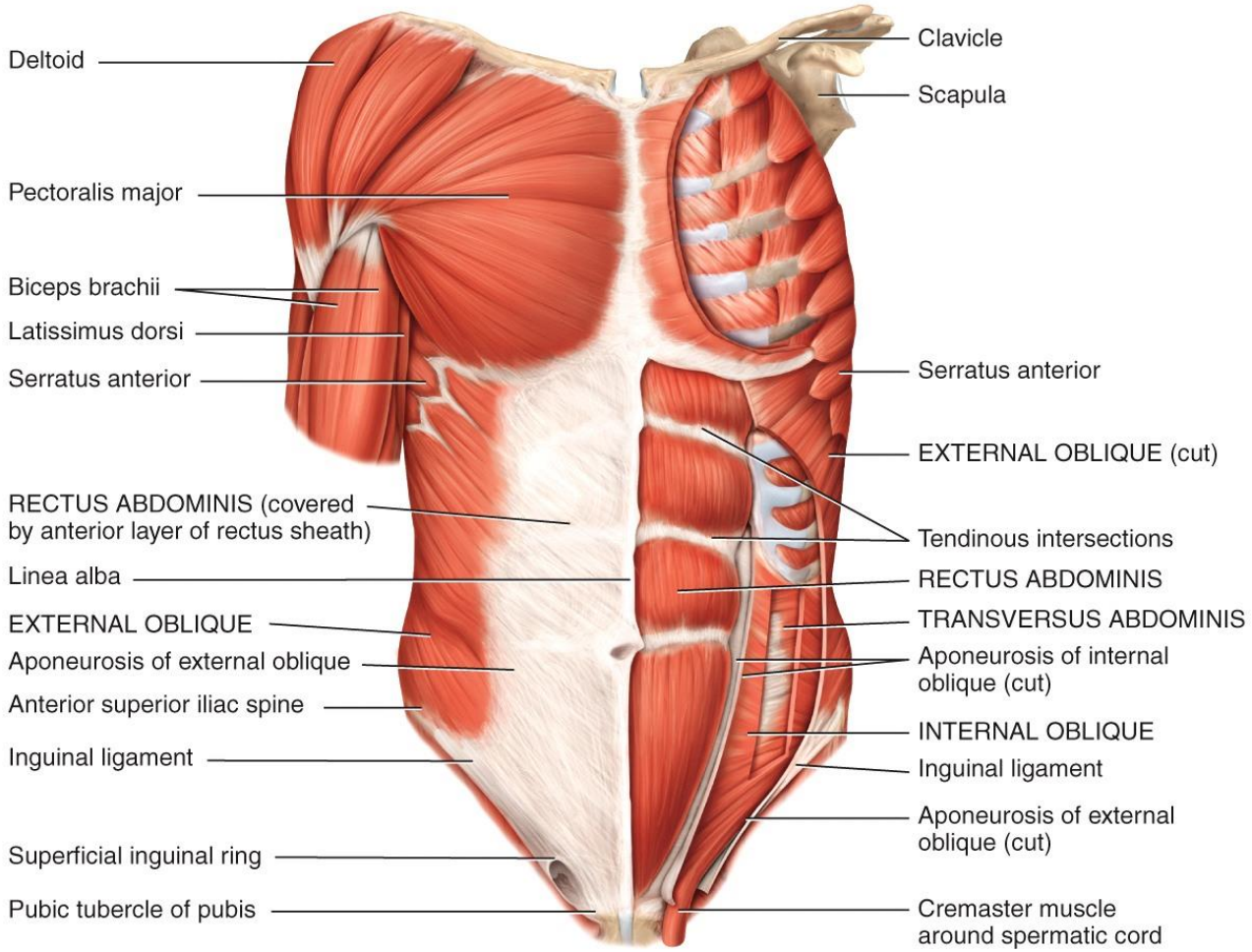
- It is protrusion of part of small intestine due to rupture or separation in the inguinal area
- Common in males as they have larger inguinal canal & it's a week area in the abdominal wall
- Treatment: surgical repair

Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column

- Abdominal wall is composed of:
  - Skin
  - fascia
  - 4 pairs of muscles

- Function: protection of viscera in the abdomen

Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column



Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column

Anterior

1. **Rectus Abdominis:**
2. **External Oblique**
3. **Internal Oblique**
4. **Transversus abdominis**

Posterior

Quadratus lumborum

Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column

Anterior

1. **Rectus Abdominis:**

Origin: pubic crest& pubic symphysis

Insertion: lower costal cartilages & xiphoid process

Innervation

Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column

Anterior

2. External Oblique

Origin: lower ribs

Insertion: iliac crest & linia alba

Innervation:

Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column

Anterior

3. **Internal Oblique**:

Origin: iliac crest & inguinal ligament

Insertion: cartilage of lower ribs & linia alba

Innervation:

Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column

Anterior

4. Transversus abdominis:

Origin: iliac crest & inguinal ligament & cartilage of lower ribs

Insertion: xiphoid & linia alba

Innervation

Action for anterior: compress abdomen in defecation, urination, forced exhalation, child birth

All flex vertebral column except transversus abdominis

Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column

Posterior

Quadratus lumborum

Origin: iliac crest

Insertion: inferior border of 12th rib & L1- L4

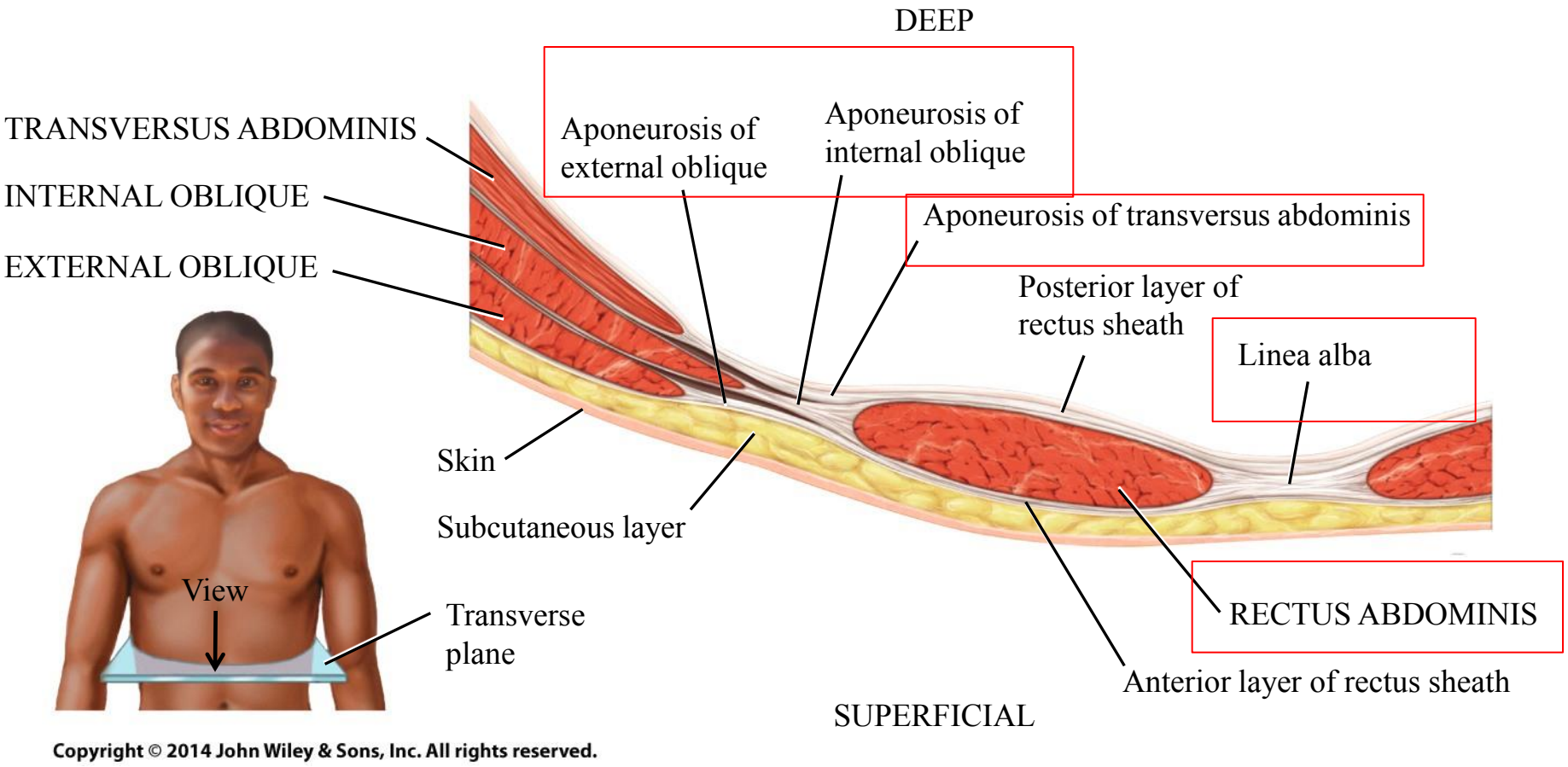
Innervation:

Action: on 12th rib: fix & pull interiorly

on Lumbar vertebrae: extend & lateral flexion

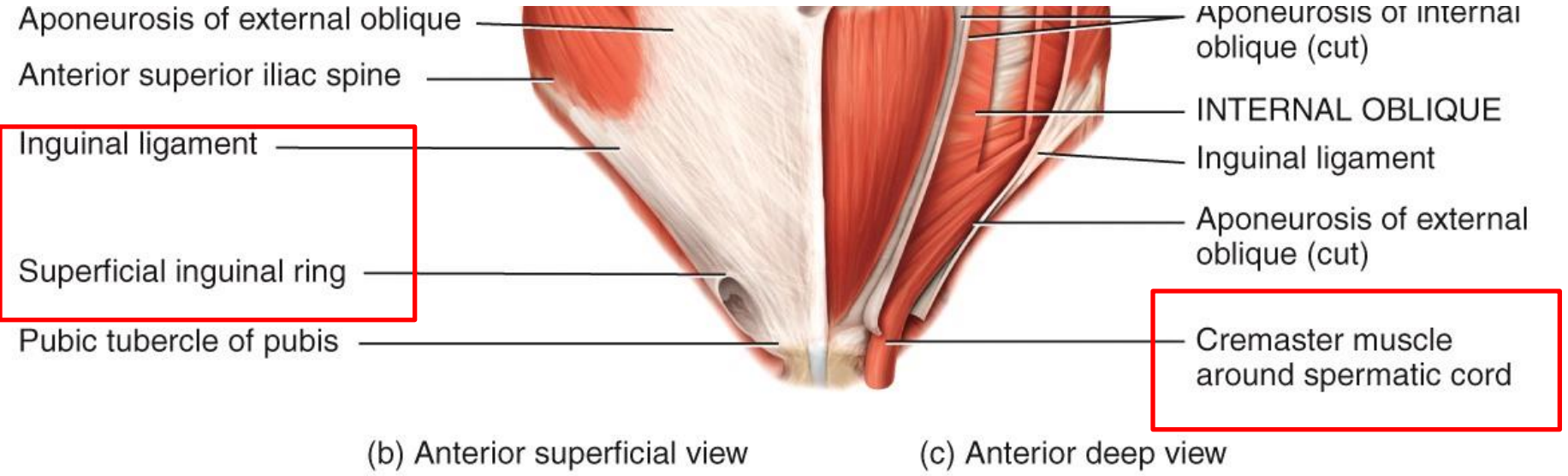
MUSCLE	ORIGIN	INSERTION	ACTION
Rectus abdominis (REK-tus ab-DOM-in-is; *rectus-*=fascicles parallel to midline; *abdomin*=abdomen)	Pubic crest and pubic symphysis	Cartilage of ribs 5–7 and xiphoid process	Flexes vertebral column (especially lumbar portion), and compresses abdomen to aid in defecation, urination, forced exhalation, and childbirth RMA: Flexes pelvis on the vertebral column
External oblique (ō-BLĒK; *external*=closer to surface; *oblique*=fascicles diagonal to midline)	Ribs 5–12	Iliac crest and linea alba	Acting together (bilaterally), compress abdomen and flex vertebral column; acting singly (unilaterally), laterally flex vertebral column, especially lumbar portion, and rotate vertebral column
Internal oblique (*internal*=farther from surface)	Iliac crest, inguinal ligament, and thoracolumbar fascia	Cartilage of ribs 7–10 and linea alba	Acting together, compress abdomen and flex vertebral column; acting singly, laterally flex vertebral column, especially lumbar portion, and rotate vertebral column
Transversus abdominis (tranz-VER-sus; *transverse*=fascicles perpendicular to midline)	Iliac crest, inguinal ligament, lumbar fascia, and cartilages of ribs 5–10	Xiphoid process, linea alba, and pubis	Compresses abdomen
Quadratus lumborum (kwod-RĀ-tus lum-BOR-um; *quad-*=four; *lumbo-*=lumbar region) (see Figure 11.14)	Iliac crest and iliolumbar ligament	Inferior border of rib 12 and L1–L4	Acting together, pull twelfth ribs interiorly during forced exhalation, fix twelfth ribs to prevent their elevation during deep inhalation, and help extend lumbar portion of vertebral column; acting singly, laterally flex vertebral column, especially lumbar portion RMA: Elevates hip bone, commonly on one side

Rectus Sheath

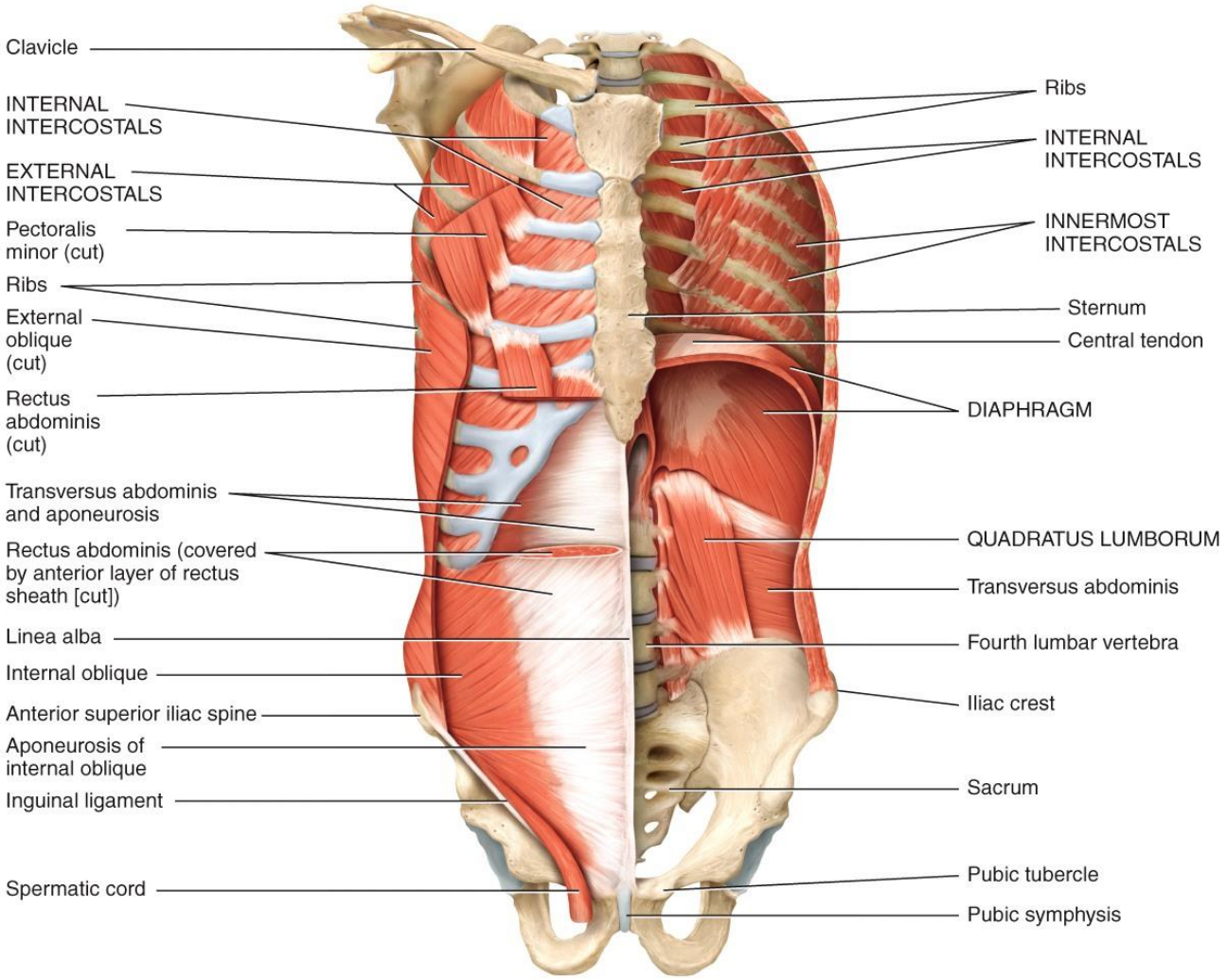


(a) Superior view of transverse section of anterior abdominal wall superior to umbilicus (navel)

Inguinal ligament & Inguinal canal



Muscles of the Thorax That Assist in Breathing (Respiration)



Muscles of the Thorax That Assist in Breathing (Respiration)

Action: change the size of the thorax & help in ventilation

Inspiration = inhalation
Expiration = exhalation

1. **Diaphragm**
2. **Intercostal muscles**

Muscles of the Thorax That Assist in Breathing (Respiration)

Diaphragm:

- Most important muscle of respiration
- Dome- shaped
- Musculotendinous
- Separate thorax from abdomen

- Consists of 2 parts: peripheral muscular part & a central tendinous part

- Central tendon: strong aponeurosis, serves as tendon of insertion for the muscular part.

- Peripheral muscular fibers

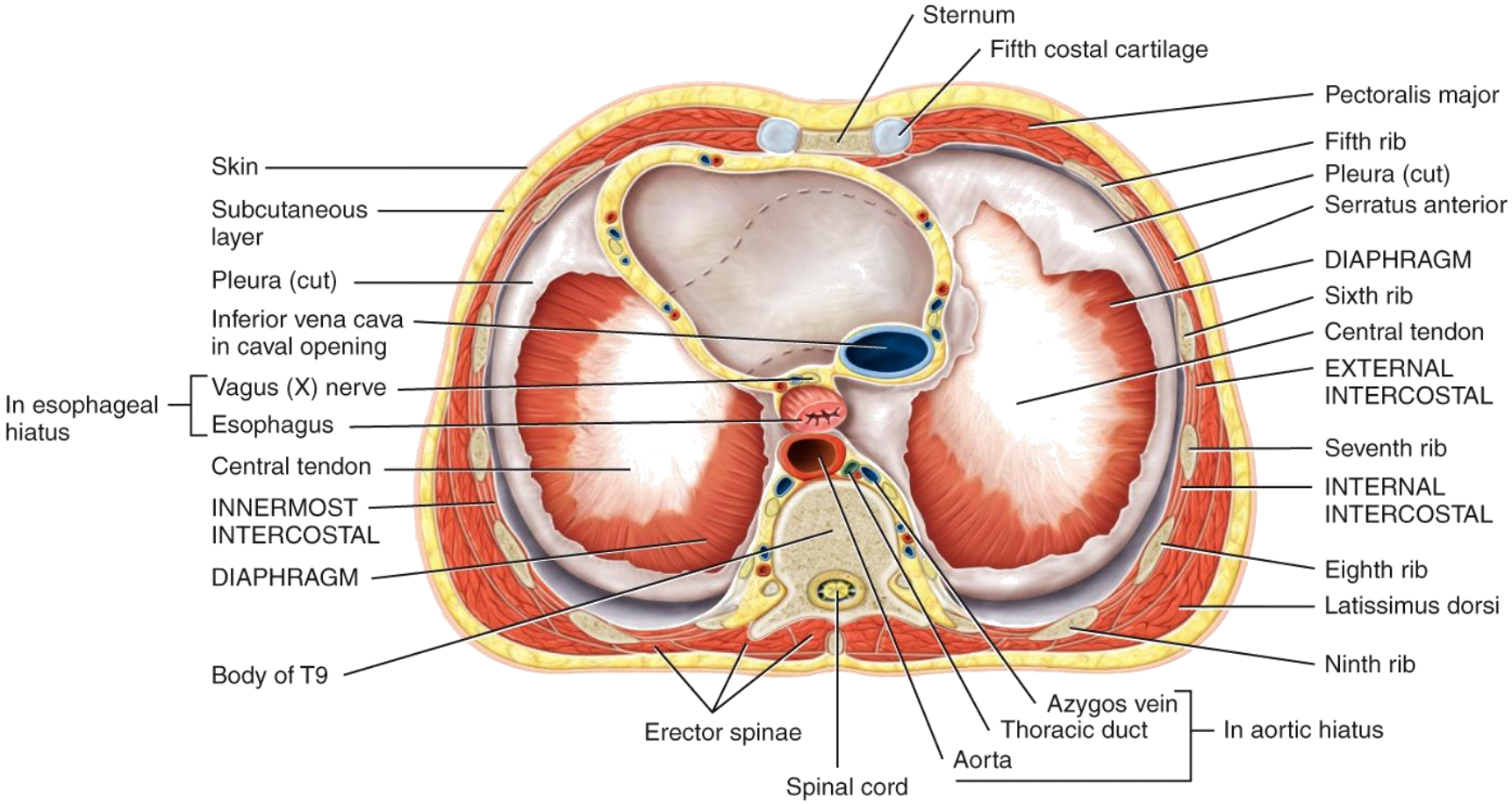
Muscles of the Thorax That Assist in Breathing (Respiration)

Diaphragm:
It fuses with inferior surface of pericardium (external covering of the heart) and parietal pleura (external covering of lungs)
Origin: xiphoid process, costal cartilages of inferior ribs, lumbar vertebrae
Insertion:?????
Innervation: phrenic nerve
Action: makes the floor of the thorax
pull central tendon inferiorly and increases vertical length of thorax

3 openings in diaphragm:

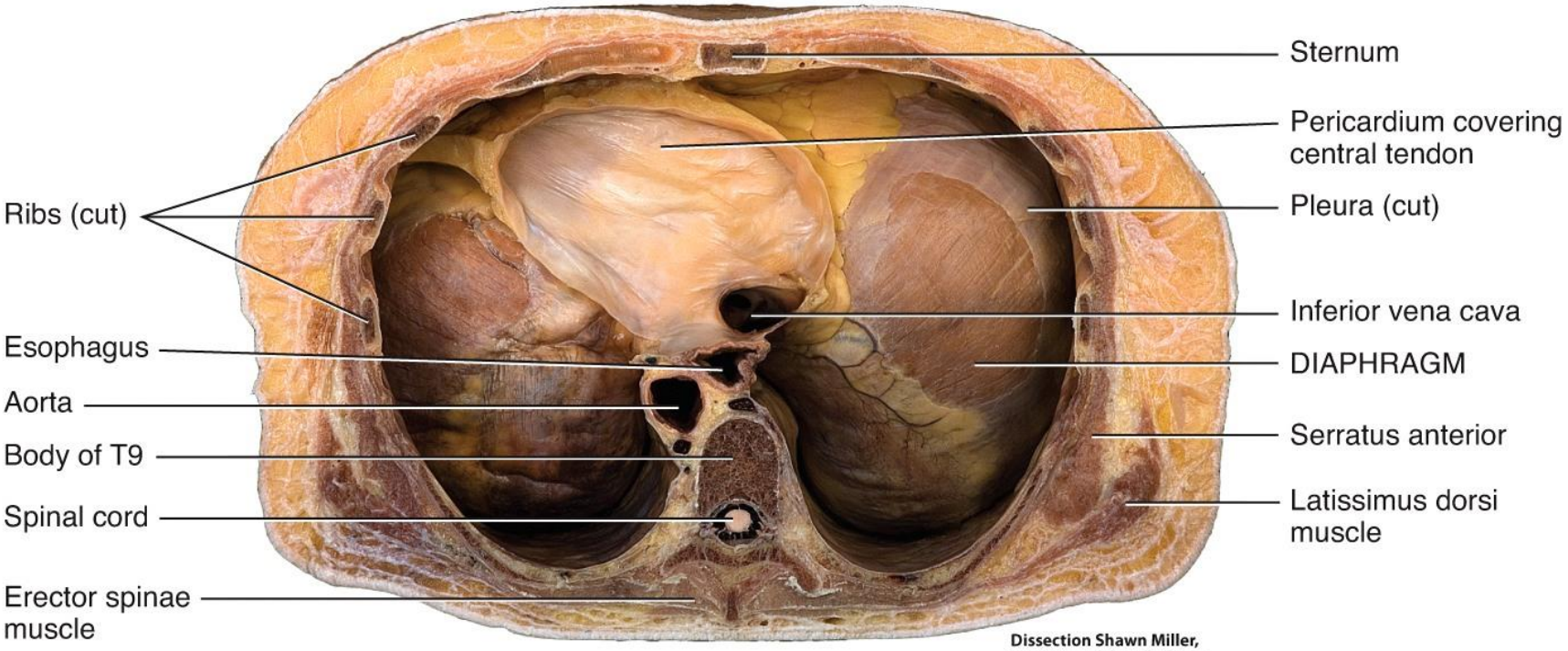
1. Aortic hiatus
2. Esophageal hiatus
3. Foramen for vena cava

Muscles of the Thorax That Assist in Breathing



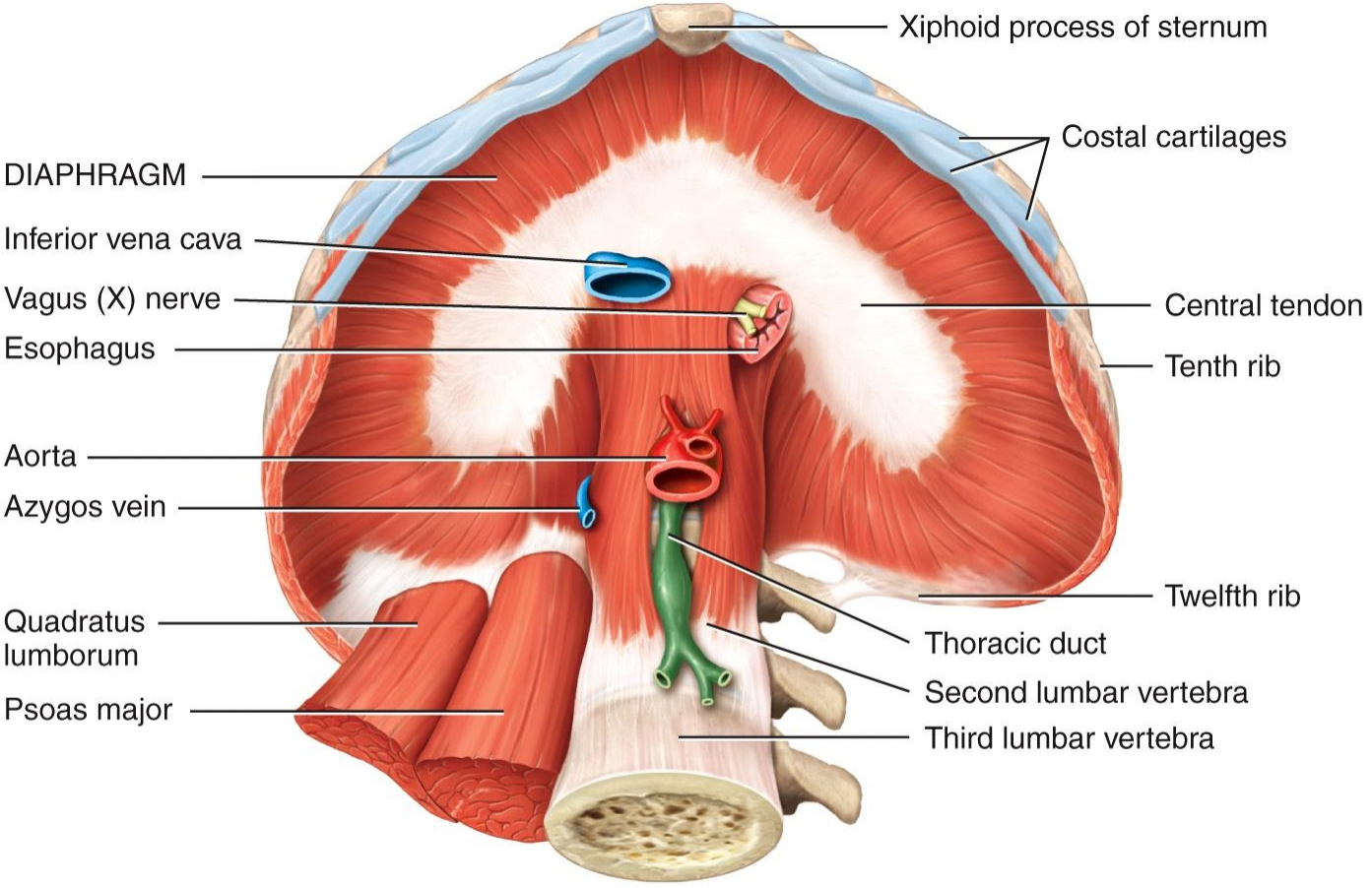
(c) Superior view of diaphragm

Muscles of the Thorax That Assist in Breathing



(d) Superior view

Muscles of the Thorax That Assist in Breathing



(e) Inferior view of diaphragm

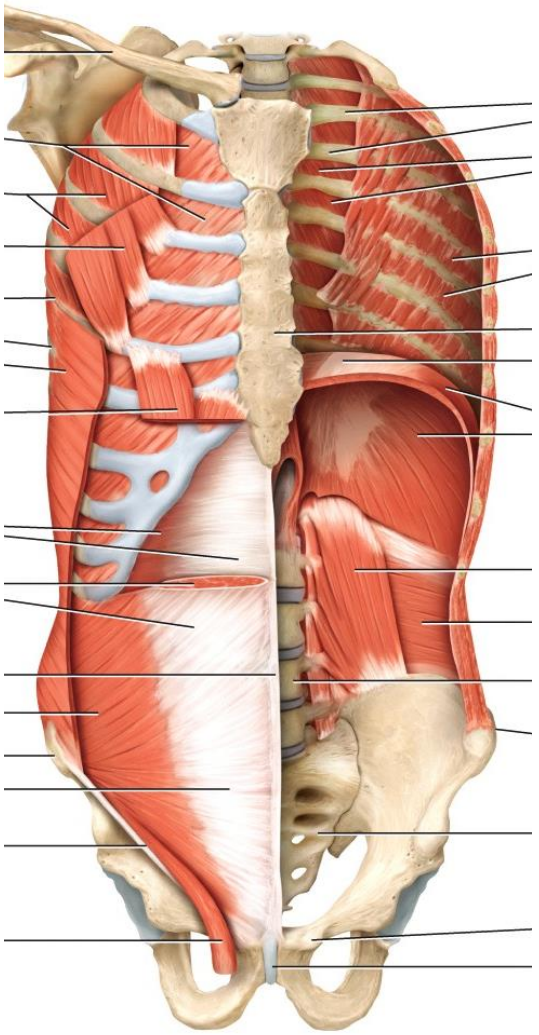
Muscles of the Thorax That Assist in Breathing (Respiration)

Intercostal muscles:

- 3 layers:

1. External intercostal
2. Internal intercostal
3. Transverus thoracis

- Nerve: intercostal nerves



nterior superficial view (b) Anterior deep vi

Muscles of the Thorax That Assist in Breathing (Respiration)

Intercostal muscles:

1. External intercostal

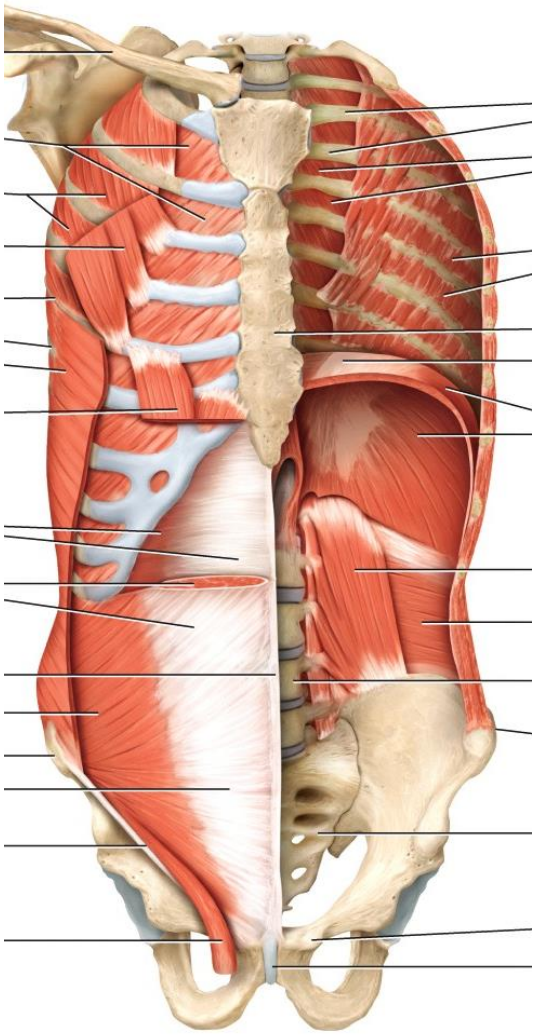
Superficial muscle

Runs obliquely inferiorly & anteriorly

Origin: inf border of rib above

Insertion: sup. Border of rib below

Action : elevate ribs



nterior superficial view (b) Anterior deep vi

Muscles of the Thorax That Assist in Breathing (Respiration)

Intercostal muscles:

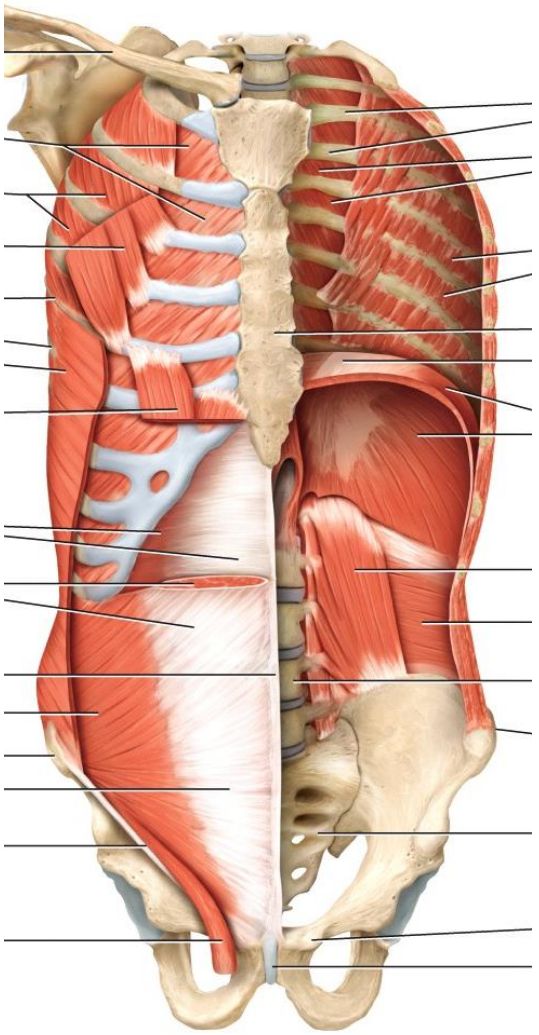
2. Internal intercostal:

Deep to ext. intercostal

Muscle fibers run obliquely inf. & post.

From sup border of rib below to inferior border of rib above

Act to draw adjacent ribs together



nterior superficial view (b) Anterior deep vi

Muscles of the Thorax That Assist in Breathing (Respiration)

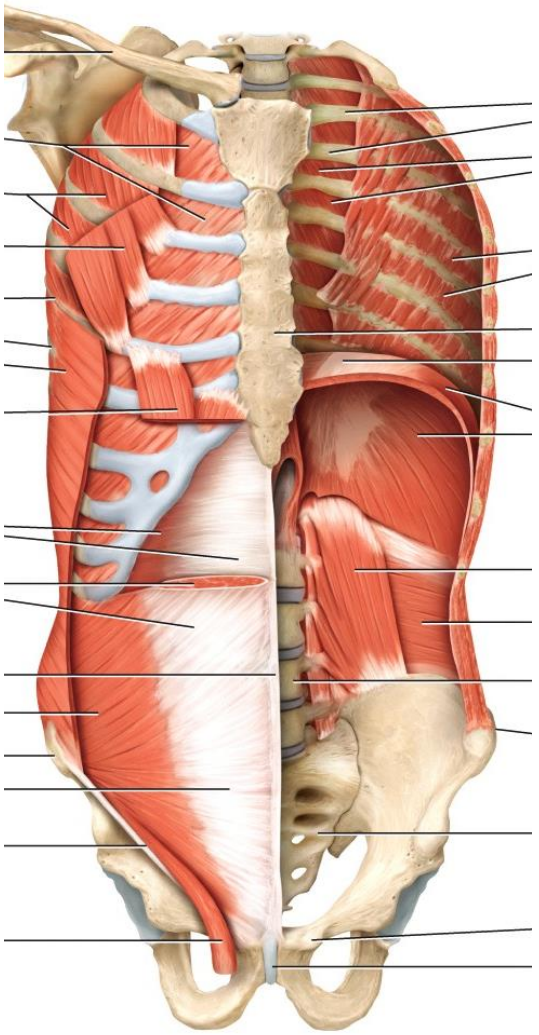
Intercostal muscles:

3 . Transverus thoracis

Deep

Run as internal intercostal

Same action



nterior superficial view (b) Anterior deep vi

Muscles of the Pelvic Floor That Support the Pelvic Viscera and Function as Sphincters

- Levator ani muscle
- With surrounding connective tissue it makes pelvic diaphragm

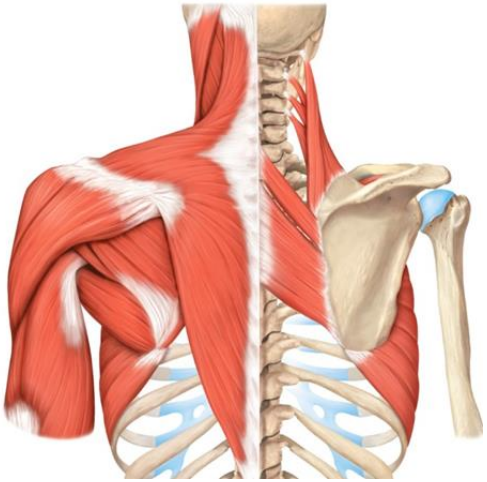
Muscles of the Perineum

Perineum is inferior to pelvic diaphragm

Muscles of the Thorax That Move the Pectoral(shoulder) Girdle

Ant. & post. Thoracic muscles
Action: stabilize scapula
(so scapula can act as a stable point of origin for most muscles that move humerous)

Muscles of the Thorax That Move the Pectoral(shoulder) Girdle

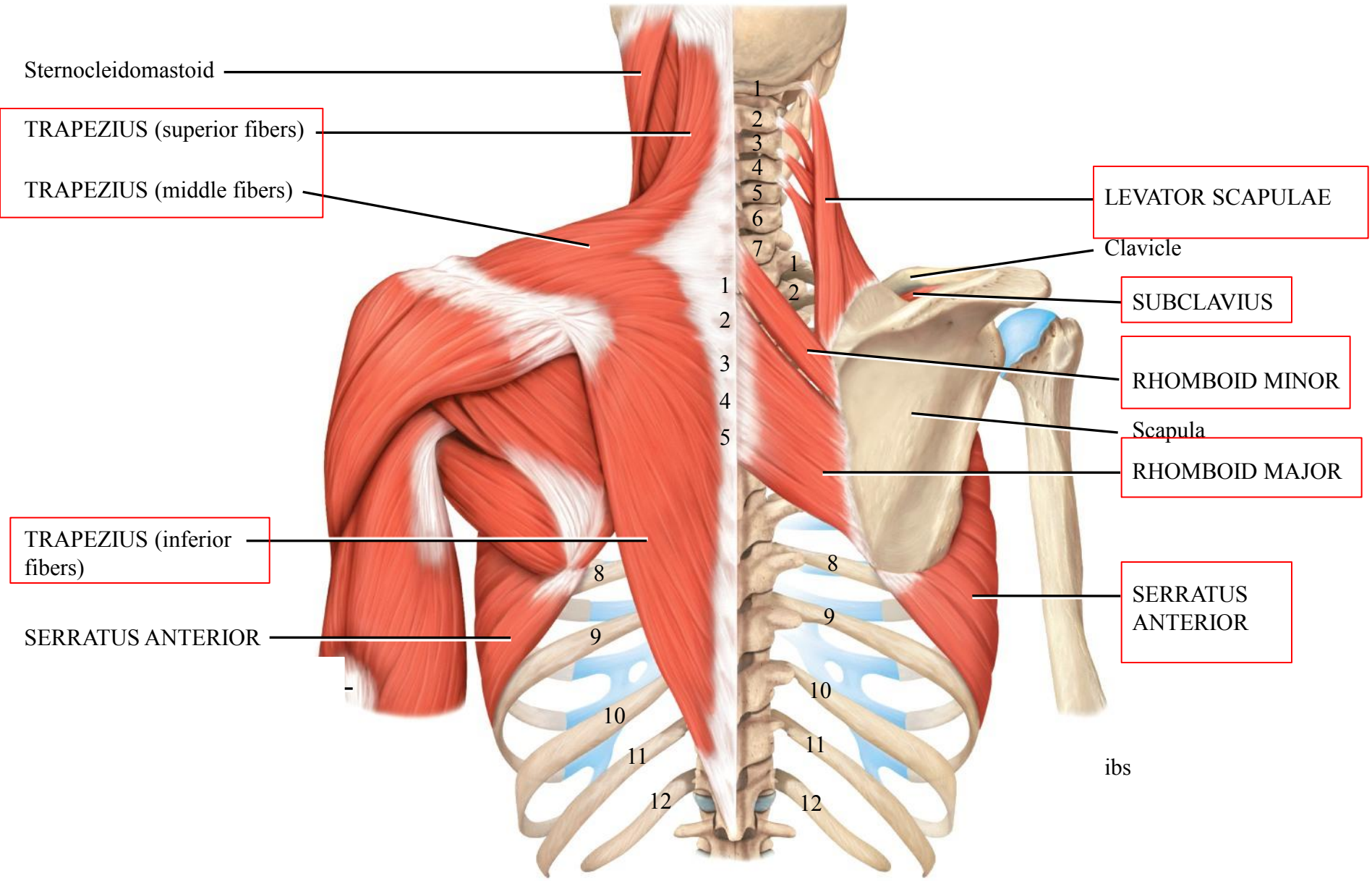


Anterior Thoracic muscles:

1. Subclavius(1st rib- clavicle)
2. Pectoralis minor(ribs- scapula)
3. Serratus anterior(ribs- scapula)

Posterior Thoracic muscles:

1. Trapezius(skull & vertirae- clavicle & scapula)
2. Levator scapula(vertirae- scapula)
3. Rhomboide major(vertbrae- acpula)
4. Rhomboide minor(vertbrae- acpula)



(d) Posterior superficial view (e) Posterior deep view

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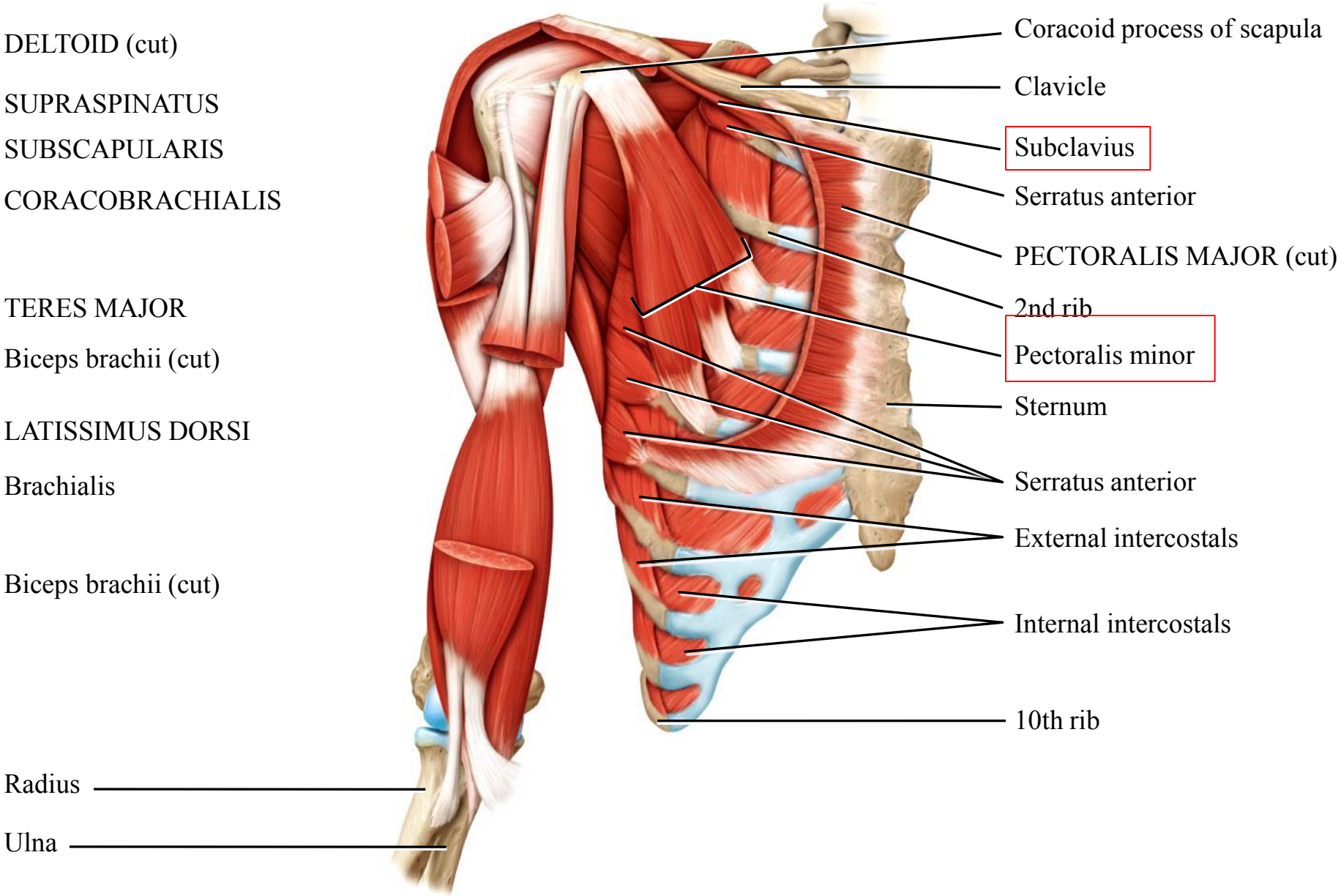
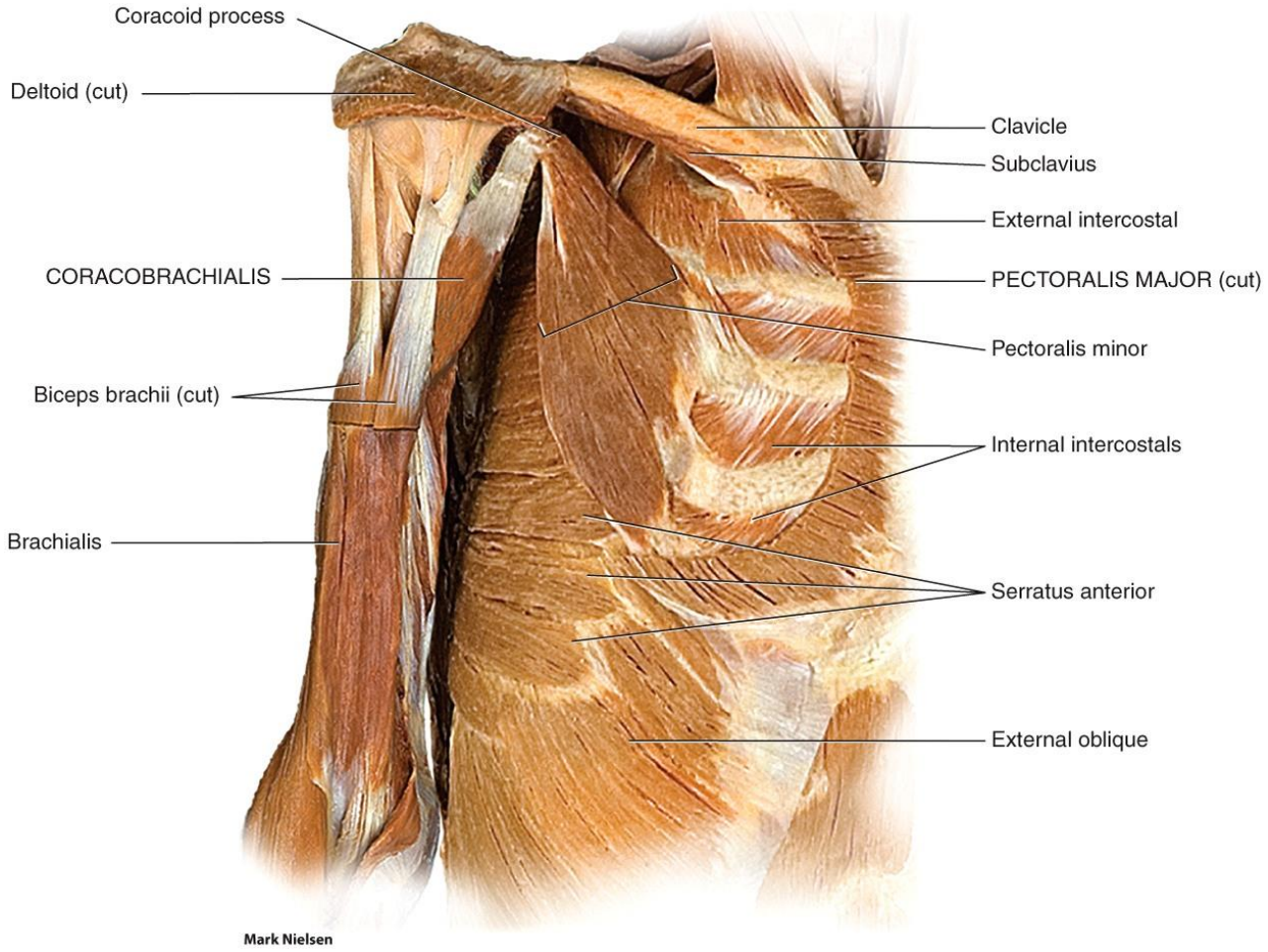
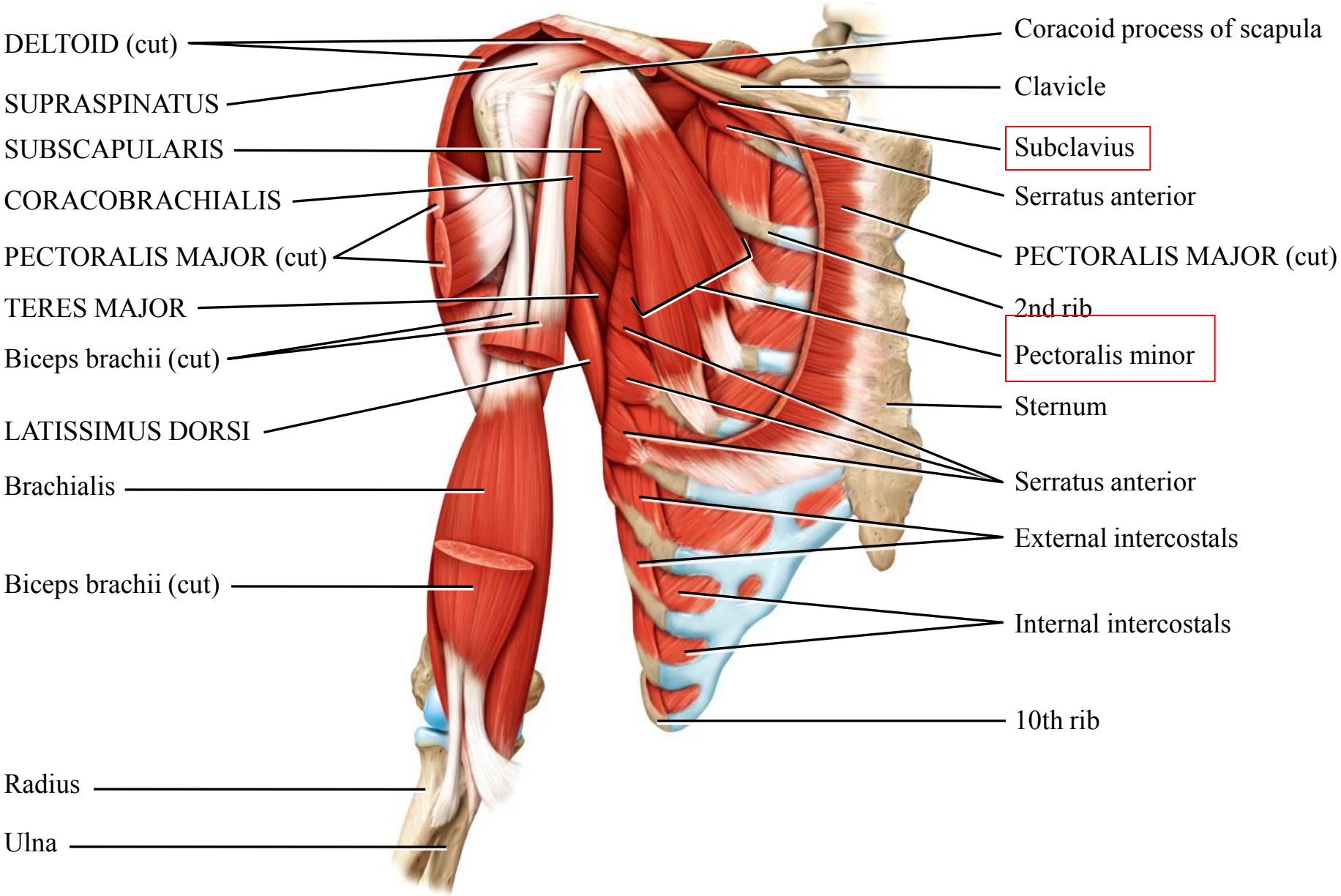


(a) Anterior deep view (the intact pectoralis major muscle is shown in Figure 11.3a)

Muscles of the Thorax and Shoulder That Move the Humerus

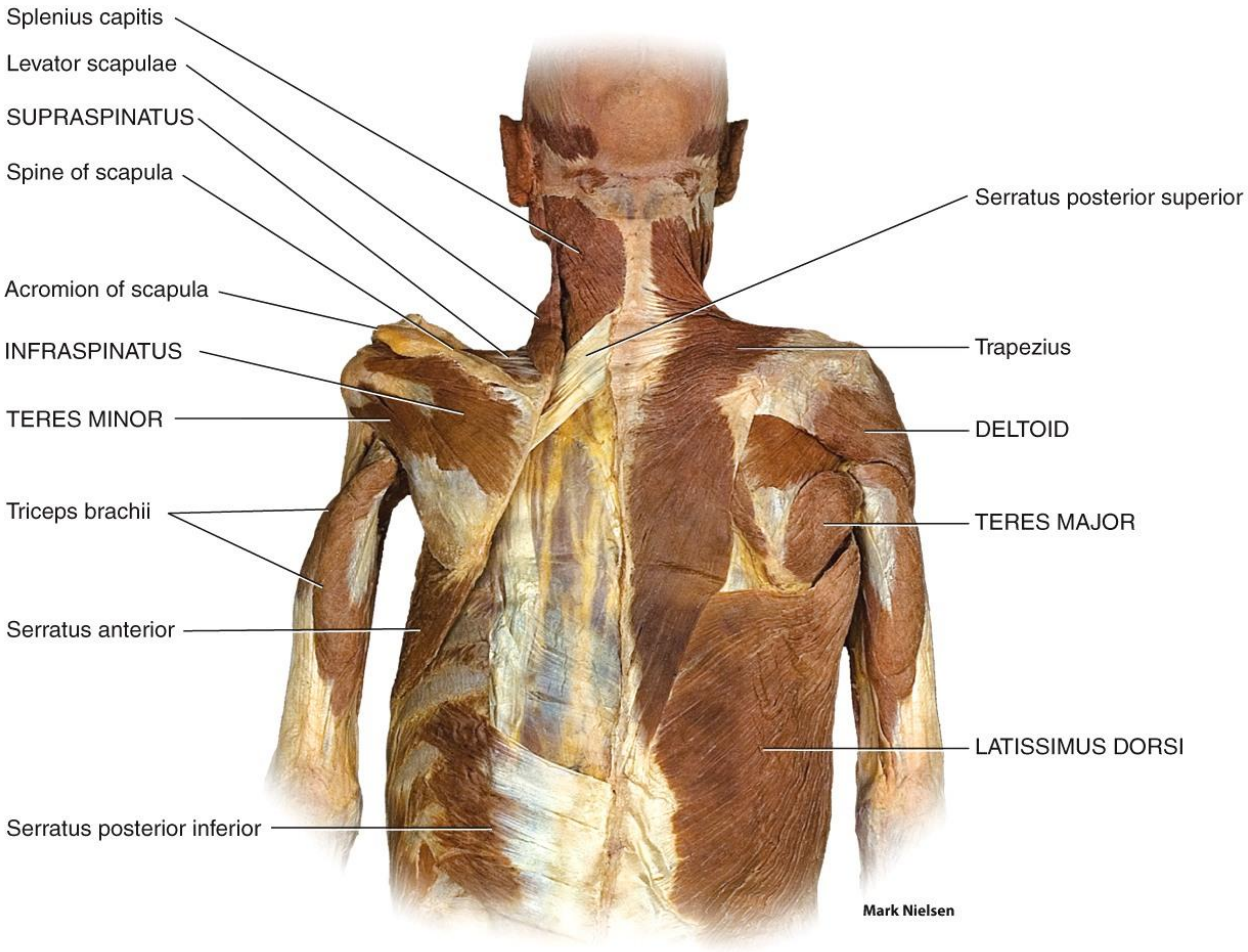


(b) Anterior deep view

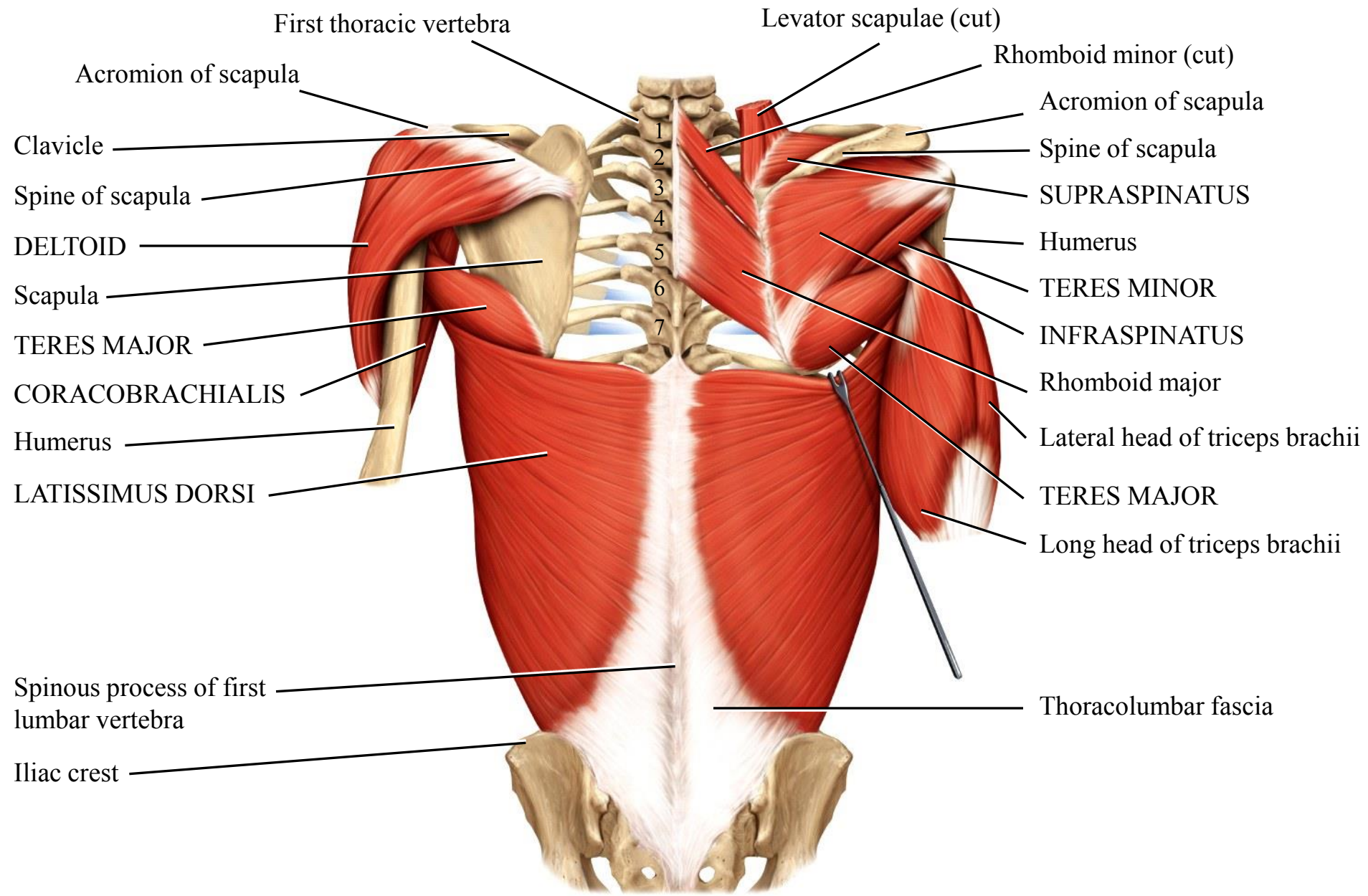


(a) Anterior deep view (the intact pectoralis major muscle is shown in Figure 11.3a)

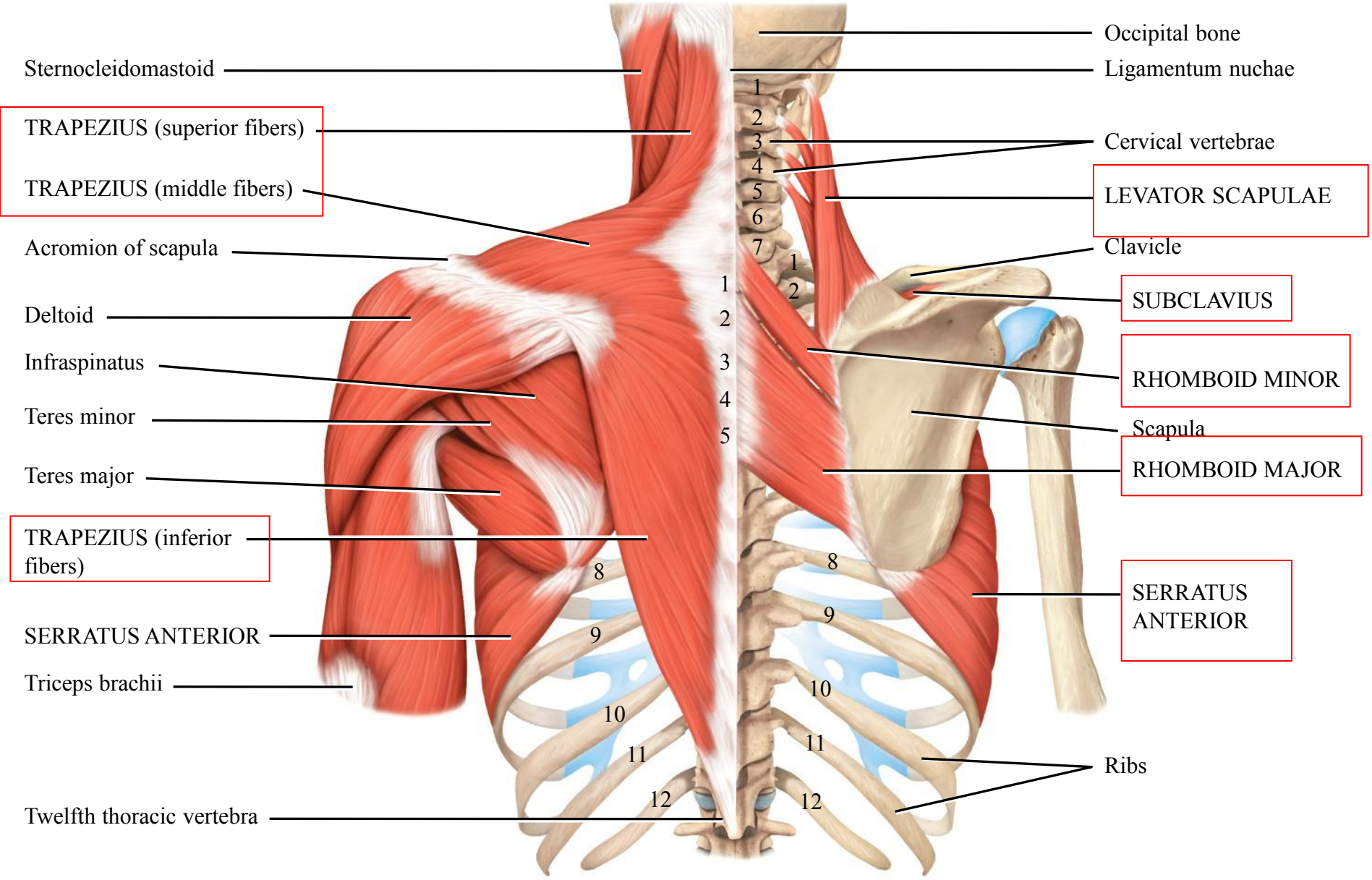
Muscles of the Thorax and Shoulder That Move the Humerus



(e) Posterior view



(c) Posterior view (d) Posterior view



(d) Posterior superficial view (e) Posterior deep view

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