

MUSCLES INVOLVED IN RESPIRATION

By :

Prof. Ahmed Fathalla &

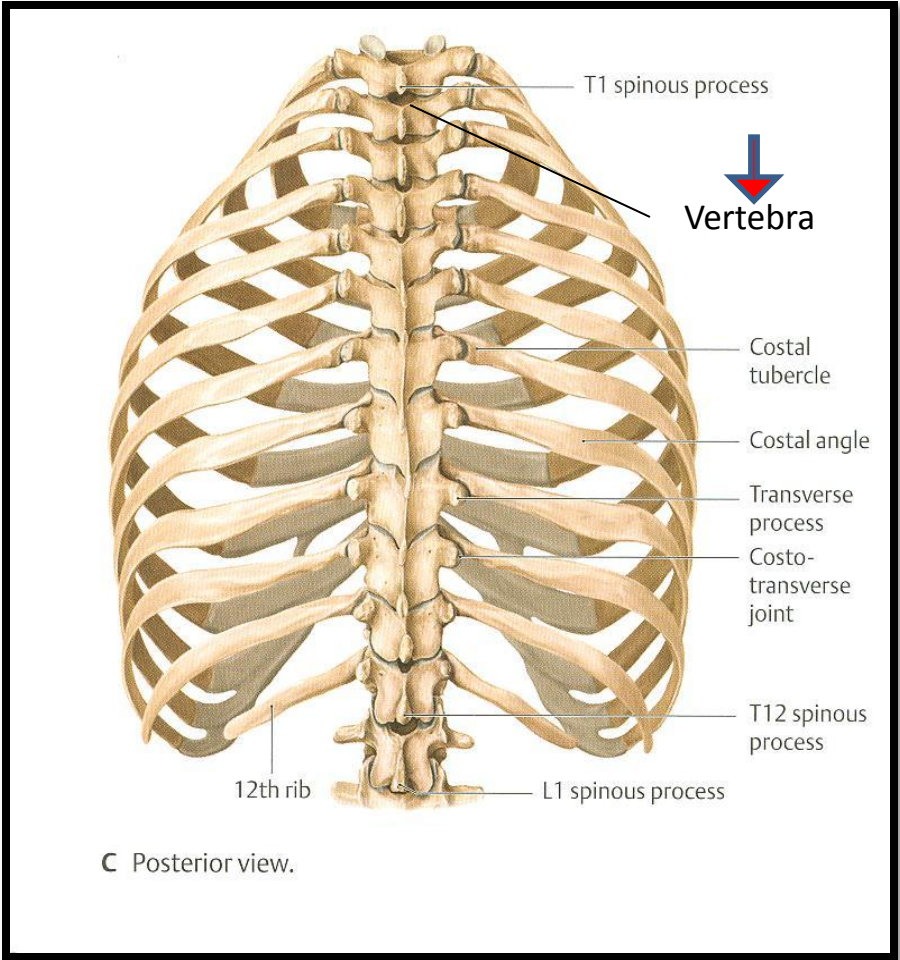
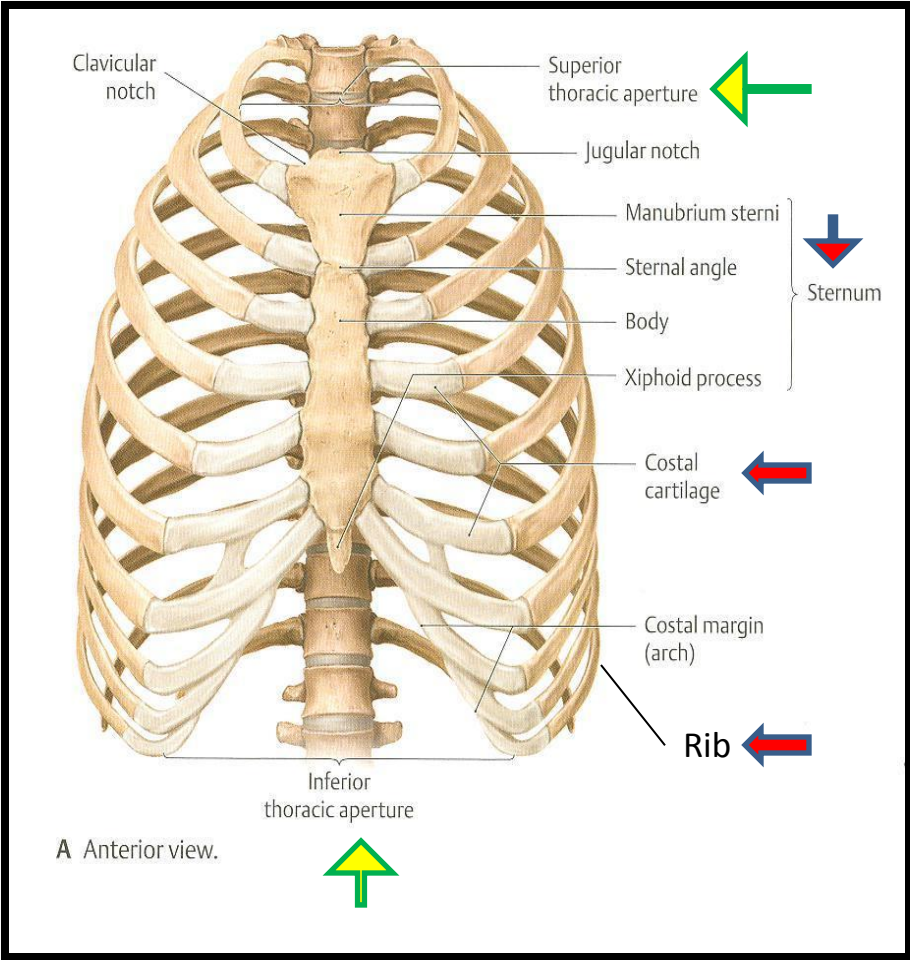
A.Prof. Sanaa Alsharawy

OBJECTIVES

At the end of the lecture, students should:

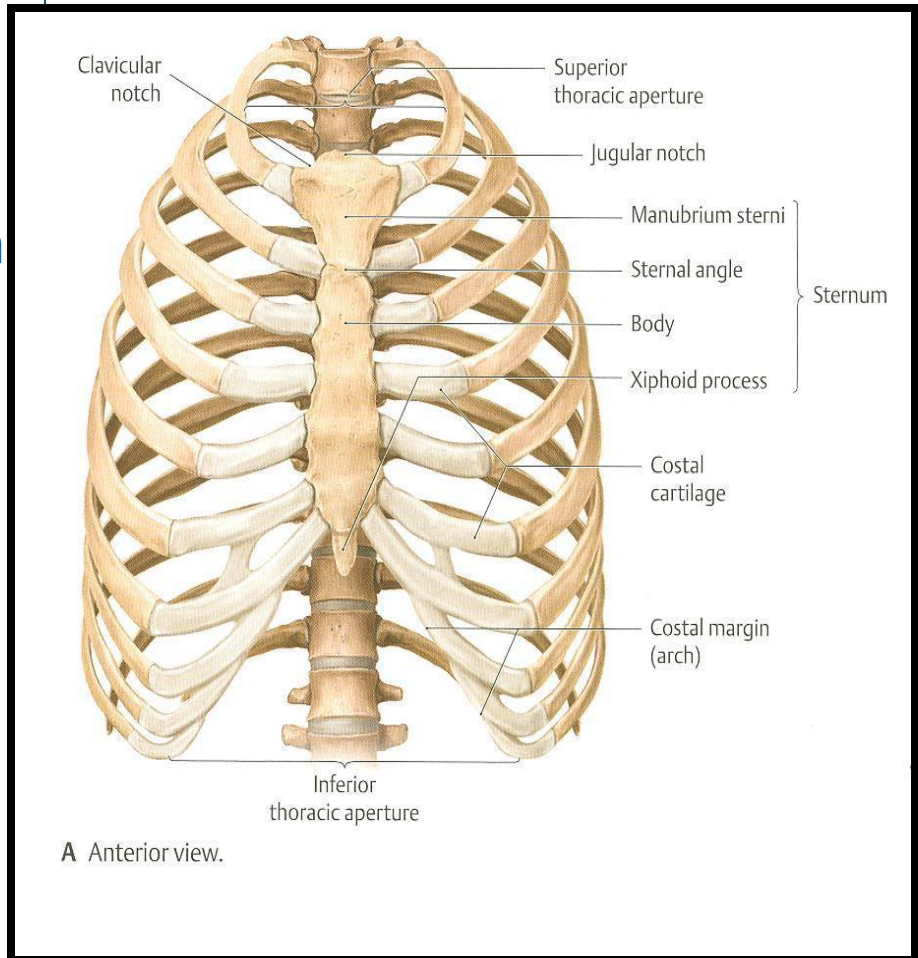
- *Describe the components of the thoracic cage and their articulations.*
- *Describe in brief the respiratory movements.*
- *List the muscles involved in inspiration and in expiration.*
- *Describe the attachments of each muscle to the thoracic cage and its nerve supply.*
- *Describe the origin, insertion, nerve supply of diaphragm.*

THORACIC CAGE

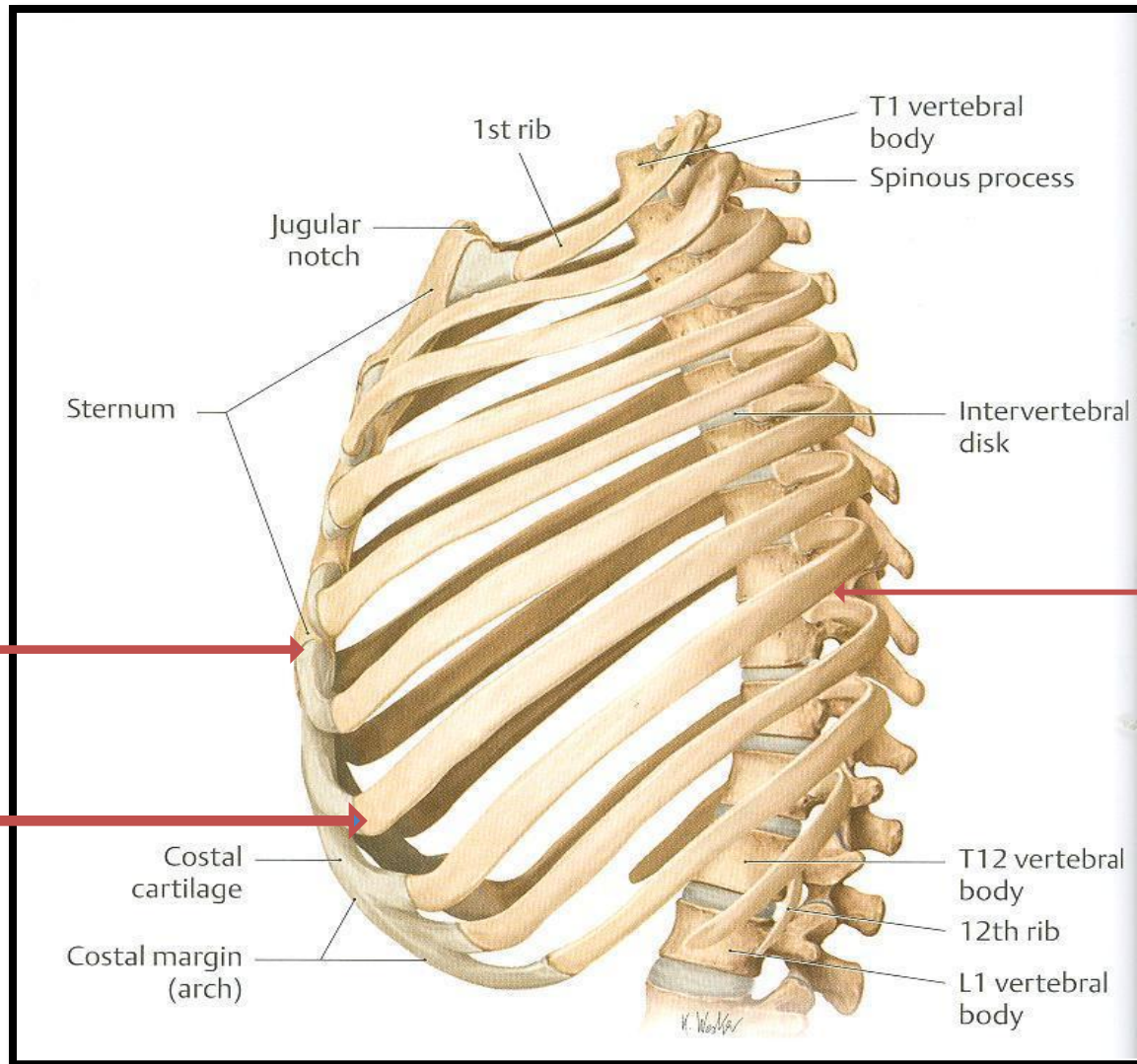


THORACIC CAGE

- ❑ **Conical in shape**
- ❑ **Has 2 apertures (openings):**
 1. **Superior (*thoracic outlet*): narrow, open, continuous with neck**
 2. **Inferior: wide, closed by diaphragm**
- ❑ **Formed of:**
 1. **Sternum & costal cartilages: *anteriorly***
 2. **Twelve pairs of ribs: *laterally***
 3. **Twelve thoracic vertebrae: *posteriorly***



ARTICULATIONS



Sternocostal

- 1st costal cartilage: articulates with manubrium by a **primary cartilaginous j. (Hyaline)**
- From 2nd to 7th cartilages articulate with sternum by **plane synovial js.**

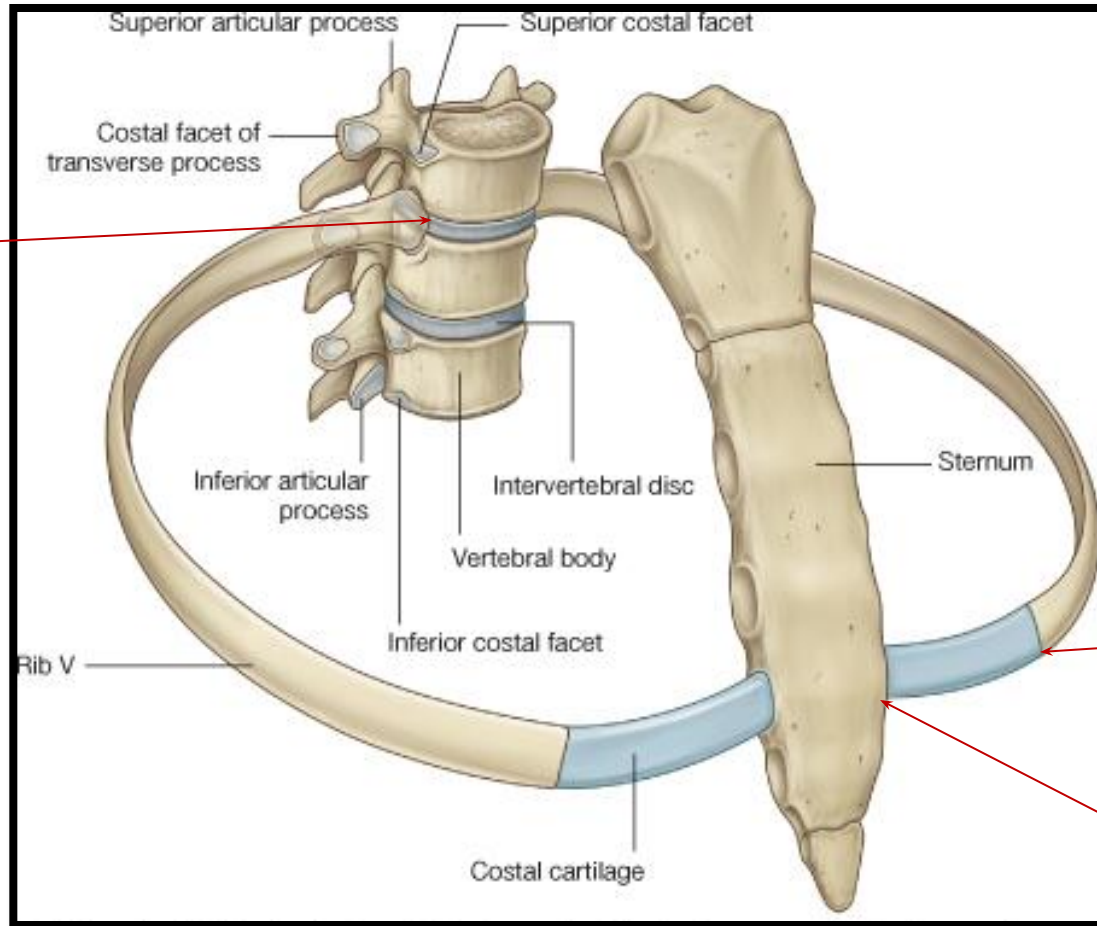
Costo-chondral

- Between the costal cartilage and the ribs
- **Hyaline Cartilaginous j.**

Costo-vertebral

- These are **plane synovial joints.**
- Between heads of ribs & thoracic vertebrae.

ARTICULATIONS



Costovertebral

Plane synovial j.

Costochondral

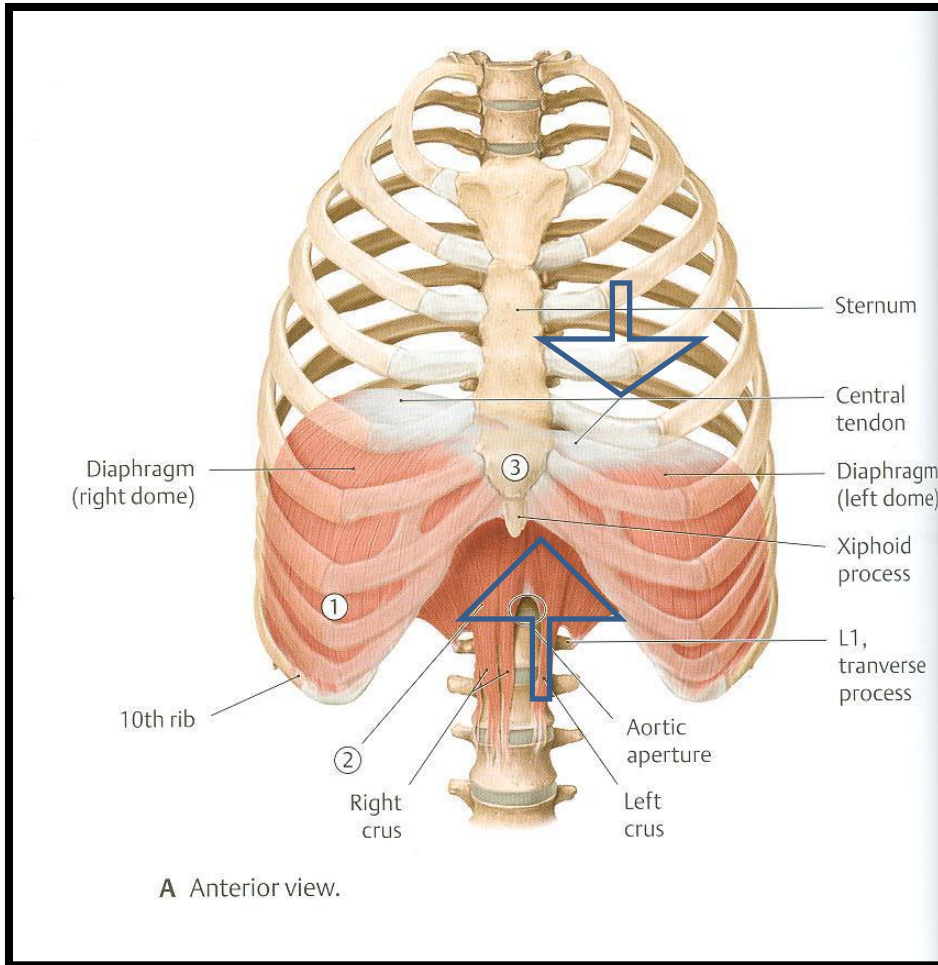
Cartilagenous j.

Sternocostal (2-7)

Plane synovial j.

RESPIRATORY MOVEMENTS

A- MOVEMENTS OF DIAPHRAGM



Inspiration

Contraction (descent)
of diaphragm



Increase of vertical diameter
of thoracic cavity

Expiration

Relaxation (ascent)
of diaphragm

RESPIRATORY MOVEMENTS

B- MOVEMENTS OF RIBS

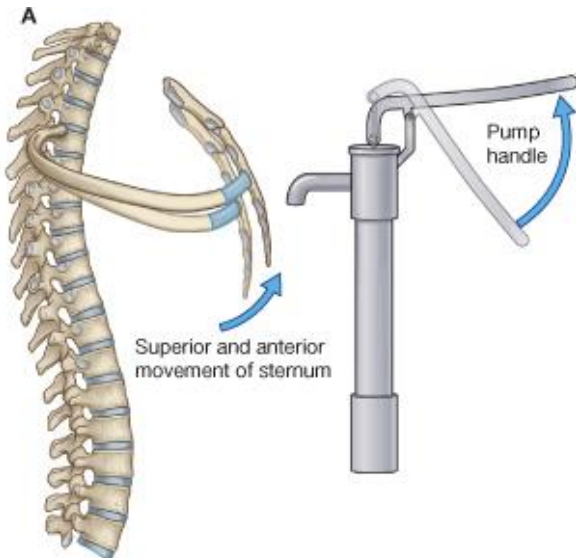
(In Normal Inspiration)

PUMP HANDLE MOVEMENT

Elevation of ribs



Increase in antero-posterior diameter of thoracic cavity

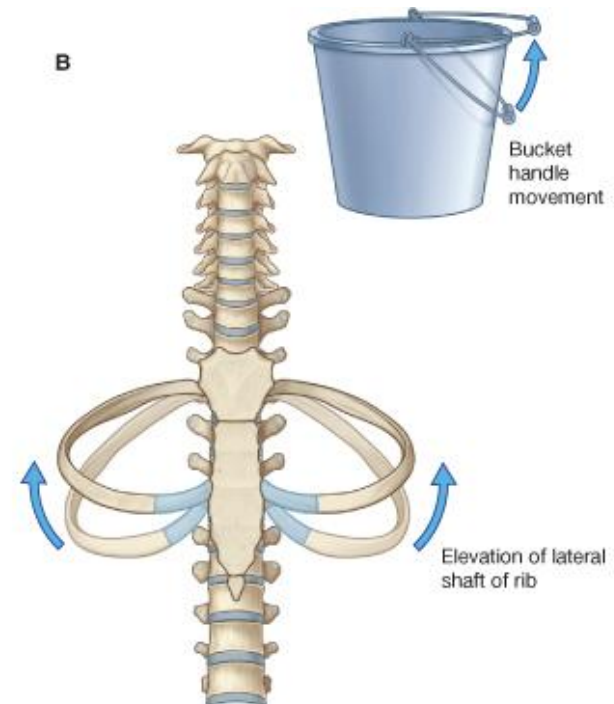


BUCKET HANDLE MOVEMENT

Elevation of ribs



Increase in lateral (transverse) diameter of thoracic cavity

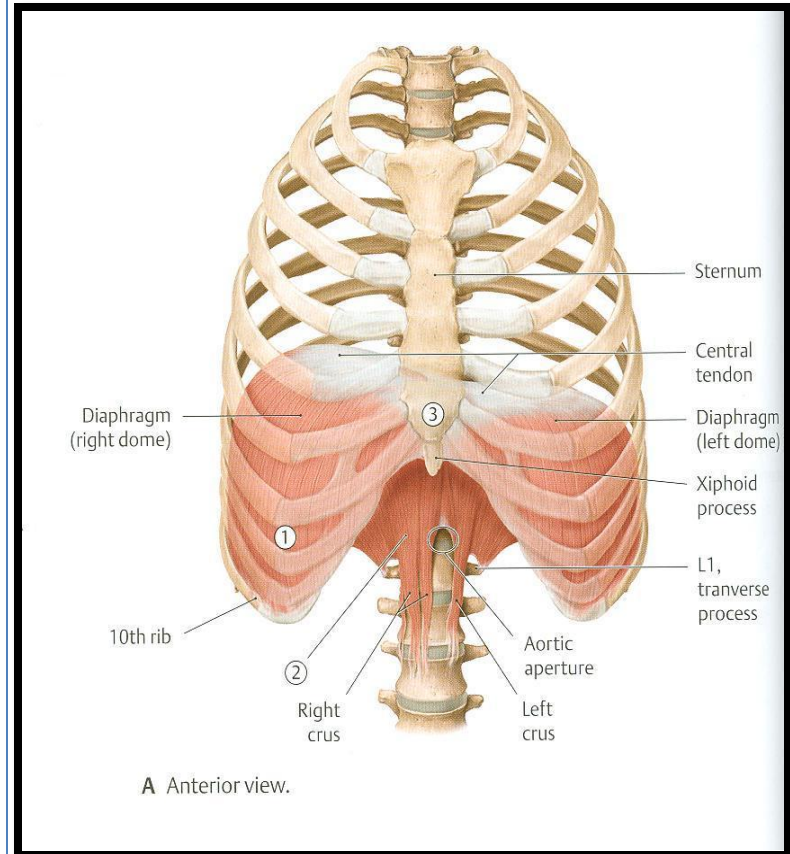


INSPIRATORY MUSCLES

- ❑ Diaphragm (most important muscle)
- ❑ Rib elevators: external intercostal muscles
- ❑ Accessory muscles (only during forced inspiration) :
 1. Muscles attaching cervical vertebrae to first & second rib: scalene muscles
 2. Muscles attaching thoracic cage to upper limb: pectoralis major

DIAPHRAGM

- **A musculotendinous partition** between thoracic & abdominal cavity
- **Convex toward thoracic & concave toward abdominal cavity**
- **Attached to: sternum, costal cartilages, 12th rib & lumbar vertebrae**
- **Fibers converge to join and inserted into the central tendon**
- **Nerve supply: **phrenic nerve (C3,4,5)**, penetrates diaphragm & innervates it from abdominal surface**
- **Action: contraction (descent) of diaphragm increase vertical diameter of thoracic cavity (**essential for normal breathing**)**

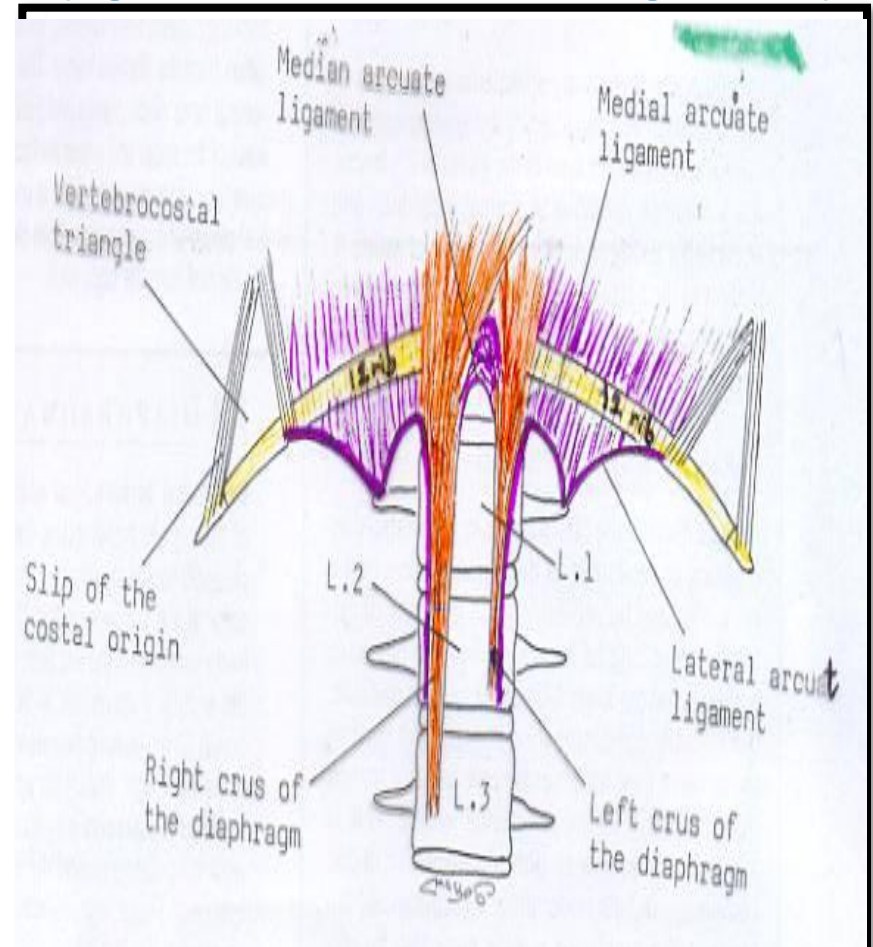
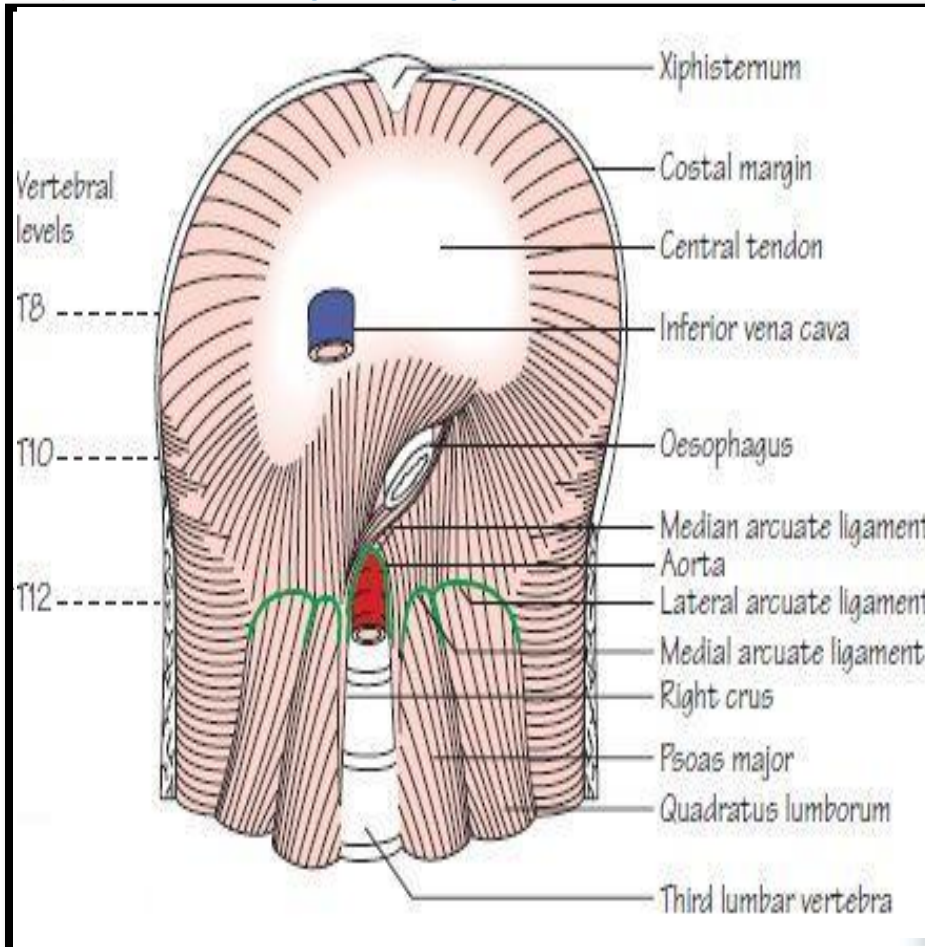


ORIGIN OF DIAPHRAGM

1) **Costal:** lower 6 costal cartilages

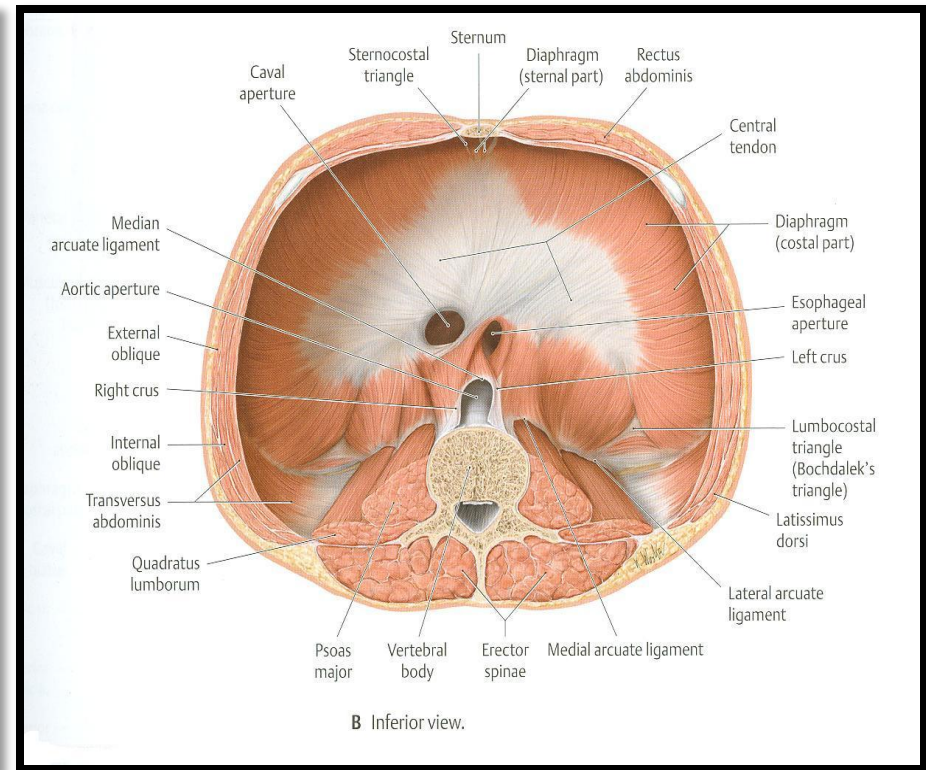
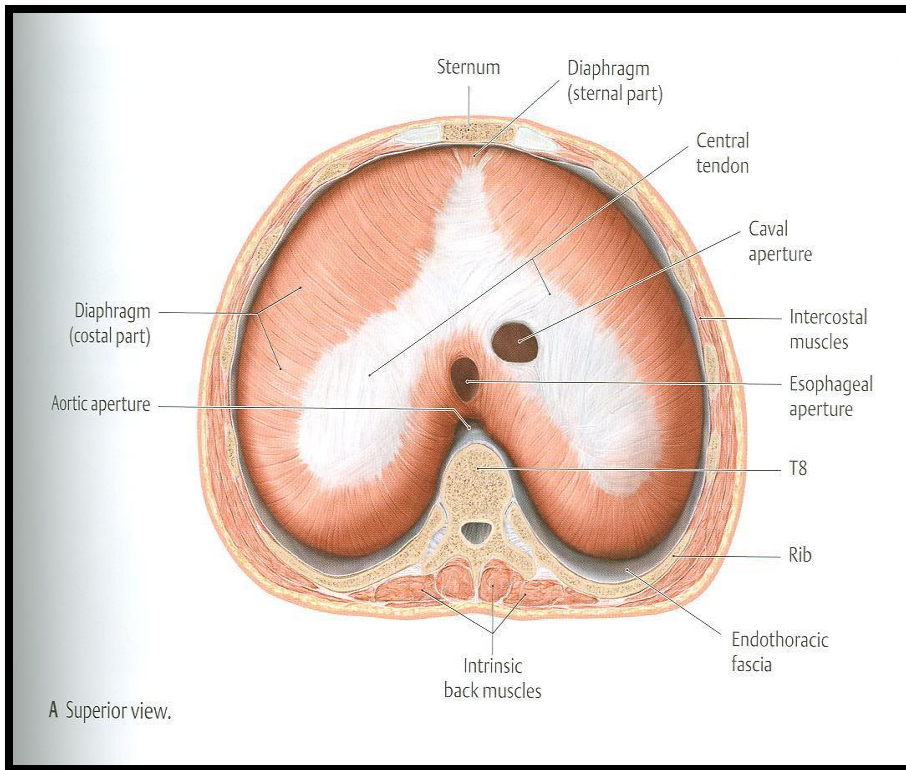
3) **Sternal:** xiphoid process of sternum

2) **Vertebral:** upper 3 lumbar vertebrae
(right & left crus + arcuate ligaments)



INSERTION OF DIAPHRAGM (CENTRAL TENDON)

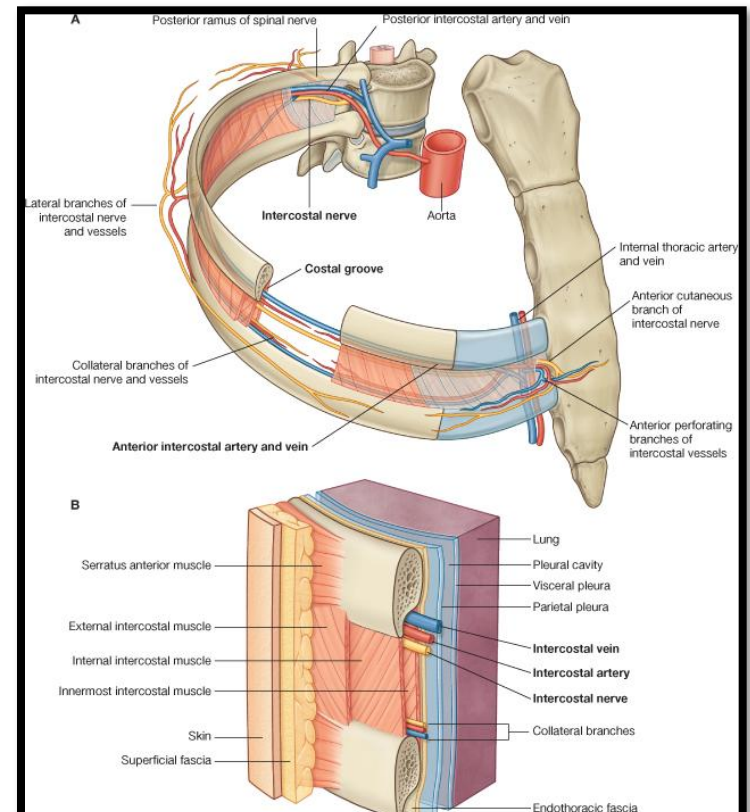
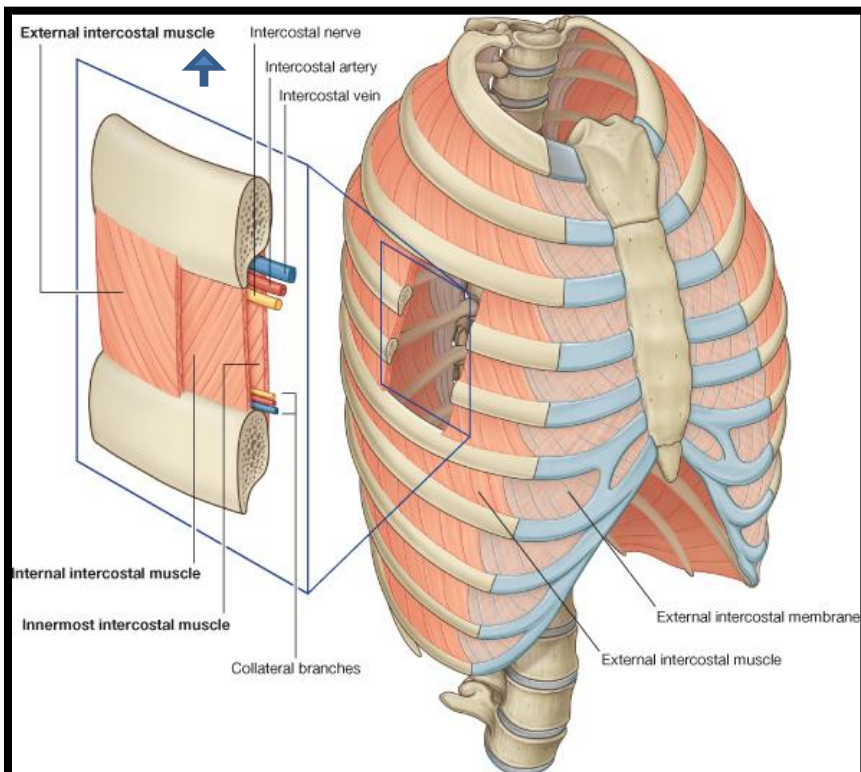
□ (lies at the level of xiphisternal joint, at 9th thoracic Vertebra)



EXTERNAL INTERCOSTAL

(Inspiratory Muscle)

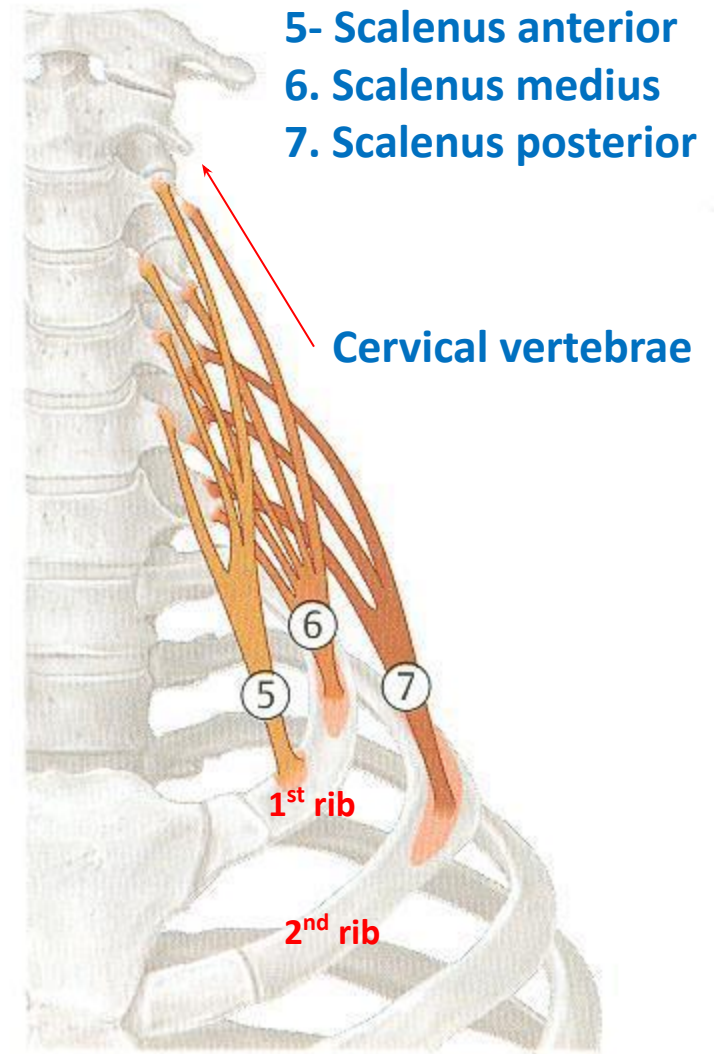
- **Attachments:** from lower border of rib above to upper border of rib below
- **Direction of fibers:** downward & medially
- **Nerve supply:** intercostal nerves
- **Action:** rib elevators (inspiratory)



SCALENE MUSCLES

(In Forced Inspiration)

- **Origin:** cervical vertebrae
- **Insertion:** 1st & 2nd ribs
- **Action:** elevates 1st & 2nd ribs (inspiratory)



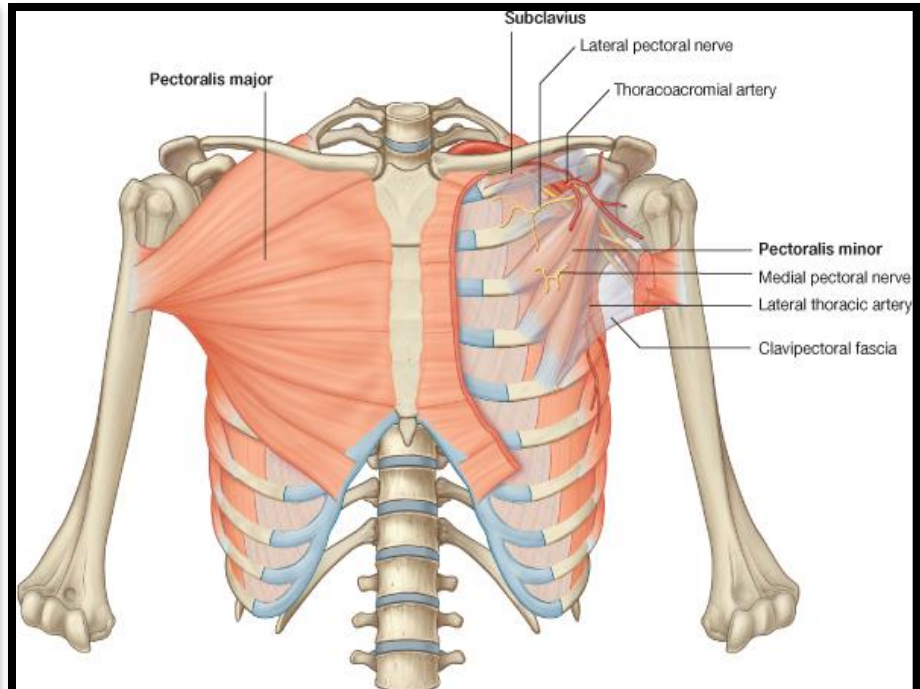
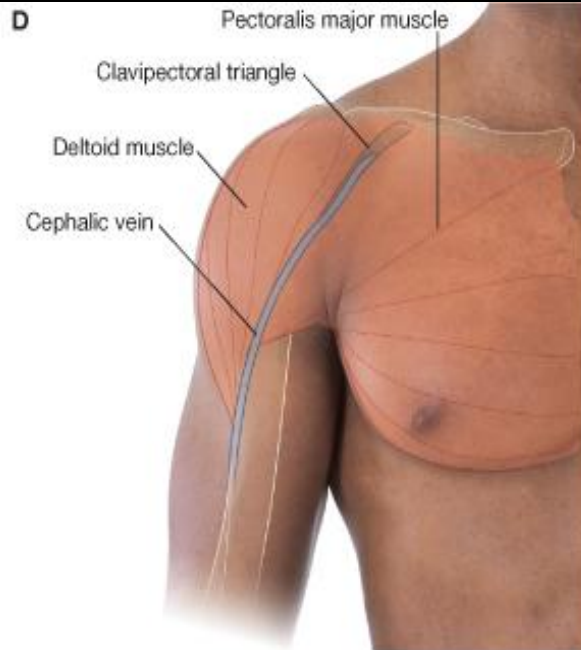
B Scalene muscles, anterior view.

PECTORALIS MAJOR

(In Forced Inspiration)

- **Origin:** sternum + costal cartilages
- **Insertion:** humerus

- **Action:** increases antero-posterior diameter of thoracic cavity, when arm is fixed (inspiratory)



EXPIRATORY MUSCLES

Act only during forced expiration

- Rib depressors:

1. Internal intercostal
2. Innermost intercostal
3. Subcostals
4. Transversus thoracis

- Anterior abdominal wall muscles:

(Compression of abdominal viscera to help in ascent of diaphragm).

1. External oblique
2. Internal oblique
3. Transversus abdominis
4. Rectus abdominis

RIB DEPRESSORS: REST OF INTERCOSTAL MUSCLES

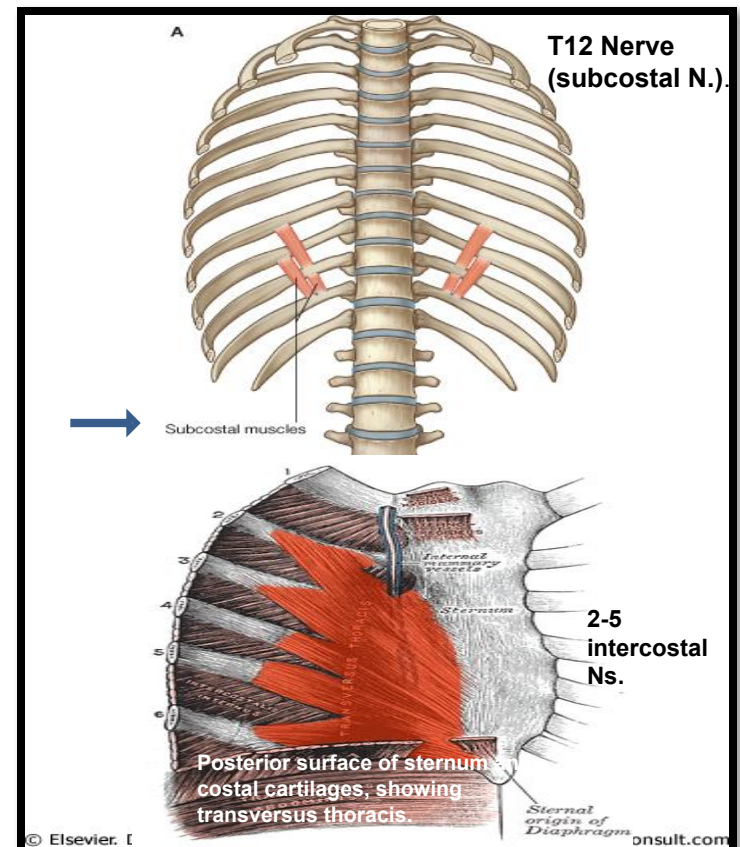
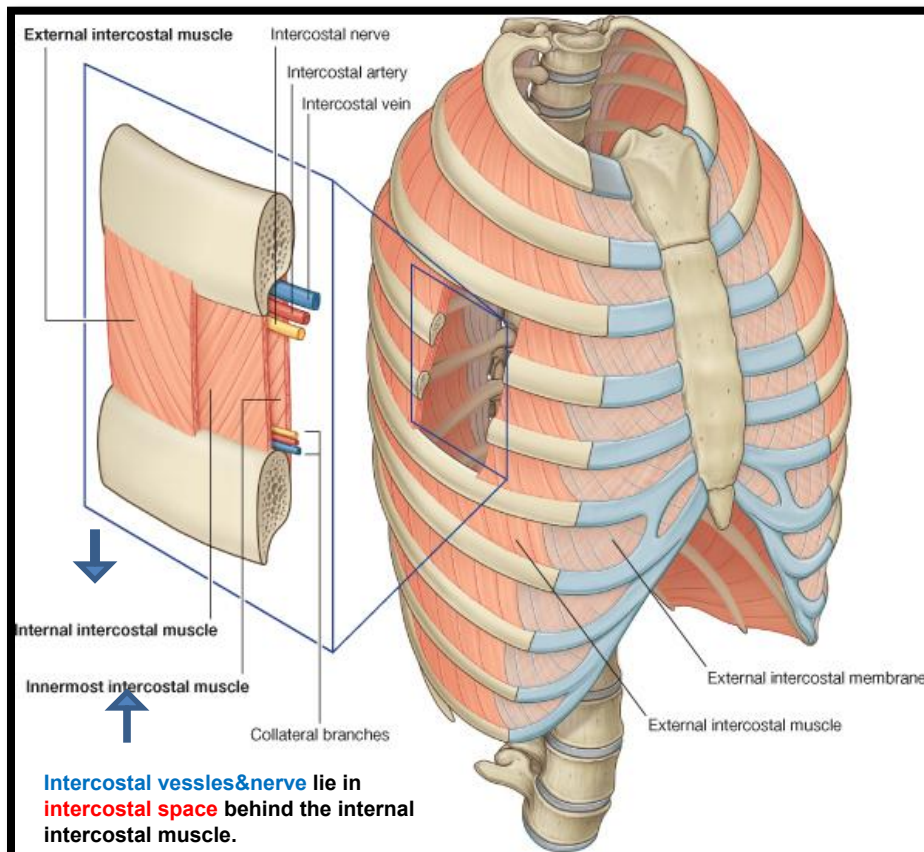
1. Internal intercostal
2. Innermost intercostal

Direction: upward & medially

3. Subcostal

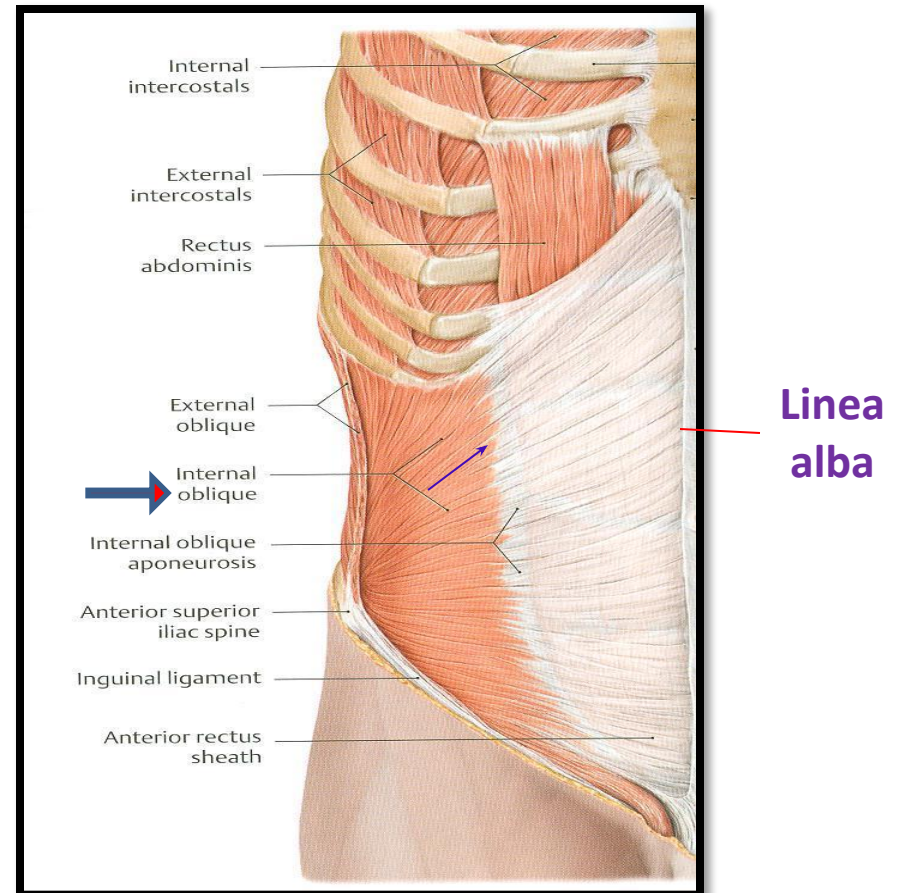
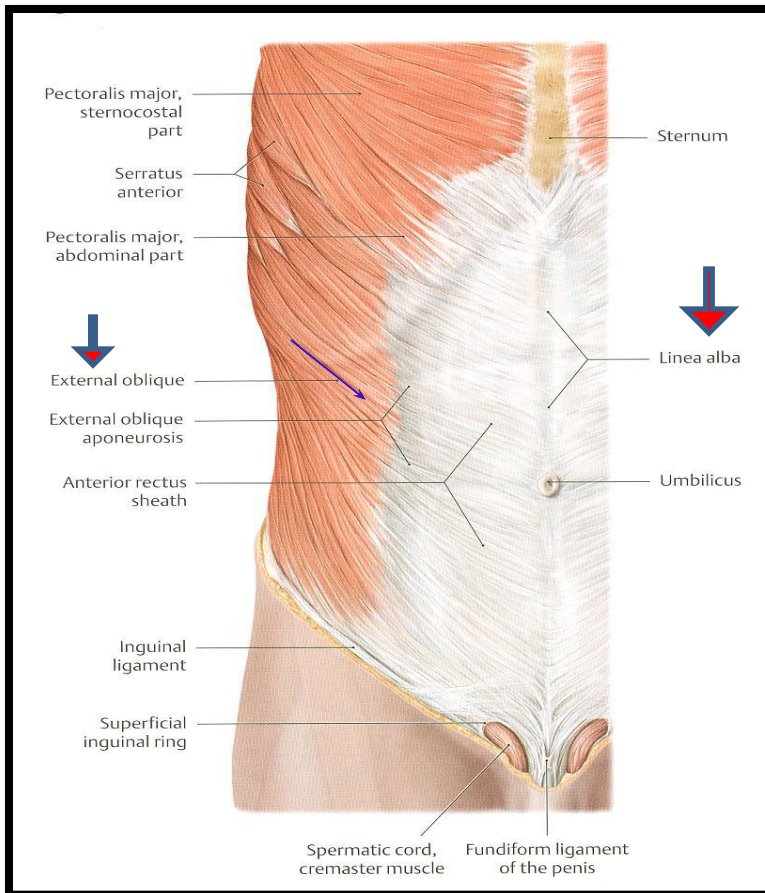
4. Transversus thoracis

Nerve supply: intercostal nerves (ventral rami of T1-T11)



ANTERIOR ABDOMINAL WALL

- External oblique (outer layer)
 - Direction: downward & medially
- Internal oblique (middle layer)
 - Direction: upward & medially



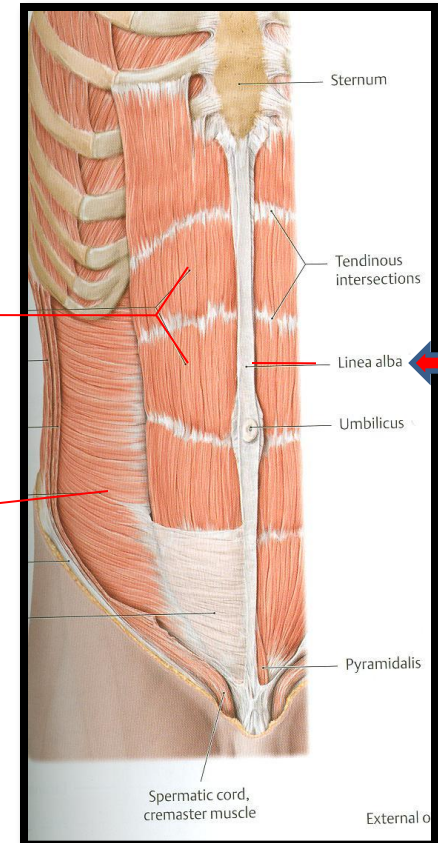
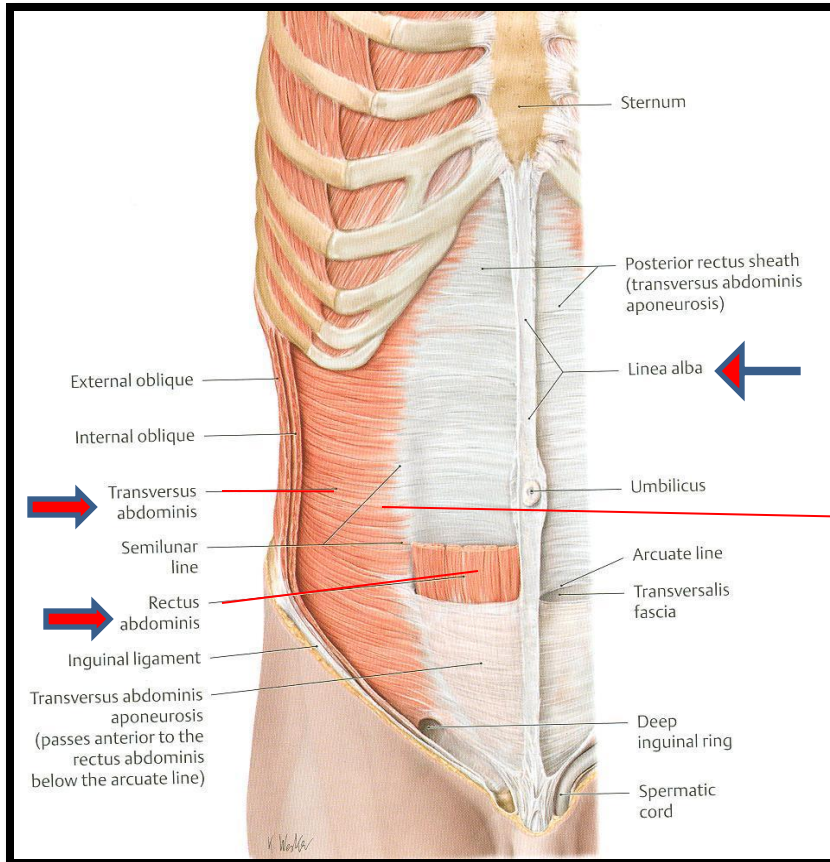
ANTERIOR ABDOMINAL WALL

Transversus abdominis (inner layer)

■ Direction: transverse

Rectus abdominis

■ Direction: vertical



Rectus abdominis

Transversus abdominis

Anterior abdominal wall

- ❑ Is formed of 3 layers of muscles of fibers running in different directions (to increase strength of anterior abdominal wall)
- ❑ The 3 muscles form a sheath in which a fourth muscle lies (rectus abdominis)
- ❑ Muscles are attached to: sternum, costal cartilages and ribs + hip bones
- ❑ The aponeurosis of the 3 muscles on both sides fuse in the midline to form linea alba
- ❑ **Action (during forced expiration):** Compression of abdominal viscera to help in ascent of diaphragm (during forced expiration).
- ❑ **Nerve supply:** lower 5 intercostal nerves (T7 – T11), subcostal nerve (T12) and first lumbar nerve (L1).

The image features two large, stylized yellow roses with white and yellow petals, set against a teal background. The roses are rendered in a low-poly, geometric style. The text "THANK YOU" is overlaid in a blue, serif font across the center of the roses. The entire composition is framed by a thick orange border.

THANK YOU