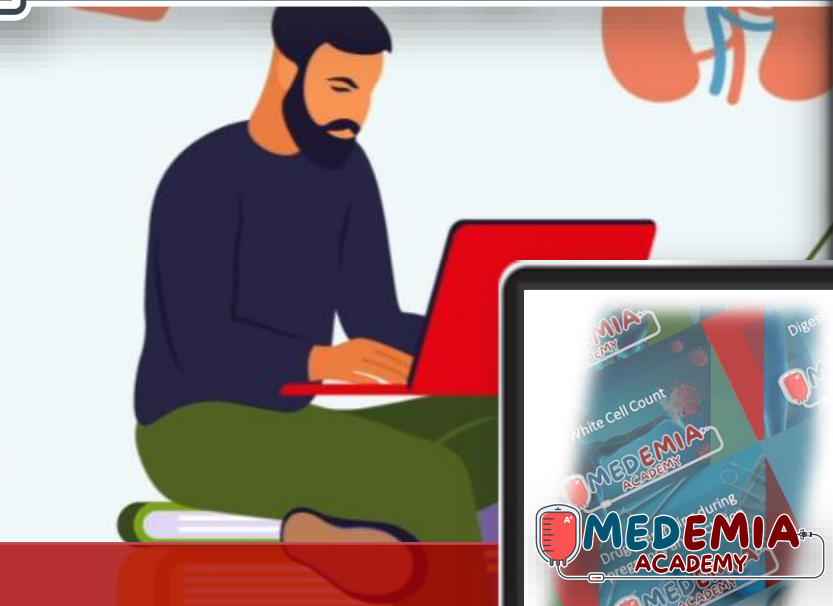


# Thoracic Cage Intercostal Muscles

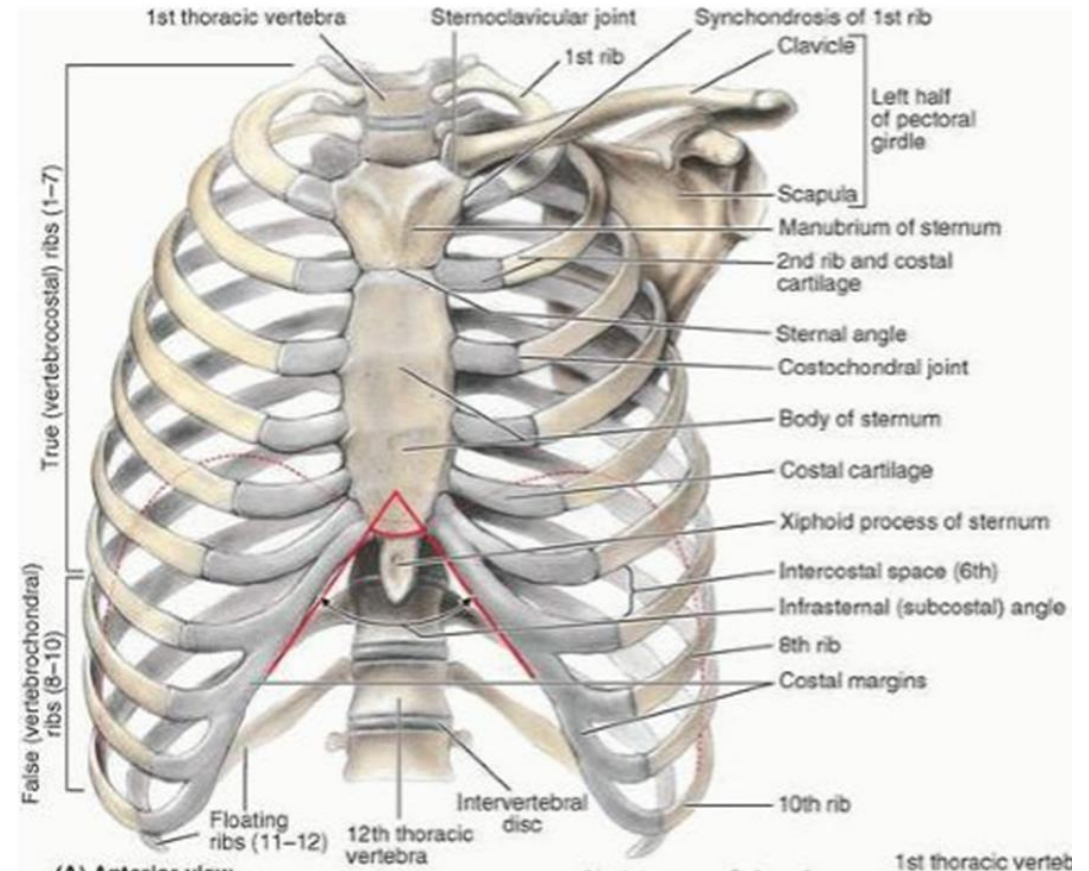


# MEDEMIA ACADEMY



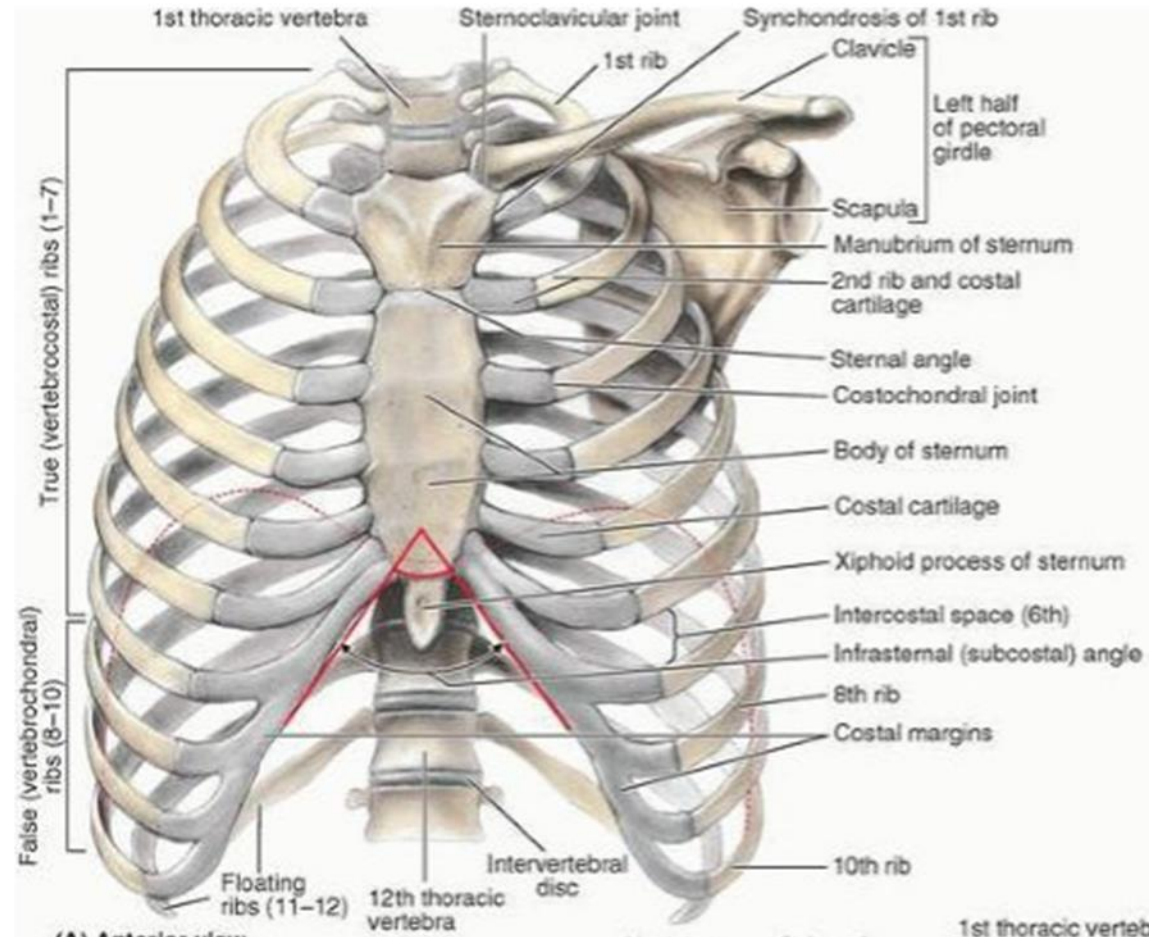
# The Thoracic wall

- ❖ The thorax (or chest) is the region of the body between the neck and the abdomen.
- ❖ It is flattened in front and behind but rounded at the sides.
- ❖ The framework of the walls of the thorax, which is referred to as the thoracic cage



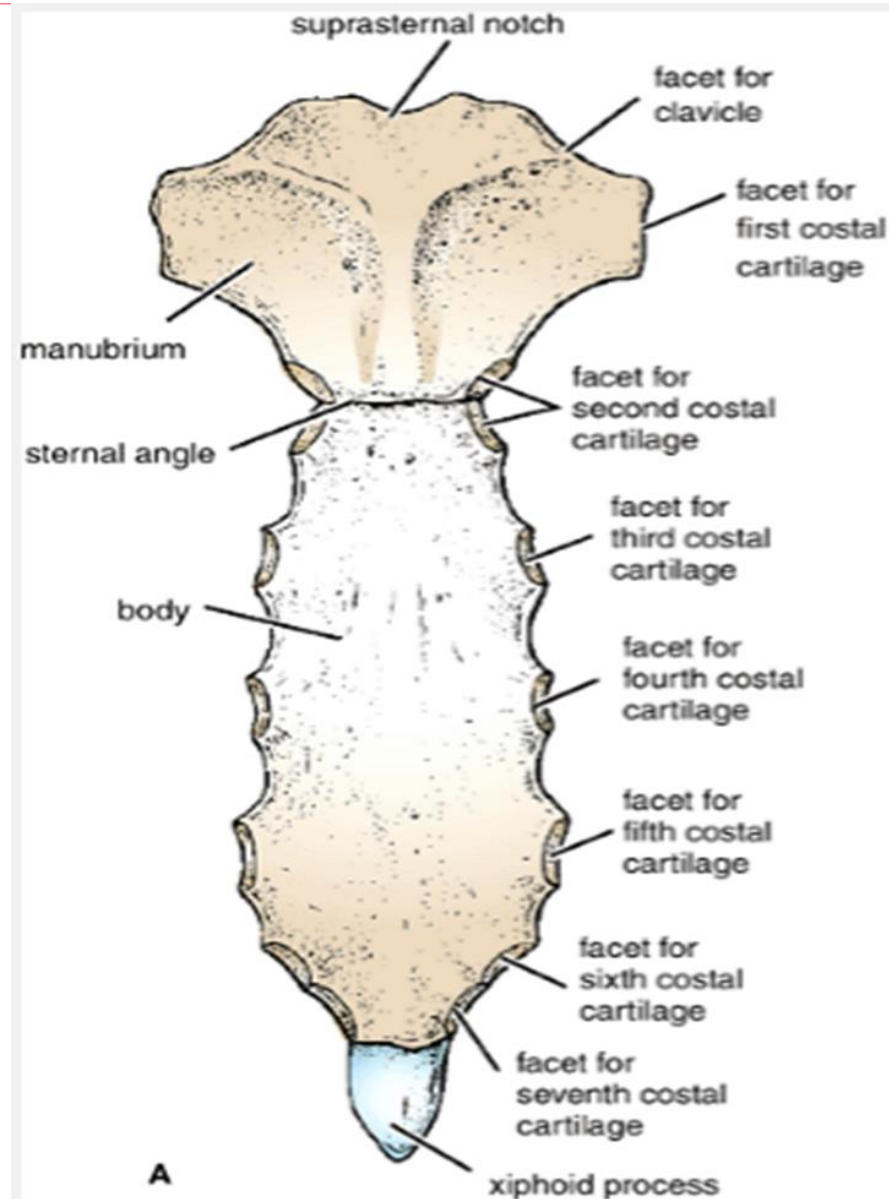
# Thoracic cage

- ❖ The thoracic wall is formed :
1. Anteriorly by the sternum and costal cartilages.
  2. Posteriorly by the thoracic part of the vertebral column;
  3. Laterally by the ribs and intercostal spaces
  4. Superiorly by the suprapleural membrane
  5. Inferiorly by the diaphragm, which separates the thoracic cavity from the abdominal cavity.



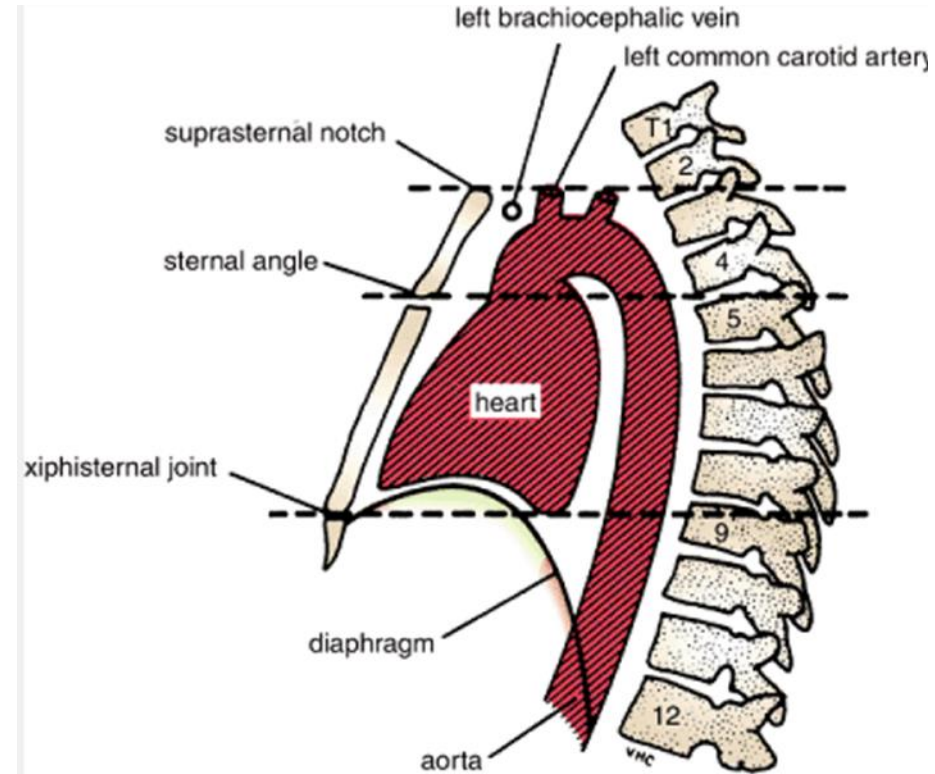
# Sternum

- ❖ lies in the midline of the anterior chest wall.
- ❖ It is a flat bone that can be divided into three parts:
  - Manubrium sterni.
  - Body of the sternum.
  - Xiphoid process.



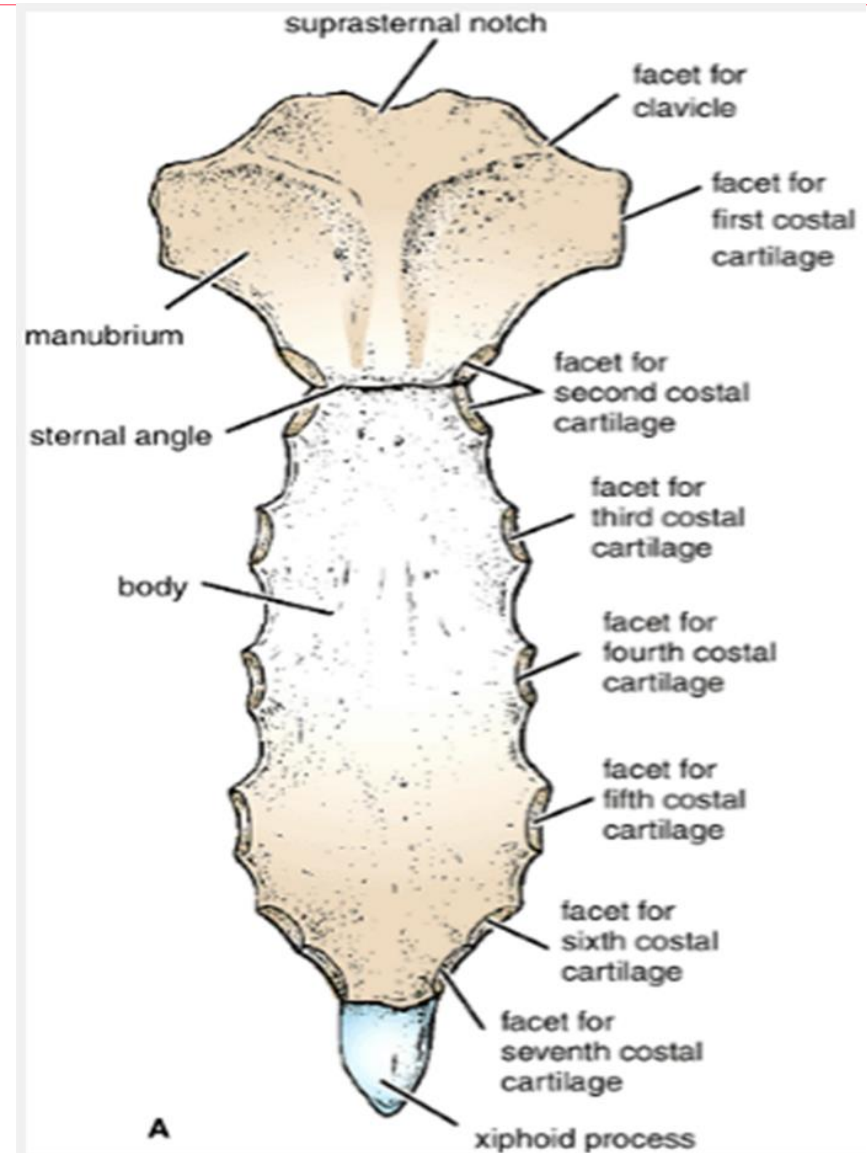
# Manubrium

- ❖ It's the upper part of the sternum.
- ❖ It articulates with the body of the sternum at the manubriosternal joint.
- ❖ It also articulates with the clavicles and with the first costal cartilage and the upper part of the second costal cartilages on each side.
- ❖ It lies opposite the third and fourth thoracic vertebrae.



# Body of the sternum

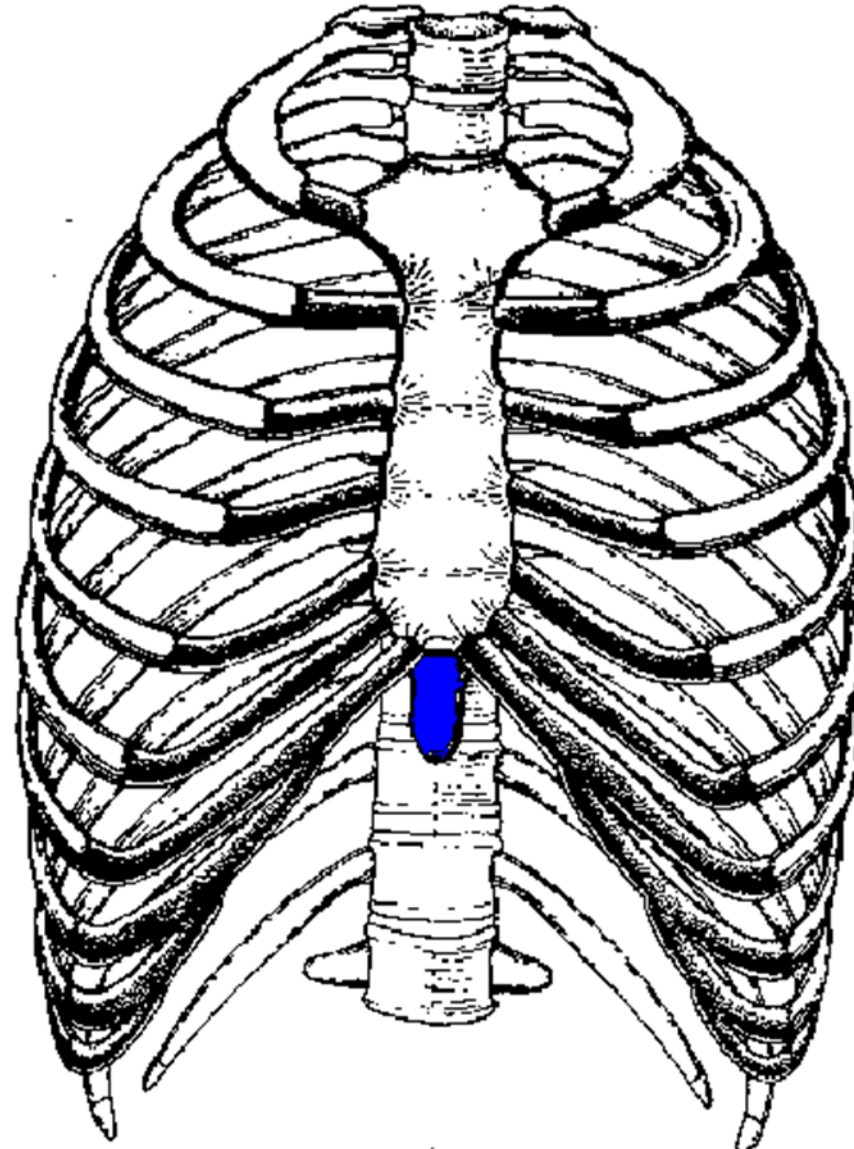
- ❖ Articulates above with the manubrium at the manubriosternal joint.
- ❖ Articulates below with the xiphoid process at the xiphisternal joint.
- ❖ On each side it articulates with the second to the seventh costal cartilages.



# Xiphoid process

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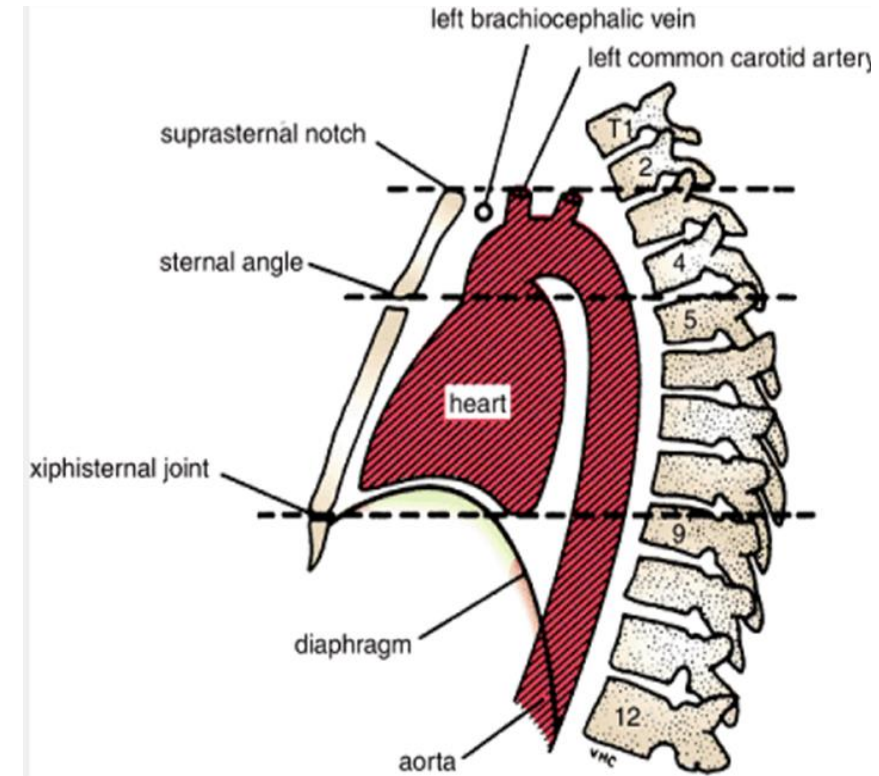
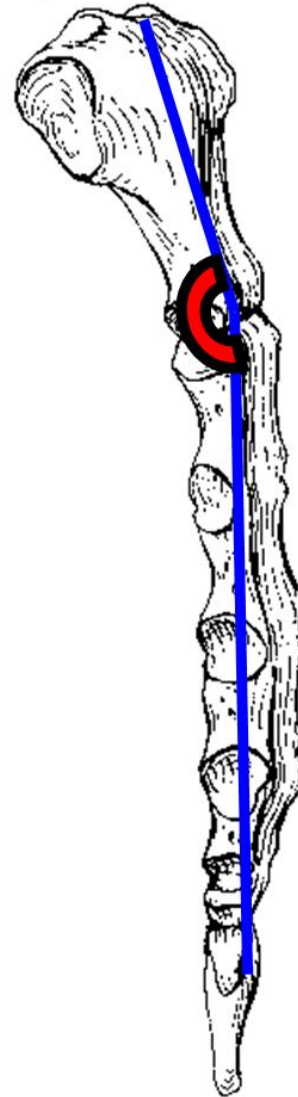
- ❖ Its a thin plate of cartilage that becomes ossified at its proximal end during adult life.
- ❖ No ribs or costal cartilages are attached to it.
- ❖ The xiphisternal joint lies opposite the body of the ninth thoracic vertebra.





# The sternal angle (angle of Louis)

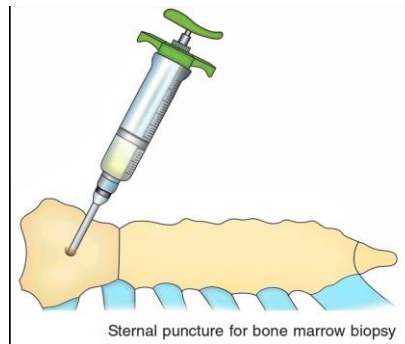
- ❖ It's formed by the articulation of the manubrium with the body of the sternum.
- ❖ The transverse ridge lies at the level of the second costal cartilage.
- ❖ The point from which all costal cartilages and ribs are counted.
- ❖ It lies opposite the intervertebral disc between the fourth and fifth thoracic vertebrae.



# Sternal Biopsy

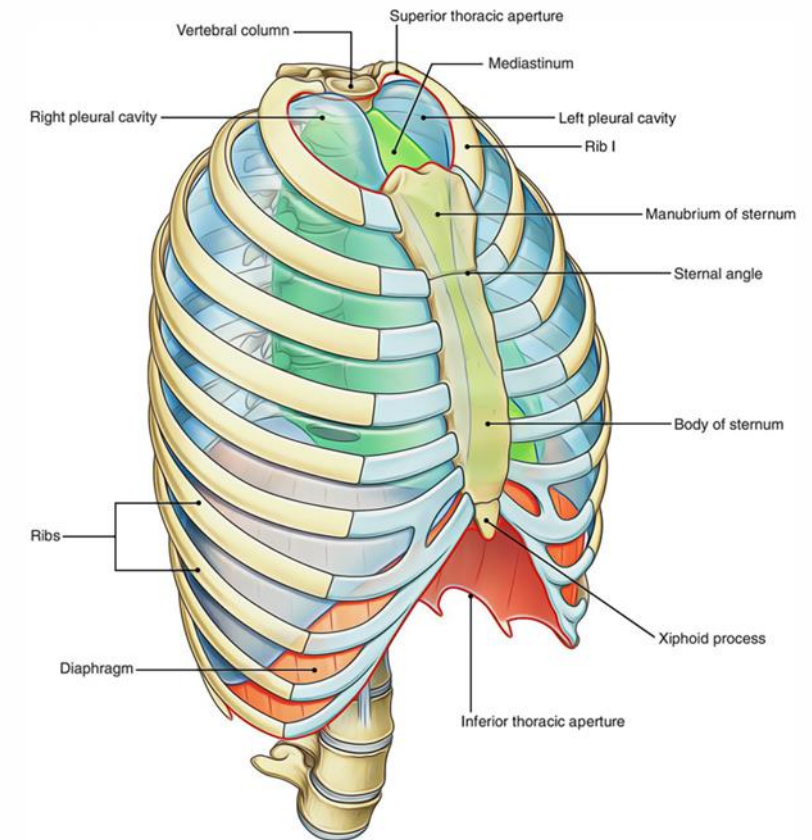
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- ❖ The sternal body is often used for bone marrow needle biopsy because of its breadth and subcutaneous position.
- ❖ The needle pierces the thin cortical bone and enters the vascular spongy bone.
- ❖ Sternal biopsy is commonly used to obtain specimens of marrow for transplantation and for detection of metastatic cancer and blood dyscrasias (abnormalities).



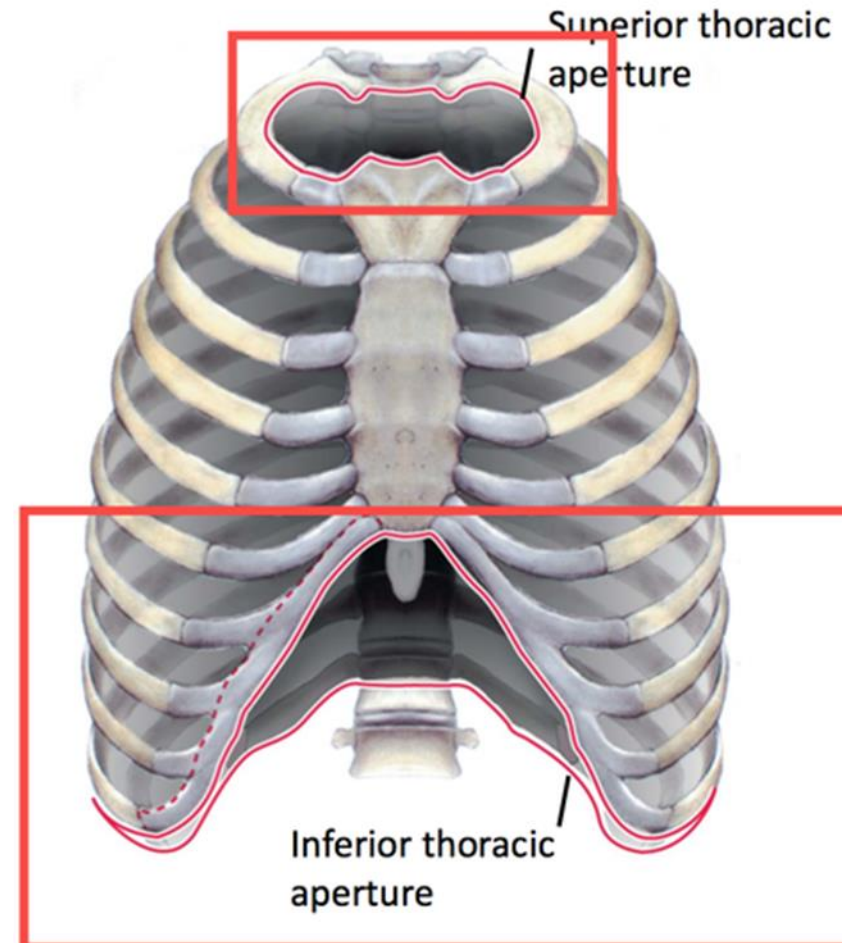
# Superior Thoracic aperture

- ❖ The chest cavity communicates with the root of the neck through an opening called the thoracic outlet.
- ❖ The opening is bounded :
  - Posteriorly by the 1st thoracic vertebra.
  - Laterally by the medial borders of the 1st ribs and their costal cartilages.
  - Anteriorly by the superior border of the manubrium sterni.



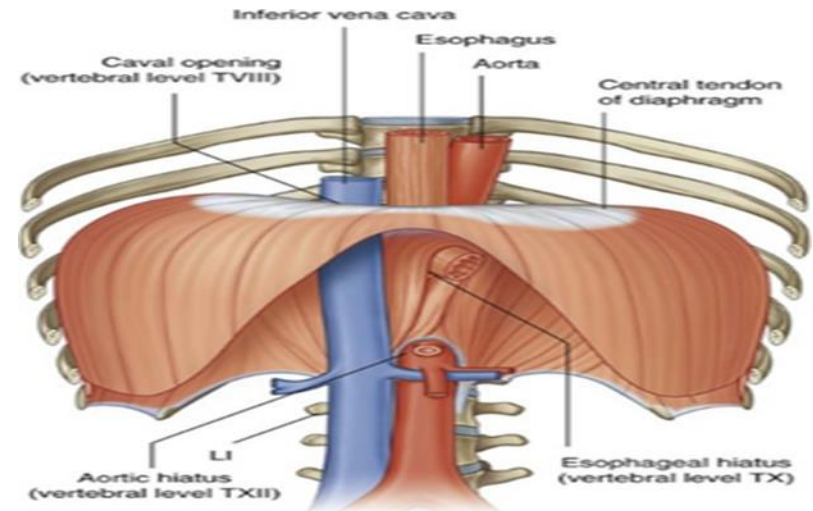
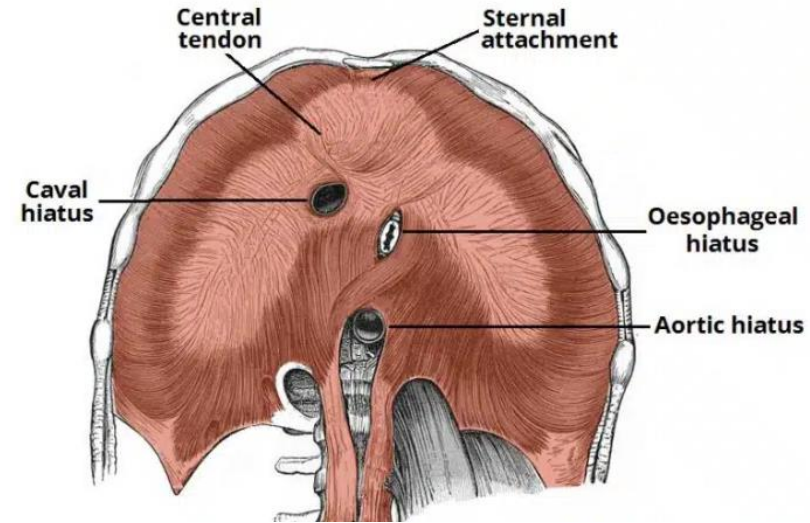
# Inferior Thoracic aperture

- ❖ The thoracic cavity communicates with the abdomen through a large opening.
- ❖ The opening is bounded:
  - Posteriorly by the 12th thoracic vertebra.
  - Laterally by the curving costal margin.
  - Anteriorly by the xiphisternal joint.



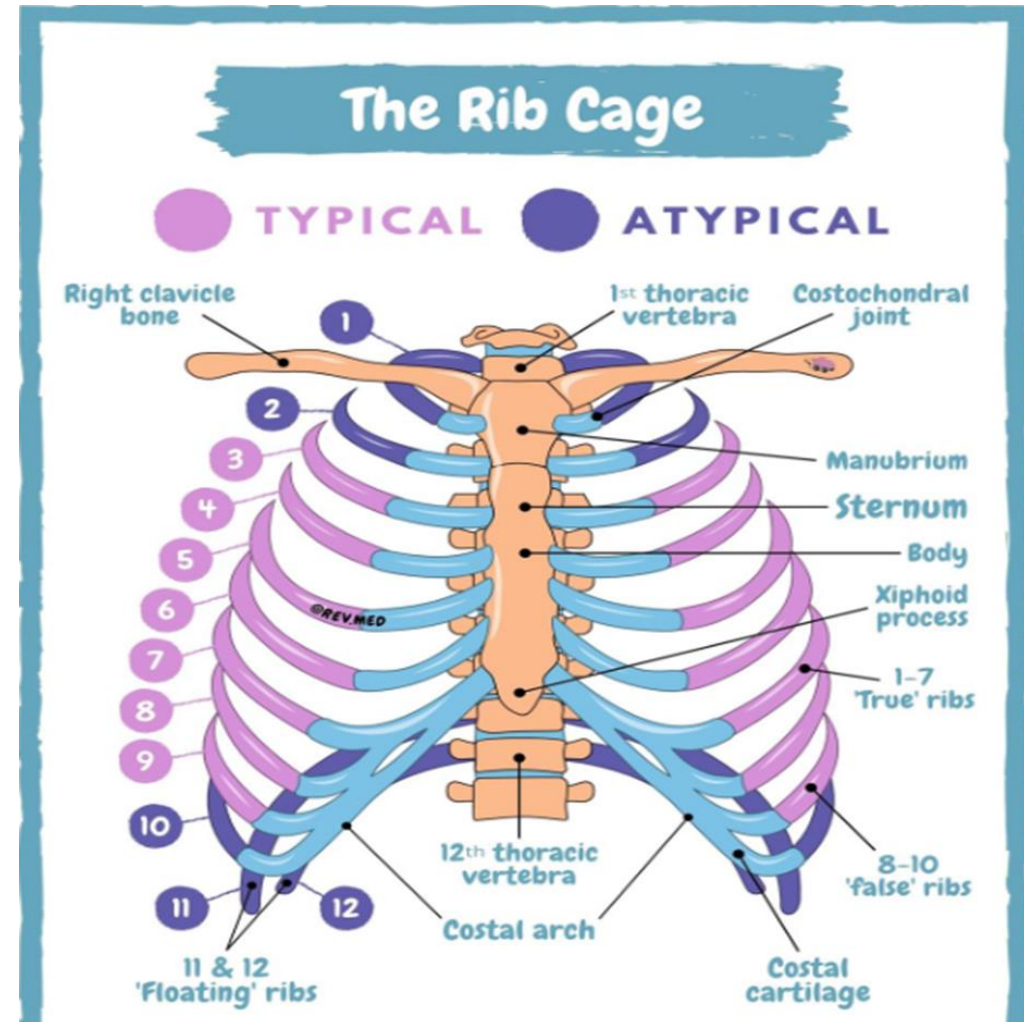
# Diaphragm

- ❖ Caval opening: T8
  - Inferior vena cava.
- ❖ Esophageal hiatus : T10
  - Esophagus, Vagus nerve.
- ❖ Aortic hiatus :T12
  - Aorta, thoracic duct, azygous vein.



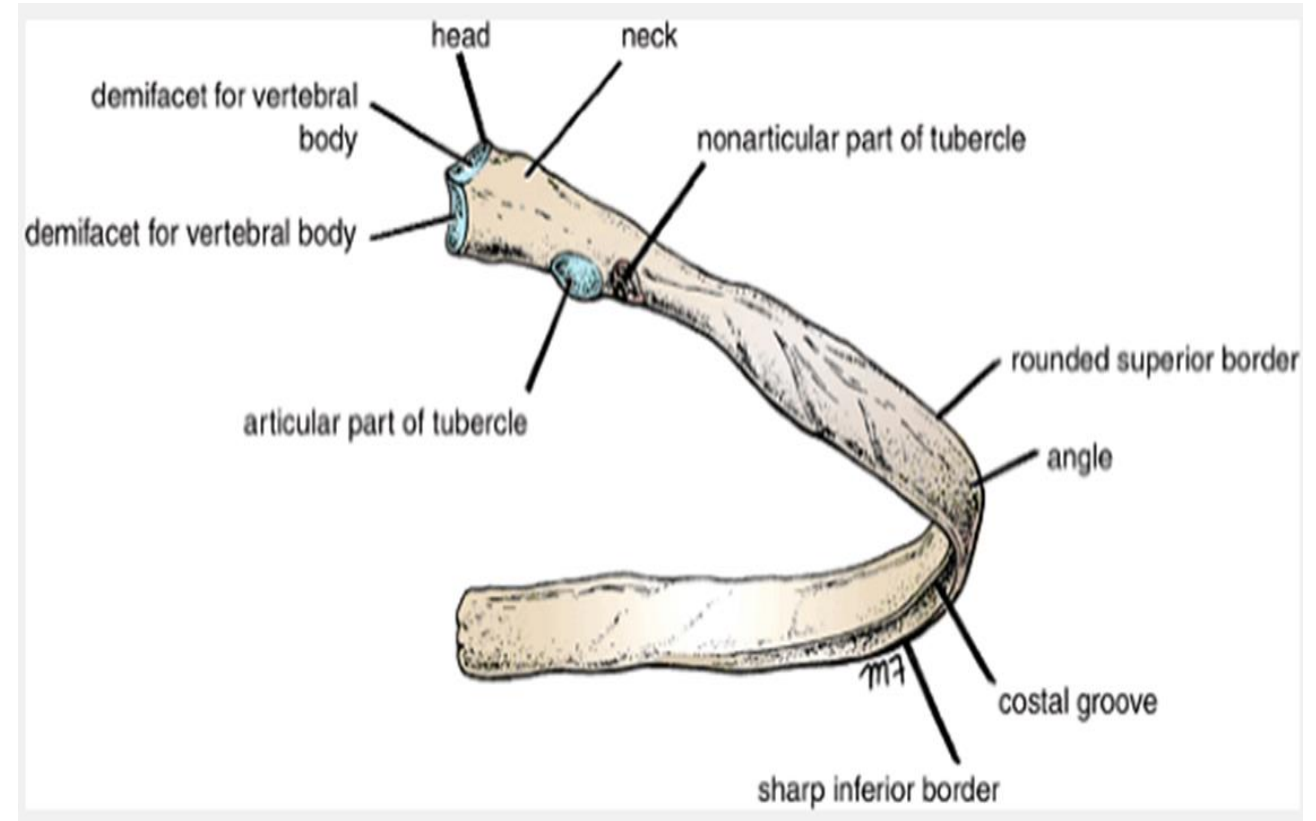
# Ribs

- ❖ There are 12 pairs of ribs, all of which are attached posteriorly to the thoracic vertebrae
- ❖ True ribs (ribs 1-7): Connect directly to the sternum via costal cartilage.
- ❖ False ribs (ribs 8-10): Connect indirectly to the sternum via the costal arch.
- ❖ Floating ribs (ribs 11-12): Do not connect to the sternum.



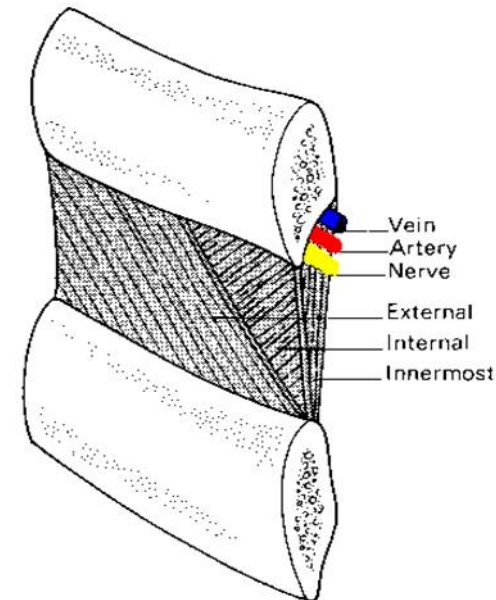
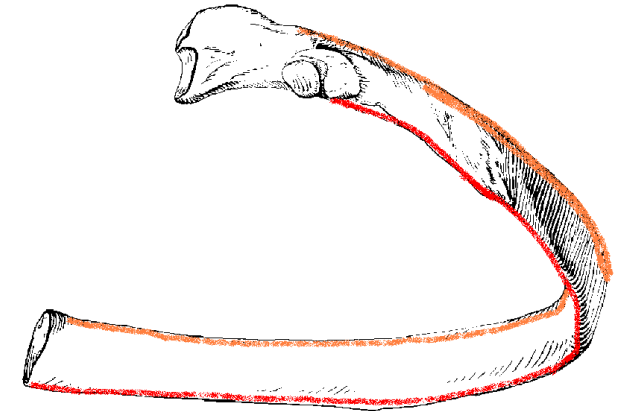
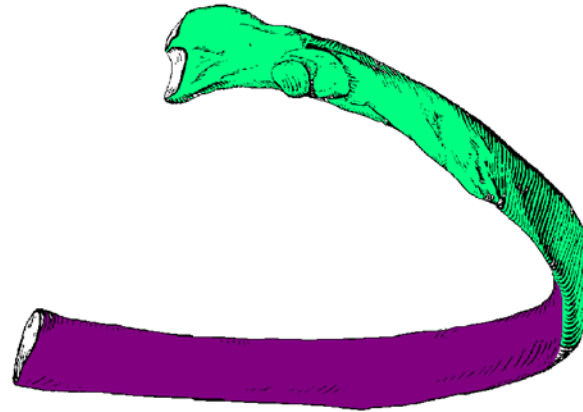
# Parts of Typical rib(3-10)

- ❖ Head of the rib : Posterior end that articulates with the facets of the thoracic vertebra.
- ❖ Neck.
- ❖ Tubercle of the rib: Small bump near the head on the posterior rib surface, and it articulates with the transverse processes of the thoracic vertebra.
- ❖ Body of the rib (shaft).
- ❖ Angle.



# Typical Ribs

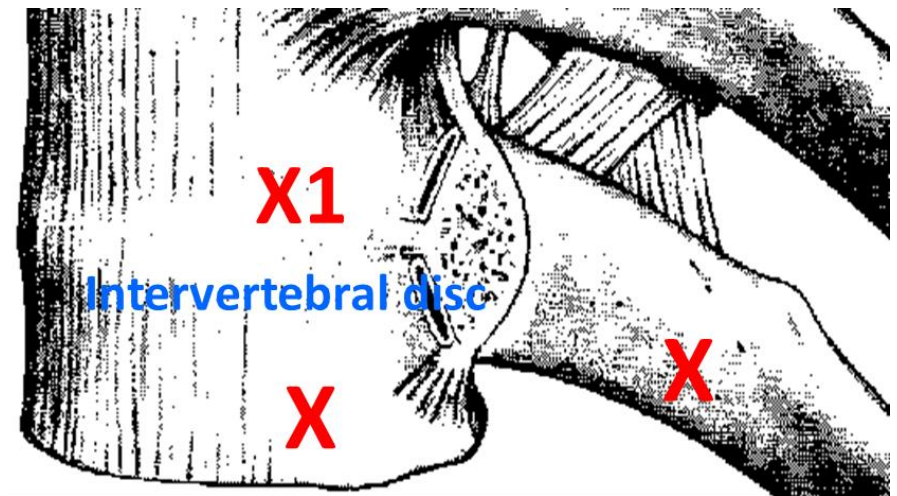
- ❖ External and Internal surfaces .
- ❖ Superior and inferior borders :
  - The inferior border is sharp and extends inferior to the costal groove on the internal surface of the shaft so that it protects intercostal neurovascular bundle located in the costal groove.





# The Head of Typical rib

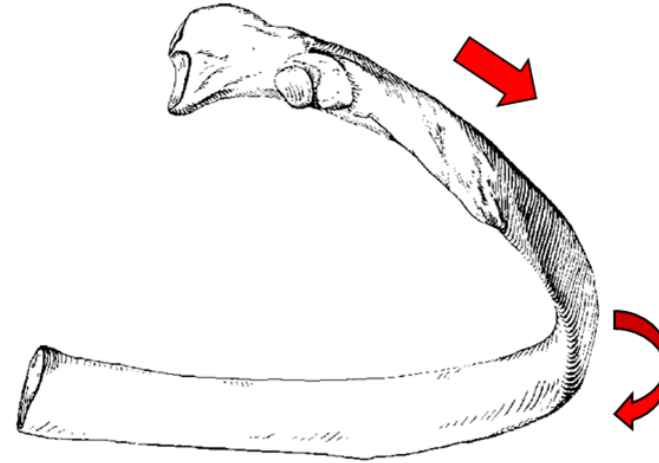
- ❖ It's the posterior end of the rib
  - Wedge-shaped
  - Carries two articular facets
  
- ❖ The head has two facets for articulation with the numerically corresponding vertebral body and that of the vertebra immediately above .



# Shaft /Angle

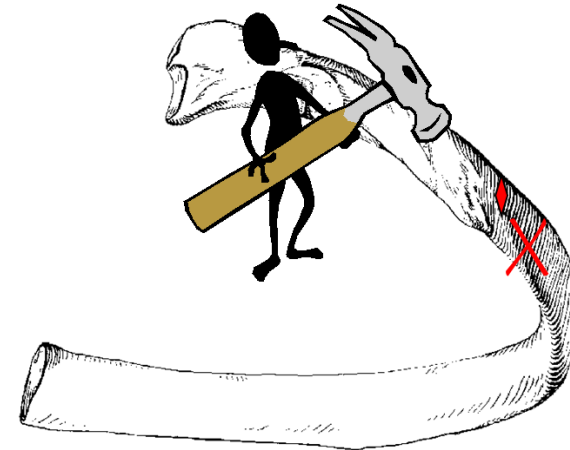
## ❖ Shaft:

- It's lateral to the tubercle.
- primarily it is directed posteriorly then it bends sharply anteriorly.



## ❖ Angle :

- The point of greatest change in curvature .
- It's weakest part where it tends to fracture.



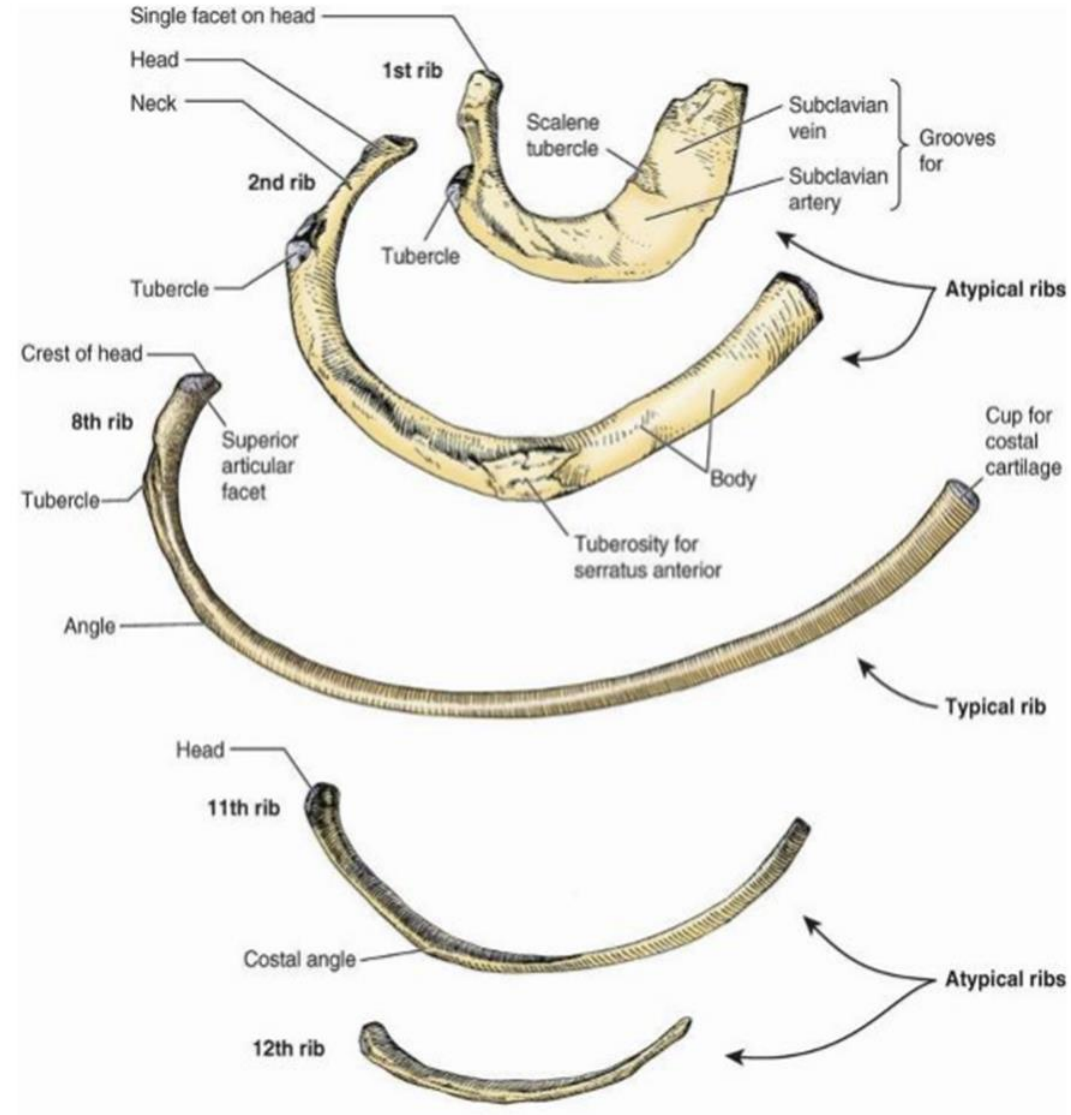
# Atypical Ribs

❖ 1<sup>ST</sup> rib.

❖ 2<sup>ND</sup> rib.

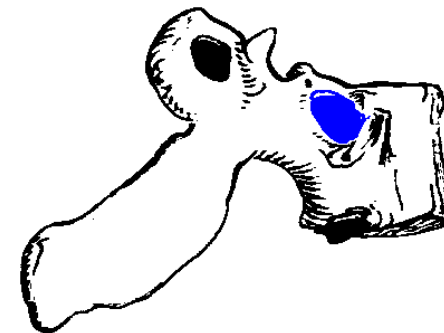
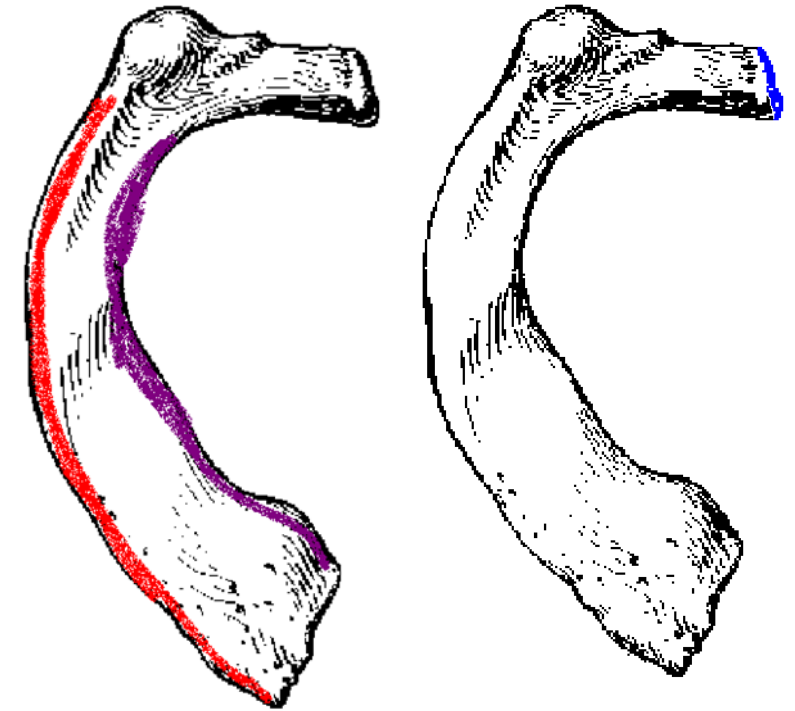
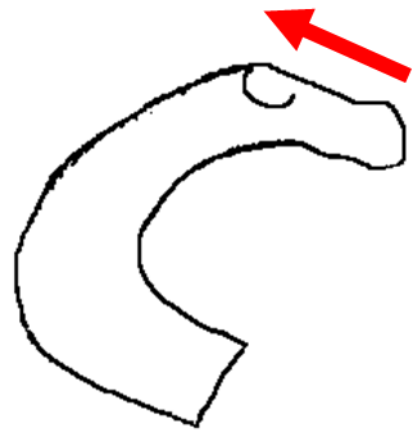
❖ 11<sup>TH</sup> rib.

❖ 12<sup>TH</sup> rib.



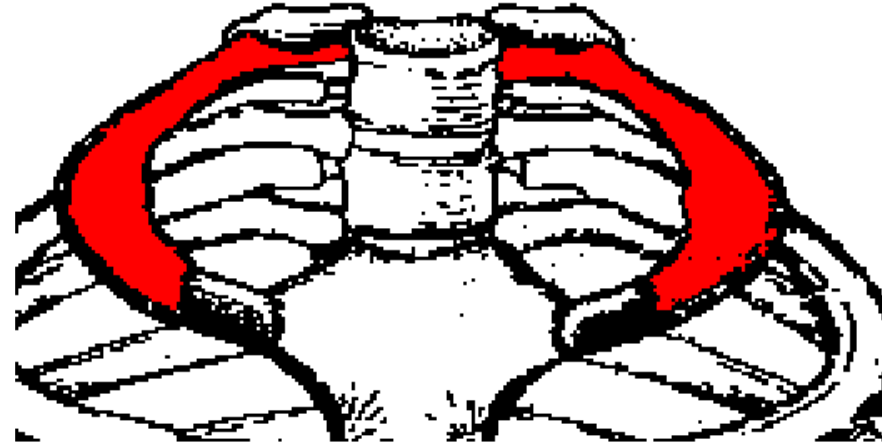
# First rib

- ❖ It's the broadest and most curved rib.
- ❖ The head carries a single facet for articulation with the body of T1 vertebra.
- ❖ The neck slopes up from the head towards the shaft.
- ❖ The shaft has inner and outer border.

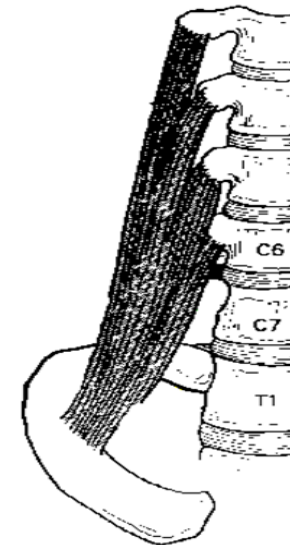
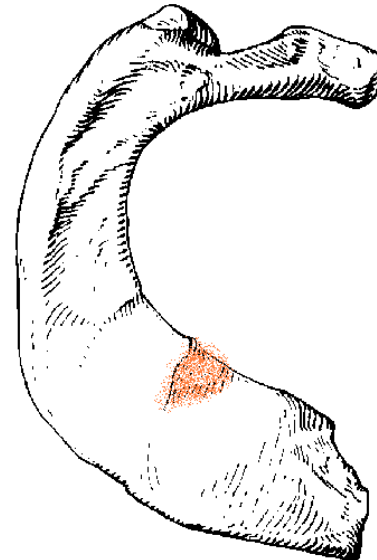


# First rib

- ❖ The shaft has superior and inferior surfaces.

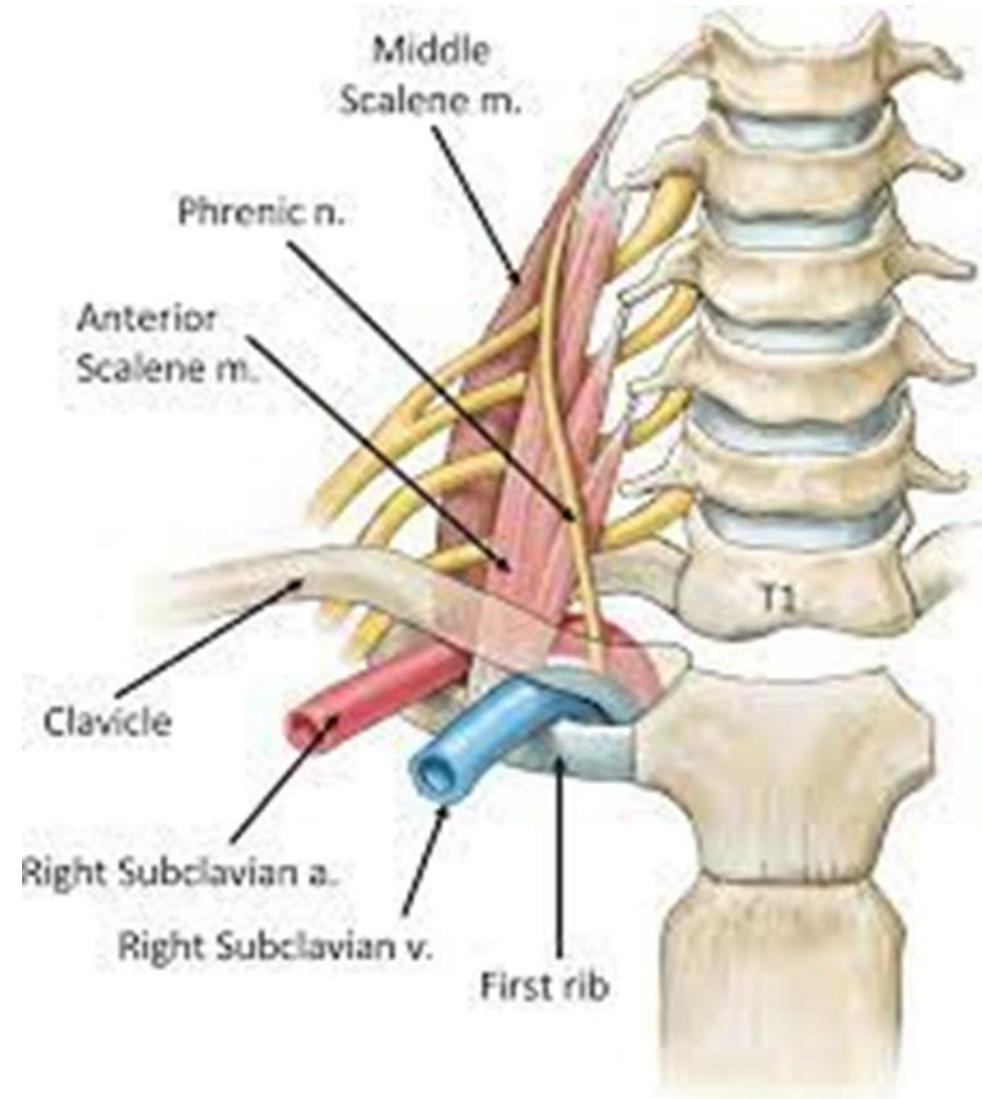


- ❖ The superior surface carries a prominent scalene tubercle on its inner border for the insertion of scalenus anterior muscle.



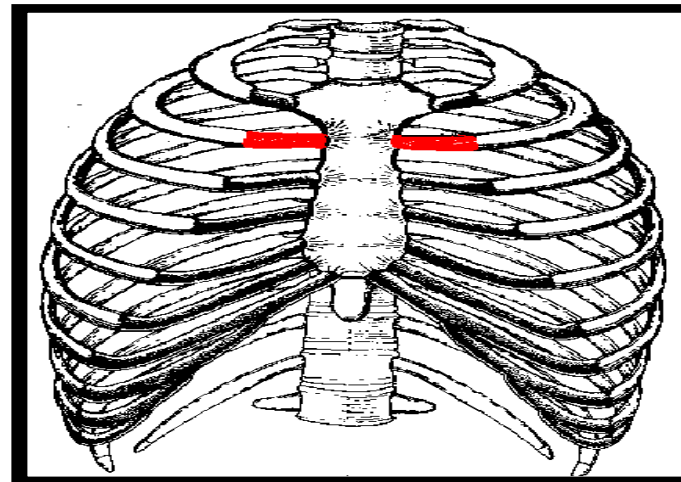
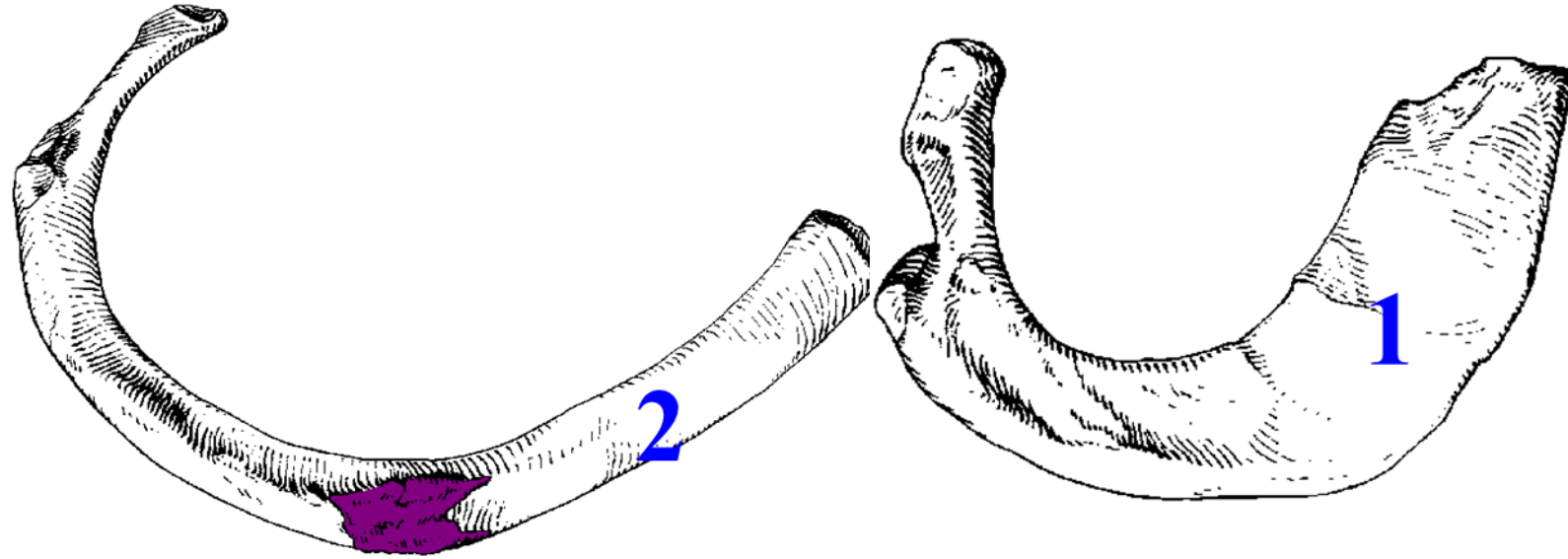
# First Rib

- ❖ The subclavian vein crosses anterior to scalene tubercle.
- ❖ The subclavian artery and the inferior trunk of the brachial plexus pass posterior to it.



# Second rib

- ❖ It's longer than the first rib.
- ❖ It's characterized by the presence of a tuberosity for the attachment of serratus anterior muscle.
- ❖ Sternal angle:
  - It's the second costal cartilage that joins the sternum.
  - It's the starting place where the physician counts the ribs to use them as landmarks.

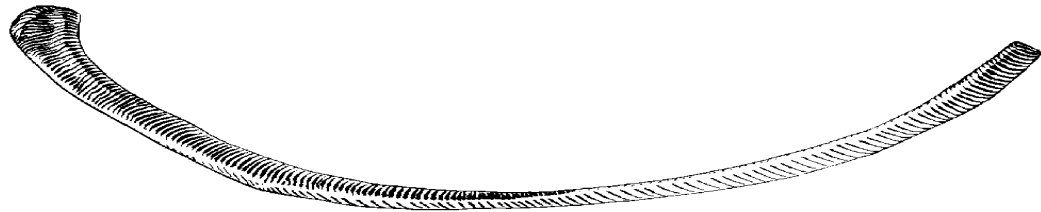


# 11<sup>th</sup> and 12<sup>th</sup> ribs

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- ❖ They're short and carry a single facet on the head.
- ❖ They have neither neck nor tubercle .

11



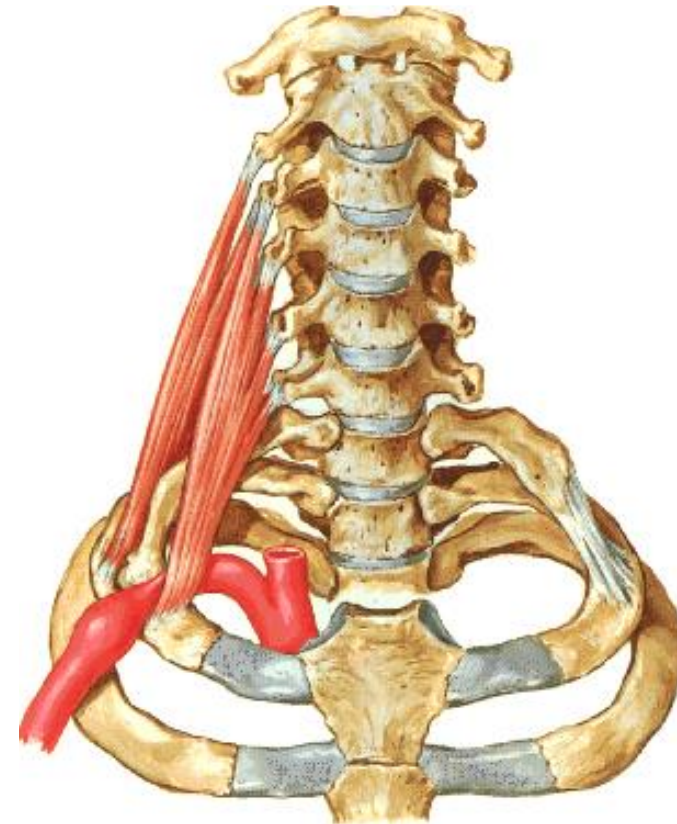
12





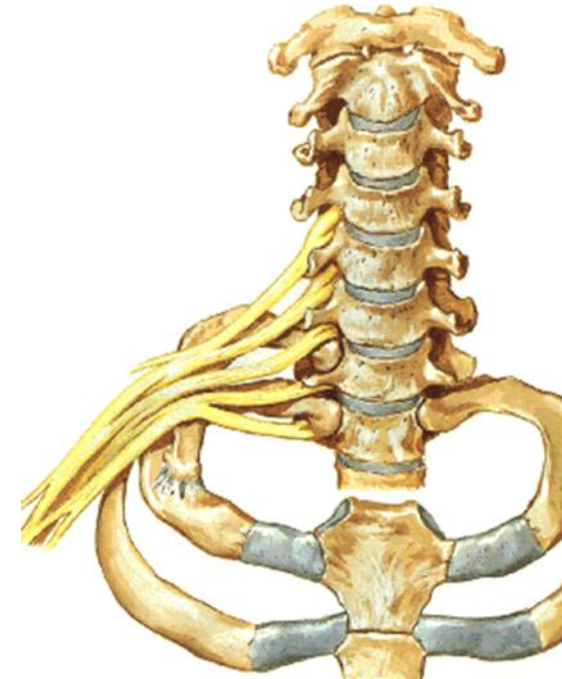
# Cervical rib

- ❖ It occurs in 0.5 per cent of subjects and its bilateral in half of the cases.
- ❖ It is attached to the transverse process of the seventh cervical vertebra (C7).
- ❖ Vascular symptoms :It may produce pressure on subclavian artery leading to ischemia of upper limb ( Note the post stenotic dilatation ).



# Cervical rib

- ❖ It may produce stretch on the lower trunk of brachial plexus leading to Klumpke's paralysis (Neurological symptoms):
  - Tingling and numbness along the ulnar border of the forearm and hand.
  - Wasting of the small muscles of the hand, inability to carry out fine movement.



# Intercostal muscles

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❖ The thoracic wall is made up of five muscles:

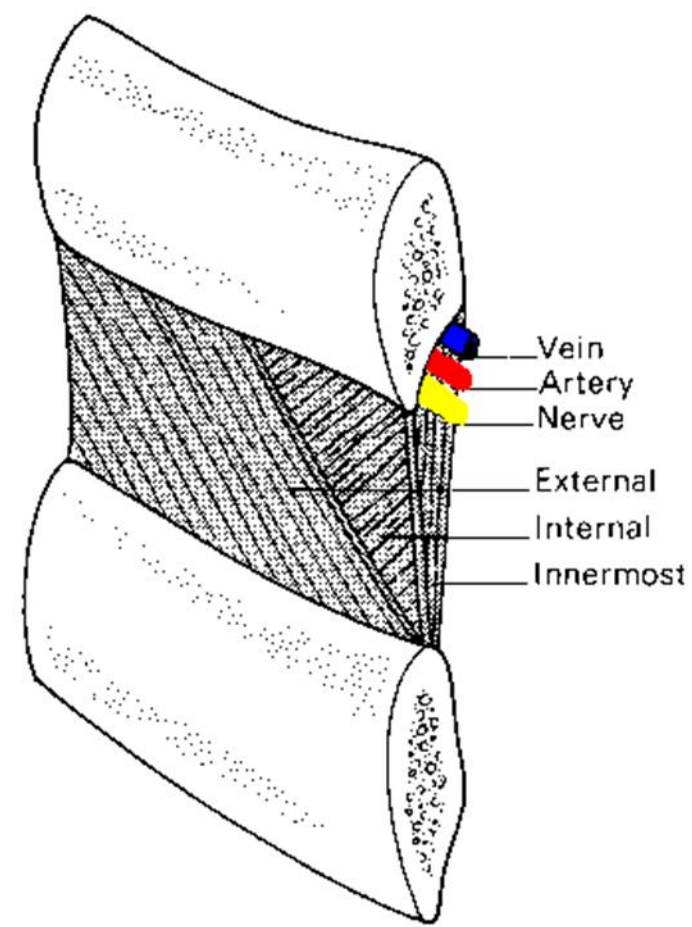
1. External intercostal muscles.
2. Internal intercostal muscles.
3. Innermost intercostal muscles.
4. Subcostalis.
5. Transversus thoracis.

❖ These muscles are primarily responsible for changing the volume of the thoracic cavity during forced respiration.



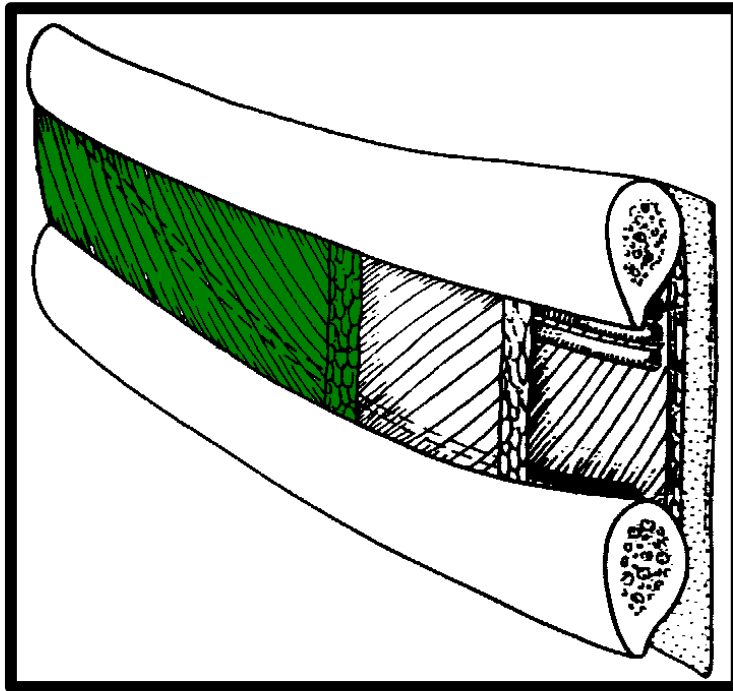
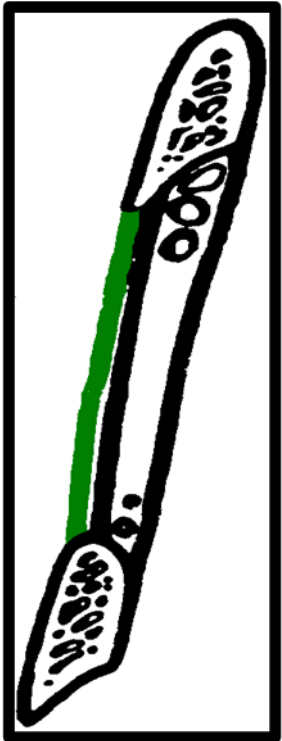
# Intercostal vascular bundle

- ❖ The intercostal nerves and blood vessels run between the intermediate and deepest layers of muscles .
- ❖ They are arranged in the following order from above downward: (VAN)
  - Intercostal vein.
  - Intercostal artery.
  - Intercostal nerve.



# External intercostal muscle

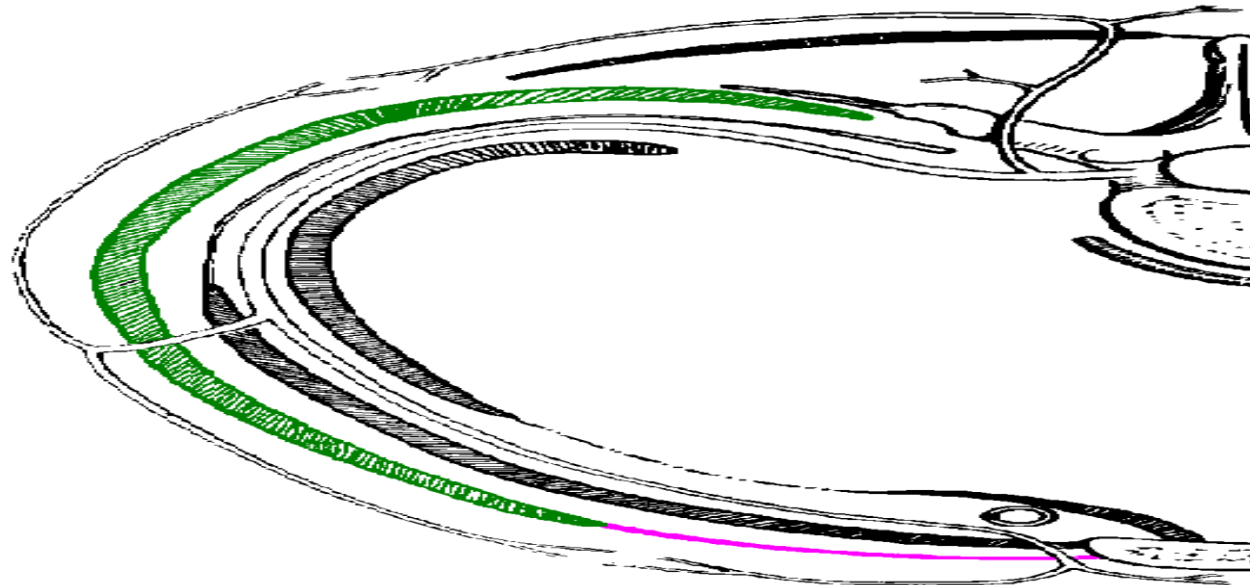
- ❖ Forms the most superficial layer.
- ❖ Its fibers are directed downwards and forward (same direction of external oblique muscle of the abdomen).
- ❖ From the inferior border of the rib above to the superior border of the rib below.



# External intercostal muscle

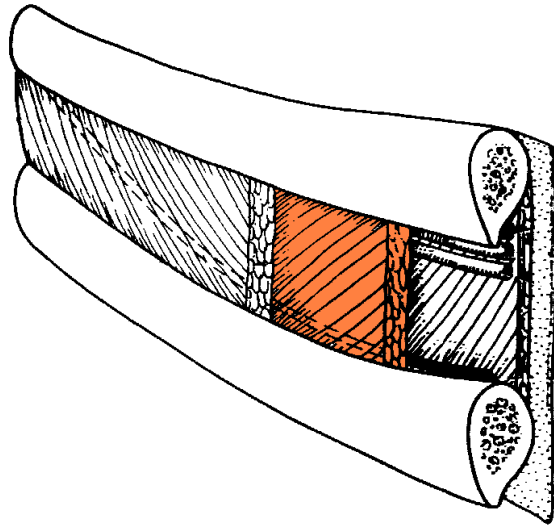
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- ❖ The external intercostal muscle extends from the rib tubercle behind to the costochondral junction in front.
- ❖ Anteriorly the external intercostal muscle is replaced by an aponeurosis (thin flat tendon), the anterior (external) intercostal membrane.

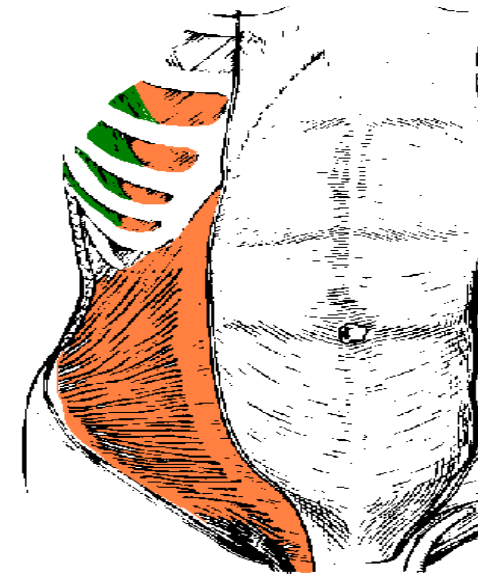


# Internal intercostal muscle

- ❖ Forms the intermediate layer.
- ❖ Its fibers are directed downwards and backwards (same direction of the internal oblique muscle).
- ❖ Extends from the costal groove of the rib above to the upper border of the rib below.



**Internal intercostal**

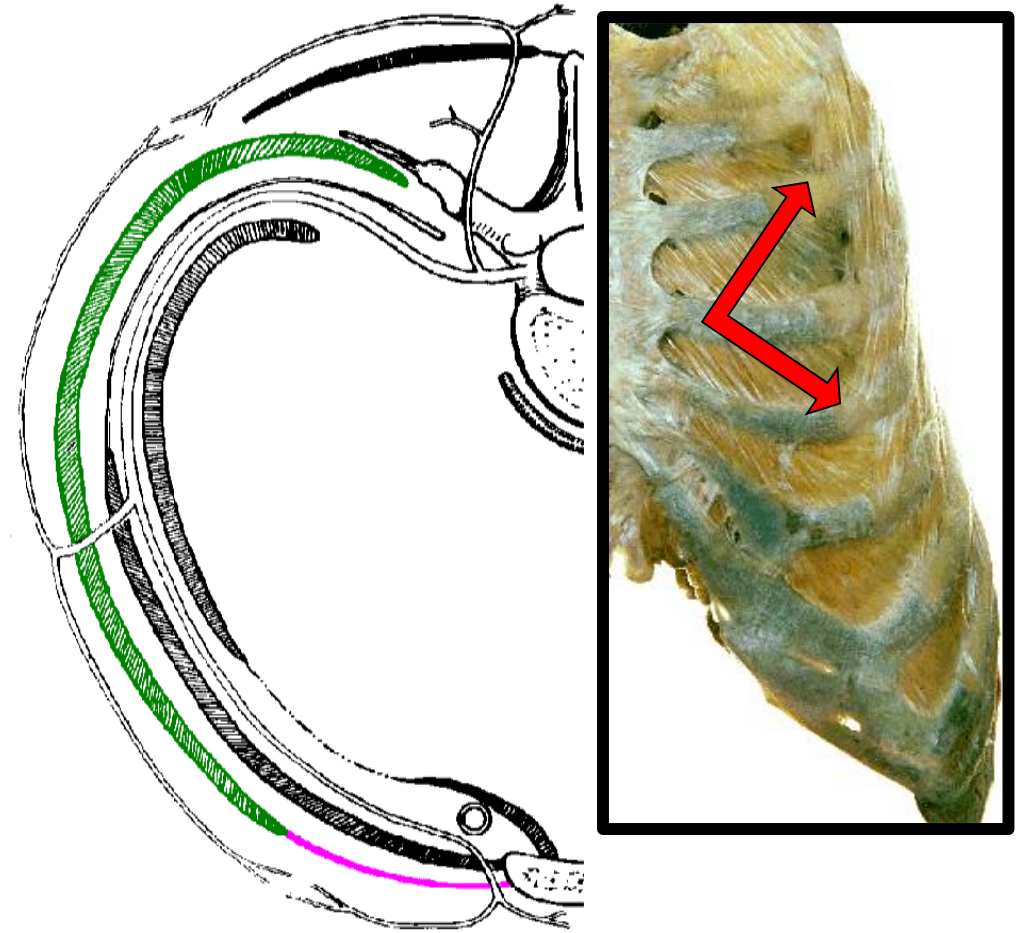


**Internal oblique**



# Internal intercostal muscle

- ❖ The internal intercostal extends from the side of the sternum in front to the angles of the ribs behind.
- ❖ The internal intercostal muscle is replaced by an aponeurosis, the posterior (internal) intercostal membrane.
- ❖ The fibers of the internal intercostal are therefore at right angles to those of the external intercostal.





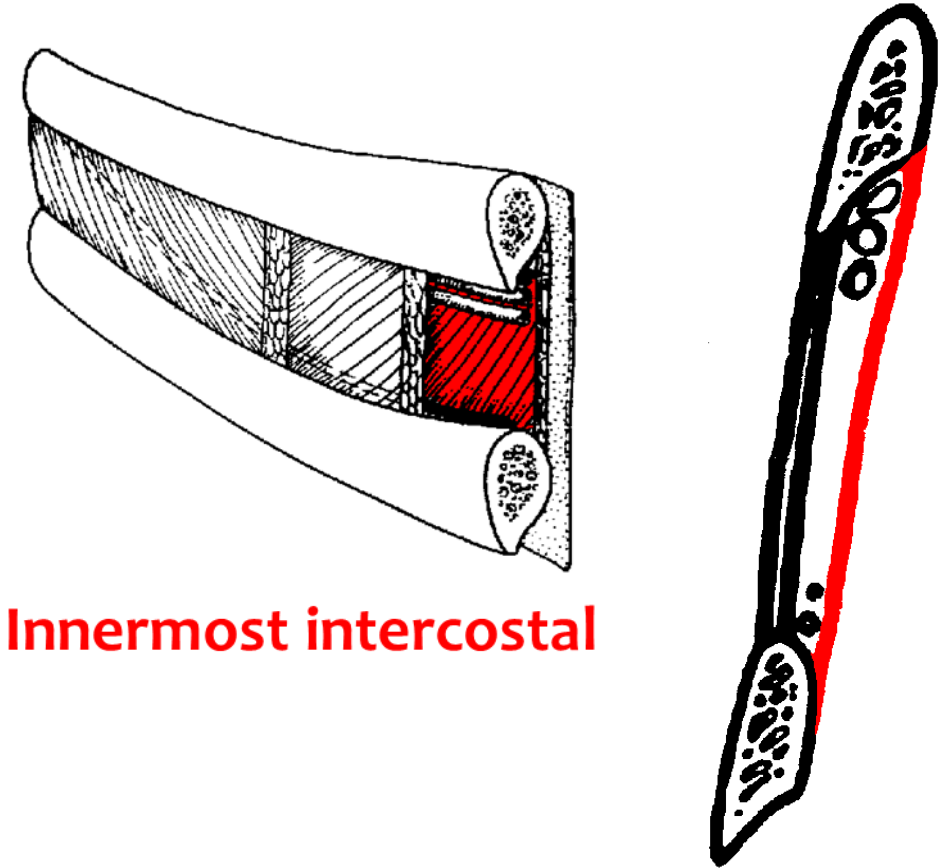
# External/Internal intercostal Muscle

| Muscle               | Fibers                | Start               | End                       | Replaced by?   |
|----------------------|-----------------------|---------------------|---------------------------|--|
| External intercostal | Downward ,<br>forward | Tubercle of the rib | Costochondral<br>junction | Anteriorly by<br>anterior intercostal<br>membrane      |
| Internal intercostal | Downward,<br>backward | Sternum             | Angle of the rib          | Posteriorly by<br>posterior<br>intercostal<br>membrane |

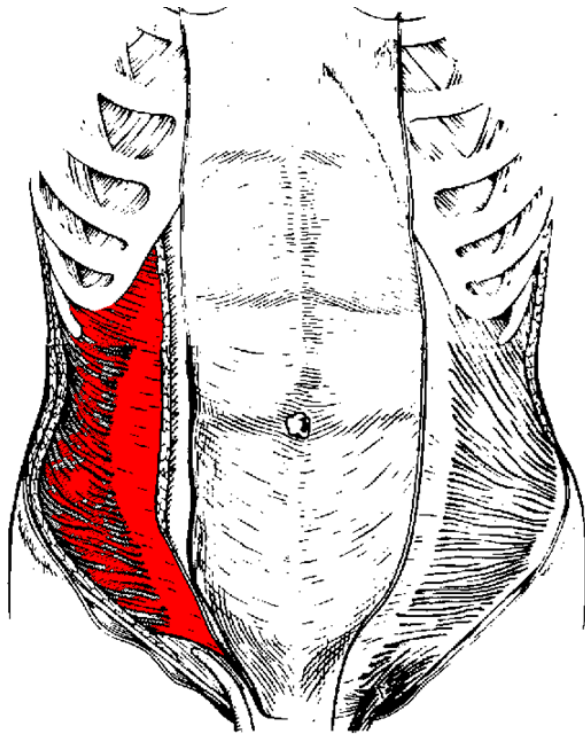


# Innermost intercostal muscle

- ❖ Extends between internal surfaces of adjacent rib above to the internal surface rib below.
- ❖ It corresponds to the transversus abdominis muscle of the anterior abdominal wall.



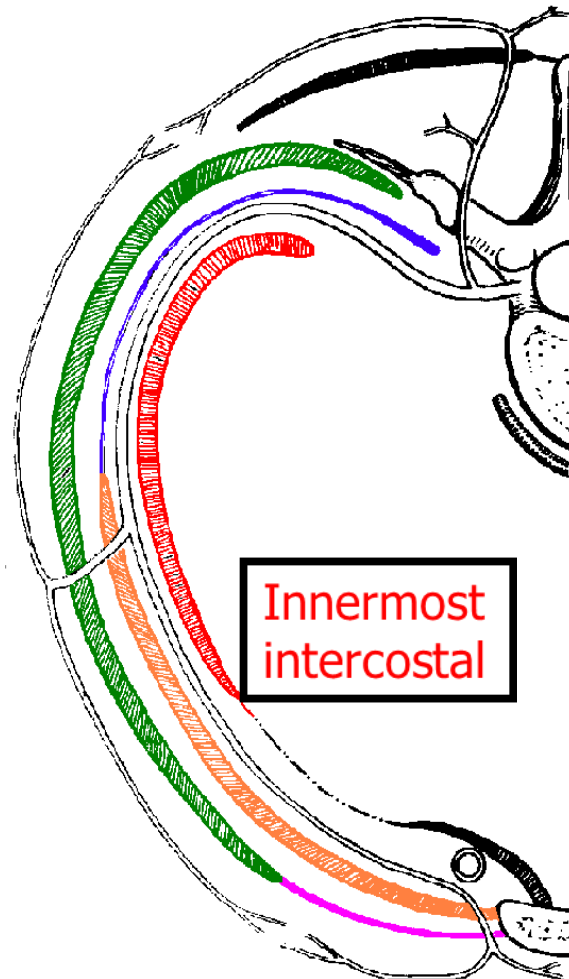
**Innermost intercostal**



**transversus abdominis**

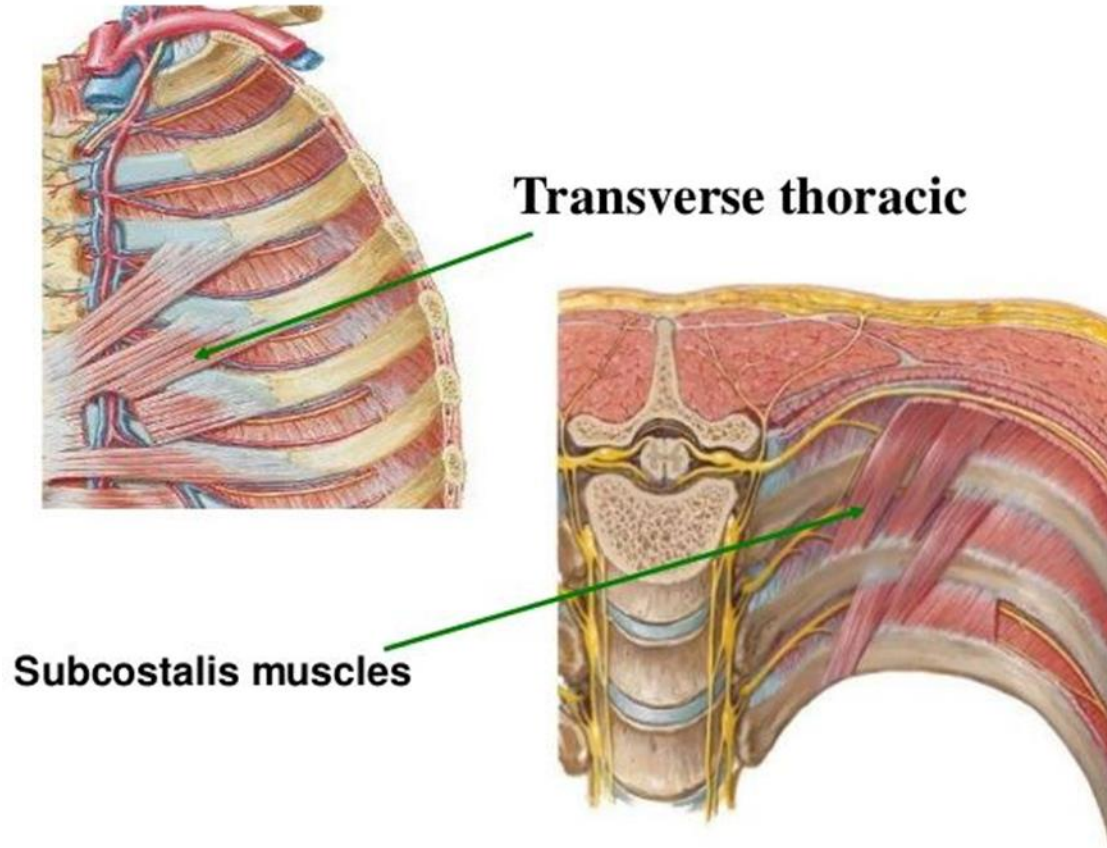
# Innermost intercostal muscle

- ❖ The innermost intercostal fibers cover the middle 2/4th of the intercostal spaces .



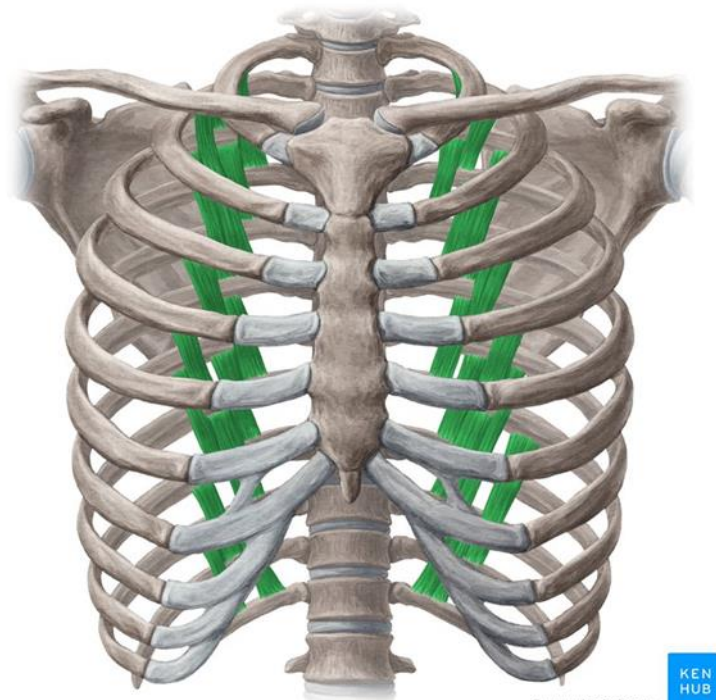
# Subcostalis and Transversus Thoracis

- ❖ Lie in a deeper plane than the innermost intercostal .
- ❖ Their fibers cross more than one intercostal space.



# Subcostalis muscle

- ❖ The Subcostalis slips are located near the angles of the ribs mainly in the lower intercostal spaces.
- ❖ Their fibers run parallel with those of the innermost intercostal.



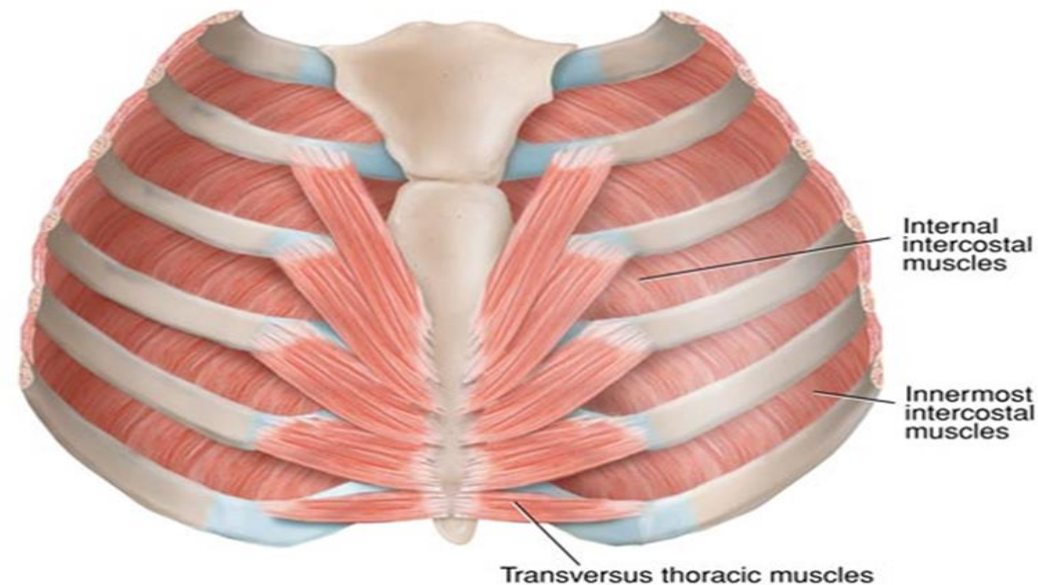
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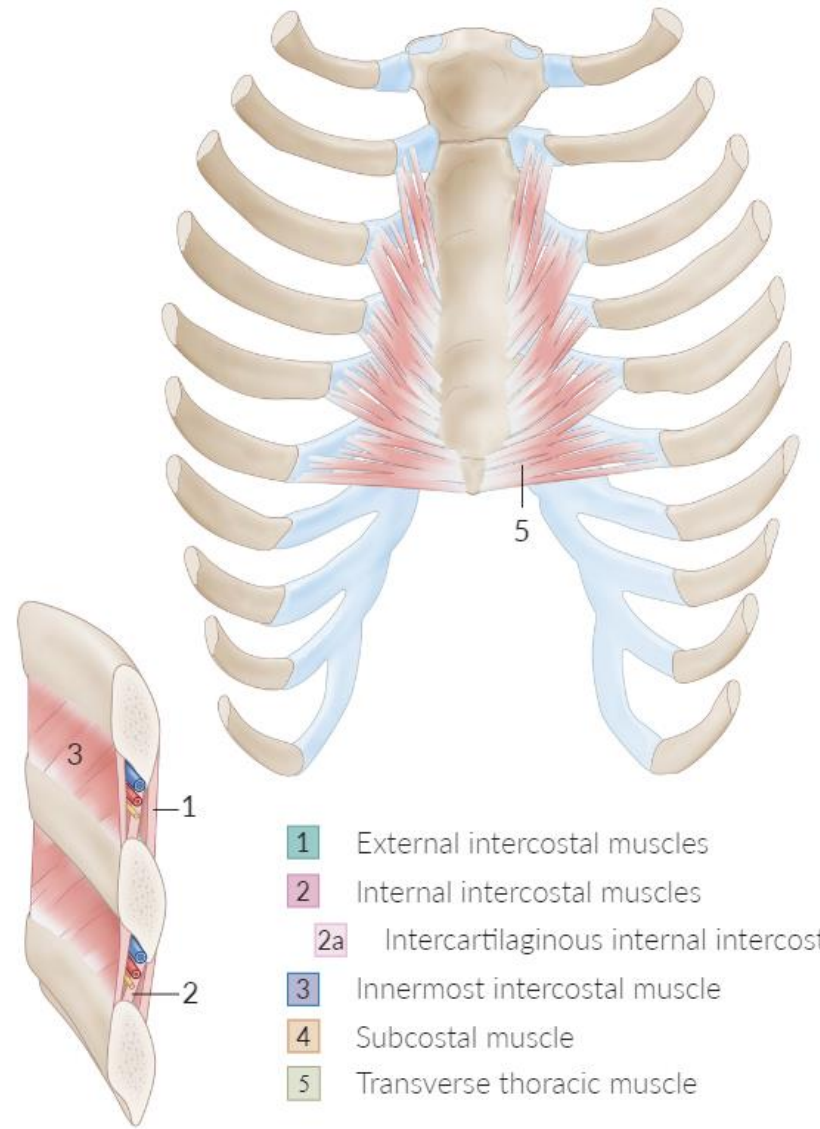
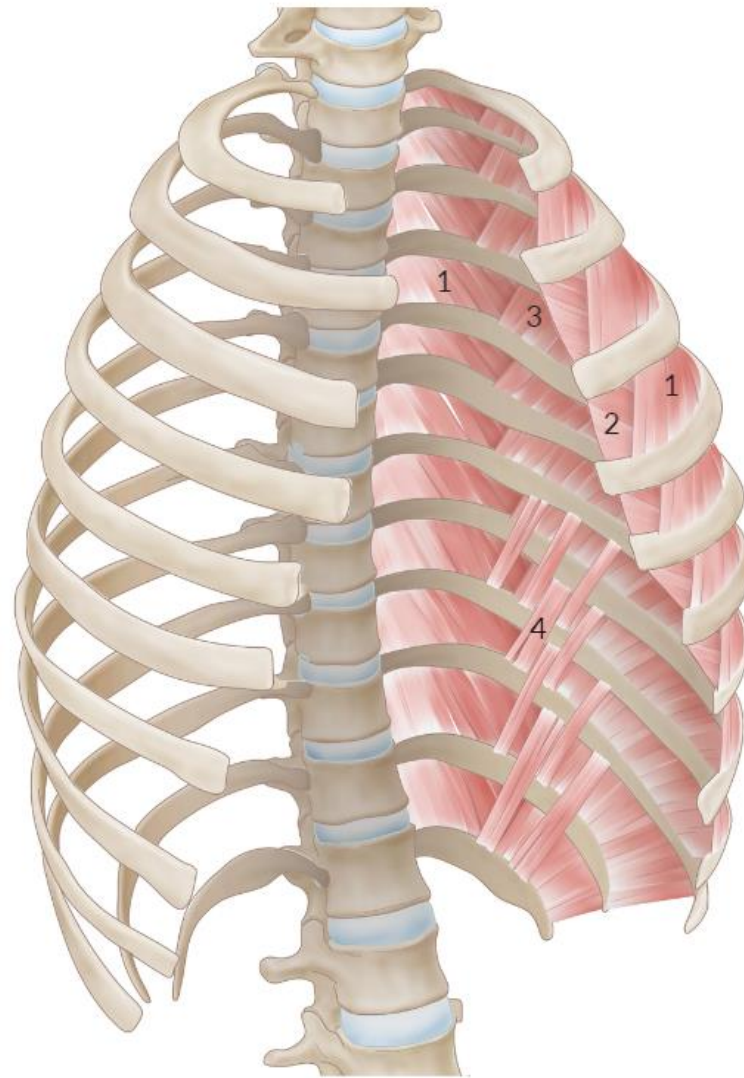
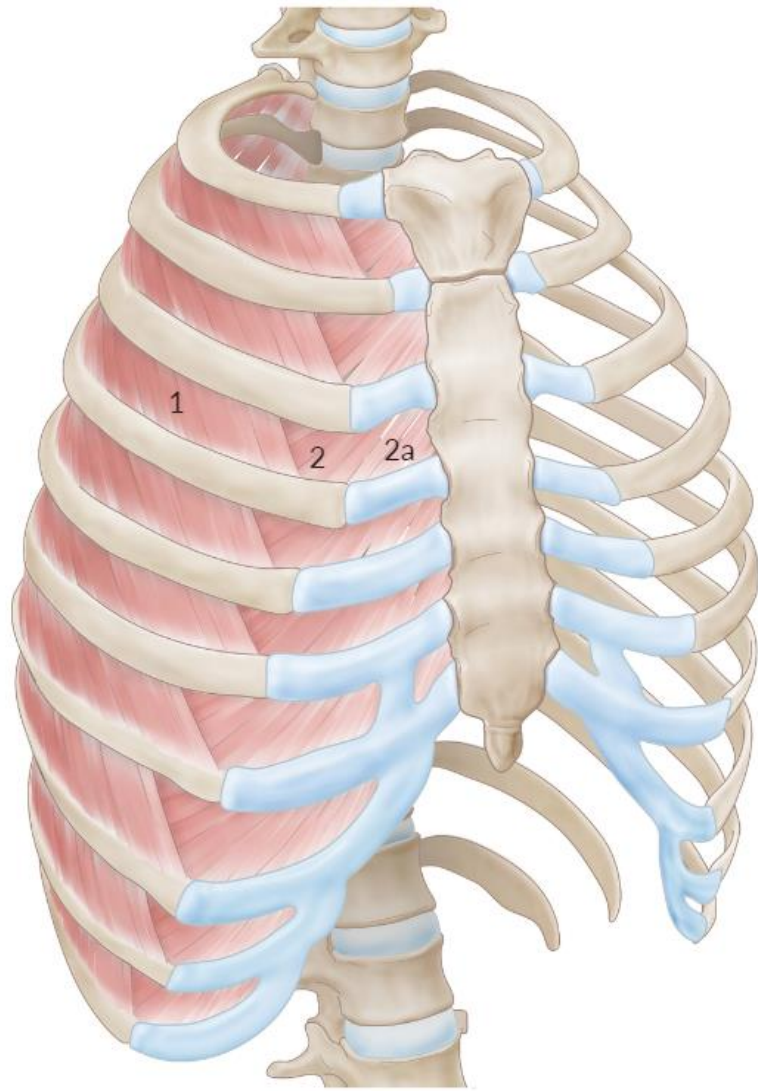
# Transversus thoracis muscle

- ❖ Its also called sternocostalis since its fibers extend from the lower 1/3rd of the posterior surface of the sternum and the costal cartilages of the lower true ribs to the internal surfaces of the upper costal cartilages.
- ❖ Its fibers have different obliquity.
- ❖ The lower fibers are horizontal and become continuous with the transversus abdominis muscle, hence the name transversus thoracis.



View from within thoracic cavity

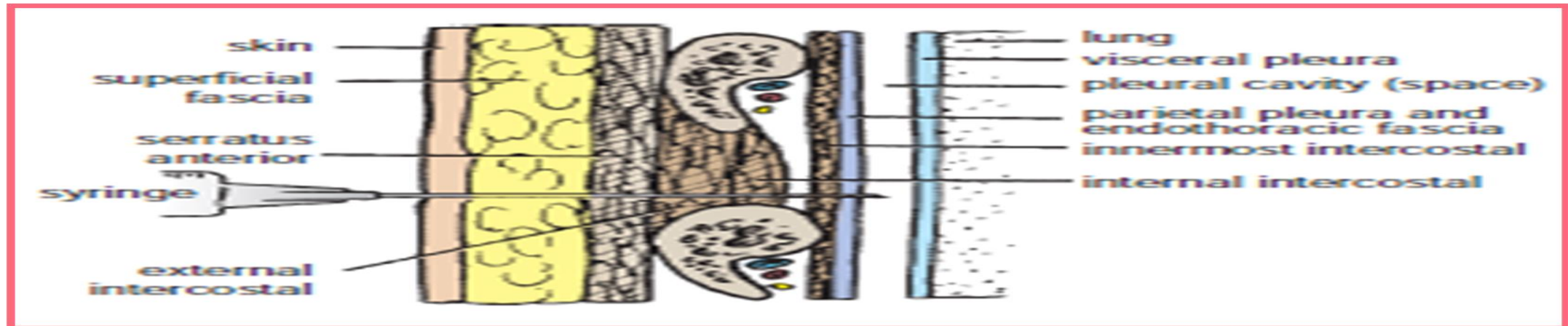
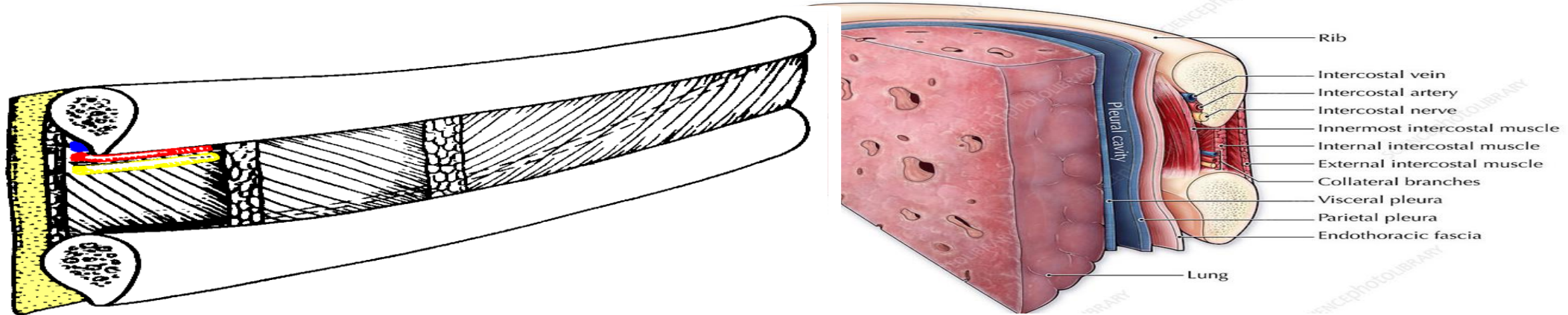




- 1 External intercostal muscles
- 2 Internal intercostal muscles
- 2a Intercartilaginous internal intercostal
- 3 Innermost intercostal muscle
- 4 Subcostal muscle
- 5 Transverse thoracic muscle

# Endothoracic Fascia

❖ The innermost intercostal, Subcostalis, and transversus thoracis separate the intercostal neurovascular bundle from the layer of fascia external to the pleura called the endothoracic fascia.



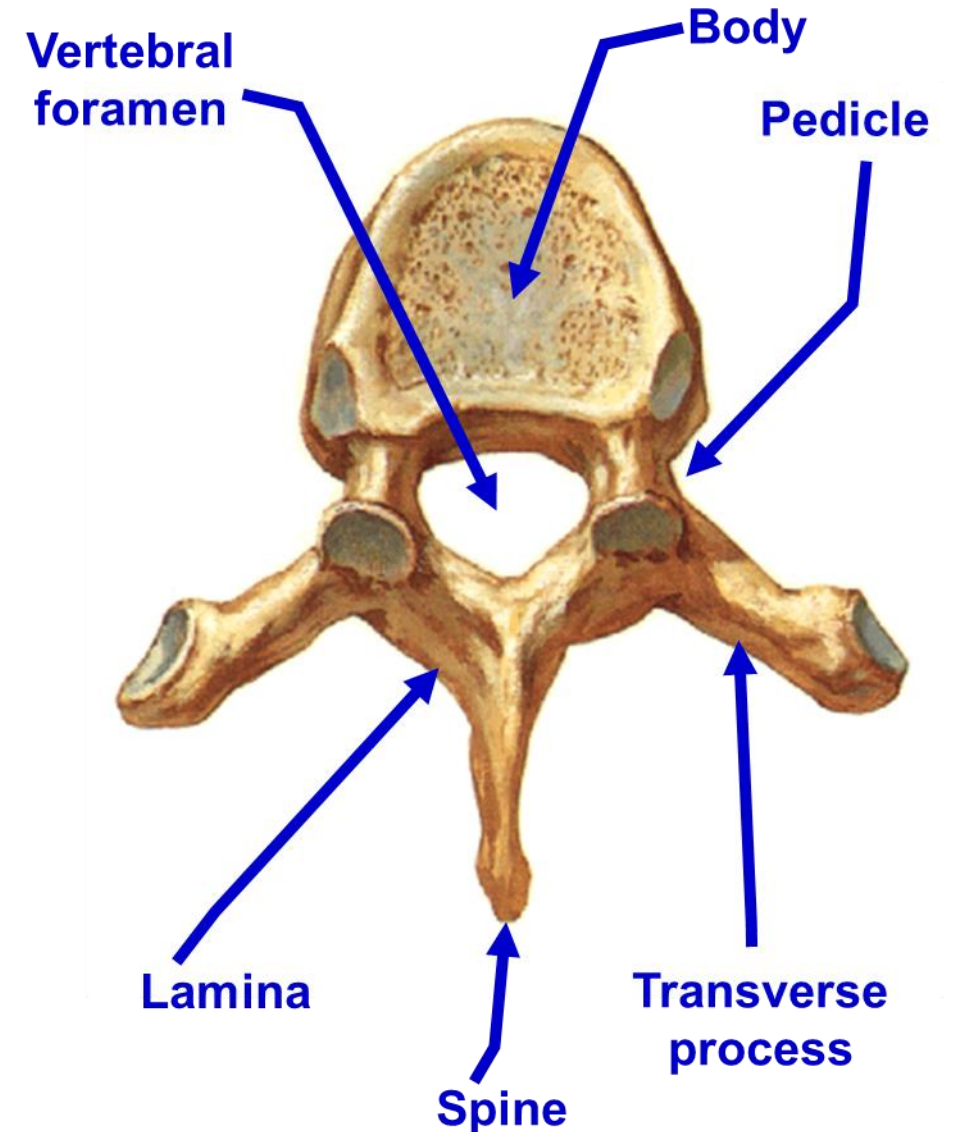


# Superior view of typical thoracic vertebrae

## From 2nd - 9th

### ❖ Characters of typical thoracic vertebrae:

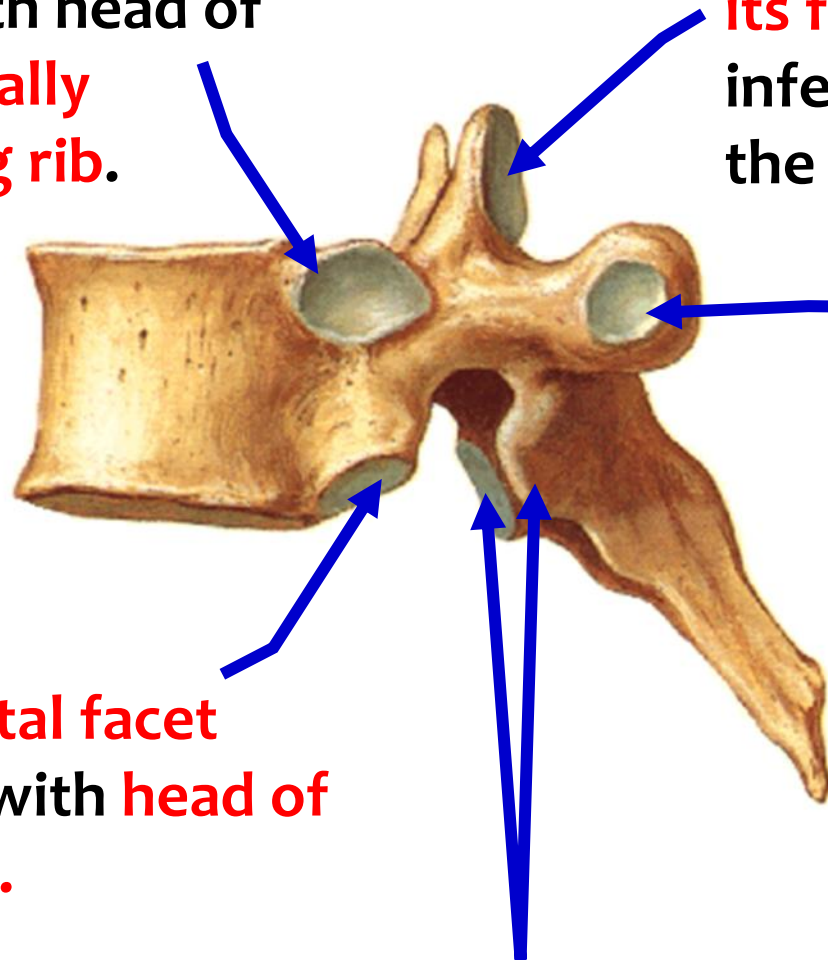
- Two demifacets (large superior & small inferior) on each side of body.
- An articular facet on transverse process.
- Body is heart shaped.
- Spine is long and directed backwards and downwards.



# Lateral view

**Superior costal facet articulates with head of same numerically corresponding rib.**

**Superior articular process and its facet articulates with inferior articular processes of the vertebra above.**



**costal facet of transverse process articulates with tubercle of the same numerically corresponding rib.**

**Inferior costal facet articulates with head of the next rib.**

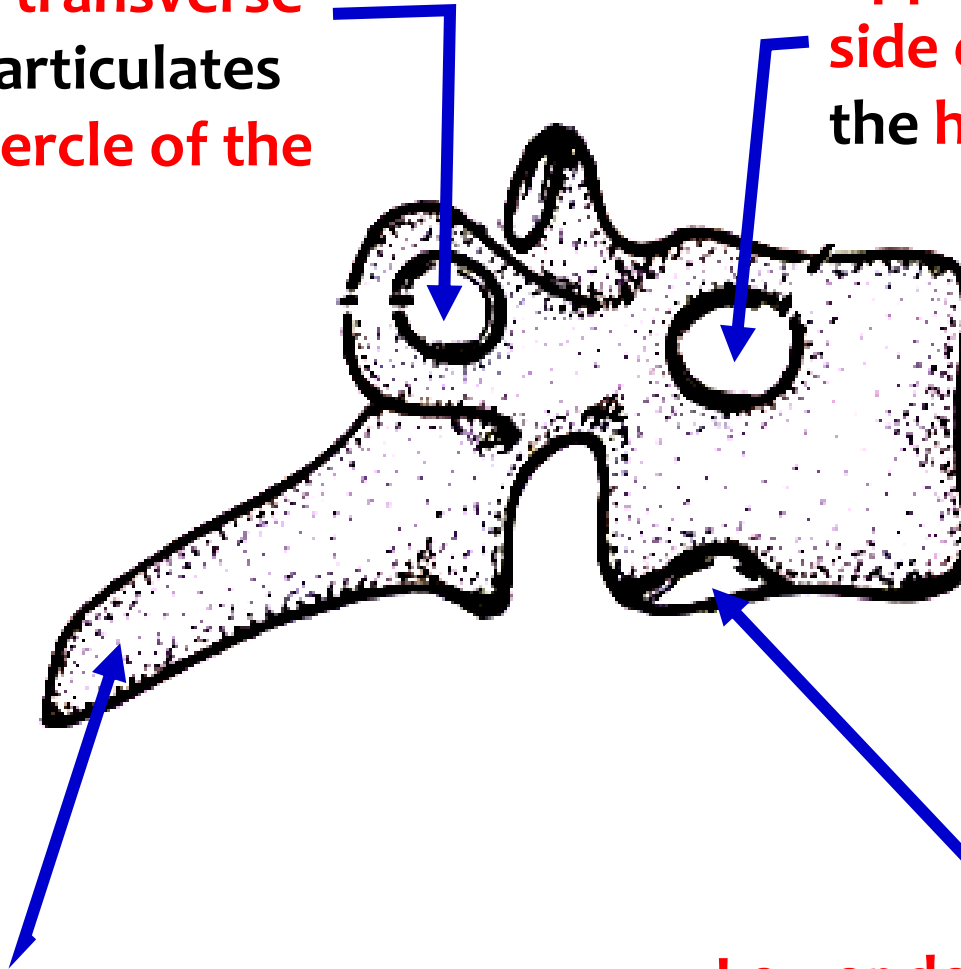
**Inferior articular process and facet**



## • The 1st Th. vertebrae

Facet on transverse process articulates with tubercle of the 1st rib.

Upper complete facet on the side of body articulates with the head of the 1st rib.



Spine is thick, long and nearly horizontal.

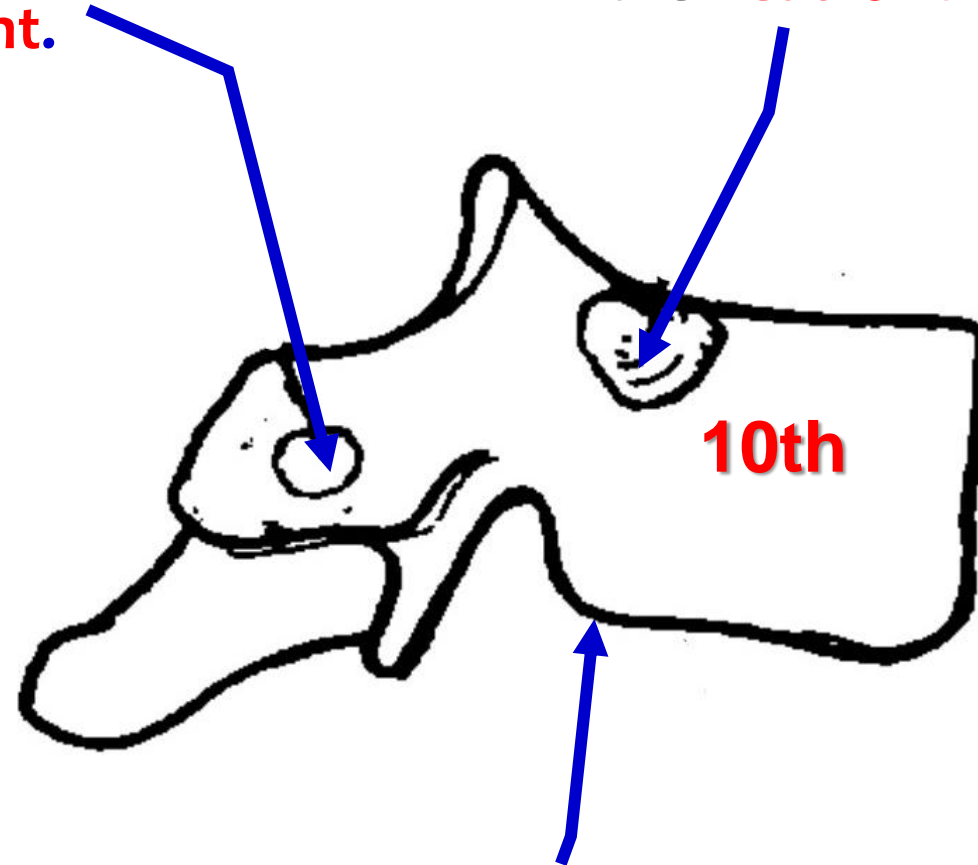
Lower demifacet on the side of body articulates with the head of the 2nd rib.



- The 10th Th. vertebrae

Facet on transverse process articulates with tubercle of the 10th rib, may be absent.

Upper complete facet on the side of body articulates with the head of the 10th rib.



NO inferior demifacet

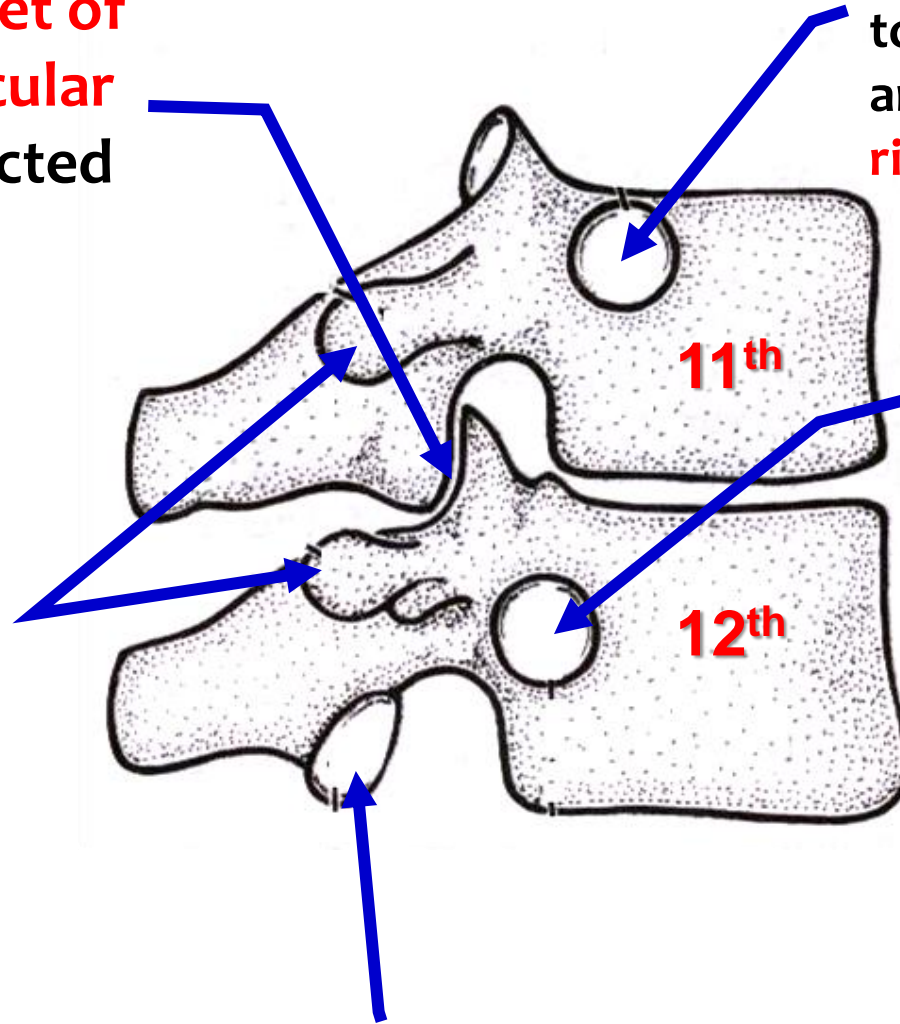


## • The 11th & 12th Th. vertebrae

Articular facet of Inferior articular process directed forward.

Transverse process has no articular facet.

Articular facet of Inferior articular process directed laterally.



Complete circular facet close to upper border of the body, articulates with head of 11th rib.

Complete circular facet away from upper border of body and extending on the pedicle, articulates with head of 12th rib.