

# ***Respiratory System***

## ***Thoracic Cage Intercostal muscles***

***Dr. Aiman Qais Afar  
Surgical Anatomist***

***College of Medicine / University of Mutah***

***2022-2023***

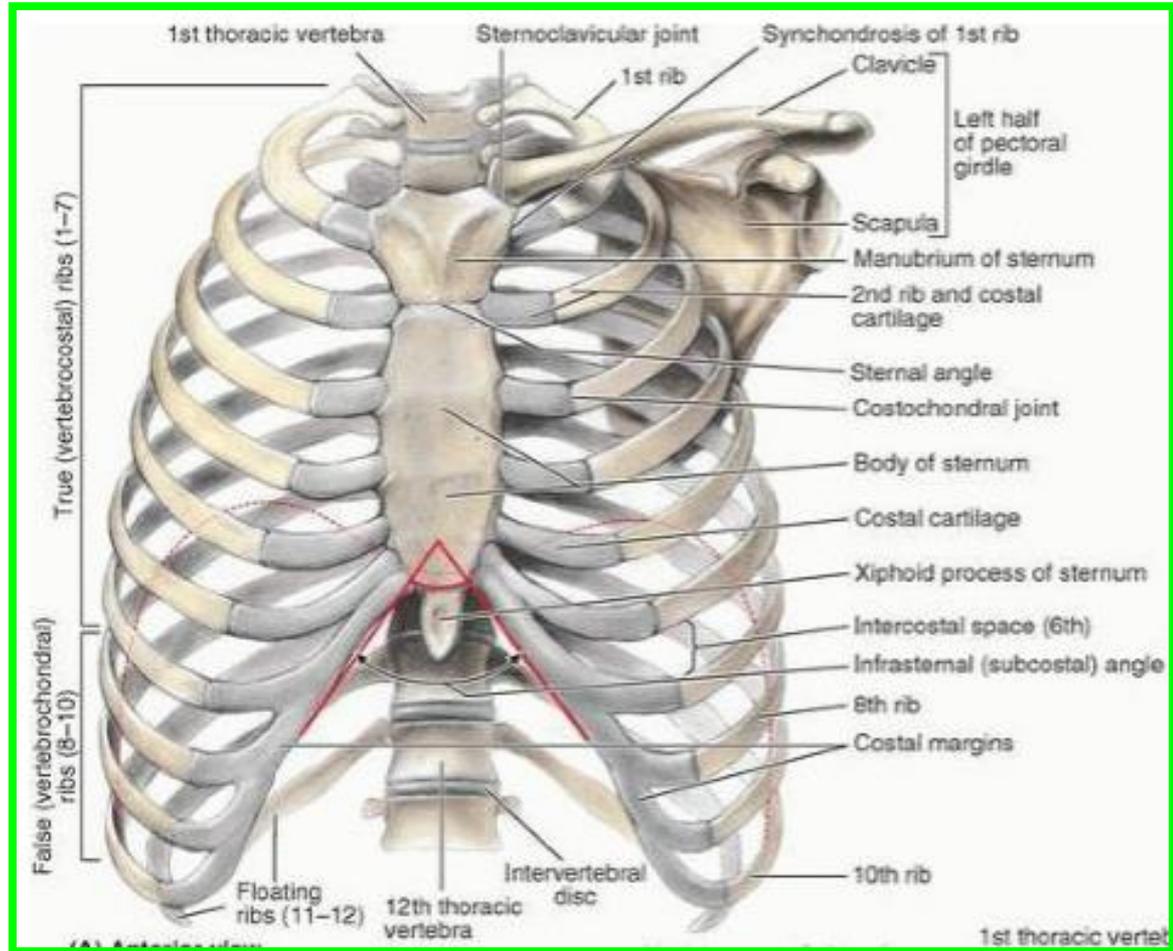
***Sunday 9 October 2022***

# 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

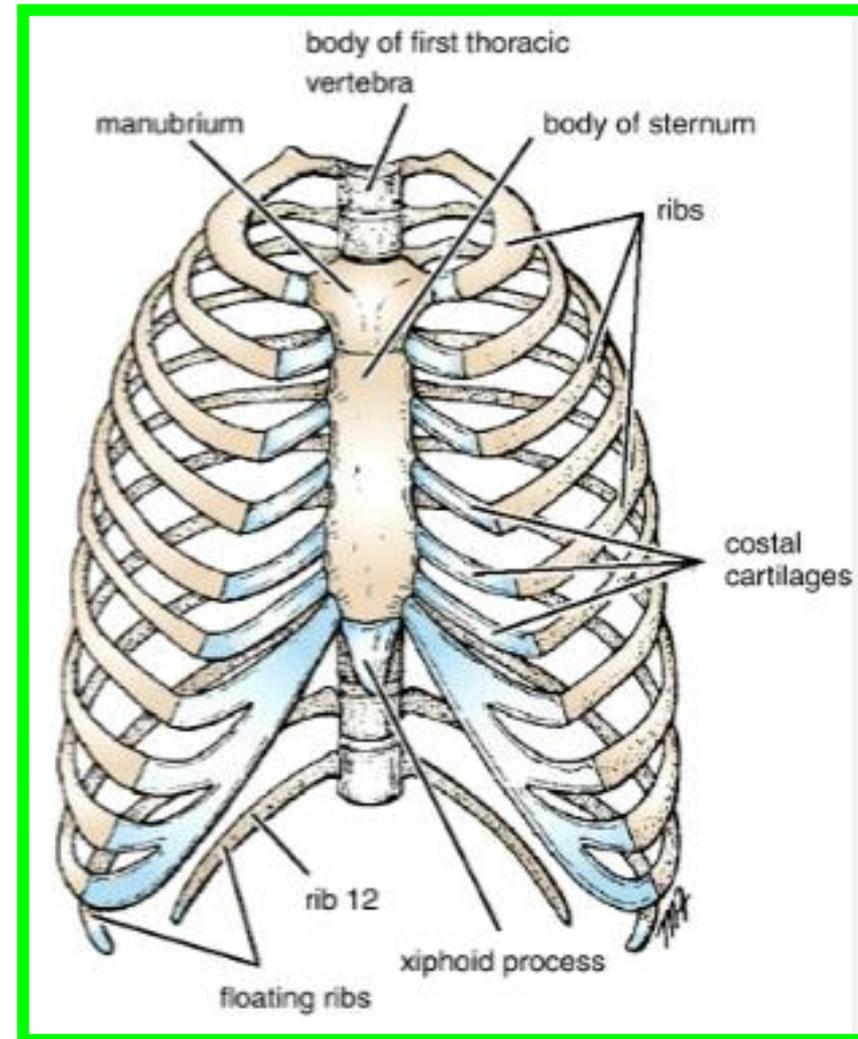
The thoracic wall is formed **posteriorly** by the **thoracic part of the vertebral column**;

**anteriorly** by the **sternum and costal cartilages**.

**laterally** by the **ribs and intercostal spaces**;

**superiorly** by the **suprapleural membrane**; and

**inferiorly** by the **diaphragm**, which separates the thoracic cavity from the abdominal cavity.

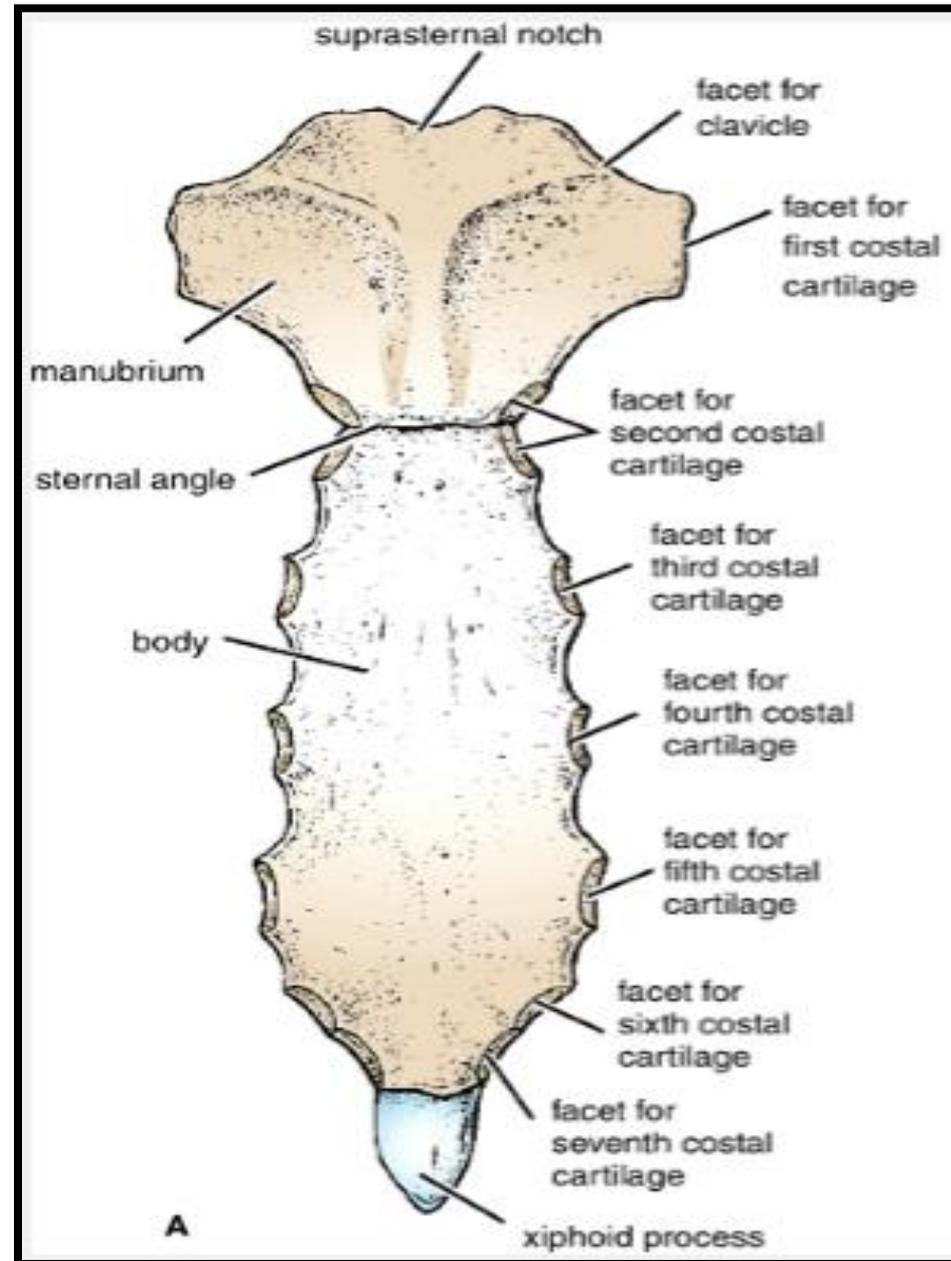


# Thoracic Cage

## 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, and xiphoid process.

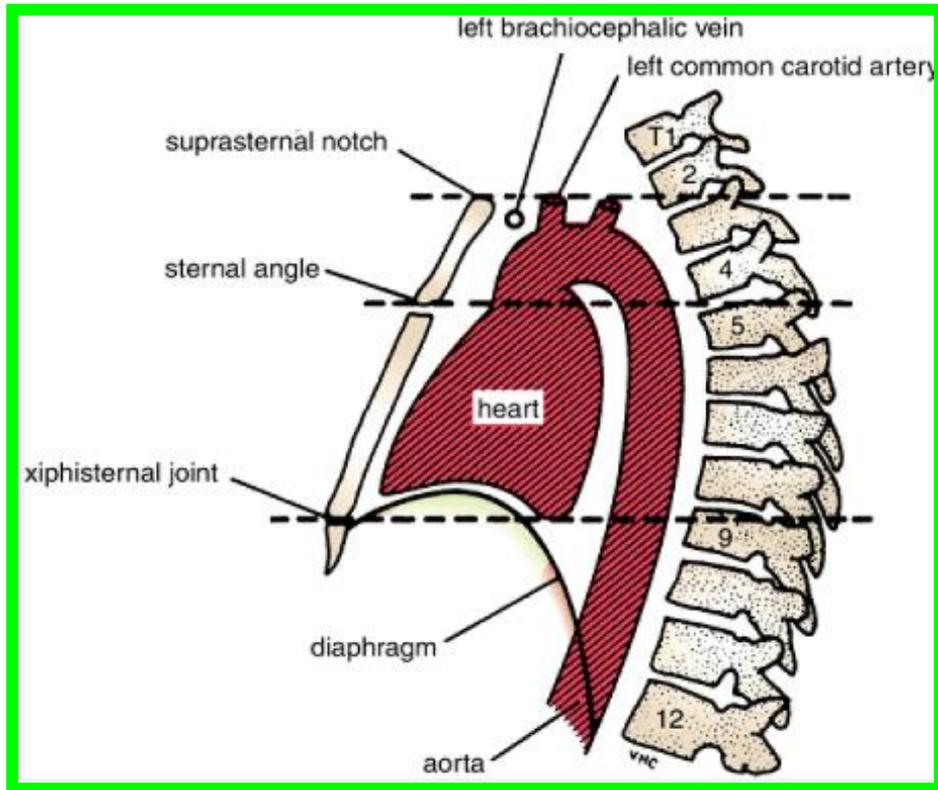


# Sternum

The manubrium is the upper part of the sternum.

✓ It articulates with the body of the sternum at the **manubriosternal joint**,

✓ and 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**

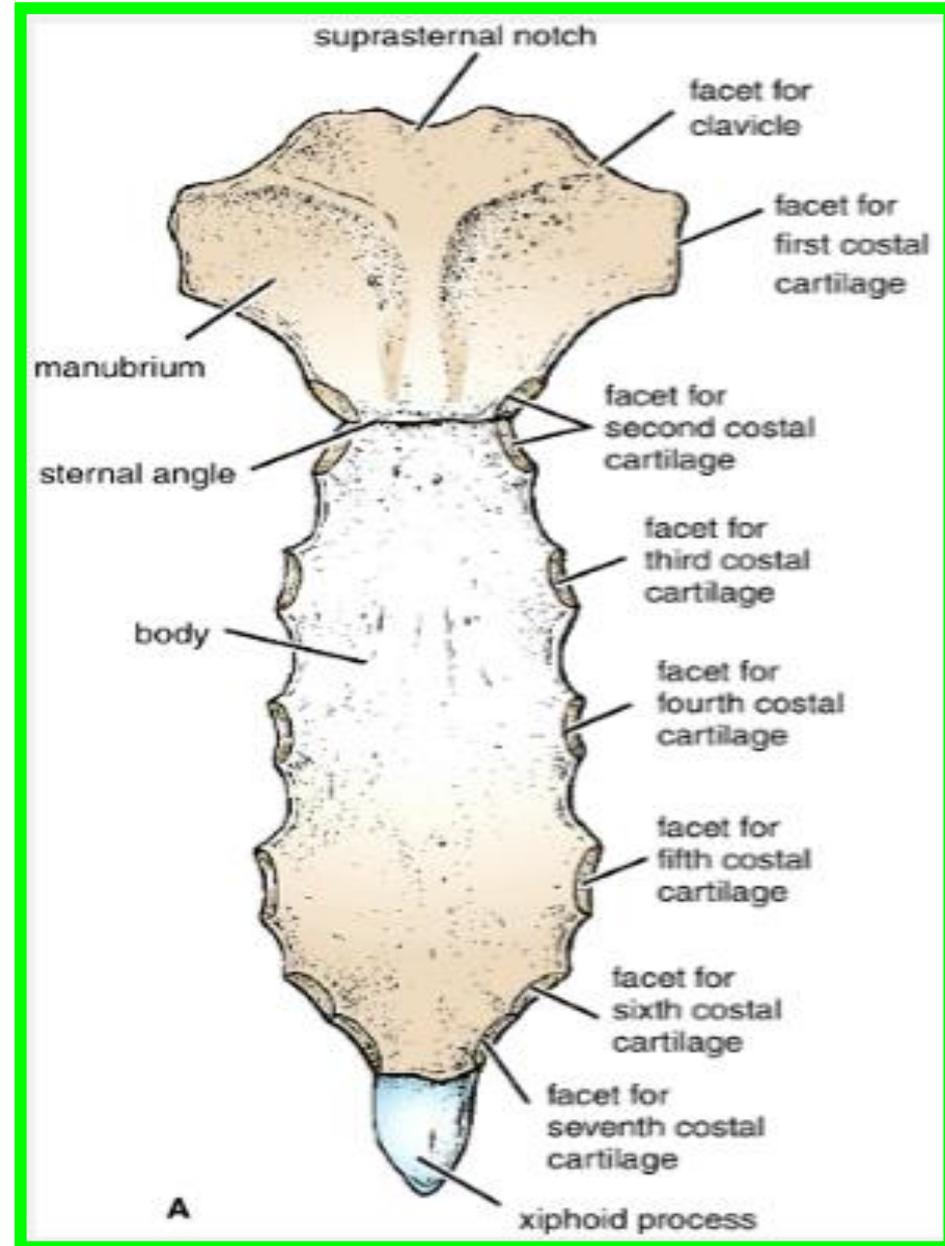
# Sternum

## The body of the sternum

Articulates above with the manubrium at the manubriosternal joint

And below with the xiphoid process at the xiphisternal joint.

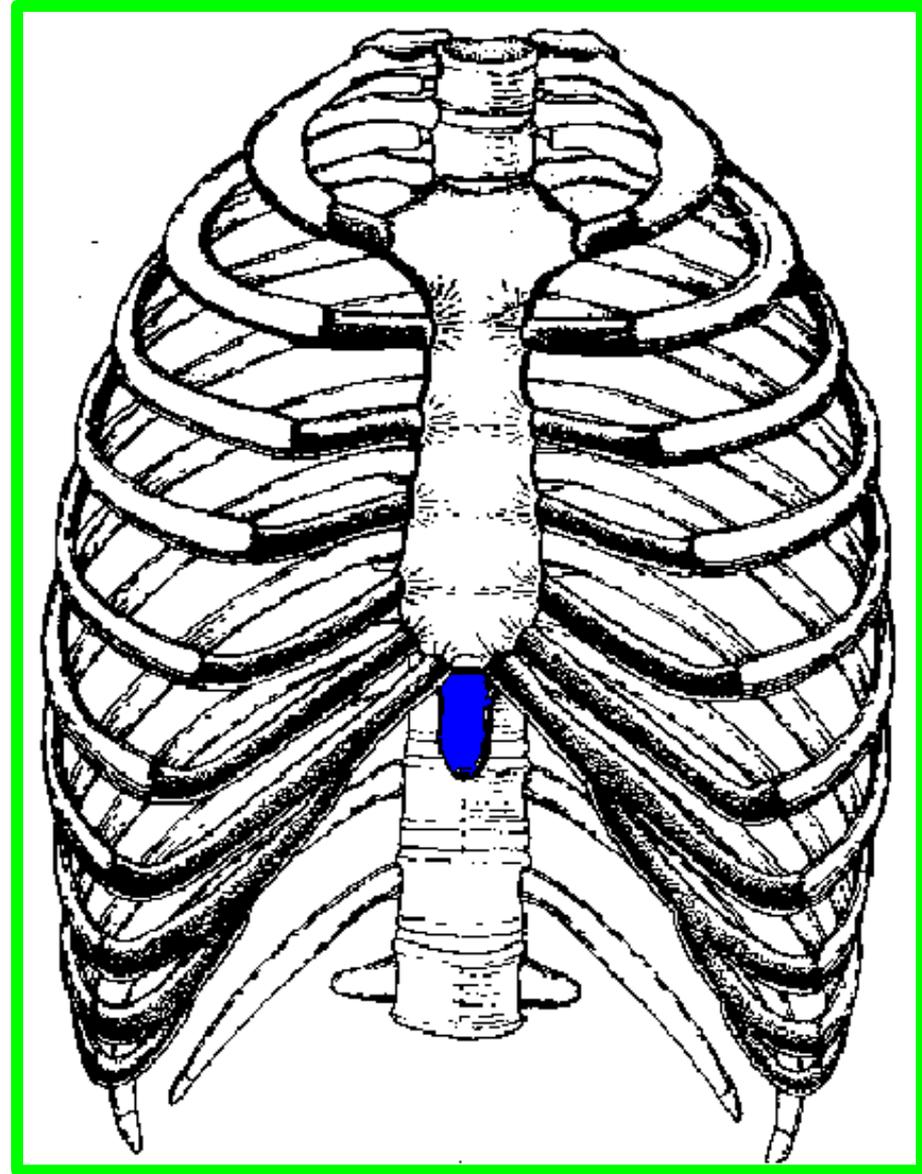
On each side it articulates with the second to the seventh costal cartilages



# Sternum

**The xiphoid process**  
Is a **thin plate of cartilage**  
that **becomes ossified** at  
its proximal end during  
adult life.

**No ribs or costal cartilages**  
**are attached to it.**

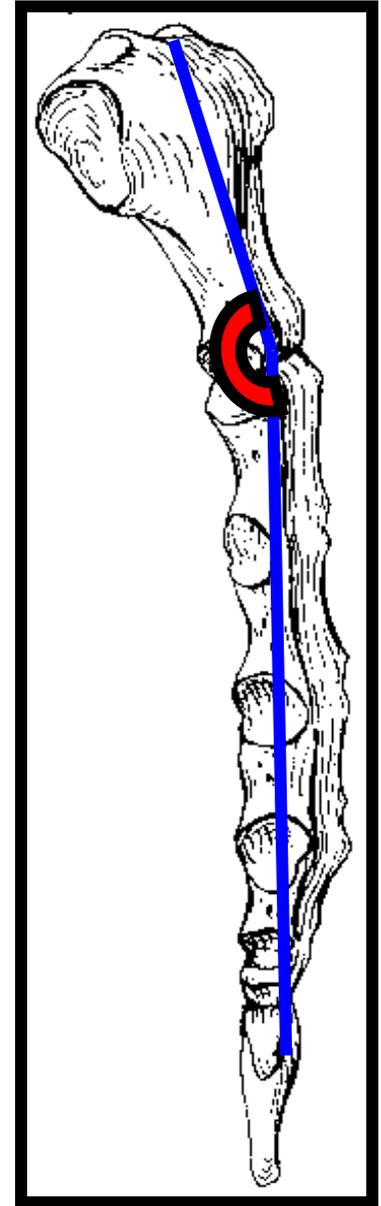


# Sternum

**The sternal angle (angle of Louis).** 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.**

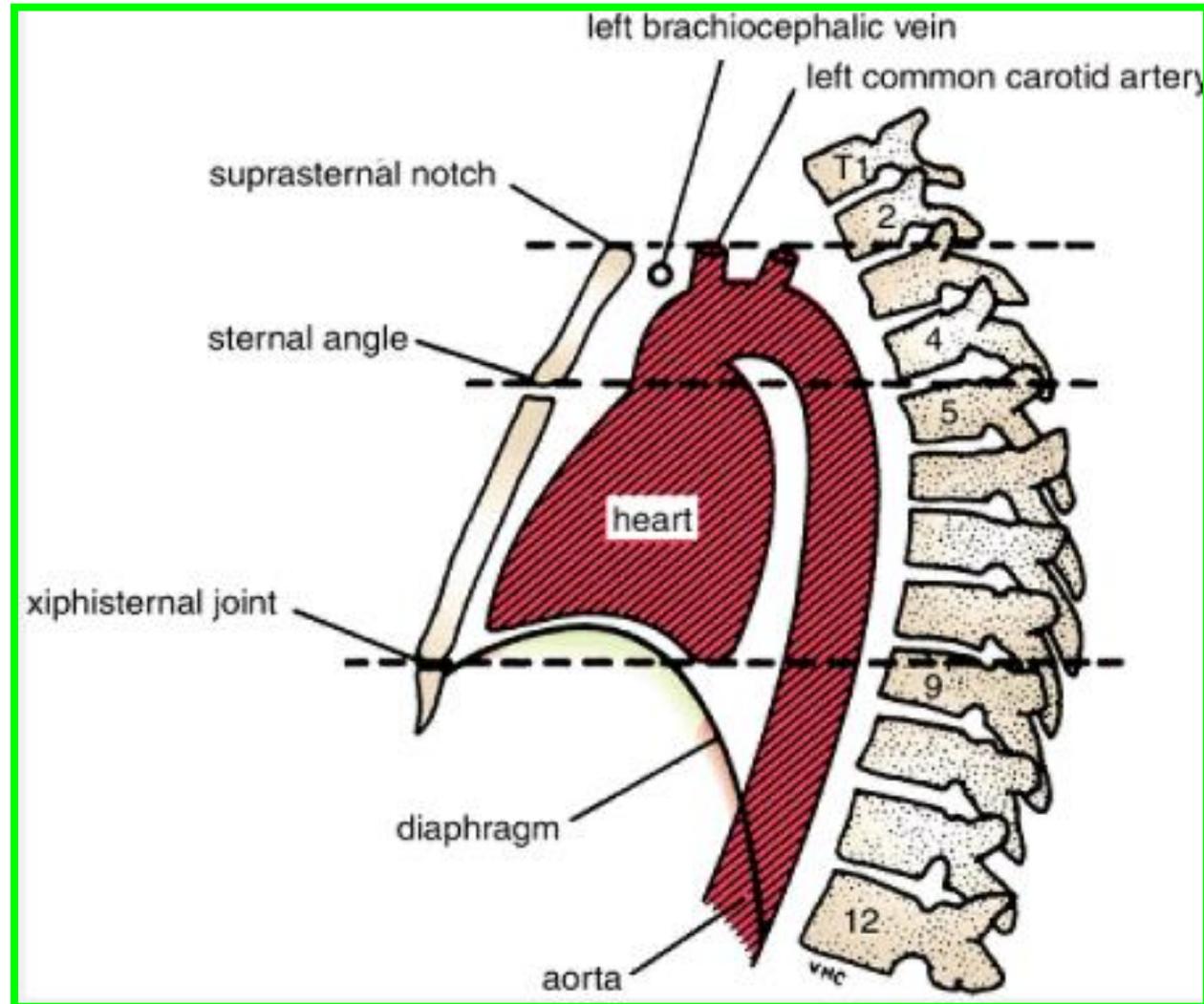
❖ **The point from which all costal cartilages and ribs are counted.**



# Sternum

Sun. 9 October 2022

**The sternal angle** lies opposite the intervertebral disc between the **fourth and fifth thoracic vertebrae**.



**The xiphisternal joint** lies opposite the body of the **ninth thoracic vertebra**

### **Sternal Biopsy**

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 .

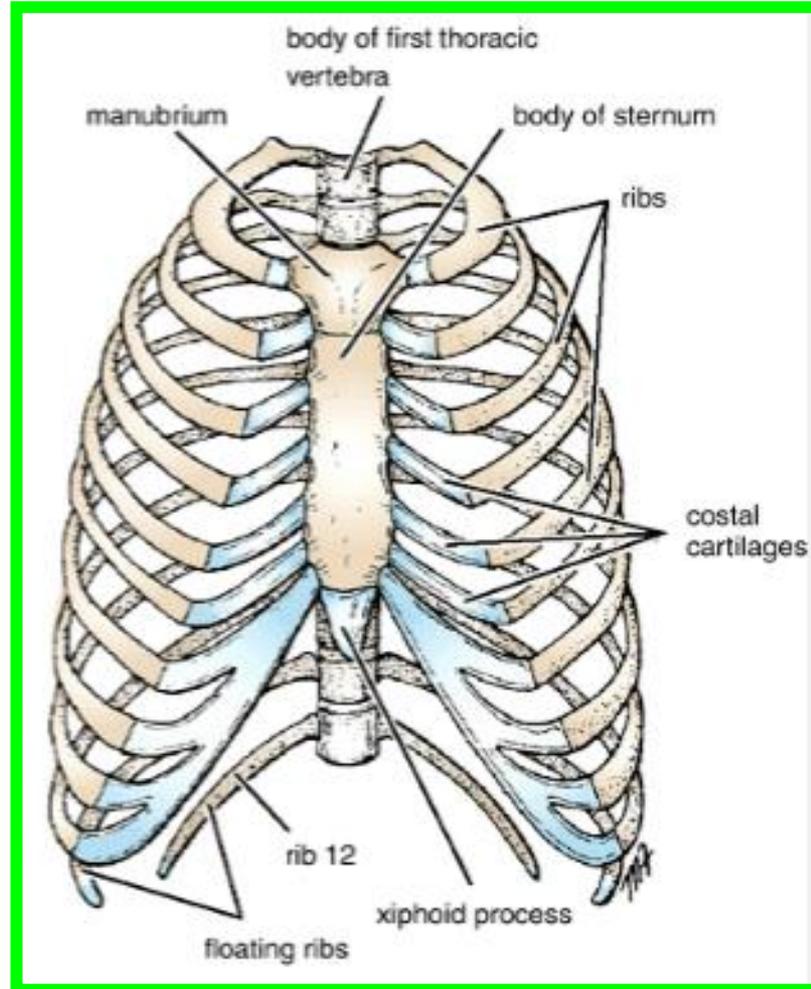
Sternal biopsy is commonly used to obtain specimens of marrow **for transplantation** and for **detection of metastatic cancer and blood dyscrasias (abnormalities)**

# Thoracic Cage

## Ribs

There are **12 pairs** of ribs, all of which are attached posteriorly to the thoracic vertebrae

The ribs are divided into three categories:

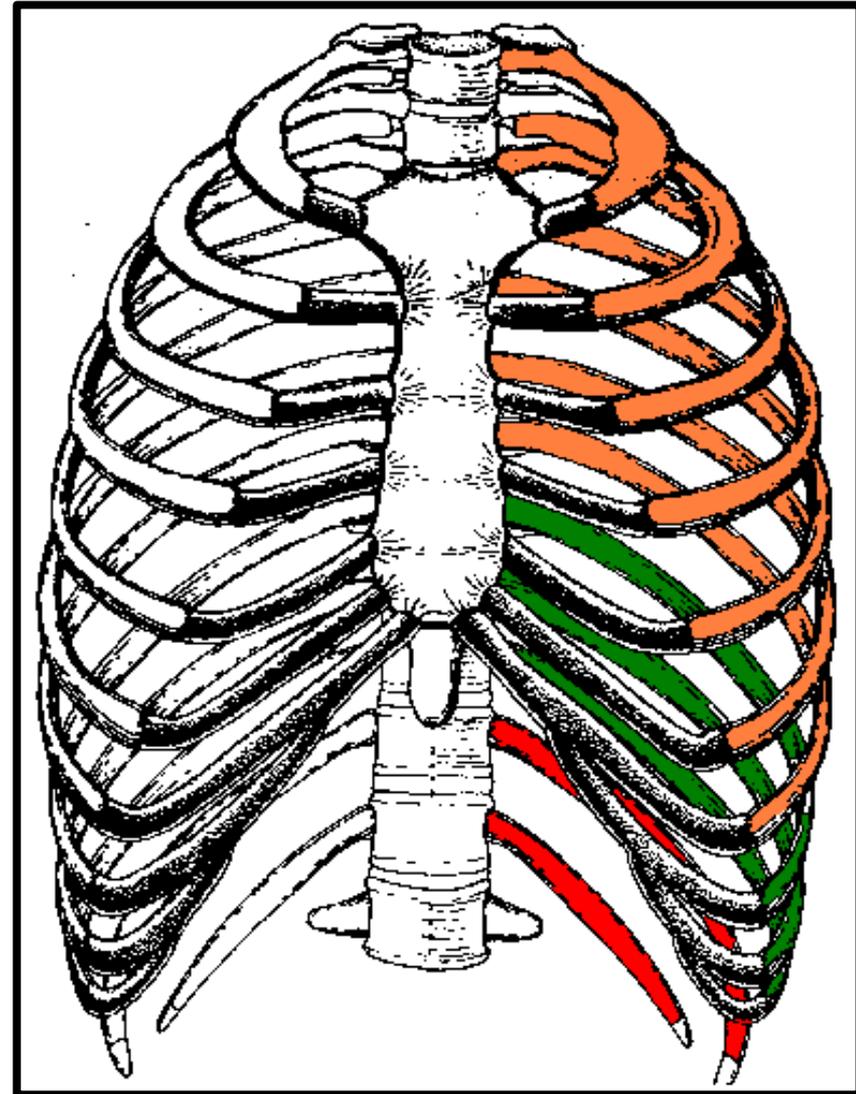


❖ **True ribs:** The **upper seven** pairs are attached anteriorly to the sternum by their **costal cartilages**.

❖ **False ribs:** The **8th, 9th, and 10th** pairs of ribs are attached anteriorly to each other and to the **7th rib** by means of their costal cartilages and small synovial joints.

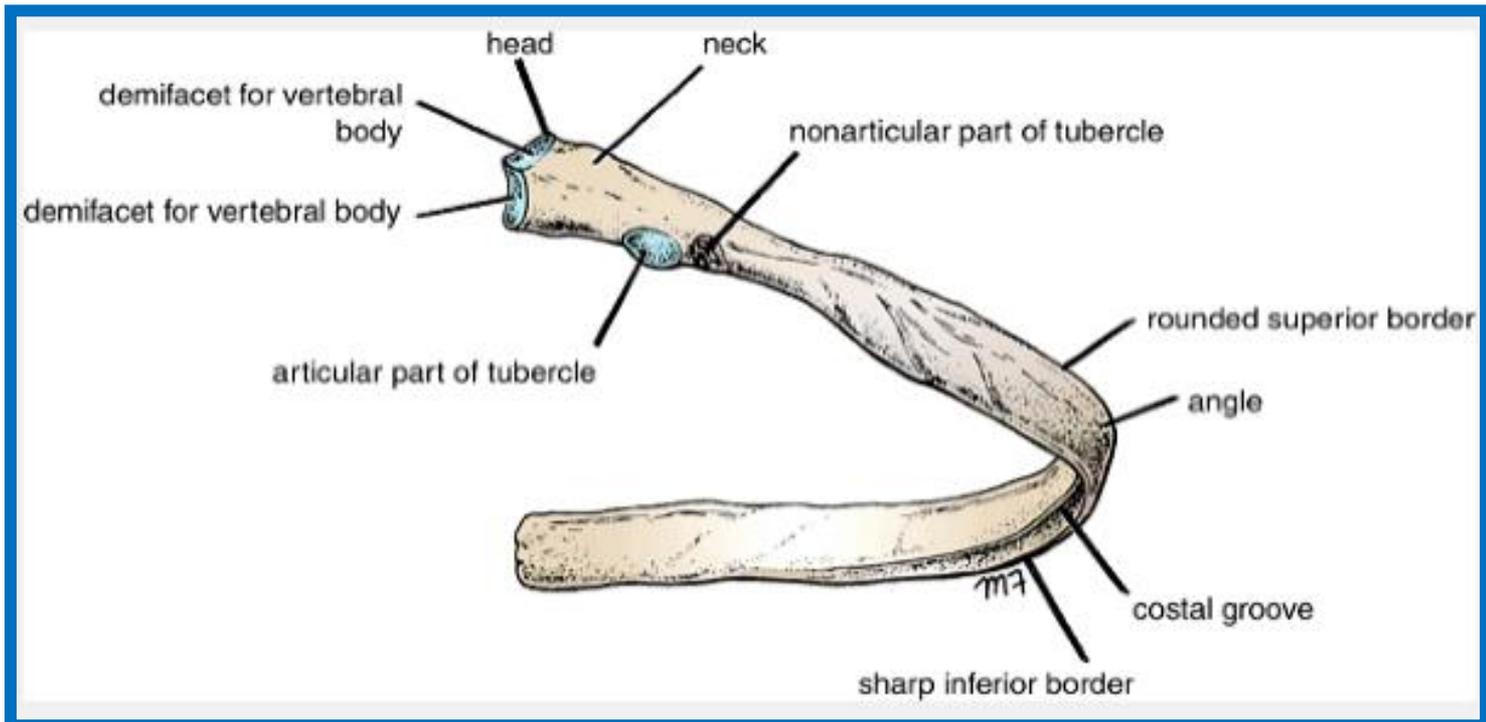
❖ **Floating ribs:** The **11th and 12th** pairs have no anterior attachment

## Thoracic Cage



## □ Typical Rib

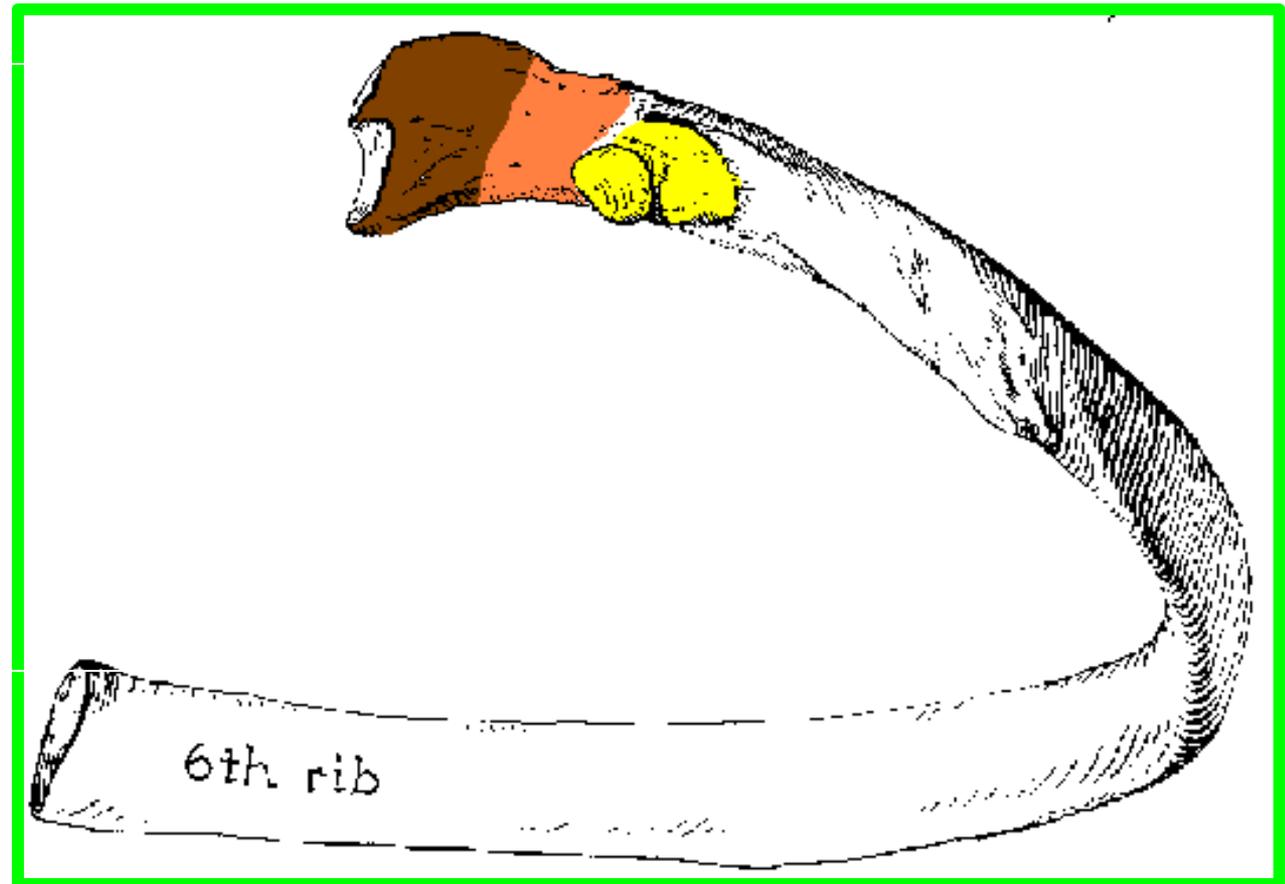
A typical rib is a long, twisted, flat bone having a rounded, smooth superior border and a sharp, thin inferior border. The inferior border overhangs and forms **the costal groove**, which accommodates **the intercostal vessels and nerve**. The anterior end of each rib is attached to **the corresponding costal cartilage**.



## □ Typical Rib

The typical rib has a head, neck, tubercle, shaft, and angle.  
**The neck** is a constricted portion situated between the head and the tubercle.

- ❖ head
- ❖ neck
- ❖ tubercle
- ❖ and a shaft

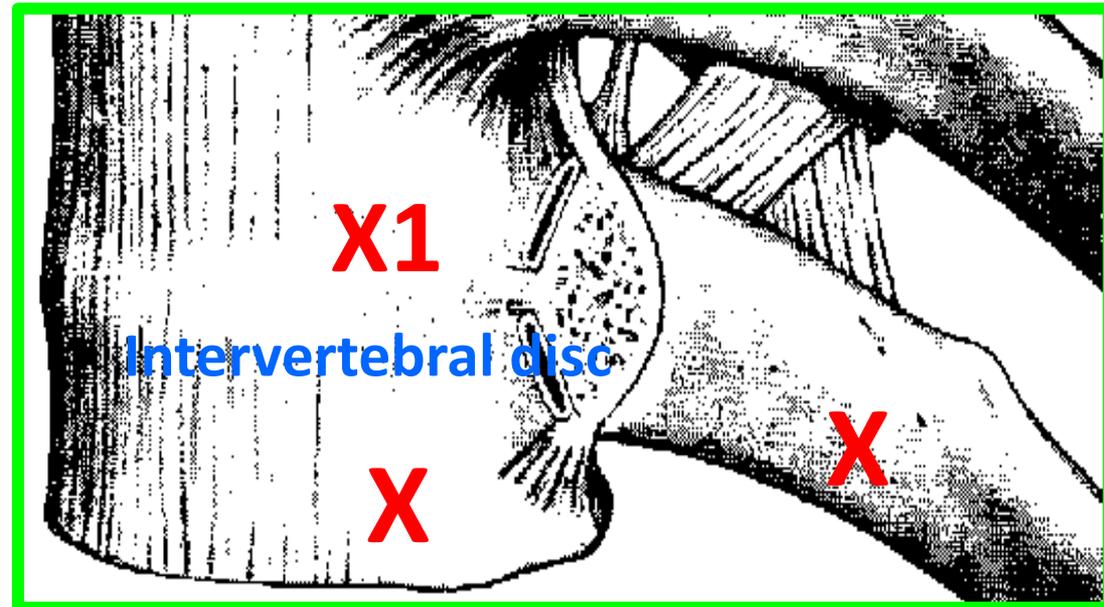


## *The head of the typical rib*

- ❖ is the posterior end of the rib
- ❖ is wedge-shaped
- ❖ carries two articular facets

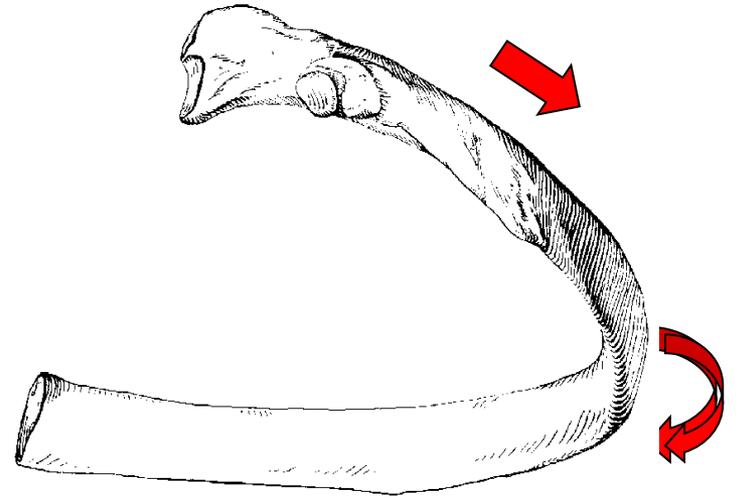


*The head has two facets for articulation with the numerically corresponding vertebral body and that of the vertebra immediately above.*



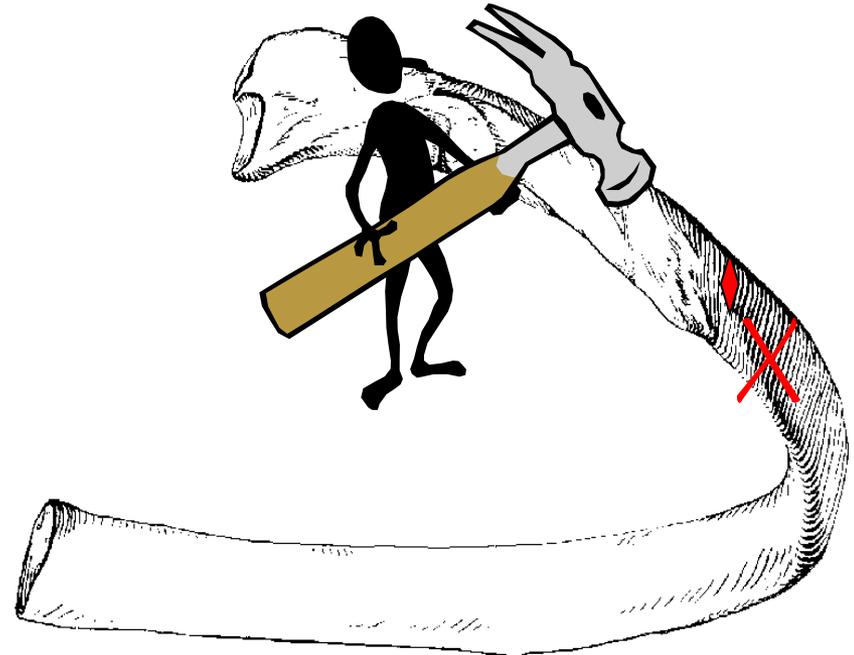
# The shaft

- ❖ Is lateral to the tubercle
- ❖ primarily it is directed posteriorly
- ❖ then it bends sharply anteriorly



# The angle

- ❖ The point of greatest change in curvature is :
- ❖ The angle of a rib is its **weakest part** where it tends to fracture.

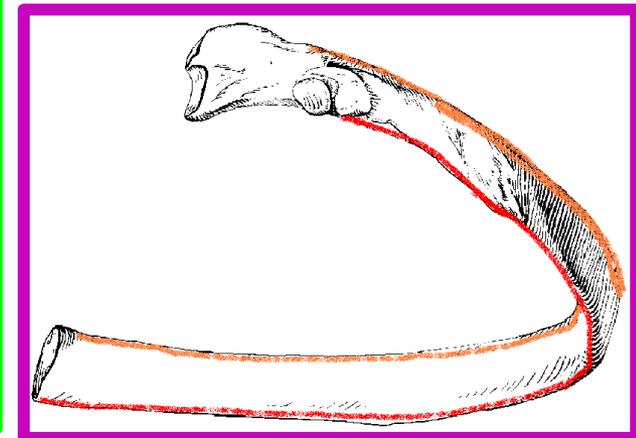
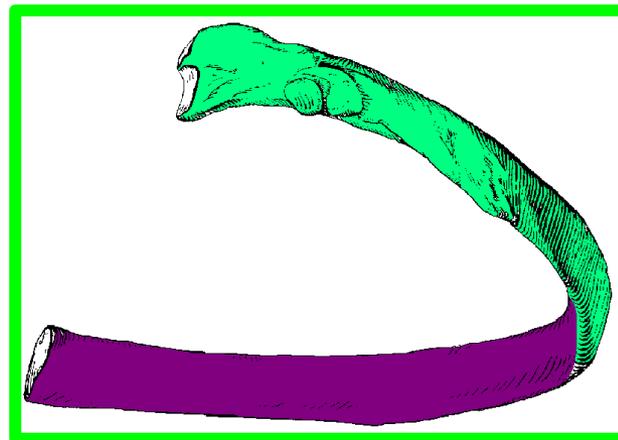
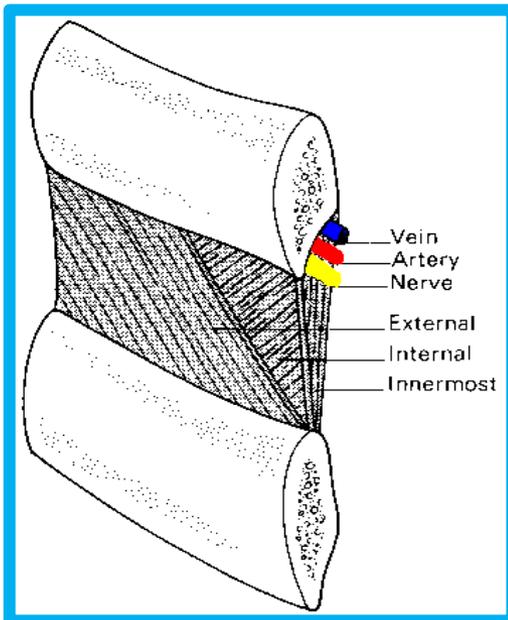


# Typical ribs (3-10) Have

Sun. 9 October 2022

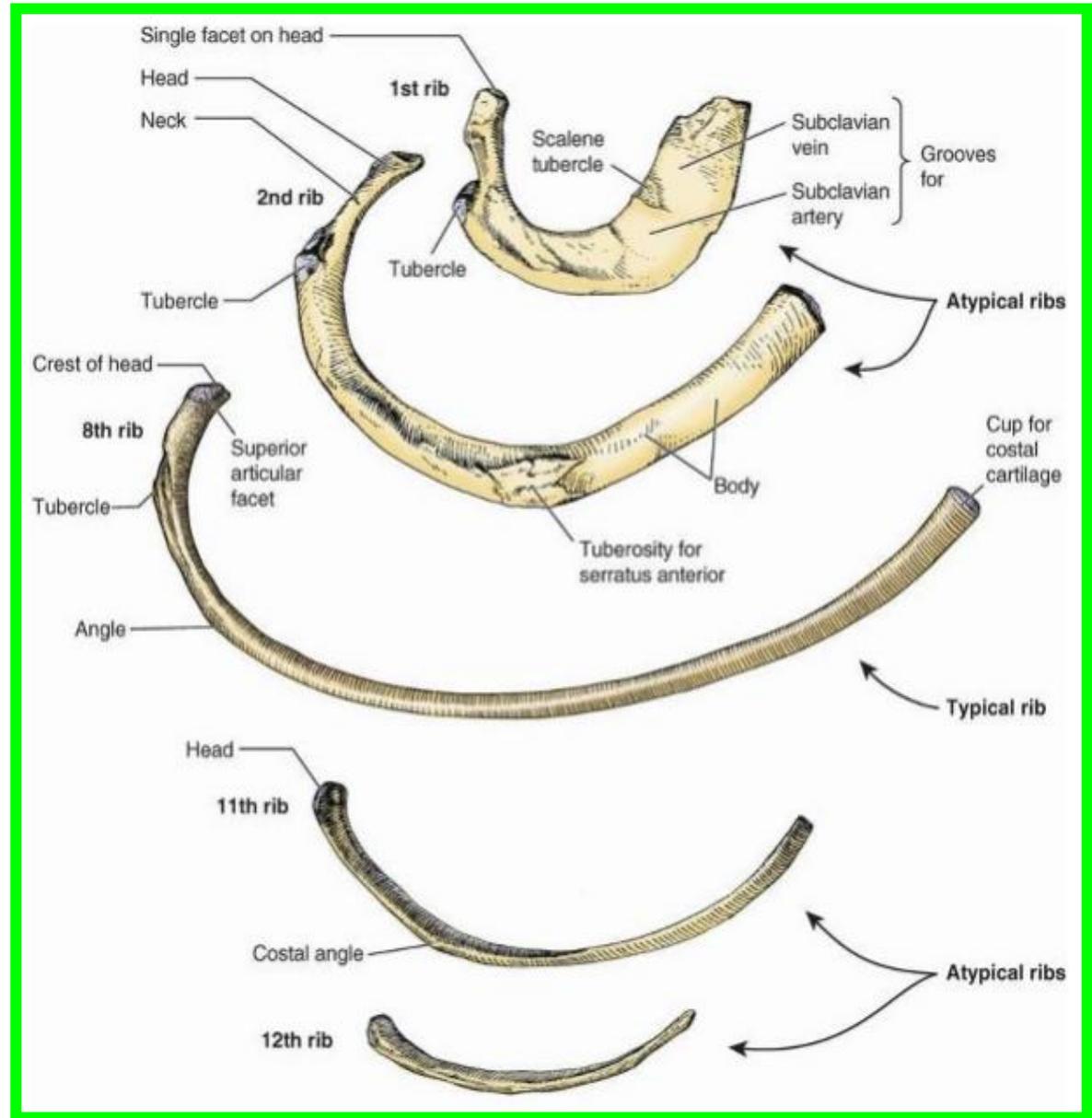
Dr. Aiman Qais Afar

- **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 the:
- **intercostal neurovascular bundle** located in **the costal groove**.



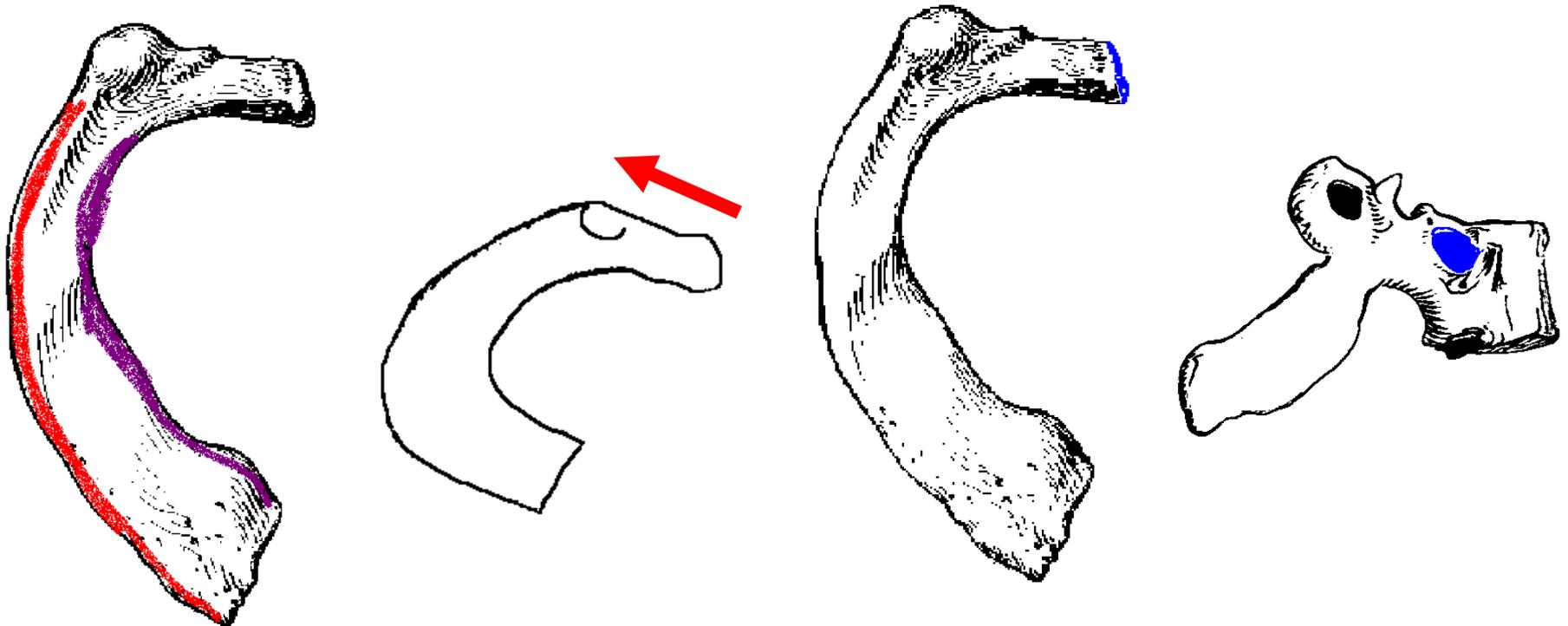
# ❑ Atypical ribs

(1st, 2nd, and 11th-12th) are dissimilar :



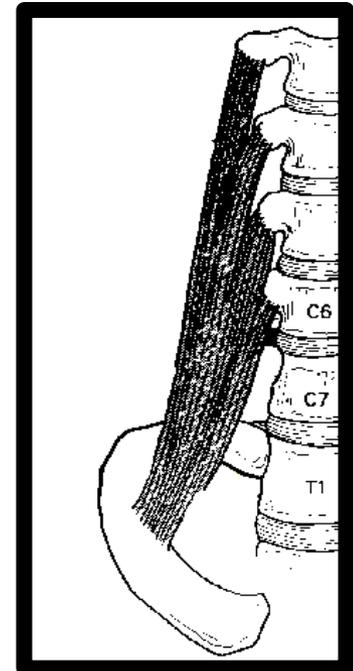
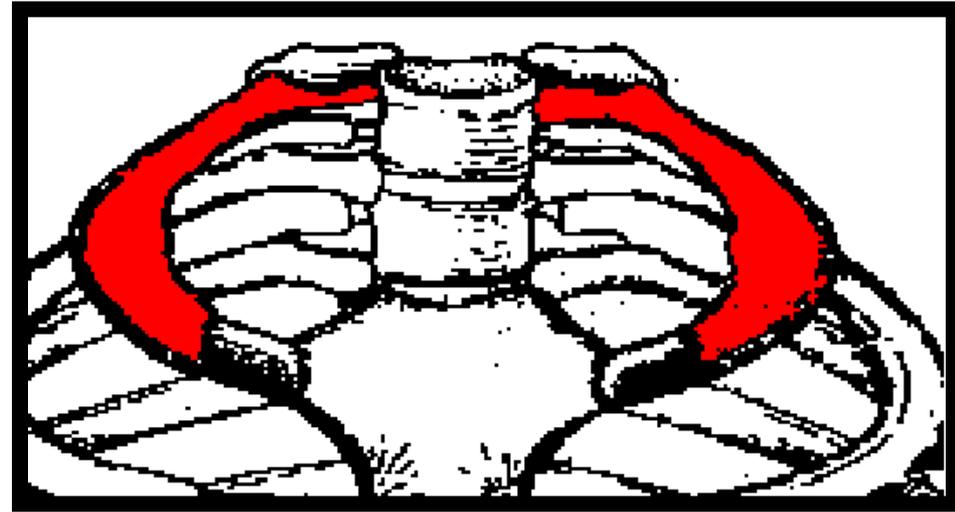
# The first rib

- ❖ is the broadest and most curved rib
- ❖ Its 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** borders



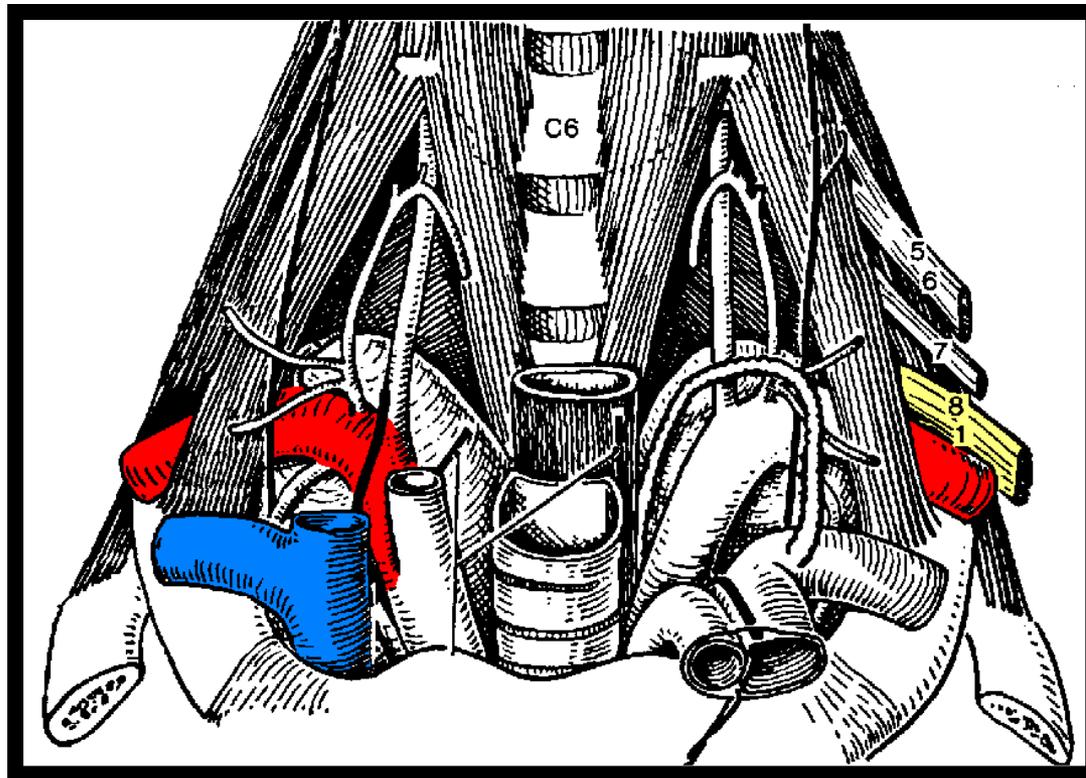
# The first rib

- ❖ 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**

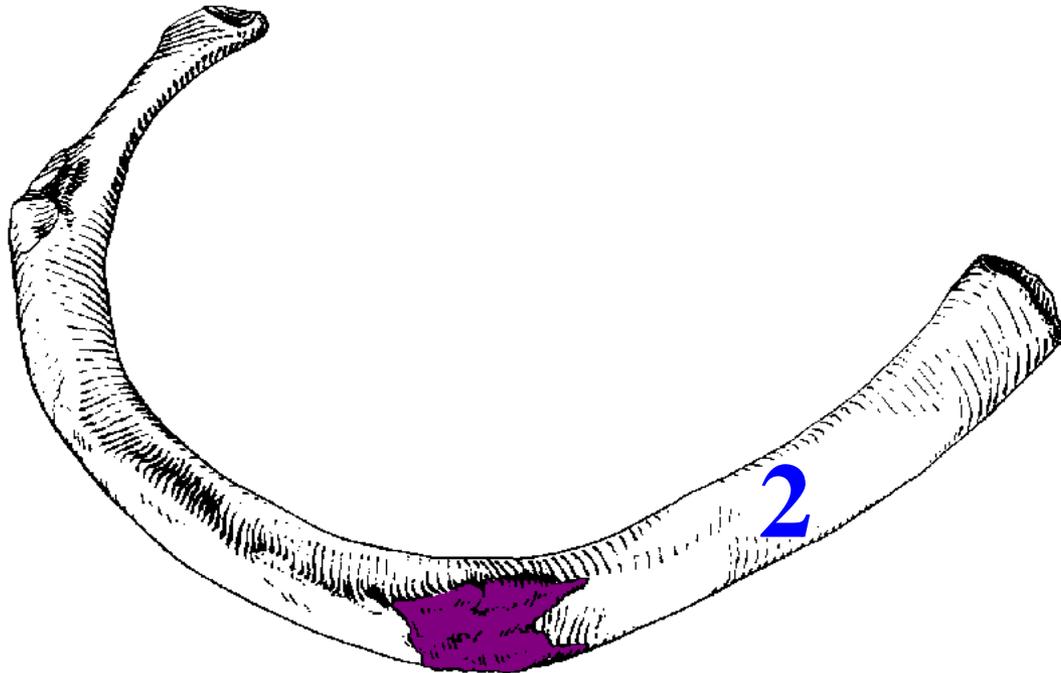
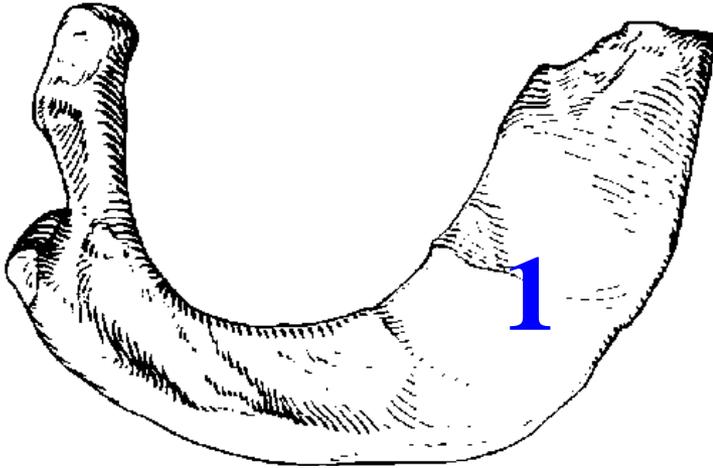


# The first rib

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



# The second rib

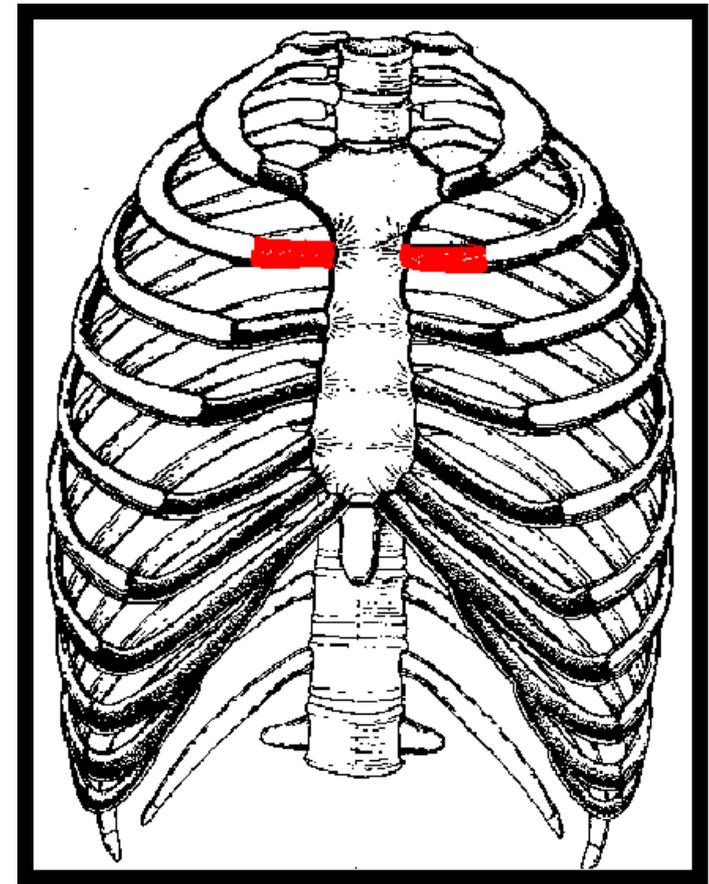
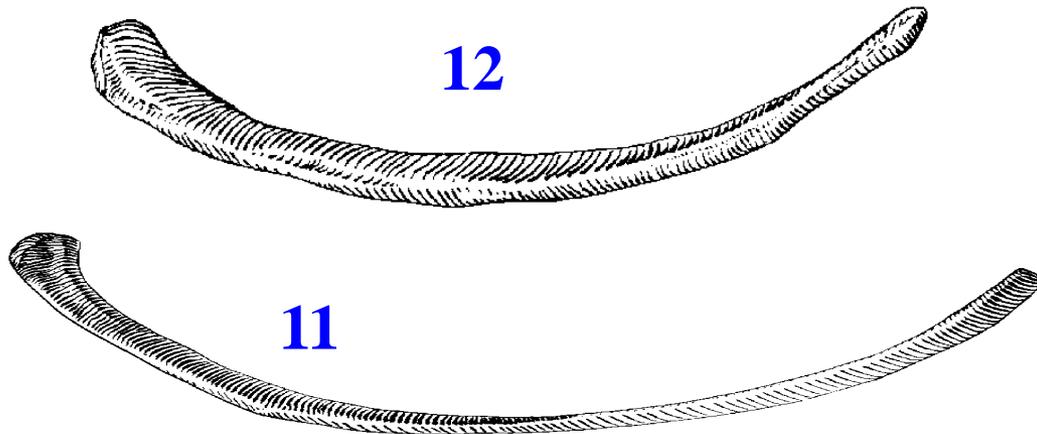


- ❖ Is longer than the first rib
- ❖ is characterized by the presence of a **tuberosity** for the attachment of serratus anterior muscle

# Sternal angle

- ❖ It is here that the **second costal cartilage** joins the sternum
- ❖ It is the starting place where the physician **counts the ribs** to use them as landmarks.

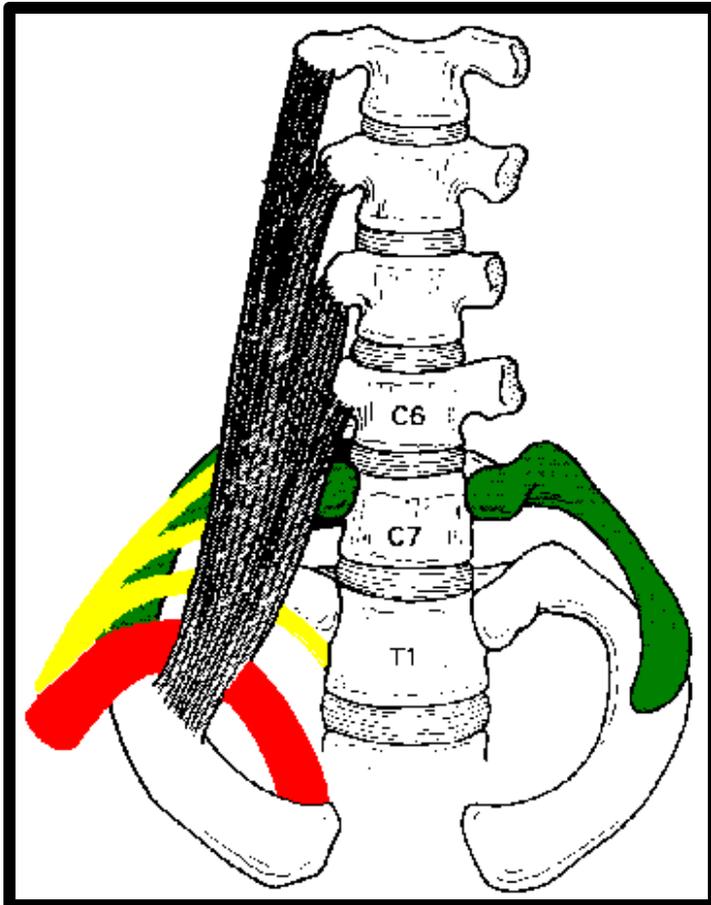
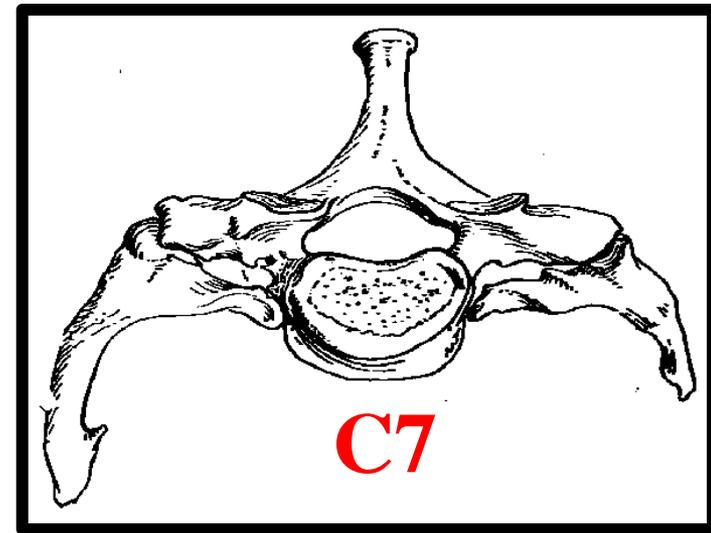
## The 11th & 12th ribs



- ❖ are short and carry a single facet on the head
- ❖ **have neither neck nor tubercle**

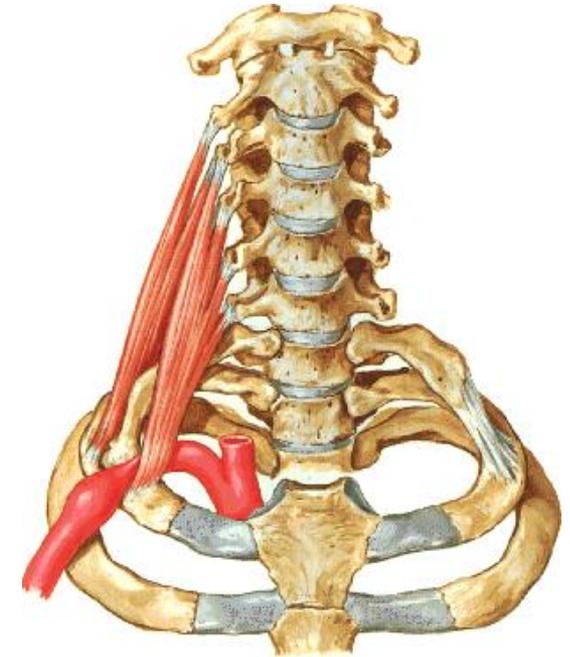
# Cervical rib

- ❖ may articulate with the transverse process of **C7 vertebra** which is directed downward



- ❖ May be symptomless or may cause **neurovascular symptoms** in the upper limb due to **stretching or compression** related to structures on the superior surface of the first rib

# Cervical rib

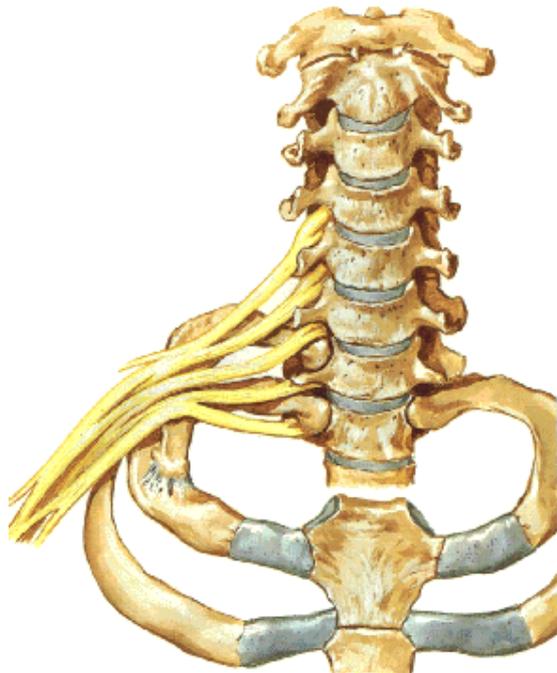


❖ symptoms may be produced by compression

**Vascular symptoms:**

The cervical rib compresses the subclavian artery.

Note the poststenotic dilatation



❖ symptoms may be produced by stretching

**Neurological symptoms:**

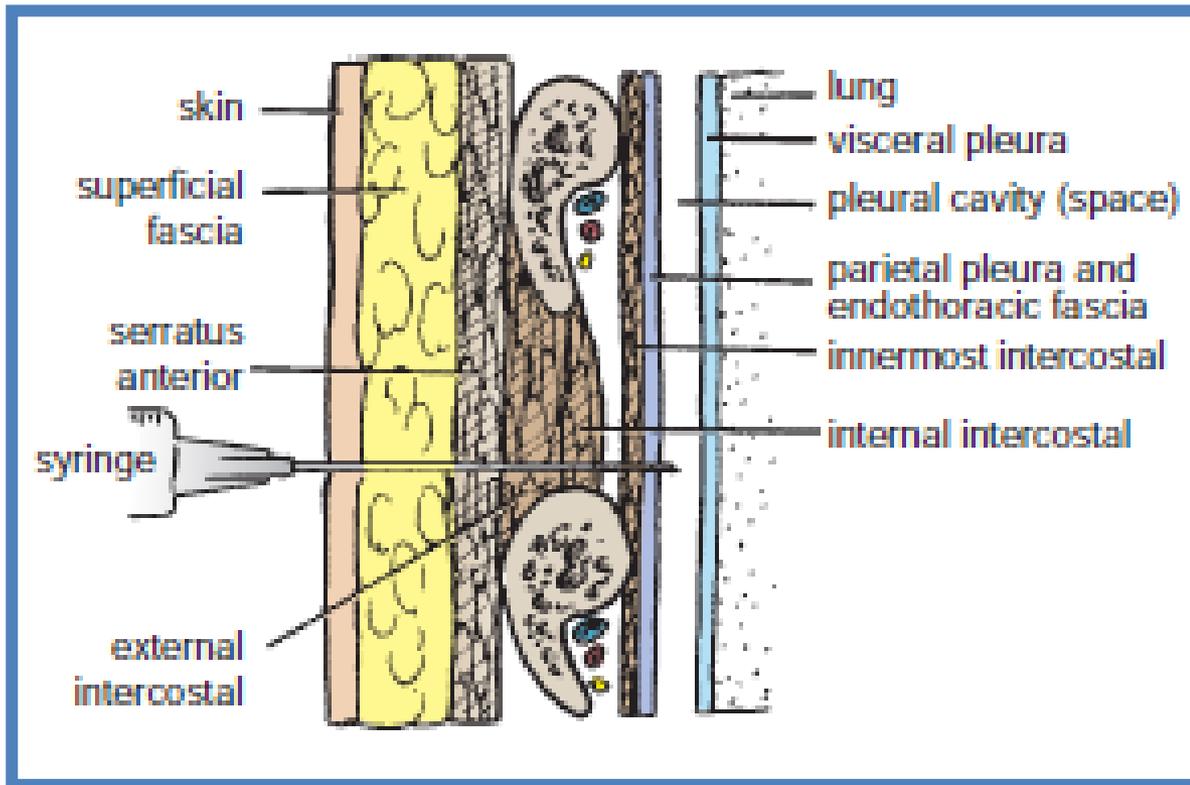
The cervical rib stretches the brachial plexus.

# Intercostal Spaces

The spaces between the ribs contain three muscles of respiration:

the **external intercostal**, the **internal intercostal**, and the **innermost intercostal** muscle.

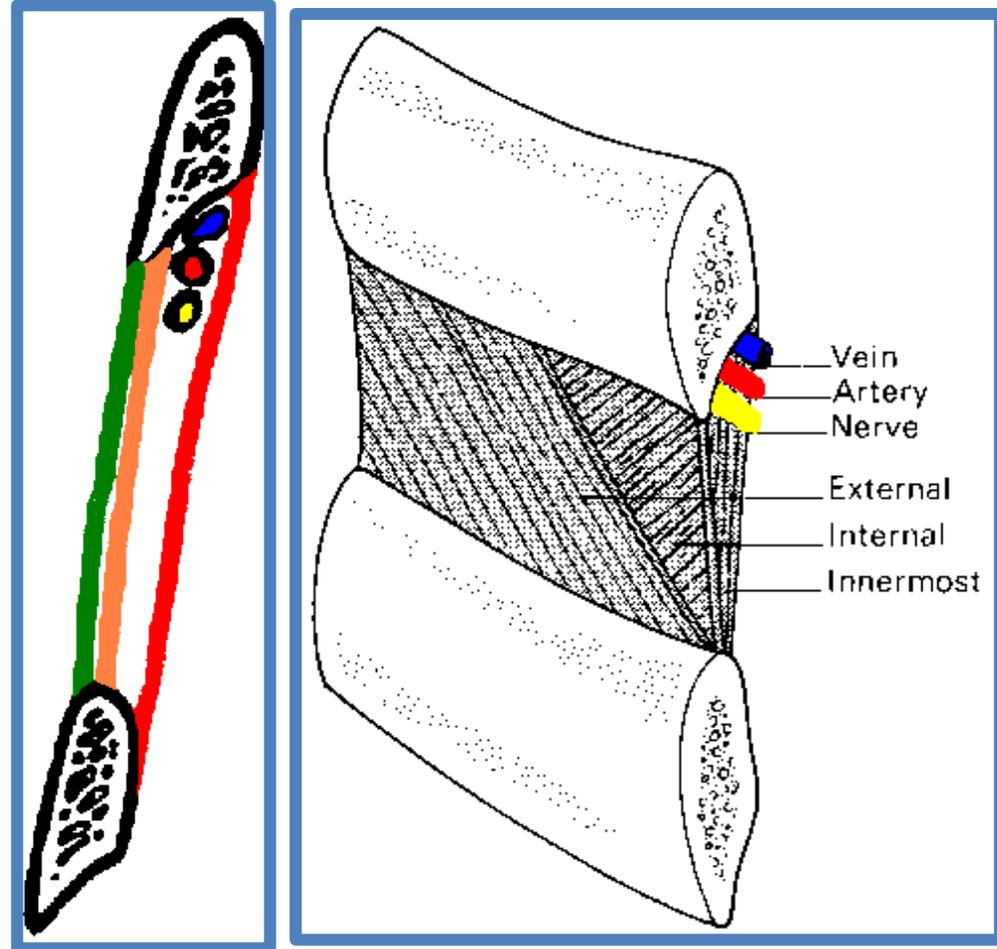
The innermost intercostal muscle is lined internally by the **endothoracic fascia**, which is lined internally by the **parietal pleura**.



# Intercostal Spaces

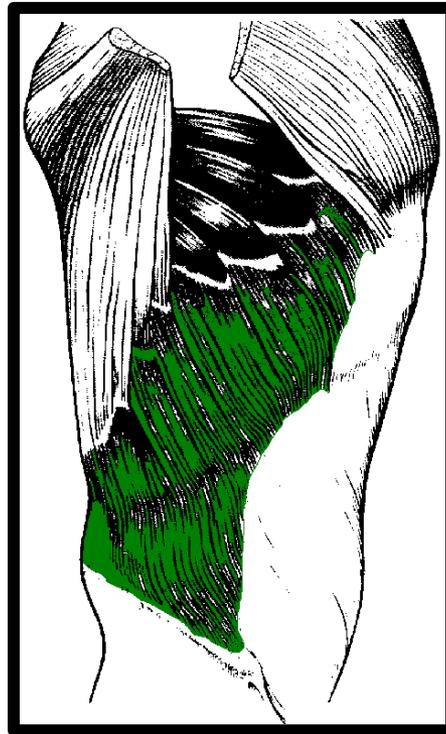
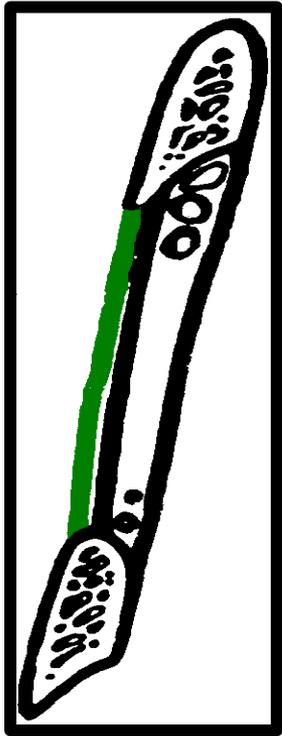
The intercostal nerves and blood vessels run between the **intermediate** and **deepest layers** of muscles

They are arranged in the following order from above downward:  
**intercostal vein**,  
**intercostal artery**, and  
**intercostal nerve** (i.e., **VAN**).

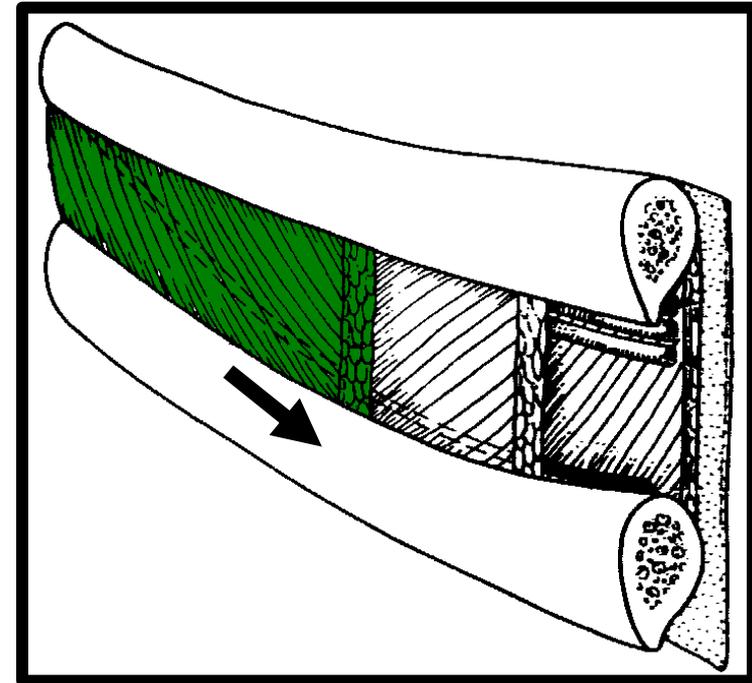


# External intercostal

- ❖ 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



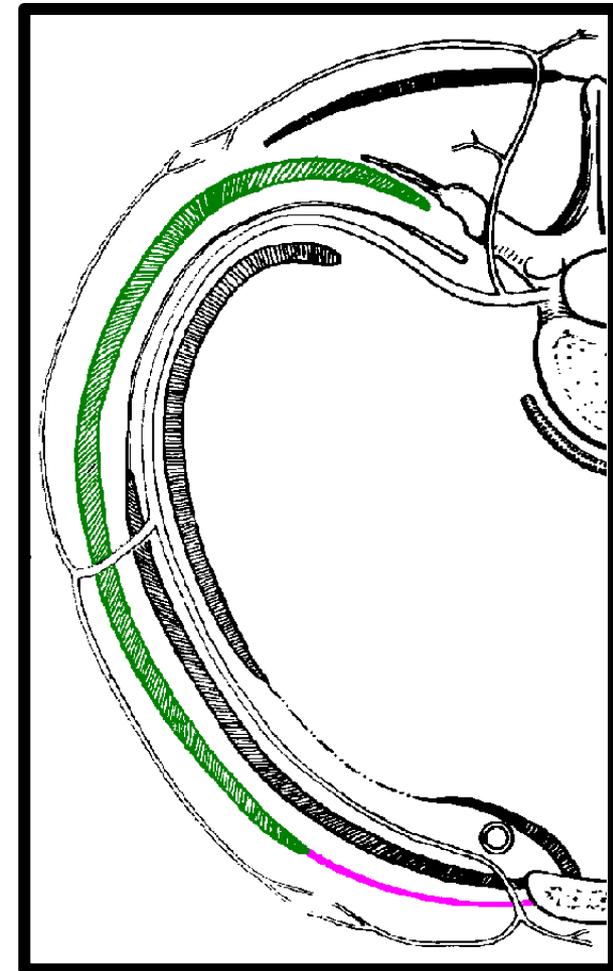
External oblique



External intercostal

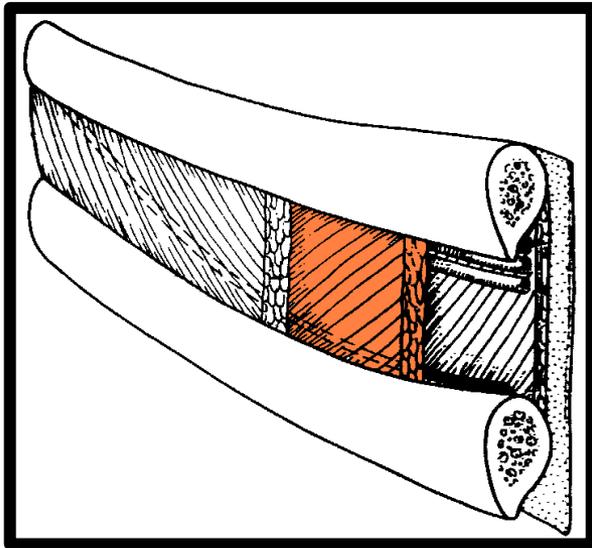
❖ **The external intercostal muscle** extends from the **rib tubercle** behind to the **costochondral junction** in front

❖ Anteriorly the **external intercostal muscle** is replaced by an **aponeurosis** (thin flat tendon), the **anterior (external) intercostal membrane**

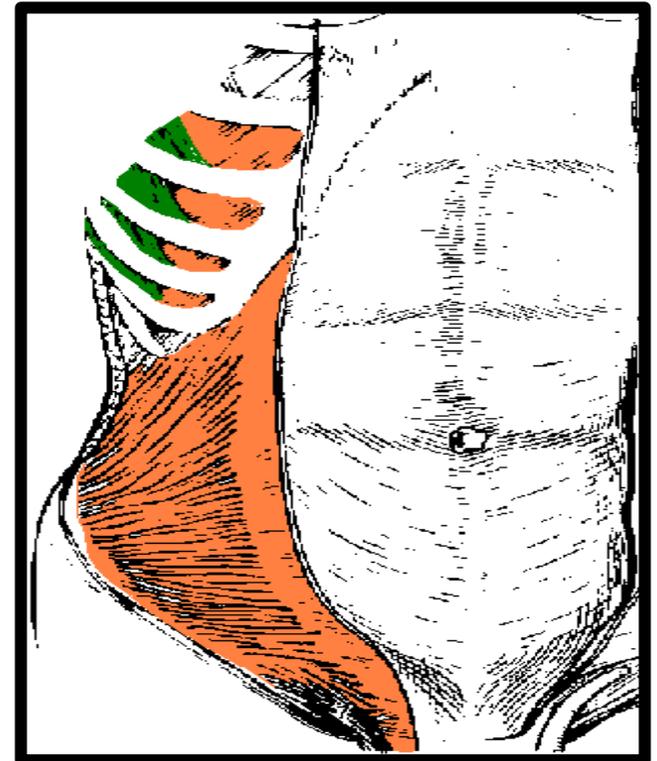
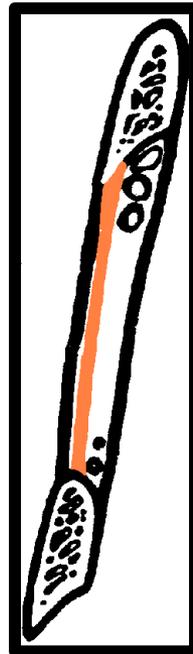


# Internal intercostal

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



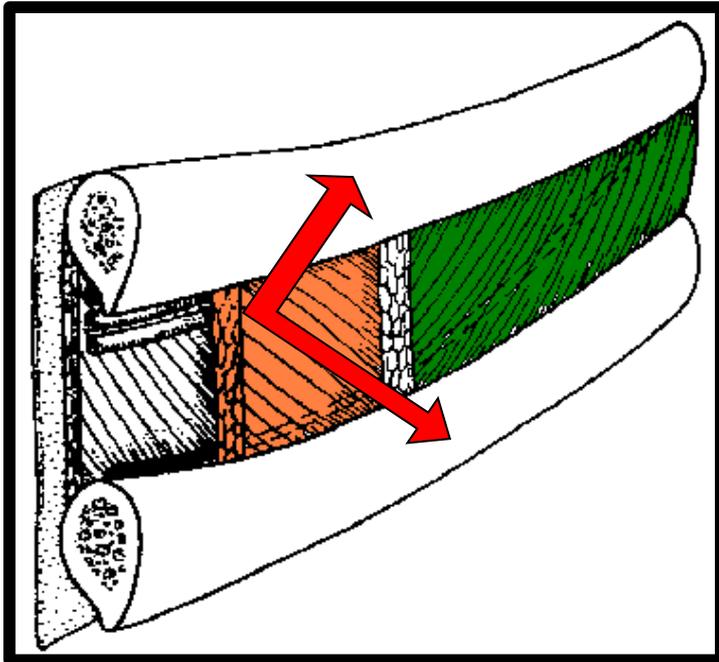
**Internal intercostal**



**Internal oblique**

# Internal intercostal

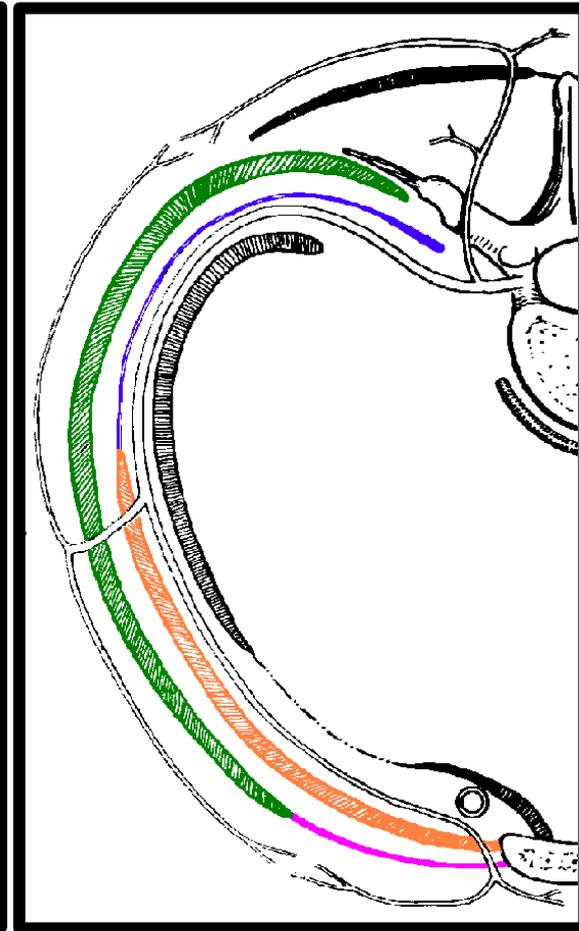
- ❖ the fibers of the **internal intercostal** are therefore at right angles to those of the **external intercostal**



# Internal intercostal

32

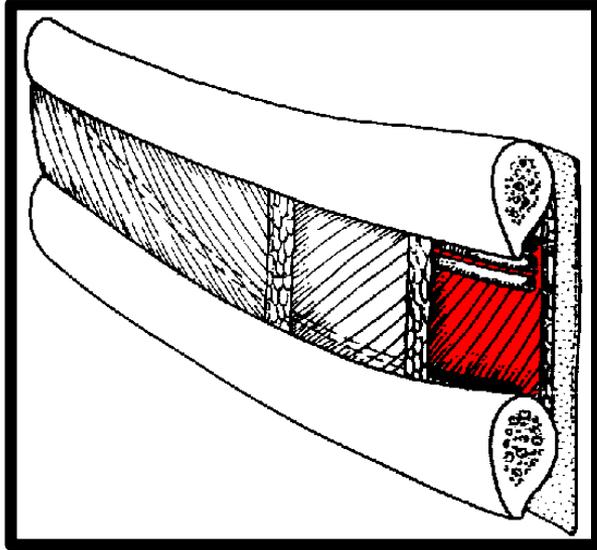
- ❖ The **internal intercostal** extends from the side of the sternum in front to the angles of the ribs behind
- ❖ The **internal intercostal** muscle is replaced by an aponeurosis, the **posterior (internal) intercostal membrane**



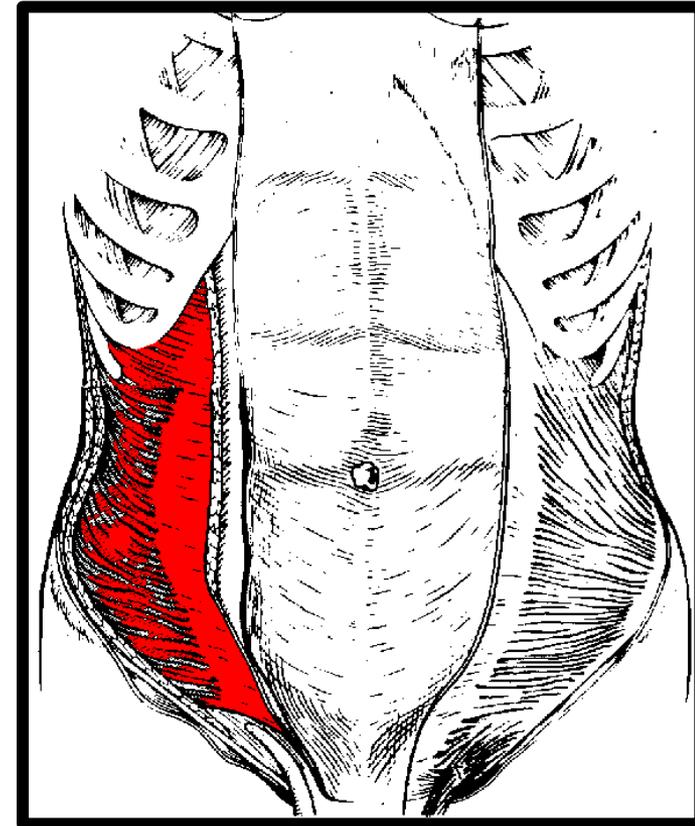
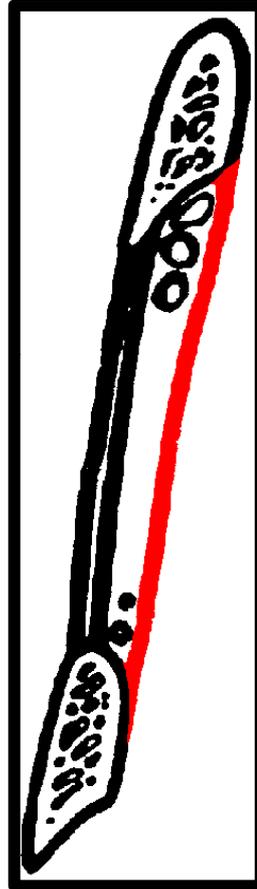
# Innermost intercostal

Dr. Aiman Qais Afar  
Sun. 9 October 2022  
33

- ❖ Extends between internal surfaces of adjacent



Innermost intercostal

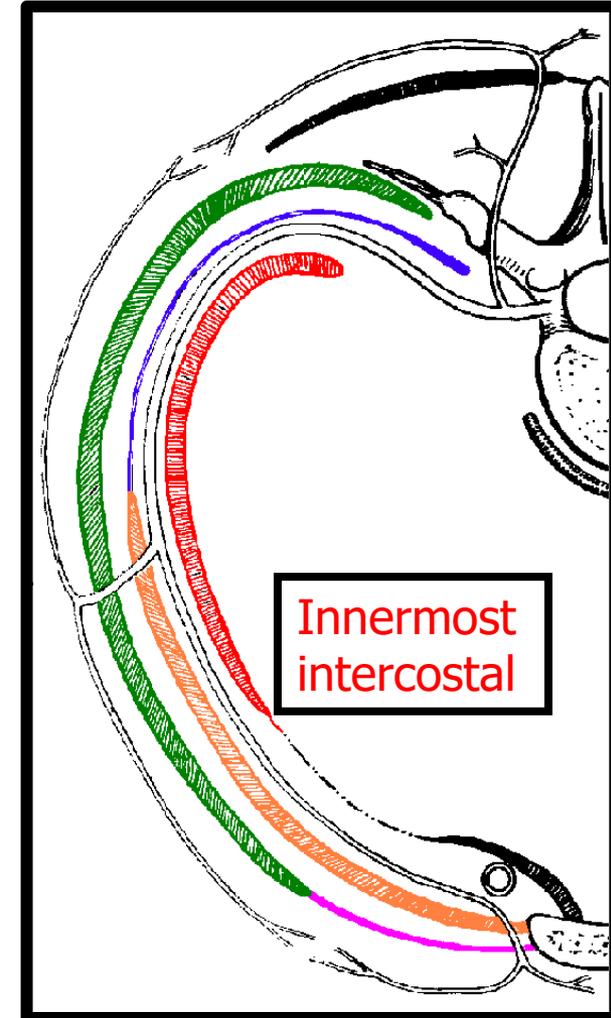


transversus abdominis

- ❖ It corresponds to the **transversus abdominis** muscle of the anterior abdominal wall

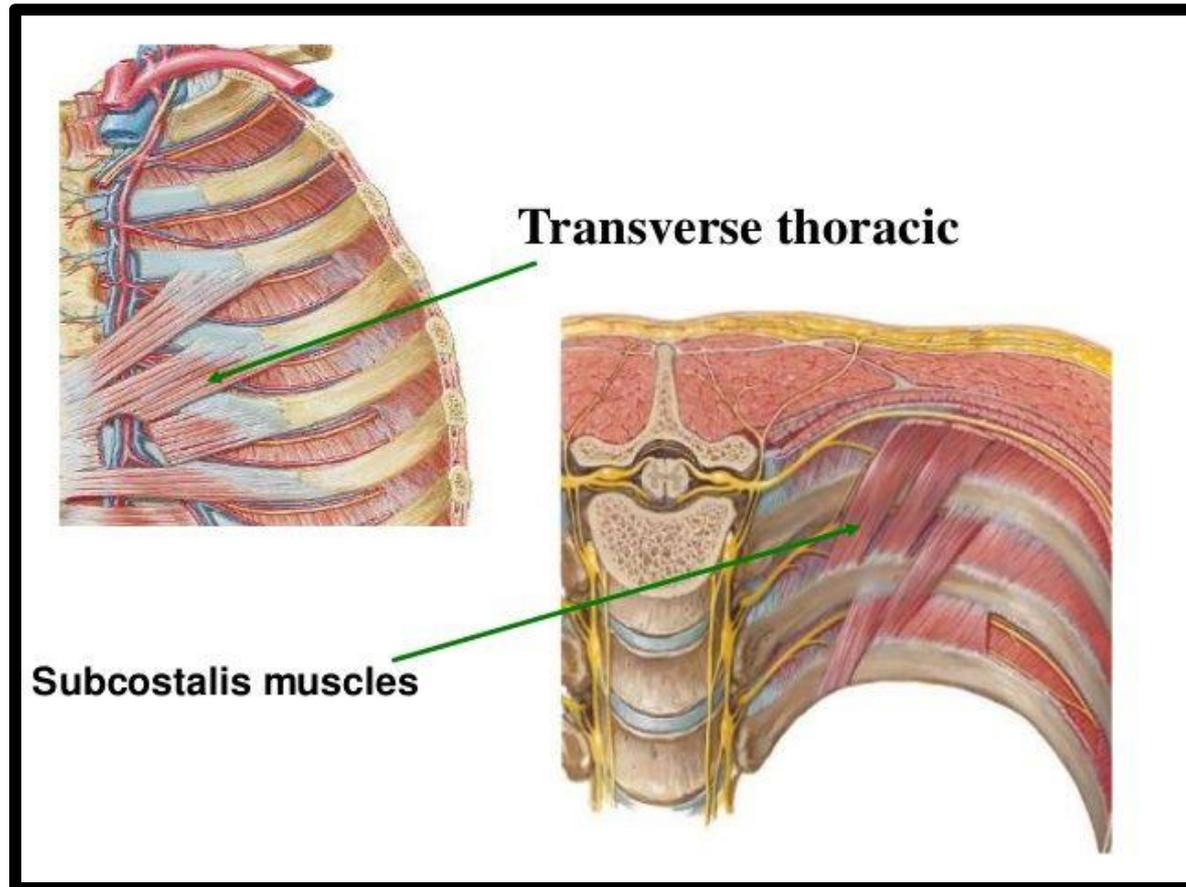
# Innermost intercostal

- ❖ The innermost intercostal fibers cover the middle  $\frac{2}{4}^{\text{th}}$  of the intercostal spaces



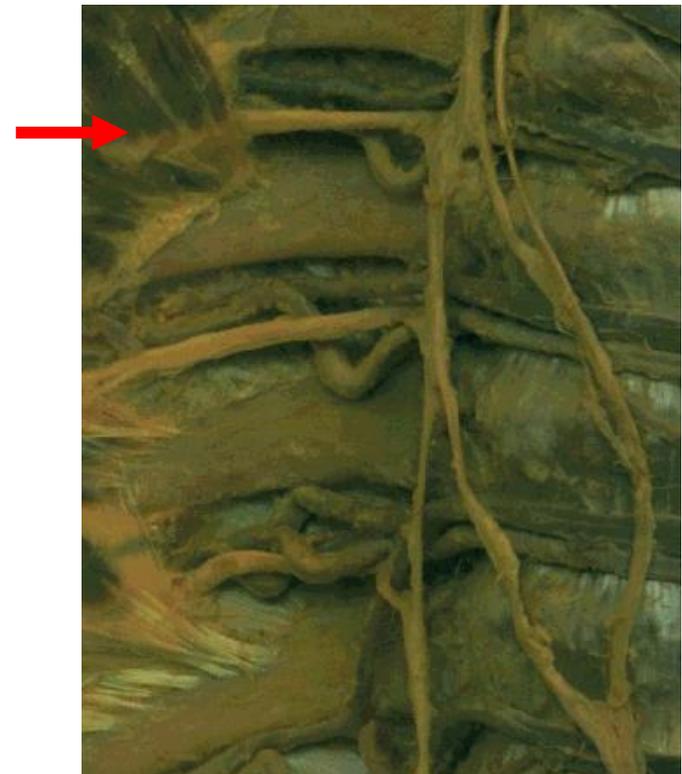
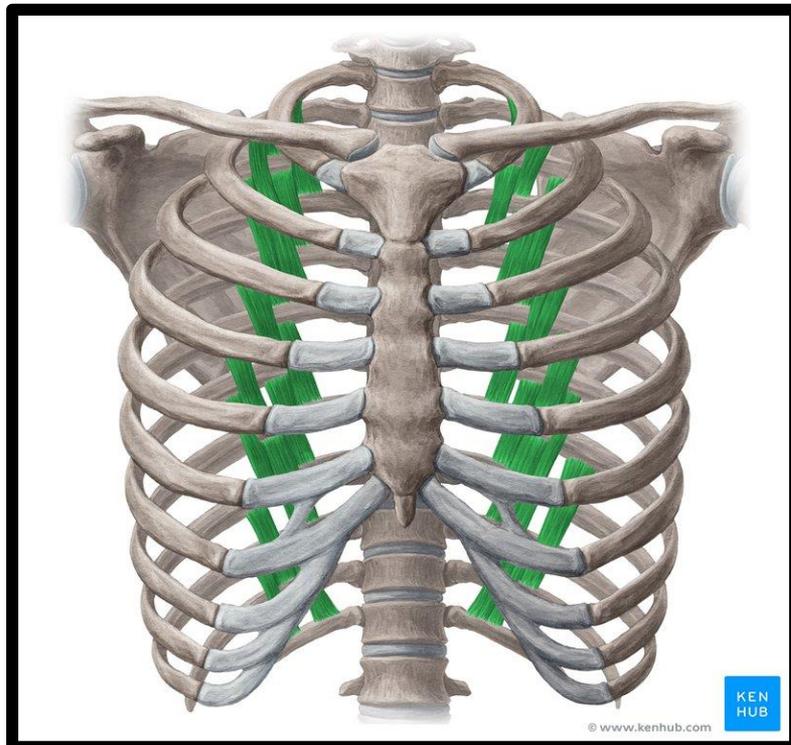
# **Subcostalis & Transversus Thoracis**

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



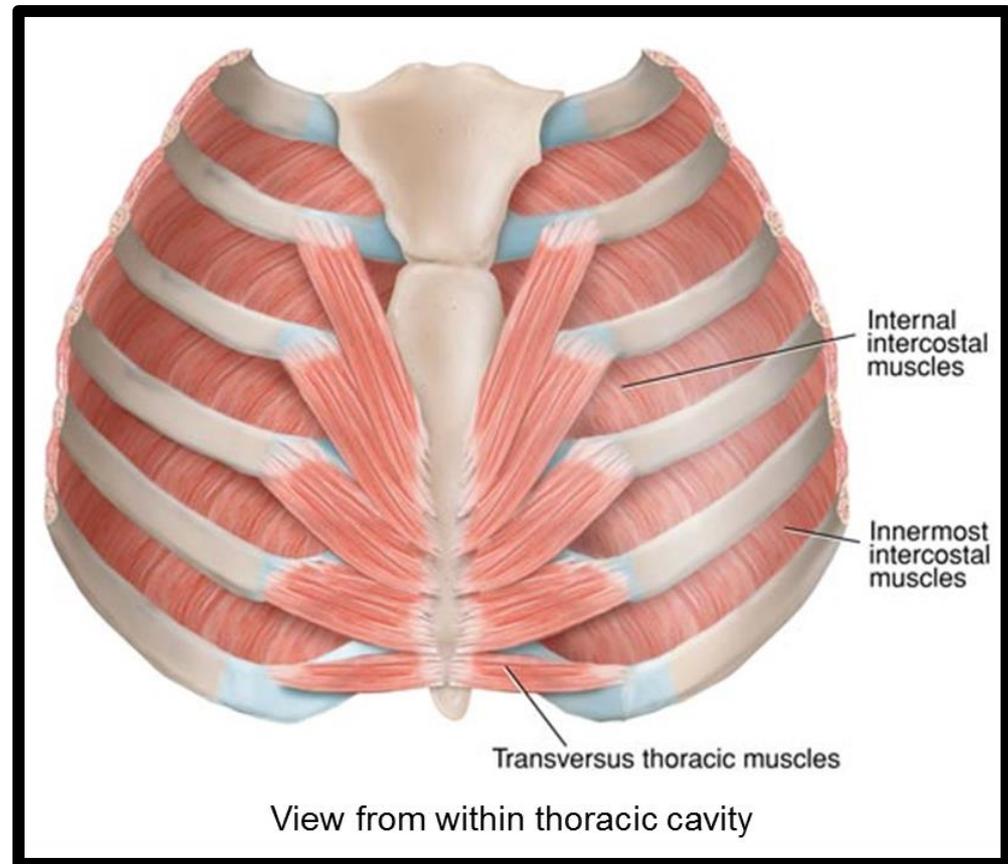
# Subcostalis

- ❖ 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



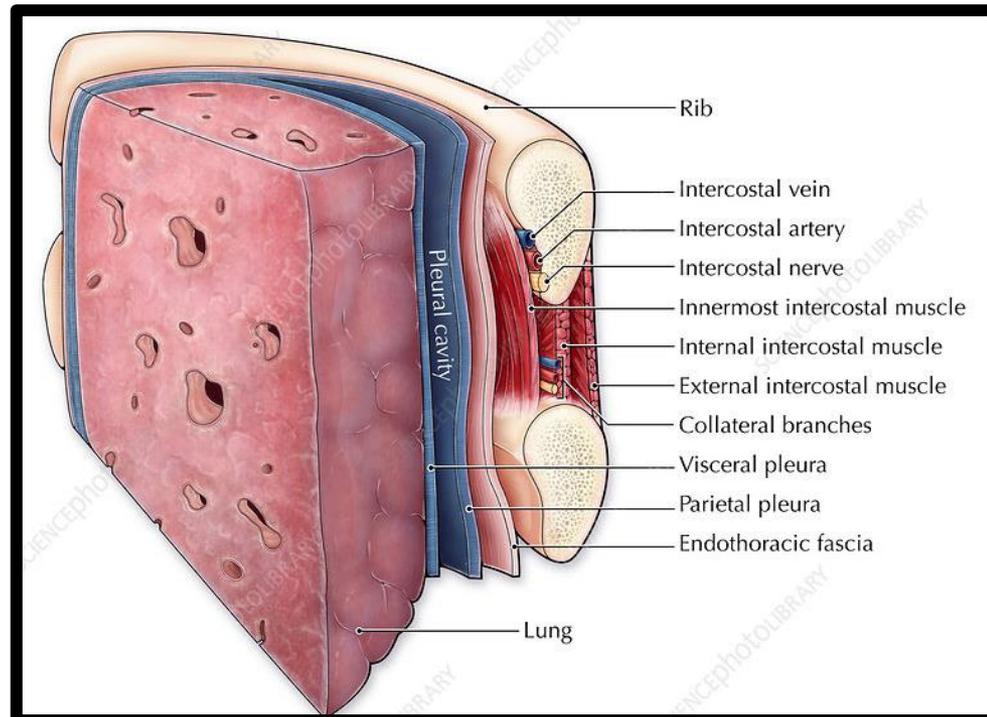
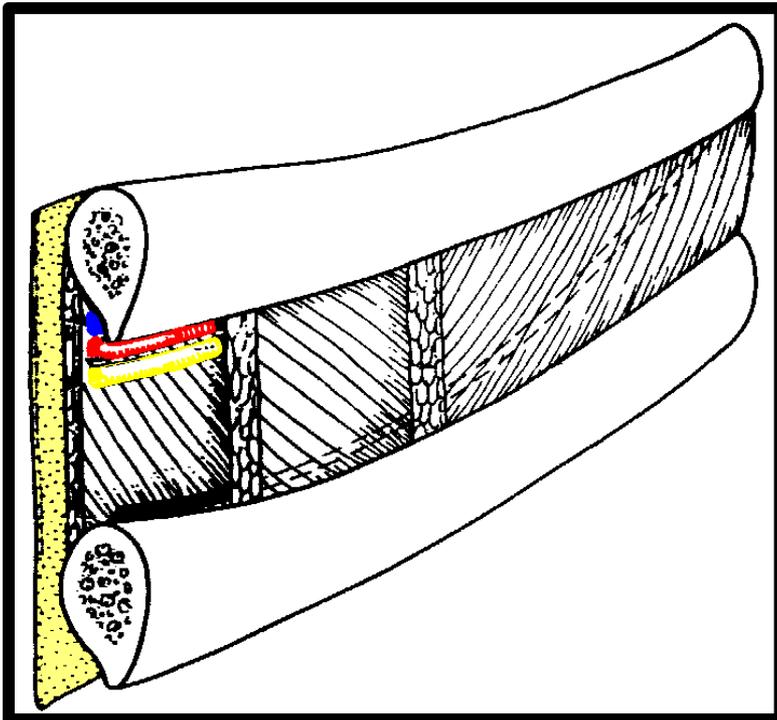
# Transversus thoracis

- ❖ Is also called **sternocostalis** since its fibers extend from **the lower 1/3<sup>rd</sup> 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**



# 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**



# Openings of the Thorax

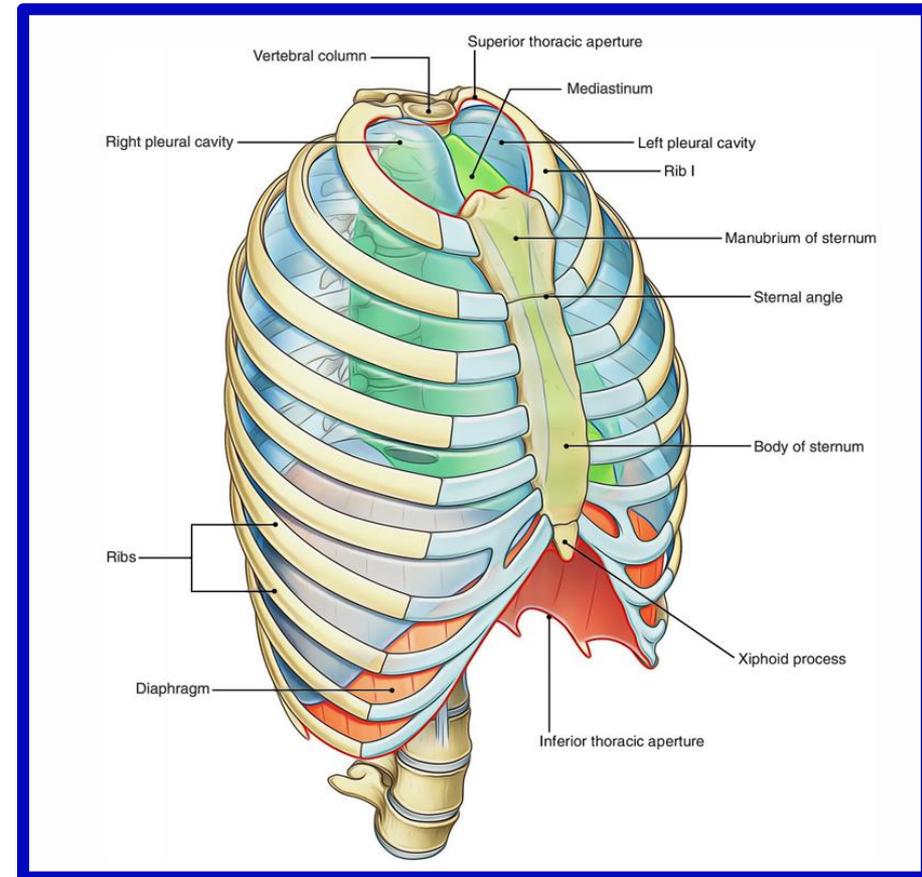
Dr. Aiman Qais Afar  
Sun. 9 October 2022

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**,

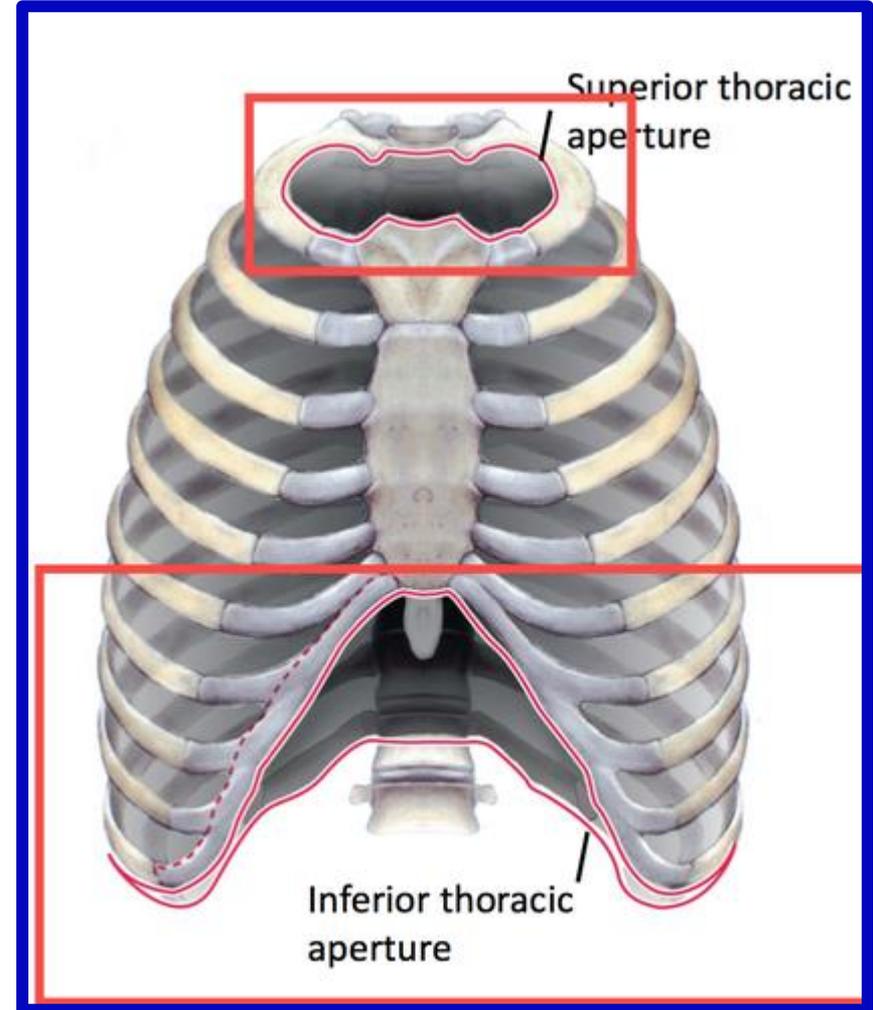
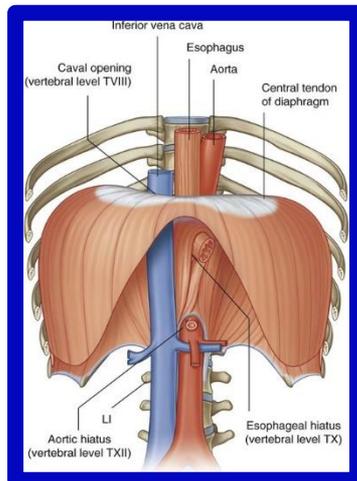
and **anteriorly** by the **superior border of the manubrium sterni**.



# Openings of the Thorax

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, and anteriorly by the xiphisternal joint.





***Dr. Aiman Qais Afar***  
***Sun. 9 October 2022***