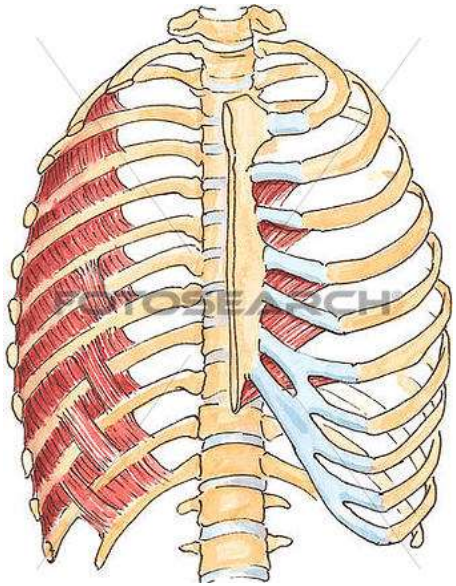
Jordan University
Faculty Of Medicine



Thoracic Wall

DR. AHMED SALMAN

Associate professor of anatomy

Thoracic wall

Boundaries :

Anteriorly : sternum and costal cartilages
Posteriorly : vertebral column
On either side : ribs and intercostal spaces

The thoracic wall is composed of :
1- Skeleton (Thoracic cage)
2-Intercostal muscles
3-Intercostal vessels
4-Intercostal nerves

I-Skeleton of the thorax

This is an Osseo cartilaginous cavity composed of :

1-Sternum

2-Ribs

3-Costal cartilage

4-Thoracic Vertebrae

Sternum

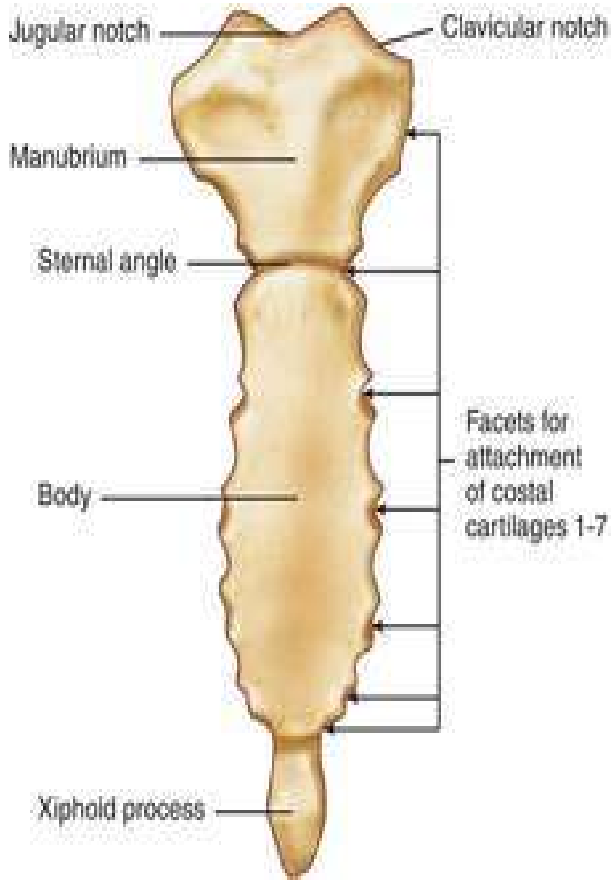
It has Three parts

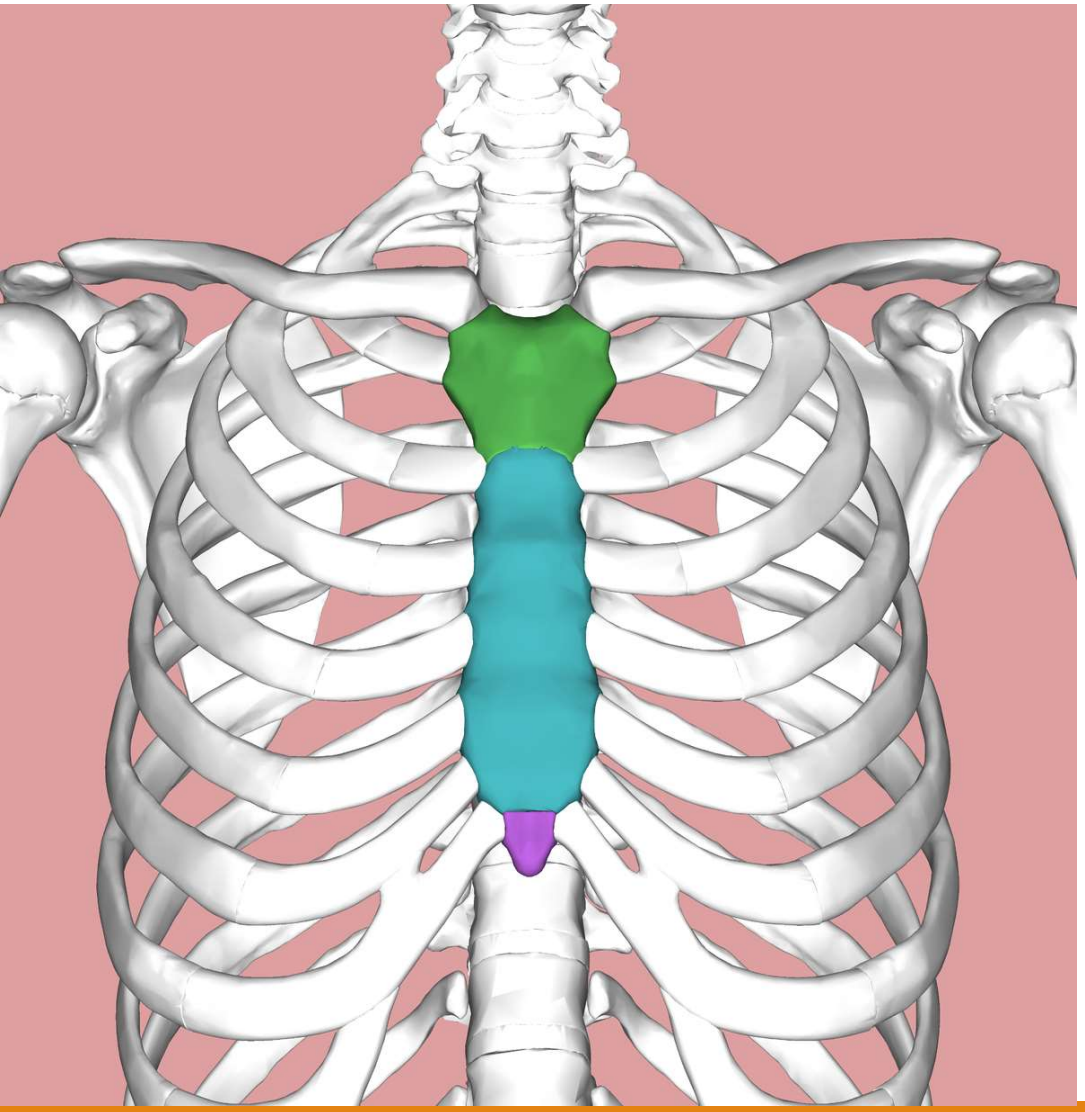
- Manubrium
- Body
- Xiphoid process
- The sternal angle (angle of Louis) it formed by the articulation of the manubrium with the body of the sternum
- It is at the level of the second costal cartilage

Q. What is function of sternal angle ?

A. Counting of the ribs

N.B : Sternum is one of sites to take Bone marrow biopsy



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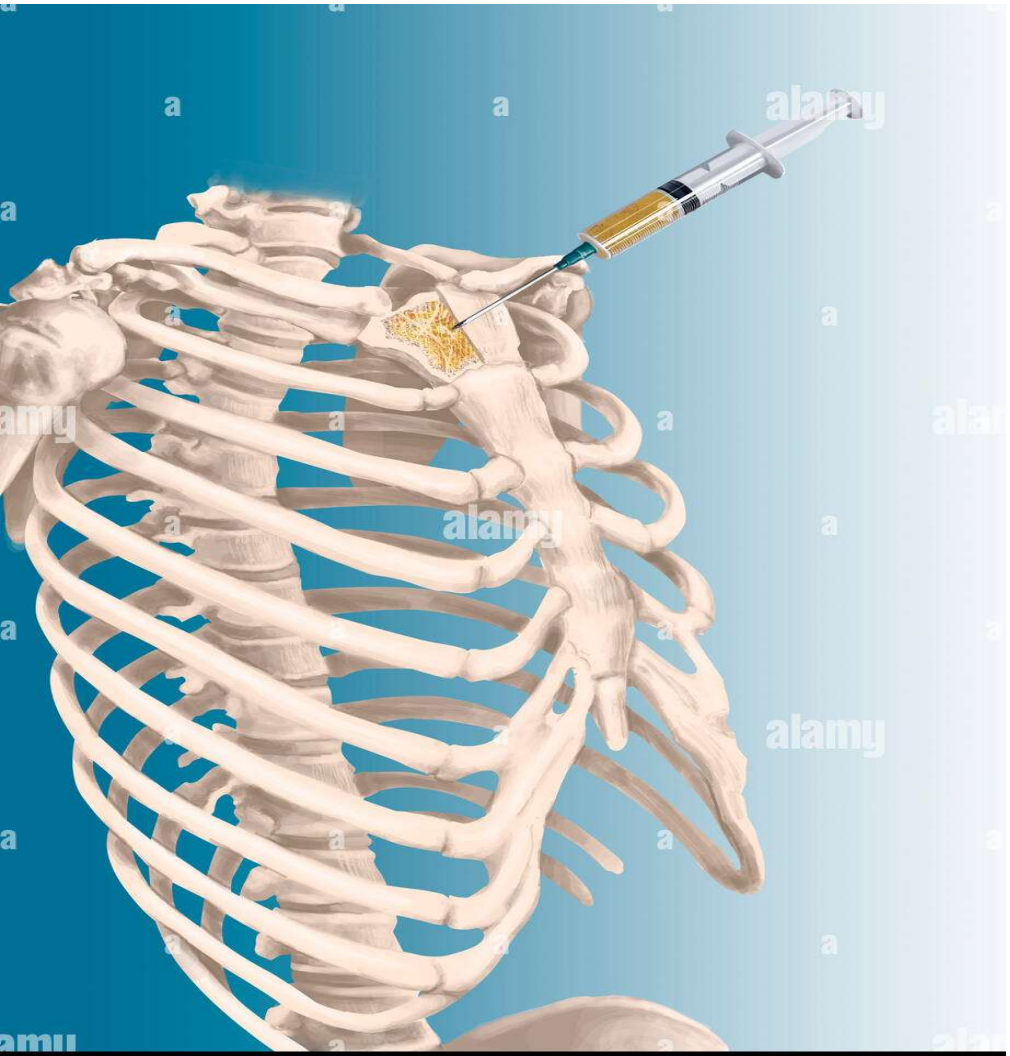


Bone marrow biopsy

Ribs

12 Pairs

True ribs

1st to 7th ribs

Attach to thoracic vertebrae and sternum

False ribs

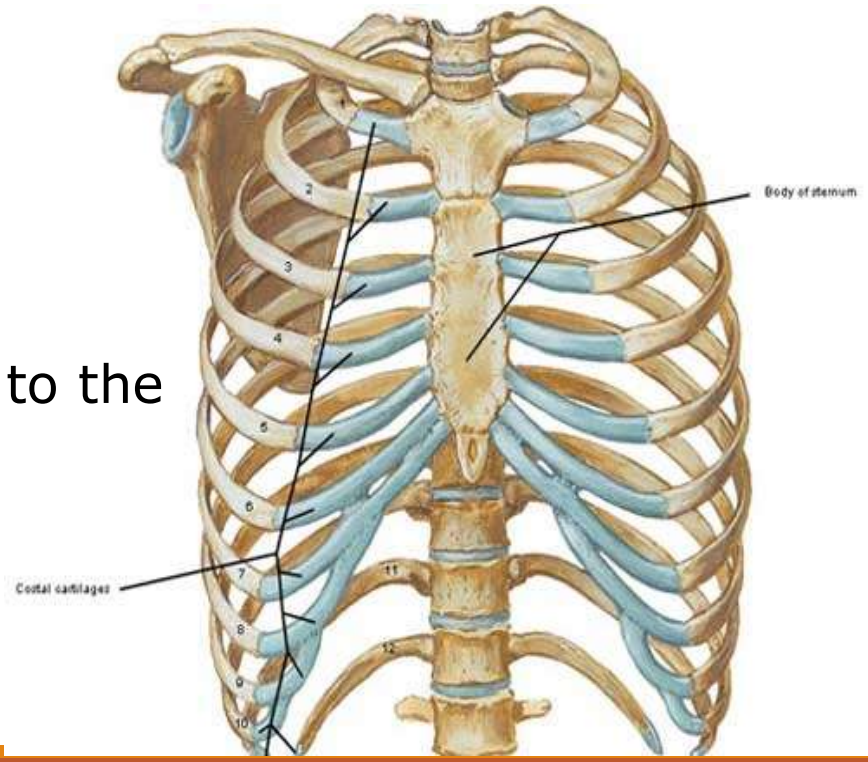
8th ,9th ,10th ribs

are attached anteriorly to each other and to the 7th rib

Floating ribs

11th ,12th ribs

Have no attachment in the front

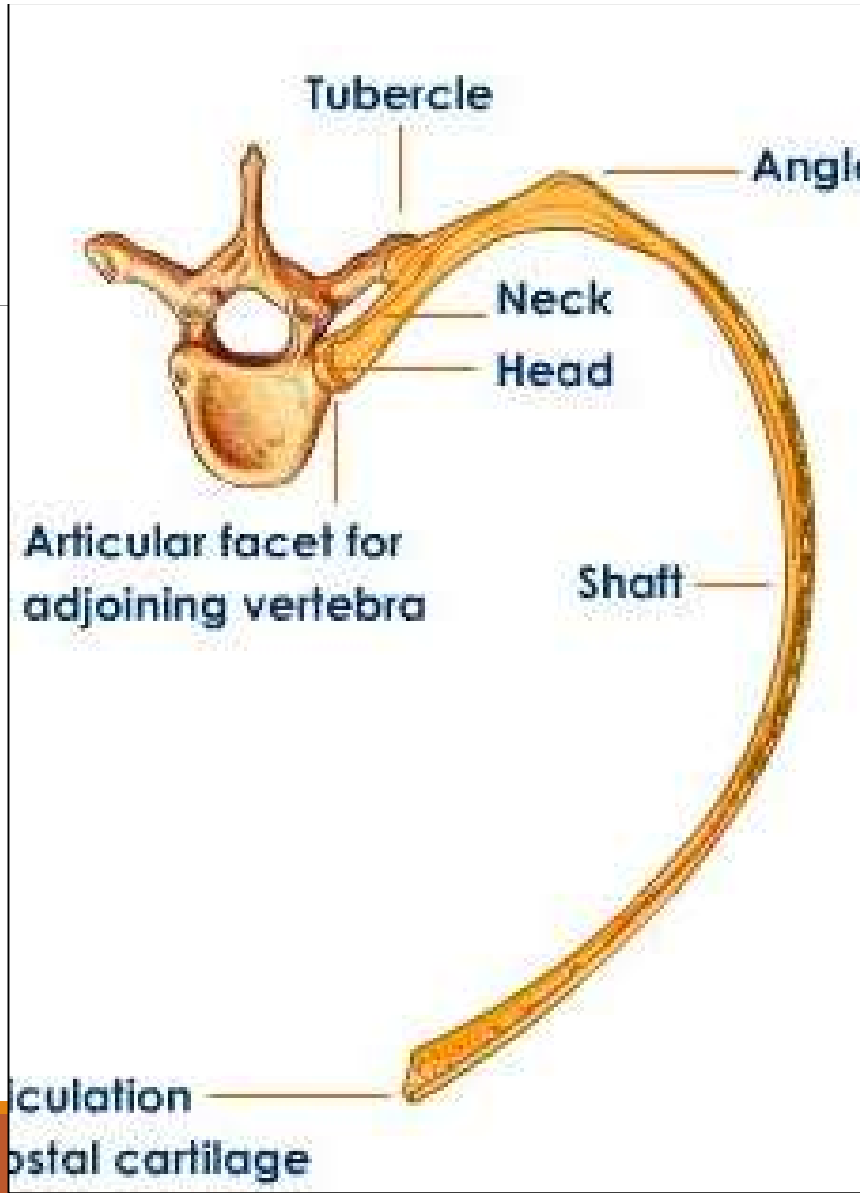


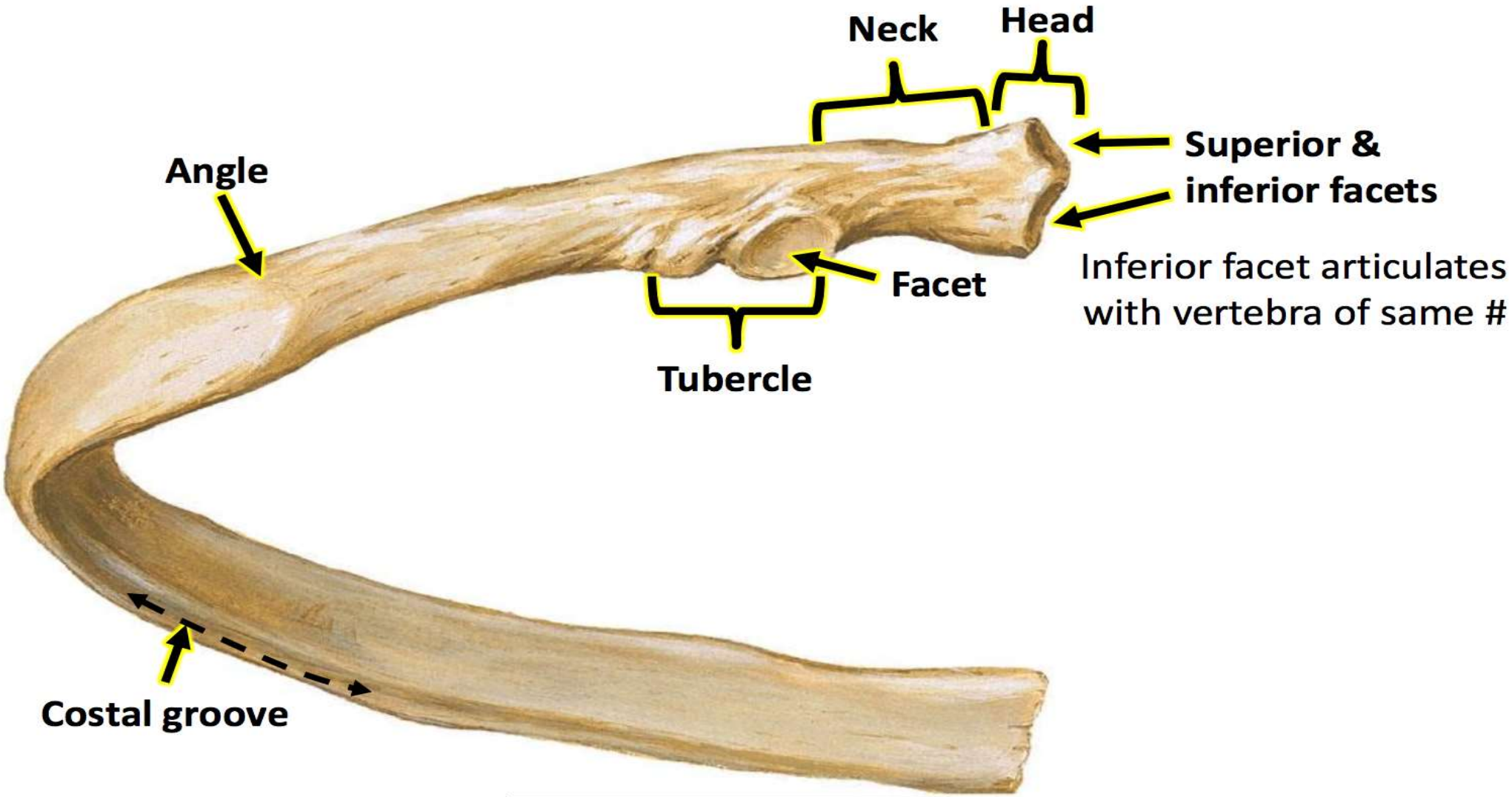
Ribs

Typical Rib should has this landmarks

- Head
- Neck
- Tubercle
- Angle
- Shaft or body
- **Subcostal Groove** , contains

A-Intercostal **V**ein
B-Intercostal **A**rtery
C-Intercostal **N**erve



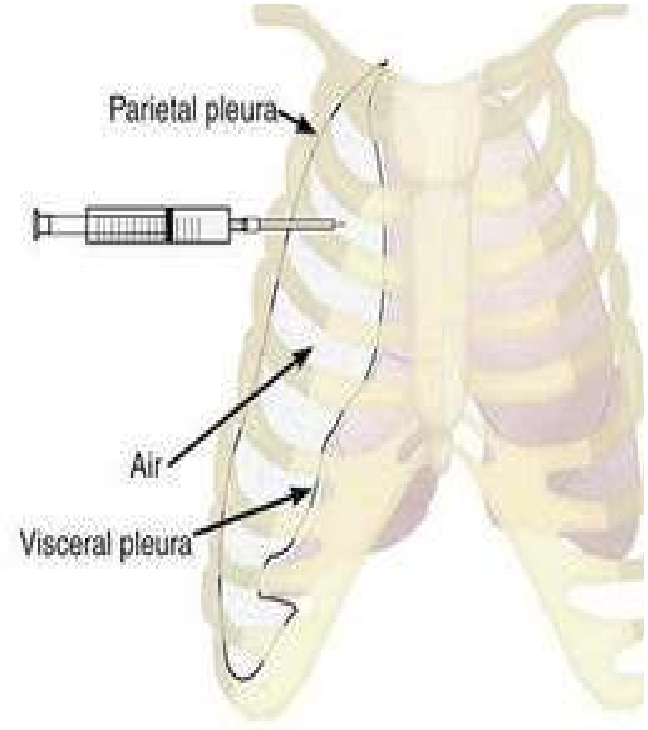


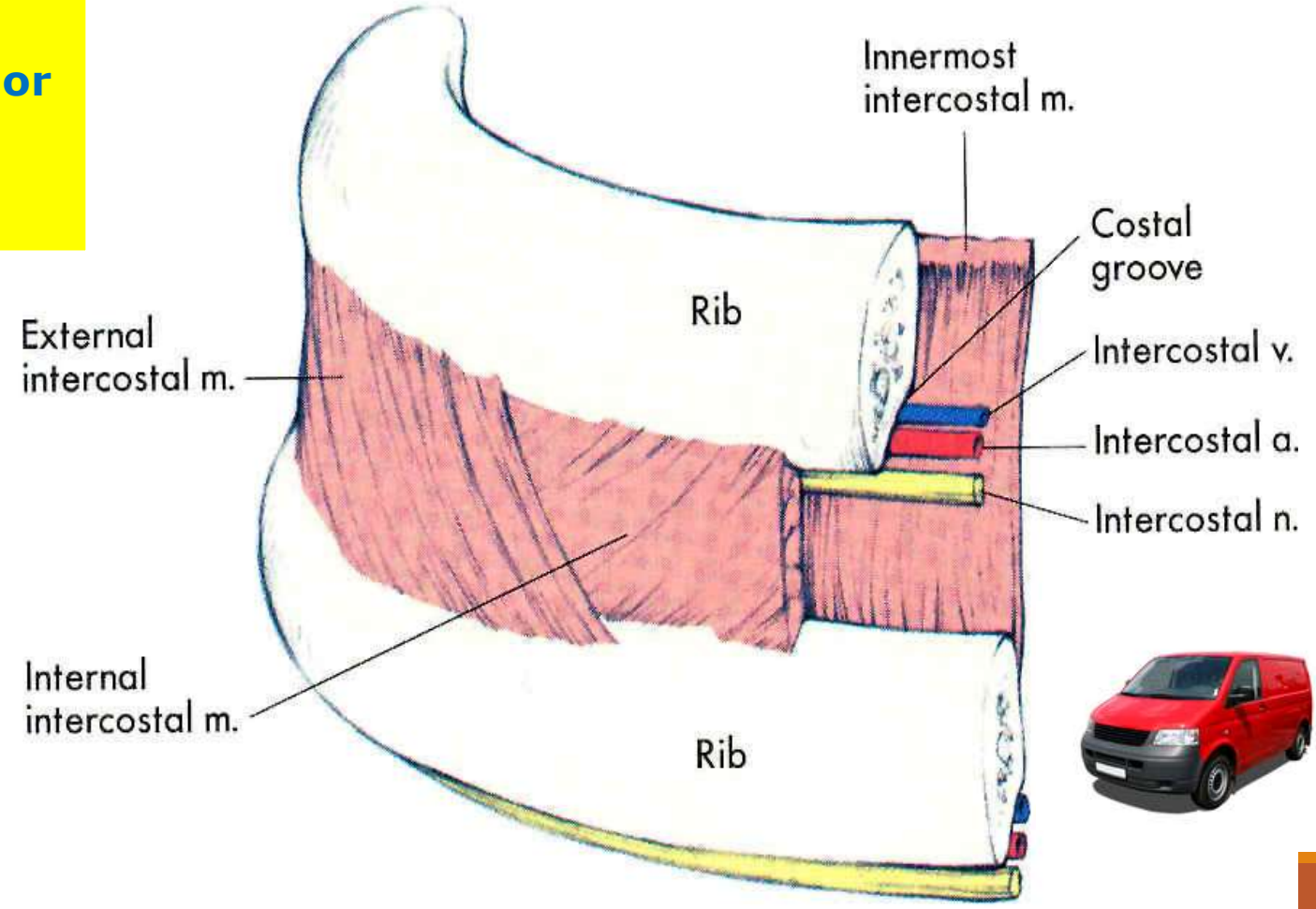
Left rib: Posterior view

Subcostal Groove : contains; Intercostal vein Intercostal artery and Intercostal nerve

VAN

The needle should be inserted above the superior border of the rib





Openings of the Thorax

Thoracic outlet

It is an opening between chest cavity and the root of the neck .

Boundaries :

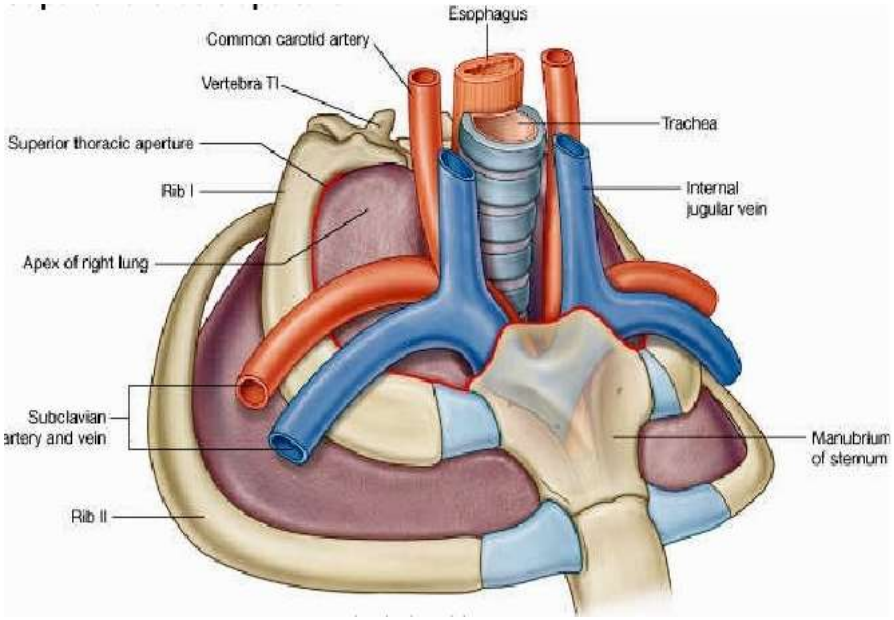
Anteriorly: Superior border of the manubrium sterni

Posteriorly : First thoracic vertebra

Laterally : Medial borders of the first ribs and their costal cartilages

Structure passing :

Esophagus , trachea and many vessels and nerves.



Inferior thoracic aperture

The thoracic cavity communicates with the abdomen through a large opening.

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- **Boundaries :**

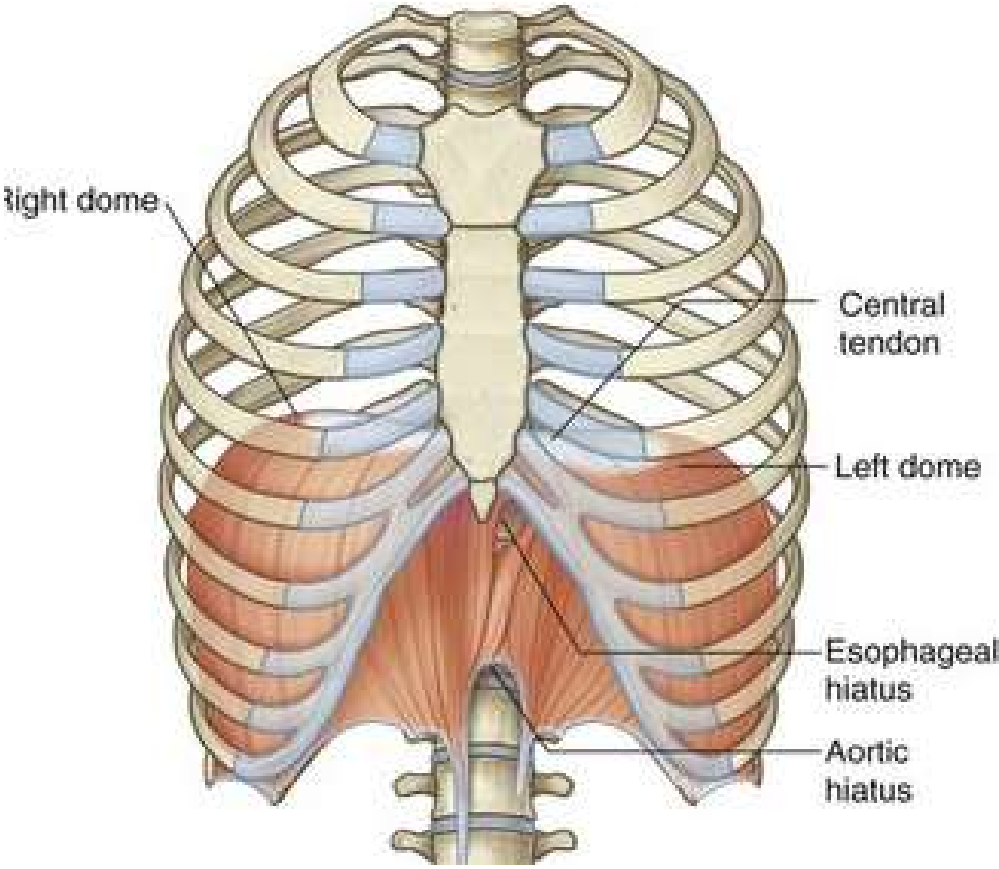
Anteriorly : Xiphisternal joint

Posteriorly : 12th thoracic vertebra

Laterally : Costal margin

Structure passing :

esophagus and many large vessels and nerves, through diaphragm foramina



The Thoracic Outlet Syndrome

Cause :

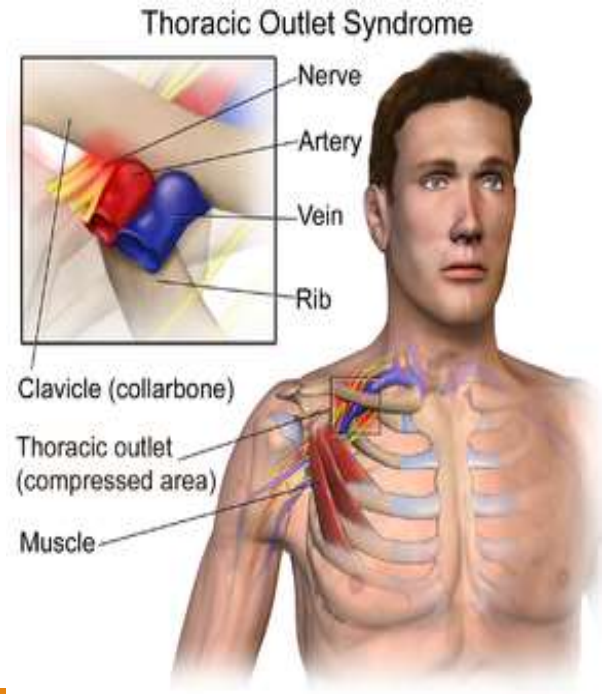
Compression of roots of brachial plexus (C5, 6, 7, and 8 and T1) and the subclavian artery and vein against 1st rib

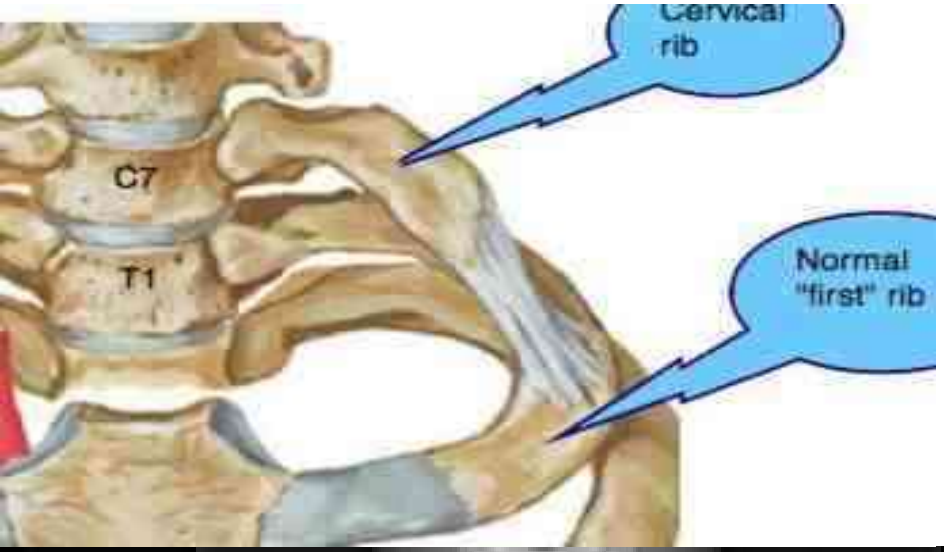
Cervical Rib

A cervical rib (a rib arising from the anterior tubercle of the transverse process of the 7th cervical vertebra) It may have a free anterior end or connected to the 1st rib by a fibrous band.

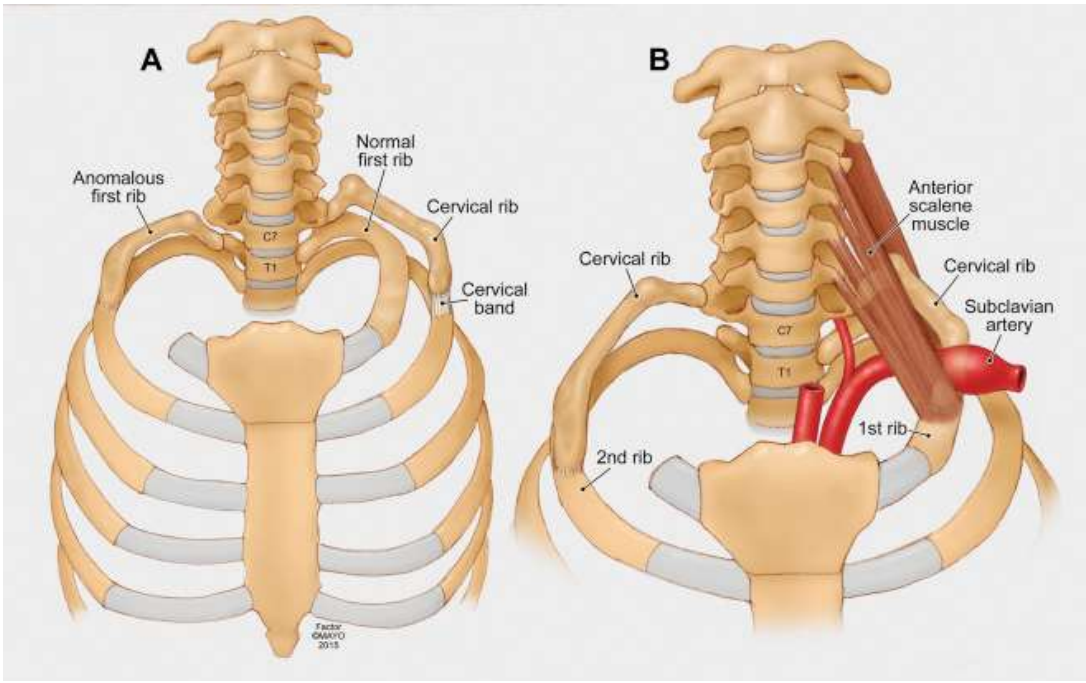
Symptoms :

Compression of nerves leads to pain down the medial side of the forearm and hand and wasting of the small muscles of the hand

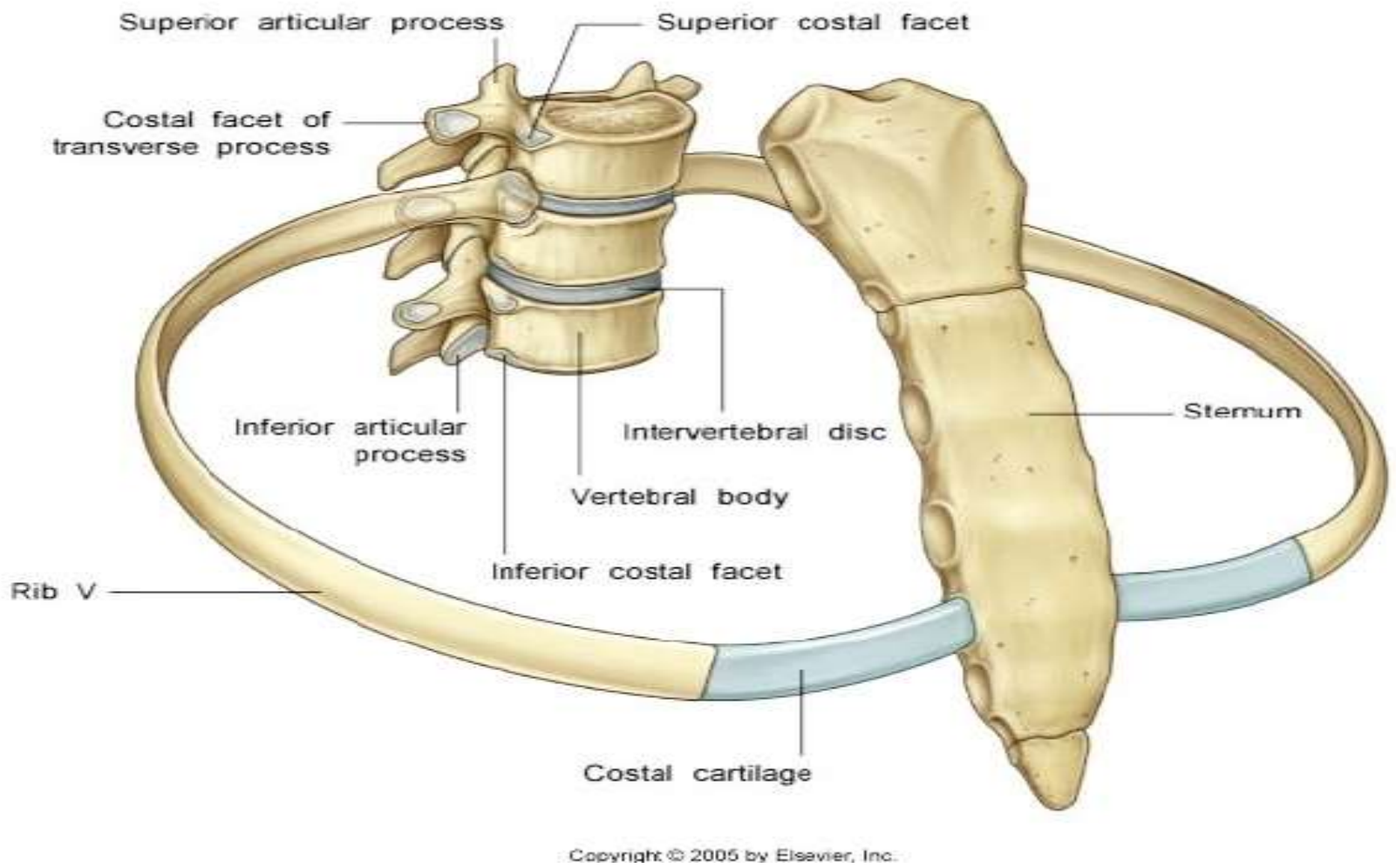



Cervical rib
C7
T1
Normal "first" rib


L


A
Anomalous first rib
Normal first rib
Cervical rib
C7
T1
Cervical band
B
Anterior scalene muscle
Cervical rib
Cervical rib
Subclavian artery
C7
T1
1st rib
2nd rib

Joints of the Chest Wall



I- Joints of the Sternum

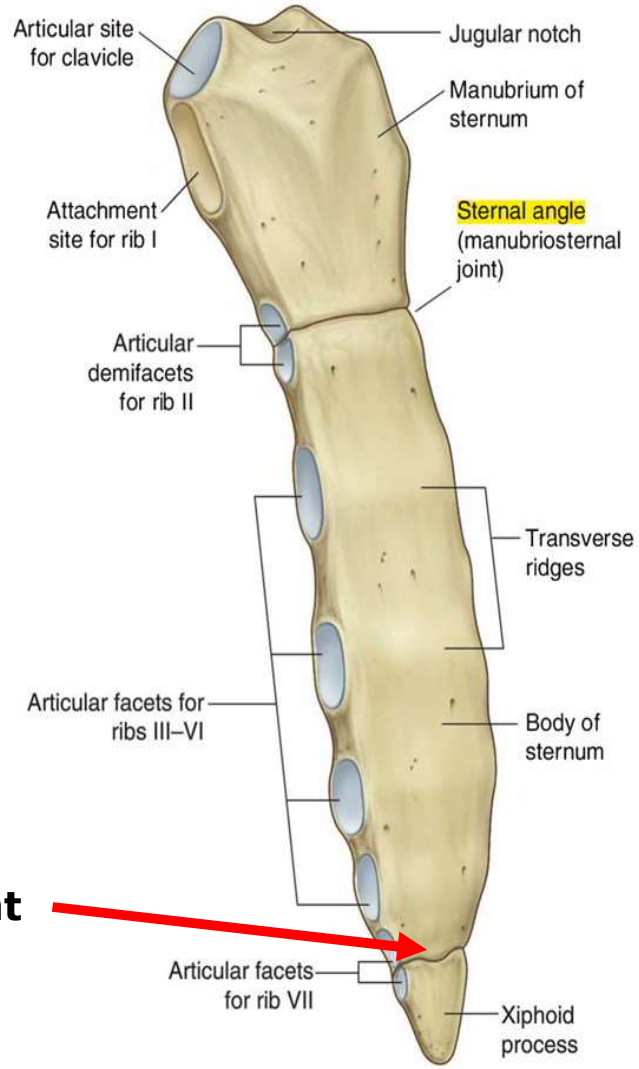
A.Manubriosternal joint

Secondary cartilaginous joint between the manubrium and the body of the sternum.

A small amount of angular movement is possible during respiration.

B.Xiphisternal joint

Secondary cartilaginous joint between the xiphoid process and the body of the sternum.



Xiphisternal joint

II- Costovertebral Joints

A. Costocorporeal joint (Joints of the Heads of the Ribs)

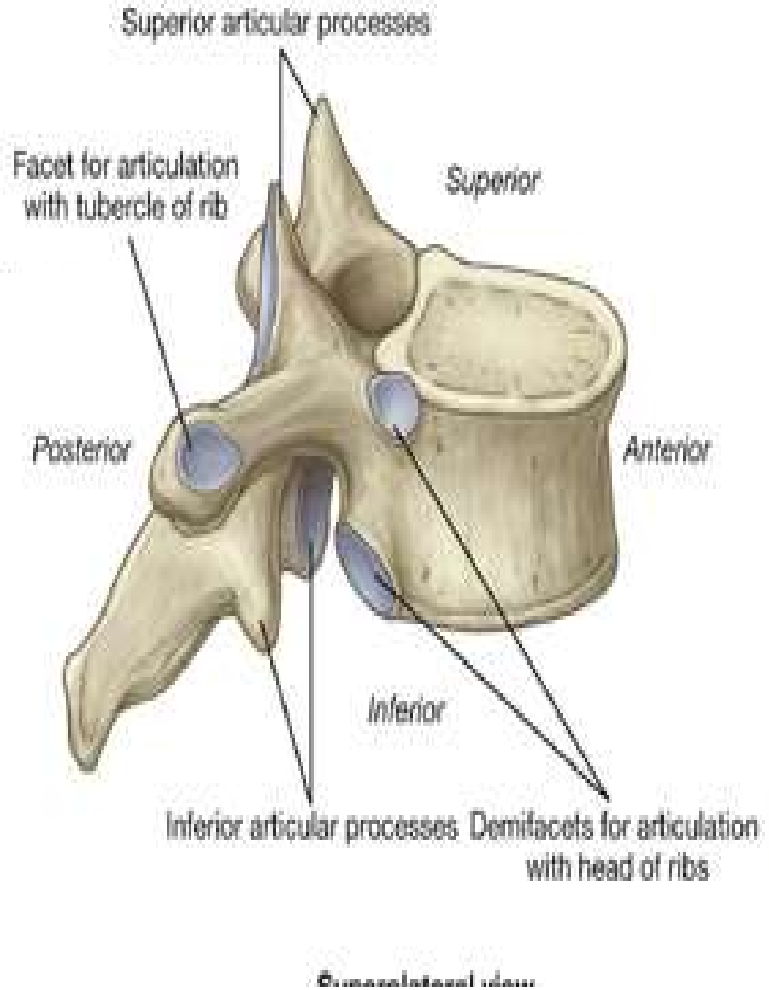
- Plane Synovial joint
- Between the head of typical rib and corresponding vertebrae
- The ribs articulate with corresponding vertebral body and that of the vertebra above it.
- 1st rib and last three ribs articulate with corresponding vertebral body only.
- There is a strong **intraarticular ligament** that connects the head to the intervertebral disc.

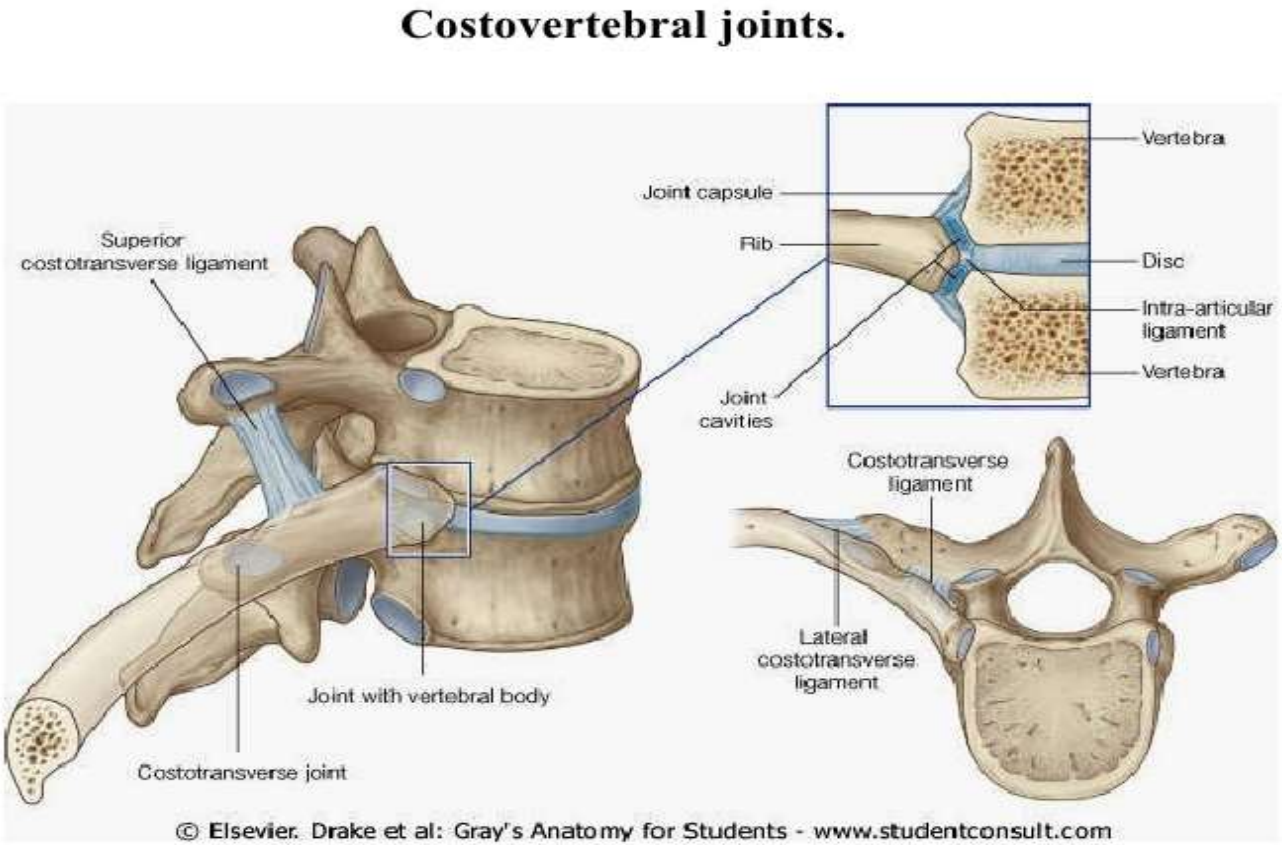
B. Costotransverse Joint

- Plane Synovial joint
- Between tubercle of ribs and transverse process of corresponding vertebrae

N.B *This joint is absent on the 11th and 12th ribs*

Articulation of Ribs with Vertebra





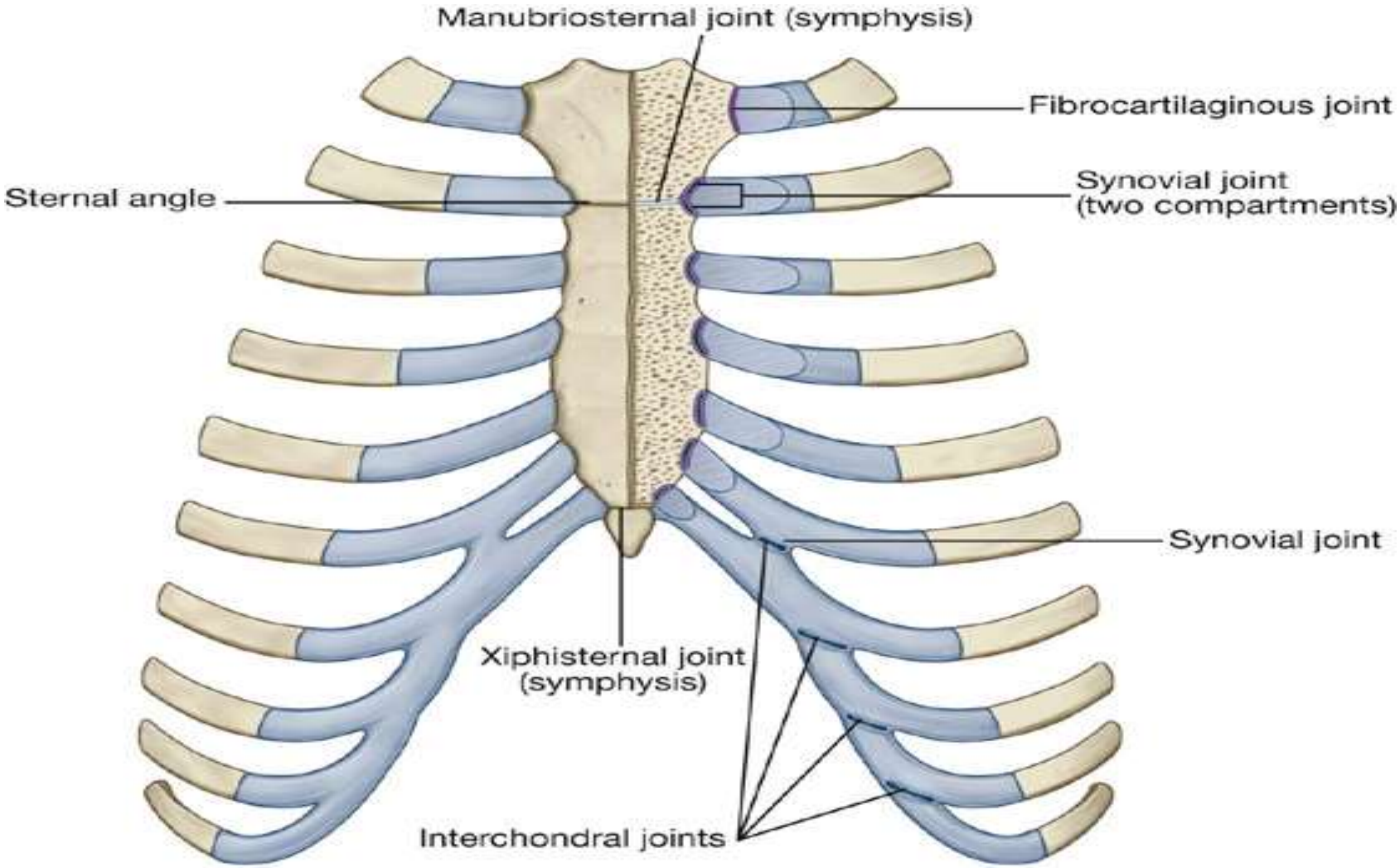
III- Joints of the Costal Cartilages

A.Sternocostal Joint

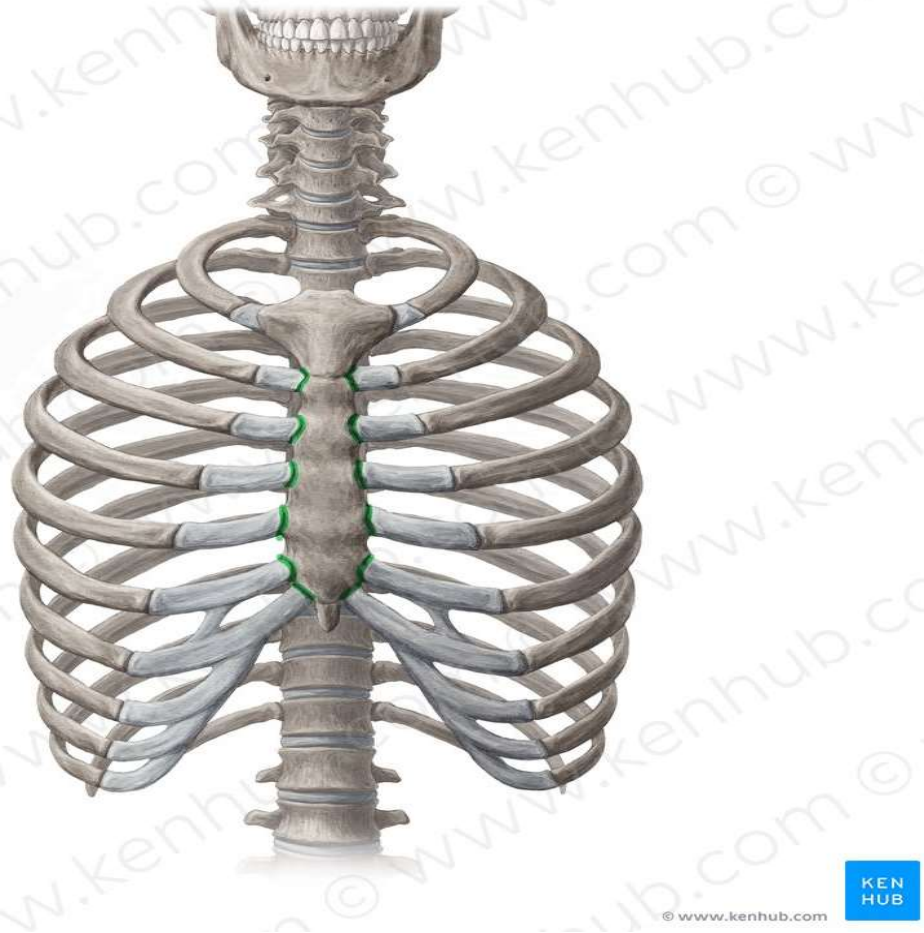
- Plane Synovial joint
- Between sternum and costal cartilage of true ribs
- The 1st costal cartilages articulate with the manubrium, by cartilaginous joints with no movement

B. Chostochondral Joint

- Cartilaginous joints.
- Between ribs and costal cartilage .
- No movement is possible.


Manubriosternal joint (symphysis)
Fibrocartilaginous joint
Sternal angle
Synovial joint
(two compartments)
Synovial joint
Xiphisternal joint
(symphysis)
Interchondral joints

Costochondral joints



Sternochondral joints

Intercostal muscles

1-External intercostal muscle

Its fibres are directed **downward and forward**

It extends from the inferior border of the rib above to the superior border of the rib below .

2-Internal intercostal muscle

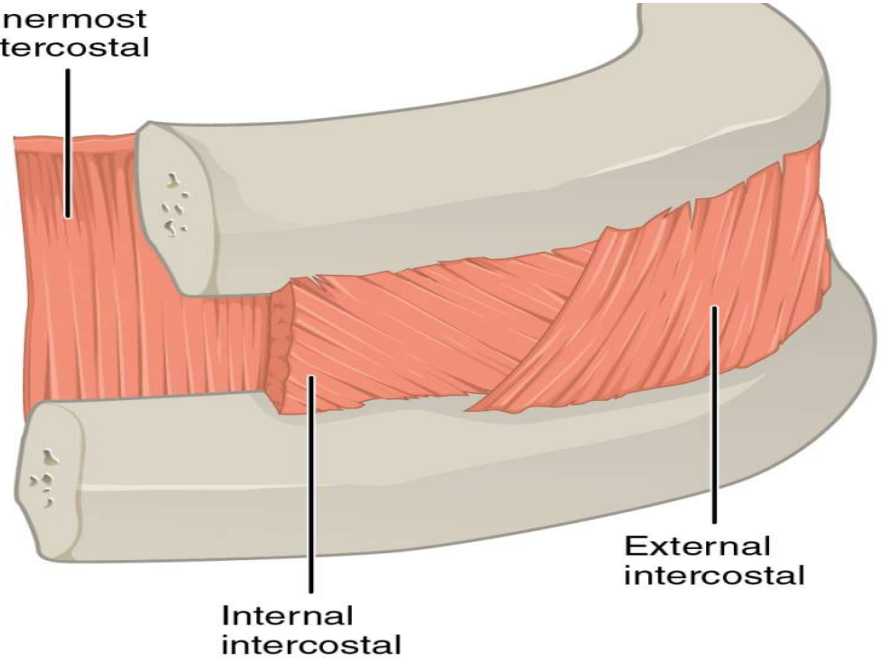
Its fibres are directed **downward and backward**

It extends from inferior border of the rib above to the upper border of the rib below

3-Innermost intercostal muscle

It is an incomplete muscle layer , It extends from inferior border of the rib above to the upper border of the rib below

Anterior



4-Subcostal muscle:

Arise from internal surface of the rib to internal surface of the rib 2-3 levels below the origin

Transversus thoracis muscle

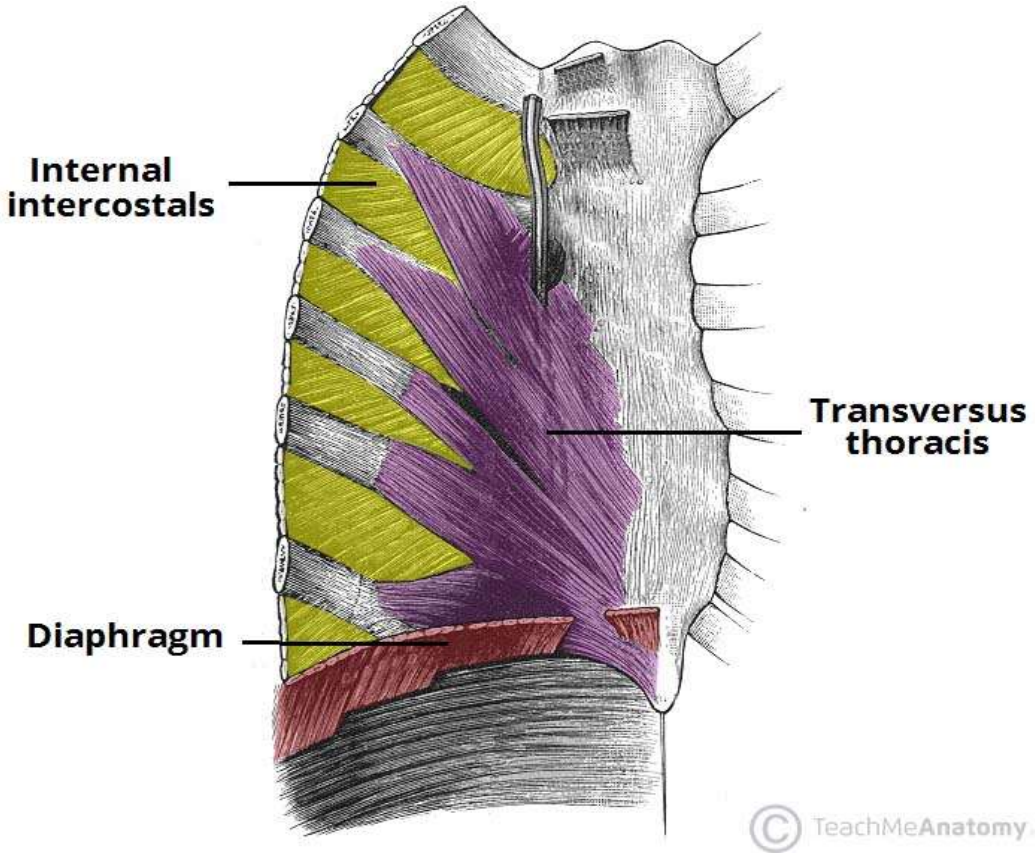
Posterior surface of lower sternum to internal surface of 2-6 costal cartilage

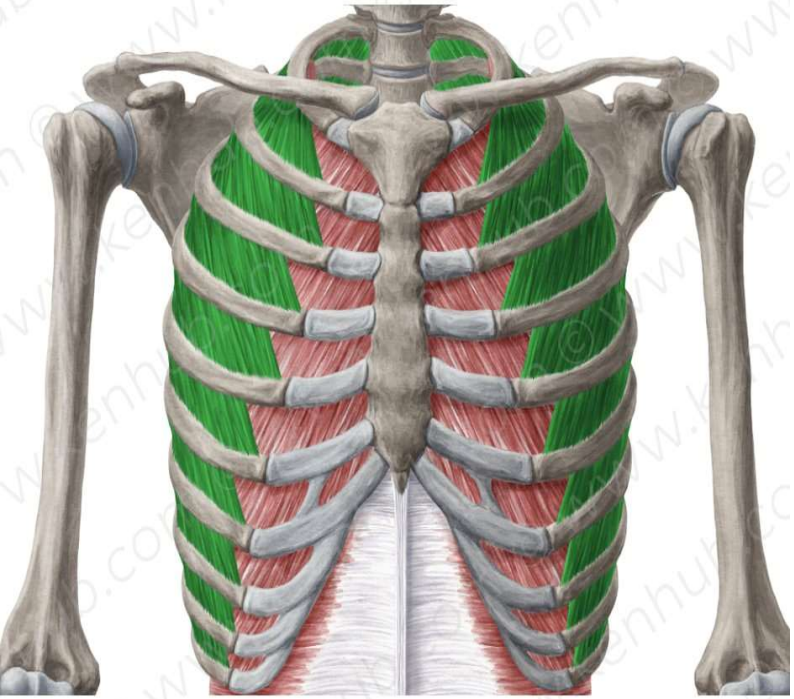
Nerve Supply

Intercostal nerves

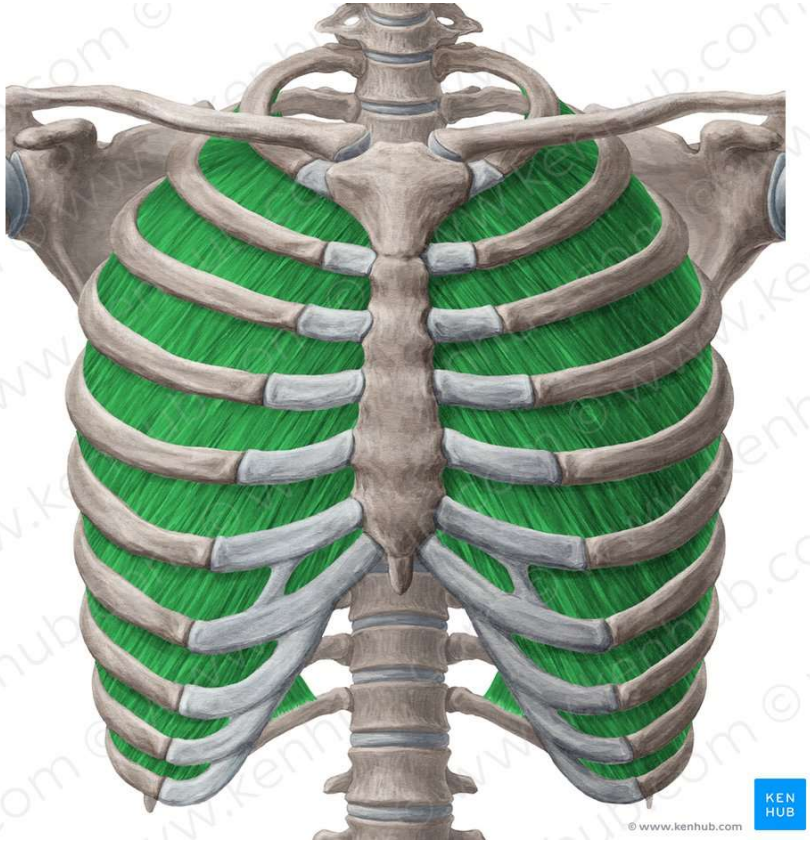
Action :

- ❑ Respiration
- ❑ Strengthen the intercostal spaces

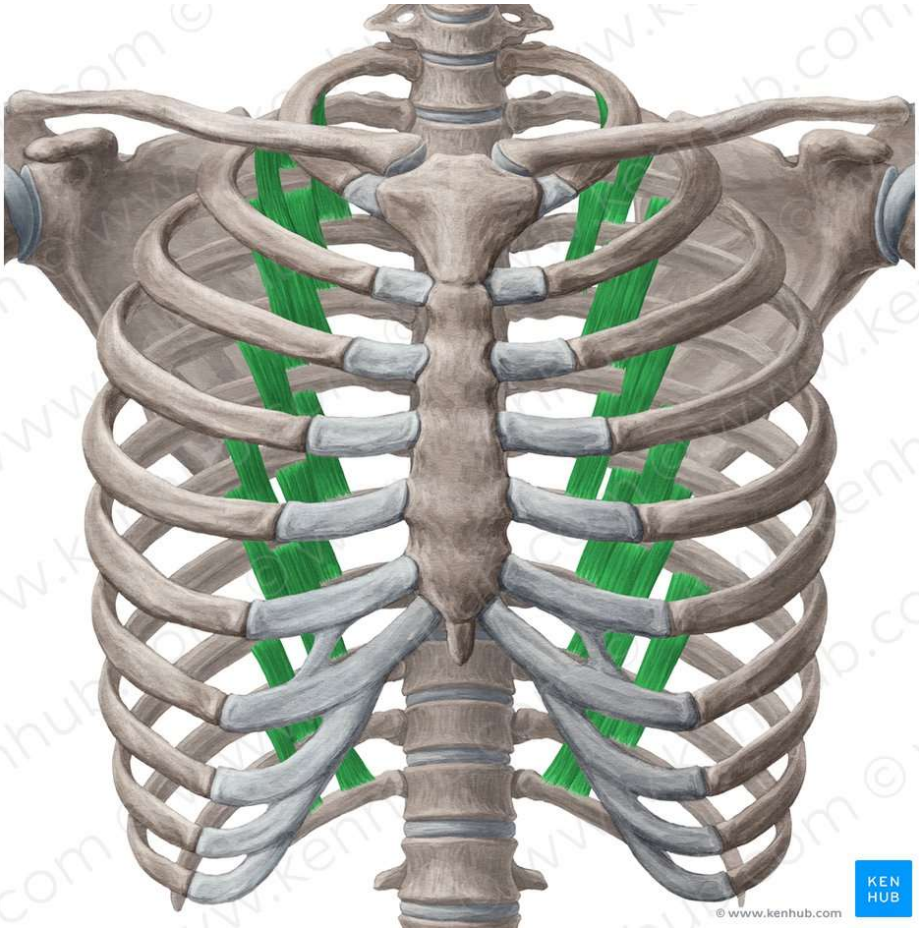




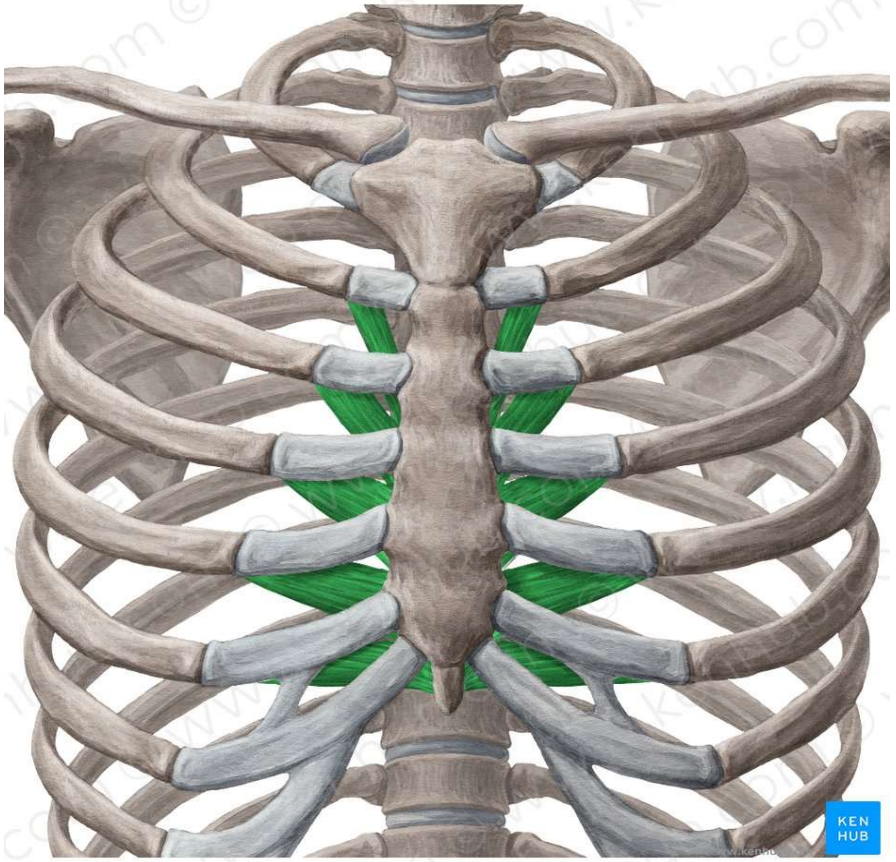
External intercostal muscle



Internal intercostal muscle



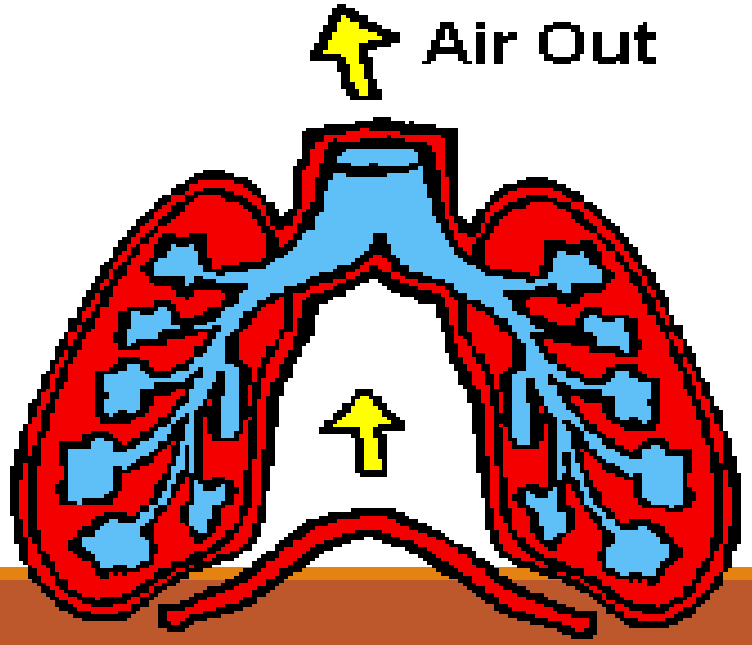
Subcostal muscle



Transversus thoracis muscle

Mechanism of Respiration

Normal respiratory rate is 16-20 /minute in resting .
It is faster in children and slower in elderly.
Respiration consists of two phases; inspiration and expiration



Inspiration

Quiet Inspiration

Thoracic cavity as a box with a single entrance at the top, which is a tube called the trachea

It has tree diameters ;

Vertical Diameter

The roof is formed by the suprapleural membrane and is fixed , the floor is formed by the mobile diaphragm.

When the diaphragm contracts, the level of the diaphragm is lowered.

Anteroposterior Diameter (Pump Handel movement)

The ribs were raised at their sternal ends, and the lower end of the sternum would be push forward .

This can be brought about by fixing the 1st rib and contracting the intercostal muscles.

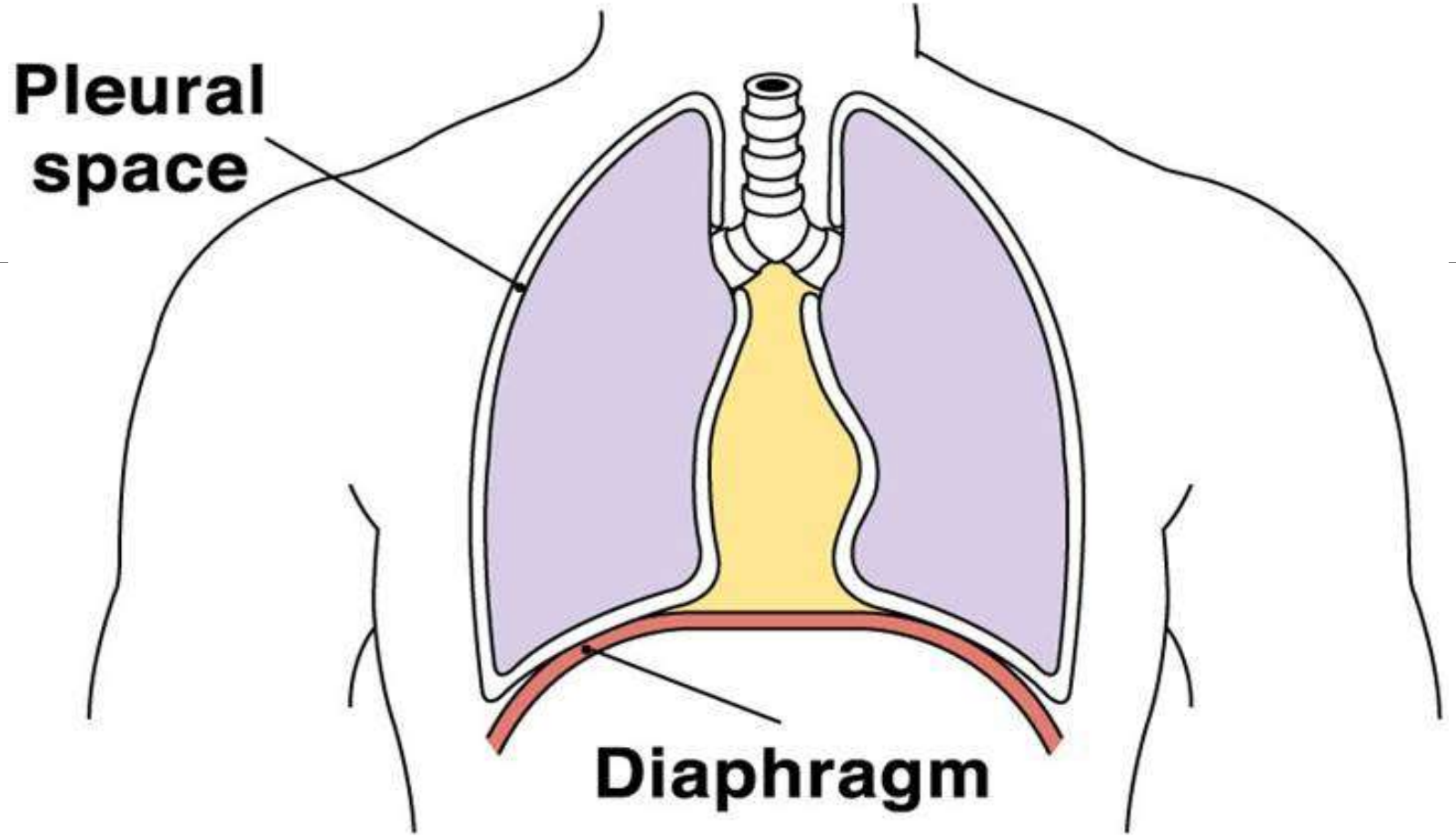
Transverse Diameter (bucket handles)

The ribs are raised , the transverse diameter of the thoracic cavity will be increased.

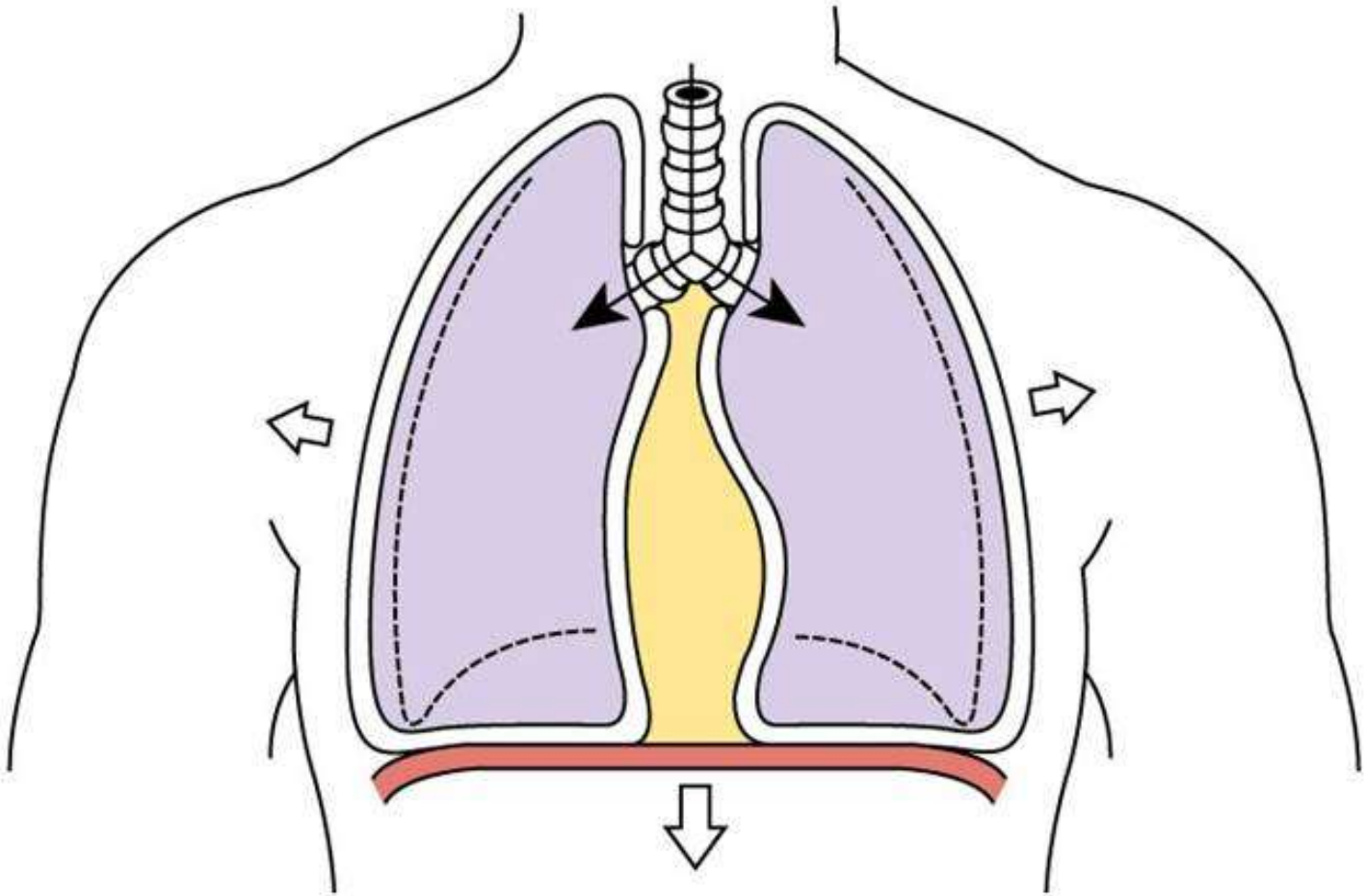
Expiration

Quiet Expiration

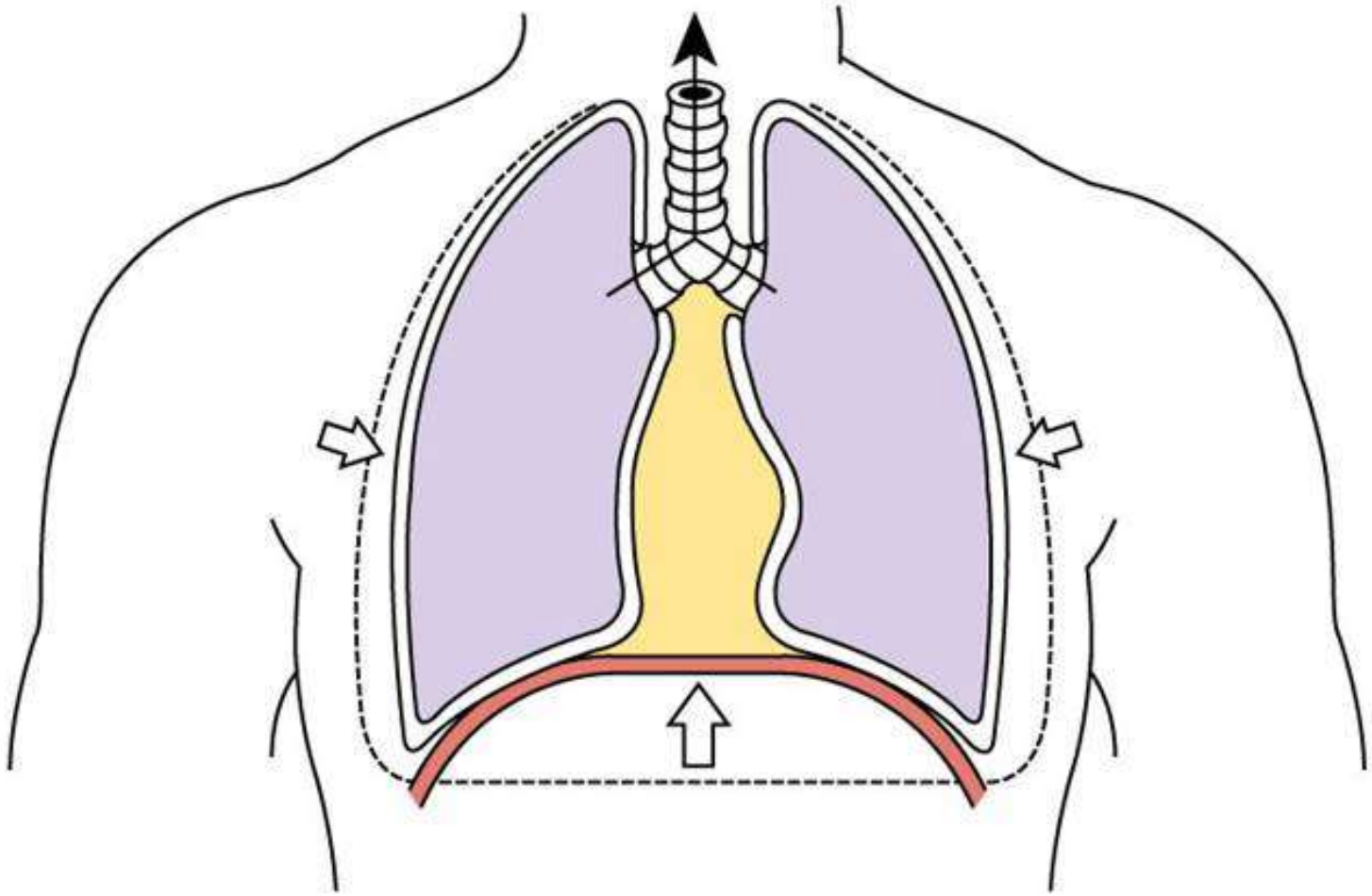
It is a passive phenomenon and is carried about by the elastic recoil of the lungs, the relaxation of the intercostal muscles and diaphragm, and an increase in tone of the muscles of the anterior abdominal wall muscles.



At rest, diaphragm is relaxed



Diaphragm contracts, thoracic volume increases.



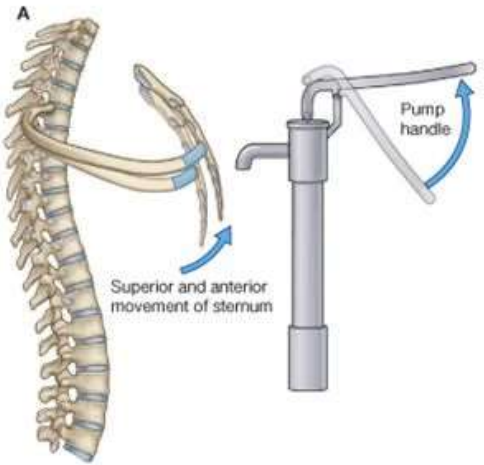
Diaphragm relaxes, thoracic volume decreases.

RESPIRATORY MOVEMENTS
B- MOVEMENTS OF RIBS

PUMP HANDLE MOVEMENT

Elevation of ribs

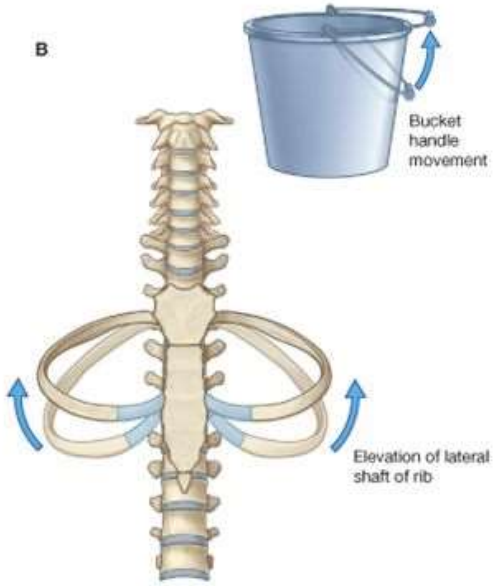
Increase in antero-posterior diameter of thoracic cavity



BUCKET HANDLE MOVEMENT

Elevation of ribs

Increase in lateral diameter of thoracic cavity



Respiratory Muscles

Main Muscles of respiration

- Diaphragm
- Intercostal muscles

Accessory Muscles of respiration

They helps in respiration especially in respiratory distress

Accessory muscles of inspiration:

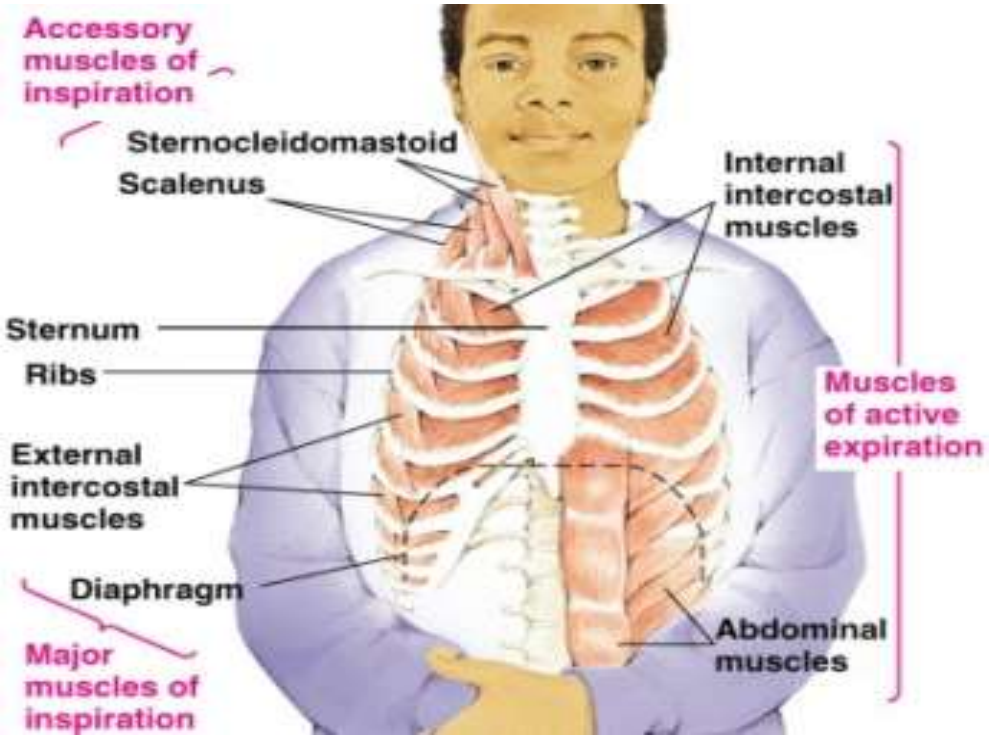
Pectoralis major and minor, Serratus anterior, Scalene group of muscles and sternocleidomastoid

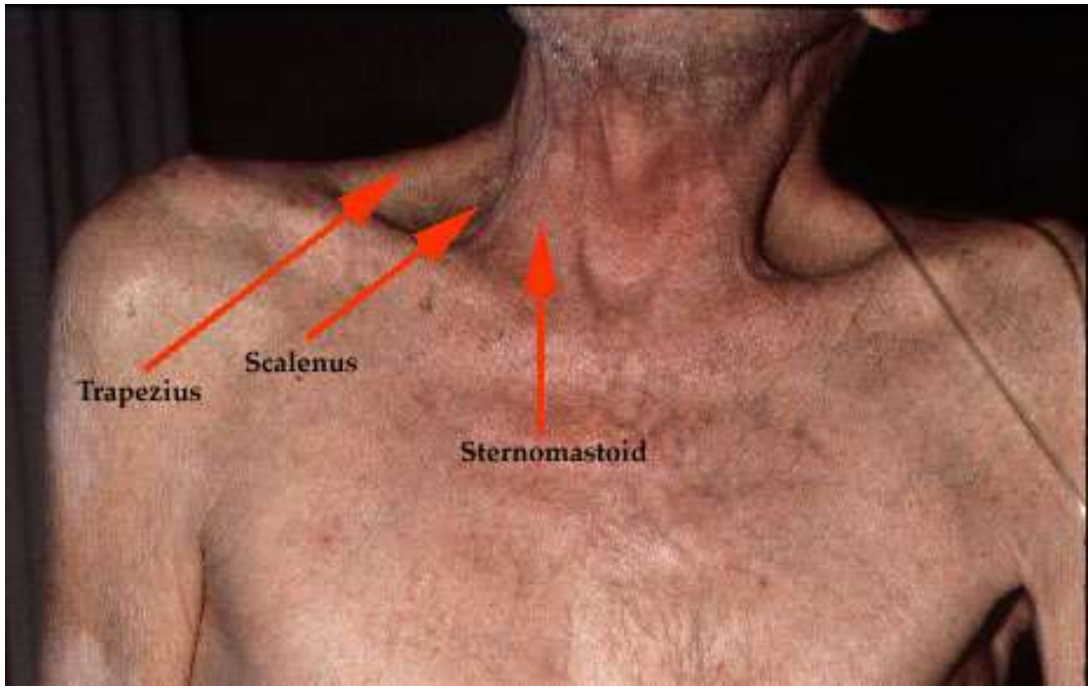
By elevation of first and second ribs.

Accessory muscles of Expiration

Muscles of anterior abdominal wall, quadratus lumborum, latissimus dorsi and serratus posterior inferior.

muscles of anterior abdominal wall compress the lower part of thorax and increased the intra-abdominal pressure whereas quadratus lumborum fixes the 12th rib


Accessory muscles of inspiration
Sternocleidomastoid
Scalenus
Internal intercostal muscles
Sternum
Ribs
Muscles of active expiration
External intercostal muscles
Diaphragm
Abdominal muscles
Major muscles of inspiration


Trapezius
Scalenus
Sternomastoid

Intercostal nerves

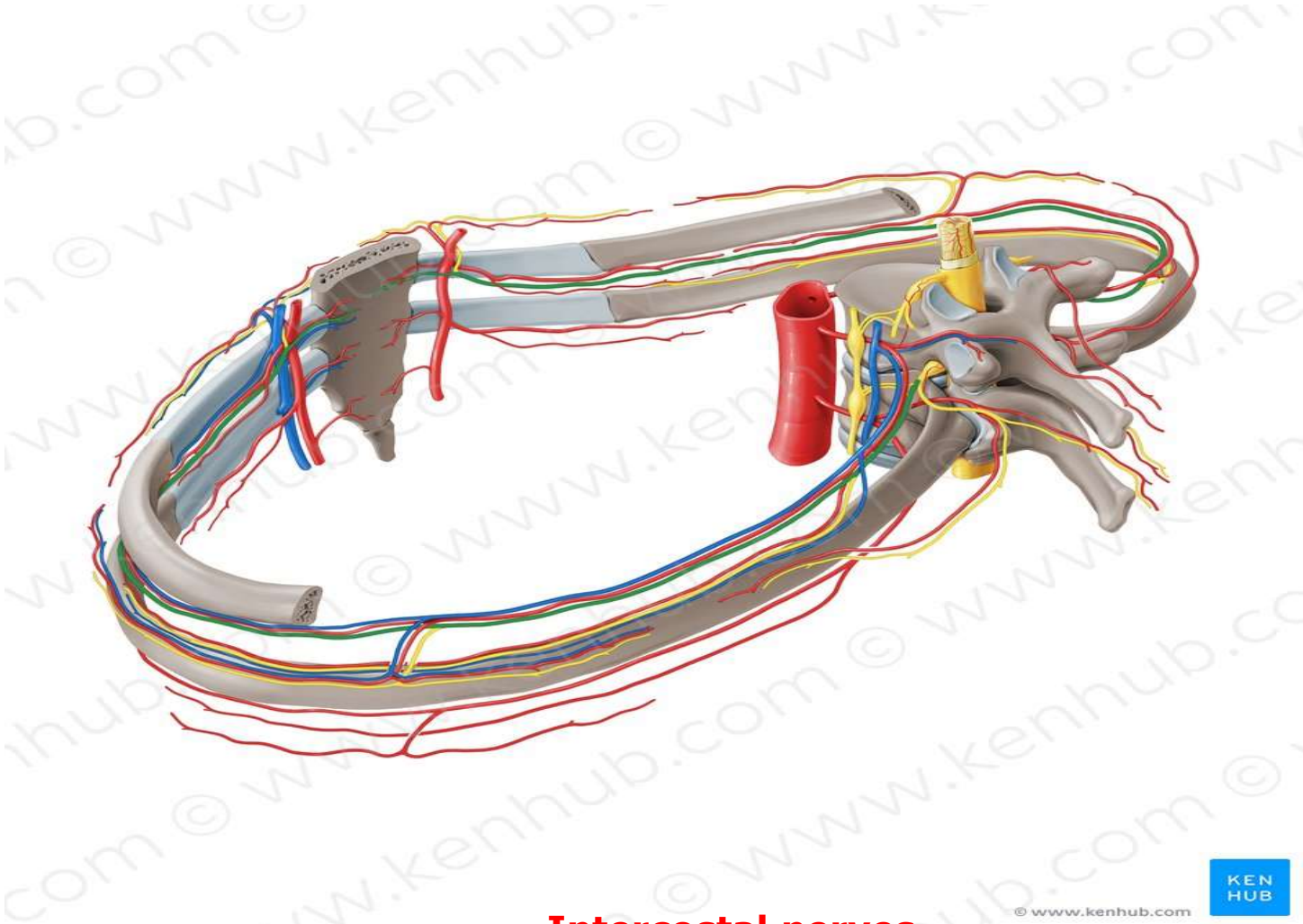
- It is a ventral ramus of thoracic nerves
- There are 12 nerves on each side
- The last one is called subcostal nerve

Branches of intercostal nerves

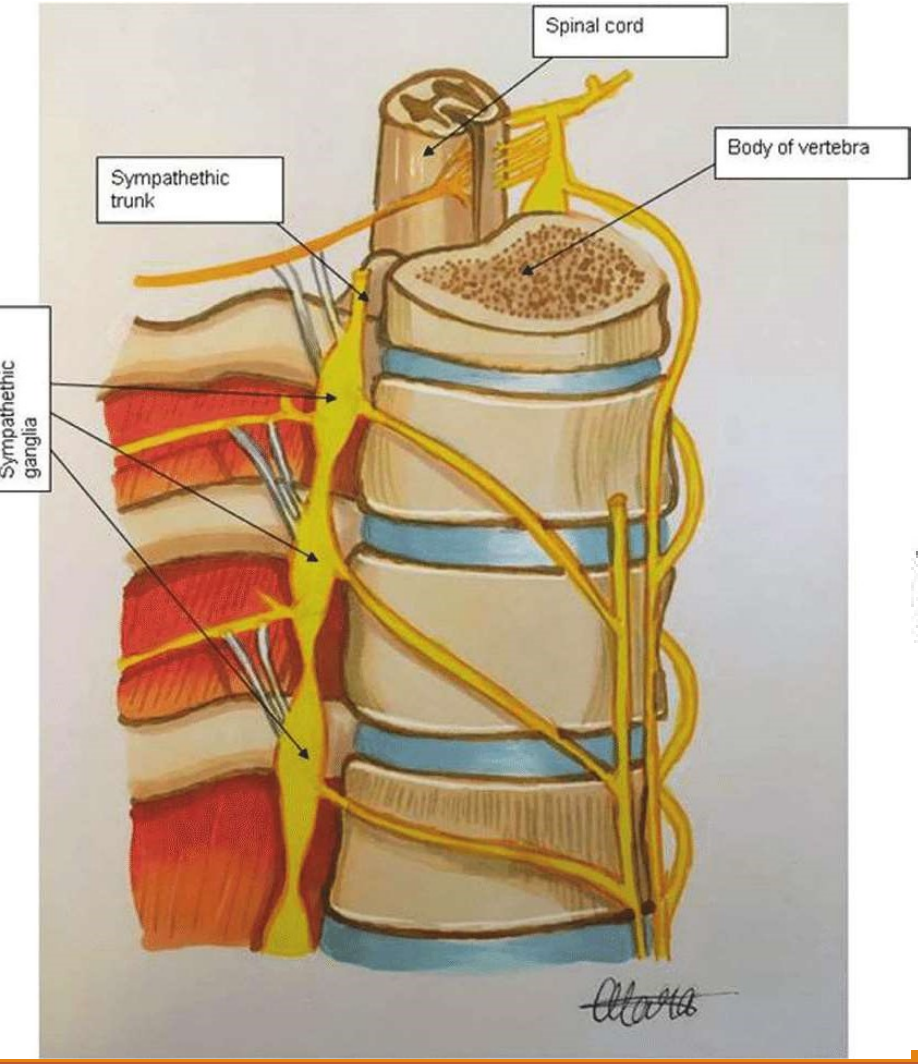
- ✓ **Collateral :supply :** Supply Intercostal muscles and parietal pleura
- ✓ **Rami communicating :**

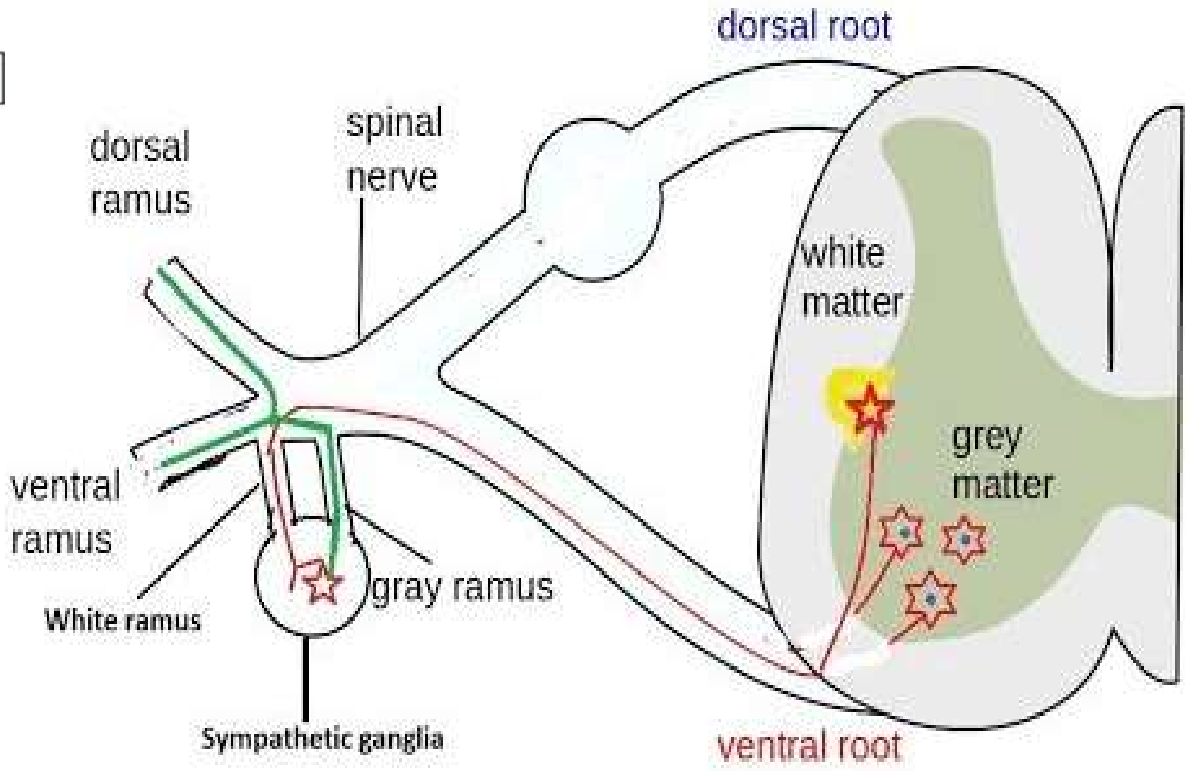
  White rami (preganglionic) sympathetic fibers to sympathetic trunk

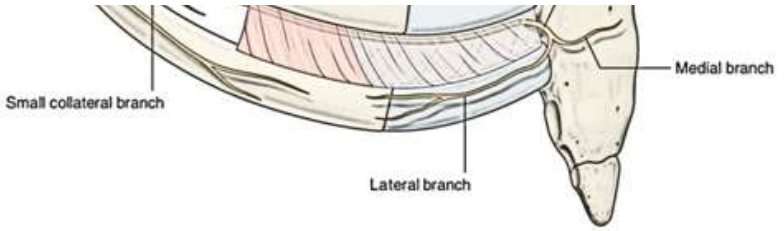
  Grey rami (preganglionic) sympathetic fibers to be distributed with spinal nerves
- ✓ **Muscular :** muscles of anterior thoracic & abdominal walls.
- ✓ **Anterior cutaneous :**Skin of anterior thoracic and abdominal wall
- ✓ **Lateral cutaneous :** Skin of lateral thoracic and abdominal wall



Intercostal nerves


Spinal cord
Body of vertebra
Sympathethic trunk
Sympathethic ganglia


dorsal root
dorsal ramus
spinal nerve
white matter
grey matter
ventral ramus
White ramus
gray ramus
Sympathetic ganglia
ventral root


Small collateral branch
Medial branch
Lateral branch

Arterial supply of thoracic wall

Anterior wall

9 on each side

2 in each space

Upper 6 from internal thoracic artery.

7,8,9 from musculophrenic artery

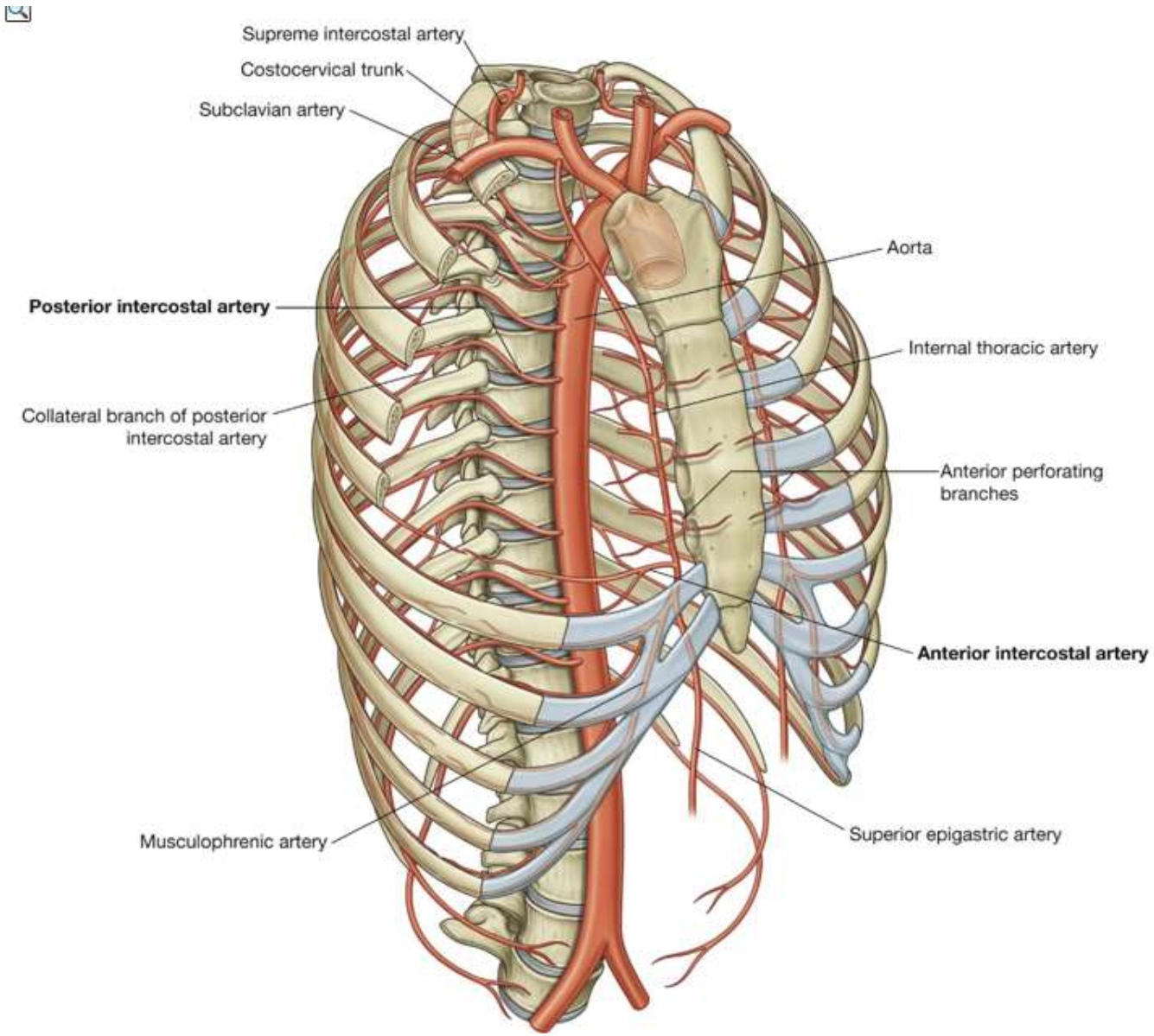
Posterior wall

11 on each side

One in each space

1st ,2nd from superior intercostal artery.

3 -11 from descending thoracic aorta.


Supreme intercostal artery
Costocervical trunk
Subclavian artery
Aorta
Posterior intercostal artery
Internal thoracic artery
Collateral branch of posterior intercostal artery
Anterior perforating branches
Anterior intercostal artery
Musculophrenic artery
Superior epigastric artery

Internal Thoracic (Mammary) artery

Origin: branch of 1st part of subclavian artery

Course: it descends vertically behind upper 6 costal cartilages and intercostal spaces

Termination: opposite the 6th intercostal space into : superior epigastric A. and Musculophrenic A.

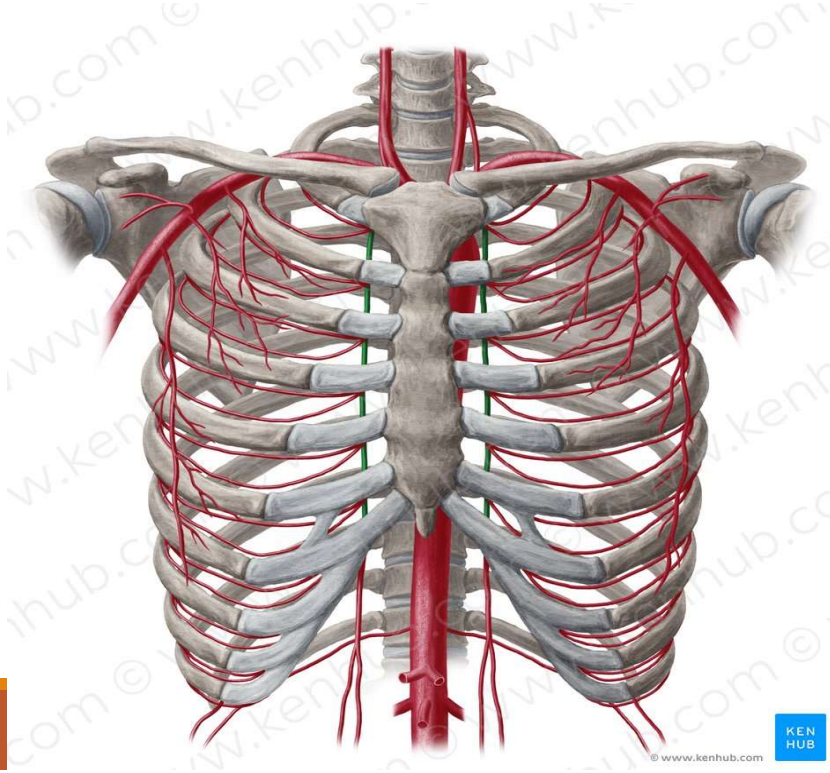
Branches : REED ONLY

1-Pericardio-phrenic

2- Pericardial branches

3- Anterior intercostal a to upper six spaces.

4- Perforating branches to skin , muscles and mammary gland.



Venous drainage of thoracic wall

Anterior wall

Anterior intercostal veins
Drain into Internal thoracic vein

Posterior wall

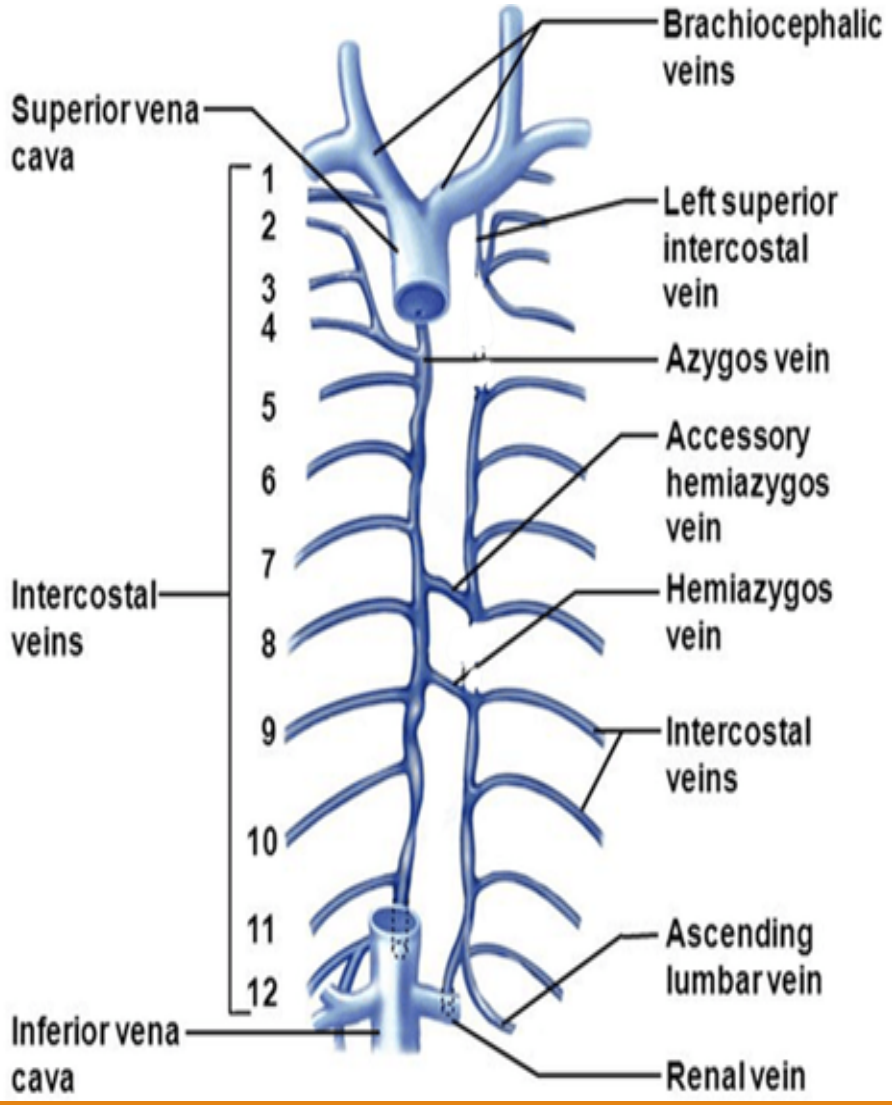
1st intercostal vein drains into brachiocephalic vein

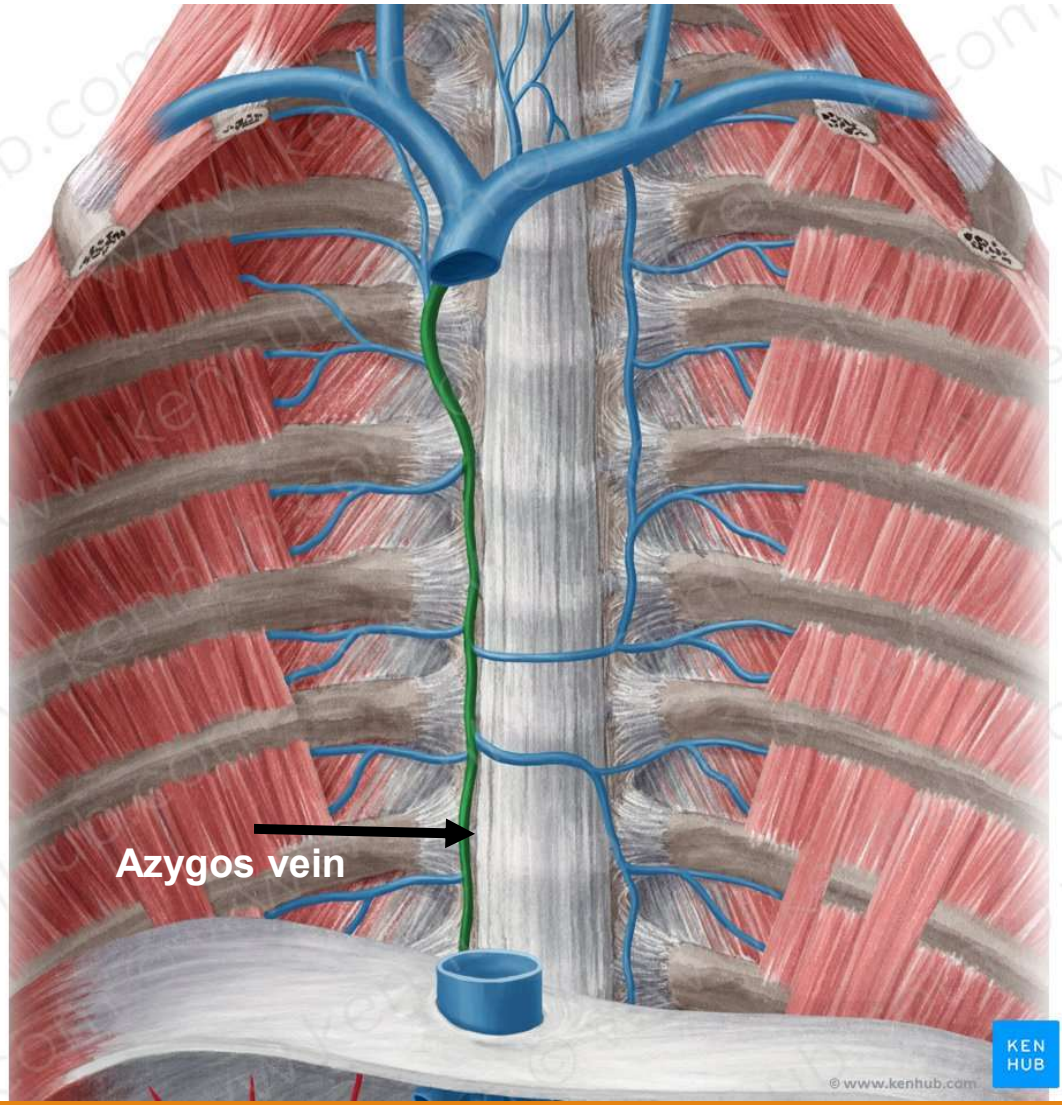
Right

2nd -11th drain into azygos vein

Left

- 2nd ,3rd drain into left brachiocephalic vein
- 4th -8th drain into superior hemiazygos vein
- 9th -11th drain into inferior hemiazygos vein


Brachiocephalic veins
Superior vena cava
1
2
3
4
Left superior intercostal vein
Azygos vein
5
6
7
8
9
10
11
12
Accessory hemiazygos vein
Hemiazygos vein
Intercostal veins
Intercostal veins
Ascending lumbar vein
Inferior vena cava
Renal vein


Azygos vein
KEN HUB
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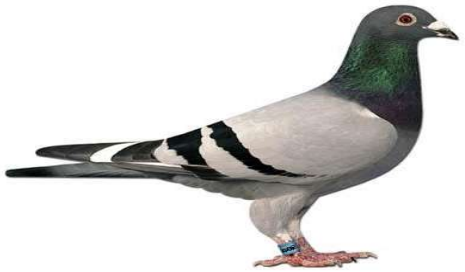
Chest wall abnormalities

1- Pectus excavatum (sunken or funnel chest)

It is a congenital deformity in which several ribs and the sternum grow abnormally, producing a concave, or caved-in, appearance in the anterior chest wall.

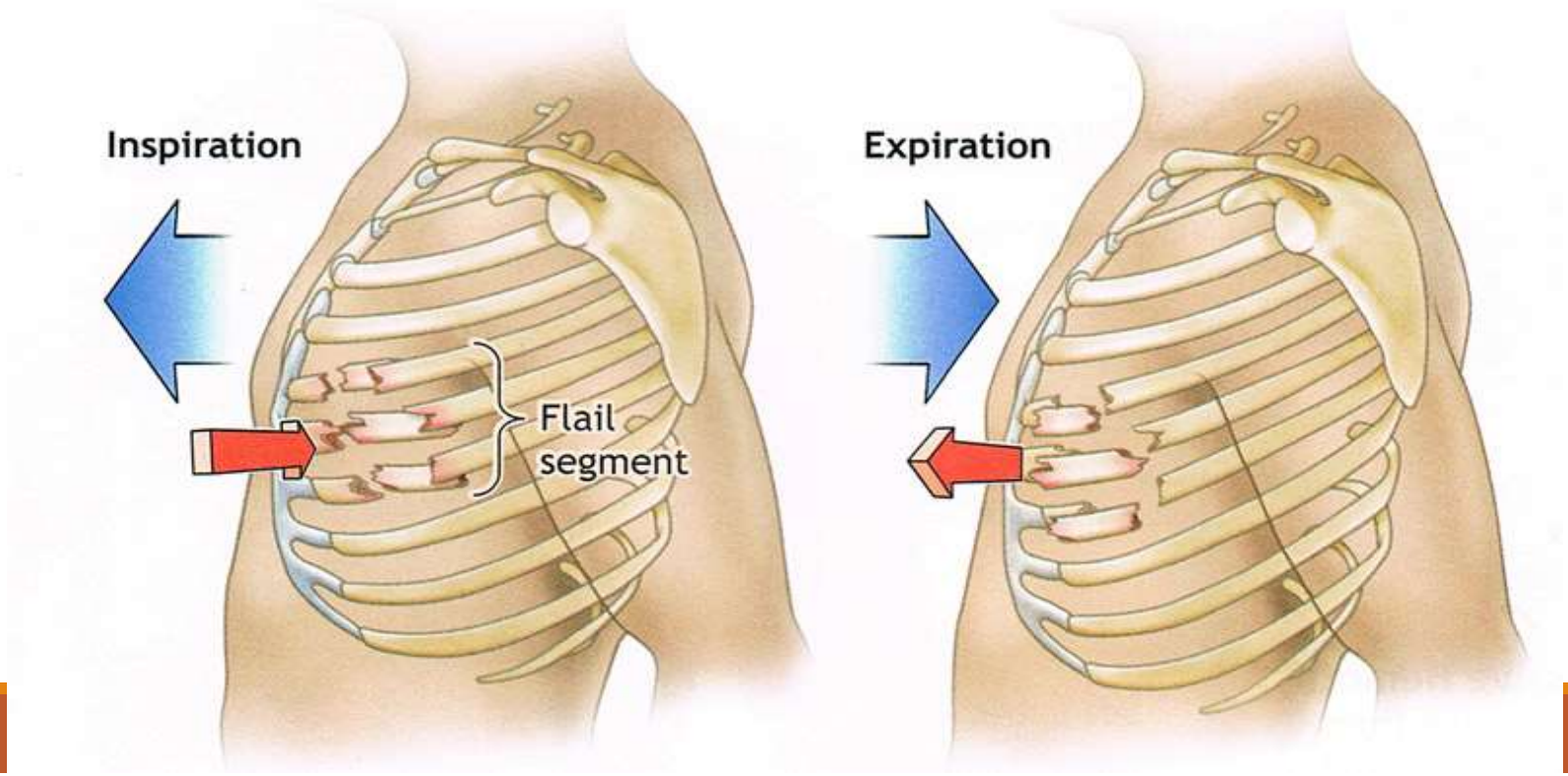
2- Rectus carinatum (pigeon chest)

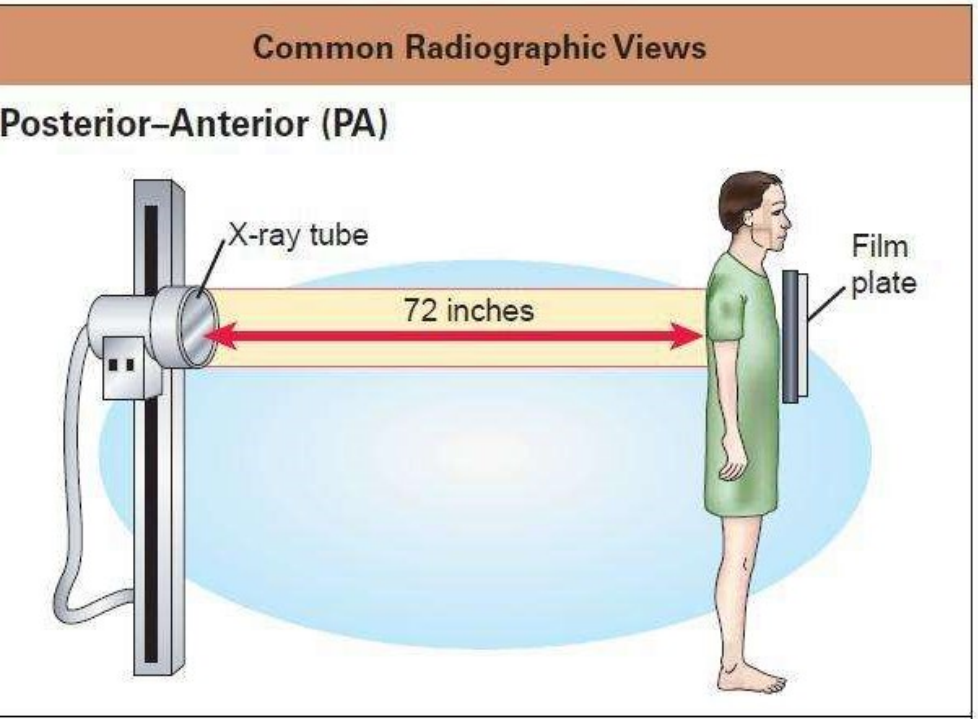
is a deformity of the chest characterized by a protrusion of the sternum and ribs .

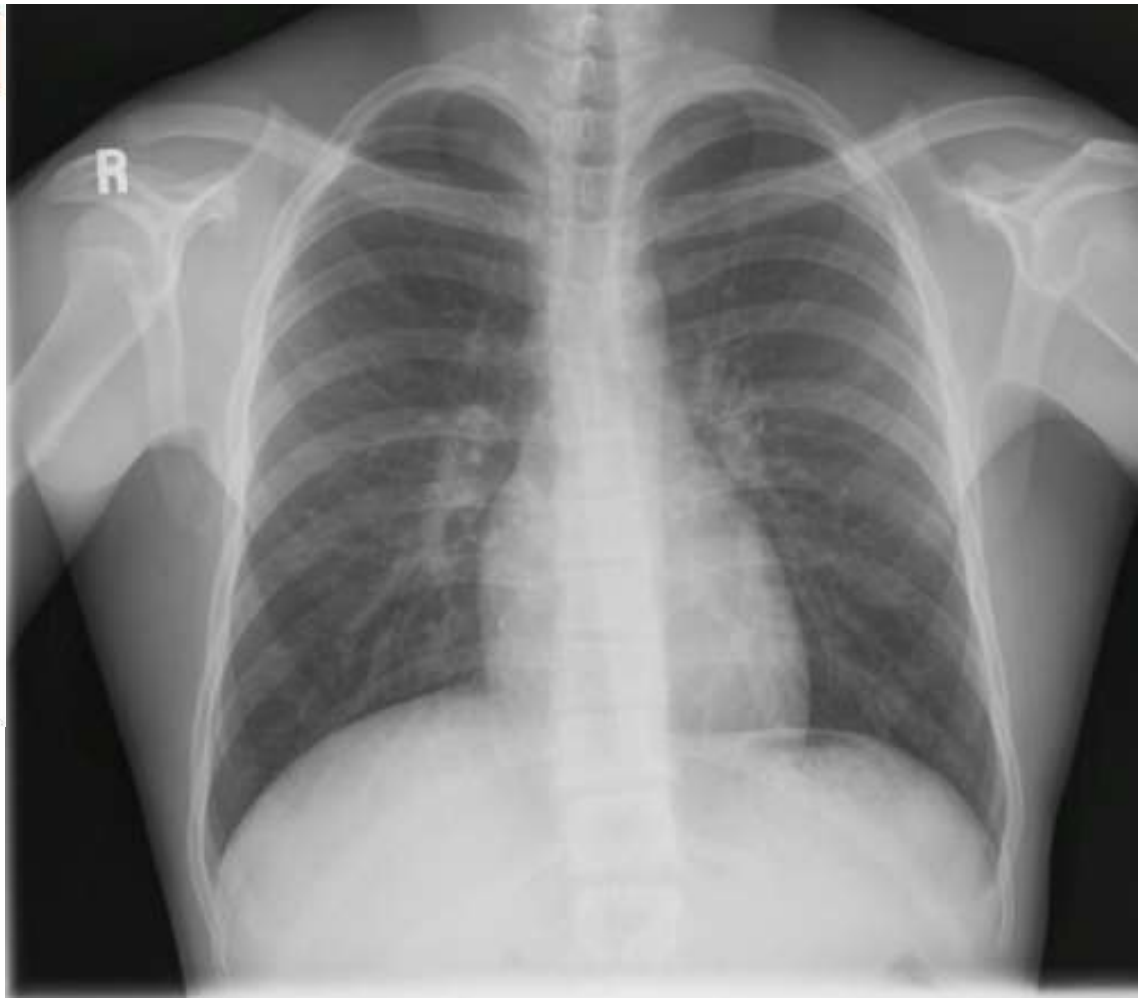


Flail Chest

- ✓ It is s a life-threatening medical condition that occurs when a segment of the rib cage breaks due to trauma .
- ✓ In this case ; multiple adjacent ribs are broken in multiple places, separating a segment, so a part of the chest wall moves independently
- ✓ Two of the symptoms of flail chest are chest pain and shortness of breath.







Chest X ray Posterior anterior view


THANK
YOU!