

BIOMECHANICS OF THORAX

Dr. Nidhi Ahya (Asst Prof)
Cardio-Vascular & Respiratory PT
DVVPF College of Physiotherapy
Ahmednagar 414111

objectives

❑ GENERAL STRUCTURE:

❑ Rib Cage:

- ❑ Sternum

- ❑ Thoracic vertebrae

- ❑ Ribs

❑ KINEMATICS

- ❑ Ribs and manubriosternum

- ❑ Ribs and thoracic vertebrae

❑ MUSCLES ASSOCIATED WITH RIB CAGE

- ❑ Primary muscles of ventilation

- ❑ Secondary muscles of ventilation

❑ PATHO-MECHANICS

Thorax

- ❑ **Consist :**
 - ❑ **Ribs**
 - ❑ **Thoracic vertebrae**
 - ❑ **Sternum**

- ❑ **Provides a stable base for the muscles attachments**

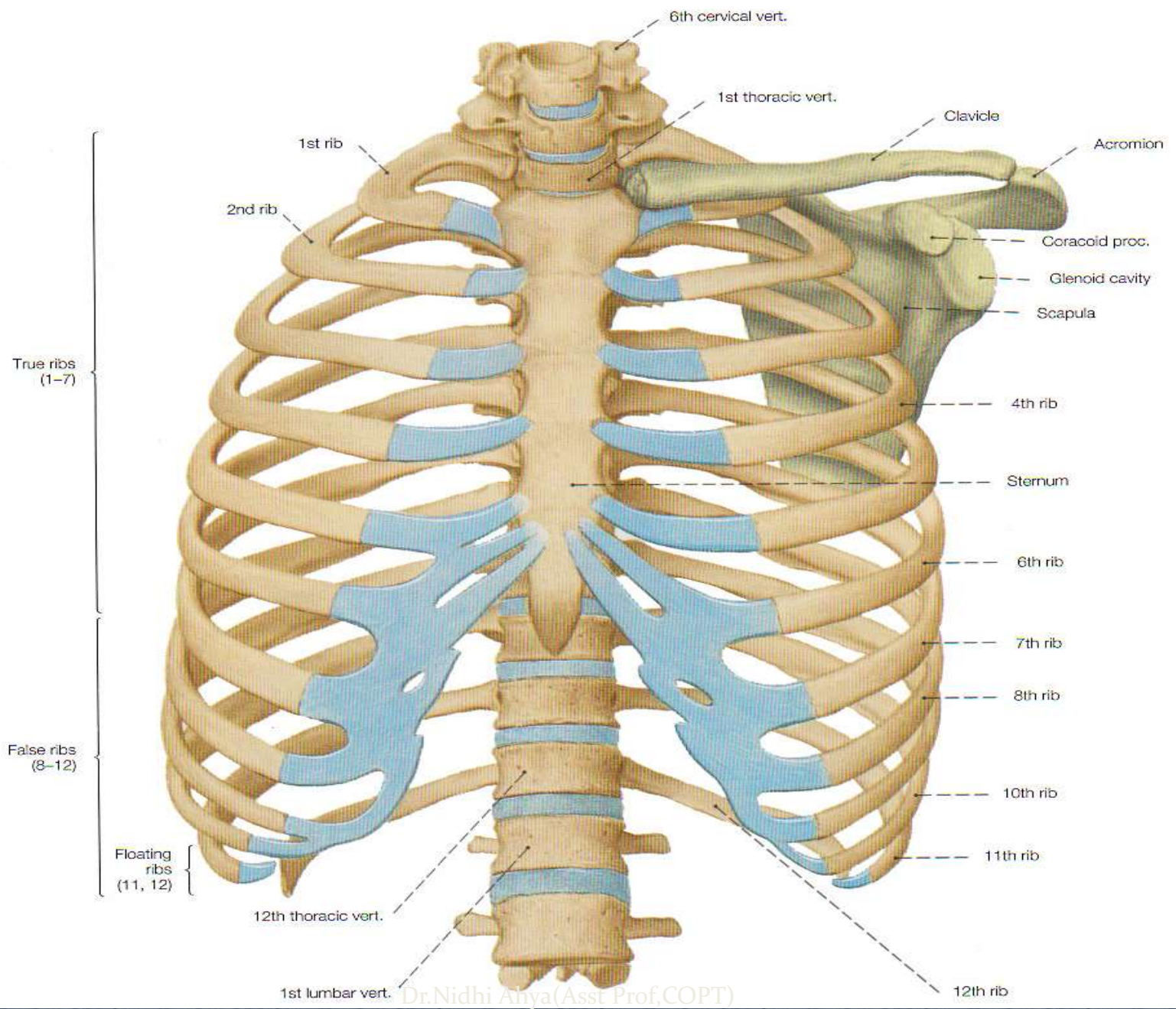
- ❑ **Protection of lungs, heart, viscera**

- ❑ **Ventilation**

General structure :

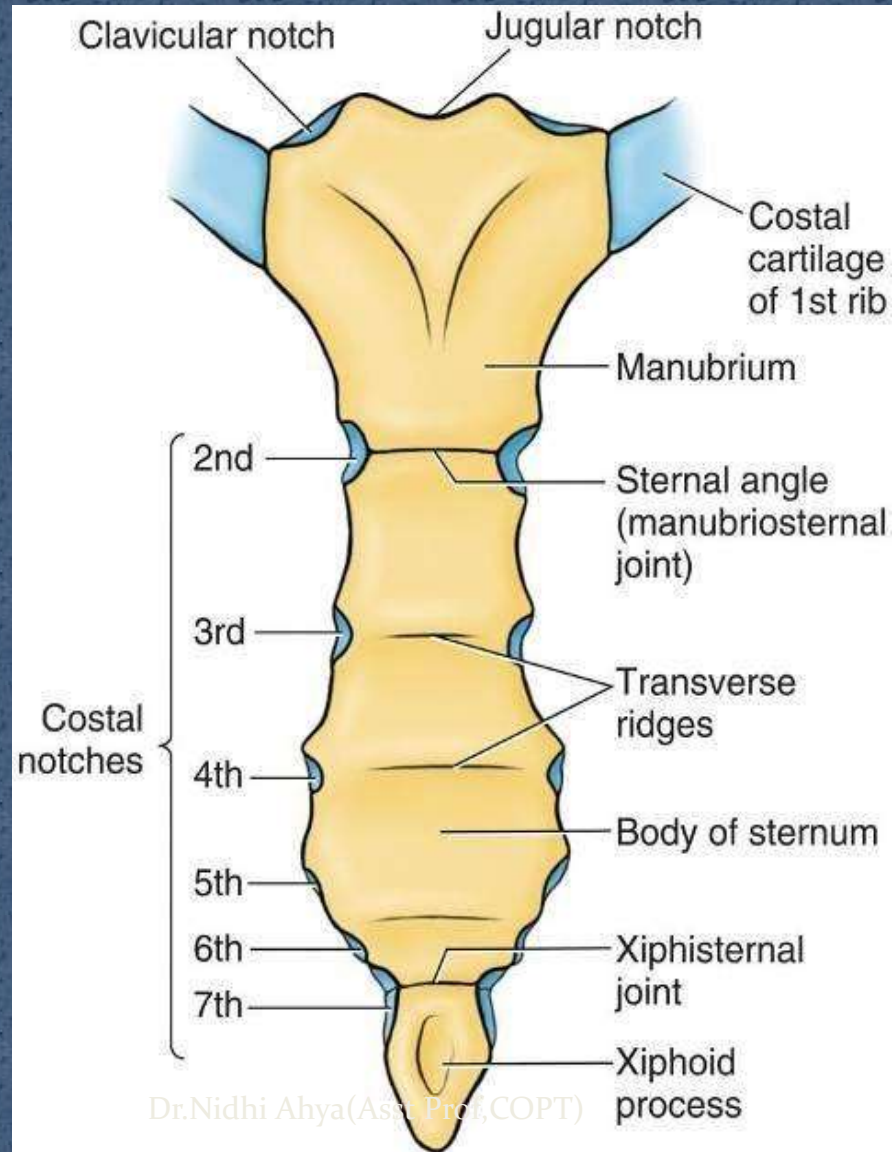
❖ Rib Cage:

- ❑ Sternum
- ❑ Thoracic vertebrae
- ❑ Ribs

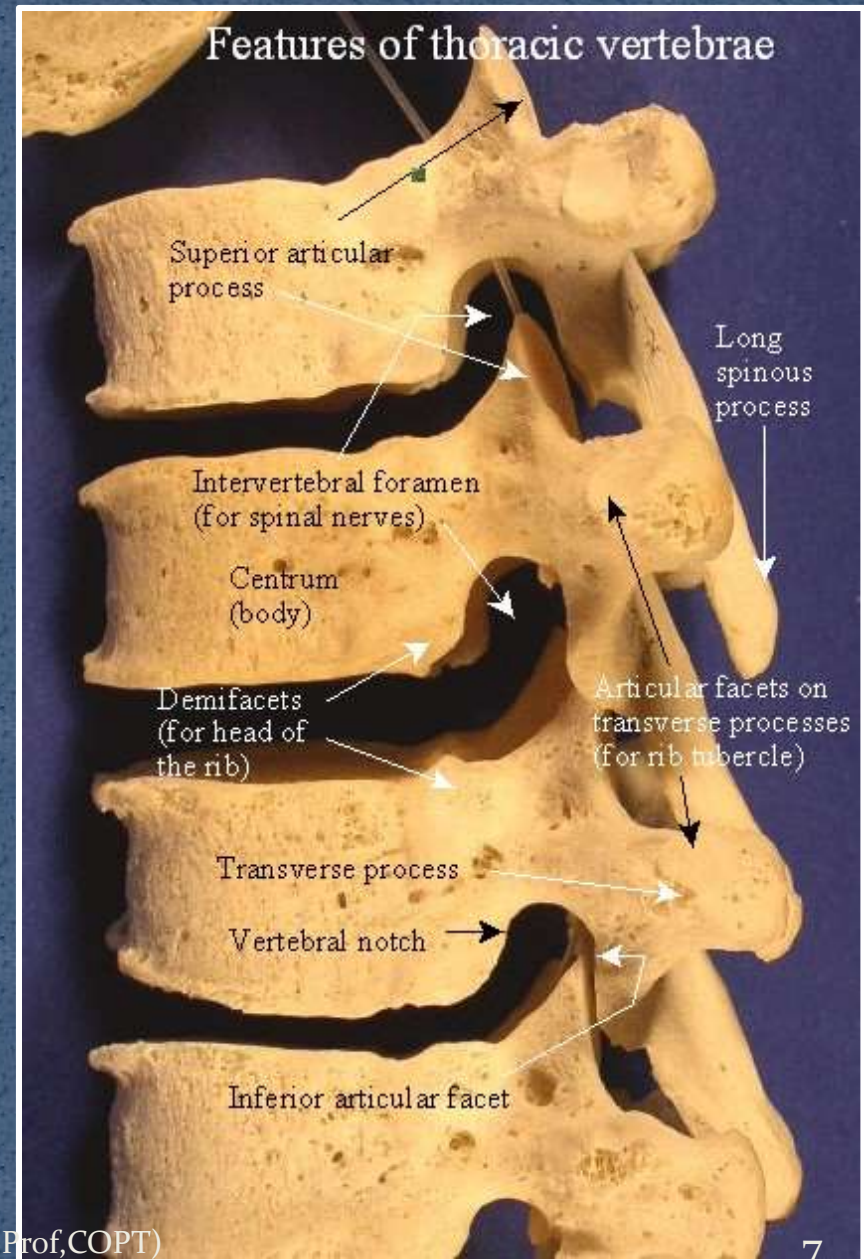
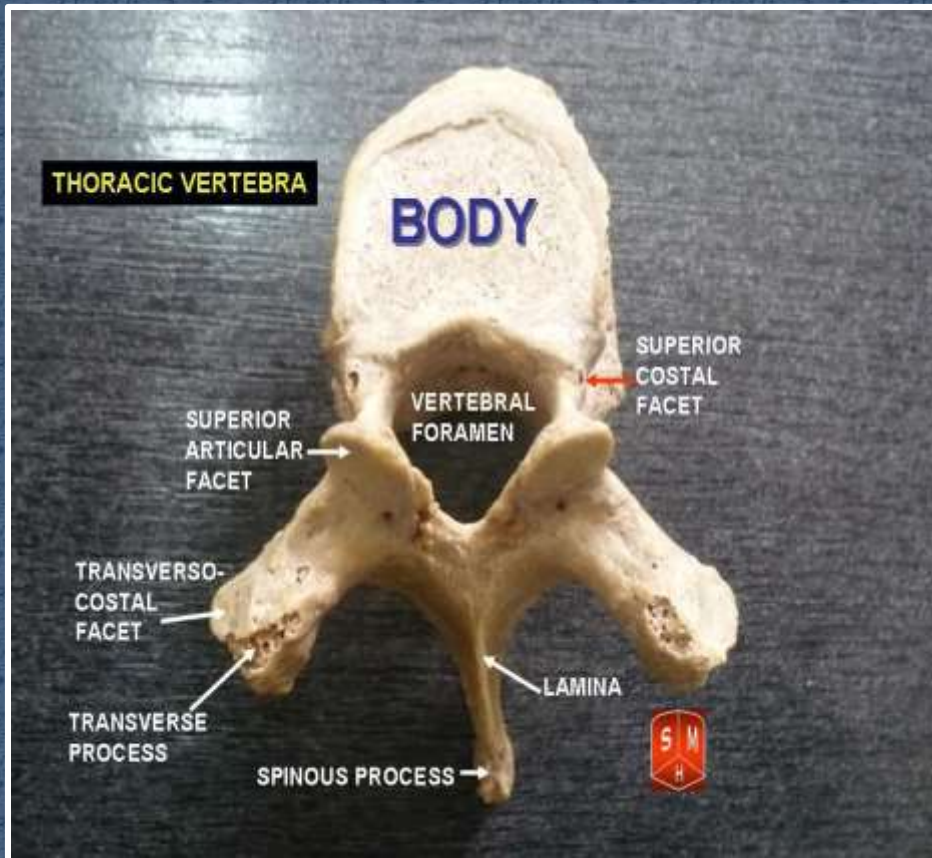


Dr. Nidhi Anya (Asst. Prof., COPT)

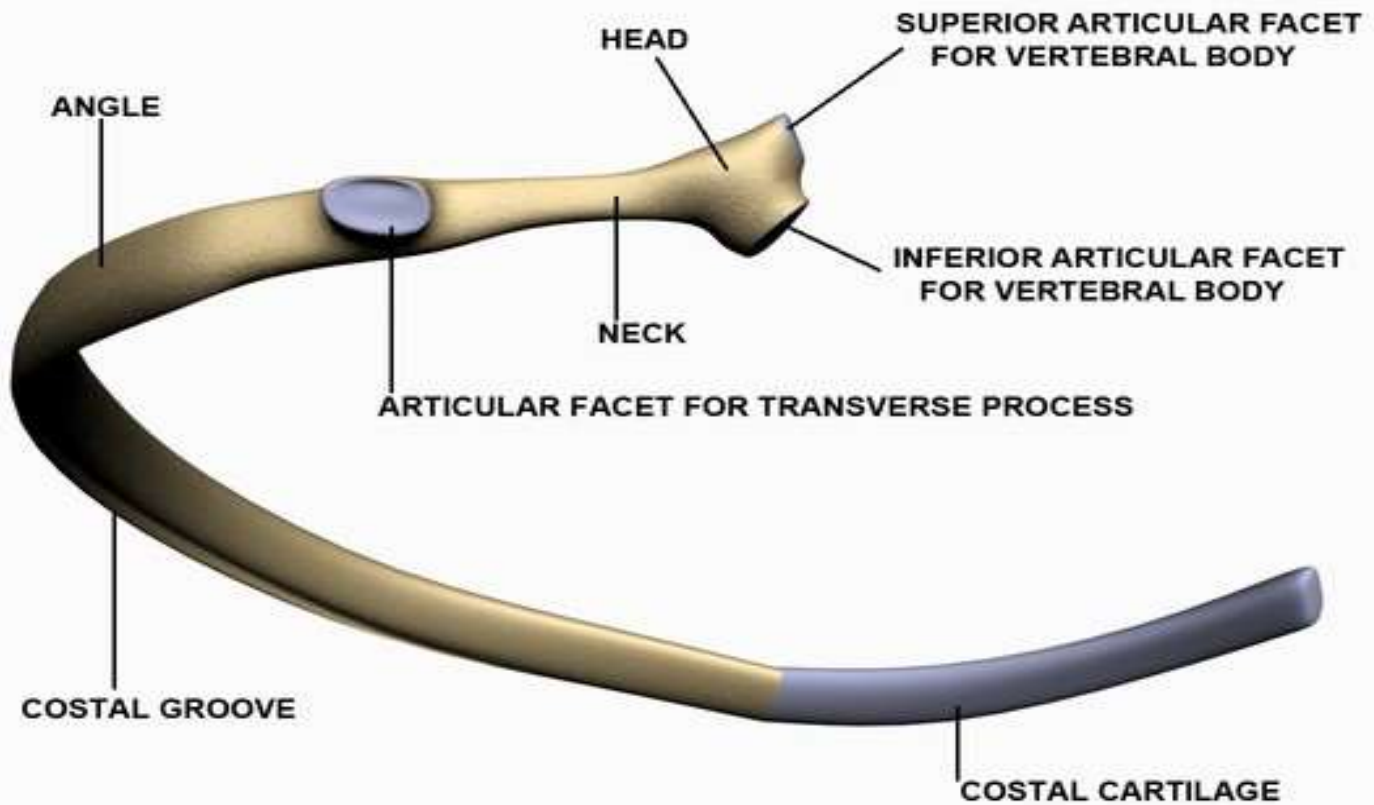
Sternum



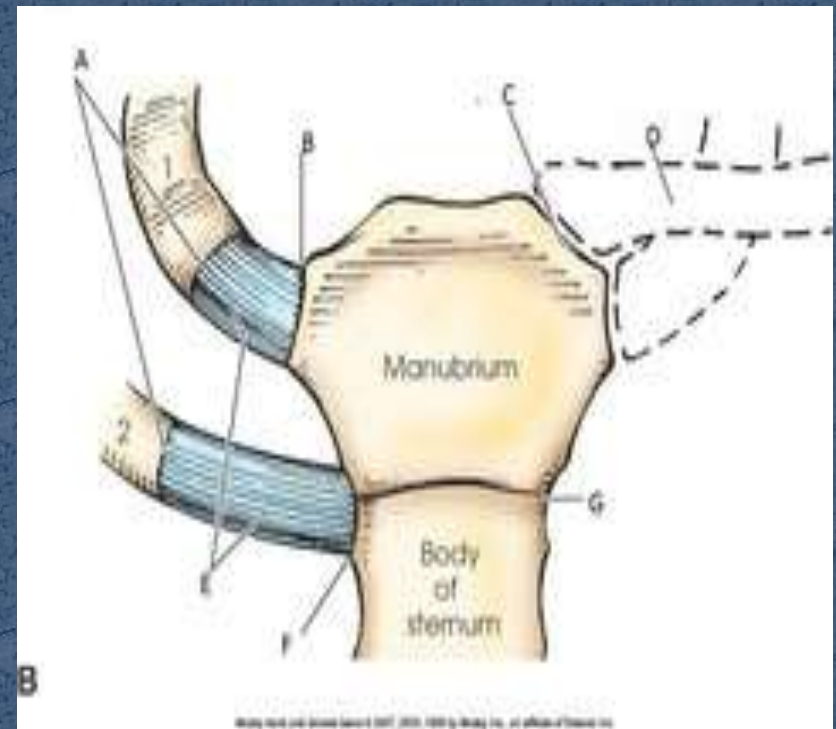
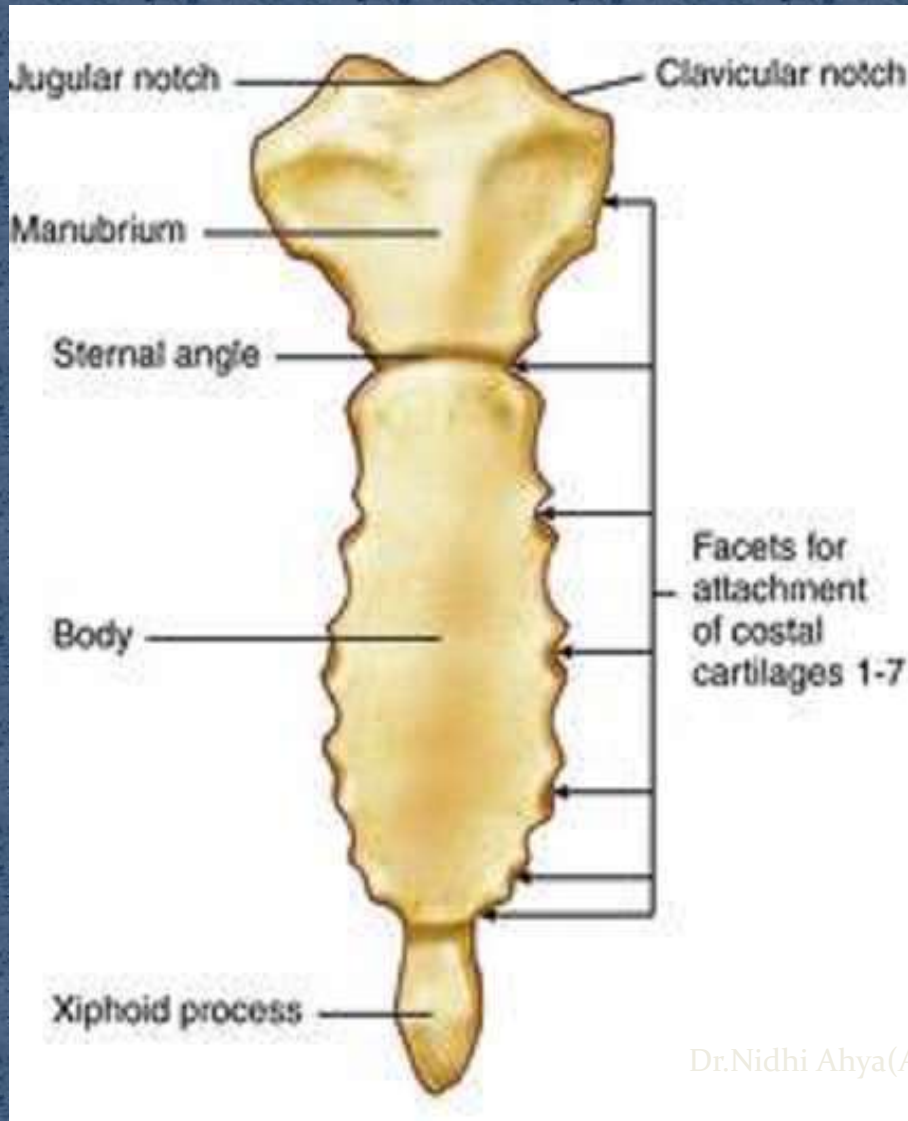
Thoracic vertebrae

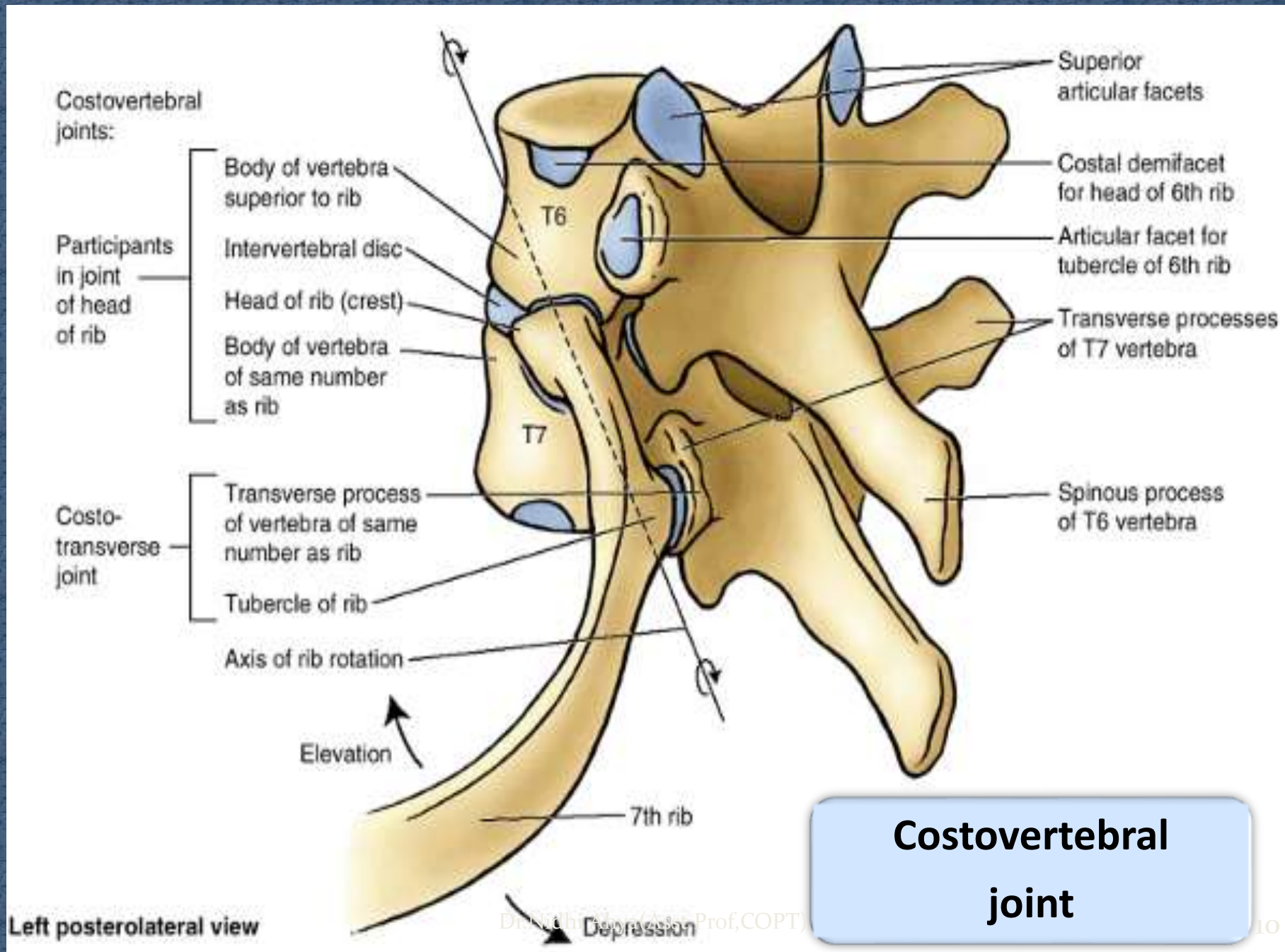


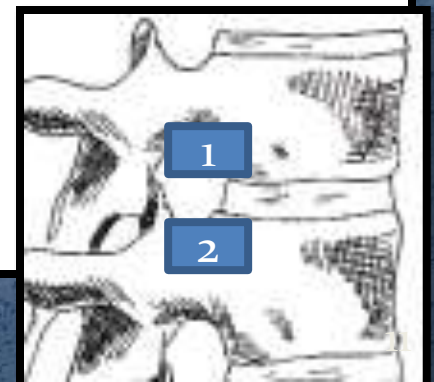
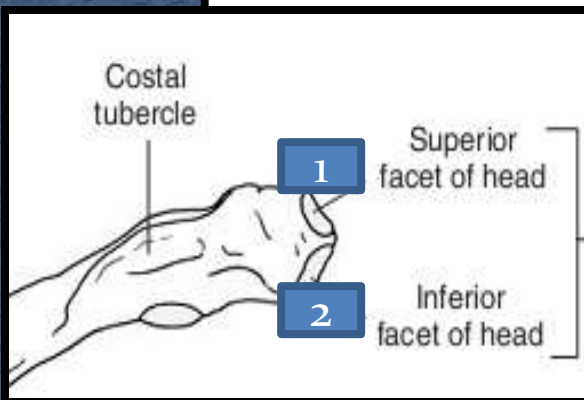
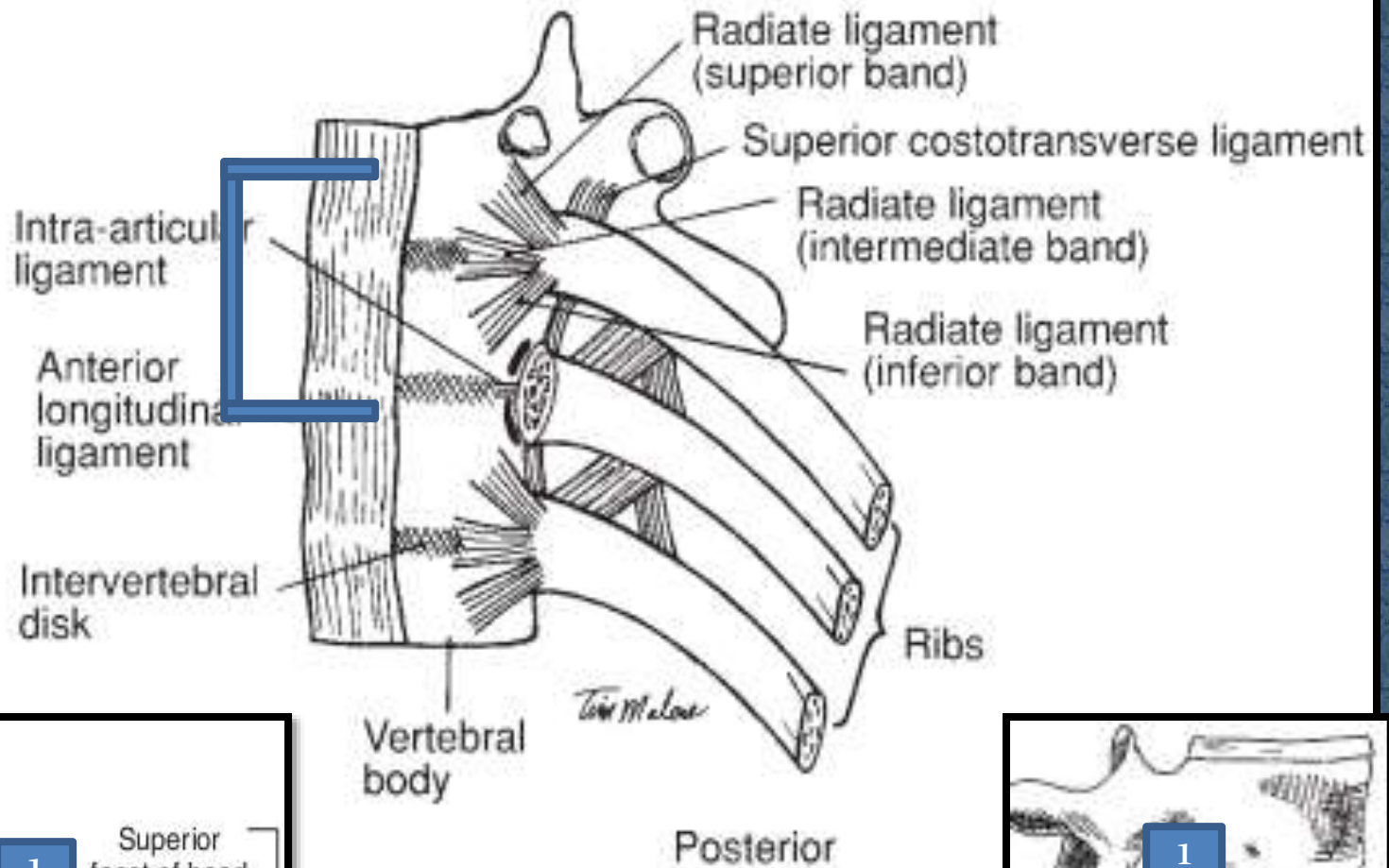
Ribs



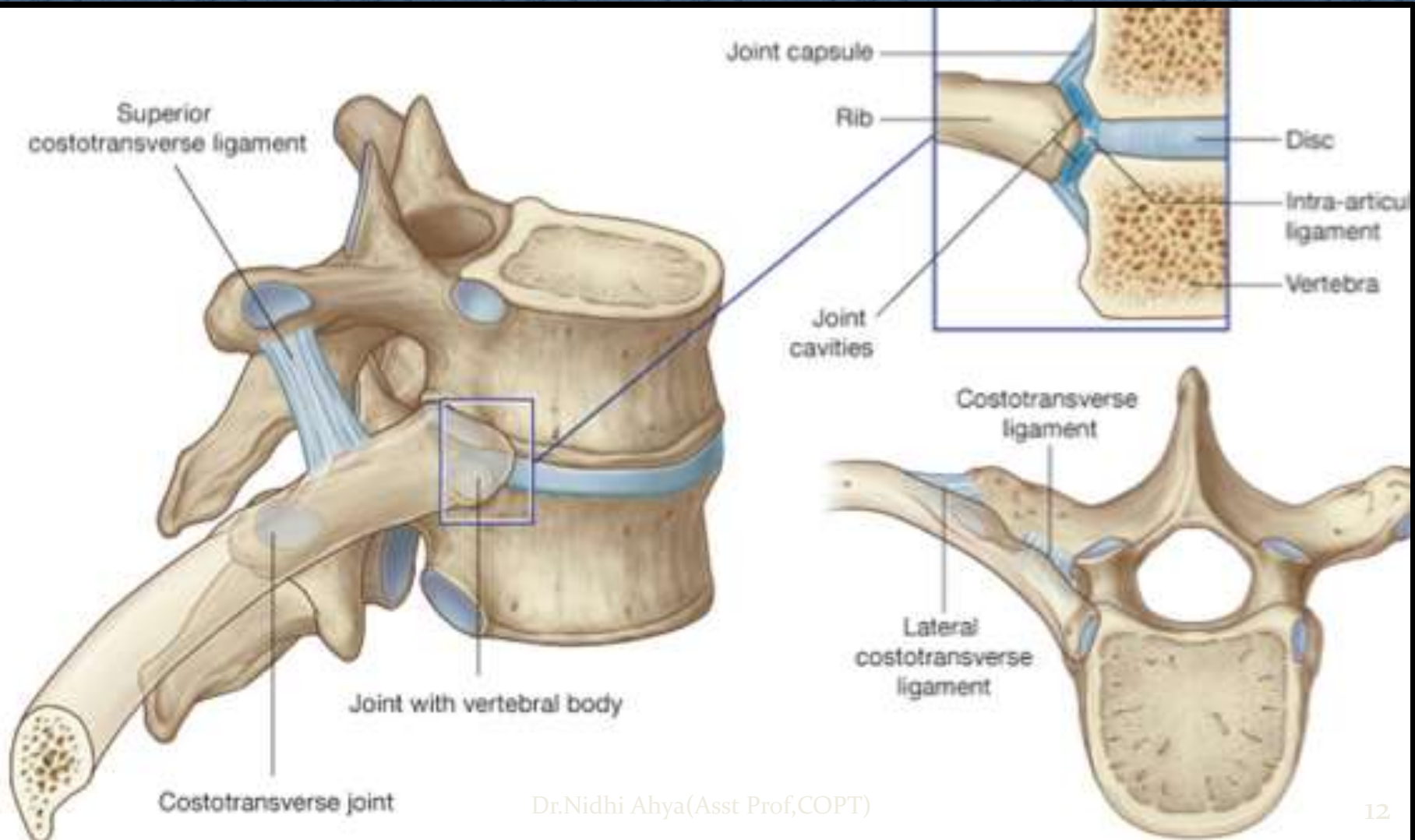
Manubriosternal and Xiphisternal Joints

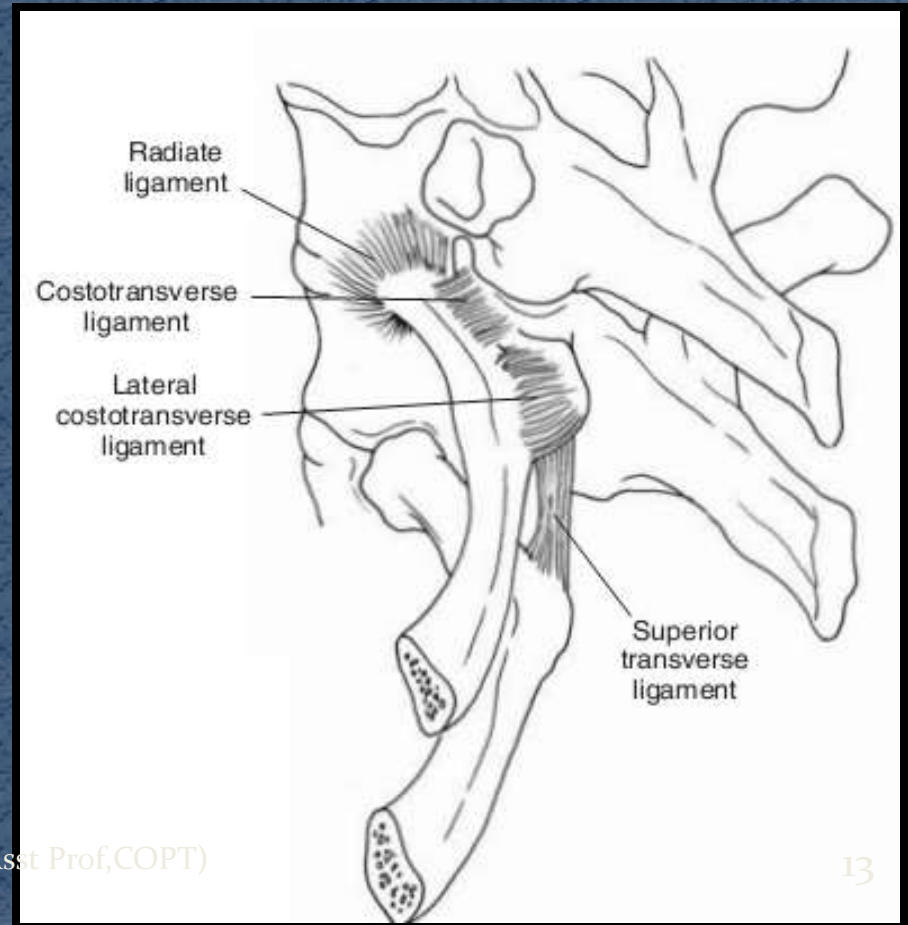
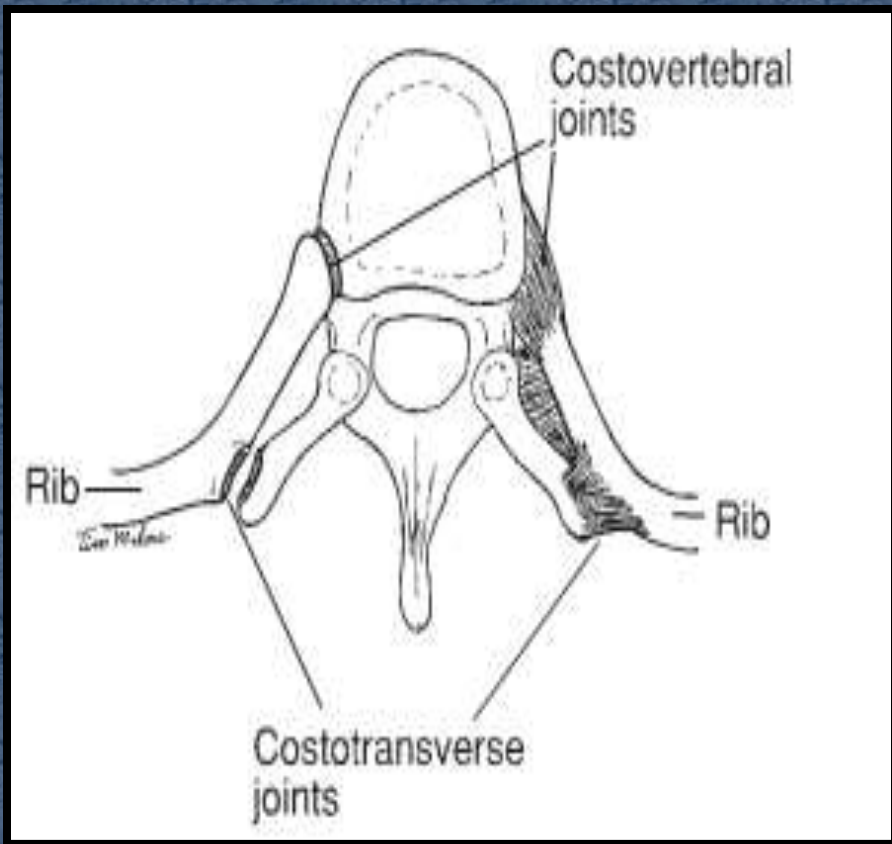




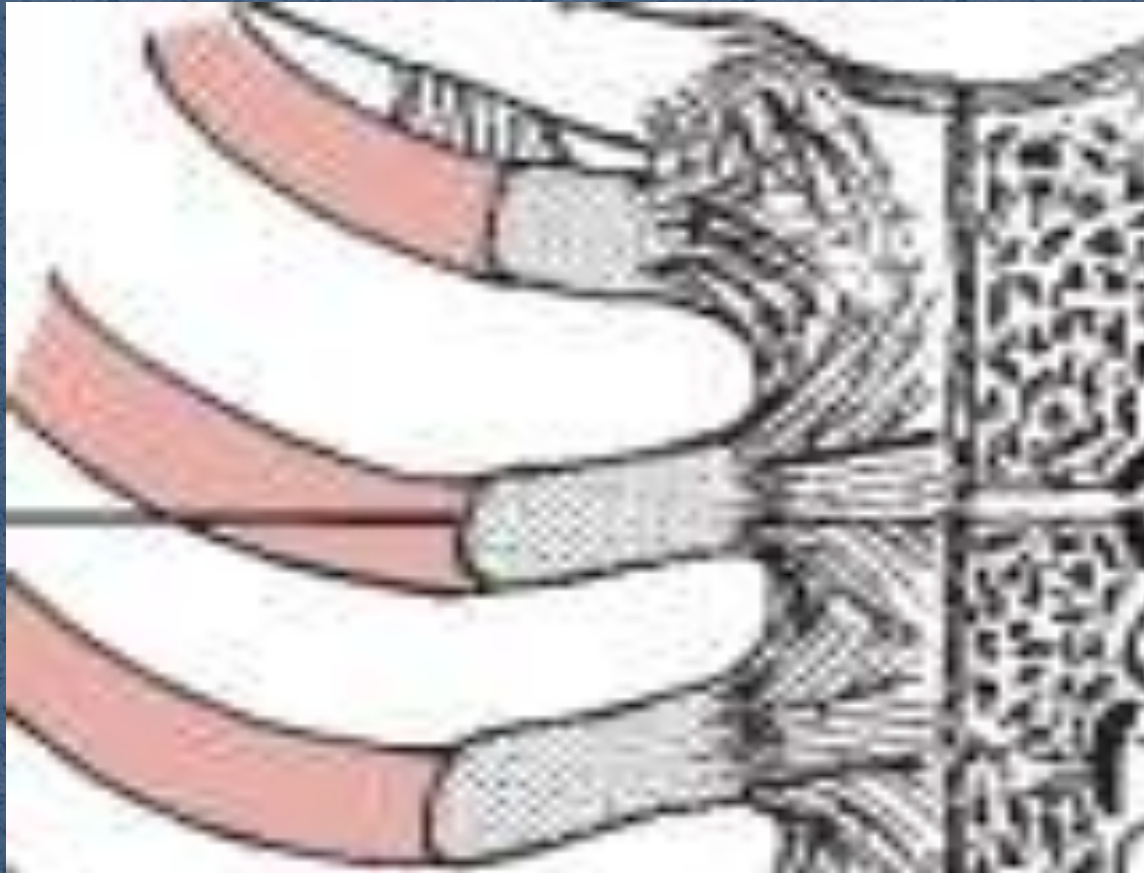


Costovertebral Joint

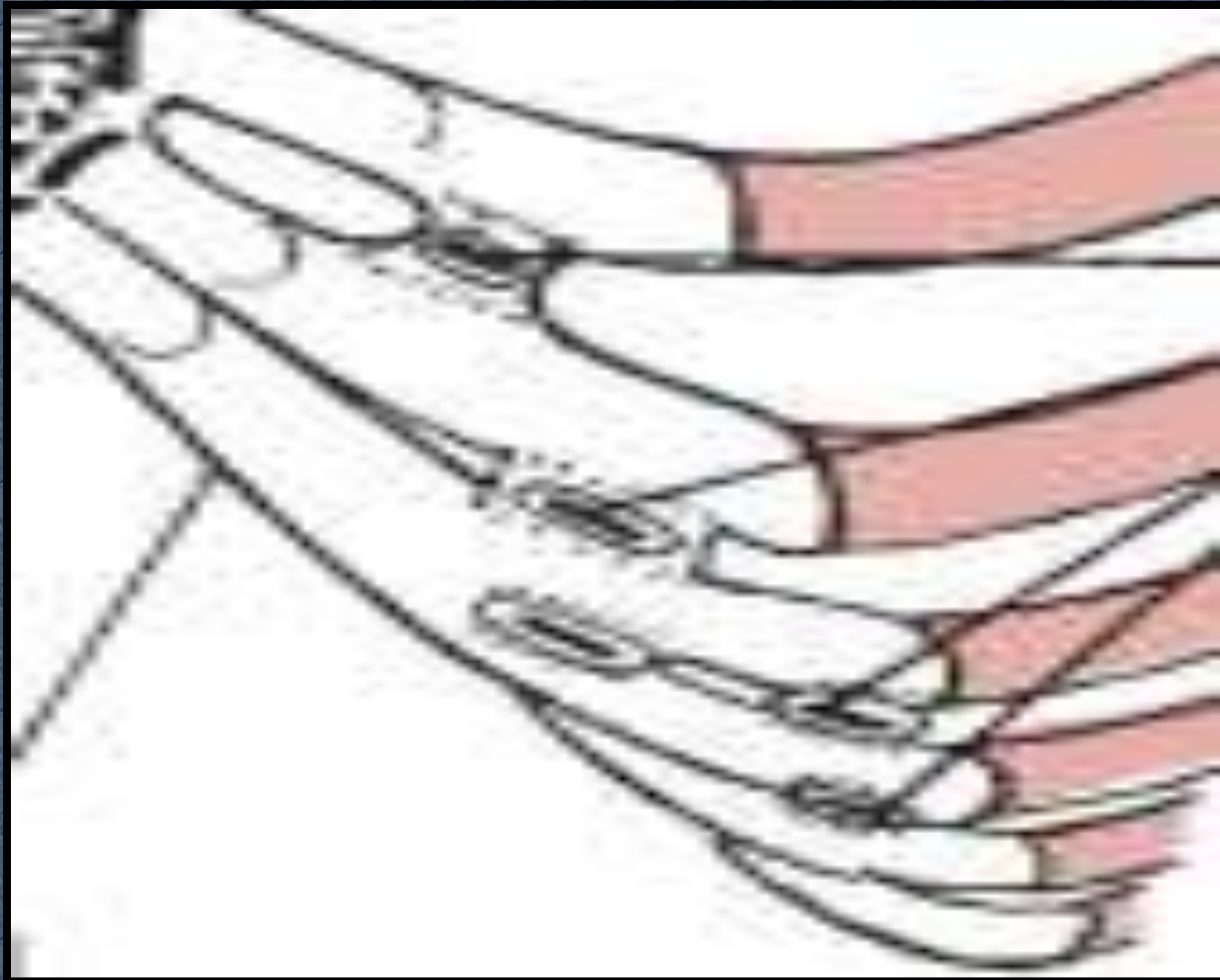




Costochondral Joint



Interchondral joint

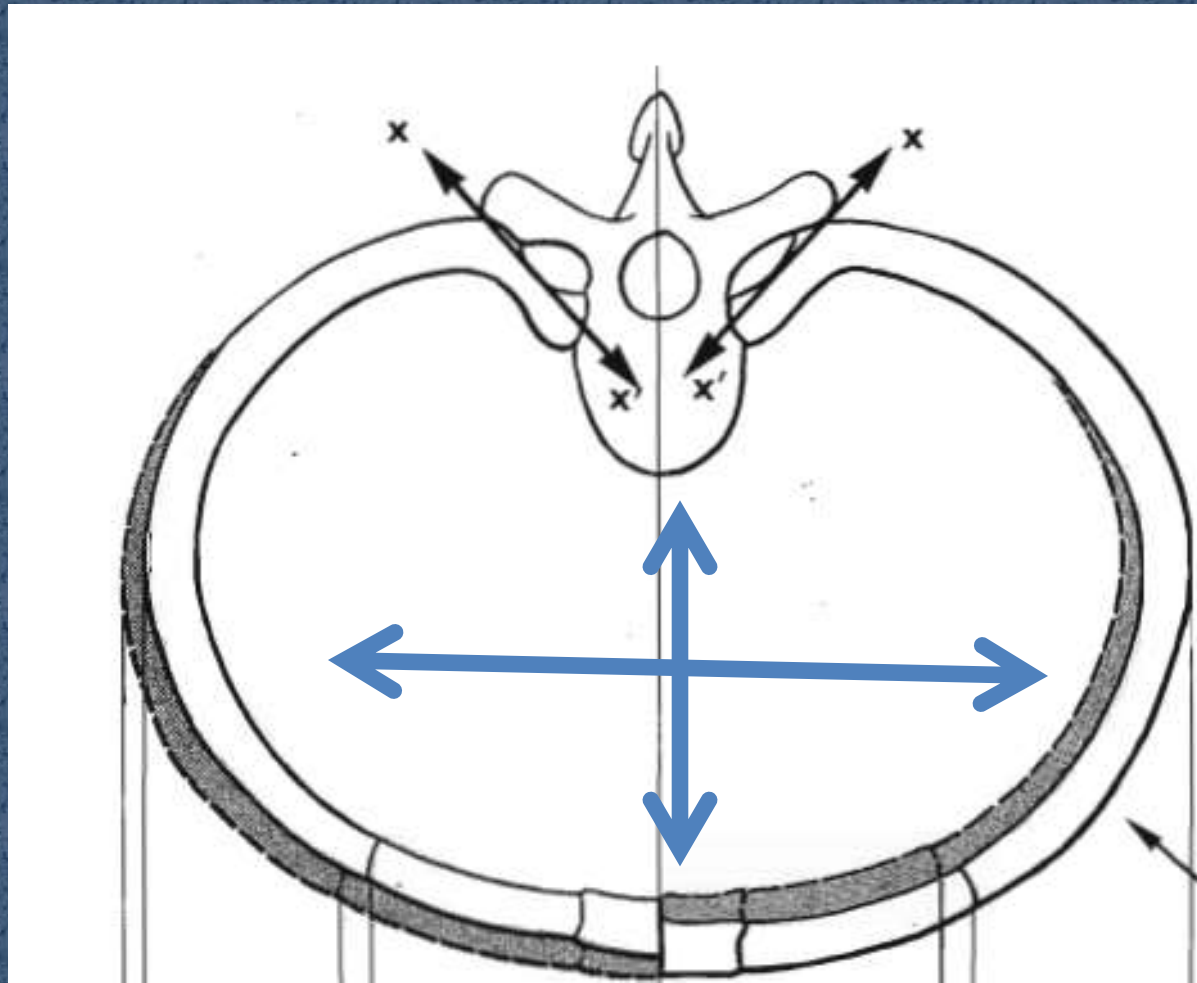


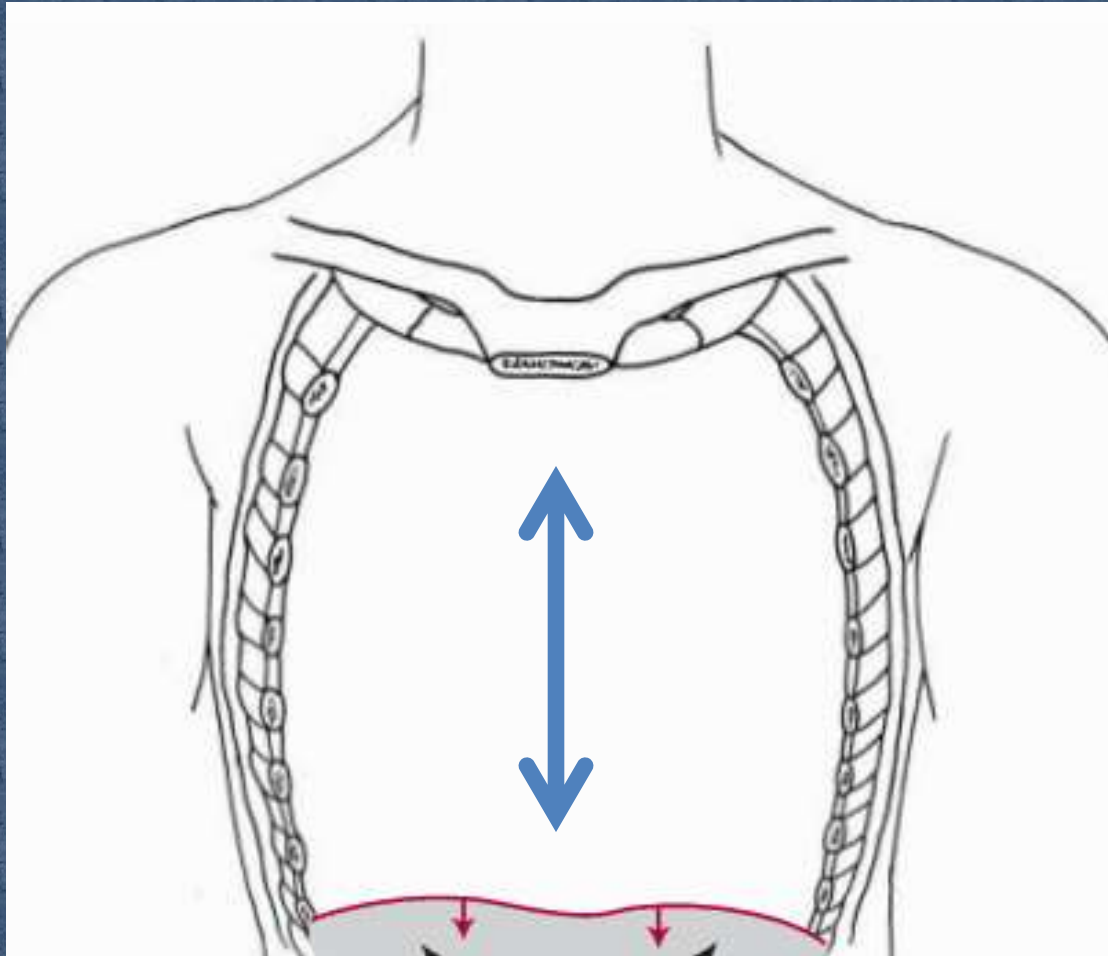
Kinematics



Dimensions of thorax

- ❑ Expansion of thorax take place in three dimensions:
- ❑ Anterio-posterior (A-P)
- ❑ Transverse
- ❑ Vertical





- ❑ **Movement of rib cage is a combination of geometry governed by:**

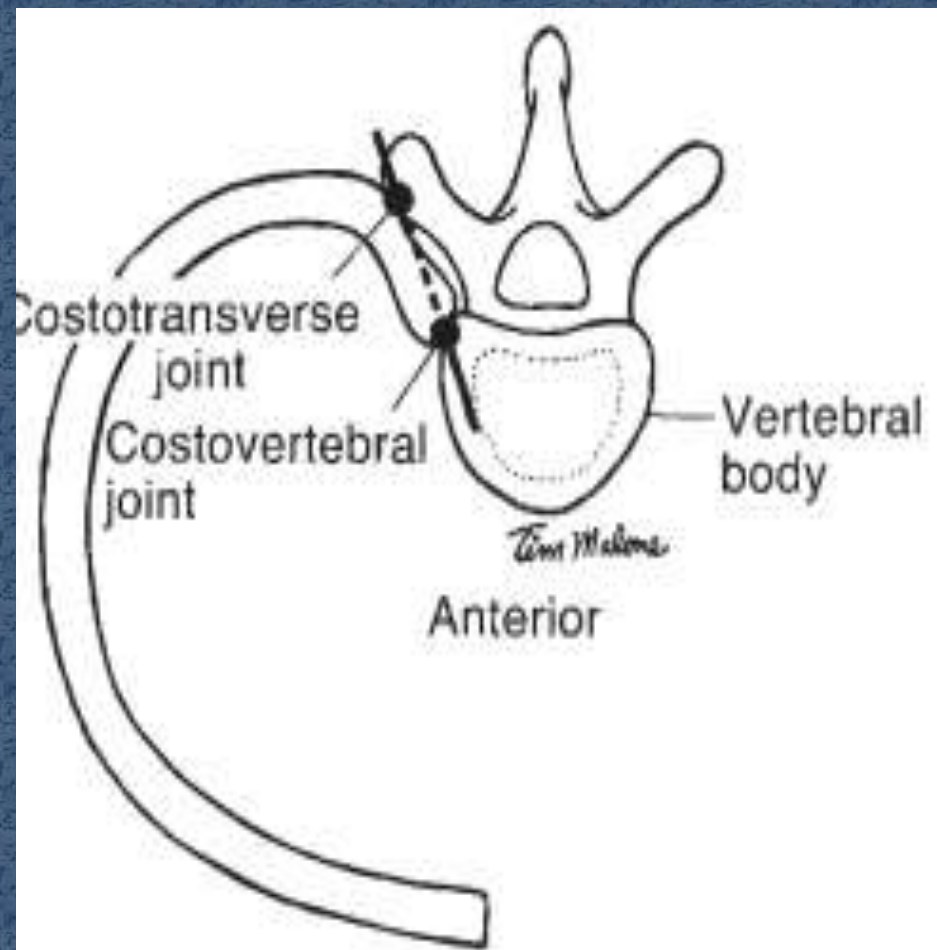
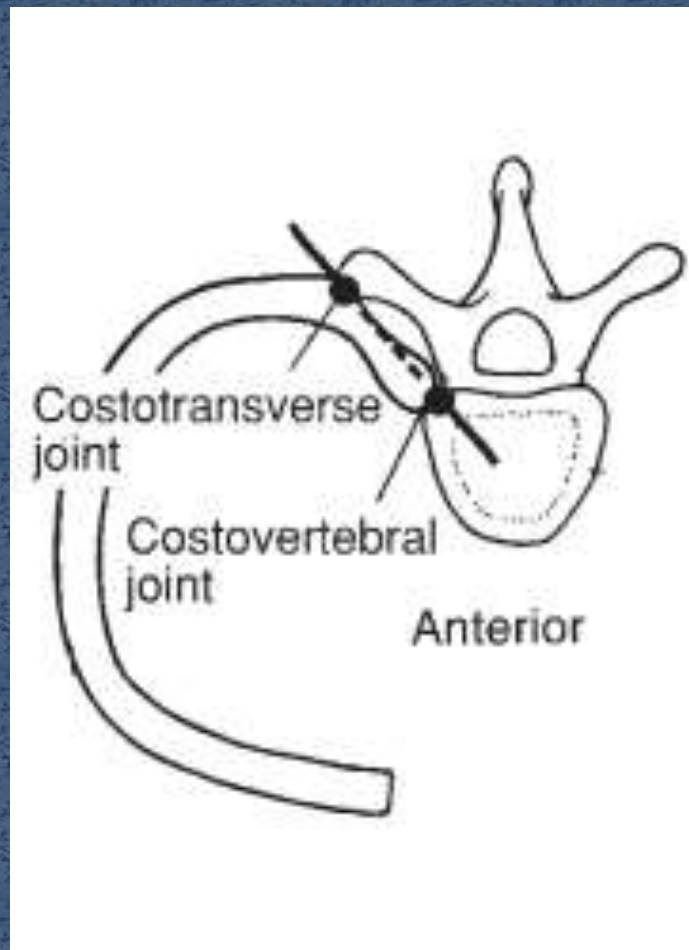
Angle of the articulation

Movement of Manubriosternum

Elasticity of the Costal Cartilage

Single Axis of the motion

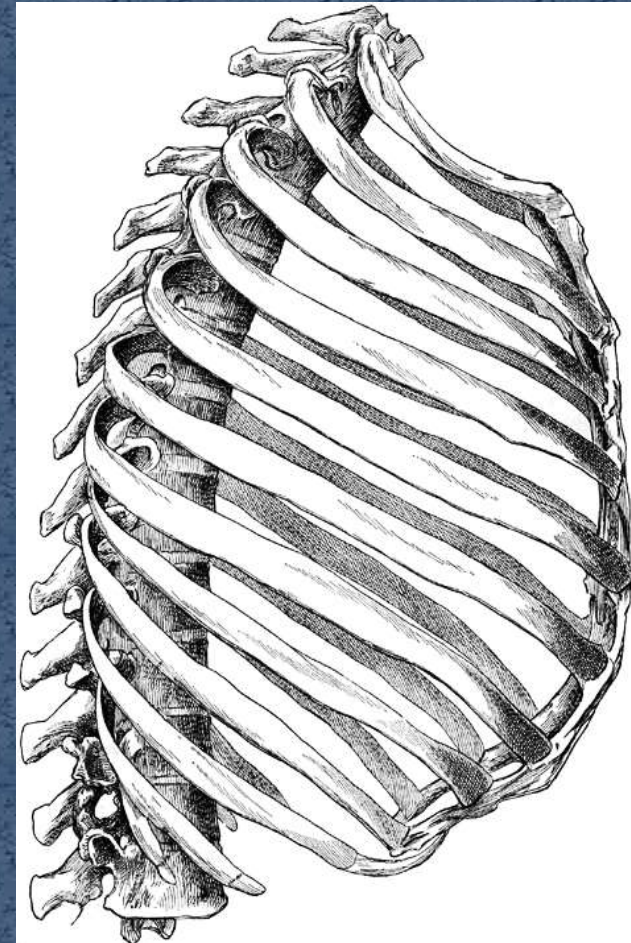
- ❑ It is believed that CV and CT joints are mechanically interlinked
- ❑ Single axis passing through the centre both joints
- ❑ Axis of upper ribs lies close to frontal plane (allows motion in sagittal plane)
- ❑ Axis of lower ribs lies close to sagittal plane (allows motion in frontal plane)



First rib:

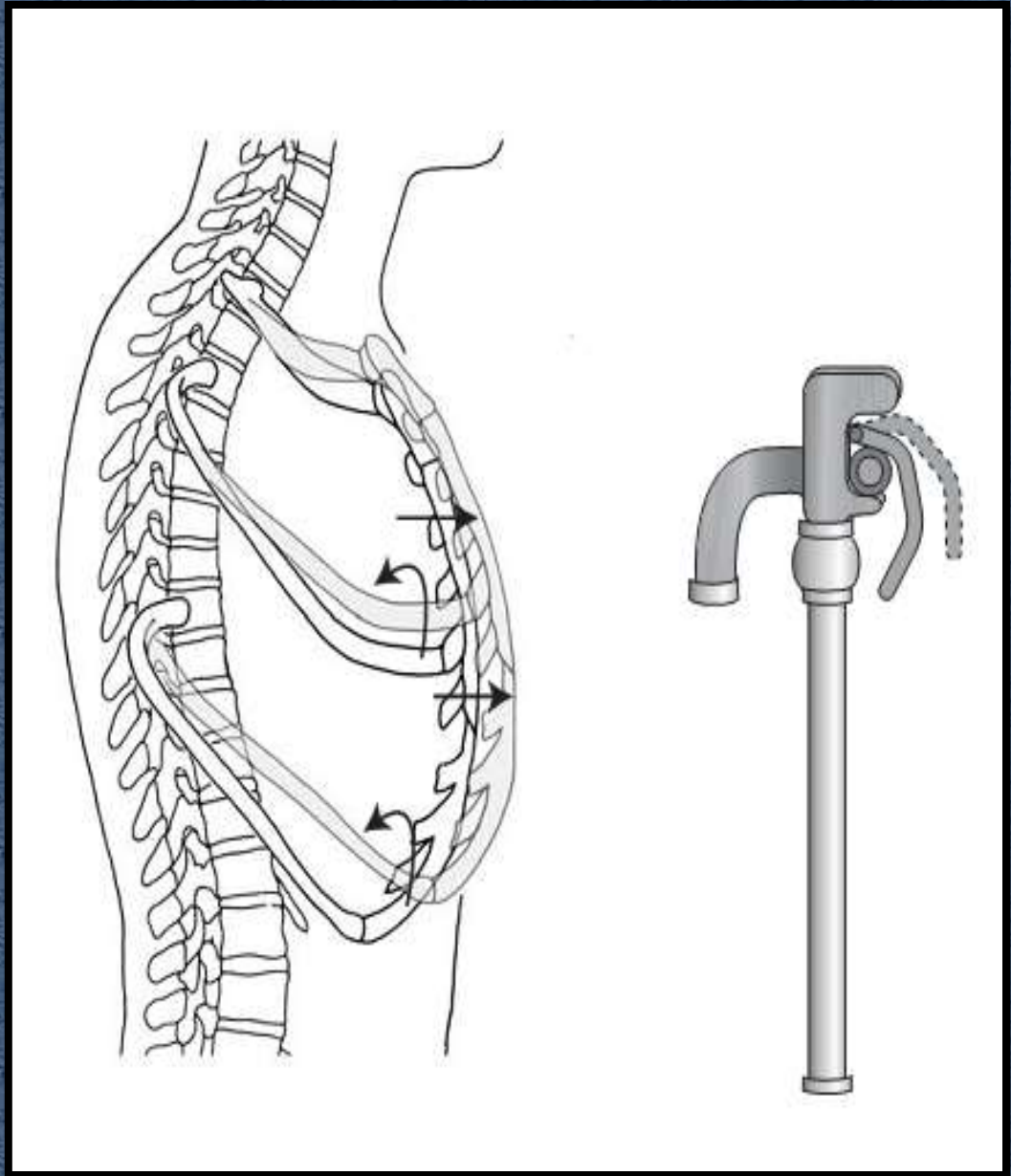
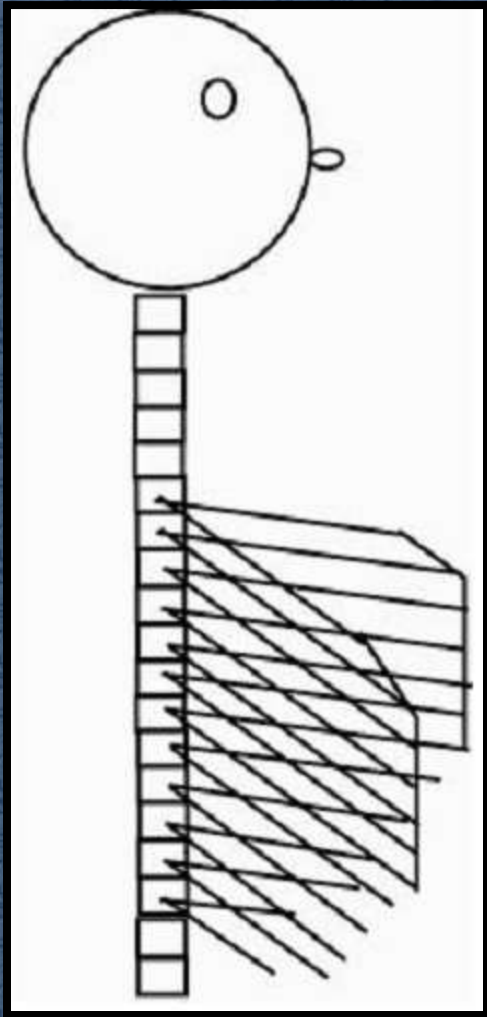
- ❑ Anteriorly :
 - ❑ Thicker anterior articulation
 - ❑ Costal cartilage is stiffer than the others
 - ❑ 1st chondrosternal joint is synchondrosis
 - ❑ Limit mobility

- ❑ Posteriorly:
 - ❑ CV joint has only one facet
 - ❑ Increase mobility



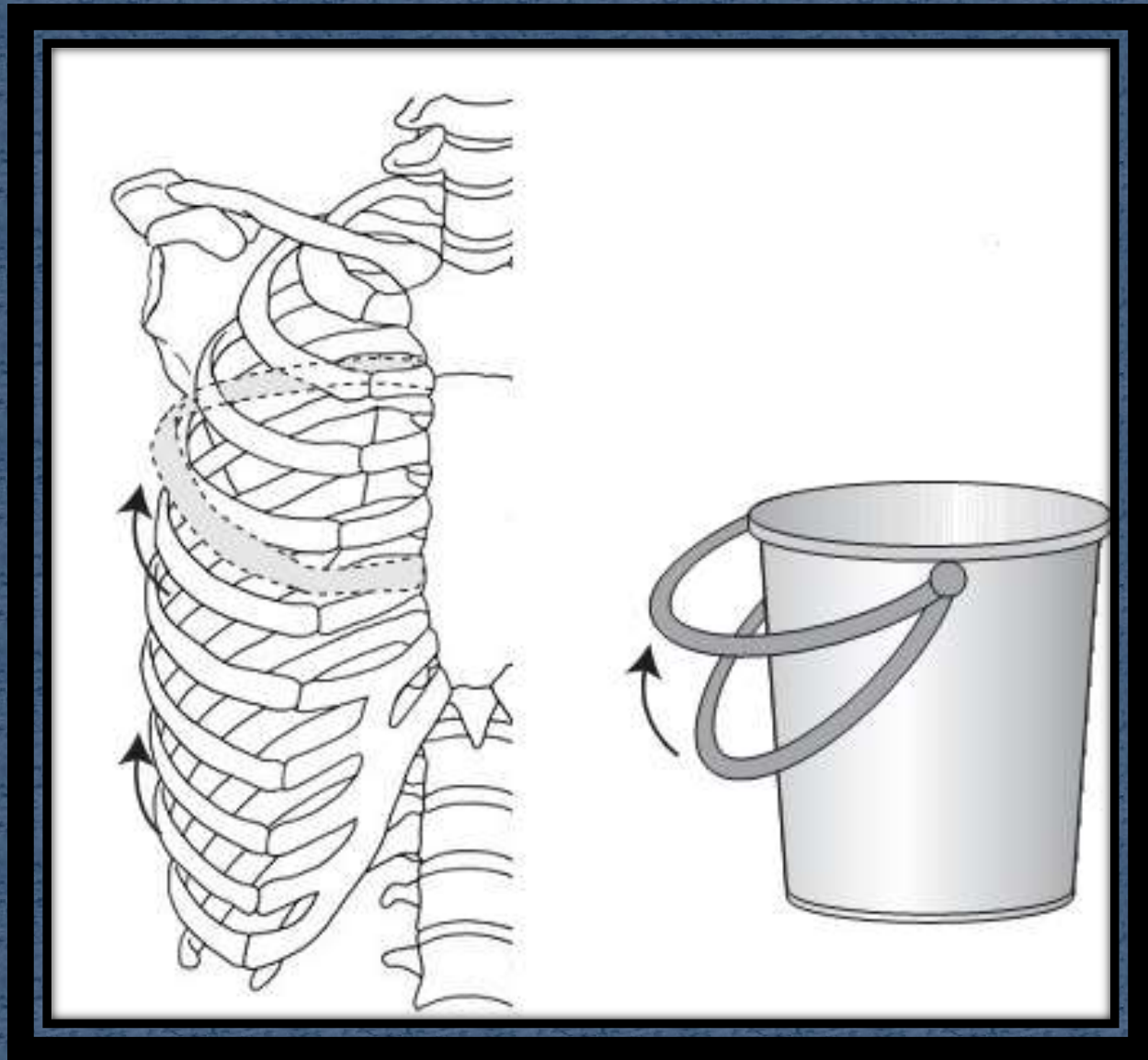
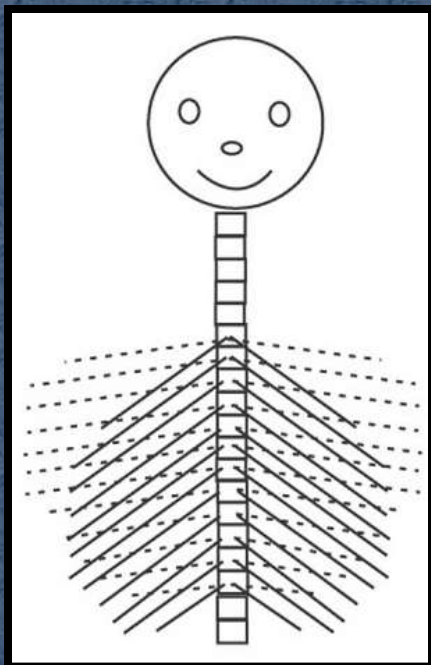
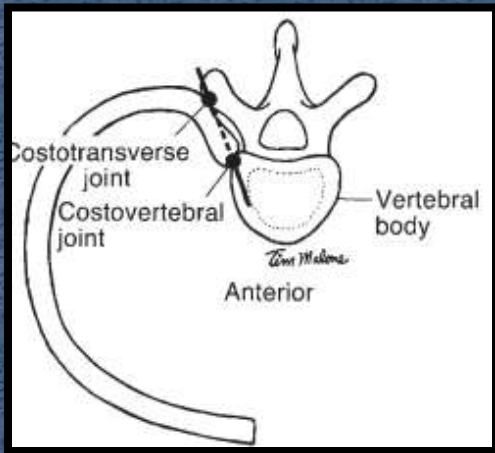
Movement of Upper ribs

- ❑ Take place at anterior aspect of ribs at coronal axis
- ❑ Costal cartilage become more horizontal
- ❑ Ribs pushes sternum ventrally and superiorly
- ❑ Excursion of manubrium is less than the body
 - ❑ 1st rib has shortest length
 - ❑ Length increase caudally till 7th rib
 - ❑ This discrepancy cause movement at MS joint



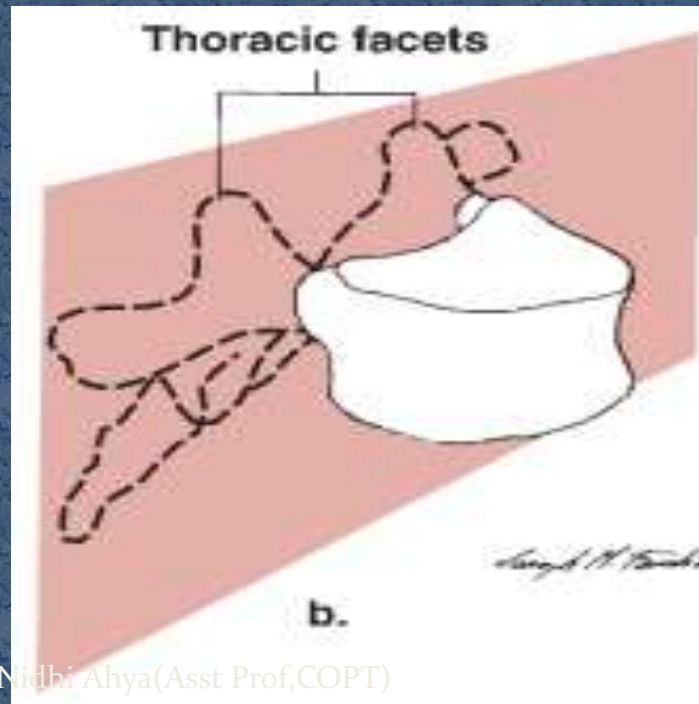
Movement of lower ribs

- ❑ Elevation occurs about axis of motion lying nearly in the sagittal plane
- ❑ Have more angled shape (obliquity increases 1st-10th)
- ❑ Indirect attachment anteriorly to the sternum
- ❑ These factors allow the lower ribs more motion at the lateral aspect of the rib cage
- ❑ Increase the transverse diameter (BUCKLE HANDLE)



Movements of thoracic vertebrae

- ❑ Depends up on the orientation of the zygoepiphyseal (ZP) joints orientation
- ❑ Orientation of ZP joints are in 20* off the frontal plane



MUSCLES OF VENTILATION

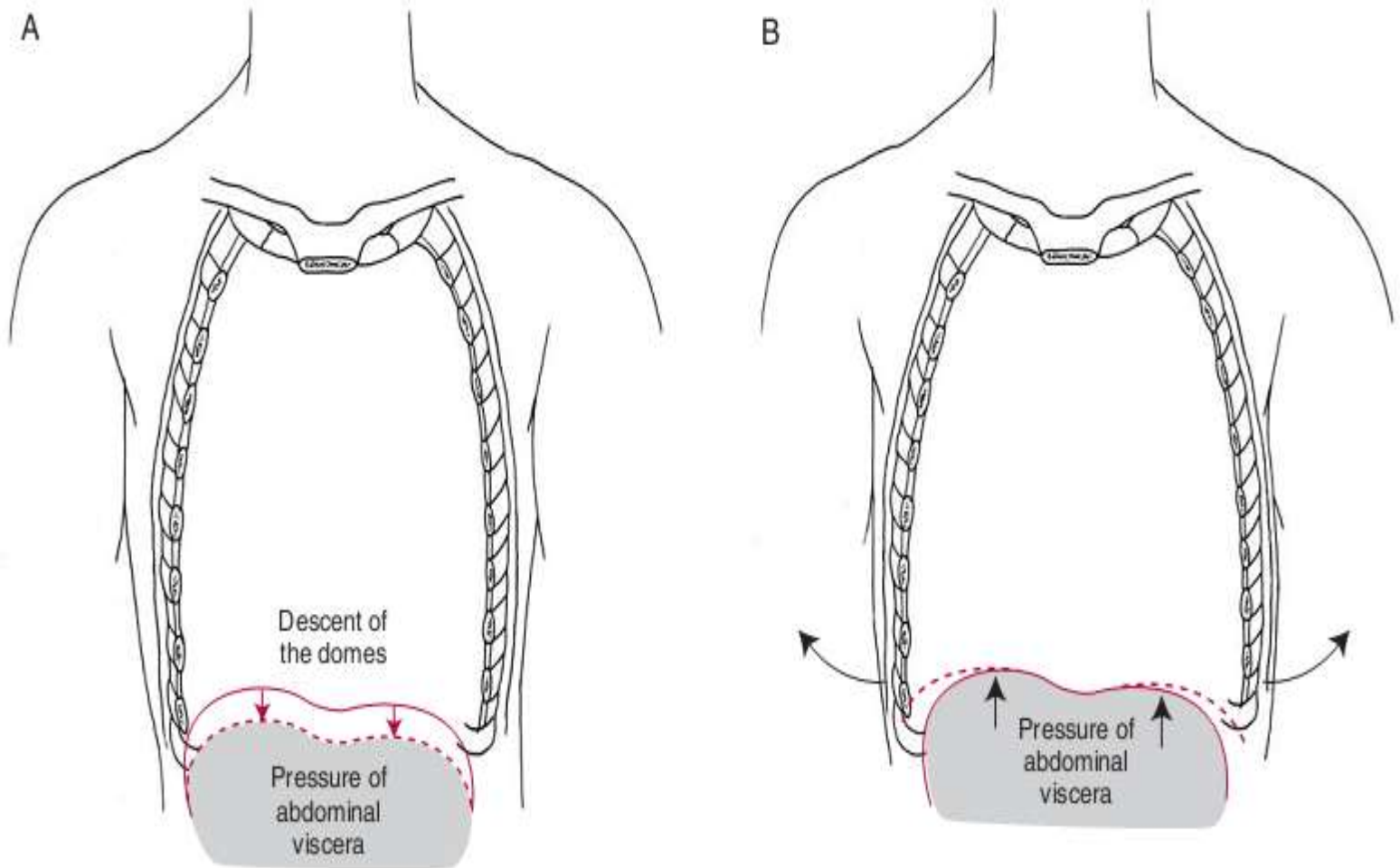
Primary muscles:

- ❑ Recruited for quite ventilation
- ❑ Diaphragm
- ❑ Intercostals (Parasternals)
- ❑ Sclaene
- ❑ These muscle promote inspiration
- ❑ Expiration is a passive process

Diaphragm

- ❑ Accounts for 70-80% of inspiration during quiet breathing

- ❑ Circular set of muscles arises from:
 - ❑ Sternum
 - ❑ Costal cartilage
 - ❑ Ribs
 - ❑ Vertebral bodies

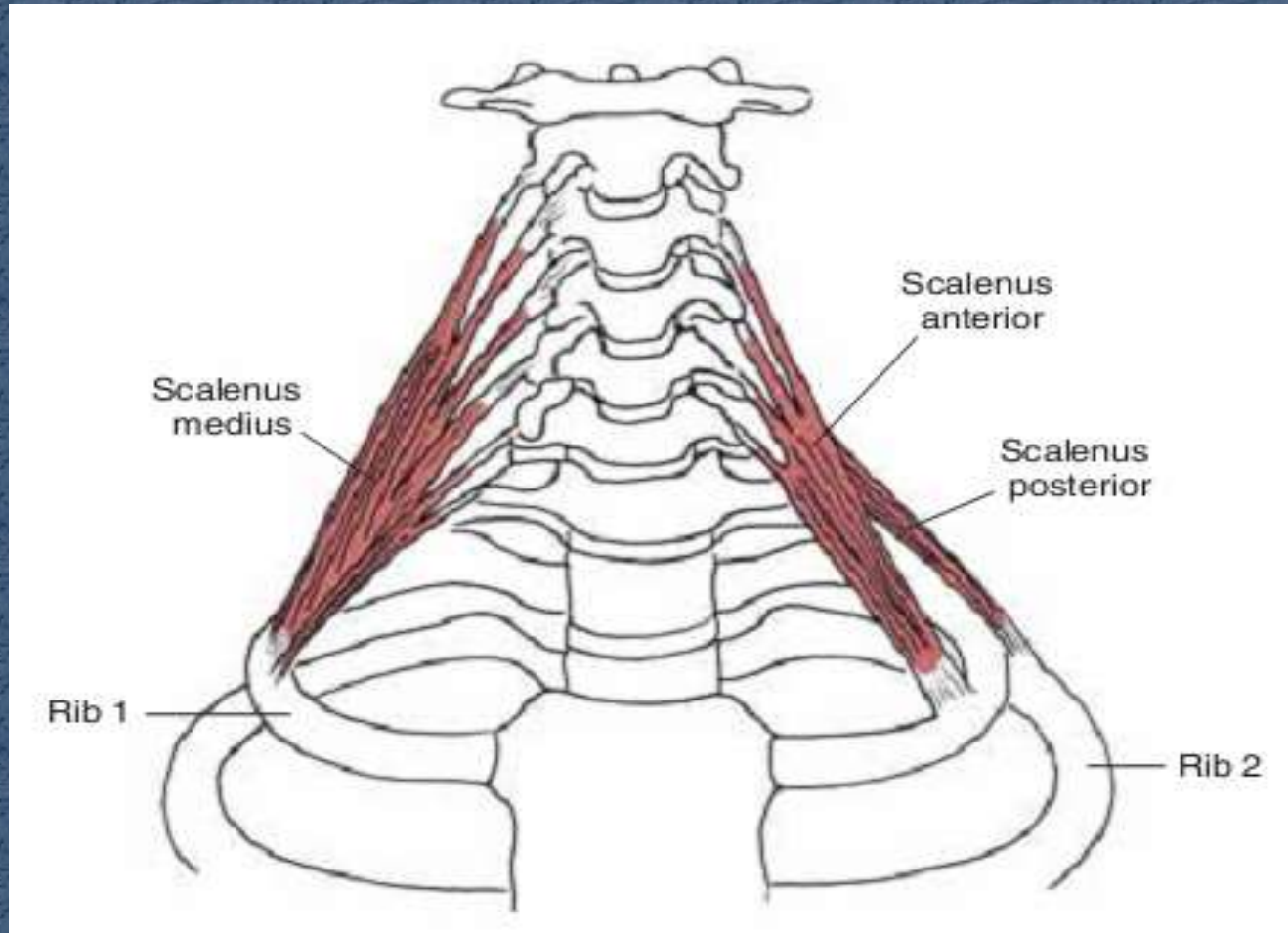


A. During tidal breathing, the diaphragm contracts, causing a descent of the dome of the diaphragm and an increase in intra-abdominal pressure. The increase in intra-abdominal pressure eventually prevents further descent of (stabilizes) the central tendon of the diaphragm. **B.** Continued contraction of the costal fibers of the diaphragm on the stabilized central tendon results in expansion (bucket-handle motion) of the lower ribs.

Intercostals

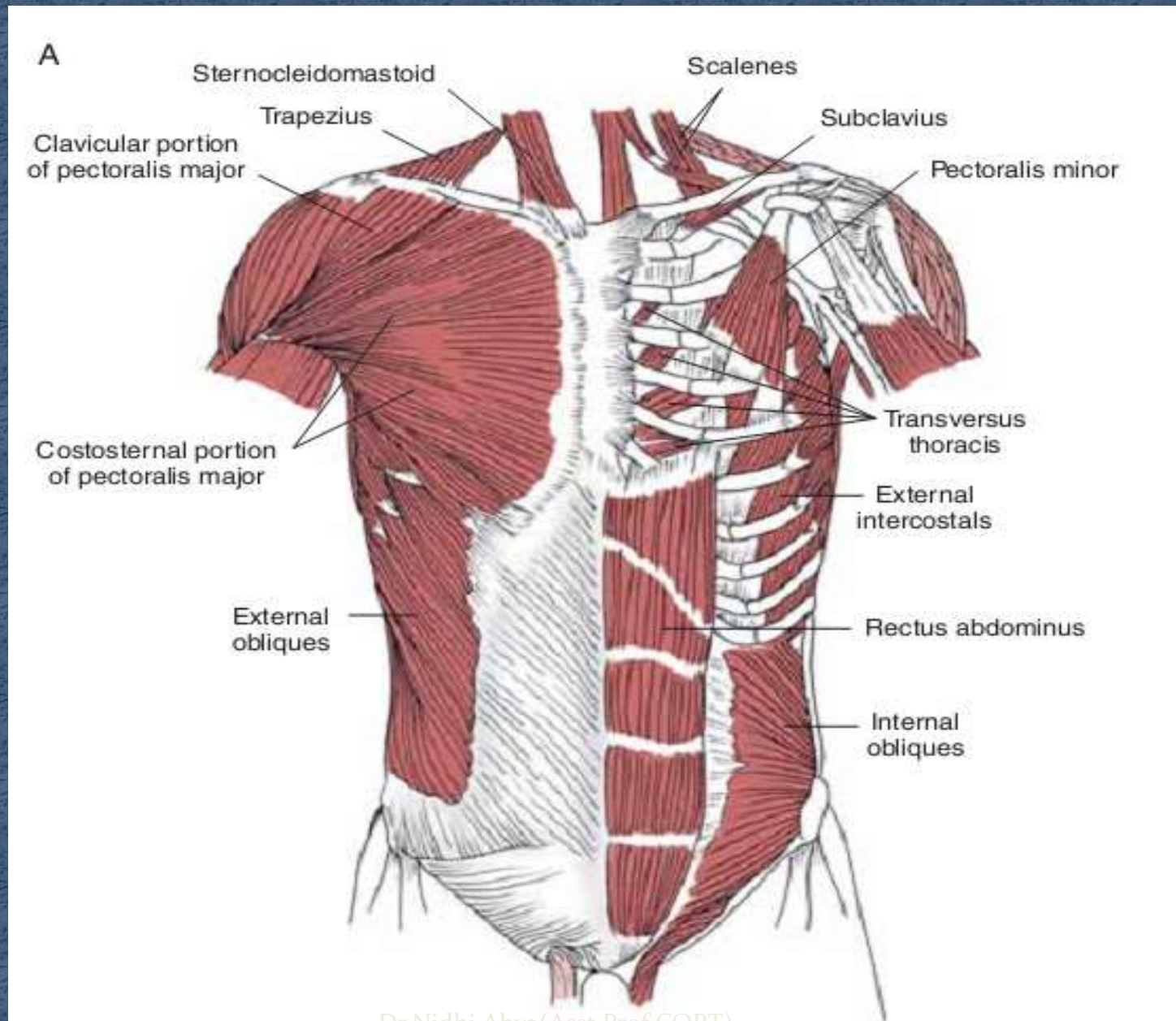
- ❑ External and internal intercostals
- ❑ Only parasternal portion are considered as primary muscles of ventilation
- ❑ Sub costal group of muscles
- ❑ Connects adjacent ribs to one another

Scalene muscles



Accessory muscles of ventilation

- ❑ Attaches the rib cage to shoulder girdle, head, vertebral column, or pelvis
- ❑ Assist with inspiration or expiration in situation of stress
- ❑ When trunk is stabilized, they moves:
 - ❑ Vertebral column
 - ❑ Arm
 - ❑ head



Differences associated with neonates

- ❑ The newborn has a cartilaginous, and therefore extremely compliant, chest wall
- ❑ Chest wall muscles must act as stabilizers, rather than mobilizers
- ❑ Rib cage has more horizontal alignment of the ribs
- ❑ Angle of insertion of the costal fibers of the diaphragm also more horizontal

Differences associated with elderly

- ❑ Many of the articulations of the chest wall undergo fibrosis with advancing age:
 - ❑ The inter-chondral and costochondral joints can fibrose,
 - ❑ Xiphisternal junction usually ossifies after age 40
- ❑ True synovial joints may undergo morphologic changes associated with aging, which results in reduced mobility
- ❑ Costal cartilages ossify, which interferes with their axial rotation
- ❑ Increased kyphosis: Decreases the mobility of thoracic spine and the rib cage

summary

❑ GENERAL STRUCTURE

❑ Rib Cage:

- ❑ Sternum

- ❑ Thoracic vertebrae

- ❑ Ribs

❑ KINEMATICS

- ❑ Ribs and manubriosternum

- ❑ Ribs and thoracic vertebrae

❑ MUSCLES ASSOCIATED WITH RIB CAGE

- ❑ Primary muscles of ventilation

- ❑ Secondary muscles of ventilation

Questions

1. Write the kinematics of the thorax? 3mrks
2. Write the upper ribs movement? 3mrks
3. Write in detail muscles of ventilation? 5mrks



Thank you

Have a nice day....

Dr.Nidhi Ahya(Asst Prof,COPT)

