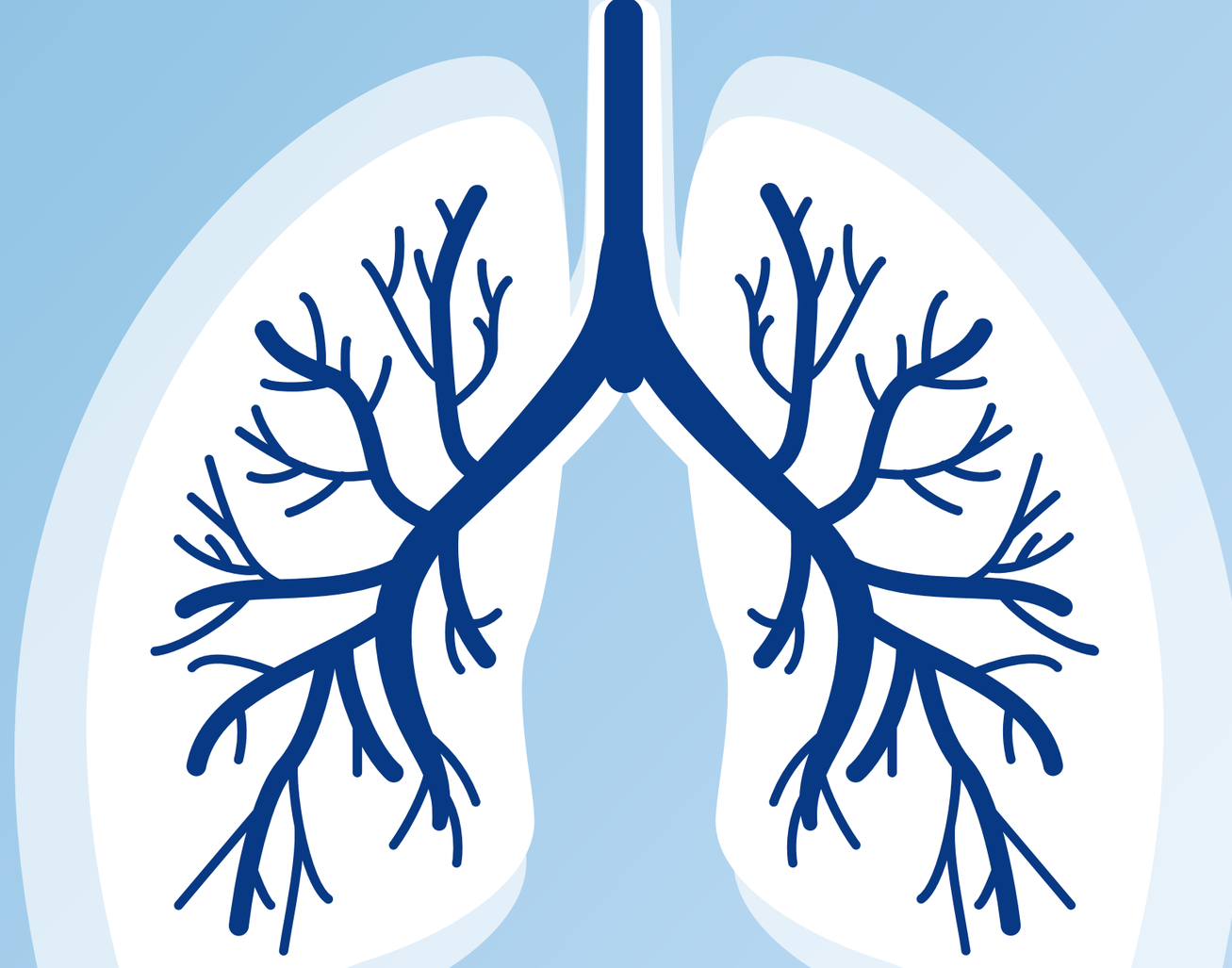

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- Main text
- Boys' Slides
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- Important
- Dr's Notes
- Extra

Editing File

Lecture 1

MUSCLES INVOLVED IN NORMAL RESPIRATION

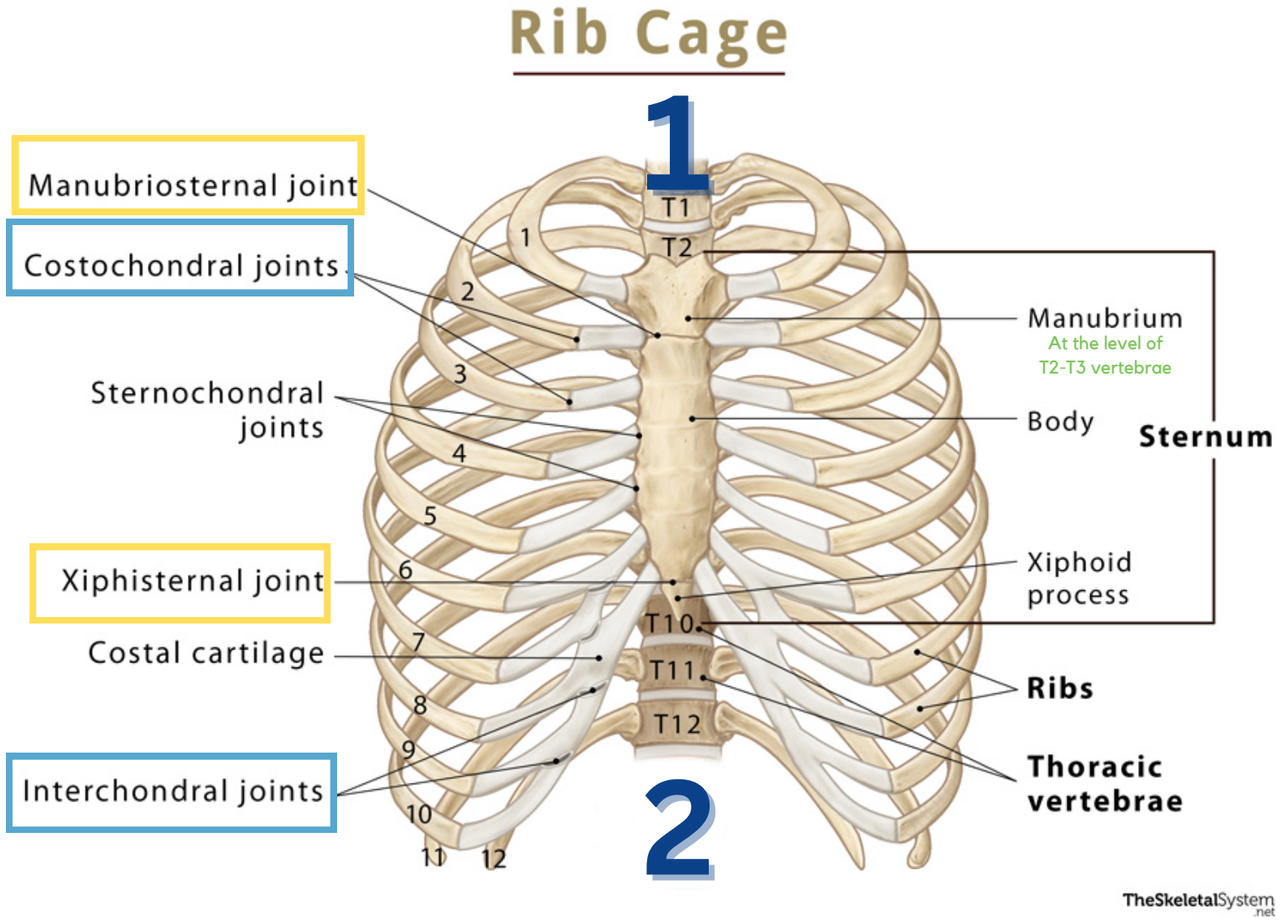
OBJECTIVES

- 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

✦ **Conical in shape**

Formed of:	
Anteriorly:	Sternum Costal cartilage
Posteriorly:	12 thoracic vertebrae
Laterally:	12 pairs of ribs



✦ **Has 2 apertures (openings):**

1 **Superior (Thoracic outlet):**
narrow, open, continuous with neck

2 **Inferior (Thoracic outlet):**
wide closed by diaphragm

Articulations

Primary cartilaginous (Hyaline) No movement-Ossify later	**Secondary cartilaginous** (midline joints)	**Plane synovial Joints**
1st Sternocostal joint (1st costal cartilage articulates with manubrium)	Manubriosternal joint (between manubrium and sternal body) Dr's note: **Important to know** - the manibriosternal junction level is at the 2nd rib (from anterior) and T4- T5 vertebra (from posterior)	Costovertebral joints: (Between heads of ribs & thoracic vertebral bodies
Costochondral joints (between the costal cartilage and the ribs)	Xiphisternal joint (between sternal body and xiphoid process) At the level of T9-T10 vertebrae	The rest of Sternocostal joints (2-7) (2nd to 7th cartilages articulate with sternum)
Interchondral joints. (connects costal cartilages) Ribs (8-10 with rib 7)	Intervertebral discs (between bodies of vertebrae)	Joints between tubercles of ribs and transverse processes of vertebrae (Costotransverse joints)

Respiratory movement

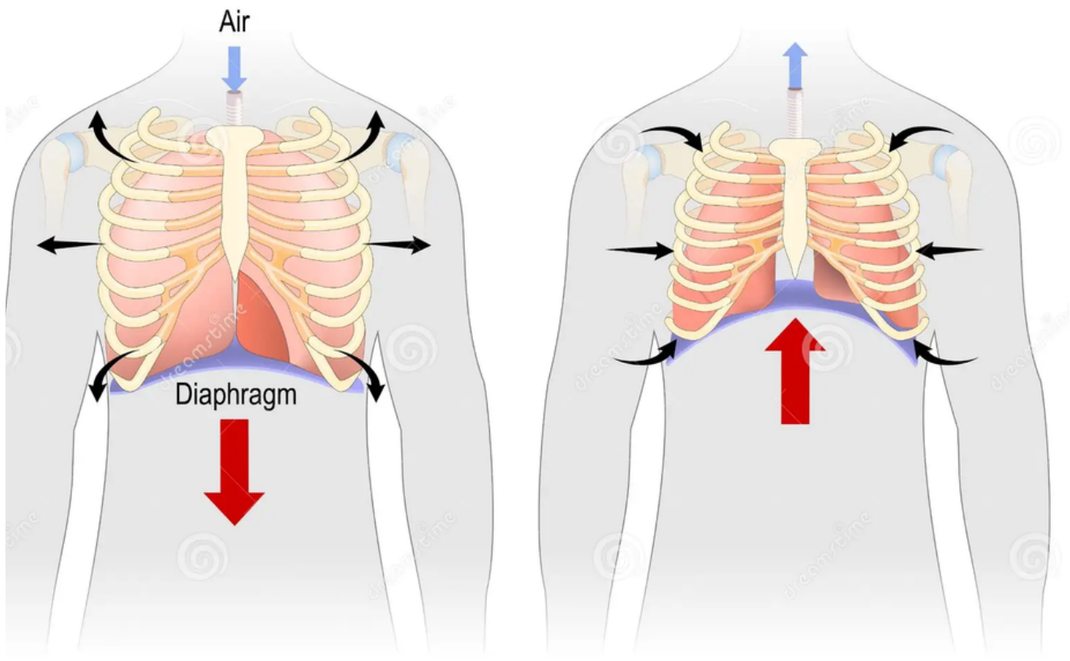
By Diaphargm

Inspiration

- Contraction (descent) of diaphragm
- Increase of vertical diameter of thoracic cavity

Expiration

- Relaxation (ascent) of diaphragm



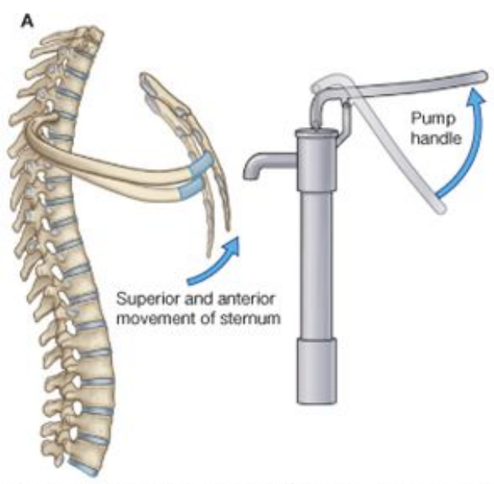
By Ribs

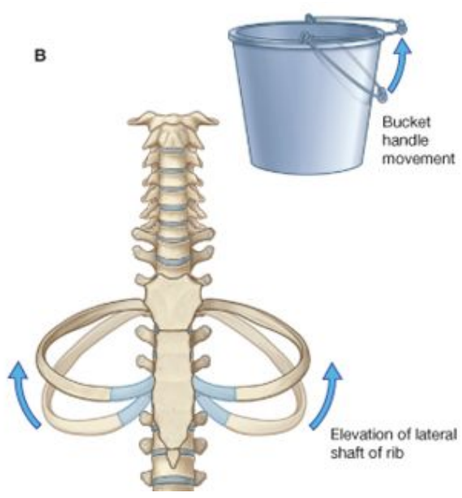
PUMP HANDLE MOVEMENT

- 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





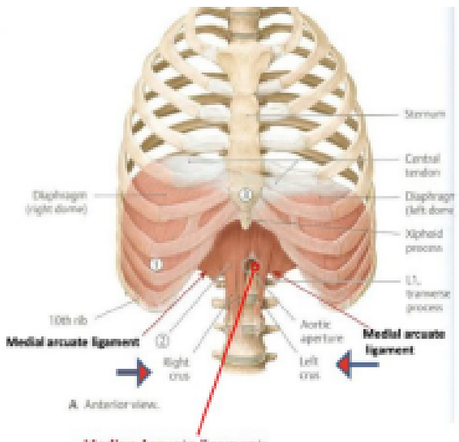
Inspiratory	Expiratory (Act only during forced expiration)
Diaphragm (most important muscle)	**Rib depressors:** 1. Internal intercostal 2. Innermost intercostal 3. Subcostals 4. Transversus thoracis
Rib elevators: External intercostal muscles	
Accessory muscles: (Only during forced inspiration) 1. Muscles attaching cervical vertebrae to first & second rib ex; scalene muscles 2. Muscles attaching thoracic cage to upper limb ex; pectoralis major, pectoralis minor, serratus anterior 3. Muscles attaching thoracic cage to skull ex; sternocleidomastoid	**Anterior abdominal wall muscles:** 1. External oblique 2. Internal oblique 3. Transversus abdominis 4. Rectus abdominis (Compression of abdominal viscera to help in ascent of diaphragm)

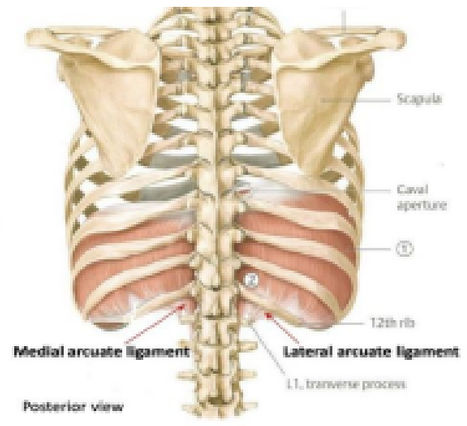
Diaphragm

- A musculotendinous partition between thoracic & abdominal cavity
- Convex toward thoracic cavity.
- Concave toward abdominal cavity.
- It's the **chief muscle** for **normal inspiration**
- The **right** dome of the diaphragm is higher due to the presence of liver under it

Attachments	1. Sternum. 2. Costal cartilages. 3. 12th rib. 4. lumbar vertebrae
Origin	1. Costal: lower 6 costal cartilages. 2. Sternal: xiphoid process of sternum (from anterior) 3. Vertebral : upper 3 lumbar vertebrae (right & left crus + arcuate ligaments) (from posterior)
Insertion	Fibers converge to join and inserted into The Central Tendon It lies at the level of xiphisternal joint, at 9th thoracic Vertebra
Nerve supply	Phrenic nerve (C3,4,5) It penetrates diaphragm & innervates it from abdominal surface
Action	Contraction (descent) of diaphragm that increase the vertical diameter of thoracic cavity. Essential for normal breathing

The thickness of the fascia covering quadratus lumborum forms the lateral arcuate ligament

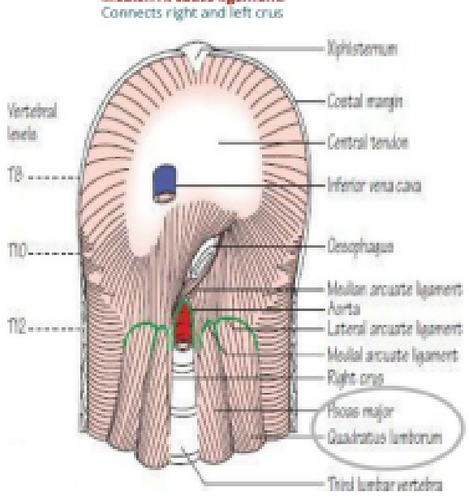


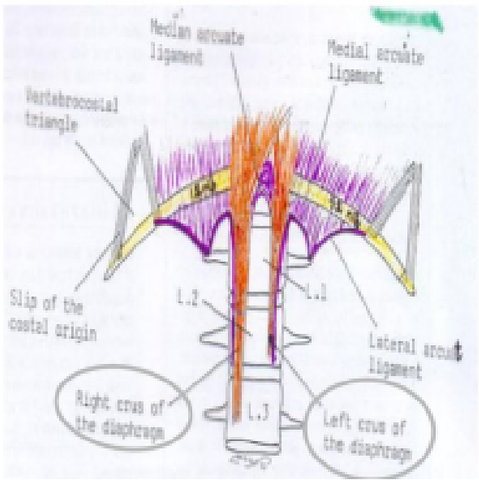


The thickness of the fascia covering psoas major forms the medial arcuate ligament

Median Arcuate ligament:
Connects right and left crus

Left crus is shorter and attached to the upper 2 lumbar vertebrae



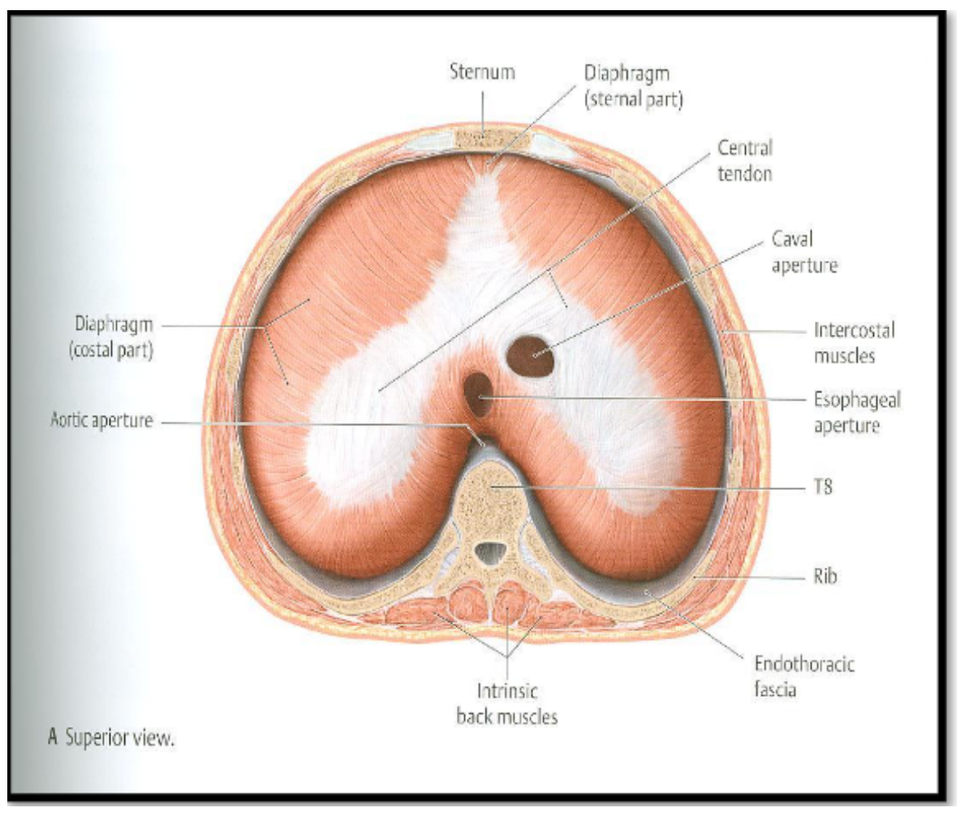


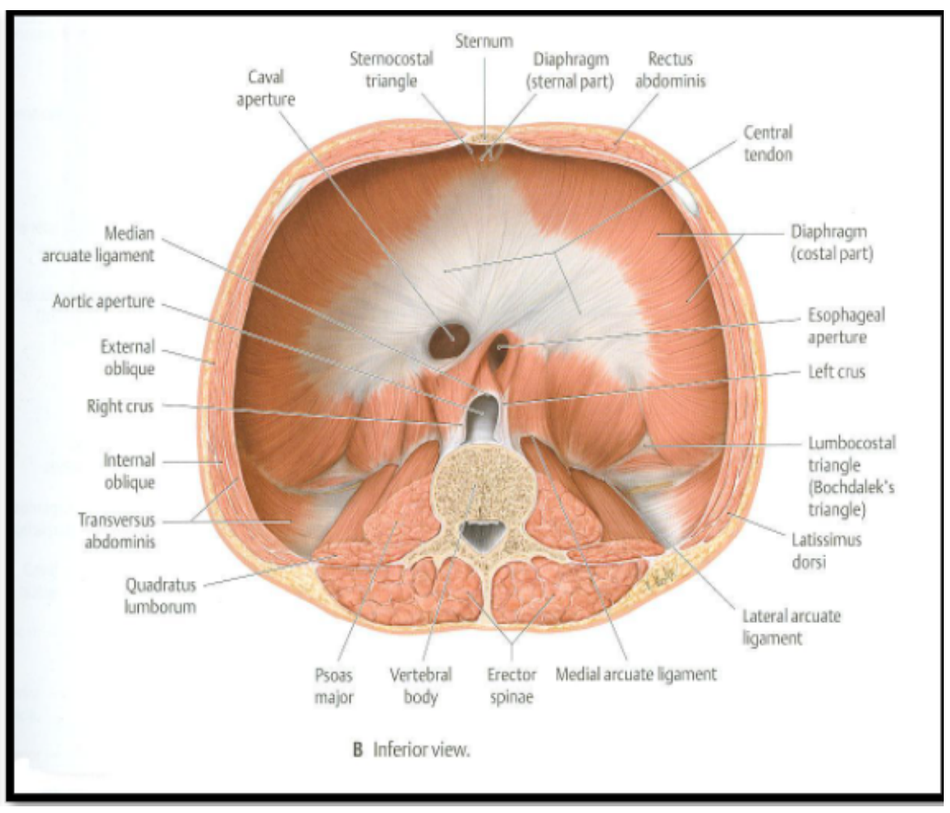
Right crus is longer and attached to the upper 3 lumbar vertebrae

Major openings in the diaphragm

IMPORTANT!

	Inferior vena caval opening (hiatus)	Esophageal opening (hiatus)	Aortic opening (hiatus)
Level	**T8**	**T10**	**T12**
Site	In central tendon	In right crus (The only opening that is formed by a muscle, so it acts as a sphincter)	Between right and left crus
Structures passing	1. Inferior vena caval (IVC). 2. Right phrenic nerve. 3. Lymphatics. 443: The right phrenic nerve enters through the IVC opening while the left phrenic nerve penetrates the diaphragm alone	1. Esophagus. 2. Right & left vagus nerves. 3. Esophageal branches of left gastric artery and corresponding veins	1. Aorta. 2. Azygos vein. 3. Thoracic duct





Median arcuate ligament:
Connects right and left crus

Medial arcuate ligament:
Connects each crus to 1st Lumbar

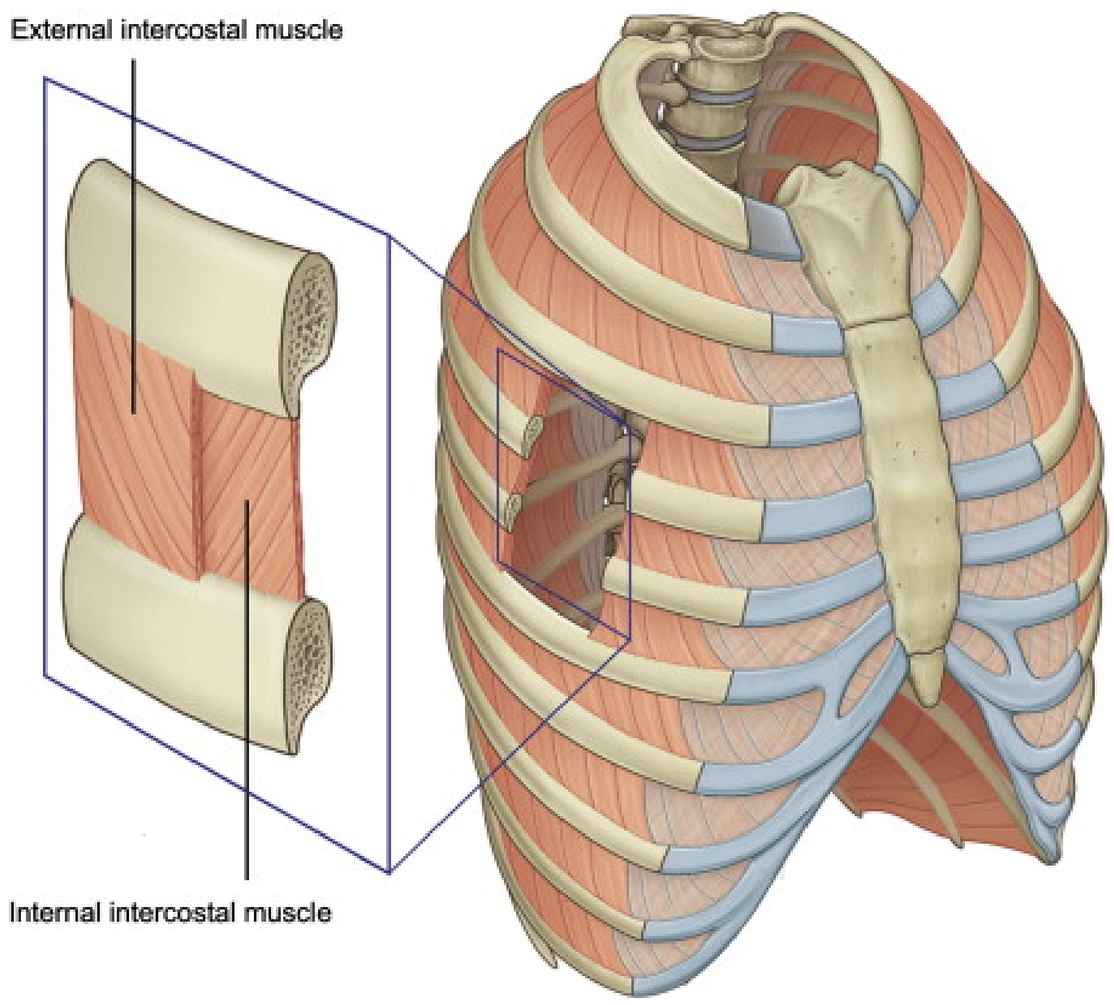
Lateral arcuate ligament:
Connects 1st Lumbar to last rib

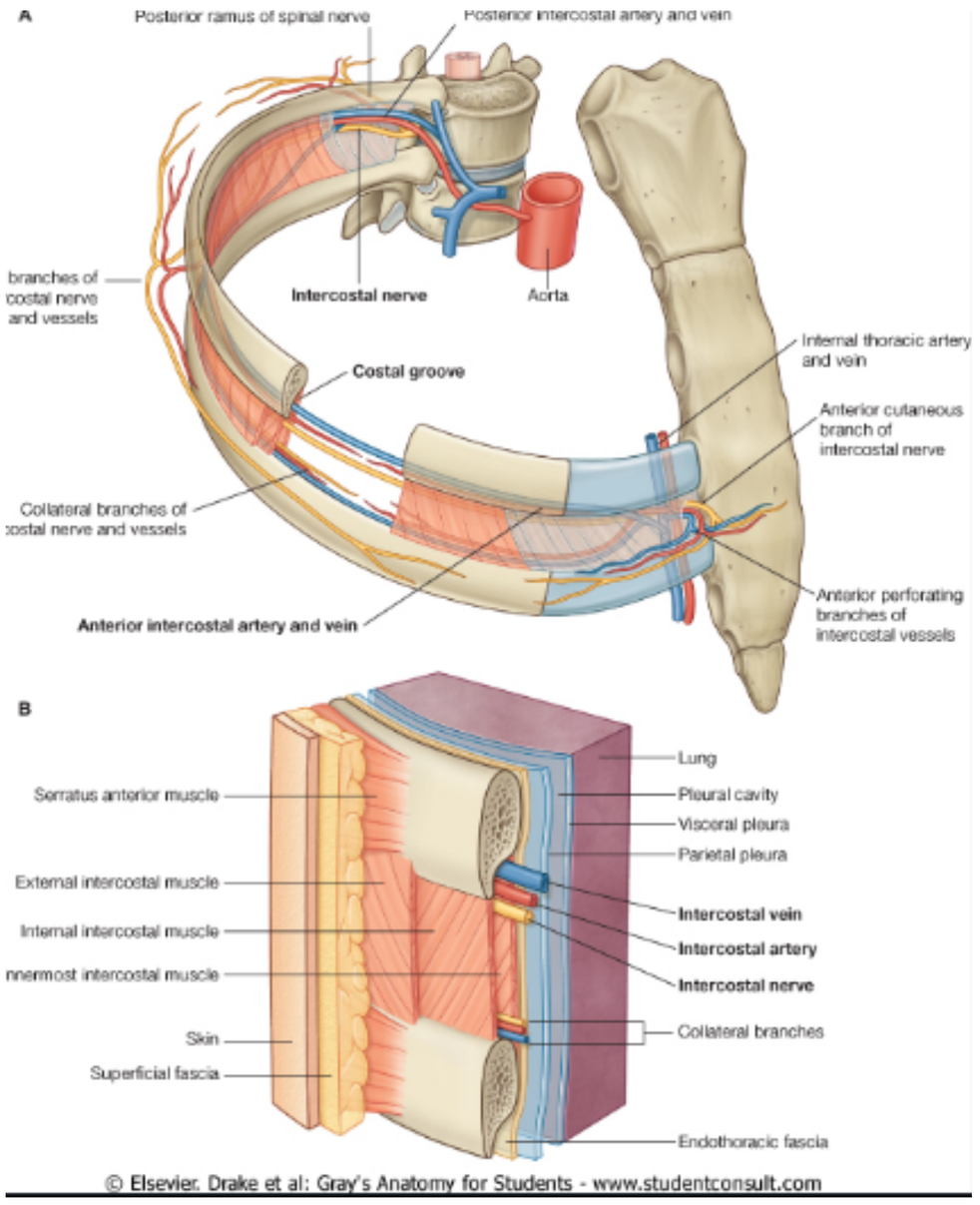
443:
Esophageal hiatus
يساعد esophagus في الحركة بحيث اثناء الانقباض يضغط على المريء ويتحرك

vena cava 8 letters -> T8
esophegeal 10 letters -> T10
aortic hiatus 12 letters -> T12

External Intercostal Muscle

Muscle	External Intercostal Muscle
Attachment	From lower border of rib above to upper border or rib below
Direction of fibers	Downward, forward & medially
Action	Rib elevator (inspiratory)
Nerve supply	Intercostal nerves (ventral rami of T1-T11)



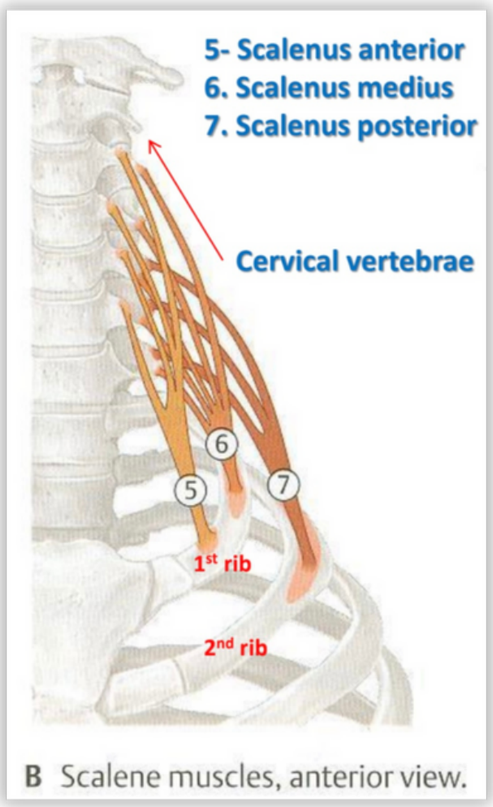


Accessory muscles of inspiration

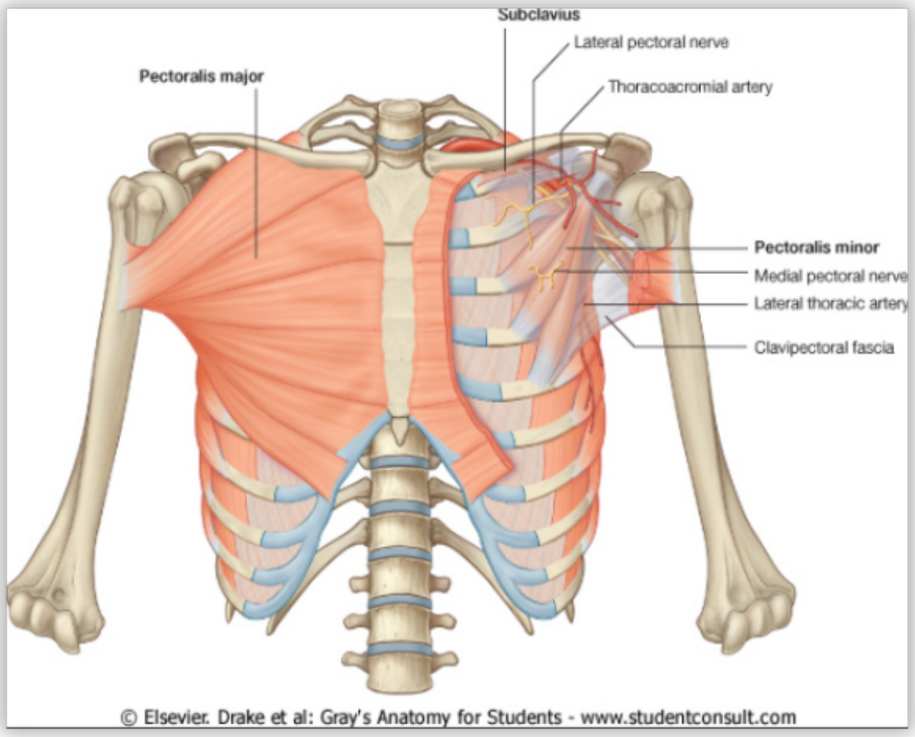
- During forced inspiration only

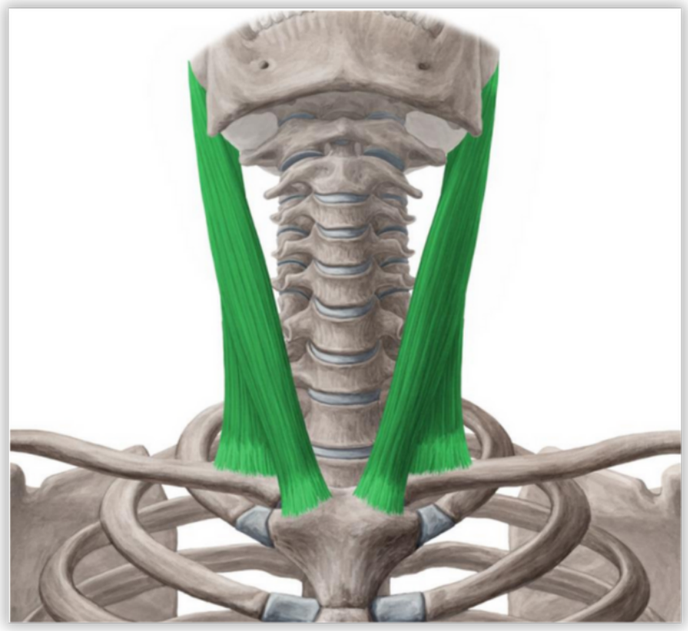
بمعنى ان هذه العضلات وقت inspiration normal م يكون لها علاقة في التنفس، لكن في حالة ال inspiration forced تساعد في عملية التنفس.

Muscle	Scalene muscles	Pectoralis major	Sternocleidomastoid In Males' slide
Origin	Cervical vertebrae	Clavicle + Sternum + Upper 6 costal cartilages	**Sternal head**: Front of Manubrium sterni **Clavicular head**: Medial 1/3 of clavicle
Insertion	1st rib (Scalenus anterior and medius) 2nd rib (Scalenus posterior)	Humerus (lateral lip of the bicipital groove)	Mastoid process
Action	**Elevate** 1st & 2nd ribs (Inspiratory), (In forced inspiration)	**Increases antero-posterior diameter** of thoracic cavity, when arm is fixed (Inspiratory)	**Elevates** the manubrium



B Scalene muscles, anterior view.

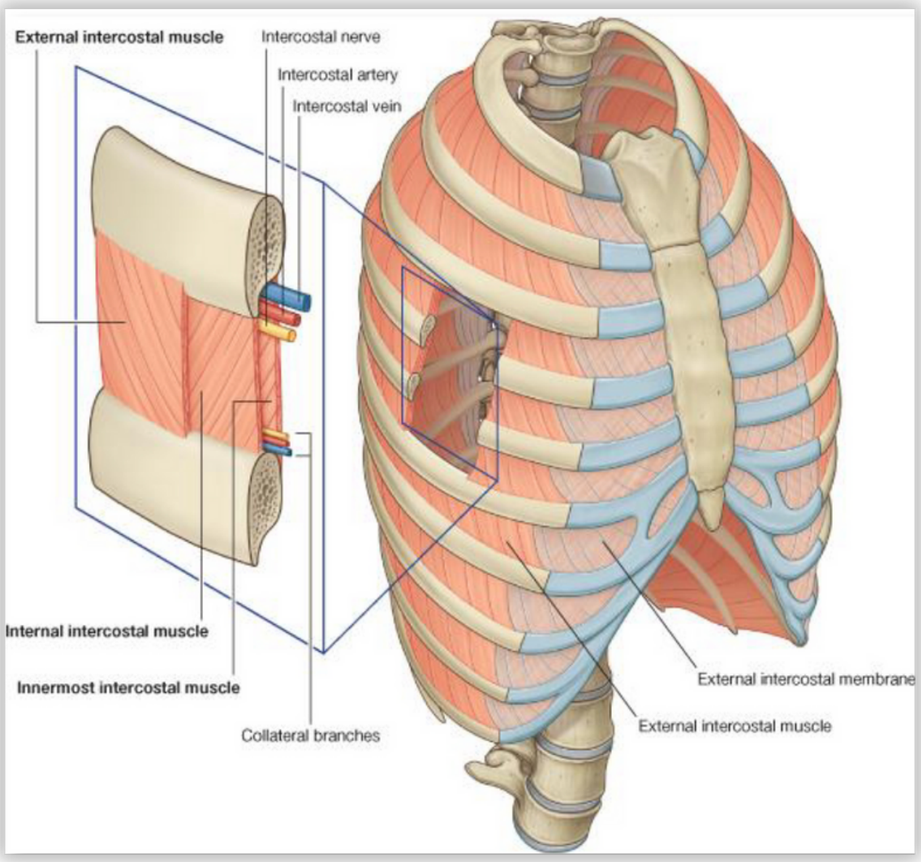


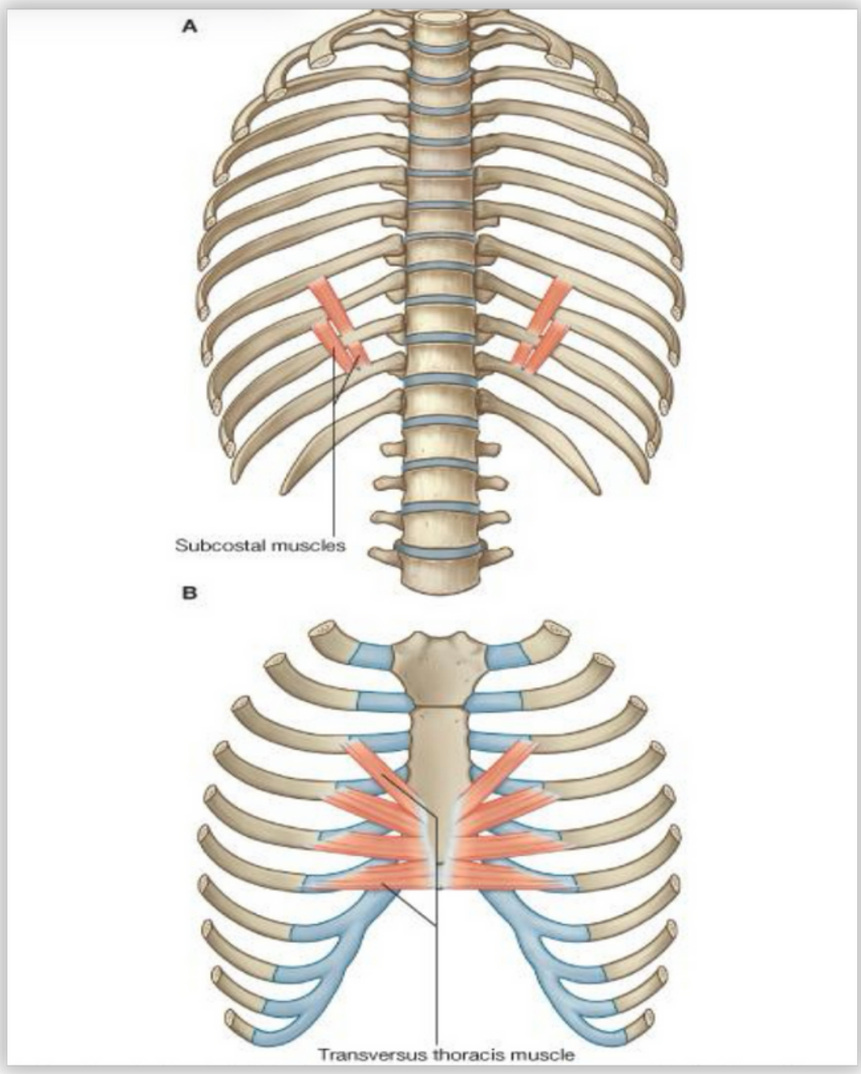


Expiratory muscles

- Act only during forced expiration

A- Ribs depressors				
Muscle	**Internal intercostal**	**Innermost intercostal**	**Subcostal**	**Transversus thoracis**
Attachment	from lower border of rib above to upper border of rib below		-	
Direction	Backward & laterally Upward & medially*			
Nerve	Intercostal nerves (ventral rami of T1-T11)			
Action	Depression of the ribs			





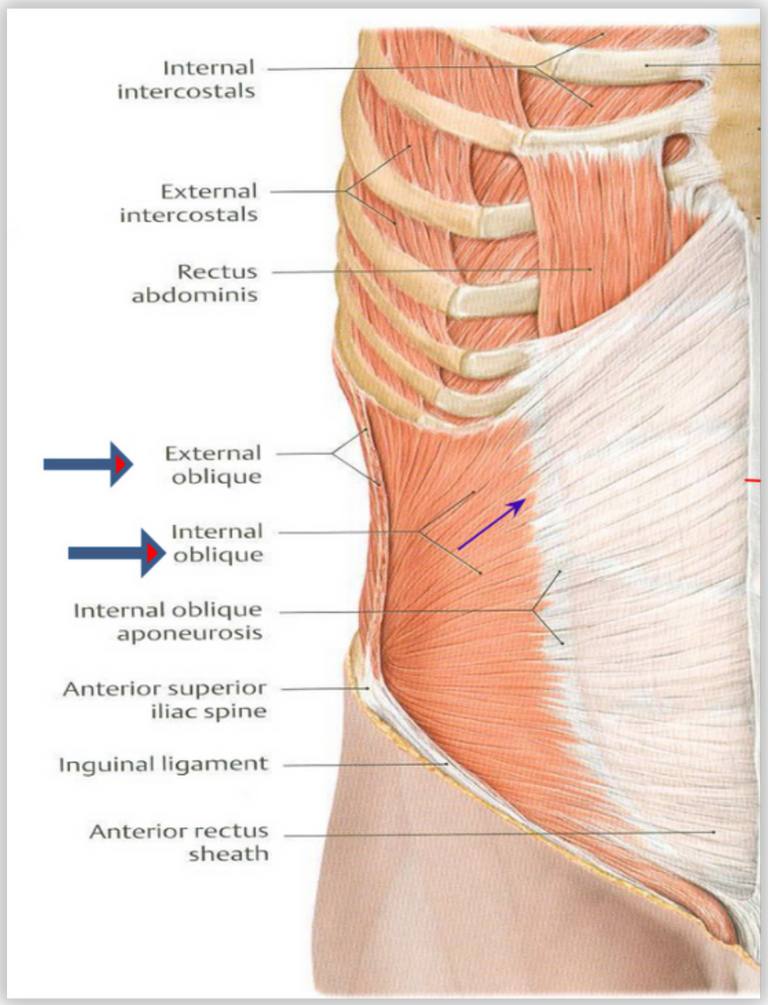
Intercostal vessels & nerve lie in intercostal space behind the internal intercostal muscle.

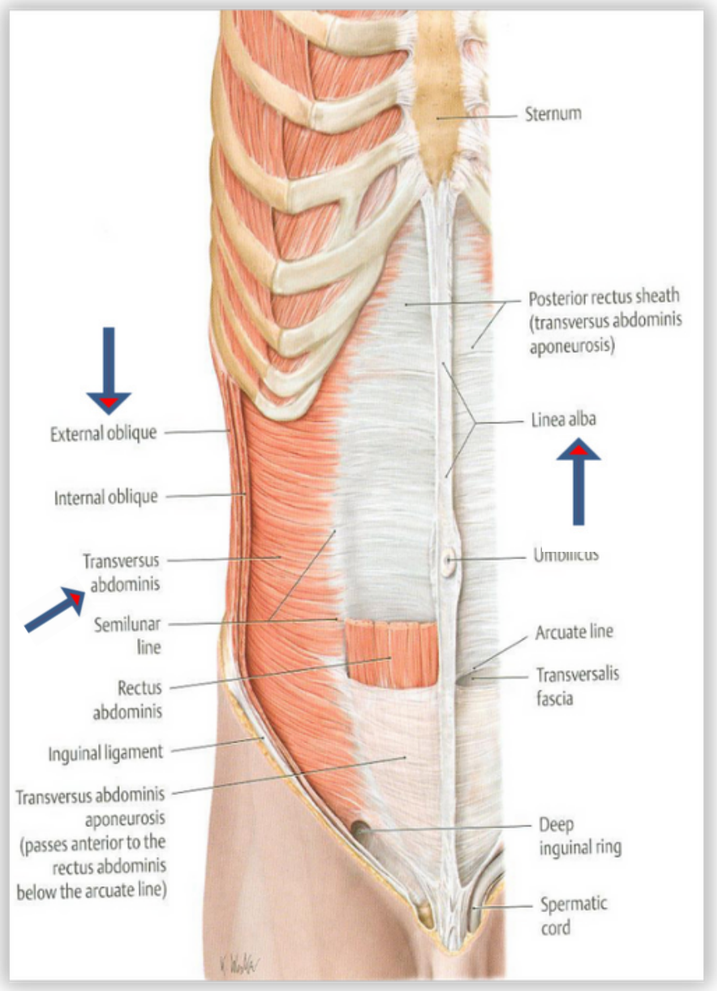
Cont. Expiratory muscles

B- Anterior abdominal wall muscles

- It 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 muscles 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**.

Muscle	External oblique Outer layer	Internal oblique Middle layer	Transversus abdominis Inner layer	Rectus abdominis
Direction	Downward, Forward & medially	Upward, Forward & medially	Transverse	Vertical
Nerve	Lower 5 intercostal nerves (**T7-T11**), subcostal nerve (**T12**) and ilio-hypogastric first lumbar nerve (**L1**).			
Action	**During forced expiration**: Compression of abdominal viscera to Action help in ascent of diaphragm			





Boys' Slides

Summary of Respiratory Movements

Inspiration

Quite inspiration (Active)	Forced inspiration (Active)

Contraction (descent) of diaphragm ↓ Increase in vertical diameter	Elevation of ribs (external intercostals) ↓ Increase in: Anteroposterior diameter lateral diameter	Accessory muscles of inspiration Examples: **Pectoralis major** & **minor**, **Scalene** muscles, **sternocleidomastoid**,...

Expiration

Quite expiration (Passive)	Forced expiration (Active)	
• Elastic recoil of lungs • **Relaxation** of diaphragm & external intercostals	Contraction of anterior abdominal wall muscles ↓ Compression of abdominal viscera ↓ Ascent of diaphragm	Depression of ribs (rest of intercostal muscles) • Internal intercostal • Innermost intercostal • Subcostal • Transversus thoracis

Questions

Dr said these are just for brainstorming

Are the following muscles have a respiratory role? If yes, what is it?

1. Levatores costarum. Accessory muscle of forced deep inspiration, elevates the costal cartilage
2. Serratus posterior superior. Accessory muscles in deep inspiration, they help in elevating the ribs. Already forgot MSK? :o
3. Serratus posterior inferior.
4. Pectoralis minor. Mentioned in the lecture
5. Serratus anterior. Mentioned in the lecture
6. Latissimus dorsi. Accessory muscle of forced deep inspiration active especially in coughing and sneezing
7. Quadratus lumborum. fixes the 12th rib to stabilize diaphragm attachments during inspiration

- **Why diaphragm is supplied by cervical nerves?**

  Because the earliest element of the embryological diaphragm, the septum transversum, forms in the cervical region, the phrenic nerve that innervates the diaphragm originates from the cervical spinal cord (C3,4, and 5).

- **Why right crus of diaphragm is larger than left crus?**

  The right crus is attached to Lumbar vertebral bodies L1, L2, L3 which makes it larger than left crus (attached only to L1 & L2).

⚠ These are the team leader answer, so mistakes are possible.

MCQs

1 Which of the following joint is Secondary cartilaginous

A) First sternocostal joint	B) Xiphisternal joint	C) Costochondral joint	D) A&C

2 Which of the following openings of the diaphragm is T12?

A) Aortic opening	B) Esophageal opening	C) Inferior vena caval opening	D) Left phrenic

3 Which of the following muscles contribute in the ascent of the diaphragm and forced expiration?

A) External intercostal	B) pectoralis major	C)Transverse thoracis	D) External oblique

4 which one of the following muscles is used in normal inspiration?

A) External intercostal	B) Deltoid	C) pectoralis major	D) Transversus abdominis

5 Internal oblique muscle forms which layer of anterior abdominal wall?

A) Middle	B) Inner	C) Outer	D) Lateral

1:B 2:A 3:D 4:A 5:A

SAQs

1 Enumerate structures passing through Inferior vena caval opening?

Inferior vena caval
Right phernic nerve
Lymphatics

2 What are the muscles involved in normal inspiration?

Diaphragm
External intercostal muscle

3 Enumerate the layers and muscles of the anterior abdominal wall?

- 3 layers, outer layer,middle layer, inner layer.
- 4 muscles, external oblique, internal oblique, transverse abdominis Rectus abdominis.

4 Enumerate the three Secondary Cartilaginous joints around the thoracic cage?

Xiphisternal joint, Manubriosternal joint, and Intervertebral discs

More questions? Click here!

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