

JUST BREATHE 101

Function of Respiration

Debra Dent BPT Dip Manip PT OCS (Emeritus) FCAMPT (Emeritus)



1. Discuss the functions of the intercostals.
2. Describe two functions of the diaphragm.
3. Relate how upper chest breathing and the scalenes are related.

OBJECTIVES:



CANADIANISM'S



Cardiac	Dissecting Aneurysm	Thoracic Peptic Ulcer
<ul style="list-style-type: none"> •History or risk factors for CVD •Angina •Nausea 	<ul style="list-style-type: none"> •Severe unrelenting chest pain •Referral •Upper back •Not relieved by lying down 	<ul style="list-style-type: none"> •Boring pain epigastric area •Caused by eating •History of NSAID use •Perforated ulcer refers to shoulder
Cholecystitis	Renal infection Kidney stones	
<ul style="list-style-type: none"> •RUQ •Pain •Fever, nausea, vomiting 1-2 hours after eating 	<ul style="list-style-type: none"> •Flank pain •Fever, nausea, vomiting •Ongoing UTI 	



Fracture

- Trauma
- Compression-fracture associated with osteoporosis
- Acute pain with trivial trauma in females over 60

Neoplastic conditions

- Over 50 years of age
- Previous history of Ca
- Unexplained weight loss
- Constant pain unrelieved by position
- Night pain

•Inflammatory Disorders

Ankylosing spondylitis

- Limited chest expansion, SI joint pain and (+) SI joint stress tests
- Morning stiffness
- Peripheral joint involvement
- (+) HLAB27 test

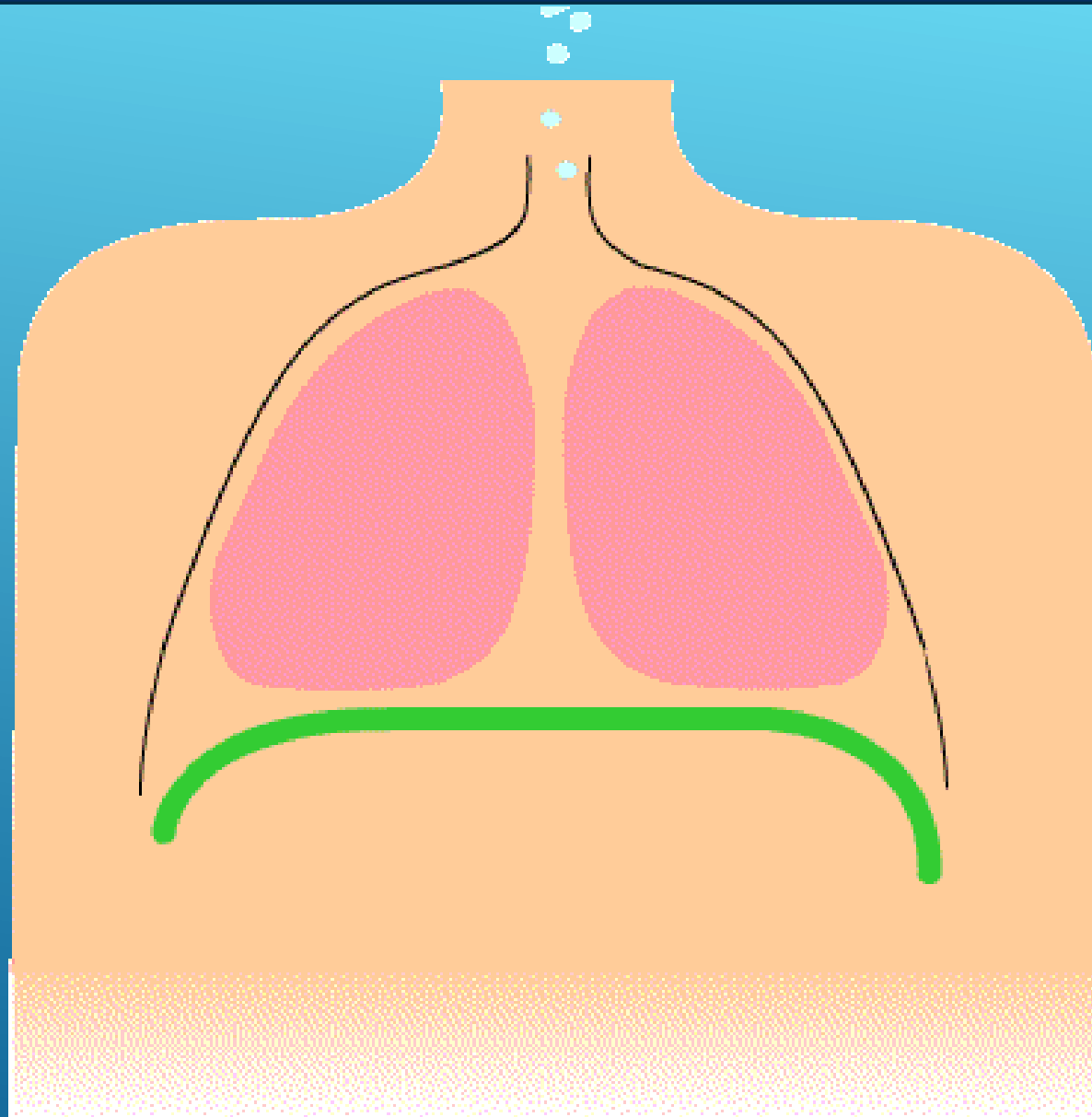
•Inflammatory Systemic Disease

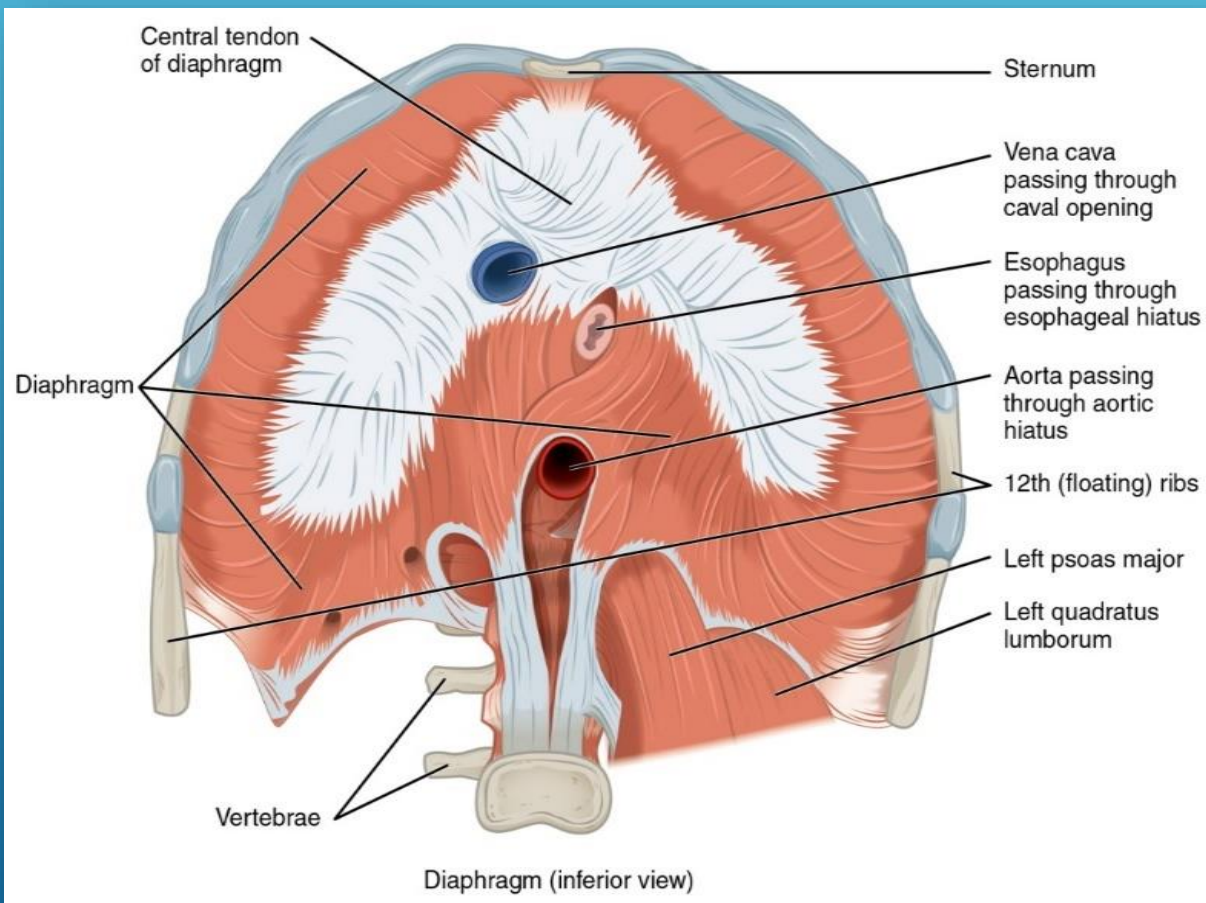
Osteomyelitis, Discitis, Epidural Infection, Pericarditis

- Fever greater than 100
- Blood pressure elevated 160/95
- Tachycardia of 100 or greater
- Respiratory rate 25 or greater
- Fatigue









Origin:

- Vertebral: crura from bodies of L1, 2 (left), L1-3 (right)
- Costal: medial and lateral arcuate ligaments, inner aspect of lower six ribs
 - Moves most with breathing
- Sternal: two slips from posterior aspect of xiphoid

Insertion: Central tendon



- Innervation:
 - Motor: phrenic nerve C3, C4, C5
 - Sensory: phrenic, intercostals (6-12) and upper two lumbar nerve roots
- Function:
 - Inspiration and assists in raising intra-abdominal pressure
 - Postural

DIAPHRAGM



ANTERIOR ASPECT OF DIAPHRAGM



Right Crus or crura inserts into upper three Lumbar vertebrae

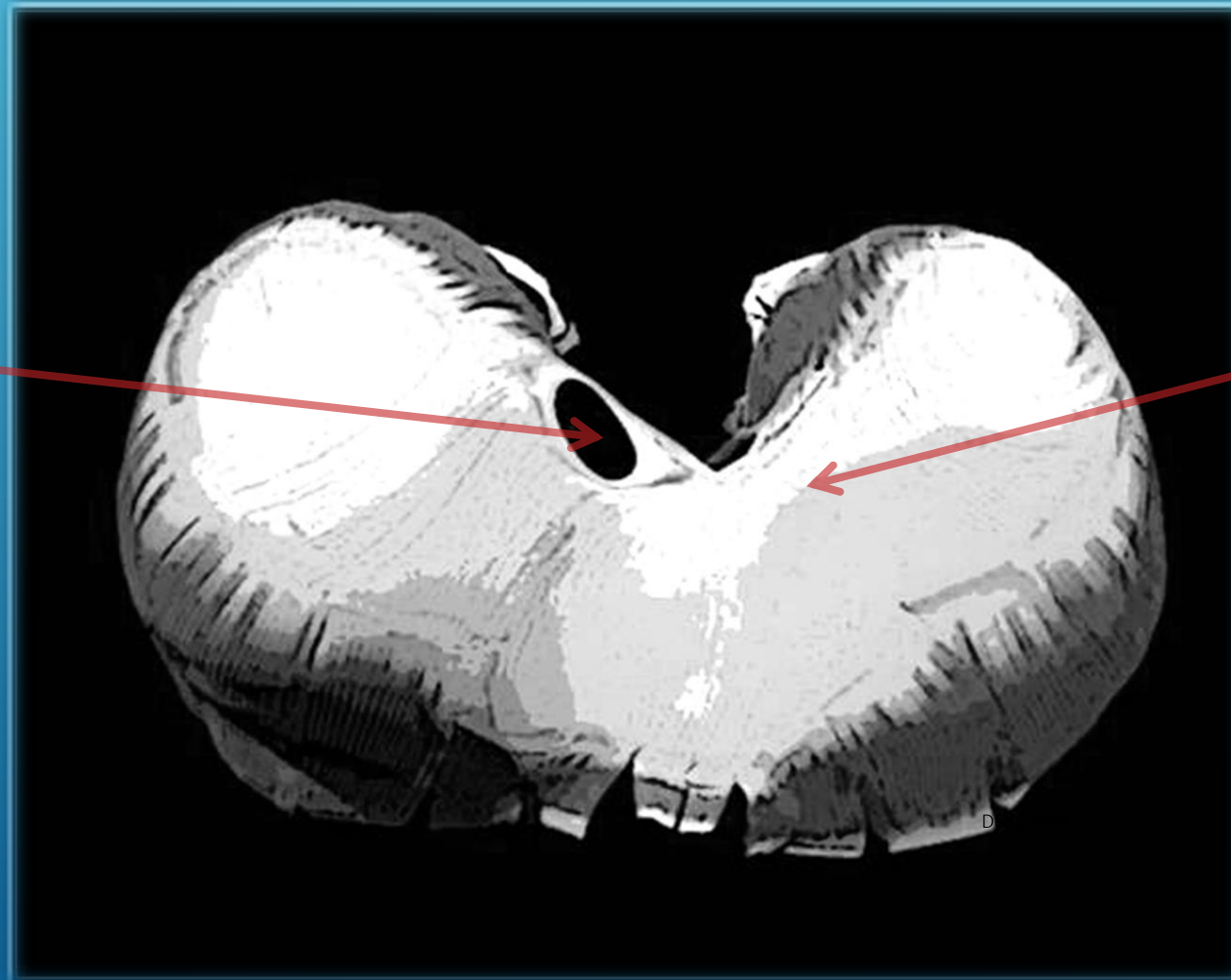
Diaphragm Crura

Left Crus or crura inserts into upper two Lumbar vertebrae



SUPERIOR ASPECT OF DIAPHRAGM

Vena Caval
Aperture



Central Tendon



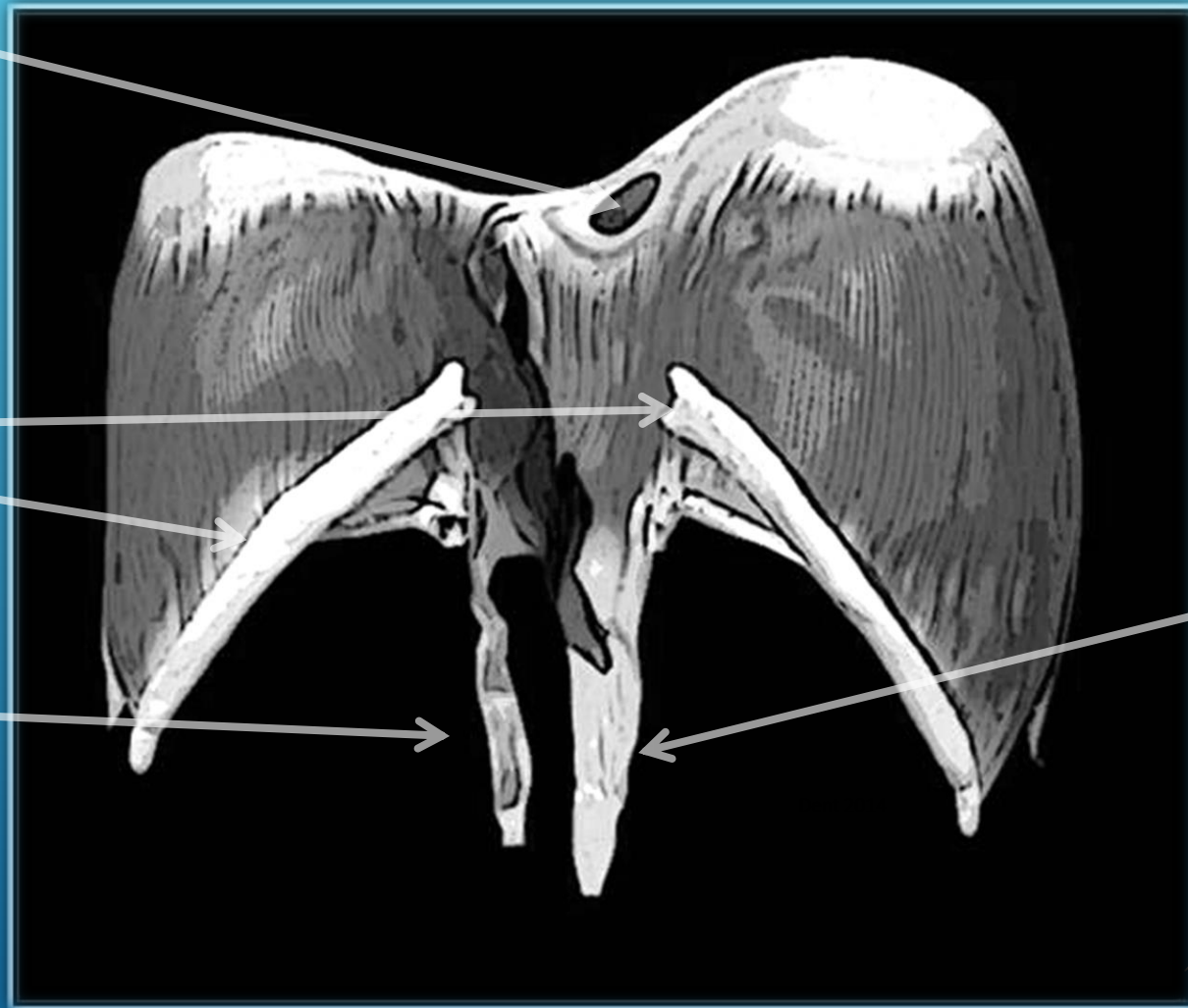
POSTERIOR DIAPHRAGM

Esophageal Aperture

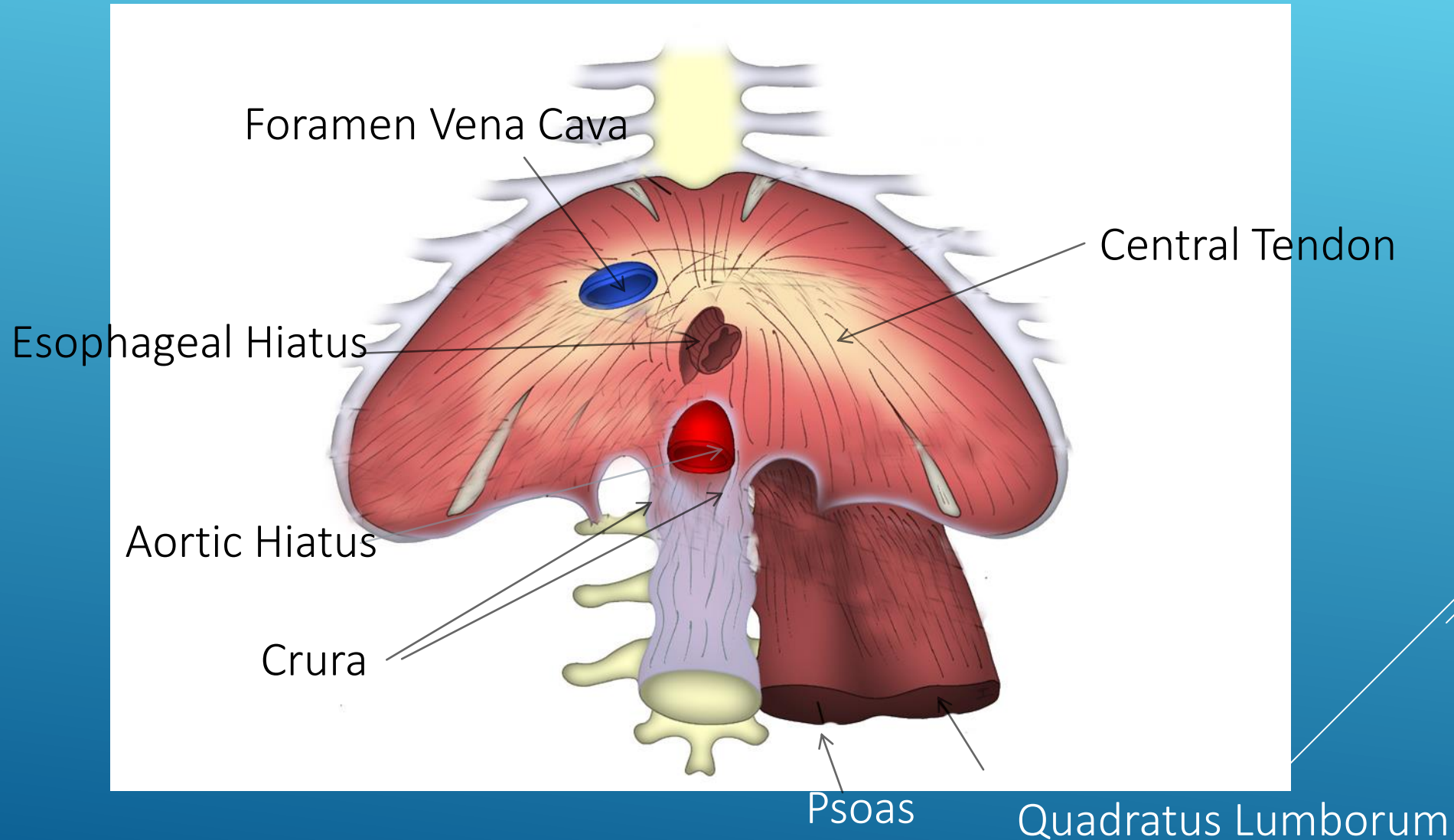
12th rib

Left Crus

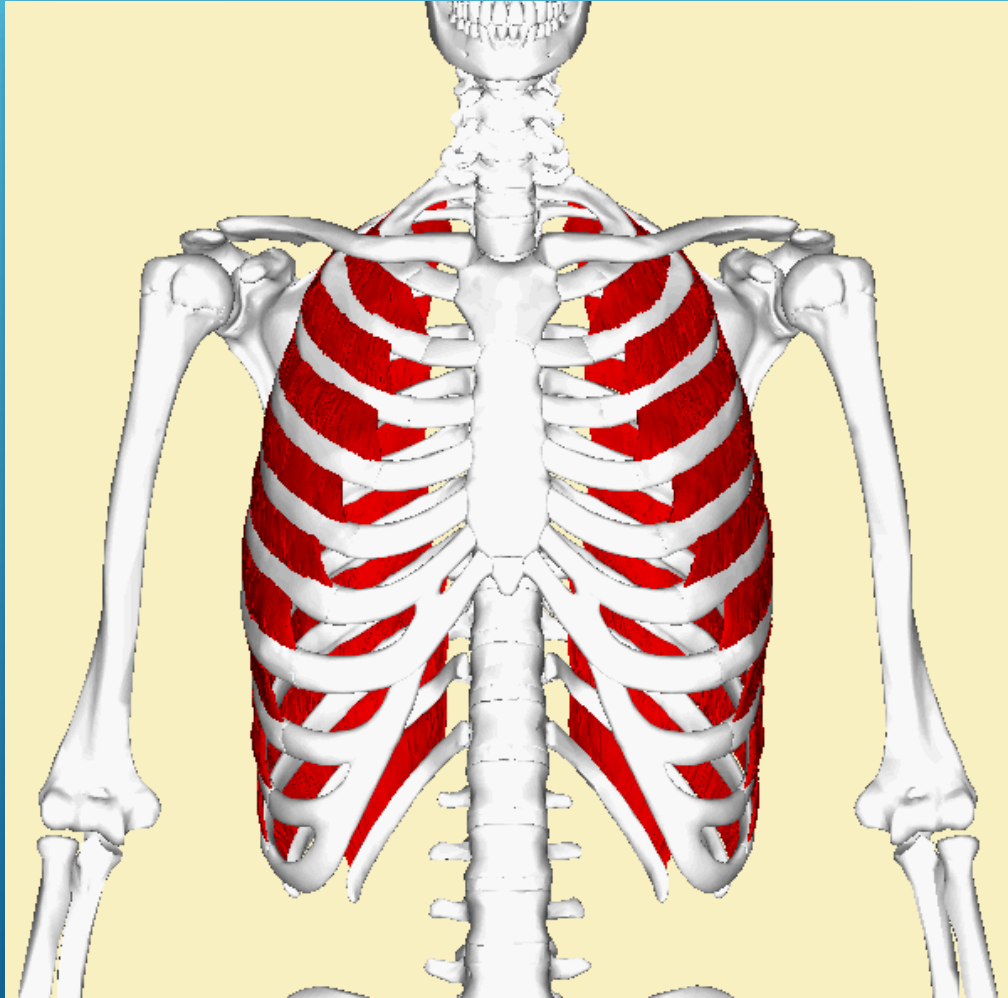
Right Crus



DIAPHRAGM



EXTERNAL INTERCOSTALS



- 11 per side
- **Origin**
 - Lower border of a rib above- fiber direction is inferior and medial
- **Insertion**
 - Upper border of the rib below

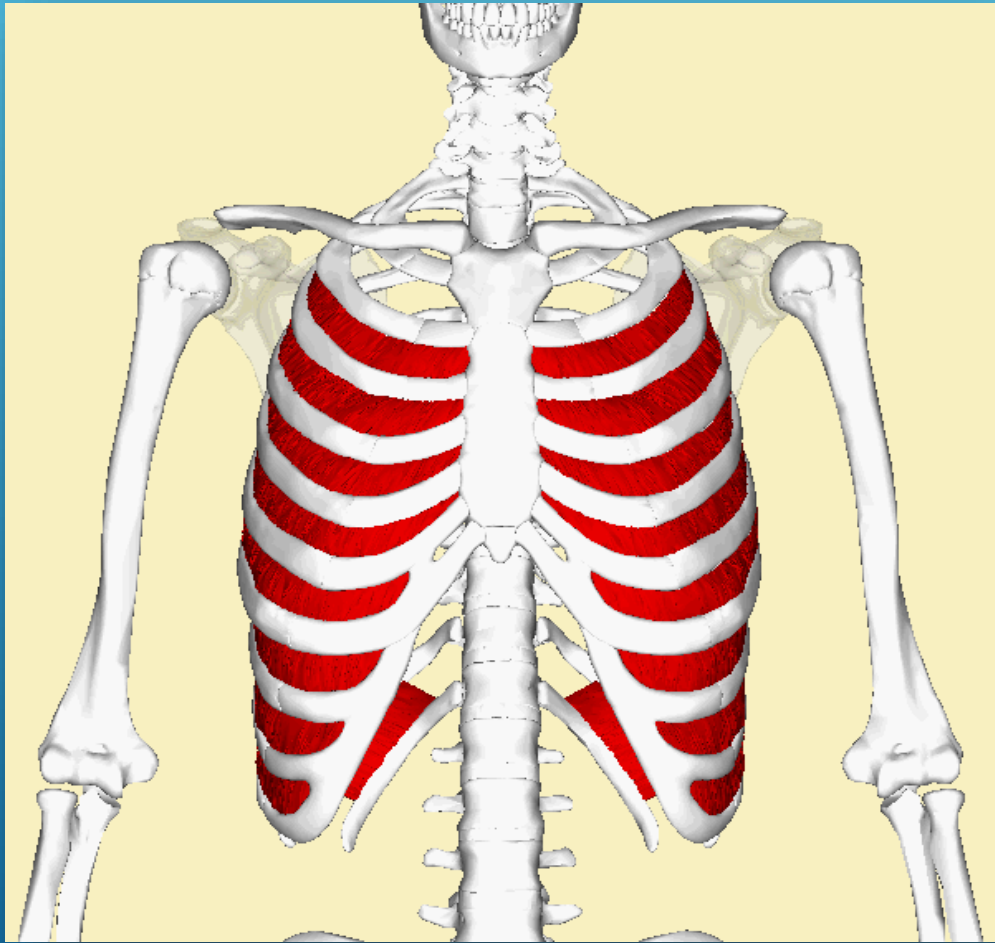


- **Function**
- Works to stiffen the chest wall during respiration
- Elevate the rib cage during inspiration
- **Innervation**
- Muscular collateral branches of intercostal nerves (T1-T11)

EXTERNAL INTERCOSTALS



INTERNAL INTERCOSTALS



- 11 per side
- **Origin**
- 90 degrees to external intercostals
- **Insertion**
- Lower border of rib above in the subcostal groove and adjacent cartilage



- **Function**
- Works to stiffen the chest wall during respiration
- Draw ribs together in respiration and expulsive movements.
- Most active in expiration
- **Innervation**
- Muscular collateral branches of intercostal nerves (T1-T11)

INTERNAL INTERCOSTALS



- Function:
 - Respiration
 - Postural
 - Locomotor activities
- Contraction can alter the stiffness and mobility of the rib cage
- Rotation induces postural tone but it is modulated with respiration

INTERCOSTALS

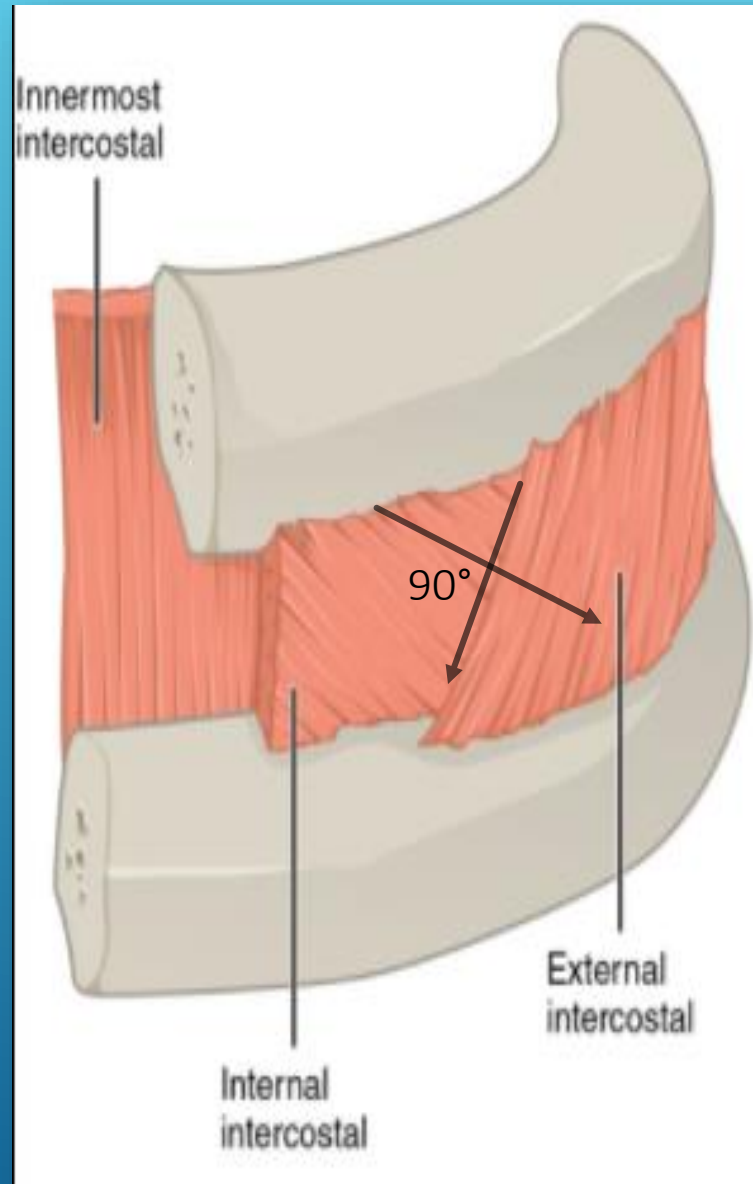


- Internal intercostals can be completely inhibited by inspiration
- External intercostals demonstrated phasic inspiratory activity while rotated
- Rotation did not change Tidal Volume

INTERCOSTALS

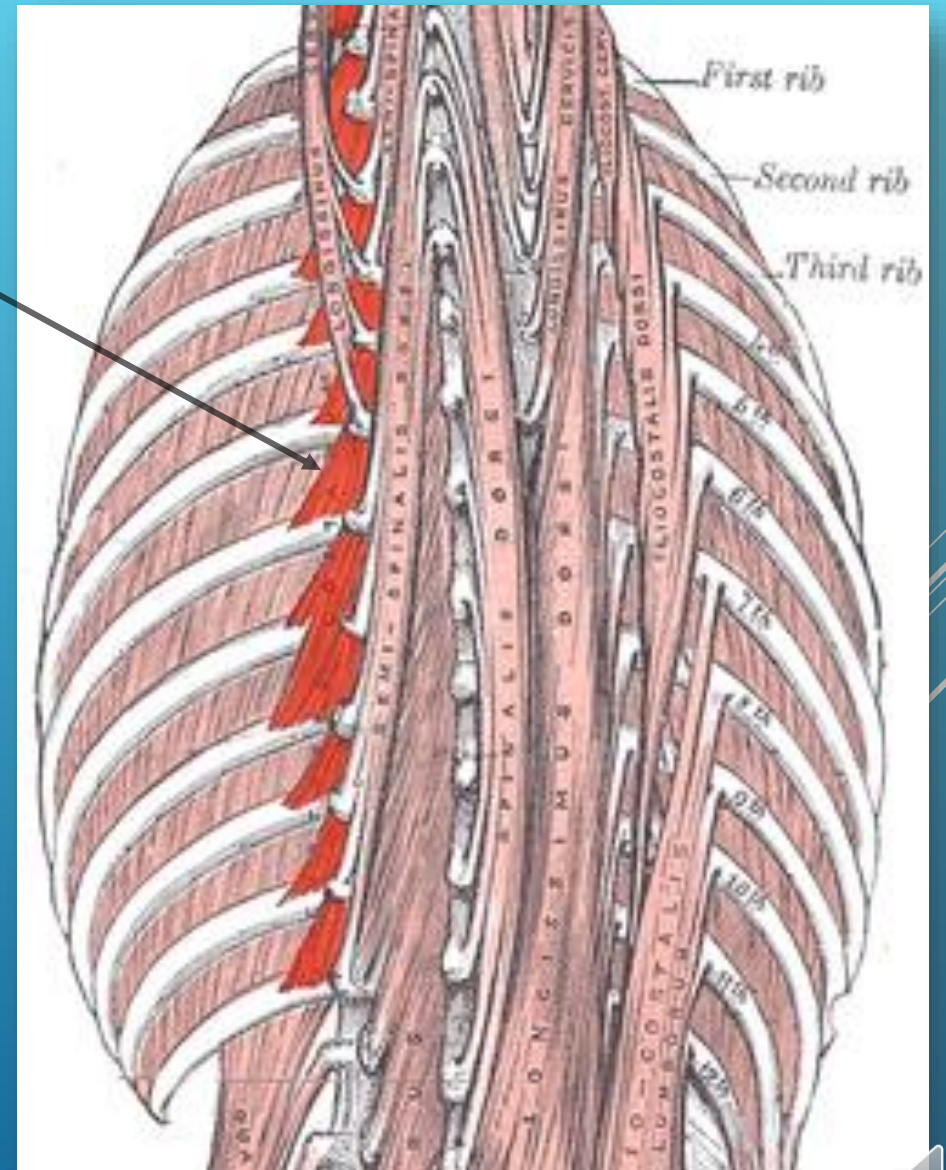


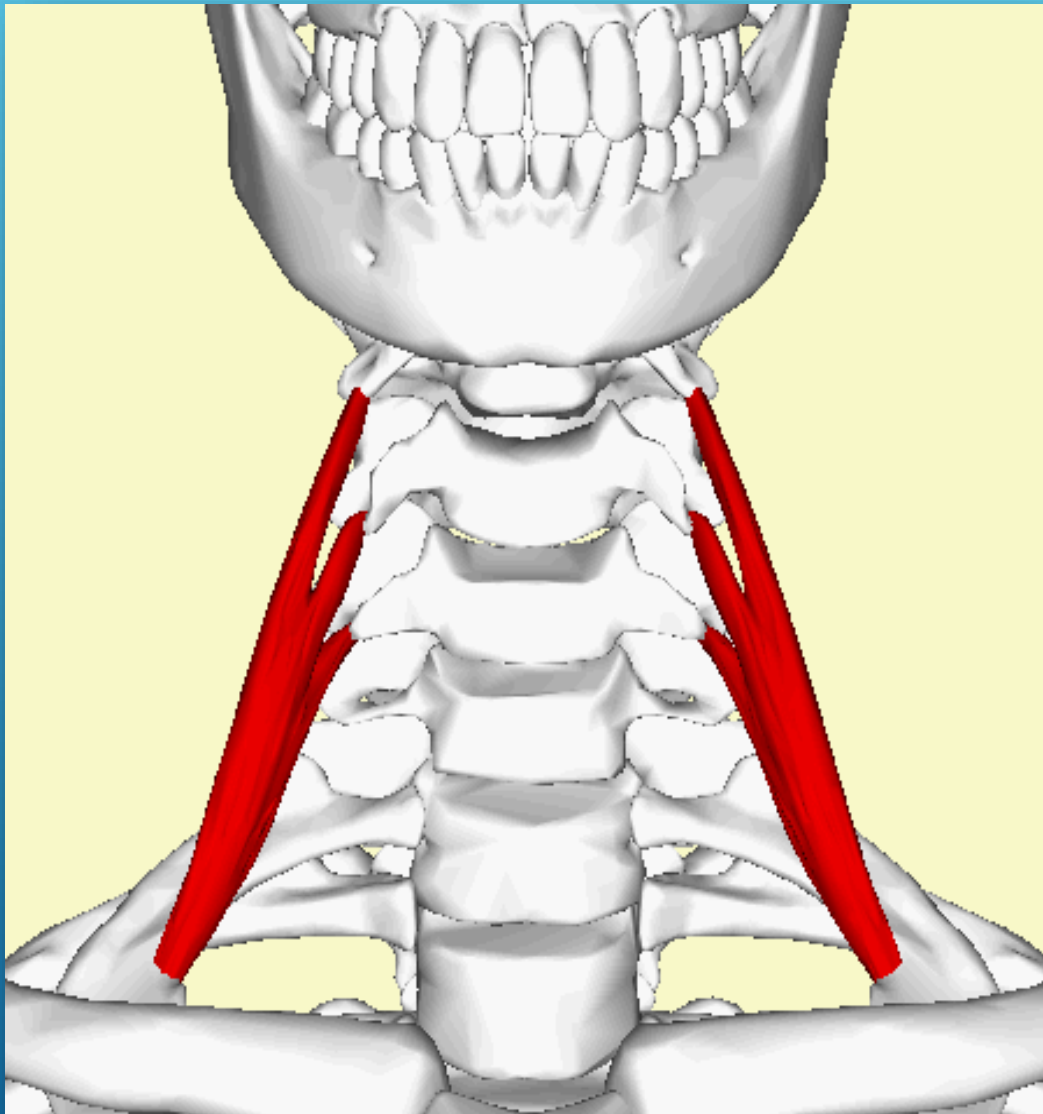
INTERCOSTALS



- Muscular fasciculi from tips of TVP of C7 to T11
- Run inferiorlaterally and attaches to the superior aspect between articular tubercle of rib and angle.
- Innervated by lateral branch of dorsal nerves

LEVATOR COSTARUM

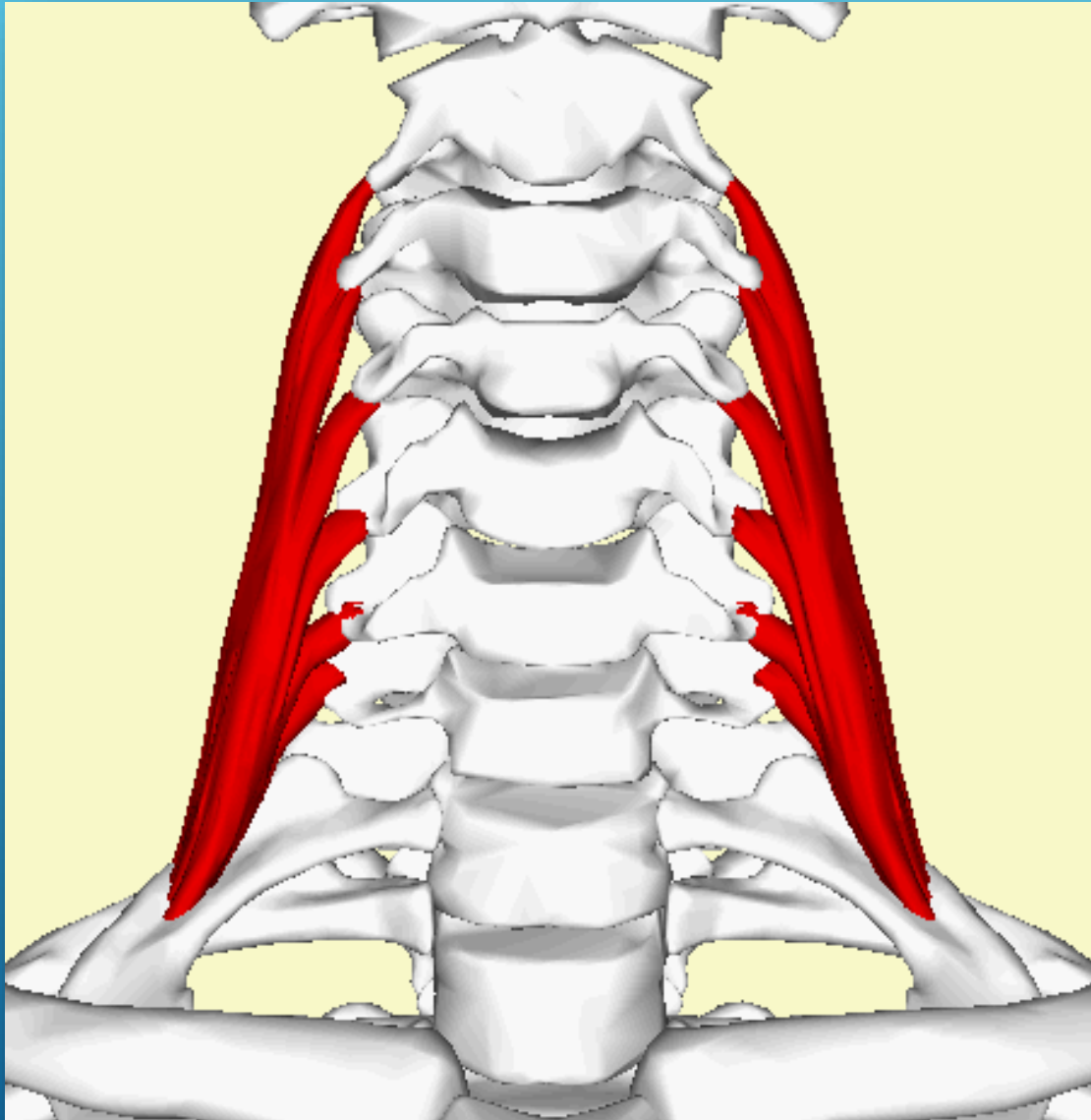




SCALENUS ANTERIOR

- Originates anterior tubercles of TVP of C3-6
- Inserts into scalene tubercle on superior aspect of first rib
- Accessory muscle to inspiration
- Innervation: anterior primary rami of C5/6



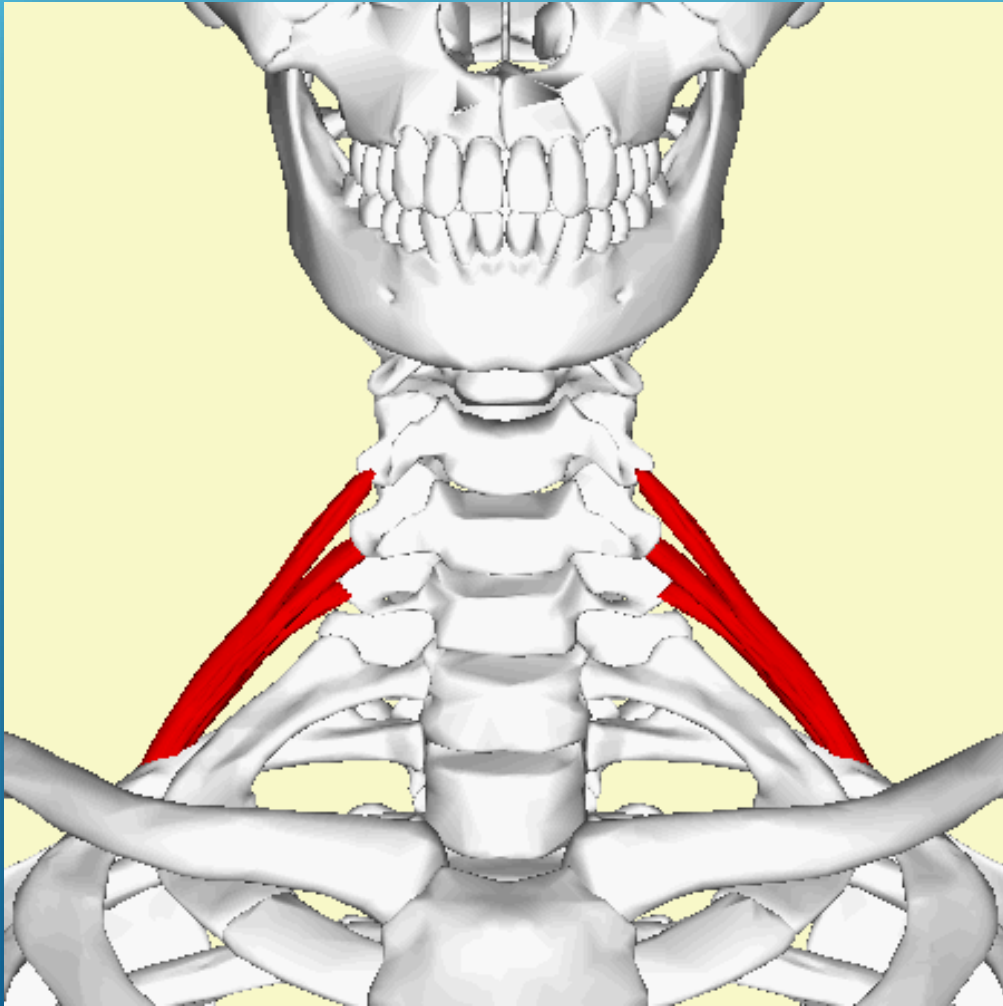


SCALENUS MEDIUS

- Originates from the posterior tubercles of the TVP C2-C7
- Inserts into the superior surface of the first rib behind the subclavian groove.
- Innervated by the primary rami of C3, C4



SCALENUS POSTERIOR



- Originates from posterior tubercle of TVP C4-6
- Inserts in posterior lateral surface of second rib
- Accessory muscle of inspiration
- Innervation anterior primary rami of C6-8



- Ligaments
- Muscles
- Fascia

21

HOW MANY STRUCTURES INSERT INTO THE FIRST RIB???



Primary

- Diaphragm
- External intercostal
- Levator costae

Accessory

- SCM
- Scalenes
- Pectoralis Major and Minor
- Serratus anterior
- Lat dorsi
- Serratus posterior superior
- Iliocostalis (recruited with dysfunction)

RESPIRATORY MUSCLES (INSPIRATION):



RESPIRATORY EXPIRATORY MUSCLES

Primary

- Elastic recoil
- Internal intercostals
- Abdominals
 - Superficial should be minimal
 - TrA activity must occur

Accessory

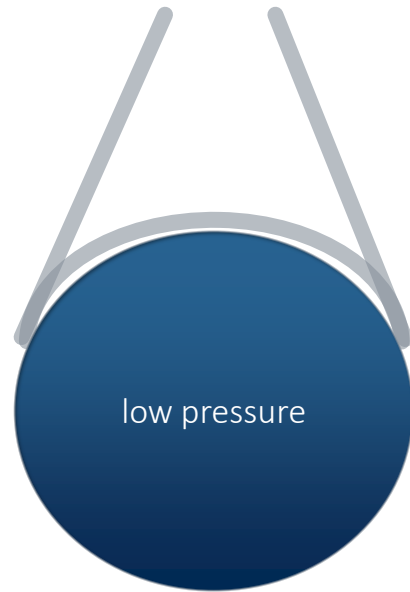
- Longissimus
- Serratus posterior inferior
- Quadratus lumborum (recruited with dysfunction)



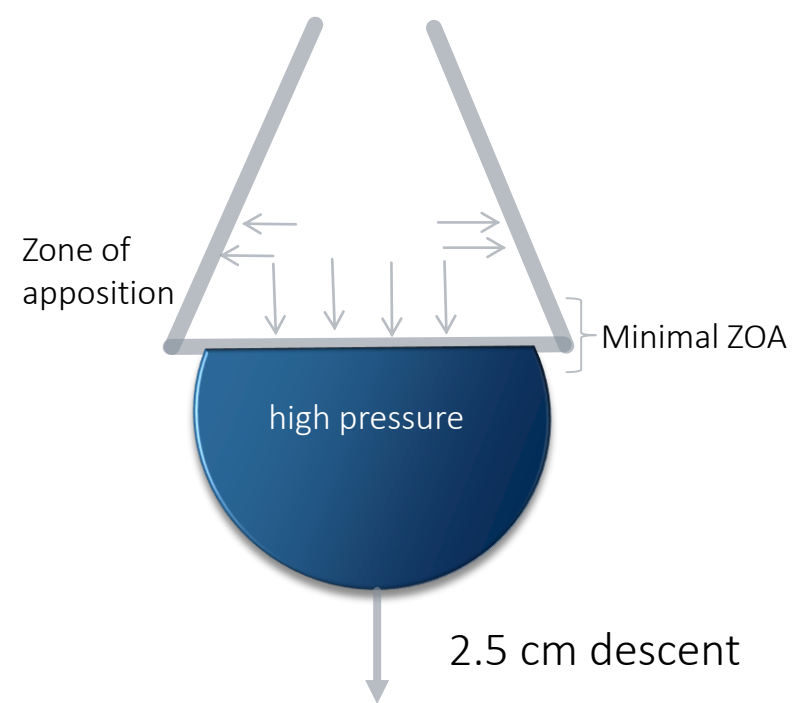
MECHANICS OF QUIET BREATHING



Full Expiration



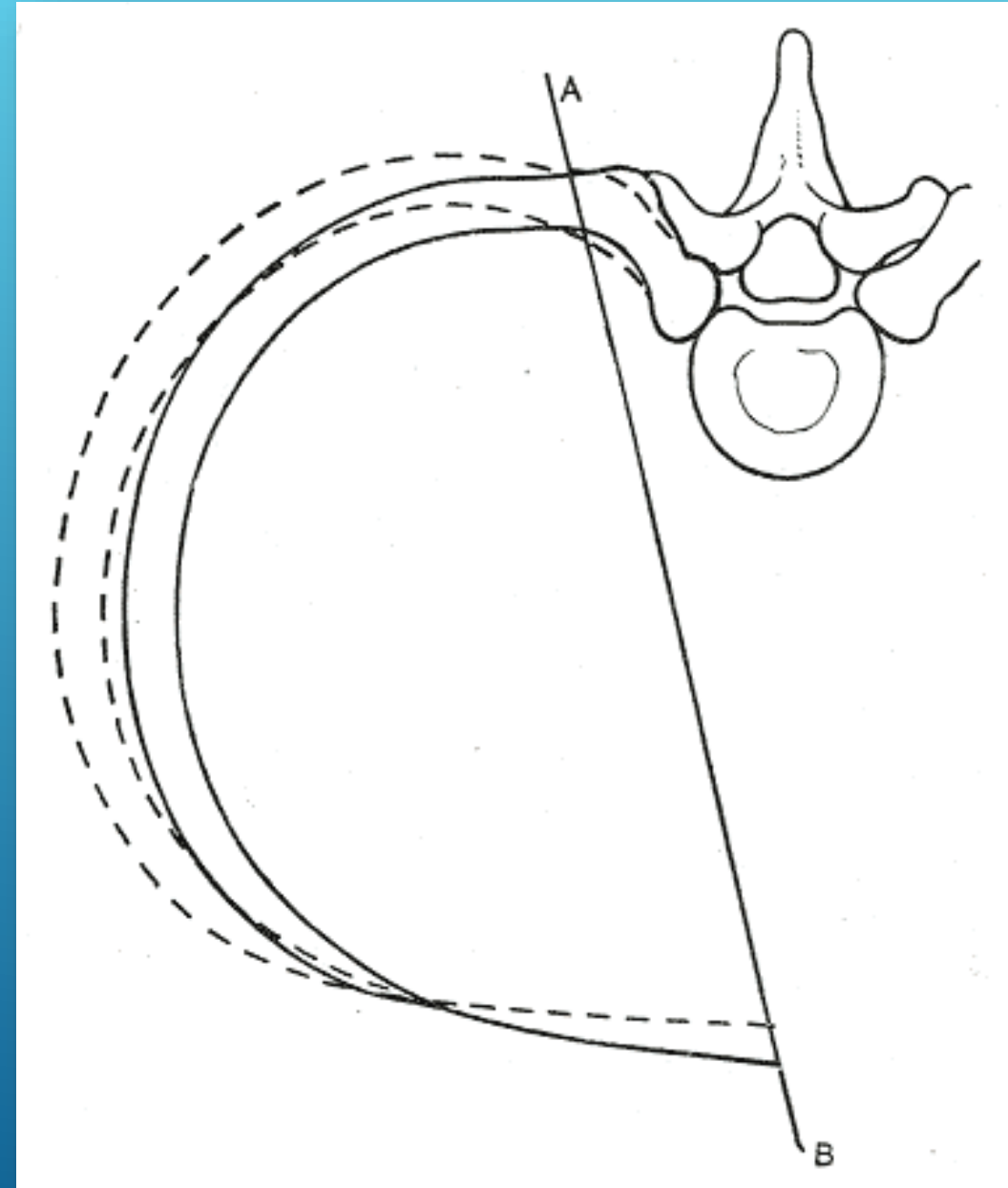
Full Inspiration



Bucket handle breathing

- Lateral costal expansion

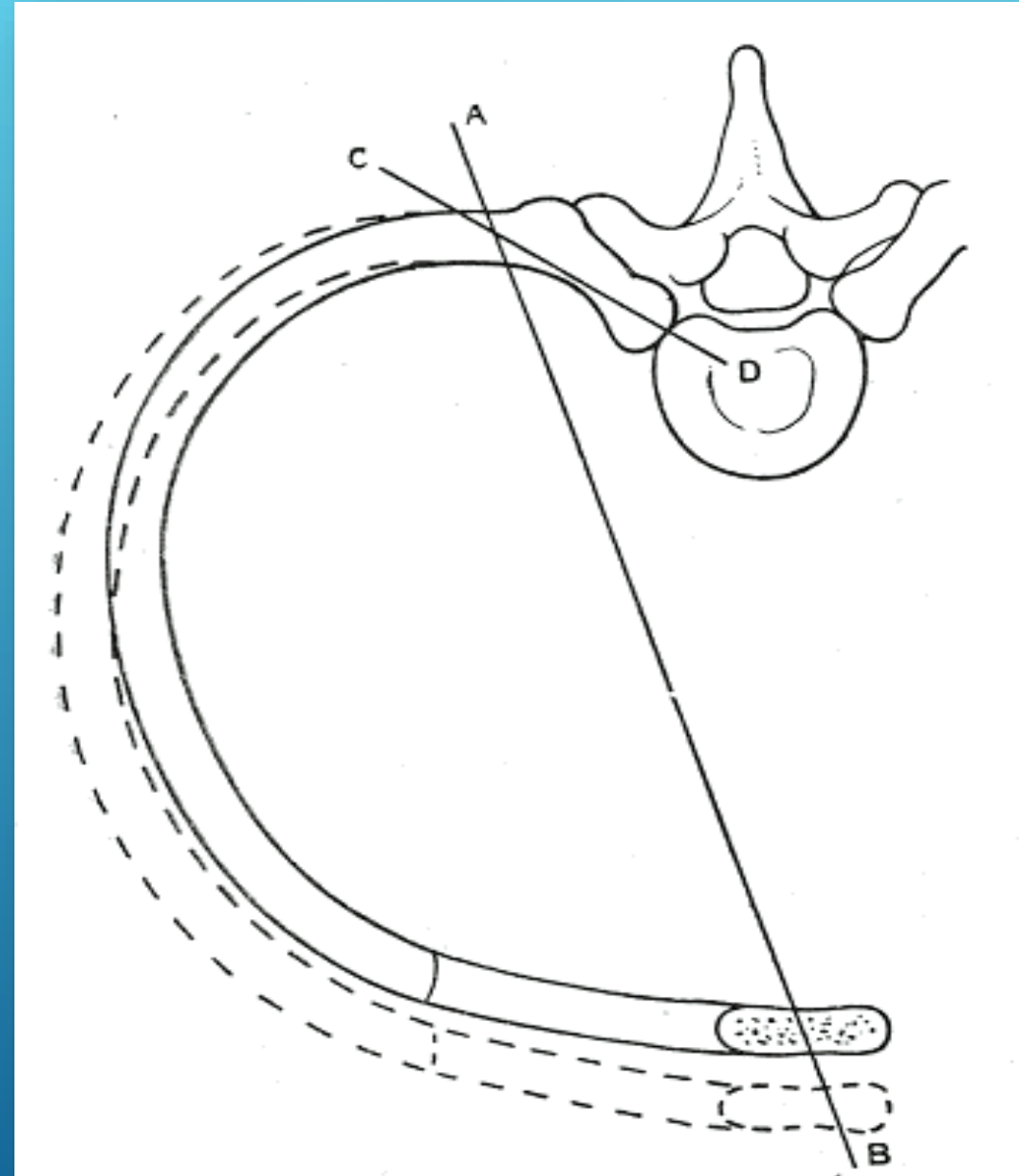
INITIAL INSPIRATION



Pump Handle

- Lateral costal expansion has been exhausted and the lower six ribs elevate anterosuperior
- Superior and anterior motion of sternum

SECOND STAGE



- Diaphragm is primary respiratory muscle
- Initially lateral costal expansion or bucket handle motion- increases transverse dimensions
- Progresses to anterior expansion, flexion of manubrial sternal joint - pump handle- increases anterior posterior dimensions
- Scalenes stabilize Ribs 1 and 2 and maintain vertical diameter by preventing 1st and 2nd ribs from being drawn in while fascia suspends the thorax to the axial skeleton
- Lower ribs stabilized by Quadratus Lumborum

SUMMARY OF QUIET RESPIRATION



- Nasal breathing provides twice the resistance than mouth breathing with more efficient O₂ extraction and CO₂ excretion (Chaitow 2014)
- Creates back pressure to keep bronchioles open for air exchange
- Turbinates create turbulence
- Cleanses the air through the cilia

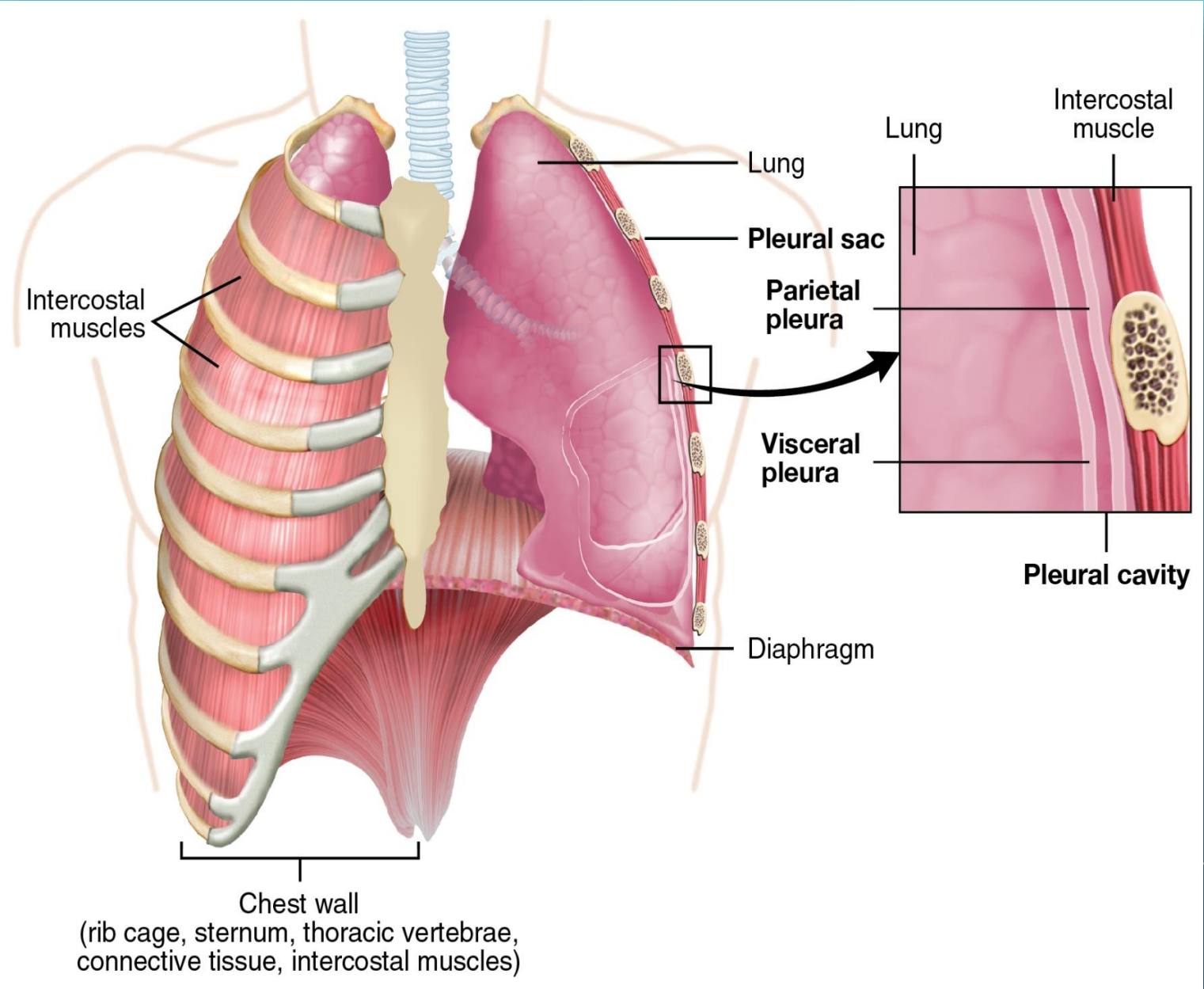


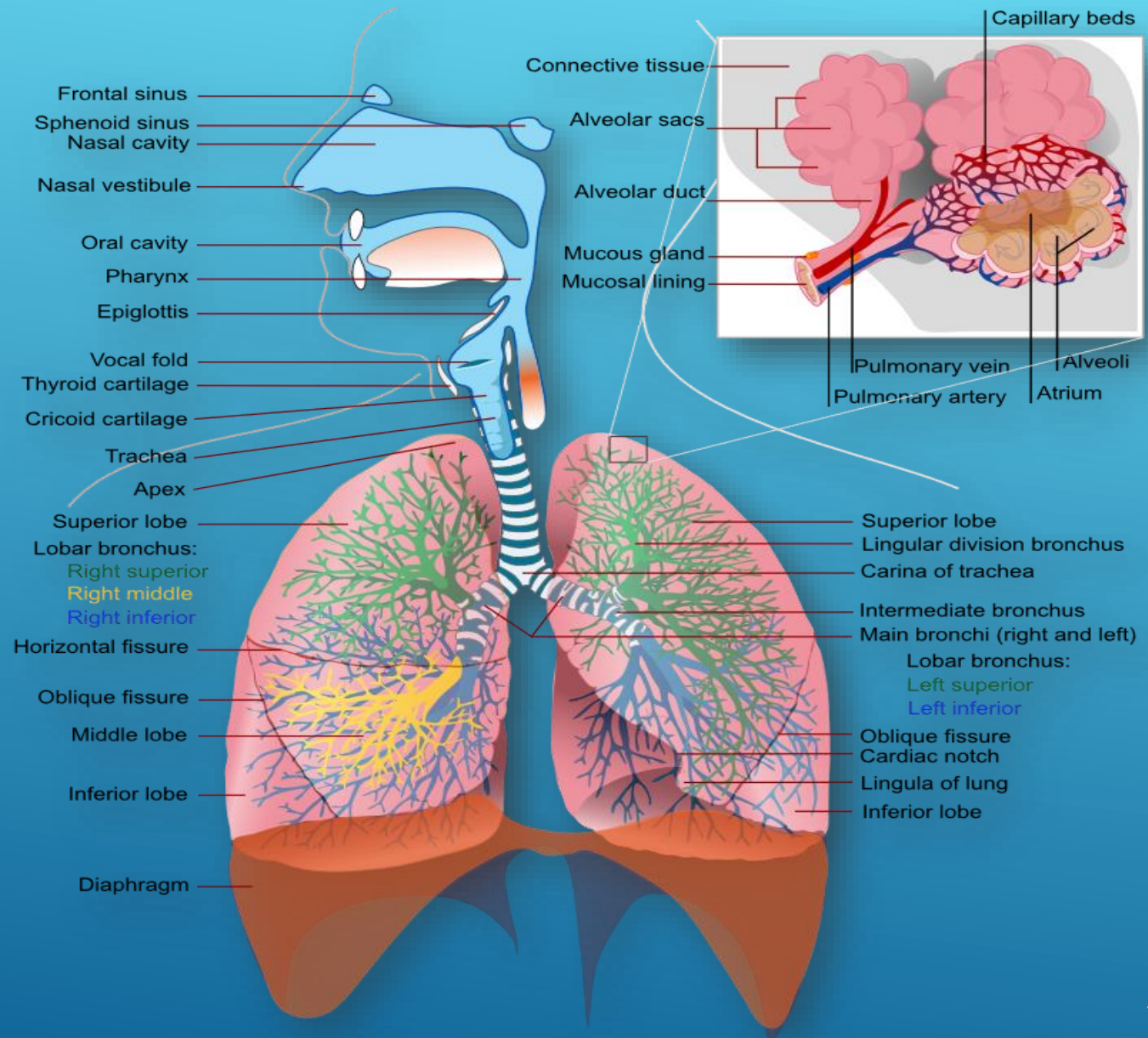
Full expiration to full inspiration

- Results were studied in healthy subjects, the mean of upper and lower expansion ranged from 1.0 to 7.0 cm (.4" to 2.7") D. Leelarungrayub 2012

CHEST EXPANSION







Upper Thoracic Breathing

Diaphragmatic

Lateral Costal Expansion

Sniffing





BIOMECHANICS OF THE RIBS REVIEW

Lee, D. J. Biomechanics of the Thorax -research evidence and clinical expertise. *Man Manip Ther.* 2015 July; 23(3): 128-138.





FUNCTION OF THE DIAPHRAGM



- 14,000-21,000 breaths per day for the average individual- 40,000 in chronic hyperventilators!
- Diaphragm is the primary driver of inspiration
- Coordinated activity between the diaphragm, abdominals, scalenes, intercostals, pelvic floor and accessory respiratory muscles

FUNCTION OF THE DIAPHRAGM: INSPIRATION

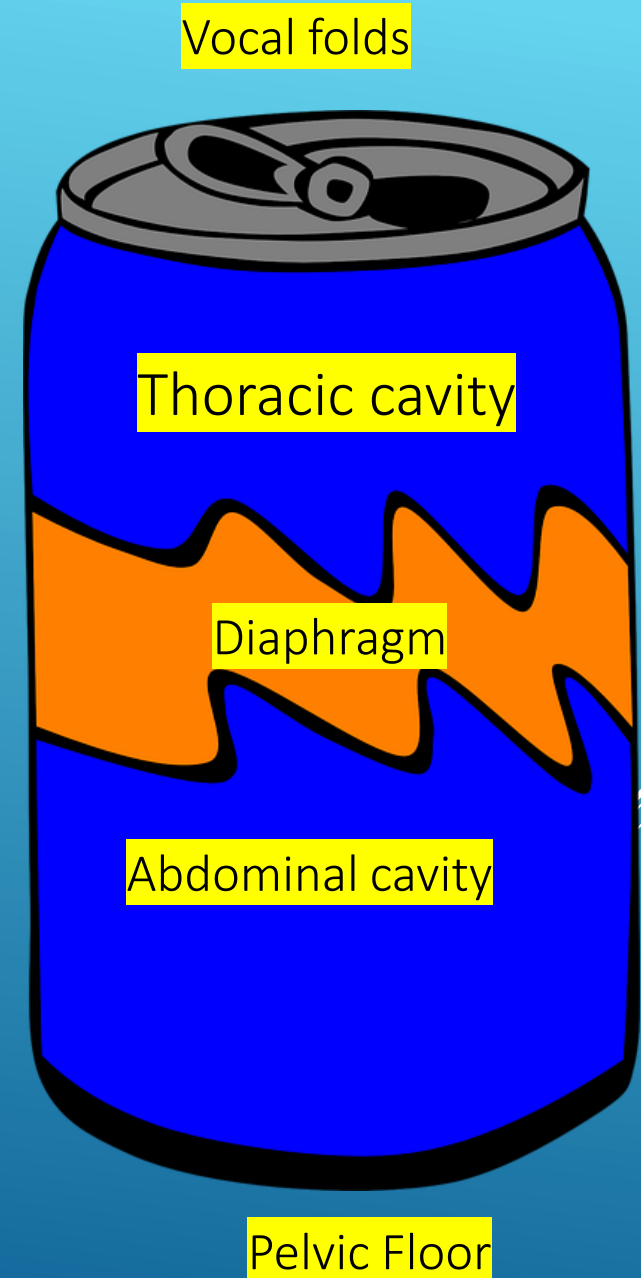


- Creates a respiratory pump
- Pelvic floor and TA contract to create a abdominal pressure to provide stability for the diaphragm to contract efficiently
- Dual function- respiration and trunk stability

FUNCTION OF THE DIAPHRAGM



"The diaphragm completely separates the thoracic cavity from the abdominal cavity and as such is capable of creating and utilizing pressure differences in the chambers to support the simultaneous needs of respiration and trunk stabilization" (M. Massery 2012)



- Diaphragm precedes any movement of the body by increasing the intra-abdominal pressure (Vostatek 2012)
- Remains tonically active with sustained movement
- Modulates its activity for breathing.
 - Increases for inspiration and decreases for expiration
- Segmental motion control maybe a function of the diaphragm via intra-abdominal pressure.

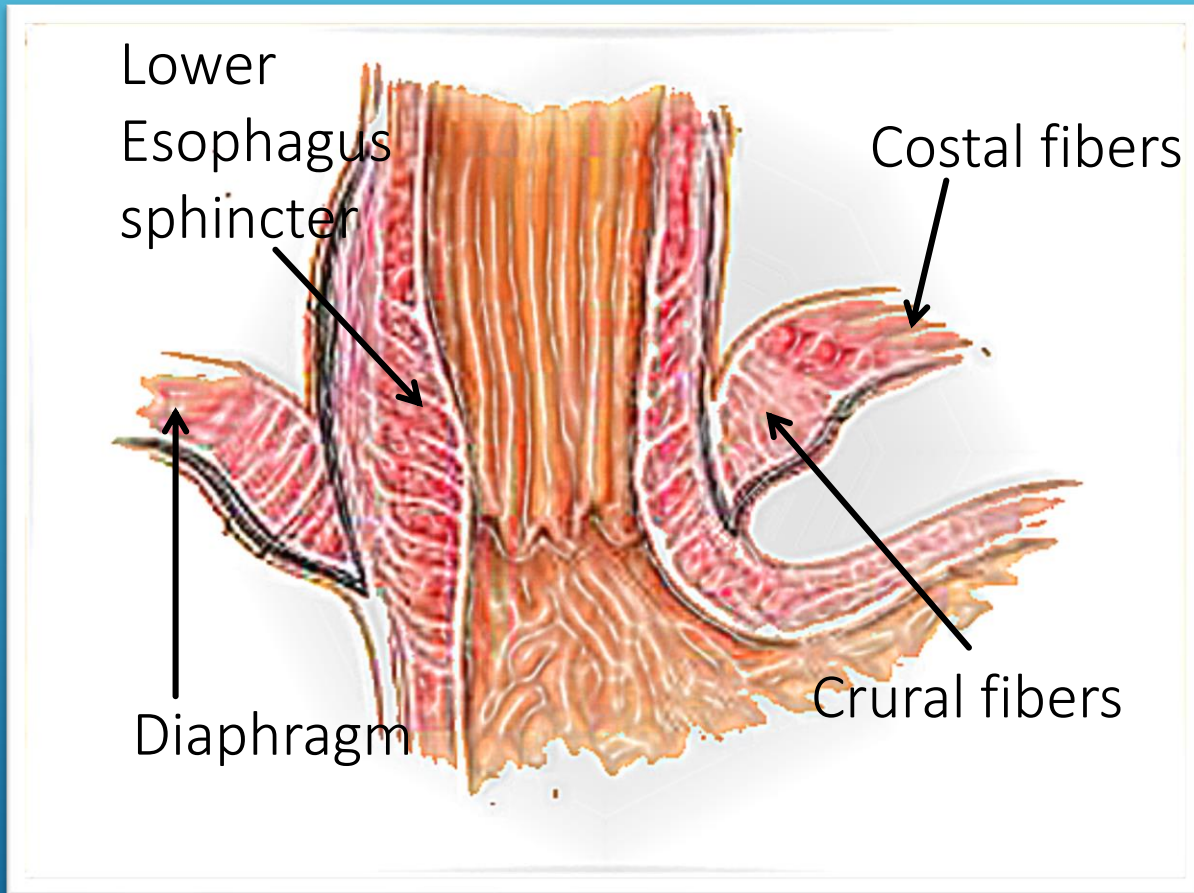
FUNCTION OF THE DIAPHRAGM: POSTURAL CONTROL



- Necessary for effective GI motility, venous return and lymphatic drainage (Courtney 2009)
- Pressure change assist in the function of the esophagus by improving the motility
- Crural region of the diaphragm is important for preventing gastro-esophageal reflux (B.Bordoni 2013)

FUNCTION OF THE DIAPHRAGM: INTERNAL ORGAN EFFECTS



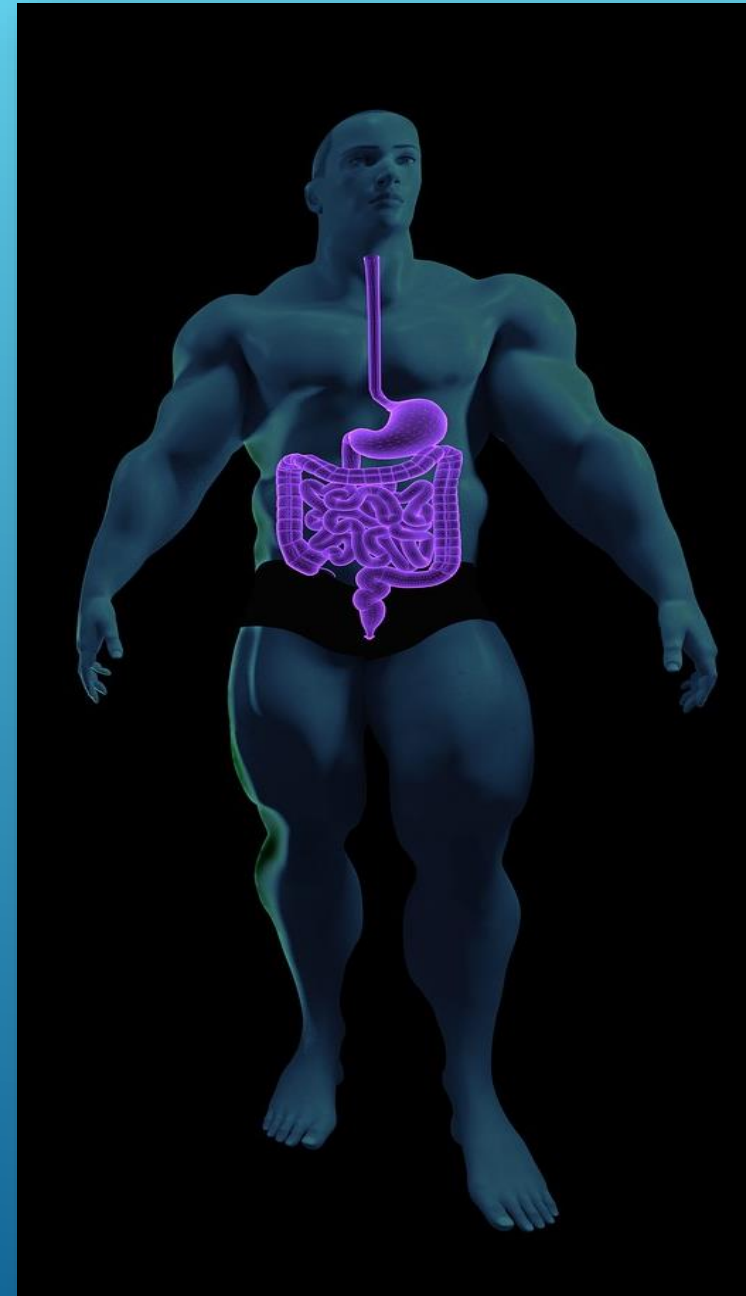


Crural portion of diaphragm is considered to be the main portion of the lower esophageal sphincter and dysfunction of the diaphragm one of the causes of GERD (Chaitow 2014)

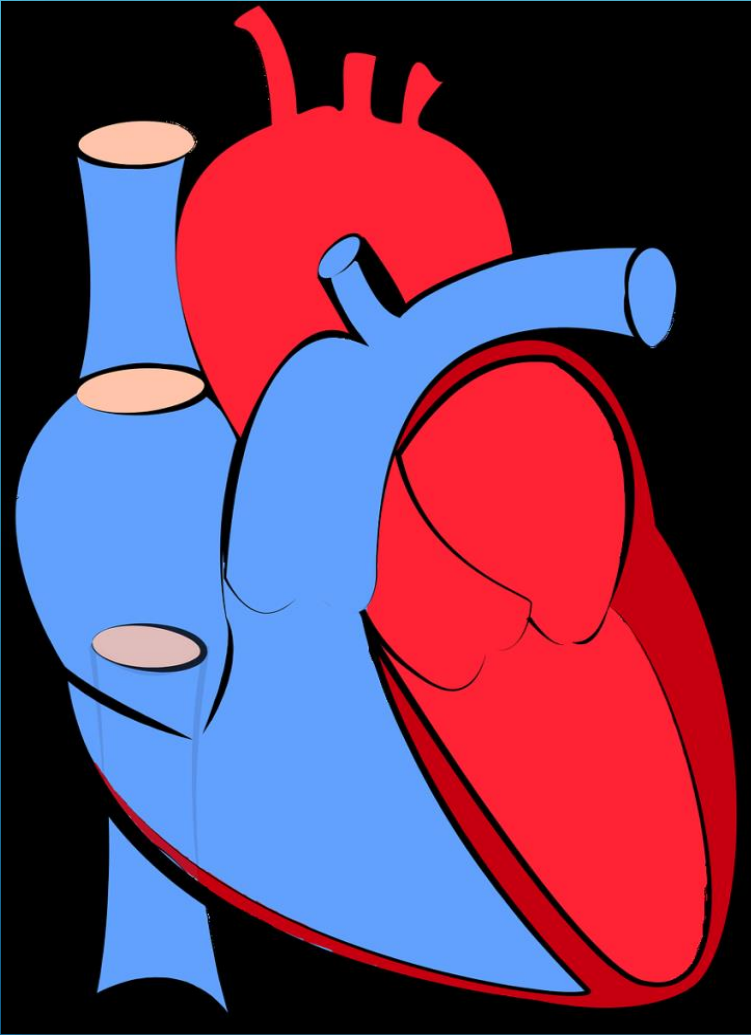


INTERNAL ORGAN EFFECTS

Optimal pressure changes in the abdomen
improve lower gastrointestinal motility (B.Bordoni 2013)



INTERNAL ORGAN EFFECTS



Cardiovascular system utilizes the changes in pressure between the thorax and the abdomen to improve venous return and optimize blood pressure and blood circulation



- Respiration may cause a cyclical disturbance to balance which changes with LBP
- Center of Pressure (COP) at the ground of a normal human has little displacement during respiration

FUNCTION OF THE DIAPHRAGM: BALANCE AND RESPIRATION



- Certain movements that are driven by respiration, that the body does to compensate for respiration.
- Perturbations (A-P body sway) are small angular motions of body segment phase locked with respiration (Grimstone 2003)

BALANCE AND RESPIRATION



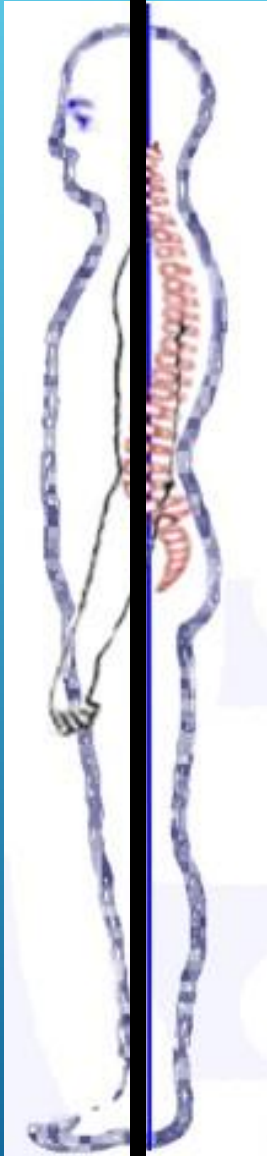
- Can be altered by neurological deficits and LBP
- Studies have shown that increase in A-P body sway and COP displacement in concert with rib cage movement occurs with LBP and poor postural control

Grimstone and Hodges 2003



BALANCE AND RESPIRATION





Just Breathe101 Program

You have completed Function of Respiration

- Mechanics of the Region
- Physiology of Respiration
- Altered Breathing Patterns and Somatic Dysfunction
- Altered Breathing Effects on the Spine and Trunk
- Sleep Apnea
- Breathing Theories

IN CLOSING

