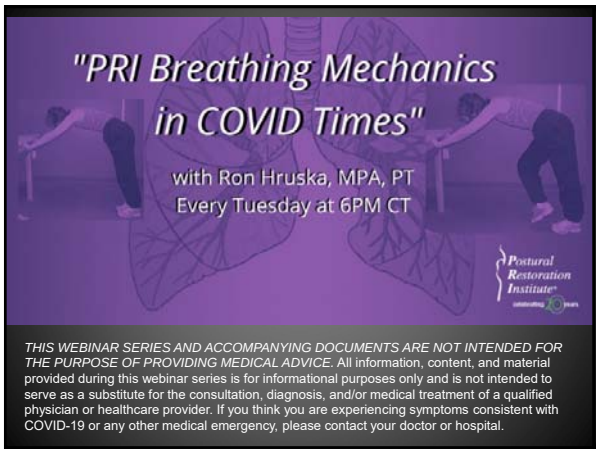

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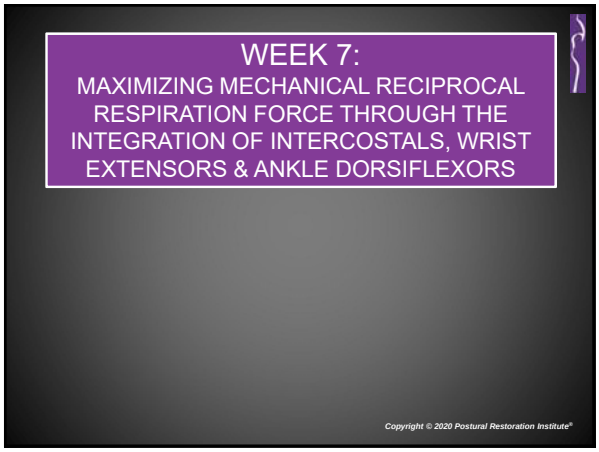
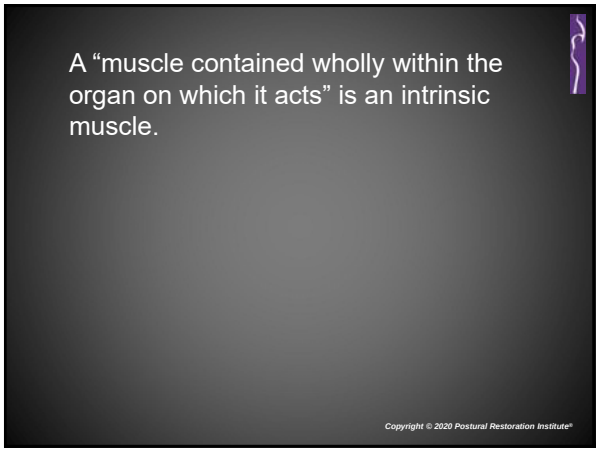




There probably is not a better example of “core” intrinsic muscles than the intercostals.

The primary muscles responsible for expansion and shrinkage of the size of the chest cavity to facilitate breathing are the intercostals.

After gaining or regaining extrinsic control of the left internal oblique abdominals and unobstructed airflow, maximizing mechanical reciprocal rib cage function for more optimal breathing efficiency requires intrinsic intercostal rhythmic stabilization.

The facilitation of breathing, with these intercostals, is enhanced by proprioceptive neuromuscular facilitation (PNF) concepts and integration of these concepts with distal appendage movement.

This discussion will address the facilitatory relationship between forced inhalation and wrist extension, and forced exhalation and ankle dorsiflexion, to maximize inter-rib mechanical reciprocal respiration.

Humans use extrinsic abdominals to rotate the thorax diagonally and shift the thorax laterally, which we discussed last week.

Intrinsic intercostals, are shorter and more stable than extrinsic abdominals.

They, along with the wrist extensors and bilateral extrinsic abdominals assist in moving the thorax forward when getting out of a chair; and along with the ankle dorsiflexors and bilateral extrinsic muscles assist in moving the thorax backward when going to a chair.

Our most proximal, central part of our body's rhythmic stability is patterned off of neuromuscular mechanical reciprocal respiration that is facilitated by the most distal, lateral parts of our body.

And the musculature that is the most responsible for isometric contraction, during 'forced' inhalation and 'forced' exhalation, of antagonistic and agonistic co-contraction, without losing control of thoracic stability, are the intercostals.

The muscle that is in the best neuromuscular position to govern and grade this trunk stability control are the wrist extensors and ankle dorsiflexors.

Specifically, the wrist extensors facilitate external intercostal effectiveness of rib function during inhalation and the ankle dorsiflexors facilitate internal intercostal effectiveness of rib function during forced exhalation.

Overview of Intercostal, Wrist Extensors, and Ankle Dorsiflexors As Related to Postural Respiration

Internal Intercostals

- ✓ Aid in forced expiration (quiet expiration is a passive process)
- ✓ They attach to ribs 2-12 and ribs 1-11
- ✓ Their fibers pass anterior and superior from the upper margin of the rib and costal cartilage to the lower margin of the rib that is above

Internal Intercostals

- ✓ The internal intercostals are responsible for the depression of the ribs and bending of the ribs inwardly, thus decreasing the transverse dimensions of the thoracic cavity

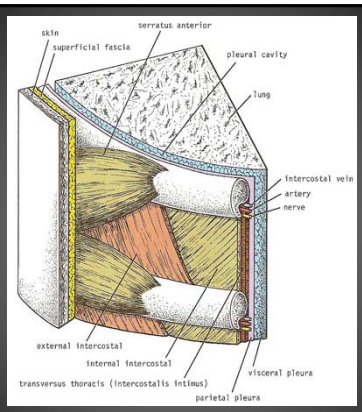


Image from: https://www.daviddarling.info/encyclopedia/I/intercostal_muscles.html

External Intercostals

- ✓ Aid in quiet and forced inhalation
- ✓ They attach to ribs 1-11 and ribs 2-12
- ✓ Their fibers are directed obliquely downward and laterally on the back of the thorax, and downward, forward and medially on the front.

External Intercostals

- ✓ They are responsible for the elevation of the ribs and bending of the ribs more outwardly or more open, thus expanding the transverse dimensions of the thoracic cavity

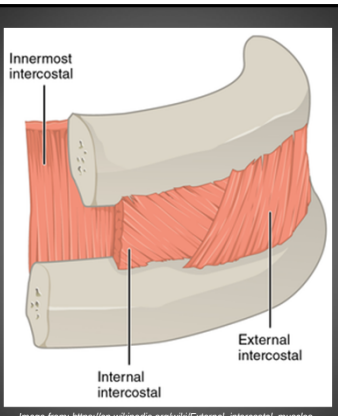


Image from: https://en.wikipedia.org/wiki/External_intercostal_muscles

Extensor Carpi Radialis Longus

- ✓ Aids in quiet and forced inhalation when ankles are in a state of dorsiflexion
- ✓ This long muscle attaches to the lateral side of the humerus and to the base of the and the second metacarpal bone or metacarpal of the index finger
- ✓ It is responsible for extending the wrist and deviating the wrist to the radius (radial deviation)

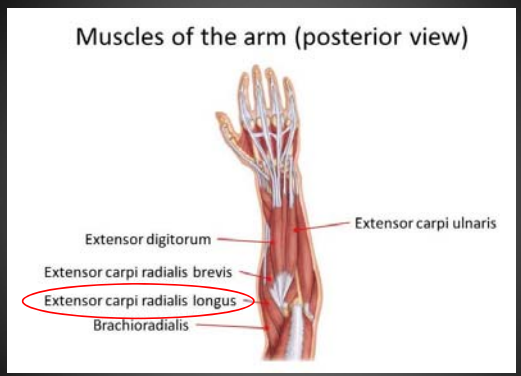


Image from: https://myhealthonly.net/extensor-carpi-radialis-longus/

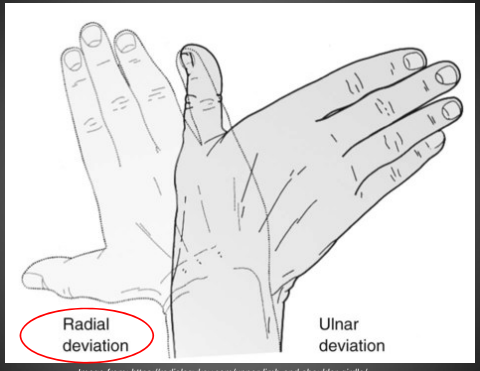
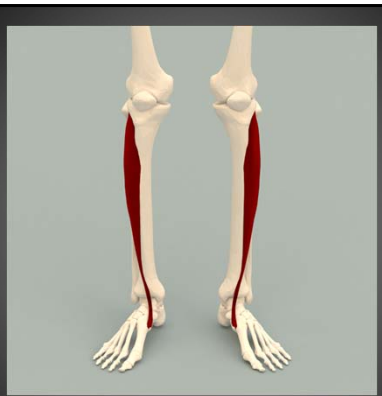


Image from: https://radiologykey.com/upper-limb-and-shoulder-girdle/

Tibialis Anterior

- ✓ Aids in forced exhalation when wrists are in a state of extension
- ✓ This long muscle attaches to the lateral side of the lower tibia and to the base of the first metatarsal
- ✓ It is responsible for dorsiflexing the ankle and inverting the foot (tibial deviation)



By Polygon data were generated by Database Center for Life Science (DBCLS) - Polygon data are from BodyParts3D, CC BY-SA 2.1 jp, https://commons.wikimedia.org/w/index.php?curid=84525680

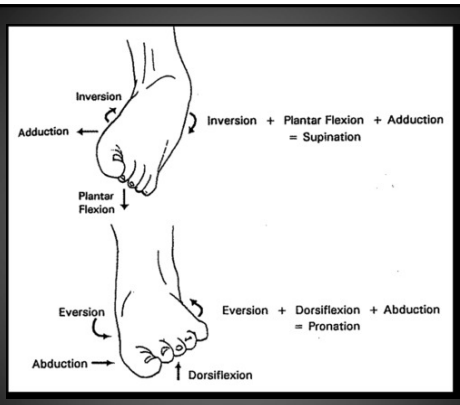


Image from: https://quizlet.com/286861739/lab-diagnosis-and-techniques-flash-cards/

Muscles of the Anterolateral Leg - Anterior

Name	Origin	Insertion	Action	Nerve
Tibialis anterior	Lower lateral tibial condyle Lateral tibia interosseous membrane	Medial side, 1st cuneiform Base, 1st metatarsal	Dorsiflexes foot Inverts foot	Deep peroneal (fibular)
Extensor digitorum longus	Lateral tibial condyle Ant. Crest fibula Interosseous membrane	Bases of 2nd and terminal phalanges of lateral 4 toes	Extends toes Dorsiflexes foot Everts Foot	Deep peroneal (fibular)
Peroneus (fibularis) longus	Lateral tibial condyle Head of fibular Ant. Capitular lig. Middle lateral fibula	Inferior, 1st cuneiform Lateral 1st metatarsal	Plantar flexes foot Everts foot Supports arch	Superficial peroneal (fibular)
Peroneus (fibularis) brevis	Middle lateral fibula	Dorsal surface of tuberosity, 5th metatarsal	Everts foot Plantar flexes foot	Superficial peroneal (fibular)

From: Pansky, B. Review of gross anatomy 3rd Edition. Macmillan Publishing Co, Inc 1975.

Implementing Rhythmic Stabilization and Proprioceptive Neuromuscular Facilitation (PNF) of Agonistic Lower Extremity (D1F) & Upper Extremity (D2F) Muscle To Maximize Reciprocal Respiration

'Rhythmic Stabilization' employs isometric contraction of antagonistic and agonistic patterns, which results in co-contraction of antagonists if the isometric contraction is not released during the "holding" phase of the exercise.

Knott M, Voss D. Proprioceptive Neuromuscular Facilitation – Patterns and Techniques, 2nd ed. 1968.
**See pages 97 & 98 in the 2nd edition for more information; the 3rd edition is now available for purchase online*

Lower Extremity PNF D1F Pattern of Treatment Intervention

Hip Flexion

Adduction

External Rotation

Dorsiflexion

Inversion

Tibial Deviation

Upper Extremity PNF D2F Pattern of Treatment Intervention

Shoulder Flexion

Abduction

External Rotation

Supination

Thumb Extension, Adduction and External Rotation

Radial Deviation

Upon inhalation through the nose, the antagonists are the internal intercostals (right internal intercostals for PRI R BC patterned humans), and the agonists are the external intercostals (right external intercostals for PRI R BC patterned humans) and the extensor carpi radialis longus (right extensor carpi radialis longus for PRI R BC patterned humans).

Muscles of the arm (posterior view)

Image from: https://myhealthonly.net/extensor-carpi-radialis-longus/

Upon exhalation through the pursed mouth, the antagonists are the external intercostals (left external intercostals for PRI R BC patterned humans), and the agonists are the internal intercostals (left internal intercostals for PRI R BC patterned humans) and the tibialis anterior (the left tibialis anterior for PRI L AIC patterned humans).

Summary of Rhythmic Stabilization/Reciprocal Respiration As Related to PNF and PRI Integration

LEFT

- Internal Intercostals
- Forced Exhalation
- Ankle dorsiflexion (D1F)
- Tibial deviation
- Tibialis anterior
- Push and hold down outside foot

RIGHT

- External Intercostals
- Forced Inhalation
- Wrist extension (D2F)
- Radial deviation
- Extensor capri radialis longus
- Push and hold down outside finger

Standing Supported Bilateral Posterior Mediastinum Expansion

When you perform rhythmic stabilization using PNF techniques, the therapist or movement specialist is asking the patient or client to “pull” an extremity or the body toward resistance that is applied by agonistic muscle contraction.

In this technique the agonists are the external intercostals that are “pulling” the hands/palms to the counter top. (step 4)

By holding this position upon exhalation, in step 5, the antagonistic internal intercostals are now engaging without movement of the rib cage going into a more collapsed or inwardly direction.

The weaker muscle, the agonistic external intercostals, did not "break" or the ribs did not fully collapse upon the previous exhalation effort, and thus air moving into the chest wall, upon the next inhalation sequence, will have a more overall expansion influence on the stabilization of the chest wall.

Step 6 asks the patient to "hold this position" while attempting to fill or expand the upper back with air upon each inhalation, using the external intercostals as agonistic muscle, again, in this rhythmic stabilization process, as the hemi-diaphragms "pull", "pull", "pull" air in, without the "break" or loss of the internal intercostal antagonistic co-contractive stabilization.

Both sets of intercostals are now engaging in rhythmic stabilization of the rib cage for diaphragmatic breathing without rib depression or collapse, without rib elevation/ over expansion (hyperinflation) and without unbalanced rib cage position at rest.

The patient/client could push the right lateral border of the hand down more for more inhalation effectiveness during external intercostal stabilization.

Or the patient/client could generate more push on the left lateral border of the left foot for more exhalation effectiveness during internal intercostal stabilization.

Or the patient/client could do both for rhythmic stabilization of both sets of intercostals during reciprocal rhythmic breathing.

Standing Supported Bilateral IO/TA

This technique could follow the same instructions regarding rhythmic stabilization as outlined above.

However, it implements more internal rib rotation synergistically from the dorsiflexors and therefore, assists more with antagonistic activity from the internal intercostals during exhalation.

Provided, the individual performing the technique doesn't lose control and stability offered by the external intercostals during the inhalation phase of respiration, while in the squat down position, outlined in step 4.

Standing Wall Press

This technique could follow the same instructions as in the first technique in this series.

However, it implements more internal rib rotation synergistically from the wrist extensors and therefore, also assists more with agonistic activity from the external intercostals during inhalation.

Also, the individual performing the technique has to concentrate on how to continue to engage pressure or push on the wall from the wrists during inhalation, without losing control of the internal intercostals during the exhalation phase of respiration while maintaining the back rounded position, as outlined in step 4.

THANK YOU!

We hope you will join us again next week!

WEEK 8:
Somatosensory Processing of Respiratory Based Right Thoracic Rotation and Expansion