PRIVY Episode #444

Maintaining Thoracic ZOA During Thoracic Lumbar Flexion and Posterior Mediastinal Expansion Theoretically Enhances Desirable Length of Sagittal, Coronal and Transverse Thoracic Diaphragm Skeletal Muscle

By Ron Hruska

This article by Whitelaw (Shape and size of the human diaphragm in vitro), published in the J Appl Physiol (1985)1987 Jan;62(1):180-6, discusses diaphragm length, and its relationship to transdiaphragmatic pressure. From the abstract:

> "Diaphragm length and volume displaced were measured, the zone of apposition of diaphragm to rib cage was mapped, and the line of the diaphragm silhouette in anteroposterior and lateral X-rays identified. Coronal and sagittal sections were constructed.
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> In the inspiration studied, the diaphragm movement displaced 680 ml. Meridian lines in sagittal, coronal, and transverse directions over the right hemidiaphragm dome shortened by 6.7-7.2 cm, but over the left dome by only 4.0-4.3 cm. Lines of X-ray silhouettes were close to meridian lines, and estimates of shortening were like those made previously from X-rays.
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> The saddle shape of the muscle may help the hemidiaphragms to operate independently, the fibers of the saddle acting as an anchor for midline directed fibers of the hemidiaphragm domes. The shape of the diaphragm also has implications for the distribution of transdiaphragmatic pressure and for the kind of distortion of the lower rib cage margin that is seen during inspirations at high lung volume."

Those who have taken PRI® courses understand the impact of back extension on mediastinal expansion, back and torso stability and alternation of lateral shifting of one's center of mass needed for forward locomotor movement and single leg balance.

"When you bring the spine into extension, as in a backbend, you stretch the diaphragm. It can be difficult to contract the diaphragm during inhalation in this position, especially if a practitioner is not used to practicing backbends. It's not unusual for newer students of yoga to have difficulty breathing in a backbend. Over time and with steady practice, the diaphragm will get stronger and it will become easier to breathe." *(Sara Doyle, Yoga UOnline.com, Feb 10, 2018)*

When abdominal strength is poor, bilateral ZOAs are reduced. Extension, and flexion of thorax and lumbar torso, can negatively influence diaphragm length tension, intra-abdominal pressure and spinal stability if this pathologic diaphragm position is not restored.

The hemi-diaphragm function becomes torsional and imbalanced upon inhalation, and breathing becomes shallow, all which results in hyper lordosis of the mid and lower back and flattening of the diaphragm's central tendon. This often leads to compensatory effort during both inhalation and exhalation phases of respiration and requires abnormal ANS and CNS hyperactivity in attempting to normalize neurophysiologic homeostasis.

PRI® non-manual techniques that incorporate balanced resistance to the asymmetrical hemi-diaphragms, especially to the left crural and costal fiber, ensure lengthening of the entire diaphragm to some degree, during both vertical and horizontal respiration. Furthermore, this counter-balance activity reduces demands on neck, back and appendage polyarticular chains of muscle and fascia.

Concomitant abdominal oblique shortening and diaphragm oblique lengthening increases both the human's functional capacity and non-compromised breathing; factors that are necessary to keep contractile strength of the diaphragm for both effortless and effort respiration.

"Diaphragm stretching generates a significant improvement in cervical extension, right and left cervical flexion, flexibility of the posterior chain, and ribcage excursion at xiphoid level compared to a placebo technique in healthy adults." *(Gonzalez-Alvarez FJ, et al. Effects of diaphragm stretching on posterior chain muscle kinematics and rib cage and abdominal excursion: a randomized controlled trial. Braz J Phys Ther. 2016 Jun 16;20(5):405–411.)*

The Postural Restoration Institute® provides both manual and non-manual guidance on maintaining the length of the hemi-diaphragms, with higher emphasis placed on the reasoning, research and rehabilitative acceptance of preserving and enhancing the length of the left hemi-diaphragm, which is ultimately responsible for the strength and function of both hemi-diaphragms.