

# Complex Circuitry for Complex Machinery

Charles S Masarsky

**Abstract:** Practitioners who adjust the upper cervical area are generally aware of the potential benefit of this service in terms of vagal function. This is because of the proximity of the *vagus* n to the occipital condyles as it exits the jugular foramen. What is not always appreciated is the potential for mid-cervical and lower thoracic adjustments to benefit the vagus as well, due to the relation of that nerve to the diaphragm. If the chiropractic adjustment did nothing but improve *diaphragm* function, the whole-body benefits of our service would already have ample explanation.

**Indexing Terms:** chiropractic; diaphragm; adjustment; subluxation

## One-third of your spinal nerves

Ask most of your health care colleagues about the nerve supply to the diaphragm, and the immediate answer will usually be the *phrenic* nerve, formed by contributions from spinal nerves C3-5. That of course is the somatic motor innervation, but the sensory innervation has more to it.

The *phrenic* nerve supplies afferents to the central portion of the muscle only. The peripheral portions, which attach to the lower rib cage, sternum, and thoracolumbar spine, receive sensory branches from spinal nerves T7-T12. The same spinal nerve levels (T7-T12) are responsible for most of the sympathetic nerve supply to the diaphragm's arteries via the *celiac plexus*. That's nine of your thirty-one pairs of spinal nerves involved in the control of one muscle (or two muscles if you consider the left and right hemidiaphragm separately).

Why so much circuitry for one piece of machinery? It must be involved in more than just inspiration.

## Musculoskeletal Interactions

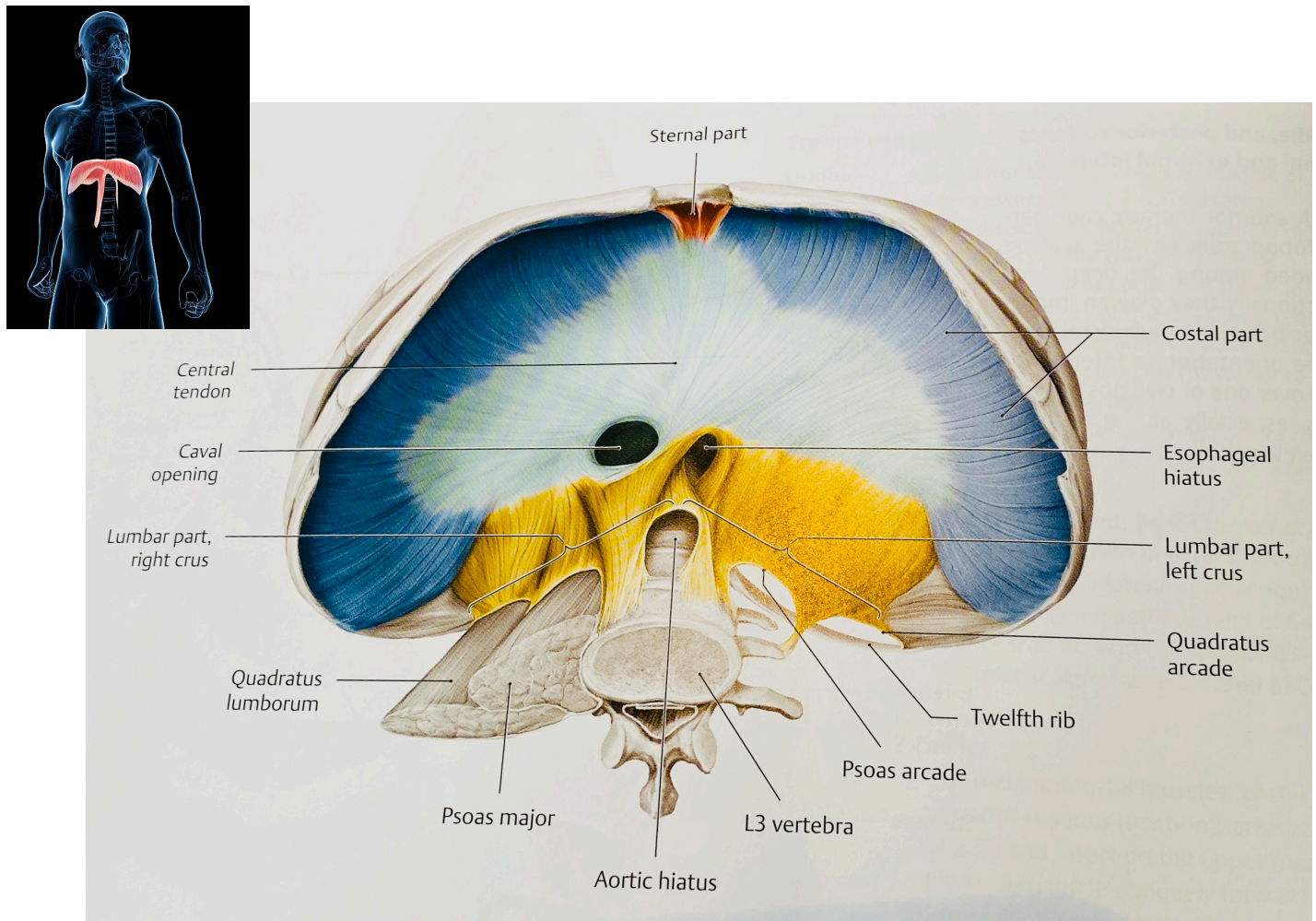
That the diaphragm must functionally coordinate with the other muscles of the trunk is clear from its location at the anatomical boundary between the thoracic and abdominal cavities. More specifically, it is mechanically entangled with the psoas major and quadratus lumborum muscles. When one considers this entanglement along with the posterior attachments of the diaphragmatic crura to the thoracolumbar spine, the importance of diaphragm function in low back health becomes clear.

... the diaphragm is a muscle that uniquely straddles the somatovisceral interface'



The linkage of the *diaphragm*, *psoas major*, and *quadratus lumborum* include connective tissue structures such as the *median arcuate ligament*. Dysfunction of this ligament can cause a bewildering constellation of somatic and visceral symptoms, including abdominal pain after eating, weight loss, swelling in the head and/or upper body, dyspnea, heart palpitations, dizziness, and muscle pain, among others. At least one case report included chiropractic care in an inter-professional approach to median arcuate ligament syndrome. (1)

Of course, deep breathing requires the diaphragm to coordinate with auxiliary muscles of inspiration such as the external intercostals and sternocleidomastoid. It is reasonable to assume that any disturbance of this coordination can contribute to cervical or thoracic subluxation.



### The Digestion connection

The oesophagus passes through a hiatus in the left hemidiaphragm on its way from the thoracic to the abdominal cavity. For this reason, too much or too little diaphragmatic tone can cause digestive problems. In a 2012 study, one group of patients with gastroesophageal reflux disorder (GERD) were coached through four weeks of diaphragmatic toning exercises, while a control group was observed (2). Outcome measures included oesophageal measurements of pH and a quality-of-life questionnaire. The GERD patients practicing diaphragmatic exercise demonstrated better outcomes than the controls, the difference between groups being statistically significant.

There have been several case reports of patients experiencing alleviation of GERD manifestations under chiropractic care. Relevant to this article, a patient with costochondritis and GERD responded with a multifactorial approach including chiropractic adjustments and breathing exercises. (3)

### Venous return

In the right hemidiaphragm is a foramen for the *inferior vena cava*, which returns venous blood from the lower body to the heart. Diaphragm contraction compresses this vein, while relaxation of the muscle allows it to dilate.

A 2012 echocardiography study confirmed that diaphragm action assists venous return by milking the inferior vena cava. (4) A physical therapy research team in Brazil found significantly reduced heart rate and improvement in heart rate variability following manual release of the diaphragm. (5) Improved diaphragmatic assistance of venous return may be a partial explanation of the Brazilian team's results.

### Lymphatic circulation

Many lymphatic vessels pass through the diaphragm, the largest of which is the thoracic duct. It makes anatomical sense that the contraction and relaxation of the diaphragm assists lymphatic circulation in a way very similar to the beneficial effect of diaphragmatic action on venous return. In fact, deep diaphragmatic breathing has been found to be beneficial even when lymphatic circulation is profoundly disrupted as in post-surgical lymphedema. (6)

Lymphatic circulation is an important component of the body's innate immunity. The pumping action of skeletal muscles, including the diaphragm, plays a vital role in lymphatic circulation. The chiropractic adjustment benefits the function of skeletal muscles, including the diaphragm. Therefore, the chiropractic adjustment has a role to play in supporting innate immunity by supporting diaphragm function, among other mechanisms. (7)

### Vagus function

As it travels from the cranium to the abdomen the vagus nerves must pass through the diaphragm. Normal diaphragmatic contraction and relaxation provides natural stimulation to the parasympathetic and sensory fibres of the vagi, thereby balancing excess sympathetic stimulation. This is a critically important factor in controlling problems aggravated by sympathetic hypertonia such as anxiety, arterial hypertension, and digestive disorders. A recent posting by the Harvard Medical School advocates diaphragmatic breathing ('belly breathing') as an anti-stress practice. (8)

Practitioners who adjust the upper cervical area are generally aware of the potential benefit of this service in terms of vagal function. This is because of the proximity of the *vagus* n to the occipital condyles as it exits the jugular foramen. What is not always appreciated is the potential for mid-cervical and lower thoracic adjustments to benefit the vagus as well, due to the relation of that nerve to the diaphragm.

### Outcome measures

Direct palpation of the *diaphragm* at the costal margins is an obvious place to start, but it can be somewhat confusing. The powerful *abdominal muscles* are superficial to the *diaphragm*, and they become active during deep breathing. Palpating the costal margins during forced inspiration, which favours *diaphragm* activity more than abdominal contraction, may be useful in differentiating the two muscle groups from each other.

An indirect outcome measure involves the observation of lower rib excursion. When the *diaphragm* contracts, it causes the lower ribs to move superiorly and laterally. Observing this



movement can be done by having the patient stand or sit in front of you, with their back toward you. You place your fingers around the patient's lower ribs (T10-T12) while bringing your thumbs as close as possible at the patient's back. The pressure you apply to these lower ribs is according to patient comfort, of course. Ask the patient to take a deep breath in, while watching your thumbs. This gives you simultaneous input from palpation and visual observation. A lack of movement may indicate little or no *diaphragm* contraction. A marked asymmetry may mean one hemidiaphragm is hypertonic or hypotonic. Normalisation of lower rib excursion after a series of adjustments would be a favourable outcome.

Due to the important role the diaphragm plays in respiration, measurements of breathing capacity such as spirometry or single breath count can be indirect outcome measures as well. A 2013 paper demonstrated a positive correlation between spirometry and single breath count. (9) Improvement in breathing capacity under chiropractic care is not unusual, as demonstrated in several papers. (10, 11, 12, 13, 14, 15)

### A somatovisceral interface

If the chiropractic adjustment did nothing but improve *diaphragm* function, the whole-body benefits of our service would already have ample explanation. This is because the *diaphragm* is a muscle that uniquely straddles the somatovisceral interface.

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Dr. Charles Masarsky has been in the private practice of chiropractic with Dr. Marion Todres-Masarsky since 1983. Their office is located in Vienna, Virginia, U.S.A in the suburbs of Washington, DC. He also offers continuing education programs for chiropractic colleges and associations. For information about his practice or his C.E. programs, please e-mail [viennachiropractic@verizon.net](mailto:viennachiropractic@verizon.net).

Dr Masarsky writes a frequent feature in the *Journal* called ‘*The Wide Angle Lens*’ in which he takes a broader than usual perspective on one issue or another.