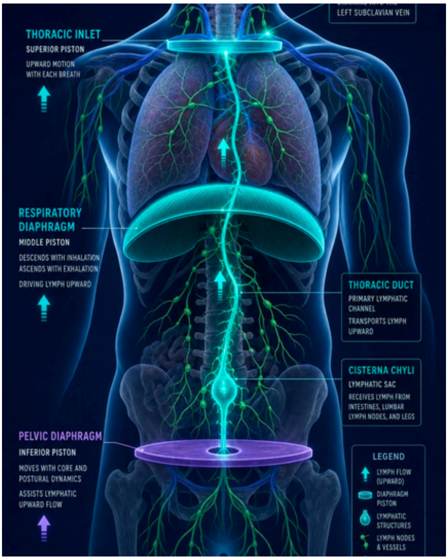
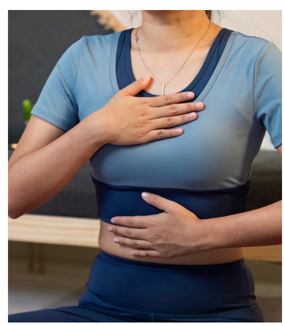


The lymphatic system lacks its own central pump and relies on external forces, such as skeletal muscle contractions, venous pressure changes, and respiratory movements, to transport lymph back to the bloodstream. Among these, the diaphragms' movement during breathing is the most significant and trainable. This article explores the anatomy and movement of each diaphragm, as well as the restriction patterns that hinder lymphatic flow, which is important for clinical practice.

DIAPHRAGM PISTON SYSTEM AND ITS INFLUENCE ON The Lymphatic Pump



Diaphragmatic breathing is a key technique in lymphatic programs that helps promote lymphatic flow from pelvic nodes to the cisterna chyle and up through the thoracic duct.

LAINE KRISTIN MILLER

LMT, PTA, CLT

Understanding the Diaphragms' Role in the Lymphatic system

When you ask most clinicians about the function of the diaphragm, they often respond with, “It facilitates breathing.” While this answer is not incorrect, it lacks a critical clinical perspective. The dome-shaped respiratory diaphragm that many envision is merely one component in a larger, coordinated system of transverse diaphragms that extend throughout the trunk and skull.

Osteopathic literature has long recognized this system, typically describing four or five diaphragms:

1. The pelvic floor
2. The respiratory diaphragm
3. The thoracic inlet (upper thoracic diaphragm)
4. The tentorium cerebelli at the cranial end
5. Sometimes, the tongue/hyoid complex is included as a fifth diaphragm

Each of these structures is oriented approximately horizontally and plays a significant role in altering the pressure within the cavity above and below it with every breath cycle.

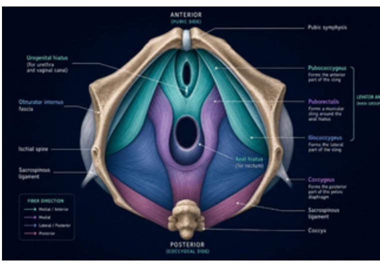
The Piston System: A Stacked Pressure Chain

Picture the diaphragms as pistons stacked vertically through the torso and skull. None of them move in isolation. Each contraction or release changes the pressure gradient in the cavity immediately above and below it, and it is that pressure differential — not muscular squeezing alone — that actually propels lymph centrally toward the venous return points at the base of the neck.

Restriction Patterns at Each Level

This is where the piston framework becomes directly actionable in clinical assessment. A restriction anywhere in the chain bottlenecks flow through the entire system, and each level tends to fail in characteristic, recognizable ways.

Let's begin by looking at the pelvic diaphragm and move up from there.



The pelvic diaphragm is a muscular structure made up of the levator ani group (pubococcygeus, puborectalis, iliococcygeus) and the coccygeus muscle, forming a hammock across the pelvic outlet. It is innervated by branches of the pudendal nerve and the fourth sacral nerve, with lymphatic drainage directed to the internal and common iliac nodes.

Functional Role of the pelvic diaphragm

The pelvic floor serves as the base plate against which the entire piston column presses.

During inhalation, as the respiratory diaphragm descends and intra-abdominal pressure increases, the pelvic floor lengthens and slightly lowers to accommodate this pressure.

Conversely, during exhalation, it recoils upward as the diaphragm rises.

This motion is genuinely reciprocal and synchronized; it is not a passive surface being pushed upon but rather an active partner in the pressure wave.

A relaxed and mobile pelvic diaphragm is essential for effective lymphatic and venous drainage from the pelvis and perineal tissues.

Without this flexibility, the pressure changes generated above it become far less effective, akin to attempting to inflate a balloon with a hole at the bottom.

Pelvic floor — hypertonicity dysfunction.

Rather than weakness, the more common lymphatic-relevant pattern is a hypertonic, non-relaxing pelvic floor: chronically shortened levator ani and coccygeus muscles that never fully lengthen on inhalation.

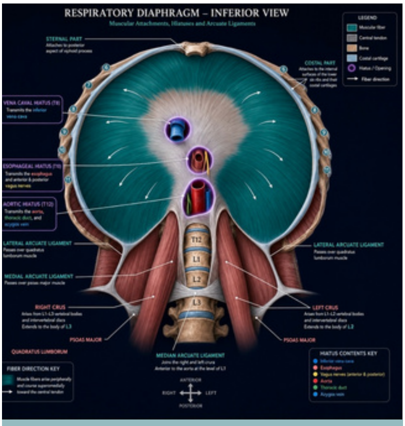
Clinically, this shows up as a paradoxical contraction on Valsalva — the muscles tighten instead of lengthening and creating space.

Because sympathetic innervation to the pelvic floor originates from T10–L2 — the same spinal segments the diaphragmatic crura anchor to — thoracolumbar junction restriction and pelvic floor hypertonicity frequently travel together.

The result is a foundation that cannot lengthen to accept the downward pressure wave, which caps the effectiveness of every breath taken above it, regardless of how well the respiratory diaphragm itself is moving.

The Respiratory Diaphragm — The Engine

This is the primary pressure generator in the system, and its anatomy explains why.



The diaphragm connects posteriorly via the right and left crura to the lumbar vertebral bodies and discs, with the right crus usually extending down to L3 and the left to L2. These crura are centrally joined by the median arcuate ligament. Additionally, the medial arcuate ligament crosses over the psoas major, while the lateral arcuate ligament spans the quadratus lumborum.

On the anterior and lateral sides, the diaphragm attaches to the xiphoid process as well as the lower six ribs and their costal cartilages.

This muscular sheet features three hiatuses that allow important structures relevant to lymphatic flow to pass through: the aortic, esophageal, and inferior vena cava hiatuses.

The vagus nerve also traverses this remarkable structure, highlighting why deep diaphragmatic breathing has such a calming effect on the nervous system.

The esophagus descends through the diaphragm and connects to the stomach at the hiatal sphincter. In cases of a hiatal hernia, the stomach can protrude into the chest cavity, potentially causing reflux, esophagitis, and other complications.

Aortic hiatus (T12) — the most posterior/retrocrural of the three, transmitting the aorta, the thoracic duct, and the azygos and hemiazygos veins. This is the doorway through which nearly all sub-diaphragmatic lymph must pass on its way to becoming thoracic duct flow.

Esophageal hiatus (T10) — transmits the esophagus, vagus nerve, and sympathetic branches, surrounded by crossing fibers of the right crus that act as a physiological sphincter.

Inferior vena cava hiatus (T8) — sits within the central tendon itself and, notably, enlarges during inspiration, aiding venous return exactly when intra-abdominal pressure is rising.

On inhalation, the diaphragm contracts and flattens, descending into the abdominal cavity.

This simultaneously raises intra-abdominal pressure and lowers intrathoracic pressure.

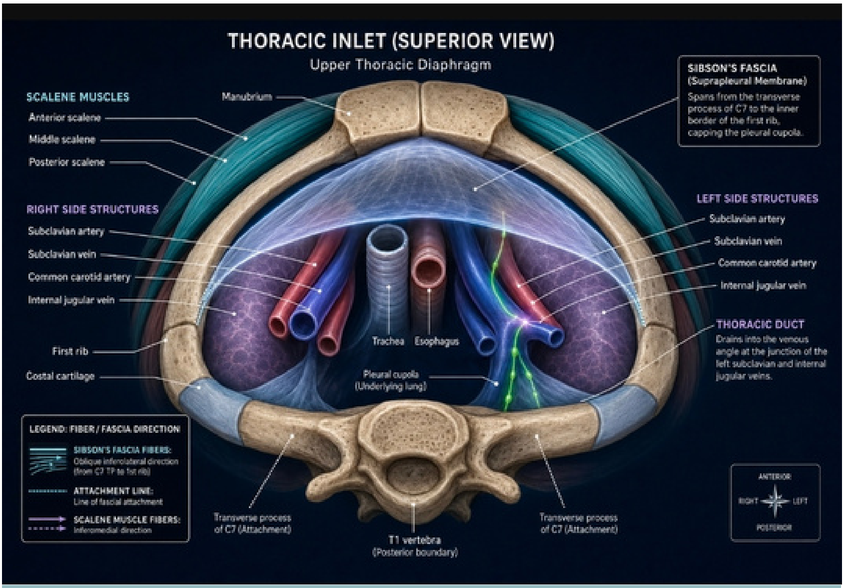
On exhalation, the diaphragm domes back upward and the pressure gradient reverses.

This cyclical differential — often called the thoraco-abdominal pump — is a well-documented driver of lymph movement through the thoracic duct into the subclavian veins.

Michael Foldi described the exhale and inhale as working almost in relay: on exhalation, the cisterna chyli empties into the thoracic duct; on the following inhalation, that column of lymph is drawn onward toward the venous angle at the base of the neck (Foldi's Textbook of Lymphology).

The diaphragm's motor innervation comes exclusively from the phrenic nerve (C3–C5), which explains the old clinical mnemonic "C3, 4, 5 keep the diaphragm alive," and also explains why cervical spine restriction and phrenic nerve irritation can have downstream effects on diaphragmatic excursion — and therefore on lymphatic pumping.

The Upper Thoracic Diaphragm (Thoracic Inlet)



At the base of the neck sits the thoracic inlet, bounded by the first ribs, the manubrium, and T1, and often called the upper thoracic diaphragm in manual medicine literature. This is where the thoracic duct finally empties its collected lymph into the venous system near the left subclavian-internal jugular junction, and where the right lymphatic duct empties into the right brachiocephalic vein, Sibson's fascia, the scalene muscles, and the clavicular attachments all pass through or border this region.

If this area is restricted — from postural tension, scalene tightness, scar tissue, or simple disuse — lymph has nowhere to drain even when the pressure changes generated below it are working perfectly.

This is precisely why osteopathic and manual lymphatic drainage protocols so consistently prioritize opening the thoracic inlet before any other technique: it is, in effect, opening the drain before running the water.

The scalenes, sternocleidomastoid, and Sibson's fascia commonly tighten in response to forward head posture, shallow apical breathing patterns, prior surgery (including axillary node dissection or reconstructive procedures), or simple chronic tension.

The thoracic inlet serves as the final drainage point for lymph in the body, and any restriction here significantly affects lymph flow.

Congestion may manifest in the face, neck, or arms even if the blockage is at the neck's base. This is why thoracic inlet myofascial release is is a valuable first step in lymphatic treatment, regardless of visible swelling.

Evidence suggests lymphedema can lead to secondary thoracic outlet syndrome due to soft tissue crowding, highlighting the interconnectedness of structural restriction and lymphatic congestion.

Using Supraclavicular Fullness as a Terminus Assessment

Why this area is diagnostic.
The supraclavicular fossa sits directly over the terminus — the point where the thoracic duct empties into the venous angle at the junction of the left subclavian and internal jugular veins, and where the right lymphatic duct empties into the right venous angle.

Because this is the final common drainage point for essentially all lymph in the body, restriction or congestion here tends to produce visible, palpable changes before more distal signs appear elsewhere.

What to look for on inspection.
With the client seated and shoulders relaxed, compare the two supraclavicular fossae side by side. Normally, these hollows should appear symmetrical, with a visible concave dip just above the clavicle on both sides. Look for:

- Asymmetry between sides — one fossa appearing fuller or more filled-in than the other, which can point to a unilateral restriction (often the left, given the higher lymphatic volume draining through the thoracic duct terminus compared with the right lymphatic duct).

- Loss of the normal concave contour — a fossa that looks puffy, flattened, or "filled in" rather than hollow suggests fluid accumulating at or just below the drainage site rather than clearing through it.

- Skin texture and color changes — subtly duller, thicker-looking, or slightly discolored skin over the fossa compared to surrounding tissue can indicate more chronic, low-grade congestion.

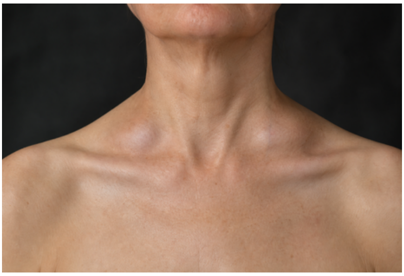
Of all the restriction patterns described, the thoracic inlet level offers one of the most accessible clinical assessment tools available at the start of a session: visual and manual inspection of the supraclavicular fossae, the paired hollows just above the clavicles on either side of the neck. Puffiness here indicates a drainage issue at the terminus which can occur for various reasons

When palpating tissue quality in and around each fossa, consider the following:

- Healthy tissue feels soft, mobile, and compressible, with skin gliding easily and rebounding upon pressure release.

- Congested tissue appears boggy or doughy, yielding slowly under pressure and may be mildly tender, lacking the clear borders of a lymph node. It can be pillow like.

- Firm or matted masses indicate a need for medical evaluation, especially if they are hard, fixed, enlarging, or accompanied by systemic symptoms like weight loss or fever.



What the finding means functionally.

A soft, boggy fullness in the supraclavicular fossa — particularly on the left — is consistent with the restriction pattern described earlier in this article: a thoracic inlet that has lost mobility, whether from postural tension, scalene tightness, scar tissue, or simple disuse, so that lymph arriving from below (via the thoracic duct) or descending from above (via the deep cervical nodes) has nowhere to go.

This is precisely why this area is assessed first, before any other technique, and why "clearing the terminus" is the opening maneuver in most manual lymphatic drainage sequences rather than an afterthought — the rest of the session's work depends on that drainage point actually being open to receive what is mobilized downstream.

Reassessing after treatment.

Because this fullness is fluid-based rather than structural, a genuine change should be palpable within the same session.

After thoracic inlet release or terminus-clearing technique, re-inspect and re-palpate both fossae: a softening of the boggy texture, a return of the normal concave contour, or improved symmetry between sides is a meaningful, immediate marker that drainage has been re-established — and a useful, reproducible way to demonstrate treatment effect to both the clinician and the client in real time.

Why This Matters Clinically

Swelling in supraclavicular nodes occurs due to lymph drainage from various regions, including the head, neck, and abdomen. Congestion in the thoracic duct or right lymphatic duct can lead to visible swelling in the supraclavicular fossae.

- Right supraclavicular nodes drain the mid-chest, lung, and parts of the breast.
- Left supraclavicular nodes (Virchow's node) indicate potential abdominal issues, especially serious conditions like intra-abdominal malignancy.

Swollen nodes can result from infections, systemic inflammation, lymphatic insufficiency, lymphomas, or metastatic cancers. Persistent or unexplained swelling is a red flag requiring medical evaluation.

For lymphatic and manual therapists, the supraclavicular fossae serve as indicators of central lymphatic load, helping assess readiness for increased flow during treatment sessions.

Regular inspection can track changes and effectiveness of techniques used.

Virchow's node, located above the left collarbone, is a left supraclavicular lymph node that receives lymph from the abdomen and lower body. An enlarged Virchow's node (Troisier's sign) can indicate underlying malignancies, especially gastric and abdominopelvic cancers, and requires comprehensive medical evaluation rather than just manual lymphatic treatment.

The Deep Central Lymphatic Factor

The concept of central lymph propulsion goes beyond the mechanics of a single diaphragm.

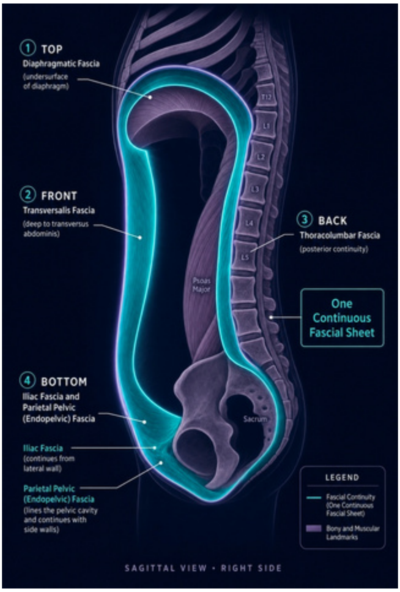
Dr. Jack W. Shields demonstrated in 1980 that a deep breath caused the thoracic duct to flow more vigorously than walking or jogging.

He formalized this in his paper "Central Lymph Propulsion," explaining that the diaphragm and other muscles aid in moving lymph into the veins in sync with oxygen consumption. The cisterna chyli, located near L1–L2, collects lymph and is directly linked to diaphragmatic movement.

Each contraction of the diaphragm massages the cisterna chyli, facilitating lymph flow.

Restrictions in the thoracic duct can lead to clinical issues, such as puffiness in seemingly unrelated areas.

The Fascial Chamber: How Abdominal Fascia Shapes the Pressure Gradient



The endoabdominal fascia lines the entire internal aspect of the abdominal wall as a single continuous sheet, simply named differently depending on which structure it overlies.

The piston metaphor only works because the abdominal cavity is a sealed chamber, and that seal is made of fascia, not just muscle.

Understanding the fascial architecture of the abdomen — and how it couples to the diaphragm's own microscopic lymphatic pump — completes the picture of how a single breath becomes a lymphatic event.

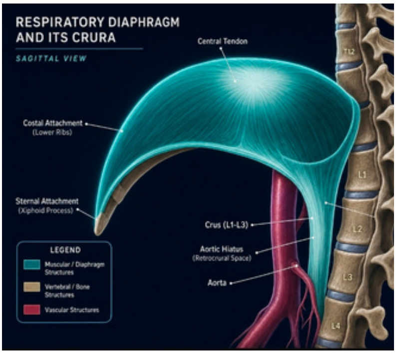
The abdominal cavity is one continuous fascial cylinder.

It is named regions are all one structure: the transversalis fascia (deep to transversus abdominis) is directly continuous superiorly with the diaphragmatic fascia on the undersurface of the respiratory diaphragm, continuous posteriorly with the anterior layer of the thoracolumbar fascia, and continuous inferiorly with the iliac fascia and, ultimately, the parietal pelvic (endopelvic) fascia

In practical terms: the fascia lining the underside of the diaphragm, the fascia wrapping the deep abdominal wall, the thoracolumbar fascia at the back, and the fascia lining the pelvic floor are not four separate structures that happen to sit near each other — they are one uninterrupted fascial envelope, and the diaphragm forms its ceiling.

This is why the piston system described earlier isn't simply three muscles stacked in sequence. It is three muscular diaphragms operating inside — and mechanically coupled by — a single fascial cylinder.

A pressure change generated at the top of that cylinder does not have to "travel" to the bottom through open space; it is transmitted directly through a continuous connective-tissue sheet that has no seams.



Intra-abdominal pressure is the mechanism, not a side effect.

On inhalation, the respiratory diaphragm contracts and descends into this fascial cylinder, compressing its contents and raising intra-abdominal pressure (IAP).

Because the cylinder is continuous — transversalis fascia above blending into thoracolumbar fascia behind and iliac/pelvic fascia below — that pressure rise is not confined to the space directly under the diaphragm.

It is distributed circumferentially through the fascial wall itself, which is precisely how the diaphragm's descent is felt simultaneously as outward abdominal wall expansion, posterior loading through the thoracolumbar fascia, and downward loading on the pelvic floor.

The crura themselves are the direct fascial bridge for this.

They blend into the fascia covering psoas major and quadratus lumborum, which in turn continues into the thoracolumbar fascia and onward toward the pelvic floor — the same myofascial line that anchors the cisterna chyli's neighborhood to the pelvic diaphragm below.

A second, smaller pump lives inside the diaphragm itself.

Separately from its role generating whole-cavity pressure, the diaphragm contains its own miniature lymphatic pump — one that most manual therapy literature never mentions, but that is directly relevant here.

The peritoneal (inferior) surface of the diaphragm is studded with mesothelial stomata: microscopic openings, roughly 4–20 micrometers across, that lead into subperitoneal lymphatic lacunae woven between the diaphragm's muscle fibers.

These stomata are the single largest absorptive route for peritoneal fluid in the body, and they are literally gated by the breath:

On exhalation, as the diaphragm relaxes and its central tendon rises, tension in the muscle fibers drops and the lacunae dilate. This creates a local pressure gradient that draws peritoneal fluid through the open stomata and into the lacunae.

On inhalation, as the diaphragm contracts and the fibers shorten, the lacunae are compressed. The stomata narrow or close, and overlapping endothelial flaps act as one-way valves, preventing backflow into the peritoneal cavity while forcing the collected fluid onward into the deeper collecting lymphatics and, from there, toward the parasternal trunks and the venous system.

This is, functionally, the exact same fill-and-empty logic as the macroscopic piston system — dilate and fill on release, compress and propel on contraction — just executed at microscopic scale, within the tissue of the diaphragm itself, using intra-abdominal pressure as the driving gradient rather than gross muscular squeezing.

It means the diaphragm is not only the engine generating the pressure differential that helps propel lymph up through the cisterna chyli and thoracic duct (as described in the Deep Central Lymphatic Factor above); it is simultaneously running its own local peritoneal lymphatic pump, gated open and closed by the same respiratory rhythm.

Why fascial restriction blunts both pumps at once.

Because the transversalis-thoracolumbar-iliac fascial cylinder is one continuous structure, restriction anywhere in it — post-surgical adhesion, chronic guarding, scar tissue from abdominal or pelvic procedures, or simple loss of extensibility from prolonged shallow breathing — does two things simultaneously.

First, it dampens the circumferential transmission of the pressure wave, so less of the diaphragm's descent is converted into the kind of even, distributed IAP rise that loads the pelvic floor and drives central lymph propulsion.

Second, because the diaphragmatic stomata themselves depend on the muscle fibers around them cycling freely between relaxed (dilated) and contracted (compressed) states, restricted diaphragmatic excursion directly reduces stomatal cycling — meaning peritoneal fluid absorption slows at the exact same time that central lymph propulsion is weakening.

The two pumps fail together because they share the same driver.

The rationale for combining diaphragmatic breathing retraining with abdominal fascial release techniques lies in their interconnectedness. A 2022 clinical trial examined this combination for treating lower extremity lymphedema. Restoring fascial glide and diaphragmatic excursion are two aspects of the same mechanical intervention.

A Simple Practice

To feel the piston system in action:

- Lie on your back with knees bent, feet flat on the floor.
- Place one hand on the upper chest and one hand on the belly, just below the ribs.
- Inhale slowly through the nose for 3–4 seconds, letting the belly rise while the chest stays relatively still.
- Pause gently for 1–2 seconds.
- Exhale slowly through pursed lips for 4–6 seconds, letting the belly fall completely.
- Repeat for 10–15 cycles, noticing whether the pelvic floor softens on the inhale and whether the throat/neck stays free of tension throughout.
- This single pattern engages the pelvic floor, respiratory diaphragm, and thoracic inlet in sequence — the pelvic floor lengthening, the respiratory diaphragm moving through its full excursion, and the thoracic inlet opening and closing with each cycle.
- It is, quite literally, central lymph propulsion in action.

Integrating this into treatment

The diaphragm functions as a unified mechanical chain, where restrictions can bottleneck flow in the system.

For example, a hypertonic pelvic floor can hinder the respiratory diaphragm's effectiveness, while thoracic inlet congestion restricts lymph drainage.

This is why decongestive therapy often starts and ends with diaphragmatic breathing and thoracic inlet work.

Clinical research supports this approach; studies show that diaphragmatic breathing combined with gentle movement can significantly reduce arm volume in lymphedema patients and outperform standard therapies for lower-limb lymphedema.

Manual diaphragm release techniques also improve diaphragmatic mobility across various patient populations.

Consequently, manual therapists should assess the entire piston chain—pelvic floor, respiratory diaphragm and the thoracic inlet—as interconnected systems to identify and resolve to optimize deep lymphatic function.

Systemic Flow: The Three-Body-Cavity Approach

This article emphasizes that the body operates as a unified system rather than three separate diaphragms.

It advocates for a systemic flow approach to manual therapy, focusing on the interconnected major body cavities: the pelvic, thoracic/abdominal, and cervicothoracic cavities.

Each cavity has its unique pressure environment and is linked to others through diaphragms, suggesting that treatment should address the entire system rather than isolated parts.

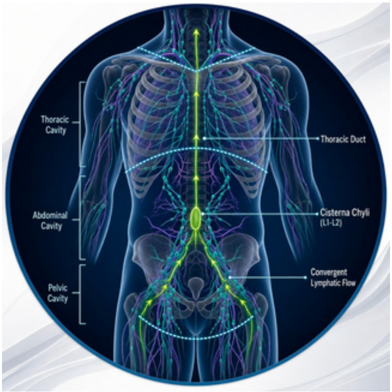
The Foundation of a Systemic Flow Approach to Manual Therapy

This approach emphasizes a holistic understanding of manual therapy. Instead of focusing solely on an individual restricted joint, muscle, or node, treatment is structured around the three primary body cavities created and separated by the piston diaphragms:

- **Pelvic Cavity**: Contains the pelvic floor and the urogenital organs.
- **Abdominal Cavity**: Houses the organs essential for digestion and immune function, divided by the respiratory diaphragm.
- **Thoracic Cavity**: Encloses the heart, lungs, esophagus, and thoracic duct, bounded by the thoracic inlet.

Each cavity possesses its own internal pressure environment and is interconnected with its neighbors solely through the diaphragm that serves as its floor or ceiling.

Since no part of this interconnected system operates in true isolation, it follows that no treatment should focus on one aspect in isolation either.



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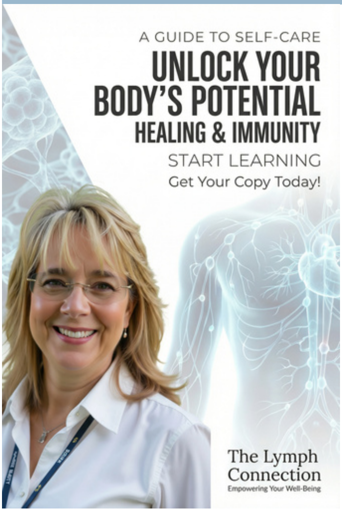

Laine Miller is a PTA, LMT, and CLT who runs her private practice in Boca Raton, Florida. When she's not busy treating clients or soaking up the sun in South Florida, she enjoys writing, researching, and teaching. Her expertise in lymphatic care includes decongestive therapy, postoperative care, orthopedic recovery, and neurolymphatic techniques. Laine is enthusiastic about sharing her insights and loves to educate fellow therapists on her methods!

You can reach her at studylrt@gmail.com or learn more about her courses and content at Lymphaticrestorationtherapy.com.

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