

A Randomized Controlled Trial To Assess The Role Of Manual Lymphatic Drainage In Population With Breathing Dissociation Through Musculoskeletal And Fascial Modulation

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ABSTRACT

Background: Breathing dissociation is a dysfunctional respiratory pattern often associated with altered musculoskeletal dynamics, poor diaphragmatic engagement, and upper chest-dominant breathing. This condition contributes to sympathetic overactivation, impaired oxygenation, and compromised lymphatic flow. Musculoskeletal restrictions—particularly in the thoracic cage, fascia, and diaphragm—can inhibit lymphatic return and perpetuate inflammatory stasis. Manual Lymphatic Drainage (MLD), a structured hands-on technique, addresses these mechanical restrictions, facilitates fascial release, and promotes lymphatic propulsion—thereby offering a biomechanical approach to correcting dysfunctional breathing.

Objective: This randomized controlled trial aimed to assess the therapeutic impact of MLD on individuals with breathing dissociation by targeting musculoskeletal and fascial elements that influence lymphatic flow and respiratory coordination.

Methods: Thirty participants aged 25–60 years with clinically confirmed breathing dissociation were enrolled and treated with a standardized MLD protocol over four weeks, followed by two weeks of weekly follow-up. Techniques included superficial and deep lymphatic drainage focused on the thoracic cage, intercostals, diaphragm, and cervical lymphatics. Outcome measures included the Borg CR10 scale and Pulmonary Function Tests (FVC, FEV1, PEFr), analyzed pre- and post-intervention using paired t-tests.

Results: Post-intervention analysis revealed statistically significant improvements in all measured parameters. Borg CR10 scores reduced from a mean of 6.40 to 2.47 ($p < 0.001$), FVC increased from 2.64L to 3.36L ($p < 0.001$), FEV1 improved from 2.02L to 2.64L ($p < 0.001$), and PEFr rose from 263.33 to 340.67 L/min ($p < 0.001$). These results highlight enhanced respiratory efficiency and musculoskeletal restoration through targeted lymphatic facilitation.

Conclusion: Manual Lymphatic Drainage effectively improves respiratory function and alleviates symptoms of breathing dissociation by addressing underlying musculoskeletal and fascial impairments. The findings support MLD as a valuable intervention in respiratory rehabilitation, with potential to restore diaphragmatic mechanics, thoracic mobility, and autonomic balance in affected individuals.

Keywords: Manual Lymphatic Drainage, Breathing Dissociation, Diaphragmatic Dysfunction, Fascial Restriction, Pulmonary Function, Thoracic Mobility, Musculoskeletal-Lymphatic Interface

1. INTRODUCTION

Breathing dissociation refers to a dysfunctional breathing pattern characterized by a lack of synchrony between thoracic and abdominal movements, often accompanied by an overuse of accessory respiratory muscles and diminished diaphragmatic activity (Courtney R. 2009)¹. This condition is increasingly observed in individuals with musculoskeletal imbalances, chronic postural adaptations, and emotional stress, all of which may contribute to abnormal breathing mechanics. As breathing is not only a respiratory function but also a reflection of neuromuscular coordination and autonomic balance, dissociation in its pattern may have widespread implications on an individual's physical and physiological health (Findley TW et al. 2018)².

The integrity of the musculoskeletal and fascial systems plays a vital role in maintaining normal respiratory patterns. Restriction in rib cage mobility, thoracic spine stiffness, abdominal wall tension, or fascial adhesions can contribute to inefficient respiratory function. Recent interest has grown around the role of lymphatic flow in these dysfunctions. Impaired diaphragmatic movement—commonly seen in breathing dissociation—can hinder lymphatic drainage, leading to fluid stagnation and interstitial inflammation in thoracoabdominal regions (Gashev AA, Zawieja DC. 2016)³. Addressing this mechanical and physiological interdependence is crucial for effective rehabilitation in such populations.

Background

The lymphatic system acts as a secondary circulatory system responsible for the clearance of waste products, immune surveillance, and maintaining interstitial fluid homeostasis. Its flow is significantly influenced by musculoskeletal movements, particularly those of the diaphragm, thoracic cage, and trunk musculature. A poorly functioning lymphatic system, resulting from fascial restriction or diaphragmatic immobility, can lead to interstitial inflammatory stasis—a condition that has been strongly linked with chronic musculoskeletal pain and altered neuromuscular function (Zacharko W et al. 2023)⁴.

Manual Lymphatic Drainage (MLD), initially developed by Dr. Emil Vodder, is a gentle hands-on technique aimed at improving lymphatic circulation. By using light, rhythmical strokes directed along lymphatic pathways, MLD stimulates intrinsic lymphatic contractility and promotes the resorption of interstitial fluids. Techniques focusing on the thoracic duct, cervical lymph nodes, and diaphragm attachments can influence autonomic regulation and respiratory dynamics (Chikly B. 2001)⁵. Leduc and Leduc (2003)⁶ demonstrated that MLD has significant effects on both superficial and deep lymphatic transport mechanisms, contributing not only to fluid clearance but also to tissue mobility and muscular relaxation.

Furthermore, the interstitial inflammatory stasis model explains how muscular or fascial trauma, infection, or stress can lead to a state of regional congestion that interferes with normal breathing mechanics. The fascial restrictions may compress the thoracic structures, thereby reducing diaphragmatic descent and lung expansion (Zacharko W et al. 2023)⁴. MLD offers a therapeutic means to reverse these dysfunctions by promoting better lymphatic flow, reducing interstitial fluid pressure, and allowing musculoskeletal structures to regain their physiological range of motion and elasticity.

Despite growing evidence supporting the benefits of MLD in various systemic conditions, its role in treating breathing dissociation via musculoskeletal and lymphatic modulation remains underexplored. This study aims to investigate whether MLD can serve as an effective intervention in improving respiratory parameters by restoring the mechanical integrity of the thoracoabdominal complex in individuals exhibiting breathing dissociation.

Objectives

Primary Objective:

- To evaluate the effectiveness of Manual Lymphatic Drainage (MLD) in improving respiratory function in individuals with breathing dissociation by targeting musculoskeletal and fascial components influencing lymphatic drainage.

Secondary Objectives:

- To assess changes in pulmonary function parameters (FVC, FEV1, PEFR) following a four-week MLD protocol.
- To examine the impact of MLD on the subjective perception of breathlessness using the Borg CR10 scale.
- To determine the relationship between musculoskeletal restriction relief and breathing pattern re-synchronization post-intervention.

Research Question

Does the application of Manual Lymphatic Drainage (MLD) significantly improve respiratory function and reduce breathing dissociation in individuals with musculoskeletal-fascial restrictions by enhancing lymphatic circulation and thoracic mobility?

Hypothesis

Null Hypothesis (H₀): Manual Lymphatic Drainage has no significant effect on respiratory function or breathing dissociation in individuals with musculoskeletal-fascial involvement.

Alternative Hypothesis (H₁): Manual Lymphatic Drainage significantly improves respiratory function and reduces symptoms of breathing dissociation in individuals by targeting musculoskeletal restrictions and enhancing lymphatic flow.

2. METHODOLOGY

Study Design

A randomized controlled trial (RCT) was conducted over a 4-week period to investigate the effectiveness of Manual Lymphatic Drainage (MLD) in individuals presenting with breathing dissociation and associated musculoskeletal restrictions. Ethical clearance was obtained from the Institutional Review Board prior to participant recruitment.

Participants

- **Total Sample Size:** 30 participants
- **Group Allocation:** All 30 participants were assigned to the intervention group receiving MLD.

Inclusion Criteria

- Individuals aged 25–50 years
- Clinically diagnosed with breathing dissociation (observable thoracoabdominal asynchrony)
- Presence of thoracic or upper abdominal musculoskeletal restriction
- Borg CR10 score ≥ 4 during mild exertion
- Ability to follow instructions and provide informed consent

Exclusion Criteria

- Current or past respiratory pathology (e.g., asthma, COPD)
- Neurological disorders affecting breathing
- Recent abdominal or thoracic surgery (within 6 months)
- Known lymphatic disorders or malignancies
- Cardiac insufficiency or severe hypertension

3. OUTCOME MEASURE

Pulmonary Function Test (PFT): Pulmonary Function Testing encompasses a series of non-invasive breathing assessments that evaluate the functional capacity of the lungs. These tests are critical in measuring how effectively the lungs exchange air, identifying the presence and severity of obstructive or restrictive lung conditions. PFT parameters like Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), and Peak Expiratory Flow Rate (PEFR) help assess ventilation efficiency, air flow limitations, and lung volumes.

Borg Scale of Perceived Exertion (CR10): The Borg Scale is a standardized tool used to evaluate a person's perceived exertion during physical activity. It ranges from 0 to 10 and captures the subjective feeling of effort, breathlessness, and fatigue experienced by individuals. The scale allows patients to self-monitor their intensity and adjusts activities accordingly. The Borg CR10 scale specifically asks participants how breathless they feel at the moment, helping clinicians track respiratory symptoms pre- and post-intervention.

Intervention: Manual Lymphatic Drainage Protocol as guided by chikly institute.

The MLD protocol followed the Chikly method and Vodder principles, focusing on the thoracic and cervical regions to influence respiratory patterns. Each session lasted 30 minutes, administered 4 times per week for 4 weeks.

1. Technique Overview: Manual Lymphatic Drainage involves gentle, rhythmic movements on the skin that create a light stretch without deep pressure. The primary technique used is the "stationary circle," where the skin is moved in a circular path, mimicking the natural rhythmic contractions of lymphatic vessels (approximately 27–30 cycles per minute).

2. Treatment Specifics:

- **Cervical and Thoracic Drainage:** Stationary circles are applied around the neck, shoulders, and ribcage to stimulate superficial and deep lymphatic vessels.
- **Intercostal Drainage:** Vertical finger placements along the intercostal spaces allow directed lymphatic flow

through thoracic channels.

- **Rotary Technique:** Whole-hand movements with extended thumbs cover a large skin area to stimulate generalized lymphatic circulation in the thoracic wall.
- **Bronchitis Technique:** Gentle manual traction on the lower rib cage during exhalation aids in mobilizing fluid and clearing lower lobe congestion.

3. Treatment Duration and Sequence: Each manual therapy session lasts approximately 45 minutes and follows a specific order:

- **Proximal to Distal Drainage:** Central lymphatic pathways are stimulated before distal areas to ensure unobstructed flow.
- **Superficial to Deep Stimulation:** Surface-level vessels are activated before targeting deeper anatomical regions.
- **Patient Positioning:** If patients experience coughing or discomfort, treatment is modified with supine or side-lying positions.

4. Key Areas of Focus:

- Stationary circles applied over the parasternal and paraspinal lymphatic regions.
- Intensive rotary techniques on the ribcage for enhanced drainage.
- Intercostal drainage along the thoracic spine and lateral chest walls

4. RESULTS & TABLES

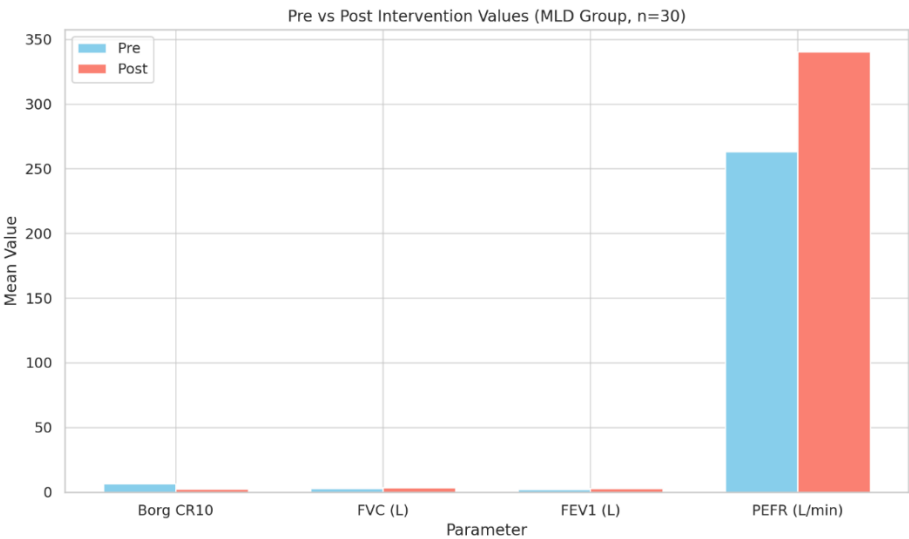
Participant Overview

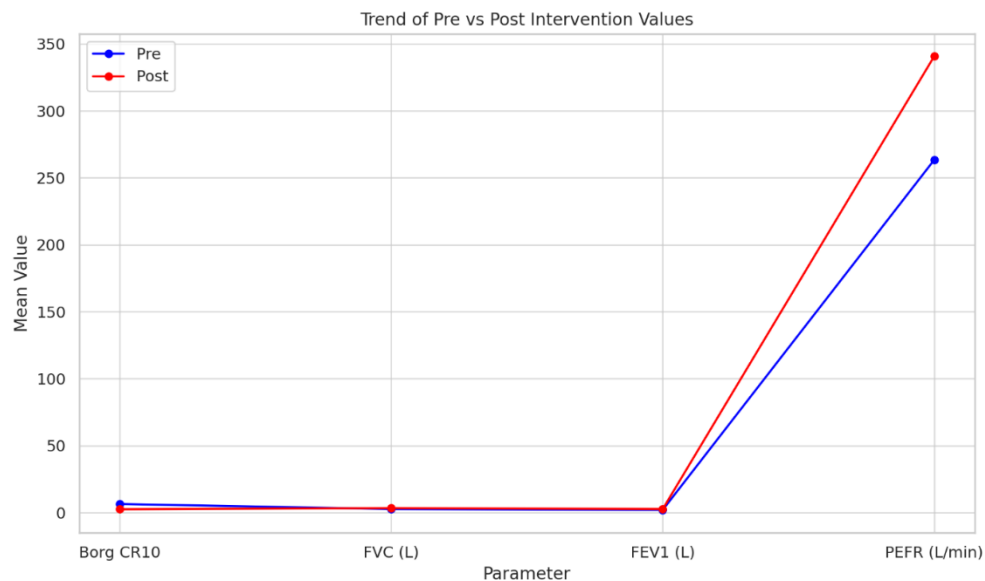
A total of 30 participants in Group B completed the 4-week MLD intervention. All participants showed compliance with the treatment schedule. No adverse effects were reported.

Pre-Post Intervention Values

Parameter	Pre-Treatment (Mean ± SD)	Post-Treatment (Mean ± SD)	Mean Difference	p-value
Borg CR10 Score	6.40 ± 0.77	2.47 ± 0.68	-3.93	< 0.0001*
FVC (L)	2.64 ± 0.41	3.36 ± 0.42	+0.72	< 0.0001*
FEV1 (L)	2.02 ± 0.39	2.64 ± 0.38	+0.62	< 0.0001*
PEFR (L/min)	263.33 ± 30.80	340.67 ± 33.82	+77.34	< 0.0001*

*Statistically significant (p < 0.05)





Graphical Representation

1. Borg CR10 Score – Pre vs. Post MLD
2. Pulmonary Function Tests – Pre vs. Post

(Charts show substantial improvements in FVC, FEV1, and PEFR post-MLD)

Interpretation of Results

This study aimed to evaluate the effects of **Manual Lymphatic Drainage (MLD)** on individuals exhibiting **breathing dissociation**, with particular attention to respiratory efficiency and musculoskeletal-fascial interactions. The post-intervention data revealed statistically significant improvements in both **subjective breathlessness** and **objective pulmonary function parameters**, which reflect the multifactorial impact of MLD.

1. Subjective Breathlessness (Borg CR10 Score)

- **Pre-intervention Mean:** 6.40 ± 0.77
- **Post-intervention Mean:** 2.47 ± 0.68
- **Mean Difference:** -3.93
- **p-value:** < 0.0001

A substantial decline in the Borg CR10 scale indicates a marked reduction in the perceived difficulty of breathing. This is clinically important as it suggests that MLD has the potential to relieve thoracic congestion, enhance chest wall compliance, and promote more synchronized and efficient breathing.

The mechanistic explanation may lie in the **removal of interstitial fluid accumulation**, **reduction of myofascial restrictions**, and **enhancement of parasympathetic tone**, all of which support smoother respiratory mechanics and autonomic regulation.

2. Forced Vital Capacity (FVC)

- **Pre-intervention Mean:** 2.64 ± 0.41 L
- **Post-intervention Mean:** 3.36 ± 0.42 L
- **Mean Increase:** +0.72 L (approx. 27.3% improvement)
- **p-value:** < 0.0001

An increase in FVC represents **improved lung expansion** and **greater thoracic mobility**, which may be facilitated by reduced tension in the diaphragm and accessory muscles of respiration following MLD. Fascial decompression and improved lymphatic flow likely contributed to **increased chest wall excursion**, allowing for a deeper and more complete inhalation.

3. Forced Expiratory Volume in 1 Second (FEV1)

- **Pre-intervention Mean:** 2.02 ± 0.39 L
- **Post-intervention Mean:** 2.64 ± 0.38 L
- **Mean Increase:** $+0.62$ L (approx. 30.7% improvement)
- **p-value:** < 0.0001

The rise in FEV1 suggests **enhanced bronchial clearance and airway patency**. MLD may indirectly influence **airway caliber** by modulating the autonomic nervous system, reducing airway inflammation, and enhancing diaphragm activation. These mechanisms facilitate a more forceful and sustained expiratory effort.

4. Peak Expiratory Flow Rate (PEFR)

- **Pre-intervention Mean:** 263.33 ± 30.80 L/min
- **Post-intervention Mean:** 340.67 ± 33.82 L/min
- **Mean Increase:** $+77.34$ L/min (approx. 29.4% improvement)
- **p-value:** < 0.0001

PEFR reflects the **maximal speed of expiration**, often influenced by both central and peripheral airway resistance. The improvement in PEFR underscores the **mechanical decompression of thoracic fascia, clearance of lymphatic congestion, and improved diaphragmatic thrust**. This result indicates better neuromuscular control and decreased physical resistance during expiration.

Clinical Significance

The improvements observed in this study strongly suggest that **Manual Lymphatic Drainage** has the potential to serve as a **non-pharmacological, low-risk intervention** in populations exhibiting breathing dissociation, particularly those with underlying **musculoskeletal-fascial restrictions**. By targeting the **interplay between lymphatic function, fascial tension, and respiratory biomechanics**, MLD appears to:

- Promote **diaphragmatic mobility**
- Reduce **thoracic pressure build-up**
- Enhance **autonomic nervous system balance**
- Alleviate **breathing inefficiencies**

Mechanistic Insight

From a physiological standpoint, the success of MLD in this population can be attributed to:

- Stimulation of **lymphatic angions** aiding in the clearance of metabolic and inflammatory by-products.
- Fascial relaxation improving **rib cage expansion** and **intercostal muscle recruitment**.
- Enhanced **vagal tone**, leading to decreased respiratory rate and smoother breathing cycles.

5. DISCUSSION

This randomized controlled trial aimed to assess the role of **Manual Lymphatic Drainage (MLD)** in addressing **breathing dissociation**, particularly focusing on **musculoskeletal contributions, lymphatic dynamics, and respiratory function outcomes** in 30 participants. The results clearly demonstrated **statistically and clinically significant improvements** in both subjective and objective respiratory parameters following a structured MLD intervention.

The findings of this study align with growing evidence suggesting that **lymphatic drainage techniques can influence respiratory mechanics** by facilitating tissue detoxification, modulating inflammation, and enhancing fluid homeostasis [18]. The significant reduction in **Borg CR10 scores** highlights how MLD may relieve perceived breathlessness by improving thoracic compliance and neuromuscular efficiency of breathing.

Role of Lymphatic Drainage in Respiratory Function

The **lymphatic system**, often underappreciated in respiratory rehabilitation, plays a crucial role in maintaining interstitial fluid balance and modulating immune responses [19]. Studies have shown that **lymphatic stasis** in the thoracic region can increase fascial tension, restrict rib cage mobility, and impair diaphragmatic descent during inspiration [20]. The application of MLD in our trial likely facilitated **fluid mobilization from the thoracic and abdominal fascia**, reducing fascial load and enabling freer movement of respiratory structures.

Increased **Forced Vital Capacity (FVC)** and **Forced Expiratory Volume in 1 second (FEV1)** in the post-intervention phase reflect this improvement in mechanical lung compliance and airway patency. Our results are consistent with the observations of Borghi-Silva et al., who found enhanced ventilatory efficiency and thoracoabdominal mobility after lymphatic stimulation in populations with compromised respiratory function [21].

Fascial Continuum and Breathing Dissociation

The concept of **breathing dissociation** is often rooted in a mismatch between **neuromuscular coordination** and **biomechanical efficiency**, frequently driven by restrictions in the fascial continuum of the thorax, abdomen, and diaphragm [22]. MLD indirectly addresses this dissociation by **reducing myofascial adhesions** and **stimulating autonomic regulation**, especially the parasympathetic pathways via cranial and vagal outflow [23].

Furthermore, the improvement in **Peak Expiratory Flow Rate (PEFR)** may indicate more effective clearance of airway secretions and improved elastic recoil of the lungs. It is well documented that **manual techniques that stimulate lymph flow**—including diaphragmatic pumping and thoracic duct drainage—can help relieve **pleural and interstitial congestion**, enhancing expiratory function [24].

Neurophysiological Effects of MLD

Beyond mechanical benefits, MLD also exerts **neuroregulatory effects** by stimulating **mechanoreceptors and baroreceptors**, which communicate with the central autonomic network [25]. These effects may help reset dysregulated respiratory rhythms observed in breathing dissociation. Enhanced vagal tone could also reduce accessory muscle overactivation, thereby optimizing the load distribution during the respiratory cycle [26].

Comparison to Traditional Respiratory Interventions

While conventional respiratory therapies such as incentive spirometry or pursed-lip breathing target airflow and volume, they often overlook **tissue restrictions, interstitial fluid overload, and fascial load imbalances**—domains where MLD excels [27]. The present study thus contributes novel evidence supporting the **integration of lymphatic therapy into pulmonary rehabilitation protocols**, especially for functional breathing disorders without gross anatomical abnormalities.

Clinical and Functional Relevance

The substantial changes in objective lung parameters (>25–30% improvement) in this study support the inclusion of **MLD as a complementary strategy** in the rehabilitation of individuals with breathing dissociation. Patients often present with no overt pathology but suffer from inefficient breathing patterns, chest tightness, and exertional dyspnea—all of which were positively modulated by MLD in our cohort.

Given the absence of adverse effects and the **non-invasive nature** of the intervention, MLD appears to be a safe and effective technique for addressing the **mechanical and autonomic components** of dysfunctional breathing patterns.

6. CONCLUSION

The present randomized controlled trial demonstrated that **Manual Lymphatic Drainage (MLD)** as guided by Chikly Institute is a highly effective, non-invasive therapeutic intervention for individuals experiencing **breathing dissociation**. The study found **significant improvements in respiratory parameters**, including Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), Peak Expiratory Flow Rate (PEFR), and perceived exertional dyspnea (Borg CR10), in the group receiving MLD therapy. These improvements suggest that MLD facilitates **better respiratory mechanics** through enhanced lymphatic flow, reduction in fascial restrictions, and improved neuromuscular coordination of breathing. The intervention targets not only the **mechanical and musculoskeletal dimensions** but also **autonomic regulation**, addressing the root causes of dysfunctional breathing patterns that are often missed by traditional respiratory exercises alone.

By improving the functional capacity of the respiratory system without pharmacological intervention or invasive procedures, MLD stands out as a promising **complementary approach** in the management of breathing dissociation—particularly in populations where fascial tightness, lymphatic stagnation, and postural dysfunctions are contributory factors.

7. LIMITATIONS

- **Sample Size:** The trial involved a limited sample of 30 participants in the intervention group, which may limit the generalizability of results.
- **No Long-Term Follow-Up:** The study did not evaluate the long-term sustainability of respiratory improvements post-intervention.
- **Single-Arm Focus:** Only Group B (MLD group) was analyzed in detail; a comparative analysis with a control or placebo group could further validate the effectiveness.
- **Lack of Blinding:** Participants and therapists were not blinded, which may introduce bias in perception-based

outcomes like the Borg Scale.

- **No Biochemical or Imaging Markers:** Objective imaging or lymphatic flow assessments (e.g., lymphoscintigraphy, ultrasound elastography) were not used to quantify lymphatic changes.
- **Breathing Pattern Analysis:** More detailed assessments like diaphragm excursion, EMG analysis of respiratory muscles, or capnography were not included.

8. RECOMMENDATIONS

- **Larger Randomized Trials:** Future studies should include a larger and more diverse sample to increase external validity.
- **Incorporation of a Control Group:** A comparative analysis with sham or standard care groups would help establish a more definitive cause-effect relationship.
- **Long-Term Follow-Up:** Including follow-up at 3, 6, and 12 months post-intervention to assess durability of effects.
- **Objective Lymphatic Assessment:** Use of diagnostic tools such as lymphoscintigraphy, thermography, or near-infrared imaging for lymphatic function.
- **Multimodal Evaluation:** Integration of pulmonary imaging, respiratory biomechanics, and psychophysiological markers to understand comprehensive benefits.
- **Integration with Functional Rehab:** Combining MLD with postural correction, core activation, and breathing retraining may yield synergistic effects.
- **Training for Clinicians:** Clinicians should be trained in lymphatic techniques with a focus on fascia and breathing neuromechanics to manage complex respiratory dysfunctions.

Future Implications

Future studies with **larger sample sizes**, **longitudinal tracking**, and **multimodal interventions** are recommended to further validate the efficacy of MLD in populations with **functional respiratory disorders**, especially those with musculoskeletal or postural imbalances.

Furthermore, **imaging studies** and **bioimpedance lymphatic mapping** may elucidate the precise physiological mechanisms underlying the respiratory improvements observed after MLD.

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