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Original Article

Effect of selective manual therapy techniques in chronic obstructive pulmonary disease: A randomized control trial

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الملخص

أهداف البحث: هدفت الدراسة إلى معرفة تأثير تقنيات العلاج اليدوي الانتقائية على توسيع الصدر، وظيفة الرئة (القدرة الحيوية القسرية، حجم الزفير القسري في الثانية الأولى، ونسبة حجم الزفير القسري في الثانية الأولى/القدرة الحيوية القسرية)، والزاوية القحفية الفقرية، وزاوية الحداب، والقدرة الوظيفية وضيق التنفس لدى مرضى الانسداد الرئوي المزمن.

طرق البحث: تجربة عشوائية محكومة مزدوجة التعمية متوازية شملت 52 ذكرا بمتوسط عمر 56.23 ± 3.54. تم تقسيم المرضى عشوائيا إلى مجموعتين، تتكون كل منهما من 26 شخص. تلقت المجموعة الضابطة (أ) العلاج الطبيعي التقليدي فقط. تلقت المجموعة التجريبية (ب) كلا من العلاج اليدوي والعلاج الطبيعي التقليدي. يتم العلاج ثلاث مرات في الأسبوع لمدة 8 أسابيع. تمدد الصدر بواسطة الفرجار الصدري، (نسبة القدرة الحيوية القسرية وحجم الزفير القسري في الثانية الأولى وحجم الزفير القسري في الثانية الأولى/القدرة الحيوية القسرية) عن طريق قياس التنفس، والزاوية القحفية الفقرية وزاوية الحداب بواسطة برنامج "كينوفيا"، والقدرة الوظيفية عن طريق اختبار المشي لمدة ست دقائق وضيق التنفس عن طريق مؤشر ضيق التنفس المعدل التابع لمجلس البحوث الطبية، تم قياسها جميعا عند خط الأساس وبعد ثمانية أسابيع.

النتائج: قبل العلاج، لم يكن هناك فروق ذات دلالة إحصائية بين المجموعتين في التحليلات بين المجموعة. بعد العلاج، تم العثور على فرق ذو دلالة إحصائية بين المجموعتين، مع ميل المجموعة التجريبية في حجم الزفير القسري في الثانية الأولى بمقدار 0.55 لتر، القدرة الحيوية القسرية بمقدار 0,39 لتر، حجم الزفير القسري في الثانية الأولى/القدرة الحيوية القسرية بمقدار 18,97، ضيق التنفس بمقدار -2,58، اختبار المشي لمدة ست دقائق بمقدار 92,81 متر، الزاوية القحفية الفقرية 5,21 درجة، زاوية الحداب 3,1 درجة، توسع الصدر الأمامي الخلفي 1,08 سم، وتوسع الصدر الجانبي 1,54 سم.

الاستنتاجات: يؤدي الجمع بين أساليب العلاج اليدوي والعلاج الطبيعي التقليدي إلى اختلاف كبير سريريا في توسع الصدر الأمامي الخلفي، والقدرة الحيوية القسرية، وحجم الزفير القسري في الثانية الأولى، والزاوية القحفية الفقرية، والقدرة الوظيفية، وضيق التنفس، وفرق ذو دلالة إحصائية في زاوية الحداب، ونسبة حجم الزفير القسري في الثانية الأولى/القدرة الحيوية القسرية، وتوسع الصدر الجانبي مقارنة باستخدام العلاج الطبيعي التقليدي فقط في مرضى الانسداد الرئوي المزمن.

الكلمات المفتاحية: مرض الانسداد الرئوي المزمن؛ الحداب؛ إطلاق اللفافة العضلية؛ اختبار وظائف الرئة

Abstract

Objective: To investigate the effect of selective manual therapy (MT) techniques on chest expansion, pulmonary function (forced vital capacity [FVC], forced expiratory volume in 1 s [FEV1], and FEV1/FVC ratio), cranio-vertebral angle (CVA), kyphosis angle, functional capacity, and dyspnea in patients with chronic obstructive pulmonary disease (COPD).

Methods: A parallel double-blinded randomized controlled trial involved 52 male subjects with a mean age of 56.23 ± 3.54. Patients were randomly assigned to two groups, each consisting of 26 subjects: the control group (A) received only conventional physical therapy, and the experimental group (B) received both MT and conventional physical therapy. Treatment was administered three times per week for 8 weeks. Chest expansion by chest caliper; FVC, FEV1, and FEV1/FVC ratio by

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spirometry; CVA and kyphosis angle by Kinovea software; functional capacity by the 6-min walk test (6MWT); and dyspnea by the modified Medical Research Council dyspnea index all were measured at baseline and after 8 weeks.

Results: Prior to treatment, there was no statistically significant differences between the two groups in the between-group analyses ($p > 0.05$). After treatment,a statistically significant difference was found between both groups, with a predilection for the experimental group in FEV1 middle difference (MD) of 0.55 L, FVC MD = 0.39 L, FEV1/FVC% MD = 18.97, dyspnea MD = −2.58, 6MWT MD = 92.81 m, CVA MD = 5.21°, kyphosis angle MD = 3.1°, anteroposterior (AP) chest expansion MD = 1.08 cm, and lateral chest expansion MD = 1.54 cm.

Conclusion: The combination of MT approaches with conventional physical therapy leads to a clinically significant difference in AP chest expansion, FVC, FEV1, CVA, functional capacity, and dyspnea, and a statistically significant difference in kyphosis angle, FEV1/FVC %, and lateral chest expansion compared to using conventional physical therapy only in patients with COPD.

Keywords: Chronic obstructive pulmonary disease; Kyphosis; Myofascial release; Pulmonary function test

Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by permanent airway manifestations such as coughing, sputum production, and dyspnea. These symptoms are caused by anomalies of the alveoli, resulting in a constant and rising restriction of airflow.[1] COPD affects approximately 10.3% of the global population, with higher rates observed among smokers and those over 60.[2] This rate is increased with age and exposure to various risk factors.[3]

Postural issues associated with COPD, such as forward head posture, are caused by tensions in the cervicothoracic fascia, which wraps the chest wall. This leads to increased chest tightness and breathing difficulty. Patients with COPD have a larger angle of thoracic kyphosis than healthy people due to a higher utilization of secondary breathing muscles and limited diaphragmatic mobility.[4] Treatment methods aim to mitigate symptoms, promote quality of life (QoL), inhibit flare-ups, and halt the deterioration of the pulmonary system.[5] Antibiotics, inhaled corticosteroids, and bronchodilators are common medications used for the treatment of COPD. Physical therapy is an essential element of COPD treatment.[6] Manual therapy (MT) is a therapeutic, hands-on approach that stimulates the spine, joints, and fascia. It reinforces joint mobility and lowers muscular hypertonicity.[7]

A systematic review was conducted to examine the effectiveness of musculoskeletal system interventions in patients with COPD. The review analyzed six randomized controlled trials (RCTs) comparing MT, including spinal manipulation, respiratory muscle stretching, diaphragmatic release, and aerobic training, with sham techniques and light manual interventions such as gentle massage and exercise alone. Furthermore, the authors evaluated a combination of these interventions. The studies also evaluated (forced expiratory volume in 1 s [FEV1]), exercise capacity by (6-min walk test [6MWT]), and health-related QoL (HRQoL). The results showed no significant effect on FEV1. However, there was a significant increase in 6MWT in three studies. Two studies evaluated the impact on HRQoL. While two studies reported an overall improvement, only one study observed a specific reduction in the dyspnea domain.[8] No studies were found that examined the combined effect of soft-based MT (myafascial release of accessory breathing muscles and myofascial release of diaphragm) and joint-based MT (specially thoracic mobilization and rib mobilization) in conjunction with conventional treatment (including pursed lip breathing, diaphragmatic breathing, and active exercises of the upper extremities) on various measures including FEV1, forced vital capacity (FVC), FEV1/FVC ratio, chest expansion, dyspnea, functional capacity, kyphosis, and forward head posture in patients with COPD.

Therefore, the current study aimed to propose a treatment protocol that would enhance the efficacy of physical therapy in eliminating the persistent effects of pathomechanical changes in COPD. This research investigated the effects of specific MT techniques on chest expansion, pulmonary function (FVC, FEV1, and FEV1/FVC ratio), craniovertebral angle (CVA), kyphosis angle, functional capacity, and dyspnea in patients with COPD. The research hypothesis posited that there is no statistically significant difference between the combination of MT and conventional treatment and conventional treatment alone in patients with COPD.

Materials and Methods

Setting

The study was conducted at Qasr Al-Einy Hospital (Cairo, Egypt) from March 2023 to March 2024. Prior to enrollment, all subjects provided written informed consent. This study adhered to the Consolidated Standards of Reporting Trials guidelines.

Design

Parallel double-blinded randomized control trial

Subjects. The study included 72 subjects diagnosed by a chest physician with mild to moderate COPD based on history, physical examination, and an FEV1/FVC ratio ≤ 0.7 with the FEV1 ratio for mild COPD $\geq 80\%$ and FEV1 for moderate COPD of 50−80% based on the Global Initiative for Chronic Obstructive Lung Disease.[9] Male subjects were included who met the following criteria: age range from 50 to 60 years, body mass index of 18−25 kg/m^2, kyphosis angle $\geq 40°$, and CVA $<48°$.[10−14] Patients with a history of hiatus hernia, substantial gastroesophageal reflux, osteoporosis, acute cardiac events within the last 6 weeks, congestive heart failure, acute exacerbation, exacerbation 6 months prior, active hemoptysis, or malignant disease were excluded from the study.

Sample size calculation

The sample size was determined using G*Power software (version 3.0.10). The sample size was determined based on pulmonary function with 80% power at the $\alpha = 0.05$ level. The study included two groups, with two measurements taken for each group. The effect size was set at 0.5, and the F-test multivariate analysis of variance (MANOVA) was used to analyze within and between interaction effects. The minimal suitable sample size was 46 people, with an additional 6 (15%) dropouts, for a total sample size of 52 subjects (26 subjects in each group).

Randomization

The study included patients with COPD diagnosed and referred by a chest physician. A random generator was used to choose 72 subjects, 20 of whom were excluded from this study because they did not meet the inclusion criteria. The second author randomly assigned the subjects who met the recruitment standards and consented to participate. A block randomization program that was generated by a computer was used. The subjects were randomized into four-person blocks with a 1:1 allocation ratio to eliminate bias between groups. The randomization code was stored in sealed, opaque envelopes that were consecutively numbered. The randomization was conducted by a researcher who was not involved in the study, as shown in Figure 1.

Procedures

Assessment

The third author collected dependent measure assessment outcomes at baseline and 8 weeks later. Assessment of pulmonary functions (FVC, FEV1, and FVC/FEV1 ratio) were assessed using a previously calibrated portable spirometer (Niscomed Contec automated spirometer, 97 L × 89 W × 36 mm- Niscomed Electro Medical Devices, Delhi, India). It is a valid test with higher reliability, with intraclass correlation (ICC) = 0.912 for FVC, ICC = 0.953 for FEV1, and ICC = 0.874 for the FVC/FEV1 ratio. The subjects were instructed to sit in a backrest chair, wear a nose clip, inhale deeply, hold their breath, and then exhale through a mouthpiece that was connected to the spirometry. The average of three trial readings was taken.[15]

Chest expansion assessment: Lateral and anteroposterior (AP) chest expansion were assessed using a chest caliper, which is considered to be valid and has demonstrated good reliability (ICC = 0.82 and 0.84, respectively). The chest diameter was measured at the end of deep inspiration, and a second measurement was taken at the conclusion of expiration. In addition, the chest expansion was determined by subtracting the inspiratory diameter from the expiratory diameter.[16] An average of three trial readings was taken. AP expansion was performed by placing one caliper point anteriorly on the xiphoid process and the other tip posteriorly on the tenth thoracic spinous process while the subject sat comfortably. The two caliper tips were positioned on either side of the imaginary line that crossed the mid-axillary line to take a lateral measurement, as demonstrated in Figure 2.[17]

Dyspnea: Dyspnea was assessed using the modified Medical Research Council (mMRC) dyspnea scale. It demonstrated an ICC of 0.82 (0.74–0.88), which indicated its validity and

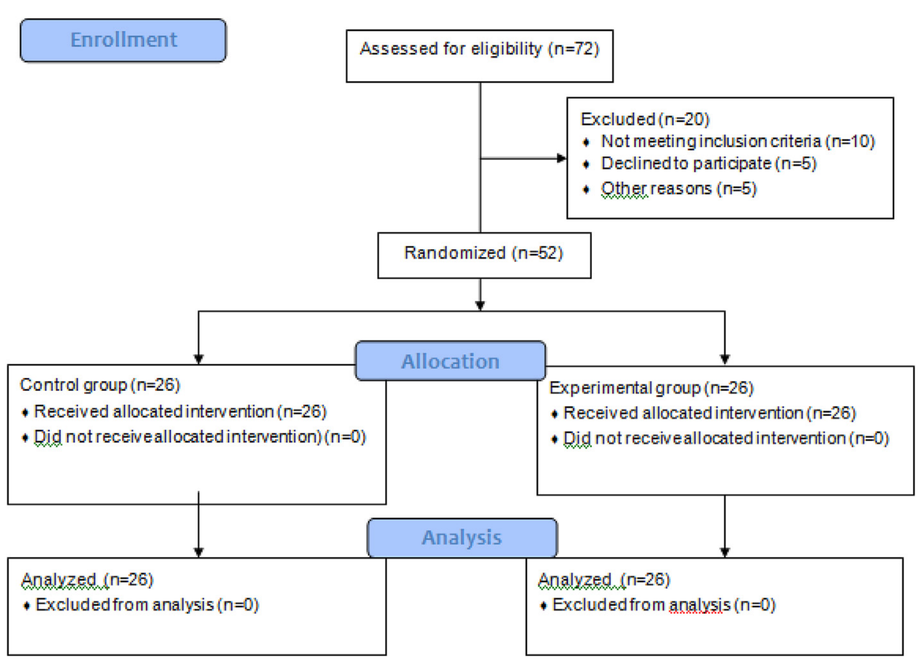


Figure 1: Flow CONSORT Diagram.

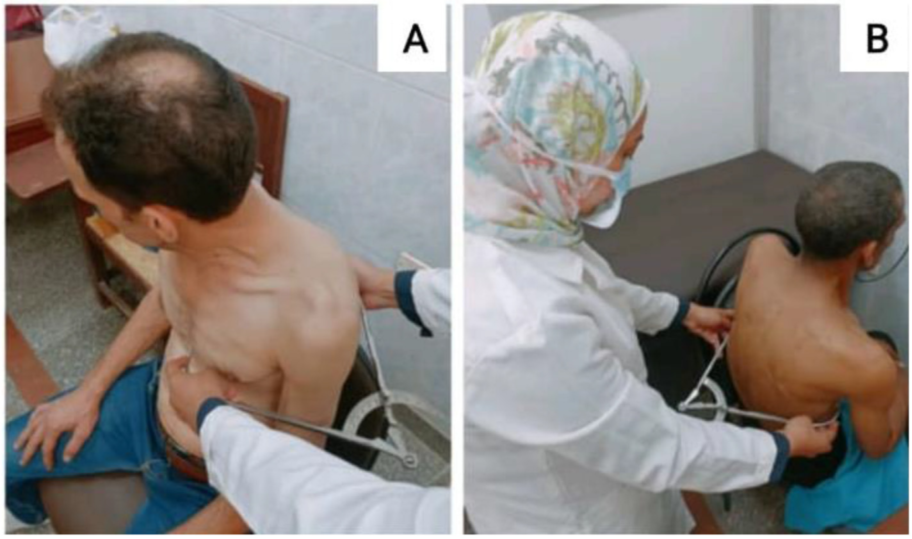


Figure 2: Antroposterior (A) and lateral measurement (B) of chest expansion using a chest caliper.

reliability. The 5-point scale measures the intensity of various active tasks, with scores ranging from 0 to 4.[18]

Functional capacity assessment: The 6MWT demonstrated an ICC of 0.91 (0.86–0.94), which indicated a high level of reliability. Subjects were instructed to walk a 30 m straight hallway as efficiently as possible for 6 min.[19]

CVA and kyphosis angle assessment: KINOVEA software was used because of its excellent reliability (ICC = 0.985–0.997). The CVA was calculated by intersecting a line horizontally from the spinous process of the C7 vertebra with that passing from the C7 vertebra to the ear tragus.[20] The landmarks applied to quantify the angle of kyphosis were the T12 endpoint and the C7 spinous process commencing point of the arc.[21]

Intervention

Group A (control): Subjects received conventional physiotherapy in the form of pursed lip breathing (PLB), diaphragmatic breathing, and active range of motion (AROM) of both upper extremities. Treatments were performed three times weekly for 8 weeks.

PLB: Subjects were instructed to take a slow nasal breath and breathe out via pursed lips with the rate of exhalation twice the inhalation. Subjects performed 10 repetitions per session.[22]

Diaphragmatic breathing exercise: Subjects were advised to take a deep, quiet nasal breath for 2 s before slowly and steadily exhaling via their mouth for about 6 s. Subjects performed 10 repetitions per session.[23]

AROM of both upper extremities: While comfortably sitting, subjects were instructed to perform: (A) shoulder flexion from 0° to 180° during inhalation and return to 0° during exhalation; and (B) shoulder horizontal abduction during inhalation and return to full adduction during exhalation. Subjects performed 10 sets (each lasting 1 min), with a 2-min rest between sets.[24]

Group B (experimental): Subjects received conventional physiotherapy and MT (chest mobilization and myofascial release techniques). Treatments were performed three times weekly for 8 weeks.

Chest mobilization was performed using Grade III joint oscillations, with three sets of 30 oscillations per second, repeated 3–5 times. The following techniques were used.

Rib mobilization from a sitting position: The subject sat with both arms crossed over the chest, as shown in Figure 3A. The first author stood behind the subject, placing one hand over the patient's anterior chest to rotate the thoracic region to the opposite side. Then the other hand's pisiform was used to apply force over the patient's rib angle in the anterior, superior, and lateral directions.[25]

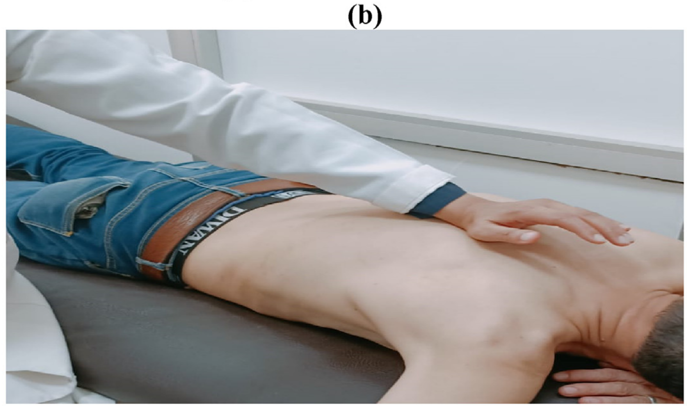
Rib mobilization from a supine position: The therapist stood next to the subject to apply a rib cage inspiration glide with the subject's reclined supine, as demonstrated in Figure 3A. The mobilizing hand guides the rib with the web space in a lateral and superior direction as the patient inhales and resists medial and inferior motion as the patient exhales.[25]

Central posterior-anterior (PA) mobilization of thoracic facet joints: The therapist's wrist was fully extended and pointed cranially while the subject reclined in a prone position. Pisiform was used to apply PA mobilization over the selected spinous process, as shown in Figure 3B.[26]

Unilateral PA mobilization of the costovertebral joints: With the subject reclined in a prone position, as shown in Figure 3C, the therapist stood beside the subject, with the thumb of the mobilizing hand used to transfer an oscillating force to the affected costovertebral joint.[26] Myofascial release techniques were applied for 3 min for each release.

Diaphragmatic myofascial release: Both hands were bilaterally placed on the bottom of the $7^{th}$to 10th ribs while the subject lay supine. During inhalation, traction was delivered, which increases the hand grip and maintains the effort imposed in the preceding phase through expiration, as depicted in Figure 4. We hired two sets of 10 extended respiration episodes, with a 1-min pause in between.[27]

(A) Rib mobilization from a sitting position (a) Rib mobilization from a supine position (b)



(B) PA mobilization of thoracic facet joints

(B) **Unilateral PA mobilization of costo-vertebral joints**

Figure 3: Chest mobilization techniques.

Scalene muscle and neck fascia myofascial release: The subject lay supine, as shown in Figure 5A. First, locking was applied to the distal attachment of the scalene at the groove of the first rib using the thumb. Then the therapist put the muscle in a shortened position while the subject inhaled deeply. Afterward, the thumb moved deeply into the first rib while the subject exhaled. At this point, during normal breathing, a stretch of the muscle was applied.[28]

Sternocleidomastoid myofascial release: The therapist sat at the head level of the subject, who lay supine. The release was applied using the pincer compression technique, as shown in Figure 5B.[29]

Pectoralis minor myofascial release: The subject lay supine, as shown in Figure 5C. The release was performed at the axillary fold, starting from the coracoids and moving

Figure 4: Diaphragmatic myofascial release.

(A) Scalene myofascial release **(B) Sternocleidomastoid myofascial release**

(C) Pectoralis minor (a) and pectoralis major and clavipectoral fascia (b) myofascial release

Figure 5: Myofascial release techniques.

diagonally toward the sternum. Simultaneously, the other hand performed abduction and external rotation.[12]

Pectoralis major and pectoral fascia myofascial release: The subject reclined supine with the arm abducted at a pain-free range, as demonstrated in Figure 5C. The release was applied to the pectoral region of the muscle, while the other hand simultaneously performed abduction and external rotation.[30]

Statistical analyses

The Shapiro–Wilk and Levene's tests were performed to verify the normality of the data and assess group homogeneity. The distribution of the data was normal, and the variance was homogeneous. When comparing groups based on all demographic characteristics, the unpaired *t*-test was used. The effects of treatment on FEV1, FVC, FEV1/FVC ratio, dyspnea, functional capacity, CVA, kyphosis angle, AP, and lateral chest expansion were investigated using mixed MANOVA. When the MANOVA showed significant results, additional univariate ANOVAs were conducted. Post-hoc testing using the Bonferroni correction was carried out for multiple comparisons. For all statistical tests, $p < 0.05$ was considered statistically significant. SPSS version 23 (IBM, Armonk, NY, USA) was used.

Results

Demographic characteristics

Table 1 shows the patient's characteristics in the control and experimental groups. There were no statistically significant differences in the patients's general characteristics between groups ($p \geq 0.05$). A mixed-design multivariate analysis was conducted to investigate the effect of treatment on the measured variables. A statistically significant difference was found between groups as Wilks' lambda = 0.32, F-value = 10.12, $p < 0.0001$, and partial eta squared ($\eta^{2)}$ = 0.68. In addition, there was a statistically significant effect on time (pre-post treatment) as Wilks' lambda = 0.09, F-value = 46.67, $p < 0.0001$, and $\eta^2 = 0.91$, as well as for the interaction between groups and time as Wilks' lambda = 0.14, F-value = 28.25, $p < 0.0001$, and $\eta^2 = 0.86$.

Between-group comparison: Baseline and after 8 weeks of intervention

At baseline, no statistically significant differences were found between both groups in all of the evaluated variables ($p \geq 0.05$), as shown in Tables 2 and 3. After 8 weeks of intervention, all examined variables revealed statistically significant differences between the two groups, with a

Table 1: General characteristics of the patients (N = 52)*.

	Study group $\overline{X} \pm$ SD	Control group $\overline{X} \pm$ SD	t- value	p-value
Age (years)	56.23 ± 3.54	55.46 ± 3.1	0.83	0.4[a]
Weight (kg)	66.5 ± 7.74	64.5 ± 5.22	1.09	0.28[a]
Height (cm)	166.8 ± 5.98	165.88 ± 4.07	0.65	052[a]
BMI (kg/m^2)	23.83 ± 1.57	23.42 ± 1.37	1.01	0.32[a]

*: Data are expressed as the mean ± standard deviation; N: number; P: probability; BMI: body mass index.
[a] Non-significant difference.

Table 2: Within and between-group analysis for FEV1, FVC, FEV1/FVC, dyspnea, and 6MWT.

Variables	Experimental Group	Control Group	MD (95% CI)	p-value (between groups)	n^2
FEV1 (L)					
Pre-treatment	0.67 ± 0.11	0.69 ± 0.18	0.02 (−0.16 to 0.13)	0.8[a]	
Post-treatment	1.31 ± 0.12	0.77 ± 0.05	0.55 (0.32−0.77)	0.0001[b]	0.32
p-value (within-group)	0.0001[b]	0.12[a]			
MD (95% CI)	−0.64 (−0.74 to −0.54)	−0.08 (−0.18 to 0.02)			
FVC (L)					
Pre-treatment	1.14 ± 0.34	1.13 ± 0.3	0.01 (−0.23 to 0.24)	0.98[a]	
Post-treatment	1.62 ± 0.22	1.22 ± 40.36	0.39 (0.09−0.7)	0.01[b]	0.12
p-value (within-group)	0.0001[b]	0.09[a]			
MD (95% CI)	−0.48 (−0.59 to −0.38)	−0.09 (−0.19 to 0.01)			
FEV1/FVC (%)					
Pre-treatment	58.62 ± 4.91	61.4 ± 5	−2.78 (−5.55 to 0.01)	0.06[a]	
Post-treatment	82.09 ± 7.31	63.13 ± 3.44	18.97 (15.78−22.15)	0.0001[b]	0.74
p-value (within-group)	0.0001[b]	0.25[a]			
MD (95% CI)	−23.47 (−26.46 to −20.48)	−1.73 (−4.72 to 1.27)			
Dyspnea					
Pre-treatment	7.81 ± 1.2	7.46 ± 1.17	0.35 (−032 to 1.01)	0.3[a]	
Post-treatment	4.23 ± 1.37	6.81 ± 1.2	−2.58 (−3.29 to −1.86)	0.0001[b]	0.51
p-value (within-group)	0.0001[b]	0.06[a]			
MD (95% CI)	3.58 (3.12 to −4.03)	0.65 (−0.2 to 1.11)			
6MWT (m)					
Pre-treatment	353.62 ± 69.19	359.5 ± 41.62	−5.88 (−37.69 to 25.92)	0.71[a]	
Post-treatment	460.81 ± 70.98	368 ± 47.39	92.81 (48.72−136.9)	0.0001[b]	0.26
p-value (within-group)	0.0001[b]	0.3[a]			
MD (95% CI)	−107.19 (−123.33 to −91.05)	−8.5 (−24.64 to 7.64)			

FEV1: Forced expiratory volume in 1 s; FVC: Forced vital capacity; 6MWT: 6-min walk test; *p*-value: probability.
CI: confidence interval; MD: mean difference.
[a] Non-significant difference.
[b] Significant difference.

Table 3: Within and between-group analysis for CVA, kyphosis angle, anterior posterior and lateral chest expansion.

Variables	Experimental Group	Control Group	MD (95% CI)	p-value (between groups)	n^2
CVA (degree)					
Pre-treatment	38.13 ± 3.91	37.46 ± 3.49	0.66 (−1.4 to 2.73)	0.52[a]	
Post-treatment	42.75 ± 4.49	37.54 ± 3.48	5.21 (2.98−7.45)	0.0001[b]	0.31
p-value (within-group)	0.0001[b]	0.87[a]			
MD (95% CI)	−4.62 (−5.54 to −3.71)	−0.08 (−0.99 to 0.84)			
Kyphosis angle (degree)					
Pre-treatment	45.04 ± 4.39	44.81 ± 3.19	0.23 (−1.91 to 2.37)	0.83[a]	
Post-treatment	41.46 ± 4.27	44.56 ± 3.21	−3.1 (−5.2 to −0.99)	0.005[b]	0.15
p-value (within-group)	0.0001[b]	0.31[a]			
MD (95% CI)	3.58 (3.09−4.06)	0.25 (−0.24 to 0.74)			
Anterior posterior chest expansion					
Pre-treatment	1.62 ± 0.43	1.6 ± 0.32	0.02 (−0.23 to 0.27)	0.88[a]	
Post-treatment	2.85 ± 0.35	1.77 ± 0.28	−1.08 (0.72−1.44)	0.0001[b]	0.42
p-value (within-group)	0.0001[b]	0.09[a]			
MD (95% CI)	−1.23 (−1.43 to −1.03)	−0.17 (−0.38 to 0.03)			
Lateral chest expansion					
Pre-treatment	1.73 ± 0.25	1.77 ± 0.28	−0.04 (−0.31 to 0.24)	0.78[a]	
Post-treatment	3.56 ± 0.53	2.02 ± 0.36	1.54 (1.07−2.01)	0.0001[b]	0.46
p-value (within-group)	0.0001[b]	0.1[a]			
MD (95% CI)	−1.83 (−2.12 to −1.53)	−0.25 (−0.54 to 0.04)			

P-value: probability.
CI: confidence interval. MD: mean difference; CVA: Craniovertebral angle.
[a] Non-significant difference.
[b] Significant difference.

preference for the experimental group ($p < 0.05$), as shown in Tables 2 and 3

Within-group comparisons

The experimental group exhibited statistically significant differences in all outcome measures when comparing the pre- and post-intervention results ($p < 0.0001$), as shown in Tables 2 and 3

Discussion

This study examined integrating MT with conventional physical therapy for COPD management. The combined intervention improved multiple outcomes in patients with mild to moderate COPD. The experimental group showed significant enhancements in pulmonary function. FEV1 increased by 0.55 L and FVC by 0.39 L. Chest expansion, postural alignment, functional capacity, and dyspnea levels also improved substantially. These findings suggest that MT in COPD rehabilitation offers benefits beyond conventional physical therapy alone. It may address both respiratory symptoms and musculoskeletal impairments. MT in COPD management addresses multiple interconnected systems simultaneously. By targeting fascial restrictions, respiratory muscle function, and thoracic mobility, it influences both biomechanical and neurophysiological aspects of respiration.[31] This multifaceted approach creates a synergistic effect, enhancing overall respiratory mechanics and functional capacity. The integration of soft tissue techniques with joint mobilization addresses not only primary respiratory impairments but also secondary postural and musculoskeletal adaptations characteristic of COPD.[32]

The most striking finding was the substantial improvement in FEV1/FVC ratio (MD = 18.97%) in the experimental group. This improvement indicates a significant reduction in airflow limitation, a hallmark of COPD progression.[33] Such a marked enhancement in lung function suggests that MT, when combined with conventional treatment, may offer a more effective approach to managing COPD than conventional therapy alone. FEV1 and FVC significantly increased (MD = 0.55 L and 0.39 L, respectively). These improvements result from MT effects on respiratory mechanics and thoracic mobility. Myofascial release enhanced thoracic cage mobility.[34] Chest expansion increased (AP MD = 1.08 cm, lateral MD = 1.54 cm). These changes improve respiratory efficiency in patients with COPD. Postural parameters also improved (CVA: MD = 5.21°, kyphosis angle: MD = 3.1°). This indicates reduced forward head posture and thoracic kyphosis. Improved posture optimizes respiratory muscle positioning, particularly the diaphragm. It facilitates efficient breathing and reduces work of breathing.[34]

The 6MWT distance increased substantially (MD = 92.81 m). This exceeds the minimal clinically important difference. Dyspnea was signifiacantly reduced (MD = −2.58 on the mMRC scale). These functional benefits stem from improved respiratory mechanics and postural control. The intervention addresses both primary respiratory impairments and secondary adaptations in COPD. It offers a comprehensive approach to COPD management. These outcomes suggest potential improvements in patients' QoL and daily activities. Our findings in improved pulmonary function align with the study by Engel and Vemulpad,[35] which reported similar enhancements following MT interventions in patients COPD. However, our study demonstrated more substantial improvements in FEV1 (18.3% vs. 15.8%) and FVC (13.0% vs. 12.7%) compared to the findings by Yilmaz et al.,[36] possibly due to our more comprehensive MT approach.

The significant reduction in dyspnea and improvement in functional capacity observed in our study surpass those reported by Ahmad et al.,[12] who examined the acute effects of MT in COPD. This difference may be attributed to our longer intervention period, suggesting the cumulative benefits of sustained MT application. Our study's comprehensive approach, addressing both respiratory and postural impairments, yielded broader benefits than studies focusing on single techniques, such as the work by Rocha et al.[37] on diaphragmatic release. This multifaceted protocol improved not only lung function but also postural parameters and functional capacity, highlighting the potential synergistic effects of combined MT techniques in COPD management.

Strengths of the study

This study design strengthens the impact on COPD research. Double-blinding and adequate sample size ensure reliability. The 8-week intervention reveals immediate and sustained effects. Our unique manual technique combination targets multiple COPD pathomechanics. Integrating postural and pulmonary assessments provide comprehensive patient outcomes. Validated, clinically relevant measures enhance applicability. The detailed protocol improves replicability in clinical and research settings.

Limitations

The study limitations include a narrow demographic focus, short follow-up period, and exclusion of severe COPD cases. The single-center design and lack of a placebo MT group may affect result generalizability. Uncontrolled confounding factors could have influenced outcomes. Future research should address these limitations to validate and extend our findings.

Clinical implications

Our findings suggest MT should be integrated into COPD rehabilitation programs. Clinicians should consider early incorporation of these techniques to potentially reduce dyspnea and improve functional capacity, possibly decreasing reliance on pharmacological interventions. A multimodal approach is recommended, combining myofascial release, thoracic and rib cage mobilization, and postural correction exercises. Our protocol of 2–3 sessions weekly for 8 weeks proved effective and feasible. Regular assessments using pulmonary function tests, dyspnea scales, and functional capacity evaluations are crucial for guiding treatment. Patient education on self-mobilization techniques and postural awareness exercises can complement in-clinic treatments.

Recommendations

Future research should examine this MT protocol's long-term effects and efficacy in severe COPD. Studies with diverse populations are needed. Optimal treatment frequency, duration, and combinations with other interventions should be explored. Investigating the physiological mechanisms behind these techniques would deepen understanding. These efforts could significantly advance COPD management strategies.

Conclusion

Combining selective MT with conventional physical therapy improved pulmonary function, chest expansion, posture, functional capacity, and dyspnea in mild to moderate COPD patients. These results suggest MT's value in COPD rehabilitation, potentially enhancing life quality and function. Further research in diverse COPD populations is needed to validate these findings.

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Conflict of interest

The authors have no conflicts of interest to declare.

Ethical approval

The study was approved by Cairo University's institutional Physical Therapy Faculty ethics committee (No: P.T.REC/012/004169) and was registered at ClinicalTrials.gov (NCT05781867).

Authors contributions

ASM developed the idea, conducted the research, and gathered and organized the data. MOG was responsible for conducting clinical evaluations and statistical analyses. SAS examined the literature and aided in writing the original draft. RIK critically reviewed and confirmed the last draft. All authors critically reviewed and accepted the final document and are responsible for the content and similarity index of the manuscript.

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