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Review

Effect of joint manipulation and muscle energy technique in patients with Chronic Obstructive Pulmonary Disease: A review

Joint manipulation and muscle energy technique in COPD patients

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Abstract

Aim: Chronic Obstructive Pulmonary Disease (COPD) influences the function of the diaphragm muscle, thus affecting the maximum inspiratory pressure. It is a constantly progressive disease characterized by chronic obstruction of pulmonary flow, which is irreversible in nature. We reviewed the literature for evidence of improvement in pulmonary function through Muscle Energy Technique and Joint Manipulation by decreasing the work of accessory muscles of breathing, improvement in chest expansion, improving thoracic spine mobility, and increasing diaphragm muscle strength.

Material and Methods: Articles used in the review were only in English, and non-English language articles were excluded. The database used to extract the literature was restricted to PubMed, Science Direct, Cochrane. Participants with COPD of both genders between 40 to70 years of age were included. Only articles with randomized controlled trials and non-randomized controlled trials and studies, which used manual therapy involving muscle energy techniques and manipulation were included. Studies that did not use main treatment such as physical hand contact were excluded. Outcome measurements included spirometry, Health-Related Quality of Life, Modified Borg Exertion Scale, pulse oximeter and Maximum Inspiratory Pressure, exercise capacity was measured with 6-minute walk test.

Result: The current evidence regarding the effect of joint manipulation, Muscle Energy Technique, and manual therapy on the musculoskeletal system in patients with COPD is inconclusive. The analysis included six randomized controlled trials and non-randomized controlled trials having dissimilar study design, study population, as well as outcome measures. All studies showed a higher risk of bias.

Discussion: The current study provides less evidence about muscle energy technique and joint manipulations effect on COPD patients but found a significant effect of both techniques in combination with manual therapy on pulmonary functions.

Keywords

Manual Therapy, Joint Mobilization, Thoracic Manipulation, Chronic Disability, Chest Physiotherapy

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Introduction

Chronic Obstructive Pulmonary Disease (COPD) is one of the major health issues predicted to be the third leading cause of death and the fifth leading cause of chronic disability [1]. COPD is a progressive condition characterized by chronic obstruction in the flow of the lung, which is irreversible in nature [2] and characterized by loss of pulmonary function with symptoms such as the production of sputum, breathlessness and cough [3]. In return, impaired respiratory rate leads to increased morbidity and mortality by decreasing physical function [4]. COPD accentuates changes in the airway and lung parenchyma, which leads to bronchial hypersecretion and bronchoalveolar instability, resulting in reduced expiratory flow rate and air trapping, which is called "dynamic hyperinflation". This further leads to increases in Expiratory Reserve Volume (ERV), Residual Volume (RV) and End- Expiratory Lung Volume (EELV) [5].

Phrenic nerve motor innervation, supplying to diaphragm, originates at C3-C5 nerve root and works along with secondary muscles to allow normal respiration [6]. COPD not only affects the lungs but also involves the peripheral muscle system and its function [7]. Therefore, respiratory muscles play important role in the pathogenesis of breathlessness [2]. Pulmonary hyperinflation causes respiratory muscle alteration, which decreases the contraction of the diaphragm, in other words, diaphragm capacity is reduced to generate trans-diaphragmatic pressure. Thus, the workload is transferred to the accessory muscle, which increases airway resistance and limitation of airflow [8].

Over the time, recruitment of accessory respiratory muscle in COPD leads to compensatory shortening and over activation of the scalene, sternocleidomastoid, and trapezius muscles. Manual therapy is becoming increasingly preferred as a treatment for COPD. The aim of manual therapy is to improve function, decrease pain and facilitate movement [9]. Soft tissue mobilization and massage therapy are therapeutic options for the treatment of a pathological condition, which simultaneously affects the musculoskeletal system and other systems of the body [10]. Manual therapy includes soft tissue therapy, joint manipulation, and mobilization have the potential to address variations in breathing mechanics related to decreased function of the lung. It is also used to increase the mobility of the thoracic region, by reducing the work of breathing, as well as manage pain related to musculoskeletal system.[11].

The Muscle Energy Technique (MET) is a form of manual therapy used to improve conditions related to COPD [2]. MET is a technique used to lengthen muscles and fasciae, which resist flexibility. In MET, the patient is required to generate force by triggering the musculotendinous unit against the counterforce applied by the therapist/clinician. MET application consists of contractions 3-5 times for 5 seconds, followed by 3 stretching for 0-60 seconds [12]. Whereas spinal manipulative therapy is a high-speed, low-amplitude force used to mobilize a joint. This technique can increase joint range of motion and decrease the intensity of pain. [11] This high-graded joint manipulation and mobilization is applied to the region of spinal stiffness or paravertebral tissue, which improves the chest wall compliance [13].

Need for Research: It is therefore hypothesized that in COPD, there is tightness of accessory muscles, which may influence the function of the diaphragm muscle, affecting maximum inspiratory pressure and restricted chest mobility. There is a dearth of literature on conclusions following a systematic review studying the combined effect of Joint Manipulation and MET. Thus, the rationale of this short review is to find the effect of Joint Manipulation of the thorax and MET of the accessory muscle of the neck on lung function in patients with COPD.

Therefore, the aim of the current review is to synthesize and evaluate studies, which have investigated the effect of joint manipulation and MET on Pulmonary Function Test (Spirometer) and 6-minute walk test in COPD patients.

Material and Methods

The review collected data from randomized controlled trials (RCTs) and non-randomized controlled trials (non-RCTs) and followed the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) guidelines (Figure 1).

Articles on manual therapy complemented soft tissue manipulation, stretching, muscle energy technique and thoracic joint manipulation to improve pulmonary function and joint range of motion were used. MET is a manual technique that involves the voluntary contraction of a muscle and increases or decreases the length between origin and insertion. Articles used in the review were in English only and those other than English were excluded. The database used to extract literature were restricted to PubMed, Science Direct and Cochrane. Medical Subject Heading (MeSH) terms or title/abstract keywords and synonyms were used and modified for every database. The articles that were used for review were published from January 2011 to May 2019 (Table 1).

- Chronic Airflow Obstruction, Chronic Obstructive Pulmonary Disease, Chronic Airflow Obstructions, Chronic Obstructive Airway Disease, COAD, Chronic Obstructive Lung Disease, Airflow Obstruction, Chronic, Airflow Obstructions,
- Manipulation, Osteopathic, musculoskeletal manipulation, Diagnostic Techniques and Procedures, Manual therapy, stretching, osteopathic manipulation techniques, joint mobilization, chiropractic, chiropractic manipulation, and MET (post-isometric relaxation and variants)

Eligibility Criteria

Participants: Only participants with COPD were included. Articles with subjects aged 40 to 70 years were included, considering the specifics of both genders.

Interventions: Articles only with RCTs were included and studies with Manual Therapy containing MET and Manipulation were included. Studies were excluded in which main treatment like physical manual contact of hand was not applied (e.g., with mechanical tools or devices) or other than physiotherapy such as tai-chi, point application, yoga, acupressure, acupuncture, Chinese herbal medicine, reflexology, or other traditional Chinese medicine techniques were excluded. In addition, studies based on MET and Thoracic manipulation along with Manual Therapy intervention such as gentle massage, passive stretching were included and other than such treatment studies such as chest physiotherapy, which include chest vibration, percussion, secretion clearance techniques, including postural drainage or facilitatory chest physiotherapy were excluded.

Comparisons: RCTs include conventional therapy (stretching, myofascial release), sham therapy, exercise, and light manual technique

Outcome measures: RCTs included the following outcome measures: spirometry, exercise capacity on the 6-Minute Walk Test (6-MWT), HRQL, Modified Borg Exertion Scale (MBES), pulse oximeter and Maximum Inspiratory Pressure.

Results

Yilmaz Yelvar GD et al. (2016) investigated a study to find out the immediate effect of manual therapy on 30 severe COPD with a mean age of 62.4 ± 6.8 years. Outcome measurements included a spirometer, pulse oximeter, Maximal Expiratory Pressure (MEP), Maximal Inspiratory Pressure (MIP), Dynamic volumes (FEV1, FVC, and VC), modified Borg rating of perceived exertion scale and Visual Analog Scale (VAS) for breathing difficulty taken before and after the 45 minutes of manual therapy included: decompression of the suboccipital, cervical vertebral gliding in the anterior-posterior direction, myofascial release of the trapezius muscles, sternocleidomastoid, intercostal muscle, paravertebral muscle and sternoclavicular, thoracic vertebral joint gliding in the direction from anterior-posterior, diaphragmatic release, rib raising technique, scapula-thoracic joint mobilization. Myofascial release techniques were applied only once, 3–5 minutes for each muscle. The gliding techniques were applied 5 times to each joint for 30 seconds. The study concluded that a single session of manual therapy immediately improved the condition of COPD. There was an improvement in inspiratory muscle strength, an improvement in oxygen saturation, and a significant decrease in fatigue, dyspnea, heart rate, and breathing rate (Table 2).

Engel et al. (2016) included 33 patients with COPD aged 55-70 years in their study to evaluate the effect of manual therapy on pulmonary rehabilitation. Participants were divided into 3 groups and the pulmonary function test was tested using the Forced Expiratory St. George's Respiratory Questionnaire (SGRQ), Volume in the first second (FEV1), Forced Vital Capacity (FVC), 6-Minute Walk Test (6-MWT), and Hospital Anxiety and Depression (HAD) scale. Group 1 received Pulmonary Rehabilitation (PR) only, Group 2 received Soft Tissue Therapy (ST) and PR and Group 3 received PR, ST, and Spinal Manipulative Therapy (SM). Pulmonary rehabilitation contained 24 weeks of intervention. Week 0-8 for 'initial assessment', end of 8th week for 'introductory stage', week 16 for 'maintenance stage' and week 24 was non 'interventional phase' The results of the study indicated that there was a significant increase between 3 groups at 24 weeks for FVC and for 6 MWT for ST+PR, ST+SMT+PR at 16 and 24 weeks there was a significant difference compared to PR group.

In a study by Maskey-Warzechowska et al. (2019), the authors investigated 19 COPD patients with a median age of 68 years, who were randomly allocated into two groups. Group 1 who received osteopathic manual therapy (OMT) (Suboccipital decompression, Deep cervical fascia release, Thoracic lymphatic pump, Diaphragm stretching, or sham therapy include mobilization), and other group received sham therapy, and after 2 weeks of intervention, participant were crossed over before and after both procedures, pulmonary function and dyspnea were compared during the second session. They concluded that there was no significant effect shown in a single session of OMT and sham therapy, neither on pulmonary function nor on dyspnea before and after OMT or sham procedures.

In a study by Sule et al. (2017), 30 patients with Gold Criteria having severe COPD in the age group of 40-60 years were included, who were divided into 2 groups. One group received 3 repetitions of static stretching for 30-60 seconds, twice a day for 1 week, and the other group received pulsed MET Pulsed MET 20-30 times twice a week for 1 week, and this demonstrated that Pulsed MET showed better results than Static Stretching, as there was a greater improvement in FEV1, a reduction in Respiratory rate, and an increase in oxygen saturation. Muscle strength was also seen with MET, with an increase in muscle strength, FEV1 is increased from 43.27 to 49.4 as compared

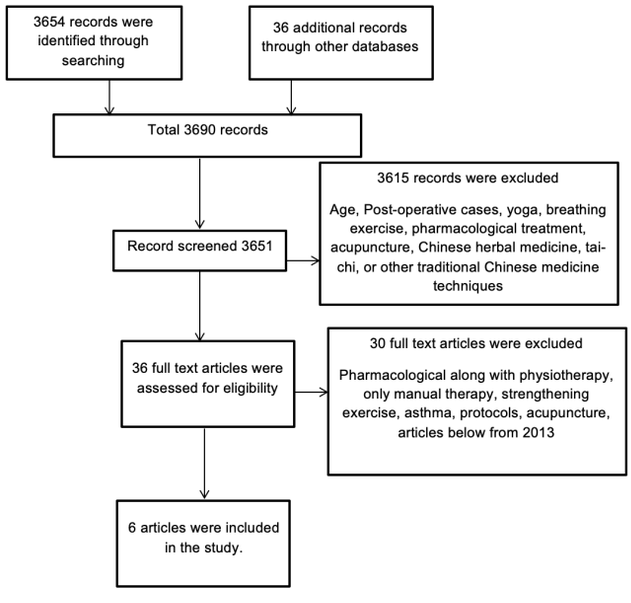

Figure 1. Flow chart for identification of studies for review

Table 1. Search Strategy

((obstructive pulmonary disease) AND manual therapy) AND pulmonary function test Filters: Clinical Trial; Humans
(("obstructive pulmonary disease") AND manual therapy) AND 6-minute walk test Filters: Clinical Trial; Humans
(((chronic obstructive pulmonary disease AND "last 5 years"[PDat])) AND (muscle energy technique AND "last 5 years"[PDat])) AND (breathing Schema: all Filters: Clinical Trial; Humans
(((chronic obstructive pulmonary disease AND "last 5 years"[PDat])) AND (muscle energy technique AND "last 5 years"[PDat])) AND (breathing Filters: Clinical Trial; Humans
((pulmonary disease chronic obstructive) AND spinal manipulation) AND lung function Filters: Clinical Trial; Humans
((pulmonary disease chronic obstructive) AND spinal manipulation) AND lung function Filters: Humans
"Manual therapy" AND" chronic obstructive pulmonary disease" Filters: Humans
"Manual therapy" AND" chronic obstructive pulmonary disease"
"Manual therapy"
Muscle [Title] AND energy [Title] AND technique [Title] AND chronic [Title] AND obstructive [Title] AND pulmonary [Title] AND disease [Title]
"Muscle energy technique " AND "chronic obstructive pulmonary disease"
muscle energy technique
chronic obstructive pulmonary disease

Table 2. Outcome measures of Muscle Energy Technique in Patients with Chronic Obstructive Pulmonary Disease

Authors	Outcome measures	Intervention	Duration	Conclusion
Yilmaz et al. (2016) 30 severe COPD with a mean age of 62.4±6.8 years	Spirometer, volumes modified Borg scale Visual Analog Scale (VAS) for breathing difficulty	Thoracic vertebral Joint gliding. Rib raising, scapula-thoracic joint mobilization.	45 minutes pre- and post-measurement	Significant decrease in fatigue, dyspnea, HR, and BR
Cruz-Montecinos et al. (2017) 12 stable patients with gold stages 3 and 4 with a mean age of 62.4 years	Pulmonary function test: Residual Volume (RV), Inspiratory capacity (IC), Expiratory Reserve Volume (ERV), and Vital Capacity (VC).	Manual therapy for 30 minutes, including suboccipital muscle release, myofascial release of anterior thoracic and anterior cervical, release of sternum, balance costal ligament.	Single treatment session of soft tissue manual therapy (STMT)	RV (P = 0.002), IC (P = 0.039) and SpO2 increased from 93% to 96% (P = 0.001). Improvement in severe and more severe COPD patients.
Sule et al. (2017) 30 severe COPD with Gold Criteria (age group 40-60 years)	Spirometer: Forced Expiratory Volume in One Second (FEV1)	Group A received static stretching with conventional exercise and Group B received Pulsed MET for back of the neck muscle	Group A: Static stretching 30-60 seconds of 3 repetitions, twice a day for 1 week Group B: Pulsed MET for 20-30 times twice a week for 1 week.	Pre FEV1 of group A = 44.47 and post FEV1 = 44.53. Group B pre FEV1 = 43.27 and post FEV1 = 49.4 i.e. Group B is highly significant than group A
Engel et al. (2016) 33 with COPD aged 55-70 years	Forced Expiratory St. George's Respiratory Questionnaire (SGRQ), Volume in the first second (FEV1), Forced Vital Capacity (FVC), 6-Minute Walking Test (6-MWT), and the Hospital Anxiety and Depression (HAD) scale	Group 1: Received Pulmonary Rehabilitation (PR) Group 2: received Soft Tissue Therapy (ST) and PR Group 3: received PR, ST, and Spinal Manipulative Therapy (SMT)	Session lasts 24 weeks. During the eight-week period of PR and the eight-week period of non-intervention, two sessions per week of ST therapy and SMT were provided.	At 24 weeks, there was a statistically significant increase between the three groups for FVC and for 6 MWT for ST+PR, ST+SMT+PR, and ST+PR at 16 and 24 weeks, respectively, when compared to the PR group.
Maskey-Warzechowska et al. (2019) 19 participants with severe COPD; median age of 68 years	Spirometry (pulmonary function test) and VAS (for dyspnea)	Participants were randomized to osteopathic manipulative therapy (Suboccipital decompression, Deep cervical fascia release, Thoracic lymphatic pump, Diaphragm stretching) or sham therapy (mobilization) at baseline and crossed over after 2 weeks of intervention.	Session duration is four weeks, and each session lasts 25 minutes.	There is no discernible difference between a single session prior to and following treatment.
Anand et al. (2013) 30 Moderate and Severe staged COPD with age between40-60 years	6-MWT CCQ Borg scale	The first group received conventional chest physiotherapy (CPT), whereas the second group received conventional chest physiotherapy combined with muscle energy technique (CPT + MET).	3 sessions for 3 days	MET had a highly significant effect on improving pulmonary function in patients with COPD.
Cruz-Montecinos et al. (2017) 12 stable patients with gold stage 3 and 4, with mean age group 62.4 years	Total lung Capacity (TLC), Expiratory Reserve Volume (ERV), Pulse Oximetery, Vital Capacity (VC), Residual Volume (RV), Inspiratory Capacity (IC), Airway resistance, Respiratory rate and Heart rate	Suboccipital muscle release, anterior thoracic and anterior cervical myofascial release, sternum release, Costal ligament balance, and Muscle Energy Techniques for 1 minute 40 seconds on each muscle.	The duration of a single treatment session is 30 minutes.	On patients with severe and more severe COPD, a single treatment session of soft tissue manual therapy (STMT) had an immediate effect on lung function. RV increased from 93 to 96 percent (P=0.002), IC increased from 0.039 to 0.039, and SpO2 increased from 93 to 96 percent (P=0.001). As a result, a single STMT session results in significant improvement.

to static stretching. They concluded that Pulsed MET is more effective in improving FEV1 compared to static stretching in COPD patients, but statically it was less significant.

In a study by Anand et al. (2013), 30 moderates to severe staged COPD patients aged between 40–60 years were included and allocated into two groups. Group 1 received Conventional Chest Physiotherapy (CPT) and Group 2 received CPT with MET. Both groups received 3 sessions for 3 days. This study has shown that significant improvement was seen after three days of a treatment session in both groups, but with greater improvements in CPT with the MET group in the form of increased chest expansion, reduced dyspnea, increased exercise tolerance, regulation of autonomic dysfunction and improved quality of life.

Cruz-Montecinos et al. (2017) performed a study to evaluate the effect of immediate soft tissue therapy on severe COPD patients. The study included 12 stable patients with gold stages 3 and 4 with a mean age of 62.4 years. The pulmonary function test included Total lung Capacity (TLC), Expiratory Reserve Volume (ERV), Pulse Oximetry, Vital Capacity (VC), Residual Volume (RV), Inspiratory Capacity (IC), Airway resistance, Respiratory rate and Heart rate. Participants received an immediate 30-minute session manual therapy, including suboccipital muscle release, myofascial release of the anterior thoracic and anterior cervical, the release of sternum, balance costal ligament, muscle energy techniques for 1 minute 40 seconds for each muscle (1 minute 40 seconds each). Single treatment sessions of soft tissue manual therapy (STMT) had an immediate effect on lung function in patients with severe and more severe COPD. RV (P=0.002), IC (P=0.039) and SpO2 increased from 93% to 96% (P=0.001). Therefore, a single session of STMT has a significant improvement.

Discussion

This systematic review investigated the latest evidence on the effect of joint manipulation and Muscle Energy Technique along with manual therapy on the musculoskeletal system in patients with COPD. The analysis included six RCTs having dissimilar study designs, study population and outcome measures. All studies showed a high risk of bias. The current study findings are not similar to the results of other literature sources. Two current studies have shown that in patients with severe COPD after a single session of intervention, including manual therapy, there may be a positive effect on pulmonary hyperinflation [14, 15]. Cruz-Montecinos et al. (2017) proved that manual therapy resulted in a significant decrease in RV, TLC, and ERV along with an increase in oxyhemoglobin saturation, inspiratory capacity in the single treatment session [5]. Yilmaz et al. (2016) found a

significant progression in FEV1, FVC, the strength of respiratory muscle, oxyhemoglobin saturation, and a decrease in dyspnea perception, following a single session of mobilization of thoracic spine and soft tissue therapy [14].

According to Sule et al., pulsed MET showed better results than static stretching as more improvement is seen in FEV1, reduction in respiratory rate, and increased oxygen saturation. MET is an active technique, whereas stretching is passive. An increase in muscle strength was seen with MET, with an increase in muscle strength, FEV1 increased from 43.3 to 49.4, whereas the group who received MET along with conventional exercise showed a better improvement in FEV1 [14,16].

Anand et al. [17] revealed the potential effect of the application of MET on lung function and also efficiency in improving the conventional chest physiotherapy in patients having COPD. After application of MET to dysfunctional accessory inspiratory muscles, it had significant potential to improve pulmonary function and also better quality of life in COPD patients. This study showed significant improvement in both groups following three days of treatment session. Greater improvements were seen in CPT with MET group by reducing dyspnea, improved chest expansion, tolerance to exercise regulation of autoimmune dysfunction, and improved quality of life [17].

Several limitations of the current review are acknowledged. Alteration in treatment protocol, treatment session duration, as well as in outcome measures between studies likely influenced the results. The populations also were small in size and had a chance of bias. There was no study, which indicated only single MET, and Joint Manipulation had an effect on pulmonary lung functions.

Conclusions

The present study provides less evidence about muscle energy technique and joint manipulations effect on COPD patients but has a significant effect of both techniques in combination with manual therapy on pulmonary functions, health-related quality of life, 6-minute walk test, chest wall mobility, dyspnea and oxyhemoglobin saturation. Furthermore, studies with scientific validity and more evidence are yet to be conducted to assess both muscle energy and the effect of joint manipulations on pulmonary functions in COPD patients.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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