Effect of Manual Therapy, Motor Control Exercise, and Inspiratory Muscle Training on Maximum Inspiratory Pressure and Postural Measures in Moderate Smokers: A Randomized Controlled Trial

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Abstract

Objective: The aim of this study is to assess whether adding manual therapy to motor control exercises protocol with inspiratory muscle training (IMT) (combined intervention) resulted in a greater effect than IMT alone in enhancing maximum inspiratory pressure (MIP) in the short term.

Methods: This was a single-blind, randomized, controlled trial. Fifty-one healthy moderate smokers were randomized into 2 groups: (1) IMT and (2) combined intervention. All participants received 8 individual sessions, 2 per week during a 4-week period. The primary outcome (MIP) and the secondary outcome (pulmonary function, forward head posture, and thoracic kyphosis) were recorded at baseline and after the treatments.

Results: There were differences between groups in change score for MIP (mean, 23.8; 95% confidence interval [CI]: 16.48-31.12), forward head posture (−1.57; 95% CI: –2.79 to –0.35), and thoracic kyphosis (–0.92; 95% CI: –1.74 to –0.1). The combined intervention revealed statistically significant differences for MIP (mean, –34; 95% CI: –39.12 to –28.88) and for postural measures (forward head posture 2.31; 95% CI: 1.45-3.16; thoracic kyphosis, 1.39; 95% CI: 0.8-1.97), whereas the IMT was only observed for MIP (mean, –10.2; 95% CI: –15.42 to –4.98). In addition, the intraclass correlation coefficient and minimal detectable change for MIP were 0.96; 95% CI: 0.93-0.97, and 17.70, respectively.

Conclusion: Inspiratory muscle training protocol combined with manual therapy and motor control exercise had greater effect in enhancing MIP than did IMT in isolation in moderate smokers in the short term. In addition, both groups experienced changes in MIP but not in lung function. (J Manipulative Physiol Ther 2018;xx:1-11)

Key Indexing Terms: *Exercise; Physical Therapy Modalities; Posture; Reproducibility of Results; Breathing Exercises*

Introduction

More than 20% of deaths worldwide are caused by respiratory diseases.[1] These include chronic obstructive pulmonary disease (COPD), which is expected to become the third leading cause of death in 2020.[1] Its prevalence is increasing because of exposure to risk factors such as tobacco. Chronic obstructive pulmonary disease occurs in 3% to 11% of smokers.[2]

The obstructive respiratory diseases are characterized by airflow limitation that involves changes in thorax geometry, inducing structural disturbances in the musculature.[3-5] These changes may unleash an alteration of muscle function and a decrease in strength and endurance.[3] In addition, some authors suggest an association between respiratory dysfunctions and postural disorders; an increase in thoracic kyphosis

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Paper submitted October 31, 2016; accepted November 29, 2017.
0161-4754

https://doi.org/10.1016/j.jmpt.2017.11.004

is especially associated with an increase in accessory inspiratory muscle activity.[4,5] The biomechanical model shows a rise in thoracic kyphosis and leads to greater head protraction.[6] This position is commonly referred to as "forward head posture."[6] Increasing forward head posture involves a reduction in the maximum voluntary ventilation and the maximum inspiratory pressure (MIP).[7] In addition, forward head posture leads to an inhibition of deep neck muscles and flexor and extensor groups. This can produce changes in the chest mechanics.[8,9] Consequently, maintaining correct thorax mobility is crucial for respiratory function because this allows complete excursion of the respiratory process.

Recent studies have reported improvements in inspiratory muscle strength in terms of MIP and peak inspiratory flow both in people with COPD[10-12] and in healthy people[13,14] after inspiratory muscle training (IMT) using threshold valves. These devices allow increasing inspiratory resistance progressively and represent a safe modality to improve inspiratory muscle.[15]

Furthermore, studies suggest that the application of manual therapy techniques that focus on the thoracic region (eg, mobilizations and manipulations) and exercise produce benefits in the range of motion, postural modifications,[16-19] and the volumes and capacities of the lungs in people with and without respiratory disease.[20-24] However, the literature regarding the benefits of manual therapy in lung volumes and capacities in COPD is lacking because it is difficult to determine the effectiveness of this therapy in this population.[25] Hence, this study could contribute to knowledge of manual therapy in respiratory disease.

The aim of this study was to assess whether manual therapy plus motor control exercises protocol combined with IMT results in a greater effect than IMT alone in enhancing MIP in the short term. The secondary objective was to determinate whether this combined intervention produces postural changes (eg, forward head posture and thoracic kyphosis) and modifications in lung function. It was hypothesized that an intervention that combines manual therapy techniques, exercises to stabilize muscles of the neck and shoulder girdle, and IMT would be more effective than IMT in isolation in improving MIP.

Methods

Study Design

This is a randomized, controlled, single-blinded, longitudinal trial. The study took place in the Center for Advanced Studies University La Salle (Madrid, Spain) according to the Consolidated Standards of Reporting Trials 2010 statement.[26] All of the procedures followed the Helsinki Declaration and were approved by the Ethics Committee of La Salle University Center for Advanced Studies, Madrid (PI-044). In addition, the trial was registered with the United States Clinical Trials Registry (registration number: NCT02514161).

Randomization

The sample was classified in 2 groups: (1) IMT group and (2) combined intervention group (combination of IMT with manual therapy and motor control exercise techniques). An external person assigned each participant to 1 of the 2 treatment groups according to a simple random allocation method, assisted by GraphPad Software (La Jolla, California). To ensure blinding, the assessor was unaware of the assigned group; all participants were instructed not to speak about the intervention with the evaluators.

Participants

The participants were recruited on the university campus by email and social networks from June to November 2015. All participants were 18 to 60 years old and had a pack per year index of $\geq$5 (moderate smoking index). In addition, all participants read and signed the informed consent form. This study excluded those who presented a cardiorespiratory pathology, systematic or metabolic disease (eg, rheumatoid arthritis or cancer), history of thoracic surgery, vertebral fracture, or osteoarticular disorders of the spine and thoracic area (eg, pectus excavatum, scoliosis) and those who had any contraindication to the treatment techniques (eg, osteoporosis).

Intervention

All participants completed 8 sessions during 4 weeks, twice per week. Every session was individual; a time interval of at least 72 hours was used between sessions. Participants who did not complete 7 sessions were withdrawn from the study.

Inspiratory Muscle Training Group. The participants performed IMT for 30 minutes, 2 days per week, for 4 weeks using POWERbreathe Medic Classic (Gaiam Ltd, Southam, Warwickshire, United Kingdom) (Fig 1). The training was done individually in a lateral position under the supervision of the same physiotherapist. This was distributed in 5 blocks of 5 repetitions with 30 seconds of rest. The training loads were increased: first week, 30% MIP; second week, 40% MIP; third week, 50% MIP; and the fourth week, 60% MIP. The training started with 30% loading because it is considered the minimum intensity for IMT in people with COPD.[11,27] In addition, this group carried out a domiciliary breathing exercises protocol for a minimum of 4 days per week, at least once a day. Appendix 1 describes the exercise intervention (available online only).

Combined Intervention. This group followed the same IMT protocol described previously in combination with manual therapy and motor control exercise. These exercises were introduced progressively during the first week in 50- to 60-minute sessions (30 minutes for IMT and 20-30 minutes for