[PILOT STUDY]

VARIATION IN LUNG VOLUME IN ASTHMATIC SUBJECTS AFTER APPLYING THE THRUST TECHNIQUE IN ROTATION TO THE THORACOLUMBAR JUNCTION

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Introduction: Asthma is one of the most common chronic diseases in the world; it affects 300 million people. The objective of treatment is to control the disease, reducing the number of exacerbations and improving the patient's quality of life. However, despite the known effectiveness of the medication, it does not control the disease in all patients and it can present risks and secondary effects.

Objectives: To determine whether the thrust technique in rotation applied bilaterally to the thoracolumbar junction in asthmatic subjects while seated produces variations in forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), FEV1/FVC ratio and MiniAQLQ quality of life.

Materials and Methods: We carried out a controlled, randomised clinical trial on 24 asthmatic subjects (n=24). We analysed any variation in the following spirometric variables: FVC, FEV1, FEV1/FVC ratio and MiniAQLQ quality of life. These variables were measured against the pre-intervention values at three points in time: 1 minute post-intervention, 30 minutes post-intervention and 1 week post-intervention.

Results: The results obtained show that the difference in FEV1/FVC ratio 1 minute post-intervention between the Experimental Group (EG) and the Control Group (CG) was statistically significant (p=0.023). However there were no statistically significant changes in any of the other variables from pre-intervention to 1 minute, 30 minutes or 1 week post-intervention. We did observe differences between the post-intervention results for both FVC and FEV1. They were higher in the EG than the CG and the difference increased as more time elapsed since the intervention.

Conclusions: There were statistically significant variations in FEV1/FVC ratio 1 minute post-intervention. There were no statistically significant variations in any of the other variables at any point in time post-intervention.

KEY WORDS

› Asthma.
› Spinal manipulation.
› Osteopathic medicine.
› Alternative medicine.

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INTRODUCTION

Asthma affects 300 million people in the world[1-3]. It is a chronic inflammatory disease of the airways, that increases bronchial hyperresponsiveness, wheezing, dyspnoea and coughing[4], associated with variable airflow obstruction[1,3,5]. Spirometry is considered to be the best test for lung function as it is simple, accessible and reproducible[6-8].

Research justification

The objective of administering medical treatment for asthma is to control the disease, reducing the number of exacerbations and improving the patient's quality of life[9-11]. Rescue medication (short-acting β2-adrenergic agonists) and control medication for the chronic inflammation (inhaled glucocorticoids, long-acting β2-adrenergic agonists etc.)[11,12] are used but they do not control the disease in all patients and they can present risks and secondary effects[12].

Korr has shown that spinal manipulation causes impulses to fire in the afferent fibres of the muscular bundle and the small diameter afferents, silencing the facilitated gamma motor neurons, which reduces pain and increases joint mobility[13-16]. This normalisation of the somatic dysfunction interrupts the spinal facilitation responsible for the local sympathicotonia, the associated neurovascular dysfunction and the loss of physiological movement in the facet joints and joint capsules[17].

Osteopathic techniques applied to the rib cage and the thoracic spine have been shown to increase vital capacity and mobility in the rib cage, improve the functioning of the diaphragm, maximise the efficiency of the respiratory cycle and to help to clear secretions[18,19]. Treatments used in some studies include techniques aimed at restoring muscle, bone and fascial physiological mobility in the rib cage, bearing in mind its relationship with the autonomic nervous system and the viscerosomatic and somatovisceral reflexes[18,20-23]. Another important factor is the treatment of the diaphragm, given its close relationship with the pleura and the lungs, via the endothoracic fascia[24,25].

Because the crura of the diaphragm originate in the inferior surface of T1224-26 and in the anterior and lateral surfaces of the intervertebral bodies and discs of the first 3 or 4 lumbar vertebrae (right crus) and the first 2 or 3 lumbar vertebrae (left crus)27-30, the thrust technique in rotation applied to the thoracolumbar junction while the patient is seated will improve joint mobility and reduce pain, leading to the functioning of the diaphragm and the ventilation mechanics being normalised, which produces changes in lung volume.

HYPOTHESIS AND OBJECTIVES

Hypothesis

Applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated produces statistically significant changes in the following spirometric parameters: Forced Vital Capacity (FVC), forced expiratory volume in the first second (FEV_1), FEV_1/FVC ratio and MiniAQLQ quality of life.

Objectives

The proposed objectives of this study are: to quantify the potential variations in FVC after applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated; to assess the potential variations in FEV1 after applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated; to outline the potential variations in FEV1/ FVC ratio after applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated and to determine the potential variations in MiniAQLQ quality of life after applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated.

MATERIALS AND METHODS

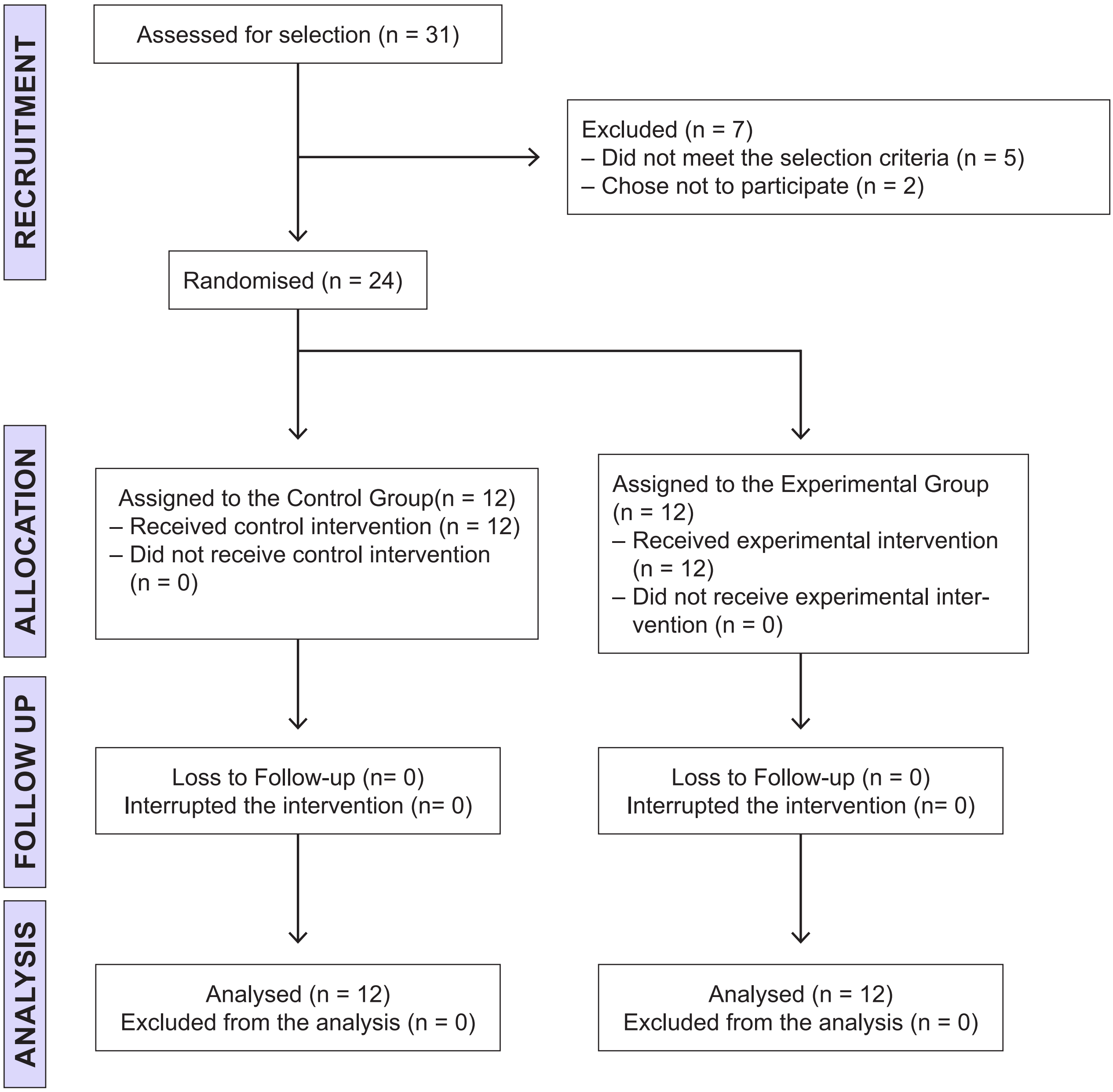
Design

We carried out a controlled, randomised, double-blinded clinical trial (both the patient and the assessor wore a blindfold) in the Clínica Salud & Pilates (Pilates and Health Centre), located on Calle Maldonado in Madrid and in the Consulta de Osteopatía Nuaferda (Nuaferda Osteopathy Centre), located on Calle Estrasburgo de Nuevo Baztán in Madrid. We requested authorisation to carry out this study from the Comité Ético de Experimentación de la Universidad de Sevilla (Research Ethics Committee of the University of Seville) and we received approval.

Study Population

There were 24 subjects (n = 24), referred from the assessor's osteopathy clinic, diagnosed by their doctor with asthma.

16 of the subjects were female (66.7%) and 8 were male (33.3%) and the subjects were distributed into two groups: an Experimental Group (EG) and a Control Group (CG). See Figure 1 for more information about the sample population.



GROUP	VARIABLES				
	SEX MALE FEMALE	AGE (YEARS)	HEIGHT (CM)	WEIGHT (KG)	BMI (KG/M²)
EG (N = 12)	M: 33,3 % (n = 4) F: 66,7 % (n = 8)	32,83 (SD = 8,19)	165,58 (SD = 10)	73,43 (SD = 18,88)	27,06 (SD = 6,04)
CG (N = 12)	M: 33,3 % (n = 4) F: 66,7 % (n = 8)	28,33 (SD = 7,3)	162,83 (SD = 7,29)	64,98 (SD = 11,87)	24,73 (SD = 4,2)

Figure 1. Flow diagram and descriptive statistics for the study sample.

Experimental Group

The EG was formed of 12 subjects (n = 12), 8 of whom were female (66.7%) and 4 of whom were male (33.3%), with an average age of 32.83 years (SD = 8.19) (SD will herein refer to *standard deviation, Stand. Dev.*), an average weight of 73.43kg (SD = 18.88), an average height of 165.58cm (SD = 10) and an average Body Mass Index (BMI) of 27.06 (SD = 6,03).

41.7% were non-smokers, 25% smoked less than 5 cigarettes per day, 8.3% smoked between 5 and 10 cigarettes per day and the remaining 25% smoked more than 10 cigarettes per day. 41.7% had a low level of physical activity, while 58.3% had a medium level of physical activity.

Control Group

The CG was formed of 12 subjects (n = 12), 8 of whom were female (66.7%) and 4 of whom were male (33.3%), with an average age of 28.33 years (SD = 7.30) an average weight of 64.98 kg (SD = 11.87), an average height of 162.83 cm (SD = 7.29) and an average BMI of 24.73 (SD = 4,19).

75% were non-smokers, while the remaining 25% smoked between 5 and 10 cigarettes per day. 50% had a low level of physical activity, 41.7% had a medium level of physical activity and 8.3% had a high level of physical activity.

Randomisation

The method of randomisation was to allocate the subjects with an even inclusion number to the EG and the subjects with an odd inclusion number to the CG.

Research Protocol

The subjects were informed about the type of study they were participating in and were given an informed consent form, which they were required to sign. The personal data required for the purposes of the study was treated with confidentiality, in accordance with the Spanish Data Protection Law 15/1999[31].

The participants were distributed into two study groups (EG or CG). Both groups underwent four spirometric tests: pre-intervention, 1 minute post-intervention, 30 minutes post-intervention and 1 week post-intervention, in order to determine how long any effects of the manipulation lasted on the patient's lung volume. The MiniAQLQ quality of life questionnaire (Annex 5) was used on two occasions: pre-intervention and 1 week post-intervention[32]. The International Physical Activity Questionnaire (IPAQ) (Annex 6) was used to calculate the patients' level of physical activity. The thrust technique in rotation was applied to the thoracolumbar junction in the EG (seated), while the CG received a placebo manoeuvre. Measurements were taken in an air conditioned room, with a stable temperature of between 18 and 25ºC.

The spirometric variables analysed for this study were: FVC- Forced Vital Capacity- which is the amount of air that can be forcibly exhaled from the lungs after a maximum inhalation, in litres; FEV_1- Forced Expiratory Volume- which is the volume of air exhaled in the first second of FVC, in litres and FEV_1/FVC, ratio, which is the total percentage of FVC exhaled in the first second.

Selection Criteria

The subjects who participated in the study all met the following inclusion criteria: diagnosed with asthma 1 year ago or more[33]; aged between 20 and 49 years, inclusive[34] and signed an informed consent form.

The exclusion criteria included: the presence of COPD[35-37], lung cancer[27], emphysema[37], pulmonary oedema[37], heart failure[37], pulmonary hypertension[37], smooth and striated muscle disorders[37], lung surgery and/ or procedures on the rib cage, the use of inhaled β2 agonists in the 24 hours preceding the study[14], changes in asthma medication in the last 6 weeks or during the study[35], admission to hospital for an acute asthma attack and/ or the use of oral corticosteroids in the last month or during the study[35], anxiety[38], depression[39], an infection of the airways in the last month[35], osteopathic treatment in the last month, osteopathic treatment for asthma in the last 5 years[40], and any potential contraindications to the manipulations used in this study: fractures and/ or dislocations, tumours, infections, inflammatory rheumatisms, congenital malformations or osteoporosis[41].

Experimental Group Intervention

The EG received a high-velocity, low-amplitude technique applied to the thoracolumbar spine, known in osteopathy as the "Thrust technique in rotation, applied to the thoracolumbar junction (seated) or the modified Fryette Technique for T12 dysfunction in ERS"[39,40] was applied to the EG. The objective of applying this technique is the increase lung volume, restoring mobility to T12, where the crura of the diaphragm originate.

Subject: Seated, with the hands in the same position as for the lift-off technique.

Assessor: One foot forwards, beside the patient.

Points of Contact: The chest makes contact with the external part of the patient's arm, above the elbow, blocking the trunk. The anterior hand is placed on the posterior surface of the shoulder, rotating the subject's trunk. The patient's elbow is raised, allowing the patient to rest their forehead on their arm. The posterior hand is placed on the T12 facet joint, using the pisiform contact and the ulnar border of the hand (figure 2).

Technique: Ask the patient to rotate their trunk as much as possible towards you then passively rotate the patient's trunk further, bringing the patient's upper arm into contact with the chest. Regulate flexion-extension of the patient's spine, down to T12 and look for the tension in the rotation. Apply the thrust by increasing the rotation of the patient's trunk, rotating your own trunk and applying a slight lateral thrust to the vertebra.

Apply the technique on both sides. In half of the subjects, apply the technique to the dominant side first and then the non-dominant side. In the other half of the subjects, apply the technique in the non-dominant side first and then the dominant side.

Control Group Intervention

The same as the EG but do not reduce the slack or apply the thrust.

Evaluation and Variables

The spirometry tests were carried out by a qualified nurse with more than 5 years of experience, using a *Spirobank USB*[41] (MIR, Rome, Italy) regularly calibrated, following the manufacturer's recommendations and the guidelines outlined by the *American Thoracic Society* (ATS), the *European Respiratory Society* (ERS) and the NIOSH Guide[6,42,43].

The spirometric variables analysed for this study were: FVC, FEV_1 and FEV_1/FVC.

Figure 2. Thrust technique in rotation applied to the thoracolumbar junction (seated). Own source.

Statistical Analysis

The software SPSS version 19.0 was used to carry out the statistical analysis. The student's T-test was used to compare the EG and CG pre-intervention results. The difference between the pre-intervention results and post-intervention results was calculated for both the EG and the CG. Once these variables had been calculated, we compared them using the Mann-Whitney U test. The analysis was carried out with a confidence interval of 95%. Results with a p-value < 0.05 were considered statistically significant, given that in biomedical research, a p-value < 0.05 is universally considered to be sufficient for statistical significance.

RESULTS

There were no significant differences between the EG and the CG in any of the variables measured at the beginning of the study ($p > 0.05$), except for tobacco consumption ($p = 0.04$), with a higher average in the EG.

The results obtained from the EG revealed an average difference in FVC of 0.02L (SD = 0.27) one minute post-intervention, 0.12L (SD = 0.47) 30 minutes post-intervention and 0.2L (SD = 0.68) 1 week post-intervention, compared with the pre-intervention results.

We observed an average difference in FEV_1 of -0.04L (SD = 0.23) 1 minute post-intervention, 0.06L (SD = 0.33) 30 minutes post-intervention and 0.15L (SD = 0.67) 1 week post-intervention. Finally, we found an average difference in FEV_1 / FVC ratio of -1.55% (SD = 2.7) 1 minute post-intervention, -0.08% (SD = 3.65) 30 minutes post-intervention and -0.55% (SD = 5.9) 1 week post-intervention.

In the CG, we found an average difference in FVC of 0.05L (SD = 0.12) one minute post-intervention, 0.09L (SD = 0.22) 30 minutes post-intervention and 0.03L (SD = 0.26) 1 week post-intervention, compared with the pre-intervention We observed an average difference in FEV_1 of -0.06L (SD = 0.11) 1 minute post-intervention, 0.01L (SD = 0.13) 30 minutes post-intervention and 0.01L (SD = 0.17) 1 week post-intervention. We found an average difference in FEV1 / FVC ratio of 0.77 % (SD = 2.4) 1 minute post-intervention, 1.1% (SD = 2.56) 30 minutes post-intervention and 0.3% (SD = 5.07) 1 week post-intervention.

In the EG, we did not observe any statistically significant differences in FVC 1 minute post-intervention (p = 0.225), 30 minutes post-intervention (p = 0.385) or 1 week post-intervention (p = 0.340), compared with the CG. There were also no statistically significant differences in FEV_1 1 minute post-intervention (p = 0.184), 30 minutes post-intervention (p = 0.193) or 1 week post-intervention (p = 0.418), compared with the CG. However, the FEV_1/ FVC ratio results revealed a statistically significant difference between the EG and the CG 1 minute post-intervention (p = 0.023), but not 30 minutes (p = 0.112) or 1 week post-intervention (p = 0.817).

There were no statistically significant differences between the EG and the CG, apart from in the FEV1/FVC ratio 1 minute post-intervention (p = 0.023). Despite this, we did observe that the post-intervention measurements taken for both FVC and FEV_1 were higher in the EG than the CG, and the difference increased as more time elapsed since the intervention (figure 3).

We also observed a strong correlation in both groups between the FEV1 and FVC variables ($r > 0.85$), as seen in Table 1, as there is a direct relationship between them. This correlation was statistically significant ($p < 0.05$).

	EG		CG	
VARIABLES	PEARSON'S CORRELATION COEFFICIENT	SIGNIFICANCE	PEARSON'S CORRELATION COEFFICIENT	SIGNIFICANCE
FEV_1/FVC PRE	0,924	0,001	0,942	0,001
FEV_1/FVC 1 MIN	0,926	0,001	0,923	0,001
FEV_1/FVC 30 MIN	0,917	0,001	0,942	0,001
FEV_1/FVC 1 WEEK	0,955	0,001	0,864	0,001

Table 1. Pearson's Correlation Coefficient for FEV_1/FVC.

We did not observe any statistically significant differences in the MiniAQLQ quality of life questionnaire pre and post-intervention, but the differences were greater in the EG than the CG, which reflects a slight positive trend in the EG.

DISCUSSION

Other authors have observed that the use of osteopathic techniques in subjects with asthma did produce changes in pulmonary function, but not statistically significant changes. Nielsen et al. found no statistically significant changes in pulmonary function or the use of bronchodilators but they did observe an unspecified improvement of 36% in bronchial responsiveness and a subjective decrease of 34% in the severity of the condition following spine manipulations for specific dysfunctions, diagnosed by the clinic[38]. Bockenhauer et al. showed that there were no significant changes in spirometry or in symptoms, although they did observe an increase in upper and lower thoracic excursion following osteopathic treatment[46].

Gibbs demonstrated over a series of cases that osteopathic manipulation of the upper thoracic spine combined with medical treatment produces objective improvements in spirometry and subjective improvements in symptoms[23].

	FVC	FEV_1	FEV_1/FVC	Mini AQLQ	Edad	Sexo	Talla	Peso	IMC	Activ. Física	Consumo Tabaco
Sig	.597	.671	.909	.197	.169	1	0.450	.203	.285	.491	.043*

*Significativa $p < 0.05$
* Significance $p < 0.05$

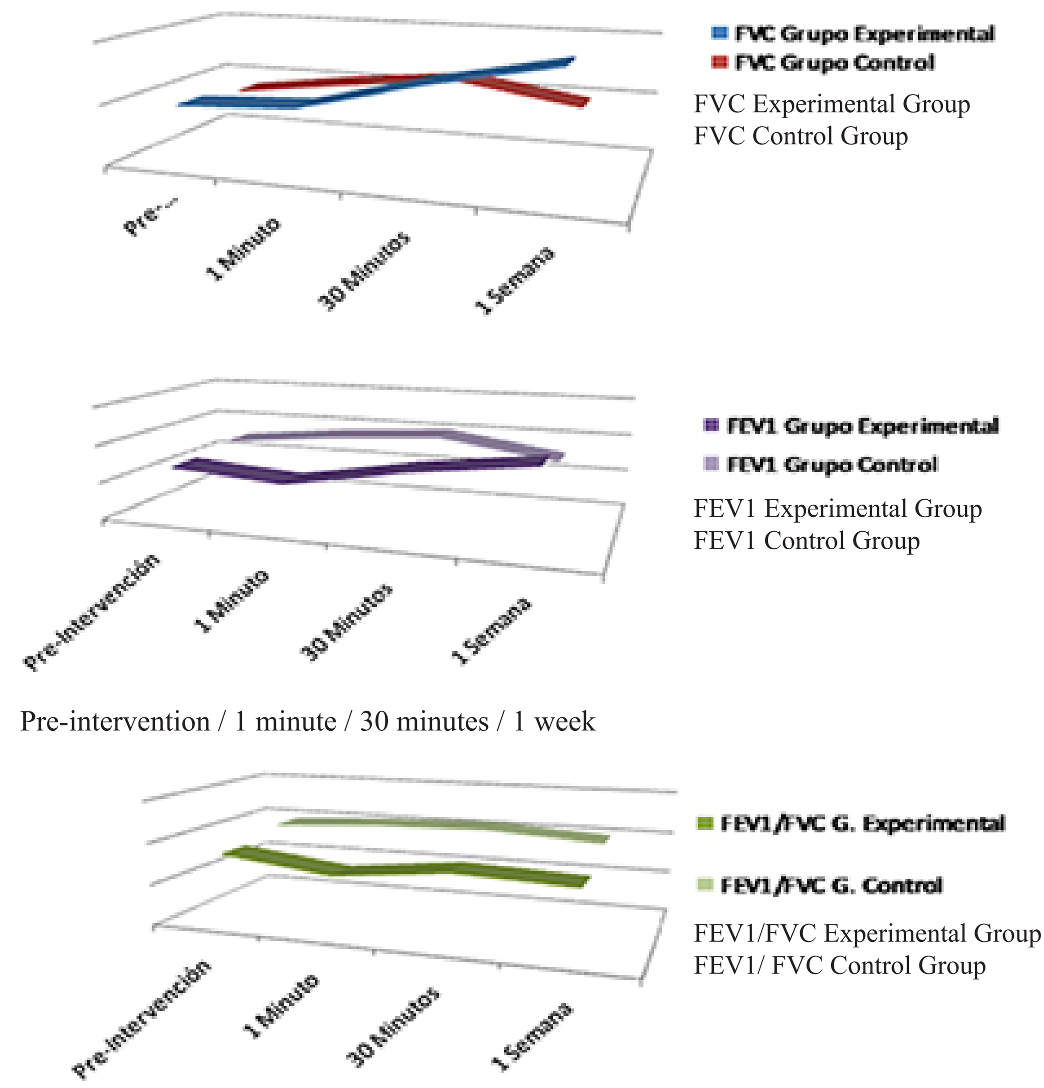


Figure 3. Comparison of the two groups pre-intervention and a frequency polygon for FVC, FEV_1 y FEV_1/FVC.

The majority of these studies included subjective results such as improved quality of life, improved breathing post-treatment, improved symptoms, a decrease in the sense of severity of the condition, a decrease in the use of bronchodilators and even reduced bronchial hyperresponsiveness.

Bronfort et al. concluded after 12 weeks of osteopathic treatment in children, that the subjects reported a substantial improvement in quality of life and reported that their asthma was less severe although there were no significant changes in pulmonary function (FEV_1, PEF and bronchial hyperresponsiveness)[22]. However, in the study carried out by Guiney et al.[18] on similar subjects, the results did reveal statistically significant changes between the experimental group and the control group.

Improvements in PEF were observed in non-smoking subjects after receiving osteopathic manual therapy on the diaphragm[47] and the pulmonary compression technique[48], while there were improvements in FVC and FEV in subjects with no defined pathology, but with irregular pulmonary functioning who received an upper cervical spine manipulation[49].

After completing the study, we found no significant changes in the spirometric variables FVC, FEV_1 and FEV_1/FVC at any of the points of assessment, except for in the FEV_1/FVC ratio 1 minute post-intervention. However we did observe that the differences were higher in the EG than the CG and the difference increased as more time elapsed since the intervention. In this study, we were analysing the potential effect of an isolated technique on lung function. Applying the technique was not part of an intervention protocol related to the pathology, which leads us to believe that the positive trend seen in the EG, compared to the CG could be greater if the technique were applied as part of a treatment protocol.

Limitations of the study

There are several possible limitations of this study, such as the sample size, which we would advise to be increased in future studies. We also recommend that in future studies, a higher number of interventions is carried out to strengthen our conclusions on the possible effect of the technique analysed. We also recommend that the technique be applied as part of a treatment protocol for this pathology in order to assess its practical application, which could improve the results obtained from this study. Furthermore, we did not take into account any specific osteopathic diagnoses for the segment of the spine that we manipulated, which could limit the potential positive effects of the technique.

CONCLUSIONS

The thrust manoeuvre in rotation applied to the thoraco-lumbar junction (seated) produces statistically significant changes in FEV_1/FVC ratio 1 minute post-intervention, but not in any of the other variables measured at any point in time after the intervention.However, the difference was higher in the EG than the CG, and the difference increased as more time elapsed since the intervention, which indicates a positive trend. There were no statistically significant changes in FVC, FEV_1 or MiniAQLQ quality of life, the differences in these variables were also higher in the EG than the CG, and the differences increased as more time elapsed since the intervention, which indicates a positive trend.

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CONFLICT OF INTEREST

The author hereby declares that there are no conflicts of interest associated with this study.

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