

# Effects Of Joint Passive Manual Stimulation On Restriction Of Movement Before Thoracic Surgery: Single Blind Controlled Randomized Clinical Trial

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## Abstract

Persistent pain following thorax surgery is a well-documented consequence leading to long-term shoulder function restriction and range of motion, reduced muscle strength, chronic pain and reduced health-related quality of life.

The study was conducted by the Center for Physical Medicine and Rehabilitation of "G.d'Annunzio" University Chieti-Pescara with the aim to investigate the pre-operative manual therapy effectiveness in reducing and controlling the development of post-operative pain and postural disease following a thoracic surgery in patients with a pre-existing shoulder dysfunction. A sample of 26 subjects were recruited and divided into an experimental group and control group. The former has benefitted of a pre-operative manual therapy, while the latter only received standard nursing and medical care. Using VAS scale [Visual Analogic Scale] and S.P.A.D.I. index [Shoulder Pain and Disability Index], the effects of pre-operative manual therapy on experimental group were evaluated both before surgery [T0] and after surgery [T1].

Statistical analysis of outcome measurements showed a statistically significant reduction of the perception of pain [0.002] and disability in the experimental group [0.005] compared to the control group in patients who underwent to thorax surgery for lung cancer.

**Keywords:** rehabilitation, lung cancer, manual therapy, ipsilateral shoulder pain, thoracic surgery

## Introduction

Post-operative ipsilateral shoulder pain is suffered by up to 85% of patients undergoing thoracic surgery, despite right thoracic epidural analgesia at the surgical site. Ipsilateral shoulder pain following a thoracic surgery is a distressing problem and it is associated with respiratory impairment and shoulder function.

There are many suggested etiologies for this shoulder pain, including: ligament distraction, referred phrenic nerve pain, transection of bronchi, lateral decubitus positioning, rib retraction, muscle division, nerve injury and prolonged surgery.

Lateral decubitus positioning is a cause of ipsilateral shoulder pain after lung resection. The risk increases in prolonged surgery and inadequate positioning, which may negatively influence the discomfort [1].

Ipsilateral shoulder pain after thoracic surgery impairs respiration and active mobility and autonomy in the early post-operative period.

Moreover, it contributes to increase bronchial secretions and a prolonged hospital stay.

The presence of pain and shoulder dysfunction before surgery could contribute to the increment of the post-operative pain [2].

Manual therapy is often used for the normalization of muscle contraction and for increasing range of motion [3]. However, the use of manual therapy in thoracic surgery patients has not been reported [4]. The purpose of the study is to investigate the effectiveness of the preoperative manual therapy in reducing and controlling the development of post-operative pain and postural disease following thoracic surgery in patients with a pre-existing shoulder dysfunction.

## Materials and methods

### Inclusion and exclusion criteria

The study was conducted from January to October 2014 in the Department of Thoracic Surgery in "Santo Spirito" Hospital of Pescara.

In both experimental group and control group, patients aged between 30 and 80 years old, of both genders, with a malignant lung cancer operated through a thoracic surgery video assisted [VATS] were included.

The VATS approach has been chosen because it is associated with better preservation of shoulder function and less analgesics requirement in the early post-operative period, when compared with the standard open approach [5,6].

The exclusion criteria applied to the entire study sample were: past medical history of shoulder surgery, presence of neurological disorders or bone fractures, rotator cuff injury, shoulder instability, bone metastases and osteoarthritis/arthritis.

Population 26 subjects were recruited (19 males and 7 females) with an average age of 65 years old operated by VATS surgical meth

The experimental group was composed by 13 patients (2 females and 11 male) with an average age of 64 years old and all operated by VATS surgical method for lung cancer (7 right and 6 left).

The control group was composed by 13 patients (5 females and 8 male) with an average age of 66 years old operated by VATS surgical method for lung cancer (7 right and 6 left).

The experimental group received five treatment of manual therapy, while the control group did not receive any manual rehabilitation treatment, only standard nursing and medical care [figure 1].

The randomized pilot study was approved by the local ethics committee in accordance with the Helsinki Declaration. All subjects involved in the study have been informed about procedures and aim of the study and have signed the informed consent.

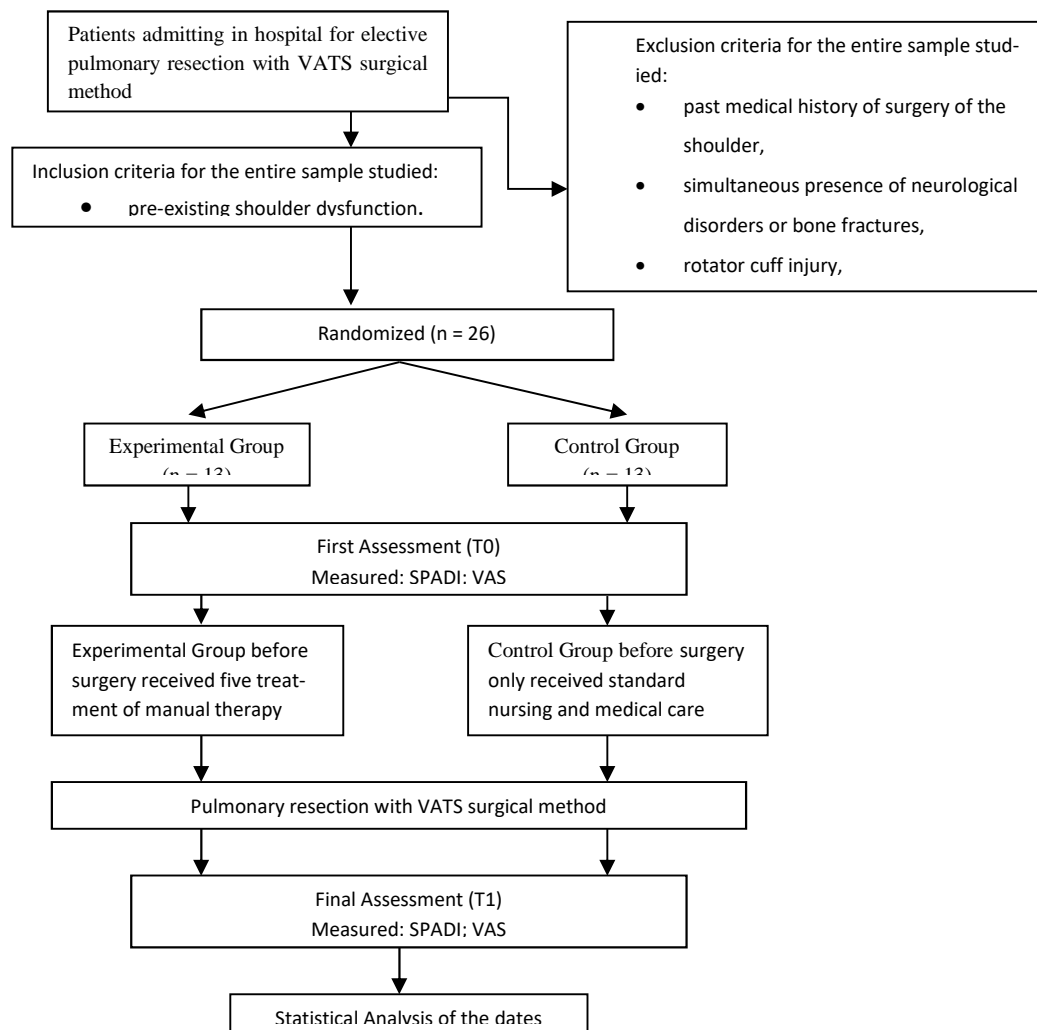


Fig 1: Design and flow of participants through the trial.

#### Outcome measurements

The outcome measurements selected in order to assess the rehabilitation protocol were the Shoulder Pain and Disability Index (SPADI) [5,6] and the Visual Analogue Scale (VAS).

The SPADI is considered a valid measurement for people with shoulder pain and impairments.

It is a questionnaire that examines two major domains: pain and disability specifically related to the shoulder pathologies [7,8].

The VAS is one of the most commonly used pain intensity measurement in pain research [9,10].

#### Rehabilitation Protocol

The rehabilitation protocol started on the day of admission in hospital and lasted five sessions. Every patient was assessed by the physiotherapist through interview and physical examination.

The joint assessment is important for the performance of any manipulation technique. Treatment manipulations are graded in according to the amount of range of movement of the joint.

The experimental group received five manual therapy treatments and active movements of the shoulders.

Manual therapy decreases pain perception interrupting pain impulse through gate control mechanism, as well as reflexive muscle relaxation.

The primary function of the shoulder complex is to position the upper extremity in space to allow the hand to perform its tasks.

In order to increase range of movement decrease pain in the shoulder joint and the other periarticular structures, the passive manual mobilizations were carry out to the glenohumeral joint, sternoclavicular joint, acromioclavicular joint, coracoclavicular and lower cervical spine.

Passive manual mobilizations directed to the lower cervical spine were applied in anteroposterior unilateral direction, because of the suffering of the brachial plexus could generate pain perception.

The intervertebral level of technique application varies enormously from patient to patient, but it is easy to localize the joint to be mobilized by accurated placement of the fingers (Figure 2).

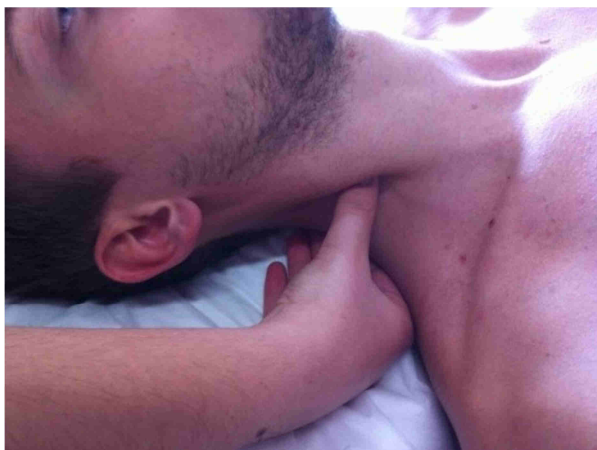


Fig 2. Unilateral anteroposterior vertebral pressure.

Subsequently, it was performed passive mobilization of the first rib.

For this technique, the patient is placed in supine position while the physiotherapist standing at the patient's shoulder level to be treated.

The physiotherapist applies a soft pressure to produce the oscillatory anteroposterior and caudal movement on all palpable parts in the first rib (Figure 3).

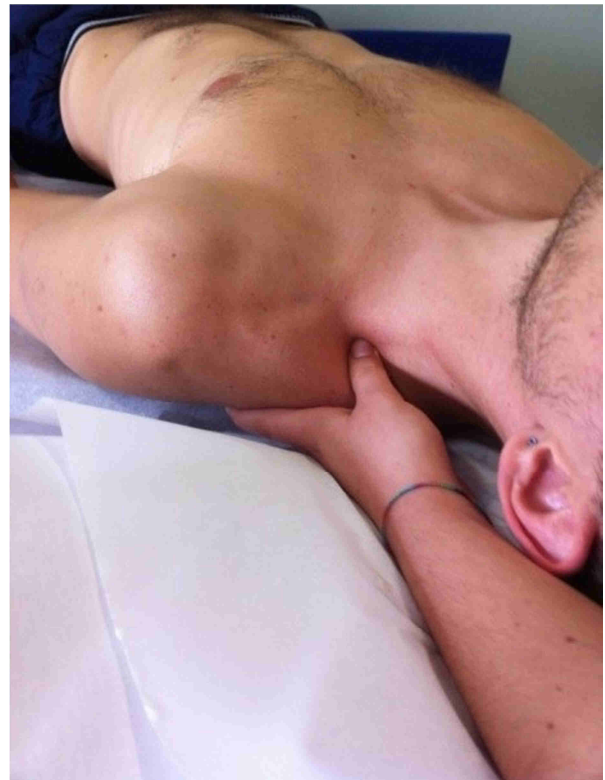


Fig 3. Pressure applied to the first rib anteriorly

A passive mobilization of the acromioclavicular and sternoclavicular joints increases the stretch of the muscular structures connected (Figure 4).

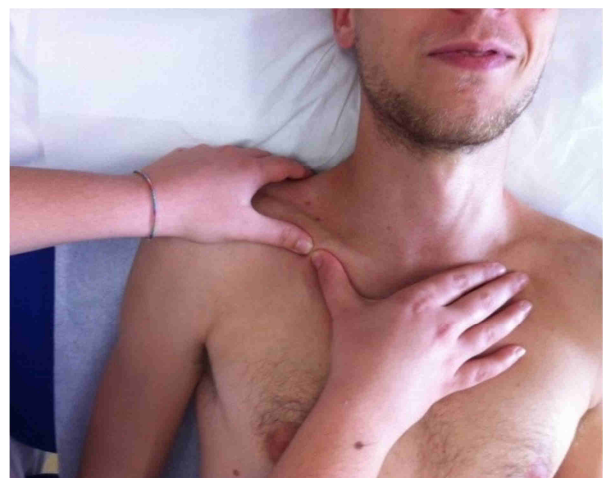


Fig 4. Pressure applied to the sternoclavicular joint

In addition, were performed active movements of the shoulder, in particular toward the direction of restricted or painful movements, in order to improve the flexibility.

### Results

The statistical analysis has been performed using the NCSS® for Windows Statistical Software package (NCSS® LLC, version 9, Kaysville, UT).

Data are expressed as mean  $\pm$  standard deviation (SD) and results were compared by Wilcoxon's signed rank test (paired sample) or by Wilcoxon's Rank Sum Test (two sample).

A p value less than 0.05 was considered significant.

The experimental group successfully completed the five treatments of pre-operative manual treatment.

Comparing the experimental group and the control group, a statistically significant reduction of pain and disability in

the post-operative phase has been recorded in all patients composing the experimental group.

The comparison of the SPADI score (Figure 5) demonstrates that the differences obtained between the experimental group and the control group is not due to chance but exclusively to manual technique chosen for the study (Table 2).

In addition, the experimental group have reported a statistically significant improvement on VAS scale (Figure 6). The data collected have shown a decrease in perceived pain in post-operative course, connected with a greater flexibility that promotes the recovery and the reduction of pain (Table 3).

Table 1. Population

Characteristics of experimental group			Characteristics of control group		
Number patients	13		Number patients	13	
Average age	64 $\pm$ 11,54		Average age	66 $\pm$ 13,24	
Gender			Gender		
Male	11	84,6%	Male	8	61,5%
Female	2	15,4%	Female	5	38,5%
Chirurgical Side			Chirurgical Side		
Right side	7	53,8%	Right side	7	53,8%
Left side	6	46,2%	Left side	6	46,2%

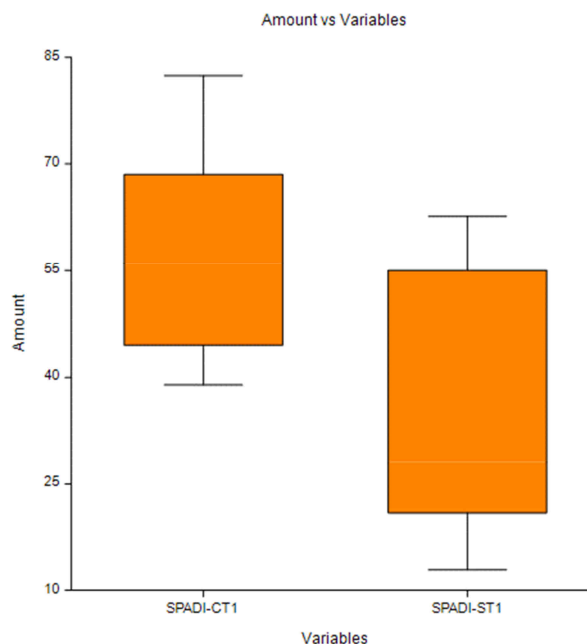


Fig 5. The comparison of the SPADI score between the experimental group and the control group

Table 2. SPADI at admission time (T0) and after surgery (T1)

Variable	Count	Mean $\pm$ SD	p value*
SPADI-C (T0)	13	40 $\pm$ 11	ns
SPADI-S (T0)	13	28 $\pm$ 18	
SPADI-C (T1)	13	57 $\pm$ 14	0,005
SPADI-S (T1)	13	34 $\pm$ 18	
SPADI-S (T0)	13	28 $\pm$ 18	0,001
SPADI-S (T1)	13	34 $\pm$ 18	

SPADI-C = Shoulder Pain and Disability Index score of the control group

SPADI-S = Shoulder Pain and Disability Index score of the sperimental group

\* p value shows the differences between T0-T1 of the experimental and control group (Wilcoxon Rank-Sum Test two-sample), as well as the differences between T0-T1 of the experimental group (Wilcoxon matched-pairs signed rank test).

Table 3. VAS at admission time (T0) and after surgery (T1)

Variable	Count	Mean $\pm$ SD	p value*
VAS-C (T0)	13	4 $\pm$ 1	ns
VAS-S (T0)	13	4 $\pm$ 1	
VAS-C (T1)	13	7 $\pm$ 1	0,0002
VAS-S (T1)	13	5 $\pm$ 1	
VAS-S (T0)	13	5 $\pm$ 1	0,001
VAS-S (T1)	13	4 $\pm$ 1	

VAS-C= Visual Analogue Scale score of the control group

VAS-S= Visual Analogue Scale score of the sperimental group

\* p value shows the differences between T0-T1 of the experimental and control group (Wilcoxon Rank-Sum Test two-sample), as well as the differences between T0-T1 of the experimental group (Wilcoxon matched-pairs signed rank test).

## Discussion and Conclusion

Manual joint manipulation promotes the optimal pain free movement preserving their extensibility or by increasing their extensibility in the presence of periarticular restriction.

Restrictions of glenohumeral capsule are usually associated with a corresponding limitation in joint range of motion.

Furthermore, manual therapy decreases shoulder pain by stimulating joint receptors, interrupting painful stimuli through gate control mechanism, as well as reflexive muscle relaxation [11].

Pain management after thoracic surgery is fundamental, since it has been shown that the increased acute pain negatively influences the incidence of chronic pain, as well as untreated pain may cause an increase of morbidity.

Although VATS is quite painful, when compared with thoracotomy, many studies have found decreased visual analog pain scores [VAS] and analgesic medications requirement.

This is primarily caused by smaller surgical incisions and the avoidance of rib resections [12].

Ipsilateral shoulder pain following thoracic surgery is distressing and it impairs respiration, mobility, and autonomy in the early post-operative period [13].

Therefore, it is important to treat the shoulder pain optimally.

Several hypotheses have been proposed as possible causes of ipsilateral shoulder pain, including: transection of a major bronchus, ligament distraction by surgical retraction, shoulder joint strain as a result of intraoperative positioning, pleural irritation due to the thoracostomy tube and referred pain from irritation of the pericardium or mediastinal and diaphragmatic surfaces [14].

Indeed, severe shoulder flexion and abduction have been suggested to contribute to its pain leading to the hypothesis that the overhead arm raising is another factor in the generation of post-operative shoulder pain.

The supraspinatus and infraspinatus regions were the main site of shoulder pain and approximately 50% of painful shoulders were associated with trigger points in their painful areas.

Larger grade flexion of the elbow was one of the possible causative factors for the generation of post-operative shoulder pain [15,16].

Lateral decubitus positioning is another cause of shoulder pain and the risk increases in prolonged surgery and inadequate positioning.

Indeed, during thorax surgery, the scapula is retracted upwards to let the surgeon insert a hand and identify all the ribs.

During rib spreading, the scapula was subjected to rotational forces and the acromioclavicular and coracoclavicular joints was distracted.

The cancer pain induces a state of central sensitization, in which neurochemical changes in the spinal cord and fore-brain promote an increased transmission of nociceptive information.

Moreover, nerve and root damage causes peripheral alteration of peripheral receptors excitability with abnormal input and imbalanced afferent input, as well as phenomena of denervation, thus resulting in an abnormal afferent message and a spontaneous or induced abnormal activity in the central ways of transmission and conduction of pain [17,18,19].

Finally, the results of this study show the positive effect of manual therapy in reducing and controlling the development of post-operative pain and postural disease following thoracic surgery in patients with a pre-existing shoulder dysfunction.

the protocol for patients with lung malignant tumor lesion, admitted and enlisted for thoracic surgery, with a pre-existing shoulder dysfunction, show interesting results in term of pain and shoulder function benefit, better post-operative pulmonary function and shorter hospitalizations.

In conclusion, despite the mentioned limitations and small number of patients, the study showed the effectiveness of the pre-operative manual therapy in reducing and controlling the development of postoperative pain and postural disease following thoracic surgery in patients with a pre-existing shoulder dysfunction.

Further trials, with a larger number of patients, could corroborate these findings and include the assessment of patients follow up.

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## Conflict of interest:

The authors have declared no conflict of interest.