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Review Article

Effectiveness of Intercostal Stretch Technique on Pulmonary Conditions: A Narrative Review

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Abstract

Background: The Intercostal Stretch Technique is one of the physiotherapy techniques that is used to solve different respiratory problems. It is used for increasing chest expansion and diaphragm excursion improvement and also intra-thoracic lung volume.

Aim: The study aims to evaluate the effectiveness of the intercostal stretch technique.

Methodology: A narrative review. In this study, an RCT study was used to review the intervention.

Results: Several articles are used to discuss the effectiveness of the intercostal stretch technique. In stable COPD, diaphragmatic breathing and the intercostal stretch technique both work equally well to improve chest expansion and functional capacity while lowering dyspnea. Research has shown that IC stretch outperforms the anterior basal lift technique in lowering heart and respiratory rates while increasing oxygen saturation. According to this study, IC stretching in conjunction with breathing control may improve dynamic lung parameters, particularly FEV1/FVC%, more than breathing control alone. Patients with COPD have an increased functional exercise capacity and reduced dyspnea when aerobic training and respiratory muscle stretching are combined.

Conclusion: Different articles demonstrated that IC stretch improved lung function, expired tidal volume, decreased dyspnea, and increased chest expansion.

More Information

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Keywords: Intercostal stretching; Chronic obstructive pulmonary disease; ICU

Introduction

The diaphragm is the primary inspiratory and expiratory muscle, primarily used in breathing. Inter intercostal muscle helps in respiration. There are two types of intercostal muscles, they are internal intercostal muscle and external intercostal muscle. These two muscles work together during the inspiration and expiration process. In physical inactivity, these muscles become atrophy so it may affect respiration. Chest wall mobility and expansion of the chest are reduced because of it [1].

In the human breathing cycle, the phase of the inspiratory is observed by the expansion of the rib cage and abdominal wall. The diaphragm's activity produces it. When the diaphragm is activated, the muscle fibers become shortened and the dome moves in the caudal direction which pushes the abdominal viscera [2].

When a person breathes in, the lungs and intercostal muscles expand connect the ribs, and lengthen them. So the intercostal muscle needs flexibility, if the muscles are tight the movement of the rib becomes limited and forceful, which may affect breathing comfortably. That's why stretching of the intercostal may benefit respiration [3].

Intercostal muscles work with the rib cage differently. IC stretch technique improves lung volume as well as increases chest expansion and chest wall elevation. Internal intercostal muscles and external intercostal muscles are one kinds of skeletal muscles that help for upward and outward movement of the ribs [4]. Intercostal stretching is one kind of PNF technique that helps to improve breathing patterns and the activity of respiratory muscles. Intercostal muscles work for both inspiration and expiration forcefully. But in healthy people and respiratory suppressive patients that is less common [5,6].

COPD is a chronic condition of the pulmonary part. It is an obstructive pulmonary disease that is caused by inflammation and structural changes to the lung that cause loss of broncho-alveolar attachments to the reduction of elastic support during expiration. Weakness of the respiratory muscles is a major problem in COPD have focused on the diaphragm because this

is the main muscle of inspiration. These types of patients may have dyspnea and chest weakness [7,8].

Reduced parenchymal elasticity and a chronic and progressive restriction in airflow are indicators of COPD. Consequently, the respiratory muscles remain contracted for long periods in an attempt to meet the increased ventilatory flow demand, increasing the load on the respiratory muscles [9].

Intensive Care Unit (ICU) is an experienced staffed and equipped hospital that is dedicated to the management of patients with life-threatening illnesses, injuries, or complications. Patients with life-threatening illnesses, injuries, or complications are managed in the ICU which is a specialized area of a hospital. Sometimes mechanical ventilator is used for critically ill patients. Intercostal stretch is one kind of proprioceptive neuromuscular facilitation which has effective effects for ICU patients [10].

Aim

The study aims to evaluate the effectiveness of the intercostal stretch technique.

Methodology

Design: Narrative review article.

Data sources and Study selection process

An Electronic database search strategy was conducted through a database linking with HINARI Summon, PubMed, Google Scholar, and Physiotherapy Evidence Database (PEDro). We used the Medical Subject Headings of the U.S. to search for the articles. National Library of Medicine (Mesh). The Keywords were Intercostal stretching, chronic obstructive pulmonary disease, and ICU. The current investigation only included randomized controlled trials and randomized clinical trials including patients receiving exercise programs or physiotherapy, and it was published in English.

Inclusion criteria: COPD is the case's diagnosis and here Intercostal stretching technique combined with therapeutic physical exercise intervention is used for the data. The RCT-based studies were conducted between 1972 and 2017.

Exclusion criteria: Duplicated data and nonclinical trials were excluded.

Our intervention measures are either inconsistent or our interventions are mixed with various forms of rehabilitation.

Results and discussions

In India, Dangi Ashwini, Sheth Bhagyashri, and Deo Medha conducted a study in 2017 comparing the effects of the Intercostal Stretch Technique and Diaphragmatic Breathing on Dyspnoea, Chest Expansion, and Functional Capacity in stable COPD patients (Table 1). A randomized control trial was the study design. The study aimed to compare the intercostal stretch technique with diaphragmatic breathing on dyspnea, chest expansion, and functional capacity in stable COPD patients. The inclusion criteria of the study were an age group between 50-70 years and both males and females were included, their FEV1 was between 50% - 80% and they did not have acute exacerbation in the past 4 months. The exclusion criteria were acute exacerbation of COPD, who were taking physiotherapy already and unwilling patients. 18 COPD patients were selected for the study and they were divided into two groups randomly. There were two groups, one labeled as Group A and the other as Group B. Group A consisted of individuals who performed intercostal stretches, while Group B consisted of individuals who practiced diaphragmatic breathing. Approval was obtained from the ethical committee, and all patients provided written consent to participate in the research. Demographic data was gathered, and various tools were utilized for data calculation. Dyspnea was assessed using the MRC dyspnea scale, and chest expansion was measured in three areas: the anterior axillary fold, xiphisternal area, and nipple area, using a measurement tape. The minute walk test was measured by a six-minute walking distance. COPD is a chronic obstructive pulmonary disease that is characterized by airway limitation and it is not fully reversible. It is a chronic pulmonary condition. Pathology of COPD is inflammation in the anatomical structure which is why there is a loss of bronchio alveolar attachment that reduces the elastic support. Muscle weakness is a problem and there is increased lung dead space is another. One of the challenges of COPD is difficulty breathing, known as dyspnea. In Group A PNF technique was given as a form of intercostal stretch. The patient was in a supine position and pressure was applied to the upper border of the third rib in a downward direction that widened the intercostal space above it. Stretched was given during expansion time and the patient maintained a stretched position and breath in the usual manner. This technique was given from the 3rd rib to the 8th rib12 along with conventional chest physiotherapy twice a day, 5 days a week for 4 weeks. In Group B, diaphragmatic breathing was administered while the participants were positioned in a semi-Fowler's position. One hand was kept on the rectus abdominis muscle just below the anterior intercostal margin and told the patient to breathe in deeply and slowly by the nose keeping the shoulder relaxed and quiet the chest to allow the abdomen to rise and exhale slowly with the mouth. The technique was also given along with conventional chest physiotherapy twice a day, 5 days a week for 4 weeks. Obtained data was analyzed statistically by using a *t* - test, and Wilcoxon signed rank test after four weeks there was a statistical change in dyspnea and chest expansion. Statistical analysis was performed within the group and between the groups. Intercostal stretch and diaphragmatic stretch both were effective as shown in the research but intercostal stretch was performed by the therapist only and diaphragmatic stretching could be included in the home program [7].

Table 1: Article summary.

Title	Author	Aim of the study	Results
Comparison of Intercostal Stretch Technique Versus Diaphragmatic Breathing on Dyspnoea, Chest Expansion, And Functional Capacity in Stable Copd	[7]	The study aimed to compare the intercostal stretch technique with diaphragmatic breathing on dyspnea, chest expansion, and functional capacity in stable COPD patients.	Both intercostal stretch technique and diaphragmatic breathing are equally effective in reducing dyspnoea and improving chest expansion and functional capacity in stable COPD.
Effect of Intercostal Stretch Technique and Anterior Basal Lift Technique on Respiratory Rate, Saturation of Peripheral Oxygen and Heart Rate among ICU Patients	[10]	The study aimed to find whether Intercostal stretch and anterior basal lift were techniques of proprioceptive neuromuscular facilitation that had beneficial effects among ventilatory patients.	It has been found that IC stretch is more effective in the reduction of respiratory rate and heart rate and in improving oxygen saturation over the anterior basal lift technique.
Effect of intercostal stretch on pulmonary function parameters among healthy males	[5]	The study aimed to determine the impact of Intercostal (IC) stretch in improving the dynamic pulmonary function parameters (Forced Expiratory Volume in the first second (FEV1), Forced Vital Capacity (FVC), and FEV1/FVC % and respiratory rate among healthy adults.	This study suggested that IC stretching with breathing control may be more effective in improving dynamic lung parameters, especially FEV1/FVC % than breathing control alone.
Effects of aerobic training combined with respiratory muscle stretching on the functional exercise capacity and thoracoabdominal kinematics in patients with COPD: a randomized and controlled trial	[9]	The study aimed to find the effect of aerobic training combined with respiratory muscle stretching on functional exercise capacity and thoracoabdominal kinematics in patients with COPD.	Aerobic training combined with respiratory muscle stretching increases the functional exercise capacity with decreased dyspnea in patients with COPD. These effects are associated with an increased efficacy of the respiratory muscles and participation of the ABD compartment.

In 2013 research was conducted by Gupta et al about the Effect of the Intercostal Stretch Technique and Anterior Basal Lift Technique on Respiratory Rate, Saturation of Peripheral Oxygen, and Heart Rate among ICU Patients. The study aimed to find whether Intercostal stretch and anterior basal lift were techniques of proprioceptive neuromuscular facilitation that had beneficial effects among ventilatory patients. The objective of this study was to compare the efficacy of the IC stretch and ABL on respiratory rate, saturation of peripheral oxygen, and heart rate. A randomized control trial was the study design. There were two groups, one was experimental and the other was the control group. Group A was intercostal stretch and Group B was anterior basal lift technique. The experiment was held in the ICU of C.U Shah Medical Hospital. There was 30 patients in the ICU were selected by inclusion criteria who were male only aged between 18 to 55 years mechanically ventilated and had stable cardio-vascular function. The exclusion criteria were fever, chest infection, and malignancy. Besides this, they went through cardiac and abdominal surgery, rib fracture, untreated haemothrox, and pneumothorax. Patients were given the mediation agreeing to their designated gather for 3 days and the impacts of these strategies on RR, SpO2, and HR parameters were watched. In the intercostal stretch group patient was in the supine position and the therapist was behind the patient. The therapist palpated the angle of Louis and firstly the supra sternal notch. The intercostal stretch was applied over the 2nd and 3rd rib bilaterally with the index finger. The direction was downward towards the next rib during expiration. It is applied for three breaths with 1 minute rest and three times repetition. This technique will be applied twice a day for 3 days. On the other anterior basal lift was performed by placing the therapist's hands under the posterior ribs of the supine patient and lifting them upwards. This was also performed for 3 days. At the baseline, there were no significant results in Respiratory rate, heart rate, and SpO2. In the post-test by using paired t-test there was a significant result of both but intercostal stretch showed more significance. This study had shown that for the group of patients of IC stretch was more effective compared to the anterior basal lift technique on RR, SPO2 & HR Parameters in ventilatory patients [10].

The point of the consideration was to decide the effect of Intercostal (IC) in moving forward the energetic aspiratory work parameters (Constrained Expiratory Volume within the to begin with moment (FEV1), Constrained Imperative Capacity (FVC) and FEV1/FVC % and respiratory rate among sound grown-ups. A randomized control path was the considered plan. There were two bunches of 30 patients. They were arbitrarily chosen and subjects were dazzled almost the matter. In the test gather there were 15 and the control gather had as well as 15 members. Exploratory gather gotten intercostal extend with breathing control works and control gather received breathing control workout within the semi-prostrate position. There were a few considerations and prohibition criteria. Solid grown-up people between 19 to 24 a long time were incorporated criteria and prohibition criteria were persistent malady (WHO, 2005), rheumatoid disarranges, and smoking. Assent from all members was collected and moral endorsement was gotten from College Teknologi MARA. In the test gather same physiotherapist did the intercostal extend strategy. The method was done through the cleared outside halfway between the midaxillary line and a line through the areola within the descending course of the third IC space. It was connected by the record finger. At that point utilized a breathing control workout. It was performed in a reasonable position with a pad beneath both knees. The members placed their hands over the guts so that he might feel the development. Within the control gather the members performed as it were breathing control workout in semi prostrate position. Immediately, taking after intercession, the respiratory rates were recorded and pneumonic work tests were performed utilizing spirometry to assess the impact of mediation in both bunches. Subjects experienced three IC extends and breathing control works out with a time crevice of 2-3 minutes for the exploratory gather. Each extend was

utilized for ten breaths all through the inspiratory stage of the respiratory cycle. For the control bunch they experienced breathing control works out alone. An added up to 15-minute session kept going for both bunches. The information was analyzed by SPSS Form 17 assessment of ordinariness measured by Kolmogorov Smirnov. Wilcoxon marked rank test was utilized to decide the impact of IC extend in exploratory and control bunches. Moreover, the Mann-Whitney test was performed to discover on the off chance that contrasts existed between the test and control bunches in each parameter. In this consideration, exploratory gather appeared essentially enhancement in FEV1/FVC % with p = 0.017 than the control gathers. So the intercostal extends expands lung volume and makes strides in lung work. The IC extending with breathing control may be more compelling in moving forward energetic lung parameters particularly FEV1/FVC % than breathing control alone [5].

The objective of this study was to investigate the impact of combined aerobic training and stretching of respiratory muscles on the ability to perform functional exercises and the movement of the torso and abdomen in individuals with Chronic Obstructive Pulmonary Disease (COPD). This research was conducted as a randomized controlled trial. A total of 30 participants were divided into two groups, with 15 individuals assigned to the treatment group and 15 to the control group. The study took place at the Clinics Hospital, School of Medicine, University of Sao Paulo, Sao Paulo, Brazil. Participants were selected based on specific criteria, including age between 40 and 80 years, a Body Mass Index (BMI) between 18 to 30 kg/m2, stable health status (no changes in medication or symptoms in the previous month), not dependent on supplemental oxygen, no history of heart or chest surgeries, no lung diseases, no physical disabilities, and not involved in a pulmonary rehabilitation program in the last three months. Those who did not meet these criteria were excluded. Informed consent was obtained from all participants, and the study received approval from the School of Medicine, University of Sao Paulo. The study measured functional exercise capacity using a 6-minute walk test, respiratory muscle activity through surface electromyography, and the movement of the torso and abdomen before and after the tests. Each participant attended 24 sessions, twice a week for 12 weeks. In the treatment group, respiratory muscle stretching was performed before aerobic exercise. This included stretching of the intercostal muscles, as well as other muscles such as the scalene, sternocledoidmastoid, trapezius, pectoralis major, and minor rectus abdominis. The control group engaged in stretching of the upper and lower limbs, including the wrists and ankles. Both groups participated in aerobic training sessions, each lasting 30 minutes. The data collected was analyzed, revealing that the treatment group demonstrated greater improvements in lung volume, mobility, functional capacity, and a reduction in shortness of breath compared to the control group. This suggests that combining respiratory muscle stretching with aerobic exercise can enhance functional exercise capacity and alleviate shortness of breath in individuals with COPD [9]. The PNF method, applied in the ICU for patients, has been observed to enhance patient health by reducing breathing rate, improving oxygen saturation levels, lowering pulse, and facilitating early removal from mechanical support. One specific PNF method known as IC stretch aids in alleviating shortness of breath and promoting deeper chest expansion [11]. (Table 2).

The list incorporates the evidence.

An important motor skill is postural stability, which is primarily based on muscle synergies that work to minimize the displacement of the center of pressure (CoP) and preserve an upright posture, appropriate orientation, and sufficient locomotion. The diaphragm and external intercostals are the main inspiratory muscles. Surface tension and the lungs' elastic recoil cause relaxed normal expiration, which is a passive process. Nonetheless, certain muscles aid in forceful expiration; these muscles include the abdominal muscles, subcostals, internal intercostals, and intercostalis intima. There are three different kinds of intercostal muscles: the outermost (or external) muscle, the innermost (or internal) muscle, and the most superficial (or internal) muscle. Decreased strength of the respiratory muscles when lying down as opposed to when sitting. The length-tension relationship, which describes how a muscle fiber can develop active tension, is influenced by the length of the muscle from a biomechanical perspective. An efficient diaphragm muscle contraction is necessary to support a normal breathing pattern. Slouching lowers the diaphragm's capacity to produce the right amount of force for contraction.

Conclusion and recommendation

Inter intercostal stretching technique is useful for COPD patients and ICU patients. It was also helpful for the healthy adult to improve dynamic lung parameters. To enhance pulmonary functions, manual stretching techniques have become more widely used in cardiorespiratory physiotherapy. The IC may improve expansion to increase intra-thoracic lung volume, which in turn improves the flow rate percentage by elevating the chest wall. This could be a factor in the rise in minute ventilation, tidal volume, and oxygen status, among other ventilatory capacities. The changes in pulmonary function parameters following an IC stretch may make this method of IC stretching necessary and helpful in guiding future patient population studies. Therefore, when the stretch mode is used on patients with pulmonary disease, it may aid in improving ventilation.

There is, however, little data available to evaluate their efficacy. But there are very less articles about this matter so it was very difficult to rearrange this topic. It is a very important part of manual therapy so more research is needed to research.

Table 2: List of the evidences.

Comparison between Intercostal Stretch Technique and Diaphragmatic Breathing on Dyspnoea, Chest Expansion, And Functional Capacity in Stable COPD	→	In stable COPD, diaphragmatic breathing and the intercostal stretch technique both work equally well to improve chest expansion and functional capacity while lowering dyspnea.
Effect of Intercostal Stretch Technique and Anterior Basal Lift Technique on Respiratory Rate, Saturation of Peripheral Oxygen and Heart Rate among ICU Patients	→	IC stretch outperforms the anterior basal lift technique in lowering heart and respiratory rates while increasing oxygen saturation.
Effect of Intercostal Stretch On Pulmonary Function Parameters Among Healthy Males	→	IC stretching in conjunction with breathing control may improve dynamic lung parameters, particularly FEV1/FVC%, more than breathing control alone.
Effects of aerobic training combined with respiratory muscle stretching on the functional exercise capacity and thoracoabdominal kinematics in patients with COPD: a randomized and controlled trial	→	Patients with COPD have an increased functional exercise capacity and reduced dyspnea when aerobic training and respiratory muscle stretching are combined.

My suggestion is that a comparable study be conducted over a longer period and with a greater number of studies.

References

1. Keuning B, Kouwenberg T. Kenneth Saladin: Anatomy & Physiology. De Osteopaat Magazine. 2009.
2. D'Angelo E, Sant'Ambrogio G. Direct action of contracting diaphragm on the rib cage in rabbits and dogs. J Appl Physiol. 1974;36(6):715-719. Available from: https://doi.org/10.1152/jappl.1974.36.6.715
3. Remmers JE. Inhibition of inspiratory activity by intercostal muscle afferents. Respiration Physiol. 1970;10(3):358-383. Available from: https://doi.org/10.1016/0034-5687(70)90055-1
4. De Troyer A, Kirkwood PA, Wilson TA. Respiratory action of the intercostal muscles. Physiol Rev. 2005;85(2):717-56. Available from: https://doi.org/10.1152/physrev.00007.2004
5. Mohan V, Aziz KBK, Kamaruddin K, Leonard JH, Das S, Jagannathan MG. Effect of intercostal stretch on pulmonary function parameters among healthy males. EXCLI J. 2012;11:284-90. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/pmc4942790/
6. Chang A, Paratz J, Rollston J. Ventilatory effects of neurophysiological facilitation and passive movement in patients with neurological injury. Aust J Physiother. 2002;48(4):305-310. Available from: https://doi.org/10.1016/s0004-9514(14)60170-7
7. Ashwini D, Bhagyashri S, Medha D. Comparison of intercostal stretch technique versus diaphragmatic breathing on dyspnoea, chest expansion, and functional capacity in stable COPD. Int J Sci Res Publ. 2017;7(5):256-260. Available from: https://www.ijsrp.org/research-paper-0517/ijsrp-p6528.pdf
8. Vestbo J, Hurd SS, Agustí AG, Jones PW, Vogelmeier C, Anzueto A, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am J Respir Crit Care Med. 2013;187(4):347-365. Available from: https://doi.org/10.1164/rccm.201204-0596pp
9. Wada JT, Borges-Santos E, Porras DC, Paisani DM, Cukier A, Lunardi AC, et al. Effects of aerobic training combined with respiratory muscle stretching on the functional exercise capacity and thoracoabdominal kinematics in patients with COPD: a randomized and controlled trial. Int J Chron Obstruct Pulmon Dis. 2016;11:2691-700. Available from: https://doi.org/10.2147/copd.s114548
10. Gupta P, Nambi G, Gupta G, Nagar R, Mehta P, Makwana A. Effect of intercostal stretch technique and anterior basal lift technique on respiratory rate, saturation of peripheral oxygen, and heart rate among ICU patients. Int J Health Sci Res. 2014;4(1):26-31. Available from: https://www.ijhsr.org/IJHSR_Vol.4_Issue.2_Feb2014/6.pdf
11. Sharma R, Narwal R, Kumar S. Comparison of proprioceptive neuromuscular facilitation vs resistance training of respiratory muscles on the respiratory rate of patients in ICU during weaning off period. Physiother Occup Ther. 2010;4(4):125-130. Available from: https://www.semanticscholar.org/paper/Comparison-of-proprioceptive-neuromuscular-vs-of-on-Sharma-Narwal/c9fbb91795370f6c606af9e17fb74aac069171f4