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Research Article

EFFECTS OF TRUNK PNF TECHNIQUES ON RESPIRATORY FUNCTIONS OF PATIENTS WITH COPD

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A R T I C L E I N F O

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A B S T R A C T

Background: In India, COPD is the second most common lung disorder after pulmonary TB. The pathological changes occurring due to the inflammatory processes produce deficits such as decreased ventilation, mucus accumulation, dyspnea, etc. In current literature, although the effects of various PNF techniques have been studied to reverse these deficits, very few studies have included the trunk PNF patterns like lifting and chopping.
Objective: The present study aims to assess the effect of trunk PNF patterns compared to conventional respiratory therapy on chest expansion, single breath-hold count, and modified rate perceived of exertion of patients with COPD.
Methodology: 30 male and female subjects diagnosed with COPD were allotted to one of the two groups: Group A (conventional group, n=15) received conventional respiratory therapy; Group B (experimental group, n=15) received trunk PNF patterns along with conventional treatment. Outcome measures were taken before and after 7 days of an intervention period. The statistical analysis was done using Graph Pad Prism 8.3.1 software to verify the results obtained.
Results: The inter-group analysis results showed that there was a significant difference (p value<0.05) in values of chest expansion and single breath-hold count in Group B as compared to Group A; there was no significant difference (p value>0.05) in the values of modified rate of perceived exertion.
Conclusion: Trunk PNF patterns and conventional respiratory therapy combined have a significant effect on chest expansion and single breath-hold count of COPD patients than conventional therapy alone.

INTRODUCTION

Global initiative for chronic obstructive lung disease (GOLD) defines COPD as a disease state characterized by the progressive development of chronic airflow limitation that is not fully reversible and includes chronic bronchitis, emphysema and small airway disease.[1]

The pathological changes which occur due to the inflammatory processes, increased activity of oxidants and high concentration of oxygen free radicals are:

- Reduction in the calibre of air passages
- Reduction in ciliated cells
- Goblet cell hyperplasia
- Mucosal oedema and intraluminal mucus plugs[2]

The deficits thus produced due to these changes are

- Decreased ventilation and gaseous exchange
- Dyspnea
- Mucus accumulation
- Progressive decline of respiratory muscle strength
- Decreased cardiorespiratory endurance[2]

GOLD's Criteria for the staging of COPD[2]: In patients with $FEV_1/FVC<0.70$

Grade I	Mild COPD	$FEV_1 \geq 80\%$ of predicted
Grade II	Moderate COPD	FEV_1 50-80% of predicted
Grade III	Severe COPD	FEV_1 30 to <50% of predicted
Grade IV	Very severe COPD	$FEV_1<30\%$ of predicted

Although many physical therapeutic approaches which minimise or reverse these deficits up to a certain extent exist in the current literature, these studies indeed comprise simple breathing exercises or one-dimensional basic resistive exercises.[3]

PNF is an integrated approach that is positive, reinforcing with a primary goal to help patients achieve their highest level of function. To reach this highest level of function, the therapist integrates principles of motor control and motor learning.[4]

The effects of the PNF approach which has been studied on COPD patients in previous research includes techniques such as anterior basal lift[6,7], stretching of intercostal and accessory

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muscles of respiration[7,8], methods for the facilitation of diaphragm and so on.

The PNF approach aids in respiration if used in following ways

- Treating the sternal, costal, and diaphragmatic areas to improve inspiration.
- Exercising the abdominal muscles to strengthen forced exhalation.
- Hand alignment is particularly important to guide the force in line with normal chest motion.
- Using the stretch reflex to facilitate the initiation of inhalation. Continue with Repeated Stretch through range (Repeated Contractions) to facilitate an increase in inspiratory volume.
- Appropriate resistance strengthens the muscles and guides the chest motion.
- Preventing motion on the stronger or more mobile side (timing for emphasis) will facilitate activity on the restricted or weaker side.
- Combination of Isotonics is useful when working on breath control.
- The patient should do breathing exercises in all positions. Emphasize treatment in functional positions[4].

All these techniques have observed a significant effect on parameters like chest expansion[8], pulmonary functions[8,9], and exercise capacity[6]. However, there is very little literature available which studies the effects of trunk PNF patterns on COPD.

As previously mentioned, poor ventilation and a decline in respiratory muscle strength in COPD increase the work of breathing and reduce the thoracic wall compliance.

Also, the weak oblique abdominal muscles place the thoracic cage into an elevated position, thus resulting in an insufficiency of the diaphragmatic activity; reduced FEV_1, FVC, FEV_1:FVC ratio.[10]

So, this study aimed to assess the effects of Chopping and Lifting i.e. trunk PNF patterns on the respiratory functions of patients with COPD.

MATERIALS AND METHOD

30 male and female subjects were selected and screened according to the selection criteria through a convenient sampling method.

Inclusion Criteria

1. Subjects willing to participate.
2. Male and female subjects diagnosed with Grade 1 and Grade 2
3. COPD according to GOLD’s criteria.
4. Age group: 40-50 years
5. Medically stable.

Exclusion Criteria

1. Grade 3 and grade 4 COPD according to GOLD’s criteria.
2. Unstable vital signs.
3. Underlying Cardiovascular conditions
4. Recent Surgery
5. Musculoskeletal injuries or disorders
6. CNS or PNS involvement.

Before the study, written consent was obtained by signing the consent form and the subjects were allotted to one of the two groups: Group A(conventional Group, n=15) and Group B(experimental group, n=15). The intervention period for both the groups was of 7 days with one session per day lasting for 25-30 mins.

Their vitals were monitored during each session. Outcome measures such as chest expansion, modified rate of perceived exertion, and single breath-hold count were obtained before and after 7 days of intervention.

The modified Borg scale was used for assessing the rate of perceived exertion and chest expansion was measured using a tape measure.

The single breath-hold count is a novel technique for measuring pulmonary function[11]. It is the measurement of how far an individual can count using a normal speaking voice after one maximal effort inhalation. The count is in cadence to a metronome that is set at 2 beats per second, normal range being between 30-40.

Group A received conventional respiratory therapy:

Breathing exercises- Diaphragmatic Breathing
Active Cycle of Breathing Technique
Chest mobility exercises- Mobilising the upper chest and mobilising one side of the chest.

Group B received the trunk PNF patterns along with conventional treatment

Subjects of Group B were taught the PNF patterns of the trunk first, after which 2-3 practice trials were performed. They were asked to do 2 repetitions on each side i.e. left and right in sitting position and encouraged to inhale while lifting and exhale while chopping.

'Chopping' consists of bilateral asymmetrical upper extremity extension with neck flexion while 'Lifting' consists of bilateral asymmetrical upper extremity flexion with neck extension[4].
The statistical analysis of the present study was done using Graph Pad Prism 8.3.1 software to verify the results obtained. All the statistical tests were done based on the normal distribution of the data obtained.

Comparison of the intragroup data i.e. pre- and post-intervention changes on day 1 and day 7 was done using a paired t-test and Wilcoxon test. Comparison of the intergroup data i.e. difference between the pre- and post-intervention values was done using the Mann Whitney U test. Significance was set at 0.05 and Data will be presented as mean, standard deviation and its significance based on the p-value.

RESULTS

Table 1 Intra-Group Analysis of Group A (Conventional Group)

	PRE		POST		p VALUE
	Mean	SD	Mean	SD	
1. CE	24.2	0.456	27.4	0.47	0.0001*
2. SBHC	358	2.949	378	2.81	<0.0001*
3. MRPE	3.933333333	1.668	2.866666667	1.25	<0.0001*

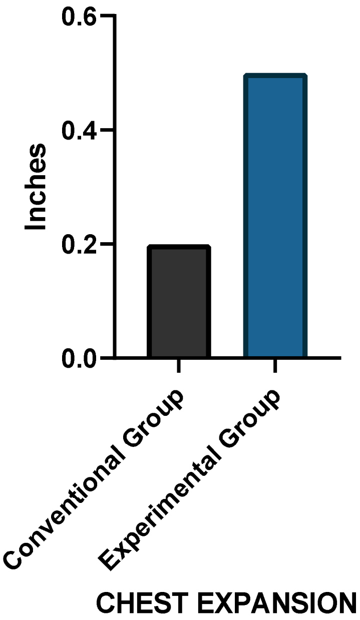
Table 2 Intra-Group Analysis of Group B (Experimental Group)

	PRE		POST		p VALUE
	Mean	SD	Mean	SD	
1. CE	21.8	0.44	28.2	0.43	<0.0001*
2. SBHC	371	3.65	413	3.34	<0.0001*
3. MRPE	3.93333333	1.71	2.933333333	1.28	<0.0001*

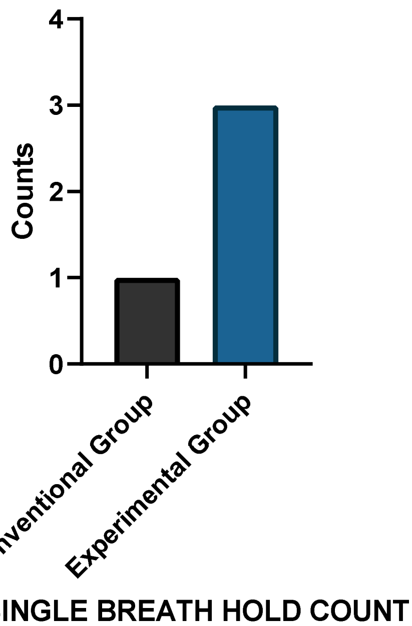
Table 3 Inter-Group Analysis Between Group A & Group B

	p VALUE	SIGNIFICANCE
1. CE	0.001	highly significant
2. SBHC	0.001	highly significant
3. MRPE	0.862	not significant

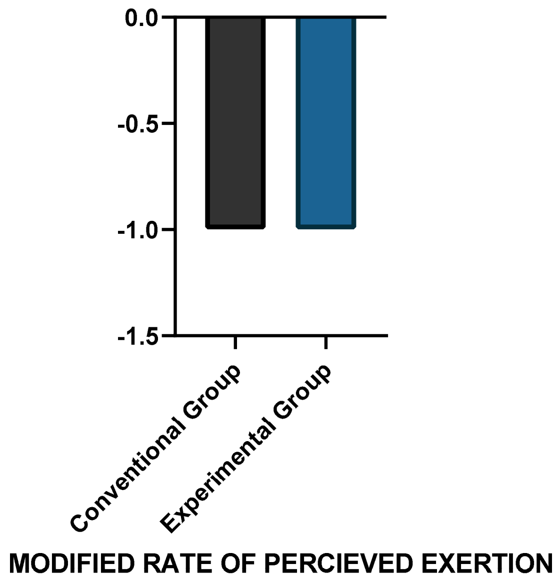
Footnote: *statistically highly significant, CE- chest expansion, SBHC- single breath-hold count, MRPE- modified rate of perceived exertion, SD- standard deviation.



Graph 1 Chest Expansion



Graph 2 Single Breath-Hold Count



Graph 3 Modified Rate of Perceived Exertion

DISCUSSION

Statistical analysis and interpretation of the results obtained from the present study revealed that, in comparison to the conventional treatment alone, the trunk PNF patterns had a highly significant effect on chest expansion and single breath-hold count however, no significant effect was found on the modified rate of perceived exertion.

The possible mechanism behind the improvement of chest expansion could be that the chop and lift trunk patterns may have enhanced the neurophysiological drive to the intercostal, diaphragmatic, and abdominal muscles, which may have resulted in more movement awareness and thoracic wall compliance[10].

Another reason could be the stretch reflex elicited in the intercostal and thoracoabdominal muscles by giving a stretch at the end of each pattern. The stretch reflex comes into play whenever we try to stretch a muscle, it contracts reflexively because the stretching of muscle causes stretching of muscle spindle which gets stimulated and start discharging sensory impulses; the impulses are then transmitted via primary and secondary nerve fibres to the spinal cord and end directly on alpha motor neurons, which by receiving an impulse from sensory nerve fibres, send motor impulses to muscles through their fibres and cause contraction of extrafusal fibres[9]. A study conducted by Dangi Ashwini concluded that IC stretch enhances the chest wall elevation and increases chest expansion[12].

Also, the proprioceptive information arising from respiratory muscles may regulate the motor activity through long loop reflexes that include the medullary respiratory centres. Proprioceptive information through segmental and intersegmental loops at the spinal level may also influence the motor activity. Afferent information from the lower intercostals and the abdominal muscles (T9-T10) may facilitate phrenic motoneurons by spinal reflex, and the thoracic respiratory neurons seem to receive respiratory drive mainly via a network of thoracic interneurons[9]. The single breath-hold count has been correlated well with standard

measures of pulmonary functions (FEV1, FVC, FEV1/FVC, PEFR, forced expiratory flow)[11]. In the present study, particular emphasis was placed on inhaling and exhaling during the lift and chop patterns respectively. In their study Kyo Chul Seo *et al* have described the mechanism that due to repetitive PNF breathing exercises, the mobility of the subjects' chest walls increased, which led to improvements in pulmonary function[3]. The present study also shows an improvement in chest expansion which has been correlated with lung volumes in the previous literature. Thus, the combination of both these factors- breathing activity during PNF patterns and improved chest expansion may have produced a significant effect on the single breath-hold count.
Borg described that heart rate (HR) is directly related to perceived exertion andthe local production of muscle lactate[13].

In the study of Gültekin *et al*, it was proven that the exercise using the PNF technique increases the concentration of lactate after exercise[14], which supported the evidence of Alessandra Araujo da Silva *et al* who observed an increase in HR and perceived exertion after administrating a protocol of upper body PNF patterns with loaded pulleys (2kgs-10kgs) for 3 sets of 10 repetitions[15]. In the present study, as no resistance was applied in any form and only 2 repetitions were given, it did not contribute an increase in HR and production of muscle lactate, thus having no significant effect on the modified rate of perceived exertion.

CONCLUSION

The present study concluded that there is a significant effect of Trunk PNF patterns and conventional respiratory therapy on chest expansion and single breath hold count of COPD patients than conventional therapy alone, so it has a definite role to play in rehabilitation. However no significant effect was observed on the modified rate of perceived exertion of these patients.

Limitations

The limitations of this study are that it’s sample size and the period of intervention is small. Also, a follow up was not kept after the 7 days of the treatment sessions.

Recommendations

Thus, it can be recommended that further studies could be carried out with a larger sample size and with a longer duration of intervention. Also, a follow up after a period of 2 to 4 months may be done to ascertain the long-term effects of trunk PNF technique on COPD.

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