

## Comparison of rib cage mobilization and diaphragmatic breathing on lung function in patients with COPD

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### ABSTRACT

COPD patients shows limited thoracic expansion due to loss of mobility at costovertebral joint, costochondral joint and costotransverse joint. Rib cage mobilization can increase rib cage mobility and improve thoracic expansion in COPD patients.

**Objective:** The study was conducted to compare the effects of rib cage mobilization and diaphragmatic breathing on lung function in patients with COPD.

**Materials and Methods:** A Randomized clinical trial was conducted. IRCT No: IRCT20210108049966N2. Data was collected from Idrees teaching hospital Sialkot Cantt, Allama Iqbal memorial hospital Sialkot, Chest and gynae hospital Sialkot. Sample size was 22. Patients with COPD was recruited and divided in two groups. One group received rib cage mobilization (10 males and 1 female) and other group received diaphragmatic breathing (7 males and 4 females) were participated by using a non-probability convenience sampling technique and the data was analyses through SPSS version 25. Baseline values for height, weight, BMI FEV1/FVC ratios and dyspnea index were calculated before the interventions. 3 weeks of both interventions were given. After 3-week FEV1/FVC and dyspnea index was measured again to check the effects of both treatments.

**Results:** Groups were homogenous at baseline and not statistically significant in all the parameters including FEV1/FVC ratio and dyspnea index with p value > 0.05. After the analysis, it was found that within group analysis showed a statistically significant (p < 0.001) improvement in the entire outcome measures including FEV1/FVC ratio and dyspnea index in both groups.

**Conclusion:** In this study rib cage mobilization is more effective rather than diaphragmatic breathing on lung function in COPD patients to improving FEV1/FVC ratio and dyspnea index.

**Index Terms-** COPD, rib cage mobilization, diaphragmatic breathing.

### I. Introduction:

COPD is well known progressive multisystem complex medical condition with pulmonary and extrapulmonary symptoms which are not fully

reversible. Chronic obstructive pulmonary disease (COPD) is defined by Global initiative of chronic obstructive pulmonary disease (GOLD) a prevalent, manageable, and preventive disease which have constant pulmonary signs and symptoms with airway obstruction and alveolar destruction.<sup>(1)</sup> COPD patients have structural and functional changes e.g., structural changes of diaphragm and thoracic cage make patients more impaired. Most complaint of shortness of breath is due to airflow limitation during exercise.<sup>(2)</sup> An estimated 65 million people have moderate to severe COPD in 2015, from about 3 million die yearly and the numbers are increasing. COPD is mostly observed in men but number of deaths and cases are also increasing among women.<sup>(3)</sup> COPD mortality rate has fallen from three million to 2.8 million from 1990 to 2010; overall decrease is due to reduction in causes of death in COPD.<sup>(4)</sup> Among risk factors for COPD smoking is considered one of most important risk factors. Tobacco is cause of one hundred million deaths in 20<sup>th</sup> century. Lifetime smokers have more chances to develop COPD rather than non-smokers. But COPD among non-smokers is 30% prevalent which shows other links of risk factors among these patients.<sup>(5)</sup> COPD patients shows limited thoracic expansion due to loss of mobility at costovertebral joint, costochondral joint and costotransverse joint. Rib cage mobilization can increase rib cage mobility and improve thoracic expansion in COPD patients. Physical therapy and rehabilitation can play key role in COPD patients.<sup>(6)</sup> Fletcher and Peto curve show the decline in forced expiratory volume 1 (FEV1) across the life span of an individual and this shows lung aging process with advancing age. This curve shows that in unites states FEV1 declined more with age in never smokers. FEV1 shows slow decline at beginning of disease and become faster with advancing disease.<sup>(7)</sup> Pulmonary rehabilitation is a non-pharmacological technique and has vital role in reliving the symptoms of COPD and improvement in health-related quality of life in COPD patients. Respiratory conditioning maneuver involves therapist assisted rib cage mobilization optimizing the breathing patterns and increases in rib cage flexibility.<sup>(8)</sup> Diaphragmatic breathing reduces stress and relaxing therapeutic technique used in yoga

and physical therapy. It is practiced without aid of physical corset and have key role in rehabilitation of COPD and asthma patients. Diaphragmatic breathing improves tidal volume and also reduces breathing frequency.<sup>(9)</sup>

A RCT study was done by Marcelo et. al. to determine the effects of diaphragmatic breathing in patients with chronic obstructive pulmonary disease. Study concluded that diaphragmatic breathing training can reduce dyspnea and improve tidal volume in patients with intact respiratory musculature.<sup>(10)</sup> Taciano Rocha did a randomized control trial on manual rib cage mobilization technique. Chronic obstructive pulmonary disease patients can be managed by applying rib cage mobilization technique.<sup>(11)</sup> Random cross over trail study was done by Aishwarya Nair (2019) to compare the effects of diaphragmatic breathing technique and manual diaphragmatic release technique in patients with chronic obstructive pulmonary disease. In diaphragmatic release technique significant improvement found after and before the technique rather than diaphragmatic breathing technique. They also reported the safety of both techniques application in patients with mild to moderate symptoms of COPD.<sup>(12)</sup> Pulmonary functions are being assessed by measurement of respiratory function. Improvement in respiratory function can be made through rib cage mobilization and diaphragmatic breathing. Moreover, there was limited literature for comparative study of diaphragmatic breathing technique and rib cage mobilization technique in COPD patients.

## II. Materials & Methods:

This research was a randomized clinical trial (RCT) and trail no. is IRCT No: IRCT20210108049966N2. Prior to being included in the trial, all patients signed an informed consent agreement. Non- probability convenient sampling approach was accustomed to recruit the individuals for the study and after that randomization process was done by Lottery method to divide the subjects into Group-A and Group-B. Data was collected from Idrees teaching hospital Sialkot Cantt, Allama Iqbal memorial hospital Sialkot, Chest and gynae hospital Sialkot. Sample size was calculated by epi-tool. In this study, 22 participants were selected as per criterion for inclusion and exclusion. 11 participants were in group-A and 11 participants in group-B. Age 40 to 70year, at least history of COPD from 1 year, altered dyspnea index, decrease FEV1/FVC and COPD Grade II and III were included. EXCLUSION CRITERIA was acute exacerbation of COPD, grade

IV COPD patients, patients with comorbidities and patient in any life-threatening condition. Data Collection Tool was Dyspnea index, FEV1/FVC ratio and Spirometer

Group A: Rib cage mobilization, postural drainage, breathing exercises (expiratory)

Group B: diaphragmatic breathing, postural drainage, breathing exercises (expiratory)

## III. RESULTS

SPSS version 21 was used to interpret the data. The feature frequency %, mean, and standard deviation were utilized to show categorical and demographic data. The level of significance accepted as  $P < 0.05$ . Numeric variables were defined as mean  $\pm$  standard deviation. The data's normality was evaluated using the Shapiro-Wilk test of normality and uniformity. If Value of the Shapiro-Wilk Test  $> 0.05$ , the data would be normal and parametric tests of analysis would be used. A significant difference was defined as one with a p-value  $< 0.05$ .

The following tests were used: Differences between pre- and post-treatment values: within the same group, analyzed by using the paired t-test Differences between the groups: between the groups, analyzed by using independent samples t-test.

The CONSORT diagram (figure 1) shows the progress of participants at each stage of the study. 28 participants were assessed according to the eligibility criteria. 6 of them were excluded. 2 of them were not fulfilling the inclusion criteria, 3 of them refused to participate and 1 had other issues. Baseline values of demographic data variables like age, gender, weight, height and BMI of participants across both groups were comparable on basis of mean  $\pm$  std. deviation.

Total 22 patients, 11 in rib cage mobilization group while 11 in diaphragmatic breathing group. Most participants in rib cage mobilization are between 45-55 years of age while most participants in diaphragmatic breathing are between 63-67 years of age. 10 males and 1 female were got the rib cage mobilization while 7 males and 4 females were received the diaphragmatic breathing. Rib cage mobilization had mean value of 60.63kg for weight while diaphragmatic breathing group had mean value 71.09kg. Rib cage mobilization with mean value of 2.72m<sup>2</sup> for height and Diaphragmatic breathing group had mean value of 2.57m<sup>2</sup> for height. DAPRE technique with mean value of 170.41cm for height and diaphragmatic breathing group had mean value of 168.79cm for height. Rib cage mobilization with mean value of 22.22 kg/m<sup>2</sup> for BMI and diaphragmatic breathing group had mean value 27.50 kg/m<sup>2</sup> for BMI.

Groups were homogenous at baseline and not statistically significant in all the parameters including FEV1/FVC ratio and dyspnea index with p value > 0.05 (table 1).

**TABLE 1: Between group comparison of FEV1/FVC ratio and Dyspnea index among the groups:**

Variable	Rib cage mobilization (Mean± S.D)		Diaphragmatic breathing (Mean ± S.D)		p-Value
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	
<b>FEV1/FVC ratio</b>	70.90±12.81	93.45±3.26	72.36±1.81	78.36±7.68	0.00
<b>Dyspnea index</b>	39.27±8.78	67.54±5.69	40.54±12.04	50.54±6.31	0.00

After the analysis, it was found that within group analysis showed a statistically significant ( $p < 0.001$ ) improvement in the entire outcome measures including FEV1/FVC ratio and dyspnea index in both groups. (Table 2)

**Table 2: Baseline measurement of outcome variables:**

Variable	Rib cage mobilization	Diaphragmatic breathing	Value
	Mean±S.D	Mean±S.D	
<b>F</b>	70.90±12.81	72.36±11.81	.785
<b>D</b>	39.27±8.78	40.54±12.04	.780

The between-groups analysis showed statistically significant differences in FEV1/FVC ratio and dyspnea index with p-values of 0.00 and 0.00 respectively. (Table 2)

The results of this study state that rib cage mobilization is more effective rather than diaphragmatic breathing in terms of outcome measures.

#### IV. Discussion

This study was a randomized control trial designed to determine the effects of rib cage mobilization and diaphragmatic breathing on lung function of COPD patients. 22 participants were included in this study. 2 groups were made; one was given rib cage mobilization treatment and other was given

diaphragmatic treatment. 11 participants were assigned to each group. Baseline values for height, weight, BMI FEV1/FVC ratios and dyspnea index were calculated before the interventions. 3 weeks of both interventions were given. After 3-week FEV1/FVC and dyspnea index was measured again to check the effects of both treatments. There was no significant correlation in diaphragmatic breathing and rib cage mobilization. It concluded that rib cage mobilization has more benefit over diaphragmatic breathing for treatment of COPD patients.

Previous research found the significant improvement in respiratory muscle synergists with breathing exercises but avoid too much mobilization because it can cause dyspnea. Role of body function was also highlighted in improvement of respiratory function in patients with mild COPD.<sup>(13)</sup> A study concluded that rib cage mobilization and diaphragmatic breathing improved FEV1/FVC ratio, PEF, Dyspnea index and chest circumference in patients rather than control group. It stated that rib cage joint mobilization technique in combination with diaphragmatic breathing have more beneficial effects rather than only application of rib cage mobilization.<sup>(14)</sup> In contrast to our study concludes that rib cage mobilization is more beneficial in improving FEV1/FVC ratio and dyspnea index. Diaphragmatic breathing showed a little change in FEV1/FVC ratio and dyspnea index as compared to rib cage mobilization technique.

#### V. Conclusion

Rib cage mobilization is more effective rather than diaphragmatic breathing on lung function in COPD patients.

#### Conflict of Interest

There was no conflict of interest.

#### Financial Statement

No fundings were given by any authorities; it was a project thesis of doctor of physical therapy.

#### Data availability

Data will be provided on the demand by corresponding author.

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