# Comparative Study of Flutter Device and Active Cycle of Breathing Technique in Airway Clearance in Subjects with Chronic Obstructive Pulmonary Disease

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## Abstract

**Background and Objectives:** Chronic obstructive pulmonary disease is a disorder characterized by presence of air flow obstruction that is generally progressive, may be accompanied by airway hyperactivity and maybe partially reversible. COPD comprises major pathological changes. Conventional airway clearance techniques form the main stay of the routine Pulmonary Rehabilitation of subjects with chronic obstructive pulmonary disease. The procedure of Active Cycle of Breathing Technique causes an increase in lung volume which allows air to flow via collateral channels and may assist in mobilizing the secretions which but incorporating newer techniques that are effective, comfortable and can be independently performed by the subject without assistance help motivate the subjects to participate actively in their own health care. A device is proposed to have good efficacy, reliability and provides relief of the symptoms in a better way than the manual therapy in a way by excluding the bias and thus can be used as an alternative to it, so proves efficient to it. This study incorporates a device called 'THE FLUTTER DEVICE' which aids in mucus clearance in subjects with COPD effectively. **Materials and Methodology:** The Study participants were thirty subjects aged 35 to 45yrs with chronic obstructive pulmonary disease. After two weeks of ACBT and Flutter therapy with routine Physiotherapy each patient was told to record their VAS score for breathlessness on Visual Analogue Scale for breathlessness, the patient's peak expiratory flow rate was then checked with the peak flow meter and $FEV_1$/FVC percentage was also obtained from the patient's Pulmonary Function Test reports. **Results:** Data was analyzed by statistical means, standard deviation and students t- test and the results showed significant changes in terms of the VAS score for breathlessness, PEFR, $FEV_1$/FVC percentage of PFT. **Conclusion**: It can be concluded that application of flutter therapy for airway clearance to patients with Chronic obstructive pulmonary disease decreased the breathlessness drastically and increased the peak expiratory flow rate and $FEV_1$/FVC percentage than the application of ACBT.

***Key Words**: COPD- Chronic Obstructive Pulmonary Disease, PEFR- peak expiratory flow rate, $FEV_1$/FVC- Ratio of forced expiratory volume in one second to Forced Vital Capacity, ACBT- Active Cycle of Breathing Technique.*

## Introduction

Chronic obstructive pulmonary disease is a disorder characterized by presence of air flow obstruction that is generally progressive, may be accompanied by airway hyperactivity and maybe partially reversible. This disorder includes conditions like chronic bronchitis, Emphysema and Asthma. Diagnosis of COPD should be considered in any patient with symptoms of cough, sputum production, dyspnea and history of exposure to risk factors for the disease. The diagnosis requires spirometry, post-bronchodilator $FEV_1$/FVC< 0.7 confirms presence of airflow limitation that is not fully reversible. A Spiro-metric classification predicts health status, utilization of health care resources[01], development

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of exacerbation[02, 03] and mortality in COPD. A post-bronchodilator $FEV_1$/FVC < 70%, in combination with an $FEV_1$< 80% predicted, in an individual cough, sputum production or dyspnoea and exposure to risk factors confirms the diagnosis.

The different pathogenic mechanisms include Mucous hyper secretion and Cilliary dysfunction , Airflow limitation and hyperinflation , Gas exchange abnormalities , Pulmonary hypertension with other Systemic effects.

The goals of physiotherapy are to optimize oxygen transport, improve ventilation-perfusion mismatching, increase lung volume and enhance mucocilliary clearance (Ciesla 1996, Stiller2000). In the more recent years incorporating newer techniques that are effective, comfortable and can be independently performed by the subject without assistance help motivate the subjects to participate actively in their own health care. A device is proposed to have good efficacy, reliability and provides relief of the symptoms excluding the bias can be used as an alternative to it. This study incorporates a device called 'THE FLUTTER DEVICE' which aids in mucus clearance in subjects with COPD effectively[14].

## Materials and Methodology

Study participants were sixty male and female COPD subjects according to American Thoracic Society criteria aged 35 to 45yrs. Patients who enrolled in the study were from Tertiary care Hospitals and Clinics in Bangalore. Simple Random Sampling Technique was used and it was a Comparative Study Design. Subjects with dyspnoea at rest, chest pain, hemoptysis and hematemesis, Un co-operative patients, previous history of cardiac, lung and abdominal surgeries, Pregnant women, previous hernias, prolapsed uterus, any underlying cardiac disease, or musculoskeletal disorders were excluded from the study. After selection they were randomly assigned into two groups,

Group A- 30 subjects received Flutter device.

Group B- 30 subjects received Active Cycle of Breathing Technique

Outcome Measure : VAS score for breathlessness on Visual Analogue Scale for breathlessness, peak expiratory flow rate with the peak flow meter and $FEV_1$/FVC percentage from the patient's Pulmonary Function Test Reports.

**Procedure**

After obtaining ethical clearance from the committee subjects were selected, screened and diagnosed with COPD by chest physician for the study. On obtaining the filled consent, the subjects were thoroughly assessed before taking them in the study. Subjects were assigned to two groups i.e. Group A and Group B having 30 patients in each group.

Each patient was then told to record their VAS score for breathlessness, Peak expiratory flow rate checked with Peak flow meter and $FEV_1$/FVC percentage from patient's Pulmonary Function Test reports.

Group A was assigned for Flutter therapy. All 15 subjects were given flutter therapy for 15mins for two weeks alongwith routine Physiotherapy treatment[5,6].

**Stage 1 - Mucus Loosening and Mucus Mobilization:** Patient slowly inhaled to approximately 3/4 of a full breath. Flutter positioned at proper angle was placed in the mouth with lips closed firmly then 2 to 3 second breath-hold was performed and Patient was asked to exhale through Flutter fast but not too forceful and repeated for 5 breaths.

**Stage 2- Mucus Elimination:** The patient was made perform 1 or 2 additional breaths through the Flutter. This time full inspiration, breath hold and a forceful exhalation that moved mucus up to a level in the lungs that triggered a cough followed by a pause for breathing control following a huff or cough.[6] continuing for a total session of 15mins.

Group B was assigned for Active cycle of breathing technique treatment for 15 min for two weeks alongwith routine Physiotherapy Treatment. The ACBT was performed according to guidelines developed by Patridge et al (1989) and Pryor (1991).

The standardized **ACBT cycle** consisted of Breathing Control; four Thoracic Expansion exercises; Breathing Control; three to four Thoracic Expansion exercises; Breathing control; two forced expirations (huffs and breathing control) (Pryor 1991). Each standardized ACBT cycle was around two minutes with

duration of each session for 15mins.

After two weeks of therapy each patient was told to record their VAS score for breathlessness on Visual Analogue Scale for breathlessness, the patient's peak expiratory flow rate was then checked with the peak flow meter and $FEV_1$/FVC percentage was also obtained from the patient's Pulmonary Function Test reports.

## Result

**TABLE NO.1- Comparison of Breathlessness within Flutter device and Active cycle of breathing technique**

| Breathlessness (VAS) | Pre therapy | | Post therapy | | Effect size | z-value | P-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Flutter device | 6.80 | 0.86 | 2.60 | 0.99 | 1.23 | 3.535 | <0.001 |
| Active cycle of breathing technique | 6.60 | 0.99 | 4.67 | 0.90 | 0.54 | 3.624 | <0.001 |

In this study it is observed that in Flutter therapy the mean + SD for VAS score in pre-therapy is 6.80 ± 0.86 and post-therapy is 2.6 + 0.99 It has an effect size of 1.23 hence the difference in mean is found to be statistically significant ($p<0.001$) . In ACBT group the mean + SD for VAS score in pre-therapy is 6.60+0.99 and post-therapy is 4.6 ±0.90. It has an effect size of 0.54, hence the difference in mean found to be statistically significant ($p<0.001$). This showed that within the group individually both the therapies can bring improvement in reducing breathlessness measured by VAS score for breathlessness from pre-therapy to post-therapy.

**TABLE NO.2- Comparison of PEER from pre-test to post-test in Flutter device and Active cycle of breathing technique**

| Flutter Device | Pre therapy | | Post therapy | | Effect size | z-value | P-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Flutter device | 235.33 | 23.56 | 365.33 | 40.15 | 0.03 | 25.636 | <0.001 |
| Active cycle of breathing technique | 263.33 | 45.93 | 278.67 | 49.98 | 0.002 | 4.219 | <0.001 |

It is observed in this study that in Flutter therapy the mean + SD of PEFR in pre-therapy is 235.33 ±23.56 and post-therapy is 365.33 ± 40.15, it has an effect size of 0.03 hence the difference in mean is found to be statistically significant ($p<0.001$). In ACBT group the mean ± SD of PEFR in pre-therapy is 263.33 + 45.93 and post-therapy is 278 ± 49.98. It has an effect size of 0.002, hence the difference in mean found to be statistically significant ($p<0.001$). This showed that within the group individually both the therapies can bring improvement in peak expiratory flow rate measured peak expiratory flow meter from pre-therapy to post-therapy.

**TABLE NO. 3- Comparison of $FEV_1$/FVC percentage from pre-test to post-test in Flutter device and Active cycle of breathing technique**

| Flutter Device | Pre therapy | | Post therapy | | Effect size | z-value | P-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Flutter device | 56.73 | 5.61 | 65.87 | 6.02 | 0.07 | 22.141 | <0.001 |
| Active cycle of breathing technique | 54.80 | 4.77 | 55.73 | 4.27 | 0.01 | 2.824 | <0.014 |

In Flutter therapy the mean +SD of $FEV_1$/FVC percentage in pre-therapy is 56.73+5.61 and post-therapy is 65.87 ±6.02, it has an effect size of 0.07 hence the difference in mean is found to be statistically significant ($p<0.001$). In ACBT group the mean +SD of $FEV_1$ /FVC percentage in pre-therapy is 54.80 +4.77 and post-therapy is 55.73 +4.27. It has an effect size of 0.01, hence the difference in mean found to be statistically significant ($p<0.014$).This showed that within the group individually both the therapies can bring improvement in the ratio of forced expiratory volume in one second to forced vital capacity from pre-therapy to post-therapy.

**TABLE NO.4- Comparison of breathlessness between Flutter device and Active cycle of breathing technique during pre and post therapy**

| Breathlessness (VAS) | Flutter device | | Active cycle of breathing technique | | Effect size | z-value | P-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Pre therapy | 6.80 | 0.86 | 6.60 | 0.99 | 0.23 | 0.482 | >0.653 |
| Post therapy | 2.60 | 0.99 | 4.67 | 0.90 | 2.32 | 4.051 | <0.001 |

In Flutter therapy group the mean ±SD of VAS in pre therapy was 6.80 + 0.86 and 2.60 + 0.99 in post therapy. In ACBT group, the mean ± SD of VAS in pre therapy is 6.60 + 0.99 and 4.67 + 0.90 in post therapy. The effect size in pre therapy between Flutter therapy and ACBT group was 0.23. It has a low effect size of and hence the difference in mean is found to be statistically not significant **(P value > 0.634).** But the effect size in post therapy between Flutter therapy and ACBT group is 2.32 **(P value < 0.001).** Thus signifies that Flutter therapy is better reducing the breathlessness than Active cycle of breathing technique.

**TABLE NO.5- Comparison of PEFR between Flutter device and Active cycle of breathing technique during pre-therapy.**

| PEFR | Flutter device | | Active cycle of breathing technique | | Effect size | z-value | P-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Pre therapy | 235.33 | 23.56 | 263.33 | 45.93 | -0.01 | 2.101 | <0.045 |
| Post therapy | 365.33 | 40.15 | 278.67 | 49.98 | 0.01 | 5.235 | <0.001 |

In Flutter therapy group the mean + SD of PEFR in pre therapy was 235.33 ± 23.56 and 365.33 + 40.15 in post therapy. In ACBT group, the mean ± SD of PEFR in pre therapy is 263.33 + 45.93 and 278.67 ± 49.98 in post therapy. The effect size in pre therapy between Flutter therapy and ACBT group was -0.01**(P value < 0.045).** The effect size in post therapy between Flutter therapy and ACBT group is 0.01, statistically significant and **(P value < 0.001)** and greater than in pre-therapy. Thus signifies that Flutter therapy improves the peak expiratory flow rate better than Active cycle of breathing technique.

**TABLE NO.6- Comparison of FEV1/FVC percentage between Flutter device and Active cycle of breathing technique during pre-therapy**

| FEV1/FVC (%) | Flutter device | | Active cycle of breathing technique | | Effect size | z-value | P-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Pre therapy | 56.73 | 5.61 | 54.80 | 4.77 | 0.02 | 1.107 | >0.318 |
| Post therapy | 65.87 | 6.02 | 55.73 | 4.27 | 0.09 | 5.317 | <0.001 |

In comparison the Flutter therapy group the mean + SD of $FEV_1$/FVC percentage in pre therapy is 56.73 + 5.61 and 65.87 +6.02 in post therapy. The effect size in pre therapy between Flutter therapy and ACBT group was 0.02. It has a low effect size of and hence the difference in mean is found to be statistically not significant **(P value > 0.318).** In ACBT group, the mean + SD of $FEV_1$/FVC percentage in pre therapy is 54.80 + 4.77 and 55.73+4.27 in post therapy but the effect size in post therapy between Flutter therapy and ACBT group is 0.09 **(P value <0.001)**. Thus signifies that Flutter therapy is better in improving the ratio of forced expiratory volume in one second to forced vital capacity from pre-therapy to post-therapy than Active cycle of breathing technique.

## Disscussion

Patients that recieved flutter therapy decreased

the breathlessness drastically than ACBT therapy. It also increased PEFR and $FEV_1$/FVC percentage in two weeks as compared to ACBT therapy. No acute adverse response to flutter therapy or Active cycle of breathing technique in terms of oxygen saturation, heart rate, blood pressure, and respiratory rate was observed. The findings reveal that the Flutter therapy in the airway clearance of COPD patients accelerates recovery than Active cycle of breathing technique without any detrimental effects, whereas some studies have suggested undesirable acute effects of conventional chest physiotherapy on pulmonary function in patients with acute exacerbations of chronic bronchitis. Campbell (1975) and Wollmer et al (1985)[13,14] demonstrated a decrease in $FEV_1$ as an acute response to head down positioning combined with chest percussion in patients with acute exacerbation of chronic bronchitis. Girad JP and Terki N[10] demonstrated forced expiratory volume in one second; vital capacity and peak expiratory flow were significantly improved by daily use of this therapeutic device as the sole physiotherapy and did not take any mucolytics.

The Flutter assisted patients in achieving goal of airway clearance comfortably and efficiently. Also the findings reveal that the Flutter therapy accelerated recovery than ACBT without any detrimental effects. Thus, device showed to have better efficacy and provided relief of the symptoms in a better way than the manual therapy in a way by excluding the bias and thus can be used as an alternative to it, so proves efficient to it.

**Limitation**

- Some limitations of this study were that sputum production; health related quality of life like outcome measures could have been taken into consideration.
- Also a larger sample size could have been selected.

**Suggestions For Future Study**

- The same study can be done on a larger population
- The study duration can be increased.

## Conclusion

From this study we can conclude that Flutter therapy is more effective treatment approach for airway clearance in COPD patients. The findings showed that Active cycle of breathing technique therapy would take relatively more period of time for obtaining near similar results which were achieved by Flutter therapy. Thus it can be concluded that application of flutter therapy for airway clearance to patients with Chronic obstructive pulmonary disease decreased the breathlessness drastically and increased the peak expiratory flow rate and $FEV_1$/FVC percentage than the application of Active cycle of breathing technique.

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**Conflict of Interest** - Nil

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