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Effect of Soft Tissue Release Manual Therapy Techniques in Patients with Moderate Chronic Obstructive Pulmonary Disease- A Pilot Study

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ABSTRACT

In Chronic Obstructive Pulmonary Disease (COPD) an extra pulmonary manifestation includes altered chest wall mechanics and musculoskeletal dysfunction. The influence of soft tissue manual therapy techniques on chest expansion and pulmonary function remains largely unclear. Therefore, the purpose of this pilot study was to find the effectiveness of soft tissue release manual therapy techniques (STRMTT) on improvement of chest expansion, Pulmonary function- FEV/FEV6, health related quality of life in patients with moderate COPD. A comparative study design with two groups- Experimental Group and Control Group, conducted on total 20 subjects, 10 in each group. The Experimental group subjects received soft tissue release manual therapy techniques along with conventional treatment whereas control group subjects received only conventional exercises. Both the group subjects received treatment twice in a week for a period of eight weeks. The outcome measures such as Chest expansion, pulmonary function FEV1/FEV6 and Quality of life were measured at before intervention and after 8 weeks of intervention. The comparative analysis of post intervention means using Independent 't' test between the groups found statistically significant difference ($p<0.05$) in Chest expansion at Axillary level and Xiphisternum level, FEV1/FEV6, between the groups and there is no statistically significant difference in Quality of life measured using St. George respiratory questionnaire components- Symptoms, Activity, Impact and total score. The study concluded that 8 weeks of soft tissue release manual therapy techniques along with conventional treatment shown statistically significant effect in improving chest expansion and FEV1/FEV6 when compared with the only conventional exercises.

KEY WORD: S Moderate COPD, Soft tissue manual release techniques, Manual therapy, chest expansion, Pulmonary function, FEV/FEV6, health related quality of life, St George Respiratory Questionnaire.

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INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a respiratory disorder characterized by progressive airflow limitation, partially reversible airway obstruction and lung hyperinflation associated with an abnormal inflammatory response of the lung to noxious particles or gases with some significant extra pulmonary effects that may contribute to increasing frequency and severity of exacerbations in individual patients.[1] COPD is a major cause of morbidity and mortality worldwide and is becoming more prevalent.[1]

The extra pulmonary manifestations in COPD include altered chest wall mechanics and musculoskeletal dysfunction, these changes in COPD shown to have exercise-limiting dyspnoea, reduced exercise tolerance and impaired health-related quality of life (HRQOL).[2,3] Chest wall mechanics is altered due to the tightness of cervico thoracic fascia around the chest wall causing postural changes such as head is in forward projection, neck in hyperextension, exaggerated thoracic kyphosis and shoulders in protraction and internal rotation. The altered chest wall mechanics increases chest tightness which decreases the ability to generate inspiratory pressures and volumes and an increase the work of btreathing.[3,4] The consequence of altered chest wall mechanics and chest tightness causes pulmonary hyperinflation which forces the diaphragm to operate at non-optimal lengths, along with this the reduced chest wall compliance further decrease the lung volumes.[5] In subjects with COPD due to disease process along with altered chest wall mechanics and musculoskeletal dysfunction there is increase in airway resistance and airflow limitation which activates accessory muscles of respiration further increases respiratory muscle tightening, joint stiffness, increased work of breathing,[6] postural alterations and changes in rib cage configuration.[7,8]

Previous studies reported that reduction in thoracic spine mobility was linked to lower lung function, with decreases in forced vital capacity (FVC) and forced expiratory volume in one second (FEV1).[9] Kaneko H et al., studied 51 elderly male subjects with COPD, they found in their study that the majority of subjects with COPD had reduced chest and abdominal wall mobility, which was independently associated with FVC. Even though abdominal wall mobility was relatively preserved compared with chest wall mobility, it was also independently associated with 6-min walk distance (6MWD).[10] Thus, improving postural alignment and mobility of the chest wall, spine, and shoulders is now part of the recommendations for comprehensive pulmonary rehabilitation programs.[11] However, the possible effect of such interventions in patients with COPD is uncertain because little is known about the interaction between pulmonary function, posture, and mobility of the head, cervical and thoracic spines, thorax, and upper limb.[12]

Pulmonary rehabilitation has been clearly demonstrated to reduce dyspnea, increase exercise capacity, and improve quality of life in individuals with chronic obstructive pulmonary disease

(COPD). Physiotherapy interventions which is a part of Pulmonary rehabilitation uses techniques such as respiratory muscle stretching; manual therapy techniques such as agonist contraction against resistance, soft tissue release and stretching, passive joint mobilization; and respiratory muscle training, have been used to minimize changes to chest wall configuration.[11] Manual therapy techniques involves uses of hands to provide treatment to the musculoskeletal and/or visceral systems. There are many studies have described effect of manual therapy in musculoskeletal structural changes in isolation among people with COPD[13,14], although the influence of soft tissue manual therapy techniques on chest expansion and pulmonary function remains largely unclear. There are studies that studied the effectiveness of soft tissue release manual therapy techniques (STRMTT) addressing the diaphragm, anterior and posterior thoracic Myofascial structure, but there are no studies that addressed the combination of soft tissue manual therapy techniques on chest expansion and pulmonary function FEV1/FEV6 in subjects with moderate COPD. Therefore, the pilot study was proposed to find the combination of soft tissue releasing techniques to address the involved soft tissue structure in COPD. As a part of our original study, we conducted a pilot study to find the effectiveness of soft tissue release manual therapy techniques (STRMTT) on improvement of chest expansion, lung functions- FEV1/FEV6, health related quality of life in patients with moderate COPD.

MATERIALS AND METHODS

A comparative study design with two groups- Experimental Group and Control Group. As this study involved human subjects the Ethical Clearance was obtained from Assam down Town University Ethical Committee. The subjects have been selected for the study from Down Town Hospital, Guwahati, referred by Pulmonologist or the physician diagnosed with moderate COPD based on spirometry test. The study was conducted at Down Town Hospital. Subjects included in the study were with age group between 45-60 years, Physician diagnosed COPD According to GOLD Criteria Moderate: FEV_1/FVC_6 = <0.70, 50 % ≤ FEV_1<80% Predicted. [15] Be medically stable with no exacerbations in the preceding 2 months. Subjects with chest expansion measured through inch tape <1.5 cms of average of three trial at xiphisternal level and more than 0.5 cms, Subject with decreased with reduced soft tissue flexibility of thoracic muscles, evaluated by physical examination.[10] Subjects were excluded with history of asthma (defined as a ≥ 25% change in FEV_1 post bronchodilator), Patients with acute exacerbation of COPD and Supplemental oxygen dependency, history of neuromuscular conditions, history of any Vestibular condition, rheumatoid condition, neuromuscular or musculoskeletal pathology, cognitive disability that could affect their understanding or execution of the assessment tests or intervention protocol. The purpose of the study was explained to the subjects and the informed consent was obtained from the subjects in both

groups. Subjects who met inclusion criteria were allotted into Experimental and Control group by simple random sampling method.

Procedure of Treatment for Control Group:

The control group subjects were given conventional treatment[16-23] without s soft tissue release manual therapy techniques. The supervised conventional treatment was given for 2 days in a week and rest of the days subjects performed the exercises at their home, the total duration of treatment was for 8 weeks. Conventional treatment consists of 60 minutes rehabilitation program with adequate rest period includes Breathing Exercises - 5-10 minutes, Upper and Lower extremity Strength Training- The amount of resistance based on patient's ability to complete 10-15 repetitions. Progression includes increased resistance and number of sets. Social and Psychological Support.

Procedure of Treatment for Experimental group:

The subjects were treated with soft tissue release manual therapy techniques (STRMTT)[24-28] in addition to conventional treatment. Treatment regimens was applied twice weekly for 8 weeks. The STRMTT consist of a pre-determined set of following techniques was delivered as part of a single treatment session lasting 30 minutes. All techniques were administered in the same order and by a single therapist. All patients were directed to maintain deep and quiet breathing pattern as possible throughout the sessions, closely monitored during the treatment sessions to exclude any signs that may interfere with the continuity of the study.

The techniques and their respective durations are: Diaphragmatic manipulation includes- Diaphragmatic release in supine (Figure-1) and sitting (Figure-2), Re-Doming of the diaphragm in supine (Figure-3)-3 sets of 4 repetitions per each session, with 2 minutes' rest between sets. Costal/ Rib manipulative procedures includes Rib rising in supine and sitting: 3 sets of 4 repetitions per each session, with 2 minutes' rest between sets. Anterior cervical myofascial (Figure-4) applied up to 5 minutes until tissue release occurs. Anterior Thoracic Myofascial Release and Sternum Release applied up to 5 minutes until tissue release occurs. Sub occipital release (Figure-5) applied up to 5 minutes until tissue release occurs. Costal ligament balance applied up to 5 minutes until tissue release occurs**.** Thoracic lymphatic pump with activation and without activation this procedure was repeated several times.

Figure 1: Subject Receiving Diaphragmatic Release in Supine.

Figure 2: Subject Receiving Diaphragmatic Release in Sitting.

Figure 3: Subject Receiving Re-Doming of the Diaphragm in Supine.

Figure 4: Subject Receiving Anterior Cervical Myofascial Release in Supine.

Figure 5: Subject Receiving Sub Occipital Release in Supine.

Continuous conventional treatment for both the group subjects:

Patients were trained for conventional exercises under supervision during visiting days and advised to perform the same exercise twice a day at home during non visiting days and shall do four days in a week and one day rest. The patient were given a note book that contains the instructions that patient shall do at home along with number of repetition. Patients were advised to report in case if they miss any exercises or session to report and any adverse events during the study period.

Outcome measures:

The outcome measures such as Chest expansion, pulmonary function FEV1/FEV6 and Quality of life were measured at before intervention and after 8 weeks of intervention, all the outcome measures used were found reliable and valid tools. The assessment of Chest expansion[29-31] was measured using measurement tape at two levels of thorax 1. the axillary (Figure-6) and 2. the xiphisternal level (Figure-7). Pulmonary function- FEV1/FEV6 was evaluated using device Vitalograph COPD-6 (Figure-8) and collected according to the standards and procedures outlined by the American Thoracic Society[32-35] Quality of life was assessed using St George Respiratory Questionnaire consists

of components such as Symptoms, Activity, Impact and total score. Prior permission was obtained from St George University to use the Questionnaire in our study.[36-39]

Figure-6: Measuring Chest Expansion at Axillary Level.

Figure-7: Measuring Chest Expansion at Xiphisternal Level.

Figure-8: Measuring FEV1/FEV6 Using Vitalograph.

Statistical Methods

Significance was assessed at 5 % level of significance with p value was set at 0.05 less than this is considered as statistically significant difference. Paired 't' have been used to analysis the variables pre-intervention. Independent't' test have been used to compare the means of variables between two groups.

RESULTS

The pilot study was conducted total on 20 subjects (Table-1). In experimental group there were 10 subjects with mean age 54.10 years and there were 10 males and no females were included in the study. In Control Group, there were 10 subjects with mean age 54.50 years and were 8 males and 2 females were included in the study. There is no significant difference in mean ages between the groups. The pre to post intervention analysis (Table-2 & 3) within the groups shows that means of Chest expansion at Axillary level and Xiphisternum level, FEV1/FEV6, and St. George respiratory questionnaire components- Symptoms, Activity, Impact and total score were found statistically significant improvement within the Experimental and control group. The comparative analysis (Table-3) of post intervention means between the groups found statistically significant difference ($p<0.05$) in Chest expansion at Axillary level and Xiphisternum level, FEV1/FEV6, between the groups and there is no statistically significant difference in Quality of life measured using St. George respiratory questionnaire components- Symptoms, Activity, Impact and total score.

Table 1: Basic Characteristics of the Subjects Studied

Basic Characteristics of the subjects d studied		**Experimental Group**		**Control Group**		**Between the groups Significance**
Number of subjects studied (n)		10		10		--
Age in years Mean± SD (Min-Max)		54.10± 1.46 (48-60)		54.50± 1.39 (45 -60)		p= 0.194 (NS)
BMI (Mean± SD)(Min-Max)		26.43± 2.44 (22.89-30.08)		25.74± 3.78 (18.59 -32.00)		p= 0.490 (NS)
Gender	Males	10	100%	8	80%	--
	Females	0	20%	2	20%	

Table 2: Analysis of Means of Chest Expansion, FEV1/FEV6, St. George Questionnaire- Pre and Post Measurements within the Experimental Group

Experimental Group	Pre Mean±SD (min-max)	Post Mean±SD (min-max)	Percentage of Change	t value [a] (Parametric)	Significance P value
Chest expansion-Axillary level	1.78± 0.50 (1.00-2.50)	4.43± 0.71 (3.30-5.50)	4.35%	-15.821	p=0.000**
Chest expansion-Xiphisternum level	2.82± 0.65 (2.00-4.00)	6.52± 0.38 (6.00-7.0)	4.68%	-17.335	p=0.000**
FEV1/FEV6	0.49± 0.06 (0.40-0.60)	0.83± 0.06 (0.70- 0.95)	23.96%	-9.350	p=0.000**
St. George: Symptoms	68.68± 10.32 (55.41- 83.20)	50.87± 7.75 (35.00-59.65)	15.93%	4.989	P<0.001**
St. George: Activity Score	56.54± 10.75 (41.73-72.82)	33.94± 4.18 (23.28-35.79)	14.75%	7.255	p=0.000**
St. George: Impact score	38.60± 16.21 (15.13-71.80)	19.59± 9.53 (7.99-41.10)	17.61%	4.179	P<0.002**
St. George: Total score	49.03± 11.79	29.13± 6.92	27.44%	6.257	p=0.000**

	(30.32 –73.62)	(17.11-42.57)			

** Statistically Significant difference p<0.05; NS- Not significant; a. Pared t test.

Table 3: Analysis of Means of Chest Expansion, FEV1/FEV6, St. George Questionnaire- Pre and Post Measurements within the Control Group

Experimental Group	Pre Mean±SD (min-max)	Post Mean±SD (min-max)	Percentage of Change	t value [a] (Parametric)	df	Significance P value
Chest expansion- Axillary level	1.62± 0.40 (1.20-2.50)	2.96± 0.60 (2.00-4.00)	2.41%	-7.565	9	p=0.000**
Chest expansion- Xiphisternum level	2.77± 0.40 (2.20-3.50)	5.00± 0.70 (4.00-6.00)	4%	-10.909	9	p=0.000**
FEV1/FEV6	0.55± 0.04 (0.45-0.60)	0.75±.07 (0.65-0.85)	1.66%	-9.585	9	p=0.000**
St. George: Symptoms	72.27± 14.98 (50.29-95.03)	45.42± 7.19 (36.82- 63.58)	43.82%	5.335	9	p=0.000**
St. George: Activity Score	59.94± 11.12 (41.73-73.06)	37.18±3.68 (30.55-42.54)	14.49%	5.821	9	p=0.000**
St. George: Impact score	40.06± 20.03 (18.08 -75.79)	18.00± 5.56 (5.30- 27.61)	15.77%	3.091	9	p=0.013**
St. George: Total score	51.43± 14.09 (37.58-76.35)	28.37± 4.50 (19.33- 37.83)	26.55%	4.450	9	p=0.002**

** Statistically Significant difference p<0.05; NS- Not significant; a. Pared t test.

Table 4: Pre and Post Intervention Comparative Analysis: Means of Chest expansion, FEV1/FEV6, St. George Questionnaire- Between Experimental and Control group

	Pre Intervention			Post Intervention		
	Percentage of difference	t value [a] (Parametric)	Significance P value	Percentage of difference	t value [a] (Parametric)	Significance P value
Chest expansion- Axillary level	0.91%	0.786	p=0.442	-82.64%	4.954	p=0.000**
Chest expansion- Xiphisternum level	2.09%	0.206	p=0.839	-73.93%	5.969	p=0.000**
FEV1/FEV6	-5.61%	-2.492	p=0.023	-70.49%	2.449	P<0.025**
St. George: Symptoms	4.68%	-0.623	p=0.541	-26.37%	1.627	p=0.121 (NS)
St. George: Activity Score	11.39%	-0.695	p=0.496	-25.49%	-1.838	p=0.083 (NS)
St. George: Impact score	-9.01%	-0.179	p=0.860	-52.48%	0.454	p=0.655 NS
St. George: Total score	-13.12%	-0.413	p=0.685	-39.47%	0.292	p=0.773 NS

** Statistically Significant difference p<0.05; NS- Not significant a. Independent t test

DISCUSSION

It is found from the analysis that subjects with moderate COPD who were treated with 16 sessions of soft tissue release manual therapy techniques (STRMTT) for a period of 8 weeks along with conventional treatment shown statistically significant effect in improving chest expansion and FEV1/FEV6 when compared with the only conventional exercises. The effect of soft tissue manual therapy technique on improvement in Quality of life found no difference when compared with improvement in Quality of life obtained only following conventional exercises.

The experimental group who received soft tissue release manual therapy techniques along with conventional treatment shown statistically significant improvement in Chest expansion at

Axillary level and Xiphisternum level, FEV1/FEV6, and St. George respiratory questionnaire components- Symptoms, Activity, Impact and total score. When these improvements were compared with control group who received only conventional treatment there is a significant difference with greater percentage of improvement in Chest expansion and FEV1/FEV6 but there is no significant difference in improvement in Quality of life. The improvement may be attributed due to effect of soft tissue manual therapy techniques. Many studies have shown the effectiveness of soft tissue release manual therapy techniques in improvement of outcome measures in subjects with COPD. Rocha T et al., studied to evaluate the effects of the Manual Diaphragm Release Technique on respiratory function of people with COPD. They concluded that Manual Diaphragm Release Technique improves diaphragmatic mobility, inspiratory capacity and exercise capacity, suggesting that it should be considered in the management of people with COPD.[24] Yelvar GD et al., investigated the immediate effect of manual therapy (MT) on respiratory functions and inspiratory muscle strength following single session of MT in patients with COPD. The lung function, respiratory muscle strength, Heart rate, breathing frequency, and oxygen saturation, fatigue and dyspnea perception were measured before and immediately after the first MT session. They found that there was a significant improvement in the forced expiratory volume in the first second, forced vital capacity, and vital capacity values. The maximal inspiratory pressure and maximal expiratory pressure values increased significantly after MT, compared to the pre-MT session. There was a significant decrease in heart rate, respiratory rate, and dyspnea and fatigue perception. They concluded that a single MT session immediately improved pulmonary function, inspiratory muscle strength, and oxygen saturation and reduced dyspnea, fatigue, and heart and respiratory rates in patients with severe COPD. MT should be added to pulmonary rehabilitation treatment as a new alternative that is fast acting and motivating in patients with COPD.[25] Putt MT[6] et al., they performed the hold and relax stretching technique of the pectoralis major and a sham technique each for 2 days. They concluded that the hold and relax technique produces short term benefits in patients with COPD. There have been studies which have compared the effects of either soft tissue therapy alone; in combination with spinal manipulation; or soft tissue therapy, spinal manipulation and exercise therapy. Compared to the uniform approach to treatment applied in previous studies, it is possible that by basing a treatment on assessment findings, this may enable a more directed treatment that is appropriate for each individual, and may account for improvement in this patient related outcome of exercise capacity. In contrast to manual therapies focused on the thoracic spine and rib cage, an alternative focus is muscle release techniques. Diaphragm release techniques in people with clinically stable COPD have been investigated over a series of six sessions. Depth of contact is increased in subsequent breaths. It is hypothesised that this contact allows cranial-directed traction of the ribs,

along with lengthening of the diaphragm near its insertion around the anterior costal margin, produced by the compression of the diaphragm fibres in this area. The lengthening of the diaphragm, in combination with the therapist-facilitated movement of the ribs, is thought to improve the mobility of the diaphragm. The results found a cumulative increase in diaphragm mobility (measured by ultrasound) by 18 mm, and an improvement in inspiratory capacity. In addition, functional exercise capacity measured by the 6 min walk distance (6MWD) improved by 15 m with diaphragmatic release, compared to a deterioration of 6 m in the control group.[9]

The control group who received soft tissue release manual therapy techniques and conventional treatment shown statistically significant improvement in Chest expansion at Axillary level and Xiphisternum level, FEV1/FEV6, and St. George respiratory questionnaire components- Symptoms, Activity, Impact and total score. This finding may be attributed due to effect of conventional treatment.Individuals with COPD may have dynamic hyperinflation, which limits their exercise capacity. Breathing exercises performed by the patients in this pilot study focuses on slowing the respiratory rate, primarily through prolonged expiration, it may be beneficial in reducing dyspnea via reducing exercise induced dynamic hyperinflation. Studies have shown that individuals who undergo breathing training are able to adopt a slower, deeper pattern of breathing. Pursed-lips breathing was successful in reducing dyspnea after a 6-minute walk, and computer-aided breathing feedback was successful in reducing dynamic hyperinflation.[11] Resistance exercises training given in this study includes local muscle groups trained by repetitive lifting of relatively heavy loads. Resistance training is considered important for adults to promote healthy aging and also appears to be indicated in individuals with chronic respiratory disease, such as those with COPD, who have reduced muscle mass and strength of their peripheral muscles, relative to healthy control subjects. Optimizing muscle strength is likely to be an important goal of rehabilitation in this population. In addition to the expected effects on muscle strength, it is possible that resistance training may also assist with maintaining or improving chest expansion, pulmonary function and Quality of life. Moreover, strength training results in less dyspnea during the exercise period, thereby making this strategy easier to tolerate than endurance constant-load training. Clinical trials in COPD have compared resistance training with no training and with endurance training. Lower limb resistance training consistently confers gains in muscle force and mass compared with no exercise training.[11]

Limitations of the Study

1. Other respiratory muscles involved in both ventilatory and non-ventilatory activities (e.g. sternocleidomastoid, scalene) may also influence pulmonary function were not considered in the study.

2. Subjects with small range age group between 40 to 60 years of age and small sample size were considered for the study, thus results cannot be generalized to all the groups.
3. The severity, duration and degree of chest wall rigidity; postural abnormalities were not considered in the study.

Recommendation for future research

1. Further long term follow-up studies are needed to find the effect of soft tissue release manual therapy techniques in subjects with COPD.
2. Future studies can be carried with other specific population with different severity of COPD subjects and other chest mobility restricted conditions.

CONCLUSION

It is found from our pilot study that soft tissue release manual therapy techniques addressing the soft tissue structure in subjects with moderate COPD who were treated with 16 sessions of soft tissue release manual therapy techniques for a period of 8 weeks along with conventional treatment shown statistically significant effect in improving chest expansion and FEV1/FEV6 when compared with the only conventional exercises. The effect of soft tissue manual therapy technique on improvement in Quality of life found no difference when compared with improvement in Quality of life obtained only following conventional exercises. As the study pilot study conducted on small sample size the original study on large sample size is in process, further effects on soft tissue manual release techniques will be found on large sample size.

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Conflicts of interest: None

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