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The Effect of Kinesio Taping On Diaphragm in Patients With Chronic Obstructive Pulmonary Disease (COPD)

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Abstract

Background: - COPD is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation. Inspiratory muscle weakness causes hypercapnic respiratory failure in COPD and maximum inspiratory pressure is an independent determinant of survival in these patients. Kinesiotaping, a rehabilitation technique performed by cutaneous application of a special elastic tape increases muscle activation. Hence, it is important to study the effect of Kinesiotaping on Diaphragm in patients with COPD.

Objective: - To compare the effects of taping with conventional therapy and conventional therapy alone on Maximum inspiratory pressure, maximum expiratory pressure, Peak expiratory flow rate, Dyspnea, Borgs scale.

Methodology and Material: - A convenient sample of 26 COPD patients was chosen based on GOLD classification. Pre assessment for Maximum Inspiratory Pressure (MIP), Maximum Expiratory Pressure (MEP), Peak Expiratory Flow Rate (PEFR), Borg's scale and Dyspnea was done. Patients were divided into 2 groups; group A- Control group, Group B- Experimental group. Group A received conventional treatment, which included pursed lip breathing exercise (5 counts, 5 repetitions), diaphragmatic breathing (3 counts, 5 repetitions) and thoracic expansion exercise (3 counts, 5 repetitions) for 3 weeks once/day. Group B received kinesiotaping for diaphragm (once every 3 days- 7 sessions in 3 weeks) along with conventional therapy. Post intervention values were recorded for above mentioned parameters and compared with pre intervention value within intra-group and between inter- group.

Result: - Highly significant difference was found within intra- group but no significant difference was found between inter-group.

Conclusion: - Study proves that kinesiotaping along with conventional therapy has same effect as of conventional therapy alone and PEFR may have a significant difference if a larger sample size was considered.

Keywords: - Chronic obstructive pulmonary disease, Diaphragm, kinesiotaping, maximum inspiratory pressure, maximum expiratory pressure, peak expiratory flow rate.

Introduction

COPD is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases (WHO). The loss of lung elastic recoil and development of expiratory flow limitation

promote progressive air trapping with a increase in end expiratory lung volume. COPD has been predicted to become the third leading cause of death and the fifth commonest cause of disability in the world by 2020[1].

GOLD guidelines categorize this disease into four stages according to severity: mild, moderate, severe and very severe. Genetic or airway hyper responsiveness or long term exposure to noxious gases also puts non-smokers at risk. Indoor and outdoor air pollution, occupational exposure, low socio economic status, genetic factors and airway hyper reactivity are few other risk factors [2].

Chronic obstructive pulmonary disease (COPD) has been predicted to become the third leading cause of death and the fifth commonest cause of disability in the world by 2020. Hypercapnic respiratory failure because of inspiratory muscle weakness is the most important cause of death in chronic obstructive pulmonary disease and maximum inspiratory pressure is an independent determinant of survival in these patients [1].

The diaphragm in the thorax is called the thoracic diaphragm and serves as an important anatomical landmark that separates the thorax, or chest, from the abdomen. It functions during breathing when it contracts to enlarge the thoracic cavity and reduce the intrathoracic pressure so that lungs can expand and fill their alveoli with air. It is a dome shaped muscle and tendon that functions as the main muscle of respiration and is essential to the breathing process. It is a fibromuscular sheet that has a convex upper surface that forms the floor of the thoracic cavity and a concave under surface to form the roof of the abdominal cavity [4].

The diaphragm being the most important inspiratory muscle lowers pleural pressure and inflates the lungs by moving in the caudal direction with the ribs [2]. Diaphragm muscle fibers from patients with COPD show reduced force generation per cross-sectional area. Early in the development of COPD diaphragm fiber contractile function is impaired due to protein degradation and consequently failure of diaphragm to generate force [1].

In severe COPD, the diaphragm undergoes a fiber-type shift towards more fatigue- resistant fibers. In addition, changes in sarcomere length, mitochondrial density, and enzyme activity occur within diaphragm muscle fibers of these patients. However, no conclusive studies have been published on direct contractile properties of the diaphragm of healthy subjects and patients with COPD. Consequently, the pathophysiology of failure of the diaphragm to generate force in COPD is in part unclear [1].

There is reduction in the diaphragmatic mobility due to the reduction in the number of sarcomeres to restore its pressure generating capacity, which marks the reduction of the respiratory function parameters in those individuals since the pressure generating capacity is altered and less effective on those respiratory functions [8].

Kinesiology taping is a technique that was developed by Dr. Kenzo Kase in 1973. The tape material used in kinesiology taping is of epidermis thickness and weight and has a structure providing elasticity up to 55–60% of its normal size. It allows evaporation and can dry on the skin easily due to it being 100% cotton fiber mat knitted with pin- holes [2].

Kinesiotaping is a rehabilitation technique performed by cutaneous application of a special elastic tape thus increasing muscle activation and blood circulation. The underlying mechanism of the taping is thought to be cutaneous stimulation of the sensorimotor and proprioceptive systems [2].

Functional breathing via abdominal and full rib-cage expansion is difficult for many patients to accomplish. Their brain has simply forgotten how to "do it" and "feel

it." Your goal is to help them remember and teach them how to do it on their own. Properly applied tape to the diaphragm will give them the necessary critical feedback to learn this pattern [3].

Elastic therapeutic taping techniques can be an effective proprioceptive feedback tool for your patients, helping reset the "feel" of optimal breathing patterns which consciously and unconsciously stimulates movement pattern. The "touch" or "feel" of tape via the sensory motor skin mechanoreceptors heightens neural communication with the brain, helping restore postural control and muscle memory. Tape consciously and unconsciously stimulates movement pattern [5].

Mechanoreceptors stimulation leads to neuro - physiological changes in the structures of the muscle fascia, including the fluidity of the treated tissue, and changes in its water content [9].

Ventilation is the movement of the gases into and out of the lungs. The musculoskeletal pump provides the necessary pressure gradients to move the gases into and out of the lungs in order to ensure adequate diffusion. Increasing chest movement with stronger contraction of respiratory muscles can help in gaining lung volume and reducing symptoms by improving aerobic capacity [14].

Methodology

Institution approval was obtained and participants were chosen on the basis of inclusion and exclusion criteria. Participants were informed and explained about the treatment and Consent form was taken. A convenient sample size of 26 COPD patients was chosen based on the GOLD classification (0,1,2). Pre assessment for Maximum Inspiratory Pressure (MIP), Maximum Expiratory Pressure (MEP), Peak Expiratory Flow Rate (PEFR), Borg's scale and Dyspnea was done. Patients were then divided on the basis of convenient sampling into 2 groups; group A- Control group, Group B- Experimental group. Patients of group A received conventional treatment, which included pursed lip breathing exercise (5 counts, 5 repetitions), diaphragmatic breathing (3 counts, 5 repetitions) and thoracic expansion exercise (3 counts, 5 repetitions) for 3 weeks (once/day). Patients of group B received kinesiotaping for diaphragm (once every 3 days- 7 sessions in 3 weeks) along with conventional therapy. Post intervention values were recorded for all the above mentioned parameters and compared with pre intervention value within the same group (intra-group) and also between the 2 groups (inter-group)

Intervention

- A patch of tape was applied on the mastoid process and checked for any skin irritation before proceeding with any further application.

Taping

1 – Skin preparation

1. Skin must be completely dry before applying the tape.
2. It also needs to be clean.

2- Tape preparation and application

1. Use good quality tape
2. Round the corners
3. Don't touch the adhesive
4. Go easy on the stretch
5. All strips must end on skin
6. Activate the adhesive

3 – wearing the tape

1. Avoid contact at the ends.

Approach

The patient was taped in the standing position. Once taped, have the patient lie down in the supine position, knees bent and feet flat, to begin practicing diaphragmatic

breathing. He/She stood with hands overhead to stretch the rib-cage depressors. Start to tape just below sternum and follow the rib-cage line posterior. Do not stretch the tape. Simply follow the rib-cage line. Cross midline posterior and tape down toward the opposite hip. Posterior tape should cross at the proximal attachment of the quadratus lumborum and intersection of thoracolumbar fascia.

Results

Demographic Data

Gender

Figure- 1

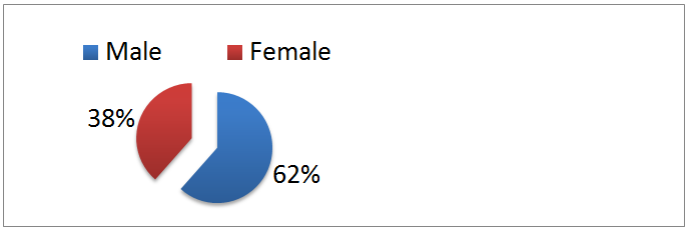

Table- 1

GENDER	N=26	PERCENT
MALE	16	62%
FEMALE	10	38%

Age

Figure- 2

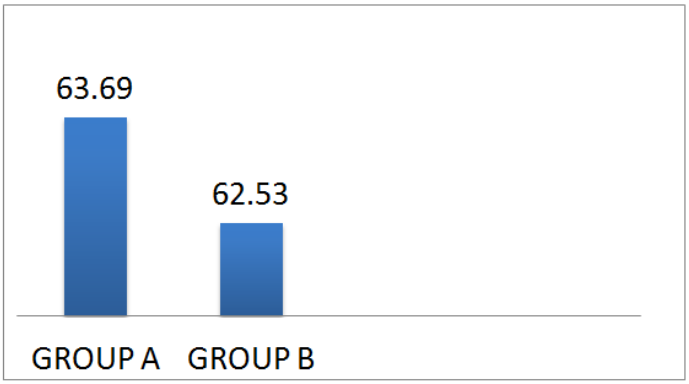

Table- 2

	MEAN
GROUP A	63.69
GROUP B	62.53

Maximum Inspiratory Pressure

Figure – 3

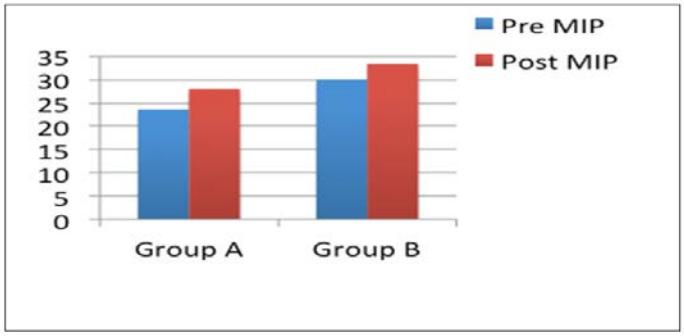

Table- 3

MIP (cmH_2O)	PRE Mean (±SD)	POST Mean (±SD)	p VALUE
GROUP A	23.62 ± 11.68	28 ± 9.967	0.000
GROUP B	30 ± 16.497	35.77 ± 15.303	0.000

Maximum Expiratory Pressure

Figure- 4

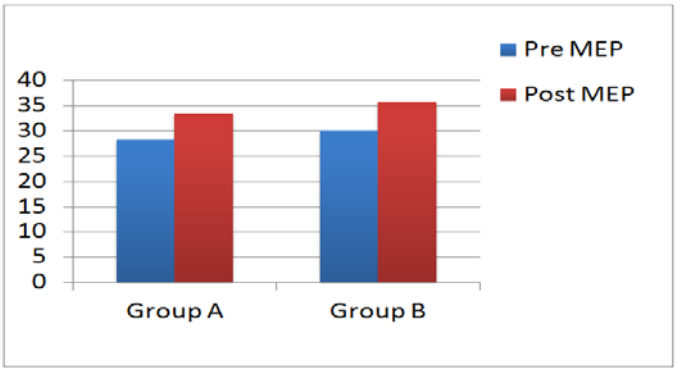

Table- 4

MEP (cmH_2O)	PRE Mean (±SD)	POST Mean (±SD)	p value
GROUP A	28.23 ± 17.579	33.54 ± 16.831	0.005
GROUP B	30.08 ± 15.58	35.85 ± 15.06	0.000

Peak Expiratory Flow Rate

Figure- 5

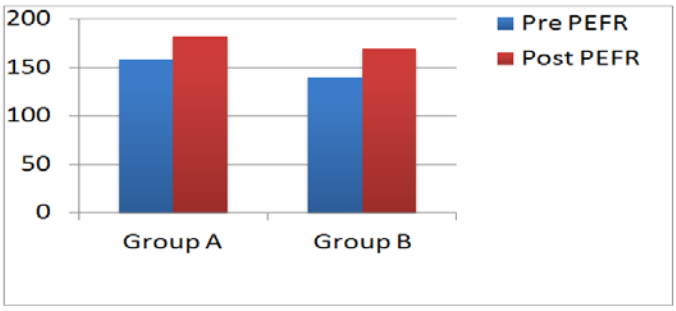

Table- 5

PEFR (litres/min)	PRE Mean (±SD)	POST Mean (±SD)	p VALUE
GROUP A	158.46 ± 57.132	182.62 ± 53.729	0.000
GROUP B	140 ± 66.833	170 ± 63.246	0.000

Borg's Scale

Figure – 6

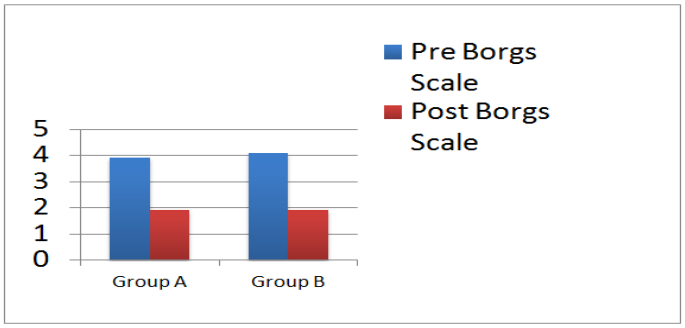

Table- 6

BORGS SCALE	PRE Mean (±SD)	POST Mean (±SD)	p VALUE
GROUP A	3.92 ± 1.188	1.92 ± 0.76	0.000
GROUP B	4.08 ± 1.256	1.92 ± 0.641	0.000

Dyspnea

Figure- 7

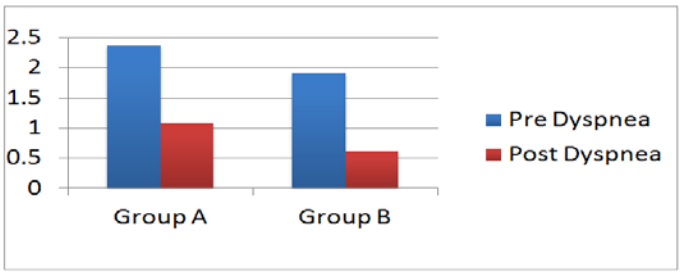

Table- 7

DYSPNEA	PRE Mean (±SD)	POST Mean (±SD)	p VALUE
GROUP A	2.38 ± 0.768	1.08 ± 0.641	0.000
GROUP B	1.92 ± 0.641	0.62 ± 0.768	0.000

Result : Intra Group

Table- 8

	MIP	MEP	PEFR	BORGS SCALE	DYSPNEA
GROUP A	p = 0.000 (<0.05)	p = 0.005 (<0.05)	p = 0.000 (<0.05)	p = 0.000 (<0.05)	p = 0.000 (<0.05)
GROUP B	p = 0.000 (<0.05)	p = 0.000 (<0.05)	p = 0.000 (<0.05)	p = 0.000 (<0.05)	p = 0.000 (<0.05)

Inference- The mean of both groups has a statistically significant difference between the pre and post values of Group A and Group B in the Maximum Inspiratory pressure, Maximum Expiratory pressure, Peak Expiratory Flow rate, Borgs Scale, Dyspnea.

Comparison between Group A And Group B

Table- 9

MIP DIFFERENCE		MEP DIFFERENCE		PEFR DIFFERENCE	
MEAN (±SD)	p value	MEAN (±SD)	p value	MEAN (±SD)	p value
5.08 ± 3.452	0.552	5.5 ± 4.598	0.235	26.31 ± 15.969	0.211

BORGS SCALE DIFFERENCE		DYSNPEA DIFFERENCE	
MEAN (±SD)	p value	MEAN (±SD)	p value
2.08 ± 1.093	0.727	1.31 ± 0.618	1.000

Result

Between Group A And Group B

Table- 10

MIP DIFFERENCE	MEP DIFFERENCE	PEFR DIFFERENCE	BORGS SCALE DIFFERENCE	DYSPNEA DIFFERENCE
p = 0.552 (>0.05)	p = 0.235 (>0.05)	p = 0.211 (>0.05)	p = 0.727 (>0.05)	p = 1.000 (>0.05)

Inference- The mean difference of both the groups does not have a statistically significant difference between the Groups A and B in the Maximum Inspiratory pressure, Maximum Expiratory pressure, Peak Expiratory Flow Rate, Borg's scale, Dyspnea.

Effect Size

Table- 11

MIP	MEP	PEFR	BORGS SCALE	DYSPNEA
d = 0.109	d = 0.217	d = 0.48	d = 0.064	d = 0.000

Inference

MIP = the experimental group outperformed 0.109 SD higher than control group. (Small difference)

MEP = the experimental group outperformed 0.217 SD higher than control group. (Small difference)

PEFR = the experimental group outperformed 0.48 SD higher than control group. (Moderate difference)

BORGS SCALE = the experimental group outperformed 0.064 SD higher than control group. (Small difference)

DYSPNEA = the experimental group outperformed 0.000 SD higher than control group. (Small difference)

Discussion

The study was conducted over 3 weeks (acute effect), which used simple breathing exercises in both the groups, and kinesiology-taping method was added in the experimental group.

Lanza Fde et al. demonstrated that chest wall mobility is associated with lung volume. It shows that greater the respiratory muscle strength, greater is the expansion of chest wall mobility during inspiration [3].

In clinical practice, respiratory muscle function is evaluated with maximum inspiratory pressure and maximum expiratory pressure. These pressures generated by the inspiratory and expiratory muscles, respectively, are responsible for volume changes in the respiratory system.**1** Based on the pressure-volume relationship of the respiratory system, the higher maximum inspiratory pressure is achieved when the inspiration starts from the lowest lung volume (residual volume), and vice versa. Therefore, the stronger the respiratory muscles, the higher the pulmonary volume [3].

Kinesiotaping-method is an approved method based on the extensive clinical studies and proven positive results in various areas of physiotherapy. Kinesio-tape improves the function of fascia, muscles, and joints. Improves strength and range of motion, tones or inhibits myofascia, overcomes pain, reduces lymphatic and blood stasis, stimulates proprioception, improves movement and coordination [9].

By specifying the region and the tissue for application, the technique and the type of application are specified (corrective, stimulating, inhibiting, anesthetic, lympho-draining, proprioceptive-stimulating etc.) [9].

The pre and post values of intra group analysis for both the group A and group B showed significant difference in the MIP, MEP, PEFR, Borg's scale and dyspnea.

Breathing exercises for people with COPD aim to alter respiratory muscle recruitment, improve respiratory muscle performance and reduce dyspnea [8].

Diaphragmatic breathing has been the primary mode of training used for patients suffering from chronic obstructive pulmonary disease [12].

Diaphragmatic dysfunction and alteration of thoraco - abdominal movements are common in patients with COPD. Breathing strategies have been considered an important component of pulmonary rehabilitation and the results of present study showed that the subjects performing diaphragmatic breathing for a month showed marked improvement in PEFR and relieved respiratory symptoms [12].

In clinical trials, where diaphragmatic breathing was conducted for 4 weeks relieved the respiratory symptoms and improved exercise tolerance [12].

However, the mean difference of both the groups does not have a statistically significant difference between the Groups A and B in the MIP, MEP, PEFR, Borg's scale and dyspnea.

Although kinesiology taping provides

- Proprioceptive stimulation – stimulates neuroreceptors located in the skin and fascia.
- Mechanical correction of the underlying soft tissues and structures by correcting techniques such as the effect of kinesio-taping, is expressed in correction of the positional errors and functional limitations between the articular surfaces, caused by shortening of muscles or muscle spasms.

It is important to know For The best result of kinesio taping, the methodology technique of kinesio taping and its type of application. In case of improper application the results can be negative [9].

Proprioceptive stimulation for kinesio-taping stimulates neuroreceptors located in the skin and fascia but the basis of PNF stretching is theorized to be through neural inhibition of the muscle group being stretched [9,10].

Elastic therapeutic taping techniques can be an effective proprioceptive feedback tool however, PNF stretching technique provide more benefits to subjects with reduced chest wall expansion than taping in terms of improvement in chest wall expansion in elderly (2016) [10].

The application of kinesiology taping may have a few therapeutic benefits however , the use age of these tapes does not promote strength gains in healthy adults [11].

An increase in muscle activation following kinesiology taping will emerge in long term applications and that acute results might be misleading [2].

It is recommended that in the future trials a longer period of intervention and follow ups post treatment, may indicate the use of kinesiology taping for improving strength.

Conclusion

- This study proves that kinesiotaping along with conventional therapy has the same effect as that of conventional therapy alone and PEFR may have a significant difference (moderate difference) if a larger sample size was considered.

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