ORIGINAL ARTICLE

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EFFECT OF LOWER LIMBS STRENGTHENING TO IMPROVE BALANCE IN COPD PATIENTS, RANDOMIZED CONTROL TRIAL.

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ABSTRACT:

Background: COPD is a progressive disease associated with an amplified chronic inflammatory response to noxious particles or gases in the airways and lungs.It's management includes Pulmonary Rehabilitation .But Pulmonary Rehabilitation stays confined to the rehabilitation of lungs , it does not include treatment for secondary impairments like balance problems in patients with COPD. **Aim -** To improve the balance of patients suffering from COPD by improving the peripheral muscle strength with the help of progressive resisted exercises in addition to regular pulmonary rehabilitation. **Objectives-** 1.To find, if there is any improvement of balance by using P.R.E of lower limbs along with pulmonary rehab in COPD patients.2.To identify whether balance improvement can be done by pulmonary rehab for COPD.3.To compare whether pulmonary rehab with P.R.E or pulmonary rehab alone is effective in improving balance in COPD patients. **Methodology-** 30 subjects fulfilling the inclusion and exclusion criteria were selected. They were then segregated into groups by simple randomization procedure i.e group A and group B. Balance was then assessed with NeuroCom's Balance Master of both the groups. Subjects of Group A received pulmonary rehabilitation with strengthening exercises for lower limbs according to De Lorme's model for 3 weeks, whereas Group B received the regular pulmonary rehabilitation (for 3 weeks). After the treatment protocol was completed, the balance was reassessed for both the groups with the help of NeuroCom's Balance Master. **Result and Conclusion-**The The intergroup significance were calculated by using Wilcoxon signed rank test and intragroup significance was calculated by using the Mann-Whitney rank sum test. On overall comparisons of treatment of group A and group B, group A showed significant improvement individually, but when compared with each other there was no statistically significant difference observed.

Key words- COPD, Balance, PFT, NeuroCom's Balance Master, strengthening protocol.

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INTRODUCTION

COPD is a progressive disease associated with an amplified chronic inflammatory response to noxious particles or gases in the airways and lung[1]. It is caused by a combination of small airways disease (chronic bronchitis) and parenchymal destruction (emphysema)[2].

Pathological changes include increased inflammatory cell types in various parts of the lung and structural changes resulting from repeated injury and repair , which further lead to air trapping and progressive airflow limitation[3].

Risk factors for COPD include exposure to cigarette smoke, environmental or occupational pollutants, recurrent pulmonary infections, pre-existing atopy or airway hyper-responsiveness. The most common manifestations of COPD include dyspnea, impaired exercise tolerance, chronic cough with or without sputum production, and wheezing[4]

Management of COPD :

Pulmonary rehabilitation includes a spectrum of intervention strategies integrated into the lifelong management ofpatients with chronic respiratory disease and involves a dynamic, active collaboration among the patient, family, and health care providers[5,6].

But pulmonary rehabilitation does not include treatment for secondary impairments like balance problems in COPD[7].Balance is an ability to maintain the line of gravity of a body within the base of support with minimal postural sway and is of a static and dynamic origin[8]. The ability to maintain balance is critical for mobility and functional independence in daily living[8].

Multiple researches suggest that there is a severe weakness of peripheral muscles in COPD patients due to chronic hypoxia because of the increased functional residual volume[9].This includes both upper and lower limb muscles[9]. The weakness of lower limb muscles can lead to balance disturbances and can affect a person's activity of daily living[10]. Since pulmonary rehabilitation, which is the key management for COPD, does not emphasize on balance impairment and its rehabilitation. Therefore the study aims at improving the balance by improving the strength of lower limb muscles in patients with COPD.

MATERIALS & METHODOLOGY

It is a pre and post comparative study design that was conducted at a tertiary medical college and hospital in Pune. A total of 30 COPD patients with grade 2 and 3 COPD were assigned into two groups by simple randomization method. The inclusion criteria for which was a patient diagnosed with COPD on the basis of Gold's criteria, ranging in stage-2 and stage-3 with an age range of 25-50 years and having balance problems. The exclusion criteria were patients having any injuries to the lower limb, pre-diagnosed Neurological pathologies and marked CVS disorders like unstable angina, ischemia, MI, recent CABG has done, severe arrhythmias, exaggerated hypertensive or hypotensive response to exercise or any other neuromuscular disorders. Materials used were : PFT machine, weight cuffs, & Neurocom balance master.

PROCEDURE

Ethical clearance was obtained from the Institutional Ethical Committee. 53subjects were screened on the basis of inclusion (analyzing via PFT) and exclusion criteria,out of which 30 subjects meeting the criteria were enrolled for the study and procedure was explained to them and written informed consent was taken.

According to simple randomization procedure, subjects were divided into two groups; group A and group B. Subjects of both the groups were then assessed for balance with NeuroCom Balance Master, using the following two domains-

-Modified Clinical Test of Sensory Interaction on balance (mCTSIB)

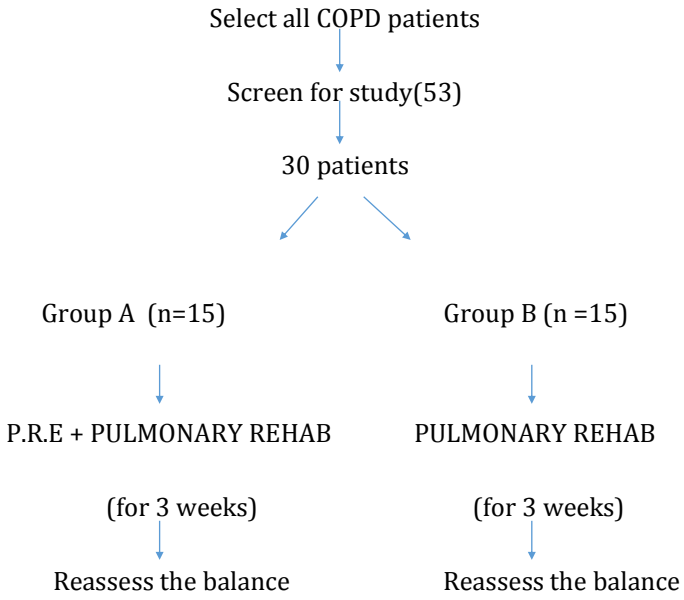
- Unilateral stance

mCTSIB contains two tests, one standing on the firm surface and the other on the foam. Both the tests were used to check balance with eyes open and eyes closed thrice respectively. Whereas for unilateral stance, a person has to stand on one leg thrice with eyes open and thrice with the eyes closed. Group A received regular pulmonary rehabilitation along with strengthening exercises for the lower limb according to the De Lorme model for 3 weeks. Major lower limb muscles such as flexors of hip and knee, extensors of hip and knee, abductors- adductors of the hip, rotators, plantar flexors and the dorsi flexors of the ankle were strengthened. Whereas Group B received regular pulmonary rehabilitation (for 3 weeks).

Table 1 : Explaining the protocol with rationale for pulmonary rehabilitation

Plan of care	Interventions
Removal of bronchial secretions	Deep and effective coughing. ACBT.(4sets/day, 10 repetitions /set)
Promote relaxation of the accessory muscles of inspiration to decrease reliance on upper chest breathing and to decrease muscle tension associated with dyspnea.	Relaxing techniques and positions- Semi reclining in bed(Semi-Fowlers) Sitting- leaning forward, resting arm on thigh or table. Standing- leaning forward on an object.
Improve patients breathing patterns and ventilation.	Controlled diaphragmatic breathing with minimal upper chest movement. Lateral costal breathing, PLB (carefully)
Minimize or prevent episodes of dyspnea.	Give a comfortable position to the patient so that the upper chest is relaxed and lower chest mobile. Emphasize controlled diaphragmatic breathing. Avoid forceful expiration
Improve the mobility of lower thorax.	Exercises for chest mobility emphasizing lower rib cage during deep breathing.
Improve posture.	Exercises and postural training to decrease forward head posture and rounded shoulders.
Improve the mobility of lower thorax.	Graded exercises and controlled exercises according to THR= 50-70%of MHR)

Fig 1: Flowchart of Procedure:



PHOTOGRAPHS

Fig 2: Patient performing spirometer (mCTSIBdomain

Fig 3: NeuroCom's Balance Master

Fig 4: Unilateral stance balance

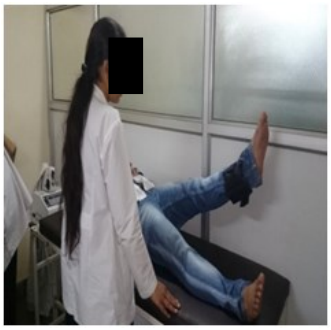


Fig 5: Lower-limb strengthening

Fig 6: Patient performing thoracic expansion exercise.

RESULT:

Data analysis was done by using the SPSS software version 16.0

Balance with the NeuroCom balance master was recorded and tabulated.

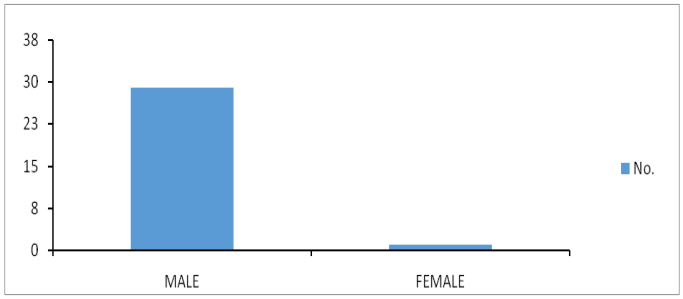
Statistical analysis was done using the following tests-

1. Shapiro Wilk test
2. Wilcoxon signed rank test
3. Mann-Whitney rank sum test

Shapir Wilk was used to comparing the scores of baseline assessment between two groups to find out whether the two groups are comparable or not. On comparing the data, there was no significant difference between the two groups, and so the groups were comparable (p value> 0.005).Intergroup significance was calculated by using Wilcoxon signed rank test and intragroup significance was calculated by using the Mann-Whitney rank sum test.

The analysis within the group was done by Wilcoxon signed rank test and between the two groups(group A and group B) was done with the help of the Mann-Whitney rank sum test.

Table 2 and Graph 1 depict the gender distribution of COPD patients enrolled for the current study.



Graph 1- - Shows the demographic representation of gender distribution of the study

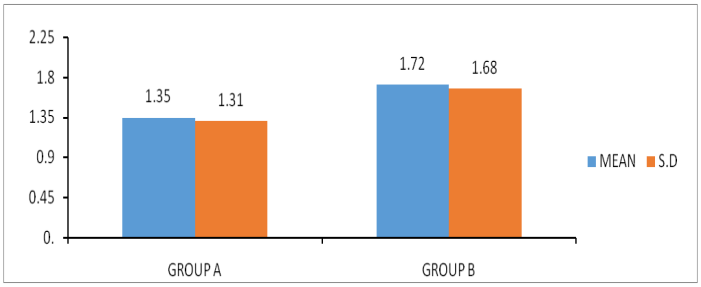
GENDER	No.
MALE	29
FEMALE	1

Table 2- Shows the demographic representation of gender distribution of the study

Table 3 and graph 2 depicts the comparison of pre and post readings of mCTSIB of group A using the wilcoxon signed rank where p value obtained was 0.039 thus proving the test to be statistically significant.

	MEAN	S.D	P VALUE
GROUP A	1.348	1.313	0.502
GROUP B	1.723	1.683	

Table 3-Depicts the baseline values of group A group B of mCTSIB

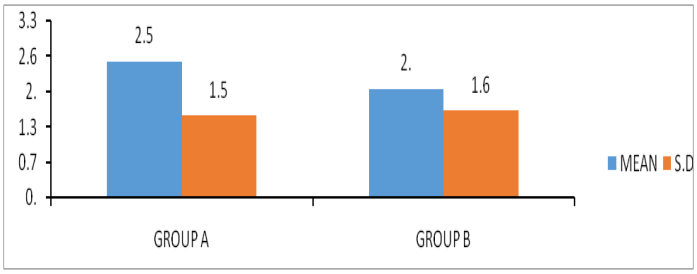


Graph 2- Depicts the baseline values of group A and group B of mCTSIB

Table 4 and graph 3 depict the comparison of pre and post readings of the unilateral stance of group A using the wilcoxon signed rank test with p value of 0.048, thus proving the test to be statistically significant.

	MEAN	S.D	P VALUE
GROUP A	2.5	1.5	0.38
GROUP B	2.0	1.6	

Table 4-Depicts the baseline values of group A and group B of unilateral stance

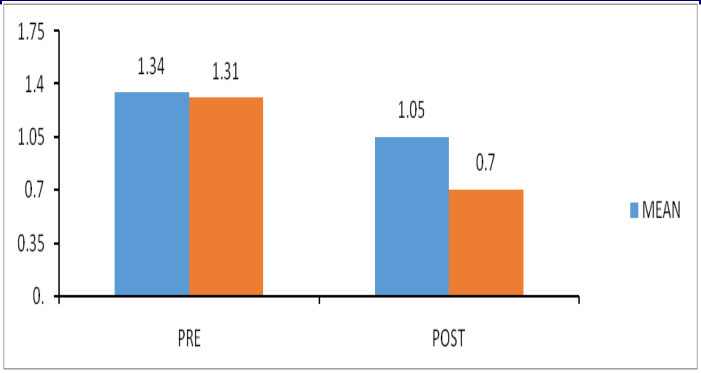


Graph 3- Depicts the baseline values of group A and group B of unilateral stance

Table 5 and graph 4 depict the comparison of pre and post readings of mCTSIB of group B using the Man-Whitney test where the p value obtained is 0.31 which is more than 0.05, thus proving the test to be non-significant.

	PRE	POST	P value
MEAN	1.34	1.05	0.313
S.D	1.31	0.70	
MEDIAN	0.76	0.90	

Table 5- Depicts the values of mCTSIB of group A

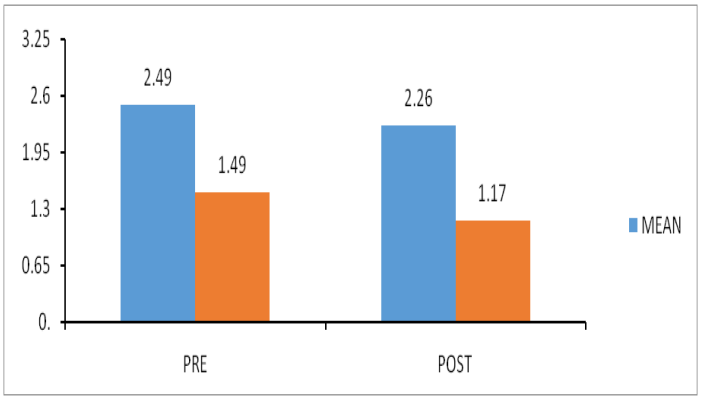


Graph 5- Depicts the values of mCTSIB of group A

Table 6 and graph 5 depict the comparison of pre and post readings of the unilateral stance of group B where the P value obtained is 0.09, which is more than 0.05 therefore proving the test to be non-significant.

	PRE	POST	P value
MEAN	2.49	2.26	0.097
S.D	1.49	1.17	
MEDIAN	1.60	1.76	

Table 6 - Pre and post readings of the unilateral stance of group A

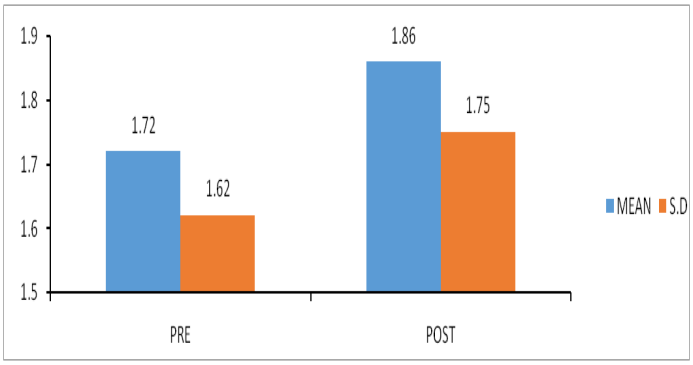


Graph 5- Comparison of the unilateral stance of group A Pre and Post intervention

Table 7 and graph 6 depict the comparison of mCTSIB of group A and group B ,where p value is 0.5(>0.005) proving test to be non-significant with a 'z'value of 0.77

	PRE	POST	P value
MEAN	1.72	1.86	0.039
S.D	1.62	1.75	
MEDIAN	0.83	1.05	

Table 7-Pre and post readings of mCTSIB of group B

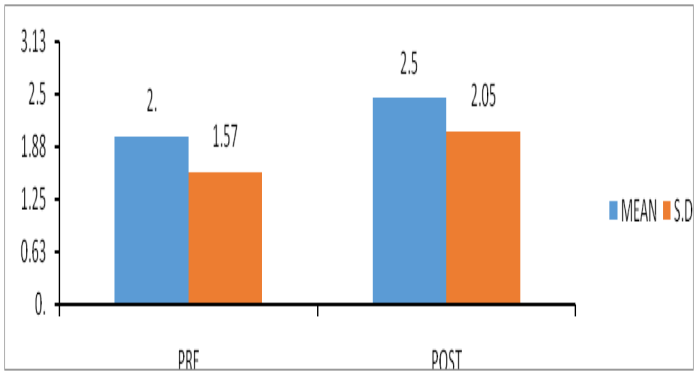


Graph 6 - Comparison of Pre and Post readings of mCTSIB of group B

Table 8 and graph 7 depicts a comparison of the unilateral stance of group A and group B, with p value of 0.75 (>0.005) proving the test to be non-significant with a 'z' value of 0.31

	PRE	POST	P value
MEAN	2.00	2.45	0.048
S.D	1.57	2.05	
MEDIAN	1.53	1.63	

Table 8 - Pre and post readings of the unilateral stance of group B



Graph 7 - Comparison of Pre-Post readings of the unilateral stance of group B

Thereby proving that when compared to the treatment of group A and group B, group A showed significant improvement individually, but when compared intergroup it depicted no statistically significant change.

DISCUSSION

The ability to maintain balance is critical for mobility and functional independence in daily living. Although the COPD management only includes pulmonary rehab, and does not focus on balance or strengthening programmes[10].

So, this study was conducted to assess whether strengthening exercises can be given to COPD patients for improving the balance.

Intergroup significance and intragroup significance was calculated. On overall comparisons of treatment of group A and group B, group A shows significant improvement individually, but when compared with each other there is no significant difference observed.

According to the pathology of COPD, the cause of the peripheral muscle weakness and balance problem is directly related to lower limb peripheral muscle strength.

This total study was planned on this basis of the above concept, which explains that due to peripheral muscle weakness, major COPD patients might be having balance problems, which also limits their activity of daily living.

Gender distribution was not kept as an important factor, because COPD is commonly seen in males in the Indian scenario. **S.K. Jindal**[11], for Asthma Epidemiology Study Group in their study "A Multicentric Study on Epidemiology of ChronicObstructive Pulmonary Disease and its Relationshipwith Tobacco Smoking and Environmental TobaccoSmoke Exposure"concluded that population prevalence of COPD is very high in India with some centre to centre differences. Smoking of both bides and cigarettes, and ETS exposure among non-smokers, were two important risk factors at all centers. Chronic obstructive pulmonary disease was diagnosed in 4.1% of 35295 subjects, with a male to female ratio of 1.56:1 and a smoker to non-smoker ratio of 2.65: 1.

When the balance was compared within the group, significant statistical changes were observed in group A because; the strengthening of the lower limb with pulmonary rehab was added to the treatment protocol for them. Strengthening of the lower limb muscles directly improved the blood circulation and biomechanical posture of the lower limb. This further improved the balance thus improving the endurance which helped in improvement in the activities of daily living.

In the case of group B, where only pulmonary rehab was the treatment protocol, the balance was not considered as a major impairment and hence, it did not show any statistically significant improvement in balance.

When we come to the comparison between both the groups, i.e. group A and group B where the base value was not statistically different, post treatment value showed better results in group A but not in group B and the result was not statistically significant.

In both the groups, i.e. experimental and controlled groups, oxygenation was the chief goal which would help improve peripheral oxygenation and muscle performance, which might be the reason that there is no statistical change between the groups. But when clinically seen patients of group A were more confident regarding their balance than group B.

So, in this study, we can see that two major balance domains, i.e. mCTSIB and unilateral stance are statistically improved in group A, but when compared to group B no significant changes were observed. Clinically and by the patient's perspective, the patients of group A were more confident regarding their balance and were able to perform their activities of daily living easily.

LIMITATION OF STUDY

The patients were difficult to get and distributing them according to the GOLD criteria of the severity was another task.

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