

To Evaluate the Effects of Romson's Respirometer and Pursed Lip Breathing Exercise in Emphysema Patents

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Abstract

Objectives: Emphysema is a condition of lungs characterized by permanent dilatation of air spaces distal to terminal bronchioles with destruction of wall of this airways. Nearly associated with chronic bronchitis but different from it to a large extent. Emphysema is a common problem in both male and female population due to environmental and biological changes, ill habits, and so on. Effective treatment protocol includes only sedatives and bronchodilators but up to restrictions, thus most effective protocol is still lacking, this study is intended to find out an (effective treatment to normalize the V.C.) for treating emphysema in longterm or permanently through physiotherapy means both manually and mechanically: a comparative study. **Methods:** A sample of 30 subjects including both males and females of age group 30–55 years, as per inclusion and exclusion criteria, from SSSMC, Dr. K.K. B.M. Subharti Hospital, Dehradun and CSS Hospital, Meerut, were included in the study. The subjects were randomly divided into two groups. The subjects were assessed forced expiration by lungs in a particular time and measured for their forced expiratory volume of lungs, vital capacity and then asked to perform the Romson's Respirometer Exercise, Purse Lip Breathing Exercise and Chest Physiotherapy. The values of forced expiratory volume of lungs and vital capacity of the subjects were documented. **Results:** The data of both Groups (A and B), revealed the mean scores of forced expiratory volume and the vital capacity of lungs on 1st, 4th and 10th day. The mean scores of forced expiratory volume of lungs [F.E.V. 1] of Group A, was 1.5074 ± 0.5121 , 1.8111 ± 0.5010 and 2.3740 ± 0.5151 and vital capacity of lungs [V.C.] was 3.0259 ± 0.3514 , 3.1630 ± 0.3260 and 3.4259 ± 0.2930 on day 1st, 4th and 10th. The paired "t" test was applied to test the significant difference between 1st & 4 day and 4th & 10th day. A significant *p* - Value of < 0.001* was found when the comparison was done with the mean score of forced expiratory volume and the vital capacity of lungs on 4th and 10th day. Which shows the significant improvement in Emphysematous subjects. The mean scores of forced expiratory volume of lungs [F.E.V. 1] of Group B was 1.7037 ± 0.4792 , 2.3674 ± 0.4236 and 2.9204 ± 0.3123 and vital capacity of lungs [V.C.] was 3.1296 ± 0.2524 , 3.5481 ± 0.2376 and 4.0352 ± 0.2311 on day 1st, 4th and 10th. The paired "t" test was applied to test the significant difference between 1st & 4th day and 4th & 10th day. A significant *p* - Value of < 0.001* was found when the comparison was done with the mean score of forced expiratory volume and the vital capacity of lungs on 4th and 10th day. Which shows the significant improvement in Emphysematous subjects. **Conclusions:** The results of this study indicate that there is significant improvement in the forced expiratory volume [F.E.V. 1] and vital capacity of lungs [V.C.] values in both the Groups - (A and B). Group - A receive chest physiotherapy (vibration+percussion+coughing) and Romson's respirometer while Group - B receive receives chest physiotherapy (vibration+percussion+coughing) and pursed lip breathing.

Keywords: Forced expiratory volume [F.E.V. 1]; Vital capacity [V.C.]; Romson's respirometer.

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Introduction

Emphysema is a condition of lungs characterized by permanent dilatation of air spaces distal to terminal bronchioles with destruction of wall of this airways.¹ Nearly associated with chronic bronchitis but different from it to a large extent.

Anatomy of Lung

Respiratory system consists of air pathways and



Fig. 1: Emphysema view.

lungs— soft tissue organs divided into upper and lower tract².

- Upper respiratory tract— Nasal passage- Pharynx- Larynx - upper of Trachea comprises URT.
- Lower respiratory tract— Lower part of trachea- bronchial tree- alveoli.
- Nasal passage lies between cribriform plate of ethmoid bone. Air sinuses in maxillary, frontal, Ethmoidal and sphenoid bones open into nasal passages.
- Pharynx— Extends from nasal passage to Larynx and common pathway for air from nose and food from mouth.
- Larynx is between pharynx and trachea from level of 3rd cervical vertebra to lower border of 6th vertebra protected with epiglottis which prevents food and liquid from entry in respiratory passages vocal cord lies between epiglottis.
- Trachea lies between larynx and bifurcation of 2 main bronchi (*carina*). Extending from 6th cervical vertebra to 5th thoracic vertebra. Upper end lies just below skin. Its wall is made up of C - shaped cartilages and smooth muscles. Cartilage keeps the airway open, while muscular wall allows esophagus expansion for bolus of food.
- Oesophagus lies behind trachea.
- Bronchial Tree— Starts at bifurcations of trachea. Right bronchus more vertical.
- Wider and shorter than left. Each dividing into lobar bronchi which divide in segmental bronchi segmental bronchus lung tissue it supplies is Bronchopulmonary segment.
- Each bronchus continues to divide into branches of over-decreasing lumen until terminal bronchioles ever formed which do not have cartilage followed by respiratory bronchioles which leads to alveoli.
- Acinus is respiratory bronchioles, alveolar ducts and alveoli from one terminal bronchioles, alveolar ducts and alveoli from one terminal bronchioles.
- Gaseous exchange occurs across thin alveolar membrane.
- Alveolar membrane— Consists of epithelial lining elastic and collagen fibers and blood capillaries.
- Epithelial lining composed of basement membrane together with pneumocytes (lung cells) - Type I— across which diffusion takes place.
- Type II— reduces surface tension of alveolar walls lowering pressure within deflated alveoli and thus reduce collapse of alveoli. This reduced pressure expands the lungs well.
- Pores of Kohn— There are alveolar walls opening which allow collateral ventilation between neighboring alveoli of segments. These prevent segmental collapse and allow air to pass into alveoli so that secretions can be dislodged in bronchioles on forced expiration (force air).

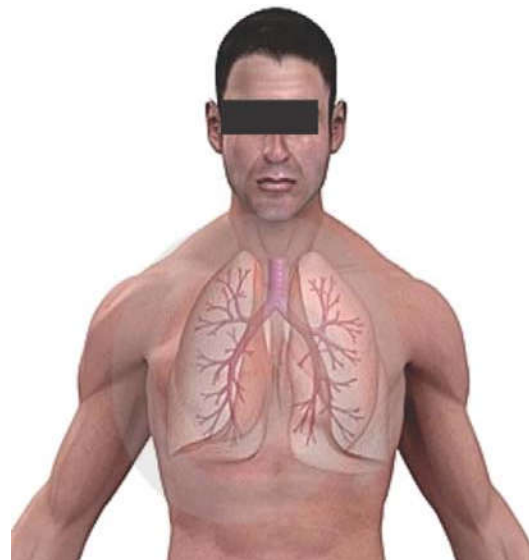
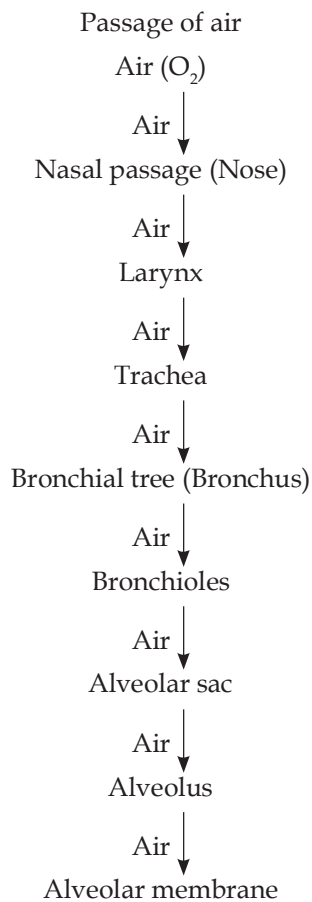


Fig. 2. Lungs in bronchioles in human body

Physiology of Respiration³



Objectives of the Study

Statement of study – Is Romson's respirometer and pursed lip breathing exercise increase the forced expiratory volume and vital capacity of Lungs to relive symptoms of Emphysema?

Hypothesis

Alternate hypothesis – There will be a significant difference in FEV₁ and vital capacity of lungs treating with Romson's respirometer and pursed lip breathing exercise to normalize symptom in Emphysematous subjects.

Null Hypothesis – There will not be a significant difference in FEV₁ and vital capacity of lungs treating with Romson's respirometer and pursed lip breathing exercise to normalize symptom in Emphysematous subjects.

Operational Definitions³

Emphysema

Emphysema is conditions in which forced expiratory volume of lung increase and thus more exertion is faced by lungs at level of terminal bronchioles with damage of wall of airways path.

Chest physiotherapy: Chest physiotherapy is the effective technique for treatment for various cardio - Pulmonary disease and thus clears lung airways and help in proper respiration; various techniques are indicated and included in chest physiotherapy.

Percussion: Technique designed to assess lungs density specifically air to solid in lungs. This technique is performed with cupped hands over the lung segment being drained. The therapist's cupped hands alternately strike the patient's chest wall in a rhythmic fashion.

Vibration: Airway clearance technique used in postural damage during expiration as the patient is deep breathing to move the secretion to larger airways Vibration is applied by placing both hands directly on skin and chest wall with one hand on top of other and gently compress & rapidly vibrate chest wall as patient breathes out.

Coughing: Patient is taught to take a deep breath in, tighten the abdominal muscles and cough. This ensures that the force of expired air is sufficient to clear secretions from the trachea and bronchi.

Respirometer: It is advice used to measure the rate of respiration of a living organism by measuring its rate of exchange of oxygen and CO₂.

Pursed Lip Breathing: Gentle Pursed Lip Breathing with controlled expiration is useful procedure which has to be performed appropriately. It keeps the airways open and clear by creating back pressure. This technique is best experimented and then effectively applied for treatment of chronic obstructive pulmonary disease (COPD) dealing with multiple episodes of dyspnoea that is emphysema.

Effect

- Decreases Respiratory Rate
- Increases tidal volume
- Improves tolerance in reference to exercise and exertion.

Precaution

- Use of forced expiration during Pursed lip breathing must be avoided as it increase turbulence in the airways and cause further restriction of small bronchioles.

Forced Expiratory Volume (in second FEV1): This is obtained by measuring change in expired volume against time. When forced expiration is started from full inspiration flow rises rapidly to peak value because of progressive airway narrowing there is rapid fall of flow rate to zero when Residual volume is reached and no more air is expelled. Full volume expired in 4 sec in normal person is called- Forced expiratory volume and the volume expired in/sec it is FEV1 and is 75% of FEV.

Vital Capacity: Vital Capacity = Tidal volume + Inspiratory reserve volume + Expiratory reserve volume. Vital Capacity = 4500 ml.

Inspiratory Reserve volume: It is amount of air a person can breathe in after resting inspiration IRV = 3000 ml.

Expiratory Reserve volume: It is amount of air a person can exhale out after normal resting expiration ERV= 1000 ml.

Residual volume: Amount of air left in lungs after maximum expiration (\approx 1500 ml). R V increases with age and with restrictive and obstructive pulmonary disease.

Tidal volume: Amount of air exchanged during a relaxed inspiration followed by relaxed expiration.

Tidal Volume = 500 ml, 350 ml of Tidal Volume reaches alveoli and participates in gas exchange.

Materials and Methods

Design: This study is a comparative study design which intends to find out if there is any significant improvement in the forced expiratory volume [F.E.V. 1] and vital capacity of lungs [V.C.] in both the Groups - A and B, having physiotherapy treatment protocol, Group A receive chest physiotherapy (vibration + percussion + coughing) and Romson's respirometer use while Group B receive receives chest physiotherapy (vibration + percussion + coughing) and pursed lip breathing within the sample.

Sample: A sample of 30 subjects (26 males and

4 females) from SSSMC, Dr. K.K. B. M. Subharti Hospital, Dehradun, and CSS Hospital, Meerut, were included in the study. All the subjects were assessed for inclusion and exclusion criteria of the study.

Sample Selection: sample selection was done as per availability of Emphysema patient who were able to continue treatment regularly and properly with no surgical lesion. A baseline assessment of clinical and functional status was assessed before the subjects were assigned to do the task as per protocol.

Inclusion criteria

- ^ Age 30 to 55 years.
- ^ X-ray findings (Swelling over the affected bang, opaque shadow also seen as the condition become critical.
- ^ X-rays findings.
- ^ All Emphysematous patients who did not undergo any kind of thoracic surgery.
- ^ Habits – Smoking (2 to 4 packets per day at least) Tobacco-chewing (last 10 years).
- ^ Occupational hazards pollution.
- ^ Patients administered with proper medications especially bronchodilators – Salbutamol.
- ^ Spinal deformity – Kyphosis.

Exclusion criteria

- ^ Patient underwent any other cardiopulmonary surgery.
- ^ Any rib fracture.
- ^ Asthma.
- ^ T.B. chest.
- ^ Pregnant women.

Instrumentation

Spirometer: It is an instrument used to assess forced expiration by lungs in a particular time and thus able to calculate the vital capacity, forced expiratory. Volume of lungs and hence FEV₁/V.C. ratio. With the help of spirometer lung function test can be done. Spirometer has been used for 1st, 4th & 10th day of treatment to know the progression of FEV₁ & Vital Capacity in emphysematous patient. Now the Procedure is as follow without use of Salbutamol – bronchodilator with empty Stomach. Patient is made to sit comfortably in front of Spirometer. Instructions have been given to have deep



Fig. 3-6. Various types of Spirometers used in Medical Laboratory

and complete exhalation through mouth piece. The graph has been shown on Monitor and can be taken by printer.

Romson's Respirometer: It is a respirometer first made by Romson's in year 2000, hence known as Romson's Respirometer. This instrument is a very simple instrument made up of fiber plastic, light weighted, easy to handle. It is latest, economical and simpler version of closed intermittent respirometer.

Components

- Three Transparent Broad tubes.
- Three Colorful light fiber balls- Red, Yellow, Blue of different weights.
- Three Blow Pipe.
- Mouth Piece.



Fig. 7. Romson's Respirometer

- Values at the base of each inverted in which Balls have been placed.

Principles of Respirometer

Maximum the forced vital capacity of lung, more will be the lift or raise of fiber colorful balls of respirometer. If more is FVC, more will be FEV₁, and Vital Capacity. Hence more FEV₁/ Vital Capacity ratio will nearly reaches to the normal value.

Group - A

- Breathing exercise to increase forced expiratory volume in one second and vital capacity with help of Romson's respirometer.
- Patient is asked to be in either high setting or long sitting with help of back support.
- Patient is now asked to sit in relaxed position without any chest exertion.
- Now patient is asked to blow into Romson's Respirometer through mouth piece, but before that patient is advised to have deep inspiration as much as he can.
- Immediately in first few days patient is able to lift the lightest (weight) ball-BLUE, this indicates the effective use of lungs to expire.
- Then he is asked to blow hard as much as he can and try to lift the YELLOW & the RED bolls which are of greater weight that BLUE ball.
- If the patient is able to lift the ball to the particular levels marked on the tubes of the respective balls their Vital capacity can be assessed in level of increase or decrease.
- Patient able to lift Blue and Yellow Balls to full and Red to certain level has been reported to gain normal level of vital capacity.

Duration: The treatment was given twice a day under the supervision of a Physiotherapist.

1st to 4th day, 8 to 10 times per session.

5th - 10th day, 18 - 20 times per session.

Both the Groups have given same few techniques.

1. Removal of secretion

- ▲ Postural drainage positions.
- ▲ Percussion- cupping.
- ▲ Vibration.
- ▲ Coughing restricted to 2-3 coughs.

2. Thoracic mobility exercise

- ▲ Free active spinal exercise.

- ▲ Free active exercise - setting, turning with loose arm swinging with relaxation of shoulder girdle.
- ▲ Postural awareness.

Re- Education of pursed lip Breathing - Group - B

- Made patient to be comfortable in high sitting and relax as much as possible.
- Patient is now asked to breathing slowly and deeply and inhale maximum air he can. And asked to purse his lips.
- Now therapist had placed his/her hands over the abdominal muscles to detect and avoid abdominal contractions.
- Now finally patient is asked to exhale out the air inspired through pursed lip mouth.
- The treatment is given under supervision twice a day with increase in repetition of PLB exercise



Fig. 8: 1st Day



Fig. 9: 10th Day

from 8 to 20 times as the day progresses.

- This technique is best for COPD, emphysema, asthma where repeated episodes of dyspnoea (Shortness of breath) with physical exertion or when contact with allergens seen.

Data Analysis – Data analysis was performed by using the SPSS version 10 for windows software descriptive statistics was used to analyze mean ± S.D. scores of forced expiratory volume and the vital capacity of lungs respectively on 1st, 4th and 10th day. The paired “t” test was used to find out the significant difference between forced expiratory volume and the vital capacity of lungs after 4th and

10th day in both the groups. In all cases a significance was set at $p < 0.001$. Further, one way ANOVA - F test revealed a high significant difference in the forced expiratory volume and the vital capacity of lungs in both groups which is $p < 0.001$, at different interval i.e. 4th and 10th day.

Results

Pre and post values of FEV1 and V.C. of subjects with chest physiotherapy and Romson’s Respirometer (Group - A) were summarized in Table 1 and 2 and Fig. 10.

Table 1: showing mean, S.D. and difference between successive time points and probability of “t” (paired) values

S.No.	Days	F.E.V.1 (Mean ± S.D.)	Difference (Mean ± S.D.)	Probability of “t” (paired)	p- Value
1	1 st	1.7037 ± 0.4792	-----	-----	-----
2	4 th	2.3674 ± 0.4236	-0.6637 ± 0.2039	0.0000	$p < 0.001^*$
3.	10 th	2.9204 ± 0.3123	-0.5530 ± 0.2034	0.0000	$p < 0.001^*$

* $p < 0.001$: shows a high significant difference between different time points

Table 2: showing mean, S.D. and difference between successive time points and probability of “t” (paired) values

S.No.	Days	Vital Capacity (Mean ± S.D.)	Difference (Mean ± S.D.)	Probability of “t” (paired)	p- Value
1	1 st	3.1296 ± 0.2524	-----	-----	-----
2	4 th	3.5481 ± 0.2376	-0.4185 ± 0.1360	0.0000	$p < 0.001^*$
3.	10 th	4.0352 ± 0.2311	-0.4870 ± 0.1298	0.0000	$p < 0.001^*$

$p < 0.001$: shows a high significant difference between different time points

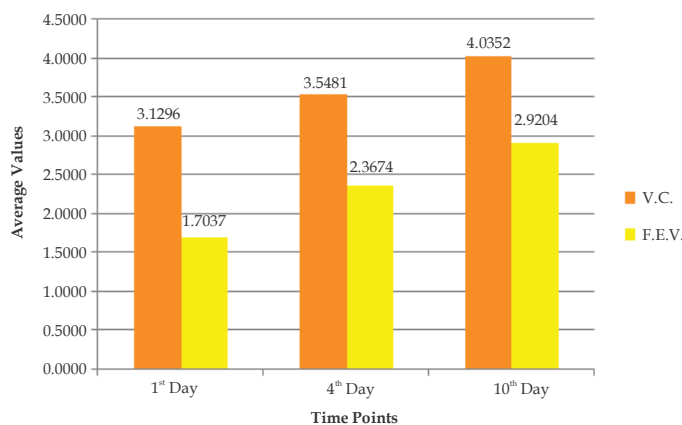


Fig. 10: The Bar Chart Showing the Mean Value of V.C. and F.E.V. at Different Time Points in Group B.

Table 3: showing mean, S.D. and difference between successive time points and probability of “t” (paired) values

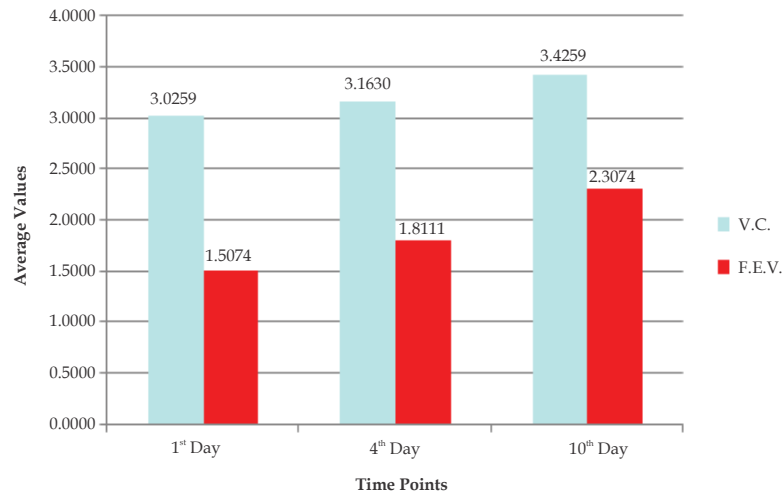
S.No.	Days	F.E.V.1 (Mean ± S.D.)	Difference (Mean ± S.D.)	Probability of “t” (paired)	p- Value
1	1 st	1.5074 ± 0.5121	-----	-----	-----
2	4 th	1.8111 ± 0.5010	-0.3037 ± 0.1344	0.0000	$p < 0.001^*$
3.	10 th	2.374 ± 0.5151	-0.4963 ± 0.2696	0.0000	$p < 0.001^*$

* $p < 0.001$: shows a high significant difference between different time points

Table 4: showing mean, s.d. and difference between successive time points and probability of “t” (paired) values:

S.No.	Days	Vital Capacity (Mean \pm S.D.)	Difference (Mean \pm S.D.)	Probability of “t” (paired)	p- Value
1	1 st	3.0259 \pm 0.3514	-----	-----	-----
2	4 th	3.1630 \pm 0.3260	-0.1370 \pm 0.1006	0.0000	$p < 0.001^*$
3.	10 th	3.4259 \pm 0.2930	-0.2630 \pm 0.1884	0.0000	$p < 0.001^*$

* $p < 0.001$: shows a high significant difference between different time points.

**Fig. 11:** The Bar Chart Showing the Mean Value of V.C. and F.E.V. at Different Time Points in Group A.

The comparison of mean value of FEV1 on 1st, 4th and 10th day is 1.7037 ± 0.4792 , 2.3674 ± 0.4236 and 2.9204 ± 0.3123 with significant $p < 0.001^*$, which shows improvement in FEV1 value.

The comparison has been made on 1st, 4th and 10th day of session in which mean value of VC is from 3.1296 ± 0.2524 , 3.5481 ± 0.2376 and 4.0352 ± 0.2311 with significant p value $< 0.001^*$ which shows significant improvement in emphysematous patient.

The Figure 10 shows significant improvement in VC and FEV1 after 10th day of treatment which is approximately 70.46% as compared to its normal value 75%.

Pre and post values of FEV1 and VC of subjects with chest physiotherapy and Pursed Lip Breathing (Group - B) were summarized in Table 3 and 4 and Figure 11.

The comparison of mean value of FEV1 on 1st, 4th and 10th day is 1.5074 ± 0.5121 , 1.8111 ± 0.5010 and 2.374 ± 0.5151 with significant $p < 0.001^*$, which shows improvement in FEV1 value.

The comparison has been made on 1st, 4th and 10th day of session in which mean value of VC is from 3.0259 ± 0.3514 , 3.1630 ± 0.3260 and 3.4259 ± 0.2930 with significant p value $< 0.001^*$ which

shows significant improvement in emphysematous patient.

The Figure 11 shows significant improvement in VC and FEV1 after 10th day of treatment.

After comparison of both the groups, Group A has shown near normal values approx. 70.46% which is highly significant than Group B. Hence the study resulted that using Romson's respirometer along with chest physiotherapy for 10 days treatment, reduces the symptoms and improves the lung capacity.

Discussion

In this study 30 subjects without any previous history of any lung or pulmonary infection or surgery, with a age group of 30–55 years were selected. For better comparative analysis of the treatment technique the subjects were divided into two groups, Group A and B, 15 in each. Subject of both the groups were monitored for FEV1 and V.C. with help of Respirometer and chest deformity and level of chest expansion with help of x-ray findings.

For Group - A subjects, the treatment protocol includes chest physiotherapy (vibration

+ percussion + coughing) with Romson's Respirometer and for Group - B subjects, the treatment protocol includes chest physiotherapy (vibration + percussion + coughing) with pursed lip breathing exercise. *t* - Test has been performed to analyze the comparative study of the treatment of Emphysema.

The results supported the incomplete findings and research of MC Threat and O.K. Ethereal et al. in 2008, and clarify the result that in case of Emphysema both Romson's Respirometer and Pursed Lip Breathing with other technique of chest physiotherapy help to cure the problem. But it is now cleared from the comparative study done with the help of Romson's respirometer the prognosis rate increases to about approx. 70.46% than that with Pursed Lip breathing exercise as both FEV₁ and V.C increases to maximum extent.

Future Research

It would be more challenging if the study will be done for longer duration with Romson's respirometer. If the number of subjects will be more than the better conclusion can be made regarding the affection of treatment protocol.

For better results advance regime of Breathing exercise can be included in the study.

Study could be done in early age groups depending on the environmental and habitual facts.

Conclusion

The results of this study indicates that there is significant improvement in the forced expiratory volume [F.E.V.1] and vital capacity of lungs [V.C.] values in both the Groups - A and B. Group - A receive chest physiotherapy (vibration+percussion+coughing) and Romson's respirometer while Group - B receive receives chest physiotherapy (vibration+percussion+coughing) and pursed lip breathing.

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