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Effect of Short Term Pulmonary Rehabilitation on Saturation of Peripheral Oxygen, Forced Vital Capacity, Forced Expiratory Volume in One Second and Exercise Capacity in Moderate COPD

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Abstract: The objective of this paper is to evaluate and to assess the effect of short term pulmonary rehabilitation on Saturation of peripheral oxygen (Spo2), forced vital capacity (FVC), Forced expiratory volume in one second (Fev_1) and exercise capacity in moderate COPD. This paper discusses the methods - A total of 25 COPD patients satisfying the selection criteria were recruited in the study subjects, were then evaluated with parameters such as SpO_2, FEV_1, FVC and 6MWT prior to the procedure, all participants submitted to Short term pulmonary rehabilitation which includes incentive spirometry, static bicycle, ergometry training and pursed-lip breathing exercises had been given for 30 min duration, given six days per week continued for five weeks. At the end of exercise again the parameters such as SpO_2, FEV_1, FVC and 6MWT were assessed. The Results found were - 25 COPD patients who were included in this short term pulmonary rehabilitation found that there is a significant difference in SpO_2, FEV_1, FVC and 6MWT which shows ($p<0.05$) and finaly the conclusions - From the present study it has been concluded that short term pulmonary rehabilitation is effective on SpO_2, Fev_1, Fvc and exercise capacity in moderate COPD.

Keywords: ***Chronic obstructive pulmonary disorder (COPD), Short term pulmonary rehabilitation, Saturation of peripheral oxygen (SPO_2) and Forced vital Capacity (FVC). Forced expiratory volume in one second (Fev_1)***

I. Introduction

COPD is not a "smoker's cough" but an under-diagnosed, life-threatening lung disease[2]. Chronic obstructive pulmonary disease (COPD) is an cause of death and disability. Smoking remains the major cause of COPD[1]. According to WHO, COPD is a lung disease characterized

by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. COPD is often diagnosed late because patients lack symptoms in the early stages of the disease despite the presence of moderate decreases in pulmonary-function.

COPD has been redefined in the GOLD guidelines as a disease state characterized by airflow limitation that is not fully reversible. The GOLD expert panel classified COPD into 4 stages, ranging from 0-3.

Stage-0: At Risk. Chronic cough/sputum production may be present, but patients have normal spirometry readings.

Stage-1: Mild-COPD. FEV_1 >= 80%, FEV_1/FVC<70%. Patients may have or have not chronic cough and increased sputum production.

Stage-2: Moderate-COPD. Worsening of airflow (30% >= FEV_1>80%). Patients with stage-2 disease are symptomatic, seek medical attention, and have SOB. Stage-2 has 2 subcategories: IIA and IIB. IIA patients have a FEV_1 between 50%-80%; IIB patient have a FEV_1 between 30%-50%. Patients with FEV_1<50% are especially prone to acute exacerbations.

Stage-3: Severe-COPD. FEV_1<30%. Patients are also included in stage-3 if they have respiratory-failure or right heart failure. The QOL is severely affected. Acuteexacerbations require hospitalization and are frequently life threatening[4].

The problems in COPD includes the dyspnea, reduction of FEV_1/FVC and FEV_1[5], and decrease in exercise-performance. SpO_2 is the percentage of hemoglobin with oxygen at the time of the measurement[7]. Normal SpO_2 values are 97%-99% [7]. Most commonly non-invasive method to find-out the prognosis in COPD is 6-minute walk test[8].The 6MWT is self-paced[9].

Incentive spirometers (IS) are tools to use for measurement of pulmonary outcomes. The IS is to provide patients with immediate visual feedback regarding achievement of preset goals. This visual-input encourages patients to continue to use and work toward increasing their maximal inspiratory effort. Here, we are using flow incentive - spirometer, these spirometers are flow-dependent[16].

Prevalence of COPD affects 9/1000 males and 7.3/1000 females. It increases in decades up to 50% of smokers over the age of 65 years[10]. Males>females, but morbidity among women has increased. Morbidity-mortality increases with severity of disease, age and co-morbidity[11].

Pulmonary rehabilitation(PR) program helps to achieve their optimal level of activity and function. Exercise-training for COPD includes aerobic-exercise, like walking or using a stationary-bike, and muscle-strengthening exercises for arm/legs[15]. Rehabilitation is to improve QOL and exercise-capacity[13]. Many studies has given the program duration of >6 weeks, only a few investigators have studied exercise programs within short duration of <6 weeks, so this study also focused on whether 5-week rehabilitation program is beneficial for COPD patients[14].

PR should be considered for COPD patients with dyspnea, other respiratory symptoms, reduced exercise-tolerance, impaired health-status, or activity-restriction. It has been shown to alleviate respiratory symptoms, increase exercise-tolerance and health-status, and helps patients better ADL[15]. Though this type of pulmonary rehabilitation generally given for more than 3 months duration, which can lead some practical difficulty as regular visits and financially. So to avoid this, there is a need of alternate study with short duration which can be beneficial for the COPD patients.

So the purpose of the study is to evaluate and to assess the effect of short term pulmonary rehabilitation on SpO_2, FVC, FEV_1 and exercise capacity in moderate COPD.

II. Material and Methodology

Study design was quasi experimental study with only one group. A sample of 25 patients had been taken. Study was conducted in C. U. SHAH PHYSIO-THERAPY COLLEGE. Patients were taken from T.B. Hospital Campus, Medicine and T.B & Chest O.P.D. Participants included are clinically diagnosed with moderate COPD; according to GOLD classification; age group of 35-55 years; on stable regime of COPD medications for at least 1 month prior to recruitment; males were included in the study. Exclusion criteria: Recent acute exacerbation of COPD; already had participation in regular exercise program during previous 6 months; any associated co-morbidity like cardiac-pulmonary disease; orthopedic problems; lower limb problems that limit the activity levels; neurological problems like significant cognitive deficit, presence of peripheral vascular diseases, severe peripheral neuropathy; uncooperative subjects.

III. Procedure

A convenience sample of 25 subjects on the basis of inclusion criteriae had been taken in study. All subjects had received verbal explanation of purpose, risk and benefits. An informed consent had been given. All subjects were evaluated thoroughly using an Evaluation Performa. Parameters were assessed on day 1 i.e. SpO_2 measured by pulse oximeter and FVC and FEV_1 were assessed by computerized spirometer. Exercise capacity was evaluated by the 6-minute walk distance test. Pulmonary rehabilitation which includes incentive spirometery, static-bicycle ergometer training and pursed-lip breathing exercises had been given to the patients for 30 minutes for 6 days/week for 5 weeks. At the end of pulmonary rehabilitation again the parameters SpO_2, FVC and FEV_1 were assessed.

Study protocol:

Incentive spirometry:

1. The subjects were positioned comfortably (semi-reclining).

2. The subjects asked to take three to four slow, easy breaths and maximally exhale with the fourth breath.

3. Then spirometer was placed in the subject's mouth and asked to maximally inhale through the spirometer and was motivated by visual feedback, through the ball rises to a preset marker.

4. The subject's aim was to generate a predetermined flow and to achieve a preset volume.

5. The subjects were encouraged to hold their breath for 2-3 seconds at full inspiration.

This sequence was repeated five to ten times for 10min.

Static Bicycle ergometer

1. Static-bicycle ergometer training (CET) consisted of exercise on a cycle ergometer under the supervision.

2. Subjects were instructed to pedal a bicycle ergometer on pedaling rate of 60 rpm for 15min. and speed is increased in every 5min. according to the tolerance of the patient.

3. This was continued 6 days/week for 5 weeks.

Pursed-lip breathing for 5min.:

For pursed-lip breathing subjects were asked to sit in semi-Fowler position with their shoulders relaxed

1. Subjects were asked to place his hands over the abdomen to detect any contraction of abdominals. Patient was instructed to breath in slowly and deeply and asked to loosely purse the lips.

2. This was taught to oppose his lips like a fish and slowly let all the air out using controlled expiration.

3. The subjects were advised to repeat this 3 or 4 times / session and then followed by rest.

IV. Statistical method

Statistical analysis was performed using SPSS software, and the data are presented as the mean ±SD. Parameters before and after the pulmonary rehabilitation program were compared using the paired t-test. Differences were considered as significant at $P< 0.05$.

V. Result

SpO_2:Paired t-test done for the values of SpO_2 pre/post rehabilitation are presented in Table 1. The mean age taken in the study 42.4 ± 9. The mean of SpO_2 before rehabilitation 93.80 and after it was 97.16 with standard deviation of 0.645 and 0.374 respectively. Significant

difference is seen in SpO_2. FVC: Paired t-test done for the values of FVC pre/post rehabilitation presented in Table 2. The mean of FVC before rehabilitation 2.35 ± 6.90 and after it was 2.68 ± 7.31 with standard deviation of .00690 and .00737 respectively, significant difference is seen in FVC. $FEV_{1:}$ Paired t-test done for the values of FEV_1 pre/post rehabilitation presented in Table 3. The mean of FEV_1 before rehabilitation 1.45± 0.209 and after it was 1.65 ± 0.207 with standard deviation of .22001 and .21854 respectively, significant difference is seen in $FEV_{1.}$ 6MWT: Paired t-test done for the values of 6MWT pre/post rehabilitation presented in Table 4. The mean of 6MWT before rehabilitation 15.00 and after it was 20.75 with standard deviation of .764 and .843 respectively, significant difference is seen in 6MWT.

There was a significant change in SpO_2, FEV_1, FVC and 6MWT from pre to post readings in 5-weeks of pulmonary rehabilitation ($p<0.05$). This implies that incentive spirometry, cycle-ergometer, pursed-lip breathing and 6MWT are effective in improving lung capacities, exercise capacity, and SpO_2 in moderate COPD. It was found that the results are significant with value of $p<0.05$ which is highly statistically significant.

VI. Discussion

In most previous studies, the duration of pulmonary rehabilitation has been more than 6 weeks based on the training effect in normal subjects[18,19]. A few studies has been demonstrated the effects of a 5 week rehabilitation period20[-22].

To clarify the effect of a pulmonary rehabilitation program we conducted a training program 6 times per week for 5 weeks, including incentive spirometry exercises, static bicycle ergometer exercises and pursed-lip breathing exercise. Our results demonstrate that this program improves pulmonary function parameter of FEV_1, FVC, improves exercise capacity as determined by walking test, reduces dyspnea on effort and improves endurance in patients with COPD.

In most previous studies, no changes in spirometeric values have been reported[23-25]. But in this study variations are seen in result of training of 5 weeks, the 6MWD significantly increased. Needleman et al have reported that static bicycle ergometer training significantly improves the 6 minute walking distance[26]. Patients were trained 6 times a week at almost the same intensity as in this previous study, which may explain the improvement in the 6MWD.

A walking test may be a good measure of "function exercise capacity", defined as a patient's ability to undertake physically taxing activities. Therefore, we assume that an increase in functional exercise capacity is necessary in managing dyspnea and in maintaining the lung volume in COPD patients.

In most of the studies improvement in FEV_1, FVC and SpO_2 is controversial[22,25,27]. Mc Govern JP et al stated that oxygen saturation as measured by pulse oximetry (SpO_2) in patients with COPD undergoing exercise testing is not sufficient accurate to replace SpO_2 as the gold standard for oxygen saturation[28]. Ciro Casanova et al stated that oxygen desaturation profile during 6MWT improves the predictive ability of the 6 minute walking distance[29]. Hiroaki

Nomori stated that the decrease in 6 minute walking distance and SpO_2 after surgery was significantly influenced by the pre-operative FEV_1, FVC%. COPD patients have a limited capacity for walking during early period after surgery due to significant oxygen saturation[30].To establish an appropriate exercise intensity to accomplish an increase in lung volumes and oxygen saturation in COPD, further investigation is necessary.

Although the effect on our patients was due to a multidisciplinary pulmonary rehabilitation program including not only ergometer exercise but also incentive spirometry and pursed-lip breathing exercises; we suggest that the prescribed exercise intensity, session duration and overall duration of the ergometer exercise protocol improves lung capacity in COPD.

However, we only investigated the exercise capacity and endurance immediately after rehabilitation. It is not clear how long this improvement will last. Further long-term rehabilitation program studies, including the assessment of physical function, QOL and prognosis are necessary.

In summary, this study of 5 week pulmonary rehabilitation program comprising incentive spirometry, static bicycle ergometer and pursed-lip breathing, improved FEV_1, FVC and SpO_2 and the 6MWD (an indicator of functional exercise capacity). These findings suggest that even if the program is of short term duration, it can still benefit patients with COPD. The increase in functional exercise capacity, even without an increase in maximal exercise capacity, will reduce dyspnea and improve endurance in patients with COPD.

VII. Limitations of the study

1. The study was conducted on a smaller sample size.
2. Only moderate COPD involved in the study.
3. Only males were included in the study.
4. Only single group were planned in this study.

VIII. Future Research

The study can be done in different subject groups who require physical training. Further long-term rehabilitation program studies, including the assessment of physical function, QOL and prognosis are necessary, randomization and comparative studies were more needed still.

IX. Conclusion

25 subjects of moderate COPD were given Pulmonary rehabilitation for 5 weeks duration and it is shown that short term pulmonary rehabilitation which includes incentive spirometry,

static bicycle ergometer training and pursed-lip breathing shows improvement among moderate COPD subjects.

X. References

1. Guideline for the management of Chronic Obstructive Pulmonary Disease (COPD): 2004 Revision
2. World Health Organization (WHO) 2010: Chronic Respiratory Diseases
3. Pauwels RA, Buist AS, Ma P, Jenkins CR, Hurd SS, GOLD scientific committee. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: National Heart, Lung, and Blood Institute and World Health Organization global initiative for chronic obstructive lung disease (GOLD) executive summary. Respir Care. 2001;46:798-825.
4. COPD: An Overview of the GOLD Guidelines
5. Ann Thomson, Alison Skinner, Joan Piercy, Tidy's Physiotherapy, 12th edition, chronic obstructive airway disease, pp 186-187, 2002.
6. Jennifer A Pryor, S Ammani Parsad, Physiotherapy for Respiratory and Cardiac problems, pp:78.
7. Sandra L.Schutz, Oxygen Saturation Moinitoring by pulse oximetry, AACN procedure manual for critical care, 4th edition, pp:77
8. Redelmeir DA,Bayoumi AM,Golgstein DS, Guyatt G.Interpreting small differences in functional status:The six minute walk test in chronic lung disease patients.Am J Respir Crit Care Med 1997;155:1278-1282.
9. Paul L Enright MD, The Six-Minute Walk Test, Respir Care 2003;48(8):783–785.© 2003 Daedalus Enterprises]
10. Lundback B, Lindberg A, Lindstrom M, *et al.* Not 15 but 50% of smokers develop COPD -Report from the Obstructive Lung Disease in Northern Sweden Studies. *Respir Med* 2003; **97:**115-122.
11. Anthonissen NR. Prognosis in chronic obstructive pulmonary disease. Results from multicenter clinical trials. *Am Rev Respir Dis* 1989; **140:** 595-599.
12. Roberts CM, Lowe D, Bucknall CE, *et al.* Clinical audit indicators of outcome following admission to hospital with acute exarbation of COPD. Thorax 57:137-141.
13. American Thoracic Society. Standards for the diagnosis and care of patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med (1995) 152, S77-S121.
14. Goldstein RS, Gort EH,Stubbing D, Avendano MA and Guyatt GH: Randomised controlled trial of respiratory Rehabilitation. Lancet (1994) 344, 1394-1397.
15. Lacasse Y, Wong E, Guyatt GH, King D, Cook DJ, Goldstein RS. Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. *Lancet* 1996; 348: 115-9.
16. H.Steven Sadowsky, Essentials of Cardiopulmonary physical therapy, Monitoring and life support equipment. 529-530
17. Carolyn Kisner, Lynn Allen Colby. Therapeutic Exercise, Foundations and Techniques.4th edition (2002); 754-755.
18. Seals DR, Hagberg JM, Hurley BF, Ehsani AA and Holloszy JO: Endurance training in older men and women. I. Cardiovascular responses to exercise. J Appl Physiol (1984) 57, 1024-1029.
19. Yerg JE IInd , Seals DR, Hagberg JM and Holloszy JO: Effects of endurance exercise training on ventilator function in older individuals. J Appl Physiol (1985) 58, 791-794.
20. Holten K: Training effect in patients with severe ventilator failure. Scand J Respir Dis (1972) 53, 65-76.

21. Chester EH, Belman MJ , Bahler RC, Baum GL, Schey G and Buch P: Multidisciplinary treatment of chronic pulmonary training on cardiopulmonary performance in patients with chronic obstructive pulmonary disease. Chest (1977) 72, 695-702.

22. Carter R, Nicotra B, Clark L, Zinkgraf S, Williams J, Peavler M, Fields S and Berry J: Exercise conditioning in the rehabilitation of patients with chronic obstructive pulmonary disease. Arch Phys Med Rehabil (1988) 69, 118-122.

23. Goldstein RS, Gort EH, Stubbing D, Avendano MA and Guyatt GH: Randomised controlled trial of respiratory rehabilitation. Lancet (1994) 344, 1394-1397.

24. Casaburi R, Patessio A, loli F, Zanaboni S, Donner CF and Wasserman K: Reductions in exercise lactic acidosis and ventilation as a result of exercise training in patients with obstructive lung disease. Am Rev Respir Dis (1991) 143, 9-18.

25. Ries AL,Kaplan RM, Limberg TM and Prewitt LM: Effects of pulmonary rehabilitation on physiologic and psychosocial outcomes in patients with chronic obstructive pulmonary disease. Ann Intern Med (1995) 122, 823-832.

26. Niederman MS, Clemente PH, Fein AM, Feinsilver SH, Robinson DA, llowite JS and Bernstein MG: Benefits of a multidisciplinary pulmonary rehabilitation program. Improvements are independent of lung function. Chest (1991) 99, 798-804.

27. O'Donnell DE, McGuire M, Samis L and Webb KA: The impact of exercise reconditioning on breathlessness in severe chronic airflow limitation. Am J Respir Crit Care Med (1995) 152, 2005-2013.

28. McGovern JP, Sasse SA, Stansbury DW, Causing LA, Light RW: Comparison of oxygen saturation by pulse oximetry and co-oximetry during exercise testing in patients with COPD. Department of Medicine, Veteran's Administration Medical Center, Long Beach, Calif 90822, USA PubMed - indexed for MEDLINE.

29. Ciro Casanova, Claudia Cote, José M. Marin, Víctor Pinto-Plata, Juan P. de Torres: distance and oxygen desaturation during the 6-min walk test as predictors of long-term mortality in patients with COPD.April 30, 2008.

30. Hiroaki Nomori, Kenichi Watanabe, Takashi Ohtsuka, Tsuguo Naruke and Keiichi Suemasu: Six-minute walking and pulmonary function test outcomes during the early period after lung cancer surgery with special reference to patients with chronic obstructive pulmonary disease. Springer Japan, Springlink (2004), volume 52, 113-115.

Table 1 shows pre and post parameters of SpO_2

Variables		Average	S.D	Table Value	P-Value	Result
SpO_2	Pre	93.80	0.645	22.2	<0.05	Difference is significant
	Post	97.16	0.374			

Table 2 shows the pre and post parameters of FVC

Variables		Average	S.D	Table Value	P-Value	Result
FVC	Pre	2.35	6.904	176	<0.05	Difference is significant
	Post	2.66	7.371			

Table 3 shows pre and post mean values of FEV_1

Variables		Average	S.D	Table Value	P-Value	Result
	Pre	1.45	0.22	251	<0.05	Difference is

FEV_1						significant
	Post	1.65	0.21			

Table 4 shows pre and post mean of 6MWT

Variables		Average	S.D	Table Value	P-Value	Result
6MWT	Pre	261.96	7.29	116.91	<0.05	Difference is significant
	Post	358.20	6.87			

Table 5 shows the pre and post mean values of SpO_2, FEV_1 ,FVC and 6MWT

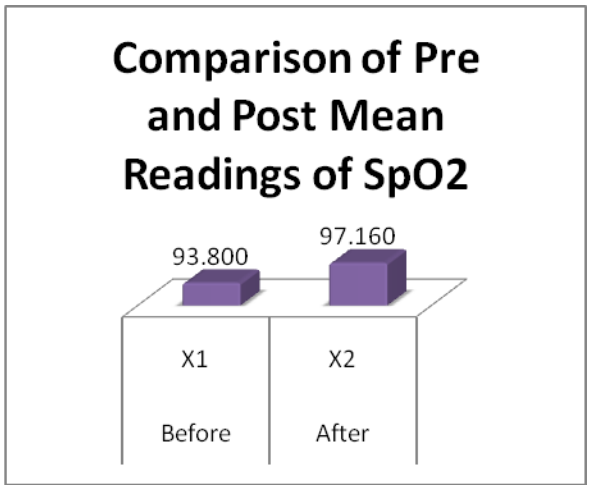
Variables	Before	After	*P* value
SpO_2	93.8 ± 0.645	97.16 ± 0.374	$p<0.05$
FEV_1	1.45 ± 0.22	1.65 ± 0.21	$p<0.05$
FVC	2.35 ± 6.904	2.66 ± 7.371	$p<0.05$
6MWT	261.96 ± 7.29	358.20 ± 6.87	$p<0.05$

Fig1-Static-Bicycle Ergometer

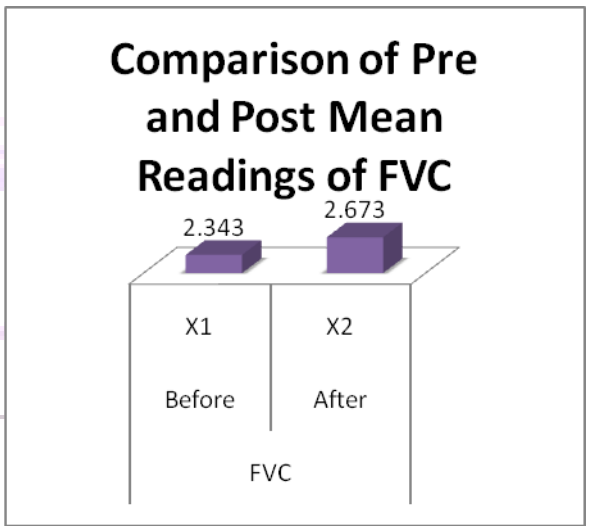
Fig-2-Bathroom weighing machine and Inch tape

Fig3Computerized Spirometer

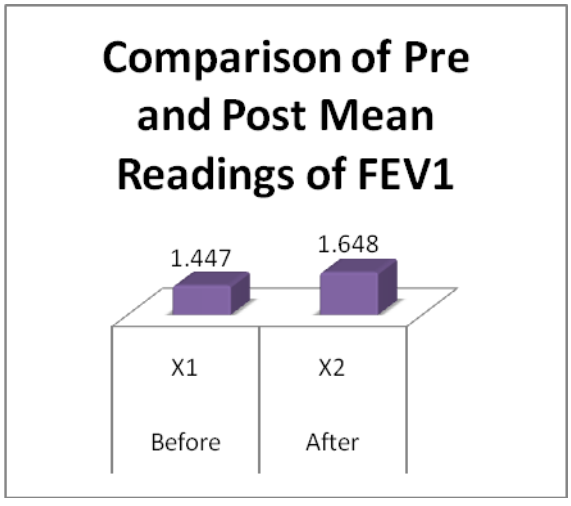
Fig-.4-Incentive Spirometer



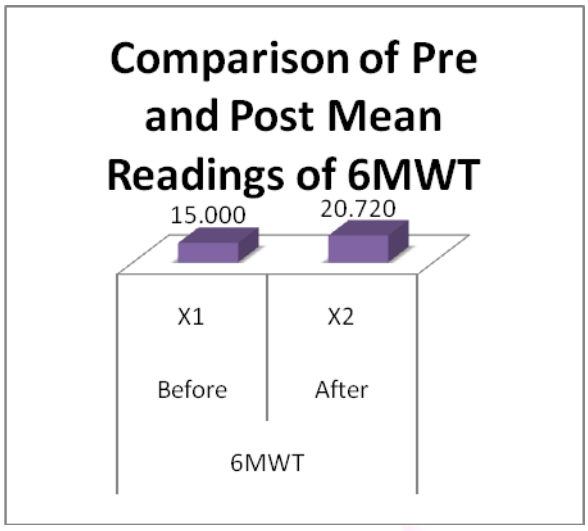
Graph 1



Graph 2



Graph 3



Graph 4

XII. Acknowledgement

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CONSENT OF THE SUBJECT

સંમતી પત્ર

EFFECT OF SHORT TERM PULMONARY REHABILITATION ON SPO_2, FVC, FEV_1 AND EXERCISE CAPACITY IN MODERATE COPD

Name of patient: Age/Gender:

દર્દી નું નામ: ઉંમર/જાતિ:

I have been explained about the research in which I agreed to participate. I know that I am giving this consent without any force. I Can discontinue the study any time and that will not affect my Treatment that I have been informed. My identity would not get disclosed in any other Research.

મને હાથ ધરાયેલ સંશોધન વિષે સમજાવવામાં આવેલ છે. જેમાં ભાગ લેવાની હું સંમતી આપું છું. હું જાણું છું કે આ સંમતી કોઈ પણ જાત ના દબાણ વગર દર્શાવું છું. હું ગમે ત્યારે તેમાંથી મુક્ત થઇ શકું છું અને તેની અસર મારી સારવાર પર નહિ થાય તેમ મને જાણ કરવામાં આવેલ છે. તે ઉપરાંત દર્દી તરીકે ની મારી ઓળખ કોઈ પણ સંશોધન માં છતી નહિ થાય.

Signature of Patient: Signature of Researcher:

દર્દી ની સહી : સંશોધનકાર ની સહી :

Date:

તારીખ :