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RESEARCH ARTICLE

COMPARISON BETWEEN POST ISOMETRIC RELAXATION AND RECIPROCAL INHIBITION TECHNIQUES OF MUSCLE ENERGY TECHNIQUES ON RESPIRATORY FUNCTION IN PATIENTS WITH CHRONIC OBSTRUCTIVE AIRWAY DISEASES

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ABSTRACT

Background: Muscle energy techniques are usually indicated to relieve pain and improve range of motion, however there are studies indicating their usefulness in COAD patients in improving chest expansiondyspnoea, chest mobility, exercise tolerance, autonomic dysfunction in a way improving vital capacity and consequently, quality of life. Both PIR and RI techniques of MET have opposite mechanisms of working, and have proved to be effective in treatment of COAD patients. However, there is no documented evidence to find out which technique is the best MET technique on respiratory function.

Objectives:

- To find out the effects of Post Isometric Relaxation with Chest Physiotherapy on respiratory function.
- To find out the effects of Reciprocal Inhibition with Chest Physiotherapy on respiratory function.
- To compare both of the effects (the effects on dyspnoea, respiratory rate, chest expansion and maximum breathing capacity.),in the two groups.

Methodology: Ethical clearance and participant consent was taken. Study design was Experimental Prospective study. The 86 subjects were divided into groups of 43 each by computer generated randomized table method, one receiving PIR and the other, RI techniques and chest physiotherapy was given to both groups. Inclusion criteria included COAD patients and exclusion included restrictive lung diseases and other systemic diseases. The pre and post intervention outcome measures were calculated for both the groups .Then the groups were compared to see if there was any significant difference in the outcome measures. Study duration was 18 months.(May 2016- October 2017) 1. SPSS 16.0 software was used to analyse the data. . Data was tested for normality using the Shapiro Wilk test. Parametric test like paired t test and unpaired t test were used for the data passing the normality test whereas nonparametric test like Wilcoxon Signed Rank test and Mann Whitney U test were used for the data not passing the normality test. Level of significance was set at 5%.

Results

- In PIR group; Maximum Breathing Capacity had significantly increased(p=0.11) at post test whereas Respiratory Rate(p=0.009) had significantly gone down at post test. Other parameters had not significantly changed.
- Within RI group; Chest expansion had significantly increased(p=0.38) at post test whereas other parameters had not significantly changed.
- 3.The amount of change was not significantly different between groups.(dyspnoea p=0.906)
- (Chest expansion axilla, p=0.879),(chest expansion xiphesternum, p=0.601),(maximum breathing capacity, p=0.193), (respiratory rate, p=0.745)

Conclusion: On comparing the differences between both groups there was no statistically significant difference in in both groups in chest expansion (axilla and xiphesternum), dyspnoea, respiratory rate, maximum breathing capacity.

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INTRODUCTION

The Global Initiative for Obstructive Lung Disease (GOLD) defines Chronic Obstructive Airway Disease(COAD) as "a preventable and treatable disease, characterized by a persistent airflow limitation that is progressive and not fully reversible and associated with an abnormal inflammatory response of the lungs to noxious gases or particles (Karen, 2003). Diagnosis and assessment of Chronic Obstructive Airway Disease (COAD) is based on the degree of airflow limitation at spirometry (Akanksha *et al.,* 2013; Rita, ?). Chronic Obstructive airway Disease is currently estimated to be the fifth leading cause of death worldwide and will rank third by 2030 (Akanksha *et al.,* 2013). The result of one study on clinical profile of diseases causing chronic airflow limitation in a tertiary centre in India by Gothi D, Shah DV, Joshi JM showed that out of 268 patients with chronic airflow obstruction,63% had asthma,17% had chronic obstructive pulmonary disease,(COPD),6% had bronchiectasis,13%had obliterative bronchiolitis (OB) and 1% had occupational airway disease (Gothi *et al.,* 2007). From the World Health Report 2004, the estimated DALYs lost due to all respiratory diseases in 2002 was 184 million (12% of the total) compared with 21% of all the infectious and parasitic diseases,13% for neuropsychiatric diseases and 10% for cardiovascular diseases. The prevalence of chronic airflow limitation is relatively high. The World Health Report 2004 estimates a range of COPD upto 1.7% with a global median at just over 1.0% (Nadia, 2007). The chief complaints of COAD include dyspnoea, cough, reduced chest expansion, affected respiratory mechanics and fatigue (Mehta, 2012). All these symptoms worsen the quality of life of the patients. Dyspnoea can be defined as an appreciation of increased effort and discomfort associated with the act of breathing. These symptoms are best appreciated during exercise by placing the cardio respiratory system under the stress of increased oxygen requirement and carbon dioxide output. Thus, quantification of exercise capacity provides an objective evidence of the degree of dyspnoea. Tests like treadmill and cycle ergometer are commonly used for this purpose but are cumbersome, time consuming and nor readily available. As a result, simpler tests like 6 minute walk tests provide a useful alternative.

In keeping with the concept that exercise test is preferrable to measurement done at rest in assessing disabilibity and perception of dyspnoea,and that a test that is cheap and easy to perform has many advantages, the study "Incentive spirometry as a means to measure breathelessness" validated the use of 3 Minute Respiratory exerciser test (3MRET) to measure the Maximum Breathing Capacity(MBC) of a subject,in normal individuals and asthamatics. The reliabilty and reproductility of this test was also proved in the same study. In this test ,the subject was required to make repetitive inspiratory efforts within a set of 3 minutes,and breathelessness perceived at the end of the inspiratory exercise converted into a score dependent on Maximum Breathing Capacity (MBC) as an index of Perception Of Dyspnoea.(POD) In 3 Minute Respiratory exerciser test (3MRET), Incentive Spirometer Columns A, B and C required flow rates of 600 ml/min, 900 ml/ min and 1200 ml/min respectively to bring the balls to reach the top, and as such, required the generation of sufficient inspiratory effort on the part of the subject to achieve this (Leh, 2015).

The number of times the subjects are able to lift the balls in 3 minutes was documented and the MBC score was calculated by using the formula:

MBC score= (number of times that all three balls reached the top of columns) x 2 + (number of times that two balls reached the column top) x 1.5 + (number of times that only one ball reached the column top) x 1.[4] The POD index was calculated by dividing the POD Visual Analog Scale(VAS)score with the MBC score, and then multiplying it by 1000. To standardize, POD VAS score of zero was replaced by a standard value of 0.125, to enable the calculation of the POD index using the equation described. Higher POD index indicated greater perception of breathlessness. The POD index makes correction for the breathing workload capability of an individual. The validity of the POD Index is also provided in the study "Incentive spirometry as a means to measure breathelessness". In addition, the POD is assessed on breathing capacity alone using a type of incentive spirometer widely available. The 3MRET test obviates the need of walking along a hospital corridor and measurement of walking distance. It takes a shorter time and can be carried out easily (Akanksha *et al.,* 2013; Leh, 2005). The altered respiratory mechanics in COAD can give rise to a Barrel shaped chest,stooped posture and tightness of neck and scapular muscles. The elastic recoil of the chest is lost. With hyperinfation, there is flattening and reduced excursion of the diaphragm, which further contributes to reduced chest expansion in these subjects. There is air trapping due to inflammation of the bronchioles and alveoli, and loss of ealstic recoil. The chest expansion gives an estimate of the movement and excursion of each of the lungs The chest expansion can be measured by a measuring tape at various levels corresponding to the lobes of the lung.

Akansha et al state that dynamic lung hyperinflation, as a result of chronic expiratory airflow limitation in chronic obstructive airway disease patients, impairs diaphragm efficiency for inspiration leading to its functional weakness, dysfunction and overuse of Accessory Inspiratory muscles (Akanksha *et al.,* 2013) Campbell (1955) stated that Sternocleidomastoid (SCM) was the first among accessory muscles to be recruited and that spastic state of these accessory muscles was a contributory cause of dyspnea in chronic respiratory patient. He further stated that this lead to thoraco-abdominal dys-synchrony which further resulted in biomechanical changes characterized by chest wall muscles shortening, weakness and fascia restriction contributing to increased work of breathing and reduced exercise capacity (Akanksha *et al.,* 2013). Furthermore, it is also stated in a study that the postural deformities like kyphosis due the hyperinflation place pectorals and other chest wall muscles in a shortened position increasing the chest wall resistance to expansion, further increasing the Work of Breathing, and thus reducing exercise capacity. Moreover these muscles, sternocleidomastoid and pectorals, are also required for the movement of upper limb and neck in daily activities.. These musculoskeletal complications increase the work of breathing and adversely affect patients'quality of life in the way that they start to associate dyspnoea on exertion with disease and no longer consider it as a normal response to exertion leading to a vicious cycle of physical inactivity (Akanksha *et al.,* 2013). As the severity of chronic obstructive airway disease progresses, use of the upper limb for functional tasks becomes increasingly difficult, because of which there is increased muscle tightening and stiffness around the muscle quadrant further increasing chest wall resistance and thus the work of breathing (Akanksha *et al.,* 2013).

Muscle energy technique(MET): Muscle Energy Technique (MET) is a manual medicine procedure that has been described as a gentle form of manipulative therapy effective for treating movement restrictions of both the spine and extremities (Dharmesh *et al.,* 2015). It is a method of treatment that involves voluntary contraction of subject's muscles in a precisely controlled direction against a counterforce provided by operator. MET may be used to decrease pain, stretch tight muscles and fascia, reduce muscle tonus, improve local circulation, strengthen weak musculature and mobilize joint restrictions (Inam, 2010). Muscle tightness is caused by decrease in ability of muscle to deform, resulting in decrease in range of motion of the joint on which it acts.

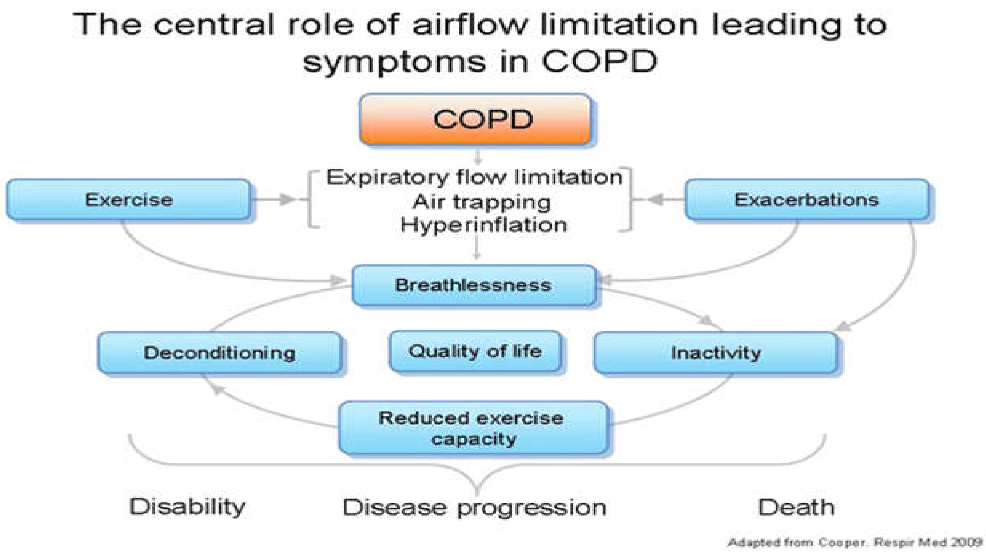


Fig. 1. Showing role of Airflow limitation

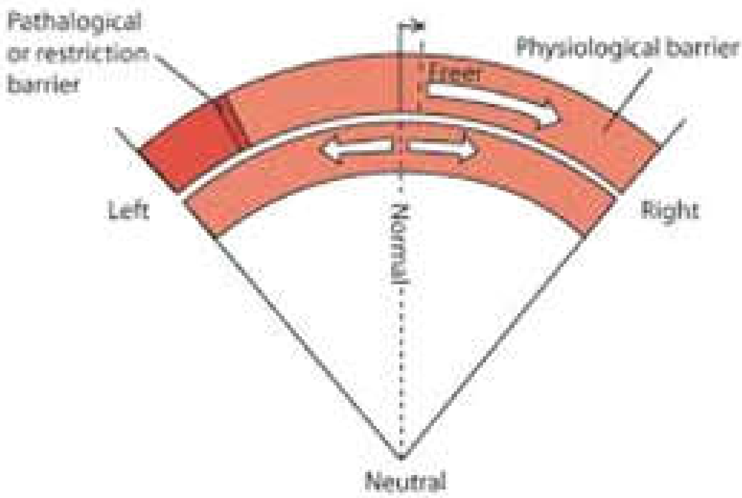


Fig. 2. Showing physiological and pathological barriers encountered while stretching

The theory behind muscle energy technique suggests that the technique is used to correct an asymmetry by targeting contraction of a muscle and moving innominate in corrected direction (Mohamed , 2015).

There are different types of METs namely:

- Lewitt's Post Isometric Relaxation
- Janda's Post facilitation stretch method
- Strengthening variation.
- Isotonic contraction MET
- Reciprocal Inhibition Variation (Susan, 2007)

Out of these, we will be dealing with two methods, Reciprocal Inhibition and Post Isometric Relaxation.

Post isometric relaxation (PIR): Lewitt's modification of MET, which he called Post Isometric Relaxation, is directed towards relaxation of hypertonic muscle. The dysfunctional joint is positioned at **the end range of** its limited motion and the patient is requested to lightly contract for approximately five seconds against the specific counterforce offered by the therapist. After relaxation, the restrictive barrier is often felt to yield, and the procedure is repeated several times (Dharmesh *et al.,* 2015). A term much used in recent developments of muscle energy techniques is PIR, especially in relation of work of Karel Lewit.PIR refers to assumed effect of reduced tone experienced by muscle or group of muscles, after brief periods following a isometric contraction.[13]

Reciprocal inhibition(RI): This method, forms a component of Peripheral Neuromuscular Facilitation methodology and MET.In Reciprocal Inhibition type, the muscle is positioned in the mid range and the muscle is contracted towards its restriction barrier.

The main effect of muscle energy techniques is relaxation. Unlike massage, the muscle energy techniques relaxation is post isometric. It consists of passive stretching, immediately followed by an isometric active contraction, exploiting the post isometric relaxation stage (Dharmesh, 2015). Lewit and Simons agree that while Reciprocal Inhibiton is a factor in some forms of therapy related to PIR techniques,it is not a factor in PIR itself, which is believed to involve a phenomenon resulting from a neurological loop associated with Golgi tendon organs (Susan, 2007). Postisometric relaxation and reciprocal inhibition are the two most widely used types of METs[4]. Both have opposite mechanisms of working, and have proved to be effective in treatment of COAD patients. However, there is no documented evidence to find out which technique is the best MET technique on respiratory function.

METHODOLOGY

Study design

Research design: Experimental prospective study.

Sample Population: Patients with airflow limitation will be assigned equally to both the groups by random allocation (Computer generated randomized table.)

Sample Size: Sample size was calculated with reference to the article "Muscle Stretching Technique increases Vital Capacity and Range of Motion in Patients With Chronic Obstructive Pulmonary Disease" **.**The Axillary chest expansion value was taken as reference from this study ,the value of mean and standard deviation pre and post intervention was taken which was,respectively,3.1,1.1 pre intervention and 3.8,1.2 post intervention. The sample size came as minimum 43 for each group,by Comparison of mean method (at 80%power and 5% alpha error).thus the total sample size came as 86 for this study.

Type of sampling: Simple Random sampling

Source of sampling: Chest medicine OPD of tertiary health care hospital

Place of study: Physiotherapy OPD of tertiary health care hospital

Duration of study: 18 months.(May 2016- October 2017)

Inclusion Criteria

- Patients with mild, moderate, and severe airway obstruction based on GOLD-stage classification of Obstructive airway disease severity to be included in the study

Mild: $FEV_1/FVC < 0.70$
$FEV_1 > 80\%$ of predicted
Moderate: $FEV_1/FVC < 0.70$
$50\% < FEV_1 < 80\%$ of predicted
Severe: $FEV_1/FVC < 0.70$
$30\% < FEV_1 < 50\%$ of predicted

- No exacerbation of symptoms in the last 1 month
- Ability to understand the purpose of the study
- Voluntary consent to participate.
- Age group 20 to 70 years.

Exclusion Criteria

- If the individual suffers from restrictive lung condition, lower limb injury, neurological injury/disease, or any vestibular problems.
- Major vision/ auditory problem
- Fever or worsening of respiratory symptoms;
- Previous lung-volume reduction surgery, lung transplantation, or pneumonectomy;
- Unstable coronary artery disease;
- Participation in any physical training activities.
- Inability to understand and co-operate.
- Asthamatic patients.

MATERIALS

- Measuring tape
- Triflow incentive spirometer

- Stop watch
- Table stool
- Weighing machine

Materials used

Outcome Measures

Resting respiratory rate
Chest expansion(axillary and xiphesternal)
Dyspnoea on VAS scale jand POD index.
Maximum breathing capacity

Fig. 3. Showing materials used

Procedure

Approval from Ethics Committee was sought. Participants were included in study after screening for inclusion and exclusion criteria. A written consent was taken from the participants after explaining the study procedure. The basic personal information, anthropometric measures, vital parameters, smoking history, PFT measures, level of dyspnoea, co-morbidities and information regarding current medication of the participant were taken. Patients were randomly allocated into two groups, Group A and Group B. Randomization was done using a computer generated randomized table .Group A received Post Isometric Relaxation with Chest physiotherapy and Group B received Reciprocal Inhibition with Chest physiotherapy. A list of 86 subjects were assembled, and 43 were assigned to each group. As subjects were chosen and assigned to group A or B on rotating bias, until all subjects were assigned. Pre intervention, both the groups were assessed for their outcome measures.(Dyspnoea, maximum breathing capacity, respiratory rate, chest expansion).

Dyspnoea: On VAS (Visual Analogue Scale) and POD(Perception Of Dyspnoea Index). The patient was asked to grade his symptoms on a scale of zero(no breathlessness) to 10(maximum breathlessness). The scale was thoroughly explained to the patient in his/her own language and the patient was asked to rate his symptoms pre assessment. Immediately after the test, the patient placed a score on a Visual Analogue Scale (VAS) between zero (not breathless at all) and ten (worst imaginable breathlessness) with regards to his POD. The POD index was calculated by dividing the POD VAS score with the MBC score, and then multiplying it by 1000. To standardize, POD VAS score of zero was replaced by a standard value of 0.125, to enable the calculation of the POD index using the equation described. Higher POD index indicated greater perception of breathlessness.

Resting respiratory rate: Patient was seated comfortably in a chair, and with the use of a stop watch, his resting respiratory rate was calculated. For correct measures, the procedure was repeated 2-3times,and then the approximate value was taken.

Chest expansion: The patient was seated in a chair. He was asked to first take some normal breaths first, expire fully and then inspire maximally and hold the breath for a second .The difference between these two was noted using a measuring tape, at axillary and xiphesternal level. For correct measures, the procedure was repeated 2-3times,and then the approximate value was taken.

Maximum Breathing Capacity: Maximum breathing capacity was assessed using ‘3 minute respiratory exerciser test’ (3MRET), using tri flow incentive spirometer. This test scores the maximal breathing capacity (MBC) by repetitive inspiratory efforts within three minutes, with an incentive spirometer. The subjects was seated comfortably and the procedure explained prior to the testing. The subjects were asked to hold the mouth piece in the mouth and inhale forcefully through the mouthpiece repeatedly for 3 minutes in order to lift the balls of the spirometer.

The spirometer was be held in front of the subjects to provide visual feedback. By repeated inspiratory effort, subjects were encouraged to get as many balls as possible to reach the top of each of the three columns (A, B and C) within three minutes. Columns A, B and C required flow rates of 600 ml/min, 900 ml/ min and 1200 ml/min respectively to bring the balls to reach the top, and as such, required the generation of sufficient inspiratory effort on the part of the subject to achieve this.The number of times the subjects are able to lift the balls in 3 minutes was documented and the MBC score was calculated by using the formula:

MBC score= (number of times that all three balls reached the top of columns) x 2 + (number of times that two balls reached the column top) x 1.5 + (number of times that only one ball reached the column top) x 1.[4]

Fig 4. Maximum Breathing Capacity By Triflow Incentive Spirometer Incentive Spirometer

After this, the patient was given regular chest physiotherapy (breathing exercise, nebulisation, huff cough techniques) followed by their respective interventions to two muscles, namely pectoralis major and sternocleidomastoid.

NEBULISATION

CHEST PHYSIOTHERAPY TECHNIQUES - NEBULISATION AND BREATHING EXERCIESES.5fFf

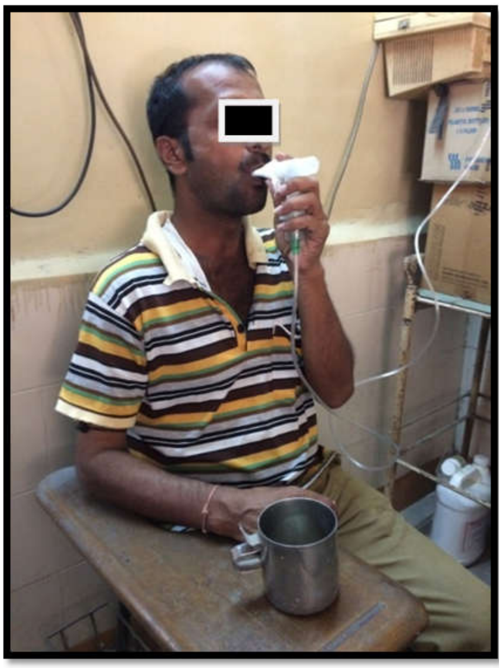


Fig 5. Nebulisation

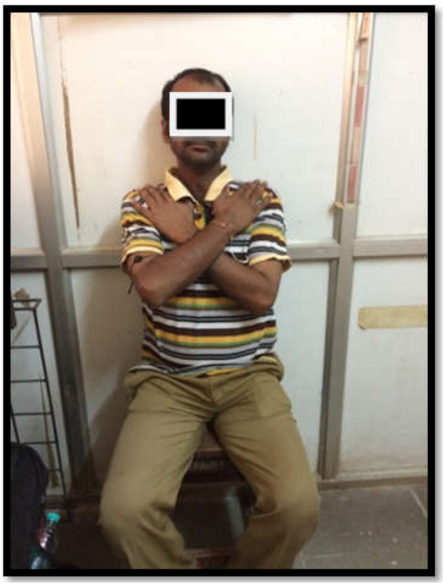


Fig. 6. Breathing exercises

Fig. 7. Breathing Exercises

Post isometric relaxation method for pectoralis major (bilateral): Postion of patient: Sitting, with both the arms abducted to 90 degree and elbows flexed to 90degree and shoulders in neutral position. Therapist position: standing behind the patient. The muscle was first stretched upto the painful barrier(horizontal abduction) by therapist.

Post Isometric Relaxation-Isometric Contraction Phase

Fig. 8. Post Isometric Contraction-Stretching Phase

Fig. 9. Post isometric contraction-stretching phase

Then the patient was asked to inhale and contract the muscle, i.e perform horizontal adduction ,applying 10to20percent of his/her resistance. Contraction is held for 5to 10s. Patient was then asked to exhale, and then the muscle was taken to the new barrier.(horizontal abduction)This procedure was repeated 2-3 times.

Reciprocal inhibition method for pectoralis major(bilateral): The muscle was taken in mid range position.(arms abducted 90degree ,elbows flexed to 90degree,arms slight horizontally adducted.). Patient was asked to push firmly towards towards restriction barrier,(horizontal abduction)and examiner resisted. On ceasing the effort, patient inhaled and exhaled fully, and muscle was passively lengthened.(horizontal abduction).

Reciprocl inhibition-isometric contraction phase

Fig. 10. Reciprocl inhibition-isometric contraction phase

Fig. 11. Reciprocal inhibition-stretching phase

Post isometric relaxation for sternocleidomastoid (bilateral): Patient position: Sitting. Shoulders, neck in neutral position. both elbows extended. Wrist neutral. Therapist position: standing behind patient. The muscle was first stretched up to the painful barrier(side flexion to opposite side, rotation to same side) by therapist. Then the patient was asked to inhale and contract the muscle, i.e perform side flexion to same side and rotation to opposite side., applying 10to20percent of his/her resistance. Contraction was held for 5to 10s. Patient was then asked to exhale, and then the muscle is taken to the new barrier. (side flexionto opposite side ,rotation to same side)This procedure is repeated 2-3 times.

Fig. 12. Post isometric relaxation-isometric contraction phase

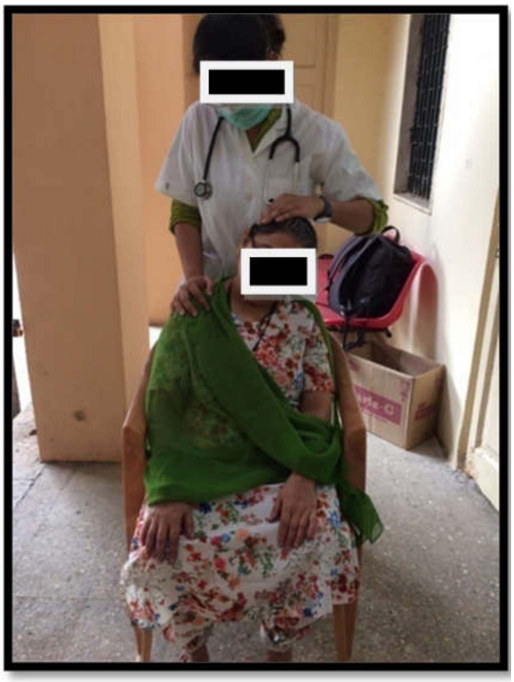


Fig. 13. Post isometric relaxation-stretching phase

Reciprocal inhibition method for sternocleidomastoid (bilateral): The muscle was taken in mid range position(slight side flexion to same side and rotation to opposite side). Patient was asked to push firmly towards restriction barrier,(side flexion of patient to opposite side and rotation to same side)and examiner resisted. On ceasing the effort, patient inhaled and exhaled fully, and muscle was passively lengthened.(side flexion of patient to opposite side and rotation to same side).These techniques were given once in a day to patient, repeated 2-3 times. this was repeated for two days. Per day, the treatment time was maximum of 15 minutes per patient.

Fig. 14. Reciprocal inhibition-isometric contraction phase cccccccccccccccccontraction phase

Fig. 15.

On the 2nd day, at the end of the treatment, the outcome variables were measured for both the groups. Then the pre and post intervention measures for each group were compared. Then the results of both the groups were compared to find out if one technique is faring better than the other.

RESULTS

- Total 86 subjects were included in study out of which 43 were in Postisometric relaxation and 43 were in reciprocal inhibition group.
- Total number of male were 20(43%) and and female were 23(53%) and in Postisometric relaxation and reciprocal inhibition respectively.
- At baseline, both the groups were homogenous with respect to age, BMI, Severity of Airway obstruction, height, weight, chest expansion (axilla and xiphesternum), dyspnoea, respiratory rate, maximum breathing capacity
- In postisometric relaxation group, there was statistically significant increase in maximum breathing capacity (p=0.10),Chest expansion (Axilla) (p=0.48) and respiratory rate had significantly decreased (p=0.003)post intervention of 2 days. Others parameters remained unchanged.
- In reciprocal inhibition Group, there was a statistically significant increase in Chest expansion (Axilla) (p=0.033) and statistically significant reduction in perception of dyspnoea (0.21) post intervention of 2 days. Other parameters remained unchanged.

- On comparing the differences between both groups there was no statistically significant difference in in both groups in chest expansion (axilla and xiphesternum), dyspnoea, respiratory rate, maximum breathing capacity.

Table 1. Distribution of diseases

Diagnosis	Total
BRONCHIECTASIS	14 (16.28%)
COAD	30 (34.88%)
COPD	12 (13.95%)
POST TB BRONCHIECTASIS	12 (13.95%)
POST TB obstruction	18 (20.93%)
Total	86

Table 1 and Graph 1 show distribution of diseases in the study.

Table 2. Gender distribution in post isometric relaxation and reciprocal inhibition groups

Gender	PIR group	RI Group
Female	23 (53.48%)	23 (53.48%)
Male	20 (46.51%)	20 (46.51%)
Total	43	43

Table 2 shows gender distribution in the groups.In each of postisometric relaxation and reciprocal inhibition groups,total number of subjects were 43,out of which,23(53.48%) were females and 20(46.51%) were males.

Graph 2:Gender distribution:

- PIR GROUP
- RI GROUP

Graph A and B shows gender distribution in Post isometric group and Reciprocal inhibition group respectively.

Table 3. Severity grading in Post isometric relaxation group and reciprocal inhibition group respectively.

SEVERITY	PIR group	RI Group	Total
MILD	17(39.5%)	17(39.5%)	34
MODERATE	20(46.5%)	19(44.1%)	39
SEVERE	6(13%)	7(16%)	13
Total	43	43	86

Table 3 shows the severity of airway obstruction graded according to GOLD's classification. In PIR group,39.5% of patients had mild,46.5% patients had moderate and 13% patients had severe airway obstruction. In RI group, patients 39.5% had mild, 44.1%had moderate and 16% patients had severe airway obstruction

Graph 3:Distribution of severity

A)Distribution of severity in PIR group

B)Distribution of severity in RI group

Graph 3 shows distribution of severity in post isometric relaxation and reciprocal inhibition group.

Baseline comparison between the groups

Table 4. Baseline characteristics in both the groups(Normally distributed)

Parameter		PIR Group	RI Group	t-test value	p-value
Age	Mean± SD	49.07±9.43	47.93±9.62	.554	.581
	CI	46.15-51.97	44.6-50.89		
	SE	1.43	1.46		
Height	Mean± SD	154.19±7.300	154.00±7.14	.119	.905
	CI	1.51-1.56	1.51-1.56		
	SE	1.11	1.08		
Weight (kg)	Mean± SD	49.63±1.05	52.28±1.52	-1.197	.235
	CI	46.39-52.80	49.19-55.36		
	SE	1.60	1.002		
BMI	Mean± SD	24.95±4.87	24.61±4.61	.339	.736
	CI	23.45-26.26	23.18-26.02		
	SE	0.74	0.70		

PIR and RI group are comparable on age, height, weight and BMI. There is no significant difference in mean values between groups. t-test results are given in the table above.

Table 5. Baseline Characteristics in Both Groups (non-normally distributed)

Parameter		PIR Group	RI Group	Mann-Whitney Value	p-value
Dyspnoea	Mean± SD	15.82±2.50	16.99±2.85	0.363	.716
	Median	1.42	1.40		
	Mean Rank	44.48	42.52		
	CI	8.10-23.53	8.19-25.77		
	SE	3.82	4.35		
Chest Expansion (A)	Mean± SD	1.97±0.87	1.93±0.88	0.242	.809
	Median	2.00	1.50		
	Mean Rank	44.14	42.86		
	CI	1.69-2.23	1.65-2.20		
	SE	0.134	0.135		
Chest Expansion (X)	Mean± SD	1.98±0.76	2.01±0.879	0.129	.897
	Median	2.00	1.70		
	Mean Rank	43.84	43.16		
	CI	1.74-2.21	1.73-2.29		
	SE	0.117	0.139		
MBC	Mean± SD	100.23±1.72	101.41±1.43	0.091	.927
	Median	109.50	108.00		
	Mean Rank	43.74	43.26		
	CI	94.91-1.05	96.97-1.05		
	SE	2.63	2.19		
RR	Mean± SD	24.98±4.60	24.26±4.31	0.141	.888
	Median	24.00	24.00		
	Mean Rank	43.87	43.13		
	CI	23.56-26.39	22.92-25.58		
	SE	0.70	0.65		

PIR and RI group are comparable on Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR . There is no significant between groups. Mann-Whitney results are given in the table above.

Pre and post comparison within pir group

Descriptive statistics of dyspnoea,chest expansion (A),chest expansion(X),respiratory rate and maximum breathing capacity(PIR GROUP)

DATA	MEAN± SD	MEDIAN	STANDARD ERROR	CONFIDENCE NTERVAL
DYSPNOEA PRE	15.81±25	1.42	3.821	8.10-23.53
DYSPNOEA POST	13.50±2.33	1.30	3.56	6.31-2.69
CHEST EXAPANSION (A)PRE	1.96±0.87	2.00	0.134	1.69-2.23
CHEST EXPANSION(A)POST	2.17±0.8	2.00	0.12	1.9-2.42
CHEST EXPANSION(X)PRE	1.97±0.76	2.00	0.117	1.74-2.21
CHEST EXPANSION (X)POST	2.21±0.7	2.00	0.10	1.90-2.34
MBC PRE	1.00±1.72	1.72	2.63	94.91-1.05
MBC POST	1.08±1.00	1.10	1.53	1.05-1.11
RR PRE	24.97±4.60	24.00	0.70	23.56-26.39
RR POST	23.27±4.06	23	0.69	22.02-24.52

Table 6 shows descriptive statistics of on Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR in post isometric relaxation group.

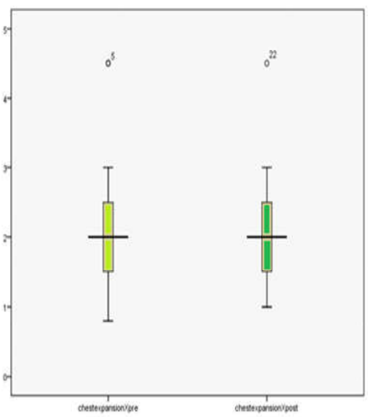
Graph 7. Boxplot for pre and post values of Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR in post isometric relaxation group.

BOXPLOT OF DYSPNOEA PRE AND POST PIR

DYSPNOEA

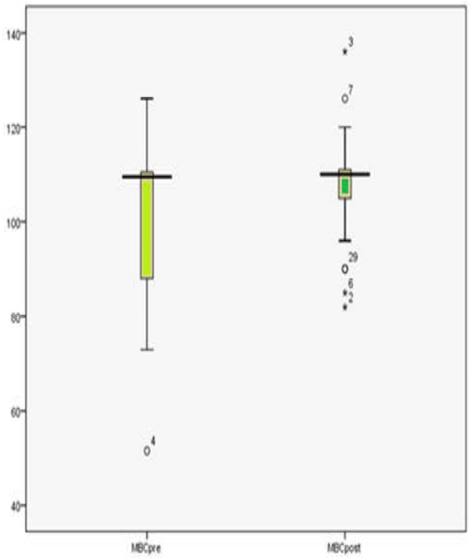
POST

PRE



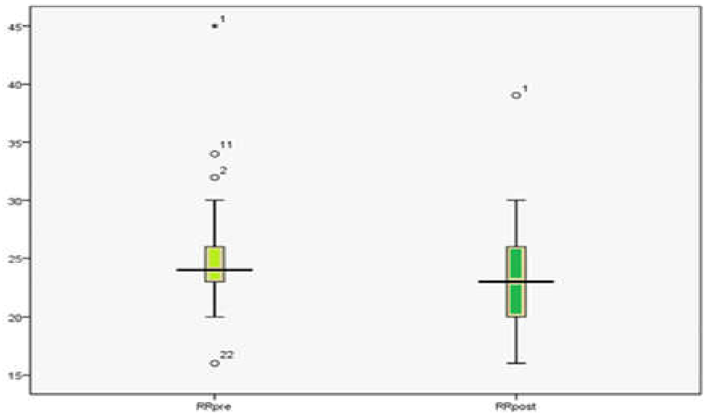
Boxplot of Mbc Pre And Post Pir

MBC
POST
PRE



Boxplot of rr pre and post pir

RR
POST
PRE



PRE AND POST COMPARISON WITHIN RI GROUP

Table 8: Descriptive statistics of dyspnoea, chest expansion (A),chest expansion(X),respiratory rate and maximum breathing capacity(RI group)

DATA	MEAN	MEDIAN	STANDARD ERROR	CONFIDENCE INTERVAL
DYSPNOEA PRE	16.98±2.85	1.400	4.35	8.19-25.77
DYSPNOEA POST	15.12±2.48	1.300	3.78	7.48-22.75
CHEST EXAPANSION (A)PRE	1.93±0.887	1.500	0.135	1.65-2.23
CHEST EXPANSION(A)POST	2.16±0.86	2.00	0.131	1.89-2.42
CHEST EXPANSION(X)PRE	2.03±0.91	1.700	0.139	1.75-2.31
CHEST EXPANSION(X)POST	2.088±0.80	2.00	0.122	1.84-2.33
MBC PRE	1.014±1.08	1.43	2.91	9.97-1.058
MBC POST	1.04±1.72	1.80	2.62	98.92-1.09
RR PRE	24.25±4.31	24	0.658	22.92-25.58
RR POST	22.88±3.66	24	0.55	21.75-24.01

Table 8 shows descriptive statistics of on Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR in reciprocal inhibition group group.

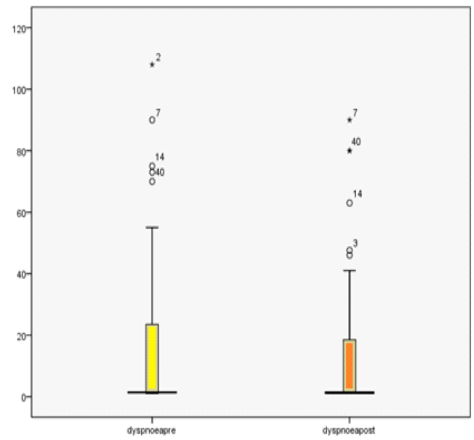
Table 9 Pre and post comparison of Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR in reciprocal inhibition group

Parameter		Pre-test	Post-test	Wilcoxon signed rank test	p-value
Dyspnoea	Mean	16.99	15.12	2.300	.021
	Median	1.40	1.30		
Chest Expansion (A)	Mean	1.93	2.16	2.131	.033
	Median	1.50	2.00		
Chest Expansion (X)	Mean	2.01	2.09	.884	.377
	Median	1.70	2.00		
MBC	Mean	101.41	104.22	-1.675	.094
	Median	108.00	108.00		
RR	Mean	24.26	22.88	1.811	.070
	Median	24.00	24.00		

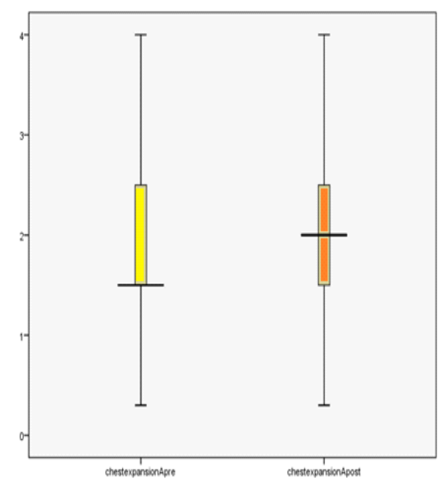
Significant post-test change was observed in Dyspnoea and Chest Expansion (A), while no significant post-test change observed in Chest Expansion (X), MBC and RR. Wilcoxon test results are given in the above table.

Graph 9:Boxplot for pre and post values of Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR in reciprocal inhibition group. Graph 9:Boxplot for pre and post values of Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR in reciprocal inhibition group.

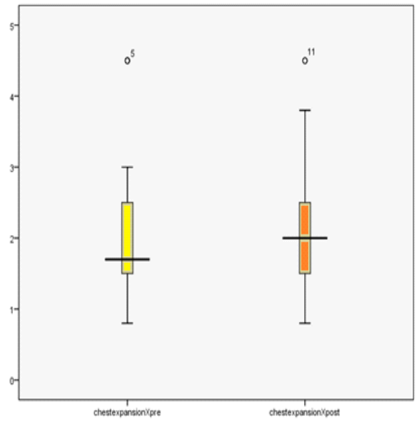
BOXPLOT SHOWING DYSPNOEA PRE AND POST RI
PRE
POST
DYSPNOEA



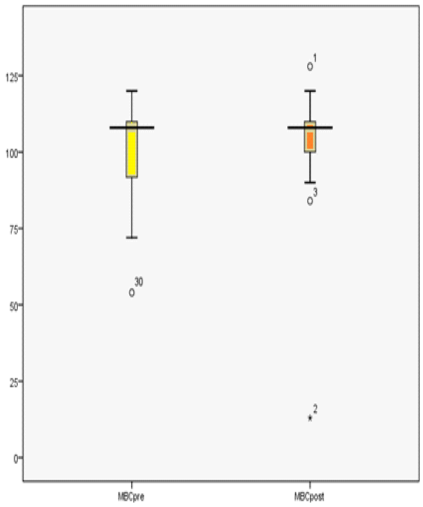
BOXPLOT SHOWING CHEST EXPANSION AT AXILLARY LEVEL PRE AND POST RI
CHEST EXP.(A)
POST
PRE



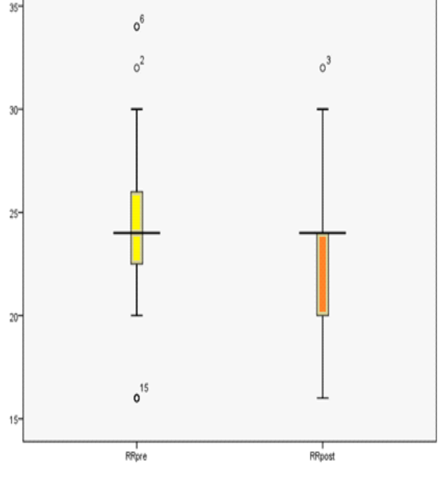
BOXPLOT SHOWING CHEST EXPANSION AT XIPHESTERNAL LEVEL PRE AND POST RI
CHEST EXP.(X)
POST
PRE



BOXPLOT SHOWING MBC PRE AND POST RI
MBC
POST
PRE



BOXPLOT SHOWING RR PRE AND POST RI
RR
PRE
POST



POSTISOMETRIC RELAXATION VERSUS RECIPROCAL INHIBITION GROUP

Table 10. Descriptive statistics of Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR

POST ISOMETRIC RELAXATION GROUP	MEAN ±SD	MEDIAN	CONFIDENCE INTERVAL	STANDARD ERROR
DYSPNOEA	-2.314±1.66	1.300	-7.43-2.80	3.56
RR	-1.69±4.05	23	-2.94- -0.44	0.61
MBC	7.95±1.96	1.100	1.91-13.99	1.53
CHESTEXPANSION(A)	0.20±0.70	2.00	0.148-0.55	0.122
CHESTEXPANSION (X)	0.148±0.559	2.00	-0.023-0.329	0.107

RECIPROCAL INHIBITION GROUP	MEAN ±SD	MEDIAN	CONFIDENCE INTERVAL	STANDARD ERROR
DYSPNOEA	-1.86±1.8	1.300	-7.49-3.75	3.78
RR	1.37±5.1	24	-1.37-5.15	0.55
MBC	2.81±1.65	1.08	-2.28-7.91	2.62
CHESTEXPANSION(A)	0.23±0.71	2.00	0.014-0.45	0.131
CHESTEXPANSION (X)	0.07±0.70	2.00	-0.14-0.29	0.122

Table 10 shows Descriptive statistics of Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR after intervention between both the groups.

Table 11. Comparison of differences between postisometric relaxation and reciprocal inhibition groups

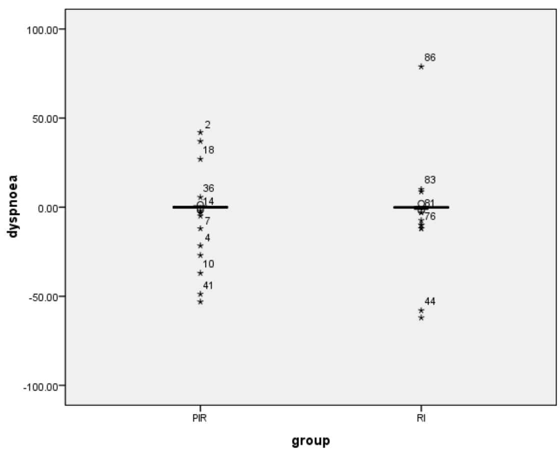
Parameter		PIR Group	RI Group	Mann-Whitney Value	p-value
Dyspnoea	Mean	-2.31	-1.87	.052	.958 NS
	Median	-.06	-.08		
	Mean Rank	43.36	43.64		
Chest Expansion (A)	Mean	.21	.23	.345	.730 NS
	Median	.00	.00		
	Mean Rank	44.34	42.66		
Chest Expansion (X)	Mean	.15	.08	1.107	.268 NS
	Median	.00	.00		
	Mean Rank	46.19	40.81		
MBC	Mean	7.95	2.81	.985	.325 NS
	Median	4.50	1.00		
	Mean Rank	46.14	40.86		
RR	Mean	-1.70	-1.37	.165	.869 NS
	Median	-2.00	-2.00		
	Mean Rank	43.06	43.94		

NS(not significant) indicates that there is no significant difference between groups in the change at post-test. i.e. both the groups are showing similar change.

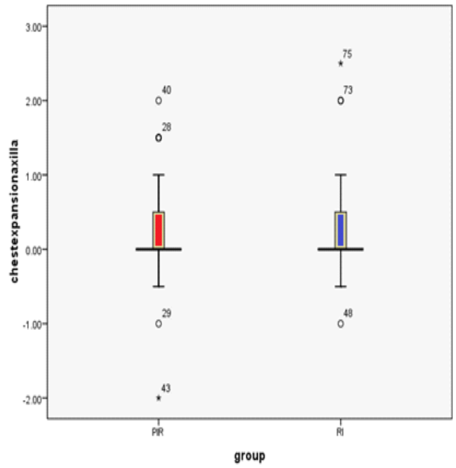
Graph 11:Boxplot of differences of Dyspnoea, Chest expansion (A), Chest expansion (X), MBC and RR in post isometric relaxation group and reciprocal inhibition group post intervention

1.**BOXPLOT SHOWING DYSPNOEA IN BOTH GROUPS**

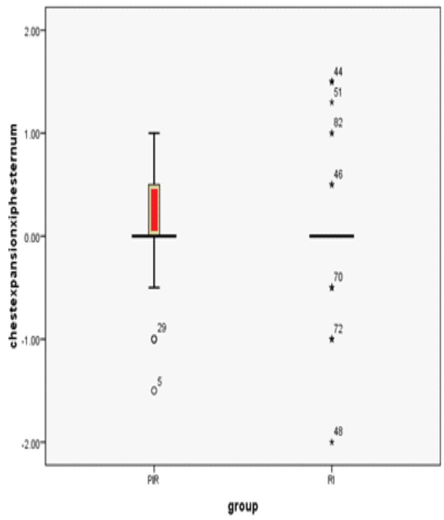
DYSPNOEA
RI
PIR



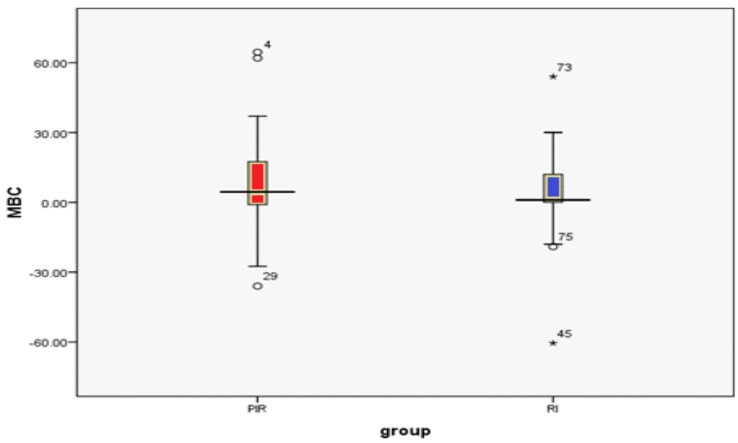
2.**BOXPLOT SHOWING CHEST EXPANSION AT AXILLARY LEVEL IN BOTH THE GROUPS**
CHEST EXP.(A)
PIR
RI



RI
PIR
CHEST EXP.(X)
3.BOXPLOT SHOWING CHEST EXPANSION AT XIPHESTERNAL LEVEL IN BOTH GROUP

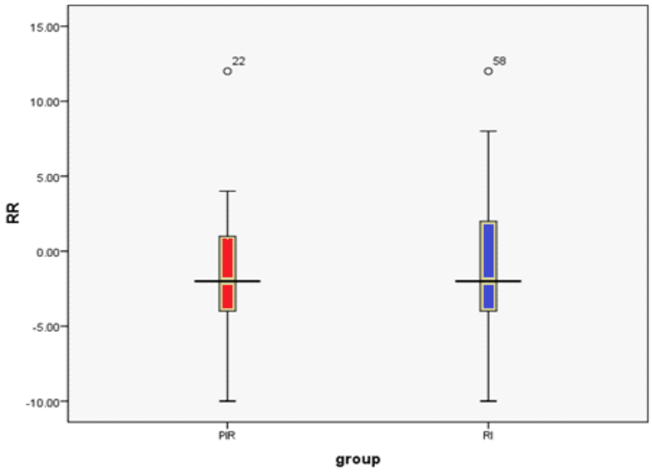


BOXPLOT SHOWING MBC IN BOTH THE GROUPS
MBC
RI
PIR



BOXPLOT SHOWING RR IN BOTH THE GROUPS

RR
RI
PIR



DISCUSSION

The Global Initiative for Obstructive Lung Disease(GOLD) defines chronic obstructive airway disease(COAD) as "a preventable and treatable disease, characterized by a persistent airflow limitation that is progressive and not fully reversible and associated with an abnormal inflammatory response of the lungs to noxious gases or particles"(1) Though the MET techniques are usually indicated to relieve pain and improve range of motion, there are studies indicating their usefulness in COPD patients in improving chest expansion (axillary and xiphisternum level), dyspnoea, chest mobility, exercise tolerance, autonomic dysfunction in a way improving vital capacity and consequently, quality of life (Akanksha, 2013). The aim and objectives of the study were to assess and compare the Changes in dyspnoea, chest expansion (axilla), chest expansion (xiphesternum),respiratory rate and maximum breathing capacity in post isometric relaxation group and in reciprocal inhibition group in patients with chronic obstructive airway diseases. 86 patients with obstructive airway diseases were recruited from the chest OPD. The patients were divided into groups of 43 each,using a computer generated randomization tabl. The patients were screened for inclusion and exclusion criteria. One group was given post isometric relaxation and chest physiotherapy and another group was given reciprocal inhibition and chest physiotherapy intervention for pectoralis major and sternocleidomastoid for 2 days. Data of dyspnoea, chest expansion (axilla) ,chest expansion (xiphesternum) ,respiratory rate and maximum breathing capacity was collected at baseline and at the end of 2 days of intervention by an independent assessor and was statistically analysed using SPSS 16.0. Table 1 and Graph 1 shows gender distribution in post isometric relaxation and reciprocal inhibition group .In this study, out of 86 patients, 34%(30)patients had Chronic Obstructive Airway Disease (COAD)39.5% (12) had post PTB (pulmonary tuberculosis) bronchiectasis,21%(18) had post PTB obstructive airway disease (OAD), 39.5% (12)had COPD, 16.27%(14) had bronchiectasis as seen in Table 3and Graph 3. Table 3 and Graph 3show the severity of airway obstruction graded according to GOLD's classification. In PIR group,39.5% of patients had mild,46.5% patients had moderate and 13% patients had severe airway obstruction. In RIl group, patients 39.5% had mild, 44.1%had moderate and 16% patients had severe airway obstruction. The percentage of male was 43% and the percentage of female was 53% in in post isometric relaxation and reciprocal inhibition group respectively. able 4 and 5 shows differences in age, BMI, height , weight and dyspnoea, Chest expansion (axilla),chest expansion (xiphesternum, RR, MBC in both the groups. There was no statistically significant difference in age (p=0. 581), BMI (p=0.95), height (p=0.905), weight (p=0.0.235) , dyspnoea (p=0.761) ,chest expansion (axilla) (p=0.809) ,chest expansion (xiphesternum (p=0.897), RR(p=0.888) ,MBC (p=0.927) in the groups. From Table 4 and 5, it was seen that there was no statistically significant difference between the groups at baseline suggesting that both the groups were homogenous with respect to age,, BMI, height , weight and dyspnoea, Chest expansion (axilla), chest expansion (xiphesternum) RR, MBC. Table 4 and Graph 4 show baseline characteristics of both the groups. In post isometric relaxation group, the mean and standard deviation of age was 49.07 years ± 9.43(95%CI 46.16-51.97) , BMI was 24.95 kg/m2 ± 4.87 (95% CI,23.45-26.25), chest expansion (Axilla) was 1.97 cm ± 0.87(95% CI,1.69-2.23), Chest expansion (Xiphesternum) was 1.98cm ± 0.76 (95% CI,1.74-2.21), MBC was 100.23 ± 1.72(95%CI,94.91-1.05), RR was 24.98 ±4.60 (95% CI,23.56-26.39), Dyspnoea was 15.82±2.50(95%CI,8.10-23.53). In Reciprocal inhibition group, the mean and standard deviation of age was 47.93yrs ± 9.62 (95% CI,44.56-50.89), BMI was 24.61 kg/m2 ± 4.61(95%CI, 23.18-26.02), RR was 24.98 per min ±4.31 (95%CI,22.52-25.58), Chest expansion (Axilla) was 1.93cm ± 0.88 (95%CI,1.65-2.20), Chest expansion (xiphesternum) was 2.01 ± 0.91 (95%CI,1.73-2.29),MBC was 101.41± 1.43 (95%CI,96.97-1.05), dyspnoea was 16.99 ±2.85(95%CI,8.19-25.77). Table 6 and Graph 5 (Boxplot) show descriptive statistics of pre and post intervention within post isometric relaxation group. Pre intervention the mean and Standard Deviation of dyspnoea was 15.81 ± 2.50 (95%CI,8.10-23.53), RR was 24.97per min ± 4.60 (95%CI,23.56-26.39) Chest expansion(axilla) was 1.96 ± 0.87 (95%CI, 1.69-2.23) Chest expansion(xiphesternum)was 2.21 ± 0.70(95%CI, 1.90-2.341), MBC was 1.00 ± 1.72 (95%CI,94.91-1.05) Post intervention the mean and standard deviation of Dyspnoea was 13.50± 2.33 (95%CI,6.31-2.69), RR was 23.27 per min ± 4.06(95%CI,22.02-24.52), Chest expansion (axilla) was 1.96± 0.87 (95%CI,1.74-2.21), Chest expansion (xiphesternum) was 2.21± .70 (95%CI,1.90-2.24),MBC was 1.08 ± 1.00 (95%CI,1.05-1.11), Table 7 shows that there was a statistically significant increase in Chest expansion(A) (p=0.048), MBC (p=0.010) and reduction in RR (p=0.003), post intervention in PIR group. Thus, following 2 days of intervention in PIR group, there was a statistically significant increase in Chest exapansion at axillary level, maximum breathing capacity and a reduction in work of breathing (RR).

Table 8and Graph 6 (Boxplot) show descriptive statistics of pre and post intervention within RI group. Pre intervention, the mean and Standard Deviation of Dysnoea was 16.89± 2.85 (95%CI,8.19-25.77), RR was 24.25per min ± 4.31(95%CI,22.92-25.58),chest expansion (Axilla) was 1.93±0.887 (95%CI,1.65-2.23), chest expansion (xiphesternum) was 2.088± 0.80 (95%CI,1.84-2.33), MBC was 1.014 ± 1.08 (95%CI,9.97-1.058)..Post intervention, the mean and standard deviation of Dyspnoea was 15.12± 2.48 (95%CI,7.48-22.75),RR was 22.8 per min ± (95%CI, 21.75-24.01), Chest expansion(Axilla) was 2.16 ± 0.86(95%CI,1.89-2.42), Chest expansion (xiphesternum) was 2.088 ±0.80 (95%CI,1.84-2.33), MBC was 1.04 ± 1.72 (95%CI,98.92-1.09). Table 9 shows that there was a statistically significant Reduction in Dyspnoea(p=0.021), Chest expansion(axilla) (p=0.033) In RI group. Thus, following 2 days of intervention in RI group, there was a statistically significant improvement in dyspnoea, and Chest expansion(Axilla). Table 10 and graph 7 (Boxplot) show descriptive characteristics of pre and post differences between the groups at the end of intervention. In PIR group, the mean and standard deviation of Dyspnoea was -2.314 ± 1.66 (95%CI, -7.43-2.80), chest expansion axilla was 0.2093 ± 0.70 (95%CI, -0.0083 – 0.4269), Chest expansion xiphesternum was 0.1488 ± 0.5590 (95%CI, -0.023 – 0.3209),MBC was 7.95 ± 1.96 (95%CI, 1.91 – 13.99), RR was -1.69± 4.05 (95%CI, -2.94- -0.44).In RI group, the mean and standard deviation of dyspnoea was – 1.86±1.82 (95%CI, -7.49-3.75), chest expansion axilla was0.23 ± 0.71(95%CI,0.014-0.45), chest expansion xiphesternum was 0.07 ± 0.70 (95%CI, -0.14 – 0.29), MBC was 2.81 ± 1.65 (95%CI,-2.28-7.91), RR was-1.37 ± 5.15(95%CI,-2.95-0.21).Table 11 shows comparison of differences of dyspnoea, RR, MBC, Chest expansion (Axilla), Chest exapsnion (Xiphesternum) between both the groups. There was no statistically significant difference in dyspnoea (p=0.958),chest expansion (axilla), (p=0.730) ,chest expansion (xiphesternum), (p=0.268),MBC (p=0.325) ,RR (p=0.869)suggesting that both groups showed similar changes post intervention.

Thus, the null hypothesis that there is no significant difference between the effects of post isometric relaxation and reciprocal inhibition techniques is accepted. The reason of no statistically significant difference between PIR and RI group can be that the duration of the intervention was very less to show a difference. There are no studies to support the evidence that either one of the techniques has better effect on respiratory function or if both have the same effect. In the second edidtion of the book,'' **Muscle** energy techniques", Leon Chaitlow states that there is general consensus among the various osteopathic experts already quoting that the use of postisometric relaxation is more useful than reciprocal inhibition in normalising hypertonic musculature. This, however, is not generally held to be the case by experts such as Lewit and Janda, who see specific roles for the reciprocal inhibition variation. In PIR group, there was a significant increase in Chest expansion (Axilla), MBC and reduction in respiratory rate and no change in dyspnoea, chestexpansion (Xiphesternum). In RI group, there was significant change in dyspnoea,chest expansion (axilla) and no change in chest expansion (xiphesternum), RR, MBC.

Similar results were seen in studies:

Akansha Anand, Ravinder Narwal, Girish Sindhwani conducted a study on Accessory Inspiratory Muscles Energy Technique effect on Pulmonary Function in COPD Subjects(2013). Method: 30 Moderate & Severe staged COPD patients in 40-60 years age group were allocated into two groups: Conventional Chest Physiotherapy (CPT) and Conventional Chest Physiotherapy with MET(CPT + MET) group. Chest expansion, Dyspnea, Exercise tolerance, Respiratory rate, Heart rate, Oxygen saturation and Quality of life were the variables that recorded prior and after the intervention for three days.and concluded that significant improvement was seen in both groups on all 3 days with greater improvementsi in CPT with MET group in form of increased chest expansion, reduced Dyspnoea, increased exercise tolerance, regulation of autonomic dysfunction and improved Quality of life. Michael T. Putt, MBBS, Michelle Watson, BPhty, Helen Seale, BPhty, Jennifer D. Paratz, PhD conducted a study on Muscle Stretching Technique Increases Vital Capacity and Range of Motion in Patients With Chronic Obstructive Pulmonary Disease (Arch Phys Med Rehabil 2008 ;89:1103-7).Fourteen stable patients with COPD who had recently completed a pulmonary rehabilitation program were enrolled, with 10 patients completing the study. A hold and relax stretching technique of the pectoralis major and a sham technique each for 2 days. The primary outcome measure was Vital Capacity (VC), with secondary outcome measures being perceived dyspnoea, axillary (ACE) and xiphisternal chest expansion (XCE), right and left shoulder horizontal extension, and respiratory rate. They concluded that the hold and relax technique to the pectoralis major compared with the sham technique produced significant effects on VC (*P*_.01), and right (*P*_.01) and left (*P*_.05). upper-limb range of motion. There was no significant effect on ACE, XCE, perceived dyspnoea, or respiratory rate.

Dharmesh Parmar, Anjali Bhise conducted a study on The Immediate Effect of Chest Mobilization Technique on Chest Expansion in Patients of COPD with Restrictive Impairment: (2015)

They conducted an Experimental study on 30 COPD patients having vital capacity <80%, to assess the pre and post differences in Modified Chest expansion by applying chest mobilization techniques - Rib rotation, Chest wall rotation, Lateral flexion of chest wall, Chest wall extension and Pectoralis major muscle stretching. And concluded that Chest Wall mobilization has significant effect on Chest expansion in COPD patients who are having restrictive impairment of chest wall in later stage of disease. Richa Mahajan, Chitra Kataria, Kshitija Bansa (2012) have stated in their study discussuin that the effects of MET component for increase in ROM post intervention can be explained on the basis of physiological mechanisms behind the changes in muscle extensibility - reflex relaxation, viscoelastic change, and changes to stretch tolerance. Reflex muscle relaxation following contraction that has been proposed to occur by activation of the golgi tendon organs and their inhibitory influence on the a-motor neuron pool. Combination of contractions and stretches (as used in MET) might be more effective for producing viscoelastic change than passive stretching alone, because the greater forces could produce increased viscoelastic change and passive extensibility. **Kevin G.et al** found that 3 passive-stretching techniques each increased Pectoralis Major length during the time of stretch.. Their results support these previous findings and demonstrated that not only did the MET assist in lengthening the pectoralis minor, but this increased resting length was sustained for at least 48 hours after the final application. Thus, MET should be considered when increased muscle length is desired for an extended period of time.Their findings indicate that MET applied twice a week for 6 weeks to the pectoralis minor and major muscles of asymptomatic swimmers resulted in increased resting PML and decreased forward scapular position**.** Carvalho AR, Assini TCKA. Improvement of functional capacity among elderly people undergoing isostretching intervention. BrazilRev. Bras. fisioter. July/Aug. 2008, vol.12 no.4. The aim of the study was to investigate the improvement in functional capacity among elderly people undergoing an is ostretching intervention. They were divided into two groups: control group (n=19) and experimental group (n=20). The experimental group underwent a ten-session intervention based on isostretching (which is classified as a postural method), applied once a week. Functional capacity was assessed using the six-minute walking test (6WT) at three times: after the screening evaluation (6WT INI), one day after the fifth session (6WT INTER) and one day after the tenth session (6WT FIN). The predicted distance, named the reference value (6WT REF), was calculated from the subjects' anthropometric data, through the formula of Enright & Sherrill. So, stretching increased the elders' functional capacity and it could be a viable therapeutic resource for preventing the deleterious effects of aging on functional capacity.

Rekha K et al. Effect of stretching respiratory accessory muscles in chronic obstructive pulmonary diseases ,have concluded in their study that respiratory accessory muscle stretching significantly improved chest expansion, reduced dyspnea, and increase exercise tolerance level in patients with COPD (Rekha *et al.,* 2016).

Mechanism of PIR and RI: In the second edition of the book ''**Muscle energy techniques**", Leon Chaitlow states that:

When a muscle is isometrically contracted, its antagonist will be inhibited, and will demonstrate reduced tone immediately following this. Thus the antagonist of a shortened muscle, or group of muscles, may be isometric ally contracted in order to achieve a degree of ease and additional movement potential in the shortened tissues. Sandra Yale (in DiGiovanna 1991) acknowledges that, apart from the well understood processes of reciprocal inhibition, the precise reasons for the effectiveness of MET remain unclear – although in achieving PIR the effect of a sustained contraction on the Golgi tendon organs seems pivotal, since their response to such a contraction seems to be to set the tendon and the muscle to a new length by inhibiting it (Moritan 1987). Above figure shows Schematic representation of the neurological effects of the loading of the Golgi tendon organs of a skeletal muscle by means of an isometric contraction, this produces a postisometric relaxation effect in that muscle. Above figure shows schematic representation of the reciprocal effect of an isometric contraction of a skeletal muscle, resulting in an inhibitory influence on its antagonist. The second is reciprocal inhibition (RI) which states that when one muscle is contracted, its antagonist is automatically inhibited. Liebenson notes that 'a resisted isotonic effort towards the barrier is an excellent way in which to facilitate afferent pathways at the conclusion of treatment with active muscular relaxation techniques or an adjustment (joint). This can help reprogram muscle and joint proprioceptors and thus re-educate movement patterns. Antagonist(s) to affected muscle(s) is used in isometric contraction, so obliging shortened muscles to relax via reciprocal inhibition. Application of MET comprises neurological as well as biomechanical elements. The isometric contraction involves two neurological components: Postisometric relaxation (PIR) will follow contraction of the agonist, as a result of Golgi tendon organ mediation Reciprocal inhibition (RI) will occur affecting the antagonist, as a result of spindle mediation. Reciprocal inhibition is again a feature when the patient actively assists an area into stretch, so reducing the likelihood of the myotatic stretch reflex being activated, while at the same time reciprocally inhibiting the tissues which are being taken past their restriction barrier. Once stretching has actually commenced, biomechanical effects are initiated as sustained, low intensity force is applied to lengthen the tissues and 'creep' begins. The longer the stretched status is maintained, the greater the viscoelastic effect on connective tissue and the more 'permanent' the increased length is likely to be (Taylor et al 1990) [(13)]

Increase in chest expansion at axillary level in both RI and PIR groups: Chest expansion at axillary level increased significantly in both the groups.In the study conducted by **Dharmesh Parmar and Anjali Bhise**,they have stated that Chest wall mobilization improves mobility of chest wall, reduces respiratory rate, increases tidal volume, improves ventilation gas exchange, reduces dyspnea, decreases work of breathing and facilitate relaxation (Dharmesh *et al.,* 2015). In the study conducted by Akansha Anand, Ravinder Narwal, Girish Sindhwani (2009), they have quoted about the reasoning for increase in chest expansion by MET by mentioning a study by Lenehan, Fryer and McLaughlin 8 which stated that stated that single sessions of thoracic MET effectively increased trunk ROM as a result of viscoelastic and plastic changes in myofascial connective tissue elements following isometric contraction by MET. So we can say that MET increased chest expansion by increasing thoracic ROM (Kedar *et al.,* 2017). Etnyre et al concluded that inhibitory neural influences have an effect in reducing motor pool excitability, that is assumed to reduce muscle contractility thereby improves muscle compliance,thus improving chest expansion (Etnyre, 1986). In studies on animal models, it was possible to analyze the muscle fibers. Such study has shown that performing stretching exercises once a week in shortened muscles was sufficient to reduce muscle atrophy ().[(39)] Some authors have reported that, in normal muscles submitted to stretching exercises three times a week, there is a serial increase in the number of sarcomeres and in the cross-sectional area of the muscle fibers (Shah, 2001; Coutinho *et al.,* 2004). Therefore, the increased muscle force due to stretching might be attributable to better interaction between the filaments of actin and myosin, by virtue of the increase in the functional length of the muscle (Marlene *et al.,* 2007).

Reduction of RR in PIR group: In the study conducted by Gail Dubinsky he has emphasized the fact that there exists a bi-directional relationship between breathing pattern and Autonomic Nervous System. He described that Sympathetic nervous system stimulation leads to, and is stimulated by, upper chest breathing. Thus, MET by eliminating upper chest breathing and making Diaphragmatic breathing more effective optimizes breathing pattern of the patient and accordingly regulates RR more effectively

(Gail, 1996). Akansha Anand, Ravinder Narwal, Girish Sindhwani have also stated with reference to a study by Nitz and Burke et al that PNF technique increased saturation of oxygen percentage by improving musculoskeletal mechanics in thoracic region (Nitz, 2002). They have further stated that since MET and PNF are similar in their function to stretch and facilitate specific muscles and joints,MET can also increase saturation of oxygen.Diaphragmatic breathing is improved by correcting accessory inspiratory muscle function,which improves ventilation and thus saturation of oxygen and correcting V/Q mismatch.Increased saturation will lead to reduced respiratory rate (Akanksha, 2013). In the study conducted by Kedar Sule, Mayur Kakade, Tushar Palekar (2017) they have stated that pulsed MET is useful in reducing respiratory rate by improving oxygen saturation in the body (Kedar *et al.,* 2017).

Improvement in MBC in PIR group

Nobuaya Miyahari et al studied the effects of short term pulmonary rehabilitation on exercise capacity and quality of life in patients with COPD. They concluded that 3 weeks pulmonary rehabilitation program, comprising of Respiratory Muscle Stretch Gymnastics and cycle ergometer exercise improved the MBC, 6 minute walk distance test and quality of life (Nobuaki, 2000). Lieber et al reported that the generation of tension in the skeletal muscle (which is determined by evaluating the length-tension relationship), is directly correlated with the degree to which actin and myosin filaments are superimposed, less superimposition of these filaments in the muscle at rest translating to greater capacity of the muscle to generate tension (Lieber, 1993). The MET used in the present study did indeed promote such an alteration in the interaction between the filaments of actin and myosin and, consequently, improved the contractile capacity of the respiratory muscle group. Another aspect relevant is the possible serial increase of the number of sarcomeres, which might have promoted the increase in the contractile capacity of this muscle group. Thus, these mechanisms can explain an increase in the MBC. Hagbarth et al. reported that muscle stretching causes a decrease in finger flexor stiffness.[44] Therefore, it is possible that respiratory muscle stretching similarly affected chest wall compliance and decreased chest wall stiffness. Studies have reported that if the respiratory muscles are stretched to their full extent, the respiratory apparatus is able to work to their maximal capacity (Wright, 1959; Gregg, 1973; Srinivas, 1999; Tilvis, 1997)

Improvement in perception of dyspnoea in RI group: In the study conducted by Dharmesh Parmar and Anjali Bhise,they have stated that Chest wall mobilisation consisting of pectoralis major stretching has immediate effect of reduction in dyspnoea in COPD subjects.They further state that due to air trapping,there is hyperinflation of lung and reduced chest wall mobility. The hyperinflation induces increased strain on the respiratory muscles, which are forced to work in a limited range of movement with negative pressure/effort relationship, leading to increased dyspnoea. Chest wall mobilisation helps to increase lung compliance,reduce work of breathing and thus reduce percetion of dyspnoea (Dharmesh, 2015). They have further quoted of a study conducted by Leelarungrayub et al. (2009) study which found acute clinical benefits of chest wall-stretching exercise on expired tidal volume, dyspnea and chest expansion in COPD patients (Leelarungrayub, 2009). In the study conducted by Lenehan KL, Fryer G, McLaughlin P, they have mentioned that MET stretching of accessory inspiratory muscles relaxes them and decreases the rate of muscle spindle firing in lengthening phase. This reduces the central respiratory motor command required for given ventilation and consequently alleviates dyspnoea (Akanksha, 2013). Wada et al. evaluated effect of respiratory muscle stretching on thoracoabdominal mechanics and functional capacity in COPD patients and found that respiratory muscle stretching improves the ventilatory capacity by reducing dyspnoea (Wada, 2014). Thus, the above studies expalin the changes in dyspnoea, chest expansion in RI group and RR, MBC, Chest expansion at axilla in PIR group. The reason that chest expansion at xiphesternum level did not increase in any of the group could be attributed to the fact that the muscles for MET were pectoralis major and sternocleidomastoid, contributing more to the upper chest mobility than the xiphesternal level.

Conclusion

The study concluded that after two days of intervention of post isometric relaxation and reciprocal inhibition along with chest physiotherapy on two groups of subjects respectivley, following results were obtained:

- In post isometric relaxation group, there was statistically significant increase in maximum breathing capacity (p=0.10),Chest expansion (Axilla) (p=0.48) and respiratory rate had significantly gone down (p=0.003)post intervention of 2 days. Others parameters remained unchanged.
- In reciprocal inhibition Group, there was a statistically significant increase in
- Chest expansion (Axilla) (p=0.033) and statistically significant reduction in perception of dyspnoea (0.21) post intervention of 2 days. Other parameters remained unchanged.
- On comparing the differences between both groups
- there was no statistically significant difference in
- in both groups in chest expansion (axilla and xiphesternum), dyspnoea, respiratory rate, maximum breathing capacity.

Glossary of abbreviations:

COAD: Chronic Obstructive Airway Disease
COPD: Chronic Obstructive Pulmonary Disease
GOLD: Global Initiative for Obstructive Lung Disease
MBC: Maximum Breathing Capacity
MET: Muscle Energy Techniques

3 MRET:3 Minute Respiratory Exerciser Test
POD: Perception Of Dyspnoea Index
PIR: Postisomteric relaxation
RI: Reciprocal inhibition
RPE: Rating Of Perceived Exertion
RR: Respiratory Rate
VAS: Visual Analog Scale

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