

# Role of Proprioceptive Neuromuscular Facilitation Techniques of Respiration in Mechanically Ventilated Patients – A Systematic Review of Clinical Evidence

Dr. Dinkey Mankad, PT<sup>1</sup>, Dr. Shreya Trivedi, PT<sup>2</sup>, Dr. Janvi P Bhatt, PT<sup>3</sup>

<sup>1,3</sup>PG scholar, Cardio-respiratory & Intensive Care, KSPR, KPGU, Vadodara

<sup>2</sup>MPT, Cardiovascular and Respiratory physiotherapy Assistant Professor, KSPR, KPGU, Vadodara

Corresponding Author: Dr. Dinkey Mankad [PT]

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## ABSTRACT

**BACKGROUND:** The Intensive Care Unit (ICU) is a specialised unit reserved for patients with life-threatening illnesses, injuries, or complications. Mechanical ventilation is a useful modality for patients who are unable to sustain the level of ventilation necessary to maintain the gas exchange functions. It is imperative to promote routine chest physical therapy in order to improve pulmonary and hemodynamic parameters. Neurophysiological facilitation of respiration is the terminology used to describe externally applied proprioceptive and tactile stimuli that produce reflex respiratory movement responses and that appear to alter the rate and depth of breathing.

**Aim:** The aim of the present systemic review is to provide comprehensive analysis of the respiratory proprioceptive neuromuscular facilitation technique in mechanically ventilated patients by focusing on all the clinical evidence.

**Method:** The present systematic review was performed according to PRISMA guidelines [Preferred Reporting Items for Systematic Reviews and Meta-analyses]. Two independent reviewers completed title, abstract, and full-text screening, assessing for study inclusion. Discrepancies were resolved by discussion or by a third reviewer. A literature search was carried out on the PubMed, EMBASE, Scopus, PEDRO, Google Scholar and Research Gate by two independent investigators using the following keywords: “chest PNF”, “Respiratory PNF”, “Neurophysiological facilitation of respiration”, “NPF”, “Chest PT”, “Mechanical ventilator”. Studies meeting all inclusion and exclusion criteria were reviewed and data were extracted. 10 articles were selected for this systematic review.

**Results:** In the present review, data from 1281 patients were retrieved. 56.3% are male and 43.7% are females. Mean age of included participants is 38 years with a range between 18-45. Out of 10 studies, 7 used a combination of intercostal stretch and anterior basal lift technique of chest PNF, 2 studies used vertebral pressure and abdominal co-contraction, and remaining 1 used perioral pressure technique. Mean duration of post-operative rehabilitation is 3-5 days.

**Conclusion:** According to the analysis of the studies that are included in the above review, we can determine that proprioceptive neuromuscular facilitation techniques of respiration are effective in improving hemodynamic [Heart rate, Blood pressure] and Pulmonary [Tidal Volume, Minute Ventilation, Lung Compliance, Respiratory rate, spo<sub>2</sub>] parameters in mechanically ventilated patients.

**Keywords:** “chest PNF”, “Respiratory PNF”, “Neurophysiological facilitation of respiration”, “NPF”, “Chest PT”, “Mechanical ventilator”.

## **INTRODUCTION**

The Intensive Care Unit (ICU) is a specialised unit reserved for patients with life-threatening illnesses, injuries, or complications. Patients admitted to the ICU typically have severe clinical manifestations and may need mechanical ventilator support to maintain normal physiologic function.<sup>1</sup> 30 to 60 percent of patients admitted to the intensive care unit (ICU) required mechanical ventilation. In the intensive care unit [ICU], the overall mortality rate was 30.7% [1590] patients<sup>2,3</sup>

A medical ventilator is a device that helps patients with respiratory insufficiency breathe by forcing air into and out of their lungs.<sup>4,5</sup> Mechanical ventilation is a useful modality for patients who are unable to sustain the level of ventilation necessary to maintain the gas exchange functions. Mechanical ventilation may be indicated in conditions due to physiologic changes (e.g. deterioration of lung parenchyma), disease states (e.g. respiratory distress syndrome, Atelectasis), excessive ventilator workload (e.g. airflow obstruction), medical/surgical procedures (e.g. post anesthesia recovery), and many other causes (e.g. head trauma, drug overdose, etc) leading to ventilatory failure or oxygenation failure.<sup>6</sup>

Commonly used modes of mechanical ventilation are Continuous mandatory ventilation [CMV], Synchronized intermittent mandatory ventilation (SIMV), Pressure support ventilation (PSV), Continuous positive airway pressure (CPAP) and Bi-level positive airway pressure (BiPAP).<sup>6</sup>

Individuals using mechanical ventilation have a higher chance of experiencing potentially fatal complications.<sup>7</sup> Barotraumas, hypotension, arrhythmia, oxygen toxicity, multiple organ failure, atelectasis, ventilator-associated pneumonia, ARDS (acute respiratory distress syndrome), pneumonia, airway injury, laryngeal injury, alveolar damage, and diaphragm disuse atrophy are

among the complications linked to mechanical ventilation.<sup>8</sup>

Maintaining bronchial hygiene, increasing bed mobility, decreasing reliance on a ventilator, lowering the risk of pulmonary complications, and helping the patient wean off of one is the goals of critical area physical therapy<sup>9</sup> Consequently, it is imperative to promote routine chest physical therapy in order to improve pulmonary and hemodynamic parameters.<sup>10</sup>

Secretions are retained when there is insufficient ventilation. Another common complication is deranged mechanical respiratory function. Presenting with a "stiff chest exhibiting little respiratory movement" is another possibility.<sup>11</sup>

Neurophysiological facilitation of respiration is the terminology used to describe externally applied proprioceptive and tactile stimuli that produce reflex respiratory movement responses and that appear to alter the rate and depth of breathing.<sup>11</sup> Intercostal stretch, vertebral pressure, abdominal co-contraction, anterior basal lift, perioral pressure, moderate manual pressure are the various techniques of chest PNF.<sup>11</sup>

Application of respiratory proprioceptive neuromuscular facilitation techniques results in visible deeper inspiration, larger expansion of the ribs, increased tone in abdominal muscles, change in respiratory rate, more normal respiratory pattern retention of improved respiratory pattern after the treatment period and apparent increase in the level of consciousness and rapid return of mechanical stability. It will facilitate the greater tidal volume and improve compliance and hemodynamic parameters.<sup>11</sup>

Respiratory PNF techniques aid in reducing Respiratory Rate and Heart Rate by inducing parasympathetic activity. Techniques like Intercostal Stretch, Anterior Basal Shift and Thoracic Thrust help in improving ventilation by improving lung expansion and thereby improving Oxygenation. It alters the rate and

depth of breathing, improving the compliance and hemodynamics.<sup>12</sup>

Unconscious patients are unable to engage in more traditional treatment modalities that necessitate a significant amount of voluntary effort, providing chest care to them can be especially difficult. Because of this, respiratory PNF techniques are more crucial for patients on mechanical ventilation; however, there is a dearth of research on the respiratory proprioceptive neuromuscular facilitation technique in patients who are on mechanical ventilation. The aim of the present systemic review is to provide comprehensive analysis of the respiratory proprioceptive neuromuscular facilitation technique in mechanically ventilated patients by focusing on the all the clinical evidence.

## MATERIALS AND METHODS

The present systematic review was performed according to PRISMA guidelines [Preferred Reporting Items for Systematic Reviews and Meta-analyses] Two independent reviewers completed title, abstract, and full-text screening, assessing for study inclusion. Discrepancies were resolved by discussion or by a third reviewer A literature search was carried out on the PubMed, EMBASE, Scopus, PEDRO, Google Scholar and Research Gate By two independent investigators using the following keywords “chest PNF” “Respiratory PNF” “Neurophysiological facilitation of respiration” “NPF” “Chest PT” “Mechanical ventilator”.

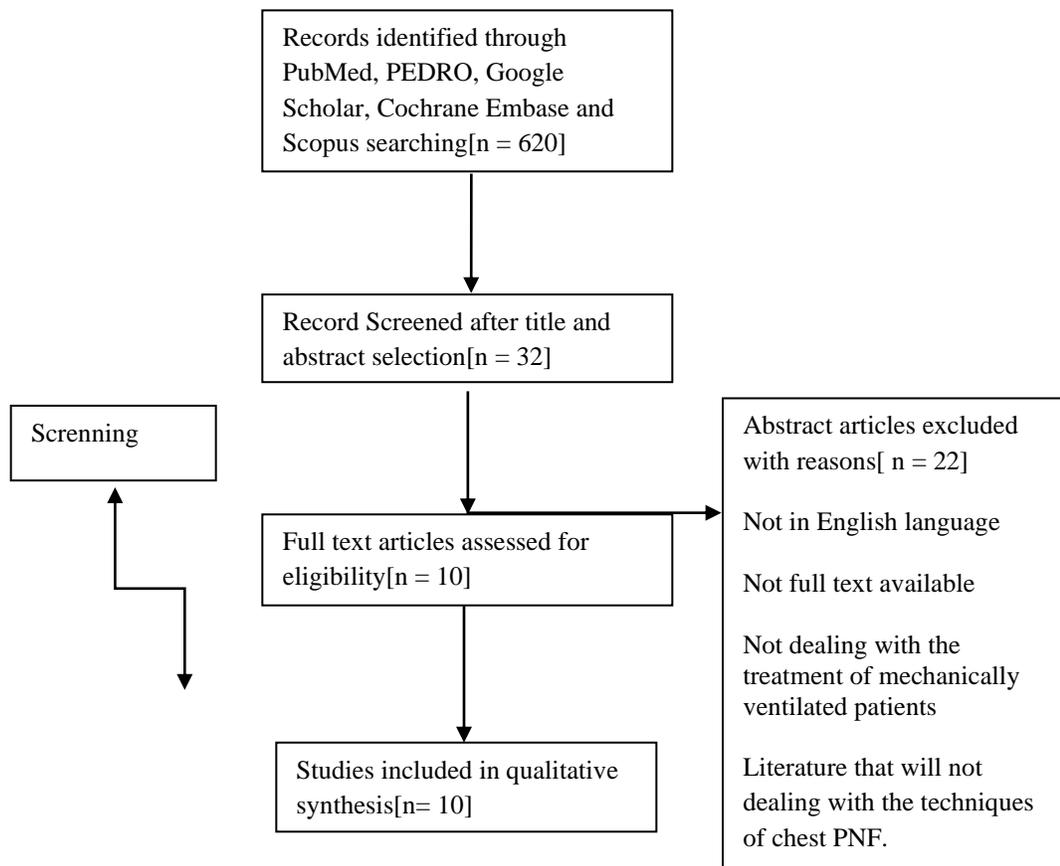


Figure 1. PRISMA Flowchart summarizing the selection process

First, all the retrieved articles were screened by title and abstract, using the following inclusion criteria for article selection.

### Inclusion criteria

1. Prospective or retrospective intervention and RCT dealing with the mechanically

- ventilated patients and treated with chest PNF techniques.
- 2. Written in the English language
- 3. Published from 2010 to 2022
- 4. Dealing with the treatment of mechanically ventilated patients with endotracheal intubation or tracheostomy or Non-invasive face mask.

- 3. Systematic reviews, conference abstracts, case studies, narrative reviews, and non-peer-reviewed studies were excluded
- 4. Articles lacking access to the full text.
- 5. literature that will not dealing with the techniques of neurophysiological facilitation of respiration.

**Exclusion criteria**

- 1. Written in languages other than English
- 2. Not dealing with the treatment of mechanically ventilated patients.

Two independent reviewers extracted all data. A third reviewer independently verified the data. The following data were extracted from each study

**TABLE 1. SHOWING CHARACTERISTICS OF INCLUDED STUDIES**

Study	Study Design	Treatment Groups	Outcome Measures	Follow-Up	Rehabilitation Program	Main Results	Conclusion
1. Dr. Ankita P Ashtankar Dr. Atharuddin Kazi <sup>13</sup>	Experimental	Group A -PNF and chest physiotherapy & Group B - chest physiotherapy alone.	RR SpO2 HR lung compliance	5 days	Control group had conventional Chest Physiotherapy which included Vibration, Percussion, postural drainage and suctioning if indicated while experimental group had PNF technique of Intercostal Stretch and Anterior Basal Lift along with conventional Chest Physiotherapy.	Post-intervention Heart Rate, Respiratory Rate, Saturation of Oxygen, Lung Compliance parameter in both groups improved but Group A improved more significant than Group B	PNF alone with chest Physiotherapy are better and effective in improving saturation of oxygen, pulmonary compliance and reduction of Heart Rate, Respiratory Rate and lead to early extubation of patients.
2. Dr. Sneha S Chordiya Dr. Atharuddin Kazi et al <sup>14</sup>	Experimental	Group A received PNF and chest physiotherapy & Group B received chest physiotherapy alone.	Static compliance Dynamic compliance Minute ventilation Heart Rate Systolic Blood Pressure Diastolic Blood Pressure	3days	Control group had Conventional CPT which includes Vibrations, percussions, postural drainage and suctioning if indicated while experimental group had conventional CPT along with PNF techniques of Intercostal Stretch and Anterior Basal lift.	There was highly significant difference in Static compliance (p=0.02), Dynamic compliance (p=0.01) and minute ventilation (p=0.01) while there was no significant difference in SPO2 (p=0.61), Heart Rate (p=0.94), Systolic Blood pressure (p=0.19) and Diastolic Blood pressure (p=0.41)	Chest Physiotherapy along with PNF technique in the management of mechanically ventilated patients with pulmonary complication proved efficient for preventing pulmonary complications , clearing the mucous secretions and better prognosis in patients with OP poisoning.
3.	Interventional	Group A	Compliance	Immediat	After chest	Values of	PNF did not

Dr. Shivananda venkata reddy Dr. Ganesh Arumugam et.al <sup>15</sup>	study	received PNF and chest physiotherapy & Group B received chest physiotherapy alone.	minute ventilation saturation of oxygen heart rate blood pressure	e	assessment patient was subjected to conventional CPT (Vibrations, percussions, postural drainage and suctioning if indicated). After recording the values 3 minutes rest was given. Then patient was administered PNF techniques of perioral stimulation, vertebral pressure (upper and lower thoracic spines) and co-contraction of abdomen	Parameters obtained were not significant to consider PNF with CPT (P = 0.310)	significantly enhance values of post CPT pulmonary & haemodynamic parameters in mechanically ventilated OP poisoning patients during acute management period.
4. Dr. Hardini Prajapati <sup>16</sup>	Experimental Study	Techniques given were Intercostal stretch, abdominal co contraction and anterior stretch posterior basal lift.	spontaneous respiratory rate [RR] spontaneous tidal volume [Vt] minute volume [Ve] middle chest expansion [at nipple level]	Immediate	All NPF techniques were given in supine lying position with limbs in neutral position. Techniques given were Intercostal stretch, abdominal co contraction and anterior stretch posterior basal lift.	RR improved significantly [P=0.0116] after application of anterior stretch posterior basal lift. Tidal volume improved very significantly after application of abdominal co contraction [p=0.009] and with anterior stretch posterior basal lift [P=0.001]. Minute volume improved very significantly after abdominal co contraction [P= 0.019] and after anterior stretch posterior basal lift [P=0.0001]	NPF of respiration can improve the ventilation of mechanically ventilated patients for very short time.
5. Tomasz Zwolinski, Magdalena Wujewicz <sup>17</sup>	Randomized controlled trial RCT	Rhythmic initiation technique (RIT) or initial stretch technique (IST) group.	heart rate (HR) systolic blood pressure (SBP) diastolic blood pressure (DBP) percutaneous oxygen saturation (SpO2)	Immediate	The RIT and IST groups received one session by a physiotherapist specialized in PNF techniques (TZ, TS) and the treatment consisted of four 90-second manual stimulations each (upper ribs, lower ribs, sternum, and diaphragm techniques). Vital signs were assessed	No significant differences in HR, SBP, and DBP were observed both for two techniques measured separately and between them. Statistically significant differences were noticed analysing SpO2 in the rhythmic initiation technique (RIT)	Short-term PNF interventions did not influence clinically relevant vital parameters among MV patients and seem to be feasible in this group of ICU patients.

					before and after the session.	group (p-value = 0.013).	
6. Abhinav Salve Sachin Maghadee <sup>18</sup>	Experimental study	Intercostal stretch technique was given to group A and vertebral pressure technique was given to group B,	HR RR SpO2 Tidal volume	Immediate	Intercostal stretch technique was given to group A and vertebral pressure technique was given to group B,  3 sets were given, 3 reps each with rest time of 1 min	There was significant difference between pre intervention and post intervention readings $p < 0.01$	Proprioceptive Neuromuscular Facilitation techniques are effective in improving HR, RR, lung capacity and Oxygen saturation in patients with OP poisoning.
7. Payal Gupta Gopal Nambi et.al <sup>19</sup>	Experimental	Group A (IC stretch) and Group B (ABL)	RR SpO2 HR	3 days	Group A received Intercostal stretch and B received anterior basal lift for 2 times/day for 3 days. Before and after third day of treatment Heart rate, Oxygen saturation and Respiratory rate was taken.	Result shows significant difference in group A in terms of RR, HR and SpO2 ( $p < 0.05$ ) compare to Group B results.	It has been found that IC stretch is more effective in reduction of respiratory rate and heart rate and improving oxygen saturation over anterior basal lift technique.
8. Sandesh P. Londhe <sup>1</sup> , Vishvath S. Pawadshetty <sup>20</sup>	Experimental	Group 1 – chest manipulation  Group 2- neurophysiological facilitation of respiration.	Lung Compliance, Minute Ventilation, Oxygen Saturation, Respiratory Rate, Heart Rate and Blood Pressure	Immediate	28 Organophosphorus poisoning patients were equally divided into Groups A and B. The intervention was given for 2 Days once daily. Immediately after the intervention suctioning was done for both the Groups A and B.	A present study showed that Chest Manipulations helps to improve haemodynamic parameters on Day 1 as well as maintain the improvement in preinterventional readings on Day 2 and used as an early intervention in organophosphorus poisoning patients.	A present study showed that Chest Manipulations helps to improve haemodynamic parameters on Day 1 as well as maintain the improvement in preinterventional readings on Day 2 and used as an early intervention in organophosphorus poisoning patients.
9. Dr.P.Muruganandam (PT) <sup>1</sup> , Dhanashree Shinde <sup>12</sup>	cross over study	Group 1- Body positioning  Group 2- chest PNF	Respiratory rate  Saturation of peripheral oxygen	Immediate	Then 2 techniques were applied on the patients: Chest PNF- which includes Intercostal stretch and Anterior Basal lift and Body Positioning- which includes	RR increased significantly with $p < 0.05$ and SPO <sub>2</sub> had a decrease which was significant and p value was $< 0.05$	Thus the neurophysiologic facilitation techniques can be used for short term effects on the patients who are ventilator dependent for

					Side lying positioning		long term and who have neurological impairment or respiratory compliance.
10 Binesh Asokan Poozhikunnath 1, Suthakar Raju <sup>21</sup>	Experimental	Group A (PNF with Conventional Physiotherapy) and Group B (Conventional Physiotherapy).	RR SpO2 HR	3days	Group A (PNF with Conventional Physiotherapy) and Group B (Conventional Physiotherapy).  Patients were given the intervention according to their allocated group for 3 days and effects of these techniques on RR, SpO2 and HR parameters were observed.	Respiratory Rate (t value 2.626) and Oxygen Saturation (t value 1.33)	Study concluded that significant improvement was noticed in terms of Respiratory Rate and Oxygen Saturation in Experimental Group when compared to Control Group.

## RESULTS

In the present review, data from 1281 patients were retrieved. 56.3 % are male and 48.5% are females. Mean age of included participants is 38 years with a range between 18-45. Out of 10 studies 7 were used combination of intercostals stretch and anterior basal lift technique of chest PNF, 2 studies were used vertebral pressure and abdominal co contraction and remaining 1 were used perioral pressure technique. Mean Duration of post operative rehabilitation is 3-5 days.

TABLE 2 DEMOGRAPHIC CHARACTERISTICS OF INCLUDED STUDIES

Demographic Characteristics of Included Studies.	
Total	286
Male	56.3%
Female	48.5%
Techniques of chest PNF	
Intercostal stretch	70%
Vertebral pressure	20%
Abdominal co-contraction	20%
Anterior basal lift	70%
Perioral pressure	10%
Treatment Duration	1-5 days

## Reported clinical outcomes

### HEART RATE

Dr. Ankita P<sup>13</sup> found significant reduction in heart rate after giving intercostals stretch and

anterior basal lift techniques of chest PNF along with chest PT for 5 days compare to chest PT alone. Ashtankar Dr. Atharuddin Kazi<sup>14</sup> also found significant improvement in HR after giving chest PNF along with conventional chest PT.

Dr. Sneha S Chordiya Dr. Atharuddin Kazi et al<sup>14</sup> conducted a study to analyze the effect of chest PNF along with conventional chest PT in mechanically ventilated OP poisoning patients and found significant improvement after giving chest PNF along with chest PT for 3 days. Dr. Shivananda venkata reddy Dr. Ganesh Arumugam et.al<sup>15</sup> conducted a study to determine immediate effect of chest PNF in OP poisoning patients. Author didn't find any significant change in HR.

Tomasz Zwolin' ski, MagdalenaWujtewicz<sup>17</sup> conducted a study on "Feasibility of Chest Wall and Diaphragm Proprioceptive Neuromuscular Facilitation (PNF) Techniques in Mechanically Ventilated Patients" 69 patients were included in the study and divided in to two groups. The first group was treated with rhythmic initiation technique and second group was treated with initial stretch technique Study doesn't find any significant improvement in HR after giving Rhythmic

initiation technique (RIT) or initial stretch technique (IST).

Abhinav Salve Sachin Maghadeet.al<sup>18</sup> carried out a study “Effect of Vertebral Pressure Technique and Intercostal Stretch Technique on Respiratory Rate, Tidal Volume, SpO<sub>2</sub> and Heart Rate among Organophosphorus Poisoning Patients: An Experimental Study” 24 ICU patients who were on mechanical ventilator were included. Each subject was split into two groups. Intercostal stretch technique was applied to group A, while group B received vertebral pressure technique. Study found significant improvement in HR immediately after giving chest PNF. Payal Gupta Gopal Nambi et.al<sup>19</sup> determine that intercostals stretch is more effective in reduction of HR over anterior basal lift technique of chest PNF.

According to the above analysis 5 out of 10 studies were found significant improvement in HR after giving chest PNF techniques along with conventional chest PT.

### **RESPIRATORY RATE**

Dr. Ankita P<sup>13</sup> found significant improvement in RR in after giving intercostals stretch and anterior basal lift techniques of chest PNF along with chest PT. Abhinav Salve Sachin Maghadeet.al<sup>18</sup> found significant improvement in RR immediately after giving Vertebral Pressure Technique and Intercostal Stretch Techniques of chest PNF. Payal Gupta Gopal<sup>19</sup> Nambi et.al determine that intercostals stretch is more effective in improvement of RR over anterior basal lift technique of chest PNF.

Dr. P. Muruganandam (PT), Dhanashree Shinde et al<sup>12</sup> conducted a study on “Effect of Chest Proprioceptive Neuromuscular Facilitation versus Body Positioning in Mechanically ventilated patients: A cross over study”. Two techniques were given to the patients. Chest PNF included intercostal stretch and anterior basal lift; Body

positioning include side lying positioning for 30 minutes. Author found significant improvement in RR immediately after giving chest PNF.

Binesh Asokan Poozhikunnath<sup>1</sup>, Suthakar Raju<sup>21</sup> conducted a study to compare the efficacy of Proprioceptive Neuromuscular Facilitation on respiratory rate, saturation of peripheral oxygen and heart rate in COVID patients and found significant improvement in RR immediately after giving chest PNF along with conventional CPT.

Sandesh P. Londhe, Vishvnath S. Pawadshetty et.al<sup>20</sup> conducted a study on “The Immediate Effect of Chest Manipulation and Neurophysiological Facilitation on Haemodynamic Parameters in Ventilator Dependent Organophosphorus Poisoning Patients” 28 individuals who had consumed organophosphorous were split evenly between Groups A and B. The intervention was administered once every day for two days. Both Groups A and B received suctioning right after the intervention. According to this study chest manipulations can be utilised as an early intervention in organophosphorus poisoning patients and aid to improve haemodynamic parameters on Day 1 as well as sustain the improvement in preinterventional values on Day 2.

The aforementioned analysis shows that when chest PNF techniques were administered in addition to traditional chest PT, 6 out of 10 studies reported a significant improvement in RR.

### **SATURATION OF PERIPHERAL OXYGEN [SPO<sub>2</sub>]**

Dr. Ankita P<sup>13</sup> found significant improvement in in spo<sub>2</sub> after giving intercostals stretch and anterior basal lift techniques of chest PNF along with chest PT. Dr. Sneha S Chordiya Dr. Atharuddin Kazi et al<sup>14</sup> found significant

improvement spo2 after giving chest PNF along with chest PT for 3 days.

Dr. Shivananda Venkata Reddy Dr. Ganesh Arumugam et.al<sup>15</sup> conducted a study to determine immediate effect of chest PNF in OP poisoning patients. Author didn't find any significant change in spo2. Tomasz Zwolin' ski, Magdalena Wujtewicz<sup>17</sup> also doesn't find any significant improvement in spo2 after giving Rhythmic initiation technique (RIT) or initial stretch technique (IST).

Abhinav Salve Sachin Maghadeet.al<sup>18</sup> found significant improvement in spo2 immediately after giving chest PNF. Payal Gupta Gopal Nambi et.al<sup>19</sup> determine that intercostals stretch is more effective in improvement of spo2 over anterior basal lift technique of chest PNF. Binesh Asokan Poozhikunnath, Suthakar Raju<sup>21</sup> found significant improvement in spo2 immediately after giving chest PNF along with conventional CPT.

Based on the above analysis we can say that 6 out of 10 studies reported a significant improvement in spo2 after giving chest PNF techniques along with conventional chest PT.

### LUNG COMPLIANCE

Dr. Ankita P<sup>13</sup> found significant improvement in lung compliance after giving intercostals stretch and anterior basal lift techniques of chest PNF along with chest PT. Dr. Sneha S

Chordiya Dr. Atharuddin Kazi et al<sup>14</sup> found significant improvement in lung compliance after giving chest PNF along with chest PT for 3 days. Dr. Shivananda Venkata Reddy Dr. Ganesh Arumugam et.al<sup>15</sup> conducted a study to determine immediate effect of chest PNF in OP poisoning patients. Author didn't find any significant change in lung compliance.

The previously mentioned analysis revealed that six out of ten studies found a significant improvement in spo2 when chest PNF techniques were used in addition to traditional chest PT.

### TIDAL VOLUME AND MINUTE VENTILATION

Dr. Sneha S Chordiya Dr. Atharuddin Kazi et al found significant improvement in MV after giving chest PNF along with chest PT for 3 days. Dr. Shivananda Venkata Reddy Dr. Ganesh Arumugam et.al conducted a study to determine immediate effect of chest PNF in OP poisoning patients. Author didn't find any significant change in MV. Abhinav Salve Sachin Maghadeet.al found significant improvement in TV immediately after giving chest PNF.

The aforementioned analysis shows that when chest PNF techniques were administered in addition to traditional chest PT, 3 out of 10 studies reported a significant improvement in TV and MV.

TABLE 2 – DATA REPRESENT THE POST PROCEDURE VALUES OF REPORTED CLINICAL OUTCOMES

STUDY	HR	RR	SPO2	MV	LUNG COMPLIANCE
1. Dr. Ankita P Ashtankar Dr. Atharuddin Kazi <sup>13</sup>	POST PNF 93.6±8.51 POST CPT 114.46±12.25	-	Post PNF 99.60 ±.63 Post-CPT 97.60±1.80	-	POST PNF 31.45±6.24 POST CPT 21.42±6.24
2. Dr. Sneha S Chordiya Dr. Atharuddin Kazi et al <sup>14</sup>	Post PNF 98.33 ± 1.2 Post-CPT 100 ± 1.34	-	Post PNF 98.60±1.76 Post-CPT 98.33±1.4	Post PNF 10.73±1.75 Post-CPT 9.6±2.01	Post PNF 45.73±7.1 Post-CPT 35.20±12.5
3. Dr. Shivananda Venkata Reddy Dr. Ganesh Arumugam et.al <sup>15</sup>	Post-CPT 128.70±8.79 Post PNF 124.93±8.83	-	Post-CPT 100.00 Post PNF 100.00	Post-CPT 14.56±1.19 Post PNF 13.94±1.28	Post-CPT 84.80±10.64 Post PNF 85.53±10.85
4. Dr. P. Muruganandam (PT), <sup>1</sup> Dhanashree Shinde <sup>12</sup>	-	Post PNF 24.27 BP – 24.2	POST BP 99.96 POST PNF 100.23	-	-

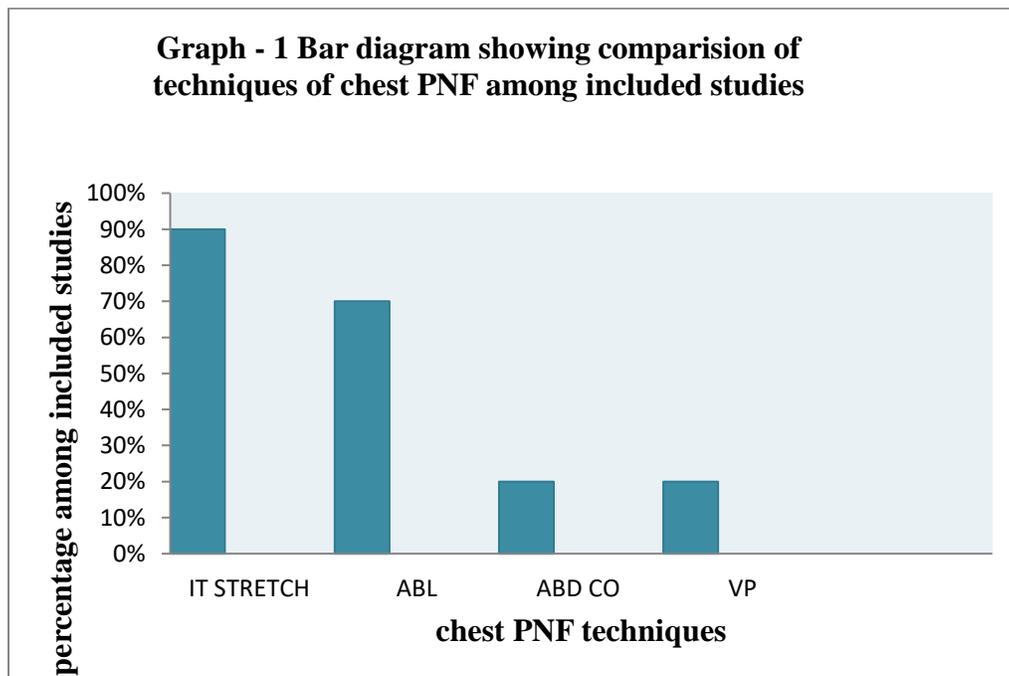
5	Binesh Poozhikunnath1, Raju2 <sup>21</sup>	Asokan Suthakar	Post PNF 77.33 Post-CPT 90.43	Post PNF 16 Post-CPT 20.57	Post PNF 100 Post-CPT 99.57		-
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\*PNF – proprioceptive neuromuscular facilitation BP – Body positioning CPT – Cardio pulmonary physical therapy \*

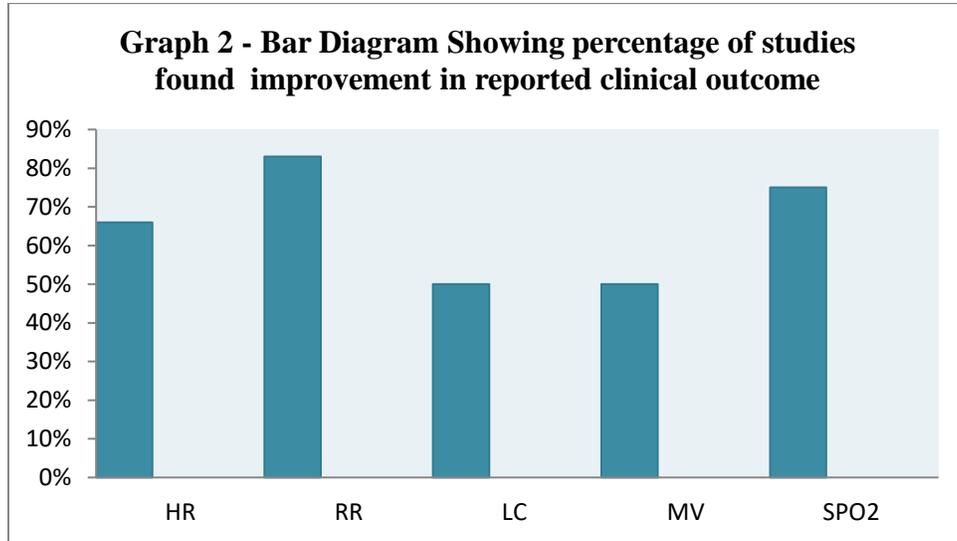
TABLE 2 – DATA REPRESENT THE COMPARISION OF POST PROCEDURE VALUES OF REPORTED CLINICAL OUTCOMES

STUDY	HR	RR	MV	SPO2
1. Dr. Hardini Prajapati <sup>16</sup>		IT-STRECH 14.8±8.87 ABD CO CON 14.9±10.13	IT-STRECH 5.95±4.06 ABD CO CON 6.15±4.33	
2. Tomasz Zwolin´ ski, MagdalenaWujtewicz <sup>17</sup>	RIT 85 IST 84			RIT 98 IST 97
3. Abhinav Salve Sachin Maghadeet.al <sup>18</sup>	IT STRETCH 107.67  VP 109.92	IT STRETCH 17.97 VP 20.08		IT STRETCH 98.67 VP 98.25
4. Payal Gupta Gopal Nambi et.al <sup>19</sup>	IT STRETCH 119.8 ABL 124.54	ITSTRETCH 19.40 ABL 21.46		IT STRETCH 96.20 ABL 95.13

\*IT STRETCH – intercostals Stretch, ABL- anterior Basal Lift, VP- Vertebral Pressure, ABD –abdominal co contraction, RIT – rhythmic initiation technique, IST – initial stretch technique \*



\*IT STRETCH – intercostals Stretch, ABL- anterior Basal Lift, VP- Vertebral Pressure, ABD –abdominal co contraction



## DISCUSSION

Rehabilitation is widely considered a cornerstone in the complex process of weaning from MV<sup>22,23</sup>. The present review highlighted the effectiveness of proprioceptive neuromuscular facilitation techniques of respiration in mechanically ventilated patients. The above review includes total 10 studies. Out of these 10 studies 5 studies were focused on the effectiveness of chest PNF along with conventional chest PT compare to conventional chest PT alone. Another 3 studies were conducted to compare the various neurophysiological facilitation techniques to determine which technique is more effective. Remaining 2 studies were focused on the comparison of proprioceptive neuromuscular facilitation techniques of respiration with the other chest PT techniques. The studies included in this review have documented significant improvements in pulmonary and hemodynamic parameters in mechanically ventilated patients.

A review was done by Shobha Keswani Sumit Kalra to determine role of proprioceptive neuromuscular facilitation techniques of respiration in intensive care unit patients. According to this review Proprioceptive Neuromuscular Techniques for respiration are effective for patients in intensive care unit.<sup>24</sup>

This study supports the statement of N. B. Thakkar (2006) and Jennifer A. Pryor that there is an advantage of application of PNF stretch technique in ICU patients as it helps in lowering the raised RR and HR and in improving SPO2 levels within near to range which is acceptable for ventilator weaning process.<sup>25</sup> Shruti Gupta, Kirti Mishr conducted a review effect of breathing exercises and PNF in COPD patients. This study shows that pursed lip breathing and diaphragmatic breathing is more effective compare to respiratory PNF exercise in COPD patients.<sup>26</sup>

Nitz J et al (2002) demonstrated that application of respiratory PNF techniques improves respiratory function in subjects with myotonic dystrophy weaning from mechanical ventilation. This study also supports the above statement.<sup>27</sup>

Intercostal stretch, vertebral pressure, abdominal co-contraction, anterior basal lift, perioral pressure, moderate manual pressure are the various techniques of chest PNF. Among those techniques intercostals stretch and anterior basal lift are the most commonly used techniques of proprioceptive neuromuscular facilitation of respiration. As 6 studies out of 10 included studies are used intercostals stretch and anterior basal lift

When we look at the studies that compare the two different neurophysiological facilitation techniques, Payal Gupta Gopal Nambi et.al determine that IC stretch is more effective in reduction of respiratory rate and heart rate and improving oxygen saturation over anterior basal lift technique. Abhinav Salve et.al conducted a study on the Effect of Vertebral Pressure Technique and Intercostal Stretch Technique on Respiratory Rate, Tidal Volume, SpO<sub>2</sub> and Heart Rate among Organophosphorus Poisoning Patients found that both the techniques have equal significant diff in mechanically ventilated patients

Dr. Hardini Prajapati found that RR improved significantly after application of anterior stretch posterior basal lift. Tidal volume improved very significantly after application of abdominal co contraction and with anterior stretch posterior basal lift. Minute volume improved very significantly after abdominal co contraction and after anterior stretch posterior basal lift

To generate reactions to reflex respiratory movement, a facilitator stimulus in the form of proprioceptive neuromuscular facilitation (PNF respiration) is well accepted. The firing release of the muscle spindle during a passive stretch could be the cause of the change in ventilation parameters.

By activating the parasympathetic nervous system, respiratory PNF techniques help lower heart rate and respiratory rate. Methods such as the Thoracic Thrust, Anterior Basal Shift, and Intercostal Stretch improve lung expansion, which in turn improves oxygenation, and thus helps with ventilation. Since dorsal root, stretch receptor, and intersegmental reflexes mediate most responses to respiratory PNF, there were only minor but statistically significant differences between the two groups.

## **CONCLUSION**

According to the analysis of the studies that are included in the above review we can

determine that proprioceptive neuromuscular facilitation techniques of respiration are effective in improving hemodynamic [ Heart rate, Blood pressure] and Pulmonary [ Tidal Volume, Minute Ventilation, Lung Compliance, Respiratory rate, spo<sub>2</sub>] parameter in mechanically ventilated patients.

## **Clinical Implication**

Respiratory PNF is feasible, safe and can be used as an early intervention in mechanically ventilated patients.

## **Limitation And Future Scope**

There is limited available evidence surrounding the proprioceptive neuromuscular facilitation techniques of respiration in mechanically ventilated patients. Some limitations of the studies that are included in this review are the small sample and the lack of follow-up respiratory measurements to see the duration of the observed increases in outcomes. Meta Analysis of these studies could not be done due to quantitative difference in patient's properties, duration of intervention, outcome measures and treatment therapies The long-term effects on pulmonary morbidity, prevention of further complication were not addressed in the current study and could be the basis of future trials.

## **Declaration by Authors**

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