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(REVIEW ARTICLE)

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Effect of Proprioceptive Neuromuscular Facilitation (PNF) Techniques in COPD patients: A narrative review

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) is a progressive, incurable lung condition marked by persistent airflow limitation, predominantly affecting smokers. It ranks as the third leading cause of global morbidity and mortality. Proprioceptive neuromuscular facilitation (PNF) techniques, involving externally applied proprioceptive and tactile stimuli, can elicit reflex respiratory responses, influencing breathing rate and depth.

Aim: To determine the effectiveness of PNF techniques in COPD condition.

Results: Several articles are used to discuss the effectiveness of the PNF techniques in COPD. Integrating PNF techniques into pulmonary rehabilitation offers significant benefits for individuals with COPD. These techniques enhance respiratory function by improving air exchange, boosting respiratory parameters, and increasing oxygen saturation levels, all while maintaining a stable respiratory rate.

Conclusion: PNF serves as a valuable adjunct or alternative to traditional therapies, effectively improving respiratory function and overall quality of life (QOL) for patients.

Keywords: Proprioceptive Neuromuscular Facilitation; PNF; COPD; Chronic Obstructive Pulmonary Diseases

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a progressive, incurable lung condition characterized by persistent airflow limitation, which can eventually lead to complications such as pulmonary heart disease and respiratory failure[1] . It predominantly affects smokers and individuals over the age of 40. The prevalence of this disease increases with age, making it the third most common cause of morbidity and mortality globally[2–5]. COPD patients demonstrate considerable variability in disease presentation, which extends well beyond the classic archetypes of the "pink puffer" and "blue bloater" proposed by Dornhorst and depicted by Netter over 50 years ago[6]. Common symptoms of COPD typically include persistent and worsening shortness of breath (dyspnea), a chronic cough, production of sputum, chest tightness, and fatigue[7].

The decline in pulmonary function in COPD patients is primarily caused by the remodeling of the airways and pulmonary parenchyma. This leads to airflow limitation, bronchoalveolar instability, and air trapping, resulting in an increase in residual volume and end-expiratory lung volume, while expiratory reserve volume and inspiratory volume decrease[8]. The restriction of expiratory airflow results in lung hyperinflation caused by air trapping[9].

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Hyperinflation of the lungs causes remodelling of the inspiratory muscles, particularly the diaphragm, which becomes depressed and experiences reduced movement. This can also result in postural deformities and increased effort in breathing[5]. In COPD patients, impaired exercise tolerance, muscle weakness, and poor quality of life are common issues, often leading to disability and social isolation. Peripheral muscle weakness, physical deconditioning, and impaired gas exchange are key factors that contribute to reduced exercise tolerance[10].

Currently available treatments for COPD focus on alleviating symptoms, improving functional capacity, enhancing quality of life, and reducing the risk of exacerbations. Management of stable COPD typically involves non-pharmacological strategies such as smoking cessation, including pulmonary rehabilitation, lifestyle modifications, and pharmacological therapies[4].

Proprioceptive neuromuscular facilitation (PNF) is widely recognized as a key exercise approach in muscle rehabilitation; however, its application in pulmonary rehabilitation remains relatively uncommon[11]. It is an exercise therapy approach that utilizes specific movement patterns in diagonal and spiral directions, combined with targeted techniques[12].

PNF stretching is effective in increasing muscle length and enhancing joint range of motion (ROM) by inhibiting the myotatic reflex[13]. These techniques are externally applied proprioceptive and tactile stimuli that produce reflex respiratory movement responses that appear to alter the rate and depth of breathing[14]. It is a facilitative technique designed to enhance chest wall mobility, thereby promoting improved chest expansion[15].

Hence PNF approach is uncommon in pulmonary rehabilitation, the study was aimed in determining the effectiveness of PNF techniques in COPD patients.

2. Methodology

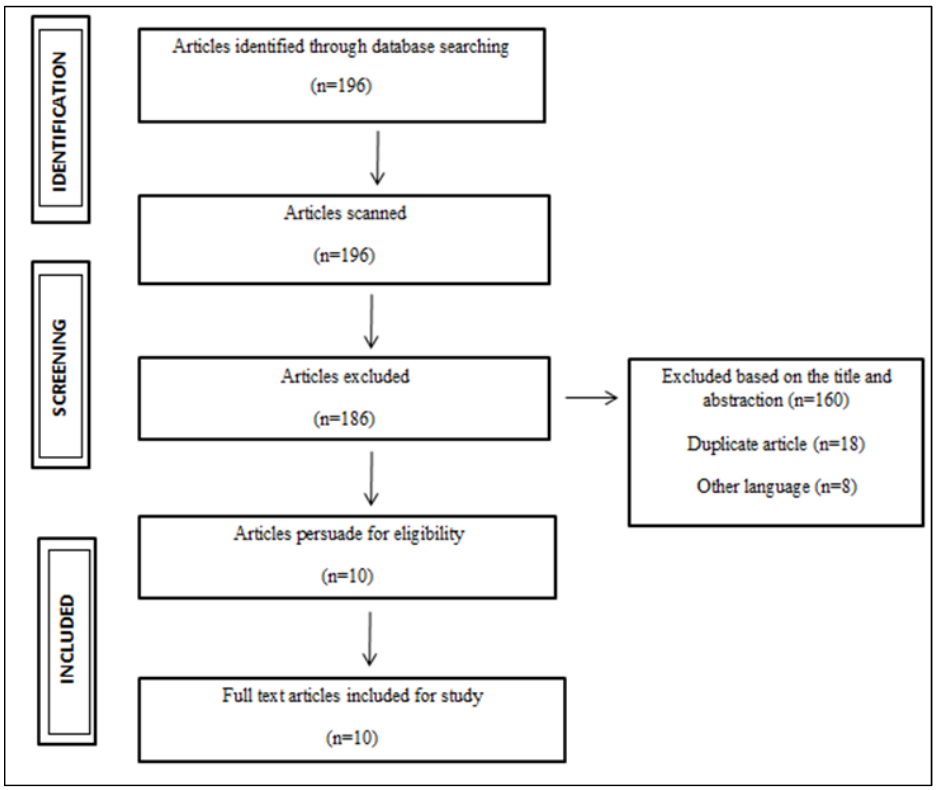

Figure 1 Flow diagram of search strategy

The Google scholar and PubMed were the primary databases utilizing for the study between the years 2014-2024, using the keyword “Proprioceptive Neuromuscular Facilitation, COPD, Chronic Obstructive Pulmonary Disease, PNF.

Inclusion Criteria: The case diagnosed with COPD, and the data involves the use of PNF techniques individually or combined with other therapeutic exercise intervention.

Exclusion Criteria: Duplicate data and non-clinical trials were excluded.

3. Results

After searching several databases 196 abstracts were extracted. The searches identified 10 appropriately significant studies which met the set inclusion criteria for further analysis.

Table 1 Summary of review of literature

First author and Year	Study design	Sample size	Study duration	Outcome measures	Interventions	Conclusion
Dangi Ashwini, 2017 [16]	Experimental study	18	4 weeks	Dyspnea score, 6 minute walk distance(6MWD), chest expansion at 3 levels.	Group A- PNF – intercostal stretch. Group B- Diaphragmatic breathing.	PNF & Diaphragmatic breathing are equally effective in reducing dyspnea, improving chest expansions & increasing functional capacity in stable COPD
Sushma singh, 2020 [17]	Experimental study (pre and post test)	60	2 weeks	Saturation (Spo2), Respiratory Rate (R.R), FEV1/FVC	PNF pattern D1 flexion and D1 extension. D2 flexion and D2 extension.	PNF pattern has improvement in Spo2, R.R, FEV1/FVC
Hetal M Mistry, 2021 [18]	Quazi experimental study	65	40 minutes	R.R, chest expansion, Peak Expiratory Flow Rate (PEFR)	Intercoastal stretch applied for 10 breaths with 1minute rest for 10 repetitions.	Immediate positive effect on R.R, chest expansion, PEFR
Kai Liu, 2021 [8]	A Randomized controlled trial	55	6 weeks	COPD assessment test(CAT),Dyspnea,Visual Analog Scale (VAS), forced vital capacity (FVC), forced expiratory volume in first second (FEV1), inspiratory capacity (IC), inspiratory reserve volume (IRV), 6MWT, the range of motion (ROM) of head protraction, shoulder flexion & non-dominant pectoralis minor muscle (PmM) length	Control group – 30min Aerobic training on a treadmill. PNF group- Aerobic training +added 10min PNF stretching.	PNF stretching combined with Aerobic training reduces Dyspnea and improves some pulmonary function measures, which is associated with neck/shoulder mobility .
Kumaresa,2022 [19]	Quazi experimental study	12	5 Days	PEFR, 6MWD	Intercostal stretch, vertebral pressure high	Implementation of PNF techniques on short term basis

					and anterior stretch by lifting Posterior basal area	optimally improves the functional exercise capacity and PEFR
N.Siva jyothi, 2022 [20]	Comparative study (pre & post)	30	6 weeks	FEV1/FVC, FEV1, FVC, chest expansion measurements-axillary level & xiphisternal level	Hold relax PNF stretch of Pectoralis major muscle	Improvement in the chest expansion & FEV1/FVC
Payal Malpani, 2022 [21]	Experimental study	30	6 weeks	FEV1/FVC, , chest expansion measurements-axillary level & xiphisternal level	Group A- Respiratory PNF with Diaphragmatic breathing exercises. Group B – Chest wall mobilization with Diaphragmatic breathing exercises.	Respiratory PNF is more effective in improving chest expansion
Prajapati, 2023 [22]	A comparative study	30	1 week	FEV1/FVC, 6MWD, dyspnea	Group A- Segmental breathing. Group B- Respiratory PNF.	Respiratory PNF is more efficient in improving pulmonary function, dyspnea and exercise tolerance
Thali, 2023 [23]	A Randomized clinical Trial	30	6 days	PEFR, MIP, chest expansion, exercise capacity MMRC	Group A- Diaphragmatic stretch with chest PNF. Group B- Diaphragmatic release with chest PNF.	Individually improved but in between groups no difference.
Kamrun Nahar, Chowdary, 2024 [24]	Narrative review				Intercostal stretch	Intercostal stretching technique improved lung function, decreased dyspnea and increased chest expansion.

4. Discussion

COPD is a chronic lung disease marked by inflammation and structural lung changes, leading to airflow obstruction and reduced elasticity. This condition often results in respiratory muscle weakness, which is crucial for effective breathing. Symptoms include dyspnea and chest weakness. To compensate for increased ventilator demands, respiratory muscles remain contracted for extended periods, further increasing their workload. This study aims to evaluate the effectiveness of PNF techniques in improving respiratory status and functional exercise capacity.

An experimental study conducted by Dangi Ashwini demonstrates that both the intercostal stretch technique and diaphragmatic breathing are equally effective in reducing dyspnea, increasing chest expansion, and enhancing functional capacity.

Sushma Singh concluded that PNF exercises play a significant role for improving pulmonary function, with their therapeutic benefits based on the stretch reflex theory. The application of D1 and D2 extension patterns has been found to enhance saturation, Respiratory rate (R.R), FEV1/FVC ratio.

Hetal M Mistry conducted Quazi experimental study and provides baseline data on the immediate effects of intercostal stretching on R.R, chest expansion and PEFR.

Kai Liu conducted an RCT that shown the effect of PNF stretching combined with Aerobic training reduces dyspnea and improves pulmonary function measures associated with Neck/shoulder mobility compared with the control group receiving Aerobic training on Treadmill as PNF stretching is highly effective in improving muscle activation and optimizing motor coordination.

Another Quazi experimental study conducted by KUMARESAN revealed that short – term implementation of PNF techniques significantly enhance functional exercise capacity and PEFR. The combination of respiratory PNF techniques has demonstrated greater effectiveness than applying a single technique alone.

N.Shiva Jyothi conducted a pre and post comparative study, it is concluded that Hold-Relax PNF stretching program targeting the Pectoralis major muscle leads to an improvement in chest expansion and FEV1/FVC. This technique enhances muscle length through the mechanism of autogenic inhibition.

Payal Malpani current studies indicate that Group A Respiratory PNF with Diaphragmatic breathing exercise and Group B chest wall mobilization with Diaphragmatic breathing exercise both techniques significantly enhance pulmonary function and chest expansion . However Respiratory PNF proves to be more effective than Chest wall mobilization in improving chest expansion.

A study conducted by Prajapati revealed that PNF is highly effective in improving pulmonary function, alleviating dyspnea and exercise tolerance resulting in notable progress.

Thali conducted an RCT that concluded Diaphragmatic stretching and manual release techniques combined with Chest PNF can serve as effective alternatives or adjuncts in the treatment of COPD.

One RCT and One comparative study has concluded that PNF hold relax stretch of pectoralis major muscle shows significant improvement in chest expansion, pulmonary function and neck/shoulder ROM.

Whereas several studies in this review demonstrated that chest PNF techniques combined or adjunct with other techniques was more efficient in improving pulmonary function, exercise tolerance and chest expansion

5. Conclusion

The studies in this narrative review emphasize the beneficial effects of PNF techniques on the respiratory function in COPD individuals. Integrating PNF technique into Pulmonary rehabilitation has proven effective in enhancing air exchange by improving respiratory parameters, saturation levels, while maintain a stable R.R. Implementation of combination of Respiratory PNF techniques has demonstrated efficacy in chest expansion and functional exercise capacity. PNF serves as a valuable adjunct or alternative to traditional therapies for improving respiratory function and QOL.

Limitations

This study examines various techniques as a whole rather than focusing on a single specific technique and its individual impact on the outcomes.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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