



EFFECT OF UPPER LIMB DIAGONAL PATTERN TRAINING WITH ELASTIC RESISTANCE BANDS ON PULMONARY FUNCTIONS IN BREAST CANCER SURVIVORS: EXPERIMENTAL STUDY.

Dr. Sampada Parmeshwar Bhutekar*

MPT*Corresponding Author

Dr. Archana K. Nagargoje

Asso. Professor

Dr. Abhijit D Diwate

HOD & Professor

Dr. Arijit Kumar Das

Professor

ABSTRACT Cancer is characterized by uncontrolled cell proliferation, with breast cancer being the most common malignancy among women and a major global health burden requiring multimodal treatment based on subtype and stage. Respiratory muscle strength, assessed via maximum inspiratory and expiratory pressures, is essential for effective lung function and may be compromised during breast cancer treatment, underscoring the need for its assessment and rehabilitation. **Objective:** To evaluate the effect of 4 weeks of upper limb PNF training with elastic resistance bands on pulmonary function parameters in breast cancer patients. **Methods:** A single-group study involving 10 female breast cancer patients (aged 35–64 years) post modified radical mastectomy, undergoing radiotherapy and chemotherapy at a tertiary care oncology centre, assessed spirometry parameters (FVC, FEV1, FEV1/FVC) before and after a 4-week upper limb PNF with ERB protocol. **Results:** Statistically significant improvements were observed in FVC and FEV1 (1.38 ± 0.12 L to 1.61 ± 0.13 L; $t=145.99$, $p<0.001$), and FEV1/FVC ratio. **Conclusion:** Upper limb PNF combined with ERB training significantly improves pulmonary function in breast cancer patients undergoing treatment, supporting its integration into rehabilitation protocols.

KEYWORDS : breast cancer , lung function, diagonal pattern

INTRODUCTION

Breast cancer ranks as one of the most prevalent cancers among women in India, affecting approximately 80,000 women annually, with management involving surgery, radiation therapy, chemotherapy, and social adaptation¹. WHO reports breast cancer accounts for nearly 50% of cancers in women, with gender and age as primary risk factors; 2022 saw 2.3 million new diagnoses and 670,000 deaths globally².

Chest radiotherapy carries significant pulmonary consequences. Coggle et al. concluded that the lung's radiation response is complex due to over 40 mostly radioresistant cell types, though limited regenerative capacity restricts tolerance to high doses, with pulmonary fibrosis and carcinogenesis as major late consequences⁵.

Common respiratory complications include diminished muscle strength and reduced exercise tolerance, with chemotherapy-induced dyspnea arising from muscle and nerve injury. Apurva J. et al. reported significant decline in diaphragm mobility and thickness after five weeks of chemotherapy⁶.

Despite research advances, gaps remain in understanding respiratory rehabilitation outcomes, particularly regarding lung function as a standalone component following modified radical mastectomy (MRM).

MATERIAL AND METHODOLOGY

Participation : Study was conducted in Department of Oncology in a Tertiary Care Teaching Hospital for which duration of the study was 1 year with patient diagnosed with Breast cancer was taken were sample size was 10 patients. Institutional Ethical Committee approval was taken before the commencement of the study Screening of patients was conducted in accordance with the specified inclusion and exclusion criteria. The patient diagnosed with Breast cancer with MRM ongoing Chemotherapy and Radiotherapy within the age limit between 35 to 64 yrs were included in this study . Patient diagnosed with congenital diseases, acquired diseases, respiratory tract infection in recent 2 weeks, any neurological or musculoskeletal issue that impact respiratory system were excluded from this study . Informed consent was taken from the patients included after the screening process. Outcome measures (PFT) was taken at baseline of the protocol and after 4 weeks at the end of protocol

Outcome Measures: A Pulmonary function was assessed pre- and post-intervention using spirometry (Heligus 401 spirometry system) in accordance with the American Thoracic Society/European Respiratory Society (ATS/ERS) guidelines. Participants were informed about the procedure before testing. They were instructed to perform a maximal inspiration followed by a forceful and complete expiration through the mouthpiece while seated upright and wearing a nose clip. Three acceptable maneuvers were recorded, and the best value was selected for analysis by the Heligus 401 software..

Intervention: The patient will than undergo exercise program for 4 weeks which is upper limb diagonal pattern training with elastic resistance band All the exercise was carried in upright position patient in sitting on chair. Upper extremity exercises were carried out in only one limb. The protocol was carried with the surveillance of medical supervision.

Patterns: (D1 flexion/extension) - Flexion-adduction-external rotation & extension-abduction-internal rotation. (D2 flexion/extension) - Flexion-adduction-external rotation & extension-adduction internal rotation. The protocol includes 2 sessions per week for 4weeks; 3 sets of 6 repetitions

Statistical Analysis : Data was analysed using SPSS Software and presented as Mean $\pm$ Standard Deviation. A Paired t-test was used to compare pre- and post-intervention spirometry values in the same patient group ($n = 10$). The significance level was set at $\alpha = 0.05$ (two-sided).

RESULT: All ten participants ($n=10$) completed the 4-week intervention. The mean age of participants was 49.5 ± 8.2 years. All participants were post-MRM and undergoing concurrent chemoradiation For FVC, a statistically significant improvement was observed, with a mean increase of 0.24 L (13.4%; $t(9)=87.444$, $p<0.001$). For FEV1, the mean increases was 0.22 L (16.1%; $t(9)=145.988$, $p<0.001$). All three parameters demonstrated statistically significant improvement ($p<0.001$) following the 4 weeks intervention , with p- value well below the predetermined significance threshold of 0.05.

TABLE – 1 Descriptive Statistics

Parameter	Pre Mean $\pm$ SD	Post Mean $\pm$ SD	Mean Diff $\pm$ SD	% Change
FVC (L)	1.76 $\pm$ 0.13	1.99 $\pm$ 0.13	0.24 $\pm$ 0.01	13.4%
FEV ₁ (L)	1.38 $\pm$ 0.12	1.61 $\pm$ 0.13	0.22 $\pm$ 0.00	16.1%
FEV ₁ /FVC (%)	78.62 $\pm$ 1.55	80.57 $\pm$ 1.17	1.95 $\pm$ 0.47	2.5%

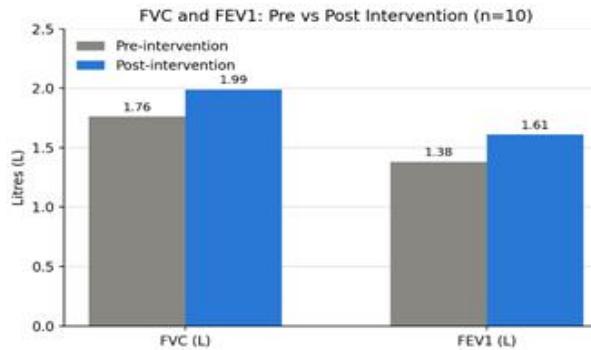


Fig 1 FVC and FEV₁ : Pre vs Post Intervention. (Mean $\pm$ SD values shown above each bar. Both FVC and FEV₁ increased significantly after 4 weeks of upper limb PNF with ERB training ($p < 0.001$).)

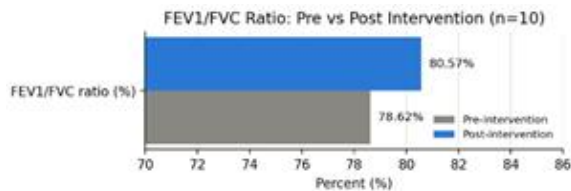


Fig 2 FEV₁/FVC Ratio: Pre vs Post Intervention (The FEV₁/FVC ratio improved from 78.62% to 80.57%, indicating improved airflow dynamics ($p < 0.001$).

DISCUSSION:

Breast cancer is among the most common malignancies affecting women worldwide. While advances in surgery, chemotherapy, and radiotherapy have improved survival rates, these treatments are frequently accompanied by reduced pulmonary function, upper limb dysfunction, fatigue, and diminished functional capacity. Rehabilitation strategies that simultaneously address upper limb function and respiratory performance are therefore of considerable clinical importance.

The present pilot study demonstrated that a structured 4-week upper limb diagonal pattern training program using elastic resistance bands significantly improved pulmonary function, as reflected in increased Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV₁), and the FEV₁/FVC ratio among breast cancer survivors. These findings suggest that incorporating upper limb diagonal movement patterns with progressive elastic resistance may enhance thoracic mobility, facilitate respiratory muscle activation, and improve ventilatory efficiency.

These improvements align with existing evidence supporting exercise-based rehabilitation in this population. Hetal M., Amar D., et al. (2024) examined the relationship between cancer-related fatigue and respiratory muscle strength in women undergoing radiotherapy, reporting a significant decline in respiratory muscle strength post-treatment and underscoring the detrimental impact of cancer therapy on respiratory function. Breast cancer is among the most common malignancies affecting women worldwide. While advances in surgery, chemotherapy, and radiotherapy have improved survival rates, these treatments are frequently accompanied by reduced pulmonary function, upper limb dysfunction, fatigue, and diminished functional capacity. Rehabilitation strategies that simultaneously address upper limb function and respiratory performance are therefore of considerable clinical importance.

The present pilot study demonstrated that a structured 4-week upper limb diagonal pattern training program using elastic resistance bands significantly improved pulmonary function, as reflected in increased Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV₁), and the FEV₁/FVC ratio among breast cancer survivors. These findings suggest that incorporating upper limb diagonal movement patterns with progressive elastic resistance may

enhance thoracic mobility, facilitate respiratory muscle activation, and improve ventilatory efficiency.

These improvements align with existing evidence supporting exercise-based rehabilitation in this population. Hetal M., Amar D., et al. (2024) examined the relationship between cancer-related fatigue and respiratory muscle strength in women undergoing radiotherapy, reporting a significant decline in respiratory muscle strength post-treatment and underscoring the detrimental impact of cancer therapy on respiratory function. Overall, this pilot study suggests that upper limb diagonal pattern training with elastic resistance bands is a safe, feasible, and promising intervention for improving pulmonary function in breast cancer survivors, offering preliminary support for future large-scale trials.

CONCLUSIONS:

The present pilot study provides evidence that a 4-week upper limb PNF combined with elastic resistance band training program produces statistically significant improvements in pulmonary function — FVC, FEV₁, and FEV₁/FVC ratio — in breast cancer patients undergoing radiotherapy and chemotherapy ($p < 0.001$ for all parameters). The null hypothesis in oncology physiotherapy rehabilitation protocols for breast cancer patients. A full-scale randomised controlled trial is recommended to confirm and extend these findings..

Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrolment

REFERENCES:

- DeSantis C, Siegel R, Jemal A. Breast cancer facts and figures 2013-2014. American Cancer Society. 2013;2013:1-38.
- Quinn C, Tan PH, Allison KH, Brogi E, Lakhani SR, Schnitt SJ, Fox SB, Jaffer S, Sahin A, Salgado R, Sapino A. World Health Organization classification of tumours of the breast 6th edition 2026. Histopathology. 2026 Apr 21.
- Hetal M., Amar D. Correlation of Cancer-Related Fatigue with Respiratory Muscle Strength in Breast Cancer Patients Undergoing Radiotherapy. Indian J Physiotherapy. 2024.
- Tugral A, Arıbaş Z, Akyol M, Bakar Y. Understanding changes in pulmonary function and functional status in breast cancer patients after systemic chemotherapy and radiotherapy: a prospective study. BMC Pulmonary Medicine. 2024 Feb 14;24(1):83.
- Coggie JE. Biological effects of radiation. 2nd ed. London: Taylor and Francis; 1983;12(2):542-560.
- Joshi, Apurva "Effect of Chemotherapy on Diaphragm Mobility and Diaphragm Thickness in Breast Cancer Patients: An Observational Study." International Journal of Health Sciences and Research (2024)
- Jo, Yeong-Jin and M-S Lee. The Effects of Proprioceptive Neuromuscular Facilitation (PNF) Using Elastic Bands on Edema, Range of Motion, and Pain in Post-Mastectomy Patients with Upper Limb Lymphedema: Differences between Open-Hand and Closed-Hand Grips. (2020);21(6):321-341
- Koli, G., & Patel, M. Effect Of Upper Extremity PNF With Resistance Band On Respiratory Muscle Strength And PEFr In Underweight Young Adults: A Randomized Clinical Trial.
- Sheetal B., Abijit D. Combined effect of upper extremity PNF and elastic resistance band training on inspiratory muscle strength in CKD patients undergoing haemodialysis. Nephrol Dial Transplant. 2023.
- Malvia, S., Bagadi, S.A., Dubey, U.S. and Saxena, S. (2017). Epidemiology of breast cancer in Indian women. Asia-Pac J Clin Oncol, 13: 289-295. <https://doi.org/10.1111/ajco.12661>
- Vira P, Samuel SR, Rai PV. Pilot study of inspiratory muscle training during concurrent chemoradiation in head and neck cancer patients. Support Care Cancer. 2021;15(3):100-112
- [D'Souza M, Samuel SR, Rai S. Pilot longitudinal study of the effects of chemoradiation on diaphragm function and respiratory function in head and neck cancer patients. 2020;10(2):110-121.
- Areas GPT, Borghi-Silva A, Lobato AN, Silva AA, Freire RC Jr, Areas FZS. Effect of upper extremity proprioceptive neuromuscular facilitation combined with elastic resistance bands on respiratory muscle strength: a randomized controlled trial. Braz J Phys Ther. 2013;17(6):541-546.
- Park YJ, Na SJ, Kim MK. Effect of progressive resistance exercise using Thera-Band on edema volume, upper limb function, and quality of life in patients with breast cancer-related lymphedema. J Exerc Rehabil. 2023;19(2):105-113.
- Eyigor S, Karapolat H, Yesil H, Uslu R, Durmaz B. Effects of Pilates exercises on functional capacity, flexibility, fatigue, depression and quality of life in female breast cancer patients. Eur J Phys Rehabil Med. 2009;45(3):351-357.