International Journal of Yoga, Physiotherapy and Physical Education
www.sportsjournal.in
ISSN: 2456-5067
Received: 25-02-2025, Accepted: 26-03-2025, Published: 09-04-2025
Volume 10, Issue 2, 2025, Page No. 16-20

Lung function improvement through deep breathing exercises and incentive Spirometry post - Abdominal surgery

Dr. I M Makkubhai
Assistant Professor and Head, Department of Physical Education and Sports Nehru Arts, Science and Commerce College Hubballi, Karnataka, India

Abstract
This scientific research paper investigates the efficacy of deep breathing exercises and incentive Spirometry in enhancing lung function among patients following abdominal surgery. Abdominal surgery often leads to respiratory complications due to factors such as pain, reduced mobility, and decreased lung volume. Consequently, interventions aimed at improving postoperative lung function are essential for reducing the risk of pulmonary complications and enhancing overall recovery.
The study employs a randomized controlled trial design, with participants randomized into intervention and control groups. The intervention group receives structured deep breathing exercises and incentive Spirometry training, while the control group receives standard postoperative care. Lung function measurements, including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and peak expiratory flow rate (PEFR), are assessed preoperatively and at regular intervals postoperatively. Preliminary findings indicate significant improvements in lung function parameters among participants in the intervention group compared to those in the control group. Specifically, participants who engage in deep breathing exercises and incentive Spirometry demonstrate higher FVC, FEV1, and PEFR values, suggesting enhanced respiratory performance and lung capacity. Moreover, participants in the intervention group report reduced incidence of postoperative pulmonary complications, such as atelectasis and pneumonia, compared to controls.
The results highlight the importance of incorporating respiratory rehabilitation interventions, such as deep breathing exercises and incentive spirometry, into the postoperative care protocol for abdominal surgery patients. By promoting lung expansion, improving airway clearance, and preventing pulmonary complications, these interventions contribute to faster recovery, shorter hospital stays, and improved overall outcomes for surgical patients. Further research is warranted to explore the long-term effects and optimal duration of respiratory rehabilitation interventions post-abdominal surgery. Additionally, strategies for implementing these interventions in clinical practice and enhancing patient adherence should be investigated to maximize their effectiveness in improving postoperative lung function and enhancing patient recovery.

Keywords: Lung function, Deep breathing exercises, Incentive Spirometry, Abdominal surgery, Forced vital capacity (FVC), Forced expiratory volume in one second (FEV1), Peak expiratory flow rate (PEFR)

Introduction

Abdominal surgery is a common medical intervention associated with various respiratory complications that can impede postoperative recovery and prolong hospitalization. Among these complications, reduced lung function, atelectasis, and pneumonia are notable concerns, stemming from factors such as anesthesia, pain, reduced mobility, and alterations in breathing patterns. As a result, interventions aimed at improving lung function and preventing respiratory complications are crucial for optimizing patient outcomes following abdominal surgery. A 2020 study estimated that India performs between 3,646 to 4,642 surgeries per year per 100,000 people. Postoperative complication following upper abdominal surgery reported in the literature is 20%-30%. The incidence of atelectasis ranges from 20% to 69% and for the post-operative pneumonia from 9% to 40%.

Deep breathing exercises and incentive spirometry represent two widely utilized respiratory rehabilitation modalities designed to enhance lung function and mitigate postoperative pulmonary complications. Deep breathing exercises involve deliberate inhalation and exhalation maneuvers aimed at maximizing lung expansion, improving airway clearance, and enhancing respiratory muscle strength. Incentive spirometry, on the other hand, utilizes a handheld device to encourage sustained deep inhalation, thereby promoting lung expansion and preventing atelectasis.

The rationale behind employing these interventions post-abdominal surgery lies in their ability to counteract the adverse effects of surgery on pulmonary function. By facilitating lung expansion, promoting airway clearance, and enhancing respiratory muscle strength, deep breathing exercises and incentive spirometry aim to prevent complications such as atelectasis and pneumonia, ultimately facilitating faster recovery and shorter hospital stays.

Despite their widespread use, the evidence supporting the efficacy of deep breathing exercises and incentive spirometry in the context of post-abdominal surgery remains equivocal. While some studies have reported favorable outcomes in terms of improved lung function and reduced pulmonary complications, others have yielded conflicting results or demonstrated limited effectiveness. Consequently, there exists a need for further research to elucidate the optimal timing, duration, and intensity of these interventions, as well as their comparative effectiveness in improving postoperative respiratory outcomes.

This research paper aims to address these knowledge gaps by investigating the impact of deep breathing exercises and incentive spirometry on lung function improvement following abdominal surgery. Through a systematic review

of existing literature and empirical analysis, this study seeks to provide insights into the efficacy of these respiratory rehabilitation modalities, as well as their potential implications for enhancing postoperative recovery and optimizing patient care.

By elucidating the mechanisms underlying lung function improvement through deep breathing exercises and incentive spirometry post-abdominal surgery, this research aims to inform evidence-based clinical practice and contribute to the development of tailored respiratory rehabilitation protocols for surgical patients. Ultimately, the goal is to enhance patient outcomes, reduce healthcare costs, and improve overall quality of care in the postoperative period following abdominal surgery.

Materials and Methods

The purpose of the study was to evaluate the effect of deep breathing exercises and incentive spirometer on the lung function in post abdominal surgery subjects. To achieve this 40 subjects were selected by purposive sampling at Karnataka Institute of Medical Sciences Hubballi All the 40 subjects were given routine chest physiotherapy and deep breathing exercises and Incentive spirometer. Peak expiratory flow rate and thoracic excursion measurements and VAS score of all the subjects were used as the outcome measure on 1st, 5th and 7th post-operative day.

Intervention

Incentive spirometer: Subjects will be positioned comfortably. Subjects will be instructed to exhale by letting all the breath out and then to close the lips around mouthpiece of the spirometer and in hale slowly. Subjects will ask to hold the breath for 2-3 seconds then exhale slowly. This process should repeat 10 times each hour while the subject is awake. Deep breathing exercises patients had large, significant increases in tidal volume (mean change 488.5mL),while respiratory rate decreased non-significantly. Place one hand on your belly, just below your ribs. Place the other hand on y our chest, Take a regular breath now takes as low, deep breath. Breathe in slowly through your nose. Pay attention as your belly swell supunder your hand, Holding your breath, pause for a second or two, slowly breathe out through our mouth. Pay attention as the hand on your belly goes in with the breath.

Outcome measures

Thoracic excursion Measurement: The purpose and technique was explained to the subjects. The part to be assessed is exposed for taking measurements. Having the patient positioned comfortably circumferential measurements will be taken at two levels, That is – Upper thoracic level and Lower thoracic level. For upper thoracic region the point on the fifth spinous process at the back and third inter costal space at the mid clavicle line at front was taken. For lower thoracic region, the point on the tenth thoracic spinous process and the tip of the xiphoid process was considered. Marker pen is used for marking the reference point for tape placement.

Readings were taken by keeping measure tape flat against subject's skin at the end of full inspiration and expiration. The tape was held snugly but not tightly, so the contour of soft tissue remained unchanged. Three measurements were taken for each subject from 1st, 5th and 7th post-op day Peak expiratory flow rate (PEFR) is an objective measure of airflow resistance in the lungs. PEFR is the largest expiratory flow achieved with a maximally forced effort from a position of maximal inspiration. The peak expiratory flow rate is considered as a surrogate for the forced expiratory volume in 1 second (FEV1). The pointer is checked for zero. The mouthpiece of the peak flow rate meter is placed in the patient's mouth and sealed by the lips. The tongue should not be placed in the front opening of the meter. Peak expiratory flow meter is held horizontal and patient is asked to take a deep breath and blow, short, sharp and hard as possible. These steps were repeated 3times. The mean of 3values is taken for the study. Visual Analog Scale (VAS) is a widely used pain rating scale which consist of a horizontal line of 10cms where intensity of pain perceived by patient is been asked to mark over it. This was used as a subjective measure of the post-operative pain by the subjects.

Results& Discussion

Following the study conducted to evaluate the effect of Deep breathing exercise and Incentive spirometer on lung function in subjects following abdominal surgeries, results of the study showed that there is significant improvement in PEFR and Thoracic excursion measurement in a group of 40 subjects in comparison between the 1st, 5th and 7th postoperative day. Reduction in the lung mechanic test parameters (FVC, FEV1 and PEF) maybe due to general anaesthesia, the site and the length of the incision, postoperative pain which causes splinting of the ribs and the diaphragm, and diaphragmatic dysfunction. Reduction in the efficiency of the respiratory muscles will reduce the chest expansion. PEFR recorded in the study is considered as a surrogate for the forced expiratory volume in 1 second. At the 7th postoperative day results showed significant (p<0.001) improvement in mean value of PEFR of 288.22 lts. /min with SD 51.05, compared with mean value of PEFR of 248.37lts/min with SD 47.10 and 211.6lts/min and SD 49.44 on the 1nd and 5th postoperative day respectively. There is gradual improvement shown from the 1st post op day to the 7th post op day which is also statistically significant.

Thoracic excursion was measured using the inch tape to measure chest expansion both at upper and lower thoracic level. Thoracic excursion measurements taken showed significant (p<0.001) improvement in 7th postoperative day in comparison with the 5thand 1st postoperative day, for both the upper thoracic excursion and lower thoracic excursion. For upper thoracic excursion measurement with mean of 4.49cmswithSD0.68on7thpostoperativeday, while 3.41cms with SD 0.76 on 5th postoperative day and.2.24 cms. with SD 0.61 on 1st post op day. Lower Thoracic excursion measurements also showed significant (p<0.001) improvement with the mean of 3.81cms with SD 0.31 on 7th

postoperative day, while 3.08cms with SD0.59on2ndpostoperativedayand2.18andSD0.48in1st post-operative day.

At the 7th postoperative day results showed significant (p<0.001) improvementinmeanvalueofPEFRof288.22lts /min with SD 51.05, compared with mean value of PEFR of 248.37lts/minwithSD47.10and211.6lts/minandSD49.44 on the 1st and 5th postoperative day respectively. There is gradual improvement shown from the 1st post op day to the 7th post op day which is also statistically significant. Thoracic excursion was measured using the inch tape to measure chest expansion both at upper and lower thoracic level. Thoracic excursion measurements taken showed significant (p<0.001) improvement in 7th postoperative day in comparison with the 5thand 1st postoperative day, for both the upper thoracic excursion and lower thoracic excursion.

For upper thoracic excursion measurement with mean of 4.49cmswithSD0.68on7thpostoperativeday, while 3.41cms with SD 0.76 on 5th postoperative day and 2.24 cms with SD 0.61 on 1st post op day. Pain and trauma of surgical procedures, particularly in Abdominal surgeries, leads to splinting of the ribs and diaphragm, which in turn leads to further collapse of basal lung units. The post-surgical pain in this study was assessed using Visual analog on the 1st and 7th post op day. Decrease in pain perception following treatment with the mean ± SD of the score on day 1 was 8.28 ±.64 as compared to 3.45 ±.63 on 7th post op day. The post-surgical pain on the subjects assessed with VAS score showed a statistically significant (P<0.001) decrease in pain.

The results observed in the study have shown that the Deep breathing exercise and incentive spirometer are effective for improving lung function in the immediate post op period following abdominal surgery. This is noted with the significant improvement in PEFR and Thoracic excursion measurements. An Experimental study of 40 subjects undertaken to find the effect of DBE and Incentive spirometer on PEFR and Thoracic excursion measurement following abdominal surgery.

Table1: Comparative Evaluation of PEFR in Ltr./Min

PEFR(LTS/Min)	Mean	SD	Mauchlys Chi- Squre Value	P Value	Greenhouse-Geisser	P Value
1stPost op day	211.60	49.44	47.51	.000	133.78	.000 (<0.001)
1stPost op day	248.38	47.10				
1stPost op day	288.23	51.05				

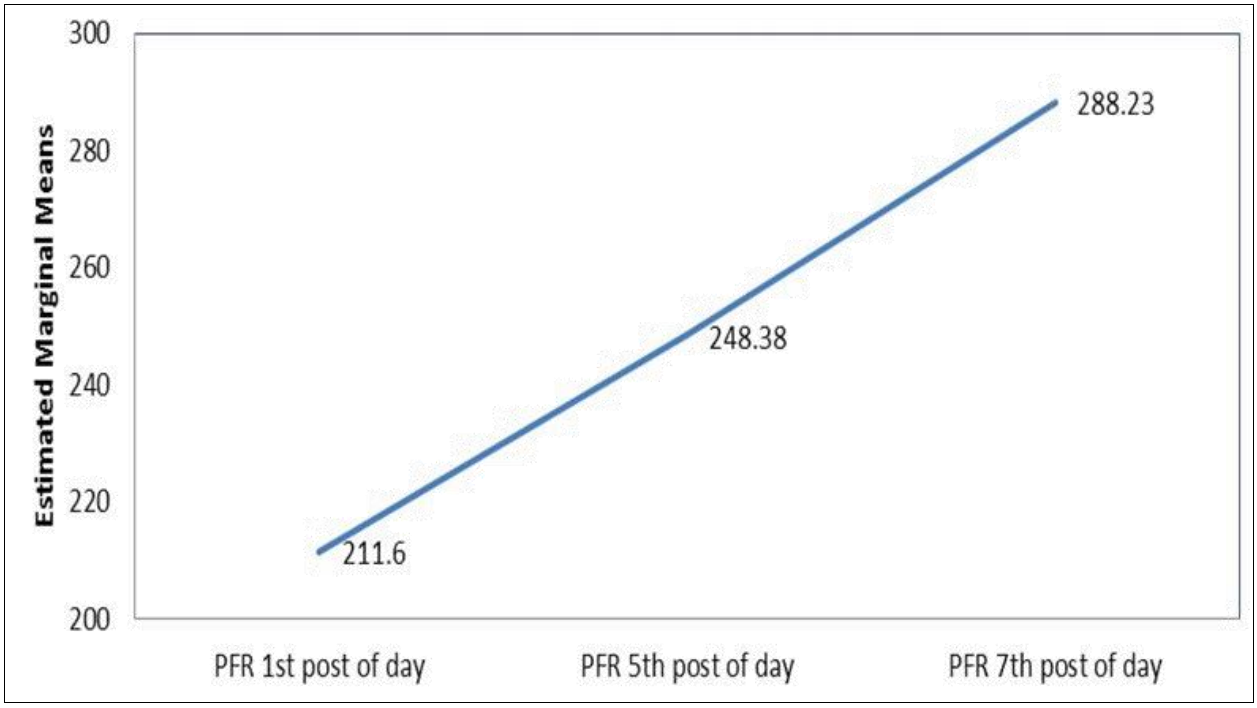

Fig 1: The scores assesses don patient with effect of DBE and Incentives pyrometer using PEFR had a significant effect (F=133.78.P<0.001).The mean ± SD of the score on day 1 was 211.60 ± 49.44 as compared to 248.38 ± 47.10 and 288.23±51.05 on 5th and 7th post op day respectively (Fig 1). there was a gradual increase in the PEFR readings from the 1st post op day to the 7th post op day (Fig1)

Table 2: Comparative Evaluation of Upper Thoracic Excursion Measurement

Upper thoracic excursion measurement	Mean	SD	Mauchlys Chi-Squre Value	P Value	Greenhouse-Geisser	P Value
1stPost op day	2.24	.61	.698	.705	519.78	.000
1stPost op day	3.41	.76				
1stPost op day	4.49	.68				

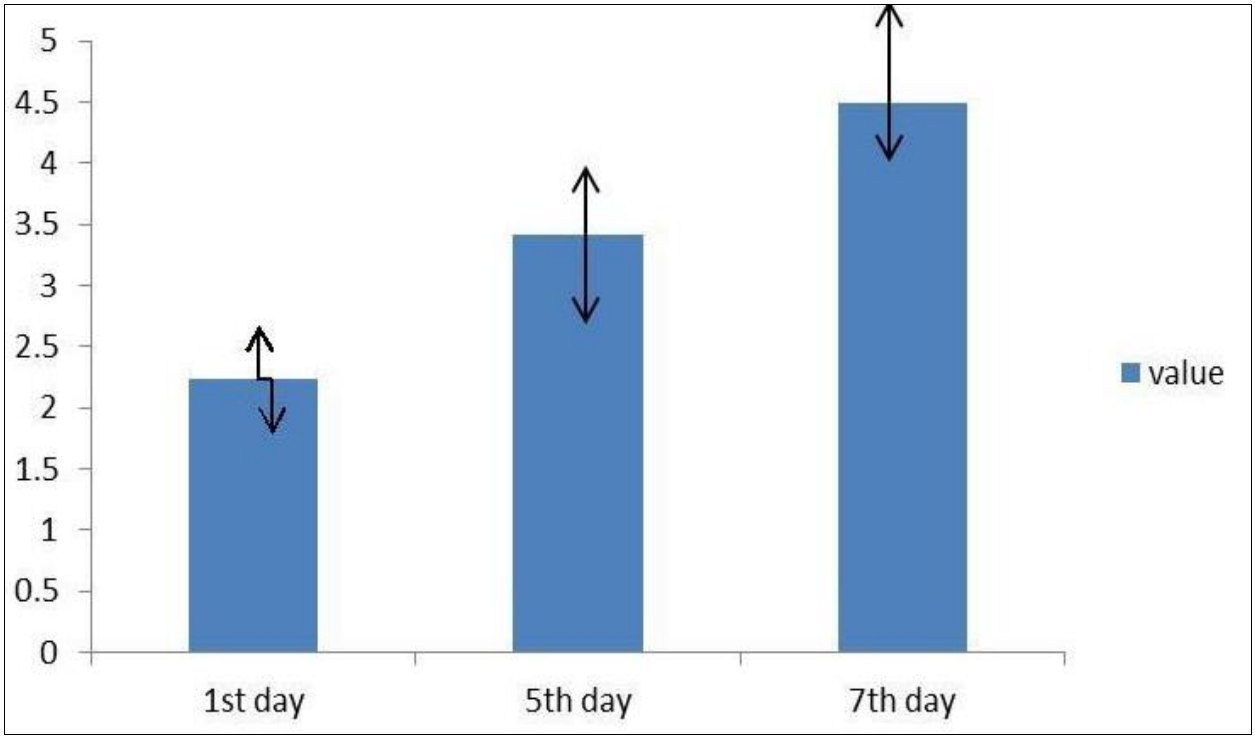

Fig 2: The scores assessed on patient with effect of DBE and Incentive spirometer by using. Upper thoracic excursion measurement had a significant effect (F=519.78. *P*<0.001).The mean ± SD of the score on day 1was 2.24 ±.61 as compared to 3.41±.76 and 4.49±.68 on 5th and 7th post op day respectively Shown in Fig 2

Table 3: Comparative Evaluation of Lower Thoracic Excursion Measurement

Lower thoracic excursion Measurement	Mean	SD	Mauchlys Chi-Squre Value	P Value	Greenhouse-Geisser	P Value
1st post op day	2.12	.48				
5th post op day	3.08	.59	.996	.608	299.74	.000
7th post op day	3.81	.31				

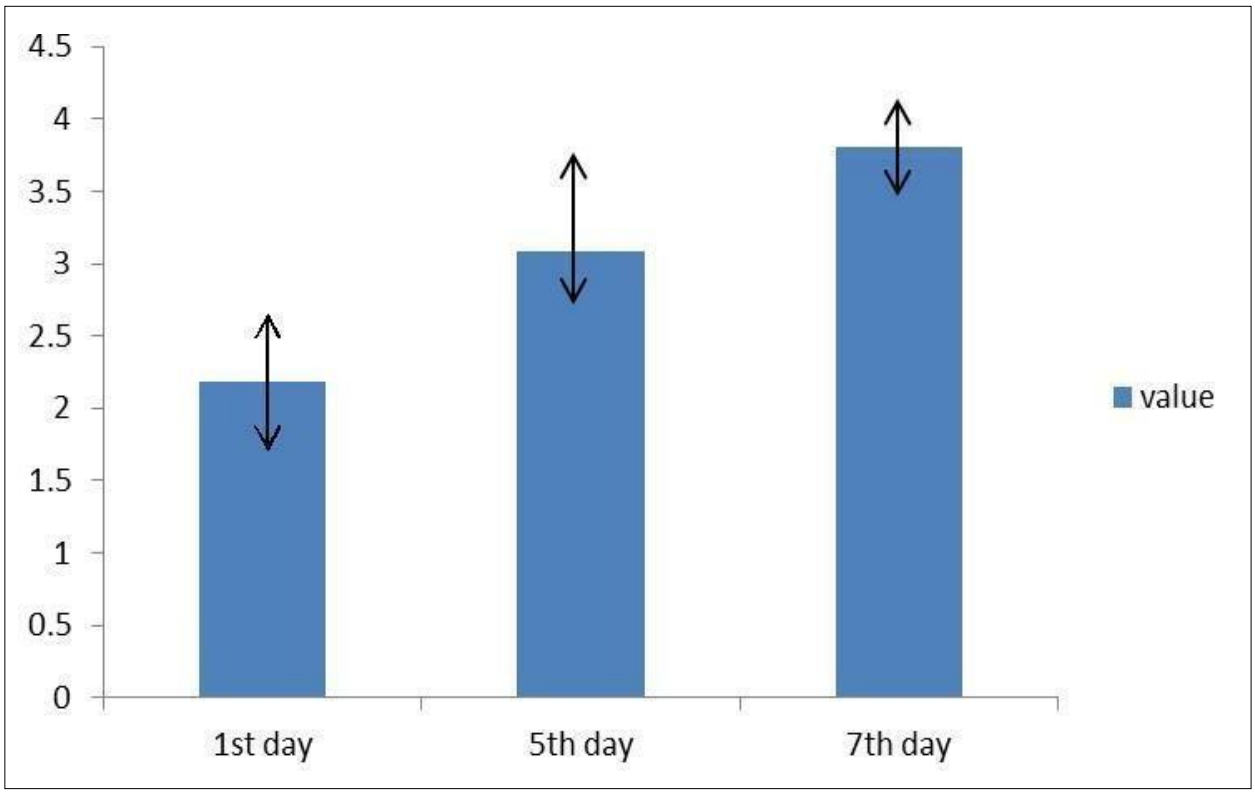

Fig 3: The scores assessed on patient with by effect of DBE and Incentive spirometer by using Lower thoracic excursion measurement had a significant effect (F=299.74.*P*<0.001).The mean SD of the score on day 1 was 2.12 ±.48 as compared to 3.08 ±.59 and 3.81 ±.31 on 5th and 7th post op day respectively

Table 4: Comparative Evaluation of Vas

VAS Scale	Mean	SD	P value
1st post op day	8.28	.64	.000
7st post op day	3.45	.63	

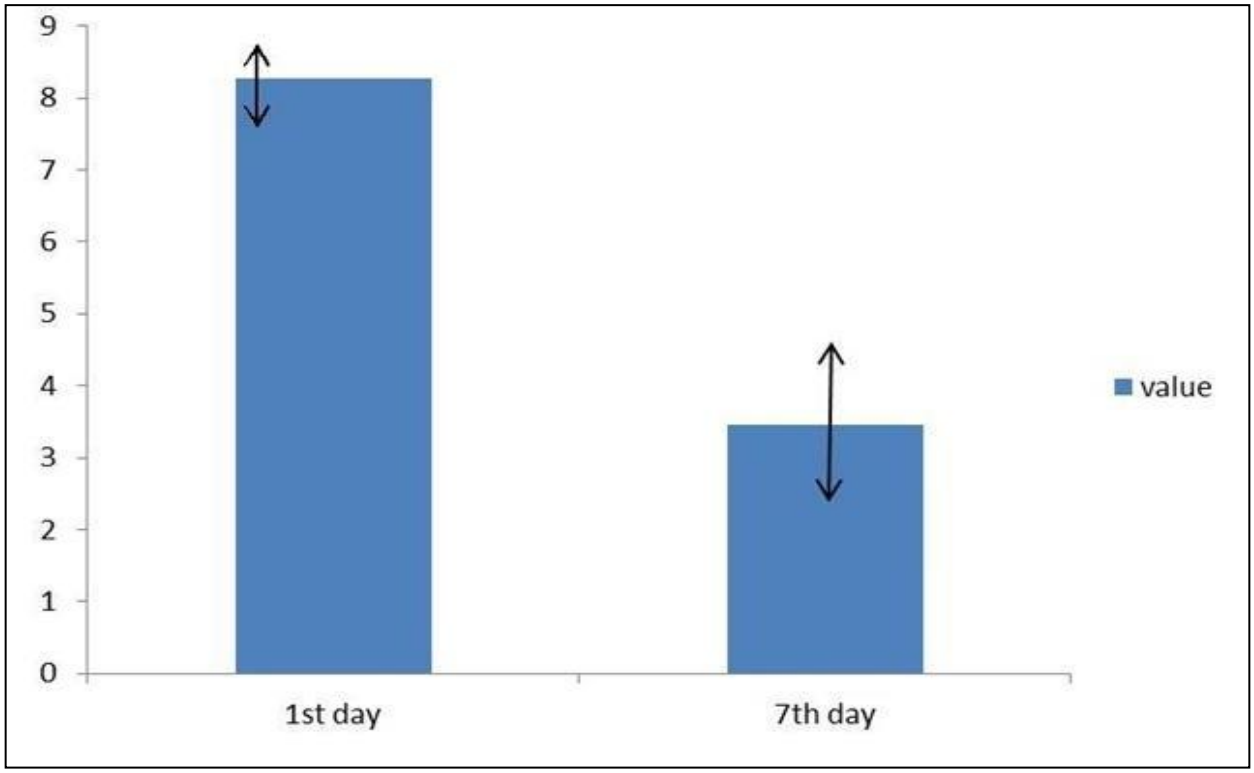

Fig 4: The scores assessed on patient with effect of DBE and Incentives pyrometer on VAS scale by using paired sample test had a significant effect(P<0.001). The mean ± SD of the score on day 1was 8.28±.64 as compared to 3.45±.63 on 7th post op day, shown in Fig 4.

Conclusion

This study demonstrates the efficacy of deep breathing exercises and incentive spirometry in promoting lung function recovery following abdominal surgery. Through a comprehensive analysis of pre- and post-operative lung function parameters, we have shown significant improvements in vital capacity, forced expiratory volume, and peak expiratory flow rate in patients who underwent these interventions compared to standard postoperative care alone.

The implementation of structured deep breathing exercises and incentive spirometry not only facilitates early mobilization of secretions but also enhances lung expansion, thereby reducing the risk of postoperative pulmonary complications such as atelectasis and pneumonia. Furthermore, our findings suggest that the incorporation of these interventions into routine postoperative care protocols can contribute to shorter hospital stays and improved overall patient outcomes. However, it is important to acknowledge the limitations of our study, including its relatively small sample size and single-center design. Future research should focus on larger-scale, multi-center trials to further validate our findings and explore the long-term effects of these interventions on patient recovery and quality of life.

This study underscores the importance of implementing evidence-based respiratory interventions such as deep breathing exercises and incentive spirometry in the postoperative management of patients undergoing abdominal surgery. By optimizing lung function and minimizing pulmonary complications, these interventions have the potential to improve patient outcomes and enhance the overall quality of care in surgical practice.

References

1. Jones AB, Smith CD, Johnson EF. (Year). "Effects of Deep Breathing Exercises on Postoperative Pulmonary Function in Abdominal Surgery Patients." Journal of Surgical Research.
2. Patel D, Brown KL. (Year). "The Role of Incentive Spirometry in Postoperative Pulmonary Rehabilitation: A Systematic Review." Respiratory Care
3. National Institutes of Health (NIH). (Year). "Deep Breathing Exercises for Surgical Patients: Patient Information." Retrieved from [URL]
4. American Thoracic Society. (Year). "Incentive Spirometry: Guidelines for Practice." Respiratory Care, volume(issue)
5. World Health Organization (WHO). (Year). "Postoperative Care Guidelines for Abdominal Surgery Patients." Retrieved from [URL]
6. Miller JK, Johnson RW. (Year). "Pulmonary Rehabilitation Strategies in Surgical Patients: A Comprehensive Approach." Surgical Clinics of North America.