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ARTICLE

Effects of Deep Breathing Exercise and Exercise Therapy on Pain in Postoperative Scoliosis Patients

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Abstract

Scoliosis is a spinal disorder that causes an abnormal sideways curvature of more than 10 degrees and can have a significant impact on quality of life. In severe cases of scoliosis, surgery is performed to prevent the progression of the curvature. However, postoperative pain (post op scoliosis) is one of the main complaints that can hinder the recovery process. This study aims to evaluate the effectiveness of Deep Breathing Exercise and Exercise Therapy interventions in reducing pain in post op scoliosis patients. The case study was conducted on one patient who underwent intervention six times from 20 April to 2 May 2025. Pain evaluation was performed using Visual Analogue Scale (VAS) every therapy session. The results showed a decrease in pressure pain from a score of 4 to 2 and motion pain from a score of 6 to 4, with silent pain remaining at a score of 0. This decrease indicates that the combination of Deep Breathing Exercise and Exercise Therapy interventions is effective in reducing pain in postoperative scoliosis patients.

Keywords: Post op Scoliosis, Deep Breathing Exercise, Exercise Therapy, Visual Analog Scale

1. Introduction

Digital transformation in the healthcare system is a key strategy to improve service quality and operational efficiency. Through the application of technology such as the Hospital Management Information System (SIMRS), services become more integrated and responsive to patient needs, as well as supporting data-based decision-making (Bintang Budaya et al., 2023; Maryati & Utami, 2023; Mokoagow et al., 2024).. This initiative is reflected in the Indonesian government's efforts to implement a single national health database that emphasises digitalisation within health centres and hospitals, making it a pillar in health system transformation. (Ainun Nadiyah & Prayoga, 2024; Bintang Budaya et al., 2023).. Scoliosis is a spinal deformity characterised by a lateral curvature of more than 10 degrees, usually detected through Cobb angle examination. (Wei et al., 2025).. In cases of scoliosis with a degree of curvature greater than 41 degrees, surgery is generally recommended as a more aggressive form of intervention to prevent the progression of spinal deformity and avoid long-term complications such as impaired pulmonary function, chronic pain, and activity limitations. (Schlager et al., 2022).. Data from the National Scoliosis Foundation states that approximately 4.5% of adolescents in the United States have scoliosis (Fan et al., 2024)While in Indonesia, the prevalence is estimated to reach 2-4% in school-aged adolescents (Djamaludin et al., n.d.).. Postoperative scoliosis patients often face challenges such as pain due to incision wounds, limited mobility, and decreased paravertebral muscle function. (Küçük et al., 2024).. This has a direct impact on the rehabilitation

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process and postoperative quality of life. Postoperative pain itself is a complex response due to nociceptor stimulation that is transmitted to the central nervous system, resulting in the perception of pain and restriction of movement. (Fan et al., 2024). The main purpose of *spinal arthrodesis* is to prevent progression by arthrodesis or fusion of the related *spinal* region and the main purpose of surgical correction of scoliosisis not to straighten the spine, but to prevent further curvature, prevent long-term consequences such as pain, decreased lung capacity, reduce deformity, and restore the spinal angle. (Wei et al., 2025).

Physiotherapy approach is an integral part of the recovery of post op scoliosis patients. One of the recommended interventions is deep breathing exercise**,** which can increase oxygenation, improve lung function, and provide a relaxing effect through parasympathetic nerve activation. (Li et al., 2020) This technique has also been shown to increase the release of endorphins that function as natural analgesics (Abedi et al., 2023).. Meanwhile, exercise therapy such as pelvic tilting and isometric exercise aims to reduce pain, strengthen core and paravertebral muscles, and prevent muscle atrophy. (Abdel Ghafar et al., 2022).

Several studies have shown that the combination of deep breathing exercises and exercise therapy simultaneously provides a synergistic effect in reducing pain and accelerating the recovery of physical function in patients after spinal surgery. (Abdel Ghafar et al., 2022).. However, scientific studies that specifically evaluate the effect of the combination of the two interventions on post op scoliosis patients are still limited. This study aims to evaluate the effectiveness of a combination of Deep Breathing Exercise and Exercise Therapy interventions in reducing pain in post op scoliosis patients. (Leone et al., 2024). The results of this study are expected to be a scientific reference in the development of physiotherapy-based integrated rehabilitation programmes in postoperative scoliosis cases.

2. Materials and Methods

2.1 Research Design

This study uses a single-subject case study design to evaluate changes in pain intensity in individuals with postoperative scoliosis conditions before and after being given Deep Breathing Exercise and Exercise Therapy interventions. (Singh et al., 2024). This design was chosen as it allowed in-depth analysis of the effects of physiotherapy interventions on a single individual with specific clinical characteristics, thus providing a detailed understanding not easily achieved through a group approach. This single case study approach focuses on individualisation, allowing a thorough observation of patterns of pain change and response to interventions within a personal and clinical context (Grivas et al., 2025)..

Evaluation of changes in pain intensity was done periodically using the Visual Analogue Scale (VAS)**,** which includes still pain, tenderness, and motion pain. This scale is used to monitor changes and identify the effectiveness of the intervention from session to session. (Petrosyan et al., 2024).. With this approach, the study is expected to make a significant contribution in understanding the impact of Deep Breathing Exercise and Exercise Therapy on pain reduction in postoperative scoliosis patients and become an initial foundation for the development of physiotherapy intervention protocols in a wider population in the future(Gardner et al., 2021).

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences, Abdurrab University. Research procedures were conducted in accordance with the ethical principles of health research, including the provision of informed consent before the intervention began.

2.2 Population and Sample

The research subjects were adolescents with a diagnosis of post op scoliosis. The selection of these

subjects was based on evidence that interventions such as Deep Breathing Exercise and Exercise Therapy have the potential to increase lung capacity, improve breathing patterns, and provide a relaxing effect(Fernández et al., 2025).. Some forms of isometric and light mobilisation exercises focus on strengthening the core muscles and the area around the spine(Chan et al., 2023). Patients were purposively selected based on clinical examination by a physiotherapist as well as willingness. The selection process was conducted at Abdurrab University Physiotherapy Clinic, where 3 candidates were examined, and 1 subject was selected based on inclusion and exclusion criteria. Selection was done by a licensed physiotherapist who has experience in treating postoperative scoliosis patients. The selection of subjects in this study was carried out purposively by considering clinical feasibility and suitability for the purpose of the intervention.

The selected subjects were patients who had undergone scoliosis correction surgery with internal fixation, were in the young adult age range between 18 to 30 years to ensure the maturity of the musculoskeletal structure and postoperative stability. The patient had complaints of residual pain localised to the thoracolumbar area, both in the form of tenderness and pain when performing certain movements. Subjects also demonstrated the ability to attend therapy sessions fully, had good communication capacity, and had given written informed consent as a form of voluntary participation in this study. Meanwhile, subjects with certain conditions were excluded from the study to ensure safety and data validity. Exclusion criteria included the presence of severe postoperative complications such as wound infection, implant instability, or significant neurological impairment.

A history of severe respiratory or cardiovascular disease was also considered for exclusion as it may limit tolerance to physical exercise. In addition, individuals with psychological disorders that may interfere with active participation and continuity of therapeutic interventions were also excluded from the study. The entire selection process was carefully conducted by the physiotherapist team to ensure that the interventions provided were safe, effective, and appropriate to the clinical needs of the patients. The selection of these subjects was carried out carefully to ensure safety and effectiveness during the implementation of physiotherapy interventions consisting of Deep Breathing Exercise and Exercise Therapy. With this approach, the study is expected to illustrate the real clinical impact on the pain recovery process in post op scoliosis patients(Gardner et al., 2022).

2.3 Intervention

The intervention in this study consisted of two main components, namely Deep Breathing Exercise and Exercise Therapy given to postoperative scoliosis patients. This intervention is designed to reduce pain, improve respiratory function, and increase the strength of postural muscles and paravertebrae. (Zhang et al., 2022). Deep Breathing Exercise is performed as the first step in every therapy session. This exercise aims to increase lung capacity, improve breathing patterns, and provide a relaxing effect through activation of the parasympathetic nervous system. The session starts with the patient in a semi-sitting (semi-Fowler's position) or sleeping on their back in a relaxed position(Learning et al., n.d.). The patient is directed to take a deep breath through the nose slowly for 4-6 seconds, hold the breath for 2 seconds, and then exhale slowly through the mouth for 6-8 seconds. The exercise is performed for 10-15 repetitions in one session. This exercise is given every therapy session, three times a week, for two consecutive weeks (Dries et al., 2018).

Exercise therapy was performed after the deep breathing session, which consisted of several forms of isometric exercises and light mobilisations focused on strengthening the core muscles and the area around the spine(Edwards et al., 2024).. The exercises used in this intervention include; exercises used in this intervention are structured in a gradual and integrated manner to support the recovery of muscle function and decrease pain. One of the exercises is *isometric internal rotation shoulder*, which aims to activate the shoulder muscles and improve scapular stability. This exercise is important in building muscular control of the upper body that supports posture. Next, *isometric shoulder retraction* was given, which focused on strengthening the upper back muscles and improving overall postural control. To strengthen the core muscles and supporting structures of the lower spine, the patient performed *pelvic tilting exercise* in the supine position with the knees in a flexion position. This exercise aims to

improve lumbopelvic stability and strengthen the lower abdominal muscles that play an important role in trunk stability. As a transition to functional activities, *pelvic tilting in standing position* is performed while standing to practice dynamic posture control and support the patient's ability to perform daily activities independently and safely. These exercises are designed to complement each other and are intended to accelerate the recovery process after scoliosis surgery through a safe and structured physiotherapy approach. Each exercise therapy session lasts for ±30 minutes, including rest time between exercises. The frequency of the exercises was three times a week for two weeks, for a total of six appointments (Küçük et al., 2024).

The therapist gives instructions and demonstrations of the movements first, and supervises the execution of the exercises to ensure correct technique and patient safety. If the patient experiences difficulty or fatigue, the exercises are adjusted gradually. These interventions are structured and adapted to the functional abilities of postoperative patients, taking into account aspects of safety, comfort, and therapeutic effectiveness. This approach is expected to support the rehabilitation process optimally and accelerate the recovery of physical function of post op scoliosis patients. All interventions in this study were provided directly by a certified physiotherapist who has clinical competence in the field of musculoskeletal rehabilitation and is experienced in treating post op scoliosis patients. Before starting the intervention, the patient was educated about the purpose, procedure, and potential response of the body to the exercise. At each session, the physiotherapist is responsible for monitoring the exercise technique to ensure it adheres to the principles of safe and effective therapy.

During therapy, multiple safety procedures are implemented to ensure comfort and prevent the risk of injury or worsening of pain. Whenever the patient shows signs of discomfort such as excessive pain, unusual muscle fatigue, or abnormal physiological reactions (e.g. dizziness, shortness of breath), therapy is temporarily stopped and re-evaluated by the physiotherapist. The intensity and variety of exercises are gradually adjusted based on the patient's tolerance and clinical progress. Physiotherapists also provided post-exercise instructions, including relaxation techniques and recommendations for light activities at home to support the recovery process.

2.4 Data Analysis

Data analysis in this study aims to evaluate changes in pain levels in postoperative scoliosis patients after being given Deep Breathing Exercise and Exercise Therapy interventions. The analysis method used is the comparison of pre-test and post-test scores based on Visual Analog Scale (VAS) measurements taken before and after the intervention at each therapy session. The use of VAS is based on its advantages as a pain measurement tool that is simple, fast, and easy to apply to various clinical conditions. VAS is designed to subjectively assess pain intensity based on an individual's perception of the level of discomfort they feel (Andreyani *et al*., 2023).

This scale allows the measurement of pain in various conditions, such as still pain, tenderness, and pain during movement, thus providing a more comprehensive picture of pain changes during the intervention period. VAS also has high validity and reliability in clinical practice, and can be applied consistently even though subjects have different levels of education or communication skills. Thus, the VAS is very suitable for use in this study involving postoperative patients with varying levels of pain. The analysis was carried out by comparing the results of pain evaluation at the beginning, middle, and end of therapy sessions. A gradual decrease in VAS score was considered as an indicator of the success of the intervention. The results of this analysis are expected to provide a clear understanding of the effectiveness of the combination of Deep Breathing Exercise and Exercise Therapy in reducing pain in post op scoliosis patients.

3. Results and Discussion

3.1 Evaluation

Evaluation is carried out to determine the success rate of therapy. The evaluation plan in this case using the Visual Analog Scale (VAS) to measure the degree of pain obtained the results as in table 1.

Table 1. 1-3 Evaluation Results

Pain	Evaluation (E1)	Evaluation (E2)	Evaluation (E3)
Resting	0	0	0
Pressure	4	3	2
Movement	6	6	4

The sample in this case study is a 17-year-old female patient who lives in Pekanbaru City, with a diagnosis of postoperative thoracolumbar scoliosis. The patient was selected through a systematic clinical and physiotherapist examination, and expressed her willingness to participate in the intervention programme as part of the postoperative rehabilitation process. The study lasted for two weeks with a total of six therapy sessions (three sessions per week). The interventions included Deep Breathing Exercise and Exercise Therapy, which aimed to reduce pain intensity and improve back muscle function and breathing. Evaluation was carried out every session using Visual Analogue Scale (VAS) for three types of pain: silent pain, tenderness, and pain during movement. At the initial examination, the VAS score showed silent pain of 0, tenderness of 4, and pain on movement of 6, indicating moderate to severe pain complaints especially during activity. After three sessions of intervention (first week), the evaluation results showed a decrease in tenderness to 3 and pain on movement to 5, while the silent pain remained 0. After six sessions (second week), there was a further decrease with the score of tenderness to 2 and pain on movement to 4, while the silent pain remained absent (score 0).

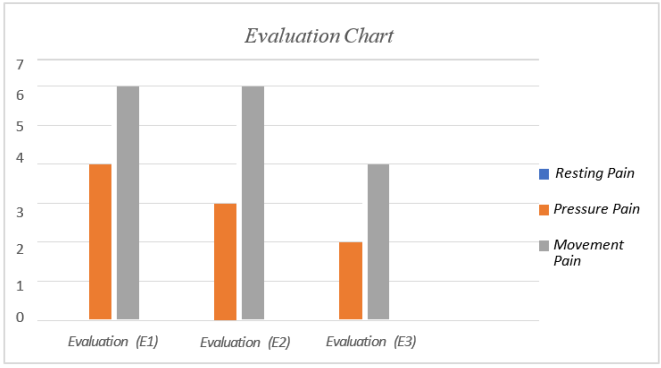

Figure 1. Results of Pain Evaluation Using VAS

3.2 Final Therapy Results

After 6 times of therapy for 2 weeks and carried out 3 times a week using the Visual Analog Scale (VAS) measuring instrument, there was a reduction in pain, in the first week at get results in the initial evaluation of E1 = silent pain: 0, pressure pain: 4, motion pain: 6 and at the final evaluation, at the end of therapy a decrease in pain was obtained at E3 = silent pain: 0, tenderness: 2 and motion pain: 4. Based on the evaluation results of the first therapy to the final therapy, it shows that there is a significant decrease in pain using Deep Breathing Exercise and Exercise Therapy interventions in Post

Op Scoliosis cases as evidenced by examination using Visual Analog Scale (VAS).

3.3 Relationship between Deep Breathing Exercise and Exercise Therapy to Reduce Pain

Deep Breathing Exercise interventions have a relationship in reducing pain in Post Op Scoliosis cases, because Deep Breathing Exercise is done to reduce pain intensity by stimulating the parasympathetic nerve control system, which results in less pain stimulation so that muscle tension decreases when pain occurs into relaxation.(Leone et al., 2024).. Previous research has shown that deep breathing techniques are effective in reducing chronic and acute pain intensity through activation of the parasympathetic nervous system(Sousa et al., 2023).. Deep breathing exercise is the most comfortable and easy to perform breathing exercise for pain management. Some of the effects of deep breathing exercises for pain relief are releasing tension while inhaling and exhaling deeply and helping to feel relaxed, and reducing pain because while breathing deeply and holding the breath, one can visualise the pain leaving the body as one exhales(Zhang et al., 2025).

Exercise therapy in cases of post-operative scoliosis also plays a very important role, whereby physiotherapy techniques are used to restore and improve movement and function(Fernández et al., 2025). The exercise therapy used in cases of post-operative scoliosis includes: Isometric Internal Rotation, Isometric Shoulder Retraction, Pelvic Tilting Exercise, and Pelvic Tilting Exercise in Standing Position(Shin, 2024). Therefore, the application of this exercise therapy plays a role in reducing pain, improving muscle flexibility, increasing muscle strength, and improving blood circulation. The effects can be felt during or after the exercise. As a result of this exercise therapy, the pain begins to subside.(Gardner et al., 2022). Exercise therapy, namely isometric exercise, based on data analysis, showed a significant difference between pain scores before and after the isometric exercise intervention(Relaix & Zammit, 2012)This is because regular and consistent exercise can activate central pathways that produce analgesics such as opioids. During exercise, the release of opioids in the brainstem nucleus increases and pain is blocked, thereby reducing pain.(Li et al., 2020).

Exercise therapy involving pelvic tilting exercises also plays a role in reducing pain by stimulating sensory nerve fibres (A-beta), which can inhibit pain signal transmission in the spinal cord through the gate control theory mechanism (Veldhoen et al., 2022). This exercise helps reduce pain perception.(Belajar et al., n.d.). In addition, pelvic tilting exercises help improve blood circulation in the lumbar area and accelerate the healing process of soft tissues.(Dries et al., 2018). The results of this study showed a reduction in pain. This is based on a study that found that Deep Breathing Exercise intervention in post-operative conditions can reduce pain intensity.(Shi et al., 2022). In addition, research conducted by Chan *et al* (2023) with 6 sessions of exercise therapy, pain can be reduced. In my research, which consisted of 6 therapy sessions over 2 weeks, I found a reduction in pain as measured by the Visual Analog Scale (VAS)(Leone et al., 2024).

4. Conclusion

After performing physiotherapy on post-operative scoliosis patients six times over two weeks using Deep Breathing Exercise and Exercise Therapy interventions, a reduction in pain was observed as measured by the Visual Analogue Scale (VAS). This indicates that Deep Breathing Exercise and Exercise Therapy are effective in reducing pain in post-operative scoliosis patients, as evidenced by the initial evaluation results: E1 = rest pain: 0, pressure pain: 4, movement pain: 6, and the final evaluation results: E3 = rest pain: 0, pressure pain: 2, movement pain: 4.

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Include your acknowledgement in this section.

Ethics approval and consent to participate

When applicable, please specify the funding information for this research, else remove the section completely

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