Majalah Ilmiah Fisioterapi Indonesia
Indonesian Scientific Journal of Physiotherapy

Case Reports
ISSN (Print): 2303-1921
ISSN (Online): 2722-0443
Volume 14, Number 1, Pages 186-190 (2026)
DOI: https://doi.org/10.24843/mifi.000001231

Physiotherapy Management After Posterior Stabilization in Thoracic Scoliosis: A Case Report

Firza Alisa Salsabilah[1], Irianto[2], Bustaman Wahab[3]

[1,2]Universitas Hasanuddin, Makassar, South Sulawesi, Indonesia
[3]Dr. Wahidin Sudirohusodo General Hospital, Makassar, South Sulawesi, Indonesia

Corresponding author:
Name: Firza Alisa Salsabilah
E-mail: firzaalisasalsabilah@gmail.com
Phone: +62 822-5070-7997

Received 16 January 2026; Revised 20 January 2026; Accepted 20 January 2026; Published 26 January 2026

Abstract

Introduction: Scoliosis is an abnormal curvature of the spine that may lead to back pain, restricted mobility, and respiratory impairment. In severe thoracic scoliosis, surgical correction with posterior vertebral stabilization is commonly performed; however, postoperative pain and functional limitations often require structured physiotherapy to optimize recovery.

Objective: To describe the effects of multimodal physiotherapy on pain, trunk range of motion, dyspnea, and activities of daily living in a patient with thoracic scoliosis following posterior vertebral stabilization surgery.

Methods: This case report was conducted at Dr. Wahidin Sudirohusodo Hospital, Makassar, in November 2024. The patient was a 23-year-old woman with thoracic scoliosis who underwent posterior vertebral stabilization surgery in August 2024. Postoperative assessment revealed pain (VAS 6/10), limited trunk range of motion, dyspnea, and impaired activities of daily living. The physiotherapy program consisted of cryotherapy, interferential current, muscle release techniques, and exercise therapy administered over three treatment sessions.

Results: Following the intervention, pain decreased to 0/10 at rest, 3/10 on palpation, and 2/10 during movement. Trunk range of motion improved from S.15°–0°–40° to S.20°–0°–45°. Dyspnea grade improved from grade 3 to grade 1, and activities of daily living scores increased from 70 to 85.

Conclusion: Multimodal physiotherapy was effective in accelerating postoperative functional recovery by reducing pain, improving trunk mobility, decreasing dyspnea, and enhancing activities of daily living in a patient with thoracic scoliosis following posterior vertebral stabilization.

Keywords
Scoliosis; Spinal stabilization; Postoperative rehabilitation; Physical therapy modalities; Thoracic spine

Introduction

Poor posture in daily activities, such as prolonged sitting, carrying a bag on one shoulder, or standing with uneven weight distribution, can disrupt body biomechanics and, over time, lead to back pain or structural deformities. One such deformity is scoliosis, defined as a three-dimensional spinal curvature with a Cobb angle greater than 10°, accompanied by vertebral rotation. This condition may result in postural abnormalities, musculoskeletal pain, restricted mobility, and respiratory impairment, ultimately affecting quality of life.[1]

Idiopathic scoliosis is the most common type, with a prevalence of 2–4% in the general population and occurring more frequently in females than in males (ratio 2:1).[2] This deformity induces both physiological and mechanical changes, including muscle imbalance, which contributes to muscle tension, postural disturbances, reduced flexibility, pain, and, in severe cases, respiratory dysfunction.[3] While mild scoliosis may cause postural asymmetry and mild discomfort, severe scoliosis can progress to chronic pain, fatigue, pulmonary restriction due to lung compression, and psychological distress, all of which significantly impair quality of life.[4]

A large spinal curvature can alter thoracic shape and position, reducing lung capacity due to parenchymal compression and altered respiratory mechanics, particularly when the Cobb angle exceeds 45°. This frequently leads to dyspnea during physical activity.[5] In addition, incomplete correction of curvature and vertebral rotation exacerbates muscle imbalance, forcing muscles to function asymmetrically, thereby increasing tension and fatigue.[6]

Medical management of scoliosis includes observation, bracing, and corrective surgery, with surgical intervention aimed at halting progression and restoring alignment.[7] However, patients often experience new postoperative challenges such as pain, reduced range of motion (ROM), and muscle weakness due to altered biomechanics. At this stage, postoperative physiotherapy plays a pivotal role in rehabilitation by reducing pain, improving muscle strength, enhancing ROM, and supporting psychological recovery.[8] Specifically, physiotherapy following posterior spinal stabilization is essential to facilitate recovery and improve overall quality of life.

Based on this background, the present case report aims to describe physiotherapy management in a patient with thoracic scoliosis following posterior vertebral stabilization at Dr. Wahidin Sudirohusodo Hospital, Makassar. This report is of particular significance given the limited published evidence on postoperative scoliosis physiotherapy in Indonesia. The case is unique in that it involves a young adult with severe thoracic scoliosis who underwent posterior stabilization surgery and exhibited a rapid recovery response following multimodal physiotherapy. Prior to surgery, the patient complained of mid-back pain, exertional dyspnea, and restricted thoracic mobility. Postoperatively, she continued to experience moderate pain (VAS 6/10), limited trunk ROM, and mild dyspnea.

Methods

This study is a case report involving a 23-year-old female patient diagnosed with thoracic scoliosis following posterior stabilization surgery. The subject was purposively selected based on this diagnosis. Primary data were obtained through auto-anamnesis, allo-anamnesis, and a general examination including patient condition and vital signs. Physical assessment comprised inspection, palpation, basic movement function tests, and specific examinations. Case analysis included a description of the patient's condition, clinical findings, physiotherapy interventions, and treatment outcomes. Quantitative assessment was derived from pre- and post-intervention scores using standardized instruments, while qualitative assessment was based on clinical observation, patient-reported symptoms, and postural changes. The findings are presented descriptively in accordance with the characteristics of a case report. Interventions and evaluations were carried out at Dr. Wahidin Sudirohusodo Hospital, Makassar, in November 2024.

The patient, who had a history of scoliosis since high school, experienced low back pain, fatigue, and dyspnea. Due to the severity of the spinal curvature, she underwent posterior vertebral stabilization on 26 August 2024. Postoperatively, she continued to report low back pain and was referred to physiotherapy. The initial physiotherapy assessment was conducted in November 2024, corresponding to the 12th postoperative week. During the first week of therapy (sessions 1–3), the patient received cryotherapy, interferential current (IFC), muscle release, and exercise therapy. After the third session, she demonstrated clinical improvements including reduced pain, increased range of motion (ROM), decreased dyspnea, and improved performance in activities of daily living (ADL).

The primary challenge was limited mobility due to pain and high postural muscle stiffness, which hindered active exercise. Clinical reasoning guided the selection of multimodal interventions to reduce pain, enhance circulation, and gradually improve motor control. The patient's prognosis was considered favorable given her young age and high motivation to participate in the program.

The outcome measures included: the Visual Analog Scale (VAS; 0 = no pain, 10 = worst pain) to assess pain intensity; a goniometer to measure thoracic flexion, extension, and rotation ROM; the Borg Scale (0 = no dyspnea, 10 = maximal dyspnea) to assess respiratory difficulty; and the Barthel Index (0–100, with higher scores indicating greater independence) to evaluate ADL.

Interventions consisted of cryotherapy for 15 minutes using a cold pack on the thoracic region to reduce inflammation and pain; IFC for 20 minutes at a frequency of 80–150 Hz for pain management; muscle release techniques applied for 10 minutes to the right thoracic paraspinal and intercostal muscles; and exercise therapy comprising trunk stretching, diaphragmatic breathing, and core strengthening exercises, each performed for 3 sets of 10 repetitions. This program was delivered three times per week, without modification during the initial three sessions.

The therapeutic goals were divided into short-term and long-term objectives. The short-term goals were to reduce pain, decrease muscle tightness, improve thoracic ROM, and lessen dyspnea. The long-term goal was to enhance the patient's functional activity level and overall quality of life.

Results

A 23-year-old female patient, referred to as Nn. ANW, presented to the physiotherapy outpatient clinic with complaints of postoperative incision pain and back discomfort. The patient had a history of scoliosis first suspected during the first year of high school, characterized by visible trunk asymmetry and shoulder height discrepancy. Early symptoms included shoulder pain, low back pain, fatigue, and recurrent dyspnea.

Medical evaluation revealed a significant spinal curvature, and due to the severity, corrective surgery was recommended. On 26 August 2024, the patient underwent posterior stabilization surgery with posterior instrumentation extending cranially to CV T3 and caudally to CV L4.

Postoperative physical examination indicated stable condition and satisfactory recovery. Vital signs were as follows: blood pressure 120/78 mmHg, pulse 89 bpm, respiratory rate 20 breaths/min, and body temperature 37°C. The patient was able to ambulate with parental assistance while wearing a spinal brace. Physical findings included limited trunk mobility, a surgical incision scar along the spine, and difficulty sleeping in the prone position.

Palpation revealed tenderness and muscle spasm in the erector spinae, latissimus dorsi, quadratus lumborum, and upper trapezius. Basic movement assessment showed restricted range of motion (ROM), and isometric testing against resistance (TIMT) could not yet be performed. Pain assessment demonstrated mild resting pain (VAS 2), moderate movement-related pain (VAS 4), and moderate tenderness upon palpation (VAS 5). ROM testing of the trunk yielded the following: extension/flexion S.15°–0°–40°, lateral flexion right/left F.30°–0°–30°, and rotation right/left R.45°–0°–45°. Dyspnea was scored as 3 on the Borg scale (moderate), while ADL evaluation using the Barthel Index indicated moderate dependency.

Physiotherapy problems were categorized as follows: primary—pain; secondary—muscle tightness in the erector spinae, latissimus dorsi, quadratus lumborum, and upper trapezius, limited ROM, and dyspnea; and complex—ADL limitations including toileting, self-care, dressing, praying, and work-related activities. Interventions were structured according to the FITT principle (frequency, intensity, technique, time). The physiotherapy interventions administered to address postoperative pain, muscle tightness, dyspnea, and postural impairment are summarized in Table 1, including the specific modalities applied and their respective dosage parameters across treatment sessions.

Table 1. Physiotherapy Interventions

No.	Physiotherapy Problem	FT Modality	Dosage
1	Pain	Cryotherapy	F: 3 min/area; I: Level 5; T: Local, 10 cm above trunk skin; SS: 6 min
		Interferential Current (IFC)	F: 90 Hz; I: 35 mA; T: Co-planar (back muscles); Time: 15 min
2	Muscle tightness	Manual therapy	F: 3–5 repetitions; I: 60% pressure; T: Muscle release and friction on erector spinae, latissimus dorsi, quadratus lumborum, upper trapezius; Time: 10 min
		Exercise therapy	F: 15 counts; I: 3 repetitions; T: Stretching; Time: 5 min
3	Dyspnea	Breathing exercise	F: 8 repetitions; I: 2–3 sets; T: Diaphragmatic breathing; Time: 5 min
4	Postural correction	Exercise therapy	F: 6 repetitions; I: 3–5 sets; T: Bridging exercise; Time: 5 min
		Exercise therapy	F: 6 repetitions; I: 3–5 sets; T: Bugnet exercise; Time: 5 min

Source: Primary Data (2024)

Interventions were delivered in three sessions over two weeks, with each session adapted to the patient's evolving symptoms and functional status. A follow-up assessment one week after the final session indicated stable condition, absence of increased pain or stiffness, and improved ability to perform light activities independently. Changes in pain intensity, trunk range of

motion, dyspnea severity, and activities of daily living before and after the physiotherapy intervention are presented in Table 2, as measured using standardized clinical assessment instruments.

Table 2. Physiotherapy Outcomes

No.	Problem	Instrument	Pre	Post	Remarks
1	Pain	VAS	Rest: 2; Palpation: 5; Movement: 4	Rest: 0; Palpation: 3; Movement: 2	Clinically significant reduction
2	Limited ROM	Goniometer	S.15°–0°–40°; F.30°–0°–30°; R.45°–0°–45°	S.20°–0°–45°; F.30°–0°–30°; R.45°–0°–45°	Clinically significant improvement
3	Dyspnea	Borg Scale	3 (moderate)	1 (very mild)	Clinically significant reduction
4	ADL limitation	Barthel Index	70 (moderate dependency)	85 (mild dependency)	Clinically significant improvement

Source: Primary Data (2024)

The patient demonstrated high adherence to both clinical sessions and prescribed home exercises. Intervention outcomes indicated meaningful improvements both quantitatively and clinically. Pain reduction (VAS) reflected effective pain control, increased ROM signified improved trunk mobility, a lower Borg score indicated enhanced activity tolerance, and higher Barthel Index scores reflected greater independence in ADL. No significant adverse effects were reported during or after therapy, aside from mild soreness after the first session, which resolved within 24 hours.

These findings highlight that a multimodal physiotherapy approach combining electrotherapy, manual therapy, and exercise produced positive clinical outcomes in a relatively short period for a patient recovering from posterior vertebral stabilization surgery.

Discussion

In each treatment session, a reduction in pain was observed, as measured by the Visual Analog Scale (VAS). Resting pain decreased from pre-intervention (VAS 2) to post-intervention (VAS 0), palpation-related pain decreased from pre (VAS 5) to post (VAS 3), and movement-related pain decreased from pre (VAS 4) to post (VAS 2). However, the patient occasionally reported pain during specific movements, though these episodes were infrequent. This residual discomfort is likely attributable to biomechanical changes following spinal fusion, which render certain spinal segments rigid. This rigidity increases biomechanical load on adjacent segments, predisposing to pain and discomfort. Moreover, tissue healing processes and soft tissue irritation or tension around the stabilized spine may contribute to postoperative pain.[9]

The application of cryotherapy effectively alleviates pain, irritation, and discomfort, while improving tolerance to rehabilitation activities. Cryotherapy reduces local blood flow through vasoconstriction, thereby decreasing inflammatory reactions and edema formation. These physiological effects facilitate improvements in range of motion (ROM) and mobility, which are critical in scoliosis postoperative recovery.[10] Our findings align with those of Iwakiri et al., who reported that cryotherapy following total hip arthroplasty not only reduced swelling and improved patient satisfaction but also contributed to faster mobility recovery, despite no significant difference in pain scores.[11]

Interferential current (IFC) electrotherapy may also reduce pain by activating non-nociceptive sensory nerves, thereby inhibiting transmission cell activity and closing the pain gate to the brain. Evidence indicates that IFC is more effective than placebo in reducing pain, particularly when combined with other therapeutic modalities.[12] Centrally, IFC modulates pain by influencing neuropeptide release in the brain, which plays a role in pain transmission and perception. In addition, IFC enhances local blood flow and tissue oxygenation, supporting healing processes.[13] This is consistent with the study by Menezes et al., who demonstrated that gradual adjustment of IFC intensity—maintaining stimulation at a “strong but comfortable” level—resulted in significant hypoalgesic effects, including increased sensory and pressure pain thresholds, and a reduction of up to four points on the numeric pain scale.[14]

Biomechanical alterations following spinal fusion lead to rigidity in certain segments, compelling surrounding muscles to compensate in order to maintain stability and posture. In scoliosis, muscles on the concave side of the curvature tend to shorten and tighten due to excessive contraction, while those on the convex side elongate and weaken. This imbalance induces asymmetric muscle tension and may trigger spasms or stiffness.[15] Manual muscle release helps reduce muscle tension associated with metabolic and hormonal factors (e.g., hypothyroidism, hypoparathyroidism) and alleviates postoperative muscle spasms.[16] Stretching further decreases stiffness, enhances flexibility, improves ROM, and restores muscle balance around the spine. By lengthening shortened muscles and reducing spasms, stretching reduces spinal loading. Additionally, stretching improves blood flow, decreases inflammation, and enhances posture, thus supporting recovery and preventing further stiffness.[17] These findings are comparable with Attia et al., who reported that manual pressure release (MPR) was significantly more effective in reducing pain and improving cervical ROM in patients with myofascial pain syndrome following neck dissection surgery. MPR, being non-invasive and safe, also reduces dependence on analgesics and promotes functional recovery, thereby improving quality of life.[18]

Dyspnea in scoliosis patients, particularly after posterior vertebral stabilization, is associated with thoracic wall deformity and impaired pulmonary function. Such deformity reduces vital lung capacity and increases respiratory effort, while mechanical changes decrease lung compliance.[19] Breathing exercises improve lung capacity and ventilation efficiency, which are often compromised by spinal deformity and postoperative pain. These exercises also alleviate muscle tension and enhance airflow distribution, crucial for preventing postoperative respiratory complications.[20] Diaphragmatic breathing, in particular, aims to maximize diaphragmatic function, which is frequently impaired by abnormal spinal positioning.[21] Our results are consistent with findings by David et al., who demonstrated that breathing exercises improved lung capacity, reduced muscle tension and pain, enhanced posture, and improved quality of life in scoliosis patients. This underscores the role of breathing exercises not only in respiratory physiology but also in musculoskeletal rehabilitation and overall well-being.

Following scoliosis surgery, patients frequently experience muscle weakness and limited joint ROM, which restrict their ability to perform daily activities. Bridging exercises, as a form of core stabilization training, improve muscle coordination, endurance, and postural control, thereby enhancing spinal stability and functional recovery. These exercises also preserve spinal flexibility and mobility, reducing stiffness and discomfort.[22] Bugnet exercises, a physiotherapeutic approach in scoliosis management, are designed to strengthen spinal support musculature, improve postural control, and enhance both muscle strength and flexibility. These benefits help prevent postoperative complications such as back pain or muscular tension.[23] Similar results were reported by Yagci and Yakut, who found that core stabilization exercises in adolescents with idiopathic scoliosis improved curve angle, trunk rotation, and postural symmetry, while also reducing pain. Their study highlighted that strengthening core musculature not only enhances spinal stability but also improves function, posture, and quality of life.[24]

The strength of this study lies in the application of a multimodal physiotherapy program combining electrotherapy, manual therapy, breathing exercises, and postural training, all individualized to address the patient's primary and secondary postoperative problems simultaneously. Nevertheless, limitations include the short treatment duration (three sessions over two weeks), which restricts evaluation of long-term outcomes. Furthermore, this report represents a single case study; thus, generalizability is limited and future research with larger cohorts is necessary. Pulmonary function evaluation was also limited, as it relied solely on the Borg scale without objective spirometric measures.

This report reinforces the importance of a multimodal rehabilitation approach in scoliosis postoperative management. Physiotherapy should not only address pain but also target muscle stiffness, ROM limitations, and respiratory dysfunction. These findings emphasize that integrated, individualized rehabilitation programs can accelerate functional recovery and improve quality of life in postoperative scoliosis patients.

Conclusion

After three sessions of physiotherapy, the patient with post-operative scoliosis following posterior vertebral stabilization still presented with pain, muscle tightness in the back and shoulder muscles, and limited range of motion (ROM). However, significant improvements were observed in terms of pain reduction, increased ROM, decreased shortness of breath, and enhanced performance of activities of daily living (ADL). This case demonstrates that multimodal interventions—including electrotherapy such as cryotherapy and interferential current, in combination with muscle release techniques and exercise therapy—were effective in accelerating recovery in a patient with post-operative scoliosis treated with posterior stabilization.

For optimal recovery, the patient is advised to continue the prescribed exercise program in order to achieve long-term improvement and an enhanced quality of life. The limitations of this case report include the relatively short duration of physiotherapy sessions, which does not allow for the evaluation of long-term outcomes, its nature as a single case study that limits generalizability, and restricted pulmonary function assessment, as only the Borg scale was used without more objective measurements. Future studies are recommended to employ longer intervention periods, involve larger sample sizes, and utilize more comprehensive pulmonary function assessments to generate stronger and more clinically applicable evidence.

Author Contribution

Firza Alisa Salsabilah: Conceptualization, Investigation, Data curation, Formal analysis, Writing – original draft.
Irianto: Methodology, Supervision, Writing – review & editing.
Bustaman Wahab: Clinical supervision, Validation, Writing – review & editing.
All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

Acknowledgments

The author would like to express deepest gratitude to Dr. Wahidin Sudirohusodo General Hospital, Makassar; academic supervisors Mr. Irianto, S.Ft., Physio, M.Kes, and Mr. Bustaman Wahab, S.Ft., Physio, M.Kes; as well as the Faculty of Nursing, Universitas Hasanuddin—particularly the Physiotherapy Study Program—for their invaluable support, guidance, and direction throughout the implementation and preparation of this article. The author also extends sincere appreciation to the patient who willingly provided written informed consent for the use of clinical data and the publication of this case report, while maintaining confidentiality of personal identity. The patient reported that after undergoing the physiotherapy program, pain was reduced, daily activities became easier to perform, and confidence in engaging in activities improved.

Conflict of Interest Statement

The authors declare that there is no conflict of interest related to this case report.

Funding Sources

This case report did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethics Statement

This case report was conducted in accordance with ethical principles for research involving human participants. Ethical clearance was obtained from the Ethics Committee of RSUP Dr. Wahidin Sudirohusodo, Makassar. Written informed consent was obtained from the patient for participation in this case report and for the publication of clinical data. Patient anonymity and confidentiality were strictly maintained.

References

1. Artha IGLNA, Ridia KGM, Suyasa IK, Arimbawa IBG, Wiguna IGNI, Kuswara LW. Severe-rigid scoliosis treated by two-staged procedures: a case series. *Eur J Med Health Sci*. 2023;5(1):10–15.
2. Gardner A, Berryman F, Sur H, Pynsent P. The variability in location of the most prominent points on the posterior torso of those without abnormal surface topography, those with adolescent idiopathic scoliosis and those with Scheuermann's kyphosis: a seven-year longitudinal analysis. *J Anat*. 2021;238(5):1244–54.
3. Maharathi S, Iyengar R, Chandrasekhar P. Biomechanically designed curve specific corrective exercise for adolescent idiopathic scoliosis gives significant outcomes in an adult: a case report. *Front Rehabil Sci*. 2023;4:1127222.
4. Syabariyah S, Anesti R, Alfin R. Kemaknaan lengkung kurvatura dan rib hump pada skrining risiko skoliosis. *Bulet Ilm Kebidanan Keperawatan*. 2022;1(2):53–62.
5. Ahmed KT, Hamed AM, El Hawary Y, El-Nahas NG, Helmy AM, Abouelenein MH. Effects of concave thoracoplasty on chest circumference and ventilatory function in adolescence with idiopathic scoliosis. *Physiother Quart*. 2024;32(4):29–34.
6. Zhang X, Lv J, Li X, Lin B, Huang Y, Lin Y, et al. Immediate effects of the Schroth method on spinal curvature and paravertebral muscle activation in adolescent idiopathic scoliosis. *Orthop Surg*. 2025;[volume?]:[pages not available].
7. He JT, Liu FY, Hu WM, Liu JJ, Xia B, Niu XQ, et al. Comparison of the curative efficacy of hemivertebra resection via the posterior approach assisted with unilateral and bilateral internal fixation in the treatment of congenital scoliosis. *Front Surg*. 2022;9:821387.
8. Naufal AF, Hastuti N. Physiotherapy intervention in improving the quality of life of scoliosis individuals: case study. In: *Graduate ISETH (International Summit on Science, Technology, and Humanity)*; 2023. p. 1319–35.

9. Zhang Y, Li C, Li L, Sun Y, Li Z, Mei Y, et al. Design a novel integrated screw for minimally invasive atlantoaxial anterior transarticular screw fixation: a finite element analysis. *J Orthop Surg Res*. 2020;15(1):244.
10. Kwiecien SY, McHugh MP. The cold truth: the role of cryotherapy in the treatment of injury and recovery from exercise. *Eur J Appl Physiol*. 2021;121(8):2125–42.
11. Iwakiri K, Kobayashi A, Takeuchi Y, Kimura Y, Ohta Y, Nakamura H. Efficacy of continuous local cryotherapy following total hip arthroplasty. *SICOT-J*. 2019;5:[pages not available].
12. Shetty PB, Balasaravanan R, Ravish V, BN PK. Study on short term effect of modified lumbar snags with conventional program in non-specific chronic low back pain patients. *Int J Physiother Res*. 2020;8(5):3639–47.
13. Theologou S, Trevlaki E, Trevlakis E. Effectiveness of interferential current for the treatment of chronic low back pain. *Eur J Med Health Sci*. 2022;4(6):113–8.
14. Menezes MA, Mendonça Araújo F, Lima LV, Souza TAS, Carvalho EAN, Melo DeSantana J. Interferential current intensity influences the hypoalgesic response in healthy subjects under mechanically-induced pain: a randomized controlled trial. *Physiother Theory Pract*. 2023;39(10):2087–98.
15. Wang Y, Wang S, Gu M, Xu J, Huang X, Xie L. Paraspinal muscles activities in S-shaped adolescent idiopathic scoliosis during physiotherapeutic scoliosis specific exercise: a case–control study. *BMC Musculoskelet Disord*. 2025;26(1):167.
16. Das R, Jhajharia B. Fascia and myofascial pain syndrome-an overview. *Asian Pac J Health Sci*. 2022;9(4):228–32.
17. Luo CL, Wu HD, Beygi BH, Liu S, Zou YY, Shang LJ, et al. The effect of stretching exercises before orthotic treatment on the immediate in-orthosis correction of patients with adolescent idiopathic scoliosis: a pilot study. *Prosthet Orthot Int*. 2025;49(3):314–20.
18. Attia AMM, Aboelnour NH, Sherif RA, Saafaan KI. Effect of manual pressure release and scapular stabilization exercises on myofascial pain syndrome following neck dissection surgery. *Egypt J Hosp Med*. 2022;89(1):4668–75.
19. Amăricăi E, Suciu O, Onofrei RR, Miclăuș RS, Iacob RE, Caţan L, et al. Respiratory function, functional capacity, and physical activity behaviours in children and adolescents with scoliosis. *J Int Med Res*. 2020;48(4):[pages not available].
20. Jasiewicz B, Rożek K, Kurzeja P, Daszkiewicz E, Ogrodzka-Ciechanowicz K. The influence of surgical correction of idiopathic scoliosis on the function of respiratory muscles. *J Clin Med*. 2022;11(5):1305.
21. Raipure A, Kumbhare R, Walke RR. An advanced comprehensive physiotherapy management for empyema thoracis and scoliosis: a case report. *Cureus*. 2022;14(10):[pages not available].
22. Moubarak EES, Aly SM, Seyam MK, El-Hakim AM, Abdulrahman RS, Awad A. Efficacy of core stabilization versus active self-correction exercises in the treatment of adolescents with idiopathic scoliosis. *Curr Pediatr Res*. 2022;26(5):1371.
23. Fan Y, Ren Q, To MKT, Cheung JPY. Effectiveness of scoliosis-specific exercises for alleviating adolescent idiopathic scoliosis: a systematic review. *BMC Musculoskelet Disord*. 2020;21(1):495.
24. Yagci G, Yakut Y. Core stabilization exercises versus scoliosis-specific exercises in moderate idiopathic scoliosis treatment. *Prosthet Orthot Int*. 2019;43(3):301–8.