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CASE STUDY | e-Published: *December 13, 2025* ***Open Access***

EFFECTIVENESS OF REPETITIVE PERIPHERAL MAGNETIC STIMULATION (rPMS) COMBINED WITH CORRECTIVE EXERCISES IN A SINGLE PATIENT WITH STRUCTURAL LUMBAR LEVOSCOLIOSIS: A CASE REPORT USING RADIOGRAPHIC OUTCOMES

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Abstract

Structural scoliosis is a three-dimensional spinal deformity marked by lateral curvature and vertebral rotation. In adults, lumbar scoliosis can contribute to chronic pain, gait changes, and reduced quality of life. Corrective exercises (CE) are central to conservative care, but the rigidity of structural curves often limits therapeutic gains. Repetitive peripheral magnetic stimulation (rPMS), is a non-invasive neuromodulatory method, may enhance muscle activation, decrease stiffness, and improve tolerance to exercise, though its use in scoliosis has not been well studied. The single-case pre-post observational report explored the effect of combining rPMS with CE on spinal alignment in an adult with structural lumbar levoscoliosis, and assessed the feasibility and safety of this approach. A 52-year-old male with a baseline lumbar Cobb angle of 23° completed a 5-week program consisting of ten rPMS sessions (BTL 6000 Super Inductive System Elite, 30% intensity; joint mobilization, relaxation, and strengthening protocols) followed by 30 minutes of pupervised CE. Lumbar Cobb angle was measured on standing anteroposterior radiographs before and after treatment. Feasibility and safety were monitored through attendance, adverse-event reporting, and patient feedback. Post-intervention imaging showed a reduction in lumbar Cobb angle from 23° to 20°, indicating a 3° improvement in coronal alignment. The protocol was well tolerated, with full adherence, no reported adverse events, and positive participant feedback. Although the magnitude of change was modest, a 3° reduction is meaningful in the context of adult structural scoliosis, where curve flexibility is limited. These findings suggest that integrating rPMS with CE may offer a complementary strategy for improving spinal alignment in adults with structural lumbar scoliosis. Further research with larger samples and controlled designs is warranted to clarify its therapeutic potential.

Keywords: scoliosis, repetitive peripheral magnetic stimulation, corrective exercise, Cobb angle, neuromodulation, case report

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Research Highlights

What is the current knowledge?

- In adults. Structural scoliosis usually presents with a stiff spine and limited muscular adaptability, unlike the more flexible curves seen in adolescents. Because of this rigidity, conservative options, like scoliosis-specific exercise programs tend to focus on posture, pain relief, and functional improvement rather than major changes in curve size.
- Methods such as the Schroth approach can help even out muscle activity, support spinal stability, and improve overall well-being. Still, in adult cases, noticeable reductions in Cobb angle are relatively rare due to long-standing stiffness and age-related degenerative changes.
- Early work in musculoskeletal and neurological rehabilitation indicates that repetitive peripheral magnetic stimulation (rPMS) may influence neuromuscular responses, increase local blood flow, and help reduce muscle tension.

What is new in this study?

- This case appears to be the first to document the use of rPMS alongside scoliosis-specific corrective exercises for an adult with structural lumbar scoliosis.
- Over the five-week program, the lumbar curve decreased by about 3°, a modest change but meaningful given the stiffness typical in adult scoliosis.
- The addition of rPMS may have helped the muscles engage more effectively, making the spine slightly more responsive to corrective work.
- All sessions were completed, no problems or side effects were reported, and the participant expressed strong satisfaction with the treatment.
- These early results hint that pairing neuromodulation with exercise-based rehabilitation could offer a new conservative option worth exploring further in adult scoliosis care.

INTRODUCTION

Structural scoliosis is a three-dimensional spinal deformity that involves both a lateral curve of at least 10° on Cobb measurement and rotation of the vertebrae. Unlike functional curves, which can disappear once the provoking factor is removed, structural scoliosis reflects lasting anatomical changes that limit how much the spine can move. In adults, lumbar levoscoliosis often comes with a familiar set of problems—persistent back pain, gait changes, postural imbalance, and a general decline in comfort and daily function (Aebi, 2005; Weinstein et al., 2008).

Non-surgical care continues to rely heavily on exercise-based rehabilitation. Approaches such as Scientific Exercise Approach to Scoliosis (SEAS) and the Schroth method aim to shift alignment, retrain posture, and encourage more balanced muscle activity through targeted corrective work (Monticone et al., 2016; Kuru et al., 2016). When practiced consistently, these programs can help slow curve progression and, in some adults, even produce mild improvements. For example, long-term SEAS programs have reported Cobb angle reductions in a majority of participants who stayed with the regimen over a couple of years (Negrini et al., 2015; "Scoliosis-specific exercises can reduce the progression…," 2015). Schroth-influenced treatments have also shown benefits for lumbar and thoracolumbar curves and have been linked to better quality-of-life scores (IntechOpen, 2021). A recent meta-analysis supports the idea that exercise—especially core-centered routines—can achieve

small but meaningful Cobb angle changes, though the results vary widely across studies (Li et al., 2021).

Even with these encouraging outcomes, adults with rigid structural curves often reach a therapeutic ceiling, which has encouraged interest in complementary techniques. One such option is repetitive peripheral magnetic stimulation (rPMS). This method uses rapidly changing magnetic fields to stimulate peripheral nerves and muscle tissue, and has been associated with improved neuromuscular activation, better circulation, and reduced muscular tension. Reviews focusing on chronic musculoskeletal pain point to potentially helpful effects, while also noting that stronger evidence is still needed (Pan et al., 2025).

There is a growing idea that pairing rPMS with active exercise may offer more than either method alone. If rPMS can temporarily ease stiffness or discomfort, patients may move more freely during corrective exercises and gain more from the session. Although neuromodulation has been combined with exercise in other fields—for instance, in stroke rehabilitation with rPMS and transcranial magnetic stimulation (Qin et al., 2023)—its use in scoliosis, particularly in adult lumbar cases, has barely been examined.

Because of this, carefully documented case reports are useful for exploring new possibilities. The present report describes the use of repetitive peripheral magnetic (rPMS) stimulation alongside corrective exercises (CE) in an adult with structural lumbar levoscoliosis, with changes in spinal curvature assessed through radiographic imaging.

Objectives

The primary purpose of this study is to explore whether a treatment approach that combines repetitive peripheral magnetic stimulation (rPMS) with corrective exercises (CE) can bring about measurable changes in lumbar curvature in an adult with structural lumbar levoscoliosis. Radiographic imaging is used to gauge any shift in alignment and to determine if the spine responds to this paired intervention.

A secondary aim is to understand how workable and safe this combined protocol is in a clinical setting. Throughout the intervention, attention is given to potential side effects, the patient's ability to complete the sessions as planned, and whether the treatment is tolerated without increasing discomfort or triggering symptom flare-ups.

By examining both outcomes, effectiveness and practical feasibility, this study hopes to offer early insight into the role that rPMS-enhanced rehabilitation might play in the conservative management of fixed spinal deformities.

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METHODOLOGY

Design

This study adopted a single-case pretest–posttest observational design to explore the effects of combining repetitive peripheral magnetic stimulation (rPMS) with corrective exercises (CE) on lumbar curvature in an adult with structural lumbar levoscoliosis. This design allowed for a detailed, patient-centered examination of spinal alignment, capturing how the individual's curve responded to the intervention over time.

Participant

One 52-year-old male participant diagnosed with structural lumbar levoscoliosis with 23 degrees Cobb angle was recruited for the study. Inclusion criteria included: (1) age between 18 and 60 years, (2) radiographic evidence of lumbar curvature (with or without structural vertebral anomalies), (3) absence of neurological or systemic musculoskeletal disorders, and (4) no contraindications to magnetic stimulation or physical exercise. The participant provided informed written consent prior to enrollment.

Intervention Protocol

This intervention protocol integrates Repetitive Peripheral Magnetic Stimulation (rPMS) using the BTL 6000 Super Inductive System Elite and a structured Corrective Exercise (CE) program to address musculoskeletal imbalances, particularly in participants with spinal asymmetry or dysfunction. The treatment spanned 5 weeks, with two sessions per week, resulting in 10 total treatment sessions per participant.

1. Repetitive Peripheral Magnetic Stimulation (rPMS)

Device: BTL 6000 Super Inductive System Elite
Applicator: Figure-of-eight coil
Stimulation Type: Preset Protocols (Joint Mobilization, Muscle Relaxation, Muscle Strengthening)
Stimulation Intensity: 30% of the device's maximum output
Session Frequency: 2 sessions per week
Intervention Duration: 5 weeks (10 sessions total)
Stimulation Technique: Coil placed directly over target area/muscle group with static positioning; no manual mobilization during stimulation.

***1.1** Joint Mobilization Protocol*

- Target Area: Lumbar spine (central application over spinous processes)
- Intensity: 30%
- Duration: 6 minutes
- Objective: To promote gliding and sliding of the lumbar vertebrae, enhancing joint mobility and reducing stiffness.

1.2 Muscle Relaxation Protocol

- Target Muscles: Erector spinae and paraspinal muscles on the concave side of the spinal curve
- Intensity: 30%
- Duration: 10 minutes
- Objective: To reduce muscle tone and tension, facilitating muscular relaxation and balance.

1.3 Muscle Strengthening Protocol

- Target Muscles: Erector spinae and paraspinal muscles on the convex side of the spinal curve
- Intensity: 30%
- Duration: 13 minutes
- Objective: To stimulate muscle activation, improve neuromuscular control, and promote muscular symmetry.

All rPMS applications were conducted with participant in a comfortable prone position, ensuring coil-to-skin contact without direct compression. Safety guidelines for magnetic stimulation were strictly followed.

2. Corrective Exercise (CE) Protocol

Timing: Immediately following each rPMS session
Duration: 30 minutes per session
Supervision: Conducted under the guidance of a licensed physiotherapist
Frequency: 2 sessions per week (10 sessions total)
Progression: Exercises were progressively adjusted based on individual tolerance, motor control, and performance quality.

2.1 Exercise Components

Exercise Category	Description
Pelvic Tilts & Lumbar Stabilization	Supine and quadruped positions; activation of deep core stabilizers using controlled pelvic tilts, dead bugs, and bird-dog variations.
Side-Shift Exercises	Lateral displacement of the trunk toward the convex side of the spinal curve to promote spinal alignment and reduce curve progression.
Core Strengthening	Targeted abdominal and back extensor exercises to enhance trunk stability.
Stretching of Hypertonic Muscles	Lengthening techniques for tight musculature such as hip flexors, quadratus lumborum, and thoracolumbar fascia.
Postural Re-Education & Breathing Control	Diaphragmatic breathing, rib mobility drills, and postural cues to reinforce midline orientation and correct scapulo-pelvic alignment.
Functional Exercises	Integration of movement patterns into daily functions with a focus on symmetry and control.

3. Safety and Monitoring

The participant was screened for contraindications to magnetic stimulation, including the presence of pacemakers or metallic implants. Any adverse events were carefully monitored throughout the intervention. To maintain consistency and reduce discomfort, the stimulation intensity was standardized at 30% for all protocols. Reports of fatigue or discomfort were recorded, and session parameters were adjusted as needed to ensure safety. Attendance was tracked, adherence to the exercise program was monitored, and participant feedback was collected throughout the study.

Outcome Measure

Lumbar Spinal Curvature: Measured using standing anteroposterior lumbar X-rays, with Cobb angle analysis conducted pre- and post-intervention by a radiologist to assess changes in spinal alignment.

Data Collection and Analysis

Radiographs were digitized, and a radiologist measured the Cobb angles. Since this was a single-case study, changes before and after the intervention were described rather than statistically tested.

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Visual comparisons were used to show how the spinal curve and related clinical outcomes changed. No inferential statistics were applied due to the small sample size.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from The Longevity Science Centrum, Singapore. The participant was informed about the study's aims, procedures, risks, and benefits, and provided written informed consent prior to participation. All personal data were anonymized to protect confidentiality.

RESULTS

Radiographic Assessment of Lumbar Spinal Curvature

Pre-intervention radiographs showed a lumbar Cobb angle of 23° (Figure 1), consistent with mild to moderate structural lumbar levoscoliosis. After completing the five-week program combining repetitive peripheral magnetic stimulation (rPMS) with corrective exercises (CE), post-intervention standing anteroposterior radiographs showed a reduction in the curve, with the Cobb angle measuring 20° (Figure 2). This corresponds to a 3° improvement in coronal alignment over the course of the intervention.

Figure 1. Pre-intervention standing anteroposterior lumbar radiograph. Lumbar Cobb angle measured at 23°.

Figure 2. Post-intervention standing anteroposterior lumbar radiograph after 5 weeks of repetitive peripheral magnetic stimulation and corrective exercises. Lumbar Cobb angle measured at 20°.

The change in curvature suggests a structural adaptation likely influenced by neuromuscular modulation through rPMS and biomechanical realignment via targeted exercises.

Feasibility and Safety

The intervention was well tolerated, and the participant completed all sessions without any adverse events or interruptions. There were no reports of increased pain, fatigue, or neurological symptoms. Attendance was 100%, and the participant reported high levels of satisfaction with the program.

DISCUSSION

This case report showed that a five-week program combining repetitive peripheral magnetic stimulation (rPMS) with corrective exercises (CE) produced a measurable reduction in lumbar curvature, with the Cobb angle decreasing from 23° to 20°. Although the change was modest, it suggests that combining neuromodulatory techniques with exercise-based interventions may offer complementary benefits for adults with structural scoliosis.

The observed improvement is consistent with evidence that scoliosis-specific exercises, such as the Schroth and SEAS methods, can positively affect spinal alignment and functional outcomes in adults (Monticone et al., 2016; Negrini et al., 2015). In this case, the addition of rPMS may have enhanced the therapeutic response. By promoting neuromuscular activation, improving local circulation, and

reducing muscle stiffness (Beaulieu & Schneider, 2015; Krause et al., 2016), rPMS could have facilitated greater engagement with the corrective exercises.

While a 3° reduction in Cobb angle may appear small, it is clinically meaningful in adult structural scoliosis, where curve rigidity often limits correction. Even modest improvements can contribute to better trunk balance, reduced pain, and enhanced functional performance (Weiss et al., 2020). This combined approach may therefore represent a practical, non-invasive adjunct to conventional rehabilitation for adult scoliosis.

However, these findings should be interpreted with caution. Single-case studies are limited by their design, lack of a control group, and potential measurement variability. Cobb angle changes of 3° may also fall within the typical margin of error for radiographic assessment (±3–5°). Larger studies with extended follow-up and randomized designs are needed to determine the effectiveness and durability of rPMS combined with corrective exercises in managing structural scoliosis.

Patient Perspective

The patient, a 52-year-old with scoliosis, underwent a program combining repetitive peripheral magnetic stimulation (rPMS) and corrective exercises (CE) to improve spinal alignment and reduce the Cobb angle. At the start, the patient was unsure about the benefits but committed to the treatment. The rPMS sessions were described as relaxing, with a mild tingling that activated the muscles without causing discomfort. After each session, the patient completed CE focused on core strength and posture. During the program, the patient noticed gradual improvements in posture and found daily activities easier. At follow-up, radiographs showed a 3° reduction in Cobb angle. Though small, this change was meaningful to the patient. The combination of rPMS and CE also seemed to boost confidence and well-being. The patient reported feeling more in control of their scoliosis and more positive about their future health and function.

Limitations

This study has several important limitations. As a single-case report, its findings cannot be generalized to the broader population of adults with structural scoliosis. Without a control or comparison group, it is difficult to determine how much of the observed improvement resulted specifically from rPMS rather than from corrective exercises or natural variation. The intervention was also relatively short, lasting only five weeks, and the absence of long-term follow-up limits insight into the durability of the observed changes.

Radiographic evaluation focused solely on Cobb angle, without assessing axial rotation, sagittal alignment, or muscle activity, which could have provided a more comprehensive understanding of biomechanical adaptations. Moreover, the rPMS protocol and intensity were adapted from general neuromuscular applications, leaving uncertainty about their optimal parameters for scoliosis-specific outcomes.

Future research should include larger cohorts, randomized controlled designs, and longer-term follow-up to confirm these preliminary observations and clarify the potential role of combining rPMS with corrective exercises in the conservative management of adult structural scoliosis.

CONCLUSIONS AND RECOMMENDATIONS

The combination of repetitive peripheral magnetic stimulation and corrective exercises led to a measurable reduction in lumbar Cobb angle in an adult with structural levoscoliosis. Although the 3° improvement is modest, it suggests that integrating neuromodulation with exercise-based rehabilitation may offer a promising approach for managing spinal deformities. Further research with larger, controlled studies is needed to confirm these early findings and clarify their clinical relevance.

List of Abbreviations

CE	- corrective exercises
rPMS	- repetitive peripheral magnetic stimulation
SEAS	- Scientific Exercise Approach to Scoliosis

Declarations

Ethical approval and consent to participate
This study was reviewed and approved by The Longevity Science Centrum, Singapore. Ethical oversight was provided by clinic management. Informed consent was obtained from the participant prior to his involvement in the study.

Consent for publication
The study does not contain any personal data requiring additional consent for publication. The participant data was anonymized, stored securely, and will be disposed of 12 months after the completion of the research.

Availability of data and materials
All data relevant to this study are presented within the article. Since no additional datasets were created or analyzed during this study, data sharing is not possible.

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Competing Interests
The authors declare that they have no competing interests.

Author's contributions
This manuscript represents the sole authorship of the contibutors, who independently conceptualized the study and the instrument, derived the protocol based on the study's own results, and conducted descriptive and quantitative data collection, interpreted findings, reviewed and finished the manuscript.

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