

Physiotherapy Management of Scoliosis Using Infrared, TENS, and Klapp Exercise: A Case Report

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Abstract

Background: Scoliosis may be accompanied by pain, restricted spinal mobility, and impaired function. Evidence on the combined use of infrared (IR), transcutaneous electrical nerve stimulation (TENS), and Klapp Exercise in an individual case remains limited.

Objective: To describe changes in clinical outcomes following a four-session physiotherapy program combining IR, TENS, and Klapp Exercise in a patient with scoliosis.

Methods: This case report involved a 12-year-old boy with scoliosis and a Cobb angle of 50°. He received four physiotherapy sessions at the Medical Rehabilitation Unit of Muhammadiyah Lamongan Hospital. Outcomes were assessed from T1 to T4 using the Visual Analog Scale (VAS), trunk range of motion, a scoliometer, Cobb angle, leg length discrepancy (LLD), and the Scoliosis Research Society-22 (SRS-22).

Results: Resting pain decreased from 2/10 to 0/10, tenderness from 7/10 to 5/10, and movement-related pain from 5/10 to 3/10. Trunk flexion increased from 65° to 85°, extension from 20° to 30°, and lateral flexion from 25° to 30°. The total SRS-22 score increased from 51 to 63. Scoliometer findings remained 5°, Cobb angle remained 50°, and LLD remained 1.5 cm.

Conclusion: In this case, four sessions of combined IR, TENS, and Klapp Exercise were associated with improvement in pain, trunk mobility, and SRS-22 score, whereas structural measures did not change during the observed treatment period.

Keywords

Scoliosis; Transcutaneous Electric Nerve Stimulation; Exercise Therapy; Physical Therapy Modalities; Quality of Life.

Introduction

Scoliosis is a three dimensional spinal deformity characterized by lateral curvature of more than 10 degrees measured by the Cobb method, accompanied by vertebral rotation and alterations in sagittal alignment.^{1,2} The condition is clinically relevant because spinal asymmetry can influence trunk mechanics, postural balance, movement patterns, and the distribution of loads across the musculoskeletal system.³ As the deformity progresses, some patients may experience back pain, reduced spinal flexibility, paraspinal muscle imbalance, limitations in daily activities, and, in more severe cases, respiratory impairment and reduced health related quality of life.^{1,2} Scoliosis is therefore not defined only by a radiographic angle. Its clinical consequences may involve symptoms, movement, body image, and participation, which supports the use of multidimensional assessment in rehabilitation.

Scoliosis may be described according to structural characteristics and curve configuration. Structural scoliosis involves a relatively fixed curvature with vertebral rotation, whereas nonstructural or functional curvature may be associated with postural factors, muscle spasm, or other potentially reversible contributors. A C curve has one principal curve, whereas an S configuration involves two curves that may function as compensatory patterns.^{1,3} The most frequently discussed form during adolescence is adolescent idiopathic scoliosis, which occurs without an identified specific cause and is generally recognized during the period of growth.¹ The original manuscript also identifies adolescent idiopathic scoliosis as the most common type and cites an estimated prevalence of approximately 2% to 3% among adolescents.¹

The clinical significance of scoliosis extends beyond the structural curve itself. Patients may seek rehabilitation because of pain, perceived asymmetry, movement restriction, or difficulty performing activities that require sustained or repeated trunk movement. These concerns are relevant even when a short treatment period is unlikely to alter a structural radiographic measure. Conservative management therefore commonly includes assessment of symptoms, spinal mobility, posture, and function in addition to monitoring the curve.⁴ For the present case, the available clinical record documented back pain, shoulder, waist, and lower limb asymmetry, a right sided rib prominence during the Adam Forward Bend Test, restricted trunk movement, and a Cobb angle of 50 degrees. These findings provided the clinical context for a multimodal physiotherapy program.

Exercise based management is an important component of conservative care for scoliosis. Current evidence summarized in the supplied manuscript includes scoliosis specific exercise approaches intended to address trunk control, spinal mobility, muscle balance, function, and health related quality of life.^{4,5} The reported effects of exercise, however, depend on the characteristics of the patient, the exercise content, treatment duration, adherence, and the outcomes being evaluated. A short series of supervised sessions may reasonably document changes in symptoms or movement, but it does not provide the same information as a longer program designed to observe structural progression or sustained functional outcomes. This distinction is important when interpreting a single case because improvement in one clinical domain does not necessarily imply change in every outcome.

Evidence supporting conservative management of scoliosis has increasingly emphasized exercise based approaches, yet the specific evidence base represented in the supplied reference set is stronger for general or scoliosis specific exercise than for the exact combination of infrared therapy, transcutaneous electrical nerve stimulation, and Klapp Exercise used in this case.^{4,5} The feedback document also identified the need for a higher proportion of recent literature and more specific evidence regarding Klapp Exercise and transcutaneous electrical nerve stimulation. Because the present finalization is restricted to the available manuscript data and reference set, claims that require additional contemporary evidence are not expanded beyond what the sources support.

Where a stronger external citation is needed for a general statement: it is marked with \$ rather than supplied as an unverified reference.

Reports describing combined physiotherapy programs in individual patients can still be useful when the intervention, patient characteristics, outcome measures, and temporal sequence are documented transparently. A case report does not establish efficacy or causal effects, but it can describe the clinical course observed during treatment.⁶ In the present case, serial data were available for pain measured with the Visual Analog Scale, trunk range of motion measured with a goniometer, scoliosis related measures obtained with a scoliometer and Cobb angle, leg length discrepancy, and the Scoliosis Research Society 22 questionnaire. The availability of repeated observations from T1 to T4 allows the direction and magnitude of recorded changes to be described without converting the findings into inferential evidence.

Accordingly, the objective of this case report was to describe the clinical outcomes observed in a 12 year old boy with scoliosis who received four physiotherapy sessions combining infrared therapy, transcutaneous electrical nerve stimulation, and Klapp Exercise at the Medical Rehabilitation Unit of Muhammadiyah Lamongan Hospital. The report focused on pain, trunk range of motion, SRS 22 scores, scoliometer findings, Cobb angle, and leg length discrepancy across four treatment sessions. No hypothesis of treatment efficacy was tested, and no causal conclusion was intended.

Methods

This report used a single patient case report design. The patient received care at the Medical Rehabilitation Unit of Muhammadiyah Lamongan Hospital. The source manuscript did not report calendar dates, a formal recruitment period, eligibility screening procedures, sample size determination, or a sampling method. The available record identifies one patient who underwent four physiotherapy sessions.

The patient was a 12 year old boy with a medical diagnosis of scoliosis based on radiographic examination documenting a Cobb angle of 50 degrees. The history available in the manuscript indicated that spinal asymmetry and the complaint had been present since approximately 9 years of age. The curve was described as a right sided C curve, with the documented symptomatic region at T3 to T5. Pain increased during heavy activity, particularly when the patient carried a relatively heavy bag. Information regarding comorbidities, other medical history, previous physiotherapy or other treatment, a detailed radiographic description, and the criteria used to establish a more specific etiological diagnosis was not available in the source documents. These data are therefore reported as unavailable rather than inferred.

Before intervention, subjective and objective examinations were documented. Postural inspection identified lateral spinal deviation, shoulder asymmetry, and waistline asymmetry. Static observation also described a prominence in the right T3 to T5 region, shoulder asymmetry while sitting, back asymmetry while standing, and visible spinal curvature. During dynamic observation, shoulder asymmetry was noted while walking and the gait pattern was described as abnormal. Palpation identified tenderness at T3 to T5, and spasm was documented in the rhomboid muscle. The Adam Forward Bend Test was positive, with a right sided rib hump and a clinical description consistent with a right C curve. Baseline findings formed the reference point for subsequent comparison.

Pain was assessed with the Visual Analog Scale.⁷ The original record reported three pain conditions: resting pain, tenderness, and movement related pain. Baseline values were 2 of 10 for resting pain, 7 of 10 for tenderness, and 5 of 10 for movement related pain. Trunk range of motion was measured using a goniometer.⁸ The baseline recording format was extension to neutral to flexion of 20 degrees to 0 degrees to 65 degrees, lateral flexion of 20 degrees to 0 degrees to 25 degrees, and rotation of 45 degrees to 0 degrees to 45 degrees. For descriptive comparison, the flexion and extension components were also reported separately when calculating absolute change.

Scoliosis related measurements included a scoliometer reading and a radiographic Cobb angle.^{1,9} The baseline scoliometer value was 5 degrees and the Cobb angle was 50 degrees. Leg length discrepancy was recorded as 1.5 cm and was assessed as part of the clinical examination using the approach described in the source manuscript.¹⁰ Functional and health related status was evaluated with the Scoliosis Research Society 22 questionnaire, with a baseline total score of 51. Evaluation and measurement were reported as being performed by a physiotherapist, but assessor consistency across sessions was not established.

The intervention consisted of infrared therapy, transcutaneous electrical nerve stimulation, and Klapp Exercise delivered as a combined physiotherapy program. Infrared therapy was administered with the patient in the prone position. The irradiation area included the thoracolumbar or paraspinal region. The infrared lamp was positioned approximately 35 to 50 cm from the skin surface and applied for 10 minutes. Thermal intensity was adjusted according to the patient's perception of comfortable warmth without a burning sensation. The recorded purposes were to support local circulation, tissue extensibility, reduced spasm, and pain relief before exercise.¹¹ No additional device settings were reported. The application of infrared therapy during the treatment session is shown in Figure 1.



Figure 1. Administration of infrared therapy to the thoracolumbar or paraspinal region with the patient positioned prone.

Transcutaneous electrical nerve stimulation was applied to the thoracolumbar paraspinal region corresponding to the documented painful area. The frequency was 100 Hz, pulse width was 100 microseconds, the mode was constant current, and the

recorded intensity was 38.0 mA. Each application lasted 10 minutes. The intensity was increased gradually until the patient reported a comfortable tingling sensation without visible muscle contraction. The recorded purpose was analgesia through sensory stimulation.¹² The manuscript did not report electrode size, exact anatomical landmarks, device brand, or other technical settings; these details are not added. The application of TENS and the electrode placement during the treatment session are shown in Figure 2.

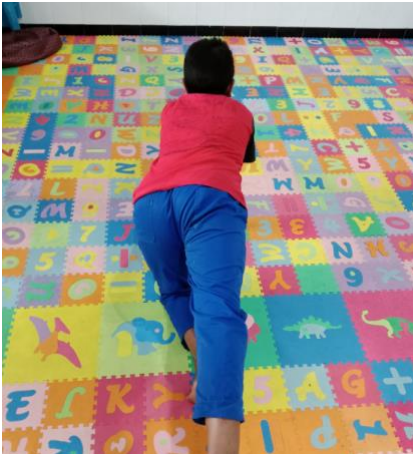


Figure 2. Administration of transcutaneous electrical nerve stimulation to the documented thoracolumbar paraspinal treatment area.

The exercise component consisted of documented Klapp based positions performed individually under physiotherapist supervision. The recorded exercises were arm and leg extension on opposite sides in a bird dog position, a low crawling position, a rest or child position, and a modified rest or child position directed to the right side. The protocol also included a five minute cooling period with breathing exercises and light thoracic and lumbar stretching. The documented dosage was 8 to 10 repetitions and 3 sets, with a 5 second holding time and a total exercise duration of approximately 30 minutes. The program was delivered over four physiotherapy sessions. The manuscript does not specify the exact order of the exercises, the dose allocated to each individual movement, rest intervals, progression criteria, or whether any component was modified between sessions. These details remain unavailable. The Klapp Exercise component performed during the physiotherapy program is illustrated in Figure 3.



Figure 3. Klapp Exercise activity performed as part of the documented supervised physiotherapy program.

A home exercise program was mentioned in the original manuscript. The available description states that the patient continued the exercises at home as previously demonstrated and provided by the physiotherapist. The exact content, frequency, duration, monitoring method, and adherence level were not reported. Adherence and long-term maintenance of the observed changes cannot therefore be inferred.

Outcome evaluation was documented at T1, T2, T3, and T4. The primary comparisons emphasized baseline T1 and the fourth treatment session T4, while the intermediate values were retained to describe the serial course. The data were analyzed descriptively because the report involved one patient and no comparison group, and no inferential statistical analysis was reported. No p value, confidence interval, effect size, assumption testing, significance threshold, or statistical software was provided in the source manuscript. Absolute changes were calculated directly from the recorded baseline and T4 values when the scale permitted straightforward subtraction. For pain, a negative change represented a lower recorded intensity; for range of motion and SRS 22, a positive change represented an increase; and unchanged structural measures were reported as zero change. No externally defined threshold for clinically important change was available in the source materials, so the results were interpreted descriptively according to the observed direction and magnitude of change. Written informed consent for participation in the physiotherapy program and publication of this case report was obtained. No treatment related undesirable events were reported during the four physiotherapy sessions.

Results

One patient completed the four documented physiotherapy sessions. Serial observations at T1, T2, T3, and T4 covered pain, trunk range of motion, scoliometer findings, Cobb angle, leg length discrepancy, and SRS-22 scores. No p values, confidence intervals, effect sizes, or inferential statistical comparisons were available.

Table 1 summarizes the available chronology and baseline characteristics. The patient was a 12 year old boy with scoliosis, a right sided C curve, and a Cobb angle of 50 degrees. The condition was reported from approximately 9 years of age. Baseline values included resting pain 2 of 10, tenderness 7 of 10, movement related pain 5 of 10, scoliometer 5 degrees, leg length discrepancy 1.5 cm, and SRS-22 total score 51. Information on comorbidities and previous treatment was unavailable.

Table 1. Available chronology and baseline characteristics of the case

Time point	Available information
Approximately age 9 years	Spinal asymmetry and scoliosis related complaint reported as present.
Baseline, T1	Age 12 years, male; scoliosis with right sided C curve; Cobb angle 50 degrees; baseline pain, trunk range of motion, scoliometer, leg length discrepancy, and SRS-22 recorded.
T1 to T4	Four physiotherapy sessions combining infrared therapy, transcutaneous electrical nerve stimulation, and Klapp Exercise; serial outcome values recorded.
T4	Final documented assessment after the fourth session.
Follow up	No post treatment follow up data available.

Table 2 presents pain outcomes across the four sessions. Resting pain was 2 of 10 at T1 and remained 2 of 10 at T2. At T3, the recorded value was 0 of 10 and it remained 0 of 10 at T4. The absolute change was minus 2 points. Tenderness was 7 of 10 at both T1 and T2, decreased to 5 of 10 at T3, and remained 5 of 10 at T4. The absolute change was minus 2 points. Movement related pain was 5 of 10 at T1 and T2, decreased to 3 of 10 at T3, and remained 3 of 10 at T4, corresponding to an absolute change of minus 2 points.

Table 2. Serial pain outcomes measured with the Visual Analog Scale

Outcome	T1	T2	T3	T4	Absolute change, T4 minus T1
Resting pain	2/10	2/10	0/10	0/10	minus 2
Tenderness	7/10	7/10	5/10	5/10	minus 2
Movement related pain	5/10	5/10	3/10	3/10	minus 2

Lower values were first documented at T3 and maintained at T4. Table 3 presents serial trunk range of motion. Extension increased from 20 degrees at T1 to 22 degrees at T2, 25 degrees at T3, and 30 degrees at T4. The absolute increase from T1 to T4 was 10 degrees. Flexion increased from 65 degrees at T1 to 70 degrees at T2, 75 degrees at T3, and 85 degrees at T4, producing an absolute increase of 20 degrees. Lateral flexion recorded as dextra increased from 25 degrees at T1 to 26 degrees at T2, 28 degrees at T3, and 30 degrees at T4, an absolute increase of 5 degrees. Rotation was recorded as 45 degrees to neutral to 45 degrees at every assessment and therefore showed no absolute change.

Table 3. Serial trunk range of motion measurements

Movement	T1	T2	T3	T4	Absolute change
Extension	20 degrees	22 degrees	25 degrees	30 degrees	plus 10 degrees
Flexion	65 degrees	70 degrees	75 degrees	85 degrees	plus 20 degrees
Lateral flexion dextra	25 degrees	26 degrees	28 degrees	30 degrees	plus 5 degrees
Rotation	45 to 0 to 45 degrees	45 to 0 to 45 degrees	45 to 0 to 45 degrees	45 to 0 to 45 degrees	0 degrees

Flexion showed the largest absolute increase. Extension and lateral flexion dextra also increased, whereas rotation remained unchanged. Structural measures are presented in Table 4. The scoliometer value was 5 degrees at T1, T2, T3, and T4. The Cobb angle was 50 degrees at each recorded assessment. Accordingly, the absolute change from T1 to T4 was 0 degrees for both measures.

Table 4. Serial scoliosis related structural measurements

Measure	T1	T2	T3	T4	Absolute change
Scoliometer	5 degrees	5 degrees	5 degrees	5 degrees	0 degrees
Cobb angle	50 degrees	50 degrees	50 degrees	50 degrees	0 degrees

The record documented stable values for both the scoliometer and Cobb angle during four sessions. No assessment after T4 was available. Leg length discrepancy values are presented in Table 5. The recorded discrepancy was 1.5 cm at T1 and remained 1.5 cm at T2, T3, and T4. The absolute change from baseline to the fourth session was therefore 0 cm.

Table 5. Serial leg length discrepancy measurements

Measure	T1	T2	T3	T4	Absolute change
Leg length discrepancy	1.5 cm	1.5 cm	1.5 cm	1.5 cm	0 cm

The discrepancy is presented as recorded. Patient reported outcomes measured with the SRS-22 are presented in Table 6. The Function or Activity domain increased from 12 at T1 to 12 at T2, 13 at T3, and 14 at T4, for an absolute change of plus 2. The Pain domain increased from 13 to 13, 14, and 15, also yielding a plus 2 change. Self image increased from 10 to 12, 13, and 14, representing the largest domain increase of plus 4. Mental Health increased from 9 to 9, 10, and 11, for a plus 2 change. Satisfaction increased from 7 to 9, remained 9, and reached 10 at T4, for a plus 3 change. The total SRS-22 score increased from 51 at T1 to 55 at T2, 59 at T3, and 63 at T4, corresponding to an absolute increase of 12 points.

Table 6. Serial SRS-22 domain and total scores

Domain	T1	T2	T3	T4	Absolute change
Function or Activity	12	12	13	14	plus 2
Pain	13	13	14	15	plus 2
Self image	10	12	13	14	plus 4
Mental Health	9	9	10	11	plus 2
Satisfaction	7	9	9	10	plus 3
Total score	51	55	59	63	plus 12

The total score increased at each time point. Self image showed the largest domain increase, followed by satisfaction; Function or Activity, Pain, and Mental Health each increased by 2 points. Across all recorded outcomes, pain scores decreased, selected trunk range of motion values increased, and SRS-22 scores increased between T1 and T4. In contrast, the scoliometer

value: Cobb angle and leg length discrepancy remained unchanged. The dataset contains no follow up assessment beyond T4. The source manuscript states that no undesirable event occurred during therapy.

The temporal pattern of the recorded outcomes was not identical across variables. Pain values were unchanged between T1 and T2 and then showed lower recorded values at T3 that were maintained at T4. For trunk movement: extension, flexion, and lateral flexion dextra increased progressively across the four assessments, whereas rotation remained identical at each time point. The absolute changes calculated from T1 to T4 were therefore direction specific rather than uniform across the complete trunk range of motion assessment.

The structural measures followed a different serial pattern. Both the scoliometer value and Cobb angle were unchanged at every recorded assessment. Leg length discrepancy was likewise 1.5 cm at T1, T2, T3, and T4. Thus, the final dataset contained three outcome groups with distinct descriptive patterns: lower pain scores, increased values for selected trunk movements and SRS-22 scores, and unchanged scoliometer, Cobb angle, and leg length discrepancy values. No additional post treatment assessment was available to describe whether any of these values changed after T4.

The SRS-22 data also showed variation among domains. Function or Activity and Pain remained unchanged from T1 to T2 before increasing at T3 and T4. Self image increased at every assessment after baseline. Mental Health was unchanged between T1 and T2 and then increased at T3 and T4. Satisfaction increased from T1 to T2, remained unchanged at T3, and increased again at T4. The total score increased from 51 to 55, then to 59, and finally to 63 across the four recorded time points.

Absolute changes were calculated only from the numerical values available in the source manuscript. No percentage change was added because several outcomes were expressed as ordinal or instrument specific scores and the source documents did not define percentage based interpretation. Similarly, no standardized clinical significance threshold was applied. The Results section therefore reports the recorded values, their serial direction, and direct absolute differences between baseline and the fourth session without assigning statistical or causal meaning to those changes.

Discussion

This case report described the clinical course of a 12 year old boy with scoliosis who received four physiotherapy sessions combining infrared therapy, transcutaneous electrical nerve stimulation, and Klapp Exercise. Several short term clinical outcomes changed during treatment: pain scores decreased, selected trunk movements increased, and the total SRS 22 score increased from 51 to 63. In contrast, the scoliometer value remained 5 degrees, the Cobb angle remained 50 degrees, and leg length discrepancy remained 1.5 cm. Because all three interventions were delivered together in a single case without a control condition, these observations cannot establish the independent contribution of any modality or a causal treatment effect.

The pattern of pain reduction is consistent with the intended symptom oriented roles of infrared therapy and transcutaneous electrical nerve stimulation described in the source literature. Infrared therapy is used as a superficial thermal modality and, in the present protocol, was applied before exercise with the intention of supporting local circulation, tissue extensibility, reduction of muscle spasm, and pain relief.¹¹ Transcutaneous electrical nerve stimulation was used to provide sensory stimulation for analgesia.¹² The observed reduction in pain occurred after the intervention had been repeated across several sessions, with lower values first recorded at T3. However, the design does not permit the change to be attributed specifically to infrared therapy, transcutaneous electrical nerve stimulation, exercise, the sequence of care, or other factors not measured in the case.

Pain reduction may nevertheless be clinically relevant within a rehabilitation session because lower symptom intensity can coincide with greater tolerance for movement and participation in therapeutic exercise. The present data showed that the decline in pain scores occurred alongside increased extension, flexion, and lateral flexion. This temporal pattern is descriptive and does not demonstrate that one change caused the other. The exercise component included quadruped based arm and leg extension, low crawling, rest or child positions, and a modified right sided rest position, all performed under physiotherapist supervision. The available scoliosis literature in the source manuscript supports exercise based conservative management and scoliosis specific exercise approaches as part of rehabilitation.^{4,5} The exact contribution of the documented Klapp based sequence, however, remains uncertain because the program was not compared with another exercise approach and detailed progression criteria were unavailable.

Flexion showed the largest absolute increase, from 65 degrees at baseline to 85 degrees at T4. Extension increased from 20 degrees to 30 degrees and lateral flexion dextra increased from 25 degrees to 30 degrees, whereas rotation remained unchanged. These findings indicate that change was not uniform across all movement directions. A plausible interpretation is that the observed program was associated with greater movement in selected directions during the four session period, while rotational range did not change in the available record. Exercise based scoliosis management aims to address trunk function and mobility, but the response of individual movement measures may vary according to the baseline restriction, exercise content, measurement method, and duration of treatment.^{4,5} Because the manuscript does not provide a minimal clinically important difference for these measurements, the magnitude of change should not be labeled clinically significant solely on the basis of numerical increase.

The absence of change in the Cobb angle and scoliometer value should also be interpreted in relation to the short observation period and the type of outcome being measured.¹³ The Cobb angle is a structural radiographic measure, whereas pain and range of motion can vary over shorter periods. The source literature emphasizes conservative management and exercise over periods longer than four treatment sessions.⁴ The present case therefore does not provide evidence that the combined program altered the structural curve during the observed period. A more specific statement regarding the expected duration required to detect radiographic change in comparable patients would require recent, verified evidence addressing structural response and follow up, which is not sufficiently represented in the supplied reference set and should be added as.¹³ The lack of change is therefore reported as an observed result rather than interpreted as treatment failure.

The unchanged leg length discrepancy is also consistent with the descriptive distinction between outcomes that changed and those that did not. The recorded value remained 1.5 cm at all four assessments. The source materials do not provide separate limb lengths, a detailed measurement protocol, or evidence that the intervention was intended to modify anatomical leg length.¹⁰ The result should therefore be reported without implying that the program was expected to change this measure within four sessions. This is particularly important in a case report because broad claims about correction of posture or alignment can exceed the information provided by the available measurements.

The case also has important limitations. It involved one patient, had no comparator, and used a combined intervention, so generalizability and causal inference are limited. The observation period comprised only four sessions, and no follow up assessment was available. The reason for the absence of follow up was not documented and should not be inferred. Clinical history was incomplete because information on comorbidities, previous treatment, and more detailed radiographic characteristics was unavailable. The report also does not establish whether the same physiotherapist performed all outcome assessments, how measurement

standardization was maintained or whether any blinding procedure was used. These limitations increase uncertainty regarding measurement consistency and the persistence of the observed changes.

Intervention reporting also remained incomplete in several respects. The source manuscript did not provide an exact sequence of all Klapp based movements, movement specific dosing, rest intervals, progression criteria, or a statement establishing whether the protocol was modified during the four sessions. A home program was mentioned, but its detailed content, frequency, monitoring, and adherence were not documented. The original manuscript states that no undesirable event occurred during therapy, but it does not describe a formal adverse event monitoring procedure. These gaps should be retained as reporting limitations rather than filled with assumptions. They also explain why the case cannot fully satisfy every CARE, TIDieR, or JBI case reporting element identified in the editorial feedback.

From a clinical perspective, the report suggests that the documented combined program was associated with short term changes in symptoms, selected trunk movements, and patient reported outcomes in this individual. It should not be presented as evidence that the combination is superior to other conservative approaches or that it changes structural scoliosis. A future study could address the remaining uncertainties by using a larger sample, a longer intervention period, predefined progression criteria, standardized measurement procedures, documented home exercise adherence, systematic adverse event monitoring, and follow up assessments. Comparative designs would also be required to estimate the contribution of individual modalities and to test treatment effects.

Overall, the findings are most appropriately understood as a descriptive account of one patient's course during four sessions of combined physiotherapy. The case contributes clinical detail regarding how infrared therapy, transcutaneous electrical nerve stimulation, and Klapp Exercise were applied and which recorded outcomes changed or remained unchanged. The strongest conclusion supported by the available data is limited to this observation period: symptom, mobility, and SRS 22 measures changed in a favorable direction, whereas the documented structural measures did not change. Stronger claims about efficacy, long term benefit, curve correction, or causal mechanisms require additional evidence.

Conclusion

This case report described the outcomes observed in a 12 year old boy with scoliosis during four physiotherapy sessions combining infrared therapy, transcutaneous electrical nerve stimulation, and Klapp Exercise. Across the documented treatment period, resting pain decreased from 2 of 10 to 0 of 10, tenderness decreased from 7 of 10 to 5 of 10, and movement related pain decreased from 5 of 10 to 3 of 10. Trunk extension increased by 10 degrees, flexion by 20 degrees, and lateral flexion dextra by 5 degrees, while rotation did not change. The total SRS 22 score increased from 51 to 63. In contrast, the scoliometer value remained 5 degrees, the Cobb angle remained 50 degrees, and leg length discrepancy remained 1.5 cm.

These findings describe changes observed within one patient over a short treatment period. They do not establish treatment efficacy, causality, superiority over another intervention, or long term benefit because the report involved one patient, no comparator, a combined intervention, and no follow up assessment. The absence of change in the documented structural measures should likewise be interpreted as an observation during four sessions rather than evidence that the intervention cannot influence structural outcomes over a different treatment period.

Clinically, the case provides a documented example of a combined physiotherapy program associated with short term changes in pain, selected trunk movements, and SRS 22 scores while structural measures remained unchanged. Future research should use larger samples, longer intervention and observation periods, clearly specified exercise progression, standardized outcome assessment, documented home exercise adherence, systematic adverse event reporting, and follow up assessments. Comparative designs are needed to determine the contribution of individual treatment components and to evaluate whether the observed changes can be attributed to the intervention.

Author Contribution

Farahdilla Ayu Cahaya Zusinta: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft Preparation, and Visualization.

Yeni Tri Nurhayati: Conceptualization, Methodology, Validation, Supervision, Writing – Review and Editing, and Project Administration. Rizka Asna Rahmawati: Methodology, Validation, Supervision, Writing – Review and Editing, and Resources. All authors have read and approved the final version of the manuscript.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

The patient received an explanation of the examination and physiotherapy procedures, including the potential benefits and risks. Written informed consent for participation in the physiotherapy program and publication of this case report was obtained.

References

1. Hresko MT. Idiopathic scoliosis in adolescents. *N Engl J Med*. 2013;368(9):834-841.
2. Chinese Society of Physical Medicine and Rehabilitation. Guideline for rehabilitation assessment and treatment of adolescent idiopathic scoliosis (2024 edition). *Zhonghua Yi Xue Za Zhi*. 2024;104(39):3647-3660.
3. Kim H, Chang BS, Chang SY. Current issues in the treatment of adolescent idiopathic scoliosis: a comprehensive narrative review. *Asian Spine J*. 2024;18(5):731-742.

4. Negrini S, Donzelli S, Aulisa AG, Czaprowski D, Schreiber S, de Mauroy JC, et al. 2016 SOSORT guidelines: orthopaedic and rehabilitation treatment of idiopathic scoliosis during growth. *Scoliosis Spinal Disord.* 2018;13:3.
5. Kuru T, Yeldan I, Dereli EE, Ozdincler AR, Dikici F, Colak I. The efficacy of three-dimensional Schroth exercises in adolescent idiopathic scoliosis: a randomised controlled clinical trial. *Clin Rehabil.* 2016;30(2):181-190.
6. Yin RK. Case study research and applications: design and methods. 6th ed. Thousand Oaks (CA): SAGE Publications; 2018.
7. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care Res (Hoboken).* 2011;63(S11):S240-S252.
8. Norkin CC, White DJ. Measurement of joint motion: a guide to goniometry. 5th ed. Philadelphia (PA): F.A. Davis Company; 2016.
9. Grivas TB, Wade MH, Negrini S, O'Brien JP, Maruyama T, Hawes MC, et al. SOSORT consensus paper: school screening for scoliosis. Where are we today? *Scoliosis.* 2007;2:17.
10. Sabharwal S, Kumar A. Methods for assessing leg length discrepancy. *Clin Orthop Relat Res.* 2008;466(12):2910-2922.
11. Low J, Reed A. Electrotherapy explained: principles and practice. 4th ed. Oxford: Butterworth-Heinemann; 2006.
12. Johnson MI. Transcutaneous electrical nerve stimulation (TENS): research to support clinical practice. Oxford: Oxford University Press; 2014.
13. Cool J, Post AM, van Royen BJ, Maas M, Streekstra GJ, Jamaludin FS, et al. Radiological follow-up strategies in adolescent idiopathic scoliosis patients: a best evidence synthesis by systematic review. *Brain Spine.* 2025;5:105865.