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Effects of Schroth Therapy on Cobb Angle and Trunk Rotation in Children and Adolescents with Idiopathic Scoliosis

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Abstract: Idiopathic scoliosis is a three-dimensional spinal deformity diagnosed during growth and commonly managed through conservative rehabilitation strategies. Physiotherapeutic scoliosis-specific exercises, including the Schroth method, aim to improve postural alignment, trunk symmetry, and neuromuscular control. This pilot study explored changes in spinal curvature, trunk rotation, and selected anthropometric parameters following a six-month supervised Schroth programme in participants with idiopathic scoliosis. This prospective single-group pilot pre-post study included 15 participants aged 9 to 22 years with idiopathic scoliosis who attended a supervised Schroth programme between January and June 2025 in Târgu Mureș, Romania. One participant was excluded because of incomplete radiographic data, resulting in a final sample of 14 participants. Assessments were conducted at baseline and after the intervention. Outcomes included thoracic and thoracolumbar Cobb angles, thoracic and lumbar trunk rotation measured with a scoliometer, standing height, sitting height, and Risser sign. The mean thoracic Cobb angle decreased from 17.64° to 15.07°, with a small effect size, Cohen's d = 0.19. The mean thoracolumbar Cobb angle decreased from 28.93° to 23.21°, with a moderate effect size, Cohen's d = 0.54. Thoracic and lumbar trunk rotation also decreased, with small effect sizes, Cohen's d = 0.29 and d = 0.34, respectively. None of the observed changes reached statistical significance. In this small pilot sample, six months of supervised Schroth therapy were associated with non-significant within-participant reductions in Cobb angle and trunk rotation. These preliminary findings support the relevance of Schroth-based interventions within conservative pediatric rehabilitation and warrant further investigation in adequately powered controlled studies.

Keywords: idiopathic scoliosis; Schroth therapy; Cobb angle; trunk rotation; physiotherapeutic scoliosis-specific exercises; pilot study

1. Introduction

Adolescent idiopathic scoliosis (AIS) is a structural three-dimensional deformity of the spine characterised by a lateral curvature exceeding 10° measured using the Cobb method and associated vertebral rotation. AIS is the most common form of scoliosis during adolescence and affects approximately 2–3% of children and adolescents worldwide [1,2]. The condition occurs more frequently in females, and the risk of curve progression increases significantly during periods of rapid skeletal growth [3]. Progression exceeding 5° is considered clinically relevant and may lead to trunk deformity, functional limitations, and, in severe cases, the need for surgical intervention [4].

AIS produces important biomechanical and functional alterations. Progressive spinal curvature affects trunk symmetry, spinal mobility, and respiratory mechanics, while also influencing psychological well-being and quality of life in adolescents [2,5]. Previous research has shown that adolescents with scoliosis may present altered trunk muscle activation patterns and impaired postural control compared with healthy individuals [6]. Axial trunk rotation is one of the main clinical features of scoliosis and contributes to rib hump deformity and aesthetic concerns that can affect adolescents socially and psychologically [5,7].

Conservative treatment represents the primary therapeutic strategy for mild to moderate curves, particularly in skeletally immature patients. Current international recommendations emphasise the role of physiotherapeutic scoliosis-specific exercises (PSSE) as an important component of conservative scoliosis management [8]. These interventions aim to improve postural alignment, neuromuscular control, and spinal stability while reducing the risk of curve progression. Recent evidence continues to support the use of scoliosis-specific rehabilitation strategies in AIS, while also highlighting the need for careful interpretation according to curve severity, skeletal maturity, intervention duration, and treatment adherence [16–18].

Among PSSE approaches, the Schroth method is one of the most widely studied exercise-based rehabilitation strategies. The method focuses on three-dimensional spinal correction using postural alignment, rotational breathing techniques, and neuromuscular reeducation, designed to counteract spinal deformity [9]. Several clinical studies have demonstrated the effectiveness of Schroth exercises in adolescents with idiopathic scoliosis. In a randomised controlled trial, Schreiber et al. reported that Schroth exercises combined with standard care produced greater improvements in Cobb angle and trunk rotation compared with standard care alone [10]. Similarly, Kuru Colak et al. observed reductions in spinal curvature and improvements in trunk muscle endurance following a supervised Schroth exercise program [11].

Recent systematic reviews and meta-analyses have further confirmed the potential benefits of scoliosis-specific exercise programs. Ceballos-Laita et al. demonstrated positive effects of the Schroth method on spinal curvature, trunk rotation, and quality-of-life outcomes [12]. Chen et al. reported that Schroth 3D exercises were more effective than traditional therapy in reducing Cobb angle and angle of trunk rotation and in improving quality of life in adolescents with idiopathic scoliosis [17]. Mohamed et al. also showed that adding Schroth exercises to standard care may improve torso asymmetry in AIS [20]. In addition, Wang et al. compared several scoliosis-specific exercise approaches and confirmed the relevance of structured exercise-based interventions in conservative AIS management [21].

More recent syntheses published in 2025 have strengthened this scientific context. Jiang et al. reported that both Schroth-based combined interventions and PSSE approaches produced favourable changes in Cobb angle, axial trunk rotation, and SRS-22 scores in adolescents with idiopathic scoliosis [22]. Zhu et al. also concluded that Schroth exercises may reduce Cobb angle and trunk rotation and may improve quality of life in AIS, although the magnitude of change depends on study design, intervention duration, and participant characteristics [23].

Despite increasing evidence supporting physiotherapeutic scoliosis-specific exercises, important limitations remain in the current literature. Previous studies have frequently included small sample sizes, heterogeneous participant characteristics, varying curve magnitudes, and intervention periods ranging from several weeks to several months [12,13,17,18,21–23]. These methodological differences make it difficult to determine the magnitude of changes expected following supervised Schroth therapy, particularly in routine clinical practice settings.

The present prospective pilot study aimed to explore changes in Cobb angle, trunk rotation, standing height, sitting height, and skeletal maturity following a six-month supervised Schroth programme in participants with idiopathic scoliosis. Given the exploratory design and the absence of a control group, the study focused on within-participant changes observed between baseline and post-intervention assessment. It was hypothesised that the intervention period would be associated with reduced or stabilised spinal curvature and trunk rotation values.

2. Materials and Methods

2.1. Study design

This study was designed as a prospective single-group pilot pre-post intervention study conducted to explore within-participant changes following a supervised Schroth therapy programme. Participants were assessed at baseline and after six months of intervention. The study focused on changes in radiographic, clinical, and anthropometric outcomes, including Cobb angle, trunk rotation, standing height, sitting height, and Risser sign. Because no control or comparison group was included, the study was not designed to establish the efficacy of Schroth therapy or to attribute the observed changes exclusively to the intervention.

2.2. Participants

The study initially enrolled 15 participants diagnosed with idiopathic scoliosis, aged between 9 and 22 years. The intervention was conducted between January and June 2025 at the OrtoProfil Medical Centre in Târgu Mureș, Romania. One participant was excluded from the final analysis because of incomplete radiographic data. Consequently, the final analytical sample included 14 participants.

The broad age range included children, adolescents, and young adults at different stages of skeletal maturity. This characteristic was accepted in the context of the pilot design, which aimed to examine the feasibility of implementing a supervised Schroth programme in a clinical setting and to describe preliminary within-participant changes. However, variability in age and skeletal maturity may have influenced treatment responses and should be considered when interpreting the results.

No a priori sample size calculation was performed because this was an exploratory pilot study based on the available eligible patients who completed the intervention and both assessment sessions during the study period. The findings should therefore be interpreted as preliminary observations intended to inform future controlled studies with larger and more homogeneous samples.

The study received approval from the Ethics Committee of the George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș, according to Decision No. 3464 of 11 December 2024. The study was conducted in accordance with the principles of the Declaration of Helsinki and its subsequent amendments. Written informed consent was obtained from all adult participants and from the parents or legal guardians of participants under 18 years of age.

2.3. Inclusion and exclusion criteria

Participants were eligible for inclusion if they met the following criteria:

- diagnosis of idiopathic scoliosis with a Cobb angle greater than 10°;
- age between 9 and 22 years;
- no previous spinal surgery;
- absence of neuromuscular or congenital conditions that could influence spinal alignment or the performance of the exercise programme;
- ability to participate actively in supervised Schroth therapy sessions;
- availability for baseline and post-intervention assessments.

Participants were excluded from the final analysis if they presented non-idiopathic scoliosis, previous spinal surgery, severe neuromuscular disorders affecting posture or exercise participation, medical or cognitive limitations preventing active participation, incomplete assessment data, or insufficient participation in the supervised intervention programme.

2.4. Intervention protocol

Participants were assessed at the beginning and at the end of the research period using spine radiographs, a goniometer, a scoliometer, and a stadiometer. These instruments were used to determine the key clinical and radiographic parameters associated with idiopathic scoliosis.

The assessed parameters were:

Cobb angle, determined with a goniometer by analysing spinal radiographs and measuring the angle of the scoliotic curvature; trunk rotation, measured with a scoliometer during the forward-bending test; standing and sitting height, measured with a stadiometer to evaluate changes in body alignment; Risser grade, used to assess skeletal maturity.

The Schroth therapy exercises were personalised for each participant according to curve severity, curve type, and clinical presentation. All exercises were performed under the supervision of a physiotherapist specialised in Schroth therapy. Each exercise included active spinal elongation, three-dimensional corrective breathing, postural awareness during both exercise and rest periods, and isometric contractions aimed at maintaining a stable corrected position.

Although each curvature pattern required individual adaptation, several fundamental exercises were used in most cases. These exercises involved wall bars, elastic bands, balls, chairs, and positioning supports. The exercises were selected according to the main curve pattern, including thoracic, thoracolumbar, or lumbar scoliosis, and according to curve direction.

Participants performed supervised Schroth therapy sessions three times per week. Each session lasted approximately 60 minutes. The intervention period lasted six months.

Thoracic scoliosis

Exercise 1: The participant was positioned in standing, lateral to the wall bars. The hand on the side of the curvature held an elastic band attached to the wall bars, while the opposite arm was abducted to open the convex side. The participant performed active axial elongation and pulled the band diagonally while directing breathing toward the concave side of the chest.

Exercise 2: The participant stood facing the wall bars and held them with both hands. The trunk was elongated, and a small ball was placed between the knees. The exercise was performed using static isometric contractions and controlled breathing.

Exercise 3: The participant sat with the trunk upright, facing a wall. A small ball was placed between the convex side of the trunk and the wall. During controlled breathing, the participant gently pressed the ball into the wall.

Thoracolumbar scoliosis

Exercise 1: The participant was positioned in a plank position, supported on the forearms, with a large ball placed under the thighs. While maintaining the plank position, the participant performed breathing directed toward the concave side, together with abdominal isometric contraction.

Exercise 2: The participant was positioned in lateral decubitus on the concave side, with small pillows placed under the thoracolumbar region. The lower arm was relaxed, and the upper arm was stretched above the head. Active elongation was performed together with breathing directed toward the concave side.

Exercise 3: The participant sat on a chair with their hands crossed on their shoulders. The pelvis was gently lifted from the chair on the side of the curvature, while maintaining controlled posture and breathing.

Lumbar scoliosis

Exercise 1: The participant was positioned on the knees with the concave side facing the wall bars. The contralateral hand was placed on the thigh, while the ipsilateral hand held the wall bars. The participant performed slight upward traction, active elongation, and breathing directed toward the concave lumbar region.

Exercise 2: The participant sat on a chair, with the foot on the convex side resting on the floor and the opposite foot placed slightly forward. The participant performed a controlled tilt toward the concave side while breathing deeply and maintaining postural correction.

Exercise 3: The participant sat on a chair and held an elastic band with the hand on the concave side. The participant slowly pulled the band laterally while breathing slowly and deliberately, and activating the lumbar muscles.

2.5. Outcome measures

Participants were evaluated at baseline and at the end of the six-month intervention period.

The following parameters were measured:

- Cobb angle. The Cobb angle was determined from spinal radiographs in the thoracic and thoracolumbar regions using standard radiographic measurement procedures.
- Trunk rotation. Trunk rotation was measured with a scoliometer during the forward-bending test.
- Standing height and sitting height. Body height was measured in both orthostatic and seated positions using a calibrated stadiometer.
- Risser sign. Skeletal maturity was assessed using the Risser grading system based on pelvic radiographs.

2.6. Statistical analysis

Descriptive statistics were calculated for all outcome variables, including mean, standard deviation, median, and range, as appropriate. Because the study used a pre-post design in which the same participants were assessed at baseline and after the six-month intervention, the statistical analysis was based on paired comparisons.

The normality of within-participant differences between baseline and post-intervention values was assessed using the Shapiro-Wilk test. For variables with normally distributed differences, baseline and post-intervention values were compared using the paired-samples t-test. For variables that did not meet the assumption of normality, the Wilcoxon signed-rank test was applied. Statistical significance was set at $p < 0.05$.

In addition to p-values, effect sizes were calculated to estimate the magnitude of within-participant changes. For outcomes analysed using the paired-samples t-test, Cohen's dz was calculated. For outcomes analysed using the Wilcoxon signed-rank test, rank-biserial correlation was considered as the appropriate effect size measure. Effect size estimates were interpreted with caution due to the small pilot sample.

No a priori sample size calculation was performed, as this was an exploratory pilot study conducted on the eligible participants who completed the intervention and both assessment sessions during the study period. Therefore, the statistical analyses were intended to describe preliminary within-participant changes and should not be interpreted as confirmatory evidence of treatment efficacy. Statistical analyses were performed using Minitab statistical software, version 20.3, State College, Pennsylvania, USA.

3. Results

3.1. Descriptive changes in outcome measures

Fourteen participants completed both the baseline and post-intervention assessments and were included in the final analysis. Descriptive values for the evaluated outcomes are presented in Table 1.

Small increases were observed in standing and sitting height after the six-month intervention period. Mean standing height increased from 162.91 ± 15.91 cm at baseline to 163.16 ± 15.69 cm after the intervention, while the median increased from 164.5 cm to 165.1 cm. Mean sitting height increased from 135.39 ± 7.91 cm to 135.54 ± 7.73 cm, with a median change from 136.5 cm to 137.0 cm.

Reductions were observed in both Cobb angle measurements. The mean thoracic Cobb angle decreased from 17.64 ± 14.47° at baseline to 15.07 ± 12.36° after the intervention, corresponding to a descriptive mean reduction of 2.57°. The mean thoracolumbar Cobb angle decreased from 28.93 ± 11.30° to 23.21 ± 9.68°, corresponding to a descriptive mean reduction of 5.72°.

Trunk rotation values measured with the scoliometer also decreased during the observation period. Mean thoracic trunk rotation decreased from 4.86 ± 5.10° to 3.50 ± 4.20°, while mean lumbar trunk rotation decreased from 4.86 ± 2.93° to 3.86 ± 2.90°. The mean Risser sign remained unchanged, with identical baseline and post-intervention values of 3.36 ± 1.86.

Figure 1 summarises the baseline and post-intervention descriptive values for all evaluated outcomes. The figure shows small increases in height measurements, reductions in Cobb angle and trunk rotation values, and no change in skeletal maturity. These descriptive findings do not establish an intervention effect and should be interpreted together with the paired statistical analysis.

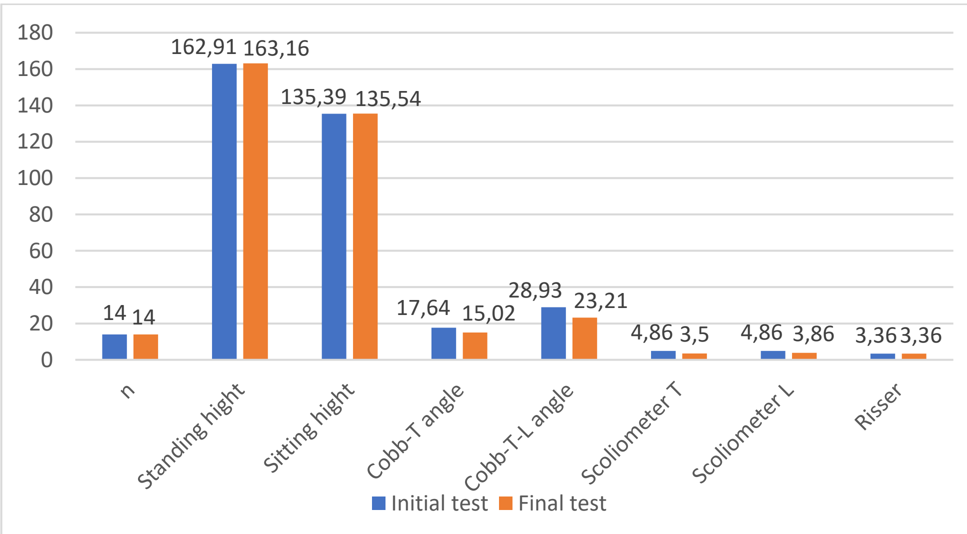

Figure 1. Baseline and post-intervention descriptive values for standing height, sitting height, thoracic Cobb angle, thoracolumbar Cobb angle, thoracic trunk rotation, lumbar trunk rotation, and Risser sign.

3.2. Within-participant statistical analysis

Because the same participants were assessed at baseline and after the six-month intervention, inferential analyses were conducted using paired comparisons. The normality of within-participant change scores was assessed using the Shapiro-Wilk test. Variables with normally distributed change scores were analysed using the paired-samples t-test, while variables that did not meet the normality assumption were analysed using the Wilcoxon signed-rank test.

The paired analysis showed no statistically significant differences between baseline and post-intervention values for any of the evaluated outcomes. Standing height showed a small mean increase of 0.25 cm, but this change was not statistically significant, $p = 0.967$. Sitting height showed a small mean increase of 0.15 cm, which was not statistically significant ($p = 0.958$).

The thoracic Cobb angle decreased by 2.57°, from 17.64 ± 14.47° to 15.07 ± 12.36°, but the difference was not statistically significant, $p = 0.618$. The thoracolumbar Cobb angle decreased by 5.72°, from 28.93 ± 11.30° to 23.21 ± 9.68°, also without statistical significance, $p = 0.163$. The effect size for the thoracolumbar Cobb angle was moderate, Cohen's $d = 0.54$, while the effect size for the thoracic Cobb angle was small, Cohen's $d = 0.19$.

Thoracic trunk rotation decreased by 1.36°, from 4.86 ± 5.10° to 3.50 ± 4.20°, $p = 0.449$. Lumbar trunk rotation decreased by 1.00°, from 4.86 ± 2.93° to 3.86 ± 2.90°, $p = 0.373$. The corresponding effect sizes were small for both thoracic trunk rotation, Cohen's $d = 0.29$, and lumbar trunk rotation, Cohen's $d = 0.34$. The Risser sign remained unchanged, $p = 1.000$.

Overall, the observed changes showed a favorable descriptive direction for Cobb angle and trunk rotation, especially for the thoracolumbar Cobb angle. However, none of the changes reached statistical significance. In the absence of a control group, these results should be interpreted as preliminary within-participant observations and cannot be attributed exclusively to the Schroth programme.

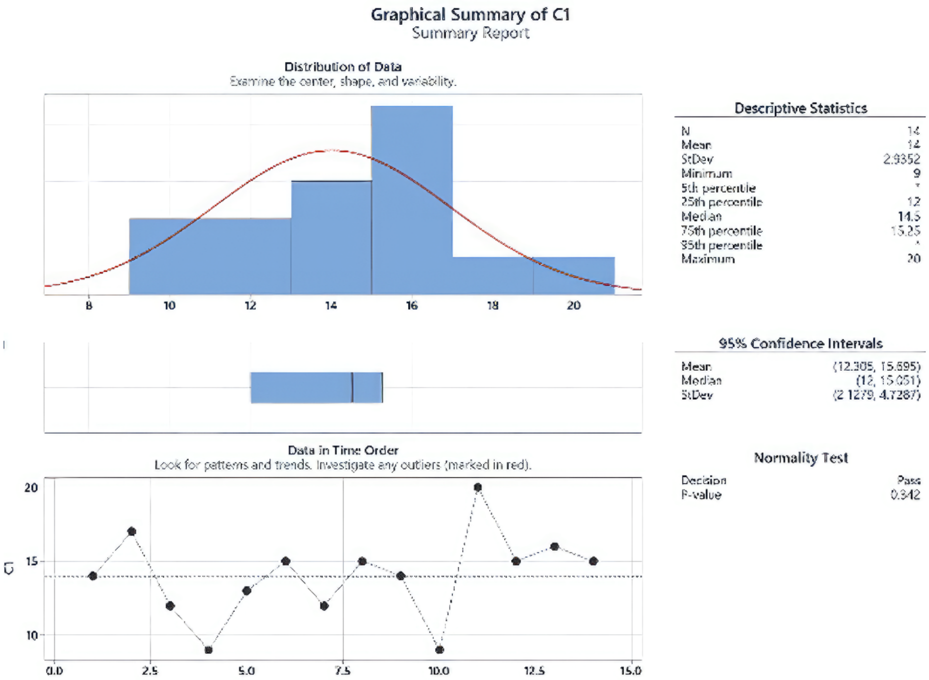

Figure 2. Anderson-Darling Normality Test Results

The median standing height of the subjects increased slightly from 164.6 cm to 165.1 cm at the end of therapy, suggesting an improvement in overall body posture.

Table 1. Baseline and post-intervention changes in clinical, radiographic, and anthropometric outcomes

Statistical parameters	Height-Orthostatism Analysis		Sitting Height Analysis		Cobb-Thoracic Angle		Cobb-Thoraco-lumbar Angle		Scoliometer-Thoracic		Scoliometer-Lumbar		Risser analysis	
	I. T.	**F. T.**	**I. T.**	**F. T.**	**I. T.**	**F. T.**	**I. T.**	**F. T.**	**I. T.**	**F. T.**	**I. T.**	**F. T.**	**I. T.**	**F. T.**
N =	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Average	162.91	163.16	135.39	135.54	17.64	15.07	28.93	23.21	4.86	3.5	4.86	3.86	3.36	3.36
Median	164.5	165.1	136.5	137	22.5	18.0	23.5	21.0	3.5	2.5	4.5	4.0	4	4
Std. dev.	15.91	15.69	7.914	7.733	14.47	12.36	11.30	9.68	5.10	4.20	2.93	2.90	1.86	1.86
CI for dif.	(-7.5, 7)		(-4.5, 4)		(-6, 13)		(-2, 15)		(-2, 4)		(-1, 3)		(-1, 1)	
CI realised 95%	-12.55	12.05	-6.25	5.93	-7.91	13.05	-2.48	13.91	-2.28	4.99	-1.27	3.27	-1.45	1.45
Mann-Whitney	P=0.963		P=0.945		P=0.52		P=0.161		P=0.399		P=0.263		P=1.00	
T-test	P=0.967		P=0.958		P=0.618		P=0.163		P=0.449		P=0.373		P=1.00	

Table 1.

[1] I. I. T. – initial test; F. T. – final test

Height-orthostatism. Initial testing – final testing

The median standing height of the subjects increased slightly from 164.6 cm to 165.1 cm at the end of therapy, suggesting an improvement in overall body posture.

There is no statistically significant difference between the medians of the two tests ($p=0.963 > 0.05$). This means that Schroth therapy did not produce a statistically significant change, but an improvement in posture can be suggested by the increase in the median of 0.5 cm. The estimated difference between the medians is 0 cm, and the 95.44% confidence interval for this difference is -1 to 3.

There are no statistically significant differences between the two test means ($p>0.05$), indicating that the height changes from the orthostatic position are not large enough to be significant. However, it is clinically relevant: an increase of 0.5 cm indicates a more correct, elongated posture. The mean difference is -0.25 cm, and the 95% confidence interval is between -12.55 and 12.05.

The test shows that the difference between the group means at baseline and posttest is -0.25, which is statistically insignificant. The power of the test indicates that, with a sample size of 14 participants, we have a 60% chance of detecting a difference of 13.729 units between the two groups, and at 90% power, the difference is 20.118 units. Since the observed difference does not reach these values, the test is not statistically significant.

Height - sitting. Initial testing - final testing

In comparing the medians of the two groups at the initial and final testing, the Mann-Whitney test did not yield a statistically significant result because the medians were 136.5 and 137.0, respectively. The estimated median difference is 0 cm. The statistical test returned a difference of -4.5 and a 4-point confidence interval, indicating a small difference between the two groups.

The difference observed within the sample of 14 participants was -0.15714, which is below the threshold. For a significant difference, the test at a power of 60% would have required a difference between means of 6.7983 units, and at a power of 90%, 9.9615 units.

Thoracic Cobb angle initial testing – final testing

After comparing the two medians, the estimated difference was 0.5, with a 95.44% confidence interval from -6 to 13.

The observed difference between the means of the two tests was 2.57, with a 95% confidence interval of -7.9059 to 13.049. Given that the confidence interval includes 0 and the p-value is 0.618, there is insufficient statistical evidence to conclude that the two groups differ significantly. The results show that, for a sample size of 14 participants, a true difference of 11.705 between the means would have been needed to achieve a 60% chance, and 17.152 to achieve a 90% chance. In contrast, the observed difference in the sample was 2.57.

Cobb angle – t-l. initial testing – final testing

The statistical result (W=234, p=0.161) indicates that there is no statistically significant difference between the medians of the two groups, as the p-value exceeds the 0.05 significance threshold. The observed mean difference between the two groups was 5.71, with a 95% confidence interval between -2.48 and 13.91. The p-value was 0.163, indicating no statistically significant difference between the two groups. The results also indicate an observed difference of 5.71. If the real difference between the means had been 9.15, the test would have had 60% power; for a difference of 13.41, the power would have been 90%. The thoracolumbar Cobb angle decreased from 28.93° ± 11.30 to 23.21° ± 9.68, corresponding to a moderate effect size (Cohen's d = 0.54).

Scoliometer t. initial testing – final testing

The test results show an estimated difference of 1 at a 95.44% confidence interval (-2;4) and a p-value of 0.399 >0.05.

The mean difference between the two tests is 1.3571, with a 95% confidence interval of -2.2787 to 4.9930, and a p-value of 0.449 (> 0.05). The actual difference between the means is 4.0638, with approximately 60% power.

Scoliometer l. – initial testing – final testing

The estimated median difference is 1, and the 95.44% confidence interval for this difference is between -1 and 3.

The observed difference between the means is 1, and if the true difference were 2.5355, the probability would be 60%; for a difference greater than 3.7153, the power of the test would increase to 90%.

Trunk rotation measured with the scoliometer decreased in both regions, with small effect sizes for the thoracic (Cohen's d = 0.29) and lumbar regions (Cohen's d = 0.34).

4. Discussion

The present prospective pilot study explored within-participant changes in Cobb angle, trunk rotation, standing height, sitting height, and skeletal maturity following a six-month supervised Schroth programme in participants with idiopathic scoliosis. Descriptive reductions were observed in thoracic and thoracolumbar Cobb angles, as well as in thoracic and lumbar trunk rotation values. Small increases were also recorded in standing and sitting height, while the Risser sign remained unchanged during the observation period. However, the observed changes should be interpreted with caution because this study included a small, heterogeneous sample and lacked a control or comparison group.

The largest descriptive reduction was observed for the thoracolumbar Cobb angle, which decreased from 28.93 ± 11.30° at baseline to 23.21 ± 9.68° after the intervention period. The thoracic Cobb angle also decreased, from 17.64 ± 14.47° to 15.07 ± 12.36°. These findings indicate a shift toward curve reduction during the six-month observation period. Nevertheless, without a control group, it is not possible to determine whether these changes resulted from the Schroth programme, natural variation, growth-related factors, measurement variability, participant adherence, or a combination of these influences.

The reductions observed in trunk rotation values are also relevant to the descriptive evaluation of the participants. Mean thoracic trunk rotation decreased from 4.86 ± 5.10° to 3.50 ± 4.20°, while mean lumbar trunk rotation decreased from 4.86 ± 2.93° to 3.86 ± 2.90°. Trunk rotation is an important clinical feature of idiopathic scoliosis because it contributes to visible trunk asymmetry and rib prominence. In the present study, the observed decreases suggest a favourable direction of change, but they should not be interpreted as confirmed clinical improvement until supported by adequately powered controlled research.

Previous studies have examined the effects of physiotherapeutic scoliosis-specific exercises in individuals with idiopathic scoliosis. Schreiber et al. reported improved Cobb angle outcomes when Schroth exercises were added to standard care in adolescents with idiopathic scoliosis [10]. Kuru Colak et al. also identified improvements in spinal curvature and trunk muscle endurance following a supervised three-dimensional Schroth exercise programme [11]. In addition, Monticone et al. reported favourable outcomes for active self-correction and task-oriented exercises in participants with mild adolescent idiopathic scoliosis [16]. The direction of the changes observed in the present pilot study is broadly consistent with these earlier findings. However, direct comparison remains limited due to differences in study design, participant characteristics, curve magnitude, intervention duration, and the absence of a control group in the present investigation.

Recent studies published in 2024 and 2025 further support the clinical relevance of Schroth-based and scoliosis-specific exercise interventions. Chen et al. reported that Schroth 3D exercises were more effective than traditional therapy at reducing the Cobb angle and the angle of trunk rotation in adolescents with idiopathic scoliosis [17]. Wang et al. compared six types of scoliosis-specific exercises and reported that Schroth exercises showed relevant long-term effects on spinal deformity and quality of life [21]. Jiang et al. found that Schroth combined interventions and physiotherapeutic scoliosis-specific exercises significantly improved Cobb angle, axial trunk rotation, and SRS-22 scores in adolescents with idiopathic scoliosis [22]. Zhu et al. also reported that Schroth exercises were associated with significant improvements in Cobb angle and quality of life, although the effect on the angle of trunk rotation was not statistically significant in their pooled analysis [23].

The findings of the present study are consistent with this recent literature in terms of the favourable direction of change, especially for thoracolumbar Cobb angle and trunk rotation. However, the present results did not reach statistical significance. This difference may be explained by the small sample size, the absence of a control group, the broad age range of the participants, and the six-month duration of the intervention. Therefore, the current results should be interpreted as preliminary clinical observations rather than as confirmatory evidence of the effectiveness of Schroth therapy.

Recent systematic reviews also highlight that exercise-based scoliosis rehabilitation should be interpreted according to intervention duration, supervision, adherence, skeletal maturity, and baseline curve magnitude [17,18,21–23]. These aspects are important for the present study because the participants differed in age and skeletal maturity, and the sample included children, adolescents, and young adults. Such heterogeneity may have influenced individual responses and may partly explain why descriptive improvements were observed without statistically significant changes.

The small increases observed in standing and sitting height should also be interpreted cautiously. Standing height increased from 162.91 ± 15.91 cm to 163.16 ± 15.69 cm, while sitting height increased from 135.39 ± 7.91 cm to 135.54 ± 7.73 cm. These small descriptive changes may reflect postural variation, growth, measurement variation, or possible changes in axial alignment. Because the sample included participants aged 9 to 22 years, natural growth may have influenced anthropometric outcomes, particularly among younger participants. Therefore, height changes cannot be attributed specifically to the intervention.

The Risser sign remained unchanged during the study period. This finding should be interpreted only as a description of skeletal maturity during the six-month observation period. The broad age range of the sample suggests that participants may have differed substantially in growth potential and in the risk of curve progression. Such variability can influence individual responses and limit the comparability of outcomes within a small sample.

Effect size estimates can assist in interpreting preliminary changes in pilot studies, particularly when statistical power is limited. In the present study, the descriptive change in thoracolumbar Cobb angle appeared larger than the changes recorded for the other outcomes, with a moderate effect size. The effect sizes for the thoracic Cobb angle and trunk rotation were small. However, these estimates should not be interpreted as evidence of treatment efficacy in the absence of a control group and statistically significant paired comparisons.

Strengths and limitations

A strength of the present study is the use of objective clinical and radiographic outcomes, including thoracic and thoracolumbar Cobb angles, scoliometer measurements, standing height, sitting height, and Risser sign. Participants followed a supervised and individualised Schroth programme delivered according to curve characteristics and clinical presentation. The six-month intervention period also allowed observation of medium-term changes in routine clinical practice.

Several limitations must be considered. First, the final analytical sample included only 14 participants. This small sample reduces precision and limits the generalizability of the findings. Second, the study did not include a control or comparison group. Consequently, the observed changes cannot be attributed exclusively to Schroth therapy. Third, the age range of 9 to 22 years included children, adolescents, and young adults, who may have different levels of skeletal maturity and growth potential. This heterogeneity may have increased variability in treatment response and anthropometric measurements.

Fourth, no a priori sample size calculation was performed because the investigation was designed as an exploratory pilot study. Fifth, the study did not include patient-reported outcomes, such as pain, perceived trunk appearance, treatment satisfaction, or health-related quality of life. Sixth, adherence outside supervised sessions and the performance of any home exercise programme were not quantified. Finally, the study did not report intra-rater or inter-rater reliability for radiographic Cobb angle measurements or scoliometer assessments. These factors should be addressed in future investigations.

Clinical implications and future research

The present findings suggest that a supervised Schroth programme can be implemented in a clinical setting for participants with idiopathic scoliosis and can be evaluated through radiographic and clinical outcomes. The reductions observed in Cobb angle and trunk rotation values indicate outcomes that warrant further examination in larger studies. Clinicians should interpret the current results as preliminary and should continue to combine exercise-based management with monitoring of curve progression, skeletal maturity, and individual clinical needs.

Future research should include adequately powered controlled studies with more homogeneous participant groups, preferably stratified by age, skeletal maturity, and initial curve magnitude. Randomised controlled designs comparing supervised Schroth therapy with standard care, observation, bracing, or other conservative interventions would provide stronger evidence regarding treatment effectiveness. Longer follow-up periods of 12 to 24 months would help determine whether observed changes are sustained and whether the intervention is associated with a reduced risk of curve progression. Future studies should also report adherence, measurement reliability, patient-reported outcomes, quality of life, and confidence intervals for all effect size estimates.

5. Conclusions

In this prospective single-group pilot study, participants with idiopathic scoliosis showed descriptive reductions in thoracic and thoracolumbar Cobb angles and in thoracic and lumbar trunk rotation values following a six-month supervised Schroth programme. The most notable descriptive change was observed for the thoracolumbar Cobb angle. However, the observed changes did not reach statistical significance and should be interpreted as preliminary within-participant findings.

Because the study included a small, heterogeneous sample and lacked a control or comparison group, the observed changes cannot be attributed exclusively to Schroth therapy. The present findings, therefore, do not establish treatment efficacy, but they support the feasibility of evaluating supervised Schroth therapy in clinical practice using radiographic and clinical outcome measures.

Further research should include larger, more homogeneous samples, controlled study designs, longer follow-up periods, and paired statistical analyses with effect sizes and corresponding confidence intervals. Such studies are required to determine whether supervised Schroth therapy is associated with clinically meaningful and sustained changes in spinal curvature and trunk rotation in individuals with idiopathic scoliosis. Within comprehensive pediatric rehabilitation programmes and conservative scoliosis management pathways, Schroth-based interventions may represent a useful therapeutic component when applied according to individual clinical characteristics and under professional supervision.

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