

Effectiveness of Traditional Chinese and Western Scoliosis-specific Exercises and Practices for Treating Adult Idiopathic Scoliosis: A Systematic Review and Meta-analysis

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ABSTRACT

BACKGROUND: Non-surgical treatments for adult idiopathic scoliosis is sometimes prescribed for patients as an alternative to surgical interventions, but their effectiveness is uncertain.

OBJECTIVE: To evaluate the effectiveness of the Schroth method, SEAS, and TCM on reducing Cobb angle in adult idiopathic scoliosis.

STUDY DESIGN: Systematic review and meta-analysis.

METHODS: Database indexing services were used to search for applicable studies. Studies are eligible if their subjects are adults, used Schroth, SEAS, or TCM, and reported pre- and post-treatment Cobb angles. Meta-analysis was performed to determine effectiveness and compare the methods.

RESULTS: With support from select, low-quality articles with unclear to high risk of bias, Schroth, SEAS, and TCM are effective in reducing Cobb angle for adult patients with idiopathic scoliosis.

CONCLUSION: Alternate, non-surgical methods for treating adult idiopathic may be effective in reducing Cobb angle. However, further high-quality research must be conducted to validate the effectiveness.

Key words: Adult idiopathic scoliosis; Schroth; SEAS; Traditional Chinese medicine

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INTRODUCTION

Idiopathic scoliosis is a common spinal deformity observed in clinical practice, with an overall prevalence of 0.47-5.2%^[1] for people worldwide. Procedures for reducing the Cobb angle include surgical techniques, such as fusion and fusionless surgery^[2], and non-surgical techniques, such as stretches, exercises, bracing, traditional Chinese medicine^[3]. As surgical techniques often carry risk and may not suit certain patients, such as those with mild Cobb angles^[4], many adult idiopathic scoliosis patients turn to non-surgical procedures in attempt to reduce their Cobb angle. Nonetheless, there are a multitude of different non-invasive interventions from various countries, and each of their efficacy on adults is not completely certain. Previous studies and meta-analyses have examined the efficacy of many Western methods such as the Schroth method and performing core-stabilizing exercises^[5], however, insufficient work has been done for a comprehensive review of both Western and traditional Chinese medicine (TCM) methods, particularly among an adult age group. In this meta-analysis, we aim to examine the effectiveness of multiple Western and TCM non-invasive techniques, and determine the best method(s) for treating adult idiopathic scoliosis.

METHODOLOGY

Data sources and searches

The search strategy used by the Cochrane Review^[6] was employed in this study. Three databases were included in the search: Google Scholar, Baidu Scholar, and iXueshu. Potential articles were first filtered through titles and abstracts; full-text articles were then obtained and assessed for eligibility.

Study selection

A study is deemed eligible for inclusion in this meta-analysis if the following criteria are met: participants are affected with adult idiopathic scoliosis; participants are over the age of 17; participants have a Cobb angle (or average Cobb angle) greater than 10 degrees; and the treatment methods consists solely of non-surgical procedures. Eligible studies also need to include the measurement of the Cobb angle before treatments and after.

Outcomes

Change in Cobb angle (in degrees).

Search Results

The process for selecting eligible studies to include in this meta-analysis is depicted in Figure 1. Twelve studies were deemed to be appropriate to be included. Three article database indexing services were used to search diverse publications: Google Scholar, Baidu Scholar, and iXueshu. The search prompts used included “adult idiopathic scoliosis”, “non-invasive treatment”, and “non-surgical treatment”, as well as respective translations. A total of 5535 studies were identified from the database search; 766 were excluded due to duplicates, 3891 were excluded due to titles and abstracts which did not fit our criteria, 100 were excluded upon screening full-texts as they did not fit our criteria.

Data Extraction

Results from each study were extracted independently by the researcher by reading the full-text articles. Some post-treatment Cobb angle were calculated by subtracting the reported decrease from the initial Cobb angle as the post-treatment Cobb angle was not explicitly reported. When multiple Cobb angles were presented

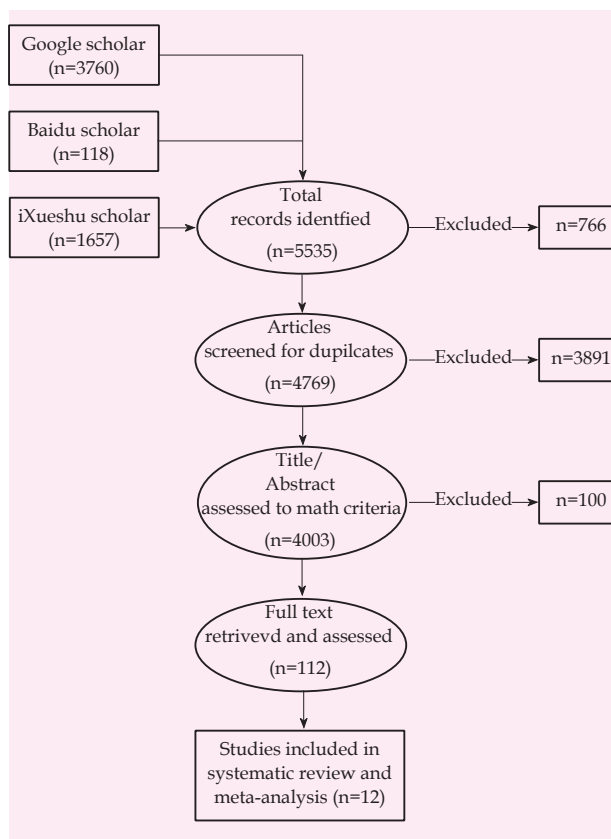


Figure 1 Flowchart depicting the selection process for studies.

for one individual (e.g. 20 degrees thoracic, 25 degrees lumbar), an arithmetic mean was calculated and used.

Risk of bias assessment

Selected studies were assessed for risk of bias through use of the Cochrane Risk of Bias assessment tool^[7]. This was done independently by the researchers.

RESULTS

	Jin et al. 2001	Negrini 2008	Negrini 2009	Liu et al. 2009	Bang et al. 2010	Jo 2012	Wartters et al. 2012	Hagit 2013	Lebel et al. 2015	Negrini 2015	Ng et al. 2017	Boehland et al. 2020
Random sequence generation	-	-	-	?	?	?	?	?	-	-	-	?
Allocation concealment	?	-	-	-	?	-	-	-	-	-	-	-
Blinding of participants and personnel	-	-	-	-	-	-	-	-	-	-	-	-
Blinding of outcome assessment	-	-	-	-	-	-	-	-	-	-	-	-
Incomplete outcome data	+	+	+	+	+	+	+	+	+	+	?	+
Selective reporting	+	+	+	+	+	+	+	+	+	+	?	+
Adherence to prescribed intervention	+	?	?	+	+	+	+	?	?	?	?	+
Overall bias assessment	Unclear risk	High risk	High risk	Unclear risk	Low risk	Unclear risk	Unclear risk	High risk	High risk	High risk	High risk	Unclear risk

Legend:
 Low risk: +
 High risk: -
 Unclear risk: ?

Figure 2 Risk of bias ratings adapted from Cochrane Risk-of-Bias Tool.

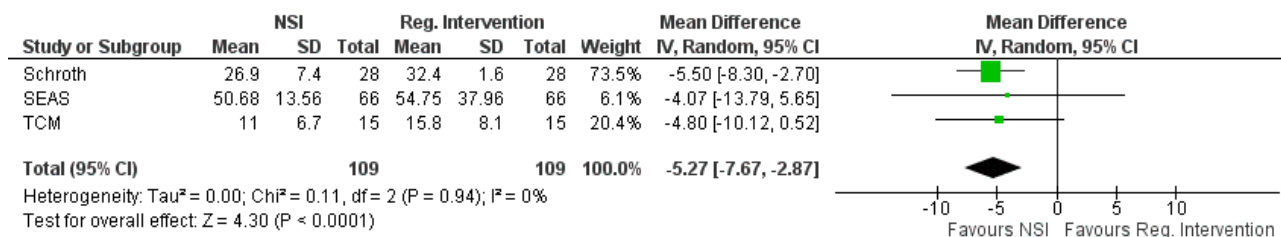


Figure 3 Forest plot depicting the mean differences in Cobb angle between non-surgical intervention (NSI) and regular intervention arms. SD, standard deviation; IV, instrumental variable; CI, confidence interval; I², inconsistency test.

Table 1 Characteristics, procedures, and outcomes of the included studies.

Study	Sample	Type and Size of Spinal Curves	Intervention Method	Results
Hagit 2013 [8]	n = 1 Loss to follow up = 0 26 years F: 1 (100%) M: 0 (0%)	Double major scoliosis. Cobb angles: 38° and 24° for thoracic and lumbar segments, respectively.	One-hour Schroth exercise sessions twice per week for four weeks followed by one session each week for 20 additional weeks. In addition, a home exercise program, which consisted of 30-minute sessions five days per week, was recommended.	After 6-months, the Cobb angle decreased significantly from 38° and 24° to 27.6° and 19° in thoracic and lumbar segments, respectively.
Ng 2017 [9]	n = 23 Loss to follow up = 11 45.9 ± 15.0 years F: 11 (91.7%) M: 1 (8.3%)	Two patients had thoracolumbar curves while the others had lumbar curves. Mean Cobb angle: 31.2 ± 9.6°.	Patients were taught Schroth best practice (SBP) exercises once weekly for four weeks, then performed the exercises at home three times a week for 9 months.	After 9 months, SBP exercises significantly decreased the Cobb angle (p<0.01) to 27 ± 7.4°.
Lebel 2015 [10]	n = 1 Loss to follow up = 0 23 years F: 1 (100%) M: 0 (0%)	Double major scoliosis. Cobb angles: 70° and 48° for thoracic and lumbar segments, respectively.	One-hour Schroth physiotherapy clinic sessions 2–4 times a month in combination with a 45–60 min home exercise program (HEP) 3–5 times a week. After 12 months, the patient also obtained a plastic Thoraco-lumbosacral-orthosis (TLSO) brace as she prepared for rib separation surgery (which she did not go through with).	After 9 months, Cobb angles decreased to 58° and 43° in the thoracic and lumbar segments, respectively. After 12 months and while wearing the TLSO brace, Cobb angles further decreased to 38° and 30° in the thoracic and lumbar segments, respectively.
Negrini 2008 [11]	n = 1 Loss to follow up = 0 25 years F: 1 (100%) M: 0 (0%)	Double major scoliosis. Cobb angles: 35.5° and 47° for thoracic and lumbar segments, respectively.	The patient was treated with SEAS (Scientific Exercises Approach to Scoliosis) only. She performed SEAS exercises 30 minutes every day at home, and went to the treatment center every two months to check and intensify her exercises.	In one year, the patient reduced her Cobb angles to 32° in the thoracic and 28.5° in the lumbar.
Negrini 2009 [12]	n = 31 Loss to follow up = 0 38 ± 11 years F: 28 (90.3%) M: 3 (9.7%)	Mean Cobb angle of 55 ± 14°.	Treated with SEAS.	Cobb angles decreased by 3.6 ± 5° after an average of 3 years of treatment.
Negrini 2015 [13]	n = 34 Loss to follow up = 0 38 ± 11 years F: 29 (85.3%) M: 5 (14.7%)	Curve types are as follows: TH: 4 (12%) TH-L: 4 (12%) LU: 6 (17%) TH + L: 17 (50%) TH + TH-L: 1 (3%) TH DOUBLE MAJOR: 2 (6%)	Patients were prescribed Scoliosis Specific SEAS Exercises only and had to practice their exercises regularly for at least 10 months per year. Therapy includes at least two weekly exercise session each lasting 45 minutes.	After an average of 2 years of treatment (range 1-18 years) patients experienced an average improvement of 4.6 ± 5.0° in their Cobb angles.
Jo 2012 [14]	n = 1 Loss to follow up = 0 25 years F: 1 (100%) M: 0 (0%)	Right thoracic scoliosis with a Cobb angle of 22°.	Treatment course of three visits per week for three weeks. Traditional Korean Medicine with acupuncture.	After three weeks, the Cobb angle of the right thoracic was measured 17°, a 5° decrease.
Boehland 2020 [15]	n = 1 Loss to follow up = 0 34 years F: 0 (0%) M: 1 (100%)	Right convex scoliosis curve of 21°.	Combination Traditional Chinese Medicine, using acupuncture with cupping therapy 2 times a week for a total of 15 treatments.	After 15 treatments (several weeks), the spinal curvature was reduced by 3° to 18°.
Bang 2010 [16]	n = 1 Loss to follow up = 0 17 years F: 1 (100%) M: 0 (0%)	Scoliosis with mean Cobb angle of 13.56°.	Unspecified period of time. TCM treatment, including acupuncture, chuna, and moxibustion.	After 18 weeks of treatment, the Cobb angle decreased to 21°.
Jin 2001 [17]	n = 12 Loss to follow up = 0 30 years F: 6 (50%) M: 6 (50%)	Lumbar scoliosis with Cobb angle of 31°.	Acupuncture, three times per week, six weeks of treatment.	Mean Cobb angle decreased to 9.31°.
Liu 2009 [18]	n = 1 Loss to follow up = 0 74 years F: 1 (100%) M: 0 (0%)	Lumbar scoliosis with Cobb angle of 31°.	Acupuncture, three times per week, six weeks of treatment.	After six weeks, mean Cobb angle decreased to 21°.

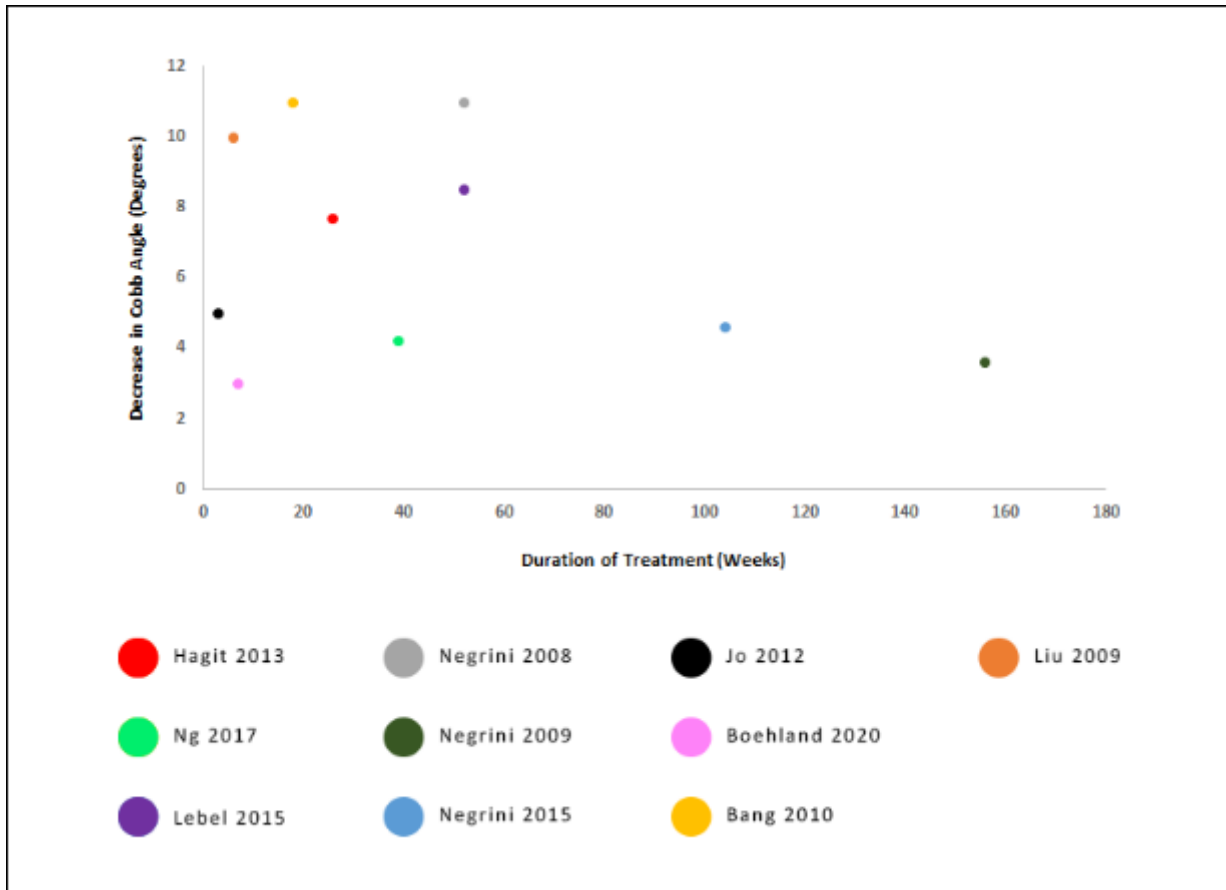


Figure 4 Scatter plot depicting the duration of treatment in each study (where applicable) as it correlates to decrease in Cobb angle.

DISCUSSIONS

Synthesis and interpretation of findings

An interesting discovery made during the review of the articles is that the mean treatment duration of TCM methods is significantly lower than Schroth and SEAS. The mean durations for the Schroth method, SEAS, and TCM methods is 39 weeks, 105 weeks, and 8.5 weeks, respectively.

All twelve studies reported a decrease in the patients' Cobb angle after performing the treatment, ranging from a decrease of 3 degrees in Boehland 2020^[15] using TCM and a decrease of 11 degrees in Negrini 2008^[11] and Bang 2010^[16], using SEAS and TCM, respectively. It is interpreted that, when compared to regular care/no intervention, all three methods are more effective in reducing the Cobb angle in adult idiopathic scoliosis.

Among the three methods, synthesis of findings suggest that the Schroth method is the most effective in treating patients with adult idiopathic scoliosis (Figure 3), with the highest change in patient's Cobb angle and highest weight of prediction. However, it is also important to consider the duration of treatment for patients of each study; this is shown in Figure 4, where we can interpret that most TCM techniques take on a shorter time span of treatment of several weeks, while Western techniques, namely Schroth and SEAS, often range from six months to two years. This may suggest that performing TCM treatment techniques may result in a faster decrease in Cobb angle.

Limitations

One of the limitations in this study is the lack of pre-existing research on the effects of non-surgical interventions on adult idiopathic

scoliosis. There are some studies on non-invasive treatments of adolescent idiopathic scoliosis, but the number of studies greatly decreased regarding similar treatments in adults.

Additionally, some studies included in this meta-analysis are oral presentation abstracts from conferences. The nature of the published oral presentation does not go in-depth into the methodology, and therefore a lack of understanding of timeframe and methods were faced when analyzing certain studies.

As seen in the Risk of Bias Chart, almost all our selected studies received a rating for high risk of bias.

Lastly, as this meta-analysis included studies where patients had highly varying Cobb angle degrees, it is difficult to generalize the results of this meta-analysis. It is still a question whether treatments like Schroth are more effective on patients with higher degrees of Cobb angle, or vice versa.

Suggestions for future research

As mentioned, more research should be conducted on the effects of various non-surgical interventions on adult idiopathic scoliosis. This will validate the significance of such methods and increase confidence for clinical recommendation.

An interesting field for potential research is the effects of TCM methods and the relationship between the duration of their treatment and decrease in Cobb angle, and whether it provides a "quick fix" alternative compared to Western methods.

CONCLUSION

Select documented studies (which include case studies and retrospective cohort studies) for the Schroth method, SEAS method,

and traditional Chinese medicine report significant reductions in Cobb angle in adults with idiopathic scoliosis.

Based on our meta-analysis, the Schroth method is the most effective method of treating adult idiopathic scoliosis, considering only the Cobb angle. TCM is found to be the next most effective, followed by SEAS.

Through our initial examination of all related publications, there suggests a feasibility in alternate— non-surgical— treatment methods for reducing Cobb angle in adult idiopathic scoliosis (Schroth, SEAS, TCM methods), though the scarcity and design of such studies impose doubts on their effectiveness. Further high-quality and replicable studies with rigorous methods must be conducted on each of the interventions to confirm its validity and to provide basis for clinical significance.

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