Spinal Manipulative Therapy for Adolescent Idiopathic Scoliosis: A Systematic Review

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Abstract

Objective: The purpose of this study was to perform a systematic review of clinical trials of spinal manipulative therapy for adolescent idiopathic scoliosis.

Methods: Search strategies were developed for PubMed, CINHAL, and CENTRAL databases. Studies were included through June 2016 if they were prospective trials that evaluated spinal manipulative therapy (eg, chiropractic, osteopathic, physical therapy) for adolescent idiopathic scoliosis. Data were extracted and assessed by 2 independent reviewers. Cochrane risk of bias tools were used to assess the quality of the included studies. Data were reported qualitatively because heterogeneity prevented statistical pooling.

Results: Four studies satisfied the inclusion criteria and were critically appraised. The findings of the included studies indicated that spinal manipulative therapy might be effective for preventing curve progression or reducing Cobb angle. However, the lack of controls and small sample sizes precluded robust estimation of the interventions' effect sizes.

Conclusion: There is currently insufficient evidence to establish whether spinal manipulative therapy may be beneficial for adolescent idiopathic scoliosis. The results of the included studies suggest that spinal manipulative therapy may be a promising treatment, but these studies were all at substantial risk of bias. Further high-quality studies are warranted to conclusively determine if spinal manipulative therapy may be effective in the management of adolescent idiopathic scoliosis. (J Manipulative Physiol Ther 2017;40:452-458)

Key Indexing Terms: *Spinal Manipulation; Scoliosis; Adolescent; Cobb Angle; Systematic Review*

Introduction

Adolescent idiopathic scoliosis represents a >10° 3-dimensional spinal deviation occurring in adolescents 10 years or older.[1] The etiology of this condition remains unknown, and its documented prevalence ranges from 1% to 3%.[2] Although scoliosis can remain stable in some adolescents throughout their growth period, it can progress in others and needs to be adequately managed.

Management of adolescent idiopathic scoliosis is aimed at preventing curve progression and respiratory dysfunction, reducing spinal pain, and improving aesthetics.[3] Appropriate management usually comprises (1) observation for a small curve <25°, (2) bracing or special intensive inpatient rehabilitation for curves between 25° and 45°, and (3) surgical correction when the curve has progressed beyond 45°.[4] Observation usually encompasses 6 to 12 months' in-clinic evaluation and, in some cases, radiologic assessment.[5]

Special inpatient rehabilitation comprises a combination of therapeutic intervention and exercises as an inpatient hospital program and is typically recommended for curvatures of 30° to 40°, with or without the addition of bracing.[3] This treatment approach, however, requires an extensive hospital stay, which may be unsuitable for some young people to undertake.

Bracing has been reported to significantly decrease the risk of progression in high-risk curves.[6] However, several issues can affect bracing compliance, including poor self-esteem and body image resulting from the brace's unpleasant cosmetic appearance, discomfort associated with pressure points or inclement weather, and impeded range of movement.[7] Given the reluctance of substantial numbers of adolescents to use bracing, it is warranted to

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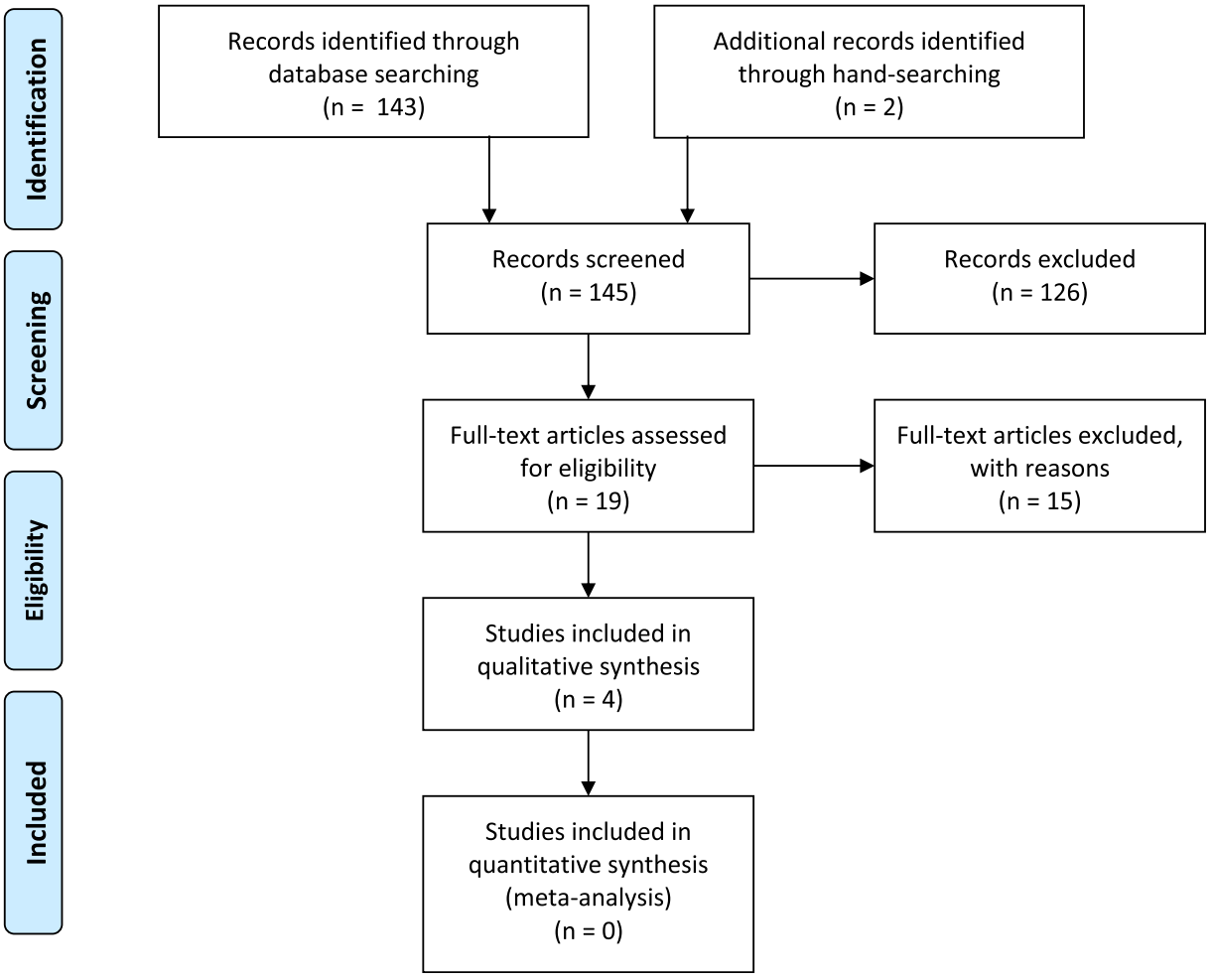

Fig 1. *PRISMA diagram of the study selection process.*

establish whether alternatives to bracing may be effective in the management of adolescent idiopathic scoliosis.

Guidelines developed by the Scoliosis Research Society suggest that spinal manipulative therapy may be beneficial in the management of adolescent idiopathic scoliosis.[8] Studies have reported that spinal manipulative therapy is commonly used by young people for the management of musculoskeletal disorders.[9] Whether adolescents with scoliosis use spinal manipulative therapy is unknown, but it would seem likely that it is the case. Hence, it is timely to systematically review the evidence regarding the effectiveness of spinal manipulative therapy for adolescent idiopathic scoliosis. The objective of this systematic review was to assess the effectiveness of spinal manipulative therapy for adolescent idiopathic scoliosis.

Methods

The reporting of this review accorded with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations.

Search Strategy

The implementation of the search strategies and selection of studies is displayed in Figure 1. Electronic search strategies were constructed to identify English or French language studies that examined spinal manipulative therapy for adolescent idiopathic scoliosis. PubMed, CINAHL, and CENTRAL databases were searched from inception to June 2016. Specific search strategies used in PubMed, CINAHL, and CENTRAL are presented in Appendix 1. Two reviewers independently screened the titles and abstracts for the studies identified through these searches to ascertain potentially relevant studies that examined spinal manipulative therapy for adolescent idiopathic scoliosis. The reference lists in these identified studies were also reviewed to identify other potentially relevant studies. Full-text copies of all potentially relevant studies were retrieved and considered for inclusion in this review.

Selection Criteria

Studies were included if they were prospective trials that evaluated spinal manipulative therapy for adolescent

scoliosis. It was originally intended to only include randomized controlled trials because that study design was best suited to address the research question. However, a preliminary review of the literature indicated that a scant number of relevant randomized controlled trials were available. Therefore, any type of single-arm prospective study or prospective study that compared the effectiveness of spinal manipulative therapy with either sham treatment or other interventions of established efficacy was included in this review. Spinal manipulative therapy was defined as a "hands-on" therapy applied to the spine, including both manipulation and mobilization, commonly delivered by chiropractors, osteopaths, or manual therapists.[10] Mobilization consists of low-grade velocity, small- or large-amplitude passive movement techniques within the joint's range of motion and control. On the other hand, manipulation involves high-velocity impulses or thrusts directed at a synovial joint over a short amplitude close to, or at, the end of the passive or physiological range of motion.[10] Adolescent idiopathic scoliosis was defined as a spinal deviation >10° in adolescents aged between 10 to 17 years old. Studies were excluded if they were published in languages other than English or French.

Data Extraction

A data extraction form was piloted to ensure consistency in interpretation of the data. Two reviewers independently extracted data from the included studies.

Outcome Measures

The selection of outcome measures included in this review was based on consensus recommendations developed by the Scoliosis Research Society and Society on Scoliosis Orthopaedic and Rehabilitation Treatment.[11] The primary outcome of interest was change in the Cobb angle. Secondary outcomes included aesthetics, pain intensity, physical disability, quality of life, and adverse events. In line with the consensus recommendations, we considered outcomes in terms of the following time periods: very short term, short term (at least 12 months of treatment), end of bone growth (Risser +3/4), end of treatment (at treatment discontinuation), and final results at full-bone maturity.[11]

Assessment of Risk of Bias for Included Studies

Two reviewers independently assessed risk of bias of the included studies using the Cochrane Bias Methods Group's criteria for randomized controlled trials[12] and the Effective Practice and Organisation of Care's criteria for nonrandomized trials.[13] Disagreements in the risk of bias were resolved through consensus.

Data Analysis

All data were double extracted into spreadsheets and then compared between reviewers to ensure consistency. Study heterogeneity prevented statistical pooling, and hence data were reported qualitatively.

Grading the Strength of Evidence

The overall strength of the evidence was assessed using the GRADE Working Group grades of evidence.[14] These grades are as follows:

- High quality: Further research is very unlikely to change our confidence in the estimate of effect.
- Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
- Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Results

Study Selection

The electronic search strategies identified 143 potentially relevant studies, and 2 additional potentially relevant studies were identified through hand searching (Fig 1). After the screening of titles and abstracts, 19 full-text studies were retrieved and considered for inclusion.[15-33] Of these studies, 4 satisfied the eligibility criteria and were included in this systematic review.[16,22,25,29]

Study Characteristics

Table 1 displays the included studies' characteristics. One study[25] was a randomized controlled pilot study, and the other 3 studies were nonrandomized trials. The interventions in 3 of the studies[16,22,25] were similar but differed considerably from the fourth study.[29] Treatment duration varied substantially: In 1 study,[16] interventions were administered 3 times per week over 8 weeks; in another study, interventions were provided 3 times per week during the first month, twice per week during the second month, once per week during the third and fourth months, and twice per month over the fifth and sixth months[22]; interventions in another study were delivered 2 or 3 times per week for patients at high risk of progression, 1 or 2 times per week for patients at medium risk, and weekly or fortnightly for patients at low risk[29]; and in the remaining study[25] interventions were delivered in an intensive inpatient admission of up to 6 weeks, followed by return treatments of 3 to 6 weeks' duration. The studies samples comprised 5, 6, 42, and 156 participants. Finally, Cobb angle was the primary outcome in all studies.

Table 1. *Characteristics of Included Studies*

Study	Design	Study Sample	Intervention	Outcome Measures	Follow-Up Period	Outcome
Byun and Han[16]	Pre-/postintervention	4 boys, 1 girl; mean age = 11.8 y; mean Cobb angle = 11.2°	Chiropractic manipulation + soft tissue therapy	Cobb angle	4 wk and 8 wk	Cobb angle significantly reduced at 4 wk and at 8 wk
Rowe et al[25]	Randomized controlled pilot study	5 girls, 1 boy; mean age = 14.0 y; mean thoracic Cobb angle = 18°, mean thoracic-lumbar Cobb angle = 26°, mean lumbar angle = 23°	Chiropractic manipulation + soft tissue therapy	Cobb angle; Scoliosis Quality of Life Index	6 mo	No change in thoracic Cobb angle Thoracic-lumbar Cobb angle reduced by 4°, lumbar Cobb angle reduced by 7° Significance unassessed
Weiss et al[29]	Pre-/postintervention	156 girls, 25 boys; mean age unreported, age ranged from 9-15; mean Cobb angle = 27°	Exercise + soft tissue therapy + traction + osteopathic manipulation + acupuncture	Cobb angle	At least 12 mo postbaseline	Compared with untreated group, intervention group significantly less likely to experience progression in Cobb angle of >5°
Lantz and Chen[22]	Pre-/postintervention	26 girls, 16 boys; mean age unreported, age ranged from 6-17 y; data were only extracted for the 10-17 y olds (adolescents); Cobb angle range = 6°-20°	Chiropractic manipulation	Cobb angle	12 mo	No significant reduction in Cobb angle

Table 2. *Risk of Bias Across the Included Studies*

Study	Random Sequence Generation (Selection Bias)	Allocation Concealment (Selection Bias)	Blinding of Participants (Performance Bias)	Blinding of Outcome Assessment (Detection Bias)	Incomplete Outcome Data (Attrition Bias)	Other Sources of Bias	
Rowe et al[25]	+	+	+	?	+	–	
	Intervention Independence	**Intervention Effect Prespecification**	**Blinding**	**Selective Reporting**	**Incomplete Outcome Data**	**Data Collection Effect**	**Other Sources of Bias**
Byun and Han[16]	–	–	?	+	+	+	–
Lantz and Chen[22]	+	–	+	+	+	+	–
Weiss et al[29]	–	–	+	+	?	+	–

+: high risk of bias; –: low risk of bias; ?: undetermined.

Risk of Bias Assessment

Table 2 displays the risk of bias assessment across the included studies. In terms of the randomized controlled pilot study,[25] the study was found to be at low risk of selection, performance, and attrition bias; unclear risk of detection bias; and high risk of other sources bias, particularly because the low number of participants in the study meant that the effect size could not be robustly established.

For the nonrandomized trials,[16,22,29] all studies were at low risk of bias for data collection effect and selective reporting, and all studies were at high risk of bias for intervention effect prespecification and other sources of bias. Two studies[16,22] were at high risk of bias, and the third[29] was at low risk of bias for intervention independence. Incomplete outcome data were a low risk of bias for 2 studies[16,22] and an unclear risk of bias for the third study.[29] Two studies[22,29] were at low risk of blinding bias, and the third[16] was at unclear risk of blinding bias.

Analysis

Aside from the common use of spinal manipulative therapy, the included studies differed substantially in terms of study populations and treatment durations. Statistical pooling was not undertaken because of the heterogeneity between studies. The results of the included studies are summarized in the following section and displayed in Table 1.

Chiropractic Spinal Manipulation

In 1 study[16] without a control group, chiropractic spinal manipulation combined with soft tissue therapy resulted in a mean reduction in the Cobb angle of 8.8° after 4 weeks and 10.2° after 8 weeks. In another study[25] involving chiropractic spinal manipulation combined with soft tissue therapy, no change in the Cobb angle was observed in the control group after 6 months, whereas the intervention group experienced 0°, 4°, and 7° Cobb angle reductions in the thoracic, thoracic-lumbar, and lumbar regions, respectively. In the remaining study[22] involving chiropractic spinal manipulation, the mean reduction in the Cobb angle was 0.5°, in a period ranging from 6.5 to 28 months, subsequent to baseline.

Physiotherapy

One study[29] matched 2 independent treatment groups by age and sex and compared no treatment in 1 group with the tailored use of osteopathic manipulation, soft tissue therapy, traction, acupuncture, and exercise in the other group. For those aged less than 12 years, 71.2% of the untreated group experienced an increase of the Cobb angle of >5°, whereas 46.6% in the intervention group experienced the same degree of progression in the Cobb angle. Among those aged 12 to 14, 55.8% of the untreated group experienced an increase of the Cobb angle of >5°, whereas 30.5% in the intervention group experienced the same degree of progression in the Cobb angle.

Adverse Events

Adverse events were only detailed in 1 of the included studies,[25] which noted that 2 benign reactions were reported over the course of the study.

Overall Strength of the Evidence

The overall strength of the evidence was low. In particular, the lack of control groups in 2 of the studies[16,22] and small number of participants in 3 of the studies[16,22,25] meant that estimates of the effect size were likely to change subsequent to further studies.

Discussion

The results of the included studies suggest that spinal manipulative therapy may be promising for the management of adolescent idiopathic scoliosis. However, the small number of participants in 3 of the included studies[16,22,25] meant that there was insufficient power to achieve a robust estimation of the interventions' effect size. In addition, the lack of control group in 2 of those studies[16,22] also increases uncertainty around the interventions' effect size. In the other included study,[29] which had an adequate sample size, the manner in which the outcomes were reported precluded

the calculation of the intervention's effect size. Hence, controlled, adequately powered studies are required to establish whether spinal manipulative therapy may be beneficial in the management of idiopathic adolescent scoliosis.

Authoritative recommendations for the assessment of scoliosis research outcomes have been recently developed.[11] These recommendations note that the following outcomes should be routinely evaluated: aesthetic concerns, curve progression, disability, pain, and quality of life. Of these, the only outcome reported in the studies included in this review was curve progression. Further studies therefore need to capture a broader of range of outcomes to ensure the development of a more complete understanding of the manner in which spinal manipulative therapy affects the lives of young people who experience adolescent idiopathic scoliosis. Moreover, to facilitate statistical pooling of data, researchers should use standardized outcome measures recommended by the Scoliosis Research Society and Society on Scoliosis Orthopaedic and Rehabilitation Treatment.[11]

In all but 1 of the studies included in this review,[22] spinal manipulative therapy was administered along with other adjunct therapies. Although the concurrent use of therapies may reflect pragmatic clinical practice, it does not allow for the isolation of the specific effect of spinal manipulative therapy in clinical trials. Hence, further studies should determine the specific effect of spinal manipulative therapy for adolescent idiopathic scoliosis through the use of a study design that involves only administering spinal manipulative therapy in 1 of the treatment arms.

The benefit of any therapy also needs to be considered in light of its adverse consequences.[34] Only 1 of the studies[25] included in this review reported adverse events. Therefore, additional studies that examine the effectiveness of spinal manipulative therapy for adolescent idiopathic scoliosis should routinely capture information about adverse events in order to weigh the benefit against the risk of treatment.[35]

Limitations

Limitations associated with the search strategy need to be considered in the interpretation of the present study's findings. The search strategy was limited to PubMed, CINHAL, and CENTRAL databases, and therefore relevant studies indexed only in other databases may have been omitted from this review. In addition, the nonindexed literature was not searched, which may also have resulted in the omission of relevant studies. Nonetheless, in our view the search strategy used in this review did not exclude a body of literature large enough to alter the conclusion that spinal manipulative therapy for idiopathic scoliosis remains an inadequately researched area.

Conclusion

There is currently insufficient evidence to establish whether spinal manipulative therapy effectively reduces curve severity in adolescent idiopathic scoliosis. The results of the included studies suggest that spinal manipulative therapy may be a promising treatment for adolescent idiopathic scoliosis, but these studies were all at substantial risk of bias. High-quality studies are warranted to determine if spinal manipulative therapy may be beneficial in the management of adolescent idiopathic scoliosis.

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No funding sources or conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): J.T., N.S., C.D.L., C.K., H.L., S.L.
Design (planned the methods to generate the results): J.T., N.S., C.D.L., C.K., H.L., S.L.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): J.T., N.S., C.D.L., C.K., H.L., S.L.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): J.T., N.S., C.D.L., C.K., H.L., S.L.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): J.T., N.S., C.D.L., C.K., H.L., S.L.
Literature search (performed the literature search): J.T., N.S., C.D.L., C.K., H.L., S.L.
Writing (responsible for writing a substantive part of the manuscript): J.T., N.S., C.D.L., C.K., H.L., S.L.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): J.T., N.S., C.D.L., C.K., H.L., S.L.

Practical Applications

- Manual therapies are widely used to manage musculoskeletal disorders in children and adolescents.
- Our findings highlight that spinal manipulative therapy may be beneficial for adolescent idiopathic scoliosis.
- Further study is warranted to consolidate the evidence base regarding the effectiveness of spinal manipulative therapy in that population.

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