



Case Study

Is early treatment for mild adolescent idiopathic scoliosis superior over the traditional ‘watch & wait’ approach? A case report with long-term follow-up

PAUL A. OAKLEY¹⁾

¹⁾ Private Practice: 11A-1100 Gorham Street, Newmarket, Ontario L3Y 8Y8, Canada

Abstract. [Purpose] To present a case of the complete correction of mild suspected adolescent idiopathic scoliosis in support of the argument that early aggressive treatment is superior to the traditional ‘watch & wait’ approach. [Subject and Methods] A 9-year-old female presented with a 14° thoracic curve indicative of early adolescent idiopathic scoliosis. The parents consented to immediate and early treatment with the SpineCor dynamic and corrective scoliosis brace. The brace was worn 20 hours per day and check-ups were performed every three months. [Results] The patient achieved complete correction of the thoracic curve within 9-months. The child was followed for 4.5 years until she approached near cessation of skeletal growth (Risser sign grade 4) at the age of 14 years, 4-months. The patient’s spine remained straight throughout the follow-up. [Conclusion] This report as well as others suggests that the SpineCor bracing system is a unique and effective intervention for mild scoliosis. Further, this case illustrates an ideal outcome and supports the argument that initiating treatment at the earliest indication of suspected idiopathic scoliosis should offer superior outcomes versus the traditional ‘watch & wait’ approach. Last, radiation exposures associated with radiography for scoliosis treatment and management are negligible and not harmful.

Key words: Adolescent idiopathic scoliosis, Scoliosis brace, Watch and wait

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INTRODUCTION

The treatment for mild (<25°) adolescent idiopathic scoliosis (AIS) has traditionally been the ‘watch and wait’ approach¹⁻³. This approach, however, is questionable as all larger curves were once smaller curves^{4,5}. In fact, untreated AIS tends to progress, both during the growth period as well as after skeletal maturity^{6,7}.

Since scoliosis curve progression remains unpredictable, we agree with Sy et al. who argue that observation (‘watch & wait’) as a passive treatment for idiopathic scoliosis with mild curves (Cobb angles <25°) in immature patients is “difficult to justify⁶.” As scoliosis curves develop, Stokes⁸ suggests that the shearing component of the asymmetrical forces would be the main contributing force to its continued progression. Because of this, any amount of scoliosis reduction (by conservative means) would be biomechanically beneficial—the straighter the spine, the less shearing force, and the less vulnerable to further progression. This is why aggressive treatment for an early detected mild AIS curve may prove superior as theoretically, the smaller the curve, the better the chance of reducing the curve towards verticality.

SpineCor bracing is a unique form of three-dimensional dynamic bracing for the treatment of idiopathic scoliosis⁹. The bracing is custom to the patient’s presenting posture and scoliosis pattern where a ‘corrective movement’ is determined during the bracing process, which is essentially a unique reversal (a combination of axial de-rotation, lateral shifting, and/or

Corresponding author. Paul A. Oakley (E-mail: docoakley.icc@gmail.com)

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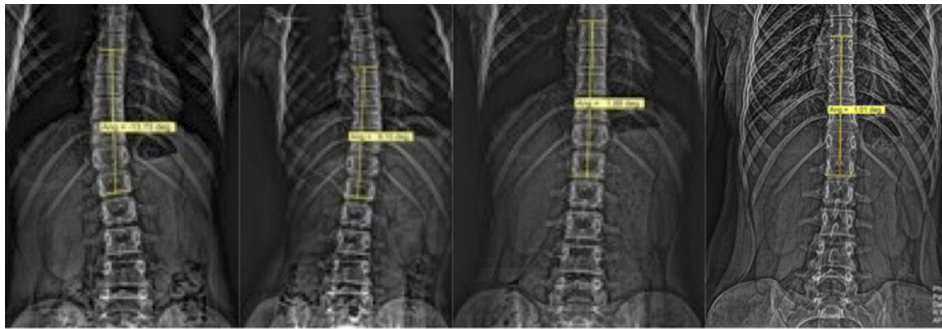


Fig. 1. AP standing lumbar radiographs showing T7-L1 Cobb angles. A: Pre-brace 14° right thoracic curve; B: In brace 9° left thoracic curve; C: No curve (2°) after 3-months no brace, (a slight left thoracic translation is present); D: No curve (1°) after 4 years 7-months follow-up.

lateral bending) of the postural and spinal asymmetry.

The functional aspects of the brace is comprised of ‘corrective’ elastic bands which provide tension between places on the torso, where they connect to a back piece (bolero), and along the waist, where they attach to sections on a pelvic base. “The moderate tension in the elastic bands allows the repetition and amplification of the corrective movement as the child undertakes everyday activities¹⁰⁾”. The brace is to be worn for a minimum of 18-months to obtain “neuromuscular integration of the new movement strategy¹⁰⁾”.

Pediatric patients are required to wear the brace for twenty hours a day, having two, two-hour breaks. Check-ups are performed every three months, where the patient’s posture and clinical status is updated and the brace is adjusted if necessary. Every six months relevant x-rays are taken to monitor treatment progress. Patients can be considered for weaning out of the brace once three criteria are met: 1. Brace worn for minimum of 18-months; 2. Minimum Risser sign grade of 4; 3. Females are minimum 2 years post-menarchy.

SpineCor claims the brace may be effective for scoliosis curves ranging from 10°–50°. There have been several studies out of St. Justine’s Hospital as to the effectiveness of this bracing system^{9, 11, 12)}. The Spinecor training manual (2006) states: “therapeutic success is possible in more than 87% of cases¹⁰⁾”. Recent evidence suggests it may be more effective than that^{13–15)}.

We present the successful results of the SpineCor bracing in a 9-year-old patient presenting with a mild thoracic AIS with long-term (4.5 yrs) follow-up proving stable spinal correction to essentially the end of skeletal growth.

SUBJECT AND METHODS

On April 24, 2013 a 9-year-old female with scoliosis came with her parents for an assessment and consultation. A clinical assessment of her posture and radiographs were taken. She reported no back pains related to her deformity. The only complaint she had was her left knee had bothered her after hitting it while playing around with a friend. This was determined to be a self-limiting issue that would clear up in time.

Upon radiographic examination, the antero-posterior (AP) thoraco lumbar view demonstrated the patient had a 14° right convex thoracic curvature as measured by the Cobb method from inferior endplate of T7–L1 (Fig. 1). The patient demonstrated a grade 0 Risser sign, indicating that the main skeletal growth period has not yet occurred.

On May 28th, 2013 the child and parents consented to go ahead with the SpineCor bracing system. It was determined through the former clinical information collected that she was a ‘Right Thoracic Type 1’ configuration according to the SpineCor classification system. The corrective movement for this type of curve pattern is a counterclockwise rotation of the thorax, a clockwise rotation and clockwise tilt of the shoulders, and a left lateral shift of the trunk. This entailed the use of four corrective bands ranging in tensions from ‘low-moderate’ (band No. 2), ‘high’ (bands No. 1 and 3), and ‘substantial’ (band No. 4). The patient as well as the parents consented to the publication of these results.

RESULTS

After the brace was assembled and placed on the patient, an AP thoracolumbar radiograph was taken to ensure feasibility of the bracing configuration. Her scoliotic deformity as measured (Cobb T7–L1) had reversed to become a 9° left thoracic curvature in brace (Fig. 1). This was determined to be ideal as the patient was in a ‘mirror image^{®16)}’ or the complete opposite spinal configuration.

On June 18, 2013 the child came in for her first post-bracing check-up. This is to make any initial adjustments to the brace and remediate any potential comfort issues with the new worn brace. She reported no problems. The brace was re-adjusted as

from clinical experience, the brace loosens and loses its functionality as it is first worn and washed etc. All four of the corrective bands were tightened to more appropriate tensional ratios as per SpineCor protocol. No x-rays were taken on this visit.

On August 27, 2013 the child returned for her first, of many, 3-month check-ups. Any bands were re-adjusted to maintain an appropriate tension. One band, number four was replaced to re-establish better elastic tension. Her AP radiograph demonstrated an increase in the reversal of her scoliosis to a 17.5° left curvature.

On November 28, 2013 the child came in for her 6-month check-up. It was determined that it was best to replace all the corrective bands to maintain an optimal elastic tension and functionality of the brace. The AP thoracic x-ray showed a 20° left curvature. On February 24, 2014 she came in for her 9-month check-up. The AP thoracic x-ray showed an 8° left curvature. An x-ray three days later without brace wearing showed a 4° right curvature. For fear of this only being a transient result and to ensure optimal training of the spinal musculature as achieved in the corrective movement, it was determined that she should wear the brace for 3 more months but to take the brace off 72 hours prior to her next check-up so to determine her actual spinal curvature as the patient was getting very quick results.

On May 26, 2014 her thoracic curve measured a 6.6° right curve after not wearing the brace for 3 days. Due to the results from the last check-up and because she appears to be in the non-scoliosis range of curvature (<10°) it was decided to prescribe no brace wearing for 3-months.

On August 25, 2014, after not wearing the brace at all for 3-months, her AP thoracic x-ray showed a 1.8° right curve (Fig. 1). The child and parents were thrilled with the results and it was determined that she could remain out of brace and an x-ray be done in 6-months time for monitoring as she was still only 11 years of age and with projected future growth and the uncertainty of scoliosis progression, close monitoring would be maintained.

Follow-up assessments attained on February 23, May 25, and November 16, 2015, demonstrated consistent spinal stabilization. Assessments on November 5, 2016 and November 25, 2017 also showed the maintenance of a vertical spine (Fig. 1). To the date of publication of this case the patients' spine has remained stable with no further progression of scoliosis, and due to the Risser sign being 4, the successful complete correction of early AIS can be concluded.

DISCUSSION

This case represents an ideal outcome for the treatment of early suspected AIS. The patient was followed for 4.5 years until she reached a Risser sign grade 4 (Risser 4), where the ilium bone is 100% calcified, but the iliac apophysis is not yet fused to iliac crest (Risser 5); this is considered a point that is 'almost at the cessation of growth.'

The total correction of a scoliotic spine to near perfect verticality with use of the SpineCor bracing has been documented by Waldrop et al¹⁷⁾. They treated a 10 year old boy in the same 'Right Thoracic Type 1' SpineCor configuration. His correction occurred in 8-months where his initial curve was 36 degrees. Our case was less severe in magnitude and correction occurred over a 9-month period.

The SpineCor brace has been found to have a very high rate of 'success;' this meaning either stabilization ($\pm 5^\circ$) and/or correction (reduction $>5^\circ$) of scoliosis deformities¹³⁻¹⁵⁾. Herrero et al.¹³⁾ reported an 88.3% success rate in 34 patients, Tsakiri et al.¹⁴⁾ reported a 96% success rate in 82 patients, and Miller¹⁵⁾ reported a 97% success rate in 33 patients. Further, stabilization and/or correction has been shown to last in 97% of a treated population after 2 years follow-up⁹⁾.

The therapeutic approach of SpineCor uses a 'corrective movement strategy' to dynamically open the scoliotic curve. Correction to scoliotic curves can only be done by progressively overcorrecting a patient's spine and postural deformity. This is exactly what the brace attempts to accomplish, as the corrective elastic bands are configured around the patient to provide a constant pull or tension on the patient in their unique corrective movement. Over time, as the patient moves within the brace, the corrective tensions slowly retrain the neuromusculoskeletal system leading to slow and progressive improvements in spine alignment and posture.

The concept of three-dimensionally reversing the spine and posture has been advocated by others in the treatment of scoliosis¹⁸⁻²²⁾. The complete correction accomplished in this patient was probably achieved because of the gross over-correction of the patient's spine in the bracing configuration (reversal of thoracic curve, Fig. 1). Often with greater and/or more rigid curves over-correction is not attainable. However, the goal for superior treatment with scoliosis is proving to be in approaches that attempt to over-correct, or ideally stress the spine into its mirror image—a termed coined by Dr. Don Harrison et al.¹⁶⁾.

The concept of three-dimensionally reversing, inverting, mirror-image, opposite kinematic approaches is proving to be more effective in the treatment of scoliosis versus typical, standard or 'cookie-cutter' traditional approaches²³⁻²⁵⁾. Three-dimensional corrective approaches for the treatment of AIS include Schroth exercises^{21, 25)}, CBP mirror image exercises and traction^{19, 20)}, as well as over-corrective bracing²²⁾, including SpineCor bracing as used in this case.

We believe that the aggressive treatment for mild suspected AIS is superior to the traditional 'watch & wait' approach. Why wait to treat scoliosis (i.e. when it gets to beyond 25°) when treatment could have been already successfully reducing and correcting the spinal curve? The 'watch & wait' approach is practically negligent as it is known that mild scoliosis curves (<25°) may progress between 5–10° within 6-months time²⁶⁾. Further, in growing children and adolescents, curve progression of $\geq 6^\circ$ within 6-months is up to 40% more likely when patients are 'observed' rather than braced²⁷⁾. For this reason we agree with Sy et al. who state: "it is very important that patients with AIS are treated with non surgical interventions as soon as possible after being diagnosed especially when the patients are pre-menarchal and have significant potential growth remaining⁶⁾."

One may ask what is the rationale to treat a 14° scoliosis curve? In this case, the answer is that it was a 14° curve in a 9 year old with many prognostic factors indicative of future progression²⁸⁾ (age; Risser sign; premenarchal). This could very well translate into a 25° curve in an 11 year old, a 45° curve in a 16 year old, etc. As previously stated, all large curves were once smaller curves^{4, 5)}. We concur with Hipps⁵⁾ whose statement is self-evident: “it is much easier to correct a slight curve than an advanced one.” Therefore, the treatment of a small curve is always ideal to the treatment of a larger curve as obviously, the smaller the curve, the closer it is to being straight (the ultimate goal for scoliosis treatment). Since the majority of spine curves will evolve into larger curves, there is much more likelihood of having a successful treatment (curve reduction/stabilization) in mild AIS from aggressive and early treatment rather than the absence of taking action (i.e. ‘watch & wait’).

It must be mentioned that patients with AIS often receive several radiographs throughout a critical period of human development. Although a topic too large to fully address, the radiation doses from spinal x-rays are only a fraction of annual ‘background’ radiation levels (radiation we get exposed to every year that we cannot escape)^{29, 30)}. It has also been argued that CT scan radiation levels are not excessively harmful and do not contribute to excess cancer rates^{31, 32)}. This is reassuring to the scoliosis clinician as CT scan exposures are about an order of magnitude greater than exposures from spinal x-rays. The fact of the matter is that spinal imaging, by CT or radiography, is not harmful. This is because all radiation risk assessment has traditionally and erroneously been based on the invalid linear-no-threshold model^{33, 34)}.

The limitation to this case is that it is only a single case. Further, one may challenge whether this case was truly an AIS case. We argue that the development of early AIS must initiate at some point during development, and if caught at the right moment in time, individual vertebral rotation will be at a minimum, and at this point correction may be easiest. More research is needed to elucidate not only the most effective treatments for AIS, but also the most effective time to initiate treatment for achieving successful outcomes in AIS. We argue that early aggressive treatment for suspected AIS is superior to the ‘watch & wait’ approach as “curvature progression is inevitable for most children with idiopathic scoliosis if they are not treated by exercise, bracing or surgery³⁵⁾.”

Conflict of interest

None declared.

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