

# Clinical evaluation of the ability of a proprietary scoliosis traction chair to de-rotate the spine: 6-month results of Cobb angle and rotational measurements

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## Abstract

The aim of this study was to investigate the immediate and 6-month effects of a scoliosis traction chair on scoliosis rotation and Cobb angle. The scoliosis traction chair has been used clinically for 10 years and has been part of previous studies, but has not been the focus of any previous study. Our goal was to test the scoliosis traction chair's ability to de-rotate the spine to create scoliosis correction.

Fifteen patient files were retrospectively selected for study. Patients were radiographically studied in a proprietary traction chair to evaluate impact on Cobb angle and apical vertebral rotation. Six-month follow-up results were recorded. Six-month results showed an average overall Cobb angle increase of about 7°. Patients with in-chair apical de-rotation showed 9° of Cobb angle improvement, while those with increased in-chair apical rotation showed an average 16° progression.

Scoliotic curves whose apical rotation worsened on stress radiography showed deterioration of the curve at 6 months. Those with improved apical rotation showed Cobb angle corrections at 6 months. Since progression of scoliotic curvatures was observed in our cohort of patients after 6 months of home and clinical use, it is imperative that further studies attempt to qualify which patients and scoliosis curve patterns are best suited for the scoliosis traction chair.

## Introduction

It has been long recognized that the biomechanical progression of adolescent idiopathic scoliosis involves coupled motion patterns of lateral bending and rotation resulting in a more focal curvature at the level of the apex.<sup>1</sup>

Elongation and de-rotation of the spine would logically be desirable in order to reverse this biomechanical progression, which has been employed by many spinal orthotic devices over the past several decades with perhaps the most famous being the Milwaukee brace.<sup>2</sup>

The creation of the scoliosis traction chair, utilized by practitioners of the CLEAR Scoliosis Institute methodology, was designed and intended to apply the same elongation and de-rotation principles to the entire scoliotic spine, rather than just the thoracic and lumbar spine. Previous, similar versions<sup>3,4</sup> of this traction chair have long been used for the same purpose. However, the addition of a vibration motor and concurrent axial traction provides an enhanced neuromuscular component.

After a decade of clinical usage of the scoliosis traction chair, as well as in-home use by patients, no clinical data on the intermediate or long-term outcomes of the device have been collected and published to date. The purpose of this study is to evaluate the device's ability to de-rotate the spinal curvature in the thoracic spine, as claimed by the manufacturer, due to the known complexities of the ribcage biomechanics in scoliosis patients.<sup>5</sup> We also report the 6-month Cobb angle measurements of patients using this device for scoliosis treatment.

## Materials and Methods

Patient charts were reviewed from the same chiropractic office where the same provider treated all involved cases. Patients were selected consecutively if they met the following criteria: i) they used the scoliosis traction chair as part of their scoliosis management; ii) they received an *in-chair* radiograph to evaluate positioning and effect; and iii) they presented to the office for a 6 month follow-up exam. A total of 15 cases met this criteria and were therefore used for this present study. Written informed consent was obtained from all patients whose data was selected. All patients selected were treated for a chief diagnosis of adolescent idiopathic scoliosis. The provider who treated all patients was appropriately certified to perform this scoliosis traction chair procedure through the CLEAR Scoliosis Institute.

The setup procedure for the scoliosis chair is very specific. Routine AP standing radiographs are performed to evaluate spinal curvature prior to treatment. X-rays are taken at a film-to-focal distance (FFD) of 72 inches on 14x17 cassettes. Rotational assessment was performed at the apical vertebrae using the Nash-Moe method. This percentage rating is based on pedicle position relative to vertebral body width. Although this measurement was not calculated originally during the patients' care, we applied these measurements retro-

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Contributions: CJS provided the background information and performed the literature search; BD analyzed all of the radiographs from selected patient files; MWM wrote and formatted the manuscript, and helped with statistical analysis; AS co-wrote the manuscript and statistical analysis.

Conflict of interests: the lead author (CJS) is the co-developer of the scoliosis traction chair. Two of the authors (CJS and BD) are former instructors for the CLEAR Scoliosis Institute, while another (AS) is a former member of the CLEAR Scoliosis Institute's board of advisors. The remaining author (MWM) declares no competing interests.

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spectively to evaluate the impact of the scoliosis traction chair on its purported ability to create spinal de-rotation. Patients are then placed in a scoliosis traction chair with overhead axial traction using a standard Saunders cervical harness and 12 pounds of weight. The chair is then set up depending on curve pattern to properly reduce scoliosis angles and de-rotate the spine three-dimensionally as taught by the CLEAR Scoliosis Institute. The chair generally consists of 2 primary straps and pads controlled by industrial strength ratchets that are placed at the apical zones of each curvature and tighten until resistance is met to patient comfort. Secondary stabilizing straps are attached above and below the primary straps which are 2 inch nylon belts with plastic cam buckles. The patient sits on a 14 inch vestibular disc and axial traction is then applied. Figure 1 shows an illustration of a typical patient setup in a scoliosis traction chair. An x-ray was then taken to properly evaluate the effectiveness of the scoliosis traction chair as it is used not only clinically but often prescribed for home use by the patient. The *in chair* x-ray is taken at an FFD of 72 inches on a 14X17 cassette. Standard Cobb angles were measured as well as rotation of the apical ver-

tebrae and adjacent regions to properly assess de-rotation using the Nash-Moe method. The patient is often instructed to perform scoliosis specific exercises or to remain still in a seated position while the force from the scoliosis traction chair is being applied twice daily for sessions lasting up to 30 min each. A whole body vibration is applied the patient and chair at a frequency of 30 Hz in an effort to induce involuntary skeletal muscle contractions, thus producing a training effect.

Patients selected for this study presented to the clinic for an average of 20 visits over 9 months. All cases started with an initial 10 days of intensive therapy combining cyclical traction, sustained traction using the scoliosis traction chair and isometric exercises. Follow-ups were every 3 months which included another 2-5 days of clinical therapy. Home care consisted of the scoliosis traction chair twice daily 30 min followed by 20 min of exercise throughout the duration of care. They also presented for follow-up at 6 months, upon which an updated scoliosis radiograph was obtained. Cobb angles and Nash-Moe apical rotational measurements were again collected from these updated radiographs. Figure 2 shows the baseline and 6 months measurements for all 15 patients.

## Results

The study sample was composed of 14 females and one male, with an average age of 14 years, 3 months. Paired sample t-tests were calculated using Microsoft Excel 2010 to observe statistically significant changes at 6 months compared to baseline. The average

baseline Cobb angle was  $56^{\circ} \pm 17$ . A total of eight patients had right thoracic curve patterns, five patients had left thoracolumbar curve patterns, and one had a left lumbar curve pattern. The remaining patient had a double major curve pattern: right thoracic/left lumbar. When subdivided according to apical changes in the scoliosis traction chair, those with apical rotational improvement had an average baseline Cobb angle of  $40^{\circ} \pm 2$ , and those with apical worsening had average starting Cobb angles of  $65^{\circ} \pm 14$ . Radiographs taken with the patient in the scoliosis traction chair showed a reduced average Cobb angle of  $25^{\circ} \pm 18$ . A total of 11 patients, while in the scoliosis traction chair, showed a worsening of apical rotation by an average 27%. The remaining 4 patients showed improved apical rotation by an average of 25%. The apex of the curve in patients whose apical rotation worsened in the chair ranged between T9-T11. Those patients with improved apical rotation in the chair had apices between T10-L2.

At six months follow-up, radiographic evaluation showed an average Cobb angle of  $81^{\circ} \pm 14$  ( $P < 0.001$ ) in the group of patients whose apical rotation worsened in the chair, while those with improved in-chair apical rotation were statistically unchanged ( $P = 0.166877$ ). Overall average Cobb angle at 6 months among all patients was  $63^{\circ} \pm 26$ . When taking Risser staging into account, those who were at most risk for progression (Risser 0-1) had initial average Cobb angles of  $56^{\circ} \pm 17$ , while those at or near skeletal maturity (Risser 4-5) began with an average Cobb angle of  $67^{\circ} \pm 17$ . At six months, these two groups had Cobb angles of  $67^{\circ} \pm 27$  and  $72^{\circ} \pm 22$ .

The patient data was subcategorized into curve patterns as well as by curve apex level.

The right thoracic curve pattern group had a statistically significant increase of  $14^{\circ}$  in their Cobb angles at 6 months ( $P < 0.05$ ). The thoracolumbar group had a non-significant curve reduction of  $2^{\circ}$  ( $P = 0.83$ ). The lumbar and double major groups could not be performed as they each only had one patient with that pattern. With regard to curve apex, patients with a scoliosis apex above or equal to T11 had a statistically significant curve progression of  $12^{\circ}$  ( $P < 0.05$ ).

## Discussion

This study is the first of its kind to attempt to quantify and qualify the biomechanical changes associated with the scoliosis traction chair. Although multiple previous studies have used the traction chair as but one of several combined modalities,<sup>6,7</sup> it has never been the sole focus, nor has its effects been examined.

When evaluating the two subgroups of patients defined by improved or worsened apical rotation in the scoliosis traction chair, there was an average reduction in Cobb angle in the apical-improved group by about  $9^{\circ}$ , while those with apical worsening had a deterioration of their Cobb angles by about  $16^{\circ}$ . It is important to note, however, that the initial starting Cobb angle was significantly higher in the apical-worsened group compared to the apical-improved group ( $65^{\circ}$  vs  $40^{\circ}$ ). Therefore, it is possible that Cobb angles of this magnitude would have continued to progress despite treatment. However, when taking Risser staging into account, those at or near skeletal maturity, who would typically have the lowest risk for progression, tended to show some of



Figure 1. This figure illustrates a typical patient setup in the scoliosis traction chair.

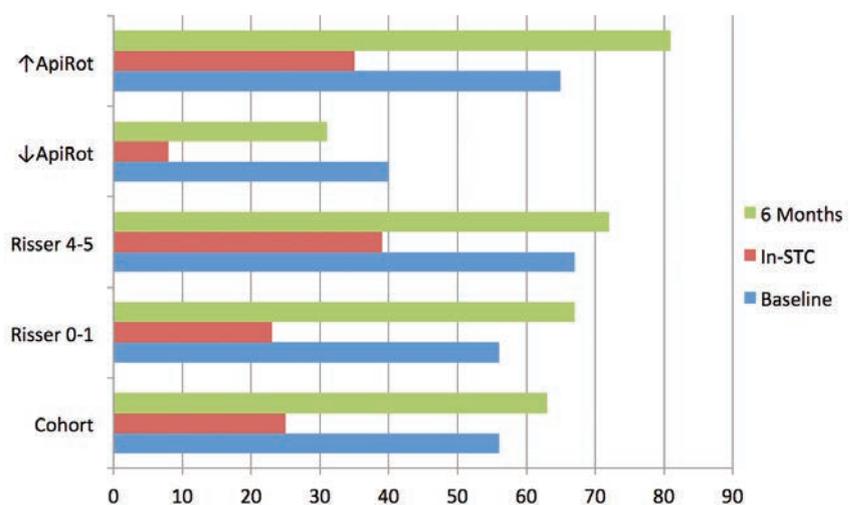
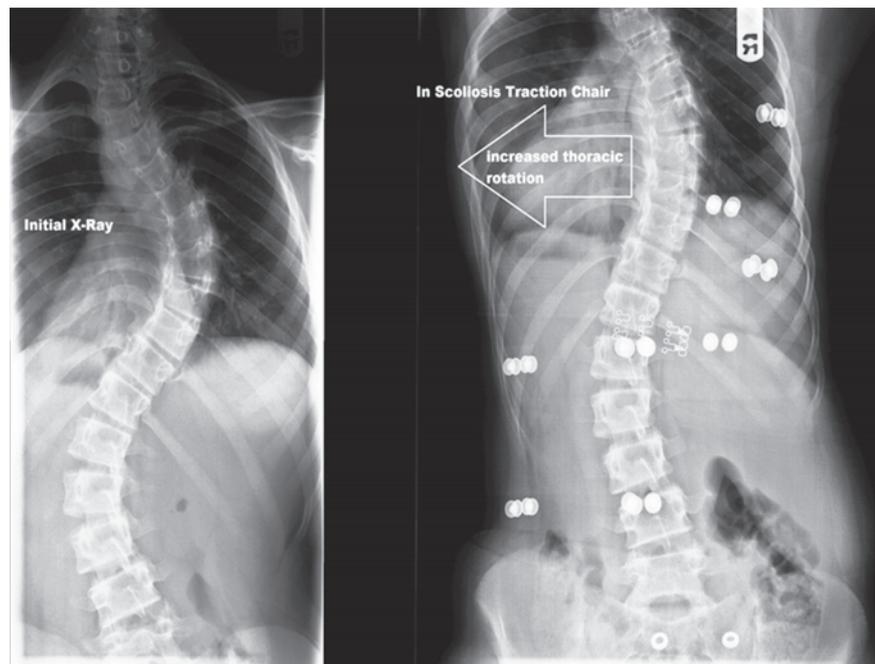


Figure 2. Baseline and 6 months measurements for all 15 patients. STC, scoliosis traction chair.



**Figure 3.** This illustration shows the manner by which apical rotation was measured and recorded before and in the scoliosis traction chair.

the largest levels of Cobb deterioration, increasing by  $9^\circ$  compared to  $11^\circ$ , in high-risk patients (Risser 0-1).

It is noteworthy to point out that those patients who had apical worsening in the scoliosis traction chair had higher apical vertebrae than those whose apical rotation improved in the chair. We feel that this may be due to the anatomical location of the lateral strap placed on the patient's rib cage. This strap, as shown in Figure 3, seemed to create a flattening of the rib cage laterally, resulting in a decreased Cobb angle in the chair despite worsening of the apical rotation when the apex was above T11.

The present study design, a retrospective cohort, limits the conclusions we can draw from this study. All of the starting Cobb angles would be considered at or near surgical threshold, therefore curvatures at lower magnitudes may have responded better or differently to the traction chair. Another important variable to consider is that patients also performed other scoliosis exercises in concert with the scoliosis traction chair over the course of this study. However, previous data indicates that patients

performing these other types of exercises without the scoliosis traction chair demonstrate improved outcomes at least 24 months after treatment ended.<sup>8,9</sup> Hence, it is less likely that these exercises would have significantly contributed to the results observed here, although it is still possible.

## Conclusions

Our study outlines the biomechanical effects we observed in a group of patients using a proprietary scoliosis traction chair as part of a scoliosis rehabilitation program. Of these, those with apical rotational improvement in the chair did not statistically significantly change after 6 months, while those with worsened apical rotation in the traction chair saw their curves statistically significantly progress by  $15^\circ$ . Those with apical vertebrae above T11 typically demonstrated increased apical rotation in the chair, while those with an apex of T11 and below saw improves in apical rotation in the chair. Based

upon this data, a more robust investigation needs to be undertaken in order to fully understand how the scoliosis traction chair may contribute to our findings, among all types of scoliosis curve patterns. Protocols should also be established to ascertain how to best predict the future benefit of using the scoliosis traction chair in individual cases.

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