

# CASE STUDY

## Reduction of Scoliosis in a 7-Year-Old Male Following Chiropractic Care: A Case Study & Selective Review of the Literature

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### Abstract

**Objective:** The objective of this case study is to examine a case of juvenile scoliosis and the outcomes related to chiropractic intervention for this patient. Idiopathic scoliosis will also be discussed and reviewed in detail.

**Clinical Features:** A 7-year-old male presented for care with recently diagnosed idiopathic scoliosis without any complaints of associated pain. The patient was assessed using motion palpation and posture analysis and a thoracic radiograph was measured for the presence of a scoliosis. Chiropractic examination revealed subluxations in the cervical and thoracic spine as well as in the sacrum.

**Intervention and outcome:** Full spine technique was used over the course of 16 visits and the patient was seen three times a week. Post radiographs showed a noticeable decrease in the Cobb angle of the scoliosis.

**Conclusion:** This case shows a situation in which chiropractic adjustments seem to have a positive effect on reduction of the scoliotic curve in this 7-year-old male. It is possible that the subluxation plays a role in the development of scoliosis and managing them accordingly may improve curvature in certain individuals. Additional research is needed in order to further explore the correlation between subluxation and scoliosis as well as the long-term effects of chiropractic management of scoliosis.

**Keywords:** *Chiropractic, subluxation, scoliosis, idiopathic scoliosis, adjustment, Full Spine, Diversified Technique, spinal manipulation*

### Introduction

According to Lonstein, scoliosis is the most common spinal deformity that requires orthopedic spinal surgery intervention.<sup>1</sup> Although statistics vary depending on source, adolescent or juvenile idiopathic scoliosis is said to affect about 0.47%-5.2% of the population.<sup>2</sup> When a population of 16,000 patients between the ages of 6-14 years was studied, about 0.5% had Cobb angles greater than 10 degrees.<sup>3</sup> More often than not, idiopathic scoliosis affects females at a much higher incidence than males with a ratio of 2:1.<sup>2</sup>

### Historical Overview

Scoliosis is a word that stems from the ancient Greek word “skolios” which means curved or crooked. In fact, the idea of scoliosis and spinal deformity has been around since ancient times, stemming all the way back to 3500 BC.<sup>4</sup> The first to describe scoliosis in writing was Hippocrates (460-370 BC). Hippocrates wrote almost 60 medical books that also include descriptions of the normal spine and spinal deformities. He

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described non-traumatic kyphosis, traumatic kyphosis, and scoliosis. It must be noted however that during that time, the term scoliosis was used by Hippocrates to describe any type of curvature, even those caused by injuries. He does however mention two causes that he believed were linked to scoliosis as we know it today. One he believed was due to disease that he described as “*due to gatherings on the inner side of the spine*”. The other caused by postural changes due to the position of sleeping individuals that accumulated over time. In a second book of *Epidemics* that Hippocrates wrote, he brought up a case of scoliosis that appeared alongside a sore throat. Hippocrates noted that the patient also was suffering from facial paralysis on one side of their face as well as the mouth, uvula and jaw.<sup>4</sup>

Hippocrates also created some of the first apparatus for the treatment of spinal deformity. He noted that diet and extension of the spine was the best way to treat scoliosis. In fact, Hippocrates was the first to create a method for inducing axial traction on his patients. He used three things, the Hippocratic ladder, the Hippocratic board, and the Hippocratic bench. The Hippocratic ladder was used to reduce spinal curves by tying a patient to a ladder while being introduced to a shaking motion. This was done with the patient erect if the area of deformity was near the neck, and facing downwards if the hump was in the lower back. Hippocrates claimed that the weight of the trunk and limbs along with the shaking of the ladder acted as a pulling force to straighten the spine. The second, known as the Hippocratic board was also used for spinal curves. Simultaneous traction of the spine as well as focal pressure is recommended with this device. The back was tied down with bands to give traction to the spine, and often the physician would exert pressure on the kyphosis of the back by walking on it.

Galen, another Greek physician followed in Hippocrates footsteps almost six centuries after.<sup>5</sup> He agreed on many of the same ideas that Hippocrates had on spinal disease, including scoliosis. He did expand on some of his ideas however, and used chest binders and jackets in attempts to also correct curvature of the spine. It is even noted that he believed that rib exercises such as singing or breathing could also improve spinal deformity when recommended to patients. Much of Hippocrates and Galen’s work helped pave the way for management of scoliosis. Casts, as well as braces which are still used today are part of the result of the work of both of these men.<sup>4,5</sup>

### *Epidemiology*

According to the Merck Manual, Idiopathic scoliosis is the most common form of scoliosis and can be seen in 2-4% of patients 10-16 years old.<sup>6</sup> Scoliosis patients are classified according to their age of onset, etiology, severity, and the type of curve that is present. Idiopathic and non-idiopathic scoliosis are the two main categories. The major subgroups in Idiopathic scoliosis are infantile scoliosis, juvenile scoliosis, adolescent scoliosis, and adult scoliosis.<sup>7</sup> Infantile scoliosis appears in infants from the ages of 0-3 and has a prevalence of about 1%. However there seems to be a higher rate of regression of this form of scoliosis than in scoliosis in older individuals. Juvenile scoliosis occurs in the ages of 4-10 year olds and accounts for about 10-15% of all idiopathic scoliosis

in kids. Adolescent scoliosis, which affects 11-18 year olds, has the greatest rate of appearance with it being responsible for 90% of the cases of idiopathic scoliosis in children. The final group, adult scoliosis, has a prevalence rate of 8% in individuals over 25 years old, which spikes rapidly after a patient hits 60 due to degenerative changes of the spine.<sup>7</sup>

It can be noted that genetics can and do influence the incidence of scoliosis as well as its progression in individuals. 97% of patients that have adolescent idiopathic scoliosis have other family members that present with scoliosis. According to a study by Kamtsiuris, there is a higher prevalence in German children up to 5.5% when compared to immigrant children.<sup>8</sup> This study suggests that the difference is due to genetic factors and not socioeconomic ones. In another study by Carter, it’s noted there was a higher incidence of scoliosis in the African American population at 9.7% when compared to the Caucasian population which was at 8.1%.<sup>9</sup>

Age is also important to note when checking the incidence of idiopathic scoliosis. In another study, there was a higher number of scoliosis patients in adolescence than those that are younger.<sup>10</sup> In children 6-7 years old, 0.12% present with it. 1.0% present in the ages of 11-12 years old and then jumping up to 3.12% in the group of 16-17 years old. These numbers vary quite a bit when it was done in Germany with a 6.5% prevalence in those that are 11-13 years old and an increase to 11.1% in those that are 14-17.<sup>8</sup> As mentioned previously, gender is also a major factor in idiopathic scoliosis. As a general rule females seem to be affected more often than men. In the German study the prevalence was seen to be in a ratio of 1.5:1. Daruwalla found a prevalence ratio of 2:1, rising to 3:1 by age 11-12.<sup>10</sup> Two other researchers also found a prevalence of 2:1 which averages across all of these to about 2:1 incidence in females increasing with age.<sup>11,12</sup>

### *Diagnosis*

Scoliosis, regardless of cause, is expected to have a curve of at least 10 degrees of angulation. This is the definite way to diagnose the patient but first it is important to run through the patient history and a physical exam first as to avoid unnecessary radiation exposure to the patient. When a patient comes in, it is not uncommon for them to complain of back pain, although it is not the case in the majority of scoliosis cases. About 1/4<sup>th</sup> of patients with adolescent idiopathic scoliosis present with back pain.<sup>13</sup> The genetic component needs to be assessed as well due to the seven fold increase of incidence among siblings, and a 3x increased prevalence in children of parents with scoliosis. Patients with scoliosis may come into the office complaining of postural imbalance as well.

Next, it is important to give the patient a thorough physical examination. If scoliosis is suspected it is important to pay careful attention to the height measurement of patients and monitor their skeletal growth as this often can indicate how far the scoliotic curve can progress. Also important is to perform a neurological evaluation to check reflexes, muscle group testing, sensory testing and balance evaluation. These tests are mostly done to rule out scoliosis that is not idiopathic such as one that could be caused by a spinal syrinx or other abnormalities. The shoulders and hips must be examined in

patients with scoliosis. Both must be observed for asymmetry. Next the patient will be asked to perform the Adam's forward bend test for scoliosis. This is done by having the patient make their back visible, then bend forward at the waist with their knees straight and palms together. The doctor then examines the horizontal plane of the spine for increased or decreased kyphosis and other anomalies of the spinal curve.

After a physical examination and neurological tests have been performed, if scoliosis is suspected, imaging must be taken. Standing P-A images should be taken and the curve of the spine examined. MRI is not usually taken unless an underlying pathology such as a tumor is suspected. When seen on film, scoliosis may be rotatory or simple. Simple scoliosis does not have rotation of the vertebral bodies along with the curve, while rotatory includes vertebral rotation. Curves of over 10 degrees are considered significant enough to be called scoliotic.<sup>14</sup>

### *Etiology*

Considering this disease is of an idiopathic nature there is no definitive known cause of idiopathic scoliosis. However, there are still some general ideas on what may influence the etiology of this spinal deformity. One such thought is that it may in part be due to a primary muscle disorder. According to Kindsfater, platelet calmodulin seems to share a connection with patients with progressive scoliotic curvatures.<sup>15</sup> Calmodulin is a mediator of calcium induced contractility in muscle. During a study of 27 patients, higher levels correlated with an increase curvature of adolescent idiopathic scoliosis (3.83 ng/ $\mu$ g vs 0.60 ng/ $\mu$ g).

Another theory is that idiopathic scoliosis may be due in part to skeletal growth that is disorganized. The theory is that rapid dysplastic bone growth leads to enforcement of the Hueter-Volkman law.<sup>16</sup> According to the law, distractive forces speed up growth while compressive growth slows it down. There have been some findings of similarities in the osteopenia that is seen in some cases of idiopathic scoliosis when related to disorganized skeletal growth.<sup>17</sup>

As mentioned previously, genetics seem to play a large role in who gets idiopathic scoliosis. Many different research methods have been employed to explore this and many avenues agree on this finding. Some believe that the inheritance of this problem is X-linked but even more research suggests a high correlation between monozygotic and dizygotic twins. Inoue suggests that more than 90% of monozygotic twins and over 60% of dizygotic twins show agreement on this.<sup>18</sup> There is also evidence that chromosomes 18, 10 and 6 are related to idiopathic scoliosis.<sup>19</sup>

### *Pathophysiology*

There are a few ideas of what might be the pathophysiology behind idiopathic scoliosis. One idea is that levels of melatonin can have an impact on the development of the condition. According to two separate articles, studies were done on chickens in which the pineal gland was removed.<sup>20,21</sup> The pineal gland produces melatonin and once it was removed the chickens developed scoliosis. The same studies also suggested that it was the removal of the melatonin itself that

created this change. This is still much up in air however as a counter test was performed to administer melatonin to chickens that had their pineal gland removed and they still developed scoliosis.

According to studies done by both Barrack and Wyatt, they believe that a posterior column lesion in the CNS may be an associated cause in patients that present with idiopathic scoliosis.<sup>22,23</sup> Because idiopathic scoliosis is an idiopathic disease, a true consensus has yet to be reached on the pathophysiology of this condition. The two examples provided however shed a bit of insight into what could be behind it, although additional research needs to be performed.

### *Prognosis*

Scoliosis is a disease that affects the entire spinal column and depending on the severity of the disease can be difficult to treat. Prognosis and outcomes of the disease are mostly related to the severity of the curvature in the patient.<sup>24</sup> Many patients that have mild scoliosis exhibit very little or no symptoms associated with idiopathic scoliosis, however special care needs to be made when observing curvature progression. If patients are still growing, early-onset idiopathic scoliosis can present with more severe ramifications. It is very rare when non-progressive untreated scoliosis patients suffer from a different mortality rate than the general public. In a study performed by Weinstein, 117 untreated scoliosis patients were compared with individuals without scoliosis of a similar age and sex.<sup>25</sup> They were assessed in terms of mortality, back pain, pulmonary symptoms and general body image and showed very little difference in health 50 years following their initial diagnosis when compared with the normal group. There were some differences in the prevalence of back pain between these two groups. Sixty six of 109 scoliotic patients complained of back pain while 22 out of 62 control group patients had pain (26% difference), although the pain reported was only mild to moderate.

In some cases the scoliosis may be severe enough to warrant surgery. Surgery for scoliosis has varying reports regarding its safety and effectiveness. A retrospective study was performed on patients who received either implants or fusions in order to correct their scoliosis. The survivability of the surgical procedures was addressed in a group of 207 patients. 9.2% needed reoperations and 26.3% required reoperation on their spine within 16 years of the initial surgery.<sup>26</sup> Patients that receive surgery for scoliosis are much more likely to experience back pain problems in the long run when compared with those that do not.<sup>27</sup>

### *Treatment for Idiopathic Scoliosis*

Idiopathic scoliosis is still not completely understood, so many of the treatment options that exist still have a fair amount of uncertainty surrounding them. Treatment is often based on the risk of curve progression in each scoliosis age group. The main means of management include observation, bracing, and surgical care. According to the Merck Manual likelihood of progression with scoliosis patients are seen the most during puberty.<sup>6</sup> The treatment that is given varies based upon the degree of the curve and the age of the patient. A general guideline is that moderate curves that are between 20-40

degrees are treated conservatively first with bracing and physical therapy. Curves greater than 40 degrees may call for surgical repair. Generally, scoliosis below 20 degrees is simply observed for signs of progression.<sup>28</sup>

### *Bracing*

If observation doesn't work and the curve begins to progress past 20 degrees or signs of rapid progression are apparent, bracing is normally what is initiated in patients. Bracing only truly works to prevent the worsening of developing scoliotic curves, and cannot help fix the problem after the patient has fully grown. However, braces are sometimes given to adult patients in an attempt to reduce pain. Braces are instruments that fit the torso and sometimes extend into the neck of the patient. When during the day it is worn, as well as how long to use bracing depends on the severity of the curve, and the patient's age. According to a study, 1020 patients were treated using a Milwaukee brace. They reported that it was successful in treating patients the most which had degrees of 20-39.<sup>29</sup> Also mentioned was the importance of immediately bracing patients that presented with curves over 25 degrees and had a Risser Sign of zero. The Risser sign is a classification system used to measure skeletal maturity that uses the ossification stages of the iliac apophysis to judge growth based on a scale of 0-5.<sup>30</sup>

### *Surgery*

Surgery is the last option that is tried if other means of care such as bracing and observation do not work. It is also done when there are fears of quick curvature progression in younger individuals. The main goal in a scoliosis surgery is to stop scoliotic progression.<sup>31,32</sup> Depending on the source, surgery can be called for on 40 to 50 degree scoliotic curves. Patients need to make sure they exhaust all other avenues as up to 38% of patients still present with back pain after receiving the surgery.<sup>31,33</sup> Upon deciding that surgery is the agreed upon route, anterior or posterior surgery may be performed. Anterior surgery is performed by making an incision in the chest wall, while posterior surgery goes through the back. During posterior surgery it is important that the back muscles such as trapezius, rhomboid major/minor and latissimus dorsi are taken into account. This is necessary because according to Kawaguchi posterior muscle injury can occur through the pressure that is placed by surgical retractors.<sup>34</sup> Because of this it is important to remove these retractors intermittently during surgery. The point of incision is through the "cartilaginous caps" and they are split in the middle to allow dissection of the spinous processes, laminae, facet joints, and transverse processes.

The anterior approach to surgery can take three paths. One is an anterior thoracic surgery via traditional open thoracotomy, one is an anterior thoracic surgery done using video-assisted thoracoscopic surgery, and the third is done with an anterior lumbar or thoracolumbar surgery through a retroperitoneal method that may involve a diaphragmatic incision. These are chosen based upon the patient's presentation. Postoperative care can vary widely but generally consists of patient monitoring and occasionally postoperative bracing.

## **Review of Literature**

In a case study published by Kauv and Dickholtz, the improvement in a 15-year-old patient with adolescent idiopathic scoliosis was recorded.<sup>35</sup> When the patient initially presented to the office, she complained of back pain of two years that she believed was linked to her scoliosis. She also mentioned that she had vertigo, some lumbar pain, and fatigue. The patient was analyzed by the chiropractor using NUCCA chiropractic protocol. The doctor found that her leg was ½ inch short on a supine leg check on the right side. This led him to believe that she had atlas misalignment. Posture was measured also using a Benesh Anatometer and full spine radiographs were taken revealing a 44 degree Cobb angle from T11-L4 confirming the presence of scoliosis. The patient initiated care and was seen 35 times over a four year and 2½ - month period. Her atlas was adjusted on five of these visits and wasn't adjusted when tests by the doctor didn't point to atlas dysfunction that was determined by utilizing supine leg checks. On her 4<sup>th</sup> adjustment after 28 months her vertigo and low back pain dissipated and she had more energy. Her last adjustment was given 8 months later. Her symptoms had gone, and her Cobb angle was reduced from 44 to 32 degrees after her initial five months. A problem with this study is that no further X-rays were taken of her at her one year, and four year appointments respectively, so we do not know how the curve has progressed since then.

Another case study was done which details the utilization of the Pierce "Results System" of vertebral subluxation analysis and documents the results achieved on a 7-year-old female patient.<sup>36</sup> This girl presented to the office with paralysis on the right side of her face due to birth trauma. On top of the trauma she also had a 13-degree Cobb angle scoliosis as well as migraines and a history of ADD. X-rays were taken and showed subluxations in the lumbar and thoracic spine. The patient was assessed using Pierce and treated each visit for a total of five visits over a one-month period. She was treated using a Zenith Hylo table for the finding of a posterior right sacral base. Using thumb pisiform contact between the PSIS and S2 tubercle a toggle set was performed on the patient. The line of drive was P-A and S-I. Legs were checked after the toggle to ensure leg balance equality. Upon receiving a 5<sup>th</sup> thermal scan, the readings showed such significant changes that the doctor took a second X-ray which showed a reduction in the Cobb angle by 8-degrees. After six months of treatment the mother discontinued care for her daughter until she returned two years later after the severity had returned to its initial presentation. The limitation with this case is that the long-term effects of the Cobb angle improvement were not recorded. There is no mention of follow up X-rays two years later when her symptoms appeared worse. Further research on the long-term effects of chiropractic care on idiopathic scoliosis is required.

In this case by Colby, another child with scoliosis received chiropractic care and achieved some improvement in the curve.<sup>37</sup> The patient was an 11-year-old female whom received care using the diversified full spine technique along with gravity assisted traction. The girl presented with her mother due to her fears of postural abnormalities as well as pain in the left trapezius which she described as "a knot" in her muscle. Upon examination she had palpatory muscle spasm and edema

at C3-4 levels as well as T5-6. The patient had a positive Adam's orthopedic test indicating scoliosis and had X-rays developed that confirmed a left thoracolumbar scoliosis measuring 22-degrees and a right thoracic curve measuring 16-degrees with the Cobb method. Care was initiated immediately following the findings and the patient was adjusted 31 times over the course of three months. 3-4 adjustments were done per visit throughout the spine. The patient also received traction to the spine during her office visits. Traction was done up to 20 minutes each visit. The goal of this was to stretch the soft tissue by pushing the convexity towards the concavity by using foam rollers. Three months later the patient was reassessed and X-rays were retaken. The X-ray showed a decrease of the thoracolumbar scoliosis from 22 degrees to 19 degrees, a 3-degree improvement.

In this 4<sup>th</sup> case study by Nektalov, another patient presented with a scoliosis and achieved improvement to their curve.<sup>38</sup> The patient was a 21-year-old female with a 14 degree left thoracic scoliosis and a 13 degree right lumbar scoliosis. The patient was given care with diversified/full spine adjustments and was treated using mirror image re-education and traction as well as postural exercises. These are all part of the Chiropractic Biophysics (CBP) protocol. When the patient came in to the office she was complaining of back pain and noted two years previously she didn't experience any pain. She was diagnosed by an MD with scoliosis when she was 10 years old. Postural exam show a left head tilt, right head rotation, anterior head translation, a left high shoulder, and right lateral thoracic rotation. An inclinometer and thermography were also used. After everything was evaluated it was decided that she would receive chiropractic care three times a week for a period of three months. She was given supine cervical adjustments, anterior thoracic adjustments, and side posture lumbar and pelvis adjustments along with an Arthrostim instrument. A posture pump was used to increase cervical lordosis during each treatment for 15 minutes a visit. She also got long axis traction for 15 minutes a visit. Her follow up X-rays showed improvement in her cervical curve, anterior head translation etc. However, there is no mention of an improvement of the two scoliotic curves that she entered with specifically and seemed to be more effective in treating the anterior head carriage and lateral lumbar curve instead. More research is needed to find if CBP is specifically effective in addressing scoliotic curves.

Jones performed another case study on a patient with idiopathic scoliosis.<sup>39</sup> This patient was a 14-year-old female that initially presented with a slightly elevated right ilium compared to the left side. Upon examination, she performed the Adam's Test which was positive with a right convexity in the thoracic spine. To be 100% certain, an X-ray analysis was taken of her thoracic spine. Upon analysis the Cobb angle was 17.2 degrees located between T2 and T6. To work on addressing the complaint, the patient received 15 adjustments with Thompson protocol over a 13-week period. She also received traction of the cervical spine five minutes before and five minutes after receiving an adjustment. She was also given mirror image exercises to perform. The patient received two assessments; on the first one, visual improvement of the patient's posture was noted. On the second reassessment new X-rays were taken and the Cobb measurements went from 17.2 to 13.5 degrees.

These case studies are all examples of scoliosis cases tackled using different approaches to care. Different techniques were used and in many cases exercise and traction were added. Due to there being more than just one variable and many interventions, these conditions would be difficult to reproduce for any chiropractor trying to achieve similar results. Also important is that these case studies are done on only one patient. According to an editorial published in 2012, only 13 studies showed traditional chiropractic intervention.<sup>40</sup> These limitations make it difficult to tell if it is actually the techniques or various other factors that contribute to improvement in these patients. As such, more research on the chiropractic care of scoliosis is recommended.

## Case Report

### *Patient History*

The patient was a 7-year-old male that presented with recently diagnosed idiopathic scoliosis. No mention of pain or associated complaints were given, however the patient's mother expressed concern due to the child being diagnosed and told to wear a brace by their orthopedic doctor as the curve was worsening. The patient presented with no other associated illnesses and the mother denied the use of any medications for her child. As a result of the recent diagnosis, the mother decided to take her child in to seek care from a chiropractor as an alternative means of management.

### *Examination*

The patient went through a chiropractic exam that included postural analysis, orthopedic testing, motion and static palpation, range of motion and an A-P thoracic X-ray. Postural analysis revealed a high left shoulder and a high right hip. The orthopedic tests performed were cervical compression, cervical distraction, Jackson's compression, Soto hall, straight leg raiser, Lasague's test, Ely's sign, Kemp's test, Milgram's test and Valsalva's maneuver. All of these tests came out negative, and no positive tests were found. All ranges of motion were normal except the patient had 25% reduced left thoracic lateral flexion. Restricted segmental motion was also seen throughout the entirety of the mid-thoracic spine. Upon static palpation mild hypertonicity of the rhomboid major and minor musculature was noted bilaterally. Further motion palpation revealed subluxations at the levels of C1, C2, T5/6, T9/10, and sacrum. Thoracic X-rays were examined that had recently been taken by the patient's orthopedist. Upon review the initial Cobb angle was noted at 25 degrees and was progressing (Figure 1).

Motion palpation is a form of analysis that rates the movement of each spinal level palpated.<sup>41</sup> According to an article by Haneline, many studies were performed on the types of motion palpation done by chiropractors.<sup>42</sup> It was found that only 8 out of 44 had high reliability of those tested. However Cooperstein felt that this was due to improper means of testing. He found that when he used three participants with similar confidence levels, the inter-examiner reliability was around 75% when done on 29 asymptomatic patients in a cervical palpation study.<sup>41</sup> Another study was also performed in which motion palpation was performed in the thoracic spine on 52 other asymptomatic patients by two chiropractors.<sup>43</sup> Finding

the restricted sections was overall poor except for when they found segments they were both confident in. When they both had high confidence in their findings the interexaminer agreement became good instead. This is a limitation to the study, as there is still discrepancy of whether or not motion palpation is a reliable means of diagnosing subluxations.

### Diagnosis

After full completion of the patient's history, physical exam and review of the patient's previous radiographs the boy was diagnosed with subluxations in the cervical, thoracic spine, and sacrum. Reviewing the orthopedic doctor's X-ray and checking the Cobb angle reconfirmed the diagnosis of idiopathic scoliosis.

### Intervention

#### *Diversified Full-spine Technique*

For this patient the technique used is known as diversified technique, or full-spine. According to the American Chiropractic Association, diversified technique is the most frequently used by chiropractors and as many as 95.9% of practitioners use it. Diversified technique incorporates the use of a high-velocity, low-amplitude thrust from the doctor's hands with the objective of restoring proper movement and alignment of the spine while also reducing joint dysfunction.<sup>44</sup> It isn't entirely known who is attributed to the development of the technique however it takes pieces from BJ Palmer's work. Also, according to Gitleman and Fligg the technique owes most of its development to the late Dr. Joe Janse.<sup>45</sup> Diversified technique uses specific lines of drive for all manual adjustments. Hands-on techniques like full spine are used to deliver deeper thrusts that often are associated with an osseous popping sound as the adjustment is delivered.

Chiropractic care was initiated at a frequency of three times a week for a month and five days, for a total of 16 adjustments in an effort to address the patient's scoliosis. Motion palpation was used during care to continue to find additional subluxations. The cervical spine, thoracic spine, and sacrum were adjusted multiple times across 16 visits.

### Outcome

Upon completion of the adjustments, the patient had a second X-ray taken. The Cobb angle of the patient was measured again and a decrease from 25 to 11 degrees was noted, totaling an improvement of 14 degrees. On rechecking postural analysis, the patient's high left shoulder was level and the mid thoracic musculature had a reduction in hypertonicity. (Figure 1). The patient's care plan was changed to 2x a week, and to date, he continues with weekly chiropractic visits.

### Discussion

#### *Model of Vertebral Subluxation*

The basis for chiropractic care is the presence of vertebral subluxation. According to Lantz, there is still a lack of consensus on the exact nature of a subluxation even among chiropractors.<sup>46</sup> However, it is noted that a common finding in

all subluxation models is that there is a biomechanical problem coupled with a form of neurological involvement. There are several different models of vertebral subluxation. One that best fits scoliosis is the dysafferentation model. The dysafferentation model describes how subluxation can lead to biomechanical dysfunction and to dysfunction of the nociceptive and mechanoreceptive structures in the intervertebral motion segments. Technically speaking, improper input leads to bad output, or "garbage in garbage out".<sup>47</sup> Within this same model Murphy asserts that altering mechanoreceptor function may affect postural tone.<sup>48</sup> Scoliosis is a condition with highly altered posture and muscular tone.<sup>49</sup> It can be noted that postural control is quite dependent on cervical joint mechanoreceptors and afferent input from ligaments and tendons. As such, it would make sense that addressing the subluxations that may be interfering with proper input may help to improve these postural distortions in pathological processes such as scoliosis.<sup>50</sup> This would apply specifically to idiopathic forms of scoliosis and not on those that are the result of other pathology.

### Conclusion

This case study examined the case of a 7-year-old male with idiopathic scoliosis and the short term effects that chiropractic care provided for this patient. It is possible that the subluxation plays a role in the development and progression of idiopathic scoliosis. There are some limitations with this case. Most notable is that this just describes a situation with one individual with scoliosis over a short time period and as such cannot be applied universally to other individuals. It would be important to replicate this study with additional patients to accrue a greater variety of data and explore the relationship between scoliosis and the vertebral subluxation. It is unknown if the scoliosis will continue to progress or that the care was enough to permanently reverse the process without taking additional imaging of this patient in the future. With these current limitations it is difficult to generalize the effectiveness of chiropractic management of scoliosis.

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**Figure 1:** Pre and Post X-ray; A-P Thoracic