ADOLESCENT IDIOPATHIC SCOLIOSIS TREATMENT USING PETTIBON CORRECTIVE PROCEDURES: A CASE REPORT

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ABSTRACT

Objective: To investigate the possible benefits of using Pettibon corrective procedures to reduce the curvature associated with idiopathic scoliosis. These procedures were tested to determine potential effectiveness in a single patient.

Clinical Features: A patient with a 35° left convex thoracolumbar scoliosis was treated using Pettibon corrective procedures. Initial and follow-up outcome measures included a Borg pain scale, a Functional Rating Index, a balance test, and radiographic analysis.

Intervention and Outcome: The patient was treated using a combination of manipulative and rehabilitative procedures designed to restore normal sagittal curves and reduce the severity of the coronal curvatures. After six weeks of treatment, the post treatment radiograph revealed a 20° left convex thoracolumbar scoliosis, as well as decreases in the Borg pain scale from six to two, and Functional Rating Index score from 18/40 to 7/40 after the trial period. Her balance time increased from 18 seconds to 56 seconds.

Conclusion: Pettibon corrective procedures seemed to be effective at reducing the thoracolumbar scoliosis 15° (43%) after six weeks. The subjective and objective results of this case study warrant further such investigations. (J Chiropr Med 2004;3: 96–103)

Key Words: Spine; Posture; Rehabilitation; Scoliosis; Chiropractic

INTRODUCTION

Adolescent idiopathic scoliosis (AIS) is defined as a lateral curvature of the spine for which no cause can be identified, occurring at or near puberty (1). It is diagnosed by the presence of a curvature greater than 10°, measured by a Cobb angle on standing anteroposterior (AP) radiographs (1). Recent literature has shown the negative effects of adolescent idiopathic scoliosis on quality of life, such as sexual function and childbearing after maturity (2). However, conventional medical treatments, such as bracing, are not indicated for curves between 35–45° (3). Several different causes of AIS have been hypothesized, including brain asymmetry (4) a shortened spinal cord (5), structural changes in the intervertebral disc and paraspinal musculature (6), melatonin deficiency (7), and neural axis deformities (8). Machida (7) reports that multiple clinical studies support either an autosomal dominant, multifactorial, or X-linked inheritance pattern for adolescent idiopathic scoliosis. It may be possible that any combination of these or other proposed etiologies will be present together, although that has not been shown. It is also unknown whether morphological alterations in musculoskeletal components (7) are causative or reactive phenomena. Adolescent idiopathic scoliosis affects approximately 2–3% of 10–16 year olds, with a female to male ratio of 3.6 to 1 (1).

With an understanding of the deleterious effects of abnormal mechanical spinal loading (9–11), conservative scoliosis treatment programs and management plans have been increasingly investigated. In chiropractic, spinal manipulative therapy has been combined with other types of adjunctive therapies; including Pilates (12), stretching and massage (13), therapeutic exercises (14), orthotics (15), and passive physiotherapeutic modalities such as ultrasound or electric stimulation (16). Based upon the collective chiropractic literature, the role of chiropractic intervention in the management of adolescent idiopathic scoliosis remains unclear.

In this case study, we used the Pettibon corrective procedures to treat a 20-yr-old female with a left thoracolumbar scoliosis. These procedures have been previously reported in the chiropractic literature. However, the use of these procedures for the treatment of idiopathic scoliosis is unclear. This case study will help to identify any potential role of the Pettibon corrective procedures in treating idiopathic scoliosis.

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CASE REPORT

History

A 20-yr-old female presented to a private spine clinic with a chief complaint of constant neck and low back pain. The subject was referred to this clinic by an existing patient, and presented with a previous diagnosis of adolescent idiopathic scoliosis. The patient previously sought help from a chiropractic physician, whereby the Cobb angle progressed during the course of treatment. She had previously been to a medical doctor, at which time she was diagnosed as having a left thoracolumbar scoliosis based upon a standing AP thoracolumbar radiograph. It was determined that she could not be helped and was prescribed an oral steroid for pain management. She presented to the author's clinic about one year after being treated by the medical doctor. The patient initially filled out a Functional Rating Index (17). This index, described and tested by Feise and colleagues, is a hybrid combination of the Neck Disability Index and the Oswestry Back Pain Index. The author chose this form because the patient presented with both low back and neck pain.

Examination

A static visual posture examination revealed an anterior right hip, a right thoracic translation, a high and anterior right shoulder, and a protruding right scapula. Based upon the author's experience, patients who have these findings may be more likely to have a scoliosis above 30°. Given the postural findings and previous diagnosis of scoliosis, a radiographic study was conducted to verify and quantify any scoliotic curvature.

An initial standing AP radiographic examination revealed a left convex thoracolumbar scoliosis of 35° (Figure 1). This measurement was taken from a Cobb angle drawn between the superior endplate of the 10th thoracic vertebra (T10) and the inferior endplate of the fourth lumbar vertebra (L4). The author utilized a sectional view of the thoracolumbar spine to reduce distortion by directing the central ray of the xray to the apex of the scoliotic curvature. Scoliotic curves above 30° have a significant rotational component (18). Gocen and colleagues (18) used a "true AP radiograph" as a more accurate way of determining the Cobb angle of a scoliotic curvature. For this view, the central ray is aimed at the level of the apical vertebra in the scoliotic curvature, so that the vertebral pedicles can be observed to be of equal size. Deacon and colleagues (19) reported this technique to be more accurate for measuring curve size and evaluating spinal anatomy. However, this technique has not been tested for reliability in determining the success of a given treatment plan. Therefore, the radiographic analysis outlined by Harrison and coworkers was used (20,21). This method has shown good to excellent reliability in terms of both patient positioning and structural analysis. Initially, standing lateral cervical, nasium, lateral lumbar, and anteroposterior lumbopelvic views were taken. These views were taken to quantify forward head posture, cervical lordosis, lumbar lordosis, the sacral base angle (Ferguson's angle), and the Cobb angle of the major lateral curvature.

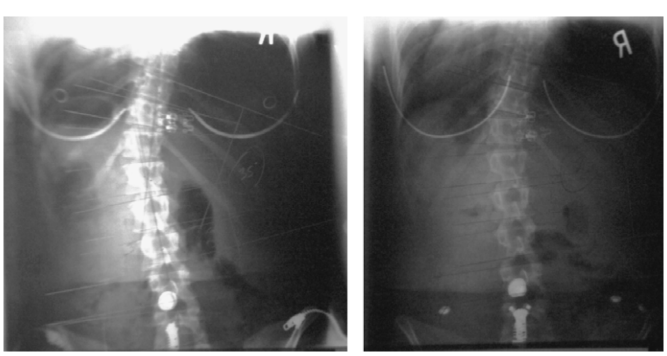

Figure 1. Initial standing AP radiographic examination: 35° left convex thoracolumbar scoliosis

At the onset of treatment, the patient rated her pain as a 6/10 on a verbal pain scale. A pain scale rating was taken at each visit for the entire six-week trial period. The patient wrote down a number from 0–10, with zero being "no pain" and 10 being "excruciating pain." The patient was not allowed to see her previous pain scale scores.

Before intervention, the patient was asked to stand on a trampoline on one foot with her eyes open and this was timed until her upper body started to lean or her elevated foot touched the floor. She was given two practice turns before timing the third. This test was conducted to assess balance and postural stability. Initially, her time registered as 18 seconds. It was thought that performance of this procedure would provide an adequate stimulus to improve balance if repeated on a regular basis and that performing the test on the trampoline would create a more unstable base. A standard orthopedic and chiropractic examination, consisting of cervical, lumbosacral, and pelvic orthopedic tests; cervical and lumbar active range of motion, and static palpation led to a working diagnosis of benign mechanical cervical and lumbar pain complicated by the presence of adolescent idiopathic scoliosis.

Intervention

After plain films were taken, the patient underwent a trial of rehabilitation unique to the Pettibon procedures.

Pettibon corrective procedures (22) have been used to improve cervical spine alignment (23,24), improve strength (25), and reduce hyperlordosis (26). The Pettibon procedures combine both manipulative and rehabilitative procedures, which may help to correct scoliosis through the same sensory, reflexive, somatosensory and neuromuscular mechanisms that have been shown defective in many scoliosis patients (27).

The patient received an anterior thoracic adjustment, and then was immediately fitted with a 4 lb anterior headweight. She was instructed to walk around with the headweight for 10 minutes. After 10 minutes, a follow-up lateral cervical radiograph was taken while wearing the anterior headweight. The purpose of this lateral stress view was to evaluate the potential improvement in cervical lordosis and reduction in forward head posture (23,24). The basis for this aspect of the protocol is based upon the inherent properties of a curved column. In the spine, lateral spinal displacements may occur when the normal sagittal spinal curves (28–33) are flattened, reversed, or accentuated. These curves are necessary for the overall strength and flexibility of the curved spinal column, according to the Delmas Index (34). Therefore, the protocol is intended to restore a normal cervical and lumbar lordosis, and reduce forward head posture before the scoliotic curvatures are addressed.

Each visit consisted of the same procedures in the exact same order, starting with specific warm-up procedures, manipulative procedures, and finally rehabilitative procedures. The warm-up procedures consisted of Pettibon Wobble Chair Exercises (Figure 2) and over-the-door manual cervical traction (Figure 3). The Pettibon Wobble Chair is a chair designed to isolate the lumbar spine so that core training may take place. This chair has been previously illustrated in chiropractic literature (23). However, the effects of the chair itself remain to be investigated. The Wobble Chair® exercises are performed by holding the head and shoulders still, moving only the pelvic girdle. The exercises consist of a front-to-back motion, a side-to-side motion, and clockwise/counterclockwise circles. Each exercise was performed 20 times, for a total of 80 repetitions at each office visit. The over-the-door manual cervical traction is performed with the patient facing the door in a standing position. This traction device allows the user to control the amount of tension placed on the spine, potentially decreasing the chance of muscle strain injury. This procedure was performed 20 times at a rate of 1 repetition per 7 seconds.

Manipulative procedures consisted of a manual traction adjustment administered with the aid of a traction harness (Figure 4). This procedure is designed to mobilize several vertebral joints. An anterior thoracic adjustment was administered with the patient's thoracic cage rotated opposite to the rotational displacement. Side-posture lumbopelvic adjustments were delivered bilaterally to correct the rotational component of the pelvic misalignment. Cervical manipulation was performed both by hand and with a double-pronged percussive instrument to mobilize any cervical and upper thoracic fixations not addressed by the manual traction adjustment. A supine blocking procedure was also used to de-rotate the pelvis. This procedure was performed for 20 minutes at each office visit.

Figure 2. Pettibon Wobble Chair exercise

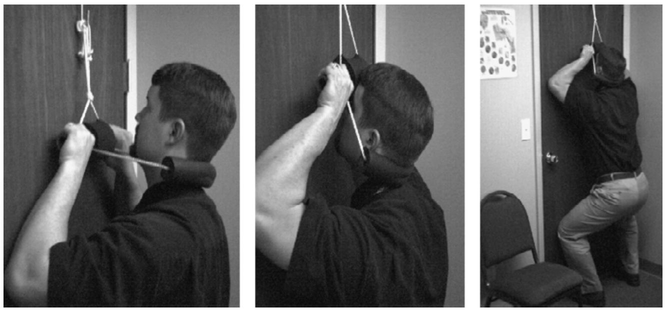

Figure 3. Manual over the door cervical spine traction.

The rehabilitative procedures used were designed to retrain normal posture control through stimulation of the vestibulo-ocular system, cervicocollic and vestibulocollic reflexes, and the somatosensory system. These procedures included the use of an anterior adjustable head weight, a right shoulder weight, and a unilateral

Figure 4. Manual traction adjustment administered with the aid of a traction harness.

front and back hip weight. Tjernstrom and colleagues indicate that postural control needs to be sufficiently challenged by stimulation or disturbance to induce active adaptive learning; they demonstrated that regular postural perturbations induce a long-term memory or motor strategy for adapting to that specific stimulation (35). Wu and coworkers have shown that the addition of external weights applied to the shoulder and hip induce a shift in the center of gravity toward the weight, causing a predictable compensation of the trunk and pelvis (36,37). In the present case, the head weight theoretically served this purpose. The goal of these postural reflexes is to maintain efficient body stance and locomotion using the least energy expenditure as possible (38–42). Figure 5 illustrates the bodyweighting position. During each office visit, the subject wore both the head and body weight while balancing on one foot with eyes alternately opened and closed. This exercise was performed for 10 minutes following the manipulative procedures. The patient was instructed to wear the headweight and hipweight at home for 20 minutes twice daily.

Figure 5. Illustration of the bodyweighting position described in this case.

Positional traction, on two triangular foam blocks placed at the cervicothoracic and thoracolumbar junctions, was performed once daily immediately before bed for 20 minutes. Normally, the subject would have been on a treatment plan consisting of 3 times weekly for 4 weeks, to help ensure that proper ligament deformation and change had taken place. However, due to the long distance between the subject's residence and the clinic, the subject was treated only once weekly.

After the sixth visit, follow-up radiographs were taken to quantify improvements in the sagittal and frontal spinal curves. Additionally, the subject filled out another Functional Rating Index to compare to the original. The Functional Rating Index score dropped from an 18/40 initially to a 7/40. The verbal pain scale rated a

6/10 at the onset of care, dropped to a 2/10. The pain scale scores, on a weekly basis, were reported as follows: 6/10, 6/10, 5/10, 3/10,3/10, 2/10. On the post-treatment anteroposterior radiograph (Figure 1), the Cobb angle from the superior endplate of T10 to the inferior endplate of L4 was reduced from 35° to 20°. Her balance time on the trampoline improved to 56 seconds.

DISCUSSION

Adolescent idiopathic scoliosis accounts for roughly 80% of all scoliosis cases (43). There are a number of different proposed etiologies for adolescent idiopathic scoliosis, including neuromuscular, hormonal, and genetic (1,7). Chiropractic physicians should focus upon reduction of the curvatures present in idiopathic scoliosis, until a definitive cause can be ascertained. Treating these curvatures alone may be a valid treatment goal, in light of the evidence illustrating the effects of these curvatures on developing pathology and disease (9–11). Additionally, there may be a positive effect on quality of life in patients whose scoliotic curvatures are reduced (2). Furthermore, there may be significant psychological issues involved with visual postural deformity (44). The possibility and effects of these issues on individual health status have not been sufficiently investigated to date.

It is important to explain the reasons behind performing the various manipulative and rehabilitative procedures utilized in this protocol. This protocol is divided into a series of both short-term and long-term goals for outcome measures. The outcome of the initial stage of care is to reduce forward head posture and improve the sagittal cervical and lumbar curves. As the position of the head migrates forward, or away from the body's vertical axis, increased strain is placed upon the muscles of the head, neck and shoulders. Cailliet (45) and Zohn (46) indicated that an additional 10 inch/lbs of leverage is added to the spinal system in a forward head posture. Additionally, this added leverage causes increased isometric contraction of various spinal muscles, such as the splenius capitis, trapezius, SCM, and levator scapula. Sjogaard et al (47) reported that blood flow through a given muscle is decreased as a muscles contraction increases, being virtually cut off at 50–60% contraction. The resultant lack of blood flow forces the muscle to rely on anaerobic metabolism. As anaerobic metabolism progresses, metabolites such as substance P, bradykinin, and histamine build up and excite chemosensitive pain receptors, causing a barrage of nociceptive afferent input (48), resulting in dysafferentation (49). Being that postural control is largely dependant upon cervical joint mechanoreceptors and afferent input from ligament and musculotendinous sources (50,51), correcting the postural distortions responsible for this process may be beneficial in patient populations where postural control is significantly altered (52).

The effects of the loss of cervical and lumbar lordosis have been previously reported (31,32). Rhee and colleagues noted that correction of the sagittal curves might be related to the long-term health of the spine in scoliosis management (53). Harrison et al (9) illustrated how a loss of the sagittal curve alters the mechanical properties of the spinal cord and nerve roots, which may change the firing patterns of involved neurons. Schafer (54) illustrated how an increased demand is placed upon the cervical musculature when the cervical curve is straightened or reversed. It is important that the cervical spine be in a normal structural alignment. A loss of the cervical lordosis and concomitant forward head posture may elicit the pelvo-ocular reflex, which causes an anterior pelvic translation to balance the center of gravity of the head (55). Wu et al (36,37) point out that in postural control, preference is given to the position of the head, neck, and trunk. Therefore, correction of the cervical spine becomes imperative so that the rest of the spine can be rehabilitated in relation to a normal reference point in space.

Once the cervical and lumbar lordoses are corrected, coronal reduction of the scoliotic curvatures begins. In the present case, this was accomplished by adding a shoulderweight to the right shoulder and a hipweight to the anterior right ilium and posterior left ilium. Wu and Essien (37) have previously reported the effects of adding external weight to the upper body via a shoulder weight. They identified predictable patterns in which the trunk would compensate for the amount and position of the weight. Wu and MacLeod (36) identified a shift in the center of mass toward the added weight when placed on the side of the pelvis. However, the trunk and head remained in the same position, while the pelvis and lower extremities shifted to counteract the weight while supporting the head and trunk (36).

In this case, we created an environment where external weight was added to the head, shoulder, and pelvic regions simultaneously. Knowing the predictable patterns of compensatory shifting to an altered center of gravity, we placed the headweight, shoulderweight, and hipweights in areas designed to reduce our patient's specific spinal distortion patterns. Theoretically, the head weight causes an anterior shift in the center of gravity of the head, thus exaggerating a forward head position. The head and neck postural reflexes, namely the vestibulocollic (29), cervicocollic (30), and cervical facet mechanoreceptors, respond to this type of postural stimulation by actively orienting the trunk's center of gravity under the head's center of gravity. The shoulderweight, when hung over the right shoulder, causes the trunk to rotate opposite the weight on the z-axis. This opens the apical side of the right lumbar concavity. Furthermore, the patient's pelvic girdle was rotated in a $+\theta y$ direction. Placing weight on the front of the right hip and back of the left hip caused a shift in the center of gravity toward the added weight. This results in a $-\theta y$ direction to compensate for the added hipweight, thereby realigning the pelvic girdle under the trunk.

Learning a new motor coordination skill can be divided into 3 phases: cognitive, associative, and autonomous (56). In the cognitive phase, the patient performs the motor task repetitively to learn until the task requirements are understood (56). As the patient progresses through the associative and autonomous phases, the task becomes easier to perform, and may ultimately be performed in a variety of practical contexts with decreased repetitions (56). Here, the patient was initially required to wear the body weighting while walking. As the patient progressed, other progressively challenging tasks were combined, such as balancing on 1 foot while standing on a trampoline. Based on clinical improvements in function, we hypothesize that the patient will eventually reduce the amount of body weighting performance necessary to maintain reduction in the scoliotic curvature. However, this remains to be investigated.

Since the patient's balance time was markedly improved, it seems that the head and body weighting system provided an adequate postural stimulus so that the task became easier over time. These results are consistent with the conclusions made by Wu et al (36,37) and Tjernstrom et al (35). Practicing this task without the head and body weighting system may have attained these same results. However, performing these tasks while wearing the head and body weighting trains the central nervous system to integrate somatosensory afferent input from joint, musculotendinous, and ligament receptors that are functioning in a normal and stable position, thus increasing functional strength and neuromuscular efficiency (17). As previously mentioned, alterations in postural control have been demonstrated in patients with scoliosis (27). Whether these alterations are causes or effects remains unclear. However, future authors may want to consider how improving neuromuscular control of posture affects the curvatures present in scoliosis.

It is important to identify that this patient was diagnosed with adolescent idiopathic scoliosis. Her past medical history and clinical exams did not indicate any gross structural or neurologic alterations common in other types of scoliosis. Neuromuscular types of scoliosis include those secondary to cerebral palsy (57), Duchenne's muscular dystrophy (57), Gordon's syndrome (58), Alexander disease (59), Charcot-Marie-Tooth disease (60), and Arnold-Chiari I malformation (61). Structural causes of scoliosis include rigid spine syndrome (62), Beals-Hecht syndrome (63), Marfan's syndrome (64), and hemivertebra (65).

Given the study design, it is inappropriate to apply these results to other scoliosis cases. Moreover, the results achieved in this study, while comprised of both subjective and objective measures, may not be directly attributed to the treatment procedures. It is also impossible to determine which of the procedures was the most beneficial and which of those were perhaps unnecessary. The placebo effect was not eliminated in this study. The subject continued the recommended treatment plan, which was initially scheduled over an 8-month period. Additional follow-up will be completed at that time and 2 years after treatment completion.

CONCLUSION

After 6 weeks of care involving the Pettibon corrective procedures, a left thoracolumbar scoliosis was reduced by 15° (43%) in this single case study. Based upon both subjective and objective outcome measures in the present study, this treatment should be repeated in larger trials using control subjects. A long-term follow-up is also desirable.

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