CHIROPRACTIC BIOPHYSICS MANAGEMENT OF STRAIGHT BACK SYNDROME AND EXERTIONAL DYSPNEA: A CASE REPORT WITH FOLLOW-UP

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ABSTRACT

Objective: To discuss a patient with increased thoracic spine kyphosis and improved exertional dyspnea who received Chiropractic BioPhysics® corrective treatments.

Clinical Features: An 18-year old male had back pain and exertional dyspnea. Radiographic assessment revealed a significant reduction in thoracic spine curve. Straight back syndrome is the loss of the physiologic thoracic kyphosis and is associated with back pain as well as the more serious compression of the heart and lungs. There is a paucity of data on non-surgical treatment options.

Intervention and Outcome: Treatment was aimed at increasing the thoracic curve using Chiropractic BioPhysics technique methods, including thoracic hyper-flexion traction and exercises as well as spinal manipulation. An assessment after 24 treatments over a 9-week period showed a 15° increase in thoracic kyphosis as well as a substantial decrease in pain and exertional dyspnea symptoms and improvements in disability and quality of life questionnaires. A 4-month follow-up indicated the patient had stability of the structural correction and remained well.

Conclusion: This case demonstrates the improvement in both straight back syndrome and cervical hypolordosis corresponding to improvements in back pain and classic exertional dyspnea commonly associated with this disorder. Straight back syndrome is a serious health disorder that may be improved by the non-surgical multimodal spinal rehabilitation methods employed in CBP technique. Routine radiography is necessary to quantify the subluxation and monitor treatment progress. (J Contemporary Chiropr 2019;2:115-122)

Key Indexing Terms: Posture; Chiropractic Manipulation; Straight Back Syndrome

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INTRODUCTION

Excessive thoracic hypokyphosis, also known as 'straight back syndrome' (SBS) (1,2), was first documented in 1960 by Rawlings and is defined as the congenital loss of normal physiologic thoracic kyphosis, particularly the mid to upper portion. Problematically, this deformity biomechanically decreases the distance between the spine and the sternum that compresses the internal structures, including the heart and lungs (1,2).

Common symptoms associated with SBS includes back pain and exertional dyspnea; it also mimics congenital heart disease as it often presents with either a mechanical heart murmur or a false heart enlargement (2). A false enlarged cardiac sign, also known as 'pancake cardiac silhouette sign' on a chest x-ray simulates cardiomegaly (3). Although diagnostic features of a systolic murmur are often present in SBS patients, these symptoms are considered benign (4). Regarding systolic murmur, however, Spapen et al. notes that this is associated with mitral valve prolapse, a condition linked with significant morbidity and mortality, and that this may be underestimated in SBS patients (5). The incidence of SBS is unknown (6), and the definitive diagnosis for SBS is made from the lateral thoracic x-ray (6,7) or CT scanning (8,9).

Although severe SBS including lordotic thoracic spinal deformity necessitates spinal surgery (10-12), less pronounced deformity may be amenable to non-surgical spinal rehabilitation. Only 3 case reports have documented successful non-surgical improvement in increasing the thoracic kyphosis in patients with SBS (13-15). Brooks reported a 16° improvement in thoracic kyphosis in a patient with kypho-scoliosis (not exclusively SBS) over a 4-year time span (13). Treatment varied over the time period and consisted of deep tissue massage, outpatient psychological therapy, daily exercises focusing on mobilization of the chest wall and spinal manipulation. Mitchel et al. reported a 10° increase in thoracic kyphosis in a 33-year old over 16-weeks (14). There was resolution of both back pain and exertional

Table 1. *SF-36 Quality of life health questionnaire.*

	Health Perception	Physical Functioning	Physical	Emotional	Social Functioning	Mental Health	Bodily Pain	Energy/ Fatigue
Normal	72	84	81	81	83	75	75	61
01/03/18	77	95	25	100	100	92	68	45
03/07/18	77	100	100	100	100	92	80	55
07/16/18	80	100	100	100	100	92	90	90

dyspnea and a greater than 2 liter increase in lung capacity, which was maintained at a 7-month follow-up. Betz et al. reported a 14° increase in thoracic kyphosis in an 18-year old over 12-weeks (15). There was relief of exertional dyspnea and back pain that was maintained at a 2.75-year follow-up. Importantly, there was also an increase in the antero-posterior thoracic diameter as well as the ratio of the antero-posterior to transthoracic diameters, 2 anatomical measurements critical to the wellbeing of SBS patients.

In this report we present the successful improvement in thoracic kyphosis curvature and other radiographic spinal parameters in a patient suffering from back pain related to SBS who was treated by CBP technique.

CASE REPORT

An 18-year-old male presented with a chief complaint of mid and low back pain (LBP) he had suffered for a period of 2 months. This was the first episode of back pain, as he stated he had strained his back while lifting weights while squatting. He also reported cramping in the left calf and right quadriceps muscle, tended to toe walk, and also suffered from exercise and allergy-induced asthma.

The young man had been previously diagnosed with asthma by their medical principal care provider, but did not take any medications. He did report a familial incidence of heart disease but stated he did not have any diagnosed cardiovascular problem. He also reported that this was the first treatment he sought out for his recent back issue.

The patient stood with visible head flexion and had a high left shoulder. Spinal range of motion (ROM) assessment was unrestricted in the low back though elicited pain in all directions and was restricted in left lateral bending in the cervical spine. Deep tendon reflexes were normal except the right patellar reflex was a 1+. Dermatome and myotome testing were unremarkable. He had a flattened upper thoracic spine as assessed by visual observation indicative of possible SBS.

On the Numerical Rating Scale (NRS) he rated the middle back pain a 3-5/10 and the lower back a 2-5/10, corresponding to pain 'on average' to pain 'at worst' (0=no pain; 10=worst pain ever). The patient scored a 10% on the Oswestry Low Back Pain Disability Index (ODI) (16), and scored low on the role-physical, bodily pain and energy/fatigue subscales on the Short-Form 36 question quality of life health questionnaire (SF-36) (Table 1) (17).

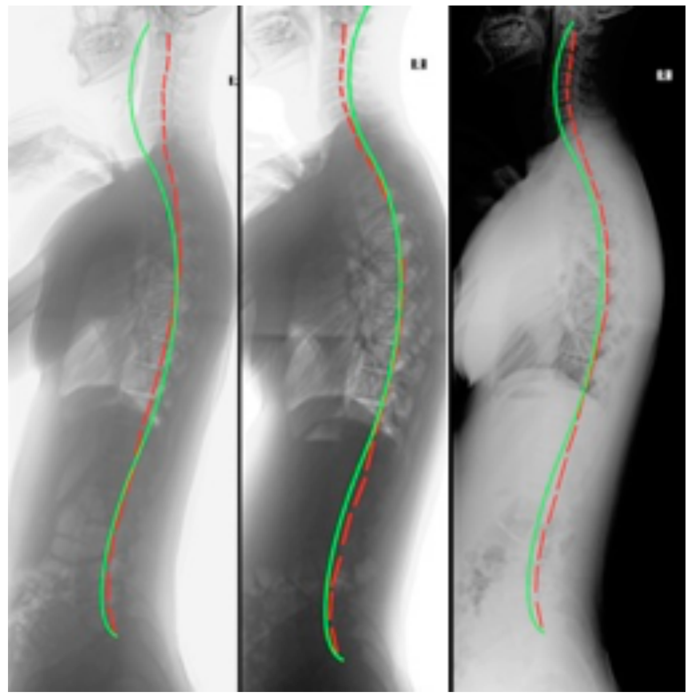

Figure 1. *Lateral full-spine radiographs. Left: Initial (1/3/18) image showing thoracic hypokyphosis or 'straight back syndrome;' Middle: Post-treatment (3/7/18) showing increase in thoracic curvature; Right: Follow-up (7/16/18) showing maintenance of structural improvements.*

A full spine radiographic assessment was completed with the patient in the neutral standing position with his feet hip-width apart (Figures 1-3). All images were digitized using the PostureRay software analysis system (PostureCo, Inc., Trinity, FL, USA). This system incorporates the Harrison posterior tangent (HPT) method (lines placed on the back of the vertebral bodies) to measure the sagittal plain spinal contours both intersegmentally (Relative Rotation Angle: RRA) and regionally (Absolute Rotation Angle: ARA) (18-21). This

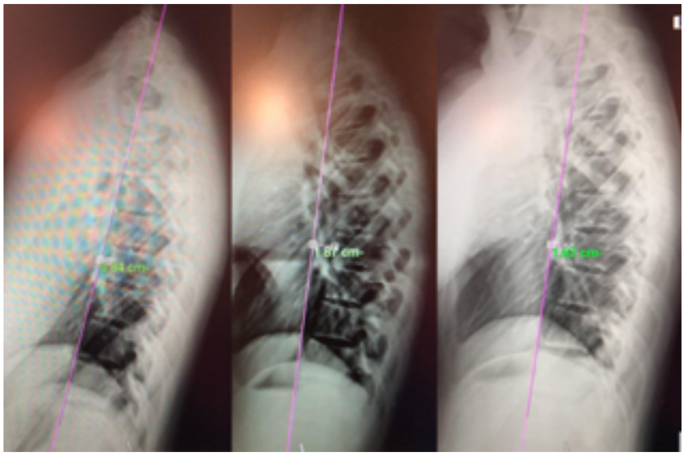

Figure 2. *Lateral thoracic radiographs. Left: Initial; Middle: Post-treatment; Right: Follow-up. Measurement shows an increase from 0.84cm to 1.62cm distance from mid-height anterior T8 to the line intersecting mid-height anterior T4-T12. This distance is diagnostic for SBS when <1.2cm (24).*

method has a standard error of measurement of about 2° and is reliable and repeatable, as is standing posture (22).

The patient was radiographically diagnosed with thoracic hypokyphosis SBS having an ARA measurement from T1-T12 of 19.5° (vs. 43.7° normal (23); Figure 1) and having a distance from a line intersecting the mid-height of T4-T12 to the mid-height of T8 <1.2cm [0.84cm vs. >1.2cm normal (24)] (Figure 2). The patient also had cervical hypolordosis [C2-C7 ARA = -20.3° vs. -31-42° normal (25, 26)] (Figure 3), reduced atlas plane line (-17.6° vs. 24-29° normal (25, 27)), and lumbar spine hypolordosis (L1-L5 ARA = -31.9° vs. -40° normal (28)), and an increased sacral base angle [45° vs. 40° normal (28)].

The definitive diagnosis of SBS was made as diagnosed from the lateral film view (Figure 2). Differential

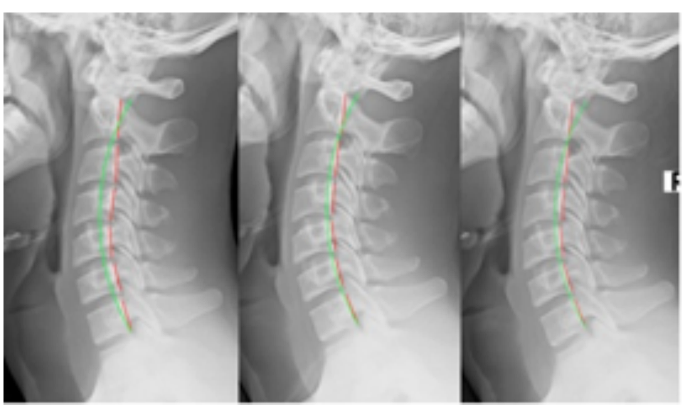

Figure 3. *Lateral cervical radiographs. Left: Initial (1/3/18) image showing forward head translation and hypolordosis; Middle: Post-treatment (3/7/18) showing reduction in forward head translation and increase in cervical curve; Right: Follow-up (7/16/18) showing maintenance of structural improvements.*

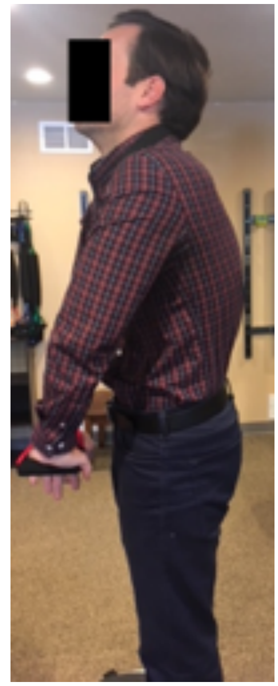

Figure 4. *Thoracic flexion exercise No. 1 (see text).*

diagnosis for SBS includes ruling out heart disease. The patient reported no prior cardiovascular issues and no enlarged heart shadow was observed on the AP thoracic film.

He was treated 3 times per week for 8 weeks by methods employed in Chiropractic BioPhysics® (CBP®) technique. CBP is a whole-spine and posture correcting method using mirror image® exercises, spinal adjustments, and spinal traction (29, 30). The primary treatment goal for this patient was to increase the thoracic spinal curve.

The patient performed 3 in-office exercises. The first exercise (Figure 4) consisted of placing a Prolordotic neck exerciser band (Circular Traction Inc., Huntington Beach, CA, USA) around the base of the neck and to elongate the strap by extending the arms forward, then to round the shoulders and flex the thorax before extending the head – this order prevented the patient from extending the upper thoracic spine. Each repetition was held for 5 seconds. The second exercise (Figure 5) consisted of placing a 10-pound thoracic-flex traction body weight (Circular Traction Inc., Huntington Beach, CA, USA) around the base of the neck and then to allow it to pull the upper back downward. A strap was placed at the thoracolumbar junction to stabilize the lower spine and to focus the majority of the bending in the upper thoracic spine. This position was held for 2 minutes. The third exercise (Figure 6) involved crossing the arms and grabbing the shoulders to pull the upper back downward. When the patient felt his thoracolumbar junction start to move, he was instructed to hold for 5 seconds and then

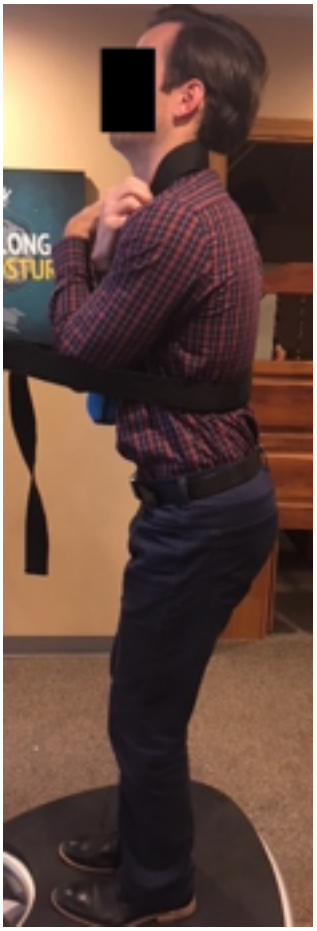

Figure 5. *Thoracic flexion exercise No. 2 (see text).*

repeat. A block was placed behind the pelvis to stabilize the movement and prevent postural shifting. This is a dynamic exercise that encourages both movement and isometric strength. All exercises took 8 minutes to complete and were performed on a PowerPlate® 3D vibration platform (Performance Health Systems, Inc., Northbrook, IL, USA) to increase the intensity of the exercises (31).

The patient also received prone spinal manipulative therapy (SMT) as well as instrument-assisted paraspinal muscle stimulation with a bolster positioned under the chest to induce forward rounding of the thoracic spine. Spinal traction was performed in the prone position on a recumbent Universal Traction System® (UTS® Las Vegas, NV, USA) pulling up at T7 while strapping the lower and upper thorax down (Figure 7). Traction duration was increased each session until the duration of 20 minutes was achieved and maintained thereafter.

The patient was prescribed a home rehabilitation routine to compliment the in-office treatment. The Prolordotic-assisted exercises as previously described; laying supine over a cervical Denneroll traction block to be placed in the mid neck for a duration of 15-20 minutes daily; laying

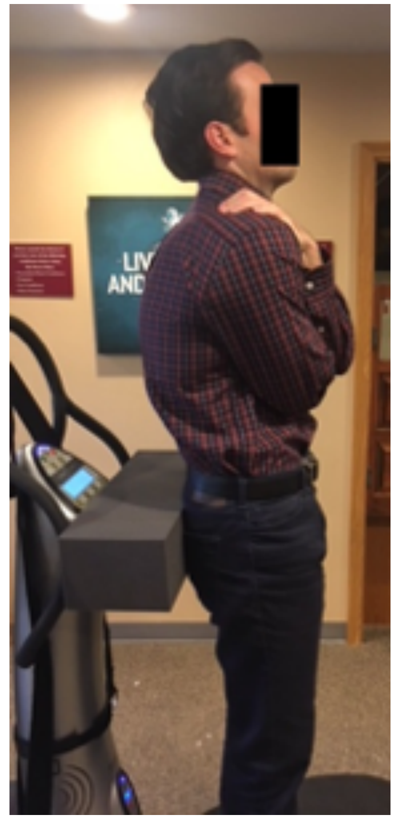

Figure 6. *Thoracic flexion exercise No. 3 (see text).*

prone over an Erikson prone traction wedge similar to the traction set-up as described above (Figure 7) for a duration of 15-20 minutes was to be done at home daily. Cryotherapy was to be used after the home routine if necessary. The patient consented to the publication of treatment results including any and all x-rays and pictures.

Figure 7. *Mirror image thoracic flexion traction.*

Results

An assessment was performed after 24 in-office treatments over a 9-week period. The patient reported the LBP to be 100% improved, the asthma symptoms to be 90% improved, the muscle cramping to be 90% improved, and the toe walking tendency to be 70% improved. He scored a 2% on the ODI, had substantial improvements in 3 SF-36 health indices, and now rated both the mid and LBP to be a 1/10 on average, and a 2/10 at worst. Physical assessment revealed all ROM tests were pain-free and within normal limits and all other tests were unremarkable.

Radiographic assessment revealed a clinically significant increase in the thoracic kyphosis of 15° (T1-T12 ARA: 34.6° vs. 19.5°; Figure 1), an increase in cervical lordosis (C2-C7 ARA: -28.2° vs. -20.3°; Figure 3), an increase in APL (-25.9° vs. -17.6°; Figure 3) and a decrease in sacral base angle towards normal (41.6° vs. 45°). The SBS diagnostic distance between T8 and the line intersecting T4-T12 also increased to within normal limits (1.62cm vs. 0.84cm) indicating the patient no longer had SBS (Figure 2).

A follow-up assessment was performed 7.5 months after starting treatment and 4.25 months after ending intensive corrective care. The patient had received only 4 subsequent 'stabilization' treatments (identical treatments for 'maintenance' purposes), approximately once per month. All subjective improvements were maintained. The patient rated the mid and LBP to be 0/10 'on average' and 0/10 'at worst' and scored a 2% on the ODI. The SF-36 scores were also maintained with a greater improvement in the energy/fatigue health scale. Radiography revealed that the correction to the thoracic spine (T1-T12 ARA: 36.5°) was maintained as was the cervical lordosis (C2-C7 ARA: -27.6°) (Figures 1, 2).

DISCUSSION

This case demonstrates the non-surgical improvement in thoracic kyphosis of 15° occurring after 24 in-office treatments as well as a home program over a 9-week time period. The improvements were verified to be stable at a 4-month follow-up. The improvements in posture correlated to improvements in pain, walking ability, muscle cramping, and exertional dyspnea originally reported as an exercise-induced asthma.

Although SBS is officially diagnosed on x-ray or CT scan, no official angle defines its presence. Radiographic measurement is the obvious and essential assessment criteria, to not only help in diagnosis but also to monitor for improvement after treatment. We used the HPT method as it is more accurate than a 4-line Cobb, and it also measures the spinal curve along its curve being consistent with an engineering analysis vs. the Cobb method that measures as a cross-section to the spinal curve and can be affected by a deviation in vertebral body shape (18, 32). As assessed using the PostureRay analysis system, an average normal thoracic contoured line gets added to the patient's image, aiding in a quick and accurate diagnosis (See Figure 1).

There are different grades of SBS that may necessitate different treatment approaches. The surgical correction of severe SBS, when the thoracic spine is lordotic is described in the literature (10-12). Surgery is only recommended for SBS patients who have cardiopulmonary symptoms with severe structural thoracic lordosis of greater than 25-30° (11). As this case and others suggest, for mild cases of SBS (hypokyphosis), non-surgical intensive rehabilitation programs incorporating thoracic hyper-flexion protocols may prove to be the most effective approach to restore/improve normal physiologic kyphosis and simultaneously relieve related back pains and exertional dyspnea typically experienced by these patients (14,15).

This case featured a 15° improvement in kyphosis in 9-weeks. The Mitchel case (14) showed a 10° improvement in 16-weeks and the Betz case (15) showed a 14° improvement in 12-weeks. Together, these three CBP cases show a 10-15° improvement in thoracic kyphosis over a 9-16 week duration which may be very clinically important. In the reduction of thoracic hyperkyphosis (THK), for example, several recent CBP case reports and 2 case series show changes of 9-23° over durations of 9 weeks to 13 months (33-38); the 2 case series showed an average improvement in THK of 11° over 9-10 weeks (33, 34). Other non-surgical rehabilitation methods used to reduce THK have not, unfortunately, used x-ray for measurement, but the 3 studies that did perform pre-post x-ray trials each showed only a 3-4° reduction over 6 months (39), 12-months (40), and 2 years (41) using anti-gravity exercises. A treatment group receiving more comprehensive Schroth exercise treatment had a 9° improvement over 12 months (40). Thus, as demonstrated, a 15° change in a thoracic spine curve is a substantial alignment change.

CBP methods may prove its efficacy for SBS and other structural spine deformities as it incorporates patient-specific mirror image traction methods. It is reasoned that sustained spinal traction in the reverse of a patient's spinal deformity may be the ideal approach to reduce the deformity as this targets the viscoelastic properties of the intervertebral discs and ligamentous tissues (41, 42). Spinal traction causes ligamentous tissues to biomechanically creep (deform over time) leading to plastic deformation (structure permanently deforming/lengthening) (41, 43); this likely contributes to the radiographically demonstrable spinal structural improvements as seen in the CBP treatment of THK (33-38), SBS (14, 15), cervical hypolordosis (44-46), and lumbar hypolordosis (47-49). Although CBP methods involve exercises and spine and postural adjusting procedures, as demonstrated in several randomized trials, the traction is key to structural spine changes and successful long-term patient outcomes (44-49).

It should be mentioned that the patient initially came for back pain. However, upon examination it was determined that the patient had other issues related to having SBS, including exertional dyspnea which is related to the function of the respiratory system. Although there are cases reporting improvement of symptoms of SBS by spinal manipulation (50), it is logical that any type of treatment to be superior in the treatment of SBS, a spinal disorder, should restore the spine towards a more normal alignment as was achieved in this case. This case, in fact, demonstrated post-treatment and at follow-up, the distance between T8 midbody to the line intersecting T4-T12 midbodies to be within normal limits (<1.2cm) (24), and therefore, reversed the diagnosis; the patient no longer has SBS. This evidence supports the argument that treatments for SBS should be a structural-based outcome goal of care versus only symptomatic-relief treatments, that will likely regress after treatment as has been found for cervical and lumbar treatment approaches (44-49).

Limitations to this case includes that it is only a single case. One may argue whether this case demonstrated a sufficiently straightened thoracic spine to be officially diagnosed as SBS. We argue that a thoracic curve having greater than 50% reduction in its normal physiologic alignment is pathological; whether termed SBS or hypokyphosis is essentially a semantics issue. Although there was a 4-month follow-up, a longer follow-up would provide better information as to the stability of spinal correction attained. We recommend more research into non-surgical methods to increase the thoracic spinal curve in SBS patients, although the rarity of the condition presents an obvious challenge for this endeavor.

CONCLUSION

This case demonstrates the improvement in both SBS and cervical hypolordosis corresponding to improvements in back pain and classic exertional dyspnea commonly associated with this disorder. The large structural improvement in thoracic curve is likely due to the unique and multimodal mirror image thoracic hyperflexion traction and exercises used in the CBP treatment approach.

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