CASE STUDY

Scoliosis Reduction Utilizing an Exercise

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Abstract — The objective of this case study is to discuss the case management of a patient with idiopathic scoliosis through application of a therapeutic exercise maneuver. For simplicity the word "exercise" is used interchangeably with therapeutic maneuver. The clinical features were based on a 28-year-old female whose case history revealed a scoliosis originally detected in 1982 at which time an orthopedic surgeon prescribed bracing to reduce the curvature. The patient observed an increase in her postural distortion while standing in front of a three-way mirror and presented to our office for care several years later. The intervention and outcome was based on a therapeutic maneuver/exercise prescribed specifically for the reduction of the scoliosis and disc wedging. The specific exercise was based upon an observation of the initial radiographs as well as stress end-loaded radiographs taken at the finished position of the exercise. Follow up radiographs revealed a reduction of the curvature. The appropriate application of a specific therapeutic maneuver/exercise resulted in decreasing the Cobb's Angle on the A-P stress end-loaded and static A-P lumbar radiographs and also decreased the disc wedging in this case.

Key Words: scoliosis, exercise, chiropractic, vertebral subluxation, biomechanics, Applied Spinal Biomechanical Engineering

Introduction

Speiser, Aragona and Heffernan, have reported that abnormal lumbar biomechanics could return to normal with isometric exercises. Kent references this case study in a review of subluxation models as does Haldeman et al in the proceedings of the Mercy conference.[1-4] After reviewing the literature in reference to scoliosis, we were unable to find any confirming specifics demonstrating the rehabilitative use of therapeutic biomechanical exercises to reduce scoliosis based upon information obtained from stress radiography. This included a search of the Chirolars data-base in reference to the association between chiropractic, exercise and scoliosis.

In a study by Bloom, Gheorgheu, and Verstandig they evaluated the radiographs of 244 subjects with scoliosis. In 80% of the subjects presenting 5 degrees or more, the psoas muscle was visualized on the convex side of the A-P radiograph. In only 30% of the subjects, it was visualized on the concave side.[5] This visualization of the psoas muscle may be due to what Stokes et al reported regarding asymmetric loading in the spine due to muscle imbalance. It may cause abnormal vertebral body growth and result in spinal deformities such as scoliosis. The terminology of "vicious cycle" has been used to refer to this occurrence.[6]

In another study, Stokes, Spence, and Aronsson tested the Heuter-Volkman principle when they used a compressive apparatus to compress rat vertebrae to create a scoliosis and a distraction apparatus on a rat tail to decompress the rat vertebrae and reduce a scoliosis in a non weight bearing situation. The distracted vertebrae grew faster than the compression group because of decreased loading forces. This may have important implications in the remodeling component of vertebral subluxation. This study's findings confirm that vertebral growth is modulated by loading according to the Heuter-Volkman principle. Other biomechanical studies have focused on post-discectomy motion or the effect of compressive forces on disc and joint biomechanics in vitro.[7,8]

A study that addressed the combination of the above factors is Carpintero et al which concluded that intrinsic muscle imbalance in the spinal column of experimental growing animals may produce scoliosis with characteristics similar to those of human idiopathic scoliosis.[9]

Historically in chiropractic effects of adjustment on lumbar pathobiomechanics (subluxation) which may be a component involved with scoliosis have also been investigated. The effect in these studies indicates normal coupling motion being restored to the lumbar spine after chiropractic adjustment. This restoring of normal patterns of motion includes both spinous rotation and lateral flexion of vertebrae.[10-14]

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Case Report

History and Examination

A patient presented to the office with concern that upon observation in a mirror, her postural distortion appeared to be getting worse. Prior treatment during the patient's adolescent years included traditional orthopedic bracing procedures for 3 years as well as numerous chiropractic procedures. Our assessment included standing A-P lumbar radiographs and postural analysis of the patient which revealed pelvic unleveling, posterior scapular asymmetry, high shoulder, and spinal curvature. Adam's test was positive. Case history, unilateral lumbar paravertebral muscular hypertrophy, asymmetrical lumbar spine range of motion, static and motion palpation findings and prior radiographic studies were consistent with the patient's initial concerns. Based upon our clinical practice experience and the chiropractic technique of Applied Spinal Biomechanical Engineering (ASBE) we determined that a therapeutic exercise based on stress radiography may reduce her scoliosis.[1,2,18]

Radiographic Analysis

All radiographs were 8" x 10" in size and were taken using state-of-the-art Kodak high speed CSG-2 film/rare earth screen/low radiation x-ray imaging system. Also, a niobium filtration system was utilized. This system and film size is recommended by Applied Spinal Biomechanical Engineering principles and practices in order to reduce x-ray exposure to the patient.[1,2,18]

- Lumbar spine A-P film
- Film/screen combination system speed: 1200
- Filtration: Niobi filter
- KVP: 80, MA: 100, Time: one tenth of a second
- Entrance skin exposure (ESE)/(MR):21 per x-ray view.

A static anterior-posterior (Fig. 1) lumbar radiograph was taken upon entry to the office (See Table 1 for all AP Lumbar standing view data) The Cobb method of mensuration was utilized throughout this study to quantify the scoliotic deformity.[11] A 41- degree right convex scoliosis was noted independently by the two examiners. The apex was at L-1. Each doctor worked separately and blinded to the other's findings. Traditionally, chiropractic has used spinous process misalignment, body rotation and disc wedging as factors of vertebral subluxation based upon the Medicare guidelines on subluxation, chiropractic spinography, Palmer and Gonstead techniques and ACA guidelines.[12-17] Using the Gonstead x-ray analysis the subluxation was noted at L-4 with a listing of PLS-M. P indicates the vertebral body has moved posterior, L indicates the spinous has rotated left, S indicates there is an open wedge on the side of spinous process rotation and the M indicates a mamilary contact would be utilized for the corrective adjustment.

The next radiograph taken the same day was a type 1 left stress end-loaded radiograph. (Fig. 2) (See Table 2 for all AP Lumbar stress end-loaded view data.) Prior to obtaining the stress-loading radiograph, the subject was instructed to perform the exercise and maintain the end range position (See Figure 3). This is the only means to assure replication of body position.

Figure 1. Lumbar A-P: 1-5-1995. Right convex scoliosis, apex is L-1, Cobb angle: 41 degrees. Disc wedges in degrees: L-4/L-5 (left 6 degrees), L-3/L-4 (left 10 degrees), L-2/L-3 (right 4 degrees), L-1/L-2 (right 10 degrees), T-12/L-1 (right 6.5 degrees).

TABLE 1
AP Lumbar Standing

FIG #	DATE OF XRAY	COBB ANGLE	APEX
1	01/05/95	41.0	L1
7	05/20/96	35.5	L1

TABLE 2
AP Lumbar Stress End-Loaded

FIG #	DATE OF XRAY	COBB ANGLE	TYPE
2	01/05/95	18.0	I
4	04/13/95	5.0	II
6	10/04/95	5.0	II

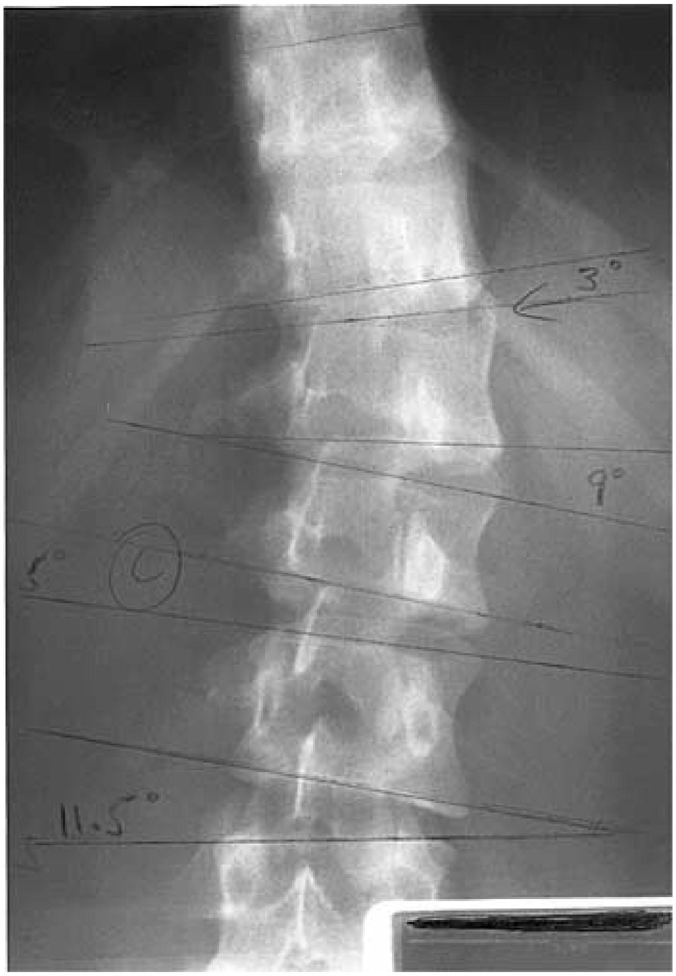

Figure 2. Lumbar A-P type 1 left stress end loaded radiograph: 1-5-1995. Right convex scoliosis, Cobb angle: 18 degrees. Disc wedges in degrees: L-3/L-4 (left 11.5), L-2/L-3 (left 5 degrees), L-1/L-2 (right 9 degrees), T-12/L-1 (right 3 degrees).

Figure 4. Lumbar A-P type 2 stress end loaded radiograph: 4-13-1995. Right convex scoliosis, Cobb angle: 5 degrees. Disc wedges in degrees: L-2/L-3 (left 7 degrees), L-1/L-2 (zero), T-12/L-1 (zero). T-11/T-12 (right 3 degrees).

The authors could not confirm any literature on the reliability of body positions for repeat stress loaded motion x-rays.

- ♦ The subject stood against the bucky and held on to the sides lightly for balance.
- ♦ The patient is instructed to extend the left leg out twenty-five degrees with the foot off the floor. The knee remains straight.
- ♦ Next, the patient is instructed to point the toes of the left foot toward the head and relax the left leg.
- ♦ Now the patient concentrates on moving the left hip downward without touching the floor (negative Y translation). This is an eccentric contraction.
- ♦ The entire relaxed leg and foot is moved inches further than the opposite foot.
- ♦ Patient was positioned without any oblique rotation of the pelvis and lumbar spine. This also applies to the Type 2 end-loaded radiograph positioning.
- ♦ The film is taken.

This film (See Fig. 2) showed a reduction in scoliosis using the Cobb's method and disc wedging. However, based upon the principles and practices of Applied Spinal Biomechanical Engineering,[1,2,18] the authors presumed that additional reduction could be achieved if the same procedure was performed with the left leg crossed over the right leg. This A-P radiograph (see Fig 4) taken approximately 3 months later revealed that the scoliosis deformity reduced more than Figure 2. No clinical or exercise intervention occurred during this 3 month time frame. Following this film the clinical intervention was limited. No manipulation/adjustment or other treatment modalities were utilized.

The prescribed type 2 stress end loaded therapeutic maneuver/exercise was based on the results shown in Fig. 4 and performed as follows (See fig.5).

- ♦ Follow the instructions of type 1 stress end loaded radiograph.
- ♦ Now the left leg is crossed over the right leg at a forty-five degree angle.
- ♦ Now the patient concentrates on dropping the left hip as far down as they can without touching the floor.
- ♦ If the left foot touches the floor bring the left foot forward farther before crossing over. A pulling sensation in the left

Figure 6. Lumbar A-P type 2 stress end loaded radiograph: 10-4-1995. Right convex scoliosis, Cobb angle: 5 degrees. Disc wedges in degrees: L-3/L-4 (left 6 degrees), L-2/L-3 (left 4.5 degrees), L-1/L-2 (right 2 degrees). T-12/L-1 (right 3 degrees).

Figure 7. Lumbar A-P: 5-20-1996. Right convex scoliosis, apex is L-1, Cobb angle: 35.5 degrees. Disc wedges in degrees: L-4/L-5 (left 4.5), L-3/L-4 (left 9 degrees), L-2/L-3 (right 2 degrees), L-1/L-2 (right 12.5 degrees), T-12/L-1 (right 11 degrees)

lower back is expected as the muscles are working during this exercise.

- ♦ Avoid leaning the patient's body toward the left side. The patient waits five seconds before another exercise is performed.
- ♦ Longer rest periods are acceptable to allow proper muscle recovery, but this period is convenient for the patient and may increase compliance.

The above isometric exercise was prescribed to the patient as a trial protocol to be performed in the following manner: ten times to the left side and once to the right side. Each repetition is held for ten seconds and performed at least three times per day. For strengthening of weak muscle fibers to occur, repetitive contractions on a consistent basis must be accomplished to sufficiently activate a stretch reflex. This stretch reflex is based upon Starlings Law of muscle physiology.

Discussion

A twenty eight-year-old female presented herself to our office and the entry static A-P lumbar radiograph (Fig.1) using the Cobb method of mensuration revealed a 41-degree right lumbar scoliosis, with the apex at L1. Two blinded examiners came to this measurement as well as all of the measurements found in this paper. The disc wedge angles were also measured. A type 1 left stress end-loaded radiograph was also taken upon intake using Applied Spinal Biomechanical Engineering principles and protocols.[18] The Cobb angle was eighteen degrees and the disc wedges were reduced (Fig.2). No treatment, exercise or other clinical intervention was instituted at that time.

Three months later an A-P lumbar left type 2 stress end loaded radiograph was taken (Fig. 4). The Cobb angle was measured at 5 degrees and disc wedges were reduced. Since this film showed the most reduction in the scoliosis by the measurements of the Cobb angle and disc wedging, the left type 2 stress end loaded exercise was chosen for the patient to perform (see Figure 5). She performed this exercise ten repetitions to the left, just like the x-ray was taken, with a holding time of ten seconds at the end point of the exercise, three sets a day. There was a five-second rest in between the repetitions.

Five months later a follow-up lumbar type 2 stress end-loaded radiograph was taken (Figure 6). The Cobb angle remained the same, and measurable global disc wedging improved (intraobserver variability for manual Cobb Angle

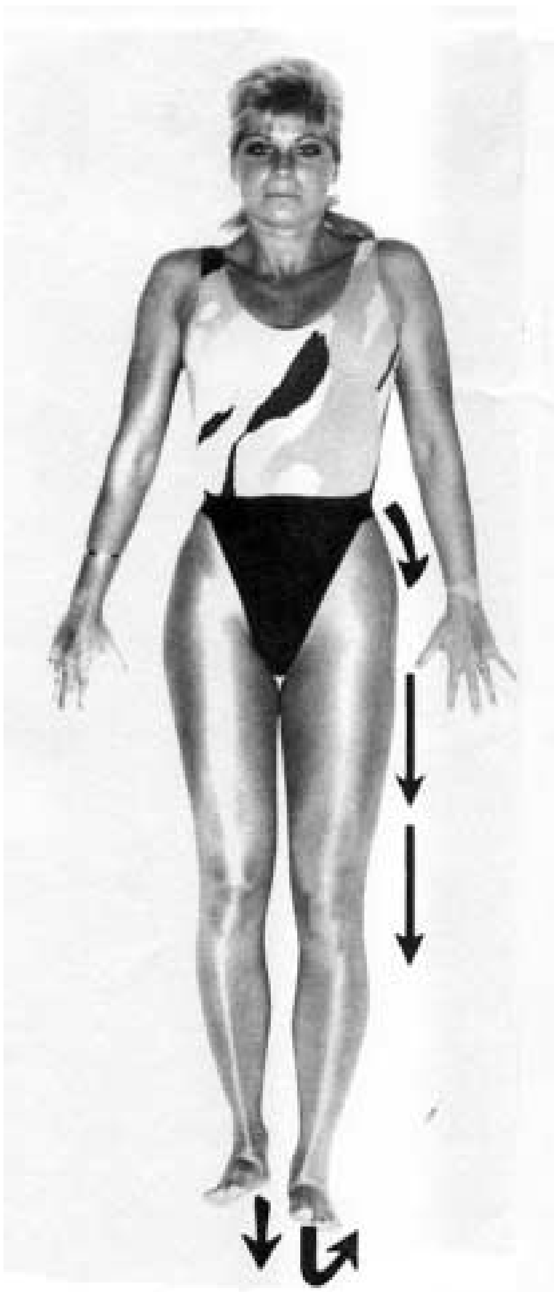

Figure 3. ((–Y)$_4$(G/L/I-P))

measurements yield a 95% confidence interval of approximately 3.3 degrees — range 2.5-4.5 degrees.[19])

Seven months later a static A-P lumbar follow-up x-ray was taken (Figure 7). Cobb angle was 35.5 degrees, apex of curvature remained at L1 and most disc wedges reduced as compared to the entry radiograph.

Figures 2, 4, and 6 appear to be oblique however the patient was placed to the buckey as an A-P lumbar view. It is hypothesized that the reverse function of the iliopsoas type I and II may reduce the theta Z and X translation deformity. In the process it may give the appearance of an oblique like view.

In summary, stress end loaded exercises (moving the hip, leg and foot downward in a negative Y translation) on the left resulted in a reduction in the Cobb angle and disc wedging. The lumbar type 2 stress end loaded crossover exercise was required and this resulted in a reduction in the scoliosis as seen in Figure 7. The only treatment intervention in this case was the type 2 stress end loaded crossover exercise. This protocol, intervention and application was based on Applied Spinal Biomechanical Engineering principles and practices.[18] Utilizing one exercise was advantageous because the number of variables was limited.

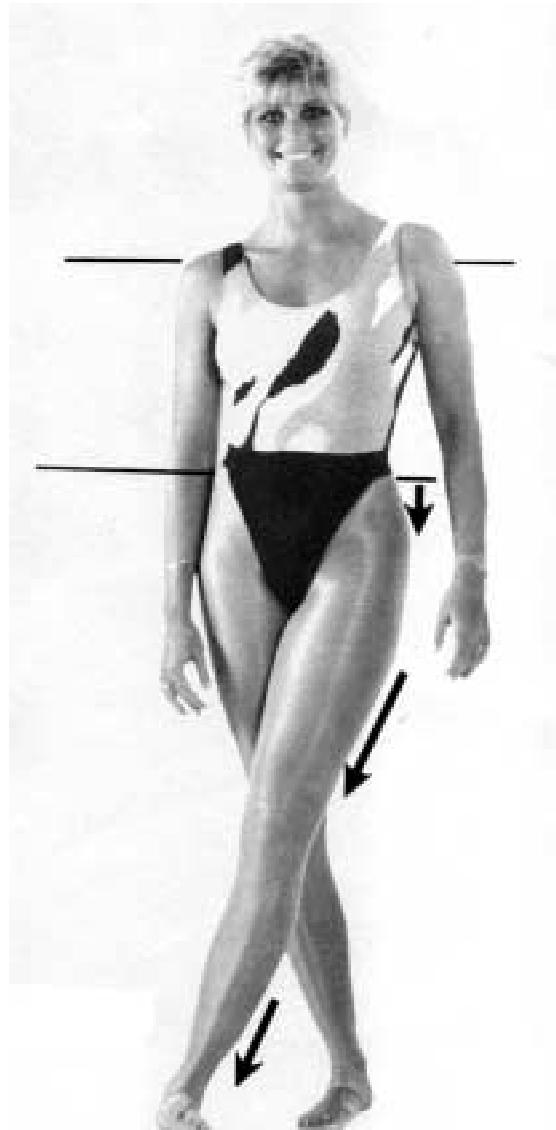

Figure 5. ((–Y)$_4$(G/L/I-P))((L/E)(+Z)(–X)(45°))

Some of the shortcomings and weaknesses of this type of case study include the following: How many repetitions and sets of the exercise did the patient perform at home each day? How long did the patient maintain each exercise contraction, and how much rest between the repetitions occurred? Did the patient position herself correctly as instructed each time when performing the exercise? Did the patient miss any sets, repetitions or days of the exercise? To improve the quality of the study more controls, as mentioned, should be implemented. The intra-examiner reliability using the Cobb Angles and disc measurements could be less than adequate and lastly, X-ray positioning errors and x-ray distortion may exist.[11]

The patient reported other benefits from the exercises, however this was not measured with a valid survey. She saw her posture improved when she looked in a three-way mirror, and was satisfied with the reduction of her lumbar scoliosis. We expected these improvements based upon the chiropractic technique of Applied Spinal Biomechanical Engineering and its protocols. Exercise alone was selected because the doctors utilize ASBE procedures and because the patient lived a long distance from the office and could not establish a scheduled care plan for adjustments to correct the biomechanical problems (subluxation & scoliosis). Therefore, a self- directed program of Applied Spinal Biomechanical Engineering therapeutic maneuvers was an appropriate alternative for this patient. Also, the authors wanted to see if exercise alone could reduce a scoliosis. Informed consent was obtained from the patient and permission for use of the trademark of Applied Spinal Biomechanical Engineering was received from the president of the organization.

Conclusion

In this report it is suggested that the repeated performance of an exercise culminated in the possible reduction of curvature in this scoliotic patient. Through repetitive motion combined with holding the static position at end-range, the exercise mechanically altered the orientation of the lumbar spine. The L-4 subluxation complex, (PLS-M) was reduced in its posterior element, which is the spinous process rotation and the anterior element, which is the disc wedging. Furthermore, by strengthening certain intrinsic muscle groups, such as through a type 2 therapeutic maneuver, it can be seen how an idiopathic scoliosis may be reduced .

Clinicians who address scoliosis in practice should use an exercise that can help reduce a scoliosis, preferably one that addresses the intrinsic myofascial structures of the spine. It is hypothesized that the iliacus-psoas muscle group synergistically may have played a role in this scoliosis and its reduction. Through elongation of the heel and associated crossover hip drop (as the exercise is described), tension along the muscle lines of action are increased through the iliacus-psoas muscle group. By elongating the insertion from the origin of this muscle group, the lumbar spine reacted positionally with decreased open disc wedging contralateral and positive X translation as demonstrated by end-loaded radiographs. The lumbar spine curvature was reduced by 5.5 degrees (Cobb angle) and most disc angles also reduced when the type 2 cross over exercise was performed. It is suggested that a radiograph be obtained during muscle end load manuever before an exercise is prescribed and performed for several months. The use of the methodology developed in this report may be appropriate for other applications where there is a question of muscle function and strengthening for scoliosis reduction. Additionally, a larger and more diverse patient base should be used to determine if similar results can be obtained.

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