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Reduction of Adolesecent Idiopathic Scoliosis through Posture Correction: A Case Report

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Abstract

Background: The purpose of this study is to present the X-axis posture improvements in the spine in a young male with adolescent idiopathic scoliosis with occasional complaints of low back pain who was treated with posture correction.

Case presentation: A 15-year-old male presented to the clinic with occasional low back pain. They brought full spine radiographs, (AP and lateral view). Radiographs revealed a cervical kyphosis, forward head, left head tilt, straightening of thoracic kyphosis and lumbar lordosis, and a Cobb angle of 29º with left convexity in the lumbar spine. The patient was treated with ASPINE Systems®; integrating spinal manipulation, corrective exercises and spinal multidimensional traction.

Results: Re-evaluation after 60 sessions during 20 weeks showed improvements in radiographical assessments. The head tilt angle disappeared, deviation of the lower rib cage was aligned to the body's midline and there was a reduction of the Cobb angle by 17º degrees.

Conclusion: A sizable study using more cases utilizing these protocols and procudures should be conducted to create greater medical awareness of more scoliosis treatment options.

Keywords: ASPINE systems • Adolescent idiopathic scoliosis • Cervical kyphosis • Symptomatic

Introduction

Adolescent Idiopathic Scoliosis (AIS) is a spinal condition causing deformity in 3 dimensions: the coronal, sagittal, and axial planes. AIS is defined as any curve equal to or greater than 10° in the coronal plane [1]. An exact cause of AIS is still unknwon and the etiology includes several factors such as: genetic, hormonal, bone, connective tissue anomalies, biomechanical and neurological factors [2]. AIS has an overall prevalence of 0.47-5.2% with a female to male ratio from 1.5:3.1 and increases substantially with the age [3]. Side curvatures greater than 30° affects 10 times more females than males according to screenings made in elementary and high schools [4].

Treatment for AIS is based on age, curve magnitude and risk of progression that includes observation, physical rehabilitation, orthotic management and surgical correction with spinal fusion; however, experts have recognized that traditional bracing lacks the ability to make 3D corrections, reduces physiological curves, and produces poor cosmetic changes [5]. Surgery is indicated when a curve is progressive despite bracing and when the curve reaches 45º to 50º [2].

Therapists have searched for new treatment methods that can help reduce side curvatures. The Society of Scoliosis Orthopedic Rehabilitation and Treatment (SOSORT) Committee align their guidelines with new evidence based rehabilation procedures and offer recommendations to ensure the clinical practice of Conservative Treatment of Idiopathic Scoliosis (CTIS) is up to date [6].

The International Society of Biomechanics (ISB) suggests human kinematics to be quantified by means of an XYZ Cardan sequence of rotations and translations [7]. The axis represents the body planes, specifically, the three-dimensional view of the spine. Scoliosis due to its nature has postural distortions in multiple planes. X-axis represents the transverse plane, Y-axis represents the frontal plane, and Z-axis represents the sagittal plane. Rotation refers to the angular movement in an axis, for example Rz refers to rotation on the Z-axis. Translation refers to a straight-line movement, such as Tx refers to a translation in the X-axis [8]. XYZ Cardan sequence of rotations and translations was used to analyzed detailed postural shifts and provide correction according to the opposite posture of the scoliotic patient in current case.

Case Presentation

On October 10, 2020, a 15-year-old male came to the clinic presenting postural distortions and previously diagnosed with lumbar scoliosis, suffering from mild low back pain after long periods in the prone position with a Visual Analogue Scale (VAS) 3/10, no other complaints were reported. The teenager underwent rehabilitation for 1 year with no notable changes. The patient reported, "I feel like my left side of the low back is very tight and my right is soft. I did therapy before but I do not feel like there was improvement". His previous rehabilation program consisted of bilateral thoracic mobility in quadruped position (20 repetitions each side), squats (30 repetitions) and situps (30 repetitions) for a total of 45 minutes twice a week.

Physical examination revealed a decrease lumbar ROM (Range Of Motion) in left lateral flexion and right translation, every other ROM was with in normal limits. Adam's forward bend test (this test is a simple and non-invasive screening method that requires from the patient to stand up straight with arms at their sides, then bend forward at a 90º degree angle with their arms hanging

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down as if they are trying to touch their toes) revelead a left lumbar hump with a scale of 16º measured by scolimeter (a type of protactor used to measure the vertebral rotation and rib humping that is seen is scoliosis with forward-bending test).

The patient had several positive orthopedic tests such as cervical distraction and shoulder depression producing pain due to his hypertonic trapezius and scalene muscles. Palpatory findings revealed tenderness and stiffness of the paraspinal muscles in the left side of the lumbar spine due to the severe rotation of the vertebral bodies (confirmed on x-ray). Several spinal fixations were identified at C2, C5, T5-T8 and L4 through static and dynamic palpation. No other orthopedic or neurological test was found positive. Several postural distortions were identified; head tilted to the left from a vertical line, lower left shoulder and lower right iliac crest (assest visually) . On the side view the head, shoulder, hip/pelvis and knee were displaced forward from the vertical line.

The patient brought full spine x-rays (Figure 1) to be assessed *via* the digitizing image data collection and radiographical interpretation software designed by ASPINE Systems. ASPINE Systems refers to a standard protocol for both spinal diagnostic procedures and noninvasive corrective rehabilitation treatments. The x-ray findings in the front view were: head tilted to the left from vertical line drawn from the middle of the vertebral body of T2 to the middle of the body of C2 creating a tilted angle of 5º degrees. The lumbar spine was shifted 4 cm to the left from center [9]. Cobb Angle gave a measurement of 29º degrees with a left convexity (using lower endplate of L4 and upper plate of T10). Modified Risser Ferguson measurement was 27º degrees using apex mid points of the vertebral bodies of L4, L1 and T10 [10,11].

Coronal view findings were the following: head shifted 2 cm forward from a vertical line starting on the posterior-inferior aspect of C7 and continue all the way up to the posterior aspect of C2; from Harrison Posterior Tanget method a cervical kyphosis was visible at C5-C7 with Hypo-lordosis measurement of -8º (normal value of -42º) and Hypo-kyphosis on the thoracic spine with a measurement of +22º (normal value of +37º) [7].

Methodology

The patient consented to posture corrective treatment targeting the both Z-axis and X-axis posture diviations. The patient agreed to a 3 session per week treatment plan; each session time lasted 60 minutes to 90 minutes.

Each session the patient was checked for spinal fixations with dynamic palpation and was corrected using a Chiropractic drop table. Posture correction was perform on the side lying position requiring the patient to perform a mirror-image position while a percussion device was utilized to produce a succession of rapidly repeating, high velocity-low amplitude thrusts to activate the patient's proprioceptors and mechanoreceptors (Figure 2).

Proprioception results from sensory receptors in the nervous system and body. Most of these receptors are located in the muscles, joints, and tendons; it is body's ability to sense movement, action, and location. The arthrostim Instrument delivers 12-14 incremental thrusts per second. This frequency, known as the low beta somatomotor rhythm (somatic motor system involves complex feedback mechanism between the brain, spinal cord, peripheral nerves and musculoskeletal structures) divides the energy of a single thrust into rapid successive inputs; this input produces a cumulative 'cascade' effect on neural receptors. This permits the instrument to create extensive neurological feedback to the brain, using greatly reduced forces.

Exercises were performed to restore the balance in the body focusing mainly in the strengthening of paraspinal muscles and stretching lumbar spine stabilizing muscles. Neck extensors and lateral flexor muscles were targeted using head resisted bands. The patient was asked to keep a straight posture and support hands on the waist, opening the chest, the patient brought the forward head backward to the vertical line (retraction) at the end of the movement he did extension of the head, holding the position 10 seconds and repeated each movement for 10 times with no rest in between sets.

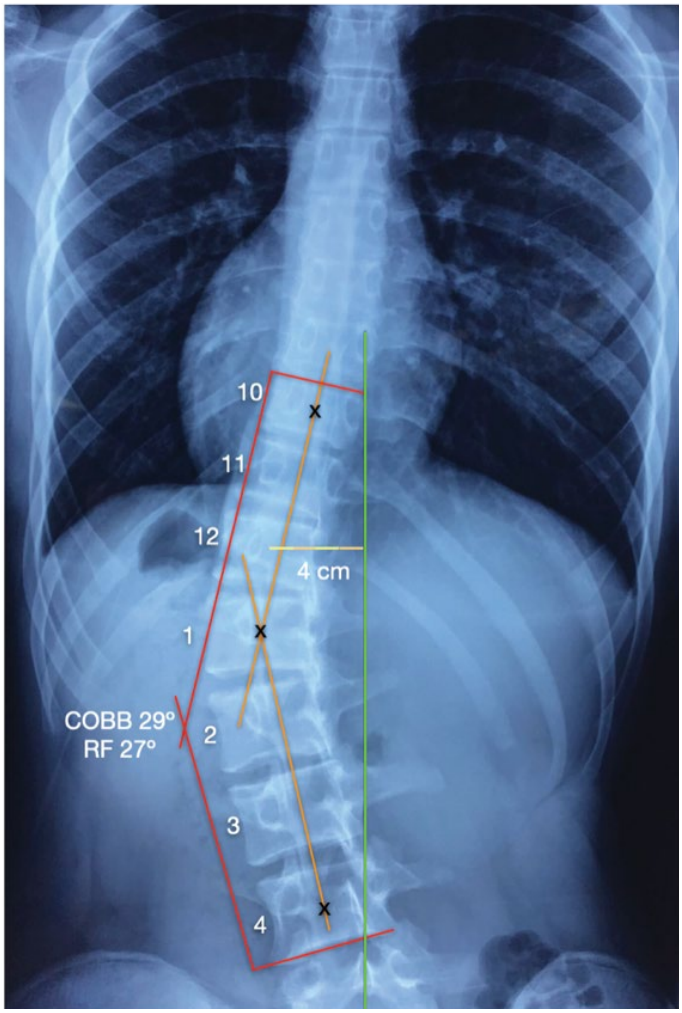

Figure 1. Lumbar X-ray viewed posterior to anterior. Cobb angle of 29º/ Risser Ferguson of 27º; left translation (+TxT) by 4 cm from center.

Figure 2. High velocity-low amplitude thrusts to activate the patient's proprioceptors and mechanoreceptors.

The second muscle group targeted were the rhomboids: in this exercise they used a pole to performed upright rows; from standing position the patient brought the pole towards the chest (keeping elbows at the level of the shoulders) holding the position for 10 seconds and repeating the movement for 10 times with no rest.

Spine extensor muslces were targeted by performing superman exercises, an exercise performed in prone position with upper and lower limbs extended. The patient was asked to lift the four limbs and move them imitating a "swimmer" for 1 minute with no rest.

Stretching of the psoas muscles (specifically the right side to reduced concavity due to the stiffness) was performed with the help of a medicine ball; the patient was instructed to lie on his left side with the apex of the lumbar convexity (L2) on the top of the ball and hold for 1 minute. Using the patient's original posture; the opposite posture or mirror image posture movement was performed. Standing with the right side of the pelvis against a pelvic block he perform a right translation of the lumbar spine in coronal plane (-Tx) followed by a right rotation in transversal plane (-Ry) and finishing with left lateral flexion (-Rz), all this movements were performed consecutively (-Tx/-Ry/-Rz), creating one single movement repeated for 5 sets and holding for 20 secs each set. The patient completed a total of 60 sessions of the treatment, each 15 visit a re-evaluation was made where the posture, Adam's Test (using Scoliosis Meter) and ROM were evaluated. Full spine x-rays were taken at the 30th session and 60th session. Mirror-image exercises of 100 reptitons were directed to perform at home; however, there's no record from the parents to confirm that the patient follow homecare recommendations (Figure 3).

Figure 3. Traction set up was for X-Axis correction, the patient was seated. **(1)** Stablizing strap was placed in the pelvis to, stabilize and prevent tilts and/or rotations of the pelvis. **(2)** A pulling strap was placed at L2 (apex of the convexity) in order to create (-TxT) Right thorax shift at 0° degrees. **(3)** Stablizing strap was placed on the right side at the rib cage (T8) in order to isolate the thoracic spine and prevent the development of a second curvature. The time spent during traction was for 20 minutes without interruption and further tension was applied every 3 minutes according patient's tolerance.

Results

After 60 sessions the patient showed improvements in posture, ROM, and appearance of lumbar hump which decreased from 16° to 10° (37.5% total reduction) confirmed with a scoliosis meter. Radiographical changes were also visualized in the Cobb and Risser Ferguson angles respectively. The head tilted 5° degrees to the left from vertical line (T2-C2) was changed to midline, no tilts (100% total reduction). Lumbar spine 4 cm shift to the left from center was reduced to 1.5 cm (62.5% total reduction); initially Cobb angle of 29° was reduced to 17° degrees (41.4% total reduction) as for Modified Risser Ferguson of 27° the angle left was 17° degrees (37.1% total reduction) see in Figure 4. The patient was humbled by giving the credit to the staff, "I feel straighter now, I feel this treatmet was intense and I could see and feel the changes. This is all thanks to your hard work".

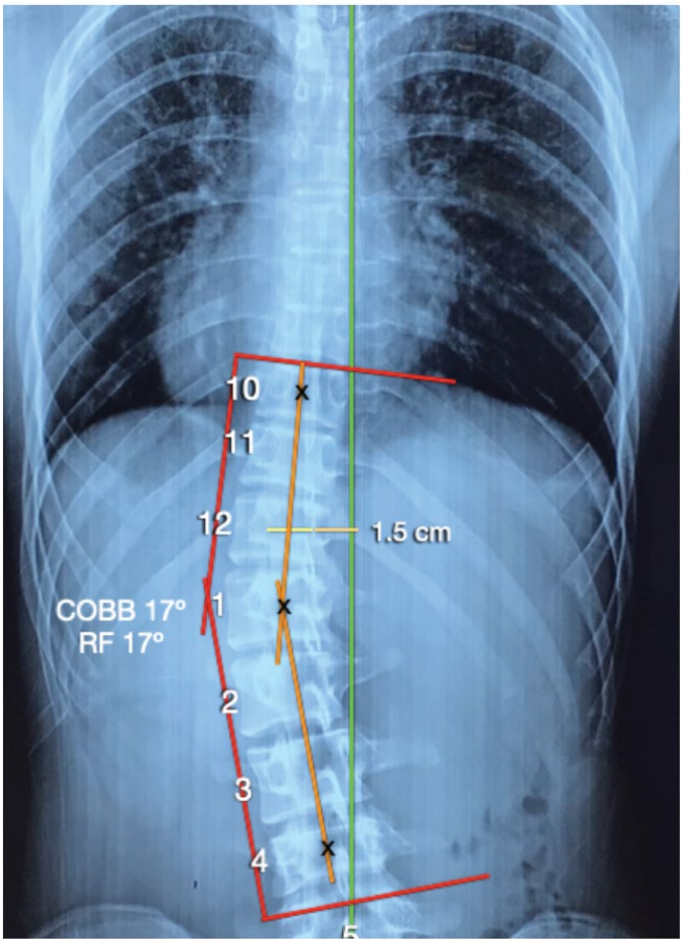

Figure 4. Bottom posterior-anterior view comparison in lumbar spine taken at 1st visit (left) and 60th visit (right).

Discussion

As students, teenagers spend considerable time at school and doing homework with poor posture. The lack of physical acitivity and poor ergonomics at school is causing postural disorders and AIS. Due the high incidence in the latest years of AIS, the National Health Commission of China released a new policy for prevention and control of abnormal spinal curvatures in children and adolescents that includes forward-bending test as a requirement for students' physical examination, which is an indication of the importance spinal health along with academic performance [11]. In 2021 the Rehabilitation Department of Tongji Hospital at Huazhong University of Science and Technology in Wuhan, China initiaed a trial pilot protocol for RCT (Randomized Control Trial) on scoliosis patients which goal was to prove the effectiveness of PSSE and spinal manipulation in patients between 10-18 years old with mild scoliosis (Cobb angle 10°-25°) the results are expected to be released soon. Further studies that support the application of spinal manipulation, bracing and corrective exercises are needed.

Which exercise or protocols are the best? When is bracing more suitable for the patient? Which are the benefits of the spinal manipulation in the treatment of AIS? Is surgery really necessary to treat AIS? This and more questions are the key to improve and develop more strategies in order to have a proper management in pattients with IS (idiopathic scoliosis). In recent years, therapist, orthopedic surgeons and some asociations have realized that traditional approaches to fix IS (such as surgery and bracing only) may not have the expected impact in sideways curvatures, rib and/or lumbar hump and physical apearence. The conservative treatment for idiopathic scoliosis (CTIS) is a model currently use by physicians and developed by SOSORT that is updated each 2 years in which several topics are discussed such as

patient assesment, bracing, imaging, biomechanics, research and PSSE (Physiotherapy Scoliosis Specific Exercises) rehabilitation with the goal to improve scoliosis management, quality of life and support physicians practice around the world.

Limitations

Limitation of this case was the lack of proper follow up after treatment due to the restrictions and permitions from the school, which didn't allow the patient to attend sessions as frequent as before. Another limitation of this case was the concern of x-ray radiation exposure from the parents allow only to take front view films to performed Cobb angle comparison (lateral view x-ray from the lumbar spine was not provided the first time either last lateral films at the end of the treatment). It is important to mention that the 3-demensional spinal traction is an important tool that mimics brace function but with the advantage of avoiding undesirable long-periods discomfort and possibility to work in the three bodies planes at once when placing the patient in mirror-image position. A detalied X-ray analysis was key to understand the body biomechanics and in the management of the sideways curvature: and spinal manipulation; pelvic position (tilts and rotations) and the directly influence over the rest os the spine as well as the understanding of the body compensations was one of the reasons why any chiropractic protocol were performed; second, the purpose of the spinal manipulation over pelvis achieved changes over translation and rotation in the lumbar spine (on X-ray comparison) which also could be seen in patient's posture. The patient's consistency and determination were valuable and helpful during this case.

Follow-up and Outcome

One of the limitations of this case study was the follow-up after 60 visits have passed, due to the school attendance and high loads of homework, the visits decreased significantly and the control over the side curves progression was alterated, an agreement with the patient to perform homecare corrective exercises was established to prevent any relapse or another postural or spinal distortion; growth speed was the first concern.

Conclusion

Conservative assessment to manage adolescent idiopathic scoliosis that includes a detail physical evaluation, full spine x-rays follow by a treatment that embrace spinal manipulation, 3D traction, posture assessment, x-ray control and muscle-balance exercises have proven to be highly effective to reduce Cobb angle degrees and translation from center. This case reduced 12º degrees of scoliosis (measured in x-ray) and decreased lumbar hump 6º degrees in total after 60 visits with ASPINE systems procedures. This study intends to be used as a model to manage further cases of adolescent idiopathic scoliosis with significant changes in the spine and posture. A sizable study using more cases utilizing these protocols and procedures should be conducted to create greater medical awareness of more scoliosis treatment options.

Informant Consent

Legal custodies of the patient provided written agreement for medical purposes and publication.

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