



To What Extent Can Adolescent Scoliosis Be Improved in Four Weeks?

Adolesan Skolyoz Dört Haftada Ne Kadar İyileştirilebilir?

Mehmet Ağırman, İlknur Saral, Oğuz Durmuş, Ali Akın Uğraş*, Engin Çakar

Istanbul Medipol University Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Istanbul, Turkey

**Istanbul Medipol University Faculty of Medicine, Department of Orthopedics and Traumatology, Istanbul, Turkey*

Abstract

Scoliosis is a condition that leads to severe disability and an impaired cosmetic appearance in adolescence. This article presents x-ray images of a patient with adolescent idiopathic scoliosis (AIS) in whom the pain and posture improved dramatically over four weeks, emphasizing the importance of physical therapy. A 13-year-old male was admitted because of posture deformity and mild back and lower back pain. He was being followed with the diagnosis of scoliosis for two years and specific exercises were proposed for scoliosis. On physical examination, we observed paravertebral muscle spasm and significant asymmetry of the thoracolumbar region. Neurological examination and laboratory tests were normal. X-ray showed arcuate thoracolumbar scoliosis (cobb angle: 24°) with a leftward convexity. Electrical stimulation was applied to the convex and concave sides for 30 minutes, five times a week for four weeks and an exercise program was performed under the supervision of a therapist. The stimulation amplitude was the maximum stimulation intensity with which the patient was comfortable. Analgesic and myorelaxant drugs were not required, and no brace was used. After the treatment, significant improvements were observed in the patient's posture and radiography (cobb angle: 10°). This work demonstrates that well-planned physical therapy is a rapid and effective option for treating AIS.

Keywords: Electric stimulation, exercise therapy, scoliosis

Öz

Skolyoz, adolesan dönemde ağır özürüllüğe ve kozmetik bozukluğa neden olabilen bir durumdur. Bu yazıda fizik tedavi uygulamalarının önemini vurgulamak için, adolesan idiyopatik skolyozu olan ve dört haftada belirgin iyileşme gösteren bir olgu grafileri ile birlikte sunulmuştur. On üç yaşındaki erkek hastamızın duruş bozukluğu ve hafif bel ağrısı şikayeti bulunmaktaydı. Hastamız iki yıldır skolyoz tanısıyla takip edilmekteydi ve hastaya skolyozu özel egzersizler önerilmişti. Fizik muayenede paravertebral kas spazmı ve belirgin torakolomber asimetrisi vardı. Nörolojik muayene ve laboratuvar testleri normaldi. X-ray grafisinde konveksitesi sola bakan torakolomber skolyozu (cobb açısı: 24°) tespit edildi. Hastaya haftada beş gün, dört hafta boyunca elektrik stimülasyonu (konveks ve konkav tarafa eş zamanlı olarak 30 dakika süre ile) ve terapist eşliğinde egzersiz programı uygulandı. Stimülasyonun amplitüdü hastanın rahatsızlık duymayacağı maksimum uyarı şiddetindeydi. Analjezik ve miyorelaksan ilaç ihtiyacı olmadı ve breys kullanılmadı. Tedavi sonunda yapılan değerlendirmede hastanın postüründe ve radyografisinde belirgin düzelme elde edildi (cobb açısı: 10°). Sonuç olarak, bu olgu iyi planlanmış fizik tedavi programının adolesan idiyopatik skolyoz tedavisinde hızlı ve etkin bir seçenek olduğunu göstermektedir.

Anahtar Sözcükler: Elektrik stimülasyonu, egzersiz tedavisi, skolyoz

Introduction

Scoliosis is a condition that leads to severe disability and an impaired cosmetic appearance in adolescence if not treated early. Medications, physical therapy, and braces have been suggested for the treatment of scoliosis, except in those with severe scoliosis, but there is no consensus on the optimal treatment. This article presents x-ray images of a patient with adolescent idiopathic scoliosis (AIS) in whom the pain and posture improved dramatically over four weeks, emphasizing the importance of physical therapy.

Case

A 13-year-old male was admitted because of posture deformity and mild back and lower back pain. His deformity had been present for two years and had increased progressively in intensity. He was being followed with the diagnosis of scoliosis for two years and specific exercises were proposed for scoliosis. The pain was non-inflammatory in nature. He had no history of trauma, comorbidities, or drug use. On physical examination, we observed paravertebral muscle spasm and significant asymmetry of the thoracolumbar region. The Adam's forward bend test was positive. The leg lengths were equal. The neurological examination and laboratory tests were normal. The standing anteroposterior (AP) x-ray of the entire spine showed an arcuate thoracolumbar scoliosis with a leftward convexity. The Cobb angle was 24° (Figure a). Electrical stimulation was applied five times a week for four weeks to the convex side using the following parameters: warming-up (frequency: 5 Hz, ramp-up time: 1.5s, phase duration: 5 min, ramp-down time: 2s), contraction (frequency: 40 Hz, ramp-up time: 1.5s, phase duration: 5 s, ramp-down time: 0.75s), active resting (frequency: 4 Hz, ramp-up: time 0.5s, phase duration: 10 s, ramp-down time: 0.5s), and cooling-down (frequency: 3 Hz, ramp-up time: 1.5s, phase duration: 10 min, ramp-down time: 3s). It was also applied simultaneously to the concave side at 1 Hz for 30 min. The stimulation amplitude was the maximum stimulation intensity with which the patient was comfortable. After the stimulation, an exercise program, consisting of myofascial relaxation, derotation of the scoliotic spine, and lumbar stabilization exercises, was performed under the supervision of a therapist. Analgesic and myorelaxant drugs were not required, and no brace was used. After the treatment, significant improvements were observed in the patient's posture. The Cobb angle was 10° at the end of the treatment (Figure b). Continuation of the exercise program and follow-up were recommended.

Discussion

Scoliosis is defined as lateral deviation of the vertical line of the spine to the right or left by more than 10° measured using the Cobb angle. The most common type is

AIS, which is frequently seen in 10-16-year-olds and more frequently in girls (1). X-ray imaging is the gold standard method for the diagnosis of idiopathic scoliosis. Advanced imaging is required in the presence of unusual findings (e.g. uncommon curvature pattern, pain, trunk stiffness, and neurological findings) (2). Early management of adolescent scoliosis reduces the possible subsequent development of a disability. The main treatment objectives are to stop the progression of the spinal curve and reverse, if possible, decrease the spinal pain intensity, preserve respiratory function, and to improve the cosmetic appearance via posture correction. Surgical correction is required in cases with a Cobb angle of $>45^\circ$. It is claimed that a conservative approach, including exercise, a brace, and physical therapy is sufficient in 90% of scoliosis patients (3-5). Other than improvement in quality of life, exercises provide increased neuromotor control, strength, postural recovery, and increased respiratory function (6,7). Various types of exercises have been proposed for AIS. During the last few years, specific exercises have been investigated by researchers. Schroth exercise which was proposed by Schroth et al. is based on three-dimensional sensorimotor and kinesthetic principles. These exercises primarily aim to reduce the scoliotic curve with the realignment of trunk segments, correction of the scoliotic breathing patterns and postural perception, and mirror control. Weiss et al.

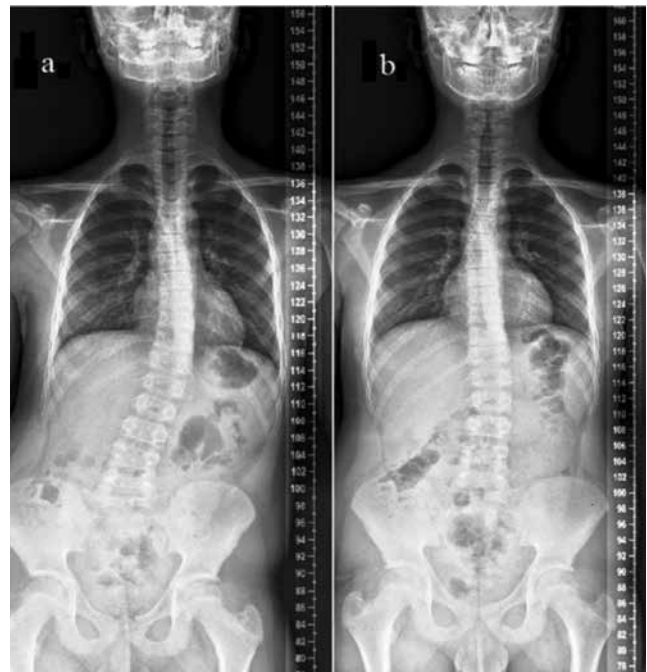


Figure A-B) Anteroposterior scoliosis x-rays before treatment shows thoracic scoliosis with a leftward convexity and no anomalies such as hemi-vertebrae or vertebral fusion. In b, after the four weeks treatment, significant improvement in the vertical spinal line was observed

(8) have suggested that minimum four weeks of Schroth exercises with supervised program could reduce incidence of progression in curvature with an improvement of 70% in treatment group versus 44% in control group (mean age 13, mean curve 29,5°). "Lyon school exercises" also aims to create awareness of scoliosis which based on intrinsic self-correction by the auto-elongation exercises. The scientific exercises approach to scoliosis, which is another three-dimensional auto-correction method, was originated from the Lyon approach (6). Other methods, such as functional individual therapy of scoliosis, Dobosiewicz method physiotherapy for idiopathic scoliosis, control spine deformation, extend shortened muscles and support the weak segments with the sensorimotor-kinesthetic approach and postural reflex activation (3). In the light of the current literature, we are yet not able to describe the best exercise protocol for scoliosis treatment.

In the scoliotic spine, the muscles located on the convex side are more active than those on the concave side, which are weaker than the trunk muscles of the normal population. The activity of the superficial and deep muscles can be increased by stimulating the paraspinal region (9,10). There are very few studies in the literature on electrical stimulation in patients with scoliosis. In biomechanical models, electrical stimulation has similar corrective effect on the spine as bracing and postural control alone (11). Curtin and Lowery (12) have suggested that activation of superficial and deep muscles stimulating may be effective in reducing spinal curvature in a computerized biomechanical modeling. Eckerson and Axelgaard (13) has recommended lateral electrical surface stimulation for mild to moderate scoliotic curves in patients with progressive idiopathic scoliosis. In a meta-analysis of the efficacy of non-operative treatments of a total of 1910 patients, it was found that the most efficacious treatment was bracing 23 hours daily. In this meta-analysis, electrostimulation success rate was lower than only observation (14). On the other hand, Anciaux et al. (15) treated 28 patients with AIS with transcutaneous stimulation of paravertebral muscles. They applied a stimulation with a surface stimulator with a frequency of 100 Hz, a pulse width of 0.2 msc and a duty cycle of 4/6 sec (on/off). At the end of the study, arrest in progression of the curvature was achieved in 56.6% of cases, and curvature regressed in 16.6% of cases. There is no consensus and a sufficient number of studies on the efficacy of stimulation in scoliosis. However, scoliosis-specific exercises are recommended as the first-step treatment (16). Exercise treatments that should be individualized for each patient reduce the need for

bracing, radiographic curve and normalizes balance and coordination in scoliosis patients (17). Therefore, we started exercise therapy simultaneously with electrical stimulation.

In our case, the curve angle decreased after physical therapy. Generally, paraspinal muscles spasms and pain can lead to non-structural scoliosis, however, with the treatment of these conditions, scoliosis can be improved. Our success in treatment may be associated with recovery in pain and spasm. However, patient's complaints continued for two years despite the exercises and it is difficult to distinguish between these two situations. With this presentation, we aimed to emphasize and remind the electrical stimulation applications in scoliosis. We assume that this work demonstrates that well-planned physical therapy is a rapid and effective option for treating adolescent-type scoliosis.

Ethics

Informed Consent: Retrospective work.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: Mehmet Ağırman. Design: Mehmet Ağırman, İlknur Saral. Data Collection or Processing: Mehmet Ağırman, İlknur Saral. Analysis or Interpretation: Oğuz Durmuş, Engin Çakar. Literature Search: Ali Akın Uğraş. Writing: Mehmet Ağırman.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Lenssinck ML, Frijlink AC, Berger MY, Bierman-Zeinstra SM, Verkerk K, Verhagen AP. Effect of bracing and other conservative interventions in the treatment of idiopathic scoliosis in adolescents: A systematic review of clinical trials. *Phys Ther* 2005;85:1329-39.
2. Kotwicki T, Chowanska J, Kinel E, Czaprowski D, Tomaszewski M, Janusz P. Optimal management of idiopathic scoliosis in adolescence. *Adolesc Health Med Ther* 2013;4:59-73.
3. Yılmaz HG. İdiyopatik skolyozda egzersiz reçeteleme. *Turk J Phys Med Rehab* 2014;60:31-5.
4. Negrini S, Aulisa AG, Aulisa L, et al. 2011 SOSORT guidelines: Orthopaedic and Rehabilitation treatment of idiopathic scoliosis during growth. *Scoliosis* 2012;7:3.
5. Reamy BV, Slakey JB. Adolescent idiopathic scoliosis: Review and current concepts. *Am Fam Physician* 2001;64:111-6.
6. Negrini S, Fusco C, Minozzi S, Atanasio S, Zaina F, Romano M. Exercises reduce the progression rate of adolescent idiopathic scoliosis: Results of a comprehensive systematic review of the literature. *Disabil Rehabil* 2008;30:772-85.

7. Weiss HR. The method of Katharina Schroth-history, principles and current development. *Scoliosis* 2011;30:17.
8. Weiss HR, Weiss G, Petermann F. Incidence of curvature progression in idiopathic scoliosis patients treated with scoliosis in-patient rehabilitation (SIR): An age- and sex-matched controlled study. *Pediatr Rehabil* 2003;6:23-30.
9. Cheung J, Halbertsma JP, Veldhuizen AG, et al. A preliminary study on electromyographic analysis of the paraspinal musculature in idiopathic scoliosis. *Eur Spine J* 2005;14:130-7.
10. Baek SO, Ahn SH, Jones R, et al. Activations of deep lumbar stabilizing muscles by transcutaneous neuromuscular electrical stimulation of lumbar paraspinal regions. *Ann Rehabil Med* 2014;38:506-13.
11. Wynarsky GT, Schultz AB. Optimization of skeletal configuration: Studies of scoliosis correction biomechanics. *J Biomech* 1991;24:721-32.
12. Curtin M, Lowery MM. Musculoskeletal modelling of muscle activation and applied external forces for the correction of scoliosis. *J Neuroeng Rehabil* 2014;11:52.
13. Eckerson LF, Axelgaard J. Lateral electrical surface stimulation as an alternative to bracing in the treatment of idiopathic scoliosis. Treatment protocol and patient acceptance. *Phys Ther* 1984;64:483-90.
14. Rowe DE, Bernstein SM, Riddick MF, Adler F, Emans JB, Gardner-Bonneau D. A meta-analysis of the efficacy of non-operative treatments for idiopathic scoliosis. *J Bone Joint Surg Am* 1997;79:664-74.
15. Anciaux M, Lenaert A, Van Beneden ML, Blonde W, Vercauteren M. Transcutaneous electrical stimulation (TCES) for the treatment of adolescent idiopathic scoliosis: Preliminary results. *Acta Orthop Belg* 1991;57:399-405.
16. Negrini S, Aulisa AG, Aulisa L, et al. 2011 SOSORT guidelines: Orthopaedic and Rehabilitation treatment of idiopathic scoliosis during growth. *Scoliosis* 2012;20;7:3.
17. Negrini S, Atanasio S, Zaina F, Romano M. Rehabilitation of adolescent idiopathic scoliosis: Results of exercises and bracing from a series of clinical studies. *Europa Medicophysica-SIMFER 2007 Award Winner. Eur J Phys Rehabil Med* 2008;44:169-76.