



# THE EFFECT OF CONVEX ROD DEROTATION ON LUMBAR LORDOSIS IN LENKE TYPE-5 ADOLESCENT IDIOPATHIC SCOLIOSIS PATIENTS WHO UNDERGONE SELECTIVE POSTERIOR SURGERY

## SELEKTİF POSTERİOR CERRAHİ YAPILAN LENKE TİP 5 ADOLESAN İDİOPATİK SKOLYOZ HASTALARINDA KONVEKS ROD DEROTASYONUNUN LOMBER LORDOZA ETKİSİ

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### SUMMARY:

**Objective:** To evaluate the effect of convex rod derotation on lumbar lordosis in Lenke type-5 AIS patients who undergone selective fusion

**Methods:** Twenty-five Lenke Type-5 AIS patients, operated by selective fusion and convex rod derotation, evaluated retrospectively. Thoracolumbar/lumbar Cobb angles and lumbar lordosis angles were measured on preoperative and last follow-up standing full-length anteroposterior and lateral radiographs. Kolmogorov-Smirnov test was utilized to assess distribution of study parameters. Preoperative and postoperative results were compared with Wilcoxon Sum Rank test.  $p < 0.05$  considered as statistically significant.

**Results:** There were 24 female and 1 male patients. Mean age was 16 years, mean follow-up was 40 months. Preoperative and last follow-up thoracolumbar/lumbar Cobb angle was  $40^\circ$  and  $9.72^\circ$ , respectively. Mean preoperative lumbar lordosis was  $52.66^\circ$  and last follow-up was  $50.29^\circ$ . Thoracolumbar/lumbar Cobb angle difference was statistically significant, however, lumbar lordosis change was not.

**Conclusion:** Convex rod derotation is an effective correction maneuver on lumbar lordosis in Lenke Type-5 AIS patients who undergone selective posterior surgery.

**Key words:** Adolescent idiopathic scoliosis, Lenke Type-V, Surgical treatment, selective fusion.

**Level of evidence:** Retrospective clinical study, Level III.

### ÖZET

**Amaç:** Selektif füzyon yapılan Lenke tip 5 adölesan idiopatik skolyoz (AIS) hastalarında konveks rod derotasyonun lomber lordoza etkisini araştırmak

**Metot:** Selektif füzyon yapılan ve konveks rod derotasyon manevrası uygulanan 25 Lenke tip 5 AIS hastası geriye dönük olarak incelendi. Hastaların preoperatif ve son kontroldeki ayakta tüm omurgayı içeren anteroposterior ve lateral grafilerinde torakolomber/lomber Cobb açıları ve lomber lordoz açıları ölçüldü. Verilerin dağılımı için Kolmogorov-Smirnov testi kullanıldı. Ameliyat öncesi ve sonrası karşılaştırma için Wilcoxon Sum Rank testi kullanıldı.  $p < 0.05$  değeri istatistiksel anlamlı olarak kabul edildi.

**Sonuçlar:** Yirmi dört hasta kız, 1 hasta erkek idi. Ortalama yaş 16, ortalama takip süresi 40 aydı. Ameliyat öncesi TL/L Cobb açısı  $40^\circ$  iken son takipte  $9.72^\circ$  olarak ölçüldü. Ameliyat öncesi lomber lordoz  $52.66^\circ$  iken ameliyat sonrası  $50.29^\circ$  olarak ölçüldü. Ameliyat öncesi ve son takip karşılaştırmasında TL/L Cobb açısında istatistiksel anlamlı fark varken, lomber lordozda istatistiksel anlamlı fark görülmedi.

**Çıkarımlar:** Selektif füzyon yapılan Lenke tip 5 hastalarda konveks rod derotasyon manevrası lomber lordozun oluşturulmasında etkili bir korreksiyon manevrasıdır.

**Anahtar kelimeler:** adölesan idiopatik skolyoz, Lenke tip-5 eğrilik,, cerrahi tedavi, selektif füzyon

**Kanıt Düzeyi:** Retrospektif klinik çalışma, Düzey III.

## INTRODUCTION

Lenke Type-5 Adolescent Idiopathic Scoliosis (AIS) is a major thoracolumbar/lumbar curve with a non-structural thoracic curve. The surgical aim is to preserve maximal mobility of the spine while fusing minimal segments. Thus, recommended fusion is to fuse only the structural curves, which is the thoracolumbar/lumbar curves for Lenke Type-5<sup>(8)</sup>.

Traditionally, anterior approach was recommended for Lenke Type-5 AIS. It provides shorter fusion levels and better coronal correction<sup>(3)</sup>. Disadvantages of anterior approach are lumbar kyphosis effect, increased pseudo-arthrosis rates, increased risk of vascular injury, and cosmetic problems<sup>(9)</sup>.

After introduction by Harrington in 1962<sup>(5)</sup>, posterior approach became the standard surgical approach for AIS. Regarding Lenke Type-5 AIS, posterior approach has better correction, lesser correction loss rates and lesser hospital stays<sup>(4)</sup>.

Several correction maneuvers can be applied to correct the 3-dimensional deformity of AIS. Commonly used maneuvers are rod derotation, direct vertebral rotation and translation. The aim of this study is to evaluate the effect of convex rod derotation technique on lumbar lordosis in Lenke Type-5 AIS patients who undergone selective posterior surgery.

## METHODS

Lenke 5 AIS patients treated at a single institution by a single surgeon was evaluated retrospectively. The surgeon prefers convex rod derotation maneuver for the thoracolumbar/lumbar curves to retain the lumbar lordosis. Inclusion criteria included: 1) a diagnosis of Lenke Type-5 AIS, 2) patients treated with selective posterior fusion, 3) no previous spine surgery 4) full sets of preoperative and last follow-up standing full-length radiographs.

Patients who were treated by non-selective fusion, had previous spinal surgery, anterior surgery and osteotomy were excluded. Those whose radiographs did not meet standards were also excluded in order to prevent measurement error.

Radiographs were measured by a surgeon who did not attend the surgeries. In the radiographs coronal TL/L Cobb angles and lumbar lordosis were measured. The Surgimap software (New York, NY, USA) was used to measure the Cobb angles.

A total of 25 patients were included in the study who met all the inclusion criteria.

Kolmogorov-Smirnov test was utilized to assess distribution of study parameters. Preoperative and postoperative results were compared with Wilcoxon Sum Rank test.  $p < 0.05$  considered as statistically significant.

## RESULTS:

There were 24 female and 1 male patients. Mean age was 16.64 ( $\pm 2.3$ ) years. Mean follow-up was 40.88 $\pm$ 21.5 months. Mean preoperative TL/L Cobb was 40° ( $\pm 8.89^\circ$ ), and last follow-up Cobb was 9.72° ( $\pm 8.33^\circ$ ). Mean preoperative lumbar lordosis was 52.66° ( $\pm 12.75^\circ$ ) and last follow-up lumbar lordosis was 50.29° ( $\pm 9.97^\circ$ ) (Figure-1).

Preoperative and last follow-up TL/L Cobb angle comparison showed that there is a significant difference ( $p < 0.05$ ), however there is no difference in comparison preoperative and last follow-up lumbar lordosis ( $p = 0.337$ )

## DISCUSSION:

AIS involves a complex 3D deformity in coronal, sagittal and axial planes and the main goal of AIS surgery is to obtain a balanced spine while correcting all 3 plane deformities, gain maximal function and maximal correction by preserving more mobile segments.

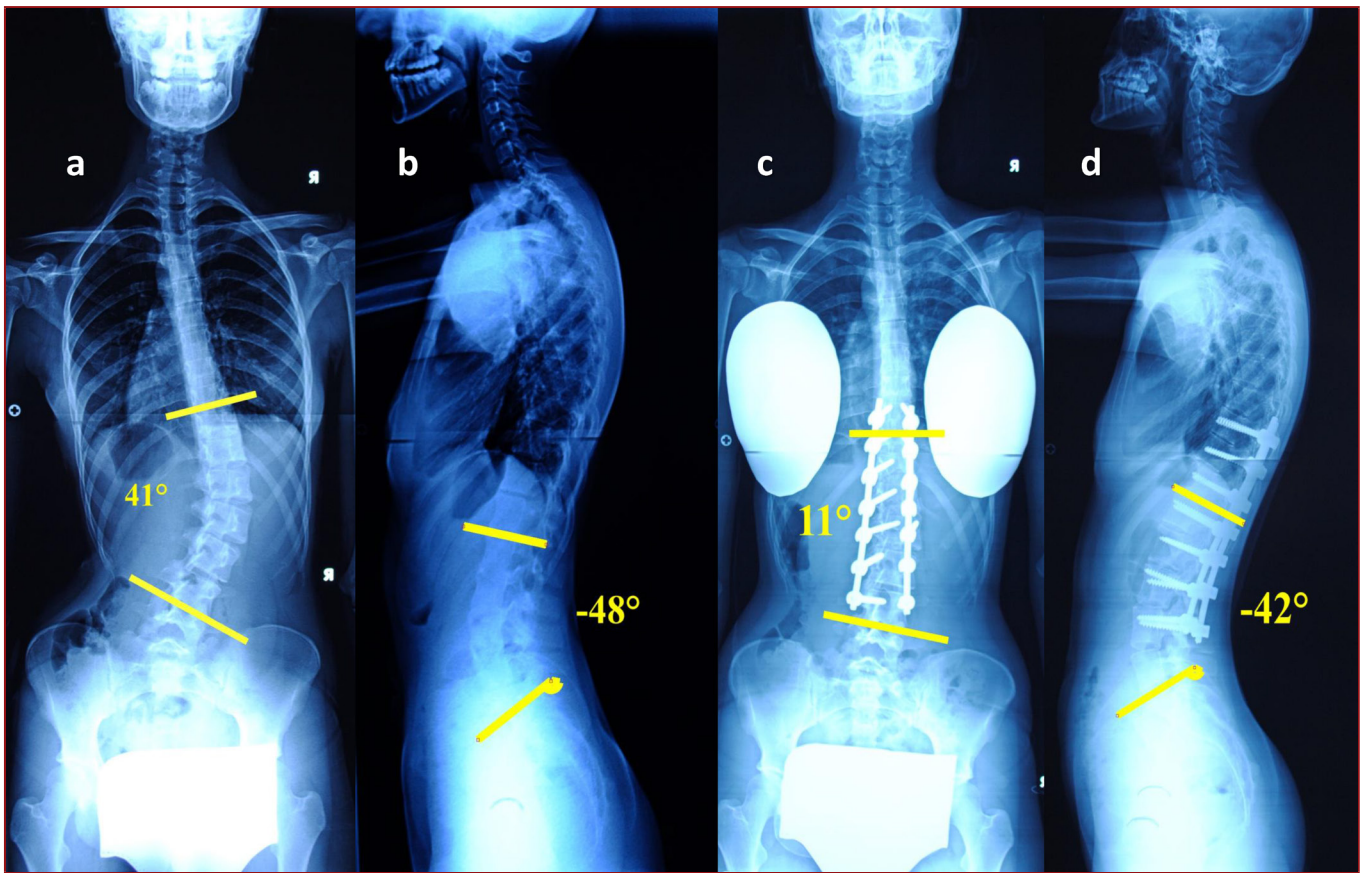
Several correction techniques were described for AIS surgery. Historically, Harrington instrumentation was introduced to apply a concave side distraction<sup>(5)</sup>. However, this technique was correcting only the coronal plane, and resulted in iatrogenic flat-back and decreased thoracic kyphosis<sup>(7)</sup>.

Cotrel and Dubousset developed an instrumentation system, called CDI, in 1988<sup>(2)</sup>. It uses pedicle screws and rods, and based on the 3D deformity of the scoliosis with simple rod derotation technique. This technique provides better coronal and sagittal correction, and significant vertebral derotation. After introduction of pedicle screws with CDI, pedicle screw instrumentation and fusion has been widely used with rod derotation, direct vertebral rotation and translation techniques because of its better deformity correction ability than transitional hook system<sup>(6)</sup>.

For Lenke Type-5 AIS, both posterior and anterior selective or non-selective fusion options can be chosen<sup>(4,9-10)</sup>. However, anterior method may result in higher kyphosis, pseudo arthrosis and correction loss<sup>(3)</sup>. In contrast, posterior selective fusion has better curve correction, less correction loss rate, less blood loss during surgery and shorter hospital stay<sup>(4)</sup>.

The surgeon in our study prefers standard posterior approach, instrumentation and convex rod derotation for Lenke Type-5 AIS patients. Placing first rod on the convex side and applying a 90-degree rod derotation maneuver creates the scoliotic curve into lumbar lordosis.

In a study by Zhang et al<sup>(11)</sup>, they used the same correction maneuver for Lenke Type-5 AIS patients and achieved a slight increase in lumbar lordosis, from 53° preoperative to 56° postoperative, which was statistically significant.



**Figure-1.** 16-year-old girl with Lenke Type-5 AIS. **a-b)** Preoperative and **c-d)** last follow-up Xrays after selective posterior fusion

Chang et al<sup>(1)</sup> analyzed their thoracolumbar and lumbar AIS patients treated by rod derotation and direct vertebral rotation. They found a slight increase in the lumbar lordosis, which was statistically not significant.

In our study, by convex rod derotation maneuver, lumbar lordosis of our patients was slightly decreased from 52° to 50°, which was statistically not significant, and maintained in normal range.

This study is not without limitations. First, this is a retrospective study and it lacks randomization and control group. The measurements were done by a computer-based software and there could be some measurement errors. Finally, we did not evaluate the patient reported outcome parameters, for the reason that they are out of the scope of our aim.

### CONCLUSION:

Convex rod derotation technique is a safe and effective maneuver for treating Lenke Type-5 AIS patients. It creates a significant correction in coronal plane and helps to maintain normal lumbar lordosis.

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