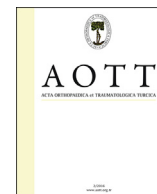


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Analysing the change of sagittal balance in patients with Lenke 5 idiopathic scoliosis

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ABSTRACT

Objective: The aim of this study was to evaluate preoperative and postoperative spinopelvic parameters and the influence of lowest instrumented vertebrae on sagittal parameters in Lenke 5 Adolescent Idiopathic Scoliosis (AIS) patients.

Methods: A total of 42 patients (37 females, 5 males; mean age: 16.71 ± 3.46 years) were included in the study. Preoperative and postoperative last follow up lumbar lordosis (LL), thoracic kyphosis (TK), pelvic tilt (PT), pelvic incidence (PI) and sacral slope (SS) angles measured. By stopped fusion in L3, L4 or L5 we divided the group into three parts.

Results: Mean follow-up was 43 months. Preoperatively, the mean TK and LL were 36.8° and 55.3° . At the last follow up, the mean TK and LL were 27.1° and 49.0° degrees, respectively. Preoperatively, the mean PI, PT and SS were 53.3° , 16.1° and 37.4° degrees. At the last follow up, the mean PI, PT and SS were 52.7° , 19.9° and 33.0° respectively. Significant differences were observed for SS ($p = 0.003$), TK ($p = 0.004$), LL ($p = 0.012$) and PT ($p = 0.013$) postoperatively for all patients. According the L3 and L4 groups there is significant difference in SS, LL ($p = 0.013$) and PT ($p = 0.018$) which means a significant decrease occurs in SS and LL when the distal fusion level changes from L3 to L4 but significant increase in PT in L3 group to compensate spinopelvic change after surgery.

Conclusion: The selection of more distal level for fusion adversely affects the compensation mechanisms of sagittal balance in Lenke 5 AIS patients.

Level of Evidence: Level IV, Therapeutic study.

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Introduction

Although the scoliosis is known to be a three-dimensional deformity for decades, it has recently grasped the attention of the spinal surgeons to pay attention for balance in the sagittal plane.¹ As a result of the limited understanding of the interaction between spinal and pelvic motion, methods for achieving better

sagittal balance has been difficult and somewhat unclear. Nevertheless, satisfactory treatment for adolescent idiopathic scoliosis (AIS) has been accepted to include adequate restoration of coronal and sagittal deformity.²

Interest to investigate outcomes related to sagittal balance in AIS started to take a rise by the beginning of the third millennium with the introduction of modern spinal instrumentation. In such an effort, Mac-Thiong et al³ evaluated the spinopelvic sagittal alignment in AIS and found lumbar lordosis was strongly related to pelvic configuration. Likewise Upasani et al⁴ also found that the sagittal contour of the lumbar spine was in strong association with the pelvic positioning. Yang et al⁵ determined that almost half of AIS patients with Lenke 5 curves had an antevert pelvis which could not be corrected by posterior instrumentation alone especially when patients had small PI or distal lower end vertebra.

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Lenke type 5 scoliosis is characterized by a structural thoracolumbar or lumbar (TL/L) curve. For this type, recommended instrumentation for fusion should include the structural region, however this may cause decompensation of spinopelvic alignment due to restriction of mobile segments close to spinopelvic region.^{6,7} Thus, we aimed to analyze the pre and postoperative changes and the effect of distal fusion level on spinopelvic parameters in Lenke 5 AIS patients.

Patients and methods

A retrospective study of Lenke 5 AIS patients treated at a single institution between 2010 and 2015 by a single surgeon was conducted. Inclusion criteria included: 1) a diagnosis of Lenke type 5 AIS, 2) patients treated with posterior pedicle screw only instrumentation, 3) no previous spine surgery 4) full sets of preoperative and last follow-up standing full-length AP and lateral radiographs. Patients who had previous spinal surgery, suffered from congenital deformities, hybrid constructs, anterior surgery and osteotomy were excluded. Those whose radiographs did not meet standards were also excluded in order to discard measurement error. A total of 218 AIS patients in the database were assessed and finally 42 patients (37 females, 5 males) with mean ages 16.71 ± 3.46 were included in the study who met all the criteria.

Radiographical assessment

Preoperative, postoperative and last follow-up standing full-length AP radiographs were analyzed by a surgeon who did not attend the surgeries, surveying for study variables with means of a digital software (The Surgimap software New York, NY, USA). Sought out study variables were lumbar lordosis (LL), thoracic kyphosis (TK), pelvic tilt (PT), pelvic incidence (PI) and sacral slope

(SS) angles. The definition of the fore mentioned study variables are provided in Fig. 1 to provide better apprehension. Furthermore patients were categorically separated into 3 groups depending on the distal most level fused during the surgery as which being L3 (group L3), L4 (group L4) or L5 (group L5).

Surgical technique

All surgical procedures were performed by the same attending spinal surgeon. The lowest instrumented vertebrae (LIV) was chosen according to the posteroanterior (PA) and lateral side-bending radiographs prior to surgery. Several surgical maneuvers were used in combination, including rod-rotation, apical vertebral derotation, convex compression, and concave distraction. The pedicle screw-rod system was used for fixation.⁵

Statistical analysis

Statistical analysis was conducted to seek for difference in study variable values between preoperative and last follow-up periods. Further analysis was conducted to look for difference regarding the distal most level fused during the surgery as which being L3 (group L3), L4 (group L4) or L5 (group L5). Application of Kolmogorov–Smirnov test to study variables' values revealed normal distribution, thus mean and standard deviation values were calculated and used instead of median and range. Independent Samples test was utilized to assess intergroup comparison. P value less than 0.05 was considered to be significant.

Results

The mean age of 42 patients with Lenke 5 AIS (37 females, 5 males) included in this study was 16.71 ± 3.46 years. The lowest

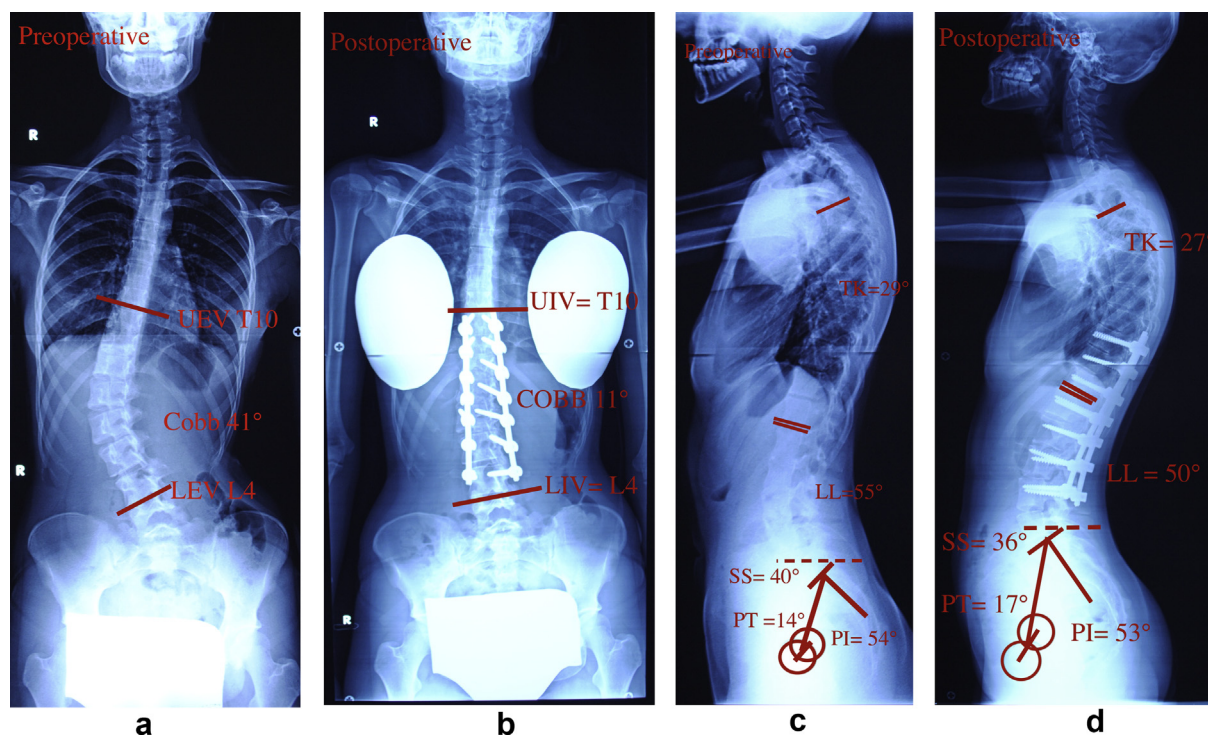


Fig. 1. A. Preoperative lateral view of a 14 year-old girl. Thoracic kyphosis (TK) the angle between superior endplate of T4 and inferior endplate of T12; lumbar lordosis (LL), the angle between superior endplate of L1 and superior endplate of S1; sacral slope (SS), the angle between the superior endplate of S1 and the horizontal line; pelvic incidence (PI), the angle between the line perpendicular to the superior endplate of S1 and the line connecting the midpoint of superior endplate of S1 to hip axis (HA, the midpoint of the line connecting the centers of two femoral heads); pelvic tilt (PT), the angle between the vertical line and the line connecting the midpoint of superior endplate of S1 to HA (considered positive if angulated behind the vertical line and otherwise negative). B. Postoperative lateral view.

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