Assessing the Flexibility of the Proximal Thoracic Segments Above the “Potential Upper Instrumented Vertebra” Using the Cervical Supine Side Bending Radiographs in Lenke 1 and 2 Curves for Adolescent Idiopathic Scoliosis Patients

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Study Design. A prospective study.

Objective. The aim of this study was to analyze the proximal thoracic (PT) flexibility and its compensatory ability above the “potential UIV.”

Summary of Background Data. Shoulder and neck imbalance can be caused by overcorrection of the main thoracic (MT) curve due to inability of PT segment to compensate.

Methods. Cervical supine side bending (CSB) radiographs of 100 Lenke 1 and 2 patients were studied. We further stratified Lenke 1 curves into Lenke 1–ve PT side bending (PTSB) < 15° ($n = 33$) and Lenke 1+ve PTSB 15° to 24.9° ($n = 37$). The right side bending (RSB) and left side bending (LSB) angles were measured (T1–T6). Compensatory ability of the PT segment was analyzed with assumption of a “horizontal UIV” position.

Results. From T1 to T6 vertebrae, the RSB angle values showed increasing positive values. The LSB angle, comparing Lenke 1–ve versus 2 and Lenke 1+ve versus 2, showed significant difference at T2 to T6. The LSB angle comparing Lenke 1–ve versus 1+ve achieved significant difference at T5 and T6. In Lenke 2 curves, >80% of cases of the PT segment were unable to compensate at T3–T6. In Lenke 1+ve curves, 78.4% were unable to compensate at T6, followed by T5 (75.7%), T4 (73.0%), T3 (59.5%), T2 (27.0%), and T1 (21.6%). In Lenke 1–ve curves, 36.4% of cases were unable to compensate at T6, followed by T5 (45.5%), T4 (45.5%), T3 (30.3%), T2 (21.2%), and T1 (15.2%). A significant difference between Lenke 1–ve and Lenke 1+ve was observed from T3 to T6. The difference between Lenke 1–ve and Lenke 2 curves was significant only at T2.

Conclusion. The compensation ability and the flexibility of the PT segments of Lenke 1–ve and Lenke 1+ve curves were different. Lenke 1+ve curves demonstrated similar characteristics to Lenke 2 curves.

Key words: adolescent idiopathic scoliosis, cervical supine bending film, Lenke 1, Lenke 2, neck imbalance, posterior spinal fusion, proximal thoracic compensation, proximal thoracic flexibility, proximal thoracic imbalance, shoulder imbalance.

Level of Evidence: 3

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Scoliosis is a three-dimensional deformity, which involves axial rotation, coronal translation, and sagittal deformity.1–4 Spinal fusion surgery may be required for adolescent idiopathic scoliosis (AIS) patients with curves greater than 50°.5–7 The aim of surgery is to fuse the curve with shortest fusion segments possible with a correction that maintains a “well-balanced spine.”3–9 Conventional surgery will maximize the amount of curve correction to achieve a horizontal upper instrumented vertebra (UIV) as well as a horizontal lower instrumented vertebra (LIV). However, the concept of achieving a horizontal UIV and LIV to obtain a horizontal T1 tilt that leads to good shoulder and neck balance has not been proven.

In contrary, shoulder and neck imbalance can be caused by overcorrection of the main thoracic (MT) curve due to the inability of unfused proximal mobile segments to