



Radiographic Outcomes of Adult Spinal Deformity Correction: A Critical Analysis of Variability and Failures Across Deformity Patterns

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Abstract

Study Design: Multicenter, prospective, consecutive, surgical case series from the International Spine Study Group.

Objectives: To evaluate the effectiveness of surgical treatment in restoring spinopelvic (SP) alignment.

Summary of Background Data: Pain and disability in the setting of adult spinal deformity have been correlated with global coronal alignment (GCA), sagittal vertical axis (SVA), pelvic incidence/lumbar lordosis mismatch (PI-LL), and pelvic tilt (PT). One of the main goals of surgery for adult spinal deformity is to correct these parameters to restore harmonious SP alignment.

Methods: Inclusion criteria were operative patients (age greater than 18 years) with baseline (BL) and 1-year full-length X-rays. Thoracic and thoracolumbar Cobb angle and previous mentioned parameters were calculated. Each parameter at BL and 1 year was categorized as either pathological or normal. Pathologic limits were: Cobb greater than 30°, GCA greater than 40 mm, SVA greater than 40 mm, PI-LL greater than 10°, and PT greater than 20°. According to thresholds, corrected or worsened alignment groups of patients were identified and overall radiographic effectiveness of procedure was evaluated by combining the results from the coronal and sagittal planes.

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Results: A total of 161 patients (age, 55 ± 15 years) were included. At BL, 80% of patients had a Cobb angle greater than 30° , 25% had a GCA greater than 40 mm, and 42% to 58% had a pathological sagittal parameter of PI-LL, SVA, and/or PT. Sagittal deformity was corrected in about 50% of cases for patients with pathological SVA or PI-LL, whereas PT was most commonly worsened (24%) and least often corrected (24%). Only 23% of patients experienced complete radiographic correction of the deformity.

Conclusions: The frequency of inadequate SP correction was high. Pelvic tilt was the parameter least likely to be well corrected. The high rate of SP alignment failure emphasizes the need for better preoperative planning and intraoperative imaging.

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Keywords: Adult spinal deformity; spinopelvic alignment; Surgical treatment; SRS–Schwab classification; Radiographic effectiveness

Introduction

Although great diversity of deformity patterns exists among patients with adult spinal deformity (ASD), one common objective of any realignment procedure is to restore harmonious spinopelvic alignment in the coronal and sagittal planes.

Several sagittal radiographic parameters define and quantify regional and global spinopelvic alignment: the sagittal vertical axis (SVA), which assesses the global alignment of the spine versus the pelvis; the pelvic incidence minus the lumbar lordosis (PI-LL), which reflects the harmony between lumbar lordosis and the morphologic pelvic incidence; and the pelvic tilt (PT), which characterizes the extent of pelvic compensation for truncal inclination. Recent studies have identified these 3 radiographic parameters as most highly correlated with patient-reported outcomes; accordingly, they were incorporated as the key parameters in the Scoliosis Research Society (SRS)–Schwab classification for ASD [1]. This validated classification [2] defines the threshold of pathological values for the 3 parameters based on correlation with clinical

scores: SVA greater than 40 mm, PI-LL greater than 10° , and PT greater than 20° .

The SRS–Schwab classification defines different coronal curve patterns based on Cobb angle measurement and location of the apex of the coronal deformity (thoracic, thoracolumbar/lumbar, or double). Historically, the coronal Cobb angle has been considered the most important parameter for the diagnosis and management strategy of patients with ASD. Glassman et al. [3] and Schwab et al. [1], however, suggested in 2 prospective multicenter studies that the magnitude of coronal deformity is less crucial than the restoration of sagittal alignment in assessing pain and disability, although Glassman et al. [3] demonstrated an association between global coronal alignment (GCA) (an offset of the C7 plumbline and the sacral line) of greater than 40 mm in the frontal plane and deterioration in patient outcomes.

From a clinical point of view, interpreting information from several different radiographic parameters in multiple planes can be difficult; an analysis of individual measurements taken independently may help identify the most important parameters to correct.

The objective of this study was to evaluate the effectiveness of surgical treatment in restoring or correcting SVA, PI–LL, PT, coronal Cobb angle, and GCA.

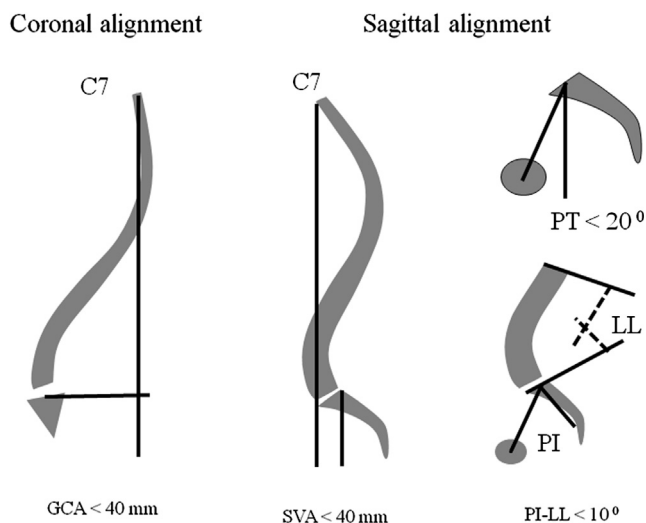


Fig. 1. Coronal and sagittal radiographic parameters and threshold associated used for the radiographic analysis. GCA, global coronal alignment; SVA, sagittal vertical axis; PT, pelvic tilt; PI, pelvic incidence; LL, lumbar lordosis.

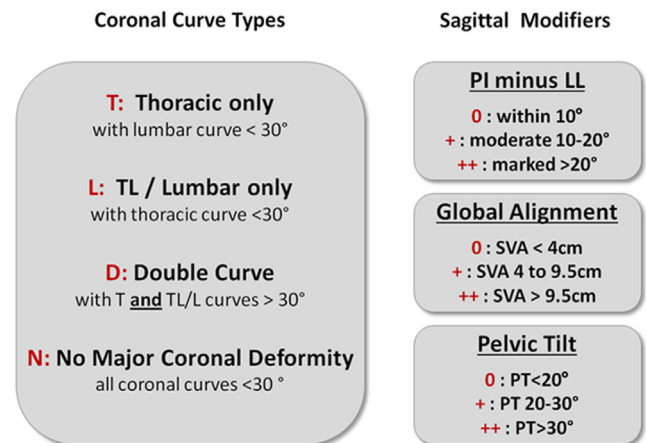


Fig. 2. Scoliosis Research Society–Schwab classification defined by coronal curve type and 3 sagittal spinopelvic modifiers. SVA, sagittal vertical axis; PT, pelvic tilt; PI, pelvic incidence; LL, lumbar lordosis.

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