The Challenge of the Lumbosacral Fractional Curve in the Setting of Adult Degenerative Scoliosis

Peter G. Campbell, MD*, Pierce D. Nunley, MD

KEYWORDS

• Fractional curve • Scoliosis • Fusion • Scoliosis correction • Adult degenerative scoliosis • L5 obliquity • Adult spinal deformity

KEY POINTS

- In the setting of adult degenerative scoliosis (ADS), the compensatory curve at the level of the lumbosacral junction below the major curve is called the fractional curve.
- The L4, L5, and S1 nerve roots on the side of the concavity of the fractional curve are the most frequent radicular pain generators in the setting of ADS.
- Ending a scoliosis construct at L4 or L5 with a preexisting the fractional curve places patients at high risk of adjacent segment breakdown or causing a compensatory major curve above the correction.
- Instrumentation options to address the fractional curve include anterior lumbar interbody fusion, oblique lumbar interbody fusion, posterior or transforaminal lumbar interbody fusion, and open rod reduction techniques.

INTRODUCTION

Adult degenerative scoliosis (ADS) is a 3-dimensional spinal disorder affecting the skeletally mature adult spine. Epidemiologically, degenerative lumbar scoliosis primarily involves patients in the sixth decade of life or greater, with a female predilection. ADS is thought to be related to osteoporotic degeneration and/or degenerative disk disease resulting in an asymmetric degradation of the intervertebral disk and facet joints.[1,2] These distortions induce a progressive lateral listhesis or rotation of the vertebra and ultimately lead to scoliosis, loss of lumbar lordosis, vertebral body translation, and rotational subluxation.[3]

In treating ADS, the main indication for performing an instrumented fusion is a lumbar curve. Unlike the typical adolescent patient with scoliosis, the curve parameters are generally considered to be unsuitable for ending fixation at L3 or L4.[4] Oftentimes, a rotatory subluxation or a coronal imbalance is present at the L4 or L5 segments. In the setting of ADS, the compensatory curve at the level of the lumbosacral junction below the major curve is called the fractional curve.[5]

The general goals of adult deformity surgery mirror those of the adolescent population in that the goals are to obtain sagittal and coronal balance, symptom relief, and solid fusion.[6,7] However, one of the difficulties in attempting to apply minimally invasive techniques to ADS curves has been in the treatment of the fractional curve.[5] Traditional approaches to deformity correction of degenerative lumbar scoliosis include both anterior-posterior approaches as well as posterior-only treatments. Open surgical procedures allow the surgeon to

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Spine Institute of Louisiana, 1500 Line Avenue, Shreveport, LA 71101, USA
* Corresponding author.
E-mail address: pcampbell@louisianaspine.org

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perform specific techniques that create spinal destabilization to ultimately facilitate correction of the deformity. Minimally invasive spinal surgery offers fewer options for rigid curve manipulation at the lumbosacral junctions and the successful surgeon must evaluate the fractional curve preoperatively to ensure adherence to these established goals to prevent clinical decline secondary to the complication of spinopelvic malalignment.

CHALLENGES IN TREATING THE FRACTIONAL CURVE

In treating ADS, full-length standing anteroposterior and lateral radiographs are obtained to identify spinopelvic parameters. A detailed discussion of correction of these parameters is outside the scope of this article and will be addressed elsewhere in this publication. Typically ADS curves have a lumbar apex.[8] These deformities often are associated with lumbar hypolordosis and distal reciprocating curves without significant scoliosis in the upper thoracic levels. A fractional curve, L4 to the sacrum, is often appreciated on anteroposterior imaging (**Fig. 1**).

Much like other degenerative conditions, pain is the indication for seeking treatment for more than 90% of the ADS patient population.[9] Patients with ADS may present with back pain associated with scoliotic curve progression or neurologic symptoms, including radiculopathy and central stenosis.[10] Severe foraminal stenosis is present in up to 97% of patients with ADS on radiographical evaluation.[11] Furthermore, the prevalence of radicular pain has been demonstrated to be significantly increased at the levels of the caudal nerve roots. The probability of radiculopathy has been shown to increase in a linear fashion as the level of the root advances caudally.[12] Hence, the L4, L5, and S1 nerve roots on the side of the concavity

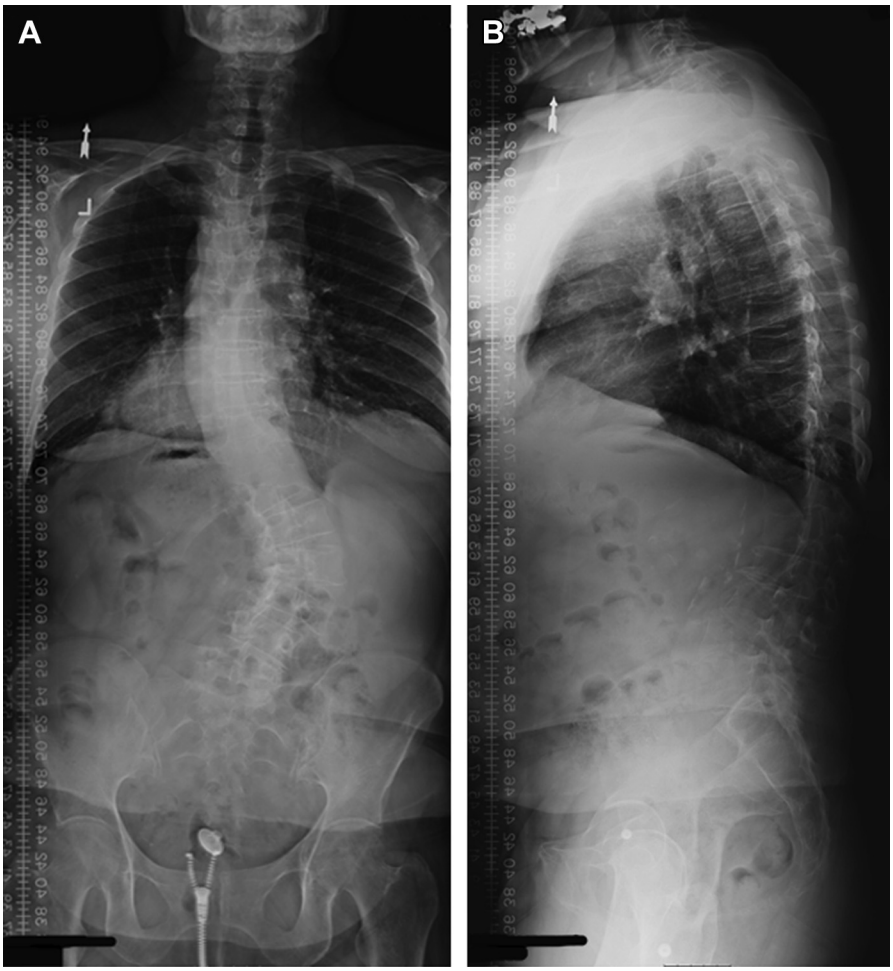

Fig. 1. (*A*) Anteroposterior and (*B*) lateral 36-inch standing radiographs demonstrating an ADS major curve with an apex at the L2/3 disk space and a fractional curve causing a rightward obliquity of L5.