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Anterior Spinal Fusion and Posterior Spinal Fusion Both Effectively Treat Lenke Type 5 Curves in Adolescent Idiopathic Scoliosis: A Multicenter Study*

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Abstract

Study Design: Retrospective cohort study.
Objective: Retrospective comparison of radiographic and clinical outcomes between anterior spinal fusion (ASF) and posterior spinal fusion (PSF) in surgical treatment of Lenke 5 curves.
Summary of Background Data: ASF and PSF are used for treatment of Lenke 5 curves in patients with adolescent idiopathic scoliosis (AIS). Currently, no consensus exists for optimal surgical treatment of Lenke 5 curves.
Methods: Patients with Lenke 5 curves treated with either ASF or PSF were prospectively enrolled in a multicenter database and then retrospectively reviewed. Demographic data, perioperative measures, radiographic data, and SRS-22R scores were collected and compared for statistical significance.
Results: A total of 149 patients were included in the study; 51 underwent PSF and 98 underwent ASF. There was no difference in demographics between groups. The PSF group was fused one level longer than the ASF group (5.9 levels PSF, 4.6 levels ASF, $p < .0001$). The PSF group had shorter operative times (223 minutes PSF, 297 minutes ASF; $p < .0001$) and a higher proportion of patients who received a postoperative blood transfusion (45% vs. 5%, $p < .0001$). PSF patients had longer hospital stays (6.1d PSF vs. 5d ASF, $p = .031$). The ASF group had larger preoperative major curve (48.2° ASF, 44.2° PSF; $p < .01$). Coronal balance, thoracolumbar/lumbar Cobb angle, shoulder height, trunk shift, and overall sagittal balance were not different between groups at two-year follow-up. Curve correction at two-year follow-up was similar between groups (66% ASF vs. 62% PSF). There were no significant differences in clinical outcomes or complication rates between groups.
Conclusion: There is no difference in radiographic or clinical outcomes in patients treated with ASF or PSF for Lenke 5 curves. ASF may save a fusion level, but has longer operative time than PSF. Ultimately, the risks and benefits of each approach merit consideration by surgeon and patient.
Level of Evidence: Level II.

Keywords: Adolescent idiopathic scoliosis; Lenke 5C; Posterior spinal fusion; Anterior spinal fusion; Instrumentation

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Introduction

Background/rationale

Contemporary surgical treatment for adolescent idiopathic scoliosis (AIS) includes both anterior and posterior approaches. Historically, treatment of thoracolumbar/lumbar idiopathic scoliosis involved anterior spine instrumentation and fusion [1,2]. With replacement of the threaded Zielke rod by a solid rod, anterior instrumentation for AIS has taken a great step forward [3,4]. Anterior dual-rod constructs have recently been advocated by some authors to address the instrumentation failures occasionally associated with anterior single-rod constructs [3,5,6]. However, with the recent development of pedicle screw technique, posterior spine fusion with pedicle screw instrumentation for thoracolumbar/lumbar idiopathic scoliosis can also achieve satisfactory clinical and radiographic results [7-10]. The optimal approach to the surgical treatment of thoracolumbar/lumbar Lenke 5 curve types (major curve in the thoracolumbar/lumbar region) has not been clearly established in the literature.

Anterior spinal fusions (ASFs) benefit from a shorter fusion area, lower infection rate, lack of paraspinal muscle dissection, potential prevention of crankshaft phenomenon, and a smaller scar [3-6]. However, anterior methods have several reported drawbacks, including scar cosmesis, potential for intra-abdominal or urologic injury, considerable blood loss, and longer recovery time [3-6,11-16]. Advocates of the anterior technique suggest that improved curve correction and shorter fusions outweigh the potential for higher complication rates historically associated with the technique [11-16].

Posterior spinal fusion (PSF) has become the "gold standard" treatment for AIS since Harrington's report in the 1960s [2]. Advantages of the posterior approach include ease of access to the spine, lack of direct invasiveness to the thoracic cavity, and relative flexibility in determining the fusion area [7-10]. Proponents of PSF have reported such advantages as reduced risk of pulmonary complications, better control of shoulder imbalance, shorter recovery time, and decreased length of hospital stay when compared to ASF [7-16]. Some disadvantages include the crankshaft phenomenon in skeletally immature patients, the "adding-on" effect after primary posterior fusion, relatively long fusion area, and greater invasiveness in the posterior region [17-22]. Previous studies compared the two with respect to correction of scoliosis, pulmonary function, and complication rates [17,19,21]. Results of many recent studies suggest that, like anterior techniques, adequate correction can be achieved posteriorly without the need for an anterior release [18,20-22].

The optimal surgical treatment of Lenke 5 curves is still under debate [11,14,23-33]. To investigate which approach is superior, studies with longer follow-up periods are required for a direct comparison of clinical and radiographic outcomes specifically for Lenke 5 curves. Both anterior and posterior spinal fusion techniques have made progressive advances in recent years; however, potential biases about the results of each technique remain [17,19,21,32]. There is no prospective, randomized controlled trial to date comparing the two techniques.

Objective

The objective of the present study is to compare the clinical and radiographic outcomes between ASF and PSF in the surgical treatment of Lenke 5 curves with a minimum follow-up period of two years. The null hypothesis was that there is no significant difference between anterior and posterior techniques for correction of adolescent idiopathic scoliosis. To our knowledge, this study is the first with prospectively collected data from consecutively enrolled patients comparing ASF and PSF in Lenke 5 curve types.

Materials and Methods

Study design

After institutional review board and informed consent approval, a prospectively collected, multicenter database of patients treated surgically for AIS and who provided informed consent was retrospectively reviewed. Inclusion criteria were diagnosis of AIS requiring surgical treatment, Lenke 5 curve classification, ages 8 to 18 years, primary spinal fusion performed prior to 21 years of age, surgery performed between January 1, 2002, and December 31, 2009, surgical treatment consisting of either anterior spinal fusion or posterior spinal fusion with pedicle screw fixation ($>90\%$ of implants were pedicle screws), and a minimum of two years' postoperative clinical and radiographic follow-up. Patients were excluded for a current or previous spine infection, evidence of tumor or malignant disease, age greater than 17 years 11 months at the time of diagnosis, primary spinal fusion surgery performed after the age of 21, combined anterior/posterior spinal fusion, presence of immune compromise, or a diagnosis of nonidiopathic scoliosis. The study population consisted of 98 patients treated with an anterior spinal fusion, and 51 patients treated with a posterior spinal fusion, for a total of 149 patients included in the study. Figure 1 demonstrates how the study cohort was achieved.

Demographics, surgical characteristics, radiographic measures, and quality of life questionnaires were collected both preoperatively and at the two-year follow-up. Demographics collected included age, gender, and body mass index. Surgical data points included operative time, estimated blood loss, intraoperative transfusions, postoperative transfusions, length of hospitalization, and number of levels fused. Radiographic measures included coronal and sagittal balance, thoracic trunk shift, thoracolumbar Cobb angle, lowest end vertebrae (LEV), lowest instrumented vertebrae (LIV), LIV tilt angle, and shoulder height difference. Cobb angle was measured from two end-vertebrae of the curve. Coronal balance was measured by alignment of the C7 plumb line in relation to the center sacral vertebral line.