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Risk Factors for Coronal Decompensation After Posterior Spinal Instrumentation and Fusion in Adolescent Idiopathic Scoliosis

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Abstract

Study Design: Retrospective review of multicenter data set with adolescent idiopathic scoliosis (AIS) patients with at least 2 years of follow-up after posterior spinal instrumentation and fusion (PSIF).
Objectives: The purpose of this study is to investigate risk factors for coronal decompensation 2 years after PSIF for AIS.
Summary of Background Data: Coronal decompensation is a potential complication of spinal instrumentation for AIS. This can result in problems requiring revision surgery.
Methods: Demographic, clinical, and radiographic measures were reviewed on 890 identified patients. Coronal decompensation was defined as a change farther away from midline from 6 weeks postoperatively to 2 years in any one of the following radiographic parameters: change in coronal balance >2 cm; change in coronal position of the lowest instrumented vertebra (LIV) >2 cm; change in thoracic trunk shift >2 cm; or change in LIV tilt angle >10°. Patients with decompensation were compared to those without. The relationship between the LIV and lowest end vertebra (LEV) was examined as an independent variable.
Results: Two years postoperation, 6.4% (57/890) of patients exhibited coronal decompensation. Multivariate regression revealed that decompensated patients were twice as likely to be male, have lower preoperative Risser score, and lower percentage major curve correction. The relationship between the LIV and LEV as well as quality of life surveys were not significantly different between decompensated and nondecompensated patients at 2 years.
Conclusions: Two years after PSIF, 6.4% of patients with AIS exhibit radiographic coronal decompensation. Although this study did not demonstrate a significant association between the relationship of LIV and LEV and decompensation 2 years postoperation, results of this study indicate that skeletal immaturity, male gender, and less correction of the major curve may be related to higher rates of coronal decompensation.

Keywords: Adolescent idiopathic scoliosis; Coronal balance; Posterior spinal instrumentation and fusion; Decompensation

Introduction

Segmental instrumentation using pedicle screws has become the standard of care for surgical treatment of adolescent idiopathic scoliosis (AIS). Although posterior spinal instrumentation and fusion (PSIF) techniques allow dramatic correction of multidimensional spinal deformities, there can be unintended effects on spinal alignment in both the coronal and sagittal planes. Poor spinal alignment directly resulting from surgery, or decompensation that develops postoperatively over time, may lead to pain, further decompensation, or other problems that require revision surgery [1]. As such, the characteristics and risk factors for spinal malalignment and decompensation must be further elucidated in order to assist surgeons in their preoperative planning to achieve optimal spinal alignment in scoliosis surgical correction.

The propensity of the unfused spine to respond to and change after the correction of coronal scoliotic deformity has been consistently demonstrated by the observation that nonstructural lumbar deformities in the coronal plane spontaneously correct after selective instrumentation and correction of the thoracic deformity [2-7]. On the basis of this concept and the presence of postoperative decompensation, it is now clear that these changes in coronal alignment may develop over time after PSIF for AIS. As such, coronal decompensation is a recognized potential complication that may develop after surgical correction of scoliosis. Several hypotheses have been reported in attempts to understand the etiology of decompensation. Coronal decompensation has been associated with the Cotrel-Dubousset rod derotation maneuver and a hypercorrection of the main thoracic curve, with management ranging from observation or bracing, to revision surgery [8-10]. Postoperative coronal decompensation in specific curve types, such as Lenke 3C, has also been correlated to derotation of lumbar apical vertebrae [11]. Despite the wide attention to correction of coronal deformity, there is inconsistency in the literature concerning the definition of coronal decompensation, and investigation of its associated risk factors is incomplete.

It is the purpose of this study to investigate risk factors for coronal decompensation 2 years after PSIF for AIS. The term *coronal decompensation* is used in this study to describe a worsening of coronal spinal alignment that develops over time after spinal fusion, rather than a static measure of coronal alignment at any specific point in time.

Materials and Methods

Study design

After institutional review board approval from the senior author's institution (MGV), a survey was conducted of the prospective multicenter database of the Spinal Deformity Study Group (SDSG) for AIS patients (10−18 years at diagnosis). There were 21 centers who contributed patients to this study. On obtaining their consent, patients in this cohort were enrolled into the database between 2002 and 2009 and had their 2-year follow-up visit between 2004 and 2011. The database identified 2,833 patients with AIS who underwent PSIF during the period with average of 3.3 years of follow-up. Out of 2,833 patients, 1,766 patients had minimum of 2-year follow-up. There were 890 (152 males, 738 females) patients with any Lenke type curve who had PSIF with a minimum 2 years of complete clinical and