



Neurologic Comorbidities Predict Proximal Junctional Failure in Adult Spinal Deformity

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Abstract

Study Design: Retrospective case-control matched cohort from a single institution.

Objective: To examine the contribution of nonmechanical factors to the incidence of proximal junctional failure (PJF) after adult spinal deformity (ASD) surgery.

Summary of Background Data: Multiple studies have reported on the prevalence of PJF following surgery for ASD. However, little is known about the contribution of nonmechanical factors to the incidence of PJF.

Methods: We identified a consecutive series of ASD patients who required revision surgery for PJF between 2013 and 2015. A matched cohort of ASD patients who did not develop PJF after surgical correction was identified based on age, gender, preoperative deformity type, number of fusion levels, and the lower instrumented vertebra level. We compared medical and surgical histories in the matched cohorts, with particular attention to the prevalence of preoperative neurologic comorbidities that might affect standing balance. Preoperative, immediate postoperative, and follow-up radiographs were reviewed to document specific characteristics of mechanical failure that resulted in PJF and required revision surgery.

Results: Twenty-eight cases of PJF requiring revision surgery were identified. The prevalence rates of preoperative neurologic comorbidities in PJF cohort were significantly higher than in non-PJF cohort (75% vs. 32%, $p < .001$). Neurologic comorbidities included prior stroke (4), metabolic encephalopathy (2), Parkinson disease (1), seizure disorder (1), cervical and thoracic myelopathy (7), diabetic neuropathy (4), and other neuropathy (4). The mean preoperative sagittal vertical axis in PJF cohort was more positive compared with the non-PJF cohort (144 mm vs. 65 mm, $p = .009$). There were no significant differences in immediate postoperative or follow-up radiographic parameters between cohorts.

Conclusions: In this study, risk factors identified for the development of PJF included nonmechanical neurologic comorbidities, emphasizing the need to look beyond radiographic alignment in order to reduce the incidence of PJF.

Level of Evidence: Level 3.

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Keywords: Adult spine deformity; Adult scoliosis; Proximal junctional kyphosis; Proximal junctional failure; Correction surgery; Neurologic comorbidity; Sagittal vertical axis; Revision surgery

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Introduction

Spinal deformity in the elderly population has become a major societal problem, with the prevalence of adult spinal deformity (ASD) reported as high as 68% in recent studies [1]. Driven by an aging population with increased expectations for a comfortable and active lifestyle, spinal deformity surgeons operate on many more elderly patients [2]. Concomitantly, the effectiveness of surgical treatment for ASD has advanced substantially based on improvements in surgical technique, surgical strategy and medical technology [3–5]. However, these surgical procedures still have a high rate of complications (10% to 50%), in part because of the magnitude of the surgery, often including fusion from the thoracic spine to the pelvis [6–12].

Proximal junctional kyphosis (PJK) and proximal junctional failure (PJF) are fairly common and potentially devastating complications following spinal reconstruction for ASD [13–17]. Glattes and colleagues defined PJK as kyphosis at the proximal end of a construct with a sagittal Cobb angle at least 10° greater than the preoperative measurement. This can lead to progressive decompensation in the sagittal plane, neurologic compromise, and worse clinical outcomes [13]. Using this definition, the prevalence of PJK after reconstruction surgery for ASD has been reported between 16.9% and 41% [18–23]. How often PJK presents as a radiologic finding without significant clinical impact is controversial. Certainly, reported neurologic consequences and revision rates are lower [13,18,21].

The presence of mechanical failure and/or spinal instability is suggestive of PJF [16,17]. PJF has been shown to be associated with increased pain, risk of neurologic injury, and need for revision surgery [16,17,24,25]. Deformity surgeons recognize the occurrence of PJK and particularly PJF as a significant challenge, attributed to be primarily the result of mechanical causes [26,27]. A recent case series suggests that nonmechanical neurologic comorbidities play an important role in the development of postoperative sagittal imbalance and PJF [28]. This study is a follow-up study to the previously published cohort study [28], potentially including all of the PJF patients from the study. In this study, a case-matched analysis was performed to further define the contribution of nonmechanical factors to the occurrence of PJF after adult deformity surgery.

Materials and Methods

PJF cohort

After receiving institutional review board approval (from the University of Louisville), we identified a consecutive series of ASD patients who required revision surgery for PJF from 2012 to 2014. PJF was defined as a change of more than 10° of kyphosis between the upper instrumented vertebra (UIV) and the vertebra two levels above the UIV (UIV+2), along with one or more of the following: fracture of the vertebral body of UIV or UIV+1, posterior osseoligamentous disruption, or pullout of instrumentation at the UIV (Figs. 1 and 2) [15–17].

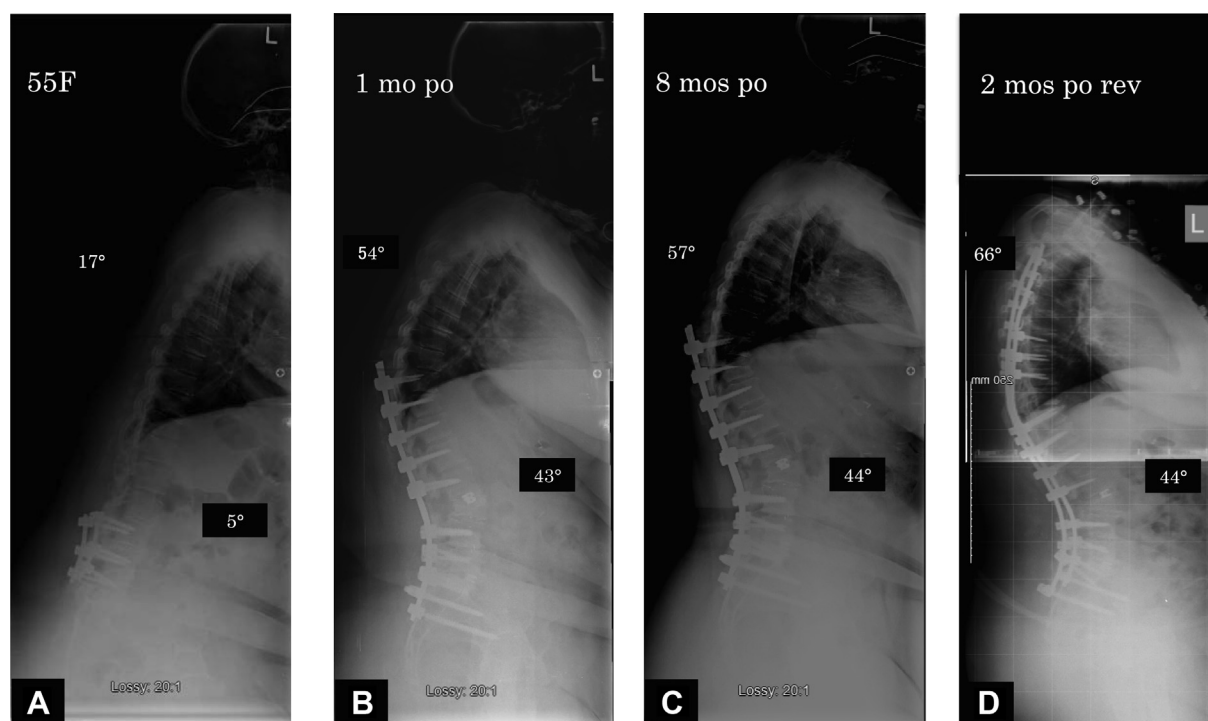


Fig. 1. (A) Lateral full-length views of a 55-year-old woman with a history of five-level lumbar decompression and fusion, with persistent complaints of low back pain, sciatica, and sagittal imbalance. She had a history of cervical surgery for cervical myelopathy. (B) Standing lateral radiograph was performed one month after posterior spinal fusion from T10 to pelvis. (C) Standing lateral radiograph 8 months after index surgery showing that proximal junctional kyphosis increased to 18° with 57° of thoracic kyphosis and 44° of lumbar lordosis. (D) Standing lateral radiograph at 2 months after revision surgery for PJF.

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