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Failure of Monoaxial Pedicle Screws at the Distal End of Scoliosis Constructs: A Case Series

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Abstract

Background: The goals of instrumented fusion for scoliosis are to correct deformities, stabilize the spine, and achieve arthrodesis. Monoaxial pedicle screws are often used in scoliosis constructs and have shown superiority over other types of pedicle screws in their ability to correct vertebral rotation and lumbar lordosis. However, because of the fixed-angle nature of the monoaxial pedicle screw head, any malalignment at the rod–screw interface could result in less than optimum stability.
Results: This series exhibits 3 cases of set screw loosening with the use of monoaxial pedicle screws at the distal end of long spinal fusion constructs for the management of patients with scoliosis; these complications all occurred within 6 months of the index procedures. The results of a detailed microscopic analysis of the failed components from 1 of the cases are also presented.
Conclusions: From this evidence, the authors of the current study recommend that surgeons exercise caution when using monoaxial pedicle screws at the distal end of long spinal fusion constructs, especially after compression has been achieved on the convex portion of the curve.

Keywords: Monoaxial pedicle screws; Set screw loosening; Posterior spinal fusion; Idiopathic scoliosis

Introduction

Instrumentation for the correction of spinal deformity has evolved considerably over the past 2 decades [1-3]. In particular, the development of pedicle screws, which anchor to the strongest part of the vertebra, has dramatically enhanced the ability to apply corrective forces to the deformed spine [4,5]. The goals of instrumented fusion are to correct deformities, stabilize the spine, and achieve arthrodesis. To accomplish these goals, the spinal implant must withstand compressive, torsional, and bending loads, because increased construct stability and stiffness have been shown to improve the rate of fusion and the strength of the fusion mass [6,7]. Therefore, optimizing the strength of the rod–screw interface may improve implant performance, increase stability of the spine, and maximize the likelihood of arthrodesis.

The nature of the rod–screw interface depends on the type of pedicle screw used. Monoaxial pedicle screws have a fixed angle head, meaning no motion is allowed between the head and the shaft. In contrast, polyaxial screws have a mobile head that can swivel freely in relation to the threaded shaft. Some polyaxial screws can be controlled with an instrument to limit the degrees of freedom of the head, and can thus partially mimic monoaxial screws. Other compromises between monoaxial and polyaxial screws include uniaxial screws and 6 degrees of freedom post-loading multiplanar adjusting screws. In addition to being less expensive than other types of pedicle screws, monoaxial pedicle screws have demonstrated superiority for vertebral rotation correction and lumbar lordosis correction [8]. Furthermore, their low profile is an advantage in the pediatric population. However, owing to the nature of the rod–monoaxial screw interface (the rod is securely seated into the screw head saddle and the

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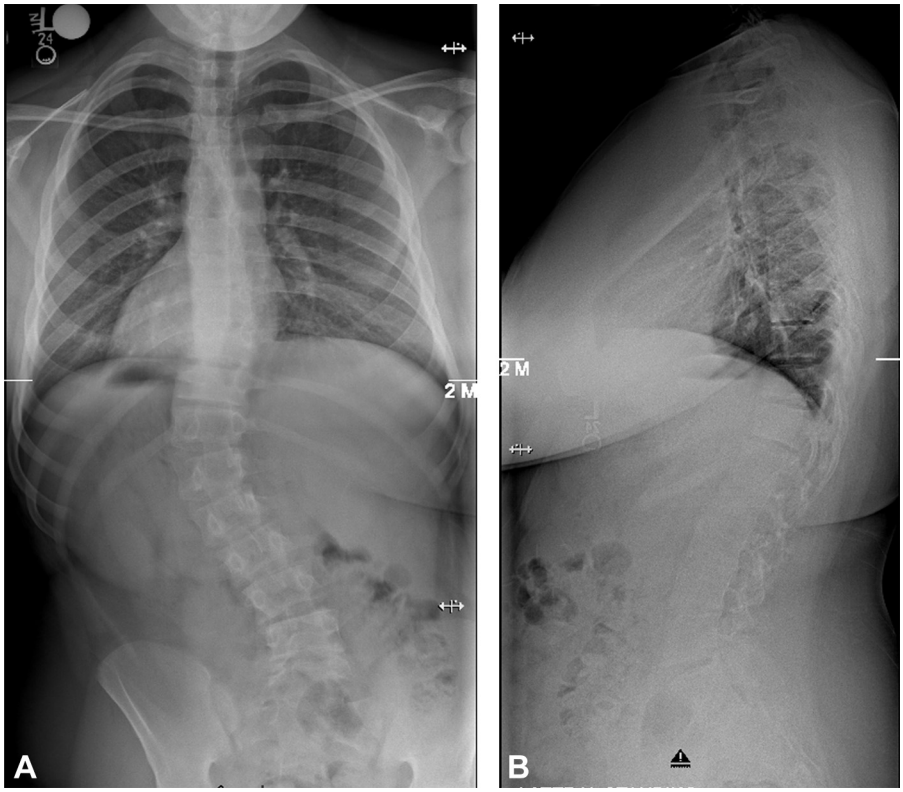

Fig. 1. Preoperative anteroposterior (A) and lateral (B) standing scoliosis radiographs demonstrating idiopathic thoracolumbar scoliosis with a Cobb angle of 45° with coronal shift.

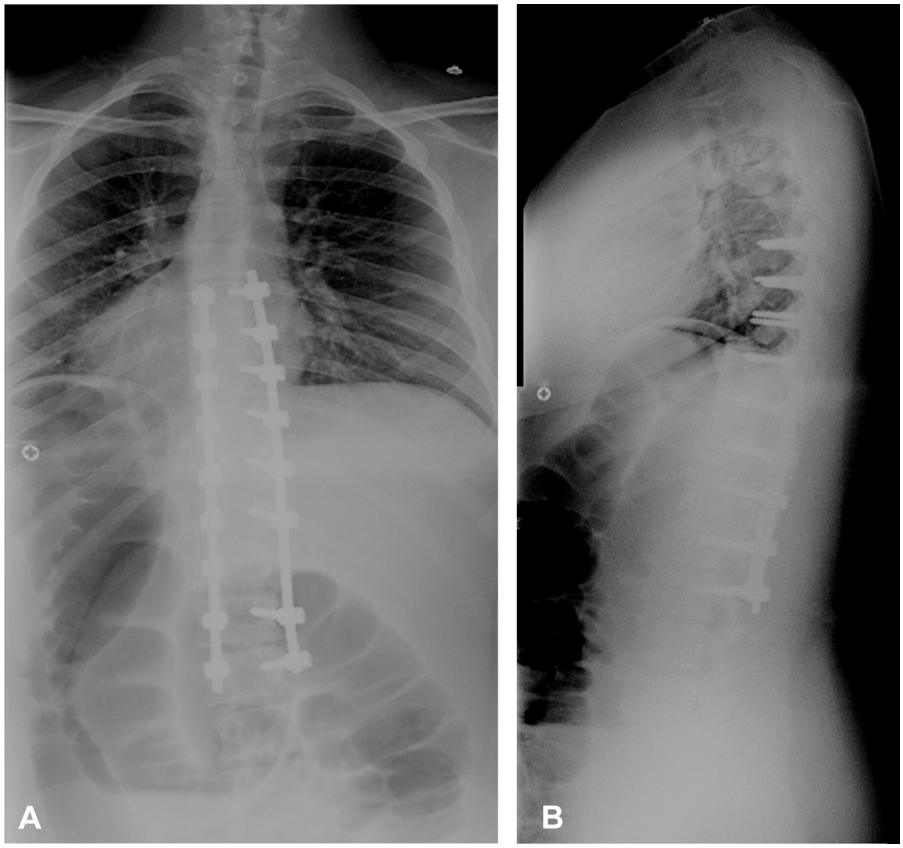

Fig. 2. Postoperative anteroposterior (A) and lateral (B) standing scoliosis radiographs demonstrating a T7–L3 posterior spinal fusion with correction of the scoliosis deformity and appropriate placement of pedicle screws.