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Complications and Radiographic Outcomes of Posterior Spinal Fusion and Observation in Patients Who Have Undergone Distraction-Based Treatment for Early Onset Scoliosis

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Abstract

Study Design: Retrospective, multicenter.
Objectives: To compare surgical and radiographic outcomes of early-onset scoliosis (EOS) patients who had stopped lengthening for ⩾2 years without additional surgery to those who had posterior spinal fusion (PSF) at the end of lengthening.
Summary of Background Data: Because of the risk of significant complications with PSF in patients with EOS, ''watchful waiting'' at the end of lengthening has been suggested as a viable alternative.
Methods: Retrospective review of the Children's Spine Study Group (CSSG) database identified all patients with the diagnosis of EOS who had distraction-based treatment, who were ⩾2 years from their last distraction, and who had complete records. Radiographic measures were obtained by a single unbiased trained observer. Treatment outcomes including curve correction, height and length gain, as well as complications were recorded.
Results: The 37 patients (21 females and 16 males) had a mean age of 7.2 years; 12 were in the observation (OBS) and 25 in the PSF group. The PSF group had a slightly greater coronal Cobb angle and maximal kyphosis at the end of distraction. Although there was some correction of the coronal Cobb angle and maximal kyphosis following PSF, the differences between the two groups were not statistically significant at final follow-up. At final follow-up, the OBS group obtained 88% of T1–T12 height and 90% of T1–L1 length of that obtained by the PSF group. Twenty-six complications occurred in 15 patients, all in the PSF group.
Conclusions: Observation may be a viable alternative to PSF after distraction-based treatment in a subset of patients with EOS. PSF was found to provide no significant curve correction or gains in spine height and length compared to observation and carries a significant risk of complications.
Level of Evidence: Level III, therapeutic.

Keywords: Early-onset scoliosis; Posterior spinal fusion; Complications; Observation; Outcomes

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Introduction

A commonly used treatment strategy for patients with early-onset scoliosis (EOS) is the use of growth-friendly techniques, usually rib- and/or spine-based, followed by a posterior spinal fusion (PSF). Although effective in patients with adolescent idiopathic scoliosis (AIS) [1], PSF after distraction-based treatment in EOS patients has been shown to have a small amount of curve correction and an increased frequency of complications compared to PSF in AIS patients [2-4].

The decision to perform a spinal fusion at the end of distraction-based treatment is complex and multifactorial based on patient, family, and surgeon-specific factors. Factors such as underlying etiology, curve magnitude, implant and/or anchor failure, previous infection, and patient comorbidities all influence surgical risks and outcomes and should be considered. It also has been shown that patients who have multiple surgical procedures and their families have increased psychosocial stress and decreased quality of life [5,6]. PSF after lengthening also may be a difficult procedure because of altered spinal landmarks and spine stiffness.

For these reasons, it has been suggested that ''watchful waiting'' at the end of lengthening may be a viable alternative to PSF [3]. The risk of complications from long-term observation, such as implant pain or failure, curve progression, and late infection, remains unknown. The purpose of this study was to compare surgical and radiographic outcomes of EOS patients who had stopped lengthening for ⩾2 years without additional surgery compared with those who had PSF at the end of lengthening. This information will be valuable in counseling patients and their families about undergoing PSF at the end of distraction.

Materials and Methods

An institutional review board−approved retrospective review of the Children's Spine Study Group (CSSG) database identified all patients with the diagnosis of EOS who had distraction-based treatment, who were ⩾2 years from their last distraction, and who had complete records. The etiology of the deformity was classified using the C-EOS classification, which has been validated and shown to be reliable [7]. Radiographic measures, including coronal Cobb angle, maximal kyphosis, thoracic spine height (T1−T12), total spine height (T1−S1), as well as sagittal spine length (SSL) from T1−L1 and T1−S1, were obtained by an unbiased trained observer. Although spinal height measurements such as T1−T12 and T1−S1 are commonly used, they are influenced by kyphosis. SSL measures the true length of the spine [8] (Fig. 1). Patients who were ⩾2 years from their last lengthening and had not undergone PSF were placed in the ''observation'' cohort. They were audited to ensure that no subsequent surgeries had been done and that they were still being observed and had not been lost to follow-up. Treatment outcomes including curve correction, spinal height and length gain, as well as complications were recorded at the completion of distraction, after PSF when applicable, and at final follow-up. Complications were stratified by the classification of Smith et al. [9]. Statistical analysis was performed using a 2-tailed t test, with statistical significance being a P value of $<.05$.

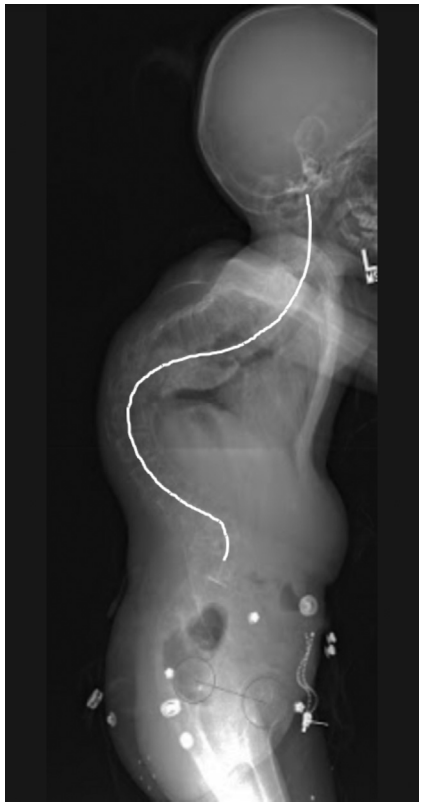

Fig. 1. Longitudinal sagittal spine length.

This study used the Children's Spine Study Group database, which received funding from the Children's Spine Foundation.

Results

The 37 patients (21 females, 16 males) had a mean age of 7.2 years; 12 (32%) were in the observation (OBS) and 25 (68%) in the PSF group. The most common C-EOS diagnosis was congenital/structural (21, 57%), followed by neuromuscular (9, 24%), syndromic (6, 17%), and idiopathic (1, 3%). The mean age of distraction-based treatment was 7.2 years, and all patients in the OBS group were treated with rib-based distraction. In the PSF group, 20 (80%) patients were treated with rib-based distraction, 4 (16%) with spine-based distraction, and 1 (4%) with a hybrid rib/spine-based implant. The mean age at final distraction was 12 years (range 9−15.6 years) in the PSF and 12 years (range 7−19.5 years) in the OBS group.