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Clinical Study

Surgical outcomes by age at the time of surgery in the treatment of congenital scoliosis in children under age 10 years

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Abstract

BACKGROUND CONTEXT: There is little information regarding the surgical outcomes with regard to the timing of surgery in children under age 10 years for congenital scoliosis with a long-term follow-up.

PURPOSE: The purpose of this study was to compare the surgical outcomes for congenital scoliosis in children 6 years or older but less than 10 years of age.

STUDY DESIGN: This is a retrospective study.

PATIENT SAMPLE: Eighteen congenital scoliosis patients under age 10 years at the time of surgery were treated by posterior hemivertebra resection and bilateral pedicle screw fixation.

OUTCOME MEASURES: Outcome measures are radiological outcomes (plain radiographs and computed tomography) and complications.

METHODS: Eighteen congenital scoliosis patients (n=18) under age 10 years at the time of surgery were treated by posterior hemivertebra resection and bilateral pedicle screw fixation. These cases were retrospectively studied and had a minimum of 7-year follow-up. We assigned patients into two groups: Group 1 (n=9) patients who had surgery before 6 years of age and Group 2 (n=9) those who had surgery after 6 years of age.

RESULTS: The groups were not found to be statistically different in operative time, blood loss, and follow-up period. In the Group 1, the mean Cobb angle of the main curve was 32.4° before surgery, 6.4° after surgery, and 9.1° at last follow-up. In the Group 2, the mean Cobb angle of the main curve was 36.5° before surgery, 10.4° after surgery, and 14.5° at last follow-up. There was significantly better deformity correction of main curve immediate postoperatively and at last follow-up in Group 1. No significant difference was observed in growth rate of the vertebral body and spinal canal parameters comparing the two groups at the vertebra with or without screws. There was no crankshaft phenomena, no clinical or radiographic features suggestive of spinal stenosis during follow-up, and no major vascular or neurological complications related to the pedicle screws in either group.

CONCLUSIONS: In congenital scoliosis patients, posterior hemivertebra resection after pedicle screw fixation before the age of 6 years had significantly better deformity correction and did not cause a negative effect on the growth of vertebral body or spinal canal compared with the group treated after 6 years of age. Therefore, early surgical correction of a congenital hemivertebra in children under 6 years of age, before structural changes occur, effectively achieves a more satisfactory correction without causing iatrogenic spinal stenosis or neurologic complications compared with children older than 6 years but under 10 years of age.

Keywords: Congenital scoliosis; Hemivertebra resection; Pedicle screw fixation; Growing spine; Immature spine; Vertebral body growth; Posterior vertebral column resection

FDA device/drug status: Not applicable.

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EVIDENCE & METHODS

Context
The authors maintain that there is insufficient evidence regarding surgical outcomes following intervention for congenital scoliosis. In this context, the authors present their results in a series of 18 patients, treated surgically for this condition.

Contribution
The authors arbitrarily assigned patients to two groups based on age at the time of surgery. Those under age 6 were assigned to one group (n=9) and those older than 6 were assigned to another (n=9). The authors report that patients who received surgery before the age of 6 had significantly greater deformity correction without negative impact on vertebral or spinal canal growth.

Implications
As a retrospective review of patients treated at a single center, without the benefit of true controls, the effect of age on the results of surgical intervention cannot truly be determined in a work of this kind. While it is encouraging that, in the event that surgery is indicated in patients under age 6, no adverse effects on spinal canal and vertebral growth may be anticipated, the number of patients in this study is far too small to facilitate broad conclusions. Readers should appreciate that, in light of the limited sample size, retrospective study design, and high potential for bias/confounding, the results presented here represent Level IV evidence.

—The Editors

Introduction

Hemivertebra has a variable natural course, but most hemivertebrae have growth potential and create a wedge-shaped deformity that progresses during further growth. The rate of deterioration and the ultimate severity of the curve depend on the age of the child, type of vertebral anomaly, the size of the deformity, and the site at which it occurs [1–9].

Hemivertebra should be treated at the earliest patient age before the deformity progresses, and structural differentiation takes place in the adjacent segments [5,6]. Early surgery in young children prevents the development of local deformities and secondary structural curves, thus allowing normal growth in the unaffected parts of the spine [2]. There are no reports in the literature regarding surgical outcomes by age at the time of surgery in children under age 10 years with congenital scoliosis.

Pedicle screws have revolutionized surgical treatment of spinal deformities by using segmental three-column fixation and have also been used to achieve deformity correction and rigid fixation after hemivertebra excision in children [10–15]. There is a paucity of data regarding the long-term follow-up of vertebral growth parameters in children who received pedicle screw instrumentation at an early age.

The purpose of this study was to compare the surgical outcomes by the age at the time of surgery in children under age 10 years undergoing posterior hemivertebra resection and short-segment fusion with pedicle screw fixation and the long-term effects on the growing spine.

Materials and methods

Patients

Twenty patients with a diagnosis of a congenital scoliosis because of hemivertebra who underwent posterior hemivertebra resection and bilateral pedicle screw fixation in our institution between 1997 and 2007 were retrospectively reviewed for deformity correction and long-term effects on the growing spine. The minimum follow-up was 7 years. Institutional review board approval of our hospital was obtained before data collection and analysis. The inclusion criteria were as follows: congenital spinal deformity requiring surgical treatment (curve magnitude: more than 25° with fast progression, this included documented progression of the curve of more than 5° in 6-month follow-up and/or failure of conservative treatment); hemivertebra resection with bilateral pedicle screw instrumentations one level above and below the hemivertebrae; age at surgery less than 10 years; and a minimum of 7-year follow-up. Patients who had an anterior approach, revision surgery, or scoliosis of other etiologies were not included in this study.

Among 20 patients, 1 patient was lost to follow-up and 1 patient was excluded because of an unclear margin of anatomic markers. Therefore, 18 patients met our criteria. We divided them into those who had surgery before 6 years of age (Group 1, n=9) and those who had surgery after 6 years of age (Group 2, n=9). The mean age was 4.2 (range: 2.6–5.6) years for Group 1 and 9 (6.7–9.8) years for Group 2. The mean follow-up was 12.5 (range: 8.1–17.3) years for Group 1 and 11.1 (7.1–16.6) years for Group 2 (Table 1).

The patients included 11 boys and 7 girls. The triradiate cartilage was open in all patients. Of the 18 patients, 5 showed associated anomalies in the spine (2 patients: syringohydromyelia, Group 2), in the cardiopulmonary system (2 patients: Tetralogy of Fallot, Group 1, and tricuspid valve regurgitation, Group 2), and in the genitourinary system (1 patient: ectopic kidney, Group 2). All hemivertebrae were nonincarcerated, and the etiologic diagnoses were fully segmented: single hemivertebra in 15 patients, double hemivertebrae in 2, and hemivertebra with block vertebra in 1 (Table 2).

Surgical technique

All the surgeries were carried out by the senior author (S.I.S.). All were monitored with somatosensory-evoked