Posterior Only Vertebral Column Resection for the Treatment of Severe Spinal Deformities in Pediatric Patients: A Retrospective Case Series

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■ OBJECTIVE: **The treatment of severe spinal deformities in pediatric patients is very challenging. Posterior only vertebral column resection (PVCR) allows for correcting of severe deformities of the vertebral column via a posterior only procedure. We analyzed radiologic outcome of PVCR performed on a series of pediatric patients with severe congenital and acquired spinal deformities.**

■ METHODS: **A case series of 11 pediatric patients with severe spinal deformity who were treated by PVCR between 2009 and 2013 were retrospectively analyzed. All patients had posterior instrumentation and reconstruction of the anterior column with titanium cages filled with autologous bone. Seven patients had pure kyphosis or kyphoscoliosis, whereas 4 patients were treated because of scoliotic deformities. The patient records were reviewed for demographic and general clinical data. Complications and adverse events, transfusion rates, and surgical time were recorded. Radiologic analysis included Cobb angles and percentage of correction, analysis of sagittal profile, time to fusion, and possible complications related to instrumentation.**

■ RESULTS: **Average preoperative scoliosis of 61° was corrected to 32°, resulting in a 50% correction at final follow-up. Coronal imbalance was improved to 36% at the most recent follow-up. Mean preoperative kyphotic deformity was 90° and was corrected to 43° at the last follow-up evaluation. Intraoperative complications included loss of the neuromonitoring signals in 2 cases and pleural laceration in 1 case.**

■ CONCLUSIONS: **PVCR for children is an effective and safe technique providing a successful correction of complex pediatric spinal deformities. Nevertheless, it remains a technically highly demanding procedure, implying the possibility of severe complications.**

INTRODUCTION

Treatment of severe spinal deformities in pediatric patients still remains a major therapeutic challenge. The required surgical procedures are often highly demanding and carry the risk of major complications.

Although an isolated anterior or posterior surgical approach or the combination of anterior and posterior instrumentation has been successfully applied to moderate deformities, treatment of more severe spinal deformities still remains a surgical challenge.[1] The degree of correction, which can be achieved when performing surgical procedures without osteotomies, is limited. Recently, vertebral column resection (VCR), performed by a posterior only approach, has been proposed for the treatment of very severe deformities.[2-4] VCR includes complete resection of 1 or more vertebral bodies and the adjacent intervertebral disks. Thoracic nerve roots may either be preserved or sacrificed. Resection can be performed using a posterior only approach or the combination of anterior with posterior techniques.

Key words
- Pediatric spine
- Revision surgery
- Vertebral column resection

Abbreviations and Acronyms
MEP: Motor-evoked potential
PVCR: Posterior vertebral column resection
VCR: Vertebral column resection
VEPTR: Vertical expandable prosthetic titanium rib

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Suk et al.[5] were the first to present results on posterior vertebral column resection (PVCR) for various spinal deformities. Other authors confirmed the success of this approach subsequently.[4-6]

The purpose of this retrospective study was to evaluate the safety and efficacy of PVCR in the treatment of severe spinal deformities in the pediatric population as a primary surgical approach or in case of revision surgery.

MATERIALS AND METHODS

In a retrospective review from a single institution, we included 11 pediatric patients with severe spinal deformities who had been treated at our institution between 2009 and 2012. Patients included 5 women and 6 men, with a mean age of 10.8 (range, 2.2–18.2) years at the time of operation. Four patients had scoliosis as the primary deformity, 3 patients had isolated kyphosis, and 4 patients had kyphoscoliosis. Seven of the patients had undergone previous spine surgeries including implantation of vertical expandable prosthetic titanium rib (VEPTR) in 4 patients, posterior instrumentation using growing rods in 1 patient, and anterior-posterior spine fusion and resection of an intraspinal tumor through extensive laminectomy in 1 patient (Table 1).

Patient records were reviewed for general clinical data. Standardized 2-plane radiographs (lateral and anterior-posterior) were used to measure major curve magnitude and sagittal profile before surgery and at the most recent follow-up. Assessment of the radiographic data included deformity correction and complications related to the instrumentation. Coronal and sagittal plane deformity were measured by the Cobb method.

SURGICAL TECHNIQUE

VCR is indicated for the most severe spinal deformities in children. The amount of resection is related to the severity and type of deformity. Intraoperative monitoring of motor-evoked potentials (MEPs) is mandatory.

The patient is positioned prone, and a standard posterior midline incision is performed. In most cases a wide laminectomy over at least 2–3 segments is performed. This also facilitates pedicle screw insertion under direct visual control close to the apex of the deformity.

Spinal fusion and instrumentation is performed at least 2 levels above and below the resected apex. In cases of thoracic deformity, bilateral rib segments are resected. The apical vertebra is then exposed subperiosteally on both sides. Both pedicles of the apical vertebra are resected with the help of a high-speed drill, which is very helpful in maintaining hemostasis. Violation of epidural veins medial to the pedicles should be avoided. Instead, they should be carefully exposed and treated with bipolar coagulation. The posterior wall is then resected with a power drill, and the vertebral body is subsequently slowly resected, leaving the periosteum intact. At this point a single short rod is placed into the concavity to avoid displacement of the spinal column. In kyphoscoliosis, it is best to place a preliminary rod at the convexity of the curve to avoid additional kyphosis and neurologic compromise during correction. Resection of the disk spaces is performed, and the adjacent end plates are exposed. The anterior gap is assessed, and

Table 1. Patient Details

Patient Identification Number	Sex	Age (years. months)	Type of Deformity	Pathology
1	M	7.7	Congenital kyphoscoliosis	Revision surgery after failure of growing rod system
2	F	18.2	Congenital kyphoscoliosis	Revision surgery, previous dorsoventral spondylodesis T12-6 and subsequent rip fusions between T8-11, Conradi Hünermann syndrome
3	F	13.4	Congenital scoliosis	Concave bar between T2-9
4	M	12.3	Congenital scoliosis	Concave bar T4-6
5	F	9.1	Neuromuscular scoliosis	Revision surgery because of progressive thoracolumbar scoliosis after VEPTR implantation, neurofibromatosis type I
6	M	8.2	Secondary kyphoscoliosis	Revision surgery, post laminectomy deformity after laminectomy between T3-7 because of T-cell lymphoma, subsequent failure of instrumentation and development of pseudarthrosis, preoperative Halo distraction
7	M	8.6	Congenital kyphosis	Segmental spinal dysgenesis with congenital luxation of the fused segment including T12-L2
8	M	14.6	Secondary kyphoscoliosis	Revision surgery, progressive thoracolumbar scoliosis after VEPTR explantation, transitional vertebra L1, VACTERL association
9	M	2.2	Severe kyphosis	Progressive kyphosis, incomplete transversal syndrome
10	F	12.8	Congenital scoliosis	Revision surgery, progressive scoliosis after VEPTR distraction
11	F	12.2	Severe kyphosis	Revision surgery, severe progressive kyphosis after VEPTR distraction

M, male; F, female; VACTERL, vertebral, anal, cardiac, trachea-esophageal, renal/kidney, and limb defects; VEPTR, vertical expandable prosthetic titanium rib.