Posterior 2-Level Vertebral Column Resection for the Treatment of Progressive Rotational Dislocation in Kyphoscoliotic Deformities

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OBJECTIVE: **Progressive rotational dislocation of the spine is rare and surgical treatment is challenging. Few reports have described surgical decompression, fusion, and partial correction by traditional 2-stage anterior decompression and the posterior fixation technique. The goal of this retrospective study was to report a series of 6 patients with this deformity and the outcome after treatment by posterior-only 2-level vertebral column resection (PVCR).**

METHODS: **Between 2011 and 2014, 6 patients were treated for kyphoscoliotic deformities with progressive rotational dislocation. In these 6 patients (2 males and 4 females), the diagnosis included 4 cases of congenital kyphosis and 2 cases of neurofibromatosis; the distribution of spine level was from T4 to T11; the kyphosis angle of the patients was 115° (range, 107–125°); the scoliosis angle was 97° (range, 80°–117°); follow-up ranged from 13 to 51 months (mean, 27 months). Four patients developed progressive onset of neurologic deficit. All patients underwent surgery by 2-level PVCR for decompression and correction of kyphoscoliosis.**

RESULTS: **Postoperatively, the patients all had different kyphosis correction rates, from 49% to 72% (mean, 63%) and scoliosis correction rates, from 57% to 78% (mean, 65%). All patients achieved successful spinal fusion with less than 3° of loss of correction at the latest follow-up evaluation. The 4 patients with incomplete neurologic deficits improved 1 or 2 American Spinal Injury Association scales at follow-up of at least 6 months.**

CONCLUSIONS: **Two-level PVCR is a safe and efficacious surgical option for the treatment of rotational dislocation in kyphoscoliosis and associated neurologic deficit.**

INTRODUCTION

Rotational dislocation of the spine is a rare disorder; the term was coined in 1972 when Duval-Beaupere and Dubousset[1] described 16 patients, and the presentation and treatment of 11 patients was reported in 2000 by Zeller and Dubousset.[2] The condition is defined as displacement between 2 groups of vertebrae, each included in a lordoscoliotic segment and the 2 groups rotated in opposite directions, which results in kyphosis in the region between the 2 groups of vertebrae.[1,2] The rotational dislocation in kyphoscoliotic deformities is slowly progressive and leads to a major twist at the junction of 2 scoliotic curves, which is characterized by short, sharp-angled kyphosis at the junction of 2 lordoscoliotic curves on radiologic images. Besides these 2 relatively large case series, a few case reports have also stressed the clinical and radiologic characteristics and the appropriate treatment.[3-9] Overall, the common site of dislocation occurs at the thoracic spine, and secondarily at the thoracolumbar junction. The cause of rotational dislocation includes neurofibromatosis type 1, diastrophic dysplasia, congenital myopathy, metaphysical chondrodysplasia, Gorham disease, and congenital defects such as butterfly vertebrae. The clinical features of this disorder include progressive spinal deformity with or without neurologic deficit. The diagnosis of rotational dislocation is confirmed by noting the apex of the kyphosis on a lateral radiograph, which should correspond with the junction of 2 scoliotic curves on a frontal radiograph.

Key words
- Kyphoscoliosis
- Posterior vertebral column resection
- Rotational dislocation

Abbreviations and Acronyms
ASIA: American Spinal Injury Association
CT: Computed tomography
MEP: Motor evoked potential
MRI: Magnetic resonance imaging
PVCR: Posterior-only 2-level vertebral column resection
SSEP: Somatosensory evoked potential

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Some studies recommended initial partial correction of the deformity before surgery using controlled traction under close supervision, followed by early circumferential fusion using anterior strut grafting and posterior fusion with or without instrumentation.[1-9] Recently, the development of segmental pedicle screw instrumentation and corpectomy via a posterior approach has allowed for 1-step correction of the deformity, avoiding lengthening of the spinal canal.[10-12] It is valuable not only for kyphosis correction and fixation but also for reduction in the risk for respiratory failure compared with an anterior approach.[13] We report a series of 6 patients with rotational dislocation of the thoracic spine associated with progressive neurologic deficit who underwent posterior-only 2-level vertebral column resection (PVCR) for correction and fusion, resulting in a successful outcome.

METHODS

Between January 2011 and December 2014, 34 patients with severe angular kyphosis presented to our group (Z.Z.). Among them, 6 patients developed progressive rotational dislocation for kyphoscoliotic deformities (Table 1). The diagnosis of rotational dislocation of the spine in kyphoscoliotic deformities is based on 2 standards: the apex of the kyphosis on the lateral radiograph should correspond with the junctional zone between the 2 scoliotic curves on the frontal radiograph, and the double-vertebrae sign of rotational dislocation of the spine on computed tomography (CT) scans. In these 6 patients (2 males and 4 females), the diagnosis included 4 cases of congenital kyphosis and 2 cases of neurofibromatosis; the distribution of the spine level was from T4 to T11; the kyphosis angle of the patients was 115° (range, 107°–125°); the scoliosis angle was 97° (range, 80°–117°); follow-up ranged from 13 to 51 months (mean, 27 months). Four patients developed progressive onset of neurologic deficit. Most occurrences involve the thoracolumbar spine (T9-T12) (4 of 6 patients), followed by the upper thoracic spine (T1-T4), and middle thoracic spine (T5-T8) (1 of 6 patients) (Table 1).

Before and after surgery, all patients underwent CT scans to define the precise abnormalities and the double-vertebrae sign of rotational dislocation of the spine, and 1.5-T magnetic resonance imaging (MRI) to define cord compression and the extent of intramedullary signal intensity change in the sagittal and axial planes, on T1-weighted and T2-weighted sequences. Standard anteroposterior and lateral films (standing if possible) were obtained before and after surgery to assess sagittal, coronal, and global balance. Neurologic status of all patients on admission and at each follow-up was evaluated according to the International Standards for Neurological and Functional Classification of Spinal Cord Injury determined by the American Spinal Injury Association (ASIA)-International Medical Society of Paraplegia.[14]

All patients underwent a posterior-only 2-level PVCR for decompression and kyphosis correction. All operations were performed by the senior author (Z. Z.) under monitoring of somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs). A posterior midline incision was made over the kyphotic spinous processes. Pedicle screws were inserted into 3 or more levels (according to kyphosis and scoliosis correction)

Table 1. Patient Data

Case Number	Sex/Age (years)	Diagnosis	Duration of Neurologic Deficit (months)	Apex of Kyphosis	Kyphosis (°) Preoperative/ Postoperative Rate (%)	Scoliosis (°) Preoperative/ Postoperative Rate (%)	Operation Time (minutes)	Blood Loss (mL)	Follow-Up (months)	Bone Fusion (months)	ASIA Preoperative/1 Day/1 Week/6 Months/1 Year	Figure
1	F/14	NF	1	T11	125/48/62	108/28/64	250	1360	51	12	D/D/E/E/E	
2	M/35	CK	—	T11	115/32/72	102/22/78	230	1330	26	8	E/E/E/E/E	
3	F/26	CK	10	T11	110/38/65	98/32/67	240	1250	13	6	B/B/C/C/C	Fig. 1
4	F/17	CK	—	T11	123/52/58	112/48/57	230	1160	13	7	E/E/E/E/E	
5	M/18	NF	19	T8	107/30/72	117/47/60	240	1670	15	7	B/B/C/D/D	
6	F/15	CK	6	T4	113/58/49	80/30/63	170	1150	42	6	D/D/D/E/E	
Average	—/19			T4-T11	115/43/63	97/33/65	226	1320	27	7		

ASIA, American Spinal Injury Association; F, female; NF, neurofibromatosis; M, male; CK, congenital kyphosis.