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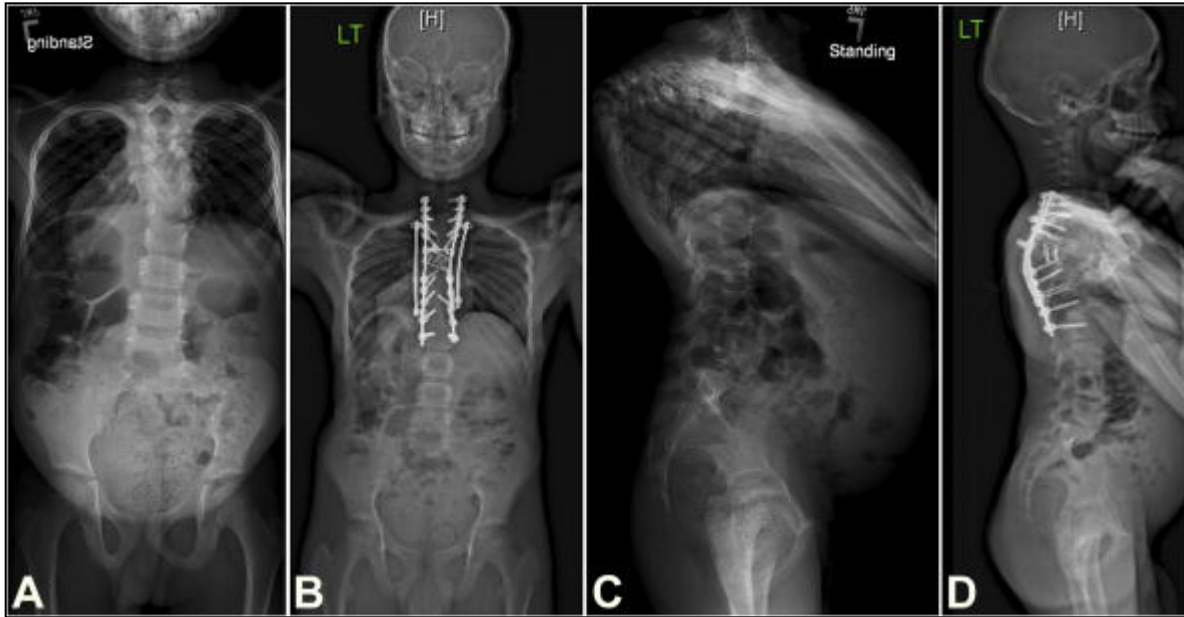
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Fig. 1



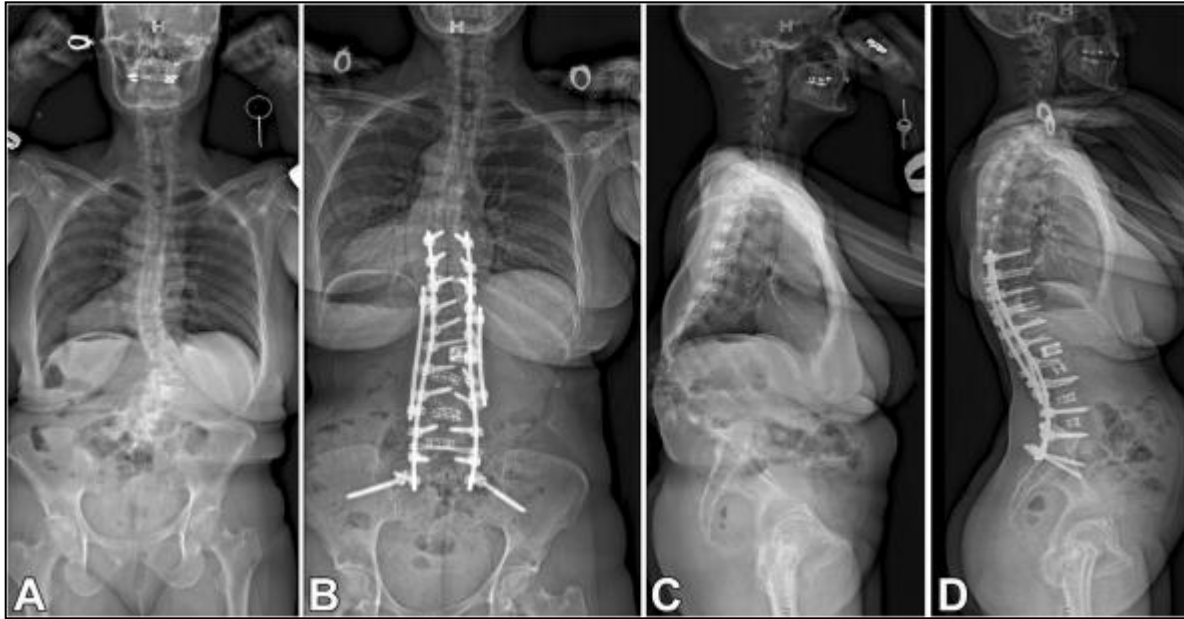
Clinical and Radiographic Outcomes After Posterior Vertebral Column Resection for Severe Spinal Deformity with Five-Year Follow-up.

Riley, Max; Lenke, Lawrence; Chapman, Todd; Sides, Brenda; Blanke, Kathy; Kelly, Michael; MD, MSc

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Fig. 1 Radiographs of a 9-year-old boy treated for a rigid kyphosis with myelopathy: preoperative (Fig. 1-A) and 5-year follow-up (Fig. 1-B) anteroposterior radiographs and preoperative (Fig. 1-C) and 5-year follow-up (Fig. 1-D) lateral radiographs. A single-stage, 3-level (T6, T7, T8) posterior vertebral column resection was performed.

Fig. 2



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Fig. 2 Radiographs of a 54-year-old woman treated for a rigid, postlaminectomy kyphosis: preoperative (Fig. 2-A) and 5-year follow-up (Fig. 2-B) anteroposterior radiographs and preoperative (Fig. 2-C) and 5-year follow-up (Fig. 2-D) lateral radiographs. A single-stage L2 posterior vertebral column resection was performed.

TABLE I

Variable	Included (N = 31)	Excluded (N = 29)	P Value
Age* (yr)	12.5 ± 3	13.5 ± 3	0.214
Sex†			0.782
Female	15 (48.4%)	16 (55.2%)	
Male	16 (51.6%)	13 (44.8%)	
BMI* (kg/m ²)	20.9 ± 4.3	19.6 ± 5.1	0.360
Preoperative neurological deficit†			0.164
No	19 (61.3%)	13 (44.8%)	
Yes	7 (22.6%)	11 (37.9%)	
NA‡	5 (16.1%)	5 (17.2%)	
Revision procedure†			0.645
No	10 (32.3%)	11 (37.9%)	
Yes	21 (67.7%)	18 (62.1%)	

* The values are given as the mean and the standard deviation.

† The values are given as the number of patients, with the percentage in parentheses.

‡ NA = not available.

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TABLE I Preoperative Pediatric Demographic Data

TABLE II

Variable	Included (N = 23)	Excluded (N = 26)	P Value
Age† (yr)	39.3 ± 20	38.6 ± 19	0.903
Sex†			0.056
Female	16 (69.6%)	15 (57.7%)	
Male	7 (30.4%)	11 (42.3%)	
BMI* (kg/m ²)	24.5 ± 5.6	24.1 ± 6.4	0.824
Smoker†			0.045
No	18 (78.3%)	14 (53.8%)	
Yes	2 (8.7%)	8 (30.8%)	
NA‡	3 (13.0%)	4 (15.4%)	
Preoperative neurological deficit†			0.084
No	18 (78.3%)	14 (53.8%)	
Yes	4 (17.4%)	10 (38.5%)	
NA‡	1 (4.3%)	2 (7.7%)	
Revision procedure†			0.041
No	5 (21.7%)	13 (50.0%)	
Yes	18 (78.3%)	13 (50.0%)	

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TABLE II Preoperative Adult Demographic Data

TABLE III

TABLE III Operative Data: Pediatric and Adult						
Variable	Pediatric		P Value	Adult		P Value
	Included (N = 31)	Excluded (N = 29)		Included (N = 23)	Excluded (N = 26)	
No. of levels fused*	9.8 ± 3.7	11.6 ± 3.3	0.073	9.8 ± 4.9	9.1 ± 5.5	0.644
No. of instrumented vertebra*	11.3 ± 3.6	12.8 ± 3.2	0.123	12.6 ± 4.9	12.3 ± 5.1	0.875
Vertebral column resection levels*	1.7 ± 0.76	1.64 ± 0.68	0.900	1.1 ± 0.29	1.44 ± 0.65	0.025
No. of stages in a staged procedure†			0.193			0.539
1	29 (93.5%)	24 (82.8%)		14 (60.9%)	16 (69.2%)	
2	2 (6.5%)	5 (17.2%)		9 (39.1%)	8 (30.8%)	
Stage 1						
No. of patients	31	29		23	26	
Operative time* (min)	571.5 ± 119.8	618.6 ± 110.7	0.207	548.7 ± 99.7	552.1 ± 122.3	0.926
Estimated blood loss* (mL)	812.9 ± 64.7	757.4 ± 86	0.608	1,580.9 ± 294.4	1,791 ± 199.2	0.548
Stage 2						
No. of patients	2	5		9	8	
Operative time* (min)	600 ± 42.4	485 ± 120.2	0.360	420.6 ± 90.7	440 ± 112.9	0.772
Estimated blood loss* (mL)	1,350 ± 150	710 ± 146.9	0.053	950 ± 275.4	1,580 ± 344	0.070
Follow-up* (yr)	5.5 ± 1			5.4 ± 1		

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† The values are given as the number of patients, with the percentage in parentheses.

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TABLE III Operative Data: Pediatric and Adult

TABLE IV

Time Point	Pediatric	Adult	Total	Outcome
Perioperative (0 to 6 weeks)	19	20	39	
Deep wound infection*	1	0	1	Irrigation and debridement without removal of instrumentation
Excessive bleeding	0	4	4	Resolved
Hemodynamic insufficiency	1	1	2	Resolved
Prolonged intubation	1	0	1	Resolved
Fixation failure	0	1	1	Required extension of fusion
Intraoperative neurological deficit*	5	2	7	2 with postoperative sequelae, 5 resolved with intraoperative correction
Motor deficit*	1	0	1	1 flaccid paralysis, resolved with pedicle excision
Pleural effusion*	2	5	7	Resolved with thoracentesis or chest tube placement
Pneumothorax*	1	0	1	Resolved with chest tube placement
Postoperative anemia	3	5	8	Resolved
Respiratory insufficiency	2	1	3	Resolved
Urinary tract infection	1	0	1	Resolved
Wound dehiscence (superficial)	0	1	1	Resolved with local wound care
Wound necrosis	1	0	1	Resolved with local wound care
Short term (6 weeks to 2 years)	2	6	8	
Compression fracture	0	2	2	Observed
Deep wound infection*	0	1	1	Irrigation and debridement with removal of instrumentation
Fixation failure*	0	1	1	Required extension of fusion to sacrum
Gastroparesis*	1	0	1	Placement of percutaneous gastrostomy tube
Motor deficit*	1	0	1	Observed, mild
Pleural effusion*	0	1	1	Required thoracentesis
Sensory deficit	0	1	1	Observed, right L4/5 dermatomes, resolved
Intermediate term (2 to 5 years)	4	4	8	
Deep wound infection*	1	0	1	Irrigation and debridement with removal of instrumentation
Global malalignment*	1	0	1	Required pedicle subtraction osteotomy
Pressure ulcer*	0	1	1	Irrigation and debridement
Prominent iliac instrumentation	0	2	2	1 required removal of instrumentation, 1 observed
Pseudarthrosis (rod fracture)	0	1	1	Observed
Sensory deficit	1	0	1	Observed; nondermatomal, resolved
Weight loss*	1	0	1	Placement of percutaneous gastrostomy tube
Long-term (>5 years)	0	1	1	
Pseudarthrosis (rod fracture)	0	1	1	Observed

*This was a major complication.

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TABLE IV Incidence and Outcomes of Complications by Time Point

TABLE V

Variable	Preoperative	6 Weeks	2 Years	5 Years	P Value†
Pediatric					
Major Cobb angle (deg)	71.9 ± 53.6	31.1 ± 32.3	27.2 ± 29.5	27.6 ± 29.1	<0.001
Coronal Cobb angle (deg)	65.6 ± 40.1	31.3 ± 19.4	29.9 ± 17.8	29.3 ± 17.5	<0.001
Coronal vertical axis (mm)	1.0 ± 23.9	-3.3 ± 23.3	-5.7 ± 24.6	-5.4 ± 20.9	0.647
T5-T12 kyphosis (deg)	51.2 ± 45.9	36.8 ± 23.5	34.3 ± 24.8	35.4 ± 23.2	<0.001
T12-S1 lordosis (deg)	-41.3 ± 55.5	-40.5 ± 34.6	-45.6 ± 30.0	-39.5 ± 34.6	0.080
Sagittal vertical axis (mm)	17.8 ± 57.3	11.2 ± 61.9	-5.7 ± 71.3	-5.0 ± 48.3	0.003
Pelvic incidence (deg)	43.4 ± 12.8	41.4 ± 12.1	44.1 ± 13.1	40.4 ± 11.0	—
Lumbar lordosis-pelvic incidence mismatch (deg)	29.7 ± 16.9	16.3 ± 14.0	20.8 ± 12.8	18.6 ± 11.9	0.165
Proximal junctional kyphosis angle (deg)	—	4.8 ± 10.2	5.9 ± 12.5	5.4 ± 11.8	—
Adult					
Major Cobb angle (deg)	69.4 ± 45.9	26.5 ± 34.5	27.3 ± 34.7	32.0 ± 25.1	<0.001
Coronal Cobb angle (deg)	47.7 ± 43.4	20.9 ± 19.5	21.4 ± 21.6	22.8 ± 20.8	<0.001
Coronal vertical axis (mm)	-5.2 ± 25.7	-3.2 ± 14.7	1.7 ± 18.2	-1.6 ± 19.9	0.005
T5-T12 kyphosis (deg)	62.1 ± 31.6	38.2 ± 12.3	35.9 ± 14.8	35.3 ± 12.1	0.558
T12-S1 lordosis (deg)	-45.6 ± 49.8	-50.4 ± 13.5	-45.6 ± 28.8	-34.3 ± 12.1	<0.001
Sagittal vertical axis (mm)	30.2 ± 72.7	25.9 ± 72.7	29.5 ± 76.6	18.5 ± 64.1	<0.001
Pelvic incidence	45.9 ± 17.4	49.7 ± 14.3	54.6 ± 15.1	54.7 ± 14.4	—
Lumbar lordosis-pelvic incidence mismatch	27.5 ± 27.2	16.1 ± 9.8	17.1 ± 14.1	18.4 ± 10.2	0.741
Proximal junctional kyphosis angle (deg)	—	5.7 ± 9.7	6.4 ± 11.6	8.5 ± 10.4	—

* The values are given as the mean and the standard deviation.
† The p value compares the 5-year data with preoperative data.

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TABLE V Radiographic Data

TABLE VI

TABLE VI Comparison of Preoperative, 2-Year Follow-up, and 5-Year Follow-up Health-Related Quality-of-Life Parameters*

	Pain	Self-Image	Function	Satisfaction	Mental Health
Pediatric					
Preoperative	4.4 ± 0.5	3.3 ± 0.8	4.0 ± 0.3	2.9 ± 1.4	4.3 ± 0.5
2-year follow-up	4.4 ± 0.7	4.2 ± 0.6	4.3 ± 0.4	4.6 ± 0.5	4.5 ± 0.4
Change from preoperative	0.1 ± 0.4	0.8 ± 1.1†	0.2 ± 0.4	1.5 ± 1.9†	0.1 ± 0.6
5-year follow-up	4.4 ± 0.6	4.2 ± 0.5	3.9 ± 0.7	4.4 ± 0.8	4.3 ± 0.7
Change from preoperative	0.03 ± 0.7	0.9 ± 0.9†	-0.1 ± 0.5	1.8 ± 1.7†	0.2 ± 0.7
Adult					
Preoperative	3.2 ± 1.4	2.3 ± 0.7	3.0 ± 1.0	2.9 ± 1.6	3.4 ± 0.8
2-year follow-up	3.4 ± 1.3	3.7 ± 0.9	3.2 ± 1.0	4.1 ± 0.8	2.6 ± 0.8
Change from preoperative	0.2 ± 0.7	1.3 ± 1.1†	0.1 ± 0.6	1.0 ± 1.7†	0.2 ± 0.4
5-year follow-up	3.5 ± 1.1	3.6 ± 0.9	3.2 ± 0.9	4.3 ± 0.8	3.7 ± 0.8
Change from preoperative	0.3 ± 0.9	1.3 ± 1.0†	0.1 ± 0.4	1.3 ± 1.7†	0.3 ± 0.3†

* The values are given as the mean and the standard deviation, in points.
† Significant change.

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