

Double Major Curvature Treated with Vertebral Body Tethering of Both Curves: How Do Outcomes Compare to Posterior Spinal Fusion?

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INTRODUCTION: Vertebral body tethering (VBT) is a non-fusion motion sparing alternative to posterior spinal fusion (PSF), the current gold standard surgical treatment for AIS. There have been few reports with small numbers of patients on VBT of two curves from bilateral approaches. We aim to compare the radiographic outcomes between VBT and PSF in patients with double curvatures in which both curves have been instrumented in the index surgery.

METHODS:

Thirty-one consecutive patients with AIS were matched by Lenke curve type, age (± 2 years), major Cobb (± 7), and T5-T12 kyphosis (± 10). Continuous variables were compared using Wilcoxon Rank Sum tests and student t-tests. Categorical variables were compared using Chi-Square.

RESULTS:

Group baseline demographics were similar (Table). There was $> EBL$ (VBT 234.2 ± 152.0 vs. PSF 616.4 ± 358.2 ; $p < 0.0001$), levels instrumented (VBT 10.8 ± 0.7 vs. PSF 12.0 ± 1.0 ; < 0.0001), and cell saver returned (VBT 76.3 ± 115.9 vs. PSF 207.1 ± 159.0 ; $p < 0.0001$) in PSF and $>$ operative time in VBT (VBT 377.2 ± 169.4 vs. PSF 266.6 ± 79.1 min; $p = 0.0044$). Major T curve types (Lenke 1, 3, 4) had significantly better major (VBT $51.5 \pm 7.9^\circ$ to $31.6 \pm 12.0^\circ$ [40%] vs. PSF $53.2 \pm 5.7^\circ$ to $15.8 \pm 6.4^\circ$ [70%]; $p < 0.0001$) and secondary curve correction in the PSF group. In total, 71% of VBT patients had a major Cobb $\leq 35^\circ$ as compared to 100% in PSF ($p = 0.0445$). Major TL curve types (Lenke 5, 6) experienced comparable major (VBT $50.4 \pm 8.1^\circ$ to $19.1 \pm 10.9^\circ$ (62%) vs. PSF $51.4 \pm 6.1^\circ$ to $23.4 \pm 10.1^\circ$ (55%); $p = 0.2815$) and secondary curve correction. In total, 93% of VBT patients had a major Cobb $\leq 35^\circ$ as compared to 86% in the PSF group ($p < 0.999$). There was no difference between groups in T5-12 kyphosis and lumbar lordosis at any timepoint for any curve type. There were 5 patients (16%) with major complications in the VBT group compared to 2 (6%) in the PSF group. In VBT group, 1 patient converted to PSF, 1 was pending PSF.

DISCUSSION AND CONCLUSION:

Patients with double major AIS who underwent VBT with major T curve types had less correction than PSF of both major and secondary curves; however, those with major TL curves experienced similar radiographic outcomes regardless of procedure. More complications were seen in VBT patients.

Table. Radiographic outcomes between VBT and PSF groups

	VBT	PSF	P Values	
Age	13.1 \pm 1.7	13.4 \pm 1.5	0.573	
Sex (F)	29 (94%)	27 (87%)	0.6713	
Sanders 1/2/3/6/7	11/11/9/4/3/1*	-	-	
Risser 0/1/2/3/4	8/4/6/10/3	2/2/7/9/11	0.0619	
Lenke 1/3/4/5/6	8/8/11/6/8	-	-	
Mean FU	24.1 \pm 2.2	23.5 \pm 4.3	0.2394	
Entire Cohort				
Pre	51.0 \pm 7.9	52.4 \pm 5.9	0.4452	
2 YR	25.9 \pm 13.0 (49.8 \pm 21.8%)	19.3 \pm 9.0 (63.5 \pm 15.7%)	0.0216 (0.0083)	
Major Thoracic Curves (N=17)				
Pre	51.5 \pm 7.9	53.2 \pm 5.7	0.4919	
2 YR	31.6 \pm 12.0 (39.9 \pm 16.5%)	15.8 \pm 6.4 (70.4 \pm 11.3%)	<0.0001 (<0.0001)	
Pre	45.8 \pm 8.3	43.5 \pm 9.9	0.4691	
2 YR	23.3 \pm 10.0 (45.8 \pm 15.8%)	13.5 \pm 6.8 (62.5 \pm 13.7%)	0.0084 (0.0098)	
Pre	10.3 \pm 13.7	10.4 \pm 13.1	0.9991	
2 YR	24.4 \pm 12.5	29.2 \pm 6.6	0.1771	
Lumbar Lordosis (°)	Pre	-58.1 \pm 18.9	-60.3 \pm 16.0	0.8147
2 YR	-59.9 \pm 13.2	-62.9 \pm 12.0	0.5209	
Major Thoracolumbar Curves (N=14)				
Pre	59.4 \pm 8.1	51.4 \pm 6.1	0.7145	
2 YR	19.1 \pm 10.9 (61.5 \pm 21.2%)	23.4 \pm 10.1 (55.1 \pm 16.6%)	0.2815 (0.3831)	
Pre	46.1 \pm 8.4	41.1 \pm 10.6	0.1787	
2 YR	20.6 \pm 9.5 (55.5 \pm 18.0%)	19.2 \pm 10.3 (53.6 \pm 20.2%)	0.7122 (0.9817)	
T5-T12 Kyphosis (°)	Pre	16.7 \pm 12.3	17.3 \pm 12.0	0.7566
2 YR	21.7 \pm 13.5	23.6 \pm 8.7	0.837	
Lumbar Lordosis (°)	Pre	-61.3 \pm 8.7	-58.1 \pm 14.3	0.4983
2 YR	-58.7 \pm 12.1	-66.5 \pm 13.8	0.1397	
Major Complications by Patient				
Overall	5 (16%)	2 (6%)	0.4248	
Reoperation	3 (10%)	2 (6%)	-	
Readmission	1 (3%)	-	-	
Pulmonary	1 (3%)	-	-	

*12 patients missing Sanders score