

Do Adult Spinal Deformity Patients with High Pelvic Incidence Require Fusion to the Upper Thoracic Spine?

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INTRODUCTION: Patients with high PI often have larger thoracic kyphosis and require larger sagittal corrections, making them prone to PJK. This study investigates whether patients with high PI should undergo fusions to the upper or lower thoracic spine to avoid this common complication. We hypothesize that adult spinal deformity (ASD) patients with high pelvic incidence (PI) are more likely to suffer from proximal junctional kyphosis (PJK) and failure (PJF) if the upper instrumented vertebrae (UIV) extends to the lower thoracic (LT) region, compared to the upper thoracic (UT) region.

METHODS: This was a retrospective review of a prospectively collected database of adult spinal deformity (ASD). ASD patients with PI greater than 65° and instrumentation to the pelvis were included. Patients were divided into groups based on their UIV (UT: T6 or above vs LT: T7 to T12). The groups were compared by demographics, radiographic parameters, HRQLs, and rate of PJK/F at baseline and 2-years using t-tests and chi² tests. Patients with revision surgeries with UIV extension were excluded from alignment analyses.

RESULTS:

253 total patients were included with 35.6% UT and 64.4% LT fusions. At baseline, UT patients had more thoracic kyphosis, higher T1-L1 Pelvic Angle (TLPA), and C2 Pelvic Angle (C2PA) than LT fusions (all p<0.01). UT patients had a lower PJK angle at baseline (p=0.006) and had a smaller change in PJK angle between baseline and 2-years post-op (p=0.03). Patients with UT UIVs had larger corrections in SVA (-91.6 ± 69mm vs 38.8 ± 57mm, p<0.001), T1 Pelvic Angle (-14.6 ± 11° vs -6.1 ± 11°, p<0.001), TLPA (-10.5 ± 6.8° vs -1.6 ± 6°, p<0.001), and C2PA (-12.6 ± 11° vs -5.8 ± 10°, p=0.004) compared to those with lower thoracic UIV. Rates of PJK/F did not differ between cohorts at any timepoint up to 2 years post-operation. There were no significant differences in baseline, 2-year, or change in T10 Pelvic Angle between UT and LT patients, showing UT patients did not achieve greater correction. No significant differences in demographics or HRQLs were observed.

DISCUSSION AND CONCLUSION: These results demonstrate that high PI patients do not need to be fused to the upper thoracic region as a rule. Surgeons should make decisions on UIV to optimize corrections while utilizing techniques to mitigate proximal junctional kyphosis and failure.

	Upper Thoracic UIV (n=56)	Lower Thoracic UIV (n=125)	p-value	
PJK/F	PJK developed within 2 Years	42 (46.7%)	73 (44.8%)	0.8
	PJF developed within 2 Years	19 (21.3%)	25 (15.3%)	0.2
Baseline	Pelvic Incidence (deg)	72.9 ± 6.8	72.6 ± 6.1	0.8
	Pelvic Tilt (deg)	34.7 ± 10.2	33.7 ± 9.2	0.5
	PI-L1 (deg)	31.5 ± 22.1	31.7 ± 19.3	0.95
	T2-T12 Thoracic Kyphosis (deg)	-41.8 ± 22.1	-33.3 ± 17.8	0.007
	SVA C7-S1 (deg)	116.5 ± 73	100.7 ± 81.1	0.2
	L1 Pelvic Angle (deg)	23.4 ± 9.8	24 ± 9.3	0.7
	T1 Pelvic Angle (deg)	57 ± 12	34.4 ± 12.2	0.2
	T4 Pelvic Angle (deg)	33.4 ± 11.7	31.3 ± 12.6	0.3
	T10 Pelvic Angle (deg)	26.3 ± 11.9	26 ± 11.1	0.9
	T1-L1 Pelvic Angle (deg)	14.8 ± 8.2	10.7 ± 7.7	0.002
	C2 Pelvic Angle (deg)	40.4 ± 12.3	35.3 ± 10.4	0.01
	PJK angle (deg)	-11.9 ± 20.1	2.4 ± 17.8	0.002
	2 Year	Pelvic Incidence (deg)	72.3 ± 6.9	72.1 ± 6.3
Pelvic Tilt (deg)		29.7 ± 7.1	29.7 ± 7	0.9
PI-L1 (deg)		10.4 ± 8.3	11.8 ± 11.8	0.9
T2-T12 Thoracic Kyphosis (deg)		-39.1 ± 16.8	-48.8 ± 19.5	0.01
SVA C7-S1 (deg)		28.3 ± 54.8	55.2 ± 42.9	0.008
L1 Pelvic Angle (deg)		19.1 ± 6.1	19 ± 6.5	0.9
T1 Pelvic Angle (deg)		24 ± 7.4	26.9 ± 8.3	0.09
T4 Pelvic Angle (deg)		19.6 ± 6.7	23.1 ± 7.8	0.028
T10 Pelvic Angle (deg)		16.6 ± 6.1	17.1 ± 7.2	0.7
T1-L1 Pelvic Angle (deg)		4.9 ± 4.1	7.9 ± 5.5	0.006
C2 Pelvic Angle (deg)		29.2 ± 8.2	30.2 ± 8.6	0.6
PJK angle (deg)		-18.6 ± 12	-15.7 ± 12.7	0.3
Change in 2 year and baseline		Pelvic Incidence (deg)	-0.6 ± 2.1	-0.5 ± 1.9
	Pelvic Tilt (deg)	-4.9 ± 7.4	-2.9 ± 9.7	0.058
	PI-L1 (deg)	-21.6 ± 19	-18.1 ± 17.4	0.4
	T2-T12 Thoracic Kyphosis (deg)	-15.8 ± 13.2	-17.1 ± 11.8	0.6
	SVA C7-S1 (deg)	-91.6 ± 68.9	-38.8 ± 56.9	<0.001
	L1 Pelvic Angle (deg)	-4.8 ± 7.2	-4.5 ± 7.5	0.9
	T1 Pelvic Angle (deg)	-14.6 ± 11.1	-6.1 ± 11	<0.001
	T4 Pelvic Angle (deg)	-14.9 ± 10.5	-6.5 ± 10.8	<0.001
	T10 Pelvic Angle (deg)	-10.4 ± 9.8	-7.9 ± 9.6	0.2
	T1-L1 Pelvic Angle (deg)	-10.5 ± 6.8	-1.6 ± 5.9	<0.001
	C2 Pelvic Angle (deg)	-12.6 ± 10.8	-5.8 ± 9.5	0.004
	PJK angle (deg)	-4.1 ± 19.6	-19 ± 19.3	0.03