

Clinical predictors of change in pelvic tilt after adult spinal deformity surgery

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INTRODUCTION: Sagittal imbalance is a critical component of adult spinal deformity leading to significant physical disability. Patients typically begin using compensatory mechanisms such as increased pelvic tilt and knee flexion to maintain the head over the pelvis. A critical goal in adult spinal deformity surgery is to restore sagittal balance and decrease patient's reliance on these compensatory mechanisms. The goal of this study was to determine preoperative patient factors as well as surgical factors associated with improvement in pelvic tilt postoperatively.

METHODS: Patients who underwent anterior, posterior, or combined approach spinal fusion of ³12 levels for adult spinal deformity correction were retrospectively identified. Spinal deformity in our study was defined as Cobb angle >20 degrees, sagittal vertebral axis (SVA) of > 5 cm, pelvic tilt > 25 degrees, or thoracic kyphosis > 60 degrees. Only patients with complete preoperative, immediately postoperative, and 1 year standing full length radiographs were included. Preoperative patient clinical and radiographic factors including age, body mass index (BMI), Charlson comorbidity index, hip osteoarthritis (OA) Tonnis grade, preoperative lumbar lordosis (LL), pelvic incidence (PI), SVA, PI-LL mismatch, as well as surgical factors such as inclusion of 3-column osteotomy were tested for association with postoperative change in pelvic tilt using univariate testing. Basic demographic variables and any variables significantly associated in univariate testing were then entered into a multivariate model. A p value < 0.05 was considered significant.

RESULTS: Fifty-six patients with an average age of 70.0 ± 8.6, BMI of 28.5 ± 6.5, and 85.7% female underwent adult spinal deformity correction surgery and had complete radiographic data for analysis. Mean preoperative measures were PT of 32.2° ± 10.6, PI of 62.3° ± 15.0, LL of 37.7° ± 20.2, a PI-LL of 24.6° ± 20.5, and 23 (41.1%) of patients had severe (Tonnis grade 3) hip OA. Eleven (20.0%) of patients had a three-column osteotomy. The mean change in PT from prep to immediate postop was a decrease of 5.7° ± 7.2. Preoperative PI-LL mismatch, severe hip OA, and inclusion of a 3-column osteotomy demonstrated statistically significant association with change in PT postoperatively (all p<0.05). In our multivariate model, severe hip OA was associated with decreased change in PT postoperatively (B=4.0, 95% CI 0.5, 7.5; p=0.025) and inclusion of three-column osteotomy was associated with increased change in PT postoperatively (B=-5.0, 95% CI -9.9, -0.1; p=0.046), while age and preoperative PI-LL were not significantly associated (both p>0.05).

DISCUSSION AND CONCLUSION:

In our cohort of patients undergoing adult spinal deformity correction surgery, most patients improved significantly in PT indicating decreased need for reliance on this compensatory mechanism. We found that patients who had severe OA experienced less improvement in their PT, and that inclusion of a three-column osteotomy led to greater improvement in PT postoperatively.

Example of PRO in revision vs primary

Group	DE vs Dist	N	Group Statistics	
			Mean	Std. Deviation
Age	.00	77	65.6049	8.40459
	1.00	150	65.6533	8.82162
BMI	.00	75	30.3065	6.82330
	1.00	150	30.2987	6.47269
CCI	.00	77	2.9999	2.42879
	1.00	150	1.9333	2.26838
Op time	.00	76	105.6642	38.14661
	1.00	150	106.4333	66.12967
EBL	.00	65	363.9231	312.26052
	1.00	142	206.4577	198.61796
LOS	.00	74	3.7849	2.91962
	1.00	150	3.5366	1.89862
6m ODI	.00	31	32.2652	13.63950
	1.00	72	38.9957	18.81209
6m PROMIS	.00	23	69.4929	6.95785
	1.00	50	61.2895	7.07156
6m PF CAT	.00	31	35.9209	6.67735
	1.00	142	36.2999	7.65615
6m VAS Pain	.00	9 ^a		
	1.00	136	3.6324	2.76435
3m ODI	.00	32	25.9514	14.66993
	1.00	71	30.9751	15.78655
3m PROMIS	.00	19	57.3296	6.63003
	1.00	41	58.8028	7.62049
3m PF CAT	.00	34	39.3553	5.89248
	1.00	141	37.6814	7.36613
3m VAS Pain	.00	7	4.4286	3.10146
	1.00	130	3.9308	2.83929
6m ODI	.00	30	26.4444	17.77525
	1.00	58	29.9506	20.95663
6m PROMIS	.00	25	66.3647	7.79539
	1.00	52	57.6152	8.09421
6m PF CAT	.00	36	41.2524	6.51892
	1.00	142	37.7834	5.97956
6m VAS Pain	.00	4	4.7500	3.99979
	1.00	111	3.2523	2.81705
1y ODI	.00	29	36.4368	16.66661
	1.00	55	24.3838	20.72168
1y PROMIS 10	.00	22	63.3158	6.76264
	1.00	46	57.0406	6.30871
1y PF CAT	.00	35	38.3274	6.69259
	1.00	136	37.5317	7.79871
1y VAS Pain	.00	4	2.5000	1.72305
	1.00	105	3.0985	3.03828
2y ODI	.00	15	32.3111	9.94681
	1.00	57	37.7195	17.81859
2y PROMIS 10	.00	17	61.8552	6.91837
	1.00	42	60.6544	6.27641
2y PF CAT	.00	24	36.0087	7.82207
	1.00	139	37.2122	7.88804

a. 1 cannot be computed because of least one of the groups is empty.