

Which Factors Contribute to the Loss of Planned Kyphosis When Using Pre-Contoured Rods in Adolescent Idiopathic Scoliosis (AIS)?

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INTRODUCTION: Pre-contoured rods are used to correct the sagittal plane in AIS. The sagittal profile planned for the rods is determined based on preoperative sagittal parameters and how much correction is needed. However, rods can flatten during placement leading to less thoracic kyphosis (TK) postoperatively than planned. The purpose of this study was to determine whether curve flexibility on bending films or degree of preoperative hypokyphosis had a greater effect on rod flattening and postoperative kyphosis loss.

METHODS: AIS patients ≤ 25 years old undergoing spinal deformity surgery using pre-contoured rods were included in the study. A 6.0 cobalt chrome rod was used on the concave side and a 6.0 titanium rod on the convex side. Posterior column osteotomies at the apex were performed in all patients. Coronal and sagittal alignment parameters including bending films were obtained from EOS images. Patients were divided into two groups: preoperative TK within 20° of normal ($20-40^\circ$; G1) or $> 20^\circ$ from normal (G2). In a sub-analysis, patients with $> 50\%$ correction on bending films (flexible group-FG) were separated from those with $< 50\%$ (rigid group-RG). Analysis included independent t-tests and χ^2 tests.

RESULTS: 81 patients were included (G1=65, G2=16). Coronal parameters were not significantly different between groups. Patients in G1 had mean TK of 35° preoperatively, 36° in the planned rod contour, and 35° postoperatively. Patients in G2 had 2° preoperatively, 36° in the planned rod contour, and 26° postoperatively. The difference in kyphosis between the planned rod contour and the postoperative rod was -1.2° in G1 and -10° in G2 ($p = .007$). Patients in G2 had higher mean PI-LL ($p < .001$) and LL ($p < .001$) preoperatively and higher PI-LL ($p = .017$) postoperatively than G1. There was no significant difference between the pre-contoured TK and the postoperative kyphosis when comparing FG and RG ($p = .502$).

DISCUSSION AND CONCLUSION: Patients who have more than 20° deviation between the preoperative kyphosis and pre-contoured kyphosis have more flattening of the rod intraoperatively and may benefit from additional pre-contoured kyphosis to achieve the desired sagittal plane profile.

Coronal and Sagittal Parameter Comparisons Between Patients with Preoperative TK within 20° of Normal (G1) and $>20^\circ$ from Normal (G2)									
	Preoperative Parameters			Preoperative Plan Parameters			Postoperative Parameters		
	G1 n=65	G2 n=16	p	G1	G2	p	G1	G2	p
Age	15 \pm 3.4	16 \pm 3.3	.223						
BMI	22 \pm 5	21 \pm 3.6	.765						
LL	-59 \pm 13	-40 \pm 16	<.001	-58.2 \pm 18	-54 \pm 12	.324	-52 \pm 12	-41 \pm 27	.118
PI-LL	-7.3 \pm 15	10 \pm 13	<.001	-8.3 \pm 10	-3.3 \pm 10	.076	-2 \pm 12	6.9 \pm 17	.017
TK	35 \pm 18	2 \pm 14	<.001	36 \pm 9	36 \pm 3.8	.731	35 \pm 11	26 \pm 9.5	.004
Sanders	5.29 \pm 2	5.14 \pm 1.95	.854						
Risser	2.9 \pm 2	2.8 \pm 2.5	.894						
	Postoperative - Preoperative Plan			Preoperative Plan - Preoperative					
LL	-44 \pm 14	-38 \pm 19	.146						
PI-LL	.97 \pm 9	13 \pm 7	<.001						
TK	-1.2 \pm 11	-10 \pm 8.2	.007	1.00 \pm 15	33 \pm 11	<.001			
Coronal and Sagittal Parameter Comparisons Between Patients with $>50\%$ Correction on Bending Films (FG) and those with $<50\%$ Correction (RG)									
	RG n=35	FG n=24	p						
Age	15.2 \pm 3.4	15.5 \pm 4	.710						
BMI	20.7 \pm 3.6	20.4 \pm 2.7	.752						
Sanders	4.9 \pm 2	6 \pm 1.7	.406						
Risser	2.7 \pm 2.2	3.5 \pm 1.8	.315						
	Postoperative - Preoperative Plan								
TK	-2 \pm 11	-4 \pm 10	.502						