Growth-Friendly vs. Posterior Spinal Fusion Surgery for Congenital Kyphosis: A Multicenter Analysis of Complications, Reoperations, and Patient Outcomes

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INTRODUCTION:
Surgical intervention for congenital kyphosis (CK) may be necessary to correct deformities, prevent progression, and minimize the impact on neurological and pulmonary function. Growth-friendly (GF) surgical approaches aim to preserve spinal growth but may result in increased complications and unplanned reoperations compared to a posterior spinal fusion (PSF). The purpose of this retrospective multicenter cohort study is to compare complications, unplanned reoperations (UPRORs), and patient-reported outcomes between GF and PSF surgical treatments for CK.
METHODS:
An international, multicenter database for early-onset spinal deformity was queried to identify patients with CK who underwent operative management of the spinal deformity. Inclusion criteria were patients under 10 years old with a pre-intervention sagittal kyphosis greater than their major coronal deformity, with the major coronal deformity being < 35°. Any patients without minimum follow-up data of at least 2 years were excluded. Patients were then stratified based on the primary intervention into two cohorts: GF and PSF. GF constructs included traditional growing rods, magnetically controlled growing rods, and vertical expandable prosthetic titanium ribs. Radiographic outcome data, including coronal deformity, sagittal deformity, and T1-S1 length were collected, as well as complications, UPRORs, and EOSQ-24 scores. Within- and between-group analyses were then conducted preoperatively, postoperatively, and at final follow-up.
RESULTS:
54 patients (27 PSF; 27 GF) met inclusion criteria with a similar mean age of 5.1 years for PSF patients and 4.3 years for GF patients. Mean follow-up was also similar between groups at 3.31 years for PSF patients and 3.81 years for GF patients. Pre- and postoperative sagittal deformity was similar between groups, and both corrected sagittal deformity (PSF: -11.6°, p=0.0182; GF: -24.5°, p=0.0003) similarly. This remained true at final follow-up. Pre- and postoperative coronal deformity was also similar between groups, but PSF saw better corrections postoperatively (PSF: -5.9°, GF: 0.7°, p=0.0343). However, long-term coronal deformity correction was similar between groups. T1-S1 length increased similarly for both groups (PSF: 6.1 mm/year; GF: 9.2 mm/year). Complications occurred in 40.7% of PSF patients vs. 63.0% of GF patients, with the PSF group experiencing 13 total complications compared to 36 in GF group (p=0.0048). UPRORs were documented in 18.5% of PSF and 33.3% of GF patients, with the PSF group experiencing 5 total UPRORs compared to 14 in the GF group (p=0.0470). The PSF group saw greater improvements preop to postop in the EOSQ-24 general health domain (PSF: 22.91, GF: -5.56, p=0.0336), with all other questionnaire domains being similar.
DISCUSSION AND CONCLUSION:
In this study, the PSF group had similar sagittal deformity correction and similar or better coronal deformity correction. Additionally, although the GF approach aims to preserve spinal growth, we found that T1-S1 growth overtime was similar between groups. PSF patients also experienced fewer complications and UPRORs than GF patients did, and had better patient outcomes in the general health domain of the EOSQ-24 questionnaire. As such, we found that PSF patients had similar or better deformity correction and EOSQ-24 scores with fewer complications and UPRORs when compared to GF patients. Clinicians should weigh these risk and benefits for shared decision making when discussing surgical treatments for the management CK.

Table 1. Posterior Spinal Fusion vs. Growth-Friendly Constructs

		PSF	GF	P-Value
# of Patients (female)		27 (11)	27 (16)	-
Age at Surgery (years)		5.1 (0.8 - 9.86)	4.3 (0.8 - 9.72)	NS
Mean f/u (years)		3.31	3.81	NS
3-column osteotomies		8 (30%)	4 (15%)	NS
Sagittal Deformity	Preop	56.1° ± 18.6°	63.6° ± 33.0°	NS
	Postop	44.0° ± 15.4°	45.1° ± 26.0°	NS
	Latest	49.9° ± 15.8°	37.6° ± 32.0°	NS
	Δ Postop	-11.6° ± 20.6° (**p=0.0182**)	-24.5° ± 25.6° (**p=0.0003**)	NS
	Δ Latest	-8.4° ± 21.7° (NS)	-22.4° ± 55.8° (NS)	NS
Coronal Deformity	Preop	23.6° ± 8.7°	22.9° ± 8.5°	NS
	Postop	19.3° ± 11.7°	22.9 °± 11.9°	NS
	Latest	20.1° ± 11.3°	22.6° ± 11.8°	NS
	Δ Postop	-5.9° ± 9.2° (**p=0.0082**)	0.7° ± 10.9° (NS)	**0.0343**
	Δ Latest	-2.3° ± 12.6° (NS)	-1.8° ± 11.3° (NS)	NS
T1-S1 Length	Preop (mm)	253.4 ± 38.0	235.9 ± 62.5	NS
	Postop (mm)	252.9 ± 39.4	250.8 ± 63.3	NS
	Latest (mm)	290.6 ± 43.0	269.2 ± 61.1	NS
	Δ Postop (mm)	7.6 ± 16.7 (NS)	13.4 ± 20.9 (**p=0.0389**)	NS
	Δ Latest (mm)	40.0 ± 24.2 (**p<0.0001**)	41.8 ± 32.5 (**p<0.0001**)	NS
	Δ Per Year (mm/yr)	6.1 ± 2.7	9.2 ± 9.8	NS
# of Patients w/ Complications		11 (40.7%)	17 (63.0%)	NS
Total # Complications (avg/pt)		13 (0.48)	36 (1.3)	**0.0048**
Hardware Related		4 (30.7%)	16 (44.4%)	NS
Infection Related		3 (23.1%)	15 (41.7%)	NS
Pain Related		3 (23.1%)	2 (5.6%)	NS
Procedure Related - Other		3 (23.1%)	3 (8.3%)	NS
# of Patients w/ UPRORs		5 (18.5%)	9 (33.3%)	NS
Total # UPRORs (avg/pt)		5 (0.19)	14 (0.52)	**0.0470**
Hardware Related		3 (60%)	4 (28.6%)	NS
Infection Related		2 (40%)	9 (64.3%)	NS
Procedure Related - Other		0 (0%)	1 (7.14%)	NS
EOSQ-24 General Health (Δ)		22.91	-5.56	**0.0336**

PSF = Posterior Spinal Fusion, GF = Growth-Friendly, UPRORs = Unplanned Reoperations, EOSQ-24 = Early-Onset Scoliosis Questionnaire