

optimization in high-risk patients and should be further studied. Children who do not have failure to thrive at presentation also require attention.
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Paper #9

Graduation Protocol After Growing Rod Treatment: Is Removal of Hardware Without New Instrumentation a Realistic Approach?



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Summary: Outcomes of a prospective treatment decision made at the commencement of growing rod treatment: remove all hardware and leave the spine free of implants when patients reached 14 years of age.

Hypothesis: It is possible to remove hardware and leave the spine free of instrumentation after growing rod treatment when the patient has reached appropriate skeletal maturity (14 years of age).

Design: Prospective non-randomized.

Introduction: The growing rod (GR) remains an effective and proven option in the treatment of early-onset scoliosis (EOS). A treatment decision was made in 2004, proposing to remove all hardware and leaving the spine free of implants when patients reached 14 yrs of age. This study summarizes the actual outcomes with this intended approach.

Methods: Patients whose chronological age was 14 years by January 2016 and who had undergone regular lengthenings every 6 to 9 months during their GR treatment were included. If curve correction was adequate and interval changes did not require extension of instrumentation, GR were removed and the patients were observed (g1). If correction was inadequate and/or extension of fusion was required, final instrumented fusion was performed after GR removal (g2). For patients who still had significant growth remaining at age 14, lengthening was continued (g3).

Results: 26 patients were included in the study. Mean age at index operation was 82 mo. There were 10 patients in g1, 9 in g2, and 7 in g3. Demographics and Cobb data can be found in Table 1. Of the 10 patients in g1 whose implants were removed with no additional spinal instrumentation, 9 had significant worsening of deformity after a mean follow-up of 26.5 mo.

Conclusions: Despite the surgeons' initial intentions to remove all hardware and observe patients when they turned 14, the results of this study showed that only 10 of the initially included 26 patients fulfilled the criteria for this approach. In 9 (90%) of these patients, deformity worsened after removal, indicating that prolonged GR treatment does not always result in spontaneous, reliable fusion. Removal of spinal hardware without new instrumentation is not realistic as a graduation protocol following GR treatment. The results of this study suggest that at the conclusion of growing rod treatment, implants present should be retained, or if extension is required, another procedure undertaken.

Table 1: Demographics and Cobb data.

Group	Age at index surgery (mo)	# lengthenings	Total follow-up (mo)	Pre-index Cobb	Post-index Cobb	Pre-graduation Cobb	Post-graduation Cobb	Pre-definitive surgery Cobb	Post-definitive surgery Cobb	Last follow up Cobb
g1	83	12	83 with GR, 19 without	56°	27°	35°	40°	50°	34°	34°
g2	79		72 with GR, 44 after fusion	60°	29°			42°	35°	
g3	87		73	48°	23°					35°

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Paper #10

Traditional Growing Rod Graduates with Various Diagnoses have Similar Clinical and Radiographic Outcomes



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Summary: Early-onset scoliosis patients across all etiologies have similar clinical and radiographic outcomes after completion of traditional growing rod treatment.

Hypothesis: Traditional growing rod patients have different clinical and radiographic outcomes upon completion of treatment.

Design: Multicenter review of retrospective and prospective data.

Introduction: Early-onset scoliosis (EOS) encompasses a diverse population of patients with multiple etiological diagnoses. Traditional growing rod (TGR) surgery has been described to be effective in treating specific underlying diagnoses within EOS (e.g. cerebral palsy, Marfan syndrome, congenital spine anomalies). However, no published literature has compared outcomes between the various etiologies in patients who completed TGR treatment. This study compared results between etiological categories in TGR graduates.

Methods: A retrospective review of a multicenter EOS database was performed. Patients were included if they had minimum 2-year follow up after index surgery, completion of TGR treatment, and post-graduation radiographs. 202 out of 232 TGR graduates met inclusion criteria. Patients were categorized by etiology per C-EOS: congenital, neuromuscular, syndromic, and idiopathic.

Results: There were 28 congenital, 65 neuromuscular, 57 syndromic, and 52 idiopathic patients. Age, gender, ethnicity, and BMI were similar between groups at time of index surgery; however, the neuromuscular group had a statistically significant higher percentage of non-ambulatory patients. Mean length of follow-up and number of lengthenings across groups were not significantly different. Major curve correction and increase in T1-S1 and T1-T12 were statistically similar from pre-index surgery to post-graduation between groups (Table 1). Furthermore, the incidence of implant-related complications and surgical site infections was similar.

Conclusions: Coronal deformity correction and amount of spinal and thoracic height gain were similar across all etiologies after completion of TGR treatment. Incidence of implant and wound complications were also similar between etiologies. While EOS patients necessitate varying degrees of medical and surgical management based on their disease and health status, TGR graduates of all etiologies have similar clinical and radiographic outcomes.

	Congenital	Neuromuscular	Syndromic	Idiopathic	p
Female	57.1%	56.9%	61.4%	71.2%	0.416
Age at time of index surgery (years)	6.7	7.3	6.8	7.6	0.104
Ambulator at time of index surgery	94.7%	80.2%	82.9%	100.0%	<0.001*
Length of follow-up (years)	7.8	7.8	8.7	7.8	0.475
Mean No. of Lengthenings	7.8	5.5	6.4	6.3	0.246
BMI: Pre Index	18.1	18.8	18	17.7	0.546
BMI: 1st Post Graduation	18.6	21.9	17.6	20.3	0.082
BMI: 2 YR Post Graduation	22.1	22.5	22.1	19.9	0.342
Curve Correction: Pre Index to Post Index	40.9%	43.8%	37.3%	41.5%	0.292
Curve Correction: Pre Index to 1st Post Graduation	40.6%	43.5%	38.7%	48.3%	0.366
Curve Correction: Pre Index to 2 YR Post Graduation	12.0%	38.8%	32.8%	38.1%	0.485
T1-S1 Gain: Pre Index to 1st Post Graduation	34.2%	42.0%	35.2%	36.6%	0.388
T1-S1 Gain: Pre Index to 2 YR Post Graduation	41.8%	37.7%	38.5%	40.7%	0.967
T1-T12 Gain: Pre Index to 1st Post Graduation	28.9%	41.4%	28.2%	37.4%	0.822
T1-T12 Gain: Pre Index to 2 YR Post Graduation	36.9%	45.3%	37.9%	41.5%	0.927
Surgical site infection	23.50%	36.90%	35.10%	19.20%	0.142
Implant complication	53.60%	41.50%	57.90%	61.50%	0.139

*Statistical significance was set to p<0.05

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