

Is There a Significant Increase in Thoracic Height after Growing Rod Surgery?

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DISCLOSURES

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John Emans, MD	Medtronic (b); Synthes (b,e)
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Charles Johnston, MD	Medtronic (a,e)
Growing Spine Study Group	Growing Spine Foundation (a)



INTRODUCTION

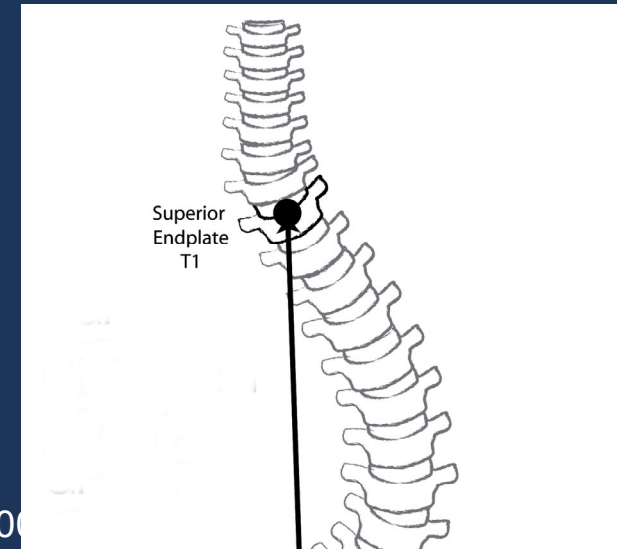
- Mean thoracic height in normal children (Dimeglio, Bonnel)
 - 11 cm at birth
 - 18 cm at 5 years of age
 - 22 cm at 10 years of age



Thoracic Height



Risk of restrictive
pulmonary disease



Karol, et al. – JBJS 200

Pulmonary Function Following Early Thoracic Fusion in Non-Neuromuscular Scoliosis

By Lori A. Karol, MD, Charles Johnston, MD, Kiril Mladenov, MD, Peter Schochet, MD,
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*Investigation performed at the Department of Orthopaedic Surgery, Texas Scottish Rite Hospital for Children, Dallas,
and the Department of Pulmonology, Children's Medical Center of Dallas, Dallas, Texas*

PA Radiograph

INTRODUCTION

- Limited fusion distraction-based growing rod surgery
 - Prevents curve progression
 - Allows gain in spinal height (T1-S1)

Akbarnia, et al. – Spine 2005

SPINE Volume 30, Number 17S, pp S46–S57
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■ Dual Growing Rod Technique for the Treatment of Progressive Early-Onset Scoliosis

A Multicenter Study

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- However, no published data on the change in thoracic height after growing rod surgery



INTRODUCTION

- PURPOSE OF STUDY

1. Evaluate the change in thoracic height (T1-T12) after growing rod surgery for early onset scoliosis (EOS)
2. Identify correlations between thoracic height and...
 - Etiology of spinal deformity
 - Patient age
 - Correction of major Cobb angle
 - Degree of kyphosis
 - Number of spinal distractions



METHODS

- REVIEW OF MULTI-CENTER EOS DATABASE (GSSG)
 - Prospectively and retrospectively collected data
 - Inclusion criteria:
 - Growing rod surgery only
 - ≤ 10 years old at index surgery
 - ≥ 3 spinal distractions
 - Complete clinical and radiographic data
- STATISTICAL ANALYSIS
 - Change in thoracic height between pre-op, post-op and latest follow-up
 - General Linear Model
 - Correlations between thoracic height and etiology, age, Cobb, etc.
 - Spearman Correlation



RESULTS

- 426 operative patients (growing rod, VEPTR, Shilla, etc.)
- 51 patients met the inclusion criteria
- 27 males, 24 females
- 47 primary thoracic curves, 4 primary lumbar curves
- Mean pre-op age = 5.9 years (range: 1.5 – 10.5 years)
- Etiologies:
 - 20 neuromuscular (39%)
 - 10 idiopathic (20%)
 - 10 syndromic (20%)
 - 9 congenital (18%)
 - 2 thoracogenic (4%)



RESULTS

Mean Change in T1-T12

Pre Index Surgery	1 st Available Post-op	Latest Follow-up	OVERALL CHANGE
151 mm (range: 72-257)	175 mm (range: 82-261)	205 mm (range: 105-299)	53 mm (range: 6-116)

$p < 0.01$

$p < 0.01$



RESULTS

Etiology and Thoracic Height

- Etiology did **NOT** significantly correlate with change in T1-T12
- However...

IDIOPATHIC
 $\Delta T1-T12 = 69 \pm 31$ mm

>
 $p=.021$

SYNDROMIC
 $\Delta T1-T12 = 45 \pm 23$ mm



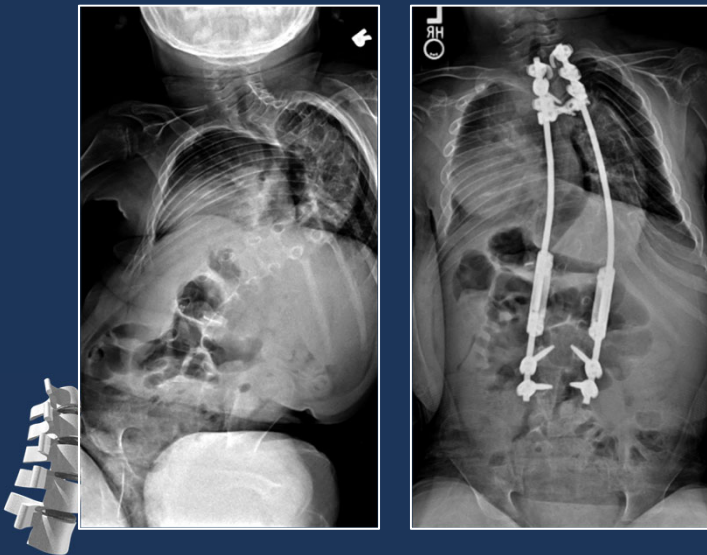
RESULTS

Cobb Angle and Thoracic Height

	Pre-op	Post-op	Latest Follow-up
T1-T12	151 mm (range: 72–257)	175 mm (range: 82–261)	206 mm (range: 105–299)
Major Cobb Angle	79° (range: 25–138°)	45° (range: 11–104°)	40° (range: 4–66°)

$p < 0.05$

Mean Cobb Correction = 49%



RESULTS

Maximum Kyphosis and Thoracic Height

	Pre-op	Post-op	Latest Follow-up
T1-T12	151 mm (range: 72–257)	175 mm (range: 82–261)	206 mm (range: 105–299)
Maximum Kyphosis	59° (range: 15–99°)	38° (range: 4–107°)	48° (range: 1–85°)

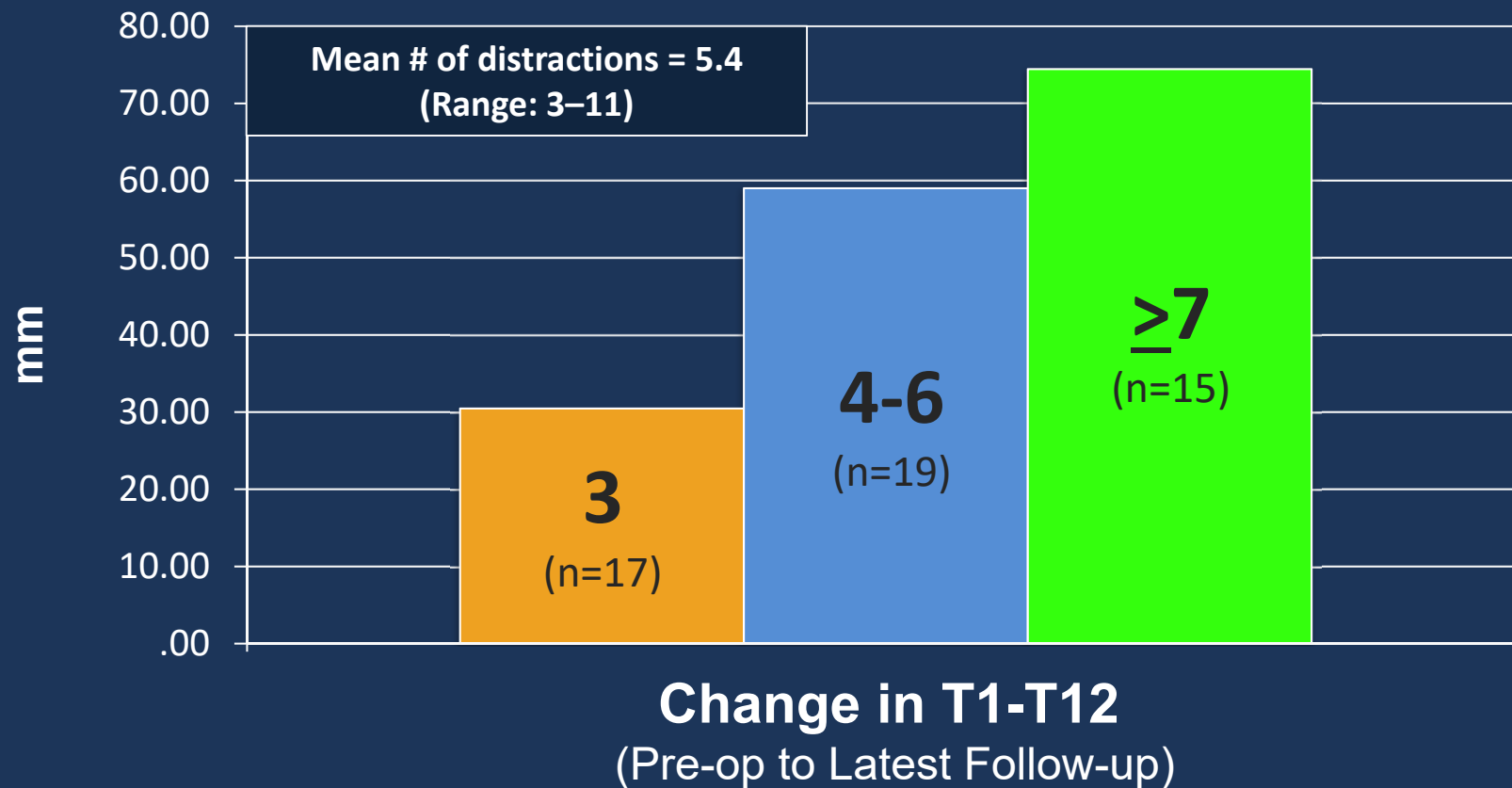
$p < 0.05$

$p < 0.05$



RESULTS

Number of Spinal Distractions



△ in T1-T12 was greater in the 4-6 and ≥7 groups ($p < 0.001$)



RESULTS

Age and Thoracic Height

	Pre-op	Post-op	Latest Follow-up
T1-T12	151 mm (range: 72–257)	175 mm (range: 82–261)	206 mm (range: 105–299)
Patient Age	5.9 years (range: 1.5–10.5)	6.2 years (range: 1.9–10.6)	9.3 years (range: 3.8–13.5)
	p<0.01	p<0.01	p<0.01



RESULTS

Age and Thoracic Height

- Growing Rod Data Compared to Normative Data (Dimeglio)
 - 180 mm at 5 years of age

77% of patients 5–9 y/o reached ≥ 180 mm at latest follow up

- 220 mm at 10 years of age

67% of patients ≥ 10 y/o reached ≥ 220 mm at latest follow up



RESULTS

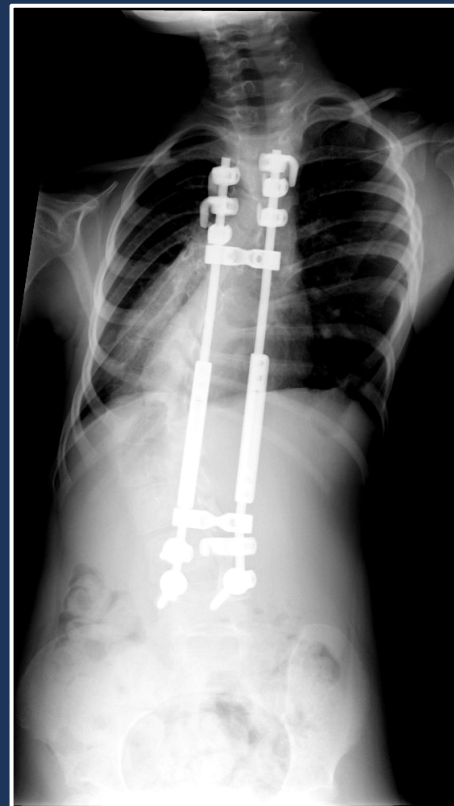
Case Example

- Female with idiopathic EOS
- Unable to maintain upright posture, history of pulmonary problems, malnutrition

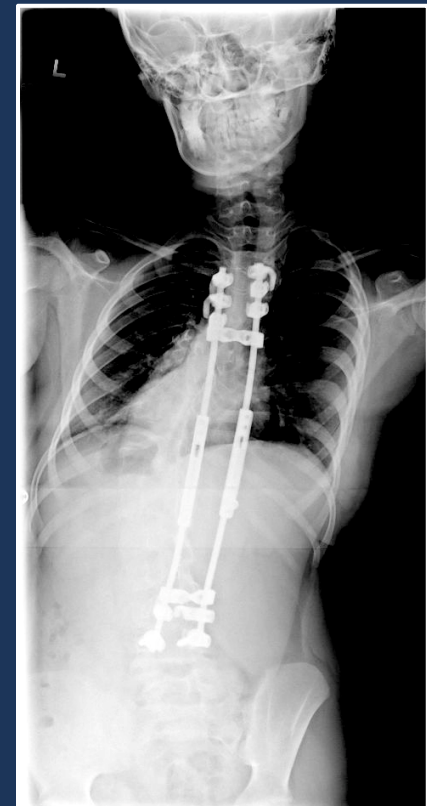
T1-T12: 102 mm, 5.7 y/o



T1-T12: 176 mm, 6.6 y/o



T1-T12: 218 mm, 12.6 y/o



CONCLUSIONS

- Thoracic height significantly increased after growing rod surgery and at least 3 spinal distractions
- Change in thoracic height correlated with the following:
 - Correction of the major curve
 - Degree of kyphosis
 - Patient age
 - Number of spinal distractions
- Adequate thoracic height was achieved in the majority of patients at specific age milestones



NEXT STEPS

- Need to evaluate pulmonary data and thoracic dimensions to better understand the effect growing rods has on lung growth and lung function
- Additional research is ongoing



THANK YOU

