

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

Jeff B. Pawelek
Behrooz A. Akbarnia, MD
Pooria Hosseini, MD
Pooria Salari, MD
David Marks, FRCS
Suken A. Shah, MD
David L. Skaggs, MD, MMM
John B. Emans, MD
Paul D. Sponseller, MD, MBA
George H. Thompson, MD
Growing Spine Study Group

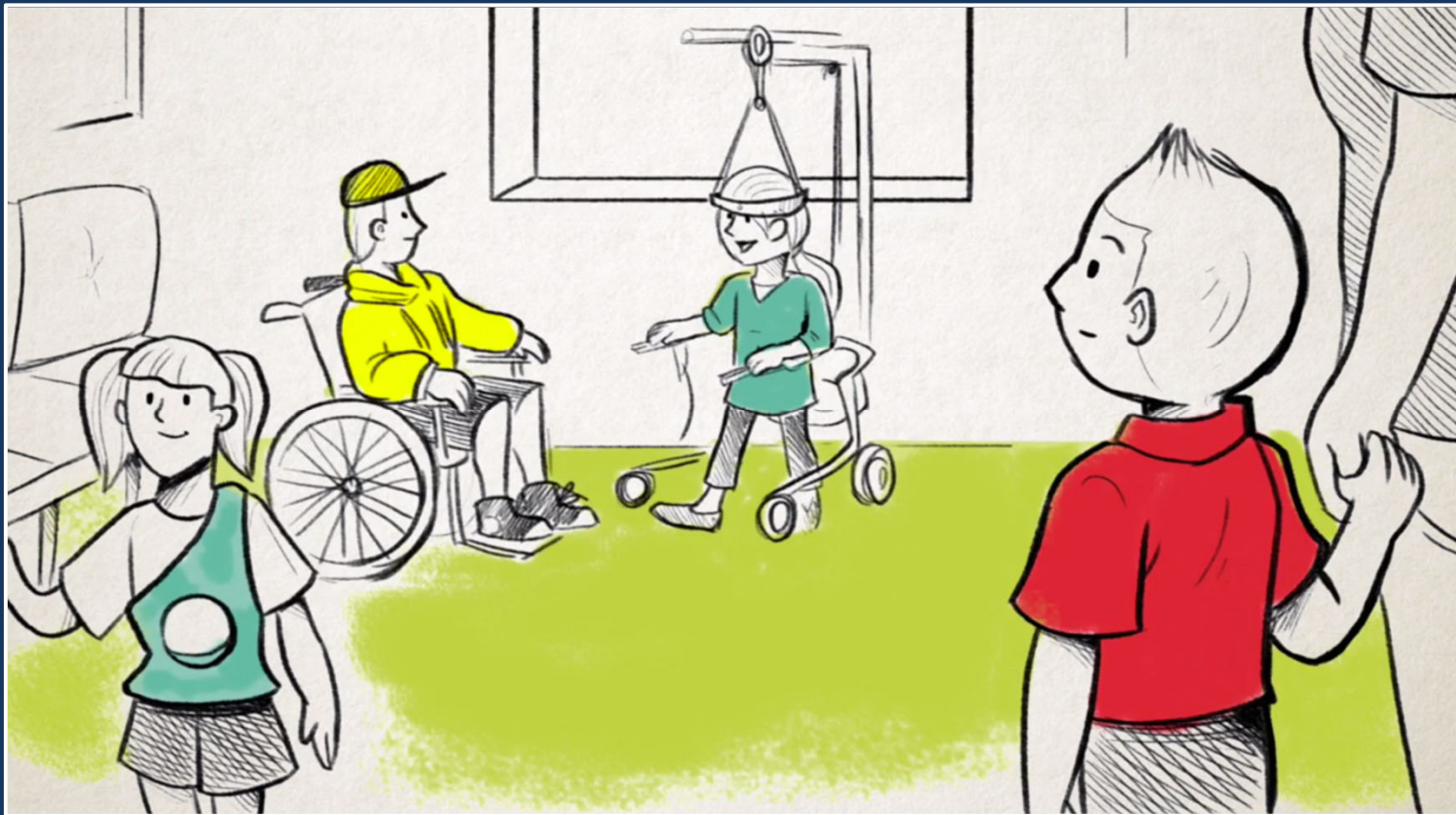
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DISCLOSURES

- Jeff B. Pawelek
- Behrooz A. Akbarnia, MD
- Pooria Hosseini, MD
- Pooria Salari, MD
- David Marks, FRCS
- Suken A. Shah, MD
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INTRODUCTION

- Early-onset scoliosis (EOS) encompasses a highly diverse patient population with multiple underlying diagnoses



INTRODUCTION

- Traditional growing rod (TGR) surgery has been described to be effective for many specific conditions

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Growing Rods for Infantile Scoliosis in Marfan Syndrome

Seminars in

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ORIGINAL ARTICLE

SPINE Volume 37, Number 24, pp E1504–E1510
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Spine
DEFORMITY

Growing Rods for the Treatment of Scoliosis in Children With Cerebral Palsy

A Critical Assessment

Mark J. McElroy, MS,* Paul D. Sponseller, MD,* Jonathan R. Dattilo, BS,* George H. Thompson, MD,†
Behrooz A. Akbarnia, MD,‡§ Suken A. Shah, MD,|| Brian D. Snyder, MD,¶ and the Growing Spine Study Group

INTRODUCTION

- All underlying diagnoses now categorized by the **Classification of Early-Onset Scoliosis (C-EOS)**



Development and Initial Validation of the Classification of Early-Onset Scoliosis (C-EOS)

Brendan A. Williams, MD; Hiroko Matsumoto, MA; Daren J. McCalla, BS; Behrooz A. Akbarnia, MD; Laurel C. Blakemore, MD; Randal R. Betz, MD; John M. Flynn, MD; Charles E. Johnston, MD; Richard E. McCarthy, MD; David P. Roye Jr., MD; David L. Skaggs, MD; John T. Smith, MD; Brian D. Snyder, MD, PhD; Paul D. Sponseller, MD, MBA; Peter F. Sturm, MD; George H. Thompson, MD; Muharrem Yazici, MD; Michael G. Vitale, MD, MPH

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CON

- ☐ Constrictive Chest Wall Syndrome
- ☐ Congenital scoliosis
- ☐ Fused ribs
- ☐ Single level/Multi-level
- ☐ Cervical/Thoracic/Lumbar/Sacral
- ☐ Diaphragmatic hernia
- ☐ Jarcho-Levin Syndrome

- ☐ Tumor: pre/post resection
- ☐ Post-thoracotomy
- ☐ Thoracogenic
- ☐ Other acquired deformity
- ☐ Spondylothoracic dysplasia
- ☐ Spondylocostal dysostosis
- ☐ Jeune Syndrome
- ☐ VATER/VACTERL

NM

- ☐ Cerebral Palsy
- ☐ Familial dysautonomia
- ☐ Friedreich's Ataxia
- ☐ Muscular Dystrophies/Diseases
- ☐ Myelomeningocele

- ☐ Spinal Cord Injury (SCI)
- ☐ Spinal Muscular Atrophy
- ☐ Rett syndrome
- ☐ SCI (spastic)

SYN

- ☐ Achondroplasia
- ☐ Diastrophic dysplasia
- ☐ Ellis Van Creveld
- ☐ Neurofibromatosis*
- ☐ Osteogenesis Imperfecta
- ☐ Spondyloepiphyseal dysplasia

- ☐ Arthrogryposis
- ☐ Down's
- ☐ Goldenhar
- ☐ Klippel-Fiel
- ☐ Marfan
- ☐ Prader-Willi

IDIO

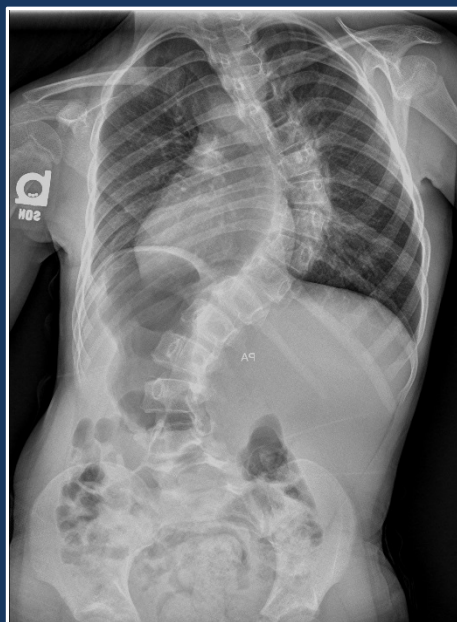
- ☐ Infantile (<3yrs)
- ☐ Juvenile (3-9yrs)

PURPOSE

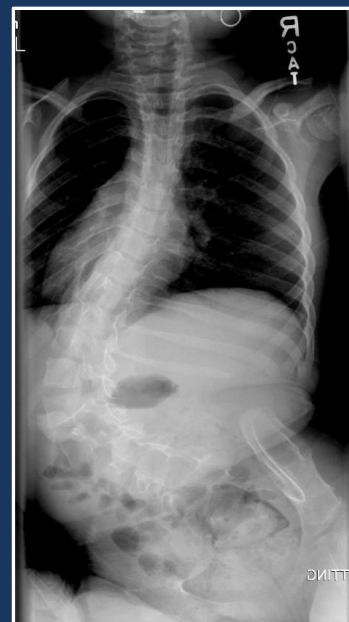
- Compare clinical and radiographic differences between the 4 etiological categories of EOS in patients who have graduated from TGR treatment



CONGENITAL



IDIOPATHIC



NEUROMUSCULAR



SYNDROMIC

METHODS

- **Retrospective review of a multicenter EOS database**
- **Inclusion Criteria:**
 - Traditional growing rod surgery
 - Minimum 2 years of lengthenings
 - Completion of treatment with post-graduation radiographs
- **Analysis of**
 - Demographics
 - Coronal and sagittal radiographs
 - Complications

RESULTS

- 202 out of 232 TGR graduates met inclusion criteria
- Over 50 specific diagnoses grouped according to C-EOS

CONGENITAL with FUSED RIBS, spinal dysgenesis/congenital spinal dislocation

ARTHROGRYPOSIS

SKELETAL DYSPLASIA

IDIOPATHIC

INTRATHECAL ABNORMALITY TYPE: CHIARI MALFORMATION, NEUROMUSCULAR

CEREBRAL PALSY, AGENESIS CORPUS CALLOSUM

MUSCULAR DYSTROPHY

MYELOYDYSPLASIA (SPINA BIFIDA)

Corpus callosum agenesis, Posterior rib cage tumor resection

MUSCLE DISEASE, Spinal muscular atrophy (SMA) Type III

Congenital myopathy

Nemaline Rod Myopathy

SCIWORA, paralytic

Spinal cord infarction w/ paralysis

Tether cord, Chromosomal: 2P+

Lipomeningocele

SPINAL MUSCULAR ATROPHY

13-Q SYNDROME (CHROMOSOMAL)

22q syndrome

Aicardi syndrome

Chromosomal: 2 deletion

Chromosomal: 4P+

Chromosomal: translation disorder (#3, 7, 15)

RESULTS

- Baseline Demographics*

	CONGENITAL	IDIOPATHIC	NEUROMUSCULAR	SYNDROMIC	<i>p</i> Value
N	28 (14%)	52 (26%)	65 (32%)	57 (28%)	--
Age (years)	6.7	7.6	7.3	6.8	.10
% Female	57%	71%	57%	61%	0.42
% Caucasian	78%	72%	72%	84%	0.69
% Ambulatory	95%	100%	30%	83%	<0.001*

RESULTS

- Treatment Course***

	CONGENITAL	IDIOPATHIC	NEUROMUSCULAR	SYNDROMIC	<i>p</i> Value
Follow Up (years)	7.8	7.8	7.8	8.7	0.48
# Lengthenings	7.4	6.3	5.5	6.4	0.25
# Surgeries	9.3	8.2	8.0	9.0	0.37
# Revisions	2.3	3.0	2.5	3.2	0.32

RESULTS

- Radiographic Outcomes: Major Curve Correction***

	CONGENITAL	IDIOPATHIC	NEUROMUSCULAR	SYNDROMIC	<i>p</i> Value
Post Index	41%	42%	44%	37%	0.27
Pre Final	35%	26%	25%	22%	0.26
6 Month Post Final	42%	47%	44%	39%	0.47
2 Year Post Final	13%	40%	40%	45%	0.42

RESULTS

- Radiographic Outcomes: Maximum Kyphosis (degrees)*

	CONGENITAL	IDIOPATHIC	NEUROMUSCULAR	SYNDROMIC	<i>p</i> Value
Pre Index	45	44	58	48	0.077
Post Index	35	37	39	39	0.902
Pre Final	50	48	52	54	0.677
6 Month Post Final	44	43	46	46	0.844
2 Year Post Final	51	51	52	52	0.632

RESULTS

- Radiographic Outcomes: Spinal Height Increase***

	CONGENITAL	IDIOPATHIC	NEUROMUSCULAR	SYNDROMIC	<i>p</i> Value
Pre Final	33%	29%	32%	29%	0.477
6 Month Post Final	35.4%	35.4%	41.3%	35.1%	0.443
2 Year Post Final	41.8%	40.7%	39.2%	38.5%	0.992

RESULTS

- Radiographic Outcomes: Thoracic Height Increase***

	CONGENITAL	IDIOPATHIC	NEUROMUSCULAR	SYNDROMIC	<i>p</i> Value
Pre Final	26%	36%	30%	28%	0.85
6 Month Post Final	33.1%	40.3%	35.7%	26.6%	0.88
2 Year Post Final	36.9%	45.3%	43.3%	37.9%	0.993

RESULTS

- Complications*

	CONGENITAL	IDIOPATHIC	NEUROMUSCULAR	SYNDROMIC	<i>p</i> Value
Medical	16 (57%)	10 (19%)	26 (40%)	29 (51%)	0.001
Infection	7 (25%)	10 (19%)	24 (37%)	20 (35%)	0.15
Implant	15 (54%)	32 (62%)	27 (42%)	33 (58%)	0.14

DISCUSSION

- EOS includes hundreds of diseases
- Patients necessitate varying degrees of medical and surgical management based on their specific disease and health status
- Grouping patients per C-EOS, TGR graduates had similar clinical and radiographic outcomes

DISCUSSION

- *Similarities between etiologic groups*
 - Age at index surgery
 - Gender
 - Ethnicity
 - Curve correction
 - Spinal height gain
 - Thoracic height gain
 - Implant complication rate
 - Infection rate

DISCUSSION

- *Differences between etiologic groups*
 - Ambulatory status (↓ neuromuscular)
 - Medical complications (↓ idiopathic)

LIMITATIONS

- **Classification systems are not perfect**
 - Individual etiological groups can have high degree of heterogeneity
- **Low sample size despite largest series of graduates**
 - For specific radiographic comparisons, sample size was low due to poor quality or missing images
- **Not all graduates had 2-year follow up after final treatment**
- **Quality of life and functional outcomes need to be studied to better understand etiological differences**

THANK YOU

