

Outcomes of Severe Early Onset Scoliosis Using Growing Rod Surgery - A matched comparison with typical EOS

Ilkka J. Helenius,^{1,2} Hanna M. Oksanen,¹ Anna McClung,³ Jeff B. Pawelek,³ Muharrem Yazici,⁴ Paul D. Sponseller,⁵ John B. Emans,⁶ Francisco J. Sánchez Pérez-Grueso,⁷ George H. Thompson,⁸ Charles Johnston,⁹ Suken A. Shah,¹⁰ and Behrooz A. Akbarnia¹¹

¹Department of Paediatric Orthopaedic Surgery, University of Turku and Turku University Hospital, Turku, Finland;

²Department of Orthopaedic Surgery, Spine Unit, Rigshospitalet and University of Copenhagen, Copenhagen, Denmark; ³Growing Spine Foundation, Milwaukee, Wisconsin; ⁴Department of Orthopaedics, Hacettepe University, Faculty of Medicine, Sıhhiye, Ankara, Turkey; ⁵Department of Orthopaedic Surgery, The Johns Hopkins University, Baltimore, Maryland;

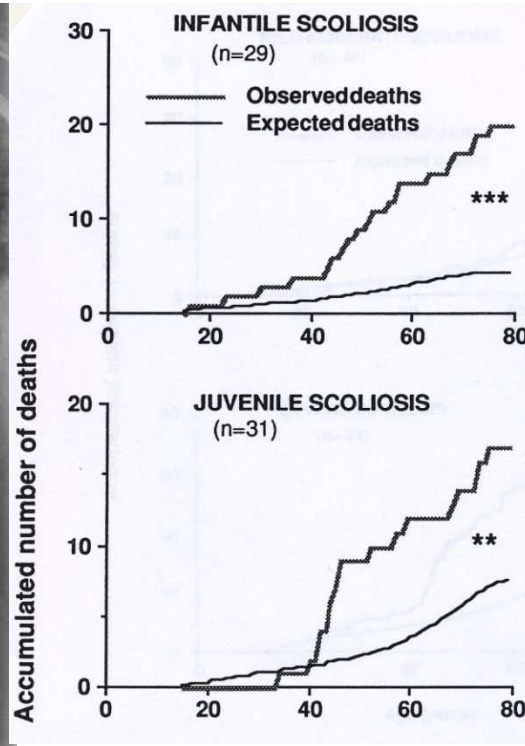
⁶Department of Orthopaedic Surgery, Children's Hospital Boston, Boston, Massachusetts;

⁷Spine Surgery Unit, Hospital Universitario La Paz, Madrid, Spain; ⁸Division of Pediatric Orthopaedic Surgery, Rainbow Babies & Children's Hospital, Case Western Reserve University, Cleveland, Ohio; ⁹Department of Orthopedics, Texas Scottish Rite Hospital, Dallas, Texas; ¹⁰Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware; ¹¹Department of Orthopaedic Surgery, University of California-San Diego, San Diego, California



Turun yliopisto
University of Turku

Severe Early Onset Scoliosis



Pehrsson et al. Spine 1992

Severe EOS: Major coronal curve $> 90^\circ$
(Williams et al. JBJS 2014)

Associated with increased mortality
(Pehrsson et al. Spine 1992)

No previous studies with any surgical
method in severe EOS

Growing rods lack apical control,
correction with cantilever & distraction
of concavity (Akbarnia JBJS 2007)

Severe EOS cohort

A retrospective review of prospectively collected Growing Spine Study Group database for growing rod surgery in EOS with min 2-yr FU (n = 569)

107 children aged 10 years or less with severe EOS (major curve $\geq 90^\circ$) operated using growing rods (99 traditional, 8 magnetically controlled), minimum 3 lengthenings and 2-yr FU



Control cohort (“typical EOS”)

Using the same database 107 matched control patients identified

Matched for

Age at index surgery (± 1 year)

Gender

Etiology of EOS (congenital, idiopathic, syndromic neuromuscular)

Index surgery device (TGR or MCGR)

Number of lengthening procedures (± 2)



Data Collection

Time points of interest: Preop, Index surgery, Post-Index, Distraction period, Pre-definitive, Post-definitive

Clinical data collected: Age at surgery, Height, Weight, Etiology of EOS, Preop Halo traction, FU time, Number of lengthenings,

Surgical data: OR time; Blood loss; Type of instrumentation; Levels of instrumentation; Revisions (Planned, unplanned)

Complications: Wound related; Implant (misplacement, pull-out, rod fracture); Alignment (PJK); Neurologic (New deficit, loss of MEPs); Other



Clinical Characteristics

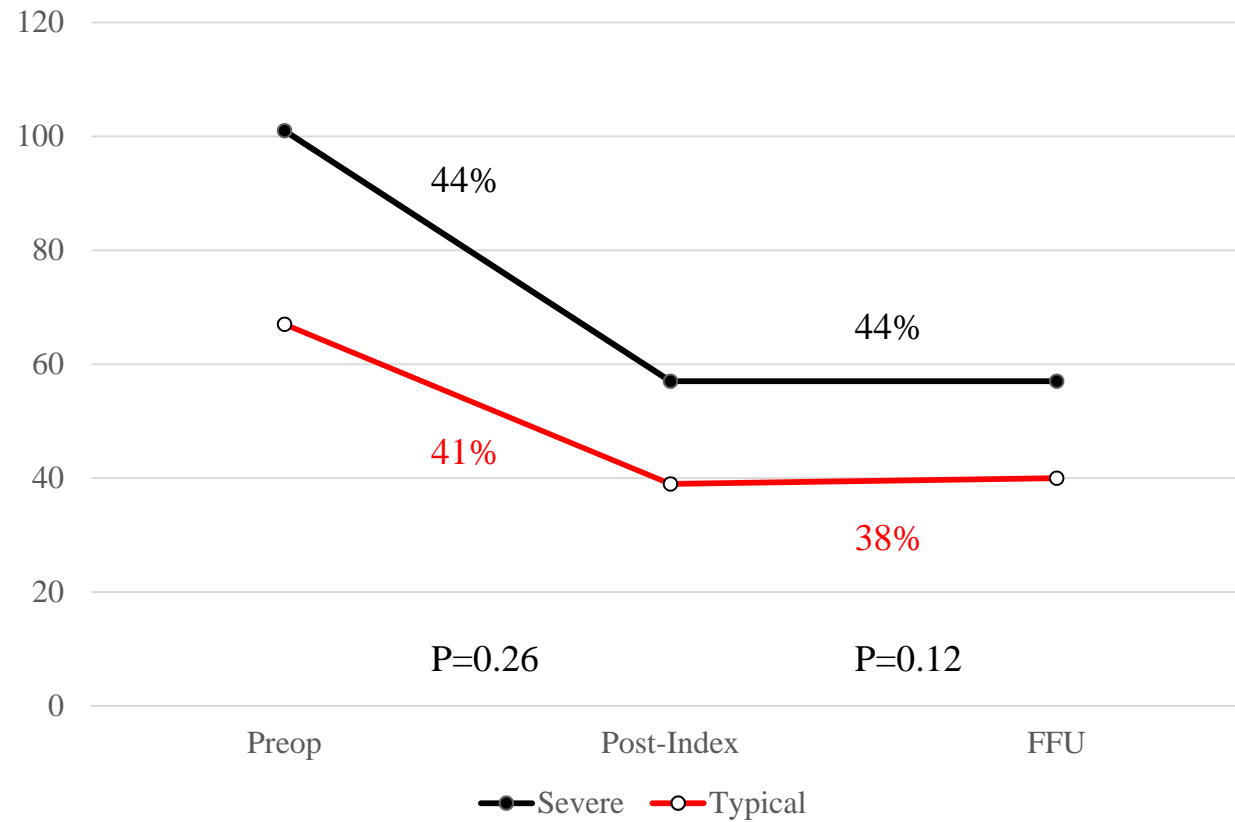
Characteristics	Severe (n=107)	Typical (n=107)	P value
Age, yrs	5.6 (1.0-9.9)	5.6 (1.0-9.9)	0.92
Follow-up, yrs	6.2 (2.0-13)	5.8 (2.0-13)	0.34
Congenital	14	14	1.0
Idiopathic	22	22	
Neuromuscular	34	34	
Syndromic	37	37	
Preop halo traction	19	9	0.022
TGR/MCGR	99/8	99/8	1.0
No. of lengthenings	7.4 (3-15)	7.3 (3-18)	0.84
Conversion to MCGR	9	5	0.27

Radiographic Outcomes

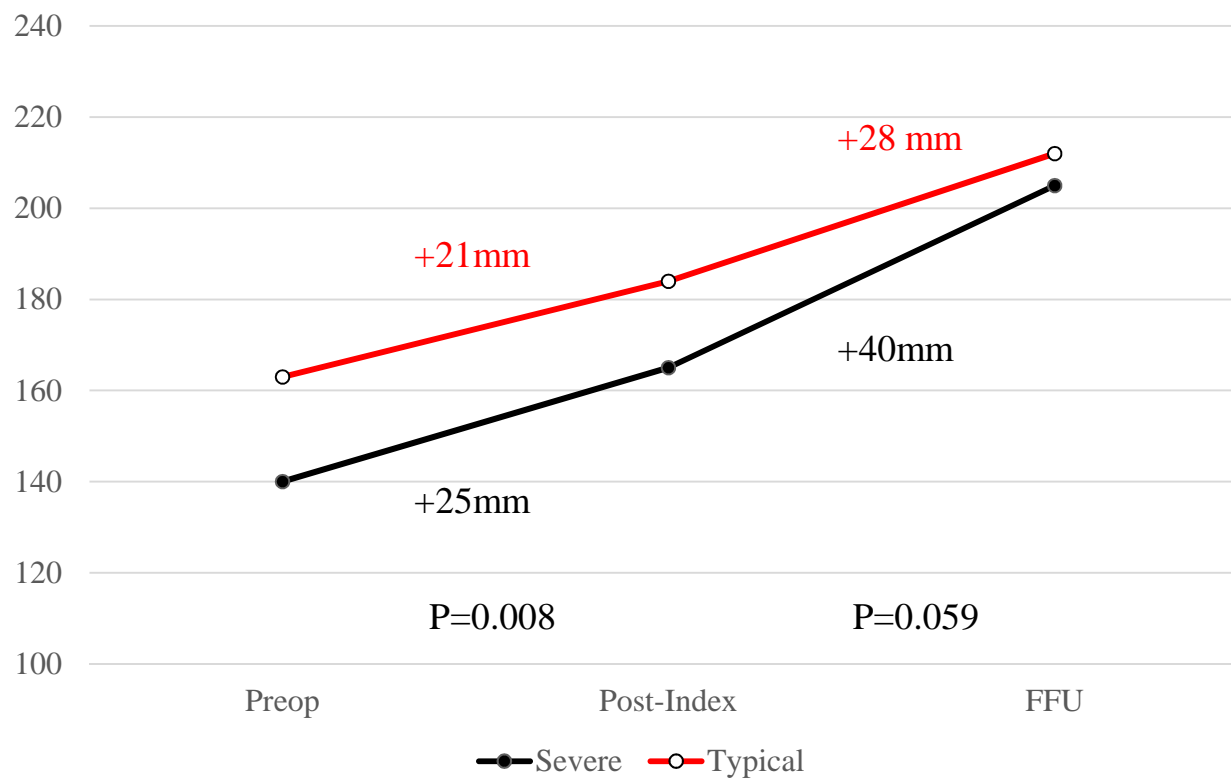
Characteristics	Severe (n=107)	Typical (n=107)	P value
Major curve (°)			
Preop	101 (90-139)	67 (33-88)	<0.001
After Index	57 (20-108)	39 (11-88)	<0.001
FFU	57 (10-96)	40 (3-85)	<0.001
T1-S1 height (mm)			
Preop	223 (138-380)	266 (145-416)	<0.001
After Index	277 (137-365)	293 (168-431)	0.014
FFU	327 (159-476)	347 (211-502)	0.019
T1-T12 height (mm)			
Preop	140 (73-244)	163 (72-257)	<0.001
After Index	165 (71-240)	184 (82-302)	0.001
FFU	205 (80-292)	212 (112-323)	0.19



Major Curve



Thoracic height (T1-T12)



Complications

	Severe (n=107)	Typical (n=107)	P value
Number of complications per pt	2.6	1.9	0.040
Surgery for complication, n	73 (68%)	60 (56%)	0.067
Rod fractures, n	43 (40%)	26 (24%)	0.013



Neurologic Deficits

Five (4.7%) new neurologic deficits in the severe vs. 3 (2.8%) in the control (p=0.47).

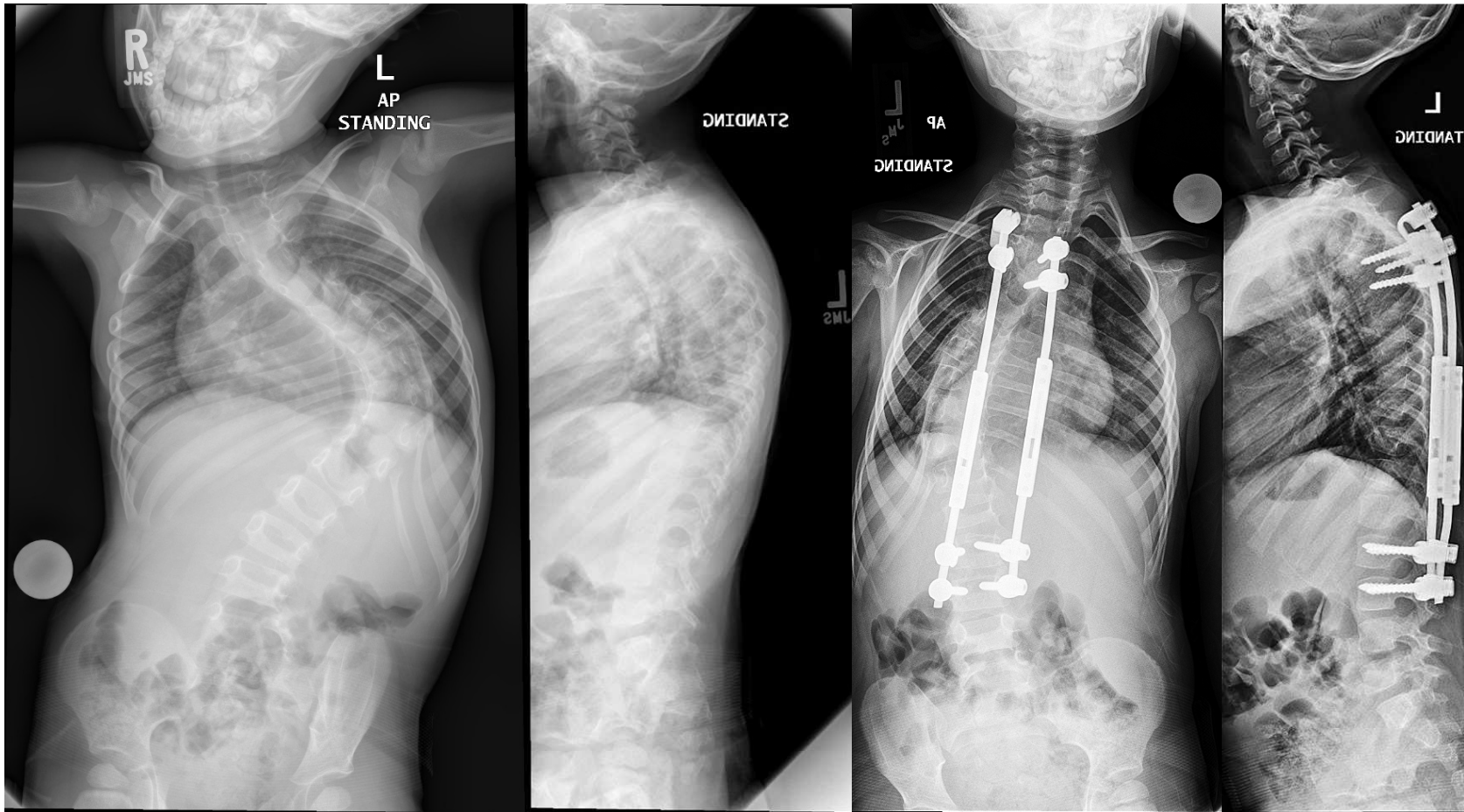
Bilateral spinal cord deficit in 4 children, unilateral spinal cord deficit in 3, cauda equina related in one.

Resolved fully in 6 children, partially in two with rapid actions taken.

	Severe (n=107)	Typical (n=107)
Correction & distraction during index surgery	2	1
Pedicle screw pull-out	2	1
Difficulty in placing PS during revision	1	1

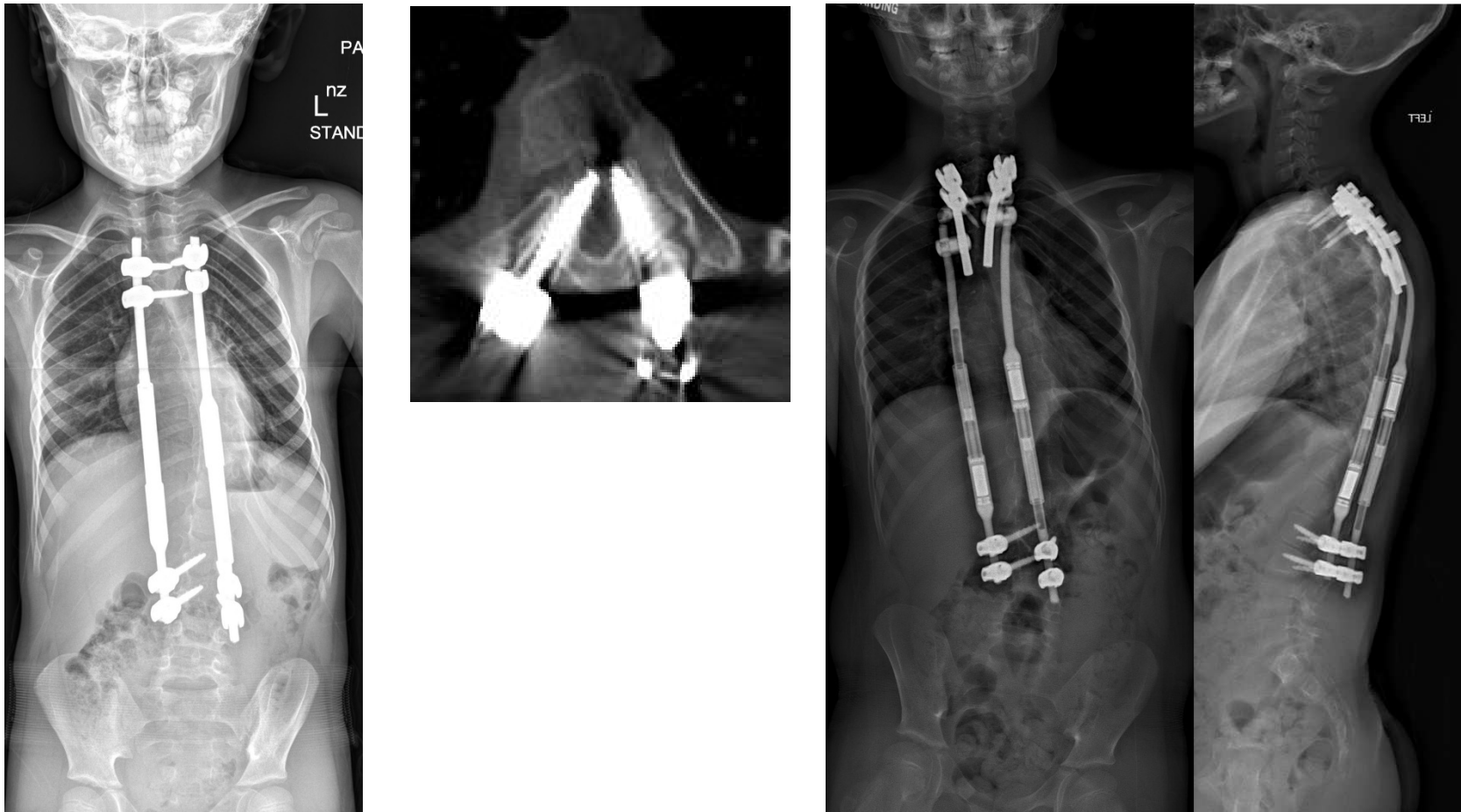


Idiopathic EOS



3-year-old boy with 100° idiopathic scoliosis
Growing rods T4-L3

Screw Pull-Out with Neuro Deficit



Conversion to MCGR 2.5 years after index surgery (four Th PS & no cross-link)
1.5 years later screw pull-out and canal encroachment producing progressive paraplegia
After revision surgery complete recovery

Conclusions

Severe EOS can be treated effectively using growing rod surgery.

Severe group obtained more spinal length during index surgery, but further spinal growth was similar between groups.

More complications, i.e. rod fractures in the severe than in the matched control group.

Neurologic complications relatively common (4.7%) and were related to 1) deformity correction , 2) pedicle screw insertion, 3) Pedicle screw pull-out.

Recommendations: Consider other methods of proximal fixation, use spinal cord monitoring even for minor revisions.

