Do Growing Rods for Idiopathic Early Onset Scoliosis Improve Activity and Participation for Children?

Mathew David Sewell, FRCS[1], Johnson Platinum, MRes[1], Geoffrey Noel Askin, FRACS[2], Robert Labrom, FRACS[2], Mike Hutton, FRCS[3], Daniel Chan, FRCS[3], Andrew Clarke, FRCS[3], Oliver M. Stokes, FRCS[3], Sean Molloy, FRCS[4], Stewart Tucker, FRCS[4], and Jan Lehovsky, FRCS[4]

Objective To investigate whether growing rod surgery for children with progressive idiopathic early onset scoliosis (EOS) effects activity and participation, and investigate factors that may affect this.

Study design Multicenter retrospective cohort study using prospectively collected data on 60 children with idiopathic EOS and significant scoliosis (defined as a Cobb angle >40°). Thirty underwent brace treatment, and 30, growth rod surgery. Questionnaire and radiographic data were recorded at 1 year. The validated Activities Scale for Kids performance version (ASKp) questionnaire was used to measure activity and participation.

Results In the brace group, Cobb angle increased from 60° to 68°. There was no change in ASKp score. In the operative group, Cobb angle decreased from 67° to 45°. ASKp decreased from 91 to 88 ($P < .01$). Presence of spinal pain correlated with greater reduction in activity and participation scores in both groups, as did occurrence of complications in the operative group ($P < .05$). Both treatments permitted growth of the immature spine.

Conclusions In children with significant idiopathic EOS (Cobb angle>40°), growth rod surgery was associated with a reduction in activity and participation and Cobb angle, whereas brace treatment was associated with an increase in Cobb angle and no change in activity and participation. Pain was the most important factor affecting activity and participation in both groups. *(J Pediatr 2017;182:315-20).*

Early onset scoliosis (EOS) is a group of disorders of various etiologies (congenital, idiopathic, neuromuscular, and syndromic) in which scoliosis develops before the age of 10 years.[1] The natural history of EOS is poorly understood because the condition is rare. The majority of curves progress as the spine grows, but some remain static and others may even spontaneously resolve.[2,3] Significant progression of these curves in a child less than 8 years of age may result in restrictive lung disease and possibly cardiac disease, both associated with early mortality.[2-5] Thoracic scoliosis inhibits the growth of both alveoli and pulmonary arterioles and may adversely affect lung maturation up to the age of 8 years.[6,7]

There is no consensus on the optimal treatment for EOS.[1] Casting, bracing, and nonfusion and fusion surgery have all been tried with mixed success.[8-15] Surgery is indicated for curves that progress rapidly despite cast or brace treatment. Spinal fusion has fallen out of favor as the surgical treatment of choice, as evidence suggests early fusion leads to pulmonary compromise, poor cosmetic result, and poorer quality of life.[14,15] Growth sparing (nonfusion) surgery aims to control EOS curve progression and allows for continued spine and chest wall growth, which is essential for pulmonary maturation. The most commonly implanted surgical devices used for this purpose are growth rods.[1] This is a major surgical intervention for the child and their families, with significant physiological, psychological, and social effects. Therefore, there is an imperative to evaluate this intervention using outcomes that are more meaningful.[16]

The World Health Organization's (WHO) International Classification of Functioning, Disability, and Health for children and youth has redefined the way disability is viewed for children with impairments (**Figure 1**; available at www.jpeds.com).[17] There is less focus on actual impairments (the scoliosis) and more on their impact for involvement in life situations, which is defined as "activity and participation." The WHO recommend activity and participation should be assessed when children undergo complex intervention to evaluate the effects on the child.[18-22]

There is a lack of evidence supporting many of the interventions for children with EOS. This study reports the outcome of growing rod surgery for children with EOS, with a particular focus on activity and participation, and investigates factors that affect this.

ASKp	Activities Scale for Kids performance version
CGR	Conventional growth rod
EOS	Early onset scoliosis
MGR	Magnetic growth rod
WHO	World Health Organization

From the [1]Department of Pediatric Spinal Deformity, The James Cook University Hospital, Middlesbrough, United Kingdom; [2]The Lady Cilento Children's Hospital, Brisbane, Australia; [3]The Royal Devon and Exeter Hospital, Exeter, United Kingdom; and [4]The Royal National Orthopaedic Hospital, Stanmore, United Kingdom

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Methods

Between 2009 and 2015, a retrospective cohort study including children with idiopathic EOS was performed at 3 specialist scoliosis centers. All children had been started in brace treatment when their curves were >25° and noted to be progressive on serial radiographs. Children were included in the study if they had idiopathic EOS with a progressive spinal deformity (defined as Cobb angle increase >5° in 1 year), were aged 5-10 years, and had a Cobb angle >40°,[23] as this was the curve severity, rate of progression, and age at which the treating physicians would consider some form of growth-sparing intervention in childhood.

The first 30 consecutive children who met the inclusion criteria for the study, wished to undergo surgery, and consented to be in the study were compared with the first 30 consecutive children who met the inclusion criteria for the study, consented to be in the study, and chose not to undergo surgery, but instead preferred to undergo observational management with braces. During the 6-year study period, we could only identify 30 children who underwent growth rod surgery, which is why 30 children were used in both groups. There were 22 males and 38 females with a mean age of 8.2 years (5.4-10.4).

Thirty underwent brace treatment as the sole treatment during the study period, and 30 underwent growth-sparing, nonfusion surgery with growing rods. The indication for surgery was a Cobb angle >40°, with evidence of progression on sequential radiographs (defined as >5° Cobb angle increase in 1 year), in a child in whom the parent and surgeon both thought this curvature was contributing to worsening spinal or chest wall deformity, pain or impaired function, or social interaction (**Figure 2**). Brace treatment was continued for all children with a progressive scoliosis >40° where the family or surgeon preferred nonoperative management. This was an individual choice, unique to each child, and was not based solely on radiographic measures. Nonoperative management was chosen when the child or family preferred it, or when the child had important life events that were preferable to surgery, such as examinations or sports. The brace group was used as a control group to compare operative with nonoperative management for this rare cohort of children, where all children met the inclusion criteria for growth rod surgery, should the child and family have opted for this treatment strategy.

In the surgical group, 18 underwent conventional growth rod (CGR) and 12, magnetic growth rod (MGR) treatment (MAGEC Ellipse technology, Irvine, California). Nine had single rod, and 21 dual rod constructs. The surgical techniques for CGR and MGR insertion have previously been described.[8,10,24] All implants were placed submuscularly. Patients who received a MGR were lengthened by approximately 5 mm every 3 months in the outpatient department using an electrically powered remote controller.[24] Patients who received a CGR were lengthened by between 5-10 mm every 6 months through an invasive procedure requiring general anesthetic.[8]

The baseline characteristics of the children are shown in **Table I**. Data from questionnaires administered to caregivers and children, clinic reviews, medical records, and radiographs were used for analysis over a 1-year period. This was a retrospective review of prospectively collected data and local ethical review classified the study a service evaluation.

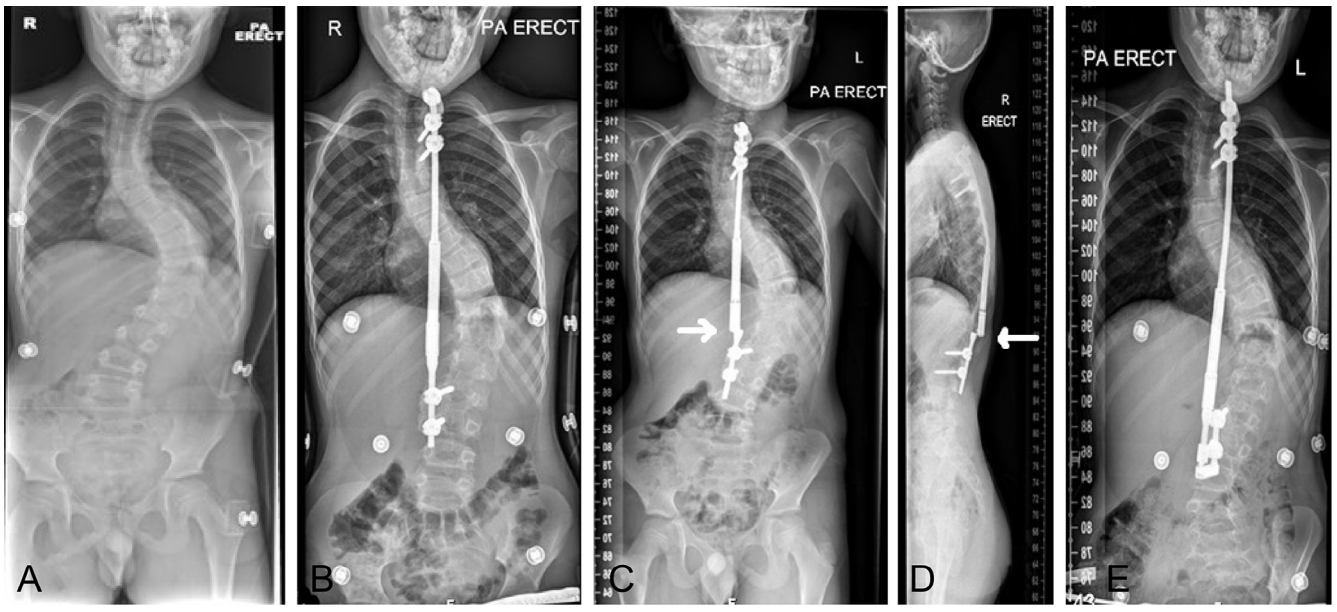

Figure 2. Preoperative postero-anterior **A**, radiograph of a 9-year-old boy with progressive, idiopathic EOS. The child had worsening spine and chest wall deformity. Postoperative postero-anterior **B**, radiograph at 1 month following magnetic growth rod insertion with pedicle screw and transverse process hook fixation between T2 to L3. The deformity has improved; however, **C** and **D**, the rod broke (*white arrows*) at 3 months, after **E,** initial lengthening, requiring rod revision.