

Patient ID	Type of implant	Sex	Age at time of blood sample (years)	Serum titanium level (ng/mL)	Time from implant insertion to blood sample (years)	Current number of rods	Total number of rods implanted during treatment	Number of lengthenings
1	MCGR	M	12	2	1.5	2	2	5
2	MCGR	F	9	3	0.9	2	2	3
3	MCGR	F	11	5	3.2	2	4	12
4	MCGR	M	11	5	1.7	2	2	7
5	MCGR	F	9	8	2.0	2	4	7
6	VEPTR	M	6	4	4.7	1	3	2
7	VEPTR	F	5	5	3.6	2	3	5
8	VEPTR	M	12	5	9.6	2	3	13
9	VEPTR	M	7	6	2.6	2	5	3
10	VEPTR	F	7	8	6.1	2	4	10
11	VEPTR	F	5	8	3.9	2	4	6
12	VEPTR	M	10	8	8.3	1	7	12
13	VEPTR	F	8	10	4.9	1	7	4
14	VEPTR	M	11	11	4.7	3	8	8
15	VEPTR	M	4	15	2.7	2	4	4

MCGR, magnetically controlled growing rods; VEPTR, Vertical Expandable Prosthetic Titanium Rib

larger population of EOS patients with different types of growth-sparing instrumentation.

Author Affiliations and Disclosures: Christopher Robbins, University of Michigan; Chelsea Graham, C.S. Mott Children's Hospital; Frances A. Farley, University of Michigan C.S. Mott Children's Hospital; Ying Li, C.S. Mott Children's Hospital

Paper #40

Magnetically Controlled Growing Rods: Sagittal Plane Analysis and the Risk of Proximal Junctional Kyphosis

Purnendu Gupta, Kevin Morash, Felix Brassard, Jennifer Schottler, Alicia January, Ron El-Hawary, Ben Roye, Kim Hammerberg, Jeffrey Sawyer, Children's Spine Study Group



Summary: Magnetically controlled growing rod (MCGR) insertion in patients with early onset scoliosis (EOS) resulted in a 12% risk of proximal junctional kyphosis (PJK).

Hypothesis: MCGR insertion has a high risk of PJK.

Introduction: MCGR can reduce the number of surgical procedures requiring anaesthesia, however, there are challenges for sagittal rod contouring due to actuator geometry. This study evaluated our initial experience using MCGR with analysis of sagittal plane parameters to determine the risk of PJK.

Methods: 67 EOS patients from a multicenter registry age 2-13 years (28 idiopathic, 23 neuromuscular, 10 syndromic, and 6 congenital scoliosis) underwent MCGR insertion and subsequently 443 lengthenings (mean 6.6 per patient), 32 revisions, and 8 device removals. 51% male patients had an average age 7.4 (± 2.7) years at initial surgery and radiographic analysis was conducted at pre-op, immediate post-op and at 24 months follow-up (F/U).

Results: Scoliosis improved from $71^\circ \pm 19$ pre-op to $39^\circ \pm 15$ post initial surgery ($p < .001$) and $44^\circ \pm 17$ at 24-month F/U ($p < .001$). Subgroup analysis of available data demonstrates a significant improvement in T1-T12 height over time, with an increase in height of 2.7 cm pre-op to post-op ($p < .001$), and an additional 1.1 cm at 24-month F/U ($p = .006$). Although lumbar lordosis (LL) did not change significantly from pre-op to immediate post-op or from pre-op to 24 months, the change from post-op to 24 months was statistically significant ($-42^\circ \pm 17$ vs. $-51^\circ \pm 18$, $p = .001$). No significant change in thoracic kyphosis (TK) ($p = .113$) or in T1 slope ($p = .141$). At 24-months, PJK developed in 4 of 33 (12%) patients. 3 of the 4 with PJK had a pre-op kyphosis greater than 50 and 2 had a pelvic incidence (PI)-LL mismatch greater than 30. Those with PJK also had a higher mean sagittal vertical axis (SVA) pre-op than those without PJK (62 vs. 13).

61 complications occurred in 39 patients (58%), requiring 45 unplanned surgeries.

Conclusion: MCGR insertion in patients with EOS resulted in a significant complication rate, including a 12% risk of PJK. Further study is needed to better understand the benefit and long-term outcomes of MCGR.

Author Affiliations and Disclosures: Kim Hammerberg, none; Purnendu Gupta, Shriners Hospitals for Children-Chicago, Depuy Johnson and Johnson; Ron El-Hawary, CSF, CSSG, POSNA, DePuy Synthes Spine, Medtronic, Halifax Biomedical Inc., Medtronic Spine, CIHR, SRS; Kevin Morash, none; Felix Brassard, none; Alicia January, none; Benjamin Roye, POSNA, OSRF, OMeGA, CPF; Jeffery Sawyer, Campbell Clinic, AAOS, Campbell Foundation, POSNA, Medica, Medica Spine, Mosby, Wolters Kluwer Health - Lippincott Williams & Wilkins, DePuy, A Johnson & Johnson Company, Nuvasive; Children's Spine Study Group, De Puy/Synthes Spine, DePuy Synthes, DePuy, A Johnson & Johnson Company; Jennifer Schottler, Shriners Hospitals for Children-Chicago

Paper #41

Comparing Risk of Unplanned Returned to the Operating Room (UPROR): Magnetically Controlled Growing Rod (MCGR) System vs Prosthetic Rib Constructs (PRC)

Benjamin Roye, Hiroko Matsumoto, Chun Wai Hung, Megan Campbell, Eduardo Beauchamp, David P. Roye, Michael Vitale



Summary: In the first 2 years after primary surgery, PRC had three times as many surgeries as MCGR, but UPROR was similar between the two groups. Preliminary survival analysis accounting for unequal follow-up and differences in curve severity demonstrated UPROR plateaued after 2 years in PRC but continued to increase in MCGR.

Hypothesis: EOS patients treated with primary MCGR have higher risk of UPROR compared to those with primary PRC.

Introduction: MCGR were designed to treat EOS without the need for iterative surgeries. Initial enthusiasm for MGCR has been high, but complication data is limited compared to traditional distraction devices such as PRC.

Methods: This was a retrospective cohort study. Consecutive EOS patients undergoing primary implants of MCGR or PRC between 2009-2016 were included. Outcome was UPROR measured at 2-years postoperatively and at last visit.

Results: 22 MCGR and 50 PRC patients met inclusion criteria. Patients with MCGR had larger pre-op major coronal and sagittal curves (71° and 52° respectively) compared to patients with PRC (59° and 32°) ($p = 0.007$). At 2 years total surgeries, excluding primary instrumentation, were 0.9 in MCGR and 3.2 in PRC ($p < 0.001$). Total number of planned