



DEPARTMENT OF SURGERY | Office of Surgical Fellowship

SHORT-TERM COMPLICATIONS IN VEPTR AND MAGNETICALLY CONTROLLED GROWING RODS TO MANAGE EARLY ONSET SCOLIOSIS

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- Vertical Expandable Prosthetic Titanium Rib (VEPTR) require multiple surgical lengthening of the rods.
- Unplanned revision surgeries for managing complications of TGR and VEPTR are common; regardless of the fixation technique used ¹
- Repeated general anesthetics adversely affect health outcomes in children and may result in psychological and financial distress for their parents and caregivers²⁻³
- Similar mechanical issues following instrumentation, such as anchors dislodgment, are still seen as a common cause for unplanned revision surgeries⁴

1.- Wudbhav N. Sankar, MD, Daniel C. Acevedo, MD, and David L. Skaggs, MD Study. Comparison of Complications Among Growing Spinal Implants. *Spine* 2010;35:2091–2096

2.- Flick RP, Katusic SK, Colligan RC, Wilder RT, Voigt RG, Olson MD, Sprung J, Weaver AL, Schroeder DR, Warner DO. Cognitive and behavioral outcomes after early exposure to anesthesia and surgery. *Pediatrics*. 2011 Nov;128(5):e1053-61..

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4.-Kwan KYH, Alanay A, Yazici M, Demirkiran G, Helenius I, Nnadi C, Ferguson J, Akbarnia BA, Cheung JPY, Cheung KMC. Unplanned Reoperations in Magnetically Controlled Growing Rod Surgery for Early Onset Scoliosis with a Minimum of Two-Year Follow-Up. *Spine (Phila Pa 1976)*. 2017 Jun 27.

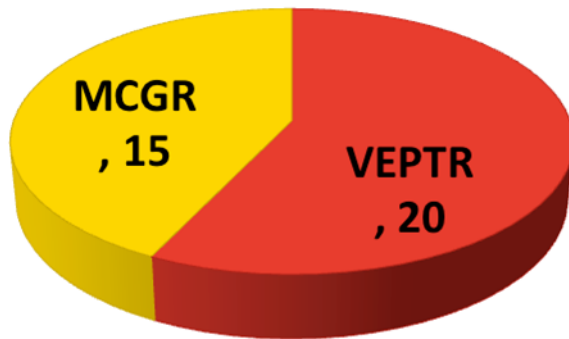
MATERIAL AND METHODS

- Retrospective cohort, single-center, quality improvement study*
- N= 35 EOS patients 2010-2016 (2 years follow-up min)

TABLE 1. DEMOGRAPHICS

	MCGR GROUP (n=15)	VEPTR GROUP (n=20)	P value
SEX (males%)	8(53.3%)	9(45%)	0.884
AGE	7(3-10)	4(1.6-12)	0.0196
N° DISTRACTIONS	8(8-8)	2(2-2)	<0.001
N° STAGES	2(1-3)	1(1-2)	
ETIOLOGY (%)			0.891
N	9(60%)	11(55%)	
C	3(20%)	3(15%)	
I	1(6.7%)	1(5%)	
S	2(13%)	5(25%)	

Demographic data. *Categorical variables are analyzed with Fisher test and continuous non parametric variables with Mann Whitney test. Etiology: N



PREOP

1 YEAR
POSTOP

MATERIAL AND METHODS

TABLE 2. PREOP RADIOGRAPHIC MEASUREMENTS

	MCGR GROUP (n=15)	VEPTR GROUP (n=20)	P value
THORACIC COBB	68(40-129)	75(18-126)	0.607
LUMBAR COBB	60(45-76)	58.5(15-78)	0.945
AVT	41(25-105)	45(4-129)	0.521
T1 TILT	17(1-32)	12(0-39)	0.781
T1T12 HEIGHT	173(105-276)	150(87-199)	0.0343
T1S1 HEIGHT	289(194-432)	257(164-296)	0.0328
CORONAL BALANCE	22(0-60)	15(0-32)	0.102
THORACIC KYPHOSIS	32(4-96)	42(-42,96)	0.515
T2T5 KYPHOSIS	13(-10,50)	6(-24,23)	0.0506
LUMBAR LORDOSIS	51(19-104)	44.5(-26,59)	0.225
SAGITTAL BALANCE	29(-37,138)	49(0-78)	0.219

Data PRE surgery. **AVT**: apical vertebral translation. *Mann Whitney test

TABLE 3. COMPLICATIONS AND REOPERATIONS

	MCGR (n=15)	VEPTR (n=20)	P value
INFECTIONS	1(6.7%)	2(10%)	0.727
HARDWARE FAILURES	1(6.7%)	7(35%)	0.048
PROGRES	0	1(5%)	0.380
NEW ROD.1Y	0	5(25%)	0.036
PNEUMO(1)	0	3(15%)	0.244
PNEUMO(2)	0	1(5%)	
NEUROLOGICAL INJURY	0	1(5%)	0.380
TOTAL COMPLICATIONS	2(1,6.7%)	21(12,60%)	<0.001
REOP(1)	0	7(35%)	<0.001
REOP(2)	1(6.7%)	2(10%)	
REOP(5)	0	1(5%)	
TOTAL REOP	2(1,6.7%)	16(10,50%)	

Hardware: includes dislodgements, migrations and breakage. **Progress:** progression requiring new rod. **Newrod1:** new rod inserted in less than 2 years. **Pneumo1:** patients with 1 pneumothorax. **Pneumo2:** two episodes of pneumothorax in same patient in less than one year. **Reop1:** patients with 1 reoperation in less than 2 years. **Reop2:** 2 reoperations in less than 2 year. **Reop5:** 5 reoperations in less than two years.
*Fisher test

TABLE 4. SECONDARY OUTCOMES: RADIOGRAPHIC DIFFERENCES

	MCGR GROUP (n=15)	VEPTR GROUP (n=20)	P value
COBB CORRECTION	34(9-77)	15(-5,63)	0.0498
COBB CORRECTION %	47.2(13-59.7)	20(-15.2,58)	0.0138
AVT CORRECTION	18(1-50)	6(-8,64)	0.0263
T1TILT CORRECTION	3(-11,23)	0(-4,4.5)	0.174
T1T12 INCREASE	27(2-61)	21(-10,62)	0.639
T1S1 INCREASE	39(10-88)	28(-40,75)	0.0768
CORONAL BALANCE DIF	0(-21,37)	-2(-21,22)	0.404
THORACIC KYPHOSIS DIF	5(-15,74)	5(-35,25)	0.329
T2T5 KYPHOSIS DIFFERENCE	-2(-18,68)	-5(-30,9)	0.48
LUMBAR LORDOSIS DIF	2(-21,50)	0.5(-39,30)	0.503
SAGITTAL BALANCE DIF	2(-68,166)	15.5(-40,78)	0.814

Differences between pre and post-surgery. *Mann Whitney test

- Very few studies comparing RBD and SBD.
 - VEPTR vs MCGR?
- A French series of 54 VEPTRs with a mean follow up of 22.5 months reported a complication rate of **137% per patient and 40% per surgery**⁵
- **Teoh et al** presented 6 revision surgeries in 14 MCGR patients (**43%**), which occurred during 17 to 46 months of follow up⁶.
- National Institute for Health and Care Excellence (NICE) in United Kingdom concluded that using the MAGEC system would avoid repeated surgical procedures for growth rod lengthening⁷.

5.- G Lucas, G Bollini, JL Jouve, et al. Complications in pediatric spine surgery using the vertical expandable prosthetic titanium rib, the French experience
Spine, 38 (2013), pp. E1589-E1599

6.- Teoh KH, von Ruhland C, Evans SL, et al. Metallosis following implantation of magnetically controlled growing rods in the treatment of scoliosis: a case series. *Bone Joint J* 2016;98-B:1662-1667.

7.- Jenks M, Craig J, Higgins J, Willits I, Barata T, Wood H, Kimpton C, Sims A. The MAGEC system for spinal lengthening in children with scoliosis: A NICE Medical Technology Guidance. *Appl Health Econ Health Policy*. 2014 Dec;12(6):587-99

- MCGR avoided an average of 2.03 scheduled surgical procedures per patient compared to traditional growing rod (GR). *Lebon et al*⁸
- There was no gradual loss of effectiveness over the course of the first year. The so-called '**law of diminishing returns**' described in GR seems **applicable to MCGR from the 4th distraction** session onward⁹. The phenomenon was first reported by Sankar et al⁹ and represents the gradual decrease in length gain with each subsequent lengthening and over time, **despite an increased distraction force applied**¹⁰.
- This may explain the low rate of hardware complications at two years in the MCGR group

8.-Lebon J, Batailler C, Wargny M, Choufani E, Violas P, Fron D, Kieffer J, Accadbled F, Cunin V, De Gauzy JS. Magnetically controlled growing rod in early onset scoliosis: a 30-case multicenter study. Eur Spine J. 2017 Jun;26(6):1567-1576.

9.-Sankar WN, Skaggs DL, Yazici M, Johnston CE, Shah SA, Javidan P et al (2011) Lengthening of dual growing rods and the law of diminishing returns. Spine 36(10):806-809.

10.- Noordeen HM, Shah SA, Elsebaie HB, Garrido E, Farooq N, Al-Mukhtar M et al (2011) In vivo distraction force and length measurements of growing rods: which factors influence the ability to lengthen? Spine 36(26):2299-2303

- **Retrospective** design
- Small sample size
- Heterogeneity of the population
- Short follow-up
- No difference between rib-rib, rib-spine or rib-pelvis in the VEPTR group
- No cost analysis data

- **MCGR** have shown to have a **lower complication rate** (6.7%) and **unplanned surgery rate** than VEPTR during the first 2 years (60%).
- **MCGR** showed to **have better Cobb angle and AVT correction** than VEPTRs at 2 years.
- The “**law of diminishing returns**” may explain the low hardware complications at 2 years in the MCGR group.

