The Significance of Clunking In Magnetically Controlled Growing Rod Distractions: A Prospective Analysis of 22 Patients

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Disclosures

- Nil

Surgical treatment for early onset scoliosis (EOS)

- **Traditional growing rods (TGR)**
  - **Repeated surgeries for distractions every 6 months**
  - **Increased risk for anesthestic and wound complications**
  - **Psychological distress to both the child and family**

- **Magnetically-controlled growing rods (MCGR)**
  - **Non-invasive distractions done at out-patient clinic**
  - **More frequent distractions to mimic normal spinal growth**

Magnetically controlled growing rods for severe spinal curvature in young children: a prospective case series

Kenneth Man-Chee Cheung, Jason Pui-Yin Cheung, Dino Samartzis, Kin-Cheung Mak, Yat-Wa Wong, Wai-Yuen Cheung, Behrooz A Akbarnia, Keith Dip-Kei Luk

Lancet 2012; 379: 1967–74

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Lengthening of Dual Growing Rods and the Law of Diminishing Returns

Wudbhav N. Sankar, MD, David L. Skaggs, MD, Muharrem Yazici, MD, Charles E. Johnston II, MD, Suken A. Shah, MD, Pooya Javidan, MD, Rishi V. Kadakia, BS, Thomas F. Day, MD, and Behrooz A. Akbarnia, MD

- Autofusion with TGR
- Diminishing gains in MCGR?

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Frequent small distractions with a magnetically controlled growing rod for early-onset scoliosis and avoidance of the law of diminishing returns

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Clunking: rod slippage during distraction/clunking sound and feeling

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Clunking leads to reduced length gains?

Aim: **To assess the occurrence and potential determinants associated with MCGR clunking during distractions**

Methods

- Prospective EOS study
- December 2009-March 2016
- At least 2 years FU and 6 distraction episodes
- Monthly 2mm distractions

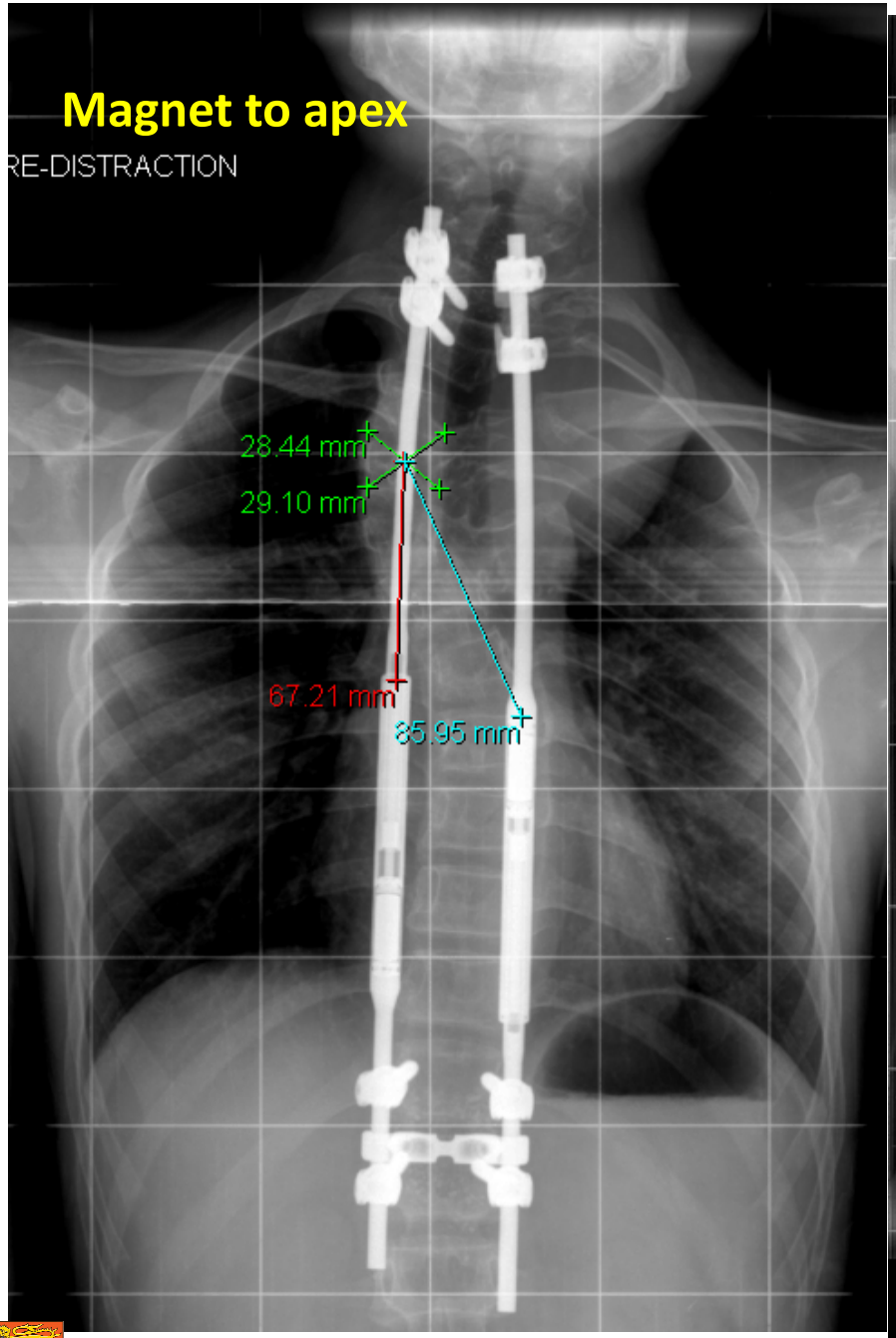
- Rod slippage/clunking
  - Early onset of clunking: ≤6 months
  - Late onset of clunking : >6 months or never clunked

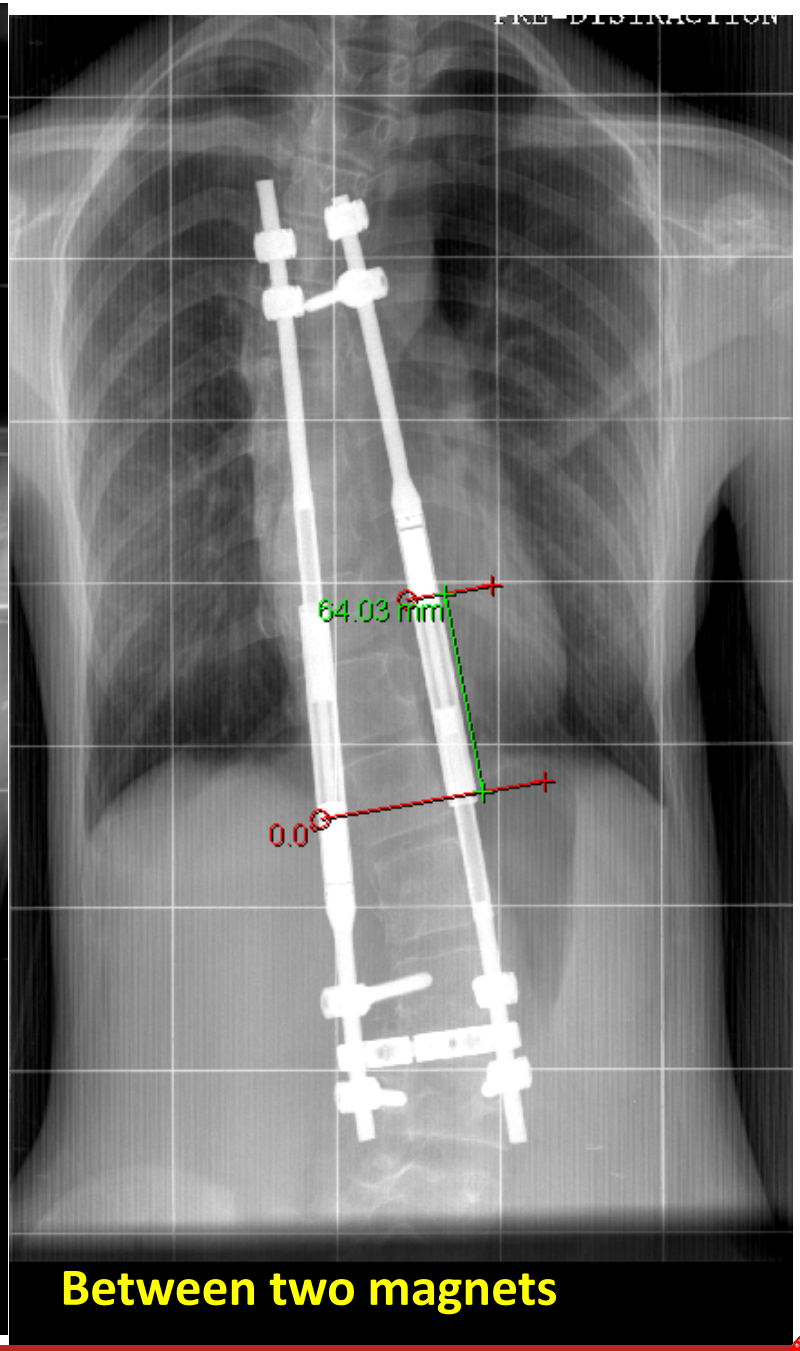
- Trend of expected vs achieved distraction lengths
  - Relationship with clunking

Factors related to clunking

- **Maturity** (Risser, DRU, age)
- **Body habitus** (height, weight, BMI)
- **Distraction** (number of distractions, timing)
- **Curve magnitude** (Cobb angle, fulcrum, FBCI)
- **Length** (T1-12, T1-S1, instrumented)
- **Magnet related** (distance between magnets and to apex)

- **Analyses**
- **Influencing timing of clunking (early vs late)**
- **Mann-Whitney test (p-value of <0.05 considered significant)**


Magnet to apex
RE-DISTRACTION
28.44 mm
29.10 mm
67.21 mm
85.95 mm


64.03 mm
0.0
Between two magnets

Results

- 22 patients
- Mean
  - Age 7.1±4.0 years
  - FU 49.8±11.0 months
  - 32.4±11.0 distractions

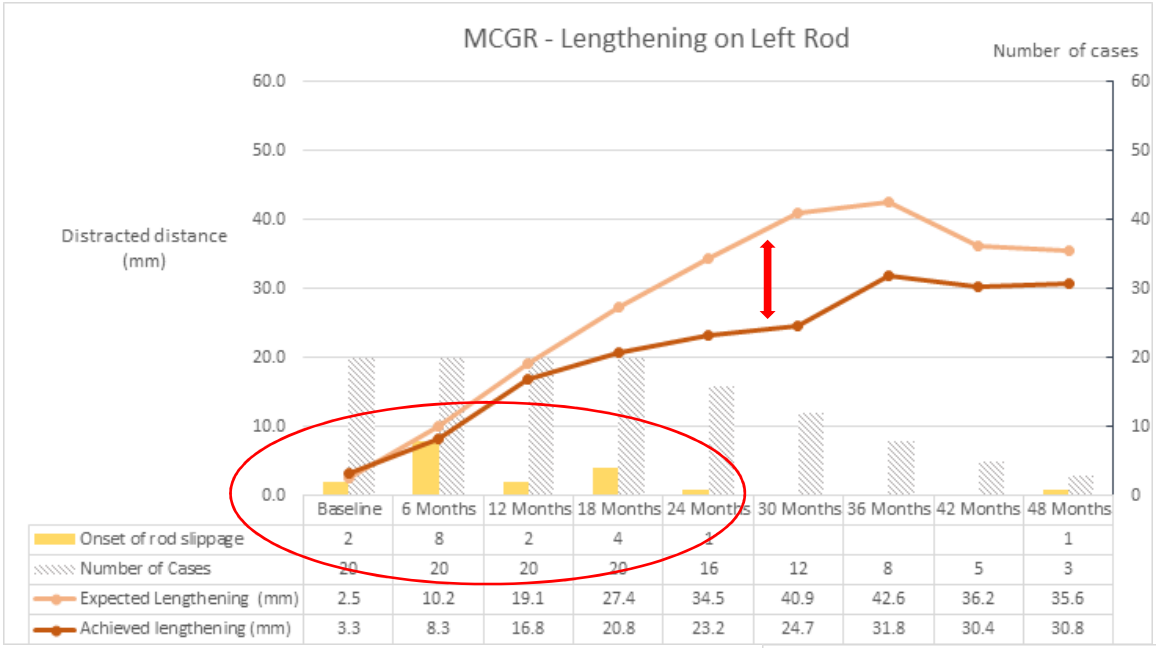
- Early-onset = 14 patients
- Late-onset = 8 patients

Parameter at implantation	Mean±SD (early)	Mean±SD (late)	p-value
Height	146.4±12.2	106.4±8.5	0.001*
Weight	35.6±10.2	17.7±2.5	0.001*
BMI	15.4±5.8	12.0±1.7	0.006*
Risser sign	0.6±1.0	0.0±0.0	0.104
Radius grade	6.2±0.9	3.8±1.0	0.007*
Ulna grade	5.0±1.0	2.1±1.3	0.006*
Chronological age			0.003*
Cobb angle			0.124
Fulcrum Cobb angle			0.843
Fulcrum flexibility			0.843
T1-12			0.012*
T1-S1			0.003*
T5-12 kyphosis			0.785
Parameters after impla			
Correction rate			0.838
FBCI			0.606
Immediate postop Cob			0.633
Immediate postop T1-1			0.012*
Immediate postop T1-S			0.001*
Immediate postop T5-12 kyphosis	18.9±12.8	14.4±13.2	0.765
Instrumented length	223.5±46.5	232.5±16.7	0.539
Distance between magnets	40.4±7.9	49.3±9.6	0.022*
Distance between magnet and curve apex (right)	35.1±37.0	57.4±33.0	0.091
(left)	48.5±20.6	49.2±43.4	0.426

Early-onset clunking

Taller, heavier, older

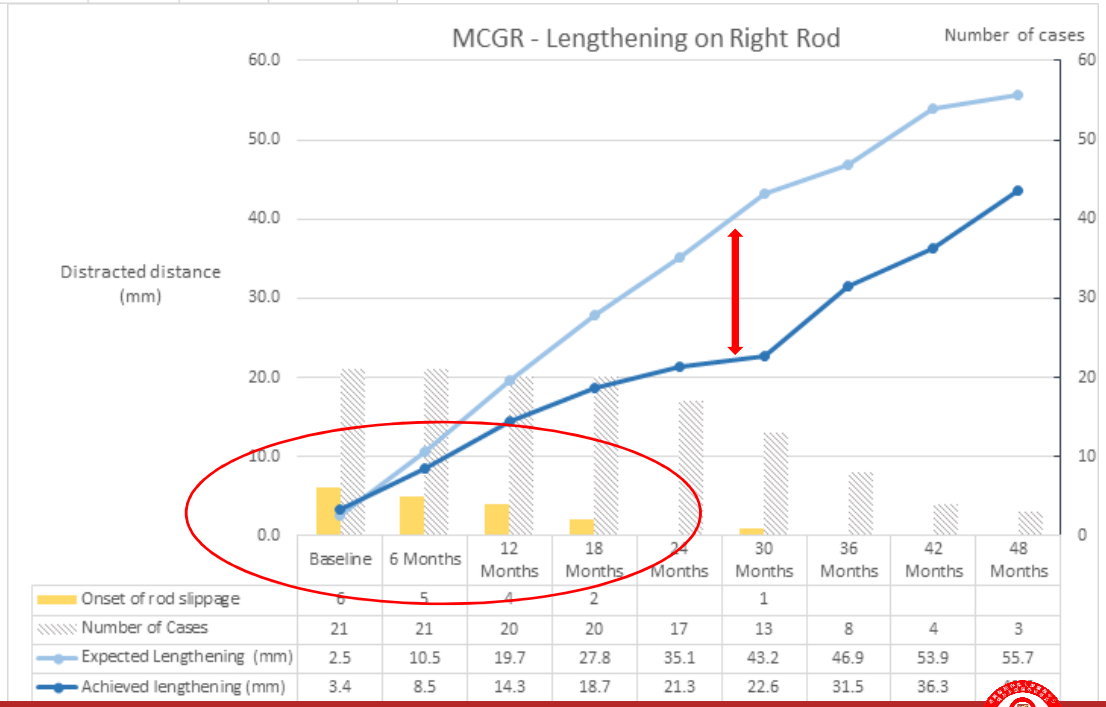
Magnets closer together



	Baseline	6 Months	12 Months	18 Months	24 Months	30 Months	36 Months	42 Months	48 Months
Onset of rod slippage	2	8	2	4	1				1
Number of Cases	20	20	20	20	16	12	8	5	3
Expected Lengthening (mm)	2.5	10.2	19.1	27.4	34.5	40.9	42.6	36.2	35.6
Achieved lengthening (mm)	3.3	8.3	16.8	20.8	23.2	24.7	31.8	30.4	30.8

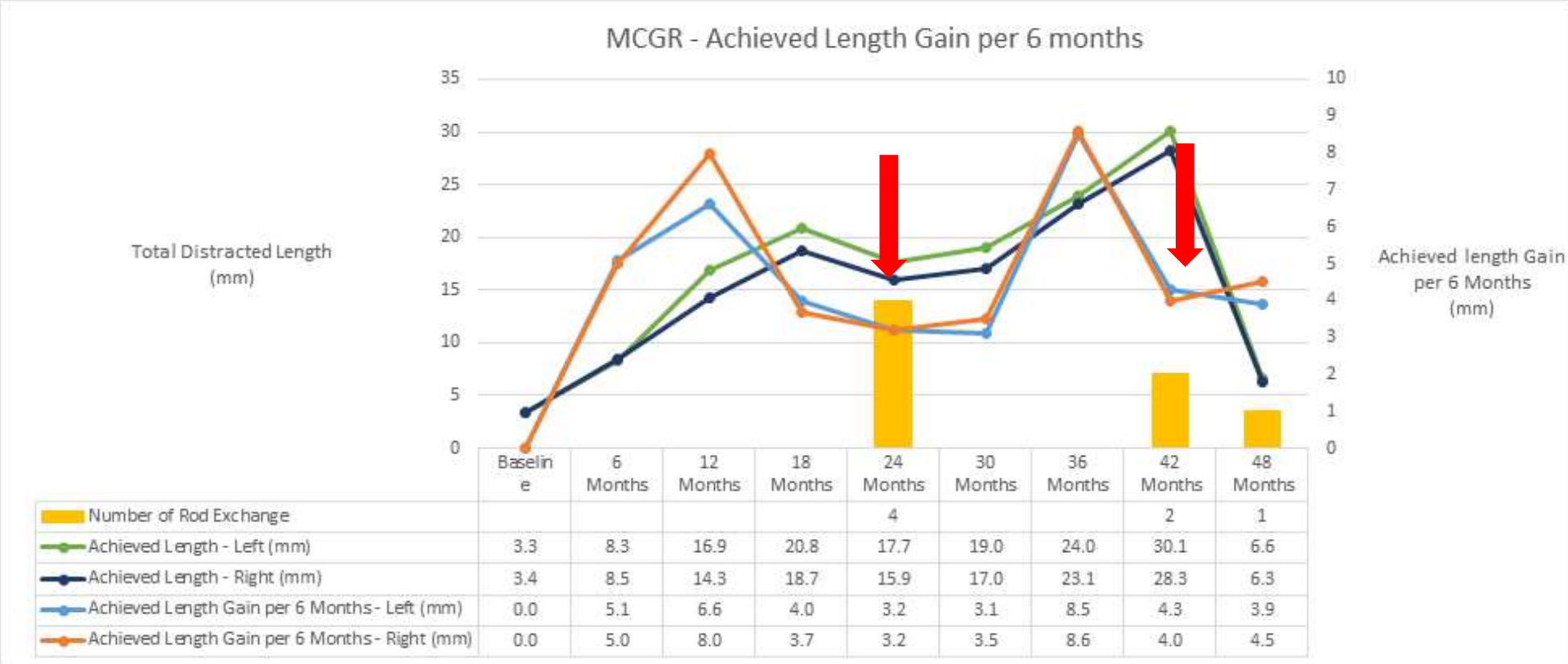
Occurs after clunks

Expected vs achieved distraction length mismatch



	Baseline	6 Months	12 Months	18 Months	24 Months	30 Months	36 Months	42 Months	48 Months
Onset of rod slippage	6	5	4	2		1			
Number of Cases	21	21	20	20	17	13	8	4	3
Expected Lengthening (mm)	2.5	10.5	19.7	27.8	35.1	43.2	46.9	53.9	55.7
Achieved lengthening (mm)	3.4	8.5	14.3	18.7	21.3	22.6	31.5	36.3	

Diminishing gains after certain rod usage



	Baseline	6 Months	12 Months	18 Months	24 Months	30 Months	36 Months	42 Months	48 Months
Number of Rod Exchange					4			2	1
Achieved Length - Left (mm)	3.3	8.3	16.9	20.8	17.7	19.0	24.0	30.1	6.6
Achieved Length - Right (mm)	3.4	8.5	14.3	18.7	15.9	17.0	23.1	28.3	6.3
Achieved Length Gain per 6 Months - Left (mm)	0.0	5.1	6.6	4.0	3.2	3.1	8.5	4.3	3.9
Achieved Length Gain per 6 Months - Right (mm)	0.0	5.0	8.0	3.7	3.2	3.5	8.6	4.0	4.5

Discussion

- Expected distraction lengths do not translate to achieved distraction lengths
- Rod slippage leads to increased mismatch
- Increased body habitus and reduced distance between internal magnets are associated with early rod slippage
- Reduced length gains were only observed after achieving one-third of the allowable distracted length
- Length gains return to baseline after rod exchange.

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Rod Lengthening With the Magnetically Controlled Growing Rod

Factors Influencing Rod Slippage and Reduced Gains During Distractions

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Thank You