



Rigshospitalet



# Distraction-to-stall ensures spinal growth in Magnetically Controlled Growing Rods

*Benny Dahl<sup>1)</sup>, Casper Dragsted<sup>2)</sup>, Søren Ohrt-Nissen<sup>2)</sup>, Thomas Andersen<sup>2)</sup>,  
Martin Gehrchen<sup>2)</sup>*

<sup>1)</sup>Department of Orthopedic Surgery, Texas Children's Hospital & Baylor College of Medicine, Houston, Texas

<sup>2)</sup>Spine Unit, Orthopedic Surgery Department, Rigshospitalet  
University of Copenhagen

# Disclosures

- Benny Dahl: Institutional grants from K2M and Medtronic
- Casper Dragsted: No conflicts of interest
- Søren Ohrt-Nissen: Institutional grants from K2M and Medtronic
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# Purpose

- Assess radiographic outcome, curve correction and complications in patients treated with Magnetically Controlled Growing Rods (MCGR)
- Evaluate the efficacy of a standardized distraction procedure

# Materials and Methods

- Retrospective study of a single-center prospective cohort
- Patients treated with MCGR from November 2013 through August 2017
- Exclusion criteria
  - Former spinal deformity surgery
  - Single rod constructs
  - Conversion cases with former growth instrumentation
- All radiographic measures performed by a single observer
- Statistics performed using R, version 3.4.0
- Data are presented as proportions (%), means with standard deviation (sd) or medians with inter quartile range [iqr]

# Materials and Methods

## Surgical procedure

- Dual MCGR - mainly with a standard rod on the concave side and off-set rod on the convex side
- Posterior-only approach with 2 attending surgeons
- Maximal distraction performed perioperative
- Fixation with pedicle screws where applicable, otherwise hooks.
- Cross-links added in selected cases



## Distraction procedures

- Every 2-3 months in an outpatient clinic setting by 1 of 2 spine surgeons
- Distraction performed to stall/"clunking" in 3 steps
- First on the concave side of major curve, then on the convex side and again on the concave side
- Stopped before stall if the patient felt pain/discomfort or the surgeon preferred not to continue



# Materials and Methods

## **Radiological assessment**

- Radiographs taken pre- and postoperative, at 3, 6 and 12 months and onwards every 6 months
- Distraction length measured on radiographs on each rod separately
- Spinal growth assessed with T1-T12 and T1-S1 pre- and postoperative and at latest follow-up
- Major curve and overall kyphosis was recorded
- All images were calibrated using the known rod-diameter

# Case



Preoperative



Postoperative



2 year



Preoperative



Postoperative



2 year

8 year old boy with Cri-du-chat syndrome, progression despite Boston bracing. Major curve improved from  $75^\circ$  preoperative to  $32^\circ$  postoperative and was  $37^\circ$  at 2 year follow-up. Kyphosis was  $22^\circ$ ,  $14^\circ$  and  $16^\circ$  respectively.

# Results

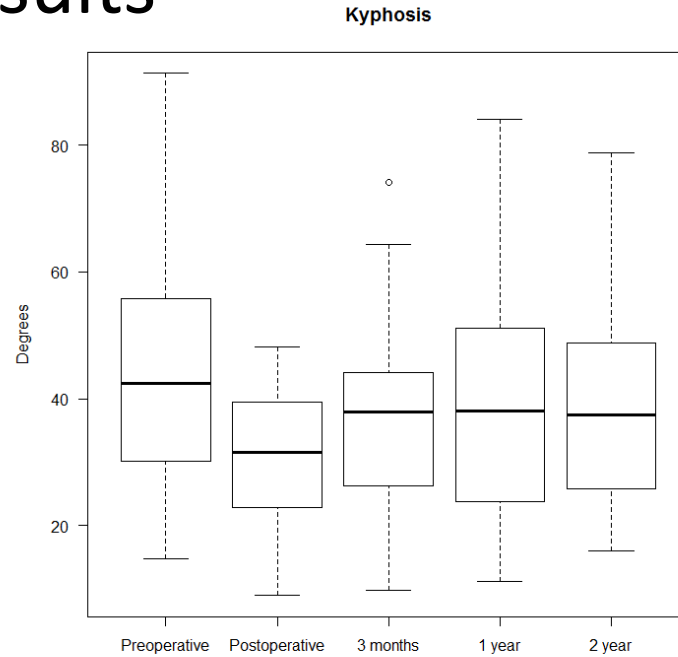
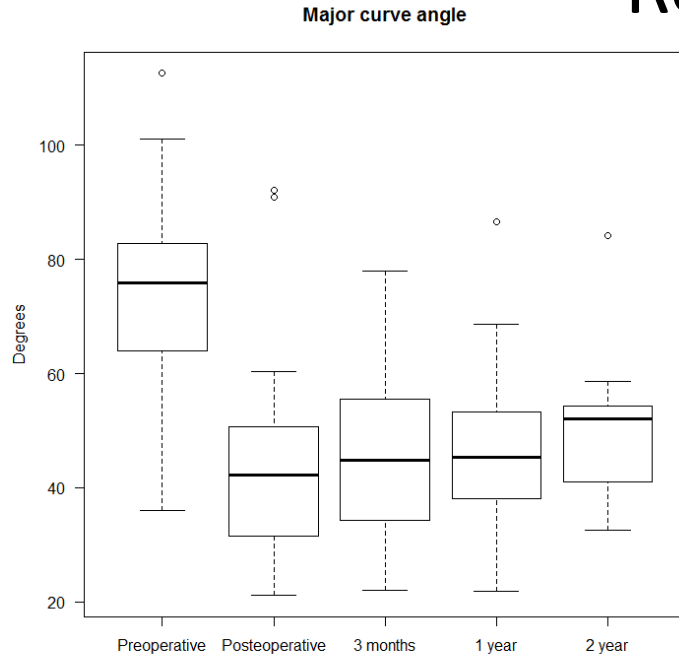
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Age at surgery (years)	mean (sd)	9.7 (1.9)
Age at diagnosis (years)	median [iqr]	5.5 [4.4, 7.9]
Gender (%)	Female	9 (47.4)
	Male	10 (52.6)
Height (cm)	mean (sd)	137.1 (15.4)
Weight (kg)	mean (sd)	28.7 (9.1)
Etiology (%)	Congenital/Structural	3 (15.8)
	Idiopathic	8 (42.1)
	Neuromuscular	5 (26.3)
	Syndromic	3 (15.8)
Major curve location (%)	Lumbar	2 (10.5)
	Thoracic	17 (89.5)
Preoperative major curve angle (°)	median [iqr]	75.8 [64.0, 82.8]
Preoperative kyphosis (°)	median [iqr]	42.4 [30.3, 54.9]
Preoperative lumbar lordosis (°)	median [iqr]	65.4 [50.0, 73.2]
Preoperative annual progression rate (°/year)	median [iqr]	14.4 [7.4, 18.9]
Preoperative T1-T12 height (mm)	median [iqr]	188.0 [170.0, 213.5]
Preoperative T1-S1 height (mm)	median [iqr]	302.0 [283.5, 333.0]

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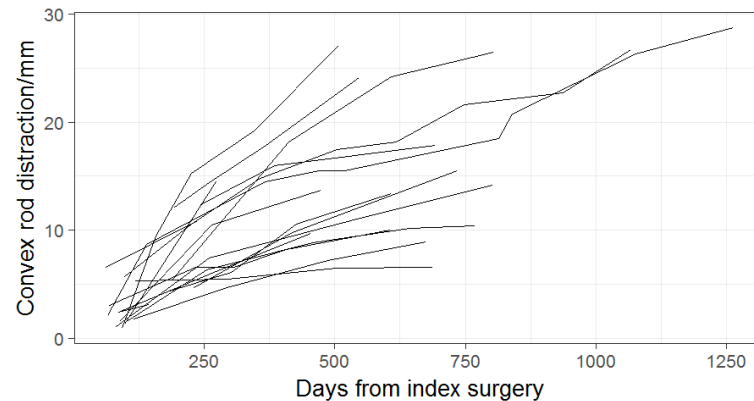
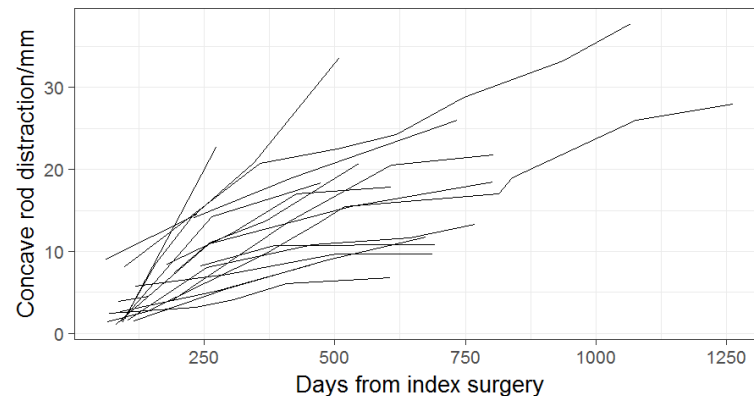
# Results



Major curve	Median [iqr]	76° [64;83]	42° [32;51]	45° [34;55]	45° [38;53]	52° [42;54]	Kyphosis	42° [30;55]	31° [23;40]	38° [27;44]	38° [24;50]	37° [26;49]
	p-value	-	<0.001*	<0.001*	<0.001*	<0.001*		-	<0.001*	0.28	0.17	1

# Distraction procedures

T1-T12 annual growth (mm/year)	median [iqr]	10.0 [5.5, 16.0]
T1-S1 annual growth (mm/year)	median [iqr]	11.0 [6.5, 33.0]
Concave rod distraction (mm/year)	median [iqr]	10.3 [6.4, 12.9]
Convex rod distraction (mm/year)	median [iqr]	8.2 [6.8, 11.6]
Concave rod distraction (mm/procedure)	median [iqr]	2.0 [1.5, 2.7]
Convex rod distraction (mm/procedure)	median [iqr]	1.7 [1.4, 2.5]
Distraction stop, n (%)	Pain/Discomfort	21 (13.4)
	Stall	130 (82.8)
	Decided by surgeon	6 (3.8)
	NA	3
Distraction interval (days)	median [iqr]	73.0 [60.8, 91.2]



# Complications

- No perioperative complications
- No distraction loss due to failure of the actuator
- Five implant-related complications (1 rod breakage, 3 screw loosening, 1 iliac hook fixation failure)
- Led to 4 unplanned reoperations (1 screw loosening managed conservatively)
- One superficial wound infection managed with oral antibiotics
- No deep infections
- One distraction led to persistent pain where the actuator had to be reversed
- Two distractions performed in a short general anesthesia

# Conclusions

- MCGR corrects major coronal curve effectively and curve correction is maintained throughout the distraction period
- A standardized distraction procedure with intended distraction-to-stall results in spinal growth
- Complication rates is satisfactory compared with the available literature