# Preparing Patients for Growth Friendly EOS Surgery

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### Elaine – clear expectations

Lindsay:

-

- risk assessment

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# Preparing Patients for Growth Friendly EOS Surgery

Medical Aspects Psychologic aspects expectations





# **EOS Patients Nutritionally Depleted**

- FAILURE TO THRIVE
  - 47-78% <5 percentile weight for age</p>
- Periactin
- GI consult, Gtube
- When improvement plateaus, operate
   don't wait for "normal"





#### Skaggs et. al, SRS, 2007, 2010

### **MRI** -without contrast

Cervical-thoracic-Lumbar

 Any EOS patient curve >20 degrees or symptomatic
 Chiari, syrinx, tumor, diatematomyelia, tethered cord, fatty filum, etc





# Cardiac Echococardiogram

- All operative congenital scoliosis
  - 20% cardiac abnormaliteis, VSD most common
- Cobb angle >75° (not supported by data)
- Cardiac History
- All neuromuscular patients
- Syndromic literature search





# **Pulmonary Consult**

- Cobb >75°
- History of pulmonary issues. ASK!
  - Hospital admission
  - Recurrent pulmonary infections





### Pediatric Spine Infections: Columbia, CHOP, CHLA: Vitale, et al 1252 pts, JBJS, 2012

- Idiopathic 2.5%, congenital 3.9%, NeuroMusc 9.2%,
- Idiopathic:
  - Fusions 1.6%
  - Growing implants 10%





# Building Consensus: Development of a Best Practice Guideline (BPG) for Surgical Site Infection (SSI) Prevention in High-risk Pediatric Spine Surgery

Michael G. Vitale, MD, MPH,\* Matthew D. Riedel, BA,\* Michael P. Glotzbecker, MD,†

Patients should have a chlorhexidine skin wash at home the night before surgery.\*
 Patients should have preoperative urine cultures obtained and treated if positive.\*
 Patients should receive a preoperative Patient Education Sheet.\*
 Patients should have a preoperative nutritional assessment.\*



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# **Pre-Op Traction?**

### 7 month old

- Cervical-thoracic kyphosis
- Severe deformity, weak anchors



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Effect of Preoperative Indications Conference on Procedural Planning for Treatment of Scoliosis

Charles M. Chan, MD<sup>a</sup>, Hasani W. Swindell, BS<sup>b</sup>, Hiroko Matsumoto, MA<sup>b,\*</sup>, Howard Y. Park, BA<sup>b</sup>, Joshua E. Hyman, MD<sup>b</sup>, Michael G. Vitale, MD, MPH<sup>b</sup>, David P. Roye, Jr, MD<sup>b</sup>, Benjamin D. Roye, MD, MPH<sup>b</sup>

#### 28% change of surgical plan for index surgeries

No cases cancelled





### **Outcome of Growing Rods**

- Decreased Cobb Angle at first, then maintaiend
- Increased Spine length Make kids taller!

• <u>???</u> Unknown Pulmonary Effects ???





# How Much Do they Grow?

	Dimeglio's Normal T1-S1 Growth	Akbarnia et al. 2012 Growing Rod Series	McCarthy et al. 2015 SHILLA Series N=40	GSSG Shilla Study N=20
T1-S1 height change during growth period	10 mm/yr	N=23 10 mm/yr	8 mm/yr	2.5 mm/yr



#### **Complications of Growing-Rod Treatment for Early-Onset Scoliosis: Analysis of One Hundred and Forty Patients**

Shay Bess, Behrooz A. Akbarnia, George H. Thompson, Paul D. Sponseller, Suken A. Shah, Hazem El Sebaie, Oheneba Boachie-Adjei, Lawrence I. Karlin, Sarah Canale, Connie Poe-Kochert and David L. Skaggs

- 24% increased risk of CCX with each additional surgery
- 13% less risk of a CCX for each year surgery delayed

- 910 growing rod surgeries
- 120% CCXs / patient
- 20% CCXs / surgery
- Rod fracture 24% of pts.
- Hook dislodgement 21%
- Infection 14%
- Pulmonary 7%



#### Bess, JBJS,2010

### Nutritional improvement following growing rod surgery in children with early onset scoliosis

Karen S. Myung · David L. Skaggs · George H. Thompson · John B. Emans · Behrooz A. Akbarnia · Growing Spine Study Group

Idopathics and congenitals gain weight %ile post op,
 – Neuromuscular and syndromic dont

J Child Orthop (2014) 8:251-256

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# SHILLA crankshaft, growth? Neuromuscular, non-ambulator

8yo





11yo





# Shilla

- Less surgery than traditional growing rods
- Less complications
- ? Growth compare to no treatment and growing rods
- ? Less surgery and CCXs than MCGRs













# Compression $\rightarrow$ Distraction????





ERE



# Ever needed surgery







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### **Traditional Growing Rods - Distraction Based**

- Spine or Rib Anchors
- Surgical Distraction
   @ 6-9 months
- $\rightarrow$  Final Fusion



# Weight as Proxy for Pulmonary Function Weight Gain following Growing Rods

- 162 pts.  $< 20^{\%}$ tile weight •
- Mean weight gain 11% over 6 years •

implant	%tile weight gain
Growing rod spine anchors	13%
Growing rods rib anchors	9%
VEPTR	4%
Guided growth construct	5%



ern California

Pending Publication, Spinal Deformity

# This is an actorActual results may vary









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### Implant Later





### Bess, JBJS,2010

# Initiative of Distraction Based Growing Rods

65 patients, 423 surgeries, (5 institutions) Congenital 22, Neuromuscular 23, Syndromic 14, Idiopathic 6

VEPTR:46; Growing Rods:14; Hybrids:4 260% CCXs per patient

42% CCXs per procedure

A joint effort of the CWSDSG and GSSG

ICEOS, 2013

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- repeated or lengthy use of general anesthetic and sedation drugs during surgery
- children<3 years</li>
- may affect brain development





# MCGR Magnetic Controlled Growth Rods





# MCGR + MRI FDA Clearance

- 1.5 Tesla
- maximum spatial field gradient of 3000 gauss/cm
- temperature rises no more than 3.7° C after 15 mins
- 20 cm of scatter



IOPAEDIC CENTER

# MCGR + MRI Clinical Study

- 10 patients
- No patient harm
- No device harm
- Brain, C-spine, other areas OK



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# T, L Spine MRI unreadable

# Magnetically controlled Growing Rods for Early-onset Scoliosis

A Multicenter Study of 23 Cases With Minimum 2 years Follow-up

Pooria Hosseini, MD, MSc,\* Jeff Pawelek, BS,\* Gregory M. Mundis, MD,\* Burt Yaszay, MD,<sup>†</sup> John Ferguson, MD,<sup>‡</sup> Ilkka Helenius, MD,<sup>§</sup> Kenneth M. Cheung, MD,<sup>¶</sup> Gokhan Demirkiran, MD,<sup>||</sup> Ahmet Alanay, MD,<sup>\*\*</sup> Alpaslan Senkoylu, MD,<sup>††</sup> Hazem Elsebaie, MD,<sup>‡‡</sup> and Behrooz A. Akbarnia, MD<sup>\*</sup>

#### TABLE 4. Radiographic Results (Mean)

		Baseline	Postoperation	6 Months	12 Months	24 Months	
Major curve	Primary	61.3	34.3	36.7	38	39.1	
maginade ( )	Conversion	49.4	43.8	37	39.5	44	

Cobb Angle did not improve

Spinal Deformity,

2016



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#### TABLE 4. Radiographic Results (Mean)

Spinal Deformity, 2016

		Baseline	Postoperation	6 Months	12 Months	24 Months
T1-T12 height (mm)	Primary	156.2	177.9	183.7	185.1	181.4
T1-S1 height (mm)	Primary	252.7	288.9	295.1	293	292.8

### PRIMARY: Spine did NOT grow from 6-24 months





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#### **TABLE 4.** Radiographic Results (Mean)

		Baseline	Postoperation	6 Months	12 Months	24 Months
T1–T12 height (mm)	Conversion	171.3	185.7	175.1	188.6	180.2
T1-S1 height (mm)	Conversion	270.3	294.4	275.8	289.8	290.2

Conversion Surgery: Spine Shrunk

• Device collapse, PJK

Spinal Deformity, 2016



# TGR: Law of Diminishing Returns -Controversial



Children's

Hospital Los Angeles CHILDREN'S ORTHOPAEDIC CENTER

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Gain (mm)

# Lengthening

Growing-Rod Graduates: Lessons Learned from Ninety-nine Patients Who Completed Lengthening Flynn, GSSG

- 86% new implants and fusion
- 10% growing rod exchange and fusion
- 62% described as "completely stiff" in op report
- 24% osteotomies

**JBJS**, 2013





# Graduation Protocol After Growing-Rod Treatment: Removal of Implants without New Instrumentation Is Not a Realistic Approach

Ismail Aykut Kocyigit, MD, Z. Deniz Olgun, MD, H. Gokhan Demirkiran, MD, Mehmet Ayvaz, MD, and Muharrem Yazici, MD

- "Plan on having spine implants in forever"
- 9/10 implant removals had clinically important worsening of the deformity and required reimplantation with fusion.





Is There an Optimal Time to Distract Dual Growing Rods? Michael D. Paloski, DO<sup>a</sup>, Paul D. Sponseller, MD<sup>b,\*</sup>, Behrooz A. Akbarnia, MD<sup>c,d</sup>, George H. Thompson, MD<sup>e</sup>, David L. Skaggs, MD<sup>f</sup>, Jeff B. Pawelek, BS<sup>d</sup>, Phuong T. Nguyen, MA<sup>g</sup>, Susan M. Odum, PhD<sup>g</sup>, Growing Spine Study Group

> > 9 months = <9 months Cobb Angle T1-S1 Length Instrumented length gain



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# Pain is the Greatest Preoperative Concern for Patients and Parents Before Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

Chan, Priscella MS; Skaggs, David L. MD, MMM; Sanders, Austin E. BA; Villamor, Gabriela A. BA; Choi, Paul D. MD; Tolo, Vernon T. MD; Andras, Lindsay M. MD

Spine: November 1, 2017 - Volume 42 - Issue 21 - p E1245–E1250

	Patient	Parent	Surgeon
1	Pain	Pain	Shoulder Balance
2	Return to Activities	Neuro Injury	Neuro Injury
3	Neuro Injury	Amount of Correction	LIV Selection
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