Classification of Growth Friendly Spine Implants
David L. Skaggs, Behrooz Akbarnia, John Flynn, Karen Myung, Paul Sponsellar, Michael Vitale

Approved by:
Chest wall and Spine Deformity Study Group
Growing Spine Study Group
POSNA
SRS Growing Spine Study Committee
Growth Friendly Implant Classification

1. Distraction based
   - Growing Rods
   - VEPTR
   - Magec & Phenix
Growth Friendly Implant Classification

1. Distraction based
   - Growing Rods
   - VEPTR
   - Magec & Phenix

2. Guided Growth
   - Luque-Trolley
   - Shilla
Growth Friendly Implant Classification

1. Distraction based
   - Growing Rods
   - VEPTR
   - Magec & Phenix

2. Guided Growth
   - Luque-Trolley
   - Shilla

3. Compression Based
   - Tether
   - Staple
Growth Friendly Implant Classification

1. Distraction based
   - Growing Rods
   - VEPTR
   - Magec & Phenix

2. Guided Growth
   - Luque-Trolley
   - Shilla

3. Compression Based
   - Tether
   - Staple

Only VEPTR FDA Approved for Spine*
Distraction Based – Traditional Growing Rods

- Spine Anchors
- Fusion at Anchors
  - @ 6-9 months
- Final Fusion
Distraction Based – Rib Anchors

Thorocotomies less common
Distraction Based
Magnetically Controlled Growth Rods

Magec
Magnetic Expansion Control

Phenix
## “Drive” T1-S1 Growth

### Normal Growth

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 yrs</td>
<td>2.0 cm/yr</td>
</tr>
<tr>
<td>5-10 yrs</td>
<td>1.2 cm/yr</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Follow-up</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 + 6 yrs</td>
<td>1.1 - 1.8 cm/yr</td>
</tr>
<tr>
<td>39 mo f/u</td>
<td></td>
</tr>
</tbody>
</table>

### VEPTR, Congenital, JBJS, 2003

<table>
<thead>
<tr>
<th>Follow-up</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 + 3 yrs</td>
<td>0.83 cm/yr</td>
</tr>
<tr>
<td>50 mo f/u</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thoracic only</td>
</tr>
</tbody>
</table>

### Distraction Based Rib Anchors

<table>
<thead>
<tr>
<th>Follow-up</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 + 1 yrs</td>
<td>Unilat -0.65 cm/yr</td>
</tr>
<tr>
<td>37 mo f/u</td>
<td>Bilat-1.2 cm/yr</td>
</tr>
</tbody>
</table>
Law of Diminishing Returns

Gain (mm)

Spine 2011

# Lengthening

Does not include gain at initial implant surgery
Traditional Growth Rods Get Stiff Over Time

T1-S1 Gain vs. # of Lengthenings

But continued gain even at L11-L15

? Smaller Effect with rib anchors?

Change T1-S1 / Lengthening (cm)
Complications of Growing-Rod Treatment for Early-Onset Scoliosis

Analysis of One Hundred and Forty Patients

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

- 24% increased risk of complications with each additional procedure
- 13% decrease in complications for each year surgery is delayed
Outcome of Distraction Based Implants (rib and spine based)

- Decreased Cobb Angle
- Increased Spine length
- Increase weight gain

- Unproven Pulmonary Effects
Growth Friendly Implant Classification

1. Distraction based
   - Growing Rods
   - VEPTR
   - Magec & Phenix

2. Guided Growth
   - Luque-Trolley
   - Shilla
Guided Growth Construct
Luque Trolley (no apical fusion)

- All fused spontaneously
  - 9 pts. 9 years old
  - All required further surgery
  - 7/9 instrument failure
  - Pre-op curve $50^0$ - Final curve $51^0$
  - Little growth of instrumented area – vague

Lubicky, Spine, 1992
Guided Growth - Shilla

Open Screws – no fusion
no bone exposed allow rod to slide multiaxial

3 level fusion compression distraction
Guided Growth - Shilla

Earliest cases suggest:
1. Less surgeries than distraction based growing rods
2. Less Cobb correction
3. Less spine growth

Growth Friendly Implant Classification

1. Distraction based
   - Growing Rods
   - VEPTR
   - Magec & Phenix

2. Guided Growth
   - Luque-Trolley
   - Shilla

3. Compression Based
   - Tether
   - Staple
Compression Based - Staples

Best for curves <35°
With growth remaining

8 yo female  3 year f/u
Courtesy Dr. Betz

Nov. 2002

March 2005
Compression Based: Tether

Pre

Post

4 yrs Post

Lenke, JBJS, 2010
Compression Based: Tether

HOPE
Anterior compression systems may restore physiologic kyphosis

Lenke, JBJS, 2010
When to Use What?

1. Distraction based
   - Growing Rods
   - Hybrid
   - VEPtr
   - MGCR

2. Guided Growth
   - Luque-Trolley
   - Shilla

3. Compression Based
   - Tether
   - Staple
Thank You
Thank You!
Thank You
Tethers

- Animal models
- Problematic
- Future?
Backpain: When to Worry

David L. Skaggs, MD
Professor and Chief
Children’s Hospital Los Angeles
University of Southern California
Children’s Hospital Los Angeles