Classification of Growth Friendly Spine Implants
David L. Skaggs, Behrooz Akbarnia, John Flynn, Karen Myung, Paul Sponsellar, Michael Vitale
J Pediatric Orthopedics, 2013

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

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

---

Distraction Based – Traditional Growing Rods

- Spine Anchors
- Fusion at Anchors
- Surgical Distraction
  - @ 6-9 months
- Final Fusion

---

Only VEPTR and SHILLA FDA Approved for Non-Fusion
Distraction Based – Rib Anchors
+/- thoracotomy

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>

VEPTR, Congenital
JBJS, 2003

“Drive” T1-S1 Growth

<table>
<thead>
<tr>
<th>Age Range</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>50 mo f/u</td>
<td>0.83 cm/yr Thoracic only</td>
</tr>
<tr>
<td>3+1 yrs</td>
<td>Unilateral -0.65 cm/yr Bilateral -1.2 cm/yr</td>
</tr>
</tbody>
</table>

Distraction Based Rib Anchors
89% congenital

Law of Diminishing Returns

Gain (mm)

# Lengthening

Does not include gain at initial implant surgery
Non-surgical Distraction
External Remote Control

Magec
Magnetic Expansion Control

Phenix

Outcome of Growing Rods

- Decreased Cobb Angle
- Increased Spine length

- ??? Unknown Pulmonary Effects ???

Weight as Proxy for Pulmonary Function

Weight Gain following Growing Rods

Myung, SRS, 2009
Guided Growth

- Luque Trolley
- SHILLA

Luque Trolley (no apical fusion)

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

Lubicky, Spine, 1992

Modified Luque Trolley

Courtesy of Brian Freeman, MD
LONG-TERM SPINAL AND RESPIRATORY FUNCTION IN EARLY ONSET SCOLIOSIS MANAGED WITH SELECTIVE EPIPHYSIODESIS AND POSTERIOR "LUQUE TROLLEY" GROWING INSTRUMENTATION

A Scheuler, N Steele, SH Medhian, MP Grevitt, BJ Freeman, JM Webb and PJ Kiely
Abstract, JBJS br, 2008

- 16 patients at maturity, 12 yr f/u
- Mean 10.5cm loss of spinal growth
- Spirometry:
  - 24% normal
  - 32% mild restrictive
  - 12% moderate restrictive
  - 28% severe restrictive

Shilla - Growth Guidance System

- Dual Rod Construct
- Limited fusion at Apex
- Shilla screws at end that slide along the rods
- Allows continued growth without surgical lengthening

Developed by Rick McCarthy

7 yo boy compliance challenge - autism

PREOPERATIVE POSTOPERATIVE 2 years
Compression Based Treatment

• Staples
  • Growth Restricting
  • “Older” young kids

• Tethers

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

curves <35°
With growth remaining

Anterior Tether

Pre  Post  4 yrs Post

Lenke, JBJS, 2010
Anterior Tether Systems

- Dynesys (Zimmer) - used by surgeons in US - FDA Off-Label
- Depuy system, clinical trials in Singapore, Dr. Hee Kit Wong

10yo, Arthrogryposis, Bilateral Dislocated Hips

Posterior Tether:

9 yo boy - mitochondrial disorder

- Progressive kyphosis and scoliosis
- Failed bracing, ambulatory

Posterior Unilateral Tether

No bone exposed
Moderate compression

Hope – Fusionless Correction
26 Months - scoliosis unchanged

Pre 41°
Post 26°
26 months f/u 26°

--

Kyphosis Improving

Pre 73°
Post 65°
26 months 42°

--

31 months post-op tether

Acute plough of T11 screw and junctional kyphosis
31 months post-op tether - age 12

Solid autofusion - bilateral!

Removing HA coated screws – no problem

Conclusions:
Unilateral Posterior Tether in 9yo in place 31 months

1. Improved scoliosis immediately (41° → 26°) but no improvement over time
2. Improved kyphosis progressively for 2.5 years (73° → 42°)
3. Resulted in solid bilateral posterior fusion

When to Use What?

1. Distraction Based
   - Growing Rods
   - Rib Based
   - Velpeau
   - Magee & Thores

   Drives the spine
   Maximize Spine Length
   Lots of surgeries & CCXs < age 7?

2. Guided Growth
   - Shilla
   - Luque-Trolley

   Less Surgery
   Less Growth
   age 6-9?

3. Compression Based
   - Tether
   - Staple

   Less Growth
   1 surgery - hope over-correction
   age 5? Over-correction
Thank You