Masters Techniques:
Rib Anchored Distraction Based Growing Rods

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Use of Spine Hooks on Ribs NOT FDA Approved
Part 1: Theoretical Advantages
Hooks on Ribs: No intentional fusion
Do not expose or fuse upper spine
No thorocotomy!
Traditional Growing Rods Cause Autofusion
Cahil, et. Al, Spine 2010

- 8/9 patients autofused - Stiff Curves!
- Growing rods in for 7 yrs
- Mean of 7 osteotomies done at final fusion
- 44% Cobb Angle correction
• Movement of the ribs joints
• “slop” of the hooks
?= less autofusion
Traditional Growth Rods Get Stiff Over Time

T1-S1 Gain vs. # of Lengthenings

? Smaller Effect with rib anchors?

But continued gain even at L11-L15
• Movement of the ribs joints
• “slop” of the hooks
?= Less likely to break rods
• Movement of the ribs joints
• “slop” of the hooks
?= Less likely to break rods

GSSG Study – 176 pts, 56 month f/u
rib anchored growing rods 77%
less likely to break rods than
spine anchored
Nutritionally Depleted Population

- Soft tissue Coverage Challenging
- 47% pts pre-op failure to thrive (<5 percentile)

Myung, 2009
Rib based anchors better for PJK?

- Hybrids 42% (5/12) Vs. Growing rods 62% (10/17)
  - $P=0.059$

Advantages of rib anchors

• Avoid proximal fusion
• Less rigid system
  – Minimize autofusion?
  – Less rod breakage
• Lower Profile
• Less PJK?
Advantages of rib anchors

• Avoid proximal fusion
• Less rigid system
  – Minimize autofusion?
  – Less rod breakage
• Lower Profile
• Less PJK?

Possible Disadvantage
– Does it hurt pulmonary function?
Why use “spine hooks” instead of VEPTR

- Already in hospital
  - Staff familiar
  - Minimize inventory
  - I am more familiar with systems I use daily
- No IRB approval needed
- Less expensive
- Easy to adjust sagittal contour and hook placement
Why use “spine hooks” instead of VEPTR

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My opinion
Clinical Equipose Between “spine hooks” and VEPTR
Part 2: Technique

- Disclosure - Technique is pretty straightforward
- Few Problems
Midline Incision - Plan for final fusion

Single Rod Case
3 and 5 cm incisions
no thoracotomy
Midline Incision - Plan for final fusion

- No Dissection of Proximal Spine
- Feel bump of transverse process
- Split muscles just lateral to TP

Adjacent to TP
Adjacent to TP

Extra-Periosteal
Want ribs to hypertrophy
NOT in chest
No chest tube
No Advantage to “Claw”
Don’t use first rib
Fails Posterior
Case Example
5yo boy

- Ambulatory
- Neuromuscular
- 91° Scoliosis - progressive
- Extremely thin
Current Preference

- Dual-sided constructs
- $\geq 3$ up-going hooks

REALLY thin kids

NO Thorcotomy
Straight Longitudinal Connector

Too Long (straight) Vs. Too Short (Few lengthenings)

Bend Rods

Connector Thoraco-Lumbar
Lengthening Through Curved Rods

- More Posterior Prominence
- More Kyphosis
Lengthening Through Curved Rods

- More Posterior Prominence
- More Kyphosis
Lengthening Through Curved Rods

- More Kyphosis
- + Sagittal Balance
Rib Anchored

Scoliosis
BAILOUT-Previous infection
Previous laminectomies/scarring
Multiple rib fusions/thoracostomy

Spine Anchored

Kyphosis
Thank You
Many Options

Unilateral Dual Rods
VEPTR like

Unilateral Single Rods

Bilateral Dual Rods
Growing rod like
Current Preference

- Dual-sided constructs
- ≥3 up-going hooks
<table>
<thead>
<tr>
<th>Normal Growth</th>
<th>0-5 yrs</th>
<th>2.0 cm/yr</th>
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<tbody>
<tr>
<td>5-10 yrs</td>
<td></td>
<td>1.2 cm/yr</td>
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<tbody>
<tr>
<td>5 + 6 yrs</td>
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<tr>
<td>39 mo f/u</td>
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<tr>
<td>1.1 - 1.8 cm/yr</td>
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<table>
<thead>
<tr>
<th>VEPTR, Congenital, JBJS, 2003</th>
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<tbody>
<tr>
<td>3 + 3 yrs</td>
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<tr>
<td>50 mo f/u</td>
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<tr>
<td>0.83 cm/yr</td>
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<table>
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<tr>
<th>Hybrid Implants, 85% congenital</th>
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<tbody>
<tr>
<td>3 + 1 yrs</td>
</tr>
<tr>
<td>37 mo f/u</td>
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- **Unilat**: -0.65 cm/yr
- **Bilat**: -1.2 cm/yr
Sagittal Contouring
Video
Rudimentary first thoracic rib with post-fixed brachial plexus
Growing Rod Surgery is Like ..
Hooks on Ribs: Lower Profile than Spine

Spine Anchors
References

Purpose

- To report the early results of this technique.
No Thorocotomy

2 ribs

2 screws
Complications

• Risk factors:
  – Younger age at index surgery (p=0.12)
  – Larger initial Cobb angle (p=0.12)
<table>
<thead>
<tr>
<th></th>
<th>% rod breakage</th>
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<tbody>
<tr>
<td>Traditional Growing Rods</td>
<td>120% (12/10)</td>
</tr>
<tr>
<td>Hybrid growing rods</td>
<td>0% (0/6)</td>
</tr>
<tr>
<td>Veptr</td>
<td>31% (6/19)</td>
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</table>
• FDA Off label
• No IRB approval
• $ < VEPTR
• Allows precise hook placements - non-constrained
  – Sagittal contouring
Conclusions

• Complications in Hybrids is less common than other distraction based growth implants
  – Low profile
  – Multiple non-constrained load sharing anchors
  – Bend Sagittal profile to meet patients needs
  – Uses standard spine implants (no IRB approval needed)

Avoids intentional fusion of upper thoracic spine
Rib Anchored Distraction Based Implants
Growing Rods
Law of Diminishing Returns
T1-S1 Gain Vs. # of Lengthenings

Gain (mm)

# Lengthening

<table>
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<tr>
<th>Length</th>
<th># Lengthenings</th>
<th>n</th>
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<tbody>
<tr>
<td>Length 1</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td>Length 2</td>
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<td>6</td>
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<td>0</td>
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