Rib Anchors in Growing Rods

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What is Dr. Newton hiding?
Stout rib hooks, not thin VEPTR
Advantages of Rib Anchors

- Avoid proximal fusion
- Lower Profile
- Less rigid system
  - Less rod breakage
- Safer failure mode
- Better Moment Arm

No Difference Rib and Spine

- Pullout Strength
- PJK
- Failure Rate
Hooks on Ribs: No intentional fusion
Do not expose or fuse upper spine
No thorocotomy!
Adjacent to TP

Extra-Periosteal

Want ribs to hypertrophy

NOT in chest

No chest tube
Nutritionally Depleted Population

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

Myung, 2009
Midline Incision – Plan for final fusion
Minimal Muscle Dissection

Low Profile
Rods broke 4X less with rib anchors than spine anchors

Yamaguchi, Skaggs, Mansour, Myung, Yazici, Johnston, Thompson, Sponseller, Akbarnia, Vitale, Growing Spine Study Group. *Spine Deformity, 2014*

<table>
<thead>
<tr>
<th></th>
<th>Patients</th>
<th>Rod Breakage</th>
<th>Anchor complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rib Anchored</td>
<td>34</td>
<td>6%</td>
<td>38%</td>
</tr>
<tr>
<td>Spine Anchored</td>
<td>142</td>
<td>29%</td>
<td>33%</td>
</tr>
</tbody>
</table>

P=0.04

P=0.12
Hooks Fail Safely Posterior

Rib Hook pullout = Screw pullout
357 patients, 6 year follow-up

Screws have failed into spinal cord

POSNA 2017

Kira Skaggs,
Ribs can provide **better moment arm** than pedicle screws.
Biomechanical Evaluation … Are Rib Anchors Comparable to Spine Anchors?
Akbarnia et al, Spine Deformity, 2014

Rib Hooks = Pedicle Screws > TP or Laminar Hooks

![Graph showing max load in N for HH, RR, TPL, SS categories with rib hooks and screw hook comparisons.](image)
Use >5 Anchors Minimizes Failure

- 22% (77/357) patients anchor pullout
- Type of Anchor (screw vs spine hook vs rib hook) did not affect pullout rate (p=0.850)

<table>
<thead>
<tr>
<th>Anchors</th>
<th>Pullout</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2</td>
<td>22%</td>
</tr>
<tr>
<td>&gt;3</td>
<td>20%</td>
</tr>
<tr>
<td>&gt;4</td>
<td>20%</td>
</tr>
<tr>
<td>&gt;5</td>
<td>12%</td>
</tr>
<tr>
<td>&gt;6</td>
<td>10%</td>
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</tbody>
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2,3, or 4 Vs. 5 or 6 anchors

p=0.01

IMAST 2016, POSNA 2017
Anchors at or above UEV
Minimizes Proximal Extension
(final fusion or revision growth friendly implants)

• at or above UEV: 20% (26/130)

• UEV: 30% (21/70) (p=0.026)

IMAST 2016, POSNA 2017
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No Difference Rib and Spine

• Pullout Strength
• PJK
• Failure Rate
Pre-Course Faculty Prefer Rib Anchors for Distraction Based Growing Rods

<table>
<thead>
<tr>
<th>Ribs</th>
<th>Indications</th>
<th>Spine</th>
<th>Indications</th>
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</thead>
<tbody>
<tr>
<td>Andras</td>
<td>&lt;8 years</td>
<td>Glotzbecker</td>
<td></td>
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<tr>
<td>Blakemore</td>
<td></td>
<td>Samdani</td>
<td></td>
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<tr>
<td>Farrington</td>
<td>&lt;8 years</td>
<td>Sanders</td>
<td></td>
</tr>
<tr>
<td>Luhmann</td>
<td>&lt;7-9 Years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawyer</td>
<td>&lt;8-9</td>
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<td></td>
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<tr>
<td>Skaggs</td>
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<td></td>
<td></td>
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<tr>
<td>Smith</td>
<td>always</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitale</td>
<td>&lt;6 years</td>
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Thank You