Which Osteotomy Should I use in Congenital Scoliosis?

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Disclosures

Lindsay Andras, MD: Biomet (d), Eli Lilly (c), Journal of Pediatric Orthopedics (e), Medtronic (d), Orthobullets (f), Pediatric Orthopaedic Society of North America (e), Scoliosis Research Society (e)

a. Grants/Research Support
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Background

Treatment of congenital spinal deformity

- 3 column osteotomies
  - hemivertebrectomy (HV)
  - vertebral column resection (VCR)

- Multiple Ponte osteotomies (PO)

Goal: To evaluate the outcomes of patients with congenital spinal deformity treated with PO vs. HV/VCR
Methods

Retrospective review of patients with congenital spinal deformity treated with posterior spinal fusion

Study period: 1996-2013

- Exclusion criteria:
  - prior instrumentation
  - isolated cervical deformity
  - growing spine instrumentation
  - < 2 year follow-up

49 patients met the inclusion criteria
- 17 PO
- 32 HV/VCR (26 HV; 6 VCR)
Deformity angular ratio (DAR) calculated for each patient (curve magnitude/# levels of deformity)

# Results

Coronal and Sagittal DAR was similar between groups

<table>
<thead>
<tr>
<th></th>
<th>PO (n=17)</th>
<th>HV/VCR (n=31)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age (years)</td>
<td>14</td>
<td>7</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mean Preoperative Cobb Angle</td>
<td>65</td>
<td>54</td>
<td>0.031</td>
</tr>
<tr>
<td>Mean Preoperative Kyphosis</td>
<td>60</td>
<td>53</td>
<td>0.30</td>
</tr>
<tr>
<td>Mean Coronal DAR</td>
<td>12</td>
<td>14</td>
<td>0.17</td>
</tr>
<tr>
<td>Mean Sagittal DAR</td>
<td>13</td>
<td>14</td>
<td>0.66</td>
</tr>
<tr>
<td># of congenital anomalies</td>
<td>1.8</td>
<td>2.1</td>
<td>0.43</td>
</tr>
</tbody>
</table>
Results

• More levels were fused in the PO group than HV/VCR group (11 levels vs 5 levels, p<0.001)
## Results

Amount of correction was the same between groups

<table>
<thead>
<tr>
<th></th>
<th>PO (n=17)</th>
<th>HV/VCR (n=31)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Postoperative Cobb Angle (°)</td>
<td>32</td>
<td>25</td>
<td>0.18</td>
</tr>
<tr>
<td>Mean Postoperative Kyphosis (°)</td>
<td>40</td>
<td>34</td>
<td>0.21</td>
</tr>
<tr>
<td>Mean Percent Correction of Cobb Angle (%)</td>
<td>54.1</td>
<td>54.4</td>
<td>0.78</td>
</tr>
<tr>
<td>Mean Percent Correction of Kyphosis (%)</td>
<td>145</td>
<td>127</td>
<td>0.753</td>
</tr>
<tr>
<td>Mean Postoperative Coronal DAR</td>
<td>6.0</td>
<td>6.1</td>
<td>0.911</td>
</tr>
<tr>
<td>Mean Postoperative Sagittal DAR</td>
<td>8.5</td>
<td>7.4</td>
<td>0.404</td>
</tr>
</tbody>
</table>
Results

Signal changes were significantly **more frequent** with VCR \((p=0.001)\):

- 5.9% (1/17) in PO group
- 3.8% (1/26) in HV group
- 67% (4/6) in VCR group
Results

• VCR group: 2 neurologic deficits
  • 1 resolved by 2 weeks postoperatively
  • 1 had complete lower extremity paralysis

• PO group: 1 neurologic deficit
  • resolved after decompression and staged fusion
Results

Return to OR was higher in the HV/VCR group but was not significantly different (p=0.35)

<table>
<thead>
<tr>
<th>Reasons for reoperation</th>
<th>PO (n=17)</th>
<th>HV/VCR (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>3 (17.6%)</td>
<td>12 (37.5%)</td>
</tr>
<tr>
<td>Decompensation below LIV</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Proximal junctional kyphosis</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Broken implants</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Implant migration</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CSF leak and wound dehiscence</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pseudarthrosis</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Wound drainage</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Implant prominence</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Progression of scoliosis</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
Do you need to operate? When to wait...

- Asymptomatic
- Nonprogressive
- Slowly progressing and small (<3yo)
Evaluate progression

• Look back at many XR, compare side by side

• High inter and intra-rater variability in measuring congenital scoliosis
  - Loder et al: intraobserver variability +/- 9.6 degrees
  - interobserver variability +/-11.8 degrees
  - true progression = >23 degree change

• Facanha-Filho, Winter et al, JBJS 2001:  
  - if comparing XR side by side, an accuracy of 
    +/-3 degrees can be expected 95% of the time
Do you need to operate? When to act...

- Progressive
  - if slow try to postpone until at least 3-4yo

- Significant Stenosis

- Poor balance
Options in Congenital Scoliosis

- Ponte
- Hemivertebrectomy
- Vertebral Column Resection
Ponte Osteotomy

Inferior Facet

- Osteotome
- Bone Scalpel

Superior Facet

- M8 Burr
- Kerrison
- Bone Scalpel

Bleeder lateral to facet
15 yo boy - T4 hemivertebrae

Treatment?
Hemi-vertebrectomy?
Multiple Ponte Osteotomies
- no resection

57°

71°
Ponte Osteotomies

Approximately 10 degrees per level

Improves flexibility for derotation
- 3 degrees per level
(Sangiorgio et al Spine Def 2013)

• Older Children having longer fusions
• Revisions/ Prior fusion mass
  (esp growing rod/VEPTR conversions)

s/p guided growth
With apical fusion
At OSH with continued progression
Ponte Osteotomies

Approximately 10 degrees per level

Improves flexibility for derotation
- 3 degrees per level
(Sangiorgio et al Spine Def 2013)

• Older Children having longer fusions
• Revisions/ Prior fusion mass
  (esp growing rod/VEPTR conversions)
Posterior Osteotomies
Previous Fusion

- Identify transverse processes
- Need Open discs
- Note which goes with which
  - Image to identify pedicles
Motion Essential
confirm w/ Laminar Spreader
Multiple Osteotomies
Hemivertebrectomy

Best for: Isolated hemivertebrae with focal deformity

- esp in small children

- try to postpone until 3 yo or older if not rapidly progressing
Template with 3D CT

- Evaluate pedicles above and below
- Often abnormality posteriorly doesn’t mirror deformity anteriorly
Hemivertebrectomy

- Bone Scalpel
Hemivertebrectomy

- Consider Hooks a 3rd rod to close osteotomy with hooks on ribs or lamina
Vertebral Column Resection

• Rarely needed in young patients
• Highest neurologic risk
• Consider other options
  - halofemoral traction
Summary

Hemivertebrectomy
- Short focal deformity
- Younger children
- More Revisions

Ponte Osteotomies
- Longer segments
- Older Children
- More Derotation
- Fewer Implant Issues