Foundation Iliac Fusion Combined With Shilla

A Technique For The Treatment Of Neuromuscular Scoliosis (NMS) With Pelvic Obliquity

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Disclosures

- POSNA BOD
- AAP Executive Committee
- Project Perfect World Medical Advisory Board
- Miracle Feet Medical Advisory Board
- Consultant Orthopediatrics
- Medtronic charitable donation
Principles of Shilla

- Harness the growth of the spine through the end plates.
- Maintain flexibility to prevent auto-fusion and stiffness.
- Load share among multiple vertebral levels.
- Less constrained system, guides the growth of the abnormal spine to a more normal shape and position.
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The Problem: Pelvic Obliquity Progression

• A 3 yo old girl with SMA and pelvic obliquity (from GSSG)
• At 9 years follow up...
Ideal

• The reason
  • Apical fusion technique can’t control the pelvic obliquity

• Inspiration and method
  • The Pylon Concept
  • Hard foundation (fixed and fusion) + growth friendly rod-screw system.
  • Correct apex of deformity without fusion
Indications and Methods

• Enough growth remaining to be worthwhile (under age 10 years).
  • Typically 5-9 years of age.

• Sufficient end plates to drive the growth.

• Flexible curve.

• Surgical goals:
  • balanced spine over a level pelvis
  • secure pelvic foundation
  • minimal constraint/prominence of the upper implants
  • minimal spine exposure to maintain growth and flexibility

• IRB approved, single center, retrospective, cohort study

• 2008-July 2017 – Inclusion: NMS patients who underwent a Shilla technique with pelvic screw foundation.

• Minimum 2 years follow up.
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- Flexible curve.
- Surgical goals:
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  - minimal spine exposure to maintain **growth and flexibility**
- IRB approved, single center, retrospective, cohort study
- Minimum 2 years follow up.
Results: 17 cases - 7 met inclusion criteria

<table>
<thead>
<tr>
<th>CASE</th>
<th>GENDER</th>
<th>DIAGNOSIS</th>
<th>BLOOD LOSS</th>
<th>AGE</th>
<th>FOLLOW UP TIME</th>
<th>PELVIC OBLIQUITY (DEGREE)</th>
<th>COBB ANGLE (DEGREE)</th>
<th>APEX LOCATION</th>
<th>T1-S1 LENGTH (CM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>SMA2</td>
<td>450</td>
<td>8.6</td>
<td>6.6</td>
<td>Preop: -14  1 year Postop: 2  Last follow up: -4</td>
<td>Preop: 42  1 year Postop: 10  Last follow up: 31</td>
<td>T5  T5  T2</td>
<td>28.7  30.7  42.4</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>spina bifida</td>
<td>750</td>
<td>3.5</td>
<td>7.2</td>
<td>Preop: 9  1 year Postop: 3  Last follow up: 2</td>
<td>Preop: 62  1 year Postop: 18  Last follow up: 20</td>
<td>L5  L4-5  L4</td>
<td>18.4  20.0  25.2</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>SMA2</td>
<td>700</td>
<td>5</td>
<td>3.9</td>
<td>Preop: 37  1 year Postop: 3  Last follow up: 0</td>
<td>Preop: 121  1 year Postop: 21  Last follow up: 23</td>
<td>T11  T11  T10-11</td>
<td>20.8  30.9  35.2</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>CP</td>
<td>1450</td>
<td>5.2</td>
<td>10.2</td>
<td>Preop: 18  1 year Postop: 4  Last follow up: -5</td>
<td>Preop: 53  1 year Postop: 18  Last follow up: 84</td>
<td>T10  T9  T3</td>
<td>30.4  33.5  42.5</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>CP</td>
<td>1150</td>
<td>4.7</td>
<td>5</td>
<td>Preop: -23  1 year Postop: -4  Last follow up: -1</td>
<td>Preop: 67  1 year Postop: 36  Last follow up: 28</td>
<td>L3  L3  L2</td>
<td>29.0  34.3  39.4</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>CP</td>
<td>320</td>
<td>5.2</td>
<td>5.3</td>
<td>Preop: -31  1 year Postop: -4  Last follow up: -8</td>
<td>Preop: 75  1 year Postop: 26  Last follow up: 40</td>
<td>L4  L3  L3</td>
<td>24.6  28.5  36.9</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>CMD Congenital muscular dystrophy</td>
<td>280</td>
<td>6.7</td>
<td>2</td>
<td>Preop: 11  1 year Postop: 5  Last follow up: 6</td>
<td>Preop: 92  1 year Postop: 56  Last follow up: 63</td>
<td>T11  T10  T10</td>
<td>26.5  31.4  33.0</td>
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<tr>
<td>mean</td>
<td></td>
<td></td>
<td>728.6</td>
<td>5.6</td>
<td>5.7</td>
<td>Preop: 20.4  1 year Postop: 3.6  Last follow up: 3.7</td>
<td>Preop: 73.1  1 year Postop: 26.4  Last follow up: 41.3</td>
<td>T11  T10  T10</td>
<td>25.5  30.0  36.4</td>
</tr>
</tbody>
</table>

T1-S1 length 25 cm Preop → 30 cm one year post op → 36 cm final FU at 5.7 years. 1 cm/year.
Case 1

- 5 yf GMFCS 5 CP
- Functional goal: comfort, sitting, care, nutrition.
Postop

1 year follow up
2 year follow up
5 year follow up
Case 2  July 2008

- 5 yf GMFCS 5 CP  22 kg
- Functional goal: comfort, sitting, care, nutrition.
postop

1 year follow up

2 year follow up

10 year follow up
13 yo, 5 year post op
Apex migration

10 years postop
Only had index surgery
Apex T3
Lessons Learned

• This technique allows
  • Spine to stay flexible while implants *guide* the growth
  • Natural end plate growth *drives* the growth
  • Balanced spine over level pelvis. Pelvic obliquity improved and not deterioration at FU
  • Potential for “one and done” surgery, but not always

• Avoid Crankshaft. Don’t expose the spine “extra-periosteal”. Use C arm and navigation to not even see the spine.

• Do the surgery when spine still flexible
• May see new apex at proximal part of the construct
• Avoid PJK
• Need for better design