Introduction of Shilla surgery into Japan
A report on the first 22 patients

National Hospital Organization
Kobe Medical Center

Teppei Suzuki, Koki Uno
# Disclosure

<table>
<thead>
<tr>
<th>Author</th>
<th>Relationships Disclosed</th>
</tr>
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<tbody>
<tr>
<td>Teppei Suzuki</td>
<td>No Relationship</td>
</tr>
<tr>
<td>Koki Uno</td>
<td>DePuy Spine (b)</td>
</tr>
</tbody>
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(a) Grants/Research Support  
(b) Consultant  
(c) Stock/Shareholder  
(d) Speakers’ Bureau  
(e) Other Financial Support
Introduction

EOS (Early-onset scoliosis)
Severe deformity
TIS (Thoracic insufficiently syndrome)

Life threatening health risk
Campbell; JBJS, 2003
Davies; Arch Dis Child, 1971

Limited Fusion
(Apical fusion, wedge resection, etc)

Fusionless treatment
Distraction based (Growth sparing)
Growing Rod VEPTR

Growth guidance
Luque Stapling Shilla

McCarthy; ICEOS, 2008
Purpose

Retrospective case review of 24 consecutive children who had modified Shilla procedure at a single institution.
<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>No. of patients</td>
<td>22</td>
</tr>
<tr>
<td>Gender (F:M)</td>
<td>13:9</td>
</tr>
<tr>
<td>Age at the initial surgery</td>
<td>8.5±2.3y.o.</td>
</tr>
<tr>
<td>Follow-up</td>
<td>3.1±1.6yrs</td>
</tr>
</tbody>
</table>

4 patients had definitive fusion
Single Thoracic, 17
Double thoracic, 1
Single Thoracic, 17
Thoracolumbar, 4
Double Major, 1
Syndromic, 12
Idiopathic, 3
Congenital, 3
Neuromuscular, 4
Larsen
Other
Marfan
PWS
Sotos
Other
Syndromic
Idiopathic
Congenital
Neuromuscular
Sotos
PWS
Marfan
Other
Larsen
Curves type
Etiology
### Modified Shilla procedure

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cephalad anchor</td>
<td>Extraperiosteal placement</td>
</tr>
<tr>
<td>Sliding screw</td>
<td>or/and Sublaminar wire</td>
</tr>
<tr>
<td>With HDPE cable</td>
<td></td>
</tr>
<tr>
<td>Apical fusion</td>
<td>3-5 vertebrae</td>
</tr>
<tr>
<td>With pedicle screw</td>
<td>With Ponte osteotomy</td>
</tr>
<tr>
<td>Caudal anchor</td>
<td>Extraperiosteal placement</td>
</tr>
<tr>
<td>Sliding screw</td>
<td>or/and Sublaminar wire</td>
</tr>
<tr>
<td>With HDPE cable</td>
<td></td>
</tr>
</tbody>
</table>

**HDPE:** High-density polyethylene
Measurement

Preinitial ➔ Postinitial ➔ Final f/u

Major Curve

Kyphosis (T1-5  T5-12)

T1-S1 Length

SAL

Concave & Convex

Complications
Coronal parameter

**Initial Correction Rate**
48±12%

---

**Degree**

- **Main thoracic**
  - Preinitial: 86
  - Postinitial: 44
  - FFU: 64

- **Lumbar**
  - Preinitial: 43
  - Postinitial: 29
  - FFU: 39

- **Upper thoracic**
  - Preinitial: 44
  - Postinitial: 22
  - FFU: 38

*P<0.01*
Coronal parameter

The correction in apical fusion was maintained

Shilla
Thoracic kyphosis

Degree

Preinitial Postinitial FFU

T1-5 T5-12

P<0.01 P<0.01 N.S.

7 47 30 16 18

47 47
Length of elongation

**Truncal height**
- T1-S1: 47 mm
- T1-12: 27 mm

**SAL**
- Concave: Initial 27 mm, Growth 2 mm
- Convex: Initial 19 mm, Growth 4 mm
### The detail of the complications

<table>
<thead>
<tr>
<th>No.</th>
<th>Detail</th>
<th>Cephalad</th>
<th>Caudal</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 Pts</td>
<td>30 complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dislodgement</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pull-out</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cephalad</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Caudal</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Infection</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Breakage</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>9 Pts</td>
<td>16 Unplanned surgeries</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cephalad anchor</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Caudal anchor</td>
<td>11</td>
<td></td>
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Almost all unplanned surgeries consisted of partial removal of implant prominence.
Definitive Fusion

Drastic correction of lumbar curve is possible at the definitive surgery.

None of the 4 cases showed autofusion in fusionless area.
### Review

<table>
<thead>
<tr>
<th></th>
<th>No of cases</th>
<th>Complication rate</th>
<th>No. of additional surg. / Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our study</td>
<td></td>
<td></td>
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<tr>
<td>Shilla</td>
<td>22</td>
<td>82%</td>
<td>0.8±1 / 4year</td>
</tr>
<tr>
<td>Akbarnia, et al.; Spine 2008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growing rod</td>
<td>140</td>
<td>58%</td>
<td>Repetitive scheduled surgeries</td>
</tr>
<tr>
<td>Watanabe, et al.; Spine 2013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growing rod</td>
<td>88</td>
<td>57%</td>
<td>8 / 4year</td>
</tr>
<tr>
<td>Emans, et al.; Spine 2005</td>
<td></td>
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<tr>
<td>VEPTR</td>
<td>31</td>
<td>55%</td>
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Potentially **negative psychological consequences** from repeated surgical interventions.

Akbarnia, et al.; JBJS 2010
Growth?

Inadequate sliding (caudal concave side)

Back out caudal anchor

Deteriorated lumbar curve and coronal balance
Growth?

Correction loss

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>UT</td>
<td>10%</td>
</tr>
<tr>
<td>MT</td>
<td>20%</td>
</tr>
<tr>
<td>L</td>
<td>40%</td>
</tr>
</tbody>
</table>

Upper thoracic curve was preserved

Apical fusion

The correction of the upper thoracic and apex curve was maintained.
Conclusion

- Retrospective case review of 22 consecutive children who had the modified Shilla procedure at a single institution.
- The Shilla technique reduced the number of total surgeries.
- The inadequate sliding of the caudal anchor may cause temporary deterioration of lumbar curve.
- The Shilla construct could maintain the correction of the curve at the apex.