Comparison of radiographic outcomes between growing rod and Shilla graduates by a single surgeon

National Hospital Organization
Kobe Medical Center

Teppei Suzuki, Koki Uno, Masaaki Ito
Early-onset scoliosis (EOS)

Thoracic insufficiency syndrome (TIS)

Life-threatening health risk

Campbell; JBJS, 2003
Davies; Arch Dis Child, 1971

Introduction

Growth Friendly strategies (GFS)

Distraction

Guided Growth

Traditional growing rod (TGR)
Shilla Growth Guidance system (SGGS)
Retrospective Comparative Cohort Study by a single surgeon

TGR  
Traditional growing rod

1999~2008  45 cases

vs

SGGS  
Shilla Growth Guidance system

2008~  40 cases

Exclusion
Congenital with Rib Anomaly
Neurofibromatosis

After Definitive Fusion (Graduate)

29 cases

21 cases
<table>
<thead>
<tr>
<th></th>
<th>TGR</th>
<th>SGGS</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. of cases</strong></td>
<td>29</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td><strong>Age at initial op (yrs)</strong></td>
<td>8.2±2.2</td>
<td>8.2±2.2</td>
<td>0.92</td>
</tr>
<tr>
<td><strong>Total duration of f/u (yrs)</strong></td>
<td>11.4±3.0</td>
<td>7.1±1.8</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>Duration of fusionless Tx (yrs)</strong></td>
<td>5.8±2.9</td>
<td>5.3±2.0</td>
<td>0.46</td>
</tr>
<tr>
<td><strong>Cobb at main curve (degree)</strong></td>
<td>87±22</td>
<td>84±16</td>
<td>0.55</td>
</tr>
<tr>
<td><strong>Non-ambulator</strong></td>
<td>5 cases</td>
<td>4 cases</td>
<td></td>
</tr>
</tbody>
</table>

**Etiology**

- Sotos
- PWS
- SED
- Diastrophic dysplasia
- Klippel-Weber
- AMC

- Synd, 14
- IDS, 8
- NMD, 4
- Cong, 3

**Material**

- Sotos
- PWS
- Marfan/Ehlers-Danlos
- Larsen
- Williams
- Freeman-Sheldon
- Turner
- Kasabach-Merritt
- Coffin-Sirus

- IDS, 2
- NMD, 2
- Cong, 2
- Synd, 15
Results

Main Curve

Thoracic Kyphosis

Initial op

Final Fusion
T1-S1 length

TGR

SGGS

T1-12 height
at post definitive fusion

Results

Initial op

Final Fusion
TGR

Complication Rate

With a minimum of one complication

24 cases (83%)

29 cases

Complication Rate per lengthening in each patient

23 ± 19%
SGGS

Complication Rate
21 cases (100%) 21 cases

The Detail of 43 complications

- neurological deficit: 1%
- ossification: 2%
- breakage: 5%
- infection: 5%
- loosening: 35%
- Crankshaft: 52%

Unplanned surgery during growth

- 29 surg.
- 15 cases

Results
Complication Rate?

**TABLE 1. Complications Classification System**

<table>
<thead>
<tr>
<th>Grading</th>
<th>Device Related</th>
<th>Disease Related</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Does not require unplanned surgery</td>
<td>Outpatient medical management only</td>
</tr>
<tr>
<td>II</td>
<td>Requires 1 unplanned surgery</td>
<td>Inpatient medical management</td>
</tr>
<tr>
<td>II A</td>
<td>Requires multiple unplanned surgeries</td>
<td></td>
</tr>
<tr>
<td>II B</td>
<td>Requires abandoning growth-friendly strategy</td>
<td>Requires abandoning growth-friendly strategy</td>
</tr>
<tr>
<td>III</td>
<td>Death</td>
<td>Death</td>
</tr>
<tr>
<td>IV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TGR vs SGGS

I 8 0 6 0
II A 2 0 8 0
II B 15 0 7 0
III 3 1 0 0
IV 0 0 0 0

Additional surgeries

Planned lengthening

21 cases × 5.2 yrs × 2 surg/yr = 218 surg

**SGGS**

86% Down!!

Planned surg.

29 surg.

It is Difficult to define meaningful comparative evaluation of different treatment option.

Discussion
Spontaneous auto fusion

TGR

89.6%

Facet fusion

8 of 9 cases (89%)
Cahill; Spine, 2010

SGGS

71.4%

Potentially avoiding auto-fusion

Heterotopic Ossification

Less rigid lumbar curve without facet auto-fusion

Pre-final
Post-final
Risk factors of complication during lengthening

Increased TK
Schroelucke; Spine 2012

Risk factors for PJK
Watanabe; Clin Spine Surg. 2016
The effects of metal implant debris on the pediatric population are not well established. Remains a clinical concern

Singh; Spine, 2013

Metal ion release

Yilgor; Spine deform, 2018
Late complications

One patient died due to disease related complication.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>6</td>
</tr>
<tr>
<td>Breakage, loosening</td>
<td>4</td>
</tr>
<tr>
<td>Deteriorated global balance (include PJK)</td>
<td>4</td>
</tr>
<tr>
<td>Neurologic issues</td>
<td>1</td>
</tr>
<tr>
<td>Pseud-arthrosis</td>
<td>1</td>
</tr>
</tbody>
</table>

5 cases required further surgeries

TGR: 10 cases, 34.5% 29 cases

SGGS graduates should be investigated in the future study.
SGGS compared with TGR

Initial correction rate

Management correction

Gain truncal height after growth

Additional surg.

Conclusion
None of the authors has any potential conflict of interest