Computed tomography analysis of L5-S1 fusion in Adult spinal deformity

Comparison of whether spinopelvic fixation, ALIF vs PLIF, and cage design

Jung-Hee Lee MD, Kyung-Chung Kang MD, Dong-Gune Chang MD, Tae-Jin Kim MD, Ki Young Lee MD, Won Ju Shin MD

Dept of Orthopedic Surgery, Kyung Hee University, Seoul, Korea
In adult spinal deformity

Fusion to L5: instability L5-S1
- back pain, sagittal imbalance, radiculopathy

Fusion to S1: pseudarthrosis
- debilitating pain, sagittal decompensation
- pseudarthrosis↓
  - sacropelvic fixation, interbody fusion, BMP...

Purpose of this study

Achieving a solid fusion of L5-S1
- risk factor analysis is important

Analyze the CT of L5-S1 fusion in ASD patients who underwent surgical correction and evaluate the surgical options
- whether spinopelvic fixation
- S2AI vs conventional iliac fixation
- ALIF vs PLIF
- cage design (metal vs PEEK)
- long vs short fusion

Introduction

Horton (1996), Spine
Eck (2001), Spine
Edwards (2005), Spine
Polly (2006), Spine
Kim (2003), KSSS
Kim (2006), Spine
Ondra (2006), Spine
Maeda (2010), Spine
Materials & Methods

Demographics & inclusion criteria

- Adult spine deformity with sagittal imbalance who underwent surgical correction
- 78 females
- Age: 70.5 years (mean)
- Interbody fusion L5-S1
- Minimum f/u ≥ 2 years

Definition and grade of fusion

Analysis by CT

Grade 1: no fusion
Grade 2: in disk space, ossification (+) not continuous with both endplates
Grade 3: bridging < 50% of the endplates
Grade 4: bridging > 50% of the endplates

→ Grade 3 & 4: solid fusion

Surgical methods

- UIV
- T10: 57
- T12: 2
- L1: 4
- L2: 6
- L3: 6
- L4: 3

- LIV: S1 (n=78)

- Fused segments: av. 6.9 seg.

- Sacropelvic fixation
  - Iliac screw: (n=12)
  - S2AI: (n=36)

- Anterior vs Posterior
  - ALIF: (n=63)
  - PLIF: (n=15)

- Without BMP
  - ALIF: allo + DBM
  - PLIF: auto + DBM

Patel (2013) J Spinal Disord Tech
## Results

### Sagittal parameters

<table>
<thead>
<tr>
<th></th>
<th>preop</th>
<th>postop</th>
<th>latest</th>
</tr>
</thead>
<tbody>
<tr>
<td>sagittal vertical axis (mm)</td>
<td>+183</td>
<td>-12.4</td>
<td>+17.5</td>
</tr>
</tbody>
</table>

#### Lumbar lordosis

<table>
<thead>
<tr>
<th></th>
<th>preop</th>
<th>postop</th>
<th>latest</th>
</tr>
</thead>
<tbody>
<tr>
<td>lumbar lordosis</td>
<td>+5.2°</td>
<td>-64.1°</td>
<td>-60.7°</td>
</tr>
</tbody>
</table>

#### Thoracic kyphosis

<table>
<thead>
<tr>
<th></th>
<th>preop</th>
<th>postop</th>
<th>latest</th>
</tr>
</thead>
<tbody>
<tr>
<td>thoracic kyphosis</td>
<td>+1.6°</td>
<td>+21.3°</td>
<td>+26.3°</td>
</tr>
</tbody>
</table>

### Total fusion rate

<table>
<thead>
<tr>
<th>Time</th>
<th>Total</th>
<th>3mo</th>
<th>6mo</th>
<th>9mo</th>
<th>1yr</th>
<th>2yr</th>
<th>3yr</th>
<th>1yr</th>
<th>2yr</th>
<th>3yr</th>
<th>3yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>68</td>
<td>28</td>
<td>15</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>3</td>
<td>7</td>
<td>10</td>
<td>3</td>
<td>total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>68 of 78 pts, 87.2%</td>
</tr>
</tbody>
</table>

Total fusion rate: 68 of 78 pts, 87.2%
Results

Union group (n=68), 87.2%

Ant vs Post
- Ant (ALIF): 55
- Post (PLIF): 13

Long vs Short (UIV under L2)
- Long: 55
- Short: 13

Cage material
- Metal cage: 58
- PEEK cage: 10

Sacropelvic fixation
- Yes: 45
- No: 23

* <.0001

Tech. of sacropelvic fixation
- S2AI: 34
- Conventional: 11

Nonunion group (n=10), 12.8%

- Ant vs Post
- Long vs Short (UIV under L2)
- Cage material
- Sacropelvic fixation
- Tech. of sacropelvic fixation
Case 1
F/67

PO 5Y

PI 55°
(ideal LL 58°)
SS 28°
PT 27°
SVA 162mm

+37°

SVA +7mm
PO 3M Grade 1

PO 1Y Grade 1

PO 5Y Grade 1

Halo - iliac screws

Nonunion L5-S1
Discussion

Case 2

F/74

**PI** 46°
(ideal LL 51°)
SS 18°
PT 28°
SVA 66mm

**PO 2Y**

**PI** 46°
(ideal LL 51°)
SS 34°
PT 12°
SVA 37mm
Halo in 13 patients
- S1 screws, iliac screws
- nonunion (1 patient)

Halo sign on X-ray
= nonunion?
**ASD in elderly patients**

87.2% union rate in CT
metal cage > PEEK cage
  - maximized contact surface with bone
sacropelvic fixation > no fixation
  - iliac screw
    : conventional, anatomic, S2AI
  - S2 alar screw

**Limitation of this study**

small patients group (78 pts)
no BMP

<table>
<thead>
<tr>
<th>ALIF</th>
<th>exact comparison</th>
<th>PLIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>alloBG + DBM</td>
<td></td>
<td>autoBG + DBM</td>
</tr>
</tbody>
</table>
87.2% union rate of L5-S1 in CT

Union rate ↑
- sacropelvic fixation vs no fixation
- metal cage vs PEEK cage

no relationship with
- ALIF vs PLIF
- long vs short fusion
- S2AI vs iliac screw

Halo sign of S1 or iliac screw on X-ray
- no correlation with nonunion of L5-S1
All authors have no financial relationships to disclose.