

# **Spino-Pelvic Sagittal Imbalance as a Risk Factor for Adjacent Segment Disease after Single-segment Posterior Lumbar Interbody Fusion**

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# Purpose

To clarify the relationship between  
**spino-pelvic radiographic parameters**  
and  
**ASD after PLIF at L4-5**

# Patients

2005-2012 years

Design: Retrospective matched case-control study

Twenty patients who had undergone revision surgery for symptomatic ASD after L4/5 PLIF (**ASD group**)

**Control** : No signs of symptomatic  
**ASD** more than **3 years** after L4/5 PLIF

	<b>ASD</b>	<b>Control</b>	
<b>Cases</b>	<b>20</b>	<b>100</b>	n.s.
<b>Age</b>	68.9	66.7	n.s.
<b>Gender(M : F)</b>	9:11	40:60	n.s.

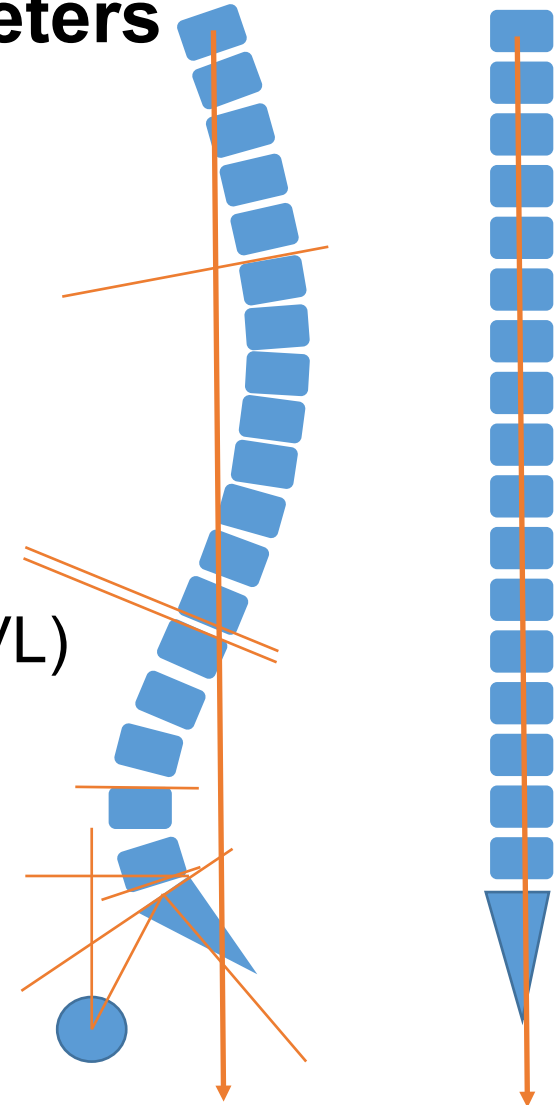
# Evaluations

## ■ Spino-pelvic radiographic parameters

- Sagittal vertical axis (SVA)
- Thoracic kyphosis (TK)
- Lumbar lordosis (LL)
- Segmental lordosis at L4/5 (SL)
- Pelvic incidence (PI)
- Pelvic tilt (PT)
- Sacral slope (SS)
- C7-the central sacral vertical line (C7-CSVL)
- PI-LL

## ■ Analysis

- Paired/unpaired t test
- Chi-squared test



# Pre- and Post-operative Parameters (ASD)

	<b>Pre-</b>	<b>Post-</b>	
SVA $\geq$ 50mm (Number)	10 (50%)	9 (48%)	n.s.
TK ( $^{\circ}$ )	24.7	22.5	n.s.
SS ( $^{\circ}$ )	32.7	33.0	n.s.
PT ( $^{\circ}$ )	27.0	26.4	n.s.
PI ( $^{\circ}$ )	59.7	59.4	n.s.
LL ( $^{\circ}$ )	40.7	39.3	n.s.
PI-LL $\geq$ 10 $^{\circ}$ (Number)	15 (75%)	15 (75%)	n.s.
SL at L4/5 ( $^{\circ}$ )	11.4	12.9	n.s.
C7-CSVL (mm)	12.2	12.7	n.s.
n.s.= not significant			

# Pre- and Post-operative Parameters (Control)

	<b>Pre-</b>	<b>Post-</b>	
SVA $\geq$ 50mm (Number)	21 (21%)	24 (24%)	n.s.
TK ( $^{\circ}$ )	29.4	30.9	n.s.
SS ( $^{\circ}$ )	33.8	34.6	n.s.
PT ( $^{\circ}$ )	22.9	22.6	n.s.
PI ( $^{\circ}$ )	56.8	57.3	n.s.
LL ( $^{\circ}$ )	47.2	48.1	n.s.
PI-LL $\geq$ 10 $^{\circ}$ (Number)	40 (40%)	43 (43%)	n.s.
SL at L4/5 ( $^{\circ}$ )	14.0	12.8	n.s.
C7-CSVL (mm)	9.5	10.0	n.s.
n.s.= not significant			

# Comparison of **Pre**-operative Parameters

	<b>ASD</b>	<b>Control</b>	<b>P</b>
<b>SVA<math>\geq</math>50mm (Number)</b>	<b>10 (50%)</b>	<b>21 (21%)</b>	<b>&lt;0.01</b>
TK (°)	24.7	29.4	n.s.
<b>LL (°)</b>	<b>40.7</b>	<b>47.2</b>	<b>&lt;0.01</b>
SL at L4/5 (°)	11.4	14.0	n.s.
SS (°)	32.7	33.8	n.s.
<b>PT (°)</b>	<b>27.0</b>	<b>22.9</b>	<b>&lt;0.05</b>
PI (°)	59.7	56.8	n.s.
<b>PI-LL<math>\geq</math>10°(Number)</b>	<b>15 (75%)</b>	<b>40 (40%)</b>	<b>&lt;0.01</b>
C7-CSVL (mm)	12.2	9.5	n.s.
n.s.= not significant			



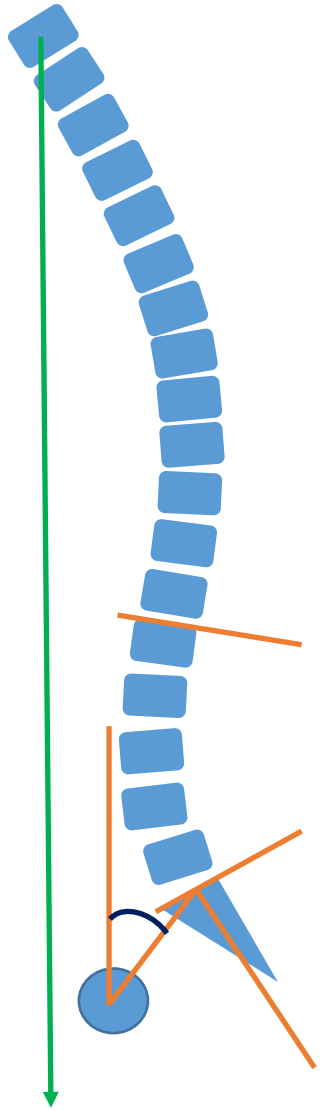
# Comparison of **Post**-operative Parameters

	<b>ASD</b>	<b>Control</b>	<b>P</b>
SVA $\geq$ 50mm (Number)	9 (45%)	24 (24%)	0.056
TK (°)	22.5	30.9	<0.01
SS (°)	33.0	34.6	0.37
PT (°)	26.4	22.6	<0.05
PI (°)	59.4	57.3	0.36
LL (°)	39.3	48.1	<0.05
PI-LL $\geq$ 10°(Number)	15 (75%)	43 (43%)	<0.01
SL at L4/5 (°)	12.9	12.8	0.89
C7-CSVL (mm)	12.7	10.0	0.25

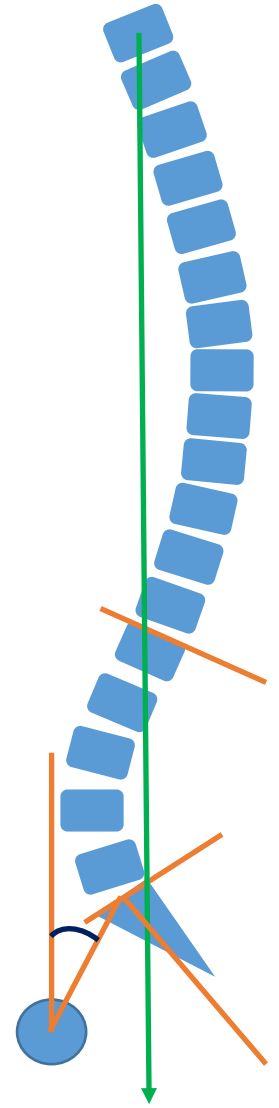
# Summary

ASD group

- **SVA** ↑
- **LL** ↓
- **PT** ↑
- **PI-LL**  $\geq 10$



ASD



Control

# Discussion

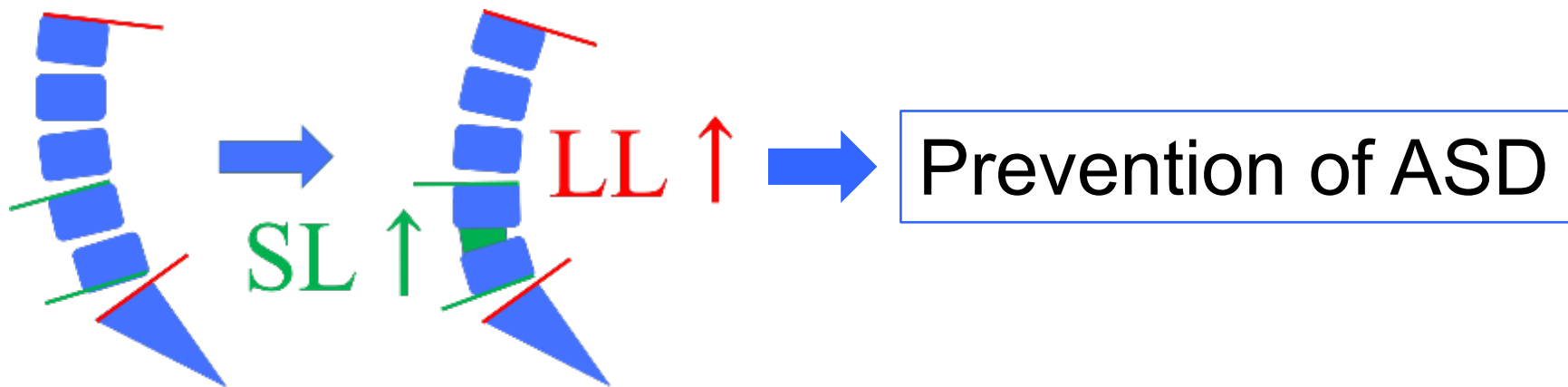
■ High incidence of ASD in patients with SVA ↑ and/or SS ↓, PT ↑, LL ↓, PI-LL mismatch

Kumar MN et.al., ESJ 2001 Dominique A et. al., ESJ2015

Martino AD et.al., ESJ2014 Djurasovic MO et al, Orthopedics 2008

■ PI-LL mismatch, SL ↓ results in increased adjacent segmental loads.

Umehara S et.al., Spine 2000 Senteler M et. al., ESJ 2014



# Conclusion

- **Pre-operative global sagittal imbalance (SVA  $\geq$ 50 mm and higher PT), and pre- and postoperative lower LL and PI-LL mismatch were significantly associated with ASD.**
- **Even with a single-level PLIF, appropriate SL and LL should be obtained at surgery in order to improve global sagittal imbalance and PI-LL mismatch.**
- **The results suggested the possibility that achieving the appropriate LL and PI-LL prevents ASD after L4/5 PLIF.**

□ None of the authors has any potential conflict of interest