

## The Changes of Sagittal Alignment after Anterior Interbody Fusion with Posterior Fixation in Spondylolisthesis of the Lumbar Spine

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### – Abstract –

**Study Design:** A prospective radiological assessment was conducted.

**Objectives:** To analyze the changes in the height of the intervertebral disc, the slippage, slip angle, lumbar lordotic angle and sacral inclination after anterior lumbar interbody fusion and posterior pedicle screw fixation in a lumbar spondylolisthesis.

**Summary of Literature Review:** The anterior lumbar interbody fusion causes changes in the lumbar sagittal alignment.

**Methods:** The mini-open anterior lumbar interbody fusion and pedicle screw fixation was undertaken in 33 cases from April 1995 to November 2003. MRI was done before and 6 months after surgery. The measuring factors were the heights of the intervertebral disc, slippage, slip angle, lumbar lordotic angle and sacral inclination. The measuring factors were independently assessed three times by three different orthopedic surgeons. The postoperative changes in measuring the factors were analyzed by a paired t-test statistically.

**Results:** The height of the intervertebral disc was increased by a mean of 14.0%, slippage was reduced by a mean of 2.8%, the slip angle was reduced by a mean of 16.0%, the lumbar lordotic angle was increased by a mean of 15.6% and the sacral inclination was increased by a mean of 3.0%. There was significance in the increase in the disc height, the reduction of slippage and the slip angle, and the increase in lumbar lordotic angle, but there were no significance regarding the changes in sacral inclination.

**Conclusions:** The anterior lumbar interbody fusion and the pedicle screw fixation significantly improved the height of the intervertebral disc, slippage, slip angle, and lumbar lordotic angle, except sacral inclination.

**Key Word:** Lumbar spine, Spondylolisthesis, Slip angle, Lumbar lordotic angle, anterior interbody fusion

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1-3), , 5.4 (4 9 ), 6.2 (4 11 ) (Table 1).

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(Fig. 1), (disc height restoration)

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(6 97 ) 50 (41 65 ), 61 (47 72 )

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3 가 4 , 4 paired t-test (SPSS 8.0 for

가 11 , 5 가 2 . Meyerding WINDOWS)

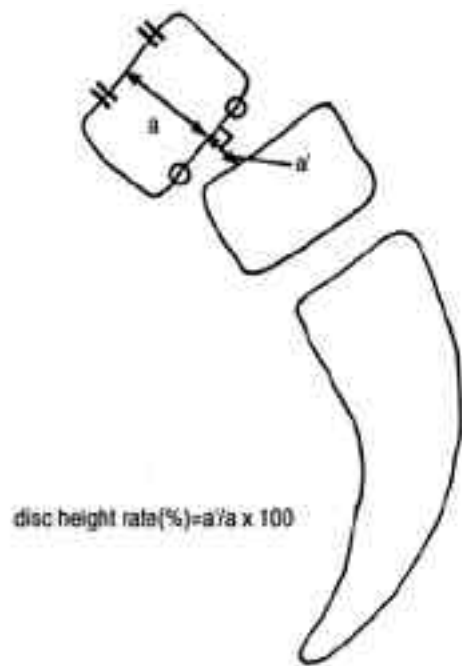
I 14 , II chi-square test (SPSS 8.0 for WINDOWS)

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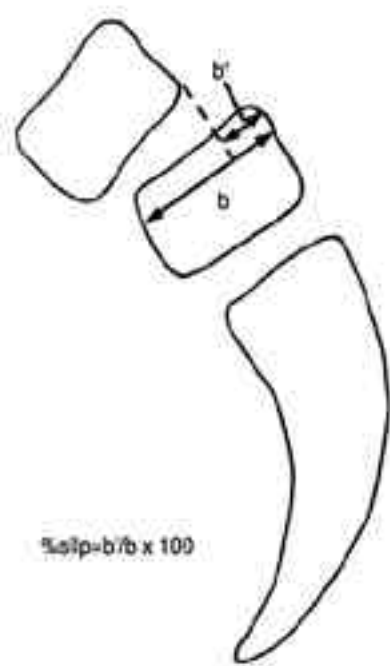
**Table 1.** Patients data

	Isthmic type	Degenerative type
Number of cases	16	17
Mean Age (years)	50	61
Gender (M:F)	3 : 13	3 : 14
Slip level		
L3	1	4
L4	10	11
L5	5	2
Meyerding grade		
I	14	15
II	2	2
Taillard (%)	11.96	8.78
Follow-up of MRI* (months)	27.1	21.4
Radiologic union (months)	5.4	6.2

\*: Magnetic Resonance Image



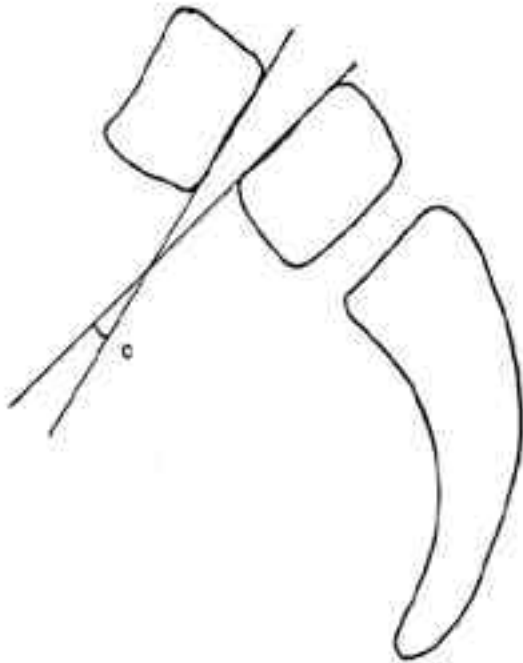
**Fig. 1.** Radiological measurement of disc height.



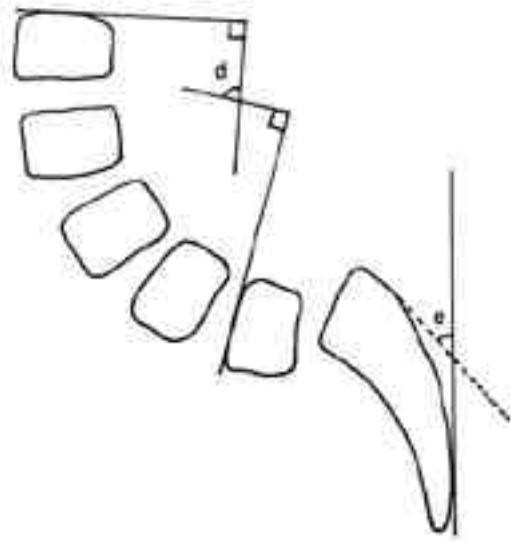
**Fig. 2.** Radiological measurment of slip percentage.

가 3 , ANOVA test (SPSS 8.0 for WINDOWS) .

1. 5.8 (4 11 ) . 19.6% 33.6% , 14.0% . (P=0.000),(Table 2,3)(Fig. 5,6).



**Fig. 3.** Radiological measurement of slip angle (c).



**Fig. 4.** Radiological measurement of lumbar lordotic angle(d) and sacral inclination(e).

**Table 2.** Radiological measurements of preoperative and postoperative parameters

	preop	postop	p-value
disc height rate (%)	19.6	33.6	0.000
slip (Taillard %)	10.3	7.6	0.000
slip angle (°)	6.5	5.6	0.012
lumbar lordosis (°)	31.4	37.2	0.015
sacral inclination (°)	41.9	42.9	0.341

**Table 3.** Rate of postoperative changes of radiological parameters

disc height restoration (postop disc height rate-preop disc height rate)	14.0%
slip reduction (preop % slip-postop % slip)	2.8%
slip angle correction rate ((postop SA*-preop SA*)/postop SA*100)	16.0%
lumbar lordosis change ((postop LA**-preop LA**)/postop LA*100)	15.6%
sacral inclination change ((postop SI <sup>+</sup> -preop SI <sup>+</sup> )/postop SI*100)	3.0%

\*: Slip angle, \*\*: Lordotic angle, <sup>+</sup>: Sacral inclination

3.

(P=0.000), (Table 2,3) (Fig. 5,6).

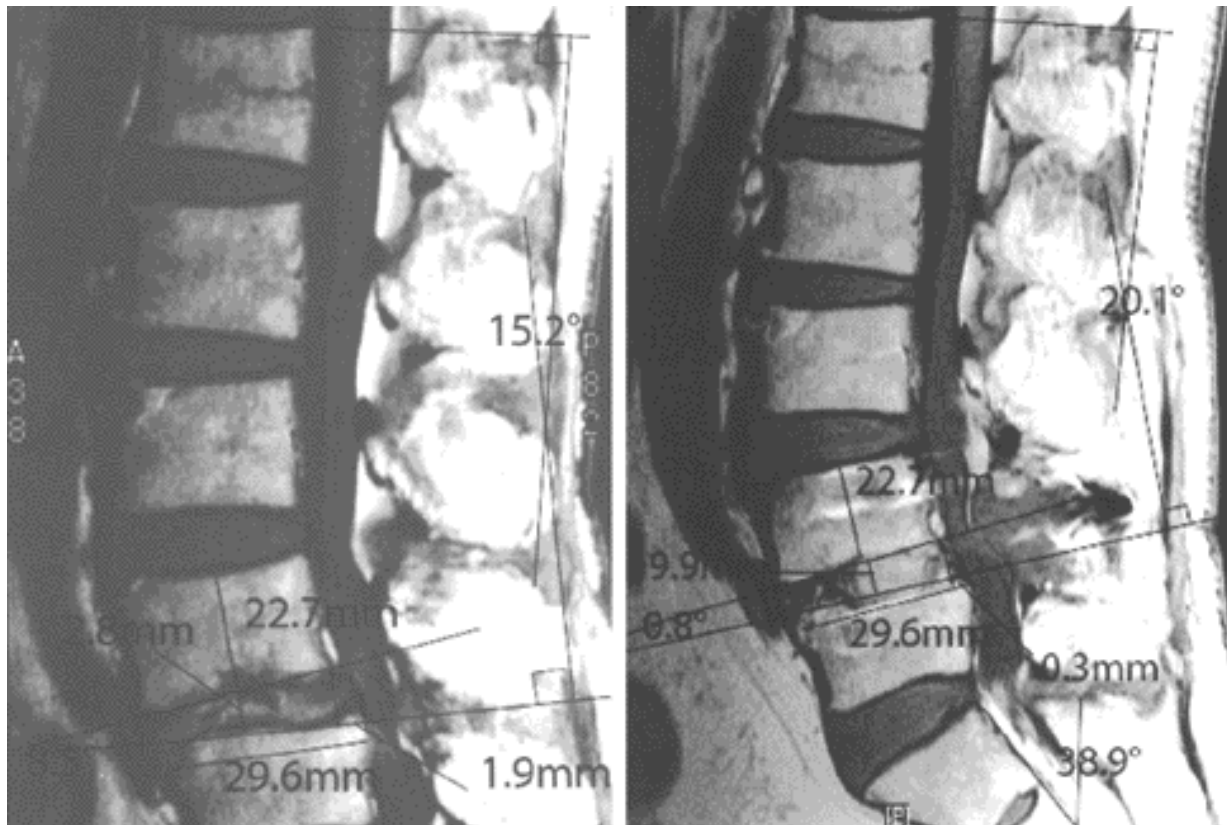
10.3% , 7.6% , 2.8% .

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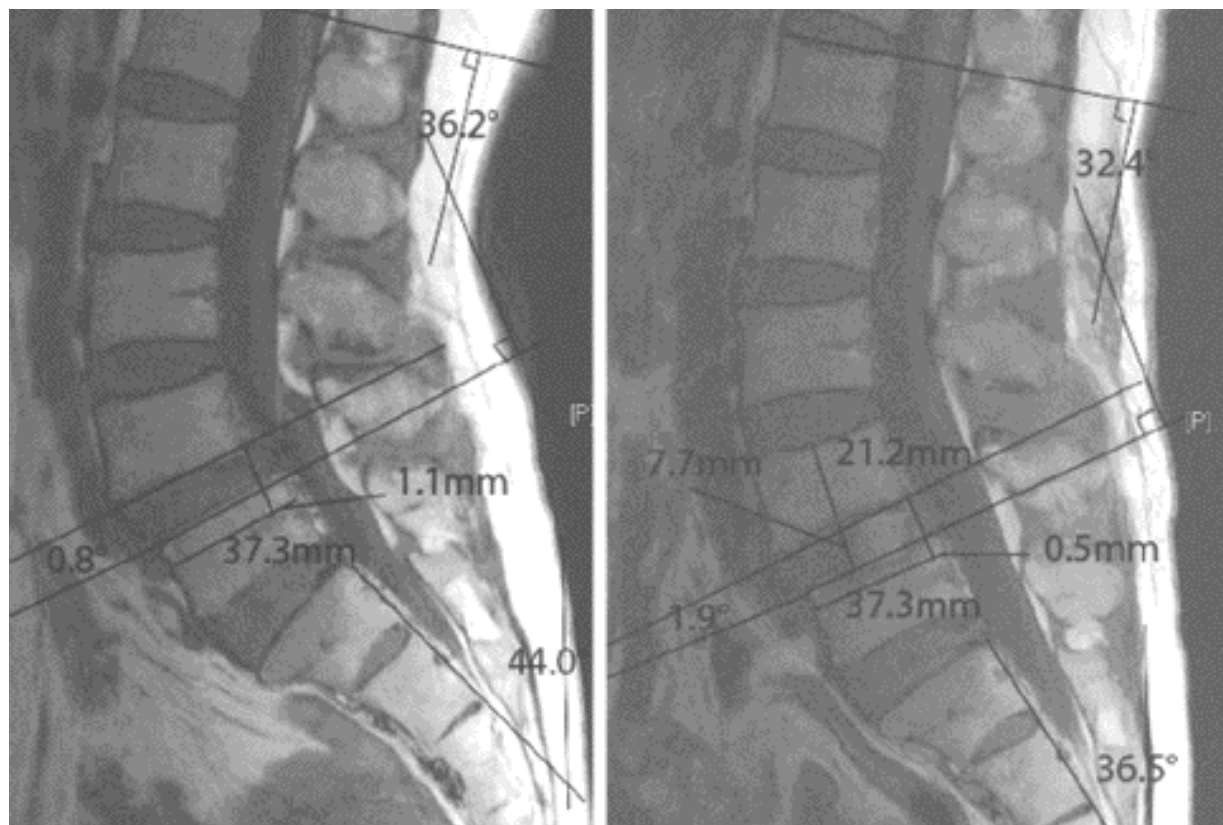
6.5 ,

**Table 4.** Comparison of isthmic type and degenerative type

	Isthmic type	Degenerative type
disc height rate		
preop(%)	20.1	21.1
postop(%)	36.8	32.8
disc height restoration(%)	16.7	11.7
slip		
preop(%)	8.8	12.0
postop(%)	5.9	9.3
slip reduction(%)	2.9	2.7
slip angle		
preop( °)	6.4	6.8
postop( °)	5.4	5.9
slip angle correction rate	18.5	15.2
lordotic angle		
preop( °)	27.3	32.8
postop( °)	38.1	35.9
lumbar lordosis change	28.3	8.6
sacral inclination		
preop( °)	42.5	41.2
postop( °)	43.9	41.8
sacral inclination change	4.0	2.0



**Fig. 5.** A 61-year-old woman with degenerative spondylolisthesis L4 on L5. (A) sagittal image of level of the midportion of vertebral body on preoperative MRI shows 12.4% in disc height rate, 3.4% in slip, 8.5 ° in slip angle, 15.2 ° in lumbar lordotic angle, 42.4 ° in sacral inclination. (B) sagittal image of level of the midportion of vertebral body on postoperative MRI shows 47.1% in disc height rate, 1.2% in slip, 0.8 ° in slip angle, 20.1 ° in lumbar lordotic angle, 38.9 ° in sacral inclination.



**Fig. 6.** A 48-year-old woman with isthmic spondylolisthesis L4 on L5. (A) sagittal image of level of the midportion of vertebral body on preoperative MRI shows 19.1% in disc height rate, 3% in slip, 0.8 °in slip angle, 36.2 °in lumbar lordotic angle, 44.0 °in sacral inclination. (B) sagittal image of level of the midportion of vertebral body on postoperative MRI shows 36.1% in disc height rate, 1.3% in slip, 1.9 °in slip angle, 32.4 °in lumbar lordotic angle, 36.5 °in sacral inclination.

5.6 , 16.0% , paired t-test  
(P=0.012), (SPSS 8.0 for Windows)  
(Table 2,3) (Fig. 5,6). (P=0.000), (P=0.000),  
(P=0.012), (P=0.015)

5. , (P=0.341)  
(Table 2).

31.4 ,  
37.2 , ANOVA test (SPSS 8.0 for Windows)  
15.6% . 0.9  
(P=0.015), (Table 2,3) (Fig. 5,6).

8.

6. 41.9 , 16.7%, 2.9%,  
42.9 , 3.0% 가 18.5%, 4.0%  
(P=0.341), (Table 2,3) (Fig. 5,6). 28.3%,  
11.7%, 2.7%,  
15.2%,  
8.6%, 2.0%

7. 8.6%, 2.0%

(Table 4).

360 6.3%, 9.4%

(P=0.000), 24.7%, 11%

(P=0.000), (P=0.000) 360

9.9% 10%

7.3% 3.7%

12)

47 3

153% 가

111%

131% 가 101%

26.4%

가

7-10)

Inoue 13)

36

100%, 85%

16.5% 7.3%

59.6%

Ishihara 14)

35

10

83%

15)

28

가

1,2,5-8)

가

11)

1

86.0% 가, 60.7% 89.2%

4-8,12)

7)

56

가

14.0%

2.8%, 16.0% 15.6%

가 3.0%

1.8 mm, 2.4 mm

가 6

1.2 mm

가

가

Madan 16)

39

35

8.8%, 6.7% 100%, 94.3%

4.7%

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5)

35

360

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fusion disease phenomenon . 가

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17) , 18) 20) ,

70 30 6.7% 2.7% 6.0% 1.9%

7.5 mm 8.6 mm , MRI  
9.7 mm 11.9 mm 가  
40

38 , 37 가

42 가 19) 54 58 360 21) , 가 가 22) ,

2.8% 3.3% , 6.3% 3.8% 8.7% 360 2.3% , 6.1% 3.8%

-0.6 mm , 가  
2.8 mm , -0.6 mm  
3.2 mm , 가  
360 1.1 mm 가  
1.9 mm , 가  
0.8 mm 3.1 mm

가

16.7%, 11.7%. 2.9%  
2.7%, 18.5% 15.2%,  
28.3% 8.6% ,  
4.0% 2.0% ,  
가

가

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 MRI , , ,  
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 16.0% , 가 15.6% , 가 3.0% ,  
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