

후방경유 요추 융합수술시 척추후관절낭 손상의 운동역학적 영향*

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= Abstract =

Biomechanical Effects of Facet Capsule Injuries in Posterior Lumbar Fusion Operations

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Objectives : Although posterior lumbar fusion operations had been reported to accelerate spinal degeneration, there have been only a few studies for their biomechanical effects. We have studied the change of motion range at the vertebral joint one level above the fusion(UVJ) in pedicle screw fixation group(PSF)(n=13) where facet capsule was destroyed and in posterior lumbar interbody fusion group(PLIF)(n=8) where it was spared.

Patients and Methods : The patients were divided into early(3 to 6 months) and late(over 12 months) according to postoperative follow - up period. The flexion, extension and flexion - extension angles(FA, EA, FEA) were measured at the UVJ with pre - operative, early and late post - operative films.

Results : Mean age and male to female ratio were 52.7 ± 9.3 and 1 : 3.2. Mean follow - up periods were 144.1 ± 30.0 and 528.8 ± 160.3 days in early and late groups, respectively. The FEA and FA in the late PSF(11.8 ± 3.1 , 8.5 ± 2.9) were significantly greater than pre - operative angles(7.8 ± 3.9 , 5.1 ± 3.7)($p < 0.01$, $p < 0.05$). All angles in the PLIF showed no significant changes with time. The FEA and FA in the late PSF(11.8 ± 3.1 , 8.5 ± 2.9) were significantly greater than those of the late PLIF(7.6 ± 2.3 , 3.4 ± 2.0)($p < 0.01$, $p < 0.001$). All angles at early follow - up period were similar between PSF and PLIF. The EA showed no significant change in relation with follow - up period or fusion method.

Conclusion : As a result, the facet capsule injury in pedicle screw fixation seems to be related with increased flexion angle or degeneration of the adjacent joint above the fused vertebra in the late phase.

KEY WORDS : Pedicle screw fixation · Posterior lumbar interbody fusion · Facet capsules · Motion range · Degeneration.

서 론

(pedicle screw fixation, PSF)⁷⁾

(posterior lumbar interbody fusion, PLIF)³⁾¹⁶⁾

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7) 1945
 (fusion transition syndrome)
 5)11)12)16)

2)9) 가 Ray¹⁶⁾
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대상 및 방법

1. 대 상

1994 10 97 5
 115
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 가 21
 4-5 4-5 -1
 1 : 3.2
 52.7 ± 9.3
 1
 (PSF, n=13), 2
 (PLIF, n=8) . PSF

. PSF
 3)16)
 . PLIF
 (bone dowel)
 (Fig. 6, 7).
 4 8 (early post-operative phase)
 1 (late post-operative phase)
 144 ± 30
 528 ± 163

2. 방 법

(flexion - extension angle),
 (flexion angle), (extension angle)
 가

1) 굴신전 각도

2) 굴전 각도

3) 신전 각도

4) 통계학적 처리

Bonferroni correction
 unpaired Student's t - test
 p < 0.05

결 과

1. 굴신전 각도
 PSF 7.8 ± 3.9, 7.0 ± 4.6, 11.8 ± 3.1
 (Table 1) PLIF

2.3 (Table 2). 9.5 ± 3.6, 6.5 ± 1.0, 7.6 ± 가 (p<0.01)
 (Fig. 1, 6). PLIF

PSF 가 (Fig. 2, 7). 가 PSF PLIF

Table 1. Flexion-extension, flexion, and extension angles at the adjacent vertebral joint above the fused vertebra in PSF group in relation with post-operative follow-up period*

Group	FEA			FA			EA		
	Preop.	Early	Late	Preop.	Early	Late	Preop.	Early	Late
	9.1	2.8	7.0	3.7	1.0	3.0	5.4	1.8	4.0
	11.0	-	15.8	10.5	-	11.2	-	-	-
	10.5	4.2	11.0	6.2	1.4	6.7	4.3	2.8	4.3
	2.4	2.5	11.3	2.2	2.0	7.8	0.2	0.5	3.5
	6.7	6.5	15.4	2.8	3.8	10.5	3.9	2.7	4.9
	12.0	5.0	10.0	6.2	2.1	9.2	5.8	2.9	0.8
	6.5	9.8	11.3	5.5	8.8	9.2	1.0	1.0	2.1
	6.0	12.2	11.0	2.6	6.0	7.2	3.4	6.2	3.8
	5.0	7.0	14.0	3.5	5.6	10.5	1.5	1.4	3.5
	8.0	-	10.0	2.2	-	7.8	5.8	-	2.2
	2.0	5.0	14.2	1.8	3.4	6.5	0.2	1.6	7.7
	7.0	4.6	6.5	4.5	1.2	6.0	2.5	2.8	0.5
	15.8	17.6	15.4	14.4	16.5	14.8	1.4	1.1	0.6
M ±SD	7.8 ± 3.9	7.0 ± 4.6	11.8 ± 3.1	5.1 ± 3.7	4.7 ± 4.6	8.5 ± 2.9	3.0 ± 2.1	2.3 ± 1.6	3.2 ± 2.1

*Preop. ; pre-operative, Early ; early post-operative, Late ; late post-operative, FEA ; flexion-extension angle, FA ; flexion angle, EA ; extension angle, M ; mean, SD ; standard deviation

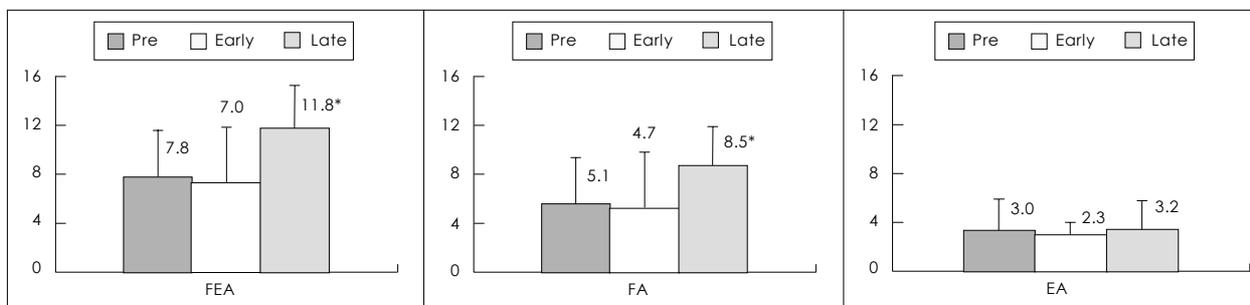


Fig. 1. Post-operative changes of flexion-extension, flexion and extension angles at the adjacent vertebral joint above the fused vertebra in PSF group. The flexion-extension angle in the late PSF is significantly greater than preoperative angle (*; p<0.01). The flexion angle in the late PSF is significantly greater than preoperative angle (*; p<0.05). The extension angle shows no significant change in relation with follow-up period.

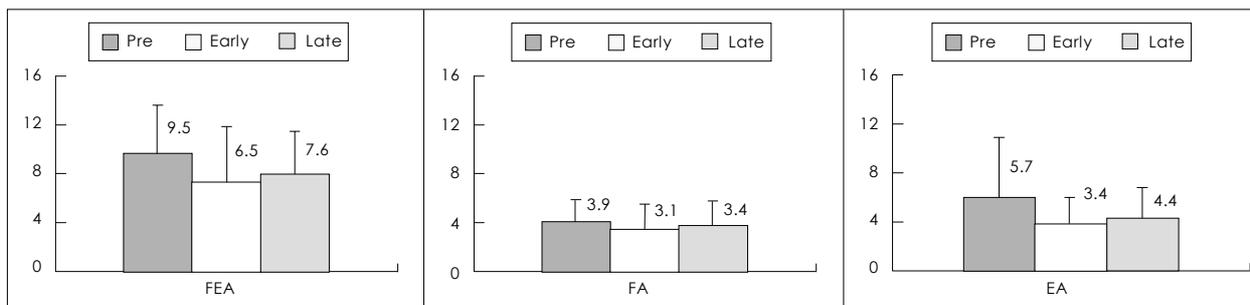


Fig. 2. Post-operative changes of flexion-extension, flexion and extension angle at the adjacent vertebral joint above the fused vertebra in PLIF group. There is no significant change.

Table 2. Flexion-extension, flexion, and extension angles at the adjacent vertebral joint above the fused vertebra in PLIF group in relation with post-operative follow-up period

Group	FEA			FA			EA		
	Preop.	Early	Late	Preop.	Early	Late	Preop.	Early	Late
	12.5	7.0	8.8	2.5	2.6	5.4	10.0	4.4	3.4
	16.5	6.0	7.0	2.1	1.0	2.0	14.4	5.0	5.0
	5.0	4.5	4.8	1.5	4.3	2.0	3.5	0.2	2.8
	9.5	-	8.5	4.2	-	6.4	-	-	-
	7.9	7.0	9.5	3.8	1.0	5.5	4.1	6.0	4.0
	10.0	7.5	6.0	6.4	6.5	1.2	3.6	1.0	4.8
	7.0	7.0	11.0	5.2	2.0	3.0	1.8	5.0	8.0
	7.8	6.5	4.8	5.5	4.5	1.7	2.3	2.0	3.1
M ±SD	9.5 ± 3.6	6.5 ± 1.0	7.6 ± 2.3	3.9 ± 1.8	3.1 ± 2.1	3.4 ± 2.0	5.7 ± 4.7	3.4 ± 2.3	4.4 ± 1.8

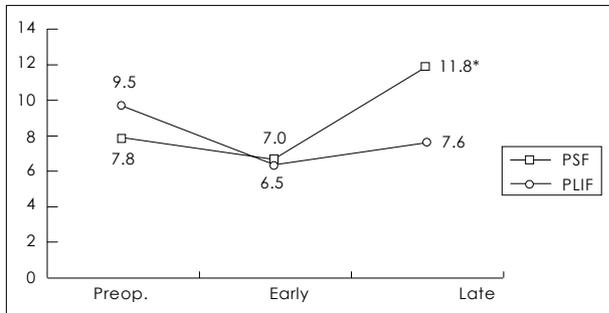


Fig. 3. Changes of flexion-extension angle at the adjacent vertebral joint above the fused vertebra in PSF and PLIF groups. The flexion-extension angle in the late PSF is significantly greater than that in the late PLIF (*; $p < 0.01$ vs. PLIF).

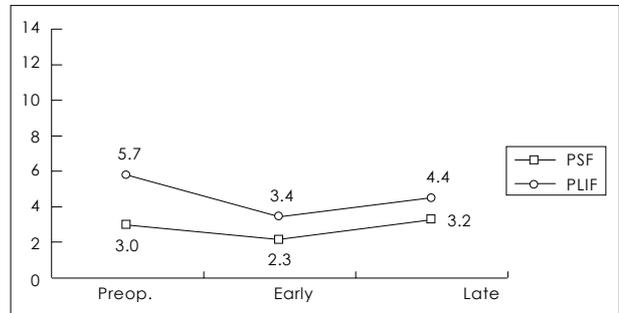


Fig. 5. Changes of extension angle at the adjacent vertebral joint above the fused vertebra in PSF and PLIF groups. The extension angle shows no significant difference between two groups.

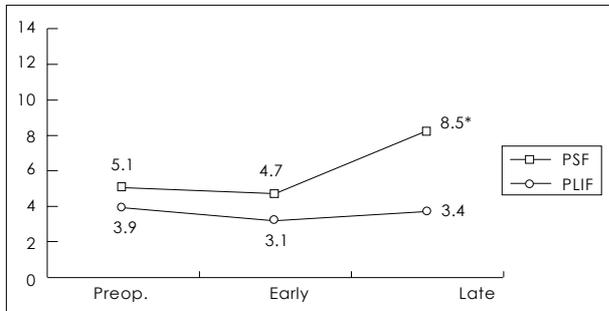


Fig. 4. Changes of flexion angle at the adjacent vertebral joint above the fused vertebra in PSF and PLIF groups. The flexion angle in the late PSF is significantly greater than that in the late PLIF (*; $p < 0.01$ vs. PLIF).

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PLIF (p<0.01)(Fig. 3).

2. 굴전 각도

PSF
5.1 ± 3.7, 4.7 ± 4.6, 8.5 ± 2.9 (Table 2).

1) PLIF
3.9 ± 1.8, 3.1 ± 2.1, 3.4 ± 2.0

(Table 2).

(Fig. 1, 2).
PSF
가 (p<0.05)
(Fig. 1, 6) PLIF

(Fig. 2, 7).
PSF
가
PLIF
PLIF
(p<0.01)(Fig. 4).

3. 신전 각도

PSF
, ,
3.0 ± 2.1, 2.3 ± 1.6, 3.2 ± 2.1 (Table 2).

1) PLIF
, ,
5.7 ± 4.7, 3.4 ± 2.3, 4.4 ± 1.8

(Table 2).

PSF PLIF

(Fig. 1, 2, 6, 7).

PSF

PLIF

(Fig. 5).

5)11)12)16)

고 찰

(fusion transition syndrome)

2)9)

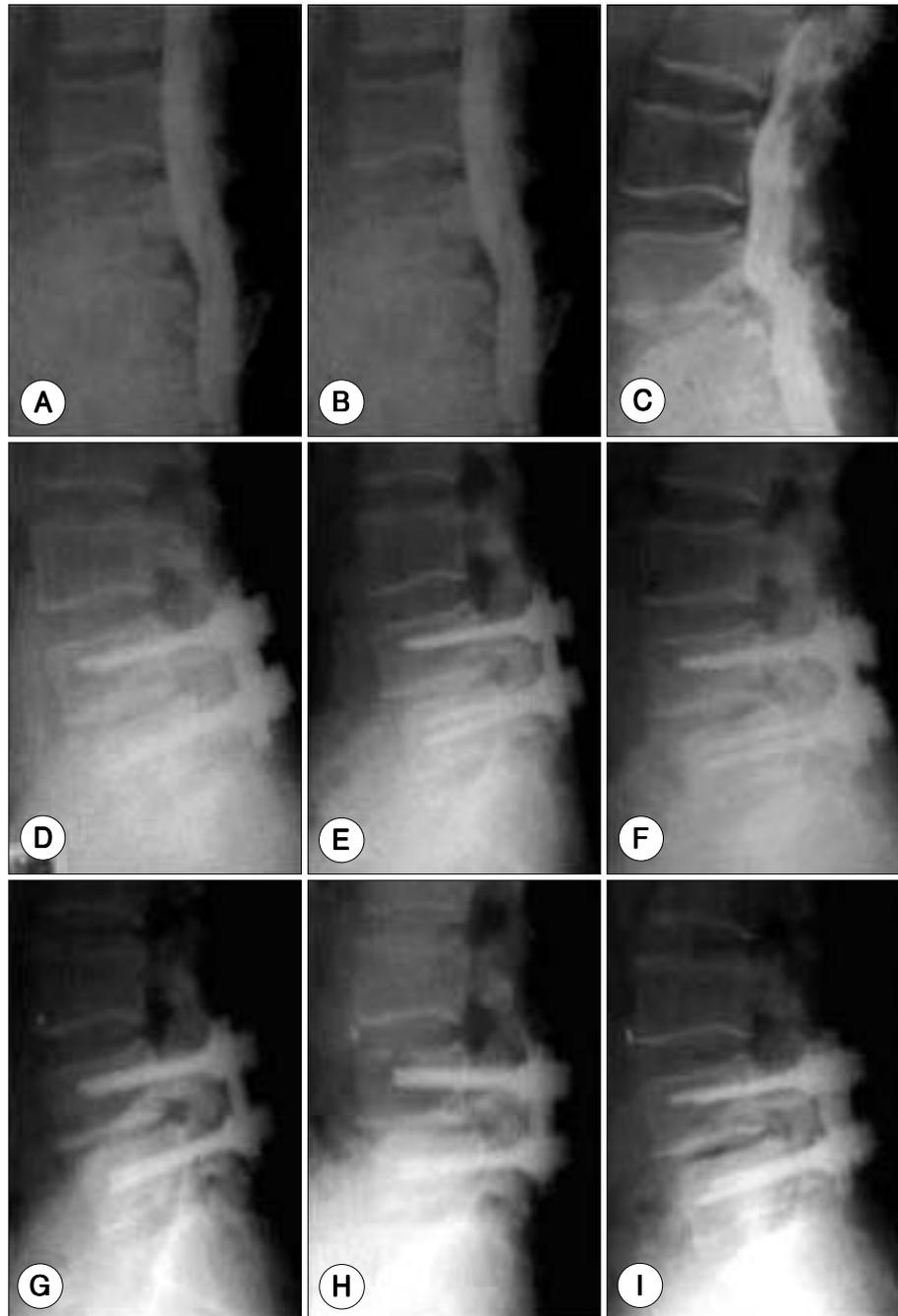


Fig. 6. Pictures of lumbar spine with pedicle screw fixation in neutral(A, D, G), flexion(B, E, H), and extension(C, F, I) positions showing preoperative L4-5 instability(A, B, C), early postoperative(D, E, F), and late postoperative dynamic views(G, H, I). The patient underwent pedicle screw fixation at L4-5 level. The flexion angle of L3-4 level is increased significantly in the late postoperative phase. The postoperative changes of the extension angle of L3-4 level are minimal.

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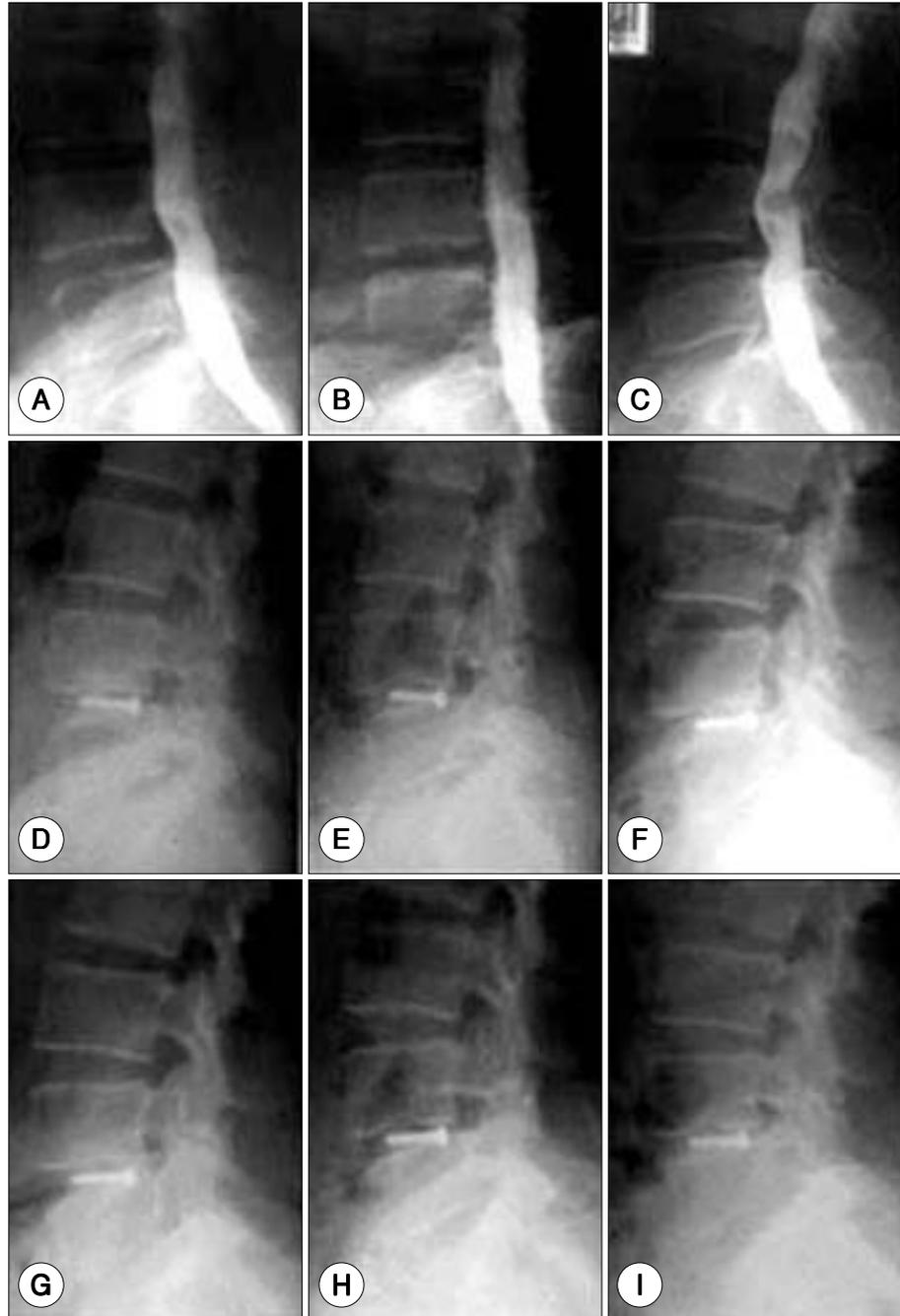


Fig. 7. Pictures of lumbar spine with posterior lumbar interbody fusion in neutral(A, D, G), flexion(B, E, H), and extension(C, F, I) positions showing pre-operative L4-5 instability(A, B, C), early postoperative(D, E, F), and late postoperative dynamic views (G, H, I). The patient underwent posterior lumbar interbody fusion at L4-5 level. The postoperative changes of the flexion and extension angles of L3-4 level are minimal.

가

17) 가 가

10) 가 가가 가

8)13) 1~2 가 PSF

가 PLIF 가

가 PSF 가

가 가 6)12) 가

가 가

8) 가 가

1) 14) 가 가 가 15)

4) 가

가 가

가 가 가 가

가 가

가 PSF 1 가

가 가

가 가

가 가

17) 가 가 4)

가 가 PLIF 1 가

가 PLIF PSF

