

Pelvic Incidence-Lumbar Lordosis Mismatch and Early Reoperation for Adjacent Segment Disease after Lumbar Fusion

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INTRODUCTION:

The incidence of symptomatic adjacent segment disease (ASD) following lumbar fusion surgery ranges from 0.6% to 3.9% per year. Sagittal malalignment may contribute to the development of ASD, particularly PI-LL mismatch, which is calculated as the difference between the pelvic incidence and lumbar lordosis. Patients with a high degree of PI-LL mismatch (over 10°) have higher incidences of ASD following lumbar fusion. The 2-year reoperation rate for patients with ASD undergoing 1-to-2 level lumbar fusion surgery was compared between patients with PI-LL mismatch and patients with normal PI-LL measurements postoperatively.

METHODS:

Consecutive patients undergoing elective 1 to 2 level lumbar fusion for degenerative conditions between 2016-2018 were retrospectively reviewed. Spinopelvic radiographic parameters were measured on immediate postoperative radiographs. PI-LL mismatch was determined using the age adjusted thresholds defined in Lafage et al. Following propensity score matching on age, sex, race, and body-mass index (BMI), early reoperation rates were compared between the PI-LL mismatch cohort and normal PI-LL cohort. Early reoperation was defined as symptomatic ASD requiring reoperation within 2 years of the index lumbar fusion surgery.

RESULTS:

A total of 219 patients underwent 1 to 2 level lumbar fusion with an average age of 59 years old and 59.8% female. The mean follow-up was 3.2 years. Patients in the PI-LL mismatch cohort (N=148) were younger (57.5 vs. 63.5, p<0.001) and had a higher proportion of black patients (31.8% vs. 11.3%, p=0.001) compared to the normal PI-LL cohort. A total of 100 patients in the PI-LL mismatch cohort were propensity score matched to 66 patients in the normal PI-LL cohort, resulting in no difference in age (p=0.177), sex (p=0.302), race (p=0.727), or BMI (p=0.892). Using these matched cohorts, the rate of early reoperation for ASD in the PI-LL mismatch cohort was 8.0 %, which was similar to the 9.1% reoperation rate in the normal PI-LL cohort (p=0.805) with a mean time to reoperation of 1.28 and 1.33 years, respectively.

DISCUSSION AND CONCLUSION:

Younger patients and African Americans were more likely to have a postoperative PI-LL mismatch. However, after propensity score matching, PI-LL mismatch was not associated with early reoperation for ASD in patients undergoing 1-to-2 level lumbar fusions for degenerative conditions.

Table 1. Demographic Characteristics of Patients Undergoing 1-2 Level Fusion for Lumbar Degenerative Disease	
	All Patients
Number of Patients	219
Age (Years)	59.4 ± 10.9 (95% CI, 58.0 - 60.9)
<50 Years	34 (15.5%)
50-65 Years	113 (51.6%)
>65 Years	72 (32.9%)
Sex	
Female	131 (59.8%)
Male	88 (40.2%)
Race	
White	164 (74.9%)
Black	55 (25.1%)
BMI	31.3 ± 6.2 (95% CI, 30.5 - 32.1)
Diabetes	42 (19.2%)
Smoking Status	
Current	38 (17.4%)
Former	79 (36.1%)
Never	102 (46.6%)
Mean Follow-Up (Years)	3.21 ± 1.16 (95% CI, 3.06 - 3.37)

Table 2. Comparison of Patients with and without PI-LL Mismatch (Age-Adjusted Thresholds)			
	PI-LL Mismatch	Normal PI-LL	p-value
Number of Patients	161	58	
Age (Years)	57.5 ± 11.1 (95% CI, 56.0 - 59.4)	64.3 ± 8.8 (95% CI, 62.0 - 66.6)	<0.001
<50 Years	32 (19.9%)	2 (3.5%)	<0.001
50-65 Years	88 (54.7%)	52 (90.1%)	
>65 Years	41 (25.5%)	3 (5.3%)	
Sex			0.828
Female	97 (60.3%)	34 (58.6%)	
Male	64 (39.8%)	24 (41.4%)	
Race			0.001
White	111 (68.9%)	53 (91.3%)	
Black	50 (31.1%)	5 (8.6%)	
BMI	31.5 ± 6.6 (95% CI, 30.5 - 32.4)	30.6 ± 5.0 (95% CI, 29.2 - 31.9)	0.481
Diabetes	33 (20.5%)	11 (19.0%)	0.362
Smoking Status			0.052
Current	33 (20.5%)	5 (8.6%)	
Former	52 (32.3%)	27 (46.6%)	
Never	76 (47.2%)	26 (44.8%)	
Proximal Fusion Level			0.191
L2	2 (1.2%)	1 (1.7%)	
L3	25 (15.5%)	5 (8.6%)	
L4	112 (69.6%)	40 (69.0%)	
L5	22 (13.7%)	10 (17.2%)	
Distal Fusion Level			0.753
L3	2 (1.2%)	2 (3.5%)	
L4	11 (6.8%)	4 (6.9%)	
L5	89 (55.3%)	34 (58.6%)	
L1	49 (30.4%)	18 (31.0%)	
Number of Levels Fused			0.364
One	121 (75.2%)	47 (81.0%)	
Two	40 (24.8%)	11 (19.0%)	

Table 3. Spinopelvic Parameters and Reoperation for Adjacent Segment Disease			
	Reoperation for ASD	No Reoperation for ASD	p-value
Number of Patients	19	200	
Propensity Parameters			
Lumbar Lordosis	52.4 ± 13.6	54.0 ± 13.8	0.624
Sacral Slope	40.1 ± 10.0	38.5 ± 10.4	0.572
Pelvic Tilt	21.3 ± 8.7	22.8 ± 10.0	0.580
Pelvic Incidence	62.2 ± 14.0	65.2 ± 12.8	0.973
PI-LL Difference	9.7 ± 12.8	7.9 ± 12.9	0.578
Postoperative Parameters			
Lumbar Lordosis	51.8 ± 13.1	51.1 ± 12.8	0.875
Sacral Slope	38.2 ± 9.2	37.8 ± 9.8	0.803
Pelvic Tilt	23.8 ± 7.1	24.2 ± 9.0	0.803
Pelvic Incidence	61.9 ± 13.3	63.8 ± 12.2	0.988
PI-LL Difference	10.2 ± 12.7	10.7 ± 11.8	0.878

Table 4. Patient Characteristics and Reoperation for ASD			
	Reoperation for ASD	No Reoperation for ASD	p-value
Number of Patients	19	200	
Age (Years)	61.4 ± 8.3 (95% CI, 58.3 - 64.6)	58.8 ± 11.7 (95% CI, 57.0 - 60.3)	0.370
<50 Years	0 (0%)	34 (17.0%)	0.003
50-65 Years	14 (73.7%)	99 (49.5%)	
>65 Years	5 (26.3%)	67 (33.5%)	
Sex			0.808
Female	11 (57.9%)	120 (60.0%)	
Male	8 (42.1%)	80 (40.0%)	
Race			0.217
White	12 (63.2%)	151 (76.0%)	
Black	7 (36.8%)	48 (24.0%)	
BMI	34.4 ± 4.8 (95% CI, 31.1 - 38.4)	30.9 ± 6.3 (95% CI, 30.0 - 31.8)	0.009
Diabetes	7 (36.8%)	91 (45.5%)	0.483
Smoking Status			0.278
Current	7 (36.8%)	95 (47.5%)	
Former	10 (53.2%)	69 (34.5%)	
Never	2 (10.5%)	36 (18.0%)	
Number of Levels Fused			0.373
One	13 (68.4%)	155 (77.5%)	
Two	6 (31.6%)	45 (22.5%)	
Laminectomy Above Fusion	10 (52.6%)	81 (40.5%)	0.348