

Introduction

This study aims to evaluate operative factors potentially associated with occurrence of adjacent segment disease (ASD) after elective single-level lumbar fusion for degenerative spinal disease.

Table 1. Demographic Characteristics

Variables	Total, % (n=369)
Median Age [IQR]	53 [44, 64]
Male Gender	160 (43.4)
Approach	
Anterior	15 (4.5)
Posterior	204 (61.4)
Circumferential	113 (34)
Fusion Type	
Pedicular Screws Only	167 (45.3)
Interbody Fusion Only	20 (5.4)
Combined	182 (49.3)
Procedures Done	
Laminotomy	61 (17.9)
Laminectomy	282 (82.2)
Foraminotomy	60 (17.6)
Corpectomy	88 (25.9)
Discectomy	208 (61.5)
Pedicular Screw Fixation	349 (94.6)
Interbody Fusion	202 (54.7)
Decompression of Adjacent Segments without Fusion	168 (45.5)
Number of unfused segments	0.65 ± 0.86
0	201 (54.5)
1	115 (31.2)
2	35 (9.5)
3	16 (4.3)
4	2 (0.5)
Interbody Fusion Approach	
Anterior	147 (72.8)
Posterior	55 (27.2)
Bone Morphogenic Protein	113 (34.3)
Bone Graft Type	
Autograft	128 (42.7)
Allograft	7 (2.3)
Autograft and Allograft	165 (55)
Smoking Status	
Current smoker	42 (12.5)
Former smoker	40 (11.9)
Lifetime nonsmoker	255 (75.7)
Osteoporosis	10 (2.9)
Diabetes	38 (11.1)
Adjacent Segment Disease	83 (22.5)
Follow-up	
Mean ± SD	3.24 ± 4.35 years
Time to ASD	
Mean ± SD	5.69 ± 5.79 years
Adjacent Segment Disease	170 (21.8)

Categorical values are presented as frequencies and percentages; continuous variables are presented as means and SD. (ASD, adjacent segment disease; SD, standard deviation)

Methods

A retrospective review was performed on patients who underwent single-level lumbar fusion for stenosis, spondylolisthesis or disc degeneration between 2007 and 2016. Patients without follow-up were excluded from the study. Effects of demographic (age, gender, smoking status, osteoporosis, diabetes) and technical factors (surgical approach, type of procedure, performing decompression in any segments without fusion, type of bone graft) on ASD rates were analyzed.

Results

369 patients met our inclusion criteria, 83 (22.5%) of whom were re-operated for ASD. Mean follow-up was 3.24 years, and mean time to ASD was 5.69 years.

Univariate analysis showed significant association of using combined autograft and allograft with lower rates of ASD (P=0.016), and there was a tendency towards significance for anterior interbody fusion approach (P=0.052), discectomy (P=0.057), and unfused decompression adjacent to the fused segment (P=0.120). There was no statistically significant association between fusion technique (pedicular screw only vs. interbody fusion only vs. both), surgical approach (anterior vs. posterior vs. circumferential), smoking, osteoporosis or diabetes and ASD. Multivariate analysis identified that presence of unfused decompression adjacent to the fused segments (OR=2.84, P=0.030), anterior interbody fusion (OR=0.13, P=0.007) and combined use of bone autograft and allograft (OR=0.37, P<0.001) were associated with ASD rate.

Table 2. Univariate analysis of prognostic factors for development of ASD.

Variables	No ASD 286 (77.5%)	ASD 83 (22.5%)	p-Value
Interbody Fusion			
No	124 (74.3)	43 (25.7)	0.173
Yes	162 (80.2)	40 (19.8)	
Fusion Type			
Screws Only	124 (74.3)	43 (25.7)	0.342
Interbody Only	17 (85)	3 (15)	
Combined	145 (79.7)	37 (20.3)	
Approach			
Anterior	13 (86.7)	2 (13.3)	0.643
Posterior	172 (84.3)	32 (15.7)	
Circumferential	91 (80.5)	22 (19.5)	
Fusion Approach			
Anterior	113 (76.9)	34 (23.1)	0.052
Posterior	49 (89.1)	6 (10.9)	
Fusion Approach in the IBF-only subgroup			
Anterior	14 (87.5)	2 (12.5)	0.531
Posterior	3 (75)	1 (25)	
Unfused Surgery on Adjacent Segments			
No	162 (80.6)	39 (19.4)	0.12
Yes	124 (73.8)	44 (26.2)	
Number of unfused segments	0.63 ± 0.86	0.73 ± 0.86	0.176
Age, years (mean, SD)	54.2 ± 14.1	52.0 ± 12.8	0.235
Gender			
Female	129 (80.6)	31 (19.4)	0.209
Male	157 (75.1)	52 (24.9)	
Laminotomy			
No	230 (82.1)	50 (17.9)	0.529
Yes	48 (78.7)	13 (21.3)	
Laminectomy	228 (80.9)	54 (19.1)	0.505
Foraminotomy	47 (78.3)	13 (21.7)	0.491
Corpectomy	72 (81.8)	16 (18.2)	0.922
Discectomy			
No	100 (76.9)	30 (23.1)	0.057
Yes	177 (85.1)	31 (14.9)	
Pedicular Screw Fixation	269 (77.1)	80 (22.9)	0.409
Bone Morphogenic Protein	99 (87.6)	14 (12.4)	0.128
Bone Graft Type			
Autograft	96 (75)	32 (25)	0.016
Allograft	6 (85.7)	1 (14.3)	
Autograft and Allograft	145 (87.9)	20 (12.1)	
Smoking Status			
Current smoker	33 (78.6)	9 (21.4)	0.556
Former smoker	29 (72.5)	11 (27.5)	
Lifetime nonsmoker	204 (80)	51 (20)	
Osteoporosis	7 (70)	3 (30)	0.468
Diabetes	29 (76.3)	9 (23.7)	0.673

Statistically significant p-values are highlighted in bold. (ASD, adjacent segment disease; SD, standard deviation)

Conclusions

No difference in ASD rates was identified between pedicular screw fixation with and without interbody fusion. However, unfused decompression of the adjacent levels was associated with higher ASD rates. When interbody fusion was performed, anterior approach was associated with lower ASD rates. Lastly, use of combined autograft and allograft was associated with lower ASD rates.

References

- Gard AP, Klopfer HB, Doran SE, Hellbusch LC. Analysis of adjacent segment degeneration with laminectomy above a fused lumbar segment. Journal of clinical neuroscience : official journal of the Neurosurgical Society of Australasia. 2013;20(11):1554-1557.
- Heo Y, Park JH, Seong HY, et al. Symptomatic adjacent segment degeneration at the L3-4 level after fusion surgery at the L4-5 level: evaluation of the risk factors and 10-year incidence. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society. 2015;24(11):2474-2480.

Table 3. Multivariate logistic regression analysis of prognostic factors for development of ASD.

Variables	Odds Ratio (CI 95%)	p-Value
Unfused Surgery on Adjacent Segments	2.84 (1.11 - 7.28)	0.03
Anterior Interbody Fusion	0.13 (0.03 - 0.58)	0.007
Discectomy	1.26 (0.1 - 16.52)	0.861
Autograft + Allograft	0.37 (0.21 - 0.65)	<0.001

Statistically significant p-values are highlighted in bold. (ASD, adjacent segment disease; CI, confidence interval)