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Clinical Study

Differences in the outcomes of anterior *versus* posterior interbody fusion surgery of the lumbar spine: A propensity score-controlled cohort analysis of 10,941 patients

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ABSTRACT

Few studies have measured outcome differences between the various available spinal fusion techniques. We compare long-term outcomes of anterior *versus* posterior lumbar interbody fusion. Using the MarketScan database (Truven Health Analytics, Ann Arbor, MI, USA) we selected patients ⩾18 years old who underwent lumbar fusion surgery from 2000–2009 using either approach. Exclusion criteria included circumferential fusion, and having less than 1 year of preoperative or less than 2 years of postoperative follow-up. Using an inverse probability-weighted propensity-score model we compared reoperation and 90 day complication rates, and postoperative health resource utilization of both approaches. A total of 10,941 patients were identified. Of these, 7460 (68.2%) and 3481 (31.8%) underwent posterior and anterior interbody fusion, respectively. Anterior fusion patients had a higher 2 year reoperation rate (odds ratio 1.43, 95% confidence interval [CI]: 1.21–1.70, $p < 0.0001$), although differences became non-significant at maximum follow-up ($p = 0.0877$). The 90 day complication rate was 15.7%, with anterior fusion patients being more likely to experience complications (relative risk 1.24, 95%CI: 1.13–1.36, $p < 0.0001$). Anterior fusion patients also had greater levels of postoperative health utilization, surpassing posterior fusion patients by an average of $US7450 in total charges (95% CI: $4670–$10,220, $p < 0.0001$). As currently practiced in the USA, anterior lumbar surgical approaches may be associated with higher postoperative morbidity and reoperation rates than posterior fusion approaches.

1. Introduction

Spinal fusion surgery is an increasingly prevalent treatment option for degenerative spine disease, with an estimated 174,223 fusion surgeries performed in 2008 alone, a 137% increase over the preceding decade [1]. Despite the many different approaches that exist to allow access to the spine for fusion, few studies have directly measured outcome differences between techniques at the time of writing [2–6]. Moreover, data comparing long-term outcomes are lacking. To address this issue we designed a retrospective, inverse probability-weighted propensity-score, cohort analysis using the MarketScan database (Truven Health Analytics, Ann Arbor, MI, USA) to compare outcomes following anterior and posterior approaches for fusion of the lumbar spine.

2. Materials and methods

2.1. Data source

For the present study, we used the Commercial Claims and Encounters, Medicare Supplemental, and Medicaid Supplemental datasets from 2000–2009 of the MarketScan database. The MarketScan databases contain longitudinal inpatient and outpatient claims data for over 170 million unique patients, collected from over 100 unique payers across the USA. All data have been de-identified per the Health Insurance Privacy and Portability Act of 1996 and appropriate Institutional Review Board approval was obtained for this study.

2.2. Selection criteria

Patients were selected on the basis of *International Classification of Diseases, Ninth Edition, Clinical Modification* (ICD-9-CM) or

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Table 1
Demographics by lateral interbody fusion type

	Total	Anterior	Posterior
Total, n (%)	10,941 (100.0)	3481 (100.0)	7460 (100.0)
Age			
Mean (SD)	53.0 (13.35)	48.5 (11.79)	55.1 (13.53)
Median (IQR)	53.0 (44.0–62.0)	48.0 (41.0–56.0)	56.0 (46.0–64.0)
Age			
35–44	901 (10.87)	376 (15.39)	525 (8.98)
45–54	2058 (24.83)	942 (38.56)	1116 (19.10)
55–64	3197 (38.58)	819 (33.52)	2378 (40.69)
⩾65	2131 (25.71)	306 (12.53)	1825 (31.23)
Female	6888 (62.96)	2153 (61.85)	4735 (63.47)
Prior + Index Charlson Comorbidity score			
0	6119 (55.93)	2221 (63.80)	3898 (52.25)
1	2812 (25.70)	798 (22.92)	2014 (27.00)
2	1203 (11.00)	275 (7.90)	928 (12.44)
⩾3	807 (7.38)	187 (5.37)	620 (8.31)
Insurance			
Commercial	6442 (58.88)	2680 (76.99)	3762 (50.43)
Medicaid	2659 (24.30)	495 (14.22)	2164 (29.01)
Medicare	1840 (16.82)	306 (8.79)	1534 (20.56)
Employment status			
Employed	2479 (22.66)	1211 (34.79)	1268 (17.00)
Retiree	1294 (11.83)	460 (13.21)	834 (11.18)
Other/Missing	7168 (65.52)	1810 (52.00)	5358 (71.82)
Preop follow-up, days			
Mean (SD)	1152.4 (606.60)	1123.8 (601.44)	1165.8 (608.57)
Median (IQR)	1018.0 (643.0–1552.0)	980.0 (633.0–1500.0)	1037.5 (648.0–1578.5)
Postop follow-up, days			
Mean (SD)	1482.0 (604.26)	1404.2 (571.80)	1518.4 (615.51)
Median (IQR)	1336.0 (977.0–1864.0)	1248.0 (951.0–1722.0)	1386.5 (996.0–1935.0)
Length of hospital stay			
Mean (SD)	4.4 (4.77)	4.3 (5.51)	4.5 (4.38)
Median (IQR)	3.0 (2.0–5.0)	3.0 (2.0–4.0)	3.0 (2.0–5.0)
Index hospitalization charges ($US1000)			
Mean (SD)	45.7 (46.94)	52.8 (54.26)	42.4 (42.70)
Median (IQR)	34.1 (19.4–59.7)	39.1 (23.4–63.7)	31.5 (17.8–57.8)
Spondylolisthesis	3033 (27.72)	433 (12.44)	2600 (34.85)
Stenosis	3643 (33.30)	553 (15.89)	3090 (41.42)
Herniated disc	7346 (67.14)	2737 (78.63)	4609 (61.78)
Scoliosis	541 (4.94)	219 (6.29)	322 (4.32)
Spondylosis	2337 (21.36)	667 (19.16)	1670 (22.39)
Fusions			
Levels not indicated	5963 (54.50)	1730 (49.70)	4233 (56.74)
2–3 vertebrae	4633 (42.35)	1664 (47.80)	2969 (39.80)
4–8 vertebrae	299 (2.73)	77 (2.21)	222 (2.98)
⩾9	46 (0.42)	10 (0.29)	36 (0.48)

Data are presented as number (%) unless otherwise indicated.
IQR = interquartile range, postop = postoperative, preop = preoperative, SD = standard deviation.

Current Procedural Terminology (CPT) codes. Patients were included if they were ⩾18 years old and had undergone a lumbar interbody fusion using either an anterior (ICD-9-CM: 81.06, CPT: 22558) or posterior (ICD-9-CM: 81.08, CPT: 22630) approach. Since no true CPT codes exist for extreme lateral interbody fusion, direct lateral interbody fusion, or transforaminal lumbar interbody fusion, the former two techniques are currently billed for using the anterior lumbar interbody fusion (ALIF) code and the latter is billed for using the posterior lumbar interbody fusion (PLIF) code and were included as such in our study.

Patients were excluded if they received a circumferential or anterior–posterior fusion (anterior and posterior surgery), or concurrent anterior and posterolateral fusions (CPT: 22612) during the same hospitalization or within 30 days of each other (such as combination PLIF and posterolateral fusion). The follow-up period was based on listed start and end-enrollment dates. If no date was listed, 1 January 2000 and 31 December 2009 were used for the purposes of calculating follow-up time. Patients were excluded if they had less than 1 year of preoperative or less than 2 years of postoperative follow-up time.

2.3. Independent and dependent variables

Patients were characterized by the approach used during initial lumbar fusion surgery, age, sex, insurance status, employment status, available preoperative and postoperative follow-up, year of surgery, comorbidity burden (as measured by Deyo's adaptation of the Charlson Comorbidity Index) [7], number of vertebrae fused, and any associated spinal diagnoses (spondylolisthesis, stenosis, herniated disc, scoliosis, and/or spondylosis).

Our primary outcomes of interest were 2 year reoperation rates (presence of either a subsequent anterior or posterior interbody fusion) and 90 day complication rates. Any procedure indicated as a planned portion of a multi-stage procedure (CPT code