Risk Factors for Total Hip Arthroplasty Following Lumbar Fusion Surgery: A Large Propensity Matched Study

Joshua M Wiener, Parshva Amit Sanghvi, Seth M Meade, Nicolas Thompson, Michael Shost, Thomas Edward Mroz[1], Michael Patrick Steinmetz[2]

[1]The Cleveland Clinic, [2]Cleveland Clinic

INTRODUCTION:

Degenerative diseases of the spine and osteoarthritis of the hip are some of the most common causes of disability in the aging population. Both conditions can be treated with lumbar fusion and total hip arthroplasty (THA) respectively when conservative management fails. Due to the complex biomechanical interactions of the hip and lower back along with shared clinical risk factors, hip pain can present similarly to lumbar spine pain, creating difficulty when attempting diagnosis. The objectives of this study were to examine the relationship between lumbar fusion and THA, identify clinical and surgical risk factors of the need for and timing of THA in the context of lumbar fusion, and finally explore the association of postoperative outcomes in lumbar fusion and THA.

METHODS:

A retrospective cohort study was performed using electronic medical records from a major academic institution between 10/2009 and 10/2015. Cohorts consisted of adult patients undergoing lumbar fusion surgery for degenerative spine disease and a control group of patients seen by primary care physicians at the same time period. Patients were propensity score matched based on age, sex, race, ethnicity, body mass index, smoking status, and 16 other comorbidities. Analytical methods included time-to-event modeling using Cox proportional hazard models and multivariable cause-specific cox proportional hazard models. The primary outcome evaluated was time to THA. Secondary outcomes were mortality differences between the two cohorts, impact of demographic and comorbidity variables on time to THA, effect of pre-lumbar fusion PROs and change in PROs on time to THA, and impact of differences in PRO scores after lumbar fusion but before THA on PROs after THA.

RESULTS:

The final cohort consisted of 25,379 patients (6,345 experimental, 19,304 controls) after matching with median follow up time of 11 years (IQR 8-14 years). At 10 years post lumbar fusion, 3.54% of controls and 5.54% of lumbar fusion patients had undergone THA. Overall, lumbar fusion patients had a 1.70 times higher risk of THA compared to control patients ($p<0.001$). Age, hip arthritis, and knee arthritis were associated with greater risk of THA in both experimental and control groups. Diabetes was associated with lower risk of THA in the experimental (HR = 0.7 [0.50, 0.98], p=0.04) and control groups (HR = 0.61 [0.57, 0.64], $p < 0.001$). Worse postoperative pain disability questionnaire (PDQ) total scores following lumbar fusion were associated with lower risk of THA.

DISCUSSION AND CONCLUSION:

Lumbar fusion is associated with greater risk of later THA. Specific risk factors such as age and arthritis may predispose patients to THA, while diabetes acts as a protective factor against later THA, potentially due to increased hesitancy to operate due to increased risk of surgical site infection in diabetic patients. There is a moderate association between worse lumbar fusion postoperative outcomes and reduced risk of THA.

Figure 1. Cumulative incidence of THA and death, stratified by group (lumbar fusion vs. control group) using the propensity-matched patient sample.

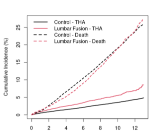

Table 1. Patient and clinical characteristics after propensity score matching

	Before Propensity Matching				After Propensity Matching			
	All Patients	Lumbar Fusion	Control	Standardized Difference	All Patients	Lumbar Fusion	Control	Standardized Difference
N	2367280	6348	2360932		25392	6348	19044	
Age, mean (SD)	51.1 (18.2)	62.6 (12.9)	51.1 (18.2)	0.892	62.7 (14.8)	62.6 (12.9)	62.7 (15.4)	-0.010
Female	1337725 (56.5%)	3100 (48.8%)	1334625 (56.5%)	-0.154	12478 (49.1%)	3100 (48.8%)	9378 (49.2%)	-0.008
Race								
White	1839654 (77.7%)	5653 (89.1%)	1834001 (77.7%)	0.364	22660 (89.2%)	5653 (89.1%)	17007 (89.3%)	-0.008
Black	295068 (12.5%)	454 (7.2%)	294614 (12.5%)	-0.207	1765 (7.0%)	454 (7.2%)	1311 (6.9%)	0.010
Other	83646 (3.5%)	100 (1.6%)	83546 (3.5%)	-0.158	391 (1.5%)	100 (1.6%)	291 (1.5%)	0.004
Unknown/Declined	148912 (6.3%)	141 (2.2%)	148771 (6.3%)	-0.277	576 (2.3%)	141 (2.2%)	435 (2.3%)	-0.004
Ethnicity								
Hispanic	128141 (5.4%)	100 (1.6%)	128041 (5.4%)	-0.309	396 (1.6%)	100 (1.6%)	296 (1.6%)	0.002
Not Hispanic	1923156 (81.2%)	5967 (94.0%)	1917189 (81.2%)	0.539	23944 (94.3%)	5967 (94.0%)	17977 (94.4%)	-0.017
Unknown/Declined	315983 (13.3%)	281 (4.4%)	315702 (13.4%)	-0.435	1052 (4.1%)	281 (4.4%)	771 (4.0%)	0.018
BMI, mean (SD)	28.7 (6.9)	30.3 (6.1)	28.7 (6.9)	0.268	30.3 (6.8)	30.3 (6.1)	30.3 (7.1)	-0.008
Missing BMI	408537 (17.3%)	32 (0.5%)	408505 (17.3%)	-2.372	123 (0.5%)	32 (0.5%)	91 (0.5%)	0.004
Smoking Status								
Never	1092750 (46.2%)	2624 (41.3%)	1090126 (46.2%)	-0.098	10488 (41.3%)	2624 (41.3%)	7864 (41.3%)	0.001
Former	621731 (26.3%)	2873 (45.3%)	618858 (26.2%)	0.383	11427 (45.0%)	2873 (45.3%)	8554 (44.9%)	0.007
Current	286922 (12.1%)	789 (12.4%)	286133 (12.1%)	0.009	3214 (12.7%)	789 (12.4%)	2425 (12.7%)	-0.009
Unknown	365877 (15.5%)	62 (1.0%)	365815 (15.5%)	-1.476	263 (1.0%)	62 (1.0%)	201 (1.1%)	-0.008
Cerebrovascular Disease	44322 (1.9%)	433 (6.8%)	43889 (1.9%)	0.197	1731 (6.8%)	433 (6.8%)	1298 (6.8%)	0.000
Congestive Heart Failure	29237 (1.2%)	243 (3.8%)	28994 (1.2%)	0.136	976 (3.8%)	243 (3.8%)	733 (3.8%)	-0.001
Connective Tissue Disease	39511 (1.7%)	441 (6.9%)	39070 (1.7%)	0.208	1707 (6.7%)	441 (6.9%)	1266 (6.6%)	0.012
Chronic Obstructive Pulmonary Disease	42100 (1.8%)	599 (9.4%)	41501 (1.8%)	0.263	2259 (8.9%)	599 (9.4%)	1660 (8.7%)	0.025
Degenerative Spine Disease	69095 (2.9%)	5589 (88.0%)	63506 (2.7%)	2.631	22356 (88.0%)	5589 (88.0%)	16767 (88.0%)	0.000
Dementia	9144 (0.4%)	33 (0.5%)	9111 (0.4%)	0.019	115 (0.5%)	33 (0.5%)	82 (0.4%)	0.012
Diabetes	89220 (3.8%)	1046 (16.5%)	88174 (3.7%)	0.343	4104 (16.2%)	1046 (16.5%)	3058 (16.1%)	0.011
Hip Arthritis	9638 (0.4%)	245 (3.9%)	9393 (0.4%)	0.180	991 (3.9%)	245 (3.9%)	746 (3.9%)	-0.003
Hypertension	245848 (10.4%)	3057 (48.2%)	242791 (10.3%)	0.758	11946 (47.0%)	3057 (48.2%)	8889 (46.7%)	0.030
Knee Arthritis	19538 (0.8%)	492 (7.8%)	19046 (0.8%)	0.260	1831 (7.2%)	492 (7.8%)	1339 (7.0%)	0.027
Myocardial Infarction	9941 (0.4%)	125 (2.0%)	9816 (0.4%)	0.112	444 (1.7%)	125 (2.0%)	319 (1.7%)	0.021
Osteoporosis	46431 (2.0%)	407 (6.4%)	46024 (1.9%)	0.182	1602 (6.3%)	407 (6.4%)	1195 (6.3%)	0.006
PVD	48736 (2.1%)	582 (9.2%)	48154 (2.0%)	0.247	2290 (9.0%)	582 (9.2%)	1708 (9.0%)	0.007
Rheumatoid Arthritis	12947 (0.5%)	221 (3.5%)	12726 (0.5%)	0.161	858 (3.4%)	221 (3.5%)	637 (3.3%)	0.007
Shoulder Arthritis	5865 (0.2%)	131 (2.1%)	5734 (0.2%)	0.128	512 (2.0%)	131 (2.1%)	381 (2.0%)	0.004

Table 2. Results of multivariable cause-specific Cox proportional hazard models for time to THA.

	Control Group		Lumbar Fusion Group	
	Hazard Ratio (95% CI)	P-value	Hazard Ratio (95% CI)	P-value
Age (per 10 years)	1.43 (1.42, 1.44)	< 0.001	1.10 (1.00, 1.21)	0.041
Female (vs. Male)	0.83 (0.81, 0.85)	< 0.001	1.10 (0.87, 1.39)	0.407
Race (vs. White)				
Black	0.81 (0.78, 0.84)	< 0.001	0.66 (0.41, 1.06)	0.086
Other Race	0.44 (0.39, 0.49)	< 0.001	0.36 (0.09, 1.42)	0.145
BMI (per 10 kg/m^2)	1.33 (1.31, 1.35)	< 0.001	0.95 (0.78, 1.17)	0.632
Smoking Status (vs. Never)				
Former	1.14 (1.11, 1.17)	< 0.001	1.06 (0.84, 1.35)	0.617
Current	1.05 (1.00, 1.09)	0.037	0.82 (0.52, 1.28)	0.385
Cerebrovascular Disease	0.80 (0.74, 0.86)	< 0.001	1.07 (0.71, 1.61)	0.762
Congestive Heart Failure	0.71 (0.64, 0.79)	< 0.001	1.47 (0.87, 2.47)	0.149
Connective Tissue Disease	1.24 (1.15, 1.33)	< 0.001	1.52 (0.95, 2.41)	0.079
Chronic Obstructive Pulmonary Disease	0.91 (0.85, 0.98)	0.013	1.10 (0.77, 1.57)	0.584
Degenerative Spine Disease	1.24 (1.18, 1.30)	< 0.001	1.48 (0.94, 2.33)	0.089
Diabetes	0.61 (0.57, 0.64)	< 0.001	0.70 (0.50, 0.98)	0.040
Hip Arthritis	8.73 (8.25, 9.23)	< 0.001	4.26 (3.04, 5.97)	< 0.001
Hypertension	1.01 (0.97, 1.04)	0.742	1.19 (0.92, 1.54)	0.185
Knee Arthritis	1.25 (1.16, 1.34)	< 0.001	1.56 (1.12, 2.19)	0.009
Myocardial Infarction	1.07 (0.93, 1.23)	0.355	1.01 (0.48, 2.11)	0.988
Osteoporosis	0.98 (0.92, 1.04)	0.524	1.04 (0.72, 1.51)	0.819
PVD	0.83 (0.77, 0.89)	< 0.001	0.94 (0.63, 1.41)	0.776
Rheumatoid Arthritis	1.21 (1.08, 1.37)	0.001	0.86 (0.46, 1.61)	0.631
Shoulder Arthritis	1.21 (1.06, 1.38)	0.004	0.90 (0.47, 1.71)	0.742

Table 3. Results of multivariable cause-specific Cox proportional hazard models for time to THA where variables of interest were pre-lumbar fusion PRO scores or change in PRO scores relative to lumbar fusion.

	N	Hazard Ratio (95% Confidence Interval)	P-value
EQ-5D Index (per 0.1 points)	3853	1.05 (0.98, 1.13)	0.133
PHQ-9 score (per 5 points)	3738	0.94 (0.83, 1.06)	0.287
PDQ Total score (per 10 points)	3403	0.94 (0.89, 0.99)	0.023
Change in EQ-5D Index (vs. Worsened)			
Stable	3364	1.59 (0.56, 4.50)	0.383
Improved		1.35 (0.49, 3.74)	0.563
Change in PHQ-9 Score (vs. Worsened)			
Stable	3095	0.56 (0.26, 1.19)	0.129
Improved		0.52 (0.24, 1.11)	0.092
Change in PDQ Total Score (vs. Worsened)			
Stable	2766	1.01 (0.51, 2.00)	0.982
Improved		0.72 (0.37, 1.39)	0.324