Long-Term Benefits of Minimally Invasive Discectomy: Reduced Risk of Spinal Fusion and Insights Across Patient Subgroups

Sung Huang Laurent Tsai, Mohamad Bydon

INTRODUCTION:

The choice between PELD and OLD for managing lumbar disc herniation (LDH) remains debated. While both techniques achieve comparable short-term outcomes, their long-term effects, particularly regarding the progression to spinal fusion, are underexplored. This study evaluates the risk of subsequent spinal fusion associated with PELD versus OLD and examines how patient demographics and comorbidities influence these outcomes.

This study evaluates the long-term risk of spinal fusion following percutaneous endoscopic lumbar discectomy (PELD) versus open lumbar discectomy (OLD), with a focus on subgroup-specific differences, including age, race, BMI, and comorbidities.

METHODS:

Study Design/Setting:

Retrospective, cohort study utilizing the TriNetX Research Network, analyzing patients from 2000 to 2023.

Patient Sample:

123,405 patients diagnosed with LDH between 2000 and 2023, including 93,853 PELD and 29,552 OLD cases. After excluding spinal fracture, malignancy, infection and applying 1:1 propensity score matching, 29,552 matched patients were included in each cohort.

Outcome Measures:

Primary outcome was the incidence of subsequent spinal fusion surgery following PELD or OLD. Subgroup analysis included age groups, sex, race, lifestyle factors, and comorbidities.

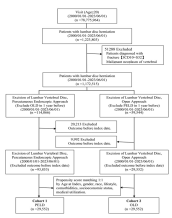
Utilizing the TriNetX Research Network, we analyzed patients diagnosed with LDH between 2000 and 2023, including 93,853 PELD and 29,552 OLD cases. Propensity score matching was applied to create a 1:1 cohort to ensure baseline comparability. Patients were followed for up to 20 years to assess the risk of subsequent spinal fusion.

RESULTS:

1,223,803 patients diagnosed with LDH were identified using TrinetX. After excluding spinal fracture, malignancy, infection and applying 1:1 propensity score matching, 29,552 matched patients were included in each cohort. (PELD group: mean [SD]age,48.0[13.7] years; 17039 males [57.7%]; OLD group: mean [SD]age,48.0[13.7] years; 17045 males [57.7%]). PELD significantly reduced the risk of spinal fusion compared to OLD over a 20-year follow-up (HR 0.706; 95% CI: 0.656–0.760). Subgroup analysis revealed consistent benefits across younger patients (20–45 years), high-BMI individuals, and White and African American populations. However, PELD demonstrated limited effectiveness in Asian patients and those with alcohol-related diseases.

DISCUSSION AND CONCLUSION:

PELD offers substantial long-term benefits in reducing the need for spinal fusion, particularly for younger, obese, and racially diverse patients. These findings support PELD as a personalized surgical approach that minimizes invasive burden while optimizing outcomes.



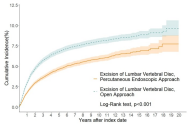
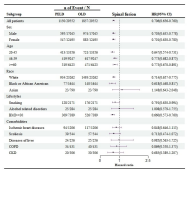


Table 1 Baseline characteristics of study subjects (before and after Propensity score matching).

	Before matching			After matching		
	PELD[a] (n = 93,853)	OLD[b] (n = 29,552)	Std. diff	PELD (n = 29,552)	OLD (n = 29,552)	Std. diff
Age at index						
Mean(SD)	48.0(14.5)	48.0(13.7)	0.0270	48.0(13.7)	48.0(13.7)	0.0000
Gender, n(%)						
Male	51182(54.5%)	17039(57.7%)	0.0644	17039(57.7%)	17045(57.7%)	0.0006
Female	38687(41.2%)	12489(42.3%)	0.0173	12513(42.3%)	12507(42.3%)	0.0006
Unknown Gender	3984(4.2%)	1(0.0%)	0.2880	1(0.0%)	1(0.0%)	0.0000
Race, n(%)						
White	38643(71.7%)	12342(76.7%)	0.1171	12342(76.0%)	12342(76.7%)	0.0012
Black or African American	7285(13.7%)	1844(11.4%)	0.0678	1851(11.7%)	1844(11.4%)	0.0010
Asian	2210(2.7%)	783(2.7%)	0.0123	783(2.7%)	783(2.7%)	0.0000
Other Race	2978(3.2%)	783(2.7%)	0.0305	783(2.7%)	783(2.7%)	0.0012
Unknown Race	11715(12.5%)	2828(9.4%)	0.1075	2832(9.3%)	2828(9.4%)	0.0007
Lifestyle, n(%)						
Nicotine dependence	7896(8.4%)	2171(7.3%)	0.0395	2202(7.4%)	2171(7.3%)	0.0032
Tobacco use	11415(9.4%)	3180(10.4%)	0.0327	3180(10.4%)	3180(10.4%)	0.0000
Alcohol-related disorders	8578(9.1%)	1963(5.9%)	0.1217	2042(6.9%)	1963(5.9%)	0.0403
Comorbidities, n(%)						
Ischaemic heart diseases	4671(5.0%)	1375(4.7%)	0.0405	1387(4.7%)	1375(4.7%)	0.0010
COPD	2071(2.2%)	678(1.6%)	0.0410	667(2.4%)	678(1.6%)	0.0503
Chronic kidney disease	1933(2.0%)	550(1.7%)	0.0021	537(1.7%)	550(1.7%)	0.0041
Diseases of liver	1033(2.0%)	354(1.3%)	0.0407	355(1.3%)	354(1.3%)	0.0003
Heart failure	1112(1.2%)	2265(0.8%)	0.0419	217(0.7%)	2265(0.8%)	0.0024
Peripheral vascular disease, unspecified	6973(1.0%)	2650(7.7%)	0.0149	2325(7.7%)	2650(7.7%)	0.0013
Other sciatica	4482(7.1%)	1921(7.0%)	0.0205	9(7.0%)	1921(7.0%)	0.0000
Acute disease of connective tissue	1921(7.0%)	1921(7.0%)	0.0000	1921(7.0%)	1921(7.0%)	0.0000
Human immunodeficiency virus (HIV) disease (B20)	2765(9.1%)	7(0.5%)	0.0872	7(0.2%)	7(0.5%)	0.0014
Pupils unequal, size unspecified	2160(2.7%)	6(0.2%)	0.2015	6(0.2%)	6(0.2%)	0.0000
Malignant (primary) neoplasm, unspecified	1745(2.7%)	4(0.2%)	0.1855	4(0.2%)	4(0.2%)	0.0000
Dysphagia and hoarseness	1242(1.8%)	3(0.1%)	0.1810	3(0.1%)	3(0.1%)	0.0000
Unspecified dementia	1950(2.5%)	2(0.1%)	0.1519	2(0.1%)	2(0.1%)	0.0000
Lymphoid leukemia	1922(2.5%)	1(0.1%)	0.1521	1(0.1%)	1(0.1%)	0.0000
Myeloid leukemia	1921(2.5%)	1(0.1%)	0.1521	1(0.1%)	1(0.1%)	0.0000
Cerebrovascular disease, unspecified	7(0.1%)	1(0.1%)	0.1049	1(0.1%)	1(0.1%)	0.0000
Other leukemia of specified cell type	1921(2.5%)	1(0.1%)	0.1521	1(0.1%)	1(0.1%)	0.0000
Monocytic leukemia	1921(2.5%)	1(0.1%)	0.1521	1(0.1%)	1(0.1%)	0.0000
Leukemia of unspecified cell type	1921(2.5%)	1(0.1%)	0.1521	1(0.1%)	1(0.1%)	0.0000
Non-Hodgkin lymphoma, unspecified	4(0.1%)	1(0.1%)	0.0019	1(0.1%)	1(0.1%)	0.0000