

Supplementary Table 1. Univariate logistic regression analysis of factors associated with 90-day comprehensive treatment failure in older adults with lumbar spinal stenosis

Variable	Category	Unadjusted OR	95% CI	P-value
Treatment	Non-operative	1.000	[Reference]	--
	PTED	0.241***	[0.110-0.527]	<0.001
Age	Continuous	1.015	[0.910-1.131]	0.785
Gender	Female	1.000	[Reference]	--
	Male	0.780	[0.371-1.644]	0.516
Central Canal Stenosis	Non-severe	1.000	[Reference]	--
	Severe	0.920	[0.447-1.892]	0.822
Lateral Recess Stenosis	Non-severe	1.000	[Reference]	--
	Severe	0.430	[0.145-1.275]	0.136
Foraminal Stenosis	Non-severe	1.000	[Reference]	--
	Severe	2.383*	[1.121-5.064]	0.024
Polypharmacy	No	1.000	[Reference]	--
	Yes	9.947***	[3.834-25.809]	<0.001
Leg Pain VAS	Continuous	1.329	[0.656-2.693]	0.426
Back Pain VAS	Continuous	0.744	[0.411-1.346]	0.331
ODI Score	Continuous	1.010	[0.965-1.057]	0.656
ADL Score	Continuous	0.868***	[0.815-0.924]	<0.001
Scoliosis	No	1.000	[Reference]	--
	Yes	1.558	[0.749-3.242]	0.236
Kyphosis	No	1.000	[Reference]	--
	Yes	2.116	[0.957-4.679]	0.65
Pedicle Rotation	No	1.000	[Reference]	--
	Yes	1.127	[0.540-2.353]	0.752
CCI	Continuous	1.705***	[1.404-2.069]	<0.001
Frailty Index	Grade 3	1.000	[Reference]	--
	Grade 4	4.439**	[1.626-12.116]	0.004
	Grade 5	11.048***	[3.940-30.979]	<0.001
ASA Grade	II	1.000	[Reference]	--
	III	7.467***	[2.890-19.291]	<0.001

Notes: Results from univariate logistic regression analyses examining the relationship between clinical variables and the primary outcome of 90-day comprehensive treatment failure. Statistical significance levels: *P < 0.05, **P < 0.01, ***P < 0.001. Reference categories are indicated for categorical variables. **Abbreviations:** OR, odds ratio; CI, confidence interval; VAS, visual analog scale; ODI, Oswestry Disability Index; ADL, activities of daily living; CCI, Charlson Comorbidity Index; ASA, American Society of Anesthesiologists.

Supplementary Table 2: Correlation Matrix of General Condition Indicators

Variable	Polypharmacy	CCI	Frailty	ASA
Polypharmacy	1.0000			
CCI	0.6226	1.0000		
Frailty	0.7006	0.5478	1.0000	
ASA	0.7366	0.5950	0.7843	1.0000

Notes: Correlation coefficients between frailty index, CCI, polypharmacy status, and ASA physical status classification. The strong correlations (range: 0.55-0.78) support the conceptual overlap of these variables in measuring patient vulnerability and informed the selection of a single representative variable for multivariable analysis. **Abbreviations:** CCI, Charlson Comorbidity Index; ASA, American Society of Anesthesiologists.

Supplementary Table 3: Variable Effects Across Different Model Specifications

Predictor	Minimal Model OR [95% CI]	Main Model OR [95% CI]	Full Model OR [95% CI]
PTED Treatment	0.17 [0.07-0.44]***	0.18 [0.07-0.47]***	0.21 [0.08-0.57]**
Foraminal stenosis (Severe)	2.81 [1.11-7.09]*	2.99 [1.11-8.01]*	3.92 [1.29-11.91]*
Polypharmacy (Yes)	12.14 [4.29-34.31]***	6.51 [2.25-18.88]***	6.99 [2.32-21.08]***
ADL Score	—	0.89 [0.82-0.95]***	0.89 [0.83-0.96]**
Age	—	—	1.02 [0.88-1.20]
Gender (Male)	—	—	1.16 [0.41-3.26]
Central Stenosis (Severe)	—	—	0.67 [0.22-2.11]
Lateral Recess Stenosis (Severe)	—	—	0.52 [0.10-2.84]

Notes: This sensitivity analysis demonstrates the stability of the primary associations under varying model specifications. Model definitions: (1) *Minimal Model*: PTED treatment + significant clinical risk factors; (2) *Main Model*: Minimal Model + ADL score; (3) *Full Model*: Main Model + demographic and additional clinical variables. The protective effect of PTED treatment (OR range: 0.17–0.21) and the risks associated with severe foraminal stenosis and polypharmacy remained statistically significant (all *p < 0.05) across all models, supporting the robustness of the primary findings. *P < 0.05, **P < 0.01, ***P < 0.001. **Abbreviations:** PTED, percutaneous transforaminal endoscopic decompression; ADL, Activities of Daily Living; OR, odds ratio; CI, confidence interval.

Supplementary Table 4: Model Fit Statistics for Sensitivity Analysis

Model Fit Statistic	Minimal Model	Main Model	Full Model
Number of Observations	143	143	143
LR χ^2	49.66	61.16	62.80
Prob > χ^2	<0.001	<0.001	<0.001
Pseudo R ²	0.287	0.353	0.363
Log Likelihood	-61.75	-56.00	-55.18
AIC	131.49	122.00	128.36
BIC	143.35	136.81	155.02

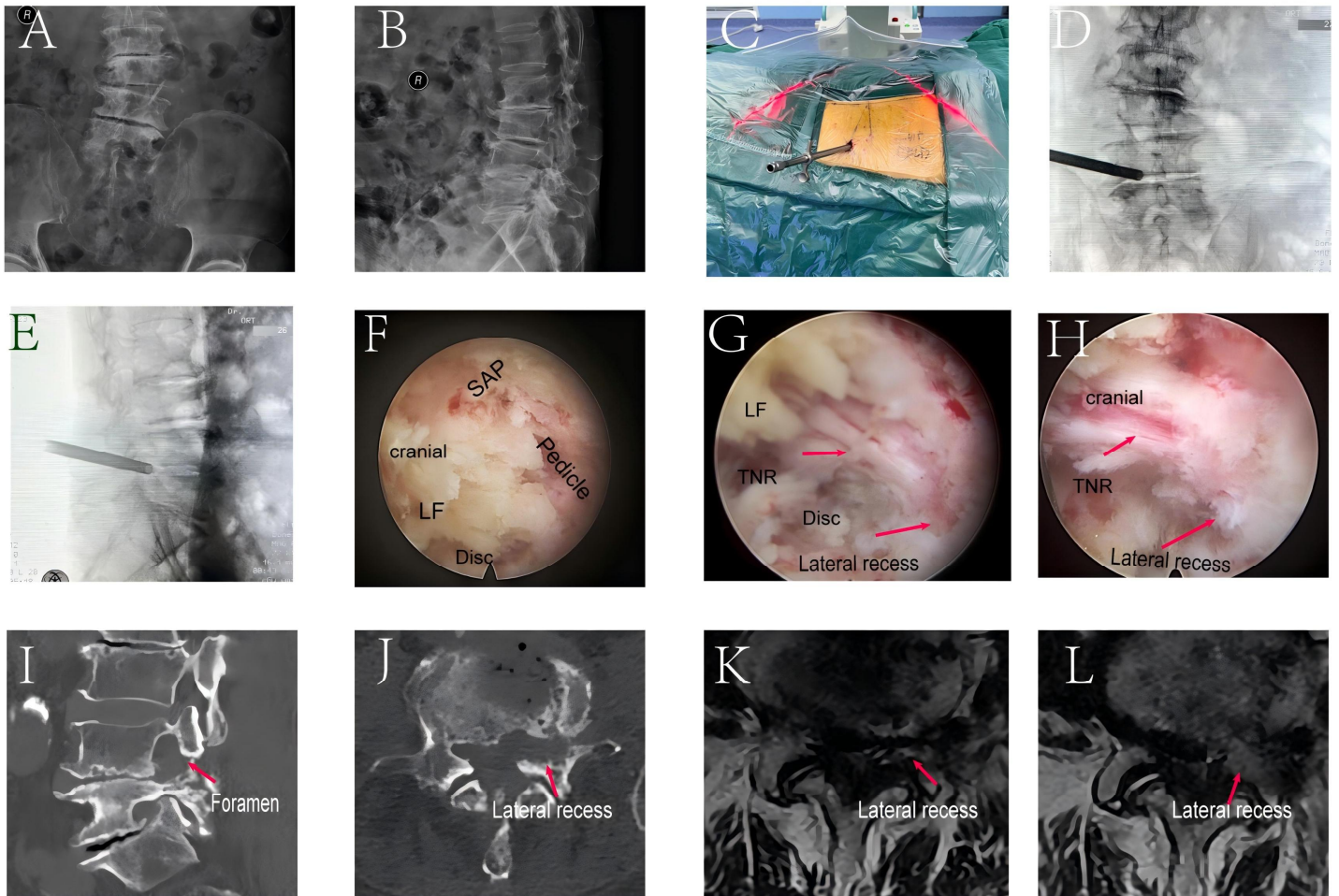
Notes: Model fit statistics for the logistic regression models compared in the sensitivity analysis. The Main Model (4 variables) was selected as the primary model because it achieved the lowest AIC and BIC values, indicating the optimal balance between goodness-of-fit and parsimony. The minimal improvement in Pseudo R² and the increase in AIC/BIC for the Full Model suggest that additional variables did not meaningfully enhance model fit. **Abbreviations:** AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion.

Supplementary Table 5. Bootstrap Internal Validation of the Primary Logistic Regression Model (200 Replicates)

Variable	Original OR	Bootstrap SE	Bias	Normal-based 95% CI	Percentile 95% CI	Bias-corrected 95% CI
PTED Treatment	0.181	0.108	-0.074	0.057-0.582	0.041-0.440	0.038-0.398
Foraminal Stenosis	2.988	1.903	0.085	0.858-10.412	0.913-13.745	0.860-10.113
Polypharmacy	6.513	3.843	0.125	2.049-20.704	2.525-24.082	1.528-17.277
ADL Score	0.887	0.040	-0.008	0.813-0.968	0.812-0.963	0.809-0.967

Notes: Internal validation was performed using non-parametric bootstrap resampling with 200 replicates. The Bias represents the difference between the original coefficient estimate and the mean estimate from the bootstrap samples. Smaller absolute bias values indicate greater stability. The Bias-corrected (BC) 95% CI is generally preferred for inference as it accounts for both sampling variability and estimator bias. The minimal bias observed for all predictors ($|\text{Bias}| < 0.13$) and the consistency of the BC 95% CIs with the original model estimates demonstrate excellent model stability and a low risk of overfitting.

Abbreviations: PTED, percutaneous transforaminal endoscopic decompression; ADL, Activities of Daily Living; OR, odds ratio; SE, standard error; CI, confidence interval; BC, bias-corrected.



Supplementary Figure 1. Percutaneous transforaminal endoscopic decompression in an 85-year-old male patient with L4/5 severe lumbar spinal stenosis.

Notes:(A) Anteroposterior X-ray: mild scoliosis, L4/5 pedicle rotation. (B) Lateral X-ray: no spondylolisthesis. (C) Minimally invasive incision (2–3 cm). (D) Intraoperative anteroposterior X-ray: working channel established. (E) Intraoperative lateral X-ray: working channel confirmed. (F) Endoscopic view: narrowed foramen and spinal canal. (G) After partial resection of ligamentum flavum and disc: compressed nerve root (arrow). (H) Complete decompression of nerve root transit area. (I) Postoperative CT: enlarged L4/5 foramen. (J) Postoperative CT: enlarged lateral recess. (K) Preoperative MRI: severe central (Grade 4) and lateral recess (Grade 2) stenosis. (L) Postoperative MRI: reduced

lateral recess stenosis (Grade 1); central stenosis unchanged (Grade 4).

Abbreviations: SAP, superior articular process; LF, ligamentum flavum; TNR, traversing nerve root.