

Surgical and Clinical Outcomes of French Door vs. Open Door Laminoplasty: A Long-Term Analysis of Neurological Recovery

Themistocles Stavros Protosaltis, Alexandra Nicole Yiachos, Lefko Theo Charalambous, Akil Saivenkat Paturi, Kingsley Ogelle, Constance Maglaras, Tina Raman

INTRODUCTION: Open-door laminoplasty (ODL) and French-door laminoplasty (FDL) are techniques used to treat multi-segmental cervical spondylotic myelopathy. ODL creates a unilateral hinge and trough, while FDL forms bilateral hinges with a midline split in the spinous process. Previous studies report similar operative times, mJOA scores, radiographic outcomes, and range of motion, but data on long-term neurological outcomes, Nurick scores, and readmissions remain limited. This is the largest study with the longest follow-up comparing neurological outcomes of FDL vs ODL.

METHODS: This retrospective cohort study included patients ≥ 18 years old who underwent laminoplasty at a single academic institution. Demographics, surgical characteristics, complications, and 30-/90-day readmissions or reoperations were assessed. Neurologic function was evaluated preoperatively and at 6 weeks, 3 months, 6 months, 1 year and 2 years postoperatively. Patients who underwent post-laminoplasty lumbar or hip surgery were assessed to determine if these procedures confounded Nurick scores. T-tests and χ^2 analyses were used to compare outcomes, with Fisher's exact tests applied for small sample sizes. Statistical significance was set at $p < 0.05$.

RESULTS:

A total of 182 patients met inclusion criteria (69.2% FDL vs 30.8% ODL). Groups did not significantly differ in age, gender, BMI, or ASA grade, though ODL patients had higher CCI scores (3.4 ± 2 vs 2.8 ± 1.9 , $p < 0.001$). ODL was associated with longer operative time ($p = 0.023$) and greater use of laminar plates (48.2% vs 19.2% , $p < 0.001$). Complications, readmissions and reoperations were similar between groups. Nurick scores were significantly better in the FDL group at 2 years postoperatively (FDL 1.4 ± 1.5 , $p = 0.01$ vs. ODL 2.9 ± 1.6). At 6 weeks and 3 months, there was no difference in the magnitude of improvement between groups; however, at 2 years, a significantly higher proportion of FDL patients improved their Nurick scores (68.4% vs 12.5% , $p = 0.006$) while significantly more ODL patients did not improve in their Nurick score from baseline at all (75% vs 28.9% , $p = 0.03$).

Interestingly, 31 patients (17%) of patients that underwent laminoplasty had subsequent lumbar spine or hip replacement surgery, with the average time to secondary operation being 460 days. These patients had significantly worse preoperative (3 ± 1.1 vs 2.3 ± 1.3 , $p = 0.005$), 6-week (2.5 ± 1.5 vs 1.9 ± 1.5 , $p = 0.014$), and 3-month (2.4 ± 1.4 vs 1.5 ± 1.4 , $p = 0.01$) Nurick scores. At 2 years post-laminoplasty, after all of these patients had undergone their secondary surgeries, there were no differences in Nurick scores from the laminoplasty alone group. After excluding these patients to isolate cervical pathology, FDL and ODL Nurick scores remained similar at all timepoints except at 2 years, where ODL patients still had worse outcomes (2.7 ± 1.8 vs. 1.2 ± 1.4 , $p = 0.03$).

DISCUSSION AND CONCLUSION: FDL and ODL techniques had similar complication and readmission profiles. ODL was associated with longer operative times, which was possibly due to increased use of laminar plating. ODL was associated with worse Nurick scores at 2 years, even after controlling for patients who had lumbar spine or hip replacement surgeries. FDL may offer more durable long-term neurologic benefits than ODL in treatment of multilevel cervical spondylotic myelopathy.

Time Point	Outcome	Frequency (n/N)		p-value
		French Door (n=108)	Open Door (n=47)	
6 Weeks and Baseline	Stayed the Same	56 (51.9%)	30 (34.9%)	0.17
	Improved	45 (41.7%)	16 (34%)	0.4
	Worsened	7 (6.5%)	1 (2.1%)	0.4
13 Months and Baseline	Stayed the Same	34 (30.6%)	17 (44.7%)	0.5
	Improved	48 (54.5%)	19 (50%)	0.6
	Worsened	6 (6.8%)	2 (5.3%)	1
6 Months and Baseline	Stayed the Same	22 (30.6%)	9 (39.1%)	0.4
	Improved	45 (62.5%)	12 (52.2%)	0.4
	Worsened	5 (6.9%)	2 (8.7%)	0.7
1 Year and Baseline	Stayed the Same	19 (32.2%)	6 (42.9%)	0.5
	Improved	36 (61%)	6 (42.9%)	0.2
	Worsened	4 (6.8%)	2 (14.3%)	0.3
2 Years and Baseline	Stayed the Same	11 (28.9%)	6 (75%)	0.03
	Improved	26 (68.4%)	1 (12.5%)	0.006
	Worsened	1 (2.6%)	1 (12.5%)	0.3

Table 2. Frequencies of patients whose Nurick scores remained the same, improved, or worsened compared to preoperative baseline

Characteristic	Frequency (n/N)		p-value
	French Door (n=126)	Open Door (n=56)	
Demographics			
Age (years)	64.3 \pm 11.5	66.4 \pm 10.7	0.3
Gender (% Female)	51 (40.8%)	20 (35.7%)	0.5
BMI (kg/m ²)	28.3 \pm 5.5	30.2 \pm 6.8	0.053
CCI	2.8 \pm 1.9	3.4 \pm 2	0.003
ASA Grade	2.4 \pm 0.5	2.6 \pm 0.6	0.2
Surgical Characteristics			
Operative Time (min)	285.7 \pm 70.2	210.9 \pm 64.3	0.023
Estimated Blood Loss (ml)	245.2 \pm 233.5	275.4 \pm 249	0.4
Lamina Plated	25 (19.8%)	27 (48.2%)	<0.001
Fluoroscopy Dosage (mGy)	1.2 \pm 2.6	2.1 \pm 5.4	0.2
Length of Stay (days)	3.2 \pm 1.7	3.8 \pm 2.6	0.09
Complications			
Intraoperative Complications	2 (1.6%)	1 (1.8%)	0.9
Durotomy	1 (0.8%)	1 (1.8%)	0.6
Neuromonitoring	1 (0.8%)	0	0.5
Postoperative Complications	18 (14.3%)	13 (23.2%)	0.1
Cardiac	1 (0.8%)	1 (1.8%)	0.6
Neurological	4 (3.2%)	5 (8.9%)	0.098
Pulmonary	2 (1.6%)	4 (7.1%)	0.055
Ileus	1 (0.8%)	1 (1.8%)	0.6
Urinary	7 (5.6%)	3 (5.4%)	0.96
Superficial Infection	4 (3.2%)	2 (3.6%)	0.9
Readmissions and Reoperations			
Readmission within 90 Days	1 (0.8%)	1 (1.8%)	0.6
Return to OR within 90 Days	3 (2.4%)	1 (1.8%)	0.8
Return to OR within 90 Days	2 (1.6%)	1 (1.8%)	0.9
Nurick Classification			
Preoperative	2.3 \pm 1.2	2.6 \pm 1.4	0.1
6 Week Postop	1.8 \pm 1.5	2.3 \pm 1.7	0.05
3 Months Postop	1.6 \pm 1.4	2.1 \pm 1.6	0.1
6 Months Postop	1.7 \pm 1.3	1.9 \pm 1.7	0.5
1 Year Postop	1.7 \pm 1.4	1.8 \pm 1.8	0.8
2 Years Postop	1.4 \pm 1.5	2.9 \pm 1.6	0.01
Changes			
6 Weeks and Baseline	-0.5 \pm 0.9	-0.4 \pm 0.8	0.4
3 Months and Baseline	-0.7 \pm 0.9	-0.5 \pm 0.98	0.3
6 Months and Baseline	-0.8 \pm 1	-0.5 \pm 1.2	0.2
1 Year and Baseline	-0.8 \pm 1	-0.6 \pm 1.2	0.7
2 Years and Baseline	-0.9 \pm 1.1	-0.1 \pm 0.8	0.056

Table 1. Differences in Demographics, Comorbidities, Surgical Characteristics, Readmissions/Reoperations, and Average Nurick Scores Between French Door and Open Door Patients

Characteristic	Frequency (n/N)		p-value
	French Door (n=126)	Open Door (n=56)	
Demographics			
Age (years)	64.3 \pm 11.5	66.4 \pm 10.7	0.3
Gender (% Female)	51 (40.8%)	20 (35.7%)	0.5
BMI (kg/m ²)	28.3 \pm 5.5	30.2 \pm 6.8	0.053
CCI	2.8 \pm 1.9	3.4 \pm 2	0.003
ASA Grade	2.4 \pm 0.5	2.6 \pm 0.6	0.2
Surgical Characteristics			
Operative Time (min)	285.7 \pm 70.2	210.9 \pm 64.3	0.023
Estimated Blood Loss (ml)	245.2 \pm 233.5	275.4 \pm 249	0.4
Lamina Plated	25 (19.8%)	27 (48.2%)	<0.001
Fluoroscopy Dosage (mGy)	1.2 \pm 2.6	2.1 \pm 5.4	0.2
Length of Stay (days)	3.2 \pm 1.7	3.8 \pm 2.6	0.09
Complications			
Intraoperative Complications	2 (1.6%)	1 (1.8%)	0.9
Durotomy	1 (0.8%)	1 (1.8%)	0.6
Neuromonitoring	1 (0.8%)	0	0.5
Postoperative Complications	18 (14.3%)	13 (23.2%)	0.1
Cardiac	1 (0.8%)	1 (1.8%)	0.6
Neurological	4 (3.2%)	5 (8.9%)	0.098
Pulmonary	2 (1.6%)	4 (7.1%)	0.055
Ileus	1 (0.8%)	1 (1.8%)	0.6
Urinary	7 (5.6%)	3 (5.4%)	0.96
Superficial Infection	4 (3.2%)	2 (3.6%)	0.9
Readmissions and Reoperations			
Readmission within 90 Days	1 (0.8%)	1 (1.8%)	0.6
Return to OR within 90 Days	3 (2.4%)	1 (1.8%)	0.8
Return to OR within 90 Days	2 (1.6%)	1 (1.8%)	0.9
Nurick Classification			
Preoperative	2.3 \pm 1.2	2.6 \pm 1.4	0.1
6 Week Postop	1.8 \pm 1.5	2.3 \pm 1.7	0.05
3 Months Postop	1.6 \pm 1.4	2.1 \pm 1.6	0.1
6 Months Postop	1.7 \pm 1.3	1.9 \pm 1.7	0.5
1 Year Postop	1.7 \pm 1.4	1.8 \pm 1.8	0.8
2 Years Postop	1.4 \pm 1.5	2.9 \pm 1.6	0.01
Changes			
6 Weeks and Baseline	-0.5 \pm 0.9	-0.4 \pm 0.8	0.4
3 Months and Baseline	-0.7 \pm 0.9	-0.5 \pm 0.98	0.3
6 Months and Baseline	-0.8 \pm 1	-0.5 \pm 1.2	0.2
1 Year and Baseline	-0.8 \pm 1	-0.6 \pm 1.2	0.7
2 Years and Baseline	-0.9 \pm 1.1	-0.1 \pm 0.8	0.056