

Complications of Poor Cervical Alignment in Patients Undergoing Posterior Cervicothoracic Laminectomy and Fusion

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Introduction

This study sought to determine if a relationship exists between caudal instrumented level and revision rates, neck disability index scores, and cervical alignment in patients undergoing multilevel posterior cervical fusion.

Methods

This study examined a dataset of all patients undergoing posterior cervical decompression and fusion at =3 levels, terminating between C4 and T4, between January 2010 and December 2015, with at least 12 months of clinical follow-up. Patients were separated into cohorts based on caudal level of the fusion: C6 (or more cranial), C7, T1, or T2 (or more caudal). Revision rate, neck disability index score, sagittal vertical axis, T1 slope, and cervical lordosis were recorded. Linear regression and multivariate analysis was undertaken to identify independent predictors of patient outcomes and disparities between ending constructs in the cervical and the thoracic spine.

Results

The overall revision rate was 10.8% (n=24). There was no statistically significant difference in the revision rate identified between fusions terminating at C6 or cranial, C7, T1, or T2 and caudal (p=0.74). Revision correlated strongly with increased sagittal vertical axis (p=0.002) and T1 slope (p=0.04). Increased neck disability index score correlated with revision rate (p=0.01), cervical kyphosis (p<0.001), and increased sagittal vertical axis (p=0.04).

Conclusions

This study suggests that constructs terminating in the proximal thoracic spine have similar revision rates, postoperative neck disability index scores, and radiographic measurements as those terminating in the cervical spine. Poor cervical alignment, as evidenced by increased sagittal vertical axis, cervical kyphosis and T1 slope, predicts need for revision and of poorer clinical outcomes.

Learning Objectives

By the conclusion of this session, participants should be able to:

1. Describe the challenges of operating at the cervicothoracic junction.
2. Understand cervical alignment radiographic data and how to use these measures to guide surgical planning.
3. Identify an effective approach to cervicothoracic operations based on preoperative diagnosis, neck disability index score, and cervical alignment.

Table 1. Demographic Information and Clinical Variables					
Caudal Level	C6 (or more Cranial)	C7	T1	T2 (or more Caudal)	P-value
N (N=221)	36	140	41	4	
Age (years)	67.67(45-88)	65.3 (37-91)	68.7 (44-86)	62.5 (46-74)	0.80
Gender (F/M)	47.2%/ 52.8% 17F/19M	44.3%/ 55.7% 62F/78M	43.9%/56.1% 18F/23M	0%/100% 0F/4M	0.90
Active Smoker, N=25	3	14	7	1	0.78
BMI (points)	29.7(18.5-46)	28.8(18.4-42.6)	28 (18.1-44.9)	28.4 (21.5-38)	0.44
Average length of construct	3	3.85	4.9	7	0.7
Months follow-up (months)	51.2 (12-96)	50.1 (12-94)	51.9 (12-98)	55.5 (36-88)	0.50
Anterior support (before or simultaneous, N=42)	4	25	11	2	0.44
Pre-op Diagnosis					
Stenosis with Myelopathy, N=93	14	61	17	1	0.83
Stenosis without Myelopathy, N=128	22	79	24	3	0.90
Pseudarthrosis, N=1	0	1	0	0	0.92
Spinal Deformity, N=15	0	11	4	0	0.89
Cephalad level					
C1	0	1	0	0	1
C2	1	7	3	2	1
C3	35	102	31	2	0.2
C4	0	30	4	0	0.07
C5	0	0	3	0	1

Table 2. Predictors of Revision and Neck Disability Index (NDI) Scores		
Variable	P-value for Revision	P-value for NDI
Male versus Female	0.78	0.001
Age (per year)	0.14	0.92
BMI (per point)	0.84	0.47
Active Smoker	0.99	0.87
Anterior Support	0.34	0.86
Length of construct	0.99	0.89
Cephalad Level C1	0.97	0.79
Cephalad Level C2	0.92	0.41
Cephalad Level C3	0.73	0.40
Cephalad Level C4	0.42	0.49
Caudal Level C5	NA	0.83
Caudal Level C6	0.96	0.86
Caudal Level C7	0.97	0.95
Caudal Level T1	0.82	0.87
Sagittal Vertical Axis	0.002	0.04
Cervical Lordosis	0.53	<0.001
T1 Slope	0.04	0.71
Worker's Comp/ MVC	NA	<0.001
Infection postoperatively	NA	0.02
Revision	NA	0.01

Table 3. The Reason for Revision					
Caudal Level	C6 (or cranial)	C7	T1	T2 (or caudal)	P Value
Revisions Total (N=24)	2	14	8	0	0.74
Revision Rate (10.8%)	5.6%	10.0%	19.5%	0.0%	0.74
Adjacent Level Disease (N=13)	2	8	3	0	0.73
Nonunion/Hardware Failure (N=10)	0	5	5	0	0.17
Spinal Deformity (N=2)	0	2	0	0	1

Table 4. Postoperative Radiographic Measurements					
Caudal Level	C6 or cranial	C7	T1	T2 or caudal	P-value
N (N=177, 79.7%)	32 (88.9%)	109 (77.9%)	33 (80.5%)	3 (75.0%)	
Postoperative Cervical Lordosis (degrees)	3.9 (-16.5-40.7)	2.3 (-19.5-25.1)	1.4 (-23.4-22.5)	0.5 (-15.4-11.5)	0.85
Postoperative Sagittal Vertical Axis (mm)	37.5 (-4.2-77.4)	45.6 (8.-98.)	48.2 (6.7-79.9)	64.0 (34.3-84.0)	0.36