Crossing the Cervicothoracic Junction Provides Greater Sagittal Correction But Does not Improve Functional Outcomes or Patient Reported Outcomes

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INTRODUCTION: Different conclusions exist regarding whether crossing the CTJ in a multi-level PCF vs. terminating segment fusion at C7 leads to improved functional outcomes, and debate over the appropriate “end level” varies. The objective of this study was to compare postoperative sagittal alignment and functional outcomes in myelopathic patients receiving a multi-level posterior cervical fusion (PCF) terminating at C7 vs. spanning the cervicothoracic junction (CTJ).

METHODS: Sixty-six adult myelopathic patients treated with PCF constructs that involved the C6-C7 vertebrae from 2017-2018 were included. Patients were divided into groups whose PCF terminated at C7 (n=36) vs. spanned the CTJ (n=30). Pre- and postoperative cervical spine radiographs were analyzed for cervical lordosis, cervical sagittal vertical axis (cSVA), and first thoracic (T1) vertebral slope on two randomized independent trials. Modified Japanese Orthopedic Association (mJOA) and PROMIS scores were used to compare functional and patient-reported outcomes 12-months post-op.

RESULTS:

Despite significant correction, patients undergoing fusion remained less lordotic than asymptomatic controls, with a C2-C7 Cobb angle of 17.7 vs. 25.5 (p<0.0001) and a T1 slope of 25.6 vs. 36.3 (p<0.0001), respectively. The CTJ cohort had greater alignment correction compared to the C7 cohort (T1 slope of 28.4 vs. 23.3, C2-C7 Cobb angle of 20.7 vs. 15.2, cSVA of 30.4 vs. 28.8; p<0.0001). There were no differences in the mJOA motor and sensory scores between cohorts pre- and postoperative. The C7 cohort reported significantly better PROMIS scores at six months (22.0 ± 3.2 vs. 11.5 ± 0.51, P=0.04) and 12-months (27.0 ± 5.2 vs. 13.5 ± 0.94, P=0.01) postoperative.

Figure 1: Radiological measurements comparing cervical alignment in age-matched asymptomatic controls with no cervical dysfunction vs. symptomatic patients with cervical myelopathy at preoperative and 1-year postoperative PCF timepoints. P values reflect post-hoc Tukey's t-tests following one-way ANOVA. *, p < 0.05; **, p < 0.01; ***, p < 0.001.

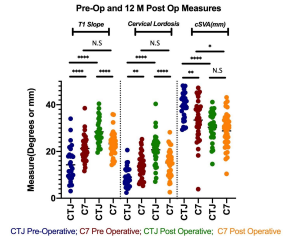
Figure 2. Radiographic alignment parameters at baseline and 1-year postoperative for patients whose fusions spanned the cervicothoracic junction (CTJ Cohort) and patients whose fusions terminated at C7. In the graph, blue data points represent the CTJ cohort pre-op; red represents the C7 patients’ pre-op; green represents the CTJ patients post op; orange represents C7 patients post-op. P values reflect post-hoc Tukey's t-tests following one-way ANOVA. *, p < 0.05; **, p < 0.01; ***, p < 0.001.

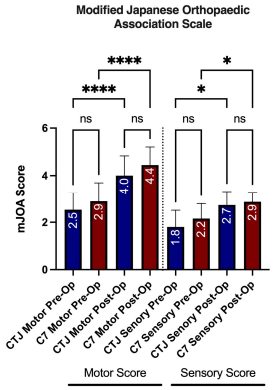
Figure 3: Modified Japanese Orthopaedic Association Scale for pre- and postoperative sensory and motor scores comparing symptomatic patients who received cervical constructs spanning the CTJ vs. terminating at C7. Mean ± SEM are reported. P values reflect post-hoc Tukey's t-tests following one-way ANOVA. *, p < 0.05; **, p < 0.01; ***, p < 0.001.

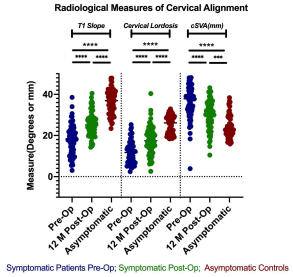
Table 1: Patient-Reported Outcomes Measurement Information System (PROMIS) Physical Functioning and Mental Health Scores in patients with C7 vs. CTJ spanning fusion constructs. Both mean scores as well as percent change from pre-op measure are reported as mean ± SEM. The rightmost column shows p value for post-hoc Tukey's t-tests following one-way ANOVA.

DISCUSSION AND CONCLUSION:

Crossing the CTJ may provide a greater cervical sagittal alignment correction in multi-level PCF surgeries. However, the improved alignment may not be associated with improved functional outcomes as measured by mJOA or patient reported outcomes as measured by PROMIS at 12-months postoperative. Future research is needed to evaluate additional variables that may effect long-term radiographic, patient reported, and functional outcomes in this patient population.







	C7 Terminate	CTJ Spanning Constructs	P Value
PROMIS Physical Functioning Score			
Pre-Operative	5.733 ± 0.442	5.830 ± 0.340	>0.99
3 Months Post-Operative	15.208 ± 1.620	12.170 ± 0.710	0.99
6 Months Post-Operative	22.000 ± 3.200	11.520 ± 0.510	**0.04**
12 Months Post-Operative	27.045 ± 5.220	13.480 ± 0.940	**0.01**
PROMIS Mental Health Score			
Pre-Operative	9.67 ± 0.620	8.720 ± 0.530	>0.99
3 Months Post-Operative	22.920 ± 2.020	14.890 ± 1.050	0.34
6 Months Post-Operative	25.310 ± 3.260	14.740 ± 1.030	**0.04**
12 Months Post-Operative	28.800 ± 5.310	17.670 ± 1.040	**0.01**

Legend:
Significant values are bolded using 95% Confidence Interval.