Development and Validation of the Forgotten Spine Surgery Score–Cervical (FS3-C): A Joint-Awareness PROM Distinguishing Cervical Disc Replacement from ACDF

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INTRODUCTION:

Traditional cervical spine PROMs like the Neck Disability Index (NDI) capture pain and disability but may overlook proprioceptive outcomes, such as how often patients "forget" the operated segment. The Forgotten Joint Score (FJS), validated in arthroplasty, offers a framework to assess joint awareness. This study introduces the Forgotten Spine Surgery Score–Cervical (FS3-C), a novel PROM designed to assess joint forgetting in the cervical spine. We aimed to validate the FS3-C and test whether it better distinguishes outcomes between cervical disc replacement (CDR) and anterior cervical discectomy and fusion (ACDF) than the NDI.

METHODS:

A prospective cohort study was conducted from 2017–2023 at a single academic center. In the pilot phase, 41 CDR patients completed a 20-item joint-awareness questionnaire; 12 items were retained for the final FS3-C based on psychometric criteria. Validation cohorts included 127 CDR and 112 ACDF patients with ≥3 months follow-up. All completed the FS3-C and NDI electronically or via structured phone interviews. Internal consistency, ceiling/floor effects, and convergent validity (Pearson r with NDI) were assessed. CDR and ACDF scores were compared using t-tests, with Cohen's d for effect size.

RESULTS:

For the pilot cohort, 41 patients were recruited. The average age of the pilot cohort was 45 ± 8 years. Questions with a high missing response rate or strong ceiling effects were excluded from the 20-item pilot questionnaire. In addition, pairwise correlation was assessed between items of similar content and eight items were combined into four, arriving at the final 12-item FS3-C. For the CDR validation cohort, 127 patients were recruited. The mean age was 44 ± 9 years. High internal consistency and corrected item-total correlation were found in the FS3-C. A strong correlation between the FS3-C and NDI was found (r=-0.606, p<0.001). For the ACDF cohort, 112 patients were recruited, and the mean age was 61 ± 11 years. The average Cronbach's alpha was higher for the FS3-C than the NDI (0.95 vs 0.88). The FS3-C was also able to discriminate outcomes between the CDR and ACDF cohorts, whereas the NDI could not. The average NDI scores for the CDR and ACDF cohorts were 5.2 ± 6.2 and 6.3 ± 6.2, respectively (p=0.074). The average FS3-C score was 59.9 ± 19.6 for the CDR cohort and 53.2 ± 22.2 for the ACDF cohort (p=0.012). The effect size between the CDR and ACDF cohorts was 0.17 for the NDI and 0.33 for the FS3-C.

DISCUSSION AND CONCLUSION:

The FS3-C captures experiential differences in joint awareness not reflected by the NDI, demonstrating a statistically significant difference between CDR and ACDF groups. Although long-term studies show that both procedures yield similar pain and functional outcomes, FS3-C may offer added sensitivity for high-functioning patients. This is particularly relevant for athletes and laborers, for whom "forgetting" the spine during activity reflects surgical success. The FS3-C holds promise as a novel, responsive PROM. Future multicenter trials should establish minimal clinically important difference thresholds and assess FS3-C utility in broader spine populations.

Table 1: Baseline demographics of cohorts

	Pilot N=41	CDR N=127	ACDF N=112	p-value
Age (mean years ± sd)	45±8	44±9	61 ± 11	<.001
Male	83%	61%	49%	0.075
One-level CDR/ACDF	56.1%	56.7%	42%	
Two-level CDR/ACDF	43.9%	43.3%	58%	
Time since surgery		60.91± 24.46	32.74± 22.79	
Charlson Comorbidity Index, n (%)				
0		86%	66%	<.001
1 – 2		12%	21%	0.065
>3		2%	13%	<.001

Table 2: Psychometric properties of the 20-item pilot survey

Table 3: Psychometric of the properties of the final FS³-C based on CDR cohort responses

Table 4: Psychometric of the properties of the final FS³-C based on ACDF cohort responses