The Association Between Plated and Stand-Alone Anterior Cervical Discectomy and Fusion and Risk for Operative Adjacent Segment Disease

Calvin Kuo[1], Heather Ann Prentice[1], Ehsan Tabaraee, Jessica Harris[1], Ravi S Bains[2], Alem Yacob[3], Allen L Ho[4], Elizabeth Picnic Norheim, Omid Reza Hariri[4], Kern Guppy[1]
[1]Kaiser Permanente, [2]Orthopedic Spine, [3]The Permanente Medical Group, [4]Neurosurgery

INTRODUCTION: Anterior cervical discectomy and fusions (ACDF) have become a common and effective means of decompression and stabilization of the cervical spine. Anterior instrumentation with plates and screws (ACDF-P) are increasingly utilized to increase rates of union. However, plate-related risks are the topic of significant research. These concerns have led to the evolution of stand-alone ACDF (ACDF-S) constructs in hopes of reducing dysphagia and adjacent segment degeneration from plate prominence although critics have pointed out potential for subsidence, instability, and nonunions. Therefore, we sought to evaluate reoperation risk following ACDF-S compared to ACDF-P in a multi-center US-based cohort.

METHODS:

A retrospective cohort study was conducted using data from a US-based healthcare system's spine registry. Patients ≥18 years old who underwent primary 1-2-level ACDF between C3-C7 for degenerative disc conditions were identified (2009-2022). Staged or hybrid procedures and those involving non-anterior approaches or skip levels were excluded. Crude cumulative incidence was calculated as one minus the Kaplan-Meier estimate at 8-years follow-up. Multivariable Cox proportional-hazards regression was used to evaluate all-cause reoperation risk, as well as risk for reoperation due to adjacent segment disease (ASD) or nonunion adjusting for confounders: age, body mass index (BMI), gender, race/ethnicity, smoking status, American Society of Anesthesiologists (ASA) classification, operative time, number of levels fused, and operating surgeon. Outcomes with <5 events in at least one study group were not modeled. Secondary analysis stratified by 1- and 2-level procedures. Hazard ratios (HR) and 95% confidence intervals (CI) are reported.

RESULTS:

3,958 ACDF comprised the study sample; 278 (7.0%) were ACDF-S. Procedures were performed by 59 surgeons at 16 hospitals. Mean age and BMI for the cohort was 56.1 years and 30.0 kg/m^2, respectively. 48.9% were 2-level procedures (17.6% ACDF-S vs 51.2% ACDF-P). Crude cumulative reoperation incidence out to 8-years follow-up is presented in the **Figure**; 8-year incidence estimates are presented in the **Table**. In adjusted analysis, no difference in all-cause reoperation risk (hazard ratio [HR]=0.97, 95% confidence interval [CI]=0.58-1.64) or reoperation for ASD (HR=1.11, 95% CI=0.61-1.99) was observed when comparing ACDF-S to ACDF-P. There were 229 and 1,794 1-level ACDF-S and ACDF-P procedures, respectively. No differences in reoperation risk were also found when restricting to 1-level procedures (all-cause: HR=0.92, 95% CI=0.50-1.68; ASD: HR=0.88, 95% CI=0.44-1.78). For 2-level procedures, there were 49 ACDF-S and 1,886 ACDF-P. There were too few events observed for regression analysis (**Table**).

When considering an average cost difference of $1247.20 when using ACDF-S compared to ACDF-P but only a difference in 8-year reoperations of 0.3%, and if the estimated cost of a reoperation is $19,938, then there is a net loss of $118,738.60 per every 100 patients when performing ACDF-S compared to ACDF-P.

DISCUSSION AND CONCLUSION: Conclusions: In this large, comparative, long-term retrospective cohort study, differences in proposed risks and benefits between ACDF construct types were not observed. However, differences in costs were observed. This information could be used to better inform surgeons, patients, administrators, and policy makers.

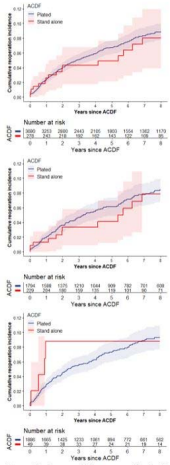

Figure. Crude cumulative reoperation incidence (solid line) and 95% confidence interval (shaded area) following ACDF, by stand-alone versus plated. Table along the x-axis presents the number still at risk at each year of follow-up. Top-Overall cohort. Middle-1-level ACDF. Bottom-2-level ACDF.

Table. Crude incidence and adjusted risk of reoperation following ACDF stand-alone versus plated.

	Crude incidence, n (%[a])		Adjusted[b]	
Reoperation outcome	**Stand alone**	**Plated**	**HR (95% CI)**	**P**
Overall cohort (N=3958)				
Any reoperation for:				
Nonunion	2 (1.2)	44 (1.4)	--	--
Adjacent segment disease	13 (6.5)	184 (6.6)	1.11 (0.61-1.99)	0.74
First reoperation regardless of reason	16 (8.0)	262 (8.3)	0.97 (0.58-1.64)	0.92
1-level procedures (N=2023)				
Any reoperation for:				
Nonunion	2 (1.4)	14 (1.0)	--	--
Adjacent segment disease	9 (6.1)	93 (6.7)	0.88 (0.44-1.78)	0.73
First reoperation regardless of reason	12 (7.9)	120 (8.5)	0.92 (0.50-1.68)	0.78
2-level procedures (N=1935)				
Any reoperation for:				
Nonunion	0 (0.0)	30 (1.9)	--	--
Adjacent segment disease	4 (8.8)	91 (6.4)	--	--
First reoperation regardless of reason	4 (8.8)	142 (9.3)	--	--

CI=confidence interval. HR=hazard ratio. --=too few events for regression analysis.

[a] % calculated as the cumulative incidence at 8-years follow-up using one minus the Kaplan-Meier estimate.

[b] Cox proportional-hazard regression adjusted for age, BMI, gender, race/ethnicity, smoking status, ASA classification, operative time, number of levels, and operating surgeon.