Safety Profile and Predictors of Long-Term Reoperation Following Three- and Four-level Cervical Disc Replacement

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INTRODUCTION:

Cervical disc replacement (CDR) is a motion-preserving alternative to anterior cervical discectomy and fusion (ACDF) for the treatment of cervical degenerative disc disease. Clinical studies have demonstrated favorable outcomes and reduced adjacent segment pathology with CDR compared to ACDF for single- and two-level procedures. Although three- and four-level CDR are increasingly utilized as off-label procedures, complication and reoperation rates for these extended constructs remain poorly characterized. Furthermore, while risk factors for reoperation after single-level CDR have been described, those specific to multi-level procedures have yet to be defined. Therefore, this study aims to evaluate postoperative complication rates and identify independent predictors of reoperation following three- and four-level CDR.

METHODS:

Patients who underwent primary three- or four-level cervical disc replacement (CDR) between 2015 and April 2023 were identified using the PearlDiver Mariner Database. Patients with surgical indications related to trauma, infection, malignancy, or those who underwent concomitant posterior cervical fusion were excluded. Medical complications were assessed within 90 days postoperatively. Dysphagia/dysphonia and neurological complications were tracked within six months, while mechanical and bone-related complications—including implant malposition, heterotopic ossification (HO), and adjacent disc degeneration—were monitored for up to one year following surgery. Reoperations were tracked for up to seven years postoperatively. Multivariable logistic regression was used to identify independent predictors of reoperation, adjusting for demographic characteristics and patient comorbidities.

RESULTS:

A total of 4,439 patients underwent three- or four-level CDR. The incidence of major postoperative complications—including hematoma, pulmonary embolism, myocardial infarction, and infection—was under 0.5% for each outcome (Table 1). Dysphagia/dysphonia occurred in 3.31%, and neurological complications occurred in 0.29% of patients. Mechanical and bone-related complications occurred in 8.85% within one year. The seven-year reoperation rate was 5.09%. Independent predictors of reoperation included obesity (aOR: 1.51), depression (aOR: 1.57), tobacco use (aOR: 1.45), alcohol use (aOR: 2.17), coagulopathy (aOR: 2.02), chronic kidney disease (aOR: 2.17), cervical myelopathy (aOR: 1.87), and spondylolisthesis (aOR: 2.89) (all $p < 0.05$)(Figure 1).

DISCUSSION AND CONCLUSION:

Three- and four-level CDR demonstrate a low incidence of complications and a seven-year reoperation rate of 5.09%. Several patient-specific comorbidities were identified as predictors of reoperation, highlighting the importance of risk stratification and patient optimization. These findings support the potential safety and durability of multi-level CDR and suggest its expanding role as a viable motion-preserving alternative in appropriately selected patients.

Figure 1: Forest Plot of Risk Factors for Revision CDR

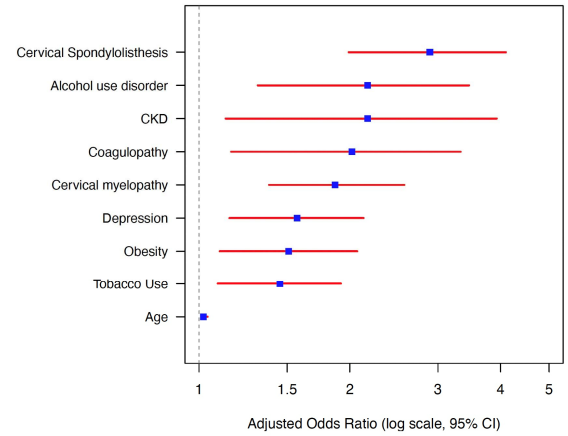

Table 1: Complications Incidence Following CDR

	CDR
90 Day Complications	4,439
Infection	16 (0.36%)
Pulmonary Embolism	* (<0.25%)
Hematoma	* (<0.25%)
Acute Kidney Injury	17 (0.38%)
Surgical Site Infection	12 (0.27%)
Wound Complications	* (<0.25%)
Myocardial Infarction	* (<0.25%)
Ileus	* (<0.25%)
Blood Loss Anemia	37 (0.83%)
Six Month Complications	
Horner's Syndrome	* (<0.25%)
Dysphagia	147 (3.31%)
Nerve Injury	13 (0.29%)
Mechanical Complications	393 (8.85%)

$p<0.05$ is considered statistically significant. *= <11 patients