

OC screw trajectory in the sagittal and axial plane was 6.12° superior and 8.5° lateral, respectively. Average C1 screw trajectory in the sagittal and axial plane was 13° inferior and 8.1° lateral, respectively. There were no injuries to critical structures.

**CONCLUSIONS:** Endonasal instrumented fixation of the occipitocervical junction is both technically and anatomically feasible. Future directions include biomechanical testing. Ultimately, this method of fixation and fusion could serve as an alternative to traditional posterior approaches, and may obviate the need for a separate-staged posterior approach for a variety of pathologies that affect the stability of the CVJ.

**FDA DEVICE/DRUG STATUS:** This abstract does not discuss or include any applicable devices or drugs.

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#### 24. Does coronal plane deformity matter for cervicothoracic kyphosis surgery? The incidence of cervical scoliosis and influence on the outcomes of cervical deformity surgery

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**BACKGROUND CONTEXT:** Cervical deformity (CD) patients may have both cervical kyphosis (CK) and coronal plane cervical deformity, ie, cervical scoliosis (CS). Although the deformity with the greatest influence on the clinical outcomes is CK, few studies have focused on the complex condition of combined CK and CS and significance of CS in the correction of CD.

**PURPOSE:** This study sought to investigate 1) the incidence of combined CS/CK from a CD cohort underwent corrective surgery, 2) whether CK patients combined CS required more aggressive treatment and 3) had different preoperative and postoperative clinical outcomes compared to the CK only group.

**STUDY DESIGN/SETTING:** This is a retrospective review of a prospective, multicenter CD database.

**PATIENT SAMPLE:** Patients undergoing surgery for CD with cervical kyphosis (defined as C2-C7 (CL) > 10° kyphosis or C2-C7 sagittal vertical axis (SVA) > 4cm) were included. Patients with lumbar scoliosis > 10° were excluded.

**OUTCOME MEASURES:** CS was defined as C2-C7 coronal Cobb angle as ≥ 10°.

**METHODS:** We compared surgical factors, preoperative PROs as well as preoperative and follow-up radiographic data. Chi Square, Fisher's Exact, and Wilcoxon-Mann-Whitney, and T-tests were utilized, as appropriate. Statistical significance was considered p<0.05.

**RESULTS:** A total of 100 operative patients with cervical kyphosis were included (mean age 61.2 years, 51.5% female). Twelve patients (12.0%) had combined CS with CK (CS/CK group) and 88 patients (88%) had CK only (CK group). Preoperative maximum cervical coronal Cobb angle was 3.7° in the CK group and 17.1° in the CS/CK group. In the CS/CK group, this value improved to 10.1° (p<0.0001), but CS > 10° was still present in 3 patients, with a mean correction percentage of 47.1% of initial scoliosis. Mean sagittal plane correction in the CK vs CK/CS group was +7.6° vs +14.9° (p=0.54) in CL, -12.2mm vs -7.4mm in C2-C7 SVA (p=0.33), -13.9° vs -11.1° in T1 slope (TS)-CL (p=0.73), -0.4° vs -1.6° in thoracic kyphosis (TK)(p=0.57). The CK group had 13.8% anterior, 52.9% posterior, 33.3% anterior-posterior surgery, and the CS/CK group had 16.7% anterior, 41.7% posterior, and 41.7% anterior-posterior surgery (p=0.77). 55.7% in the CK group underwent any type of osteotomy, versus 58.3% in the CS/CK group (p=0.86). VCR or corpectomy was performed in 18.1% of the CK only group, and in 25.0% of the CS/CK group (p=0.69). For the CK vs CS/CK, the mean baseline NDI was 49.8 vs 44.8 (p=0.41), and 14.1 vs 15.2 for mJOA (p=0.16).

**CONCLUSIONS:** Overall, 12.0% of CD patients also had combined cervical scoliosis. Postoperatively, the residual coronal plane deformity was >50% of the preoperative deformity in the CK/CS group. However, the radiographic and clinical outcomes, surgical procedures of the CK group and the CK/CS group did not demonstrate significant differences. The present study firstly provided the evidence that CK is the major component of CD and the correction of CK is the mainstay of corrective surgery of CD even combined with CS.

**FDA DEVICE/DRUG STATUS:** This abstract does not discuss or include any applicable devices or drugs.

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#### 25. The evolution of ERAS: assessing the clinical benefits of developments within enhanced recovery after surgery protocols in adult cervical deformity surgery

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**BACKGROUND CONTEXT:** Enhanced recovery after surgery (ERAS) can help accelerate patient recovery and assist hospitals in maximizing the incentives of bundled payment models while maintaining high-quality patient care. However, such protocols are dynamic and evolving, and there remains a paucity of literature assessing how developments have impacted outcomes after adult cervical deformity (CD) surgery.

**PURPOSE:** To assess the impact of ERAS protocol evolution on perioperative course after cervical deformity corrective surgery.

**STUDY DESIGN/SETTING:** Retrospective review of prospective CD database.

**PATIENT SAMPLE:** A total of 332 CD patients.

**OUTCOME MEASURES:** Intra- and postoperative complication rates; reoperation rate; medication usage.

**METHODS:** Operative CD patients  $\geq 18$  yrs with complete pre-(BL) and up to 2-year(2Y) postop radiographic/HRQL data who underwent ERAS protocols were stratified by increasing implantation of ERAS component: Early (multimodal pain program), Intermediate (early protocol + paraspinal blocks, early ambulation), and Late (early/intermediate protocols + comprehensive prehabilitation). Differences in demographics, clinical outcomes, radiographic alignment targets, perioperative factors and complication rates were assessed via Bonferroni-adjusted means comparison analysis.

**RESULTS:** In total, 131 patients were included ( $59.4 \pm 11.7$  years, 45% female,  $28.8 \pm 6.0$  kg/m<sup>2</sup>). Of these patients, 38.9% were considered Early, 36.6% were Intermediate, and 24.4% were Late. At baseline, groups were comparable by age, gender, BMI, and baseline Charlson Comorbidity Index scores (CCI) (all  $p > .05$ ). In terms of BL disability, groups demonstrated incrementally increasing mJOA ( $p = .021$ ) and EQ5D scores ( $p < .001$ ). Perioperatively, rates of durotomy were significantly lower in the Late group ( $p = .006$ ) compared to the Early cohort, as were rates of intraoperative complications ( $p = .036$ ). Postoperatively, discharge disposition differed significantly between cohorts, with Late patients more likely to be discharged to home versus Early or Intermediate cohorts ( $\chi^2(2) = 37.973$ ,  $p < .001$ ). In terms of postoperative disability recovery, Intermediate and Late patients demonstrated incrementally improved 6W mJOA scores ( $p = .004$ ), and Late patients maintained significantly higher mean EQ5D and mJOA scores by 1Y ( $p < .001$ ,  $p = .026$ ). By 2Y, cohorts demonstrated incrementally increasing SWAL-QOL Burden ( $p < .001$ ), Eating Duration ( $p = .021$ ), Food Selection ( $p = .018$ ), Mental ( $p < .001$ ), and Fatigue ( $p = .028$ ) domain scores versus Early or Intermediate cohorts. By 2Y, incrementally decreasing reoperation were observed in Early vs Intermediate vs Late cohorts ( $p = .034$ ).

**CONCLUSIONS:** ERAS protocols, as applied to adult cervical deformity surgery, have evolved over time in complexity and have begun to incorporate preoperative optimization to reduce recovery burden and complication. The present study demonstrates that patients enrolled in an evolving ERAS programs demonstrate incremental improvement in preoperative optimization and candidate selection, greater likelihood of discharge to home, decreased postoperative disability and dysphasia burden, and decreased likelihood of intraoperative complications and reoperation rates.

**FDA DEVICE/DRUG STATUS:** This abstract does not discuss or include any applicable devices or drugs.

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## 26. Cervical disc arthroplasty for the treatment of adjacent segment disease after anterior cervical discectomy and fusion

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**BACKGROUND CONTEXT:** Anterior cervical discectomy and fusion (ACDF) has been the gold standard treatment for degenerative cervical diseases since the 1950s. However, a major clinical concern following ACDF is the development of adjacent segment disease (ASD). Symptomatic ASD following an ACDF has been traditionally treated with another ACDF, thereby introducing the risk of further ASD and pseudarthrosis. As

a result, cervical disc arthroplasty (CDA) has gained attention as a potential alternative motion-preserving surgical intervention for the treatment of ASD after ACDF. Prior studies evaluating CDA for ASD after ACDF are limited by small sample sizes and often include prostheses that are no longer commercially available in North America.

**PURPOSE:** The purpose of this study was to investigate clinical outcomes of CDA used for the treatment of post-ACDF symptomatic ASD.

**STUDY DESIGN/SETTING:** A retrospective chart review was conducted at a single institution.

**PATIENT SAMPLE:** The study was based on a consecutive series of 120 patients, beginning with the first case experience, of those undergoing CDA for the treatment of symptomatic disc degeneration adjacent to prior ACDF. At least 12-months postoperative status were required. A subset of patients ( $n = 10/120$ ) received hybrid surgeries of CDA and adjacent level ACDF or refusion of prior ACDF.

**OUTCOME MEASURES:** Patient reported outcome measures (PROMs) were compared between preoperative and most recent postoperative visit. PROMS included VAS neck pain, VAS arm pain, and Neck Disability Index (NDI). Post-CDA reoperation rate was calculated.

**METHODS:** CDA patients were identified from a comprehensive surgery log. Charts and electronic surgery records were used to confirm prior ACDF. Pre- to post-CDA outcomes were compared using the paired Wilcoxon signed-rank test.

**RESULTS:** The sample was approximately evenly split female ( $n = 61$ ) and male ( $n = 59$ ). Average age was 49.43 years (SD 8.59, range 30 – 73 years). A total of 142 devices were implanted – 98 patients underwent a one-level CDA, and 22 patients underwent a two-level CDA. Most CDAs (63.33%) were performed at the level superior to the prior ACDF. The mean follow-up duration after CDA was 32.11 months. Neck pain, arm pain, and NDI scores all improved significantly from the preoperative to postoperative timepoint (Table 1,  $p < .001$ ). Neck pain VAS scores improved from  $6.14 \pm 2.53$  to  $3.02 \pm 2.84$ . Arm pain VAS scores improved from  $4.42 \pm 2.97$  to  $1.61 \pm 2.44$ . NDI score improved from  $44.28 \pm 16.92$  to  $28.62 \pm 20.46$ . In total, 7 patients underwent reoperation (5.83%). One of these patients underwent reoperation for pseudarthrosis at the level of ACDF after a hybrid surgery. The indications for index level reoperations ( $n = 3$ ) were foraminal stenosis, osteolysis, and postoperative hematoma. All patients with an adjacent level reoperation ( $n = 3$ ) received surgery at levels adjacent to the prior fusion, not the more recent CDA.

**CONCLUSIONS:** The results of this study indicate CDA was effective for the treatment of ASD following ACDF based on patient pain relief and functional level (NDI). CDA appears to be a viable alternative to additional ACDF for the treatment of ASD in appropriately selected patients.

**FDA DEVICE/DRUG STATUS:** ProDisc-C, Mobi-C, Simplify, PCM, Prestige, and M6 Cervical Disc Replacements (Not approved for this indication).

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## 27. Six-year follow-up of a prospective FDA IDE trial evaluating a PEEK-on-ceramic cervical disc replacement

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**BACKGROUND CONTEXT:** Cervical total disc replacement (TDR) is now recognized as an effective treatment for symptomatic disc