

# Magnitude of Preoperative C2 Slope and Change in C2 Slope are Associated with Postoperative Alignment Correction and Risk of Distal Junctional Kyphosis in Patients with Adult Cervical Deformity

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**INTRODUCTION:** C2 slope is a cervical sagittal alignment parameter with growing utility in radiographic and clinical prognostication after adult cervical deformity (ACD) correction. However, less evidence exists to establish whether postoperative changes in C2 slope can be used to predict radiographic and clinical outcomes after deformity correction.

**METHODS:** A retrospective analysis of prospectively collected data was performed using a multicenter database of ACD patients. Inclusion criteria included cervical SVA > 4cm, chin-brow vertical angle > 25 degrees, cervical kyphosis > 10 degrees, or cervical scoliosis > 10 degrees. Patients were grouped according to C2 slope tertile (low, middle, high) using lateral radiographs, and linear and logistic regression analyses was used to evaluate the relationship between preoperative C2 slope magnitude and change in radiographic alignment parameters and risk of postoperative distal junctional kyphosis (DJK) at one- and two-year follow-up timepoints. Additionally, ANOVA and regression analyses were conducted to assess the association between C2 slope and health-related quality of life (HRQoL) outcomes, including NSR, NDI, EQ-5D, and mJOA scores.

**RESULTS:** 74 patients were included in the analysis who underwent surgery for ACD. At one- and two-years following surgery, patients with higher preoperative C2 slope had significantly greater reductions in C2-T1 sagittal angle ( $p=0.014$ ,  $p=0.022$ ) and C2-T10 sagittal angle ( $p=0.029$ ,  $p=0.025$ ), along with a greater reduction in C2-T4 sagittal angle at one year after surgery ( $p=0.048$ ). Patients with higher preoperative C2 slope were also at greater risk of developing DJK after one year ( $p=0.014$ ), and greater changes in C2 slope after surgery were associated with higher rates of DJK at one year follow-up ( $p=0.008$ ). Preoperative mJOA scores were worse in the middle and high C2 slope groups ( $p=0.011$ ). Otherwise, there were no statistically significant differences in NDI, NSR or EQ-5D between the groups.

## DISCUSSION AND CONCLUSION:

Preoperative C2 slope magnitude and reduction in C2 slope after cervical deformity correction are associate with greater magnitude of cervical deformity correction and greater risk of postoperative DJK. Patients with higher baseline C2 slope had worse preoperative mJOA scores demonstrating the clinical impact of this important cervical deformity parameter.

Dependent Variable	n	beta	CI	p-value	Dependent Variable	n	beta	CI	p-value	Dependent Variable	n	beta	CI	p-value	Dependent Variable	n	beta	CI	p-value					
Preoperative C2 slope	74	0.00	-0.01, 0.01	0.92	Preoperative C2 slope	74	0.00	-0.01, 0.01	0.96	Preoperative C2 slope	74	0.00	-0.01, 0.01	0.92	Preoperative C2 slope	74	0.00	-0.01, 0.01	0.92					
Δ C2-T1 Sagittal Angle	74	-0.19	-0.35, -0.03	0.014	Δ C2-T1 Sagittal Angle	74	-0.19	-0.35, -0.03	0.014	Δ C2-T1 Sagittal Angle	74	-0.19	-0.35, -0.03	0.014	Δ C2-T1 Sagittal Angle	74	-0.19	-0.35, -0.03	0.014	Δ C2-T1 Sagittal Angle	74	-0.19	-0.35, -0.03	0.014
Δ C2-T10 Sagittal Angle	74	-0.19	-0.35, -0.03	0.029	Δ C2-T10 Sagittal Angle	74	-0.19	-0.35, -0.03	0.029	Δ C2-T10 Sagittal Angle	74	-0.19	-0.35, -0.03	0.029	Δ C2-T10 Sagittal Angle	74	-0.19	-0.35, -0.03	0.029	Δ C2-T10 Sagittal Angle	74	-0.19	-0.35, -0.03	0.029
Δ C2-T4 Sagittal Angle	74	-0.19	-0.35, -0.03	0.048	Δ C2-T4 Sagittal Angle	74	-0.19	-0.35, -0.03	0.048	Δ C2-T4 Sagittal Angle	74	-0.19	-0.35, -0.03	0.048	Δ C2-T4 Sagittal Angle	74	-0.19	-0.35, -0.03	0.048	Δ C2-T4 Sagittal Angle	74	-0.19	-0.35, -0.03	0.048
Postoperative DJK	74	0.00	-0.01, 0.01	0.92	Postoperative DJK	74	0.00	-0.01, 0.01	0.96	Postoperative DJK	74	0.00	-0.01, 0.01	0.92	Postoperative DJK	74	0.00	-0.01, 0.01	0.92	Postoperative DJK	74	0.00	-0.01, 0.01	0.92
Preoperative mJOA	74	-0.19	-0.35, -0.03	0.011	Preoperative mJOA	74	-0.19	-0.35, -0.03	0.011	Preoperative mJOA	74	-0.19	-0.35, -0.03	0.011	Preoperative mJOA	74	-0.19	-0.35, -0.03	0.011	Preoperative mJOA	74	-0.19	-0.35, -0.03	0.011
NSR	74	0.00	-0.01, 0.01	0.92	NSR	74	0.00	-0.01, 0.01	0.96	NSR	74	0.00	-0.01, 0.01	0.92	NSR	74	0.00	-0.01, 0.01	0.92	NSR	74	0.00	-0.01, 0.01	0.92
NDI	74	0.00	-0.01, 0.01	0.92	NDI	74	0.00	-0.01, 0.01	0.96	NDI	74	0.00	-0.01, 0.01	0.92	NDI	74	0.00	-0.01, 0.01	0.92	NDI	74	0.00	-0.01, 0.01	0.92
EQ-5D	74	0.00	-0.01, 0.01	0.92	EQ-5D	74	0.00	-0.01, 0.01	0.96	EQ-5D	74	0.00	-0.01, 0.01	0.92	EQ-5D	74	0.00	-0.01, 0.01	0.92	EQ-5D	74	0.00	-0.01, 0.01	0.92