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ORIGINAL RESEARCH

Preoperative Spino Cranial Angle Predicts Adjacent Segment Degeneration After Single-Level Anterior Cervical Discectomy and Fusion

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Background: Adjacent segment degeneration (ASD) is a common complication after anterior cervical decompression and fusion (ACDF). The spino cranial angle (SCA), a novel sagittal parameter reflecting head-to-cervical alignment, may be associated with ASD, yet its predictive value remains unclear.

Methods: A total of 98 patients who underwent single-level ACDF with at least 24 months of follow-up were retrospectively analyzed. Radiographic evaluations were conducted preoperatively and at 3, 6, 12, and 24 months postoperatively. Patients were classified into ASD and non-ASD groups based on established radiographic criteria. Pre- and postoperative cervical sagittal parameters, including SCA, T1 slope (T1s), sagittal segmental alignment (SSA), sagittal alignment of the cervical spine (SACS), and C2–C7 sagittal vertical axis (cSVA) were measured. Clinical outcomes were assessed using the Japanese Orthopedic Association (JOA) score, Neck Disability Index (NDI), and Visual Analog Scale (VAS) scores. Multivariate logistic regression and Receiver operating characteristic (ROC) curve analysis were performed to identify independent predictors of ASD.

Results: ASD occurred in 36 patients (36.7%). Preoperative SCA was significantly larger in the ASD group compared to the non-ASD group (86.7° ± 7.4° vs 80.5° ± 6.9°, $p < 0.001$), while T1s and SSA were significantly smaller ($p = 0.015$ and $p = 0.001$, respectively). Multivariate analysis identified preoperative SCA as the only independent risk factor for ASD (OR = 1.279, 95% CI: 1.010–1.619, $p = 0.041$). Patients with SCA > 84.2° showed a significantly higher incidence of ASD (55.8% vs 21.4%, $p < 0.001$). ROC analysis demonstrated that SCA had good predictive value for ASD development. No significant differences were observed in JOA, NDI, or VAS scores between the two groups at final follow-up.

Conclusion: Preoperative SCA is a significant predictor of ASD, and may be considered in preoperative risk assessment.

Keywords: spino cranial angle, adjacent segment degeneration, anterior cervical decompression and fusion, cervical sagittal alignment

Introduction

Anterior cervical decompression and fusion (ACDF) is a widely accepted surgical procedure for managing cervical degenerative diseases.[1–4] However, this procedure alters cervical biomechanics by restricting motion at the fused segments, thereby increasing stress and hypermobility at adjacent segments. This compensatory mechanism has been implicated in the development of adjacent segment degeneration (ASD).[5–9] Long-term studies have reported that more than 90% of patients exhibit radiographic signs of ASD within five years,[2] and symptomatic ASD occurs at an annual incidence of 2.9%, accumulating to over 25% within a decade.[6,7] Although the etiology of ASD is multifactorial, involving segmental hypermobility, individual susceptibility, and lifestyle factors,[6,10–13] increasing attention has been paid to the role of cervical sagittal alignment.[6,11,13,14] Previous research has demonstrated that preoperative T1 slope (T1s) is a significant predictor of ASD.[15]

Despite its clinical relevance, the utility of T1s in preoperative planning is often limited due to poor visualization on plain lateral radiographs,[16] especially in patients with a short neck, high shoulders, or obesity, with visibility ranging from only 11% to 30%.[17] Although computed tomography (CT) and magnetic resonance imaging (MRI) have been employed as

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alternatives,[18,19] they are less practical in routine evaluation due to higher costs and their inability to represent the standing, weight-bearing posture.[20] These limitations have prompted the exploration of novel sagittal parameters.

Recently, the spino cranial angle (SCA), defined as the angle between the tangent to the superior endplate of C7 and the line connecting the center of the sella turcica to the midpoint of the C7 endplate,[21] has emerged as a promising sagittal parameter. By incorporating the concept of the C7–T1 upper head offset, SCA reflects both cervical foundation morphology and head gravitational effects. Le Huec et al[22] demonstrated that SCA is significantly correlated with T1s and generally ranges from 83° ± 9° in asymptomatic individuals. With increasing recognition, SCA has become a focus of cervical sagittal balance research.[23] Prior studies have suggested its utility in evaluating cervical sagittal balance, predicting the loss of cervical lordosis, and guiding surgical planning.[24–26] However, whether SCA can reliably predict the occurrence of ASD remains unclear.

Therefore, the objective of this study was to investigate whether preoperative SCA can serve as a predictor for ASD and to further explore its association with cervical sagittal alignment and postoperative degeneration.

Methods and Materials

Patient Population

The study has been approved by our affiliated institution, which initially screened 208 consecutive patients who underwent single-level ACDF for cervical degenerative diseases between June 2018 and June 2022. Inclusion criteria were as follows: (1) diagnosis of cervical radiculopathy, myelopathy, or single-level disc herniation; (2) complete radiographic and clinical data available; (3) minimum follow-up duration of 24 months; and (4) absence of preoperative ASD on radiographs. Exclusion criteria included: (1) previous cervical spine surgery; (2) cervical spinal deformities due to trauma, tumors, or metabolic disorders; (3) significant cervical instability or severe spondylosis; and (4) incomplete or unmeasurable cervical sagittal parameters. After applying these criteria, a total of 98 eligible patients were included in the final analysis (Figure 1).

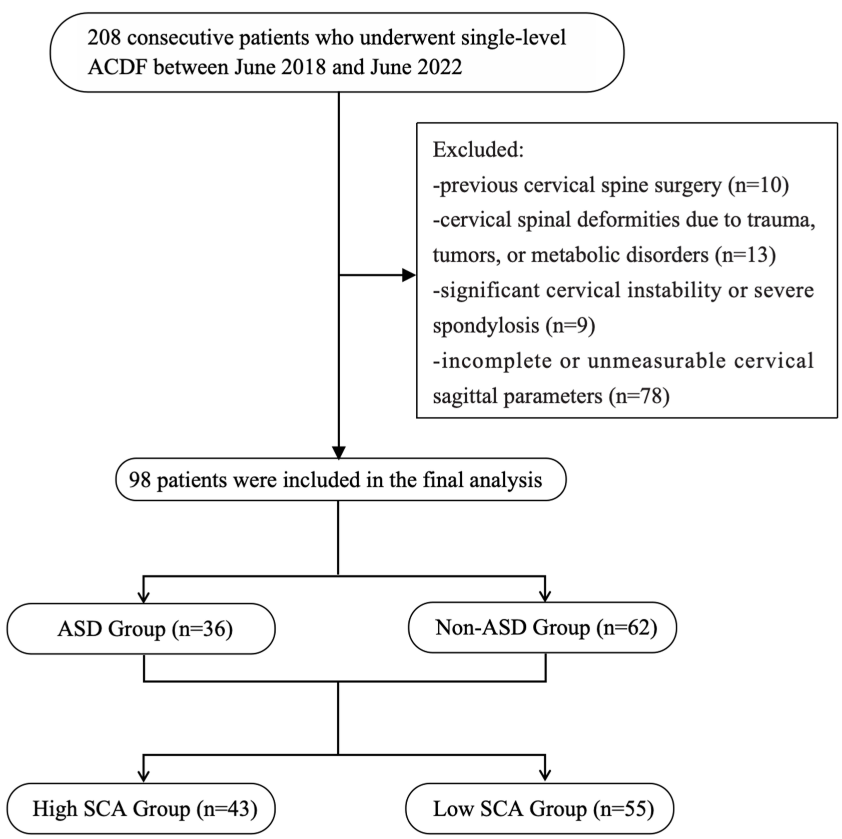

Figure 1 Study flow chart.

All patients were subsequently classified into two groups: the ASD group and the non-ASD group. ASD was defined radiographically by the presence of at least one of the following features:[27] (1) progressive anterior or posterior osteophyte formation; (2) development of anterolisthesis or retrolisthesis exceeding 3 mm; (3) new calcification of the anterior or posterior longitudinal ligament; or (4) disc space narrowing of ≥30%, a decrease in disc height of ≥3 mm, or an intervertebral flexion angle exceeding 5°.

Clinical Assessment

Although varying degrees of radiographic ASD were observed, no patient required revision surgery during the follow-up. Basic demographic and surgical data were recorded, including age at surgery, sex, follow-up duration, body mass index (BMI), smoking history, fusion levels, surgical approach, surgical level, operative time, and estimated blood loss.

All patients underwent clinical and radiological evaluations preoperatively and at 3, 6, 12, and 24 months postoperatively. The latest available data were used for analysis. Clinical outcomes were assessed using the Japanese Orthopedic Association (JOA) score, Neck Disability Index (NDI), and Visual Analog Scale (VAS) for neck and arm pain.

Radiographic parameters were independently evaluated by two experienced orthopedic surgeons using lateral cervical radiographs obtained preoperatively and at the 24-month follow-up (Figure 2):

- SCA: The angle between the tangent line to the superior endplate of C7 and a line connecting the midpoint of the C7 superior endplate to the center of the sella turcica. The center of the sella turcica was determined using the three-point method, based on the tuberculum sellae, dorsum sellae, and the midpoint of the sella floor, as previously described in Le Huec et al.[22]
- T1s: The angle between the superior endplate of T1 and the horizontal plane.
- Sagittal Segmental Alignment (SSA): The angle between the superior endplate of the cephalad adjacent vertebra and the inferior endplate of the caudal adjacent vertebra.
- Sagittal Alignment of the Cervical Spine (SACS): The angle formed by the posterior margins of C2 and C7 vertebrae.
- C2–C7 Sagittal Vertical Axis (cSVA): The distance from the plumb line dropped from the centroid of C2 to the posterior superior corner of C7.

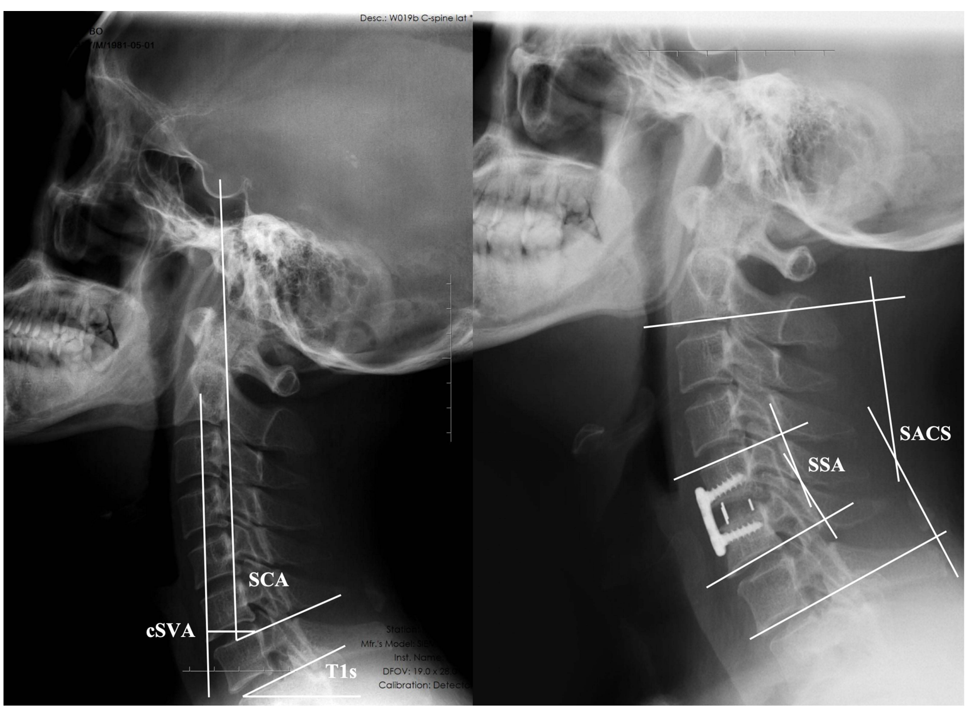

Figure 2 Measurement of radiological cervical parameters.
Abbreviations: SCA, spino cranial angle; T1s, T1-Slope; SSA, sagittal segmental alignment of the fused vertebrae; SACS, sagittal alignment of the cervical spine; cSVA, C2–7 sagittal vertical axis.

All parameters were re-measured after a two-week interval to assess intra- and inter-observer reliability. The intra-class correlation coefficients (ICCs) for all sagittal parameters exceeded 0.8, indicating excellent reproducibility. The final values were averaged across both measurements.

Statistical Analysis

Statistical analyses were performed using SPSS software (version 22.0; SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were presented as counts and percentages. Categorical data were compared using the chi-square test or Fisher's exact test as appropriate. Continuous variables were analyzed using independent-samples t-tests for normally distributed data or the Mann-Whitney *U*-test for non-normally distributed data. Multivariate logistic regression was used to identify independent risk factors for ASD, including variables with $p < 0.05$ in the univariate analysis. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the diagnostic value of predictive parameters, and the area under the curve (AUC) was calculated using MedCalc software (version 18.0). A two-sided p-value < 0.05 was considered statistically significant.

Results

Baseline Characteristics

A total of 98 patients were enrolled, including 36 patients in the ASD group and 62 in the non-ASD group. There were no significant differences between the two groups in terms of age, sex, BMI, smoking history, follow-up duration, operative time, estimated blood loss, or fusion levels (Table 1).

Comparison of Radiographic and Clinical Outcomes Between ASD and Non-ASD Groups

Preoperatively, the ASD group exhibited a significantly larger SCA (86.74° ± 7.41° vs 80.50° ± 6.89°, p < 0.001) and a smaller T1s (20.85° ± 6.47° vs 22.62° ± 4.41°, p = 0.015) compared with the non-ASD group. These differences persisted postoperatively, with the ASD group showing a significantly larger SCA (84.47° ± 8.51° vs 79.02° ± 6.73°, p = 0.001) and smaller T1s (21.68° ± 4.60° vs 24.05° ± 4.47°, p = 0.028). Additionally, the ASD group presented with a smaller SSA (−0.26° ± 3.37° vs 1.99° ± 3.08°, p = 0.001) at follow-up.

No significant intergroup differences were observed regarding cSVA, SACS, JOA scores, or VAS scores for neck and arm pain either preoperatively or postoperatively. Likewise, patient-reported outcomes including NDI showed no significant difference between the groups (Table 2).

Table 1 Comparison of Patient Characteristics According to ASD Groups

Characteristics	ASD Group	Non-ASD Group	*p*-value
No. of patients	36	62	
Age (year)	59.7 ± 5.9	57.6 ± 5.7	0.110*
Sex (male/female)	10/26	24/38	0.273⁺
Smoking history	6 (17.4%)	14 (12.7%)	0.484⁺
BMI (kg/m^2)	25.0 ± 5.3	24.9 ± 5.7	0.892#
Operation time (minutes)	72.17 ± 14.8	70.29 ± 11.4	0.520#
Estimated blood loss (mL)	69.5 ± 8.3	67.9 ± 6.8	0.678
Fused level			0.958†
C3–C4	1(2.8%)	4(6.5%)	
C4–C5	14(38.9%)	23(37.1%)	
C5–C6	15(41.7%)	25(40.3%)	
C6–C7	6(16.7%)	10(16.1%)	

Notes:*Independent *t*-test. #Mann–Whitney *U*-test. ⁺Pearson Chi-square test. †Fisher's Exact test.

Abbreviations: ASD, adjacent segment degeneration; BMI, body mass index.

Table 2 Comparison of Radiological Outcome and Clinical Outcome According to ASD Groups

	ASD Group	Non-ASD Group	*p*-value
Preoperative			
SCA (°)	86.74±7.41	80.50±6.89	<0.001*
T1s (°)	20.85±6.47	22.62±4.41	0.015#
SSA (°)	−0.41±3.61	0.98±2.49	0.068#
SACS (°)	10.39±6.30	12.72±7.08	0.060#
cSVA (mm)	22.01±6.19	20.48±6.70	0.075#
JOA	10.61±1.82	10.85±2.12	0.647#
NDI	41.80±6.3	40.87±5.90	0.416#
VAS for neck pain	6.11±1.45	5.96±1.28	0.447#
VAS for arm pain	5.98±1.26	6.08±2.11	0.847#
Follow-up			
SCA (°)	84.47±8.51	79.02±6.73	0.001*
T1s (°)	21.68±4.60	24.05±4.47	0.028#
SSA (°)	−0.26±3.37	1.99±3.08	0.001#
SACS (°)	12.21±4.84	14.49±6.32	0.087#
cSVA (mm)	19.86±5.38	18.13±5.81	0.130*
JOA	13.65±1.61	14.17±1.63	0.196#
NDI	13.67±4.05	12.35±3.94	0.103*
VAS for neck pain	2.54±1.22	2.08±1.28	0.075#
VAS for arm pain	2.28±1.17	1.87±1.25	0.084#

Notes:*Independent *t*-test. # Mann–Whitney *U*-test.
Abbreviations: ASD, adjacent segment degeneration; SCA, spino cranial angle; T1s, T1-Slope; SSA, sagittal segmental alignment of the fused vertebrae; SACS, sagittal alignment of the cervical spine; cSVA, C2–7 sagittal vertical axis; JOA, Japanese Orthopaedic Association score; NDI, Neck Disability Index score; VAS, Visual Analog Scale score.

Risk Factor Analysis for ASD

Multivariate logistic regression analysis identified preoperative SCA as the only independent predictor of ASD (OR = 1.279, 95% CI: 1.010–1.619, p = 0.041). Other variables, including preoperative and postoperative T1s, postoperative SCA, and SSA, were not significant predictors (Table 3). ROC curve showed that SCA owned good diagnostic value for the incidence of ASD, with an AUC of 0.745 and a cut-off value of 84.2°.The corresponding sensitivity and specificity were 67.4% and 76.9%, respectively (Figure 3).

Table 3 Multiple Regression Analysis of Risk Factors for ASD

Variable	OR	*p*-value	95% CI
Preoperative SCA	1.279	0.041	1.010–1.619
Preoperative T1s	1.078	0.293	0.937–1.241
Follow-up SCA	0.911	0.304	0.762–1.088
Follow-up T1s	1.009	0.932	0.814–1.251
Follow-up SSA	0.954	0.613	0.794–1.146

Abbreviations: ASD, adjacent segment degeneration; OR, odds ratio; CI, confidence interval; SCA, spino cranial angle; T1s, T1-slope; SSA, sagittal segmental alignment of the fused vertebrae.

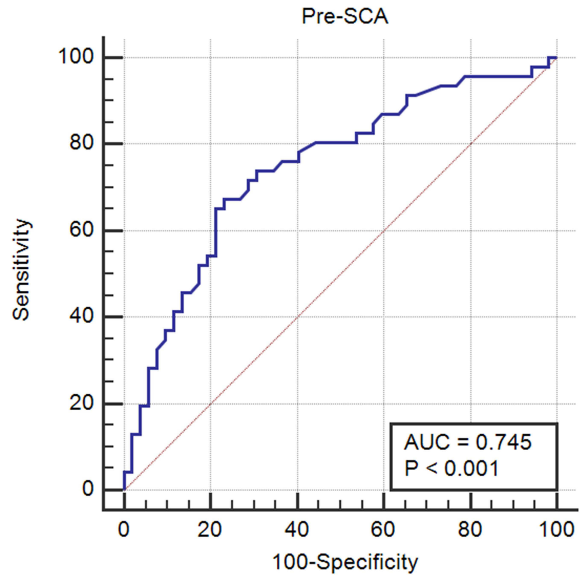

Figure 3 ROC analysis revealed a cut-off value for SCA of 84.2° yielded a sensitivity of 67.4% and a specificity of 76.9% in predicting ASD. The area under the curve AUC is 0.745.

Subgroup Analysis Based on SCA

Patients were further categorized into high SCA (n = 43) and low SCA (n = 55) groups based on the preoperative SCA cut-off value. Compared with the high SCA group, patients in the low SCA group had significantly higher T1s, SSA, SACS, and lower NDI scores both preoperatively and postoperatively (all $p < 0.05$). Notably, the incidence of ASD was markedly higher in the high SCA group compared to the low SCA group (55.8% vs 21.4%, $p < 0.001$) (Table 4). Although neck and arm pain VAS scores tended to be lower in the low SCA group postoperatively, the differences did not reach statistical significance.

Table 4 Comparison of Radiological Outcome and Clinical Outcome According to SCA Groups

	High SCA (n=43)	Low SCA (n=55)	*p*-value
Preoperative			
T1s (°)	19.33±4.57	23.72±5.46	<0.001#
SSA (°)	−1.70±3.10	1.92±2.06	<0.001#
SACS (°)	8.00±4.81	14.47±6.78	<0.001#
cSVA (mm)	22.17±7.14	20.44±5.87	0.174*
JOA	10.51±1.79	10.91±2.11	0.564#
NDI	42.86±4.60	40.09±6.27	0.023*
VAS for neck pain	6.28±1.30	5.84±1.39	0.113#
VAS for arm pain	5.93±1.37	6.11±1.36	0.587#
Follow-up			
T1s (°)	20.51±3.34	24.84±4.68	<0.001*
SSA (°)	−2.23±2.05	3.41±1.80	<0.001*
SACS (°)	9.91±4.18	16.16±5.34	<0.001#
cSVA (mm)	20.05±6.07	18.07±5.19	0.086*
JOA	13.74±1.54	14.07±1.70	0.455#
NDI	14.09±3.87	12.09±3.96	0.014*
VAS for neck pain	2.49±1.24	2.15±1.28	0.200#
VAS for arm pain	2.14±1.10	2.00±1.32	0.441#

(*Continued*)

Table 4 (Continued).

	High SCA (n=43)	Low SCA (n=55)	*p*-value
Incidence of ASD			<0.001^{+}
ASD	24(55.8%)	12(21.4%)	
Non-ASD	19(44.2%)	44(78.6%)	

Notes:*Independent *t*-test. #Mann–Whitney *U*-test. +Pearson Chi-square test.
Abbreviations: SCA, spino cranial angle; T1s, T1-Slope; SSA, sagittal segmental alignment of the fused vertebrae; SACS, sagittal alignment of the cervical spine; cSVA, C2–7 sagittal vertical axis; JOA, Japanese Orthopaedic Association score; NDI, Neck Disability Index score; VAS, Visual Analog Scale score; ASD, adjacent segment degeneration.

Table 5 Comparison of the Relationship Between the Incidence of ASD and the Level of Fusion According to SCA Groups

Fused level	High SCA (43.9%)				Low SCA (56.1%)			
	Total	ASD	Non-ASD	*p*-value	Total	ASD	Non-ASD	*p*-value
				0.754†				1.000†
C3–C4	2	1(4.2%)	1(5.3%)		3	0(%)	3(%)	
C4–C5	17	9(37.5%)	8(42.1%)		20	5(%)	15(%)	
C5–C6	19	10(41.7%)	9(47.4%)		21	5(%)	16(%)	
C6–C7	5	4(16.7%)	1(5.3%)		11	2(%)	9(%)	

Notes: †Fisher's Exact test.
Abbreviations: ASD, adjacent segment degeneration; SCA, spino cranial angle.

Relationship Between ASD and Fused Levels Within SCA Subgroups

No significant differences were observed regarding the incidence of ASD across different fusion levels (C3–C7) within either the high SCA or low SCA subgroups (Table 5). This suggests that the fused level distribution was not directly associated with ASD development in this cohort.

Discussion

In this study, we investigated the relationship between SCA and ASD after ACDF surgery. The key finding was that preoperative SCA was identified as the only independent predictor of postoperative ASD, with a cut-off value of 84.2°. Patients with preoperative SCA > 84.2° not only exhibited an increased incidence of ASD but also presented with a distinct cervical alignment pattern, characterized by a larger SCA and a smaller T1 slope both preoperatively and postoperatively. Subgroup analysis further revealed that patients with SCA > 84.2° were significantly more likely to develop ASD compared to those with a low SCA (55.8% vs 21.4%, $p < 0.001$). In contrast, other conventional sagittal alignment parameters, including cSVA, SSA, and SACS, showed no significant association with ASD occurrence. These results suggest that SCA may serve as a simple and effective preoperative indicator to stratify ASD risk.

ACDF has been widely adopted for treating degenerative cervical diseases but is often associated with ASD, potentially due to increased loading and motion in unfused segments. Although some studies suggest that ASD merely reflects the natural aging process and is not directly attributable to spinal fusion,[28–30] numerous biomechanical and clinical investigations indicate that ACDF alters the mechanical properties of adjacent intervertebral discs, impairs normal cervical kinematics, and accelerates disc degeneration.[15,31,32] Fusion of a cervical segment leads to compensatory hypermobility of adjacent levels, increasing mechanical stress, altering nutrient supply, and disturbing extracellular matrix composition, thereby promoting disc degeneration.[33–37]

Previous studies have also highlighted the influence of cervical alignment on ASD. Song et al[15] reported that head gravitational forces, reflected by cervical alignment parameters, contribute significantly to ASD development, especially in patients with a T1s less than 19.5°. Although T1s is a well-established predictor of cervical alignment, it does not directly account for head posture and gravitational forces. Moreover, its measurement is often limited by poor visualization of T1 on radiographs. Recently, SCA has been proposed as a novel parameter that integrates the gravitational effect of the head and cervical base.[23] SCA normally fluctuates within 83°±9° and is significantly correlated with both T1s and cervical lordosis.[22] Prior studies have indicated that patients with lower SCA are more vulnerable to sagittal imbalance, while excessively large SCA values are associated with poorer quality of life.[25] However, its predictive value for ASD following ACDF has not been fully established. Our study confirmed that preoperative SCA serves as a reliable predictor of ASD and clarified its relationship with cervical alignment.

Consistent with prior reports,[11,13,38] our results reaffirm the protective role of maintaining sagittal balance against ASD. Patients with ASD exhibited significantly larger SCA, smaller T1s, and lower SSA compared to non-ASD patients throughout the follow-up. This supports the notion that restoring cervical sagittal balance may mitigate ASD progression. Katsuura et al[11] showed that patients maintaining cervical lordosis postoperatively were less likely to develop ASD, while Park et al[39] found smaller T1s and cSVA in patients who eventually required revision for ASD, which is consistent with our observations. Biomechanical studies further support these findings. Scheer et al[40] suggested that insufficient sagittal balance correction increases cervical preload, contributing to ASD. Liu et al[41] demonstrated that reduced postoperative lordosis significantly elevated the stress and motion range of adjacent segments. In our analysis, ROC curve and logistic regression confirmed that preoperative SCA >84.2° was an independent risk factor for ASD. Patients with SCA >84.2° had a markedly higher incidence of ASD (55.8% vs 21.4%). Moreover, these patients consistently exhibited smaller T1s, SSA, and SACS, both preoperatively and at follow-up. This suggests that a high SCA not only predisposes patients to ASD but may also contribute to its progression.

We speculate that excessive SCA increases the anterior shift of the head's gravitational load, intensifying the burden on the anterior and posterior columns of the cervical spine. This biomechanical alteration may lead to increased mechanical stress, reduced disc nutrition, and matrix disruption in adjacent segments, ultimately accelerating degeneration. Furthermore, postoperative loss of SSA or the development of kyphosis appears to be associated with ASD. ASD patients exhibited significantly lower SSA and more frequent local kyphosis compared to non-ASD patients (−0.26° vs 1.99°). Although SSA did not emerge as a significant predictor in multivariate analysis, the trend was notable, particularly in the high SCA group, where progressive kyphosis was evident during follow-up (−1.70° vs −2.23°).

Whether radiographic ASD translates into worse clinical outcomes remains controversial. While Chung et al[42] observed a strong correlation between cervical degeneration and symptoms, we found no significant differences in JOA, NDI, or VAS scores between ASD and non-ASD patients at follow-up, suggesting a weak association between radiographic degeneration and clinical symptoms. However, when patients were stratified by SCA, those in the high SCA group consistently exhibited higher NDI scores both preoperatively and postoperatively, suggesting that excessive SCA may contribute to neck pain, likely due to posterior muscle fatigue and accelerated degeneration.[24,25]

Regarding the influence of fusion level on ASD, our results align with Faldini et al,[43] showing no significant association between ASD incidence and specific fused segments, contradicting earlier findings by Hilibrand et al.[6] This suggests that sagittal alignment may be more critical than fusion level in influencing ASD development. Therefore, when performing ACDF, emphasis should be placed on maintaining or restoring proper sagittal alignment, particularly in patients with a high preoperative SCA. While this study did not stratify ASD occurrence by cranial versus caudal direction, we acknowledge the biomechanical relevance of this distinction—particularly in the lower cervical spine. Prior studies have primarily focused on whether ASD occurs, rather than where it occurs.[11,13,38] To fully characterize the mechanical interaction between sagittal alignment (eg, SCA) and segmental degeneration patterns, dedicated biomechanical investigations such as finite element analysis or in vitro loading studies would be required. Future prospective research integrating radiographic, biomechanical, and anatomical modeling approaches will be essential to advance this understanding.

This study has several limitations. First, the effects of age-related degeneration could not be fully distinguished from ASD. Second, imaging assessments relied solely on plain radiographs without CT or MRI confirmation. Third, the retrospective design and relatively small sample size may introduce bias and limit generalizability. Additionally, we did not distinguish whether ASD occurred in the cranial or caudal adjacent segment, which could have provided more biomechanical insights. However, given the study's primary focus on the association between preoperative SCA and overall ASD risk, further stratification would have complicated the subgroup analysis and reduced statistical power. Future prospective, multicenter studies with larger samples and comprehensive imaging assessments are warranted.

Conclusion

A preoperative SCA greater than approximately 84.2° may be associated with an increased risk of ASD and could serve as a preliminary reference value for risk assessment. Surgeons should pay attention to sagittal alignment in patients with high SCA to optimize surgical outcomes.

Ethical Approval and Consent to Participate

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of Cangzhou Central Hospital. The need for individual patient consent was waived by the Ethics Committee due to the retrospective nature of the study, and all data were fully anonymized prior to analysis to ensure patient confidentiality.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

None of the authors have any potential conflicts of interest in this work.

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