Article

The Impact of Critical Shoulder Angle on ACJ Degeneration and Rotator Cuff Tears Severity: A Multivariable Analysis

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AIM: This study aimed to evaluate the relationship between the critical shoulder angle (CSA) and acromioclavicular joint (ACJ) degeneration, and its effect on supraspinatus, infraspinatus, and subscapularis tendon tear severity.
METHODS: A retrospective review of 217 patients (mean age 57.1 ± 12.9 years) between June 2019 and June 2024 was conducted. Patients were grouped based on the presence of ACJ degeneration and rotator cuff tears (RCT). Data collected included age, sex, acromion type, CSA, and ACJ degeneration. CSA was measured on anteroposterior (AP) radiographs; tendon tears were evaluated via magnetic resonance imaging (MRI). Associations among CSA, ACJ degeneration, and RCT were analyzed using receiver operating characteristic (ROC) and logistic regression.
RESULTS: Patients with ACJ degeneration had significantly higher CSA (40.0 ± 4.3 vs. 36.6 ± 2.1, $p < 0.001$). Full-thickness supraspinatus tears were more common with ACJ degeneration (34.2% vs. 1.4%), as were partial infraspinatus (54.1% vs. 2.8%) and subscapularis tears (32.9% vs. 0%) ($p < 0.001$ for all). CSA was highest in patients with full-thickness supraspinatus tears (42.5 ± 5.0). ROC analysis identified 38.4° as the optimal CSA cutoff. High CSA independently predicted ACJ degeneration. The critical shoulder angle predicted ACJ degeneration with good accuracy, as demonstrated by an area under the curve (AUC) of 0.776 (95% confidence interval (CI): 0.715, 0.836; $p < 0.001$) in ROC analysis.
CONCLUSIONS: CSA is significantly associated with ACJ degeneration and rotator cuff pathology, especially full-thickness supraspinatus and partial infraspinatus tears. CSA may serve as a useful parameter in the assessment and management of shoulder disorders.

Keywords: acromioclavicular joint degeneration; critical shoulder angle; infraspinatus; subscapularis; supraspinatus; multivariate analysis

Introduction

Rotator cuff tears (RCT) and acromioclavicular joint (ACJ) degeneration are common shoulder injuries that can severely restrict shoulder joint mobility and significantly impair the quality of life in affected individuals. Rotator cuff disease is extremely common, affecting between 6.8% and 22.4% of the population over age 40 [1]. Acromioclavicular joint degeneration is very common in the general population, with changes consistent with ACJ degeneration observed in 48% of 953 cadaveric and skeletal specimens and 70% of 210 magnetic resonance images of asymptomatic shoulders [2]. Anatomical variations of the scapula play a role in the etiology of rotator cuff tears [3]. The impact of acromial anatomy on the development of rotator cuff tears has been a subject of long-standing debate [4–6]. Acromioclavicular joint degeneration is frequently observed in conjunction with other pathological conditions [2]. A more laterally positioned acromial offset theoretically leads to a more lateral origin of the deltoid muscle, resulting in increased shear forces and reduced compressive vector on the glenohumeral joint [7].

In studies focusing on the anatomical morphology of rotator cuff tears, Moor *et al*. [8] developed the critical shoulder angle (CSA), which quantitatively defines the relationship between the glenoid and the acromion. They demonstrated that this angle is associated with both shoulder osteoarthritis and rotator cuff tears. The CSA is the angle between the plane of the glenoid fossa (a line drawn from the inferior to the superior edge of the glenoid) and a line drawn from the inferior edge of the glenoid to the lateral edge of the acromion [8]. This angle is measured on the true anteroposterior Grashey shoulder radiograph. The true anteroposterior Grashey shoulder radiograph was found to be significantly superior in detecting abnormal radiographic

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findings [9]. CSA, by combining the lateral extension of the acromion with the inclination of the glenoid fossa in a single measurement, presents a potential parameter for predicting the development of degenerative rotator cuff tears [10,11]. The study also revealed that CSA values greater than 35° increase the risk of humeral head translation [10]. Recent studies have shown that anatomical factors, such as the CSA, are associated with RCT [12–14]. In a biomechanical study conducted by Gerber *et al.* [7] in 2014, it was demonstrated that the tensile load exerted on the supraspinatus tendon to maintain the stability of the humeral head within the glenoid increases in direct proportion to the size of the CSA.

Although the relationship between the CSA and rotator cuff tears has become a popular topic in recent literature, there is a lack of studies specifically investigating its association with individual tendon tears, such as those of the infraspinatus, subscapularis, or supraspinatus. Similarly, the potential correlation between CSA and ACJ degeneration remains underexplored. We believe that our study will provide novel contributions to the existing literature by addressing these gaps.

We hypothesized that the presence and severity of subscapularis tendon tears (partial or full-thickness) would be significantly associated with ACJ degeneration, suggesting that altered shoulder biomechanics in degenerative ACJ disease may contribute to increased loading and subsequent injury of the subscapularis tendon.

In this study, we aimed to evaluate these relationships, excluding potential confounding factors, and test the hypothesis that higher CSA are associated with larger infraspinatus, subscapularis, or supraspinatus tears, and that a high CSA is an independent risk factor for ACJ degeneration.

Patients and Methods

This single-center, retrospective study was conducted between June 2019 and June 2024 at the Department of Orthopaedics and Traumatology, Bolu Abant Izzet Baysal University Faculty of Medicine. Patients were identified using the International Classification of Diseases (ICD) code for “Rotator Cuff Lesions” (M75.1) via the hospital information system, yielding a total of 950 patients. Of these, 453 patients met the inclusion criteria, and 217 patients (120 female, 97 male; mean age: 57.1 $\pm$ 12.9 years; age range: 40–70 years) who consented to participate were included in the study. Written informed consent was obtained from all participants. The study protocol was approved by the Bolu Abant Izzet Baysal Faculty of Medicine Ethics Committee (date: 4 March 2025, approval number: 2025/55). The study was conducted in accordance with the principles of the Declaration of Helsinki, and measurements were performed using PACS software (https://karmed-pacs-viewer.software.informer.com). After receiving information during the initial assessment, patients who agreed to participate were included in the study. Data from the enrolled patients were recorded, and underlying pathologies and archival images were retrospectively reviewed.

Inclusion Criteria: Patients with complaints of shoulder pain and restriction in shoulder joint mobility. Patients aged between 40–70 years. Availability of imaging tests such as magnetic resonance imaging (MRI) and X-rays. MRI imaging performed within the last 6 months with a pre-diagnosis of rotator cuff tears and acromioclavicular joint degeneration. Patients who have undergone a shoulder anteroposterior (AP) X-ray following the standard protocol.

Exclusion Criteria: Exclusion criteria included patients with avascular necrosis, inflammatory arthritis, septic arthritis, or cuff tears arthropathy; those with a history of prior surgical intervention on the same shoulder or ipsilateral shoulder fractures; individuals with anatomical variations of the scapula or clavicle; patients with previous shoulder arthroplasty or implants; and those who did not provide informed consent.

The severity of supraspinatus and infraspinatus tendon tears was evaluated using preoperative MRI findings and confirmed by arthroscopic assessment. Tendon integrity was classified into three categories: no tear, defined as a structurally intact tendon without evidence of fiber disruption; partial tear, defined as localized fiber disruption not involving the full tendon thickness, including articular-sided or bursal-sided tears with $\geq$ 50% thickness involvement; and complete tear, defined as full-thickness tendon rupture, frequently associated with tendon retraction.

After confirming the patients to be included in the study through MRI, their shoulder radiographs were examined. The CSA will be measured using the technique described by Moor *et al*. [8] from true anteroposterior (Grashey) radiographs. This angle will be defined as the angle between a line connecting the superior and inferior borders of the glenoid and a line extending from the inferior border of the glenoid to the lateral edge of the acromion [8]. The Suter-Henninger (SH) classification system will be used to validate the radiographic adequacy of a true anteroposterior radiograph for measuring CSA [15]. The patients’ acromion types, presence of acromioclavicular degeneration, and types of rotator cuff tears will be assessed and recorded by a single radiologist with extensive experience, who will be unaware of the clinical findings, based on MRI images. For each shoulder, tears of the supraspinatus, infraspinatus, and subscapularis will be classified and recorded as no tear, partial tear, or full-thickness tear. MRI imaging will be performed using a 1.5 T Siemens Magnetom Symphony (Siemens Healthineers, Erlangen, Germany) device with specialized 16-channel system coils, in the standard position. Various sequences, including T1-weighted (T1W), T2W, T2 short tau inversion recovery (STIR), and proton density-weighted (PDW), will be reviewed during the imaging. MRI examinations were performed using a 1.5 Tesla Siemens scanner. The sequences and parameters were as follows: Axial T1-weighted spin echo: Repetition Time (TR)= 600 ms, Echo Time (TE) = 10 ms, slice thickness = 3 mm, Field of View (FOV) = 160 mm. Oblique coronal PDW with fat suppression: TR = 3000 ms, TE = 30 ms, slice thickness = 3 mm, FOV = 160 mm. Oblique sagittal T2-weighted fast spin echo with fat suppression: TR = 4000 ms, TE = 80 ms, slice thickness = 3 mm, FOV = 160 mm. Coronal short tau inversion recovery (STIR): TR = 5000 ms, TE = 50 ms, Inversion Time (TI) = 150 ms, slice thickness = 3 mm, FOV = 160 mm.

Statistical Analysis

Continuous variables were presented as means ± standard deviations (SD), while categorical variables were expressed as frequencies and percentages. The normality of the continuous variables was confirmed with the Shapiro-Wilk test and histogram plots. Differences between the two independent groups were analyzed using the independent samples *t*-test. For comparisons among multiple groups, a one-way analysis of variance (ANOVA) was performed. Homogeneity of variances was assessed using Levene's test. When equal variances were assumed, Bonferroni post-hoc tests were applied to identify significant pairwise differences. If variances were not homogeneous, Tamhane's T2 post-hoc test was used. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate.

Receiver operating characteristic (ROC) curve analysis was performed to determine the discriminatory ability of CSA in predicting ACJ degeneration. Multivariable logistic regression analysis was performed to assess the association between ACJ degeneration and several independent factors. Three separate models were developed to evaluate the impact of supraspinatus, infraspinatus, and subscapularis tendon degeneration, with each tendon type serving as an independent variable in its respective model. The analysis was adjusted for age and gender to account for potential confounding effects. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported to quantify the strength of associations. All statistical analyses were conducted using R 4.2.3 (R Foundation for Statistical Computing, Vienna, Austria), with significance set at $p < 0.05$. Figures were generated using the ggplot2 package in R (Seattle, Washington, Turkey).

Results

A total of 217 patients (120 female, 97 male) were included in the study, with a mean age of 57.1 ± 12.9 years; 135 had right shoulder and 82 had left shoulder involvement. The results of the statistical tests for demographic data and clinical characteristics based on ACJ degeneration are presented in Table 1. Patients with ACJ degeneration were significantly older than those without degeneration (59.7 ± 11.6 years vs. 51.6 ± 13.8 years, $p < 0.001$). The CSA was significantly higher in patients with ACJ degeneration compared to those without degeneration (40.0 ± 4.3 vs. 36.6 ± 2.1, $p < 0.001$).

A significant relation between tear type (no tear, partial tear, complete tear) and ACJ degeneration was observed for the supraspinatus, infraspinatus, and subscapularis tendons ($p < 0.001$). In the supraspinatus tendon, 8.2% (12/146) of the patients with ACJ degeneration had no tear, whereas 57.5% (84/146) had partial tears, and 34.2% (50/146) had complete tears. In contrast, in the group without ACJ degeneration, 43.7% (31/71) had no tear, 54.9% (39/71) had partial tears, and only 1.4% (1/71) had complete tears. For the infraspinatus tendon, among patients with ACJ degeneration, 54.1% (79/146) had partial tears, and 8.2% (12/146) had complete tears, compared to 2.8% (2/71) and 0% (0/71), respectively, in patients without degeneration. For the subscapularis tendon, in the AC degeneration group, 32.9% (48/146) had partial tears, and 4.8% (7/146) had complete tears, whereas in the non-degeneration group, 97.2% (69/71) had no tear.

The mean CSA did not vary significantly among different acromion types (Fig. 1A). However, the mean CSA was significantly different among different types of rotator cuff tears (no tear, partial tear, complete tear) for supraspinatus, infraspinatus and subscapular tendons (Fig. 1B). The mean CSA was significantly different across the three groups of supraspinatus ($p < 0.001$). Patients with no supraspinatus tear had the lowest CSA (35.5 ± 1.8), while those with a partial tear had a moderately higher CSA (38.6 ± 2.8). The highest CSA was observed in patients with a complete tear (42.5 ± 5.0). Post-hoc analysis revealed that the CSA in the complete tear group was significantly higher compared to both the no tear ($p < 0.001$) and partial tear groups ($p < 0.001$). Additionally, the partial tear group had a significantly higher CSA than the no tear group ($p < 0.001$). For infraspinatus tears, the mean CSA was significantly higher in patients with a partial tear compared to no tear group (41.3 ± 4.7 vs. 37.4 ± 2.6, $p < 0.001$). For subscapularis tears, patients with a partial tear had significantly higher CSA (42.8 ± 5.1), compared to those with no tear (37.8 ± 2.8, $p < 0.001$) and complete tear (37.8 ± 4.0, $p = 0.017$).

The overall area under the curve (AUC) obtained with the ROC curve analysis of the critical shoulder angle for distinguishing between patients with and without ACJ degeneration was 0.776 (95% confidence interval (CI): 0.715–0.836; $p < 0.001$) (Fig. 2). The optimum cutoff value for CSA was determined as 38.4 (sensitivity = 68.5%, specificity = 78.9%). The ROC analysis showed that CSA is a successful indicator in the classification of ACJ degeneration.

In this study, a multivariable logistic regression analysis was conducted to evaluate the association between ACJ degeneration and several factors, including CSA and the presence of rotator cuff tears, while adjusting for age and gender. In the multivariable logistic regression analysis, gender was included in the model with females as the reference category, and male gender was not found to be significantly

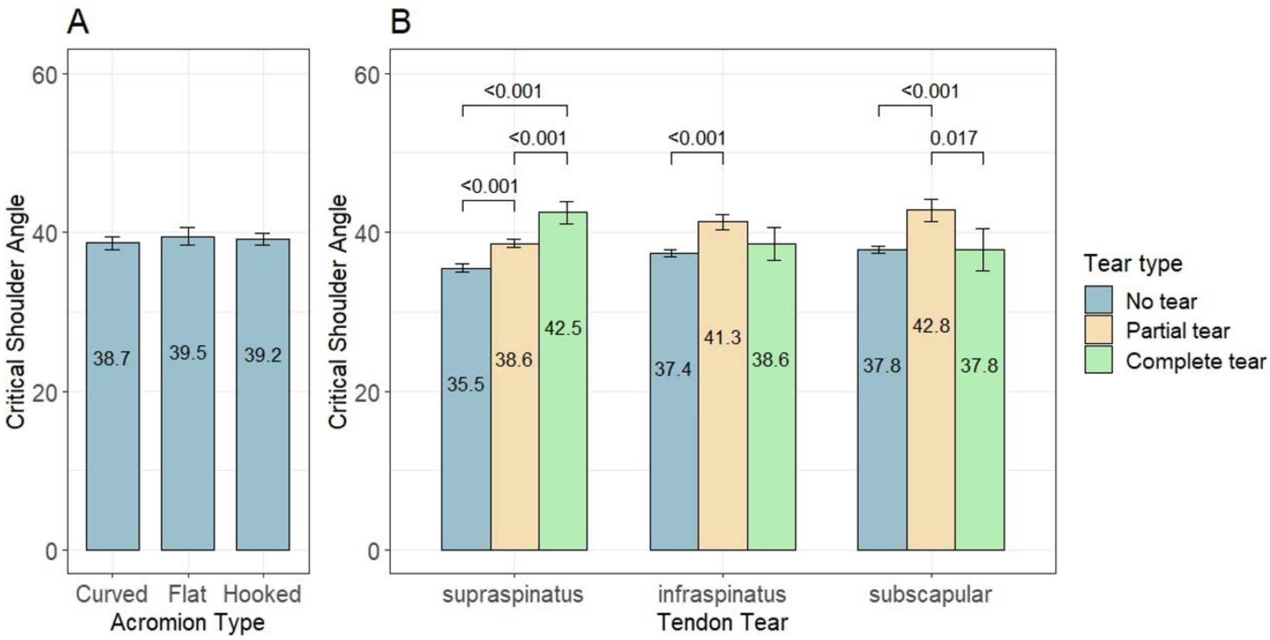

Fig. 1. Comparison of mean CSA by acromion and tear types. (A) Comparison of mean CSA among acromion types. (B) Comparison of mean CSA among three different types of tendon tear and tear type. Error bars represent 95% confidence interval of the mean. p-values were calculated using post-hoc Bonferroni or Tamhane's T2 test. CSA, critical shoulder angle.

Table 1. Comparison of demographic data and clinical characteristics between patients with and without ACJ degeneration and rotator cuff tears.

Variables	Total (n = 217)	Control group (n = 71)	ACJ group (n = 146)	p
Age	57.1 ± 12.9	51.6 ± 13.8	59.7 ± 11.6	<0.001
Gender [n (%)]				0.165
Female	120 (55.3)	34 (47.9)	86 (58.9)	
Male	97 (44.7)	37 (52.1)	60 (41.1)	
CSA	38.9 ± 4.0	36.6 ± 2.1	40.0 ± 4.3	<0.001
Dominant side [n (%)]				
Right	135 (62.2)	42 (59.2)	93 (63.7)	0.083
Left	82 (37.8)	29 (40.8)	53 (36.3)	
Acromion type [n (%)]				0.499
Flat	24 (11.1)	5 (7.0)	19 (13)	
Curved	128 (59.0)	45 (63.4)	83 (56.8)	
Hooked	64 (29.5)	21 (29.6)	43 (29.5)	
Convex	1 (0.5)	0 (0)	1 (0.7)	
Supraspinatus [n (%)]				<0.001
No tear	43 (19.8)	31 (43.7)	12 (8.2)	
Partial tear	123 (56.7)	39 (54.9)	84 (57.5)	
Complete tear	51 (23.5)	1 (1.4)	50 (34.2)	
Infraspinatus [n (%)]				<0.001
No tear	124 (57.1)	69 (97.2)	55 (37.7)	
Partial tear	81 (37.3)	2 (2.8)	79 (54.1)	
Complete tear	12 (5.5)	0 (0)	12 (8.2)	
Subscapular [n (%)]				<0.001
No tear	160 (73.7)	69 (97.2)	91 (62.3)	
Partial tear	48 (22.1)	0 (0)	48 (32.9)	
Complete tear	9 (4.1)	2 (2.8)	7 (4.8)	

ACJ, acromioclavicular joint; CSA, critical shoulder angle.

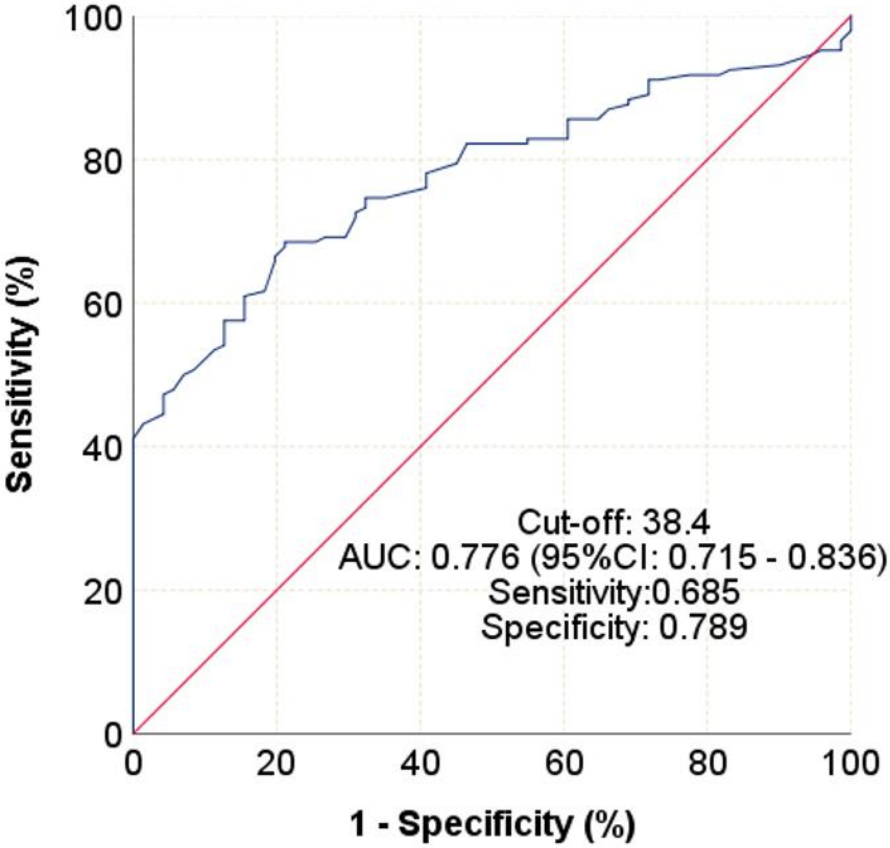

Fig. 2. Receiver operating characteristic (ROC) curve analysis for distinguishing between patients with and without ACJ degeneration with critical shoulder angle. CI, confidence interval; AUC, area under the curve; ACJ, acromioclavicular joint.

Table 2. Multivariable logistic regression analysis for ACJ degeneration.

	Model 1 (Supraspinatus)		Model 2 (Infraspinatus)		Model 3 (Subscapular)	
Variables	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Age	1.035 (1.008, 1.064)	0.012	1.030 (1.000, 1.062)	0.050	1.039 (1.011, 1.069)	0.006
Gender						
Female	reference		reference		reference	
Male	0.692 (0.348, 1.376)	0.294	0.541 (0.255, 1.147)	0.109	0.504 (0.253, 1.005)	0.052
CSA	1.229 (1.069, 1.412)	0.004	1.300 (1.126, 1.501)	<0.001	1.304 (1.143, 1.486)	<0.001
Tear type						
No tear	reference		reference		reference	
Partial tear	2.788 (1.166, 6.667)	0.021	32.231 (6.998, 148.453)	<0.001	NA	NA
Complete tear	31.447 (3.516, 281.289)	0.002	NA	NA	3.535 (0.442, 28.266)	0.234

Results of three different multivariable logistic regression analyses for ACJ degeneration as the dependent variable. In each model, age, gender, CSA and tear type in either one of the three tendons were used as independent variables. The goodness of fit of the models in the logistic regression analysis was confirmed by $p > 0.05$ in the Hosmer–Lemeshow tests. OR, odds ratio; CI, confidence interval; NA, not applicable.

associated with ACJ degeneration (Table 2). Three separate models were used to analyze the impact of supraspinatus, infraspinatus, and subscapularis tendon degeneration. Age was positively associated with degeneration across all models. CSA was a strong predictor in all models, with ORs of 1.229 (95% CI: 1.069, 1.412, $p = 0.004$) for model 1, 1.300 (95% CI: 1.126, 1.501, $p < 0.001$) for model 2, and 1.304 (95% CI: 1.143, 1.486, $p < 0.001$) for model 3, indicating a higher CSA significantly increases the likelihood of ACJ degeneration. Rotator cuff tears type showed varying effects, with complete supraspinatus tears strongly associated (OR = 31.447, 95% CI: 3.516, 281.289, $p = 0.002$)

and partial supraspinatus tears also significant (OR = 2.788, 95% CI: 1.166, 6.667, $p = 0.021$). In model 2, patients with partial tears in infraspinatus had a high association (OR = 32.231, 95% CI: 6.998, 148.453, $p < 0.001$) with joint degeneration. Subscapularis tears were not found to be significantly associated with degeneration.

Discussion

In this study, the relationship between ACJ degeneration, CSA, and rotator cuff tears was investigated. In recent years, there has been an increasing effort to identify radiographic measurements that better predict the pathology and guide clinical decision-making.

A significant and positive linear correlation has been found between acromioclavicular degeneration and age [2]. In our study, consistent with the literature, patients with acromioclavicular joint degeneration were significantly older compared to those without degeneration (Table 1).

In a retrospective study conducted by Scheiderer *et al.* [16], it was found that patients with a Critical Shoulder Angle greater than 38° had a 4-fold increased risk of re-tear. In the study conducted by MacLean and colleagues [17], no statistically significant change in the CSA was observed after acromioplasty. Furthermore, it was reported that there was no significant difference in CSA postoperatively between the groups that underwent acromioplasty and those that did not [17]. In our study, there was no significant difference in CSA among the acromion types ($p = 0.551$; Fig. 1A). We believe this may explain why acromioplasty does not affect CSA values and could potentially account for the increase in retear rates.

The role of skeletal anatomy in the development of rotator cuff tears has been a subject of research for many years and remains a topic of ongoing debate [3,18]. The study demonstrates that the CSA value is significantly higher in the group with ACJ degeneration ($p < 0.001$). Additionally, the ROC analysis indicates that a CSA value of $\geq$38.4 is the optimal cutoff point for ACJ degeneration (Fig. 2). The ROC analysis also reveals that the predictive power of CSA for ACJ degeneration is high ($p < 0.001$).

The increase in CSA leads to higher superior-inferior shear forces that contribute to rotator cuff overuse, while the decrease in CSA results in higher compressive forces that contribute to joint wear [19]. With the increase in CSA, the acromion does not extend laterally but instead assumes a more lateral position relative to the ACJ glenoid [20]. In our study, we believe that the strong independent predictive value of high CSA for ACJ degeneration may explain the mechanism leading to subacromial impingement and degeneration in the more laterally positioned ACJ. Additionally, as the severity of rotator cuff tears in the supraspinatus tendon increases, CSA also significantly increases ($p < 0.001$) (Fig. 1B) (Table 1). This finding emphasizes the importance of superior-inferior shear forces in rotator cuff biomechanics. Given the cross-sectional nature of this study, we cannot infer a causal relationship between critical shoulder angle and ACJ degeneration. Our findings only demonstrate an association between these parameters.

Since 2013, numerous scientific articles have been published on the CSA, and the literature regarding the formation of rotator cuff tears has significantly expanded. However, it remains unclear whether CSA varies in relation to the independent or partial/full thickness tears of the structures forming the rotator cuff muscles, such as the supraspinatus, subscapularis, and infraspinatus. This study is the first to address these issues.

The most widely accepted theory in the development of rotator cuff tears today is tendon degeneration [21]. In 2013, Moor and colleagues [8] developed a radiological parameter known as the CSA, which includes glenoid inclination and acromion index, and suggested that this angle may be associated with rotator cuff tendon tears and glenohumeral cartilage degeneration. The CSA values were significantly higher in patients with RCT compared to the asymptomatic population, and it was observed that these values increased with the severity of rotator cuff involvement [22]. In the literature, the average CSA of patients with full-thickness RCT is reported to be between 37° and 39° [8]. The results of our study, in line with the literature, show a strong correlation between CSA and rotator cuff tears. Additionally, as a contribution to the literature, supraspinatus full-thickness tears were found to have the strongest association with acromioclavicular (AC) degeneration (OR = 31.447, $p = 0.002$). The risk of degeneration was found to increase 32 times in cases of infraspinatus partial tears (OR = 32.231, $p < 0.001$). No significant relationship was found between subscapularis tears and AC degeneration.

In the original study by Moor *et al.* [8], it was shown that the mean CSA was 33° in the healthy shoulder control group, 28° in patients with glenohumeral osteoarthritis (OA), and 38° in the RCT group. In the study by Moor *et al.* [8], the CSA value decreases with glenohumeral OA, whereas in our study, a significant increase in CSA was observed with acromioclavicular OA ($p < 0.001$). Although a statistically significant difference in CSA values was found between the complete subscapularis tear group and the partial tear group ($p = 0.017$), this finding is consistent with the existing literature. Furthermore, multivariable logistic regression analysis revealed that CSA is an independent risk factor for subscapularis tears (OR: 1.304, 95% CI: 1.143, 1.486; $p < 0.001$) (Table 2). This can be explained by the impact of a high CSA on shoulder biomechanics, particularly the increased mechanical load on the rotator cuff tendons.

The ROC curve analysis demonstrated that the CSA is a reliable diagnostic marker for ACJ degeneration, with an AUC of 0.776, indicating good discriminative ability. According to the analysis, a CSA cutoff value of 38.4° provided the best balance between sensitivity (68.5%) and specificity (78.9%). This means that patients with a CSA above this threshold are more likely to exhibit degenerative changes in the ACJ. In clinical practice, this cutoff may serve as a useful reference point in identifying individuals at higher risk for ACJ degeneration, particularly when evaluating radiographic parameters. The combination of moderate sensitivity and high specificity suggests that while some cases may be missed, a CSA $>38.4°$ is strongly suggestive of existing degeneration.

We acknowledge certain specific limitations in our study. First, the relatively small sample size, the retrospective design, age range restriction, the single-center setting in a tertiary healthcare institution, and the fact that all measurements were performed by a single radiologist are factors that limit the generalizability of the findings. Additionally, the CSA assesses only the force balance in the coronal plane, while the force couples in the transverse plane were not considered. This study did not account for potential confounding factors such as occupational exposure, hand dominance, previous shoulder injury, and body mass index (BMI), which may have influenced the development of ACJ degeneration. Therefore, further advanced studies with larger sample sizes and more diverse populations are needed to address these limitations.

Conclusions

Since this study was conducted on a symptomatic population, the predictive utility of CSA for early-stage or asymptomatic shoulder disorders could not be confirmed. Future prospective studies including asymptomatic individuals are needed to validate CSA as a predictive tool. The CSA has been found to have a significant relationship with ACJ degeneration and rotator cuff tears. Particularly, a strong association between CSA and full-thickness tears of the supraspinatus tendon, as well as partial tears in the infraspinatus tendon, has been observed. However, no significant relationship was found between CSA and the subscapularis tendon. The results of our study suggest that CSA may serve as a potential marker in the early diagnosis and prognosis of shoulder disorders. These findings indicate that CSA could play an important role in the management of supraspinatus tears and the assessment of ACJ degeneration.

Availability of Data and Materials

The data used and analyzed during the current study are available from the corresponding author on reasonable request.

Author Contributions

Concept, design, literature review, writing the article: EA; Idea/concept, control/supervision, critical review: TA; Data collection, analysis, writing the article: HG; Data collection, analysis: CO; Formal analysis, statistical analysis, review & editing: OK. All authors contributed to the critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study was approved by the Bolu Abant Izzet Baysal Faculty of Medicine Ethics Committee (date: 4 March 2025, approval number: 2025/55). Informed consent was obtained from all individual participants included in the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

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Conflict of Interest

The authors declare no conflict of interest.

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