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Original Research Article

A Radiological Study on Acromiohumeral Centre Edge Angle (ACEA) and Sourcil Sign in Shoulder Pain Patients

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Abstract

Background: Shoulder pain is one of the common ailments of older people in India. Measuring ACEA and assessing the incidence of the sourcil sign on plain shoulder X-rays can be very useful, time-saving, and cost-effective in patients with shoulder pain.

Aim: The main objective of the study is to determine the incidence of sourcil sign in shoulder pain patients and to measure the ACEA angle in plain X-rays and compare its association with sourcil sign and increased ACEA angle.

Methodology: The study is an analytical investigation conducted among patients with shoulder pain attending SRM Medical College Hospital and Research centre, Irungalur, Trichy. A total of 77 subjects were included in the study. We collected X-rays of the shoulder joint for 6 months, from June to November 2018. Following this, the X-rays were converted to the RADIANT DICOM viewer, and the ACEA angle was measured. The incidence of the sourcil sign was determined, and the correlation with the ACEA angle was statistically analyzed.

Results: The ACEA values ranged from 15.4 to 40.0 degrees, indicating moderate variation in the study population, and 16 participants (20.8%) showed a positive sourcil sign, while 61 participants (79.2%) were negative for the sign. Participants with a positive sourcil sign had a lower mean ACEA (25.57 ± 7.49°) compared to those with a negative sourcil sign (28.73 ± 5.48°). However, this difference was not statistically significant ($p = 0.097$).

Conclusions: In our study, there is an increased prevalence of higher ACEA angle in the general population with shoulder pain. However, ACEA showed only limited predictive performance in detecting the sourcil sign. Diagnosing with this simple radiological tool (plain X-rays) and early treatment have a positive impact on quality of life.

Keywords: Shoulder pain, Acromiohumeral Centre Edge Angle (ACEA), and Sourcil Sign.

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Introduction

Shoulder pain is the third most common musculoskeletal condition. The reported annual incidence of shoulder pain in primary care is 14.7 per 1000 patients per year with a lifetime prevalence of up to 70%. [1,2]

The main cause of shoulder pain is periarthritis, subacromial impingement syndrome and acute rotator cuff injury. [3] Most common causes of shoulder pain in primary care are reported to be rotator cuff disorders, acromioclavicular joint disorder and glenohumeral joint disorders. [4] The diagnosis of these disorders is based primarily upon results of clinical tests.[5-8] Plain radiography is one of the commonest investigations performed initially for the diagnosis of shoulder pain. Adequate diagnosis and management of rotator cuff injuries is crucial to achieve improved patient outcomes. While accurate diagnosis of rotator cuff injuries requires advanced imaging in the form of shoulder magnetic resonance imaging (MRI), plain radiographs remain the first-line investigation in patients suspected of such injuries. [9,10]

A number of radiographic signs have been suggested to be associated with postero–superior cuff tears (supraspinatus and infraspinatus), including an acromial spur, a reduced subacromial

space, sourcil sign, acromial ace tabularization, greater tuberosity irregularity, humeral head sclerosis, humeral head rounding, soft tissue calcification, an osacromiale and a reduced acromio–humeral head distance.[11–23]

Singleton et al. [24] described ACEA in 2017 as the angle created between a line drawn superiorly from the center of the humeral head parallel to the glenoid and a second line from the center of the humeral head to the lateral edge of the acromion on a true anteroposterior (AP) glenohumeral X-ray.

If X-ray signs of shoulder pain like presence of sourcil sign, increased acromioclavicular edge angle, acromial spur, reduced subacromial space can predict rotator cuff injury then treatment of shoulder pain will be made time and cost effective. Sourcil sign and ACEA angle are less explored and sourcil sign is simple radiological sign which can be assessed by family physician. So our aim was to determine the incidence of sourcil sign in shoulder pain patients and to measure the ACEA angle in plain X-rays and compare its association with sourcil sign and increased ACEA angle.

Materials and Methods

The study is an analytical investigation conducted among 77 patients with shoulder pain attending SRM Medical College Hospital and Research centre, Irungalur, Trichy. To conduct this study, we have collected x rays of shoulder joint for a six-month period from june to November 2018. The x-rays were converted to RADIANT DICOM viewer software and Acromiohumeral Centre Edge Angle (ACEA) was measured, presence of sourcil sign was noted.

The study protocol was presented to the institutional ethics committee for approval and was approved. Informed consent was obtained from all participants. The confidentiality of the data collected was strictly ensured by electronic storage.

Study Design: Analytical study

Study Centre: SRM Medical College Hospital and Research centre, Irungalur, Trichy

Selection Criteria

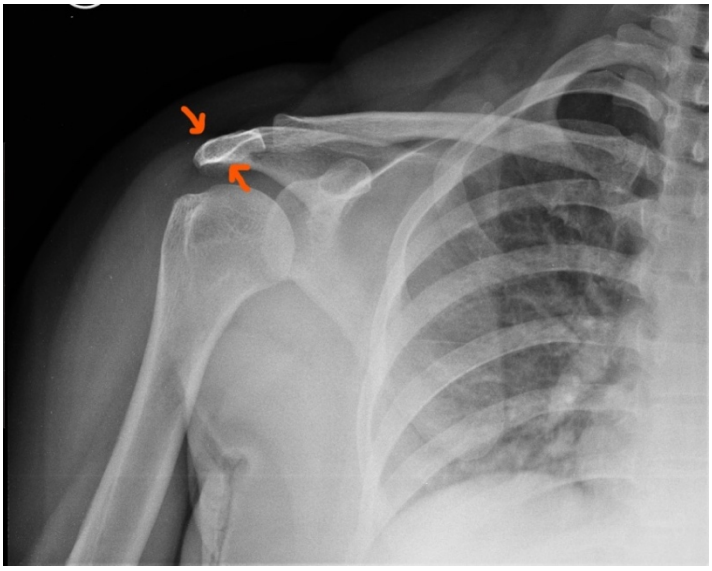
Inclusion Criteria: X-rays of shoulder joint of all shoulder pain patients

Exclusion Criteria: X-rays of patients who have already undergone surgery, fracture and shoulder dislocation were excluded from the study.

Measurement of ACEA: To measure the ACEA (see Figure 1), we superimposed a circle over the humeral head in order to find its centre. This circle followed the contour of the articular surface of the humeral head (ignoring the tuberosities).

One limb of the angle was drawn superiorly from the centre of the humeral head parallel to the glenoid. The second limb was drawn from the centre of the humeral head to the outer (most lateral) edge of the acromion. The angle created between these two lines was measured as the ACEA.

Sourcil sign is defined as an increase in sclerosis on the undersurface of the acromion compared to the superior acromial cortex. The incidence of Sourcil sign was determined and the correlation with ACEA angle was found and statistically co related.



Statistical Analysis: All the data were entered in Microsoft Excel and analyzed using SPSS, version 16. Continuous variables were summarized using descriptive statistics-Mean and standard deviation (SD). Categorical variables were expressed as frequency and percentage. For inferential statistics, independent samples t-test was applied to compare the means of continuous variables between groups.

For categorical variables, associations were tested using the Chi-square test (or Fisher's exact test when expected cell counts were <5). A p value <0.05 was considered statistically significant. To evaluate the predictive accuracy of the ACEA angle for the presence of the sourcil sign, Receiver Operating Characteristic (ROC) curve analysis was performed.

Results

The present study aimed to determine the incidence of the sourcil sign in the general population and to evaluate its association with the acromiohumeral Centre edge angle (ACEA) as measured on plain radiographs.

The analysis also explored the relationship of ACEA with demographic variables such as age and gender and assessed its predictive value for the presence of the sourcil sign using ROC analysis. The findings are summarized below.

Demographic Characteristics: A total of 77 subjects were included in the study. The mean age of the participants was 54.97 ± 11.56 years, with ages ranging from 25 to 80 years. The median age was 54 years, suggesting a relatively symmetric age distribution in the study population.

Of the 77 subjects, 65 (84.4%) were male and 12 (15.6%) were female, indicating a male predominance in the study population. Table 1 shows the demographic profile of the study participants.

Table 1: Demographic profile of the study participants

Variable		Descriptives	
Age (years)	Mean ± SD	54.97 + 11.56	
	Minimum	25	
	Maximum	80	
		Frequency	Percentage
Gender	Male	65	84.4 %
	Female	12	15.6 %

ACEA Measurements: The Acromiohumeral Centre Edge (ACEA) was measured using plain X-rays. The mean ACEA was 28.08 ± 6.78 degrees, with a median of 28.4 degrees. The ACEA values ranged from 15.4 to 40.0 degrees, indicating moderate variation in the cohort. Figure 1 shows the distribution of ACEA among the study participants.

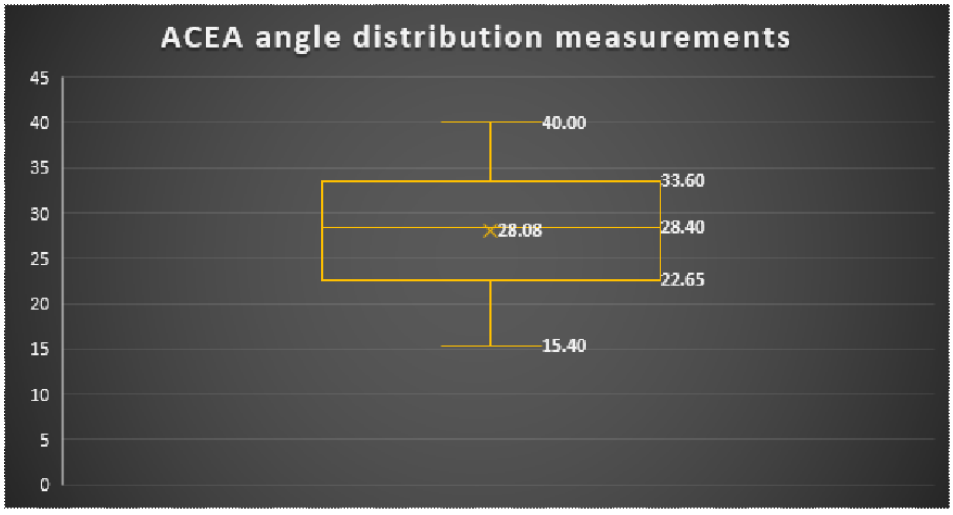


Figure 1: Distribution of ACEA measurements among the study participants

Incidence of sourcil Sign: Out of 77 radiographs evaluated, 16 participants (20.8%) showed a positive sourcil sign, while 61 participants (79.2%) were negative for the sign. Figure 2 shows the incidence of the sourcil sign among the study participants.

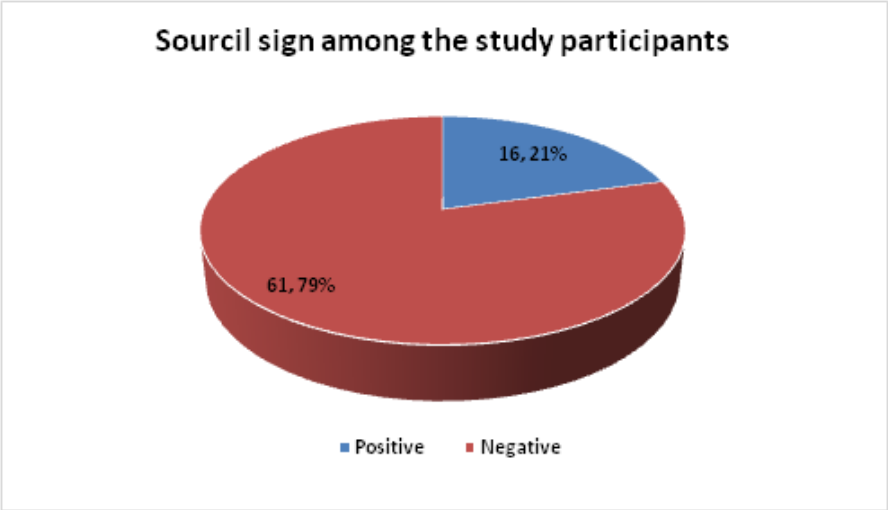


Figure 2: Sourcil sign among the study participants

Association between the sourcil sign and ACEA: Participants with a positive sourcil sign had a lower mean ACEA (25.57 ± 7.49°) compared to those with a negative sourcil sign (28.73 ± 5.48°). However, this difference was not statistically significant (p = 0.097, independent t-test). Figure 3 shows the association between the sourcil sign and ACEA among the study participants.

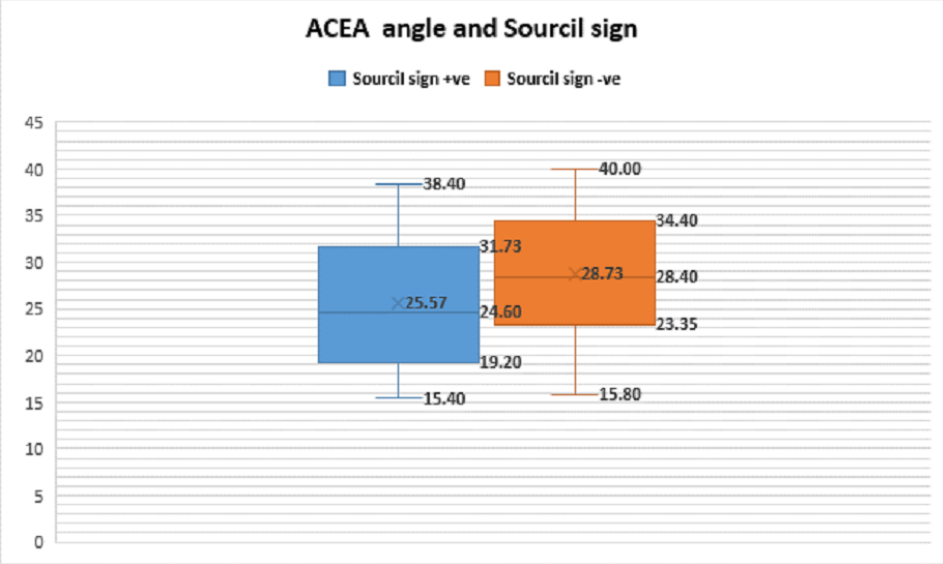


Figure 3: Association between the sourcil sign and ACEA

ROC Curve Analysis: A Receiver Operating Characteristic (ROC) analysis was performed to assess the predictive ability of the ACEA in identifying the presence of the sourcil sign. The area under the curve (AUC) was 0.374 (95% CI: 0.209–0.540), with a p-value of 0.124, suggesting poor discriminatory power. The coordinate points of the curve showed that at a cut-off of 14.4°, both sensitivity and specificity were 100%, but this may reflect overfitting due to the limited sample size and ties.

Across increasing ACEA thresholds, sensitivity declined while specificity increased, without identifying a clearly optimal trade-off point. Figure 4 (ROC curve) further illustrates the limited predictive performance of ACEA in detecting the sourcil sign, with the curve lying close to the diagonal reference line.

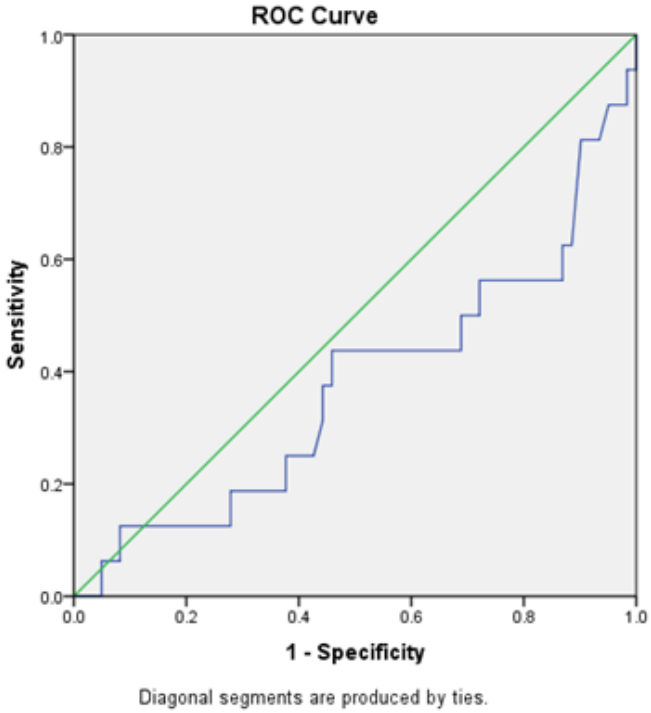


Figure 4: ROC analysis to predict sourcil sign with ACEA

Correlation between Age and ACEA: Pearson correlation analysis revealed a weak negative correlation between age and ACEA (r = –0.10), which was not statistically significant (p = 0.38). This suggests that age had no meaningful association with ACEA in the study population. Table 2 shows the correlation statistics between age and ACEA among the study participants.

Table 2: Correlation between Age and ACEA

Pearson Correlation	Correlation coefficient	p-value	Inference
Age vs ACEA	-0.10	0.38	Statistically not significant - weak negative correlation

Association between Gender and ACEA: The mean ACEA among female participants was 27.29 ± 5.19 degrees, while it was 28.22 ± 7.05 degrees among males. The difference between genders was not statistically significant (p = 0.666; independent sample t-test), indicating that gender did not significantly influence ACEA measurements in this cohort. Table 3 shows the association between gender and ACEA among the study participants.

Table 3: Association between Gender and ACEA

Gender	N	ACEA				p-value by Independent sample t-test
		Mean	Std. Deviation	Minimum	Maximum	
Female	12	27.292	5.1906	19.6	35.6	0.666
Male	65	28.220	7.0543	15.4	40.0	
Total	77	28.075	6.7764	15.4	40.0	

Association between age and sourcil sign: The mean age of participants with a positive sourcil sign was 52.00 ± 9.46 years, while those without the sign had a mean age of 55.75 ± 11.99 years. Although the sourcil-positive group was relatively younger, the difference was not statistically significant (p = 0.250, independent sample t-test). Table 4 shows the association between age and sourcil sign among the study participants.

Table 4: Association between Age and sourcil sign

Sourcil Sign	N	Age in years				p-value by Independent sample t-test
		Mean	Std. Deviation	Minimum	Maximum	
Negative	61	55.754	11.9981	25.0	80.0	0.250
Positive	16	52.000	9.4587	41.0	73.0	
Total	77	54.974	11.5610	25.0	80.0	

Association between gender and positive sourcil sign: Among the sourcil positive subjects (16 out of 77), one female (6.3%) exhibited a positive sourcil sign, whereas 15 males (93.7%) showed a positive sourcil sign. Despite a higher prevalence in males, the association between gender and the presence of the sourcil sign was not statistically significant (p = 0.229, chi-square test). Table 5 shows the association between gender and positivesourcil sign among the study participants.

Table 5: Association between Gender and Positive Sourcil sign

Gender	Sourcil Sign		Total	p-value
	Negative	Positive		
Female	11	1	12	0.229
	18.00%	6.30%	15.60%	
Male	50	15	65	
	82.00%	93.70%	84.40%	
Total	61	16	77	
	100.00%	100.00%	100.00%	

Discussion

Occasionally, the radiograph will demonstrate the so-called 'sourcil' sign or sclerosis on the under surface of the acromion, thought to be caused by pressure from the rotator cuff.[25-27] In our study the incidence of the sourcil sign was present in only 20.8 percent of the subjects with shoulder pain and we had male predominance. The mean age of participants with a positive sourcil sign was 52.00 ± 9.46 years, while those without the sign had a mean age of 55.75 ± 11.99 years, but the difference was not statistically significant and there was a male predominance (84.4%). However, there is no statistically significant gender association with sourcil sign and study population as well. These finding are similar to the findings of the study done by Smith C et al.[14] where they found that Sensitivity, specificity, positive predictive value and negative predictive value were all poor for the radiological signs as predictors of rotator cuff pathology, regardless of age.

The mean ACEA angle found in our study of shoulder pain patients was 28.08+/- 6.08, which is higher than the normal, (15.54+/-4.4) suggesting that there is an increased prevalence of higher ACEA angle in general population with shoulder pain.

This finding is similar to a study by Aiquatani et al [28], where they found that ACEA was increased in rotator cuff tear and there was association between increased ACEA angle and rotator cuff tear.

In our study, participants with a positive sourcil sign had a lower mean ACEA (25.57 ± 7.49°) compared to those with a negative sourcil sign (28.73 ± 5.48°). However, this difference was not statistically significant. (p = 0.097). Also, Receiver Operating Characteristic (ROC) analysis performed to assess the predictive ability of the ACEA in identifying the presence of the sourcil sign suggested poor discriminatory power. Hence, ACEA and sourcil sign didn't have significant association. Though X- ray findings are common in shoulder pain, based on our study, their diagnostic power and prognostic values are limited.

Conclusion

In our study there is increased prevalence of higher ACEA angle in general population with shoulder pain, although it was statistically insignificant. Sourcil sign is not consistently in relation with increased ACEA angle. The sourcil sign is not helpful in the diagnosis of rotator cuff pathology. A limitation in our study is that the ACEA measured on plain radiographs can be affected by patient position` and X- ray beam projection.

Conflict of interest: Nil

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