



## RADIO-ANATOMICAL STUDY OF CRITICAL SHOULDER ANGLE

## Radio-Diagnosis

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## ABSTRACT

Rotator cuff disease and osteoarthritis are two most important causes of shoulder pain. In addition to history and physical examination, diagnostic tests for shoulder pain are X-ray and MRI. As per previous literatures, Critical Shoulder Angle evaluation helps to rule out shoulder pathology. Roughly, Critical Shoulder Angle (CSA) is the angle between the plane of glenoid fossa and a line drawn from its lower end upto lateral edge of acromion. **Aims and Objectives:** To find out correlation between Critical Shoulder Angle and shoulder pathology and to assess clinical and radiological correlation between Critical Shoulder Angle and shoulder pain. **Materials and Methods:** After getting approval from institutional ethical committee, the study was conducted within in KPC Medical College and Hospital. Detailed history was taken from the patients came to the orthopaedic OPD with shoulder pain. The Critical Shoulder Angle was measured from the X-ray of shoulder joint, AP view of these patients. MRI also done for confirmation. **Result:** We studied 100 patients and among them patients below age 50 tend to exhibit rotator cuff tear in X-ray. Whereas, patients above age 50 tend to exhibit osteoarthritis in both x-ray and MRI or CT scan. The chance of developing Osteoarthritis among the female patients is generally higher than the male patients, out of 39 female patients, 25 developed osteoarthritis, whereas, out of 61 male patients, 16 developed osteoarthritis. **Conclusion:** We concluded that MRI performed better in detecting partial-thickness tears. If the patient feels continuous pain, that implies the patient could have been developed osteoarthritis.

## KEYWORDS

Critical Shoulder Angle, Rotator Cuff Tear, Shoulder Osteoarthritis

## INTRODUCTION

The shoulder joint is classified as a ball and socket joint; however, the joint sacrifices stability for mobility. The rotator cuff consists of four muscles originating on the scapula and inserting on the superior humeral head to improve stability. The subscapularis inserts on the lesser tubercle of the humerus, and it functions as an internal rotator. The supraspinatus muscles insert onto the greater tubercle of the humerus with its function as an abductor for the initial 30 degrees of abduction. The infraspinatus also inserts onto the greater tubercle, but a little inferior to the supraspinatus, and it functions as an external rotator. The teres minor inserts inferior to the infraspinatus on the greater tuberosity, and it functions as an external rotator as well. Additionally, they all work as stabilizers of the glenohumeral joint.

Critical shoulder angle (CSA) is the angle between the plane of glenoid fossa and imaginary line connecting lateral border of acromial process in X-ray shoulder joint, AP view (normal range 30-35 degree).<sup>1</sup> Increased CSA is associated with rotator cuff tear and decreased CSA is associated with osteoarthritis.<sup>2</sup> Patients with complaints of pain during over head abduction of shoulder joint, needs clinical correlation with CSA to prevent progression of shoulder pathology.

Partial tears are at risk for further propagation. These risk factors include: tear size, symptoms, location, and age. Tear size: A small tear may remain dormant, while larger tears are more likely to undergo structural deterioration. The critical size for sending a small tear towards a larger or complete tear has yet to be defined. Tear propagation correlates with symptom development. Actively enlarging tears have a five times higher likelihood of developing symptoms than those tears that remain the same size. The location of the tear also influences progression. Anterior tears are more likely to progress to cuff degeneration. Finally, age is a risk factor. Patients over age 60 are more likely to develop tears that progress. Younger patients with full-thickness tears appear more capable of adapting to stress and tear propagation than those 60 years of age and older.<sup>3</sup>

## AIMS AND OBJECTIVES

1. To find out correlation between Critical Shoulder Angle and shoulder pathology.
2. To assess clinical and radiological correlation between Critical Shoulder Angle and shoulder pain.

## MATERIALS AND METHODS

After getting approval from institutional ethical committee, the study was conducted within 1 year (1<sup>st</sup> June 2021- 31<sup>st</sup> May 2022) in KPC Medical College and Hospital. Detailed history was taken from the patients came to the orthopaedic OPD with shoulder pain. The Critical Shoulder Angle was measured from the X-ray of shoulder joint, AP view of these patients. MRI also done for confirmation. At the end of the study, all data were compiled and tabulated, analysis was done by using statistical analysis and graphical representation was done.

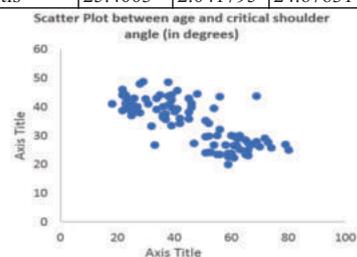
## RESULT

**Table 1: Critical shoulder angle based on X-Ray:**

Impression by X-Ray	Sample mean	Sample standard deviation	95% Confidence Interval	
			Lower level	Upper level
Rotator Cuff Tear	40.79241	3.368037	39.87311	41.7117
Normal	33.41	0.842793	32.36353	34.45647
Osteoarthritis	26.24171	2.518176	25.44687	27.03654

**Table2: Critical shoulder angle based on MRI:**

MRI or CT Scan	Sample mean	Sample standard deviation	95% Confidence Interval	
			Lower level	Upper level
Infraspinatus tear	41.90583	3.250031	39.84086	43.9708
Subscapularis tear	42.16667	2.145538	38.7526	45.5807
Supraspinatus and infraspinatus tear	43.31	6.319209	33.25473	53.36527
Supraspinatus tear	40.14577	2.721348	39.04659	41.24495
Teres minor tear	42.196	2.649723	38.90593	45.48607
Normal	32.3623	2.806483	30.91939	33.8053
Osteoarthritis	25.4003	2.041795	24.67631	26.12429



## Diagram

The diagram shows that correlation coefficient between Age and critical shoulder angle is -0.751. That is, there is highly negative linear relationship between age and critical shoulder angle.

**Table 3: Average critical shoulder angle (in degrees) of different age groups:**

Age Group	Average Critical Shoulder Angle (Degrees)
<20	41.01
20-29	41.4452381
30-39	39.14428571
40-49	38.5575
50-59	28.47
60-69	27.45809524
70-79	27.138
>80	24.9

Table no 3 shows that-

1. Patients below age 50 tend to detect rotator cuff tear in X-ray. Whereas, patients above age 50 tend to detect osteoarthritis in both x-ray and MRI or CT scan.
2. The chance of developing Osteoarthritis among the female patients is generally higher than the male patients, out of 39 female patients, 25 developed osteoarthritis, whereas, out of 61 male patients, 16 developed osteoarthritis.

**Table 4: Joint frequency distribution of clinical presentation and X-Ray:**

		Impression by X-Ray		
		Rotator cuff tear	Normal	Osteoarthritis
Clinical Presentation	Continuous pain			16
	Pain on movement	54	5	25

Table 4 interpretes that if the patient feels continuous pain, that implies the patient could have been developed osteoarthritis.



Figure 1 showing CSA >30°

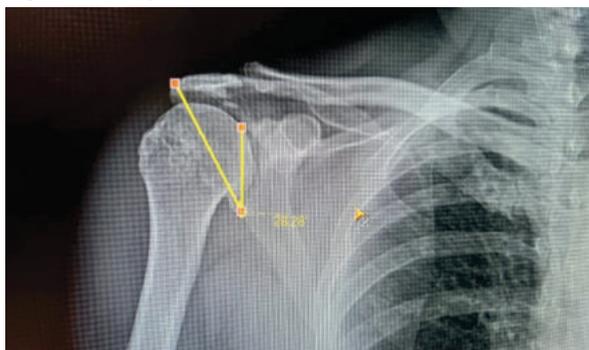


Figure 2 showing CSA < 30°

**DISCUSSION**

In our study, we found that patients below 50 years of age more prone to rotator cuff tear found in X-ray. Whereas, patients above 50 years tend to develop osteoarthritis found in both x-ray and MRI or CT scan. **Vlychou M et al (2009)** showed that both ultrasound and mri imaging modalities detected successfully 44 cases of partial tears of the supraspinatus tendon. US imaging yielded a sensitivity of 95.6%, a specificity of 70%, an accuracy of 91%, and a positive predictive accuracy of 93.6%. The corresponding values for MRI were 97.7%, 63.6%, 91%, and 91.7%, respectively. **De Jesus JO et al (2009)** found that MRI, and ultrasound for all tears show the area under the ROC

curve is greatest for MR arthrography (0.935), followed by ultrasound (0.889) and then MRI (0.878); however, pairwise comparisons of these curves show no significant differences between MRI and ultrasound (p > 0.05).MR arthrography is the most sensitive and specific technique for diagnosing both full- and partial-thickness rotator cuff tears. Ultrasound and MRI are comparable in both sensitivity and specificity. **Thakker VD et al (2017)** found that Supraspinatus was the most commonly affected tendon (79%). Partial thickness tears were the most common rotator cuff pathology.

**Teefey SA et al (2005)** showed that seventeen measurement errors occurred with full-thickness tears, 15 of those in patients with large or massive tears. Bursal thickening (n = 4), non-visualization of the torn tendon end (n = 2), non-retracted tear (n = 2), and complex tear (n = 1) contributed to the errors. Eight measurement errors occurred with partial-thickness tears. Difficulty distinguishing tendinopathy from partial-thickness tears (n = 3) and complex tears (n = 3) accounted for six errors. **Aggrawal J et al (2014)** found that full-thickness tear was confirmed in 42 cases, partial-thickness tear in 52 cases.

**Arnar O Bjarnison (9)** found in their study that osteoarthritis results in a CSA below 30°. **Ulrich J Spiegl (10)** measured CSA from radiographs demonstrated excellent interobserver agreement with less variability than CSAs from MRI, especially osteoarthritis patients. **Mathew T Mantell (11)** found in his study that concurrent glenohumeral osteoarthritis and full-thickness RCT are associated with greater CSA values compared with patient with glenohumeral osteoarthritis alone.

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