MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.10.290.293

Evaluation of Radio Morphometric Parameters of Shoulder Joint in Indian Population with Degenerative Rotator Cuff Tears

[1]Aditya, [2]Ashish Devgan and [3]Raj Singh

[1-3]*Department of Orthopaedics, Pt. BD Sharma PGIMS Rohtak, Haryana, India*

ABSTRACT

The aim of this present study was to investigate the relationship between Radiomorphometric parameters of shoulder joints and Degenerative Rotator Cuff tears (DRCT). The magnetic resonance imaging (MRI) parameters used to diagnose rotator cuff tears are weakly correlated to Radiomorphometric parameters of shoulder joint. Our hypothesis was that adding morphologic parameters resulting from biplanar radiographs to the MRI parameters would improve this correlation. Over the past two years, we obtained X-rays and MRI scans from 100 individuals (50 with DRCT as cases and 50 with Shoulder joint pathologies other than DRCT as controls) with DRCT and other shoulder joint pathologies. Radio morphometric Parameters used in this study were measured on plain AP X rays of shoulder joint and analyzed in 3 groups., Humeral Head Parameters, Glenoid Parameters and Combined Parameters. First, the trueness and reliability of these parameters were evaluated. Then, bivariate correlations between each parameter and the MRI Findings were made. We also considered factors like Dominance, Dexterity, Gender, Age group, Co morbidities, Site of tear (whether the tear was articular, bursal or intrasubstance), Specific rotator cuff tendon involved, Clinical Scoring of disability into consideration before reaching the conclusion. Humeral Head Parameters included Greater Tuberosity Angle (GTA), Greater Tuberosity Radius (GTR) and Humeral Head Radius (HHR). Glenoid Parameter was Critical Shoulder Angle (CSA). Combined Parameters were GTA + CSA, GTR: HHR and Acromial Index (AI). Mean GTA of case group was calculated as 81.2 SD 4.58, that was found to be larger than Mean GTA of control group that was 74.6 SD 2.87 (p-value 0.0001). Mean GTR of case group was calculated as 3cm SD 0.27 was smaller than mean GTR of control group that was 3.14 cm SD 0.225 (p-value 0.007). Mean value of HHR in cases was 2.14 cm SD 0.217 that was smaller than mean value of hhr in controls that came out to be 2.82 cm SD 0.236 (p value 0.0001). Mean CSA of Case group was found to be 40.104 SD 4.839, that was larger than mean value of control group CSA that was 32.758 SD 2.108 (p value 0.0001). Mean GTA+CSA of case group was 121.31 SD 4.73 was significantly larger than Mean GTA + CSA of control group that came out to be 107.36 SD 1.77 (p value 0.0001). Mean GTR: HHR RATIO OF Case group was also greater i.e. 1.39 SD 0.09 as compared to GTR: HHR of control group that was 1.11 SD 0.04 (p value 0.0001). Mean Acromial index of case group was 0.77 SD 0.06 which was greater than AI of control group that was 0.64 SD 0.03 (p value 0.0001). For patients with rotator cuff tears, the combination of MRI and Radiomorphometric parameters of the shoulder the findings suggest that radiomorphometric parameters could serve as valuable radiological markers for degenerative rotator cuff tears, aiding in clinical assessment and treatment planning. Additionally the patients who have radiological findings similar to case group can be advised lifestyle modifications and comorbidity management to reduce the risk of DRCT occurrence in the near future.

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Key Words

Radiomorphometric parameters, degenerative rotator cuff tears, shoulder joint pathologies, magnetic resonance imaging (MRI)

Corresponding Author

Aditya,
Department of Orthopaedics, Pt. BD Sharma PGIMS Rohtak, Haryana, India

Author Designation

[1]Junior Resident
[2]Sr. Prof and Head Unit 2
[3]Professor

Received: 30 July 2024
Accepted: 11 September 2024
Published: 19 September 2024

Citation: Aditya, Ashish Devgan and Raj Singh, 2024. Evaluation of Radio Morphometric Parameters of Shoulder Joint in Indian Population with Degenerative Rotator Cuff Tears. Res. J. Med. Sci., 18: 290-293, doi: 10.36478/makrjms.2024.10.290.293

INTRODUCTION

Rotator cuff tear (RCT) is the most common disorder of the shoulder nowadays and is characterized by shoulder pain and a limitation of shoulder activity. The clinical symptoms usually manifest as effort-related shoulder pain, pain at night and weakness. The mechanisms contributing to RCT are mainly classified into two aspects. the intrinsic factors and the extrinsic factors[1]. The intrinsic factors include tensile overload, Aging, Microvascular supply, associated comorbidity if any and Injuries resulting in degeneration of the tendon.

The extrinsic factors include anatomic variables which would narrow the subacromial space and increase pressure on tendons by impingement mainly from the acromion and the greater tuberosity of the humerus such as, Acromial morphologic characteristics, Glenoid morphology and Humeral head parameters. There is still debate on which mechanism is primary or secondary, but in some patients, it seems to be an interaction between them[2].

Several radiographic markers have been associated with rotator cuff tears, most centered around acromion morphology. The Critical Shoulder Angle (CSA) was described in 2013 by Moor[3] The Greater Tuberosity Angle (GTA) was described in 2018 by Cunningham[4] Ma *et al.,* did a study in 2022 in which they focused on the morphological characteristics of the greater tuberosity of the humerus and proposed the double-circle radius ratio as a new predictor for the diagnosis of rotator cuff tears[5]. Zaid *et al.,* (2021) did a systematic review to investigate on influences of scapular morphology on the development of re-tears and patient-reported outcomes following rotator cuff repair. Two of three papers reported no relationship between these acromion index and rotator cuff re-tear rate, while one paper found an increased re-tear rate[6]. In previous studies, various authors did not analyze the combined predictive effectiveness of radiomorphometric parameters of the shoulder. Hence due to paucity of literature on the radiomorphometric parameters of shoulder joint (Humerus and Scapula) in degenerative rotator cuff tears among Indian population we conducted this study.

MATERIALS AND METHODS

Data Bank: Patients enrolled from our centre as per the inclusion criteria were examined and findings were noted. 50 patients with degenerative rotator cuff tears diagnosed on clinical examination and confirmed with MRI were taken up in this study as cases and 50 patients with diagnosis other than degenerative rotator cuff tears requiring radiological investigation of shoulder joint like STI, bursitis and impingements etc. were taken as controls.

X Ray Evaluation: X-rays were done in plain AP view and 25o external rotation (ER) AP view and all the radiographs were assessed as per following parameters.

Critical Shoulder Angle (CSA) and Greater Tuberosity Angle (GTA): The CSA was measured from true anterior-posterior radiographs using the method described by Moor[3] The angles between a line connecting the superior and inferior osseous mar-gins of the glenoid cavity and a line connecting the inferior osseous margins of theglenoid cavity and the inferolateral border of the acromion were measured as the critical shoulder angle[3].

The GTA was measured from true anterior-posterior radiographs, using the method described by Cunningham[4]. The angles between a line that parallel line to the diaphyseal axis passing though the humeral head center of rotation and a line connecting the upper border of the humeral head to the most superolateral edge of the greater tuberosity were measured as the greater tuberosity angle[4].

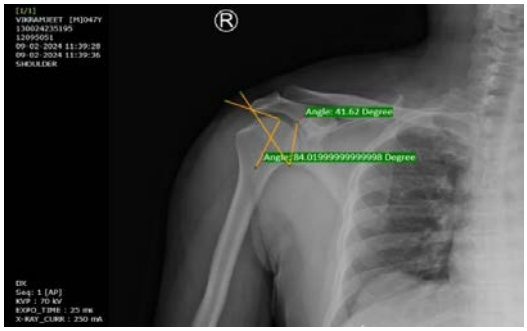

Fig. 1: Measurement of GTA and CSA

Greater Tuberosity Radius (GTR) and Humeral Head Radius (HHR): The double-circle system in anteroposterior view. The inside circle was the best-fit circle of the humeral head and the center was set. The outside circle was a concentric circle with the same point as the center and passed through the most lateral edge of the greater tuberosity. The radius of the inside circle was defined as the humeral head radius (HHR) and that of the outside circle was defined as the greater tuberosity radius (GTR)[5].

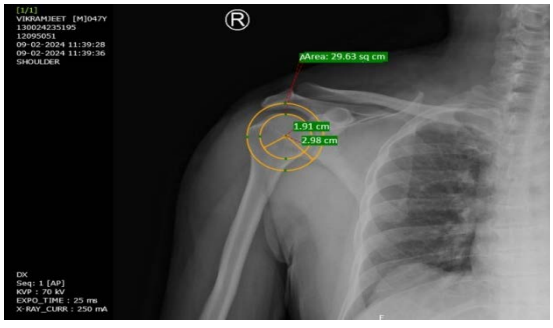

Fig. 2: Measurement of GTR and HHR

Ratio of GTR and HHR:

Acromial Index: Anteroposterior shoulder radiograph showing the calculation of the acromial index (AI). The acromial index equals the distance from the glenoid plane to the lateral border of the acromion divided by the distance from the glenoid plane to the lateral aspect of the humeral head[6].

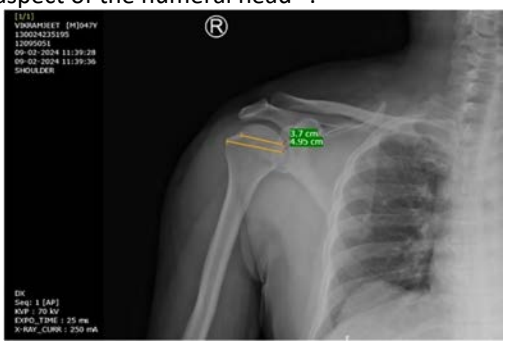

Fig. 3: Acromial Index

Measurement of AI: The X-rays were processed on DICOM software available in the institute and an Orthopaedic clinician who was blinded to the study measured the parameters. The data collected was analyzed.

Statistical testing was conducted with the statistical package for the social science system version SPSS 24.0. Continuous variables were presented as mean±SD or median (IQR) for non-normally distributed data. Categorical variables were expressed as frequencies and percentages. The Pearson's chi-square test or Fisher's exact test was used to determine the relationship between two categorical variables. For all statistical tests, a p value 0.05 was taken to indicate a significant difference.

Inclusion Criteria:

- Patients with symptomatic degenerative rotator cuff tears with 45 years of age with any one clinical signs (Jobe's test, Drop Arm Sign and External Rotation Lag Sign) positive and confirmed with MRI.
- Patients of shoulder conditions other than DRCT requiring radiological investigations (Control group).

Exclusion Criteria:

- Traumatic rotator cuff tears.
- Patients with congenital deformity leading to rotator cuff tears.
- Post op rotator cuff tears.
- Post traumatic rotator cuff arthropathy.

Rotator cuff tears are a common cause of shoulder pain and disability, particularly in the aging population. Understanding the radiomorphometric parameters associated with degenerative rotator cuff tears is crucial for accurate diagnosis and effective management. This study aimed to assess various radiomorphometric parameters and their relationship with clinical and MRI findings in patients with degenerative rotator cuff tears.

In the present study, the mean age in the Case group was 54.1 years (SD 11.5020), while in the Control group, it was 55.32 years (SD 11.0978), with no significant difference between the groups (p=0.591). Similarly, no significant difference was observed in the distribution of participants across age groups (≤60 years and >60 years) between the Case and Control groups (p=0.300). Regarding gender, the Case group had 58.0% females and 42.0% males, while the Control group had 44.0% females and 56.0% males, with no statistically significant difference in the distribution of gender between the two groups (p=0.896).

RESULTS AND DISCUSSIONS

Radiomorphometric Analysis:

Humeral Head: The table compares the x-ray findings between two groups. In the present study, a statistically significant less GTR, HHR and more GTA was found among the cases compare to control.

Table 1: Comparison of x-ray Findings of Humeral Head Between Both Groups

	Case		Control		
Findings	Mean	SD	Mean	SD	p-value
GTA	81.2018	4.58759	74.6100	2.87923	0.0001
GTR	3.00	0.277	3.140	0.225	0.007
HHR	2.1460	.21776	2.8276	.23646	0.0001

Glenoid Parameters: The table compares the x-ray findings between two groups. In the present study, a statistically significant more CSA was found among the cases compare to control.

Table 2: Comparison of x-ray Parameters of Glenoid Between Both Groups

	Case		Control		
Findings	Mean	SD	Mean	SD	p-value
CSA	40.1042	4.83965	32.7588	2.10839	0.0001

Combined Parameters of Humeral Head and Glenoid: The table compares the x-ray findings between two groups. In the present study, a statistically significant more GTA+CSA, GTR: HHR and Acromial Index were found among the cases compare to control.

Table 3: Comparison of Combined x ray Parameters Between Both Groups

	Case		Control		
Findings	Mean	SD	Mean	SD	p-value
GTA+CSA	121.3104	4.73166	107.3688	1.77803	0.0001
GTR: HHR	1.3982	.09231	1.1100	.04789	0.0001
Acromial Index	.7714	.06922	.6480	.03207	0.0001

CONCLUSION

Humeral Head Parameters:

- In the present study, a statistically significant less GTR, HHR and more GTA was found among the cases as compared to controls. (p = 0.0001 for all).

Glenoid Parameter:

- The mean Critical Shoulder Angle (CSA) was significantly higher in the Case group compared to the Control group (p=0.0001).

Combined Parameters:

- In the present study, a statistically significant more GTA+CSA, GTR: HHR and Acromial Ind. ex were found among the cases as compared to controls (p=0.0001).

In patients with degenerative rotator cuff tears, significant differences were observed in radiomorphometric parameters of the shoulder joint compared to controls with other shoulder pathologies. These alterations included differences in humeral head and glenoid parameters, as well as combined parameters. The findings suggest that radiomorphometric parameters could serve as valuable radiological markers for degenerative rotator cuff tears, aiding in clinical assessment and treatment planning. Additionally the patients who have radiological findings similar to case group can be advised lifestyle modifications and comorbidity management to reduce the risk of DRCT occurrence in the near future.

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