"CORRELATION BETWEEN DIAGNOSTIC ANATOMIC SHOULDER PARAMETERS AND DEGENERATIVE ROTATOR CUFF TEARS USING MRI SCANS": A HOSPITAL BASED 1 YEAR CROSS SECTIONAL STUDY

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Sub: Institutional Ethical Clearance for the study.

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LISTOFABBREVIATIONS

GLOSSARY	ABBREVIATIONS
RCT	ROTATOR CUFF TEARS
MRI	MAGNETICRESONANCEIMAGAING
CSA	CRITICAL SHOULDER ANGLE
LAA	LATERAL ACROMIAL ANGLE
SGI	SUPERIOR GLENOID INCLINATION
AI	ACROMIAL INDEX
AHD	ACROMIAL HUMERAL DISTANCE

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ABSTRACT

Background: Shoulder pain is frequently caused by tears in the rotator cuff. Scapular morphology is one of the extrinsic factors that affect RCT. This study's goal was to use MRI scans to assess the link between diagnostic shoulder characteristics with partial and full-thickness RCT and the RCT's size.

Objectives: To determine relationship between anatomic shoulder parameters and rotator cuff tear including tear size using MRI scans.

Materials and methods: In this cross-sectional study, 72 patients who had undergone MRI were evaluated and split into two groups: partial thickness RCT and full thickness RCT. Radiographs were used to assess shoulder characteristics such as CSA, LAA, AI, SGI, and AHD.

Results: The average CSA for partial and full thickness tears was 35.08° and 38.48°, respectively; that for LAA was 70.54° and 68.84°, respectively; that for AHD was 7.70° and 6.44°, respectively; that for SGI was 11.19° and 14.90°, respectively; and that for AI, it was 0.74° and 0.70°, respectively. The Shapiro-Wilk test was used to determine the normality of five variables in both groups. The p-value for the whole tear thickness group indicated a significant rise in all five parameters, while only two parameters (CSA and AHD) showed a significant improvement in the partial tear thickness group.

Conclusion: According to the study's findings, the best indicator of the presence of RCTs is the five shoulder characteristics as determined by MRI. MRI examination may be beneficial for patients with RCT-related tears, whether they are full or partial.

Keywords: CSA, AHD, AI, LAA, SGI, Degenerative RCT.

INTRODUCTION

Shoulder pain and dysfunction are linked to rotator cuff tears. Numerous publications exist on the frequency of rotator cuff tears found during cadaver dissections; nonetheless, the range of reports' findings is 5 to 39%. The varying subject populations could be the cause of this.

Although rotator cuff tears are considered to occasionally develop from acute injuries, the majority are caused by age-related degenerative changes. The pathophysiology of rotator cuff tears has been linked to a number of etiology, including intrinsic factors like poor vascularity, changes in material properties, matrix composition, and aging, as well as extrinsic factors like subacromial and internal impingement, tensile overload, and repetitive stress.The current study statistically determined that age, the dominant arm, and a history of trauma were the risk factors linked to rotator cuff tears in the general population. Rotator cuff tears were more closely linked to the dominant arm and a history of trauma in the participants who were younger than 49. These findings suggested that both intrinsic and extrinsic factors together impacted the incidence of rotator cuff tears; however, the tears in the younger individuals showed a stronger correlation with extrinsic factors.(1) The literature that is currently available on RCTs describes a wide range of radiographic measurement techniques. The critical shoulder angle (CSA) is a parameter that is frequently used in shoulder surgery. According to a study, investigations on the connection between shoulder disorders and lateral extension of the acromion, a CSA of greater than 35 indicates a higher chance of RCT, while a CSA of less than 30 indicates a higher risk of glenohumeral arthritis. Another crucial factor for identifying RCTs is the acromial index (AI), which was developed by an author and assigns a value to the acromial extension.(2)

Subacromial illnesses have been linked to increased lateral acromial angles (LAAs) on coronal oblique magnetic resonance imaging (MRI). RCT, however, causes the acromio-humeral distance (AHD) to diminish following the humerus' superior migration. Superior glenoid inclination (SGI), which can be determined via MRI, is one of the most current and modern measures advised for the detection of RCTs. Compared to shoulder radiography and tomography, magnetic resonance imaging (MRI) gives shoulder surgeons more precise information on fatty infiltration, retraction, size of RCT, and soft tissue patterns. For this reason, MRI has surpassed direct radiography in reliability when used for preoperative planning in rotator cuff repair. There are now new MRI examination parameters available for RCT diagnosis.

According to study results, the most accurate method for predicting the presence of RCTs is CSA using MRI scanning. For the purpose of differentiating between partial-thickness, full-thickness, and large RCTs, CSA, AI, LAA, and SGI was diagnostically valuable. [2] Few studies have assessed the shoulder parameters in the diagnosis of shoulder pathologies, particularly partial or full thickness tears caused by degenerative rotator cuff degeneration. Shoulder radiography and tomography were used to measure the shoulder parameters, and critical shoulder was frequently used as a diagnostic tool.

In light of the fact that degenerative rotator cuff tears can involve both partial and full thickness rips, the present study focuses on assessing five shoulder characteristics.

AIMS AND OBJECTIVES

To determine relationship between anatomic shoulder parameters and rotator cuff tear including tear size.

To determine relationship between anatomic shoulder parameters and rotator cuff tear including tear size using MRI scans

ANATOMY

The term ‘shoulder joint’is commonly used in reference to the gleno-humeral joint,
howeverconsideringsurgicalanatomyandthefunctionsoftheshoulder,itisobvious that the shoulder girdle-is a complex of five functional articulations.

The highly developed functions of the hand require it to be placed almost virtually in any plane. Movements along this complex system of articulations produce a rhythmic and co-ordinated movements of the arm, forearm and hand. As humans evolved there is a trade for extraordinary range of movements at the cost of instability unlike the hip joint.

The shoulder girdles are formed by the clavicle, scapula, and humerus.

Humerus

The name Humerus is derived from a latin word called ‘umerus’ which means upper arm. Proximally it forms the gleno-humeral joint by articulating with the scaphoid. This ball and socket joint is lined by a synovial membrane. This allows a dynamic range of movements along multiple axes.

Such movements arepossible primarily due to the rotator cuff muscle with the assistance of pectoralis major, deltoid, serratus anterior and other muscles. A total of 6 bursae surrounds the shoulder joint.(3)

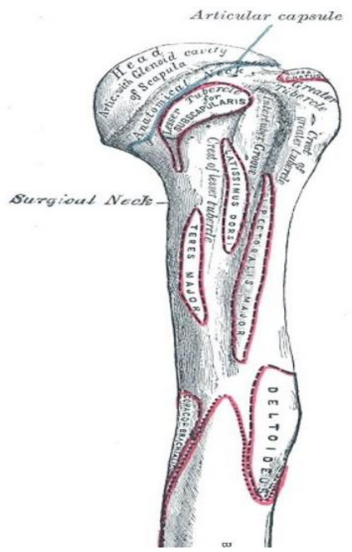


Figure1: Proximal Humerus anatomy with Muscle attachments.

Scapula

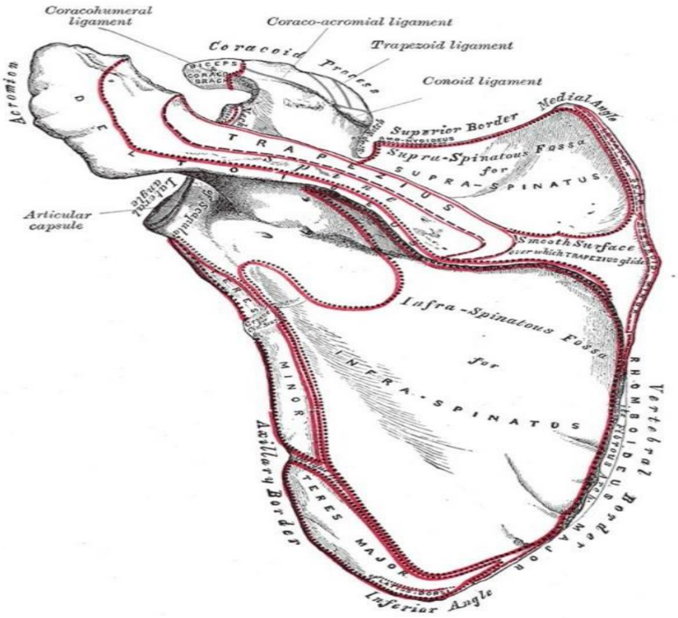


Figure2: Scapula with Muscle attachments.

Scapula

Also known as the shoulder blade. It is a flat robust bone, positioned back of the thoracic wall. Scapula articulates with humerus and clavicle (acromio-clavicular joint). Due to multiple attachments to scapula (in total 17 muscles attach to scapula) it is uncommon to fracture.[3]

Clavicle

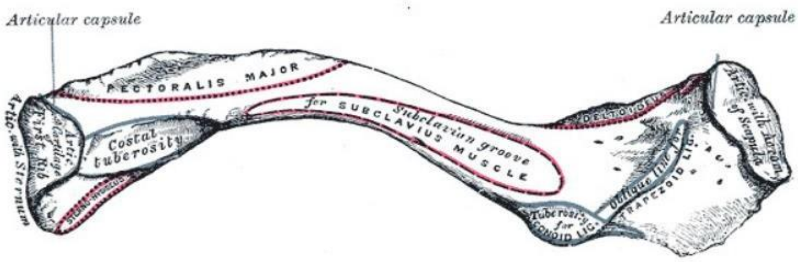


Figure3: Anteriorsurfaceofclavicle.

All long bones ossify through cartilaginous ossification, but the clavicle is the only horizontal long bone that is palpable along its entire length and has a distinct embryology where it goes through membranous ossification. The only bony attachment that tethers the upper limb to the trunk. Clavicular attachments protect neurovascular structures posteriorly (subclavian vessels and the brachial plexus) and provide important function and range of motion for the upper extremities, despite smaller size when compared to other supporting structures in the body. It is also involved in the transferring of forces from the upper limb to trunk. The intricate mechanism that permits the scapula to glide along the posterior wall of the thoracic cage is made possible by the clavicle. This process is essential for the entire range of motion of the upper extremities.[4]

The shoulder joint is a complex of five functional articulations, movements at these complex articulations allow the hand to be placed in the most optimum position for the desired activities. The following are the joints around the shoulder-

1)**<u>The Gleno-Humeral Joint</u>**:

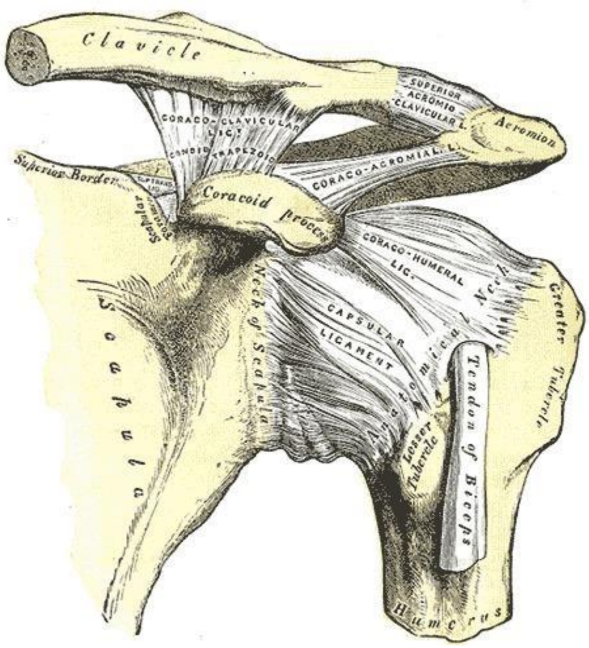


Figure4: Shoulder joint with capsule and ligaments.

It is a ball and socket type of joint formed by the head of humerus which forms the ball and glenoid cavity which forms the socket of the shoulder joint. It is surrounded by a protective synovial lining. The dimensions of the Glenoid Cavity and the Humeral Head and, forms the articulation, but are not proportionate, as the fossa accommodates less than 1/3rd of the Head of Humerus, and Fibro- Cartilaginous ring like structure called the Labrum compensates this disproportionality at the expense of joint stability but increased ranges of motion. This joint has a generous range of motion.

2)**<u>The Sternoclavicular joint</u>**:

Figure5: Sterno-clavicularjoint.

The joint has a saddle-like shape. The synovium lines the sternoclavicular (SC) joint. serves as a skeletal link between both the skeleton systems - the Appendicular and the Axial Skeleton. The manubrium of the sternum forms a joint with the clavicle.

3)**<u>The Acromio-clavicular joint</u>**:

Figure6: Acromio-clavicularjoint.

It is a plane freely mobile synovial joint. It is the uniting structure between the clavicle and acromial process.

4)**<u>The scapulo-thoracic joint</u>**:

It is a fictitious joint but it is a sliding junction between the deeper aspect of the rib cage and scapula. Movements along this plane is controlled and stabilized through variety of muscles allowing for the required positioning of the glenoid joint to assist in the functions of shoulder. Astheshoulderjointattheexpenseofjointstabilityhasatremendousrangeof motion. It is susceptible to injury. To prevent this Glenohumeral instability is dependentonseveral anatomicalandbiomechanicalfactors:

<u>StaticRestraints-</u>

- NegativeIntra-Articularpressure
- Fibrouscapsule
- GlenoidLabrum
- Articular versionandcongruity
- Glenohumeralligaments

<u>DynamicRestraints-</u>

- Rotator-Cuffmuscles
- Biceps-Long head

- Periscapularmuscles

Glenoid-labrum:

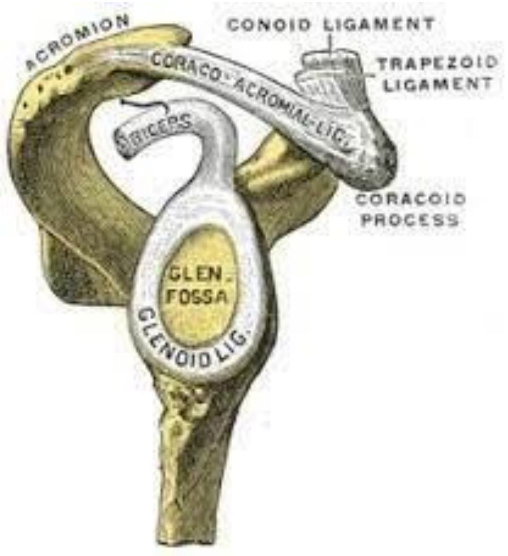


Figure7: GlenoidLabarum

The scapula's glenoid hollow is surrounded by a thick triangular fibro -cartilaginous border called the Glenoid Labrum. It varies in thickness and dimension. Superiorly, it combines with the bicep tendon. In addition to protecting the bone, it builds the joint cavity, giving the articulation of the humerus a deeper socket and increasing its stability.

Fibrous-capsule:

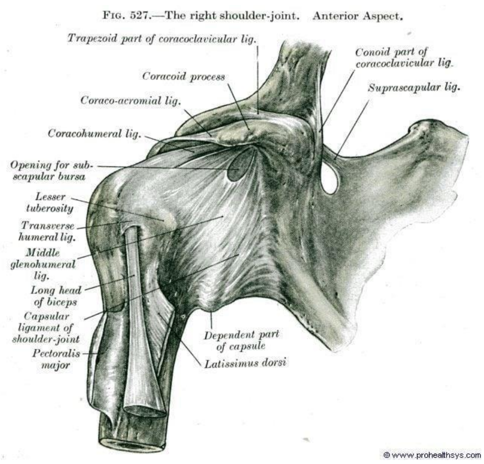


Figure8: FibrousCapsule

The gleno-humeral joint is encompassed by a fibrous sheath. Bound medially to the glenoid and blends superiorly to the tendon of LHB, and it joins laterally to the humeral neck. The biceps-brachi and rotator cuff muscles link to the capsule. The rotator interval is an exposed capsule region that forms a triangle.

Ligaments:

- The glenohumeral ligament

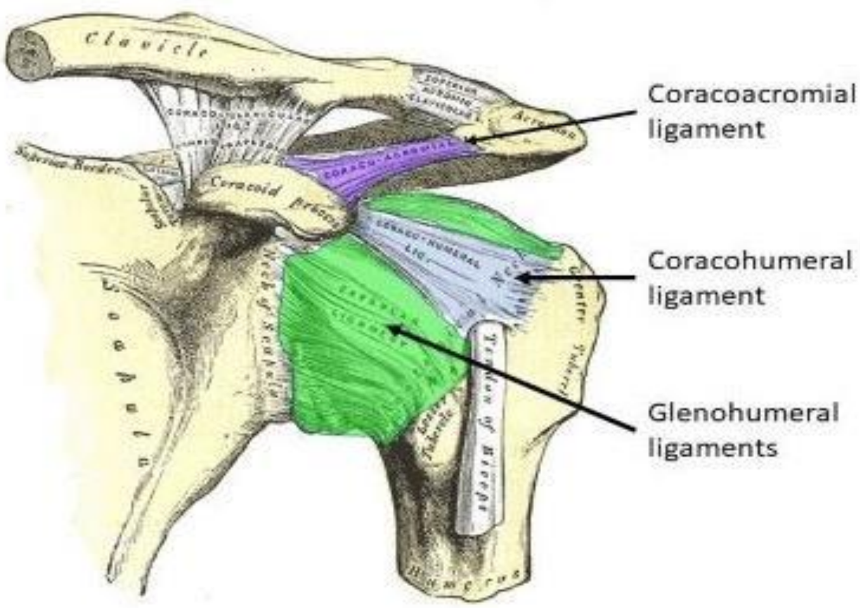


Figure9: Ligaments aroundshoulder.

The fibrous capsule is supported anteriorly and inferiorly by the glenohumeral ligaments. When compared to other ligaments in the body these ligaments have a decreased tensile strength. There are three components to the glenohumeral ligaments. Superior-glenohumeral ligaments (SGHL) - Together with the Coraco-Humeral ligament, the SGHL (which originate from the LHB and attach to the LT of the humerus), stops the inferior displacement of the humerus.

Middle-glenohumeral ligament (MGHL) provides anterior stability to the shoulder along with the Subscapularis Tendon. MGHL(Middle-glenohumeral ligament) emerges from the glenoid(anterior aspect) and inserts into the LT(Lesser Tubercle) of the humerus.

Inferior-glenohumeral ligament (IGHL) stabilizes shoulder statically. Inserting into the capsule from the glenoid labrum's inferior side.

- Coracohumeral ligament

This ligament, which resembles a tunnel, joins the fibrous capsule that the long head of the Biceps travels through after extending from the lateral side of the Coracoid Process.

Dynamicrestraints

MUSCLES:

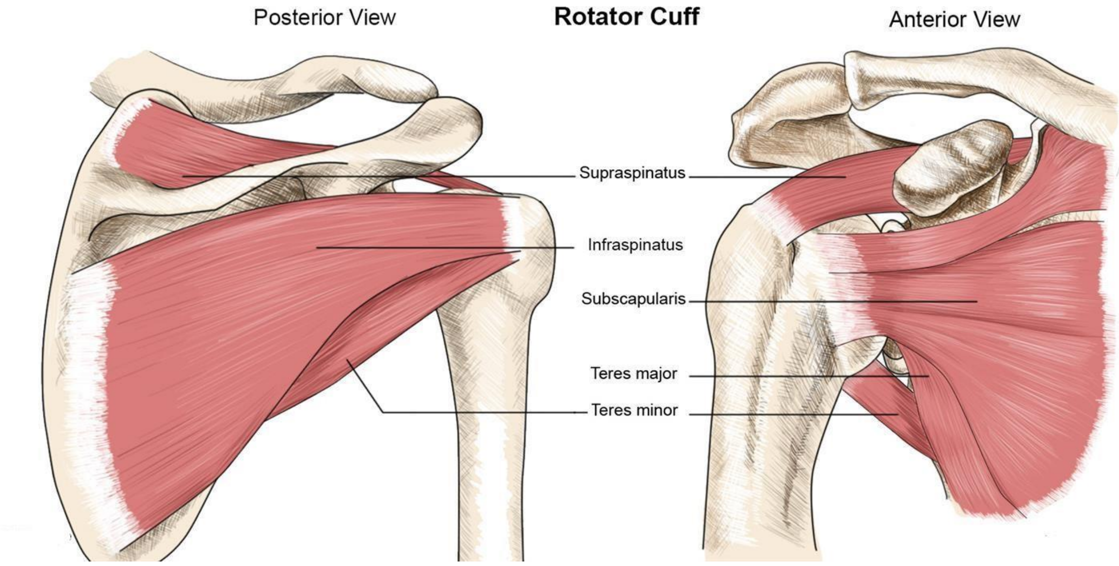


Figure10: Muscles aroundshoulder.

Muscle	Origin	Insertion	Action	Innervation
Supraspinatus	Supraspinous fossa of scapula	Greater tubercle of humerus	Abduction of arm	Suprascapular
Infraspinatus	Infraspinous fossa of scapula	Greater tubercle of humerus	Lat rotation of arm	Suprascapular
Teres Minor	Lateral border of scapula	Greater tubercle of humerus	Lat rotation of arm	Axillary
Subscapularis	Subscapular fossa of scapula	Lesser tubercle of humerus	Med rotation of arm	Subscapular

NormalRangeofMovementsatShoulderJoint –

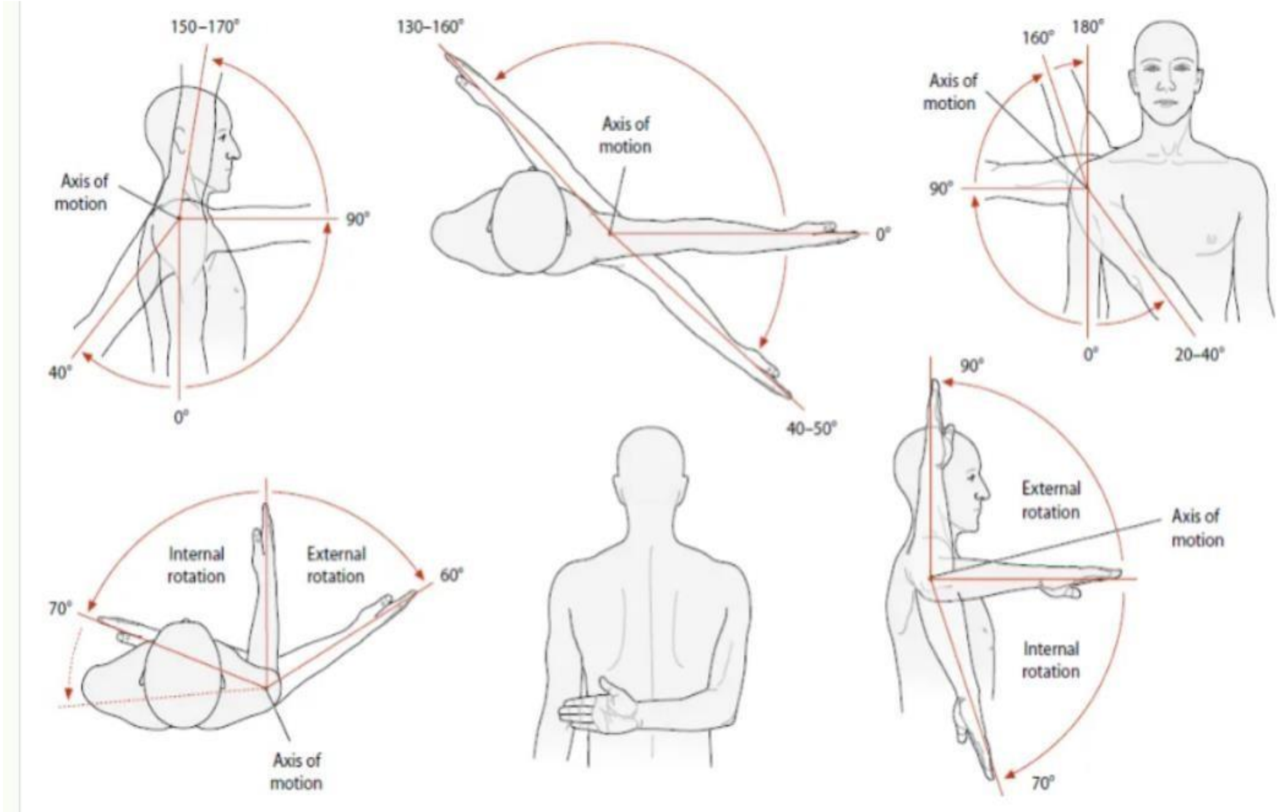


Figure11: Normal movements at shoulder joint.

Biomechanicsofshoulder:

Comparedwith thehip joint,thereisa tradeof stabilityformovements.Asthe optimumpositioningofthehandisrequiredforthefinemotorfunctions.Meanwhile scapular motion contributes mostly to abduction in the range from 80 to 140°. The compressinghumeralhead onglenoid-cavitystabilizing gleno-humeral-jointisdone primarily by the rotator-cuff.

Muscles of the rotator cuff complex undergo contraction during the shoulder ROM, achievingbothmobilityandstabilityinthemovementsoftheshoulder.Takingorigin at the scapula, the 4 muscles are inserted around the head of humerus. There is increased scope for laxity in the inferior unprotected part of the shoulder, accounting to most of such subluxations.

Asthetendonoftherotatorcuffcomplexmergeswiththejointcapsuleandformsthe Musculo-tendinous cuff offering support over the posterior, superior and anteriorparts.

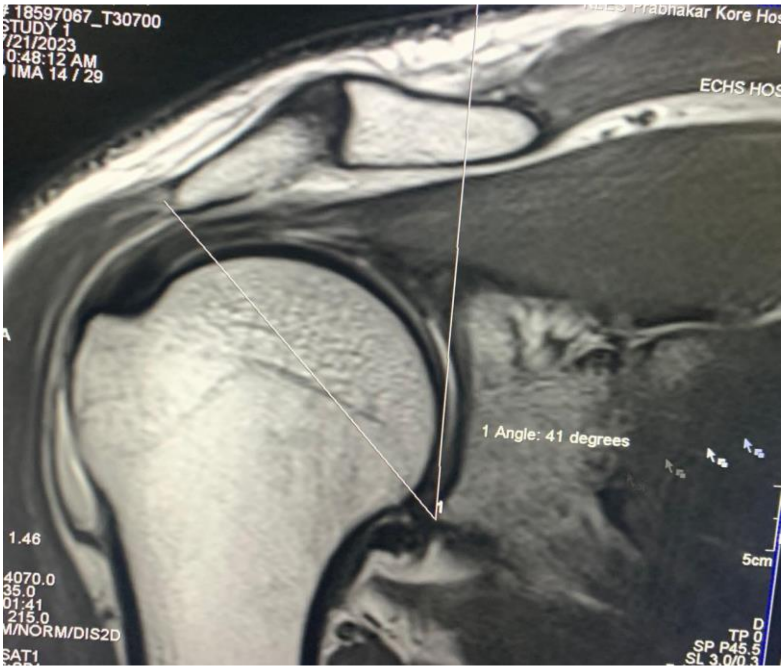
Thesemusclesareindependentlyevaluatedduringaphysicalexaminationbasedon their unique motions.

1	NEER Test	the elbow should be extended, humerus in internal rotation and the forearm pronated. When the examiner is passively flexing the arm forward	Subacromial impingement
2	HAWKIN'S KENNEDY Test	a passive test, with the examiner positioning the patient's arm at 90° in the scapular plane, the elbow bent to 90°, and the arm taken passively into internal rotation.	Subacromial impingement
3	FULL CAN Test	The arm is flexed to 90°in the scapular plane and the forearm supinated, so externally rotating the shoulder joint (the 'thumbs up position)	supraspinatus
4	EMPTY CAN/JOBE's empty can Test	The arm is flexed to 90°in the scapular plane and the forearm maximally pronated, so internally rotating the shoulder joint (the classical 'thumbs down' position).	supraspinatus
5	GERBER'S lift-off Test	The dorsum of the hand is placed on the sacrum and the patient is asked to take the hand off the back when the examiner maintains a fixed angle of elbow flexion.	subscapularis

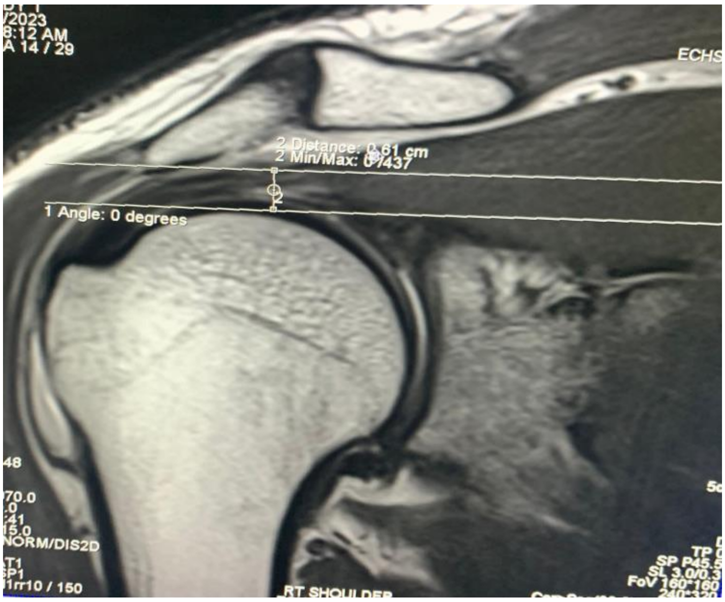
GALLERY

SHOULDER PARAMETERS

1. CRITICAL SHOULDER ANGLE

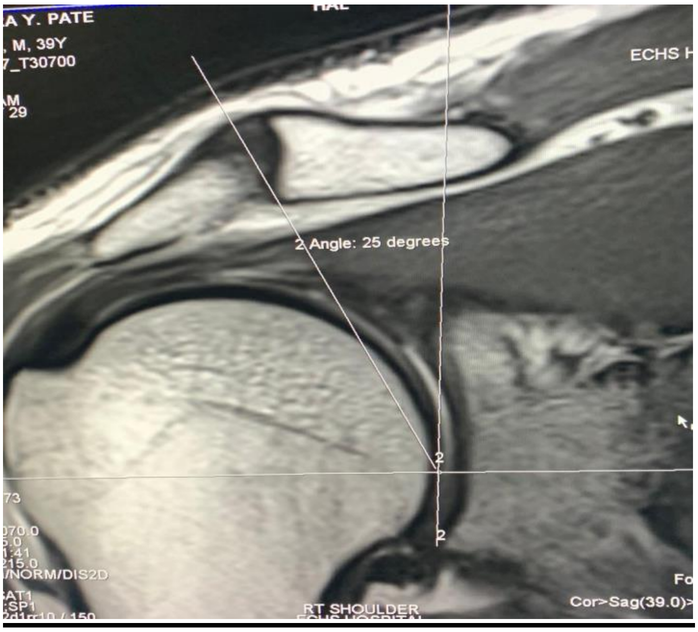


2. ACROMIO-HUMERAL DISTANCE

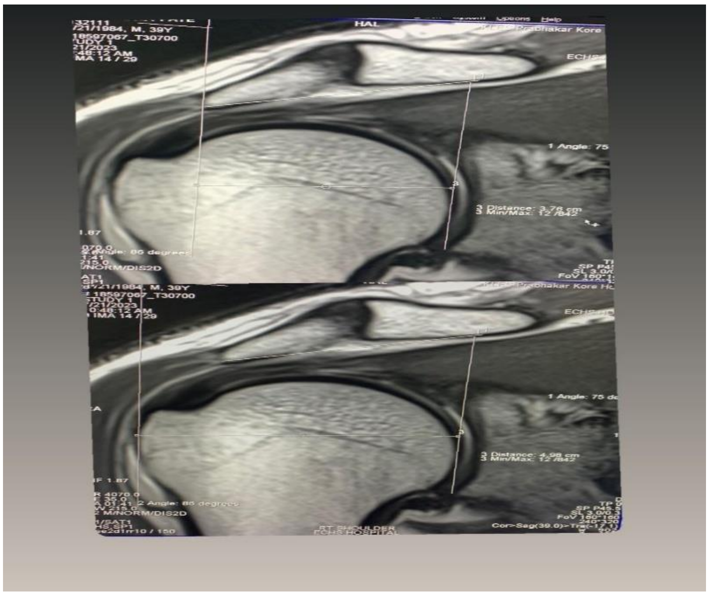


3. LATERAL ACROMIAL ANGLE

4. SUPERIOR GLENOID INDEX



5. ACROMIAL INDEX



REVIEW OF LITERATURE

Since the physical signs of shoulder pathologies are poorly reproducible, the arrival to accurate diagnosis is difficult and is usually ambiguous, therefore along with the clinical examination, many modalities of imaging can be used in order to identify the underlying pathology to determine the path of treatment. After thorough clinical examination, initial first line of imaging would be plain radiography, the disadvantage being inability to identify soft tissue pathology. Hence arthrography, USG and MRI imaging is needed to arrive at the accurate diagnosis.

The advantages of Magnetic Resonance Imaging are mainly its non-invasive, provides a superior soft tissue imaging when compared to the other imaging modalities. Since the MRI uses strong magnets, it is contraindicated in patients who have orthopaedic implants, pacemakers, and cochlear implants as they are metallic and may interact with the strong magnetic field produced by the MRI machine. Sedation might be needed for children or patients with claustrophobia as the patient must lie perfectly still for the entire duration of the scans. The accuracy of MRI in detecting a lesion depends on the reader as well as operator but its effectiveness is decided by the nature of underlying pathologic abnormality which helps us come to a diagnosis. According to a few studies, MRI has been observed to be very accurate for identifying rotator cuff tears. [(5)]The major cause of shoulder pain in patients above forty years is rotator cuff impingement and tears. With ageing, studies have shown a statistically significant rise in frequency and loss of the muscle-tendon unit due to degeneration. Prevalence of rotator cuff tear range is 5% to 40%, and majority of sore shoulders around 30 70% is due to rotator cuff diseases. Different studies have found varying prevalent rates and epidemiological characteristics of rotator cuff injuries. Tempelhof et al and Schibany et al, were of the opinion that fullthickness tears were more common in 411 and 212 participants, respectively, at 23% and 6%[(6)]

ROTATOR CUFF TEAR

It is the group of muscles around the shoulder which help in the movements of the shoulder and provides stability to it. In a study done by Xingzhen hu, [7] it has been observed it is vital to assess and treat any shoulder pathology, because rotator cuff alone can cause 50% of chronic pain and disability.

Rotator cuff tears pathophysiology has traditionally been split into extrinsic (overuse, chronic impingement syndrome, among multifactorial etiologies) and intrinsic (degeneration, micro-trauma, apoptotic hypothesis, with extracellular matrix modifications) etiologies.[8] Supraspinatus is made up of two components. Each of the two anterior and posterior components of the muscle is further split into three parts: superficial, medium, and deep. The anterior segment of the supraspinatus muscle presents as larger and tubular, displaying a bipennate structure that enables it to exert greater contractile forces compared to the smaller posterior segment. [9] This discrepancy in contractile force is partly due to the anterior segment's longer intramuscular tendon. Conversely, the posterior portion of the supraspinatus is smaller in size, characterized by a unipennate configuration, and possesses a wider, flatter tendon, decreasing the contractile forces as a consequence. [10] The tendon cross-sectional area ratio between the anterior and posterior segments is around 0.9:1, despite the anterior segment being nearly twice as large as the posterior portion.[11] Due to the difference in tendon size and the discrepancy in contractile stress, the anterior portion is more susceptible to tendon and myotendinous injury.[12] [13] [14] As observed by Dinnes et.al [15] in their study "the clinical examination preceding the diagnosis of the rotator cuff has shown a sensitivity of 90% meanwhile a specificity of only 54%. In sharp contrast when MRI is used to diagnose a rotator cuff tear, this exhibits sensitivity of 89% and a specificity of 93%" [16] Fukuda et al. Asrthi et al upon investigating MRI accuracy for rotator cuff pathology "reported a sensitivity of 96.88% and specificity of 92.86% and a diagnostic accuracy of 95%".[17]

1. Many studies stated that prevalence of rotator cuff tear ranges from 5%- 40% and majority of sore shoulders are around 30%-70% is due to rotator cuff diseases. In 2 studies the authors stated that full thickness tears were more common.
2. In a study done by the authors, observed that it is vital to assess and treat any shoulder pathology, because rotator cuff alone can cause 50% of chronic pain and disability.
3. In one study, the author investigated the accuracy for rotator cuff pathology and reported sensitivity of 96.88% and specificity of 92.86% and a diagnostic accuracy of 95%

4. In MRI study, the authors stated that critical shoulder angle measured on MRI is the best predictor for determining the presence of rotator cuff tears and is helpful to examine the CSA on MRI.
5. In another study done in 2016, the authors published that critical shoulder angle is significantly greater in patients with rotator cuff tears.
6. A recent study conducted in 2021, the authors found that critical shoulder angle and acromial index were significantly greater in full thickness rotator cuff tear and the size of rotator cuff tear increased with critical shoulder angle and acromial index and it could be predictors for larger RCT.
7. A study conducted in which the authors found statistically significant relationship between acromion angle and rotator cuff disease. The results showed significant correlation between lateral acromion angle and MRI- determined rotator cuff disease and this angle maybe useful adjuvant in evaluation and management of rotator cuff disease.
8. In a retrospective study done in 2022, the authors stated that combined acromio-humeral distance and critical shoulder angle measurements increases diagnostic performances in predicting RCT. A decreased AHD is mostly influenced by infraspinatus atrophy and fatty degeneration.

METHODOLOGY

This is a hospital based cross-sectional study, of 12 months duration. Seventy-two patients consisting of male or female of age group above 40 years come to KLE hospital diagnosed with degenerative rotator cuff tear presenting to the orthopedic outpatient department of the “KLE DR PRABHAKAR KORE HOSPITALAND MRC, BELAGAVI”.

Atotalof72patientswerepartofthisstudywho wereexaminedindetailand necessary investigations were performed.

Thepatientsweredulyinformedregardingthestudyandthosewillingto participate were noted.

Writteninformed consent was taken.

Patientswerethen askedtogetMRIoftheaffected shoulder.

Ifbothclinicallyandradiologicallyindicated,patientwascounselledfor arthroscopic intervention.

Patientswillingforarthroscopicintervention,furtherfitnessandinvestigations were performed and consent for surgery taken.

Intraoperative findingswerenotedanddocumented.

Thedataofall investigationsandintraoperativefindingsweredocumented, compiled and analyzed.

SelectionCriteriaforthe studywereasfollows:

INCLUSION CRITERIA

- Adult male or female of age group above 40 years come to KLE hospital diagnosed with degenerative rotator cuff tear.

EXCLUSION CRITERIA

- Patient with history of trauma to shoulder.
- Patient with neurological deficit.
- Patient with scapular fracture sequela.
- Patient with cyst or masses on humeral or glenoid bone
- Those who had undergone prior surgery of the affected shoulder.
- Patient with Hamada Stage 2-4 Glenohumeral Osteoarthritis.
- Patient with history of osseous pathology or glenoid bone loss.
- 2-point fracture around scapula.

MRI Measurements: The procedure for data collection was patient at OPD who reports having trouble moving their shoulders or experiencing pain in them, were meeting the requirements for inclusive exclusion, MRI scan of a supine subject showing the arm fixed with the hand's palm in the neutral medial position and in adduction. Coronal T1 weighted sequence pictures with the following parameters: field of view = 170 mm; repetition time / echo time = 608/10.4 ms; section thickness = 4 mm, cross section = 4 mm, number of excitation = 4 will be used to measure the diagnostic shoulder angles, additionally the pictures will be four times larger connecting the magnitude of the tear to these parameters

STATISTICAL ANALYSIS

SPSS version 23 was used to perform the statistical analysis. Data was initially entered into an Excel spreadsheet and was tabulated with respect to both the groups. P-value <0.05 was considered as powerful and level of significance was considered 5%. Chi- square test was used to evaluate the comparison of partial group and complete group with respect to age, gender, occupation, comorbidities, sides of shoulder affected. The Shapiro Wilk test was used to see the normality of five variables in partial and complete group. Mean and S.D was computed for the continuous data. Comparison of partial group and complete group with respect to all five parameters were done using Mann- Whitney U test.

RESULTS

All observations of shoulder pathology were statistically analyzed using SPSS (Statisticalpackageforsocialscience).Therewere72 patientsconsideredaspartof the study. Clinical parameters such asage, co-morbidities and medications weredocumented.

Statistically significant when $p<0.5$

Table1: Comparison of Partial group and Complete group with age

Age groups	Partial group	%	Complete group	%	Total	%	Chi-square	p-value
40-49yrs	7	17.50	2	6.25	9	12.50	14.9060	0.0020*
50-59yrs	20	50.00	5	15.63	25	34.72		
60-69yrs	10	25.00	20	62.50	30	41.67		
>=70yrs	3	7.50	5	15.63	8	11.11		
Mean	56.63		62.84		59.39			
SD	9.24		8.97		9.58			
Total	40	100.00	32	100.00	72	100.00		

Table2: Comparison of Partial group and Complete group with gender

Gender	Partial group	%	Complete group	%	Total	%	Chi-square	p-value
Male	27	67.50	18	56.25	45	62.50	0.9600	0.3270
Female	13	32.50	14	43.75	27	37.50		
Total	40	100.00	32	100.00	72	100.00		

Table3: Comparison of Partial group and Complete group with co-morbidities

Occupations	Partial group	%	Complete group	%	Total	%	Chi-square	p-value
None	22	55.00	11	34.38	33	45.83	3.4920	0.3220
DM	11	27.50	14	43.75	25	34.72		
HTN	5	12.50	4	12.50	9	12.50		
DM & HTN	2	5.00	3	9.38	5	6.94		
Total	40	100.00	32	100.00	72	100.00		

Figure1: Comparison of Partial group and Complete group with age

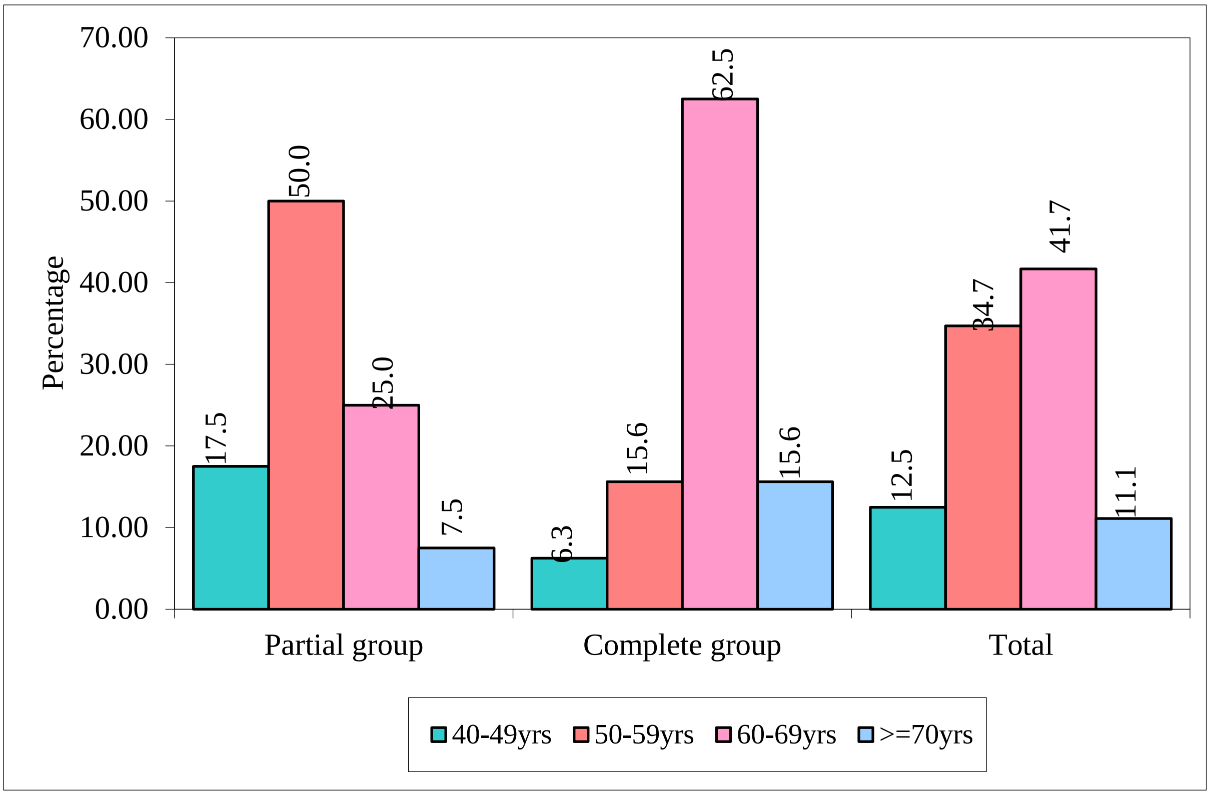


Figure2: Comparison of Partial group and Complete group with gender

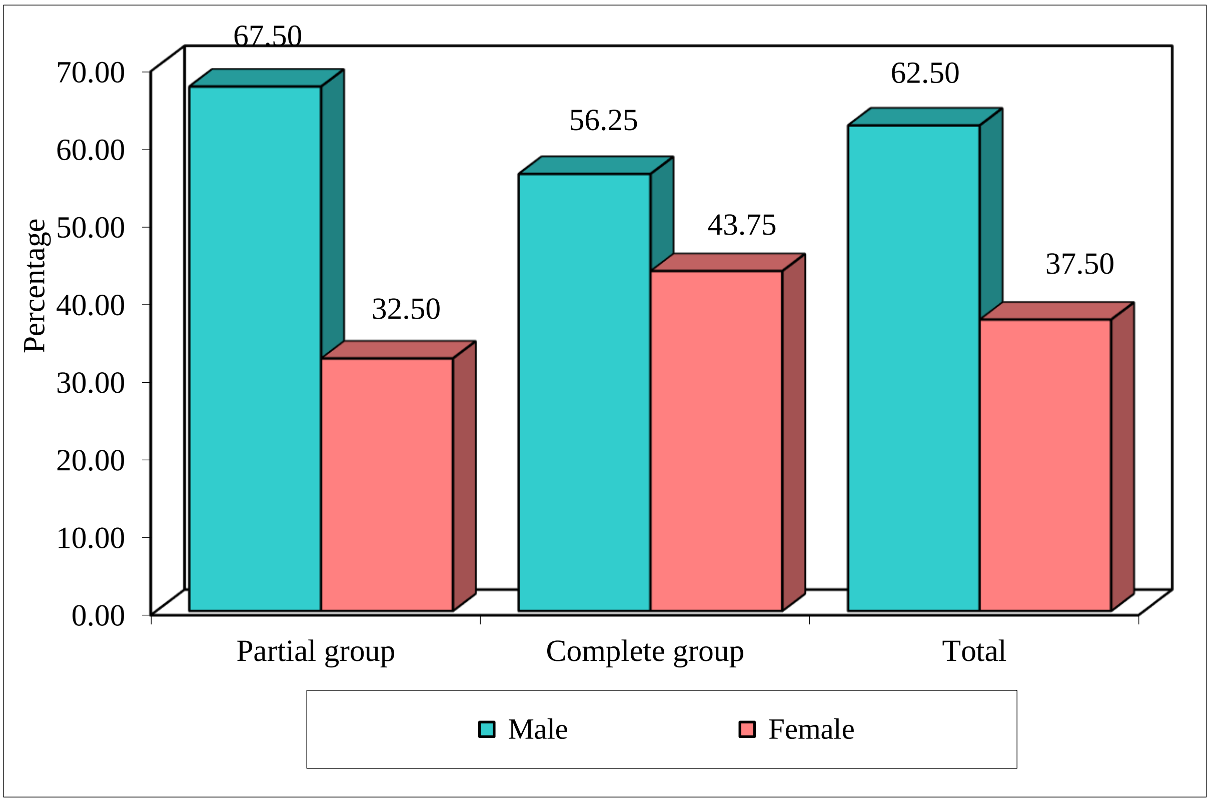
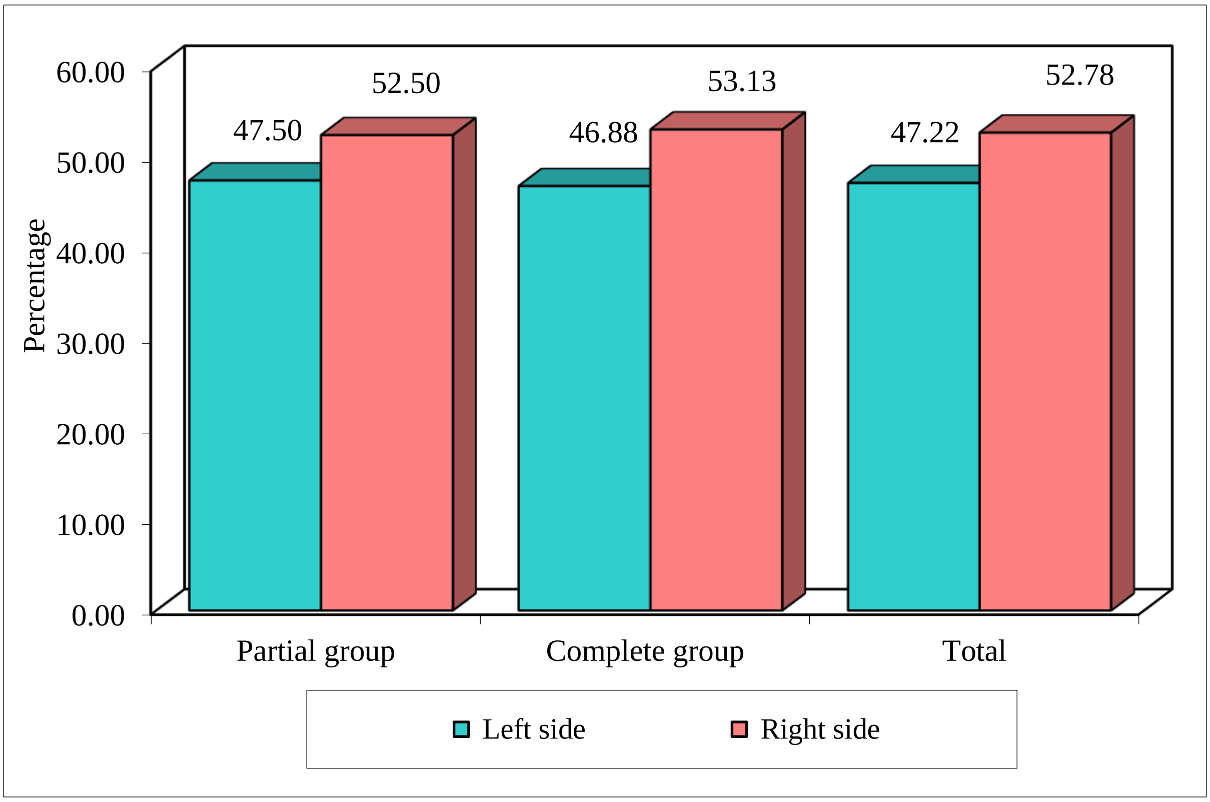


Figure 3: Comparison of Partial group and Complete group with sides of affected shoulder



Significant differences were found in all five shoulder parameter variables between the partial and total thickness tear groups using the Shapiro-Wilk test. CSA (p=0.00490*), LAA (p=0.0300*), AHD (p=0.0130*), SGI (p=0.0420*), and AI (p=0.0020*) were the measures that all displayed statistically significant differences in the complete thickness tear group. Only two of the five measures, AHD (p=0.0370*) and CSA (p=0.0100*), showed statistical significance in the partial group. (Table 4) The Mann-Whitney U test was used to compare the partial group and the complete group using all five parameters, and the findings were statistically significant (p=0.0001*). However, three factors in the partial group—LAA, AHD, and AI—showed statistical increased when compared to the whole group. Therefore, it suggests that lower LAA, AHD and AI parameters are valuable predictors in evaluating complete thickness tears. (Fig 4,5&6) Regarding tear sizes, CSA, AHD, AI, LAA, and SGI had diagnostic value for distinguishing partial-thickness and full-thickness RCTs.

Table4: Normality of five variables in Partial group and Complete group by Shapiro Wilk test

	Group	Shapiro-Wilk	df	p-value
Critical shoulder angle (degrees)	Partial group	0.9230	40	0.0100*
	Complete group	0.9330	32	0.0490*
Lateral Acromial angle(deg)	Partial group	0.9490	40	0.0710
	Complete group	0.9260	32	0.0300*
Acromio-Humeral distance(mm)	Partial group	0.9410	40	0.0370*
	Complete group	0.9120	32	0.0130*
Superior glenoid inclination(deg)	Partial group	0.9750	40	0.5050
	Complete group	0.9100	32	0.0420*
Acromial Index (ratio)	Partial group	0.9650	40	0.2440
	Complete group	0.8750	32	0.0020*

*p<0.05indicates skewed distribution

Note that, the scores of five variables in Partial group and Complete group not follow normal distribution. therefore, the non-parametric tests were applied.

Figure 4: Comparison of Partial group and Complete group with Lateral Acromial angle (deg)

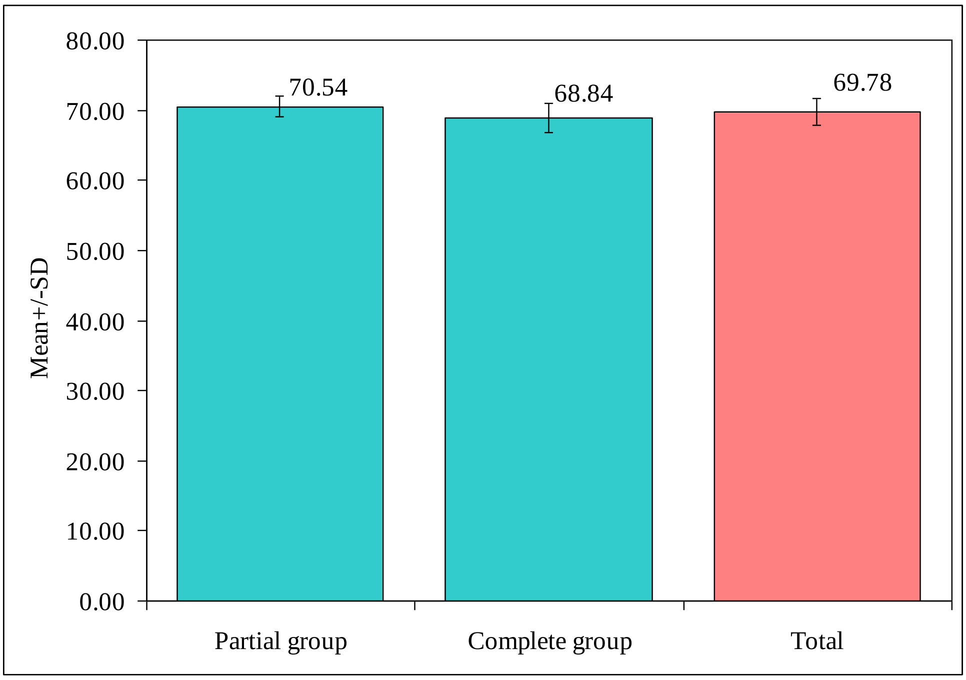


Figure 5: Comparison of Partial group and Complete group withAcromio-Humeral distance (mm)

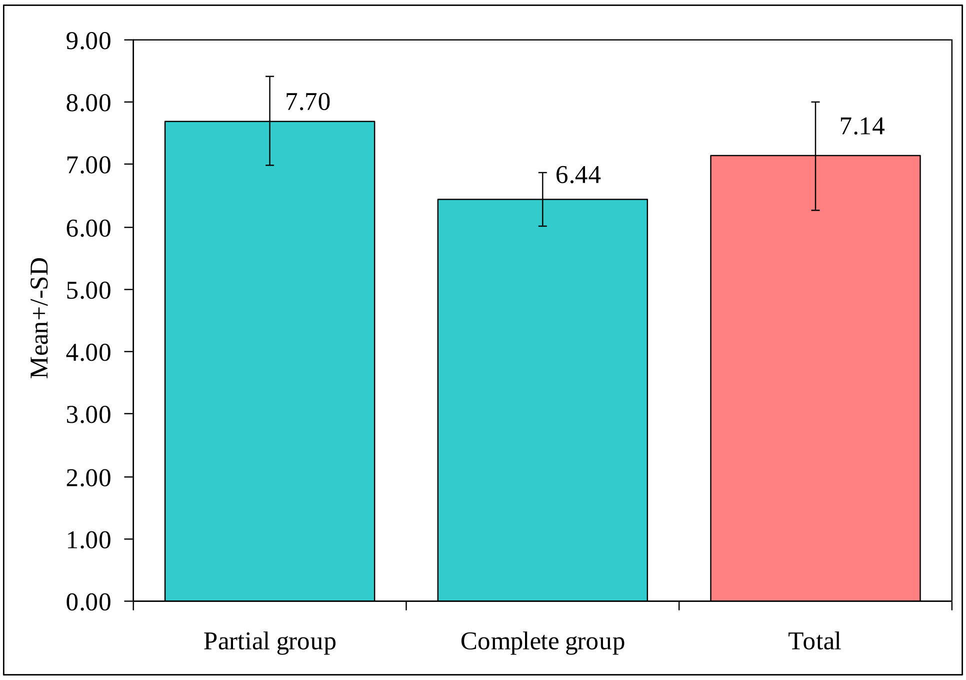
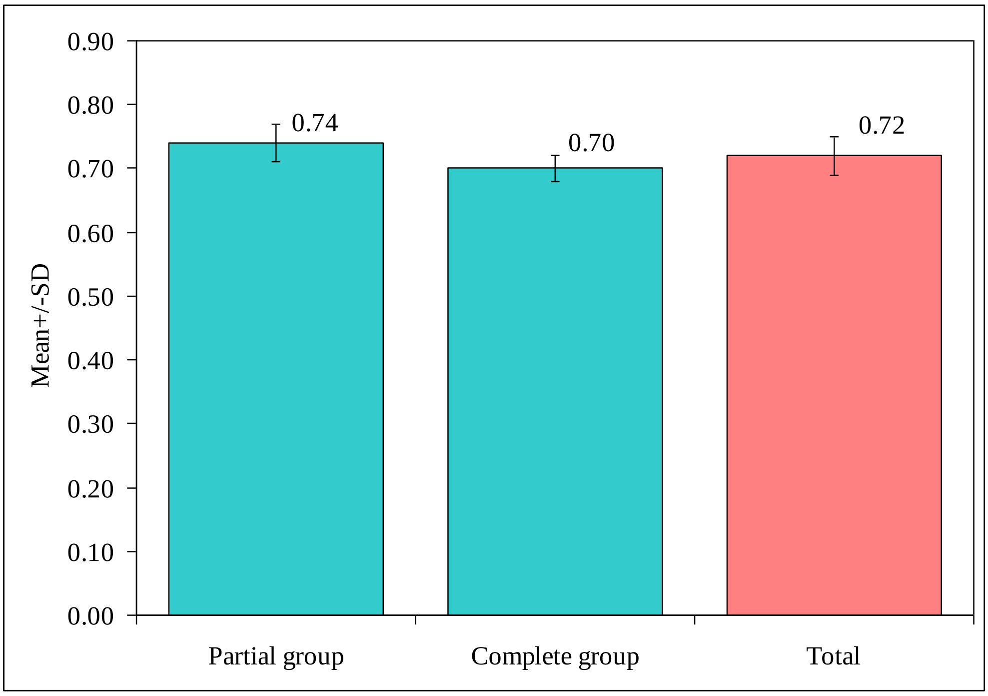


Figure 6: Comparison of Partial group and Complete group with Acromial Index (ratio)



In individuals with partial and full rotator cuff tears, there were substantial positive correlations found between the presence of RCT and CSA, acromial index, superior glenoid inclination, lateral acromial angle, and acromio-humeral distance. Five variables in the Partial and Complete groups were found to be normal using the Shapiro-Wilk test. However, in the total tear group, all five measures showed favourable results i.e. CSA (p value- 0.0490); LAA (p- value – 0.030); AHD (p value- 0.0130); SGI (p value- 0.0420); AI (p value- 0.0020) while in the partial group, only the crucial shoulder angle (p value- 0.0100) and the acromio-humeral distance (p value- 0.0370) showed beneficial results.

DISCUSSION

The study findings showed the correlation between shoulder parameters and degenerative rotator cuff tear in patients with either partial tear or complete tear using MRI scans. The findings suggests that all the five variables were significantly improved in complete tear group than the partial thickness group. Patients with the age group 40 years and above were included in the study. The mean and S.D age of the patients was 56.63 ± 9.24 and 62.84 ± 8.97 in partial and complete tear group respectively. The p-value was 0.0020* statistically significant in both the groups. The Mann-Whitney U test was used to compare the partial group and the complete group using all five parameters, and the findings were statistically significant (p=0.0001*). However, three factors in the partial group—LAA, AHD, and AI—showed statistical significance when compared to the whole group. So, the current findings suggest that it may be helpful in diagnosing rotator cuff tear.
Shoulder parameters discussed in this article are critical shoulder angle, Lateral acromial angle, Acromio-humeral distance, Superior glenoid inclination, Acromial Index.

I. Critical shoulder angle: According to a 2021 study, the authors discovered that CSA was much higher in patients undergoing full-thickness RCTs, and that CSA also increased the size of the RCT, which may indicate the possibility of larger RCTs. [18] In a different 2020 study, the authors proposed that CSA might be regarded as a risk factor for degenerative RCTs. For the diagnostic assessment of patients with full thickness RCTs, CSA assessment can be useful. [19] In a 2018 study of East Asians, the authors discovered that CSA appeared to be more correlated in those who had RCTs, suggesting that it might be a separate risk factor for RCTs. [20] The results of our investigation revealed a substantial difference between CSA and degenerative rotator cuff tears in both groups.

II. Lateral acromion angle: A statistically significant link between lateral acromion angle and rotator cuff disease was discovered by the authors of earlier research, suggesting that it could be a helpful adjuvant in the diagnosis and treatment of rotator cuff disease. (21) The authors of a 2019 retrospective investigation discovered a linkage between acromial morphology and RCTs, and they came to the conclusion that impingement linked to a low lateral acromial angle and a higher prevalence of RCTs reliably predict the occurrence of degenerative RCTs. (22) Thus, the results of the current study demonstrate that LAA was lower in the complete tear group than in the partial tear group, which is consistent with previous research and implies that it may be a helpful metric to assess complete tears.

III. Acromio-humeral Distance: In a 2022 study, the authors assessed MRI AHD in patients with unilateral RCTs and came to the conclusion that lower AHD is linked to rotator cuff tears, particularly full thickness tears. (23) The authors of another recent study from 2023 discovered that measured acromial thickness and decreased AHD are useful, affordable, and practical factors in assessing the risk of RCTs. (24) The findings of our current investigation revealed that the total thickness group had lower AHD than the partial tear group, suggesting that it may be a useful metric for assessing complete tears.

IV. Superior glenoid inclination: In 2018, a study was conducted to ascertain whether the parameter could be successfully measured on MRI. The findings indicated that rotator cuff tears were statistically more common and could be reliably measured on MRI. (25) Compared to partial tears or no tears, the authors of another study discovered a higher glenoid tilt in full thickness rotator cuff tears. (26) Compared to earlier research, our current study's results were comparable, which further supports the idea that higher SGI is a valid metric for determining tears' full thickness.

V. Acromion Index: In a 2021 study, the authors assessed the association between the Acromion index and both partial and full thickness RCTs, as well as the size of the RCT. They found that the AI was considerably higherin patients undergoing full-thickness RCTs, and the RCT size rose accordingly. AI may therefore serve as a predictor for more extensive RCTs. (27) In another study, the authors discovered a connection between the size of a rotator cuff tear and an AI. They came to the conclusion that AI might be used as a predictor to distinguish between a partial-thickness and a large-to-massive rotator cuff tear before surgery. (28) The findings of our current investigation were statistically significant, with AI being higher in the whole thickness group than in the partial thickness group. (29)

Higher CSA, AI, and SGI and lower AHD and LAA, according to the current study, may be useful, affordable, and trustworthy markers for distinguishing between partial and full thickness tears when utilizing MRI as a screening technique. This study has certain limitations. The follow-up could have been taken in consideration for this study after 1 year. The sample was small and other outcome measures could have been included to differentiate between other shoulder pathologies.

CONCLUSION

Recent technical developments have improved MRI's diagnostic accuracy. Compared to arthroscopy, which is still the unquestionable gold standard diagnostic modality, we discovered that MRI could diagnose the most prevalent shoulder problems. The most frequent injuries in our sample were rotator cuff injuries, which MRI could identify with good sensitivity and specificity.

MRI scans were used to demonstrate the relationship between shoulder parameters and degenerative rotator cuff tears in patients with partial or complete tears.

The results indicated that all five variables were significantly better in the group with a complete tear than in the group with a partial thickness.

Compared to earlier studies where the authors had neither included all the parameters altogether nor discovered the correlation between these parameters in both partial and full thickness tears, the current study offers intriguing insights regarding five shoulder parameters and degenerative rotator cuff tears. Its goal is that all five parameters are highly significant for diagnosing full thickness rotator cuff tears. In order to diagnose degenerative complete tears with an MRI scan instead of a radiograph, our study has incorporated all significant shoulder features and connected with degenerative RCT using MRI scans. This might make the MRI scan a great predictor of result.

So, it suggests that researches should imply this diagnostic tool for evaluation and research purposes.

LIMITATIONS &FUTURE SCOPE

There are a few limitations in our study such as that the patients diagnosed with degenerative rotator cuff tear only were part of the study.

In our study, we had a limited sample size which might not reflect the true burden of the disease.There is a dearth need for large multi-centric studies.Other diagnostic parameters which were more correlated to RCTs could have been included.

A uniform coding system can be applied for diagnosis which may help set the type of treatment – conservative or surgical type. Future research is required, may be with larger sample size. Also, other different diagnostic shoulder parameters in correlation with degenerative rotator cuff tear may be used for evaluation purposes.

SUMMARY

Many studies stated that prevalence of rotator cuff tear ranges from 5%- 40% and majority of sore shoulders are around 30%-70% is due to rotator cuff diseases.

Therewere72 patientsconsideredaspartof the study. Clinical parameters such asage, co-morbidities and medications were documented.

The procedure for data collection was patient at OPD who reports having trouble moving their shoulders or experiencing pain in them, were meeting the requirements for inclusive exclusion underwent MRI scans for diagnostic purposes.

In this cross-sectional study, 72 patients who had undergone MRI were evaluated and split into two groups: partial thickness RCT and full thickness RCT. Radiographs were used to assess shoulder characteristics such as CSA, LAA, AI, SGI, and AHD.

The mean and S.D age of the patients was 56.63 ± 9.24 and 62.84 ± 8.97 in partial and complete tear group respectively.

The p-value for the whole tear thickness group indicated a significant rise in all five parameters, while only two parameters (CSA and AHD) showed a significant improvement in the partial tear thickness group.

Higher CSA, AI, and SGI and lower AHD and LAA, according to the current study, may be useful, affordable, and trustworthy markers for distinguishing between partial and full thickness tears when utilizing MRI as a screening technique.

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ANNEXURE 1- INFORMED CONSENT FORM

INFORMED CONSENT FORM

"CORRELATION BETWEEN DIAGNOSTIC ANATOMIC SHOULDER PARAMETERS AND DEGENERATIVE ROTATOR CUFF TEARS USING MRI SCAN: A HOSPITAL BASED 1 YEAR CROSS SECTIONAL STUDY"

Name of Student/Principal Investigator: D[redacted]

Name of Guide/Co Investigators: D[redacted]

Introduction: I [redacted]PG resident JNMC BELAGAVI conducting a cross-sectional study for CORRELATION BETWEEN DIAGNOSTIC ANATOMIC SHOULDER PARAMETERS AND DEGENERATIVE ROTATOR CUFF TEARS USING MRI SCAN: A HOSPITAL BASED 1 YEAR CROSS SECTIONAL STUDY.

I am going to give you information and invite you to be part of this research. There may be some words that you may not understand please contact me for more information as needed.

Musculotendinous cuff of shoulder is fibrous sheath formed by four flattened tendons comprised of Subscapularis, Supraspinatus, Infraspinatus and teres minor which blend with the capsule of the shoulder joint and strengthen it. Having prevalence of full thickness rotator cuff tear in range from 7-40% is most common cause of shoulder pain.

Variousradiographic studies are being done to determine relationship between diagnostic shoulder parameters and rotator cuff tear with one or two parameters but this study includes all five parameters- 1) Critical shoulder angle 2) lateral Acromial angle 3) Acromio-humeral distance 4) superior glenoid inclination 5)Acromial index which plays an important role in preoperative planning of Rotator Cuff tear.

Previously many radiographic studies are done mainly with x-ray for these parameters but biggest handicaps in this regard is the possibility of inadequate shoulder/arm positions and thus MRI is more reliable as it provides accurate measurements as well as detailed information in the terms of imaging soft tissue, pattern, size of Rotator Cuff tear, retraction and fatty infiltration. Therefore,we would like to do this study to understand these MRI parameters in Indian population.

Explanation of procedure: Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: I will not get any benefits by participating in this study. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.
Cost of investigations done during the course of study will be paid by the principal investigator / Participant.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to conta[redacted]r. [redacted] If you have any question or complaints with regard to your right as study participant you may contact [redacted], Chairperson, Ethical committee of JNMC, [redacted]

Legal rights: By signing this consent form, we are not waiving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study “CORRELATION BETWEEN DIAGNOSTIC ANATOMIC SHOULDER PARAMETERS AND DEGENERATIVE ROTATOR CUFF TEARS USING MRI SCAN: A HOSPITAL BASED 1 YEAR CROSS SECTIONAL STUDY”. My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator: [redacted]

Signature of the investigator:

ANNEXURE2- DATA COLLECTION SHEET

PERFORMA

CORRELATION BETWEEN DIAGNOSTIC ANATOMIC SHOULDER PARAMETERS AND DEGENERATIVE ROTATOR CUFF TEARS USING MRI SCAN: A HOSPITAL BASED 1 YEAR CROSS SECTIONAL STUDY

PATIENT NAME:

AGE:

SEX:

OCCUPATION:

CHIEF COMPLAINTS:

PAST HISTORY:

CO -MORBIDITIES:

CLINICAL EXAMINATION:

HEIGHT:

WEIGHT:

AFFECTED SHOULDER-

	Active	Passive	Restricted
Range of movement			
Flexion			
Extension			
Abduction			
Adduction			
Internal rotation			
External rotation			

UNAFFECTED SHOULDER –

	Active	Passive	Restricted
Range of movement			
Flexion			
Extension			
Abduction			
Adduction			
Internal rotation			
External rotation			

SPECIAL TESTS-

	Right shoulder	Left shoulder
NEER TEST		
DROP ARM		
HAWKIN'S KENNEDY		
FULL CAN		
PAINFUL ARC		
EMPTY CAN		

COMPARISON OF SHOULDER PARAMETERS AMONG THE TEAR SIZE SUBGROUP

	Tear size		
Parameters	Partial thickness Rotator Cuff tear	Full thickness Rotator Cuff tear	Massive Rotator Cuff tear
CSA Mean+-SD Median(range)			
LAA Mean+-SD Median(range)			
AHD. Mean+-SD Median(range)			
SGI Mean+-SD Median(range)			
AI Mean+-SD Median(range)			

ANNEXURE 3- MASTERCHART

DEMOGRAPHIC DATA: PARTIAL AND COMPLETE TEAR GROUPS

1	NAME	AGE	GENDE	OCCUPATION	COMORBIDITI	AFFECTED SHOULDER
2	SONU	63	MALE	BUSSINESSMEI	NONE	LEFT
3	JOHN	55	MALE	MECHANIC	NONE	RIGHT
4	SADASHIV	52	MALE	BUSSINESSMEI	DM	LEFT
5	CHINDANANDA	63	MALE	RETIRED OFFICI	HTN	LEFT
6	SURENDRA	53	MALE	BUSSINESSMEI	NONE	LEFT
7	VISHNU	64	MALE	BUSSINESSMEI	HTN,DM	RIGHT
8	BALAJI	75	MALE	FARMER	DM	RIGHT
9	MARUTI	60	MALE	BUSSINESSMEI	NONE	LEFT
10	MANNING	63	MALE	RETIRED OFFICI	NONE	RIGHT
11	SUCHITA	69	FEMALI	HOUSEWIFE	DM	RIGHT
12	YAMNAVVA	55	FEMALI	HOUSEWIFE	NONE	RIGHT
13	HANMANTAPP,	68	MALE	BUSSINESSMEI	HTN	RIGHT
14	SULOCHANA	56	FEMALI	HOUSEWIFE	NONE	RIGHT
15	RAMKARAN	59	MALE	RETIRED OFFICI	NONE	LEFT
16	GEETA	52	FEMALI	HOUSEWIFE	DM	LEFT
17	BASAPPA	55	MALE	BUSSINESSMEI	HTN	LEFT
18	SHOBHA	57	FEMALI	HOUSEWIFE	DM	RIGHT
19	RAHUL	57	MALE	RETIRED OFFICI	NONE	LEFT
20	YADU	58	MALE	BUSSINESSMEI	DM	RIGHT
21	SHRIMANTA	58	FEMALI	HOUSEWIFE	NONE	LEFT
22	SADHIKA	51	FEMALI	HOUSEWIFE	NONE	LEFT
23	PRAKASH	63	MALE	BUSSINESSMEI	DM	RIGHT
24	KALLIUM	78	FEMALI	HOUSEWIFE	DM	RIGHT
25	LAXMI	55	FEMALI	TEACHER	HTN	LEFT
26	MALLIKARAJUI	51	MALE	BUSSINESSMEI	NONE	LEFT
27	SHRIKANT	76	MALE	FARMER	DM	RIGHT
28	SHIDRAI	48	MALE	BUSSINESSMEI	NONE	LEFT
29	GANPATI	42	MALE	FACTORY WOR	NONE	RIGHT
30	NAGANGOND	40	MALE	BUSSINESSMEI	DM	LEFT
31	UMAKANT	40	MALE	BUSSINESSMEI	NONE	RIGHT
32	SULOCHANA	56	FEMALI	HOUSEWIFE	HTN	RIGHT
33	SIDAPPA	60	MALE	RETIRED OFFICI	DM	LEFT
34	SUVARNA	53	FEMALI	HOUSEWIFE	NONE	LEFT
35	PARSHURAM	40	MALE	BUSSINESSMEI	NONE	RIGHT
36	NAGRAJ	50	MALE	FARMER	NONE	RIGHT
37	SANTOSH	51	MALE	BUSSINESSMEI	NONE	RIGHT
38	CHANDA	49	FEMALI	HOUSEWIFE	NONE	LEFT
39	GIRISH	49	MALE	BUSSINESSMEI	NONE	LEFT
40	MUKUND	52	MALE	BUSSINESSMEI	NONE	RIGHT
41	SWAPNA	69	FEMALI	HOUSEWIFE	HTN,DM	RIGHT

	NAME	AGE	GENDEI	OCCUPATION	COMORBIDITIE	AFFECTED SHOULDER
2	VIDYA	55	FEMALE	HOUSEWIFE	DM	RIGHT
3	SUMAN	68	FEMALE	HOUSEWIFE	DM	RIGHT
4	CHAYA	43	FEMALE	TEACHER	DM	RIGHT
5	PANDURAN	73	MALE	FARMER	DM,HTN	LEFT
6	MANDA	56	FEMALE	HOUSEWIFE	NONE	LEFT
7	NAGENDRA	40	MALE	FARMER	NONE	RIGHT
8	SANJEEVAI	53	FEMALE	HOUSEWIFE	DM	RIGHT
9	SIDAPPA	61	MALE	RETIRED OFFIC	DM	RIGHT
10	PARAVATI	77	FEMALE	HOUSEWIFE	DM	LEFT
11	SUMAN	67	FEMALE	HOUSEWIFE	NONE	RIGHT
12	INDUMATI	63	FEMALE	HOUSEWIFE	NONE	LEFT
13	GADIGEVV/	60	MALE	FARMER	NONE	LEFT
14	IRSHAD	60	MALE	BUSINESSMEN	DM	LEFT
15	RANJANA	62	FEMALE	HOUSEWIFE	NONE	LEFT
16	MUMTAZ	68	FEMALE	TEACHER	NONE	RIGHT
17	NARENDRA	64	MALE	BUSINESSMEN	HTN	LEFT
18	PUNDALIK	81	MALE	FARMER	DM	RIGHT
19	RACHAVVA	80	MALE	RETIRED	DM	LEFT
20	YALLAPPA	65	MALE	TEACHER	HTN	RIGHT
21	RAJENDRA	60	MALE	RETIRED OFFIC	NONE	LEFT
22	RAGHVEND	64	MALE	TEACHER	NONE	RIGHT
23	KALLAPAA	60	MALE	BUSINESSMEN	HTN	LEFT
24	DR. BHAGW	68	MALE	DOCTOR	NONE	RIGHT
25	SHOBHA	63	FEMALE	HOUSEWIFE	HTN,DM	RIGHT
26	RAIAPPA	70	MALE	RETIRED	DM	LEFT
27	SHAMBHAJ	67	MALE	RETIRED OFFIC	DM	LEFT
28	HARIRAM	63	MALE	BUSINESSMEN	NONE	RIGHT
29	RENUKA	53	FEMALE	HOUSEWIFE	DM	LEFT
30	BASAVVA	69	FEMALE	HOUSEWIFE	DM	RIGHT
31	SANTRAM	53	MALE	TEACHER	HTN, DM	LEFT
32	KRISHNAV\	64	FEMALE	HOUSEWIFE	DM	RIGHT
33	RAMAPPA	61	MALE	RETIRED OFFIC	HTN	RIGHT

PARTIAL TEAR GROUP

1	NAMES	PARAMETERS: CRITICAL SHOULDER ANGLE	LATERAL ACROMIAL ANGL	ACROMIO-HUMERAL DISTANC	SUPERIOR GLENOID INCLINATIO	ACROMIAL INDEX (RATIO)
2	SONU	35	70	7.2	11	0.71
3	JOHN	34.8	70.4	7.8	10.8	0.7
4	SADASHIV	34.6	72	8.8	10.6	0.76
5	CHINDANANE	35.2	69.6	7	11.4	0.7
6	SURENDRA	34	70.4	7.8	10.2	0.74
7	VISHNU	36.4	72	6.6	12	0.7
8	BALAJI	36	70.4	6.8	11.8	0.71
9	MARUTI	35	70	7.4	11.2	0.72
10	MANNING	34.8	69.8	7.4	10.8	0.72
11	SUCHITA	36.4	70.8	7	12	0.7
12	YAMNAVVA	35	70.8	8.6	11.4	0.71
13	HANMANTAF	36.2	69.8	6.8	12.2	0.72
14	SULOCHANA	35.4	72.6	8.5	11.8	0.74
15	RAMKARAN	35.4	69.8	7	12	0.72
16	GEETA	35	70.6	8.4	11.4	0.74
17	BASAPPA	34.8	72.2	8.2	11.2	0.73
18	SHOBHA	36	68	7	12	0.71
19	RAHUL	34.6	72	7.8	11.2	0.78
20	YADU	34.2	72.8	8.8	10.8	0.74
21	SHRIMANTA	35	70.4	8.6	10.4	0.75
22	SADHIKA	34	70	8	10	0.78
23	PRAKASH	36.6	68.8	6.8	12.6	0.74
24	KALLIUM	34.2	72.6	8.2	10.6	0.72
25	LAXMI	34	71	7.6	10.4	0.78
26	MALLIKARAJ	34	70.2	7.8	10	0.76
27	SHRIKANT	36.5	70	7	13	0.68
28	SHIDRAI	33.7	71.6	8.1	9.8	0.75
29	GANPATI	36.8	70.8	8.7	13.2	0.75
30	NAGANGONI	35.3	70.8	7.8	11	0.71
31	UMAKANT	35.3	71.8	6.9	11.2	0.74
32	SULOCHANA	36.5	68	7	12.8	0.75
33	SIDAPPA	37.2	74.5	8.5	13.2	0.75
34	SUVARNA	30.6	70.7	8.2	8.8	0.81
35	PARSHURAM	32.8	69.8	8.1	9.1	0.76
36	NAGRAJ	36.6	70.1	6.2	12.8	0.77
37	SANTOSH	33.9	69.8	8.2	9.8	0.76
38	CHANDA	34.8	69.8	8.6	10	0.8
39	GIRISH	35.6	70.9	8.1	10.3	0.79
40	MUKUND	34.4	68	0.7	10	0.78
41	SWAPNA	36.6	68	7.8	12.7	0.7

1	NAMES	PARAMETERS: CRITICAL SHOULDER ANGLI	LATERAL ACROMIAL ANGLI	ACROMIO-HUMERAL DISTANC	SUPERIOR GLENOID INCLINATIC	ACROMIAL INDEX (RATIO)
2	VIDYA	36.3	72.5	6.7	13.8	0.73
3	SUMAN	38.5	70.6	6.8	14.2	0.72
4	CHAYA	38.5	68.3	6.4	14.6	0.7
5	PANDURANG	38.3	67.4	6.7	14.5	0.68
6	MANDA	39.2	62.5	6	15.8	0.68
7	NAGENDRA	41	68	5.8	16.4	0.66
8	SANJEEVANI	38	70.2	6.7	14.2	0.72
9	SIDAPPA	38	68.2	6.8	14.2	0.72
10	PARAVATI	41	66.4	5.8	16.8	0.66
11	SUMAN	36	72	7	13.6	0.74
12	INDUMATI	38.2	70.2	6.8	14	0.72
13	GADIGEVVA	38.4	69.2	6.6	14.8	0.7
14	IRSHAD	37.2	70	6.9	14.2	0.72
15	RANJANA	41	67.8	5.8	16.4	0.7
16	MUMTAZ	36	72	6.8	13.8	0.72
17	NARENDRAPAL	40	68	5.8	16.2	0.68
18	PUNDALIK	40	66.4	6	16	0.7
19	RACHAVVA	41	67.8	5.8	16.4	0.68
20	YALLAPPA	39	68.2	6.6	15.8	0.72
21	RAJENDRA	38	70	6.8	15.2	0.72
22	RAGHVENDRA	38	70.4	6.6	15.4	0.72
23	KALLAPAA	39	68.8	6	15.2	0.7
24	DR. BHAGWAN	37.4	69.2	6.4	13.8	0.72
25	SHOBHA	41	64.2	5.8	16	0.66
26	RAIAPPA	38	70.2	6.5	15.1	0.71
27	SHAMBHAJI	39	70	7.3	15.2	0.68
28	HARIRAM	38.5	68.9	6.2	15	0.7
29	RENUKA	38	68.8	6.4	14.8	0.72
30	BASAVVA	38.6	68.4	6.4	14.4	0.7
31	SANTRAM	36.8	69.6	6.8	13.8	0.72
32	KRISHNAVVA	37.4	68.8	6.2	14	0.7
33	RAMAPPA	36.4	69.8	6.8	13.2	0.72