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ROLE OF MRI COMPARED WITH ARTHROSCOPY IN EVALUATION OF PATIENTS WITH ROTATOR CUFF TEARS

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ABSTRACT **Aim:** To Compare the Diagnostic accuracy of MRI vs Arthroscopy in the diagnosis of rotator cuff tears, considering arthroscopy as the gold standard. **Methods:** This prospective study was carried out between September 2017- September 2019. A total of 28 patients who were diagnosed with rotator cuff injury on MRI during this period and who underwent further evaluation with arthroscopy were included in this study. The data collected was analysed for significant correlation between MRI diagnosis and arthroscopic findings using kappa statistics. The sensitivity, specificity, predictive value and accuracy of MRI for the diagnosis of full and partial thickness tears were calculated using arthroscopic findings as the reference standard. **Results:** There were 12 male sand 16 females in this study. The mean age of the patients was 58.5±12.66 years. MRI showed a sensitivity of 93.3%, specificity of 73.7%, positive predictive value of 73.7% and negative predictive value of 93.3% for the diagnosis of full thickness rotator cuff tears. For partial thickness tears, MRI showed a sensitivity of 81.8%, specificity of 82.6%, positive predictive value of 69.2% and negative predictive value of 90.5%. The accuracy was 93.3% for full thickness tears and 81.9% for partial thickness tears. There was good agreement between the MRI and arthroscopic findings, with kappa value of 0.65 for full thickness tears and 0.62 for partial thickness tears. **Conclusion:** MRI revealed high sensitivity and specificity for the diagnosis of both partial and full thickness rotator cuff tears. MRI provides useful information about the size and extent of the tear, involvement of adjacent structures, presence of muscle atrophy and tendon retraction, all of which have important therapeutic and prognostic implications.

KEYWORDS : Arthroscopy, Rotator cuff tear, MRI

INTRODUCTION:

The rotator cuff comprises of four muscle – subscapularis, supraspinatus, infraspinatus and teres minor. (1) The rotator cuff muscles not only help in movement but also helps in dynamic stabilization of the shoulder joint. (2)

The common disorders of rotator cuff tendons include impingement, tendinopathy and tear. Rotator cuff pathologies are dependent on age, occupation, trauma, acromion type, acromioclavicular degeneration, proximal migration of humeral head and bony spurs. (3) Rotator cuff tears are broadly of two types, Full thickness and partial thickness tears depending on the involvement of the whole or part of the tendon. As it is one of the most versatile and important joints needed for daily activities a thorough understanding of the anatomy and functioning of rotator cuff tears is essential for treatment planning and prognostic accuracy. Now with the advent and evolution of ultrasound (USG) and magnetic resonance imaging (MRI), conventional arthrography is essentially obviated for evaluation of rotator cuff. MRI with its excellent soft tissue resolution and ability for multiplanar imaging has now become the investigation of choice for preoperative evaluation of rotator cuff tears. (4) MRI can also help in giving additional details about tendon retraction, muscle atrophy, fatty degeneration and coracoacromial impingement. (5)

Arthroscopy is the "gold standard" for the diagnosis of shoulder pathologies. However, like arthrography arthroscopy is an invasive procedure and requires hospitalization. Like any surgery there is risk of infection, damage to adjacent brachial plexus and anaesthesia related complications.

The primary objective of my study was to find the diagnostic accuracy of MRI in detecting rotator cuff tears considering arthroscopy as the gold standard.

MATERIALS AND METHODS:

Institutional Review Board approval was taken for this prospective study. Informed consent was taken from all the patients before MRI & Arthroscopy. Data set consists of MRI observations of patients with suspected rotator cuff tear and arthroscopy performed from the department of Radiodiagnosis and department of Orthopedics respectively of Amrita Institute of Medical Sciences and research centre, Kochi during the period 2017- 2019. We included 28 observations in this study.

Study population includes patients with suspected rotator cuff tear who were willing to undergo MRI, MR Arthrogram and Arthroscopic evaluation. Patients with contraindication to arthroscopic examination, with contraindication to MRI imaging, not willing for arthroscopic examination or MR imaging, with active infection and with osteoarthritis of shoulder joint were excluded. Imaging was performed using 1.5T MR Imaging HDXT Machine, GE Medical Systems, Milwaukee, Wisconsin and 3T Discovery MR750W, GE Medical system Milwaukee using specific shoulder coil placed in the affected shoulder with patient in supine position. Multiplanar imaging were obtained in axial, oblique coronal and oblique sagittal planes. The data set was initially screened by a senior radiologist of 20 years' experience applying the inclusion and exclusion criteria. Interpretation of data sets were done by 3 radiologists trained in musculoskeletal imaging. All patients were evaluated with PD fat saturation sequences in the axial, sagittal, and coronal planes, supplemented with a T1 coronal sequence. MR Arthrogram will be done whenever it is deemed necessary. Rotator cuff tears detected on MRI were classified as no tear, full thickness or partial thickness tears. All 28 patients underwent arthroscopic evaluation of the shoulder joint.

Statistical analysis was done using IBM SPSS Statistics 20 Windows (SPSS Inc., Chicago, USA). Validity parameters namely Sensitivity, Specificity, Accuracy, Positive Predictive Value and Negative Predictive Value was computed for MRI with respect to Arthroscopy (GOLD STANDARD). To test the statistical significance of the association of results between MRI and Arthroscopy (gold standard) for different pathological variables. McNemar's Chi-Square's test was applied. If the p value is found to be <0.05 the disagreement between the two methods was found to be statistically significant difference. To assess the agreement between MRI and Arthroscopy, Cohen's kappa analysis was performed.

RESULTS:

In this study a total of 28 patients who underwent both MRI and arthroscopy for evaluation of rotator cuff tears were included. We had 12 males and 16 females in our sample. The mean age of patients studied were 58.53±11.09years, the youngest being 38 years and the oldest being 87 years.

The tendon that was most involved was supraspinatus tendon- 19 of the patients, followed by infraspinatus and subscapularis which was

involved in 2 patients each. Among them 5 patients had multiple muscles involved. Teres minor tear was not seen in any of the patients (Table 1).

Out of 28 patients suspected with tear, MRI showed 19 (56%) patients to be full thickness tear, 13 (38%) of cases to be partial thickness tear and 2 (6%) of cases to be with no tear. In comparison arthroscopy revealed 15 (44%) of cases to be full thickness tear, 11 (32%) of cases to be partial thickness tear and 8 (24%) of cases to be with no tear (Table 2)

MRI was able to accurately diagnose full thickness tears in 14/15 cases with a sensitivity of 93.3%, a specificity of 73.7%, a positive predictive value of 73.7 per cent and a negative predictive value of 93.3 per cent. MRI has been able to accurately detect partial thickness tears in 9 out of 11 cases, giving an 81.8% sensitivity, 82.6 % specificity, a positive predictive value of 69.2% and a negative predictive value of 81.8%. Kappa value was also measured and found to be 0.65 for full thickness and 0.61 for partial thickness tears. This signifies that there is substantial agreement between arthroscopy and MRI in diagnosis of rotator cuff tears (Table 3)

Table 1 - Distribution of various rotator cuff tears involved among patients

Muscle	Number	Percentage (%)
Supraspinatus	19	67.85
Subscapularis	2	7.14
Infraspinatus	2	7.14
Multiple Muscles	5	17.86

Table 2- Distribution of various rotator cuff tears involved among patients

Type of Tear	Frequency in MRI	Frequency in Arthroscopy
Partial Thickness	13 (38.2%)	11 (32.4%)
Full Thickness	19 (55.88%)	15 (44.1%)
No tear	2 (5.88%)	8 (23.5%)

Table 3 - Correlation of MRI findings and Arthroscopy

	Sensitivity	Specificity	PPV	NPV	Accuracy
Partial Thickness Tear	81.8%	82.6%	69.2%	90.5%	81.4
Full Thickness Tear	93.3%	73.3%	73.7%	91.3%	93.3%

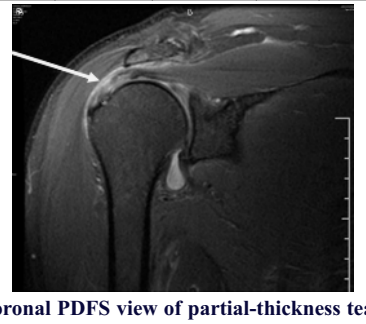

Figure 1. Coronal PDFS view of partial-thickness tear(arrow) in supraspinatus muscle

Figure 2: Coronal PDFS view of full-thickness tear in supraspinatus muscle with retraction of the tendon (arrow) from its insertion

DISCUSSION:

Equivocal distribution of rotator cuff pathologies has been described in most studies. In our study, rotator cuff pathologies were seen in 12 male patients and 16 female patients. This corresponds well with a study conducted by Milgrom et al among 90 patients, which showed no statistically significant gender-related differences in the incidence of rotator-cuff lesions. [7]

In our study the age of the patients with rotator cuff tears ranged from 40-90. The peak incidence was found in 5th and 6th decade of life. Numerous studies have shown that the frequency of tendon degeneration and damage to the rotator cuff increases with age. Multi-factorial extrinsic and intrinsic causes have been involved in rotator cuff disorders. Intrinsic factors such as low vascularity, alteration in material composition and aging properties have been studied. Ozaki et al. and Uhthoff concluded that rotator cuff disease pathogenesis is an intrinsic process, and with age, the risk of rotator cuff disorder rises. [8] Microvascular studies showed reduced vascularity with increased age in the cuff tissue, which appears to be consistent with the degeneration pattern found in degenerative tendinopathies associated with age. [9] In a study conducted by Needell et al, more tears were observed in the older age group, which is consistent with our research. he extrinsic factors such as impingement secondary to spurs, enthesophytes, down-sloping acromion, acromion type II & III also increase with age. [10]

Pathologies of the rotator cuff include subacromial impingement causing tendinopathy, rotator cuff tears in partial and full thickness, muscle atrophy, and coracoid impingement affecting the tendon of subscapularis. The most frequently affected tendons in our study are supraspinatus, followed by subscapularis and infraspinatus. In this study, Teres minor was not involved in any of the patients. This is in line with the research performed by Jerosch et al. In this study conducted on the dissected specimen of shoulder joints of 122 patients; it was found that isolated supraspinatus pathology occurred in 78% cases. [11] In our study both MRI and arthroscopy detected 24 patients with rotator cuff pathology involving supraspinatus tendon. Subscapularis pathology was noted in 7 patients and Infraspinatus pathology was noted in 3 patients. All the subscapularis and infraspinatus pathologies in our study except for 4 had supraspinatus involvement. This is comparable to study by Zlatkin et al wherein they found supraspinatus tendon involvement in all rotator cuff pathologies. [12] Another study by DePalma et al showed similar results in which he examined 96 cadaver shoulder and showed similar finding of supraspinatus as the commonly affected tendon and the incidence and degree of tear increases with age. [13]

On T2 weighted images, partial thickness tears are seen as a focal area of fiber discontinuity filled with fluid signal.(Fig1). Fluid filled tendon defect are better appreciated on fat suppressed sequences. [14] Beside tendon defect, MRI can also help in giving the clinician surface fraying and changes in tendon calibre.

Out of the 28 patients, initial MRI evaluation in our study showed 13 muscles had partial thickness tears, 19 muscles with full thickness tears and 2 muscles had no tears. In comparison, arthroscopy showed 11 muscles as partial thickness tears, 15 as full thickness tears and 8 as no tear. Of the 32 tears in MRI, 23 showed similar tears in Arthroscopy.

The Sensitivity and specificity for diagnosis of partial thickness tears using MRI compared to arthroscopy were 81% and 82% respectively and the and the Cohen's kappa value and 0.61 respectively. Sensitivity, specificity and kappa value for diagnosis of full thickness tear using MRI (Fig 2) compared to arthroscopy were 93%, 74% and 0.65 respectively. There was no significant difference on comparing MRI with arthroscopy for diagnosis of full thickness tear (p-value = 0.219) and for diagnosis of partial thickness tear (p-value = 0.687). The kappa coefficient was also high, which indicates a very close alignment of MRI results and arthroscopy in the diagnosis of rotator tears, for both partial thickness and full thickness tears. Our findings are consistent with literature, with the majority of studies showing sensitivity and specificity varying from 75% to 100%. [15] The MRI sensitivity and 92.1% and 92.9% for full-thickness and partial thickening tears were 63.6% and 91.7%, for a large-scale meta analysis carried out by de Jesus JO et al. in 2009. [16]

Our analysis therefore shows that MRI is effective in detecting rotator cuff tears and assessing the degree of tear (full or partial thickness), which can have major consequences in directing treatment choices. Davidson JF et al. stated that preoperative MRI can aid in patients with full thickness tears, and hence help in the possible repair process and provide the patient with some prognostic details. [17] An initial trial of conservative management should be undertaken in patients with

partial thickness tears with a thickness of less than 50%, while in partial tears more than 50% of tendon thickness surgery would be considered. [18]

CONCLUSION

Based on our study we would like to conclude that MRI demonstrated significant concordance with arthroscopy in the detection of both partial and full-thickness tears. Supraspinatus muscle is almost always involved in all patients with suspected rotator cuff tear. MRI also offers valuable information on atrophy of muscles, retraction of tendon, morphology of acromion, and fatty degeneration of muscle, which can have a direct effect on the final outcome of surgery. Hence we would like to recommend MRI for the initial evaluation and diagnosis of rotator cuff tears in a place of more invasive arthroscopy.

Abbreviations:

MR Arthrogram- Magnetic resonance arthrogram.
MRI: Magnetic Resonance Imaging.
USG: Ultrasound.
cm: CENTIMETER
CT: COMPUTED TOMOGRAPHY
FS: FAT SATURATED
TE: TIME TO ECHO

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