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ORIGINAL ARTICLE

MR ARTHOGRAPHY OF THE GLENOHUMERAL JOINT: ITS ROLE IN THE EVALUATION OF SHOULDER INSTABILITY AND PERSISTENT PAIN

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ABSTRACT: BACKGROUND: The purpose of the study was to evaluate the role of MR arthrography in identification and characterization of normal variants, rotator cuff tears and tears of labro-ligamentous complex of the glenohumeral joint and compare it with conventional MRI. **AIMS AND OBJECTIVES:** Identification, signal characterization and grading of rotator cuff tears and to detect, localize and characterize tears of the labroligamentous complex and to differentiate them from the normal variants. **METHODS:** Thirty three patients in the age group of 18-60 years with history of shoulder instability or persistent pain due to previous injury were prospectively evaluated with conventional MRI followed by MR arthrography. Patients with active joint infection, contrast allergy and joint effusion were excluded from the study. Conventional MRI and MR arthrographic findings were recorded separately and then compared. **RESULTS:** Statistically significant difference was found between conventional MRI and MR arthrography in the identification and characterization of labro-ligamentous tears while no statistical difference was found between the two in detection of rotator cuff tears. High incidence of co-occurrence was found between hill-sachs defect and bankart lesions/variants. **CONCLUSIONS:** MR arthrography is superior to conventional MRI for the delineation of intra-articular structures of the glenohumeral joint and in the detection and characterization of labral tears. Since rotator cuff tears are commoner in older age group in comparison to labral tears which are commoner in patients aged less than 40 years, MR arthrography is the imaging modality of choice in younger age group, irrespective of the clinical indication.
KEYWORDS: MRI, arthrography, glenohumeral, bankart.

INTRODUCTION: The shoulder is the most commonly dislocated major joint of the body. The discrepancy in size between the small glenoid fossa and the large humeral head gives the glenohumeral joint the greatest mobility among the human articulations but also makes this joint particularly vulnerable to dislocation. The stability of the glenohumeral joint is maintained by passive and active mechanisms.[1]

Use of MR arthrography to evaluate the pathological conditions of the shoulder is becoming widespread. MR arthrography is the preferred imaging technique for the investigation of patients with shoulder instability. When performed in conjunction with magnetic resonance (MR) imaging, shoulder arthrography enables detailed evaluation of the cartilaginous structures of the glenohumeral joint.[2]

It reliably shows subtle lesions of the labroligamentous complex as well as rotator cuff, providing information essential to the surgeon concerning the surgery or arthroscopic repair.[3] The diagnostic accuracy of MR arthrography of the shoulder may exceed that of conventional MR imaging of the shoulder. Intraarticular structures are better demonstrated if they are separated by means of capsular distention.

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Such separation can be achieved with intraarticular injection of contrast material (diluted gadopentetate dimeglumine) or saline or with preexisting joint fluid (joint effusion). The goal is to produce high contrast between the labrum, capsule, capsular recesses, glenohumeral ligaments (GHLs), and articular surface of the rotator cuff.[4]

Traumatic glenohumeral dislocation is a commonly encountered injury, with predictable patterns of associated injuries when the mechanism is known. Although radiography is the accepted standard for initial evaluation, CT, MRI, and MR arthrography serve critical roles in characterizing injury types and associated anatomic abnormality, ultimately influencing the operative treatment approach and timing.[5]

Rotator cuff tears cover a spectrum of injuries. At one end are relatively high-force injuries to a healthy rotator cuff that typically produce full-thickness tears. The degree of trauma usually required would be a significant fall, motor vehicle crash, or shoulder dislocation. Lesser degrees of trauma can cause partial-thickness tears. On the other end of the spectrum are overuse injuries. Traumatic rotator cuff tears can occur at any age. Overuse injuries generally occur in athletes and increase in frequency with advancing age.[6]

The SLAP lesion (superior labrum anterior and posterior) and other glenoid labral tears are common in throwing athletes who present with a painful shoulder that clicks or pops with motion. Patients often have a positive “clunk” test, especially in the overhead position. They may have tenderness to deep palpation over the anterior glenohumeral joint and signs of laxity or instability. Plain films are often normal, and MRI arthrography may be needed to view the torn labrum.[7]

MATERIALS AND METHODS: The present study included 33 patients in the age group of 18-60 years with the history of shoulder instability or persistent pain due to previous injury attending outdoor patients department or admitted in our institute were included in the study. Patients with active joint infection, contrast allergy and joint effusion were excluded from the study.

All patients underwent MRI examinations on Phillips Achieva 1.5 Tesla MRI, Phillips Medical Systems, Veenplus, The Netherlands, using Sense Flex- M coil. Sequences were acquired in axial, coronal and sagittal planes. Following conventional MR imaging, MR arthrography was performed using a fluoroscopically guided anterior approach.

We combined 0.1 mL of gadopentetate dimeglumine, 10 mL of iohexol, 10 mL of sterile 0.9% sodium chloride, and 5 ml lignocaine. It is very important to minimize the introduction of air bubbles during any of the injections because they produce artifacts at MR imaging. An injection of 10-16 mL was used to distend the shoulder. Increased resistance to injection or the retrograde flow of contrast material from the connecting tubing after the syringe was disconnected indicated adequate joint distention.[2] Then post arthrographic sequences were acquired. Both conventional MRI and MR arthrographic images were analysed and the findings were compared.

RESULTS: Amongst 33 subjects studied, maximum number of patients (15) was in the age group of 19-30 years. Mean age of the patients was 34.8 years. Male and female population contributed 23(69.7%) and 10(30.3%) cases each in the study. Thus shoulder injuries were more commonly found in the male population. The most common variation in labro-ligamentous complex detected on MR arthrography was sublabral recess in 8 patients followed by sublabral foramen and absent MGHL in 3 patients each and thickened MGHL found in 2 patients. Majority (60.6%) of the patients with

shoulder pain and instability had labral tears. Rotator cuff tears were found in 15(45.4%) patients while ligament tears were found in 33.3% of patients. This was because majority of the patients in our study were in the young age group (19-40 years) and incidence of labral tears is also most common in this age group. Amongst the supraspinatus tears, partial thickness tears (8 subjects) were more commonly found than full thickness supraspinatus tears (5 subjects). Most of the patients who had labral tears on MR arthrography were found in the 19-40 year age group. Amongst the bankart lesions found in total of 14 patients, osseous bankart lesion was found to be the most common, seen in 5 patients followed by soft tissue bankart lesion found in 4 patients. Other bankart variants found in the study were perthes lesion in 2 patients, GLAD, ALPSA and GLOM in 1 patient each. Co-occurrence of bankart lesion and hill sachs defect was found in 11 patients with isolated occurrence of bankart lesion without hill sachs defect in only 3 patients indicating a strong correlation between the two. Higher incidence of detection and better characterization of SLAP lesions was found on MR arthrography (7 patients) as compared to conventional MRI (4 patients).

DISCUSSION: The improved contrast and joint distension afforded by direct arthrography optimize evaluation of various intra-articular structures and help to define subtle abnormalities and distinguish normal variants from true shoulder pathology.[8] Intra-articular injection of a solution containing dilute gadolinium-diethylenetriamine penta-acetic acid (DTPA) followed by T1-weighted imaging (direct MR arthrography) was first described in 1987 by Hajek and colleagues.[9] Due to its superior soft tissue contrast, MR arthrography gradually superseded the use of CT by the 1990s.[8] Amongst 33 patients in our study, superior, middle and inferior glenohumeral ligaments were identified in 12.1%, 24.2% and 6.1% patients while these were detected in 90.9%, 84.8% and 93.9 % patients on MR arthrography. This is in close approximation to the previous study[10] in which the superior, middle and inferior glenohumeral ligaments were identified on MR arthrograms in 85%, 85% and 91 % of the patients respectively. Palmer et al,[11] identified superior GHL in 98% of 48 patients with MR arthrography which is in close consensus with our study.

MGHL showed variations in 5 (15.1%) of the total 33 patients in the study. The variants included absent MGHL in 9.1% subjects and thickened MGHL in 6.1% patients. Thus MGHL shows the greatest variation of all the GHLs.[12] In our study, MGHL was not identified and thus assumed to be absent in 9.1% patients. MGHL was not identified in 12% of patients evaluated with MR arthrography as published in a study by Palmer WE et al.[11] Amongst the variants of glenoid labrum, Sublabral recess was found in 8 (24. 2%) patients while sublabral foramen was seen in 3 (9.1%) patients similar to the previous study by Stroller DW,[13] in which a sublabral foramen (sublabral hole) was seen in 11% of individuals.

Out of 13 patients with supraspinatus tears, the study showed full thickness supraspinatus tears in 5 (15.1%) patients and partial thickness tears in 8 (24.2%) patients. These findings were in close agreement with the study conducted by Zanetti M et al,[14] which showed 9 partial thickness and 5 full thickness supraspinatus tears in the trauma group of 24 patients.

MR arthrography was found to be more sensitive than conventional MRI in detection of rotator cuff tears though no statistically significant difference was found between conventional MRI and MR arthrography in case of full thickness and partial thickness tears which correlates with the study conducted by Magee T,[15] which showed no statistically significant difference between the two in the detection of full thickness tears and a statistically significantly increased sensitivity compared

with conventional MRI for partial thickness articular surface supraspinatus tendon tears. Nineteen of twenty patients with labral tears were in the age group of 19-40 years which correlates with the study conducted by KR rowan.[16] A statistically significant difference was found in the detection of labral tears by MR and MR arthrography in our study. MR Arthrography t is found superior in the detection of labral tears.[17],[18]

Amongst the anteroinferior labral injuries in the study, classic bankarts was found in 9 patients, perthes lesion in 2 patients and ALPSA, GLAD and GLOM in one patient each. The findings closely correlated with the previous study by Hiari AA et al,[19] in which classic bankart was found in 15, perthes in 2, ALPSA in 3 and GLAD in one patient amongst the total 28 patients.

All the bankart variants are detected only on MR arthrography.[20]

Equal incidence of detection of hill-sachs defect was found on conventional MRI and MR arthrography in our study. No statistically significant difference was found between MRI examinations with and without intra-articular gadolinium in detection of hill-sachs lesion.[21]

11 (78.6%) out of 14 patients with bankart lesion/ bankart variant had associated hillsachs defect. Previous study by Widjaja AB et al,[22] also showed a strong correlation was found between these lesions. This study concluded usefulness in predicting the presence of a bankart lesion when a hill sachs lesion is identified on a plain radiograph. Similar conclusion was made by Horst K et al,[23] who stated that if either lesion is diagnosed, the patient is 11 times more likely to have suffered the associated injury.

Four SLAP lesions were detected on conventional MRI while MR arthrography detected SLAP tears in 7 patients. Thus MR arthrography is superior to conventional MR imaging in the detection of SLAP lesions.[20],[17],[24]

CONCLUSION: The stability of the glenohumeral joint is the function of various structures including the glenoid labrum, glenohumeral ligaments, rotator cuff tendons and the deltoid muscle. MR arthrography is superior to conventional MRI for the delineation of intraarticular structures of the joint.

Statistically significant difference is found between conventional MRI and MR arthrography in the detection of labral tears. Various bankart lesions and its variants described in our study also are better detected only on MR arthrography, prior characterization of which has surgical implications.

Since rotator cuff tears are more common in older age group in comparison to labral tears which are commoner in patients aged less than 40 years, MR arthrography is the imaging modality of choice in younger age group, irrespective of the clinical indication.

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FIGURE 1A: Coronal T2W TSE SPAIR shows linear hyperintense signal within the superior labrum (circle): SLAP 2.

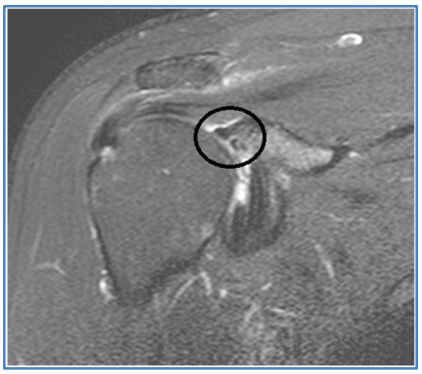

Fig. 1A

FIGURE 1B: Coronal fat saturated PD SPAIR MR arthrogram shows bucket handle tear of superior labrum (arrow): SLAP 3.

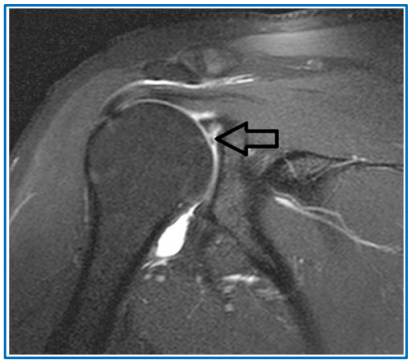

Fig. 1B

FIGURE 1C: Saggital fat saturated T1W MR arthrogram shows torn SGHL (arrow).

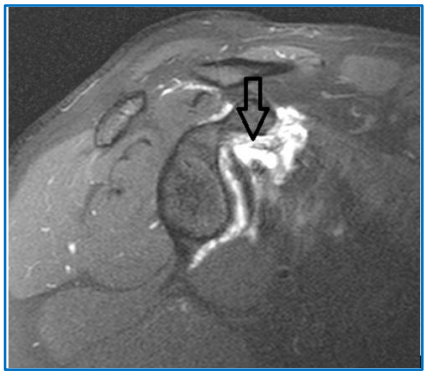

Fig. 1C

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FIGURE 2A: Axial T2W 3D FFE image shows tear of anteroinferior labrum (white circle): Soft tissue bankart lesion.

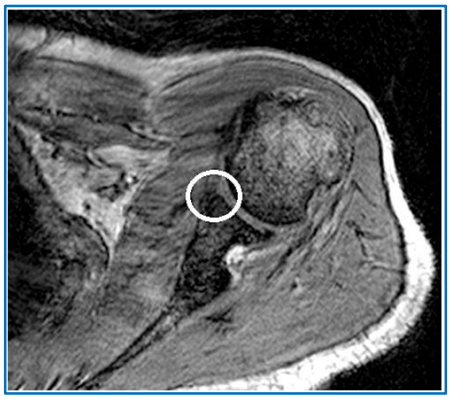

Fig. 2A

FIGURE 2B: Axial fat saturated T1W MR arthrogram shows avulsion of anteroinferior labrum (thick arrow) with focal loss of articular cartilage (thin arrow): GLAD.

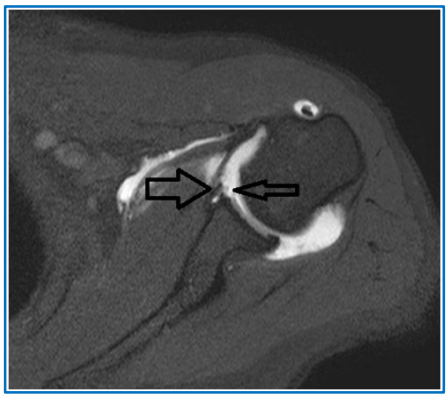

Fig. 2B

FIGURE 2C: Axial fat saturated T1W MR arthrogram shows loose body (black circle) in the glenohumeral joint from the detached articular cartilage.

Fig. 2C

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FIGURE 3: Axial fat saturated T1W MR arthrogram shows tear of the anterior labrum along with stripping of the periosteum (circle): Perthe's lesion.

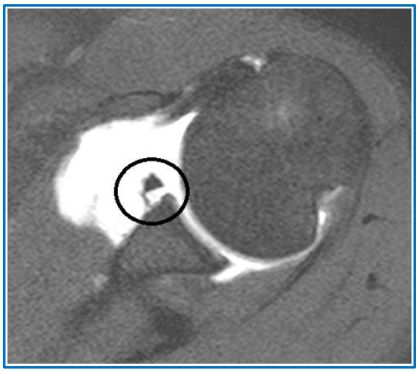

Fig. 3

FIGURE 4B: Axial fat saturated T1W MR arthrogram shows avulsion of the anterior labrum along with break in the anterior glenoid rim (circle): Osseous Bankart lesion.

Fig. 4B

FIGURE 4A: Axial fat saturated T1W MR arthrogram shows compression and cortical irregularity of the posterolateral humeral head (circle): Hill Sachs defect.

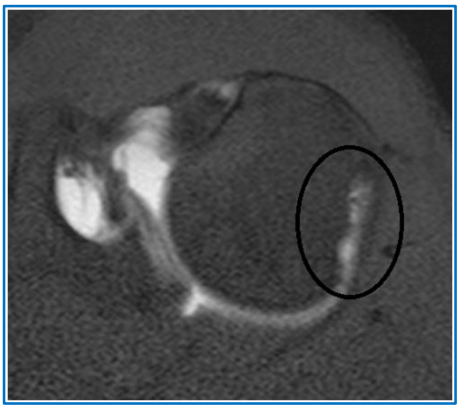

Fig. 4A

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FIGURE 5: Axial fat saturated T1W MR arthrogram shows tear of the antero-inferior labrum with medialisation of the torn labrum (arrow): ALPSA.

Fig. 5

LIGAMENTS	CONVENTIONAL MRI	%AGE	MRA	%AGE	P VALUE
SGHL	04	12. 1	30	90. 9	<0. 001
MGHL	08	24. 2	28	84. 8	<0. 001
IGHL	02	6. 1	31	93. 9	<0. 001
CHL	25	75. 7	30	90. 9	0. 099

TABLE 1: Comparison of Frequency of Detection of Ligaments on Conventional MRI And MR Arthrography

NS: p> 0. 05; Not Significant; *p< 0.05; Significant.

FULL THICKNESS SUPRASPINATUS TEAR	NUMBER OF PATIENTS
TEAR ON CONVENTIONAL MRI	4
TEAR ON MR ARTHROGRAPHY	5

TABLE 2: Comparison of Conventional MRI And MR Arthrography in Detection of Full Thickness Supraspinatus Tears

P value= 0. 292; Not Significant.

PARTIAL THICKNESS SUPRASPINATUS TEAR	NUMBER OF PATIENTS
TEAR ON CONVENTIONAL MRI	5
TEAR ON MR ARTHROGRAPHY	8

TABLE 3: Comparison of Conventional MRI and MR Arthrography in Detection of Partial Thickness Supraspinatus Tears

P= 0. 055; Not Significant.

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LABRAL TEAR	NUMBER OF PATIENTS
TEAR ON CONVENTIONAL MRI	15
TEAR ON MR ARTHROGRAPHY	20

TABLE 4: Comparison of MR and MR Arthrography in Detection of Labral Tears

P= 0. 017; Significant.

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