

Comparative Study of MRI and Operative Findings in Rotator Cuff Tears

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Abstract: Purpose: To compare the accuracy of Magnetic resonance imaging (MRI) in diagnosis of Rotator cuff (RC) tears. **Methods:** In a descriptive-analytical study at the Department of Radiology, Tabriz University of Medical Sciences on patients with shoulder pain, diagnostic accuracy of MRI in diagnosis of lesions in patients with suspected tearing of RC was evaluated. **Results and Conclusion:** 23(59%) of patients were male and 16(41%) were female. Mean age of the male patients was 52.21±6.8 years and in female patients was 53.18±7.3 years (P=0.674). The sensitivity of MRI in the diagnosis of rotator cuff lesions was 100% in Supraspinatus and 66.7% in Infraspinatus and Subscapularis lesions. The specificity of MRI in the diagnosis of rotator cuff lesions was 100% in the Supraspinatus and Infraspinatus and 90% in Subscapularis tears. Generally, MRI had high sensitivity in the Supraspinatus, and high specificity in all rotator cuff muscles tears diagnosis.

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1. Introduction

Shoulder pain is one of the most common complaints in medical visits. A wide variety of causes have been addressed for such a pain (Yamakawa, 2001; Guo, 2000). Rotator cuff (RC) involvements and its tears are the most important cause of shoulder pain in people over the age of 40 (Guo, 2000).

With advances in arthroscopic techniques for repair of RC complications, MRI plays a crucial role as a noninvasive diagnostic method in the diagnosis of such lesions. This method also has the ability to predict which patients will obtain more acceptable results after the related surgeries (Guo, 2000).

Arthrography has been introduced as an accurate imaging method for diagnosis of RCT. This method has some deficiencies such as invasiveness and lacking a high sensitivity in diagnosis of partial-thickness tearing in the rotator cuff, especially in bursal side or in its mid-tendon part (Yamakawa, 2001).

Ultrasonography is a noninvasive method in the diagnosis of RC tearing as accurately as arthrography method. This method is technically

dependant to the operator's experience and skill and lacks the ability to show full details of the RC (Yamakawa, 2001; Teefey, 2004). This method is also inefficient in obese people and those with reduced range of motion in the shoulder joint. On the other hand, it has low sensitivity for diagnosis of partial-thickness tears (Teefey, 2004).

The usual MRI sequences, along with T2WI are the preferred method for RC imaging in oblique coronal and oblique Sagittal planes (Guo, 2000).

Most researchers believe that Fat-Suppressed sequences, Fast-Spin-Echo (FSE), and T2WI are very convenient and efficient for the diagnosis of rotator cuff tears (RCT), and expected to achieve a sensitivity of 84-100 percent and a specificity of 77-97 percent in the diagnosis of full-thickness tearing lesions (Guo, 2000; Singson, 1996). Regarding all these cases, MRI is considered as the first diagnostic modality in the evaluation of the shoulder area. Due to its capability of providing a high resolution of soft tissue, non-invasive nature and ability to draw the structures at different levels, MRI has attained a special position among the various diagnostic procedures.

Previously, a few studies have compared the diagnostic power of MRI in the diagnosis of RC-related lesions such as RCT with the surgical findings. In this study, we evaluated the accuracy of MRI and proper application of its various common sequences by High Field MRI systems as a diagnostic modality for RCT cases compared to surgical findings.

2. Materials and Methods:

In a cross-sectional descriptive-analytical study in the Department of Radiology, Tabriz University of Medical Sciences on patients with shoulder pain, diagnostic accuracy of MRI in diagnosis of lesions in patients with suspected tearing of rotator cuff (RC) was evaluated.

This study was conducted on 39 patients with shoulder pain, examined by MRI and undergone reconstructive treatment.

In this study, subjects were selected with no age restrictions from among the patients with suspected tearing of rotator cuff (RC) and nominated for surgery. Prior to the surgery, all patients had MRI images of shoulder indicating a lesion in the RC. No age and sex restrictions were considered in this study. However, the subjects feeling anxious in MRI environment, or MRI imaging of shoulder was impossible for them, were excluded from the study. Exclusion criteria also included a history of previous shoulder surgeries, humerus fractures, and inflammatory arthritis.

MRI imaging was performed by a 1.5 Tesla (High Field) device. Axial, oblique coronal, and oblique Sagittal T2 weighted fast spin echo and fat sat proton-density images were taken from the shoulder area. Slices were 3-5mm thick, and all the images were reported by a radiologist with sufficient experience in the field of MRI for muscular-skeletal system. MRI interpretations were handed over to the orthopedic surgeon during the corresponding surgery. At the time of evaluating the results, the person in charge of statistical evaluation is blinded to these interpretations. An orthopedic surgeon was in charge of all referred cases (reconstructive surgery of shoulder) subject to the RC tearing.

In full-thickness tears, all tendon fibers were completely detached or the signals inside Cuff tendons were isointense to the intra-tendon fluid. Thus, in case of observing any rupture in a number of tendon fibers and not in all of them in MR images, a partial-thickness tear was diagnosed. The length of tear in partial-thickness tears, the extent of its retraction in full-thickness tears and its width in all tears were separately recorded.

Maximum anteroposterior dimensions of the tears were measured by oblique imaging, and the

maximum degree of retraction was evaluated in the oblique coronal images. The measurements were assessed on MRI images and reported in mm units. When a full-thickness tear was observed by the side of or superimposed with a partial-thickness tear, only the full-thickness tear was taken into consideration. Furthermore, due to the different situations of the shoulder in various stages of the study (MRI imaging and Surgery), the measured values at the end of the torn tendon may be different figures; thus in order to amend this issue in the two assessment methods (MRI and Surgery), the distance between the end of the retracted part of tendon and the outer edge of the articular surface was measured and reported.

Effusion of the subacromial bursa and glenohumeral joint was evaluated by oblique coronal plans in axial plans of T2WI images.

In this study, due to ethical issues and the observance of the patients' rights, the orthopedist surgeon was fully aware of the detailed reports of MRI method, and subsequently announced the surgical findings.

The presence or absence of full- or partial-thickness tears in RC was considered during surgery (open or arthroscopic). The extent of retraction, or the length, width and depth of the torn area were measured by direct observation using a scaled measurement tool designed for this purpose.

Type or types of RC tears observed in MRI images for each individual were collected, and after completion of MRI imaging data, the results of assessments and findings of open surgery were recorded and compared.

3. Results

In this study, 39 patients suffering shoulder pain with rotator cuff tears according to evaluation by MRI underwent surgery, and accuracy and efficiency of MRI in diagnosis of rotator cuff tears were evaluated.

23(59%) of patients were male and 16(41%) were female. Mean age of the male patients was 52.21 ± 6.8 years and in female patients was 53.18 ± 7.3 years ($P=0.674$).

In MRI, Supraspinatus muscle suffered full-thickness tear in 34 patients and partial-thickness tear in 4 patients. Other MRI findings in patients are shown in Table 1 based on the patients' gender.

In surgery, Supraspinatus muscle suffered full-thickness tear in 34 patients and partial-thickness tear in 4 patients and was intact in 1 patient. Other intraoperative findings in patients are shown in Table 2 based on the patients' gender.

Sensitivity and specificity of MRI in the diagnosis of rotator cuff lesions in comparison to those of surgical findings are shown in Table 3.

Significant agreement was found between MRI findings in diagnosis for rotator cuff tearing with surgery findings ($P < 0.05$). Dominant Hand, involved shoulder, history of trauma to shoulder and distance of trauma and MRI based on gender were shown in table 4.

Table 1. MRI finding of rotator Cuff lesion based of sex

		Gender		P
		Male	Female	
Supraspinatus	Full Thickness Tear	21	13	0.641
	Partial Thickness Tear	1	3	
	Intact	1	0	
Infraspinatus	Full Thickness Tear	4	2	0.563
	Partial Thickness Tear	3	1	
	Intact	16	13	
Subscapularis	Full Thickness Tear	3	0	0.315
	Partial Thickness Tear	4	2	
	Intact	16	14	

4. Discussions

Rotator cuff tears are common orthopedic injuries (Warrender, 2011). Open repair of full-thickness tears of the rotator cuff generally improves function (Nich, 2009).

MRI is one of the diagnostic tools for diagnosis of Rotator cuff tears.

Rotator cuff pathology is a common cause of shoulder pain, and imaging plays a major role in the management of shoulder problems (Gazzola, 2011).

MRI plays a crucial role as a noninvasive diagnostic method in the diagnosis of such lesions. This method also has the ability to predict which patients will obtain more acceptable results after the related surgeries (Guo, 2000).

In our study, in overall comparison of MRI results with surgical findings in the diagnosis of rotator cuff tear, only in 2 patients the rotator cuff was intact during surgical assessment.

Multiple modalities are available for imaging the shoulder, including radiography, arthrography, computed tomography (CT), CT arthrography, ultrasound (US), magnetic resonance imaging (MRI), and MR Arthrography (Cothran, 2006).

Musculoskeletal ultrasound and magnetic resonance imaging are the most suitable modalities for the investigation of the rotator cuff, having high sensitivities and specificities for full-thickness tears (Gazzola, 2011).

In a study by Shellock et al in 2001, their findings indicated a high consistency of the MRI images using low field extremity MR system with the surgical findings in diagnosis of RC lesions (Shellock, 2001).

The presence or absence of a full-thickness rotator cuff tear (FTRCT) may determine the type of surgical treatment. Both MRI and conventional arthrography can be used, but little is known about their relative diagnostic and therapeutic impact (Blanchard, 1999).

MRI or ultrasound could equally be used for detection of full-thickness rotator cuff tears, although ultrasound may be better at picking up partial tears (Dinnes, 2003).

Magnetic resonance imaging and arthrography had fairly similar diagnostic and therapeutic impact and comparable accuracy, although MRI was more sensitive and less specific. Magnetic resonance imaging may be the preferred investigation because of its better demonstration of soft tissue anatomy (Blanchard, 1999).

Table 2. Surgery finding of rotator Cuff lesion based of sex

		Gender		P
		Male	Female	
Supraspinatus	Full Thickness Tear	22	12	0.315
	Partial Thickness Tear	0	4	
	Intact	1	0	
Infraspinatus	Full Thickness Tear	9	5	0.582
	Partial Thickness Tear	1	0	
	Intact	13	11	
Subscapularis	Full Thickness Tear	6	2	0.373
	Partial Thickness Tear	1	0	
	Intact	16	14	

Table 3. Sensitivity and Specificity of MRI in diagnosis of rotator cuff lesions

	Sensitivity	Specificity
Supraspinatus	100%	100%
Infraspinatus	66.7%	100%
Subscapularis	66.7%	90%

In a retrospective study on 97 patients in 1995, Robertson et al declared that full-thickness tear of RC can be accurately diagnosed by MRI.

They also stated that MRI lacks the capability to detect the lesions of tendonitis or partial-thickness tears or even normality of RC with high accuracy and is weak in differentiating between them (Robertson,

1995).

In our study too, MRI had reported full-thickness tear of supraspinatus in 2 cases (5.1%) of patients with partial-thickness tear, and partial-thickness tear of supraspinatus in 2 cases (5.1%) of patients with full-thickness tear.

Table 4. Dominant Hand, involved shoulder, history of trauma to shoulder and distance of trauma and MRI based on gender

		Gender		P
		Male	Female	
Dominant Hand	Right	22	16	0.57
	Left	1	0	9
Involved shoulder	Right	16	13	0.48
	Left	7	3	0
History of trauma to shoulder	Yes	20	15	0.63
	No	3	1	1
Distance of trauma and MRI		28.41 ± 41.70	27.67 ± 18.68	0.94 9

The sensitivity in demonstrating partial-thickness tears was 70% for arthrography and 80% for MRI; the specificity was 75% for arthrography or MRI. The sensitivity in detecting full-thickness tears was 87% for arthrography and 90% for MRI, and the specificity was 100% for arthrography and 75% for MRI (Singson, 1996).

In our study, the sensitivity of MRI in the diagnosis of rotator cuff lesions was 100% in the Supraspinatus, and 66.7% in Infraspinatus and Subscapularis; and the specificity of MRI in the diagnosis of rotator cuff lesions was 100% for the Supraspinatus lesions, and 100% and 90% in Infraspinatus and Subscapularis tears, respectively.

In a study in 2002, Motamedi et al evaluated the RC lesions in terms of the size of recurrent tears in it and compared the results with surgical findings. This study, conducted on 37 shoulders in 33 patients, showed that MRI is capable of accurate diagnosis of tearing in 30 cases (3-Motamedi, 2002).

Its sensitivity and specificity in the diagnosis of recurrent tears of RC were determined as 91% and 25% respectively (Nich, 2009).

In this study, the diagnostic accuracy of MRI in full-thickness tears was much higher compared to partial-thickness tears. Also determining the precise lesion size was not accurate.

Sensitivities for detecting full-thickness rotator cuff tears by magnetic resonance imaging and magnetic resonance arthrography were 90.2% and 100%, respectively (Toyoda, 2005).

The sensitivity and specificity of magnetic resonance imaging for the diagnosis of full-thickness tears, partial-thickness tears, and intact rotator cuffs

were 84 and 91 per cent, 83 and 83 per cent, and 80 and 100 per cent, respectively (Gaenslen, 1996).

Conclusion:

MRI plays a crucial role as a noninvasive diagnostic method in the diagnosis of rotator cuff lesions. This method also has the ability to predict which patients will obtain more acceptable results after the related surgeries. In our study, in an overall comparison of MRI results with surgical findings in the diagnosis of rotator cuff tear, only in 2 patients the rotator cuff was intact during surgical assessment.

In MRI, Supraspinatus muscle suffered full-thickness tear in 34 patients and partial-thickness tear in 4 patients. In surgery, Supraspinatus muscle suffered full-thickness tear in 34 patients and partial-thickness tear in 4 patients and was intact in 1 patient.

Significant correlation was found between MRI findings and operative findings in diagnosis of rotator cuff tearing ($P < 0.05$).

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