EVALUATION OF THE ROTATOR CUFF TEAR WITH MAGNETIC RESONANCE ARTHROGRAPHY

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INTRODUCTION: Rotator cuff tear is one of the common shoulder disorders and surgical repair is very effective for the improvement of shoulder functions. Current surgical technique for rotator cuff tear is an arthroscopic repair or a mini-open repair. Selection of surgical technique should be determined by the appropriate patient’s selection based on the pathology of the rotator cuff tear. Magnetic resonance imaging (MRI) has become a useful imaging modality for establishing the diagnosis, confirming or defining pathology and thereby, dictating treatment of rotator cuff tears. However, studies in the literature have reported 89% of sensitivity for the evaluation of the rotator cuff tears with MRI and attention has been focused on optimizing scanning protocols to increase accuracy\(^1\). Magnetic resonance arthrography (MRA), which is the intraarticular introduction of dilute gadolinium diethylenetriamine pentacetic acid (Gd-DTPA) before MR imaging, has been used to significantly improve visualization of the anterior glenoid labrum and rotator cuff lesions\(^2\). However, there is little known about the correct comparison between MRI and MRA for the evaluation of the rotator cuff lesions. Computerized image analysis system is reported to be helpful for the accurate evaluation of MR imaging\(^3\). The goal of our study is to elucidate the advantage of the shoulder MRA by comparing the rotator cuff lesion images among MRI and MRA and surgical findings with computerized image analysis system.

MATERIALS AND METHODS: Patients: We retrospectively evaluated MRI and MRA of 14 shoulders in 14 consecutive patients with rotator cuff tears that were surgically treated. There were 8 male and 6 female who had a mean age of 61.4 years. (range, 31-73) MR Imaging: With use of a 1.5 tesla MRI (Siemens Vision 1.5T) spin-echo fat-suppressed T1-weighted images were made with or without injection of 10ml of saline solution and 10ml of radiographically contrast medium (Isovist) containing 1% Gd-DTPA into the glenohumeral joint. Computerized measurements on MR Images: Pathology and size of rotator cuff tears were analyzed with MRI and MRA images. Concerning pathological changes, we classified several types of the edge of torn rotator cuff with MRI images. Concerning rotator cuff tear size, we assessed the following two parameters with both of MRI and MRA images. 1) The maximum transverse size and 2) the maximum longitudinal size of each tear were measured by oblique sagittal images and oblique coronal images respectively with use of image analyzing soft wear (NIH image) (Fig.1). All of the measurements were performed by two of us in a blinded fashion and the average measurements were used as data. We analyzed the correlation of each computed measurement and each actual measurement during surgical procedures. Statistical analyses were performed using paired t-test. Significance was set at the 5% level.

RESULTS: Full thickness rotator cuff tears were recognized in all cases. Sensitivities of full thickness tear on MRI and MRA were 92.9% (13/14) and 100% (14/14) respectively. We could classify five different types of the edge of torn rotator cuff with MRI images and the classifications were as follows: 1) flat end 2) thinning end 3) dull end 4) horizontal tear 5) global tear (Fig.2). Frequencies and mean ages of each classification were as follows: 1) flat end: 28.6%(4/14), 51.8 years old, 2) thinning end: 14.3%(2/14), 70.0 years old, 3) dull end: 28.6%(4/14), 60.3 years old, 4) horizontal tear: 21.4%(3/14), 68.7 years old, 5) global tear: 7.1%(1/14), 66.0 years old. The mean differences of the cuff tear size between MRI findings and surgical findings were -2.6±8.7mm transversely and -12.3±18.6mm longitudinally. (Table 1-Lt) The mean differences of the cuff tear size between MRA findings and surgical findings were 1.4±4.7mm transversely and -1.7±9.1mm longitudinally. (Table 1-Rt) MRI findings tend to be low estimation both of transversely and longitudinally compared to MRA findings. Both of the maximum transverse and the maximum longitudinal size of the tear are significantly well correlated with surgical findings on MRA compared to MRI. (p<0.05) (r\(^2\): 0.834 transversely, 0.739 longitudinally on MRA, r\(^2\): 0.273 transversely, 0.004 longitudinally on MRI) (Figure 3)

DISCUSSION: The most important observation made in this study was that full thickness rotator cuff tear could be accurately visualized, correctly measured and pathologically analyzed with MRI images. In this study rotator cuff tear on MRI are evaluated smaller than those on MRA. This means that the edge of torn rotator cuff tear was not enough detailed to identify in some cases without glenohumeral joint effusion. Because we experienced easier identification of the rotator cuff tear in small number of cases with glenohumeral joint effusion than without it on MRI. In those cases without joint effusion, contrast material could penetrate between glenohumeral joint and subacromial bursa and make a helpful situation for the measurement of tear with MR images. Contrast material could also make a suitable situation to analyze pathological conditions of the endon and allow us to classify five different types. This is extremely important for the surgical treatment. We could identify the completely similar pathological conditions both on MRA and during surgery. For example, thinning end type showed atrophic changes and dull end type showed hyaline-like degeneration. This means that pre-surgical predictions of pathological changes and remained rotator cuff function are possible with MRA images. This is crucial for making a plan of rotator cuff repair surgery. Further study is necessary for the investigation of the relationship of our imaging classification and histological changes.

CONCLUSION: MR arthrography is significantly more sensitive to evaluate rotator cuff tear size and pathological condition compared to conventional MRI.