Quantitative and Diffusion MR imaging as a New Method to Assess Partial-thickness Rotator Cuff Tear

Huan-Chu Lo[1], Sheng-Tsai Hung[1], Duen-Pang Kuo[1], and Hung-Maan Lee[1]
[1]*Armed Forces Taoyuan General Hospital, Taoyuan, Taiwan, Taiwan*

Introduction

Partial-thickness rotator cuff tear is usually depicted by a focal hyperintensity within a tear shown on fat-suppression T2-weighted imaging (FS-T2WI). However, clinical results using this technique vary depending on the experience of the reader [1]. Recently, references have also reported the application of diffusion-weighted imaging (DWI) in diagnosing musculoskeletal disorders [2-3]. To the best of our knowledge, DWI has not been applied to diagnose tendon injury. Therefore, the goal of our study was to investigate the diagnostic performance of DWI for assessment of partial-thickness rotator cuff tears by means of lesion to muscle signal intensity ratios (L/M SIR).

Materials and Methods

Forty-one consecutive patients suffering from shoulder disease proven by arthroscopy were enrolled in the study. All of the study participants were examined with a 1.5T MR system (Philips Achieva 1.5T MRI) using a dedicated phase array shoulder coil. The MRI protocol included T1-weighted imaging (T1WI) (TR /TE, 450 msec /10.5 msec; acquisition time, 2 min and 13 sec) and FS-T2WI (TR/TE, 5000 msec/110 msec; acquisition time, 2 min and 38 sec) in the coronal plane. DWI were performed in the coronal plane using single shot fast spin echo echo-planar imaging (TR/TE, 1000 msec /60.25 msec; acquisition time, 16 sec). The selection of a b-value (600 s/mm^2) was based on a compromise between image resolution (signal noise ratio) and adequate diffusion strength [3] .To compare the performance of DWI and FS-T2WI in diagnosing a partial tear, L/M SIR with measurement was performed on each patient. The following criteria were used to measure the signal intensity: When the lesion of a partial-thickness tear is clear, the observer can manually draw the region of interest (ROI) intuitively. However, if the tendon is indistinguishable on the lesion or possibly diagnosed as normal, the position of ROI was drawn on critical zones, which were defined as partial-thickness tears occurring approximately 1 cm proximal to the cuff tendon insertion on the greater tuberosity. The ROIs of the DWI on lesion and supraspintus muscle were first traced manually, as shown in Fig 1. Besides, receiver-operating characteristic (ROC) curves were compared using L/M SIR to assess the diagnostic performance of DWI and FS-T2WI, and a cut-off point for predicting partial-thickness tear was determined using the Youden index.

Results

Twenty-seven patients were diagnosed partial-thickness tears; others were no tears by arthroscopy. Area under ROC curves (AUC) for diagnosing partial-thickness tears with measurements is significantly higher for DWI (0.81) than for FS-T2WI (0.68) (p=0.001), as shown in Fig. 2. Cut-off values of signal ratios for DWI and FS-T2WI were 1.06 and 1.19, respectively. The sensitivity and accuracy were significantly higher with DWI (85.2% [23/27], 80.5% [33/41]) than with FS-T2WI alone (55.6% [15/27], 63.4% [26/41]). FS-T2WI had the higher specificity (78.6% [11/14]) than DWI (71.4% [10/14]). Representative cases are shown in Fig. 3.

Discussion

There is no literature reported on the application of DWI in diagnosing tendon injuries. In our studies, the results have shown the potential of diagnosing partial-thickness rotator cuff tears. The differentiation between normal and partial-thickness rotator cuff tears is of great clinical importance because treatment options may differ [4]. Previously published data for the detection of partial thickness tears show good diagnostic accuracy for MR arthrography [5]. Nevertheless, MR arthrography is an invasive, painful procedure, and contrast media allergic reaction may occur in some patients. On the other hand, conventional FS-T2WI has been shown to have limited performance in the diagnosis of partial-thickness tears, with poor intraobserver and interobserver variations in diagnosing partial-thickness tear [6]. Our study proves that DWI is more accurate than FS-T2WI. In Conclusion, DWI may be used as an alternative means of diagnosing partial-thickness tears when they are not easily differentiate using FS-T2WI.

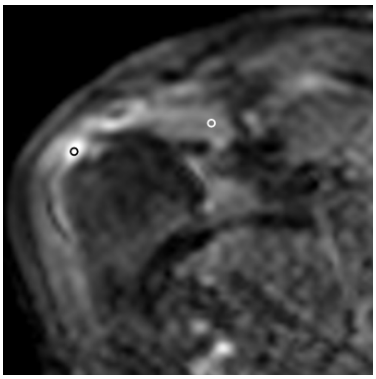

Fig. 1. Illustrations of manual tracing of free-hand ROIs for calculation of the L/M SIR performed on the coronal DWI. It revealed a bright signal (black circle) of the articular surface of the supraspinatus tendon. The supraspinatus muscle has an isointensity in DWI images (white circle).

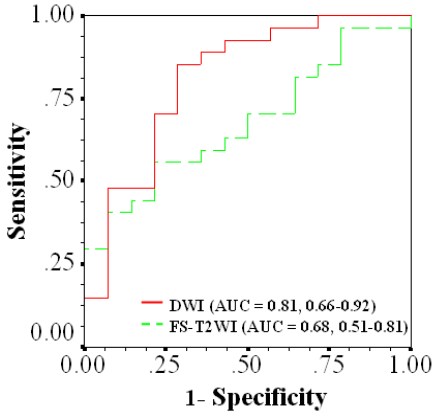

Fig. 2. Results of ROC analyses of each MR sequence based on L/M SIR to differentiate partial-thickness tears from normal. The AUC values were 0.81% for DWI (95% CI: 0.66-0.95) and 0.68% for FS-T2WI (95% CI: 0.51-0.81), respectively.

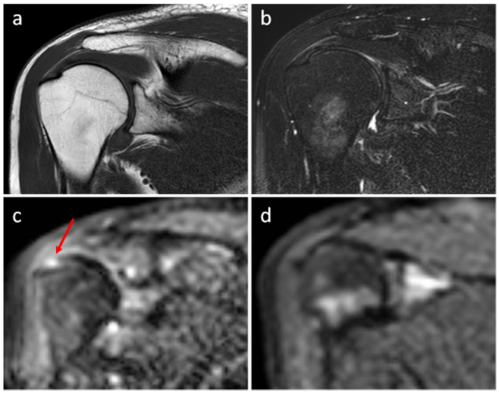

Fig. 3. A 66-year-old patient with shoulder pain. (a) T1WI (b) FS-T2WI informs the partial thickness rotator cuff tear and (c) DWI (red arrow) prove it. Compared with the partial thickness rotator cuff tear patient, we regard DWI of 21-year-old normal person (d) as a control.

References

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