Magnetic Resonance Arthrographic visualization of Surgical classification of rotator cuff tear

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Objective: Rotator cuff tears (RCT) are the most common clinical problem of the shoulder, and are the cause of the most common surgeries in shoulder arthroscopic units. On the preoperative MR, classification of an RCT is based on tear width and thickness, not on arthroscopic classifications. Magnetic resonance (MR) imaging classification determines whether the tear is partial/full-thickness and partial/full-width. Meanwhile, the method used for surgical repair of RCTs depends on the morphology of the tear. Tear types are crescentic, U-shaped, and L-shaped. However, for the arthroscopic surgeons, arthroscopic classification is more useful for surgical repair of RCTs because the repair method depends on the classification type. Recently, three-dimensional (3D) MR sequences have been used for volumetric evaluation of joints, and 3D MR imagings have the advantages of less partial-volume averaging effect and thinner imaging slices over 2D MR imagings. This study explored whether 3D volumetric MR imaging was feasible for surgical classification of the shoulder. In this paper, we compared the diagnostic accuracy of 3D isotropic MR arthrography (MRA) with 2D conventional MRA for diagnosis of RCTs, and evaluated the feasibility of surgical arthroscopic classification by MRA using a 3.0T MR.

Method: All patients underwent shoulder MRA. Patients received an intra-articular injection of diluted dimeglumine gadopentetate solution into the glenohumeral joint. All MR were conducted on a 3.0T MR system (Achieva® 3T or Achieva® Tx 3T, Philips Healthcare, Best, The Netherlands) with a dedicated shoulder coil (Invivo, Gainesville, FL, USA). All patients underwent subsequent shoulder arthroscopic surgery. MR analysis was performed using conventional 2D fast spine echo (FSE) and 3D isotrophic gradient-echo MR imaging with fat suppression on a 3-T magnetic resonance (MR) imager. The SNR (signal-to-noise ratio) of the tendon and the CNR (contrast-to-noise ratio) of the tendon and joint fluid were calculated on both MR sequences. Two musculoskeletal radiologists evaluated the presence of supraspinatus-infraspinatus and subscapularis tendon tears using conventional 2D and 3D isotropic images. They further classified full-thickness tears of the supraspinatus-infraspinatus tendon into three categories: crescentic, U-shaped, and L-shaped): (1) crescentic, full-thickness tears with less than 1 cm retraction; (2) U-shaped, full-thickness tears with significant retraction (retraction [i.e., length] > AP extension [i.e., width]); and (3) L-shaped tears with rectangle-shaped retraction and AP tears on axial views. We analyzed statistical differences between 2D and 3D images for diagnostic accuracies and tear classifications for both sequences using arthroscopic findings as the reference standard. A paired *t*-test was used to compare the SNRs and CNRs of 2D and 3D MR sequences.

Result: SNRs of the tendons and joint fluid showed no significant differences between conventional 2D MRA and 3D isotrophic MRA ($P > 0.05$); however the CNRs between tendons and fluid were significantly higher on conventional 2D MRA ($P = 0.02$). The accuracy of conventional 2D and isotropic 3D MRA were not significantly different. Among full-thickness supraspinatus-infraspinatus tendon tears (n = 25), 12 were crescentic, 8 were U-shaped and 5 were L-shaped. Correct evaluation was observed with conventional 2D and isotrophic 3D MRA for 75% of crescentic tears (n = 9/12), 63% of U-shaped tears (n = 5/8), and 40% of L-shaped tears (n = 2/5). The accuracy of visualization of L-shaped tears was low by MRA alone.

Conclusion: Diagnoses of rotator cuff tears using 3D isotropic MRA sequences were similar to diagnoses using conventional MRA sequences, but had a shorter imaging time. MR visualization of full-thickness tears of the supraspinatus-infraspinatus tendon for surgical classification was feasible. However, MRA evaluation of L-shaped tears based on surgical classification was limited using both 3D isotrophic and conventional 2D MRA sequences.

References

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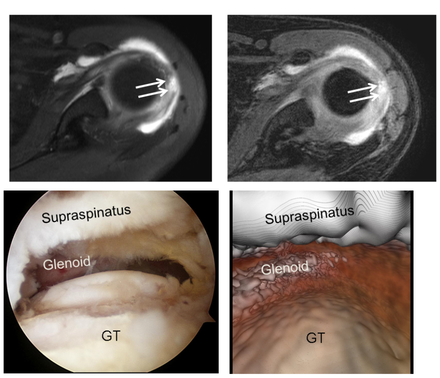

Fig. 1— Arthroscopically proven full-thickness tear of the supraspinatus tendon with cresenteric tear in a 69-year-old woman. Both 2D (A) and 3D (B) MR arthrography showed a crescent-shaped tear anteroposterior (arrows) of the supraspinatus tendon. Tear width was wider than tear length. Arthroscopy image (C) shows full-thickness crescentic shaped tear though lateral portal. Corresponding virtual arthroscopic image (D) shows similar appearance of the arthroscopic image (C) through simulated lateral portal of shoulder arthroscopy.

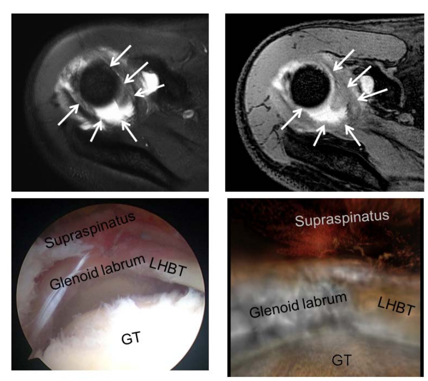

Fig. 2— Arthroscopically proven full-thickness tear of the supraspinatus tendon with U-shaped tear in a 68-year-old woman. Both 2D (A) and 3D (B) axial MR arthrography images showed retracted U-shaped tear of the supraspinatus tendon. The length of tear is greater than the width, and the tear has deep longitudinal retraction. Arthroscopy image (C) shows the massive U-shaped tear with significant retraction though lateral portal. Virtual arthroscopic image (D) shows the tear through simulated lateral portal of shoulder arthroscopy.