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Diagnostic accuracy of magnetic resonance imaging for subscapularis tendon tears using radial-slice magnetic resonance images

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Background: Magnetic resonance imaging has low diagnostic accuracy for subscapularis tendon tears. This study investigated the utility of radial-slice magnetic resonance images for diagnosing subscapularis tendon tears.

Materials and methods: We investigated 55 shoulders in 54 patients with rotator cuff tears evident during arthroscopic shoulder surgery. The intraoperative finding of a subscapularis tendon tear was compared with the identification of a subscapularis tendon tear on preoperative radial, transverse, and oblique sagittal images using a 3.0-T system. The sensitivity and specificity of diagnostic images generated using different imaging methods for subscapularis tendon tears were investigated.

Results: A subscapularis tendon tear was present in 38 shoulders (69.1%). When the diagnostic accuracy of the magnetic resonance images was compared with the arthroscopic findings, the radial images had 94.7% sensitivity and 82.4% specificity, the transverse images had 57.9% sensitivity and 100% specificity, and the oblique sagittal images had 60.5% sensitivity and 100% specificity.

Conclusion: Radial-slice magnetic resonance images have high sensitivity for subscapularis tendon tears and are useful for diagnosing these lesions. In particular, the sensitivity for tears in the superior part of the subscapularis tendon is higher than that of conventional methods.

Level of evidence: Level III, Diagnostic Study.

Keywords: Radial; MRI; subscapularis tendon; rotator cuff; shoulder; arthroscopy

Recent developments in shoulder arthroscopy have enabled subscapularis tendon tears to be evaluated in detail.[1,2,25] The subscapularis has a broad insertion in the lesser tuberosity of the humerus. The subscapularis comprises the anterior portion of the shoulder and is important

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for humeral head stability. The cephalad aspect of the subscapularis tendon adjoins the long head of the biceps tendon and contributes to its stability.[3] Because subscapularis tendon tears originate from the anterosuperior region,[22,24] lesions of the long head of the biceps tendon frequently occur at the same time.[8,23,26,27] Insufficient repair of subscapularis tendon tears may cause decreased glenohumeral joint stability[15,21] or lesions of the long head of the biceps tendon; therefore, accurate preoperative evaluation of subscapularis tendon tears is important.

Rotator cuff tears have been diagnosed using transverse, oblique coronal, and oblique sagittal magnetic resonance (MR) images. Although MR evaluation of supraspinatus and infraspinatus tendon tears has a sensitivity of greater than 90%,[10,16,17] the sensitivity for subscapularis tendon tears is not particularly high.[1,2,5,7,25] The subscapularis tendon is normally evaluated using transverse and oblique sagittal MR images,[19] but lesions in the anterosuperior region are difficult to visualize[14] because of the partial-volume effect.

We have previously reported that radial-slice MR images, in which magnetic resonance imaging (MRI) is performed using radial slices centered on the midpoint of the acetabulum in the hip joint, are useful for evaluating the acetabular labrum.[11,12,14] The rotator cuff tendons attach circumferentially around the humeral head in a circular pattern of insertion resembling that of the acetabular labrum. Radial-slice MR images centered on the humeral head provide a cross slice perpendicular to the rotator cuff insertions, thereby reducing the partial-volume effect.

The objective of this study was to investigate the value of radial-slice MR images for diagnosing subscapularis tendon tears.

Materials and methods

Patients

This study investigated 55 shoulders in 54 patients who underwent shoulder arthroscopic surgery between March 2011 and December 2012 and in whom rotator cuff tears were arthroscopically confirmed. The mean age was 62.7 years (range, 26-78 years), with 27 shoulders in 26 men and 28 shoulders in 28 women. The affected side was the right shoulder in 41 cases and the left in 14 cases. The exclusion criteria were previous shoulder surgery, age younger than 18 years, and internal impingement of the shoulder in an overhead athlete.

Arthroscopic findings

All arthroscopic examinations were performed by one orthopaedic surgeon who had 20 years of experience in shoulder surgery. The morphology of the subscapularis tendon tears was classified as type I for a partial-thickness tear of the upper third of the subscapularis tendon, type II for a full-thickness tear of the upper third, type III for a full-thickness tear of the upper two-thirds, and type IV for a full-thickness tear of the entire width of the tendon.[7,15]

The findings regarding the long head of the biceps tendon were classified as normal, subluxation, dislocation, and disappearance.[4]

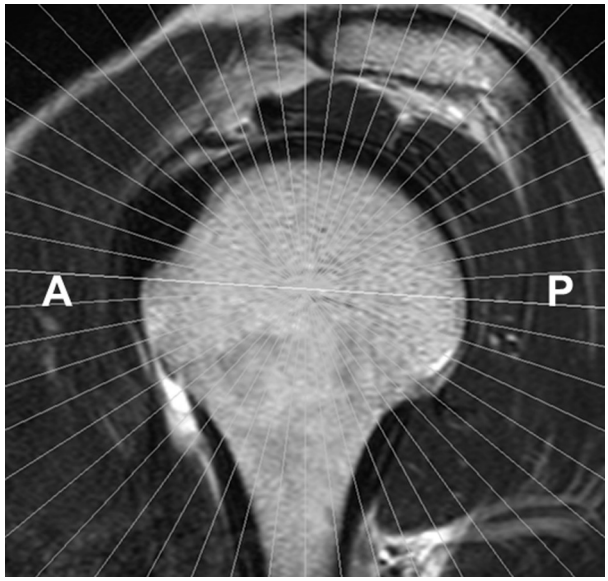

Figure 1 Radial-slice MR image plane. All slices were based on a reference image on which the sagittal plane was positioned parallel to the glenoid fossa of the scapula, with a total of 24 slices acquired at 7.5° intervals around a rotation axis formed by the line connecting the midpoints of the glenoid fossa and humeral head. *A*, anterior; *P*, posterior.

Table I Incidence of combination of each type of subscapularis tendon tear and lesion of long head of biceps tendon

	Type of subscapularis tendon tear			
	I	II	III	IV
Lesion of long head of biceps	5 of 19	12 of 14	4 of 4	1 of 1

We also investigated the incidence of combined subscapularis tendon tears and lesions of the long head of the biceps tendon.

MRI protocol

We used a 3.0-T MRI system (Achieva 3.0 T X-series; Philips Healthcare, Best, Netherlands), with a dedicated 4-channel shoulder coil. Radial images were acquired using fat-suppressed T2-weighted imaging (repetition time [TR], 9,428 milliseconds; echo time [TE], 59 milliseconds; and echo train length [ETL], 17),[13,17,20] with a slice thickness of 3.0 mm; field of view (FOV) of 150 mm × 150 mm; and resolution of 304 × 224. Planning of the radial axis scan was defined using sagittal and coronal scans to correct for the complex anatomic angulations of the glenoid and humeral head and to provide geometric offsets and angulations for the sequence. We used the axial and coronal MR images that best demonstrated the midpoint of the glenoid and humeral head when we planned the radial axis slices. The line passing through the center of the humeral head and the glenoid was set as an axis. Radial-slice images were obtained, with slice 1 in the axial or 9-o' clock position and the following slices rotated incrementally (Fig. 1). The image acquisition time was approximately 4 minutes.