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Accuracy of magnetic resonance imaging in detecting biceps pathology in patients with rotator cuff disorders: comparison with arthroscopy

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Background: There is limited information on the validity of magnetic resonance imaging (MRI) in detection of biceps disease. The purpose of this study was to examine the measurement properties of noncontrasted MRI in diagnosis of biceps disease using arthroscopic surgery as the "gold standard."

Materials and methods: Prospectively collected surgical data of patients with impingement syndrome or rotator cuff tear, with biceps disease (study group) or without biceps disease (control group), were reviewed. MRI reports of radiologists with fellowship training in musculoskeletal imaging were retrospectively reviewed and compared with surgical findings.

Results: Data of 183 (130 study and 53 control) patients (73 women [40%], 110 men [60%]; mean age, 62 years [standard deviation, 9]) who had undergone arthroscopic rotator cuff–related surgery during a period of 11 years were used for analysis. Sensitivity and specificity of MRI for detection of full tears of the biceps tendon were 0.54 and 0.98, respectively. Sensitivity and specificity were 0.27 and 0.86 for partial tears of the biceps tendon, respectively. For biceps subluxation or dislocation, sensitivity was 1.00 and specificity was 0.83. The areas under the receiver operating characteristic curves, which quantify the overall accuracy of the tests, were 0.57, 0.75, and 0.92 for partial tear, full tear, and instability of the biceps tendon, respectively.

This study received ethics approval from the Human Ethics Research Board of the Sunnybrook Health Sciences Centre, Toronto, Canada: REB# 463-2014.

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Conclusions: Noncontrasted MRI has a low sensitivity and high specificity for detection of full-thickness tears of the biceps tendon. It is highly sensitive for diagnosis of instability of the long head of the biceps. However, its usefulness for diagnosis of partial tears of the biceps tendon remains limited.
Level of evidence: Level III, Diagnostic Study.

Keywords: Sensitivity; specificity; biceps pathology; rotator cuff

Biceps tendon disease is common in patients with shoulder pain. Pathologic changes of the long head of the biceps tendon include tenosynovitis, partial- and full-thickness tears, and subluxation and dislocation.[13,14,20] Pathologic change of the long head of the biceps is often associated with subacromial and subcoracoid impingement as well as with tears of the rotator cuff, although it can also be a primary cause of shoulder pain and dysfunction.[1,4,5,14]

Magnetic resonance imaging (MRI) is frequently used as a noninvasive method to diagnose rotator cuff and biceps disease. Interpretation of MRI findings often guides management and especially surgical treatment. The literature on validity of noncontrast MRI is composed of small series that have examined biceps disease as part of examination of overall shoulder disease, in which the role of MRI in detecting pathologic change in the long head of the biceps tendon was not the original research question.[9,13] There are only 3 studies that have focused specifically on biceps tear,[1,6,18] with one report of 3 patients with biceps instability.[17]

Considering the lack of information on the validity of MRI in the diagnosis of biceps disease in a balanced sample (diseased and nondiseased), further investigation of this subject was thought to be warranted. The purpose of this study was to examine the measurement properties of MRI in diagnosis of biceps disease in a tertiary care center using arthroscopic surgery as the ''gold standard.''

Materials and methods

Validity studies require a balanced proportion of diseased and nondiseased individuals to avoid overestimation or underestimation of validity indices. To meet this criterion, having a control group (nondiseased) is essential. Therefore, patients should be representative of the population to which the test is applied, and the proportions of cases and controls should take account of the prevalence of the disease.

Sample size justification was based on a table provided by Flahault et al.[8] The authors suggested a minimum of 98 patients for an expected moderate sensitivity or specificity of 0.85 and the lower 95% confidence limit of 0.65 or higher (Table I). To maintain a balanced proportion of diseased and nondiseased individuals, a control group (patients with rotator cuff disease without biceps disease) was used. The number of control cases was calculated on the basis of prevalence of biceps disease: $N_{controls} = N_{cases}$ [(1 – Prevalence)/Prevalence]. Prevalence of biceps disease is estimated as high as 76% in patients with rotator cuff disease.[21] We estimated that with a slightly less prevalence of 70% biceps disease, for every 50 control patients, a minimum of 117 patients with biceps disease (study group) is needed.

Table I Validity indices for partial-thickness biceps tear

	Present surgically	Absent surgically	Total
Positive on MRI	24 (TP)	13 (FP)	37
Negative on MRI	63 (FN)	83(TN)	146
Total	87 (all diseased)	96 (all nondiseased)	183

TP, true positive; *FP*, false positive; *FN*, false negative; *TN*, true negative.
Prevalence = TP/total = 87/183 = 48%.
Sensitivity = 24/87 = 0.27 (CI, 0.19-0.38).
Specificity = 83/96 = 0.86 (CI, 0.78-0.93).
Positive likelihood ratio = 2.03 (small change in pretest probability).
Negative likelihood ratio = 0.84 (insignificant change in pretest probability).
Receiver operating characteristic curve: 0.57.

Inclusion and exclusion criteria

Prospectively collected surgical data of patients with impingement syndrome or rotator cuff tear, with (study group) or without (control group) biceps disease, who had participated in previous studies from 2003 to 2014 were reviewed. For the purpose of consistency, only patients whose noncontrast MRI study was performed in our institution were included. Patients with an unknown response for the extent of biceps disease on the MRI report were excluded.

MRI examination

All MR images had been interpreted by 1 of 4 radiologists with fellowship training in musculoskeletal imaging. Patients were imaged in the supine position with the arm rested in neutral position. MRI studies were performed on a 1.5T system (General Electric Medical Systems, Milwaukee, WI, USA) using a 15 platform and dedicated GE shoulder surface coil. Field of view is 13 cm T1-weighted sagittal images (600/min), sagittal proton density fast spin-echo with fat saturation (2000/22.7), axial proton density fast spin-echo with fat saturation (2000/22.7), coronal oblique T2-weighted fast spin-echo (2800/83.2), coronal oblique proton density fast spin-echo (2000/34), slice thickness from 3.0