Is the FABS view MRI more accurate than standard MRI in detecting distal biceps pathology?

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Abstract

Background: Partial biceps tendon pathology is difficult to diagnose. The Flexion Abduction Supination (FABS) view MRI has been advocated to improve the accuracy of MRI investigation.

Hypothesis: The purpose of the present study is to evaluate the accuracy of the FABS view MRI in the diagnosis of distal biceps tendon pathology.

Study Design: We compared sensitivity and specificity of the FABS view MRI and the standard MRI.

Methods: 50 patients with surgically confirmed distal biceps tendon pathology and 50 patients with other elbow disorders were included. From both groups, half had standard elbow MRI (retrospective review of previously obtained MRI data) and the other half FABS view MRI. These were evaluated by two independent musculoskeletal radiologists. Sensitivity and specificity of the both MRI views were determined. Tendinosis or grade of rupture were reported from MRI and then compared to surgical findings.

Results: There was no significant difference in sensitivity and specificity in detecting partial distal biceps injuries when comparing the FABS view MRI (sensitivity 84% and specificity 86%) and standard MRI (sensitivity 76% and specificity 98%). The inter-observer reliability (IRR) was 92% for the FABS view MRI with biceps pathology and 68% for standard MRI. In the control group the IRR was 88% for the FABS view MRI and 96% for standard MRI. FABS MRI was significantly better with regards to grade of injury.

Conclusions: No significant differences in sensitivity and specificity were found between the FABS view and standard elbow MRI in the diagnosis of partial distal biceps tendon injuries with high sensitivity and specificity for both views. Interrater reliability was better for FABS views and FABS views were significantly more accurate in grading the extend of the pathology when compared to surgical findings.

Key words: MRI, elbow, distal, biceps, tendon, partial, rupture, FABS

Level of evidence: IV

Introduction

The diagnosis of a complete tear of the distal biceps tendon is mainly based on clinical examination.[10, 11] A variety of clinical test have been described.[8, 11] However, in a complete tear with an intact lacertus fibrosus, partial tears, tendonitis or bursitis the clinical image may be less obvious.[1, 3, 9, 12, 13]

Patients often complain of pain in the antecubital region, exacerbated with activity. Biceps strength is usually good and resistance tests may be negative. This often results in a significant delay in diagnosis, or it may be missed altogether.[1, 3, 9]

MRI investigation has been proposed if the diagnosis in unclear. Although MRI has been proven to be very sensitive for complete distal biceps tendon tears, the sensitivity for partial tears or other distal biceps tendon pathology is significantly lower.[2, 4-6] In 2004, Giuffrè et al. suggested the flexion abduction supination view (FABS) to optimally view the distal biceps tendon from the musculotendinous junction to its insertion, usually on a single image (in one or, at most, two sections).[7] (Figure 1) Although it was widely adopted in clinical practice, the sensitivity and specificity of the FABS view for partial distal biceps tendon tears and other distal biceps tendon pathology has not been studied.

The purpose of this study was to evaluate sensitivity, specificity and reproducibility of the FABS view MRI to detect distal biceps tendon pathology and to compare this to standard elbow MRI investigation.

Material and methods

After internal review board approval, 100 patients with elbow pathology who underwent MRI investigation were included. All patients were treated by the senior author and MRIs were performed in a single institution. To be included in this study, biceps pathology had to be confirmed by biceps endoscopic surgery. MRI images had to satisfy the following criteria: (1) the area proximal to the biceps musculotendinous junction and distal to the radial tuberosity had to be viewable on the study; (2) the MRI hardware needed a magnet strength of 1.5 T; (3) no contrast was used. The scanner in our institution is a Siemens 1.5 T Magnetom Aera, and images before 2015 were taken by a Siemens 1,5T Symphony. The standard MRI protocol uses a 15-channel kneecoil and includes axial T2 TSE fatsat, axial T1 TSE, coronal T1 TSE, coronal T2 TSE fatsat, sagittal T2 TSE fatsat. The patient is positioned prone with the elbow extended above the head and thumb up (Superman position). Our radiologists' FABS view protocol has the following specifications: a 16-channel shoulder coil, included axial proton+T2 TSE fatsat, coronal T1 TSE and T2 fatsat, sagital T2 TSE fatsat, axial and coronal 3D DESS with water excitation. For the FABS view MRI, patient positioning is very different: the patient lies prone with the arm in 'FABS' flexion-abduction-supination (Figure 1a) during the total scanning time. Detailed resolution of all MRI sequences is presented in Table C. The Standard MRI images of 25 patients with distal biceps tendon pathology (Figure 2) and 25 patients with another elbow problem, were retrospectively included from the surgeon's database. Clinical and surgical notes were used to confirm the pathology. From 2018, 25 patients with distal biceps tendon pathology and 25 patients with another elbow problem were included prospectively and FABS views were obtained for these 50 patients.

Patients were divided into four groups. The first group had FABS view images with distal biceps tendon pathology, surgically confirmed and graded during biceps endoscopy. A low-grade partial tear was defined as less than or equal to a 25% tear of the width of the distal biceps tendon attachment. An intermediate-grade tear was defined as a 25% to 50% tear of the width and a high-grade partial tear was defined as a greater than 50% tear of the width of the distal biceps tendon attachment.

The second group included FABS views from patients with various elbow pathologies other than distal biceps tendon problems, such as lateral epicondylitis, ulnar nerve pathologies and medial

epicondylitis. Patients did not complain of anterior elbow and forearm pain and clinical tests for distal biceps tendon pathology were negative.

The third group included patients with surgically confirmed distal biceps tendon pathology and preoperative standard MRI studies.

Finally, the fourth group consisted of standard MRI investigations from patients with other elbow pathologies than distal biceps tendon problems.

All investigations were blinded, randomized and evaluated by two independent radiologists, highly experienced in musculoskeletal imaging, with 8 and 22 years of practice respectively. The radiologists participating in this study were not involved in the original care of any patient in this study and did not receive any clinical information. They were asked to provide a general diagnosis, and if the MRI proved positive for distal biceps tendon pathology, to specify according to the following criteria (1) partial tear: characterize as either a high-grade, intermediate-grade or low-grade tear, using the definition provided earlier; (2) presence of tendinosis or (3) bicipital bursitis.

MRI interpretations were then correlated to the intraoperative findings and results were statistically analyzed (SPSS Software, Chicago, IL). Comparison of FABS and standard MRI was evaluated using t-test and significance level was set at 0.05. Values reported for sensitivity, specificity, positive predictive value, and negative predictive value were calculated. Furthermore, we evaluated the inter-observer reliability (IRR). For biceps pathology, the IRR in group 1 (FABS view) and group 3 (standard MRI) was based on the different types of distal biceps tendon pathology, as described above. The IRR for the other elbow pathologies was calculated on patients with either medial or lateral epicondylitis, as these were similarly distributed in group 2 (FABS view, 13 patients) and group 4 (standard MRI, 15 patients).

Results

A total of 100 MRIs were included for review. Group 1 and 3 each included 25 surgically confirmed distal biceps tendinitis or partial ruptures. Group 2 and 4 each contained 25 MRIs of non-biceps pathologies. The mean ages in group 1 and 3 were 55 (range, 36-77 years) and 59 years (range, 34-87 years), respectively. In group 2 and 4 the mean ages were 48 years (range, 31-60 years)and 53 (range,

26-73 years). Group 1 consisted of 6 women and 19 men. In group 2, 8 women and 17 men were included. In the third group there were 8 women and 17 men and in group 4, 13 patients were women and 12 men. In both group 1 and 2, the dominant elbow was involved in 60% of patients. In group 3 and 4, the dominant elbow was involved in 56% and 68% respectively.

In group 1, endoscopic findings included tendinosis or bicipital bursitis (12%), low-grade (20%), intermediate (12%) and high-grade (56%) partial distal biceps ruptures (Table A). In group 3, there were no cases of tendinosis or bicipital bursitis and partial tears were divided into 60% low-grade, 8% intermediate and 32% high-grade tears (Table B).

In the biceps pathology groups 1 and 3, MRI interpretations were compared to intraoperative findings. Biceps pathology was correctly reported from FABS view MRI's in 84%, and in 76% on standard MRI's (p=0.32).

In the FABS view MRI group, 83% of tendinosis cases, 50% of low-grade tears, 67% of intermediate grade cases and 57% of high-grade partial tears were correctly identified (Table A). In the standard MRI group 23% of low-grade cases, none of the intermediate grade cases and 6% high-grade partial tears were correctly identified (Table B). There was a significant difference between FABS and standard MRI when comparing grading of the tears (p=0.002)

In the control groups 2 and 4, non-symptomatic biceps tendinosis was reported in 14% of cases on FABS view MRI's and in 2% on standard MRI.

The overall sensitivity in detecting distal biceps tendon pathology for the FABS view MRI was 84%, while the specificity was 86%. The standard MRI had an overall sensitivity and specificity in detecting distal biceps tendon pathology of 76% and 98%, respectively. There were no significant differences between FABS and standard MRI views in sensitivity (p=0.32) or specificity (p=0.31). The positive predictive value for the FABS view MRI was 86% and the negative predictive value was 84%. For standard MRI the positive and negative predictive values were 97% and 80%, respectively.

The inter-observer reliability (IRR) was 92% for the FABS view MRI's with biceps pathology, while for the standard MRI's with biceps pathology the IRR was 68%. In control groups the IRR was 88% for the FABS view MRI's and 96% for the standard MRI's. (Table 1)

Discussion

Partial ruptures of the distal biceps tendon are relatively uncommon injuries. Diagnosis is difficult since symptoms and clinical examination are often vague and aspecific.[1, 3, 9, 12, 13] Literature has shown magnetic resonance imaging (MRI) of the elbow to be a useful tool in the diagnosis of distal tendon pathology.[4, 6] However, most studies evaluate complete ruptures of the distal biceps tendon. A study that compared the effectiveness of standard elbow MRI for complete and partial ruptures, found the sensitivity of MRI to be only 59% for partial tears, compared to 100% for complete ruptures.[5] The sensitivity (76%) of standard MRI views in the present study is higher than the previous reported sensitivity of 59%.[5]

To improve the accuracy of MRI diagnosis of distal biceps tendon pathology, the flexion abduction supination view (FABS), was described by Giuffrè in 2004.[7] Although it has been used clinically, no specific research on the accuracy of the FABS view MRI had been published. Our data did not show a significant difference in sensitivity and specificity for FABS view MRI compared to standard MRI in the detection of distal biceps injuries.

The advantage of present study is that the radiologists were blinded to the purpose of this investigation. Only after the first distinction they were told to grade the distal biceps tendon ruptures as described before. In previous studies, the investigators were told that the MRI was suspected of distal biceps pathology.[14]

There are several limitations to present study. Firstly, standard MRI and FABS MRI were not directly compared from the same patient. However, since the radiologists were not aware that

they were evaluating distal biceps tendon pathologies in either group, we believe that the results of the study were not influenced. Secondly, we did not consider the chronicity of the tears. Previous research evaluated this and saw no influence on the results.[5] Our FABS view MRI protocol included coronal and axial 3D sequences with slice thickness of 1.5 mm while the standard elbow MRI protocol had a slice thickness of 3 mm. Accuracy and consistency of the MRI examination may have been influenced in favor of the FABS view by using thinner slice thickness compared to the standard MRI protocol.

Lastly, grading of the tear was based on surgical findings. This may have introduced an error but we feel this was the most accurate way possible.

In conclusion, the FABS view has shown to be a valuable tool in the diagnosis of partial distal biceps tendon injuries. No significant difference was found in sensitivity and specificity, when comparing FABS and standard views but interrater reliability was higher with FABS views and FABS views were significantly more accurate in grading the extent of the pathology when compared to surgical findings.

References

1. Bourne MH, Morrey BF. Partial rupture of the distal biceps tendon. *Clin Orthop Relat Res*. 1991:143-8.
2. de la Fuente J, Blasi M, Martinez S, Barcelo P, Cachan C, Miguel M, et al. Ultrasound classification of traumatic distal biceps brachii tendon injuries. *Skeletal Radiol*. 2018;47:519-532. DOI: 10.1007/s00256-017-2816-1.
3. Durr HR, Stabler A, Pfahler M, Matzko M, Refior HJ. Partial rupture of the distal biceps tendon. *Clin Orthop Relat Res*. 2000:195-200. DOI: 10.1097/00003086-200005000-00018.

4. Falchook FS, Zlatkin MB, Erbacher GE, Moulton JS, Bisset GS, Murphy BJ. Rupture of the distal biceps tendon: evaluation with MR imaging. *Radiology*. 1994;190:659-63. DOI: 10.1148/radiology.190.3.8115606.

5. Festa A, Mulieri PJ, Newman JS, Spitz DJ, Leslie BM. Effectiveness of magnetic resonance imaging in detecting partial and complete distal biceps tendon rupture. *J Hand Surg Am*. 2010;35:77-83. DOI: 10.1016/j.jhsa.2009.08.016.

6. Fitzgerald SW, Curry DR, Erickson SJ, Quinn SF, Friedman H. Distal biceps tendon injury: MR imaging diagnosis. *Radiology*. 1994;191:203-6. DOI: 10.1148/radiology.191.1.8134571.

7. Giuffre BM, Moss MJ. Optimal positioning for MRI of the distal biceps brachii tendon: flexed abducted supinated view. *AJR Am J Roentgenol*. 2004;182:944-6. DOI: 10.2214/ajr.182.4.1820944.

8. O'Driscoll SW, Goncalves LB, Dietz P. The hook test for distal biceps tendon avulsion. *Am J Sports Med*. 2007;35:1865-9. DOI: 10.1177/0363546507305016.

9. Rokito AS, McLaughlin JA, Gallagher MA, Zuckerman JD. Partial rupture of the distal biceps tendon. *J Shoulder Elbow Surg*. 1996;5:73-5. DOI: 10.1016/s1058-2746(96)80034-6.

10. Sarda P, Qaddori A, Nauschutz F, Boulton L, Nanda R, Bayliss N. Distal biceps tendon rupture: current concepts. *Injury*. 2013;44:417-20. DOI: 10.1016/j.injury.2012.10.029.

11. Schmidt CC, Jarrett CD, Brown BT. The distal biceps tendon. *J Hand Surg Am*. 2013;38:811-21; quiz 821. DOI: 10.1016/j.jhsa.2013.01.042.

12. Shim SS, Strauch RJ. A novel clinical test for partial tears of the distal biceps brachii tendon: The TILT sign. *Clin Anat*. 2018;31:301-303. DOI: 10.1002/ca.23038.

13. Vardakas DG, Musgrave DS, Varitimidis SE, Goebel F, Sotereanos DG. Partial rupture of the distal biceps tendon. *J Shoulder Elbow Surg*. 2001;10:377-9. DOI: 10.1067/mse.2001.116518.

14. Williams BD, Schweitzer ME, Weishaupt D, Lerman J, Rubenstein DL, Miller LS, et al. Partial tears of the distal biceps tendon: MR appearance and associated clinical findings. *Skeletal Radiol*. 2001;30:560-4. DOI: 10.1007/s002560100397.

Legend of Figures:

Figure 1a: Flexion abduction supination view (FABS) positioning with shoulder abduction and elbow flexion-supination.

Figure 1b: MRI image from a patient in the FABS position. The entire tendon can be viewed from insertion to musculotendinous junction in one single image. A tendinosis was diagnosed in this patient.

Figure 2: Standard MRI view of a distal biceps tendinosis. Notice that, when compared to a FABS image, only a small portion of the tendon can be seen per image.

Tables:

Table 1: Accuracy of the FABS view and standard MRI view of partial distal biceps tendon ruptures. PPV: positive predictive value, NPV: negative predictive value, IRR: inter-rater (observer) reliability.