

RESEARCH ARTICLE

The Value of the Distal Radioulnar Joint Effusion in Diagnosing Triangular Fibrocartilage Complex Tears on Magnetic Resonance Imaging

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Abstract

Background: A retrospective study was conducted to evaluate the role of distal radioulnar joint (DRUJ) effusion in aiding the diagnostic accuracy of central triangular fibrocartilage complex (TFCC) tears on non-contrast MRI.

Methods: 89 consecutive patients who had undergone wrist arthroscopy for ulna sided wrist pain in our unit were identified and their preoperative imaging reviewed. Two consultant musculoskeletal Radiologists independently reported the presence or absence of a DRUJ effusion and or a TFCC tear. The inter-observer variability was calculated using weighted Kappa tests. Two by two tables were constructed to calculate the sensitivity and specificity of reported TFCC tear or DRUJ effusion on MRI in correctly diagnosing central TFCC tears identified at arthroscopy.

Results: Sensitivity of MRI to report a TFCC tear was 0.56 and specificity was 0.79. Sensitivity increased to 0.89 if either a DRUJ effusion or TFCC tear were seen on MRI. When observed together, the presence of both a DRUJ effusion and a TFCC tear seen on the imaging lead to a sensitivity of 0.74 and PPV of 82% when compared to findings at arthroscopy. In the absence of both DRUJ effusion and TFCC tear, the specificity of MRI increased to 0.92. Agreement by the radiologists on the presence of DRUJ effusion was substantial (k value 0.67) and TFCC tear was moderate (k value 0.58).

Conclusion: The presence of DRUJ effusion on MRI can further improve sensitivity of MRI in diagnosing central TFCC tears. The sensitivity of detecting a central TFCC tear on MRI scan when both a DRUJ effusion and a TFCC tear were seen (0.74) is comparable to rates demonstrated on MRA meta-analysis results (0.78). Furthermore, considering the absence of both a DRUJ effusion and TFCC tear seen on MRI is useful in excluding the presence of a TFCC tear at arthroscopy.

Level of evidence: III

Keywords: Arthroscopy, Triangular fibrocartilage complex, Wrist injuries

Introduction

To diagnose the aetiology of ulna sided wrist pain, investigation with Magnetic Resonance Imaging (MRI) is often utilised. A common cause of ulna sided wrist pain is a central tear in the triangular

fibrocartilage complex (TFCC) with seventy percent of symptomatic patients in the age group 50–69 years being found to have a TFCC injury (1-2).

In 2012 a meta-analysis demonstrated that (Magnetic

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resonance arthrogram) MRA was superior to MRI in detecting TFCC tears, sensitivity 0.84 versus 0.75; specificity 0.95 versus 0.81 respectively (3). The largest meta-analysis to date to examine the role of MRI and MRA for the diagnosis of TFCC injuries was published in 2018. This has shown that MRA remains a superior mode of diagnostic imaging for TFCC tear (sensitivity 0.78; and specificity 0.85). However, whilst the diagnostic accuracy of MRI has remained almost constant (sensitivity 0.76; and specificity 0.82), the advantage of MRA over MRI was less than in previous studies (4). In addition, MRA is invasive, can be painful and has the potential risks of allergic reaction, irritation and swelling due to chemical synovitis from contrast. Infection, in addition, is a very rare but serious potential complication (5).

The hypothesis for this study was that the observation of an effusion within the distal radial ulnar joint (DRUJ) on a non-contrast MRI can improve the diagnostic accuracy of central TFCC tears.

Materials and Methods

A retrospective review of all consecutive patients who underwent wrist arthroscopies for treatment of ulna sided wrist pain, with suspected TFCC pathology in our unit was conducted. Patients with peripheral TFCC tears, inflammatory arthropathies or synovitis were excluded; as were patients who had previously undergone wrist arthroscopy on the same side, or where the MRI scan had movement artefact.

Two consultant musculoskeletal specialist radiologists reviewed the MRI imaging independently, provided only with the clinical history as recorded on the imaging request form and blinded to the result of arthroscopy. The scans had been performed at multiple centres, on 1.5 Tesla machines and the field of view was of the wrist, distal forearm to distal metacarpals. The standard sequences included T1, T2 and PDFS in coronal, sagittal and axial views, although there was some minor variation between centres. The radiologists reported the presence or absence of a central TFCC tear on plain MRI scan for each patient. On a literature review we found no established criteria to define a DRUJ effusion on MRI. Therefore, an effusion was defined as the presence of excessive fluid within the distal radial ulnar joint, seen on the PDFS coronal or sagittal views and reported independently by the musculoskeletal radiologist. Following these criteria, the radiologists noted the presence or absence of a DRUJ effusion, focusing on the proton density fat suppression (PDFS) coronal images [Figure 1; 2]. Each radiologist was blinded to the others report. To measure inter observer agreement between the radiologists Cohen's Kappa coefficient (k) was calculated for the reported presence or absence of DRUJ effusion and central TFCC tear respectively on MRI.

The operation notes were reviewed to ascertain whether there was a central TFCC tear identified intra-operatively. At operation, TFCC tears were confirmed or refuted using the standard practice of radiocarpal joint arthroscopic observation and probing of the fibrocartilage disc



Figure 1. MRI image demonstrating a DRUJ effusion, on the proton density fat suppression (PDFS) coronal views.

through the ulna 6R portal.

Findings at wrist arthroscopy were compared to the consensus radiologist's reports on the preoperative non-contrast MRI scans. Two by two tables were constructed based on the radiological presence of central TFCC tear



Figure 2. MRI image demonstrating a DRUJ effusion, on the proton density fat suppression (PDFS) coronal views

or DRUJ effusion and comparison made to findings at arthroscopy. This was used to calculate the sensitivity and specificity, and positive and negative predictive values. Parallel testing was used to calculate the sensitivity and specificity of the two findings (tear and effusion) on MRI. *P values* were calculated using chi-square test, with *P value* < 0.05 being considered significant. Confidence intervals were calculated using the Clopper-Pearson test.

Results

The unit performed a total of 89 consecutive wrist arthroscopies for patients with ulna sided wrist pain during the time period studied. After exclusions (including one patient with movement artefact on imaging), 81 patients were included. Two further patients were excluded as a consensus could not be reached between radiologists on the presence or absence of an effusion, leaving a final cohort of 79 patients.

The sensitivity of MRI in detecting TFCC tear was 0.56 (95% CI, 0.41-0.71), and DRUJ effusion was 0.76 (0.61-0.91) independently. The specificity of detecting TFCC tear was 0.79 (0.61-0.91) and DRUJ effusion 0.61 (0.42-0.77), [Tables 1-3]. When the findings of either a central TFCC tear or a DRUJ effusion was identified on MRI, sensitivity increased further to 0.89, on parallel testing. The specificity of MRI to exclude a TFCC tear increased to 0.92 if the TFCC was reported as intact and there was no DRUJ effusion present. Inter-observer variability was calculated using Cohen's Kappa coefficient (*k*). Where the *k*-value can fall between 0 and 1, with one being perfect agreement (6). Agreement on reported presence of DRUJ effusion was substantial (*K* value 0.67) and agreement on reported presence of TFCC tear was moderate (*K* value 0.58).

Table 1. Two by two table demonstrating patient numbers with TFCC status as seen on a non-contrast MRI against wrist arthroscopy findings of a TFCC tear

MRI	Wrist arthroscopy	
	TFCC tear	TFCC intact
TFCC tear	26	7
TFCC intact	20	26

Table 2. Two by two table demonstrating patient numbers with the presence of absence of a DRUJ effusion against wrist arthroscopy findings of a TFCC tear

MRI	Wrist arthroscopy	
	TFCC tear	TFCC intact
DRUJ effusion present	35	13
DRUJ effusion absent	11	20

Discussion

In our unit the sensitivity and specificity of MRI in identifying a central TFCC tear based on its radiological appearance is lower than that quoted previously in the literature. This highlights the complexity of identifying TFCC pathology on plain MRI, as despite our reporting radiologists being specialists in the field of musculoskeletal imaging, their inter-observer agreement on the presence of a TFCC tear was only moderate (*K* value 0.58). Familiarity with the anatomy of the TFCC is a prerequisite for identification of TFCC tears and accessibility to specialist musculoskeletal radiologists may limit provision locally in smaller units (7).

However, there was substantial agreement between the independent radiologists when reporting a DRUJ effusion (*K* value 0.67), which indicates that this finding is more easily evaluated than TFCC anatomy on plain MRI. For the purpose of diagnosing central TFCC tears, a DRUJ effusion observed in isolation has lower positive predictive value as an indicator for a central TFCC tear at arthroscopy than the observation of a TFCC tear on scan. It is likely that this is as DRUJ joint effusions may be caused by other pathologies such as joint damage or degeneration. However, when the observation of a DRUJ effusion is used with the observation of a TFCC tear on MRI, it is shown to aid the diagnosis of a TFCC tear.

Our study has also shown that non-contrast MRI scan can be useful to exclude the presence of a TFCC tear, as the specificity of MRI to exclude a TFCC tear was high (0.92) if the TFCC was reported as intact and there was no DRUJ effusion seen.

Although MRA is superior in diagnosing full-thickness central TFCC tears, non-contrast MRI remains a useful tool for investigating ulnar-sided wrist pain due to its non-invasive nature and being a quicker, cheaper procedure. We show that the presence or absence of a

Table 3. Correlation of MRI findings with TFCC tears found on arthroscopy

MRI findings	Sensitivity (95% CI)	Specificity (95% CI)	PPV (%)	NPV (%)	<i>P</i> value (χ^2)
TFCC	0.56 (0.41- 0.71)	0.79 (0.61 - 0.91)	78.79 (64.74 - 88.26)	56.52 (47.21 - 65.39)	.002
DRUJ effusion	0.76 (0.61-0.88)	0.61 (0.42-0.77)	72.92 (63.13 - 80.90)	64.52 (50.34 - 76.53)	.001
TFCC tear OR DRUJ effusion	0.89	0.48			
No TFCC tear AND no DRUJ effusion	0.43	0.92			

DRUJ effusion on an MRI scan can be a useful additional indicator of underlying TFCC pathology, in the absence of an MRA scan.

Disclosure: The authors report no conflict of interest concerning materials or methods used in this study or the findings specified in this paper.

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References

1. Saito T, Malay S, Chung KC. A Systematic Review of Outcomes after Arthroscopic Debridement for Triangular Fibrocartilage Complex Tear. *Plast Reconstr Surg.* 2017;140(5):697e-708e.
2. Chan JJ, Teunis T, Ring D. Prevalence of triangular fibrocartilage complex abnormalities regardless of symptoms rise with age: systematic review and pooled analysis. *Clin Orthop Relat Res.* 2014;472(12):3987-94.
3. Smith TO, Drew B, Toms AP, Jerosch-Herold C, Chojnowski AJ. Diagnostic accuracy of magnetic resonance imaging and magnetic resonance arthrography for triangular fibrocartilagenous complex injury: A systematic review and meta-analysis. *J Bone Joint Surg Am.* 2012, 94: 824-32.
4. Treiser MD, Crawford K, Iorio ML. TFCC Injuries: Meta-Analysis and Comparison of Diagnostic Imaging Modalities. *J Wrist Surg.* 2018;7(3):267-272.
5. Watanabe A, Souza F, Vezeridis PS, Blazar P, Yoshioka H. Ulnar-sided wrist pain. II. Clinical imaging and treatment. *Skeletal Radiol.* 2010;39(9):837-857.
6. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med (Zagreb).* 2012;22(3):276-282.
7. Ng AWL, Tong CSL, Hung EHY, Griffith JF, Tse WL, Wong CWY, et al. Top-Ten Tips for Imaging the Triangular Fibrocartilagenous Complex. *Semin Musculoskelet Radiol.* 2019;23(4):436-443.