Direct wrist magnetic resonance arthrography in triangular fibrocartilage lesions

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Objective
The objective of this study was to assess the diagnostic accuracy of direct wrist magnetic resonance arthrography (MRA) compared with arthroscopy in the diagnosis of triangular fibrocartilage complex (TFCC) lesions.

Patients and methods
A total of 25 (12 men and 13 women) consecutive patients, in the age range from 16 to 49 years (mean age: 28 years) complaining of unexplained chronic wrist pain and suspected to have TFCC lesions were prospectively examined by direct MRA with arthroscopic correlation.

Results
Compared with arthroscopic results, the sensitivity, specificity, and accuracy of direct MRA for central TFCC lesions were 100% for all three and 100, 90.9, 96%, respectively, for peripheral lesions.

Conclusion
Direct MRA can diagnose TFCC lesions with very high sensitivity and specificity and can help in reducing arthroscopies for pure diagnostic purposes.

Keywords:
magnetic resonance arthrography, triangular fibrocartilage complex, wrist

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Introduction

Triangular fibrocartilage complex (TFCC) represents an essential stabilizing structure of the distal radioulnar joint (DRUJ) and ulnar carpus providing a gliding surface for the carpal bones [1]. Plain radiograph is often used as the first line of investigation, but usually does not provide information regarding radiolucent structures. Fluoroscopic arthrography has a high incidence of false-positive and false-negative results [2]. Ultrasound (US) allows a partial visualization of TFCC because the size of the acoustic window varies with the size and the morphology of the ulnar styloid and the ulnar variance. Also, the articular disk assessment may be limited if there is positive ulnar variance or if the ulnar styloid is hypertrophic. For these reasons, US is not the modality of choice to assess TFCC integrity [3]. Magnetic resonance arthrography (MRA) is the modality of choice for TFCC assessment because it allows the combined advantages of multislice computed tomographic arthrography for depiction of chondral injuries and MRI for soft tissue abnormalities and bone marrow edema [4].

Surgical techniques directed at specific injury patterns have been proposed and precise preoperative diagnosis is necessary. Direct MRA can facilitate the diagnosis and the indication for surgery of the wrist and help to reduce arthroscopic interventions for purely diagnostic purposes and without any therapeutic consequences [5].

The aim of this study was to assess the diagnostic performance of direct MRA compared with arthroscopy in the diagnosis of TFCC lesions.

Patients and methods

This study was approved by our institutional ethics committee. In all, 25 patients were prospectively studied with arthroscopic correlation between October 2016 and December 2017. Informed consent was obtained from all individual participants included in the study.

The patients were referred to our Radiodiagnosis Department from the outpatient of the Orthopedics Department, Faculty of Medicine, Assuit University Hospital complaining of unexplained chronic wrist pain and suspected clinically to have TFCC lesions.

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All patients were subjected to: history taking, plain radiograph (straight posteroanterior and lateral views), clinical provisional diagnosis, MRA, and to arthroscopic surgical procedure.

MRA was performed by Philips Achieva 1.5-T (Philips Medical Systems, Best, The Netherlands) MRI machine using wrist coil eight elements where the patients were positioned in the prone position with the arm above their head in the so-called 'Superman' position.

Technique of magnetic resonance arthrography

A measure 2–4 ml of contrast mixture (formed of gadopentetate dimeglumine 0.1 ml added to 5 ml nonionic contrast medium, 5 ml xylocaine, and sterile saline solution was added to form a mixture of 20 ml) was injected through the dorsal posterior approach into the radiocarpal compartment which was the only injected compartment.

Introduction of the needle into the joint space was done by US-guided injection. Within 30 min after radiocarpal injection of contrast and exercise of the joint was advised, the patients were moved to the MR machine. MRA protocols include multiple pulse sequence and planes (Table 1).

Image analysis

MRA examinations were blindly, randomly, and independently analyzed by two experienced musculoskeletal radiologists (radiologist 1 with 12 years of experience and radiologist 2 with 20 years) blinded to arthroscopic findings. They had access only to the clinical history. All decisions were made by means of consensus.

All images were viewed on a dedicated Picture Archiving and Communication System, Paxera, and Philips Achieva workstation.

Table 1 Protocol for magnetic resonance arthrography imaging

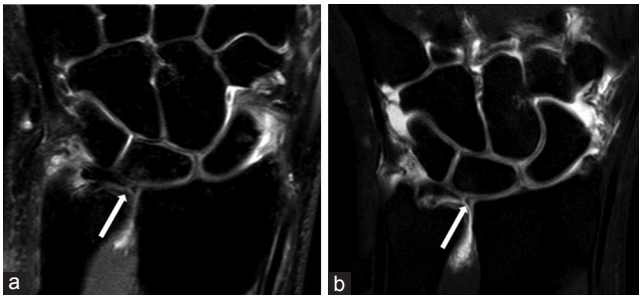
Parameter sequences	TR	TE	FOV (mm)	SL	Gap	Matrix	NSA
Axial (T1-SPIR)	487	22	80	2	0.2	268×199	4
Sagittal (T1-SPIR)	487	22	80	2	0.2	268×199	4
Coronal (T1-SPIR)	487	22	80	2	0.2	268×199	4
Coronal (T2-FFE)	450	11	100	3	0.3	124×99	2
Axial (T2-WI)	2333	100	80	3	0.3	272×210	6
Coronal (PD SPAIR)	487	22	80	2	0.2	268×199	4

FOV, Field of view; NSA, Number of signal averages; PD SPAIR, Proton density spectral attenuated inversion recovery; T2-FFE, T2-fast field echo; T1-SPIR, T1-weighted spectral presaturation with inversion recovery; TR, Time of repetition; TE, Time of echoes; SL, Slice thickness.

Consensus was finally obtained in case of initial disagreement.

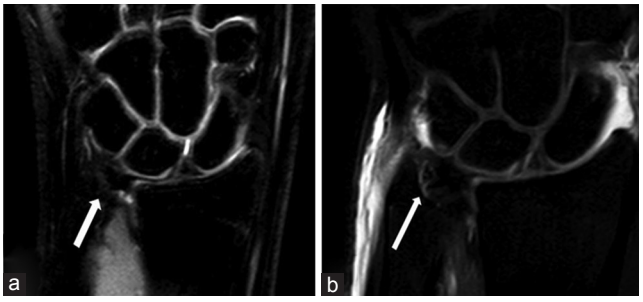
Each TFCC lesion was scored as present (1) or absent (0). Images were evaluated for the presence and location of TFCC tears, and imaging findings were compared with arthroscopic findings (gold standard).

Figure 1



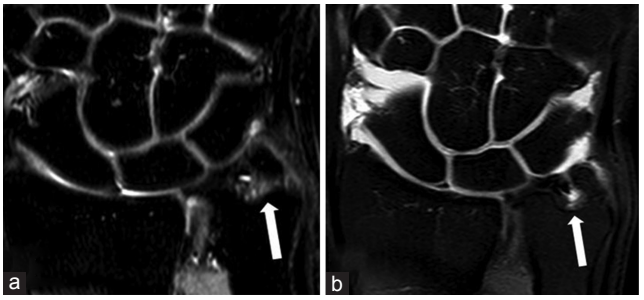
(a) Conventional MRI study: Coronal PD SPAIR image (a) showed central TFCC tear (arrow). (b) Direct MRA study: Coronal T1 SPIR image (B) showed abnormal hyper intense signal intensity involving ulno basal attachment of TFCC being outlined by injected contrast suggesting partial thickness peripheral ulnar TFCC tear (arrow) with no detected leakage to DRUJ.

Figure 2



(a) Conventional MRI study: Coronal PD SPAIR image (a) showed intact TFCC. (b) Direct MRA study: Coronal T1 SPIR image (b) showed abnormal hyper intense signal intensity involving ulno basal attachment of TFCC being outlined by injected contrast suggesting partial thickness peripheral ulnar TFCC tear (arrow) with no detected leakage to DRUJ.

Figure 3



(a) Conventional MRI study: Coronal PD SPAIR image (a) showed peripheral ulnar TFCC tear with avulsion fracture of ulnar styloid process. (b) Direct MRA study: Coronal T1 SPIR image (b) showed peripheral ulnar TFCC tear outlined by contrast (arrow) as well as avulsion fracture of ulnar styloid process.

Fig. 1 represents a case of central TFCC lesion while Fig. 2 shows a case of peripheral ulnar tear which appears only after injection of contrast and Fig. 3 shows a case of peripheral ulnar tear with avulsion fracture of ulnar styloid process.

TFCC lesions: the study included central and peripheral ulnar lesions. Central lesions were considered when located (2–3 mm) medial to the radial attachment of the TFCC (to differentiate them from radial tears). Once diagnosed, we attempted to describe TFCC tears according to Palmer's classification, taking into consideration location of the tear, associated degenerative changes, and preceding history of trauma when available.

Diagnostic criteria for TFCC lesions were absence of the TFCC or focal thickness defect as well as signal abnormalities within different portions of TFCC.

(1) Partial thickness tear: there is abnormal intermediate signal intensity within TFCC on short-time echo images that increased on T2* and reaching to one of the articular surfaces of TFCC
(2) Complete tear: when the abnormal signal reaching both superior and inferior surfaces of TFCC. Fluid collecting in the DRUJ is an important secondary sign, but the presence of fluid signal alone is not indicative of a TFCC tear.

Both complete and partial tears were scored as positive.

The criteria for carpal abutment syndrome: were central TFCC lesions with ulnar-sided lunate degenerative changes (hyperintense proton density spectral attenuated inversion recovery signal intensity of bone marrow edema and subarticular cystic degeneration) with or without positive ulnar variance. We consider central thinning of TFCC with ulnar-sided lunate changes and positive ulnar variance as one of the central TFCC lesions (carpal abutment, palmer class IIB).

Arthroscopy

Arthroscopy was performed using a 2.7 mm arthroscope. Arthroscopic examinations were performed by an expert orthopedic surgeon specialized in wrist surgery. Arthroscopy was performed at less than 1 month after imaging examinations. During arthroscopy MRA images on film hard copy were available to the surgeon.

After the completion of surgery, the arthroscopic findings were incorporated on a standard form by the operator. The result for the MRA was compared with the intraoperative arthroscopic assessment.

Statistical analysis

Statistical analysis was performed using SPSS for Windows (version 16.0; SPSS Inc., Chicago, Illinois, USA). Regarding arthroscopic findings as the gold standard, the numbers of true-positive, true-negative, false-negative, and false-positive results of MRA for each TFCC lesion were determined. For each subtype of TFCC lesion, the diagnostic performance of MRA was quantified by the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy.

Diagnostic performance of MRA versus arthroscopy in the diagnosis of TFCC lesions was obtained for both central and peripheral TFCC lesions.

Results

Arthroscopy confirmed 22 TFCC lesions, eight central lesions, and 14 peripheral ulnar lesions (Table 2).

From the arthroscopically proved 22 TFCC lesions (Table 2), MRI correctly diagnosed 17 lesions and missed 5 lesions, and MRA correctly diagnosed the 22 lesions and missed no TFCC lesion. Considering central subtype individually, MRI correctly diagnosed 7 central TFCC lesions and missed 1 central TFCC lesion. MRA made correct diagnosis of all central TFCC lesions (8). Considering peripheral ulnar subtype individually, MRI correctly diagnosed 10 peripheral ulnar TFCC lesions. MRA correctly diagnosed all peripheral ulnar lesions (14). *P* value is mentioned in Table 3.

Discussion

Our results of MRA using direct intra-articular contrast injection for central TFCC lesions (showed a

Table 2 MRI and magnetic resonance arthrography compared with arthroscopy in detecting triangular fibrocartilage complex lesions

Pathology	Operative findings (*n*=22)	Modality	True positive	True negative	False positive	False negative
Any TFCC lesion	22	MRI	17	1	2	5
		MRA	22	2	1	0
Central TFCC lesion	8	MRI	7	17	0	1
		MRA	8	17	0	0
Peripheral ulnar TFCC lesion	14	MRI	10	9	2	4
		MRA	14	10	1	0

MRA, Magnetic resonance arthrography; TFCC, Triangular fibrocartilage complex.

Table 3 Calculated sensitivity, specificity, positive, and negative predictive values and accuracy of magnetic resonance arthrography for triangular fibrocartilage complex lesions

MRA (%)	Central TFCC lesion	Peripheral ulnar TFCC lesion
Sensitivity	100	100
Specificity	100	90.9
PPV	100	93.3
NPV	100	100
Accuracy	100	96

MRA, Magnetic resonance arthrography; NPV, Negative predictive value; PPV, Positive predictive value; TFCC, Triangular fibrocartilage complex. Statistical significance was set at $P<0.05$ (P value less than 0.05 was considered to indicate a statistically significant difference).

sensitivity and specificity of 100%) are higher than the indirect (intravenous) wrist MRA results of Haims *et al.* [6] who used a 1.5 T scanner and reported sensitivity and specificity in the assessment of the central disk of TFCC (83 and 91%, respectively). Recently, Asaad *et al.* [7] who also used a single radiocarpal injection and a 1.5 T scanner showed sensitivity and specificity (89 and 91%, respectively) for central TFCC lesions being lower when compared with our results which can be attributed to their detection of full thickness TFCC tears only.

Our results of MRA for peripheral ulnar TFCC lesions showed sensitivity and specificity being 100 and 90.9%, respectively, are superior to those detected by Asaad *et al.* [7], who used a single radiocarpal injection and a 1.5 T scanner showed lower sensitivity and specificity for peripheral ulnar TFCC lesions (83 and 80%, respectively). He attributed his lower sensitivity of MRA for peripheral ulnar TFCC tears than central to the more complex anatomy of the peripheral region of the TFCC, and the possibility that associated focal synovitis at the injured ulnar TFCC attachment might impede the passage of contrast [7].

In an article by Rüegger *et al.* [8] that evaluates the accuracy of MRA of the DRUJ in depiction of peripheral tears of the TFCC using a 1.5 T scanner and DRUJ contrast injection and then adding midcarpal injection if no communication with the radiocarpal is established (different technique for injection) reported a sensitivity and specificity for peripheral ulnar TFCC tears (being 85 and 76%), which are lower than our results for ulnar TFCC lesions. We attribute that to our dependence on signal abnormalities within TFCC as well as secondary leakage.

Magee *et al.* [9] used a 3 T scanner and single radiocarpal injection comparing MRI and MRA in TFCC lesions with arthroscopic correlation and reported a sensitivity of MRI and MRA of 75 and 88%, respectively, for peripheral ulnar tears. These results are comparable to our results of MRA (100% sensitivity for peripheral ulnar tears). This can be attributed to that he considered only communicating tears and excluded partial thickness tear, whereas we considered both partial and complete thickness tears.

Conclusion

From the reports mentioned above, it would seem that the sensitivity and specificity of direct MRA in detecting TFCC tears is superior to that of MRI. It was also observed that the sensitivity of wrist MRA in detecting peripheral TFCC tears is lower than its sensitivity in detecting central TFCC tears. Direct MRA using a single radiocarpal injection has higher sensitivity for TFCC lesions than unenhanced MRI even at a higher scanner (3 T).

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Flaherty E, Chew F, Mulcahy H, Porrino J, Richardson M. Wrist MRI – Anatomy and common pathologies. In: European Congress of Radiology 2016. Seattle, Washington; 2015.

2 Aatif Mahmood JF, Vasireddy N, Waseem M. Wrist MRI arthrogram v wrist arthroscopy: what are we finding? Open Orthop J 2012; 6:194–198.

3 Taljanovic MS, Goldberg MR, Sheppard JE, Rogers LF. US of the intrinsic and extrinsic wrist ligaments and triangular fibrocartilage complex – normal anatomy and imaging technique. Radiographics 2011; 31:79–80.

4 Zanetti M, Saupe N, Nagy L. Role of MR imaging in chronic wrist pain. Eur Radiol 2007; 17:927–938.

5 Basiouny Alghannam M. The role of MRI and MR arthrography in evaluation of wrist pain. Int J Med Imaging 2014; 2:149.

6 Haims AH, Schweitzer ME, Morrison WB, Deely D, Lange R, Osterman AL, *et al.* Limitations of MR imaging in the diagnosis of peripheral tears of the triangular fibrocartilage of the wrist. Am J Roentgenol 2002; 178:419–422.

7 Asaad AM, Andronic A, Newby MP, Harrison JWK. Diagnostic accuracy of single-compartment magnetic resonance arthrography in detecting common causes of chronic wrist pain. J Hand Surg Eur Vol 2017; 42:580–585.

8 Rüegger C, Schmid MR, Pfirrmann CW, Nagy L, Gilula LA, Zanetti M. Peripheral tear of the triangular fibrocartilage: depiction with MR arthrography of the distal radioulnar joint. Am J Roentgenol 2007; 188:187–192.

9 Magee T. Comparison of 3-T MRI and arthroscopy of intrinsic wrist ligament and TFCC tears. Am J Roentgenol 2009; 192:80–85.