Clinical Imaging 51 (2018) 323–326

Contents lists available at ScienceDirect

Clinical Imaging

journal homepage: www.elsevier.com/locate/clinimag

Diagnosing extensor carpi ulnaris tendon dislocation with dynamic rotation MRI of the wrist

Peter Kaiser[a], Florian Kellermann[b], Rohit Arora[a], Benjamin Henninger[c], Ansgar Rudisch[c,*]

[a] Department of Trauma Surgery, Medical University of Innsbruck, Innsbruck, Austria
[b] Department of Intensive Care, BGU Murnau, Murnau, Germany
[c] Department of Radiology, Medical University of Innsbruck, Innsbruck, Austria

ARTICLE INFO

Keywords:
MRI
ECU
Extensor carpi ulnaris tendon
Wrist
Dislocation

ABSTRACT

Objective: The purpose of this study was to retrospectively correlate the kinematic dynamic rotation MRI (DR-MRI) of the wrist for assessment of extensor carpi ulnaris (ECU) tendon subluxation and dislocation.
Material and methods: The presence of an ECU tendon subluxation or dislocation on the DR-MRI report was correlated to findings of the surgical report.
Results: DR-MRI findings showed an ECU subluxation in 12 cases and an ECU dislocation in 13 cases. Surgery showed an ECU subluxation in 13 cases and an ECU dislocation in 12 cases ($\kappa = 0.92$).
Conclusion: DR-MRI is a feasible method to visualize ECU tendon subluxation and dislocation.

1. Introduction

Subluxation and dislocation of the extensor carpi ulnaris (ECU) tendon can be one cause for ulnar-sided wrist pain. The reason for dislocation or subluxation is an injury to the ECU tendon sub-sheath caused by trauma or rheumatic genesis [1, 2]. The ECU tendon sub-sheath is an independent layer of connective tissue underneath the extensor retinaculum stabilizing the ECU tendon [3]. Three different types of injury patterns of the sub-sheath leading to a dislocation or subluxation have been described: (1) a disruption from the ulnar wall of the ulnar groove, (2) a disruption from the radial wall of the ulnar groove and (3) a detachment of the periosteum of the ulnar wall of the ulnar groove [4, 5].

Although the assessment of ECU tendon subluxation or dislocation is made by clinical examination, imaging is necessary to confirm and visualize the diagnosis and to exclude other concomitant injuries or pathologies causing ulnar-sided wrist pain. Ultrasound as well as MRI can be used to visualize any ECU tendon pathology, like tendinopathy, tenosynovitis, tendon rupture or subluxation [6–8].

Previously ultrasound was described as the modality of choice to visualize ECU tendon subluxation or dislocation as it is a dynamic examination method [1, 5, 9, 10]. Some authors stated that MRI was useful in excluding other pathologies like lesions of the triangular fibrocartilage complex (TFCC) but not suitable to make a diagnosis of ECU tendon subluxation or dislocation because of its static examination character [5, 9].

Dynamic interactions of osseous and soft tissue structures, however, can be assessed by the use of kinematic MRI. Therefore, the purpose of this study was to evaluate the kinematic dynamic rotation MRI (DR-MRI) of the wrist for assessment of ECU tendon subluxation and dislocation. It was hypothesized that MRI could visualize ECU tendon subluxation and dislocation and distinguish in-between both.

2. Material and methods

A retrospective analysis was performed on the data of all patients who received a DR-MRI of the wrist because of symptomatic ulnar sided wrist pain with clinical signs and suspicion of an ECU tendon subluxation or dislocation between 1999 and 2013 at the department for radiology and the department for trauma surgery of the XXXXX. Institutional review board approval was granted by means of a general waiver for studies with retrospective data analysis (Local research ethics committee, XXXXX; 20th February 2009).Patients were only included if they had a surgical treatment because of ulnar sided wrist pain following the DR-MRI examination.

25 wrists from 24 patients (4 male; 20 female; mean age 31,6 years – range 15–53 years) were enrolled in the study. All patients received a DR-MRI of the affected wrist prior surgery. A 1.5 T whole-body MR-system (Magnetom Avanto, Siemens, Germany) together with a 15-channel extremity coil was used. In cases of fewer channels only little SNR reduction is to be expected and the visualization of tendon displacement is not significantly affected. Dynamic MRI was performed in

* Corresponding author at: Medical University of Innsbruck, Dept. of Radiology, Anichstrasse 35, 6020 Innsbruck, Austria.
E-mail address: ansgar.rudisch@i-med.ac.at (A. Rudisch).

https://doi.org/10.1016/j.clinimag.2018.06.015
Received 18 December 2017; Received in revised form 5 June 2018; Accepted 20 June 2018

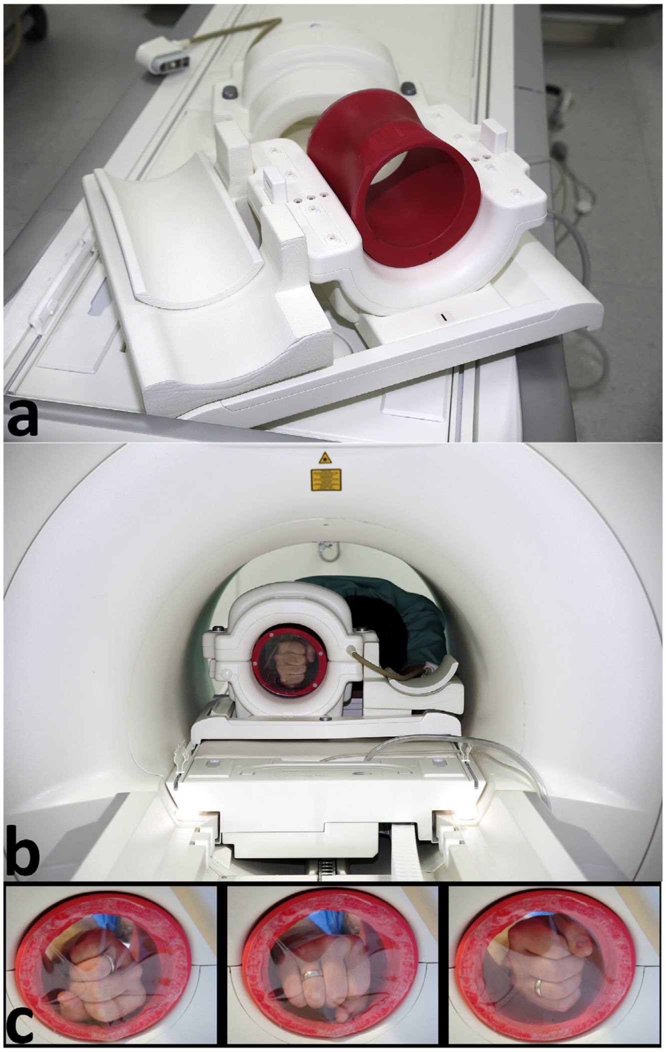

Fig. 1. a–c: a) Extremity coil with a specially designed wrist positioning device for DR-MRI b) Patient lying prone inside the MRI with the wrist inside the extremity coil and positioning device performing a pronation-supination movement c) Forearm rotation inside the positioning device.

real time during wrist rotation using an axial true FISP sequence (slice thickness: 6 mm, TR/TE: 4/1.55 ms, FA 40°, acquisition matrix: 208 × 133, voxel-size 0.74 × 0.74 × 6 mm^3). This sequence was suitable as it shows a fast image acquisition during motion without relevant artifacts with a good resolution. Within 9 s 18 sequential images were obtained for one slice position at the level of the distal radio-ulnar joint. The examination was started with the patient's wrist in a fully pronated position. The patient was asked to perform an active, slow and continuous rotation of the forearm to a maximum supinated position during the acquisition period. A wrist positioning device inside the extremity coil was used to position and lead the arm of the patient during the pronation and supination movement (Fig. 1a–c). The main purpose of this wrist device is a controlled positioning of the rotating hand. It particularly prevents a forward or backward movement allowing the hand to remain in the desired slice position. We used a cylindric plastic foam tube, originally designed by Siemens (Munich, Germany), for serving as a container for a water bottle phantom in MRI test protocols. We attached a thin plastic window at its frontside for the examiner to watch the hand movements and for the patient to feel and control the hand position.

The total radiologic facility time was approximately 15 min. A displacement of 100% of the ECU tendon's width beyond the ulnar border of the ulnar groove represented an ECU tendon dislocation in the radiologic report. A partial displacement of the tendon's width beyond the ulnar border of the ulnar groove represented an ECU tendon subluxation. The nomenclature of the preoperative report was used for evaluations. The amount of tendon subluxation was measured in a re-evaluation of the radiologic images as the percentage of the amount of the tendon's width beyond the ulnar border of the ulnar groove in relation to the total width of the tendon with Impax EE software (Agfa Healthcare, Bonn, Germany).

Wrist surgery was conducted within a maximum of three months after the DR-MRI because of persistent ulnar-sided wrist pain and the clinical and radiologic diagnosis of ECU tendon subluxation or dislocation. The surgical report was the standard reference for diagnosing an ECU tendon subluxation or dislocation. As stated in the surgical report, ECU tendon subluxation or dislocation was assessed by the surgeon by a pronation-supination motion of the forearm.

Preoperative radiologic and surgical reports were evaluated and findings were listed as followed: ECU tendon subluxation (DR-MRI), ECU tendon dislocation (DR-MRI), concomitant wrist pathologies (DR-MRI), ECU tendon subluxation (surgery), ECU tendon dislocation (surgery), presence of surgical ECU tendon treatment and concomitant operations. Because of the retrospective study design using the old reports neither report included any standardized rating sheets.

A Cohen's kappa coefficient was calculated for statistical evaluation between the findings of the surgical report and the DR-MRI report using SPSS (Version 24, IBM, Armonk, NY, USA).

3. Results

The right wrist was affected from ECU tendon dislocation or subluxation 15 times and the left wrist 10 times. One patient showed bilateral wrist involvement.

MRI findings showed an ECU subluxation in 12 cases and an ECU dislocation in 13 cases. Surgery showed an ECU subluxation in 13 cases and an ECU dislocation in 12 cases ($\kappa = 0.92$). Fig. 2 shows a DR-MRI image series visualizing an ECU tendon dislocation. The subluxation group showed an amount ranging from 50% to 90% of the tendon's width beyond the ulnar border of the ulnar groove in maximal supination.

ECU tendinosis or peritendinitis was seen in 21 cases. MRI revealed further wrist pathologies in 20 cases with lesions of the TFCC showing the highest incidence with 16 cases (8 × Palmer IIA, 2 × Palmer IIB, 5 × Palmer IIC and 1 × Palmer IID). Further relevant diagnosis were multiple small dorsal ganglia in one patient, a persistent bone bruise after a distal radius fracture in another patient, an ulnar styloid non-union after a distal radius fracture in a third patient and a severe impaction between the ulnar styloid and the carpus in two patients.

All patients were treated with a retinaculum loop for ECU tendon subluxation or dislocation. Additional surgical treatment consisted of ECU tendon synovectomy in twelve patients, TFCC débridement in four patients, ulnar styloid shortening osteotomy in two patients, ulnar shortening in one patient and transosseous TFCC refixation with concomitant ulnar styloid refixation in one patient.

4. Discussion

The most important finding of the present study was that DR-MRI can adequately visualize the ECU tendon's position in relation to the ulnar groove at the wrist in a rotational pronation-supination movement. Thus, ECU tendon subluxation or dislocation can be diagnosed correctly by the use of DR-MRI. There was one case, which showed a dislocation on the MRI images but only a subluxation during surgery. This finding might be due to the sometimes difficult differentiation in the nomenclature in threshold cases between subluxation and dislocation. Although subluxation was defined as a displacement of 99% or less of the tendon's width out of its ulnar groove, it might be difficult to