High Resolution Ultrasound vs MRI in Evaluation of Triangular Fibrocartilage Complex

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Abstract

Background: The triangular fibrocartilage consists of the triangular fibrocartilage proper, the dorsal and volar radioulnar ligaments, the ulnar collateral ligament, the meniscal homologue, the extensor carpi ulnaris, and the ulnolunate and ulnotriquetral ligament. On magnetic resonance imaging, the TFC proper is homogeneously low in signal on all sequences. The ulnar attachment is striated and sometimes has an intermediate signal intensity. Ultrasound examination has wide availability, portability, low cost and no radiation. Ultrasound is used for assessing the soft tissues. The imaging capability, practicality, and dynamic component have led to ultrasound being increasingly used as a first-line investigation for all wrist soft-tissue abnormalities except for those of the intrinsic/extrinsic ligaments and the triangular fibrocartilage complex. Musculoskeletal ultrasound sometimes does not provide enough information regarding the internal structures of the wrist to allow a final diagnosis. However, promising results have been published regarding the ultrasound examination of the triangular fibrocartilage.

Aim of Work: The aim of this study is to evaluate the diagnostic performance of both ultrasonography and MRI findings in evaluation of triangular fibrocartilage.

Patients and Methods: This study included fifty patients; 30 males, 20 females with age range from 21 to 75 years. All patients were presenting with ulnar sided wrist pain. They all were subjected to examination by both MRI and ultrasound.

Results: Statistical analysis of the results showed highly significant agreement between the two modalities in the detection of Triangular Fibrocartilage (TFCC) tear and degeneration.

Key Words: Triangular fibrocartilage – Magnetic resonance imaging – Ultrasound.

Introduction

THE Triangular Fibrocartilage Complex (TFCC) is considered to consist of the Triangular Fibrocartilage proper (TFC), the dorsal and volar radioulnar ligaments, the ulnar collateral ligament, the meniscal homologue, the sheath of the Extensor Carpi Ulnaris (ECU), and the ulnolunate and ulnotriquetral ligament [1].

On Magnetic Resonance Imaging (MRI), the TFC proper is homogeneously low in signal on all sequences. The ulnar attachment is striated and sometimes has an intermediate signal intensity [2]. The clinical presentation of TFCC injuries usually includes ulnar-sided wrist pain and a palpable or audible click on rotation of the forearm [2].

Palmer, 1989 [3] established a classification system for TFCC tears based on the cause, location, and extent of the abnormality, whereby abnormalities are classified as either traumatic (class 1) or degenerative (class 2).

According to Taljanovic et al., 2008, [4]. The TFC disk was considered normal if it was seen as homogeneously echogenic triangular tissue in the proper anatomic location at the articular aspect of the ulnar head. It was considered torn if hypoechoic clefts or defects were seen in the substance of the TFC disk. If some irregularity of the TFC disk was observed without a frank cleft on sonography it was considered frayed/partially torn.

Aim of work:

The aim of this study is to evaluate the diagnostic performance of both ultrasonography and MRI findings in evaluation of triangular fibrocartilage.

Patients and Methods

This study included fifty patients; 30 males, 20 females with age range from 21 to 75 years. All patients presenting with ulnar sided wrist pain.
This study was performed in the period from June 2014 till January 2016.

All patients were referred to the Radiology Department for ultrasonography and MRI examinations from the Orthopedic Department, Faculty of Medicine Kasr El-Eini Hospital, Cairo University.

**Inclusion criteria:**
- All patients presenting with ulnar sided wrist pain.

**Exclusion criteria:**
- Patients who are claustrophobic or unable to undergo MRI examination owing to a pacemaker, critically positioned metallic foreign body or incompatible vascular implants.
- Patients who are intolerant to contrast administration due to need to inject contrast contrast in some MRI examinations (specially patients with impaired renal functions).
- Patients with history of operative intervention.
- All patients were subjected to the following:
  - Full history taking.
  - Full examination.
  - Plain X-ray examination.
  - High resolution ultrasound examination using high frequency linear probe.
  - Dynamic ultrasound when needed.
  - Color Doppler and/or power Doppler study.
  - MRI (1.5 T) examination with or without IV contrast according to the indications.
  - Correlation with operative and pathological findings whenever possible.

**Magnetic resonance imaging:**
MRI was performed using Philips scanners Achieva or Intera (1.5 T) at the Radiology Department of Kasr El-Eini Hospital, Cairo University.

- **Ultrasonographic examination:** All patients had ultrasonography of the wrist joint with excess gel was used instead of the gel pad.
- Ultrasound examinations were performed using GE Logic pro6 (7-11 MHz).

**During examination of hand joints and wrists:** The patient was examined while sitting upright, with the hand placed on a cushion and fully pronated then supinated.

- Data were statistically described in terms of frequencies (number of cases) and percentages. Agreement between US and MRI was tested using kappa statistic. Accuracy was represented using the terms sensitivity, specificity, +ve predictive value, ve predictive value, and overall accuracy. *p*-values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).

**Results**
This study included 50 patients. It included 30 male patients and 20 female patients with age range from 21 to 75 years. All of the examined patients were suffering from ulnar sided wrist pain. In 24 patients the right wrist was affected (48%) and in 26 patients the left wrist was affected (52%).

Comparing between MRI and ultrasound in the detection of Triangular Fibrocartilage (TFCC) tear, The MRI detected TFCC tear in 27 joints. The ultrasound detected TFCC tear in 24 joints. They both agreed in 24 joints with Triangular Fibrocartilage (TFCC) tear. Ultrasound missed 3 tears which were detected by MRI. Fig. (2A,B).

Meanwhile MRI detected TFCC degeneration in 20 joints. Ultrasound detected it in 15 joints. They both agreed in 15 joints with TFCC degeneration. Ultrasound missed 5 joints with TFCC degeneration which were detected by MRI. Fig. (1A,B).

MRI detected ECU (extensor carpi ulnaris) injury in 13 joints while ultrasound detected it in 17 joints. They both agreed in 13 joints with ECU injury which was detected by ultrasound. Fig. (3A,B).

Table (1): According to their occupations, the patients were classified as following.

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Value</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpenters</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>Builders</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Doctor of orthopedic</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mechanics</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Sports players</td>
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<td>4</td>
</tr>
<tr>
<td>Nurses</td>
<td>4</td>
<td>8</td>
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<tr>
<td>Workers at hospital</td>
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<td>4</td>
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<tr>
<td>Hospital employers</td>
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<td>2</td>
</tr>
<tr>
<td>Architects</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Housewives</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>No job</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
Fig. (1): 40 years old patient with history of trauma. (A) Coronal PD SPAIR WIs showing bright degenerative signal at the ulnar attachment of triangular fibrocartilage and meniscus homologue surrounded by minimal effusion. (B) Longitudinal ultrasound image of the triangular fibrocartilage which is not properly visualized due to technical difficulties.

Fig. (2): 23 years old patient working as a carpenter. (A) Coronal PD SPAIR WI showing heterogeneous ill defined outline of the triangular fibrocartilage and lunotriquetral ligament with subchondral edematous changes of carpal bones and distal ulna associated with joint effusion. (B) longitudinal ultrasound image showing central hypoechoic area of the triangular fibrocartilage.

Fig. (3): 50 years old patient with history of trauma. (A) Coronal PD SPAIR WIs showing bright degenerative signal at the ulnar attachment of triangular fibrocartilage and meniscus homologue. (B) Transverse ultrasound image of the ECU showing distended ECU synovial sheath by mild hypoechoic fluid (which was not revealed by MRI).

Discussion

In the evaluation of the triangular fibrocartilage by ultrasound compared to MRI, our study showed a sensitivity of 64.71%, a specificity of 90.91% and an accuracy of 82% in case of TFCC tear and a sensitivity of 85.71%, specificity of 95.35% in case of TFCC degeneration. These results concerning the TFCC tear matches results stated by Finlay et al., [6] with a sensitivity approaching 64% and a diagnostic accuracy of 85% in the detection of triangular fibrocartilage tear. Ultrasound was 100%
specific. Those results suggest that with training, experience and reliable technique, ultrasound may prove a reasonable screening modality for detection of triangular fibrocartilage injury.

A study done by Chiou et al., [7] who performed high resolution ultrasound for evaluation of triangular fibrocartilage and compared his results to conventional arthrography. This study showed high resolution ultrasound of the triangular fibrocartilage to have a high specificity, PPV, NPV and accuracy. However this study stated that high resolution ultrasound has a relatively low sensitivity of 68.4% and further extensive study should be done to assess its value in screening for triangular fibrocartilage tears, which also matched our results.

Keogh et al., [8] studied ultrasound examination of triangular fibrocartilage and compared his results to the magnetic resonance imaging and arthroscopy with a sensitivity and specificity of 87.5% and 100% which did not match our results. May be because this study had several limitations one of them that the study group was selected and did not include asymptomatic patients with normal triangular fibrocartilage.

Taljanovic et al., [4] studied the ultrasound examination of scapholunate, lunotriquetral and triangular fibrocartilage with the use of arthrography and MR arthrography as gold standards, the study showed a sensitivity of 86% and specificity of 100% and 94% accuracy. In this study conducted by Taljanovic the higher sensitivity rate compared to our results may be explained by the fact that sonoarthrography was performed in some of the patients which improved the evaluation of lunotriquetral ligament and triangular fibrocartilage.

Regarding the ultrasound detection of Extensor Carpi Ulnaris (ECU) injury either tenosynovitis or tear compared to MRI, our study showed a sensitivity of 100%, specificity of 89.19% and an accuracy of 92%.

However we found studies showing that both ultrasound and MRI have complementary role in diagnosing tendon injury as Porteous et al., 2012, [2] who revealed that tenosynovitis is easily diagnosed on either ultrasound or MRI as thickening and fluid distension of the synovial sheath with or without intrasubstance degeneration or tear of the tendon.

**Conclusion:**
Both magnetic resonance imaging and musculoskeletal ultrasound have complimentary roles in the evaluation of different causes of triangular fibrocartilage injury. Magnetic resonance imaging has a very important role in the assessment of internal derangement of the wrist joint. It has a high sensitivity for detection of soft tissue injury and it allows early detection of abnormalities of triangular fibrocartilage complex or marrow edema of the involved bones and is helpful for giving a wide range of differential diagnosis in patients with ulnar sided wrist pain and limitation of motion.

Musculoskeletal ultrasound is a valuable imaging modality for evaluation of patients with ulnar sided wrist pain. Ultrasound has many advantages including being of low cost, portable, non invasive and lacks exposure to ionizing radiation. It has the ability to correlate the site of pain with the underlying sonographic appearance and it allows dynamic assessment of the examined joint.

**References**
1- ZLATKIN M.B. and ROSNER J.: MR imaging of liga-
5- BEGGS I., BIANCHI S., BUENO A., et al.: Musculoskel-
السونار عالي الجودة مقابل الرنين المغناطيسي
في تقييم الفضروان الداخلي للرخع

يعتبر أم الجاب الداخلي للرخع مفعمة تشخيصية وذلك نظراً لتعقيد تركيب هذه المنطقة. إن العرض الإكلينيكي لحالات أم الجاب الداخلي للرخع يتوقع ما بين الإصابة الحادة والحالات المزمنة.

تنتمي هذه الرسالة خمسون مريضا معاصراً بالأم الجاب الداخلي للرخع، ثلاثون رجلاً وخمسة نائي، تتراوح أعمارهم ما بين 21 ل 75 عاماً وقد تعرض جميع المرضى للفحص باستخدام الرنين المغناطيسي والسونار.

إن الرنين المغناطيسي يلعب دور مهم جداً في فحص الإصابات الداخلي لفصل الرخع، يتميز الرنين بدقته عالية في فحص الأنسجة، كما أنه يسمح بالكشف المبكر لاعتلال الفضروان الداخلي للرخع ومماهات العظام، فهو يساع في تشخيص مختلف لأسباب أم الجاب الداخلي للرخع والحالات المزمنة من الحركة.

إن السونار يعتبر وسيلاً تصويرية مهمة جداً لتشخيص فحص أمراض الأدم الداخلي للرخع. إن السونار يتميز بأنه ذو كلفة منخفضة، متقلة، لا داخلي ولا تعرض المريض للشعاع. كما أن الموجات الصوتية تستخدم على المنطقة المعززة بدقة ظهر الأم وهو يسمح بفحص الفضروان الداخلي للرخع في مختلف الأوضاع.