Fat Suppression MRI of the Triangular Fibrocartilage Complex.

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**Purpose**
Advances in magnetic resonance imaging (MRI) allow for the visualization of small structures, such as the triangular fibrocartilage complex (TFCC) of the wrist. Recent investigators have suggested that MRI is useful in the delineation of the normal TFCC and pathology affecting it (1-9)(9-11). However, the previous MR studies have primarily utilized conventional spin echo pulse sequence, as opposed to more recently developed technologies. Therefore, we studied MRI of the TFCC in normal volunteers using multiple pulse sequences. In addition, we compared MR slices of the TFCC with corresponding histologic sections from cadaveric wrists.

**Materials and Methods**
Ten right wrists of 10 normal volunteers were studied on MRI. The volunteers were from 20 to 30 years old. MRI was performed in all volunteers on a 1.5T MR device (Signa; GE, Milwaukee, WI). The subjects were in the prone position with their elbows extended, their forearms in neutral or slight pronation. The wrist was fixed in the extremity surface coil. Only the coronal images were reviewed for this study. A small 14 cm field of view, two to four excitation, and a 192 × 256 matrix were used. Slice thickness was 3 mm with a 1 mm interslice gap. A T1-weighted spin echo (SE-T1) sequence, a T2-weighted fast spin echo (Fast SE-T2) sequence, and a T2*-weighted gradient echo (GRE-T2*) sequence were performed. A T1-weighted SE sequence with the same parameters was repeated with chemical saturation method as fat suppression MRI (FS-T1). Details of the TFCC for each pulse sequence were evaluated and compared.

Five wrists from fresh frozen cadavers were studied histologically. Serial coronal sections of the TFCC were performed from dorsal edge to palmar of the TFCC. The sections were stained with HE and azan, and evaluated by light microscopy. Furthermore, a comparison between MRI and the corresponding histologic sections was made.

**Results**
The TFCC was a low signal intensity structure located between the radius, ulna, lunate, and triquetrum (Fig. 1a). The hyaline cartilage of the radius, ulna and intercalated bones had high signal intensity on the FS-T1 sequence and slightly high signal on the GRE-T2* sequence. The other pulse sequences could not delineate the joint cartilage. The FS-T1 pulse sequence visualized the details of the TFCC best, followed by the GRE-T2* images. Delineation of the TFCC on the SE-T1 and the Fast SE-T2 sequences was poor.

The morphology of the TFCC was best represented on the FS-T1 images. It was triangular at dorsal MR slice, where the continuity between the TFCC and the ulna was obvious. On the coronal central slice of the TFCC, it was thin and disc-like on the radial side, and thicker on the ulnarwards. More distally, the TFCC connected to the triquetrum, while the proximal end was curled and inserted into the fovea of the ulna. The palmar MR section again revealed the TFCC as a triangular shape. These morphology of the TFCC on the fat suppression MRI was almost identical to the corresponding histologic sections(Fig. 1b).

**Discussion**
The TFCC stabilizes the radioulnar and the uniscapar joints, permits smooth motion of the wrist, and distributes and absorbs the load between the carpal bones and the ulna. There have been many reports discussing functional anatomy(5,8), arthrography(9), and MR imaging of the TFCC(1,5,9,10). In the previous MR studies, conventional T1 and T2 weighted spin echo method is mainly used, and there was no general agreement concerning delineation of the TFCC. One reported diagnostic ability of the MRI was almost equal to the arthrogram(4,8,10), while the recently reported penetration of the TFCC in the MRI was not enough to detect details of the TFCC(1,5,7). Recent developments in MRI have resolved several problems in imaging small joints. From our findings, excellent representation of the TFCC was possible only with FS-T1. This clearly showed the complex structure of the TFCC almost exactly to the histological sections. Delineation in SE-T1 and Fast SE-T2 method was poor.

Fat suppression MRI provides excellent representation of the TFCC for the following reason: (1) it detects signal of the joint cartilage and TFCC under high gain level by suppressing the relatively high signal of fat; (2) it increases the signal to noise ratio between the joint cartilage and the TFCC; (3) it increases the dynamic range of the image; and (4) it does not cause a chemical shift artifact.

GRE-T2* weighted images have been reported to be useful for detecting TFCC tears(5). In gradient echo imaging, fat is of relatively low signal intensity, allowing for better delineation of the TFCC by same reason of fat suppression MRI. Furthermore, free water, such as joint fluids which has relatively high signal with this technique assists in detecting TFCC tears. Conventional SE-T1 and the Fast spin echo are not suitable techniques because of the high signal intensity of the fat near to the TFCC.

We conclude that fat suppression MRI was most useful for the morphologic evaluation of the TFCC. This technique accurately depicted this complex, three dimensional structure, further intra and inter elements of the TFCC.

**References**

Fig. 1 (a) Fat suppression MRI (b) Histological section
Coronal central sections of the MRI and histology are almost identical