Computed Tomography Arthrography Using a Radial Plane View for the Detection of Triangular Fibrocartilage Complex Foveal Tears

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Purpose To classify triangular fibrocartilage complex (TFCC) foveal lesions on the basis of computed tomography (CT) arthrography using a radial plane view and to correlate the CT arthrography results with surgical findings. We also tested the interobserver and intra-observer reliability of the radial plane view.

Methods A total of 33 patients with a suspected TFCC foveal tear who had undergone wrist CT arthrography and subsequent surgical exploration were enrolled. We classified the configurations of TFCC foveal lesions into 5 types on the basis of CT arthrography with the radial plane view in which the image slices rotate clockwise centered on the ulnar styloid process. Sensitivity, specificity, and positive predictive values were calculated for each type of foveal lesion in CT arthrography to detect foveal tears. We determined interobserver and intra-observer agreements using kappa statistics. We also compared accuracies with the radial plane views with those with the coronal plane views.

Results Among the tear types on CT arthrography, type 3, a roundish defect at the fovea, and type 4, a large defect at the overall ulnar insertion, had high specificity and positive predictive value for the detection of foveal tears. Specificity and positive predictive values were 90% and 89% for type 3 and 100% and 100% for type 4, respectively, whereas sensitivity was 35% for type 3 and 22% for type 4. Interobserver and intra-observer agreement was substantial and almost perfect, respectively. The radial plane view identified foveal lesion of each palmar and dorsal radioulnar ligament separately, but accuracy results with the radial plane views were not statistically different from those with the coronal plane views.

Conclusions Computed tomography arthrography with a radial plane view exhibited enhanced specificity and positive predictive value when a type 3 or 4 lesion was identified in the detection of a TFCC foveal tear compared with historical controls. *(J Hand Surg Am. 2015;40(2): 245–251. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Diagnostic II.

Key words Computed tomography arthrography, triangular fibrocartilage complex foveal tear, diagnostic accuracy, radial plane view, ulnar-sided wrist pain.

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Diagnosing ulnar-sided wrist pain is often a challenging problem.[1] A triangular fibrocartilage complex (TFCC) foveal tear, disruption of the deep fiber of the radioulnar ligament from the ulnar fovea, is a cause of ulnar-sided wrist pain.[2] However, because of the complexity of the anatomy of TFCC, accurate diagnosis of a specific TFCC pathology by physical examination alone is difficult.[3] Triple-injection wrist arthrography has been used successfully to identify ligamentous tears if the contrast material communicates through the different joint compartments.[4–7] However, this test is limited by its inability to localize the site accurately or evaluate the extent or dimensions of the damage, because overlapping of the contrast material obscures details.[1,8–13]

Magnetic resonance imaging (MRI) is another modality used to evaluate TFCC pathology; however, its sensitivity and specificity are variable.[14–23] Reported diagnostic test accuracy ranges from 44%[20] to 100%[14] for sensitivity and from 60%[17] to 100%[15] for specificity. Magnetic resonance arthrography has been introduced more recently and has shown improved accuracy over plain MRI.[24–28] However, this technique is expensive and time-consuming.

Computed tomography (CT) arthrography of the wrist was described in 1989 by Quinn et al[29] and combines the detailed CT view of the bony anatomy with a clear picture of the ligamentous structures of the wrist.[3,29–32] The contrast material enhances the radiographic delineation of normal and pathological soft tissues, and the thinness of the slices enables vastly improved detail compared with plain arthrography.[3] Moreover, the use of helical CT enables reformatting of the data in multiple planes.

The purposes of this study were to classify TFCC foveal lesions on the basis of CT arthrography using a radial plane view in which the image slices rotate clockwise centered on the ulnar styloid process and to correlate the CT arthrography results with surgical findings. We also tested interobserver and intraobserver reliability of the radial plane view.

MATERIALS AND METHODS

Patients

Between 2007 and 2014, 33 patients with a suspected TFCC foveal tear who had undergone wrist CT arthrography and subsequent surgical exploration were enrolled. All the patients had a history of trauma to the wrist and chronic ulnar-sided wrist pain. All patients had positive findings of TFCC foveal tear on clinical examination such as positive fovea sign and/or distal radioulnar joint (DRUJ) instability. We used CT arthrography to confirm the clinical diagnosis of a TFCC foveal tear. All patients underwent surgical treatment by open (27 patients) or arthroscopic (6 patients) exploration of the foveal lesion. The cohort included 15 men and 18 women, mean age 34 years (range, 13−59 y). One hand surgeon (H.M., who had 19 years of experience in hand surgery) who was not blinded to the CT scan results performed all surgical procedures. Two different hand surgeons (reviewer A [S.A.] and reviewer B [N.K.], who had more than 8 years' experience in hand surgery) reviewed the CT arthrography images in random order for an unbiased classification of the TFCC foveal lesions. We compared the operative findings of the foveal tears with the CT arthrography results of reviewer A. We used the results of reviewer B to test interobserver agreement. Reviewer A reviewed the CT arthrography images twice with a 2-week interval between evaluations to test intra-observer agreement. This sample was selected for review after approval from our institutional review board.

Computed tomography arthrography

One of the 3 authors (H.M., S.A., or N.K.) performed CT arthrography within 20 minutes after completing the arthrography of the DRUJ and the radiocarpal joint using a mixture of 3 ml iodinated contrast material (60% amidotrizoic acid, Urografin, Bayer, Osaka, Japan) and 3 ml 1% lidocaine. We used a helical CT unit (Aquilion 64, Toshiba, Tochigi, Japan) to perform CT examinations. Patients' arms were elevated over their heads, with patients in a prone position, and the wrists were carefully kept neutral in the flexion-extension and pronation-supination planes. First, isovolumetric multiplanar reformation images were generated along the coronal and sagittal planes. The reformatted slice thickness was 0.6 mm. In addition, to scrutinize the foveal lesion, we used an image reformation called the radial plane view (Fig. 1). In the radial plane view, the image slices rotate clockwise by approximately 110° in 3° to 5° increments, centered on the ulnar styloid process. Radial plane imaging uses volume averaging, which is the effect of expressing the average density of a voxel as a pixel in the image. Using the radial plane views, we obtained more than 10 slices through the foveal lesion, whereas only 4 to 5 slices were obtained in the coronal view. Moreover, with the radial plane views, we obtained images of the total length of the palmar and dorsal radioulnar ligaments, which attach the fovea and the ulnar styloid. The images were digitally assessed on a commercially available picture archiving and communication system workstation (Plissimo EX, Panasonic Healthcare Co, Ltd, Tokyo, Japan).