

Wrist Imaging with MAGNETOM Espree: Changing a Practice

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Background

One of our long-standing areas of expertise at Froedtert hospital has been wrist imaging. MRI of the wrist is particularly useful in the diagnosis of pain and instability due to ligament injuries, bone edema and occult fracture.

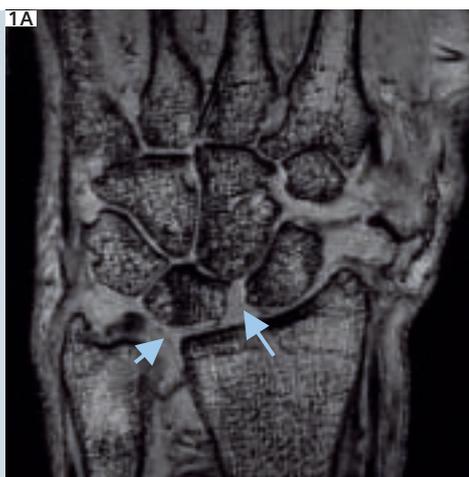
Due to the scale of the anatomy involved, wrist MRI requires a large imaging matrix at small FoV, necessitating high signal-to-noise ratio (SNR). Originally we used single-turn solenoid coils which were built in the Biophysics department. These close-fitting coils produced excellent image quality at fields of view which were as small as the manufacturer's gradients could create (8 cm). While the image quality was excellent, the positioning was the source of both benefit and difficulty. In a superconducting 1.5T magnet, the

solenoid coil had to be oriented with the axis of the coil perpendicular to that of the magnet bore. Therefore patients had to lie prone with their wrists superior to their heads. This placed the coil at or near magnet isocenter which resulted in outstanding image quality and excellent fat suppression. The patients paid a price for this in that their arms were overhead for the entire exam and the shoulder stress was not insubstantial. The prone position also contributed to claustrophobia. Recently, a small general purpose transmit/receive birdcage coil became available from Mayo Clinic Medical Devices (Rochester, MN, USA) for Siemens MAGNETOM scanners with Tim (Total imaging matrix). The BC-10 has a 10 cm diameter, as its name suggests, and allows for

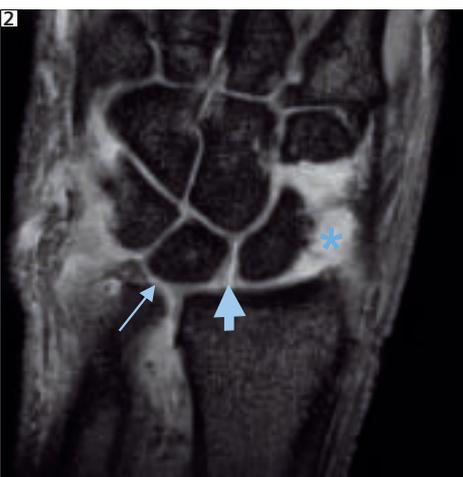
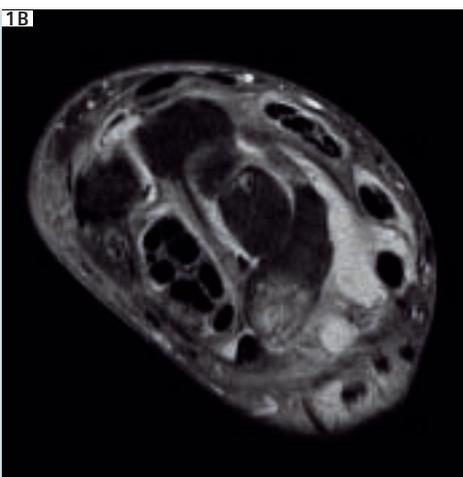
comfortable wrist positioning in a natural hand position as opposed to the flattened position required with many wrist specific coils. It also allows for a more natural positioning of the arm inline with the body.

A Case Study

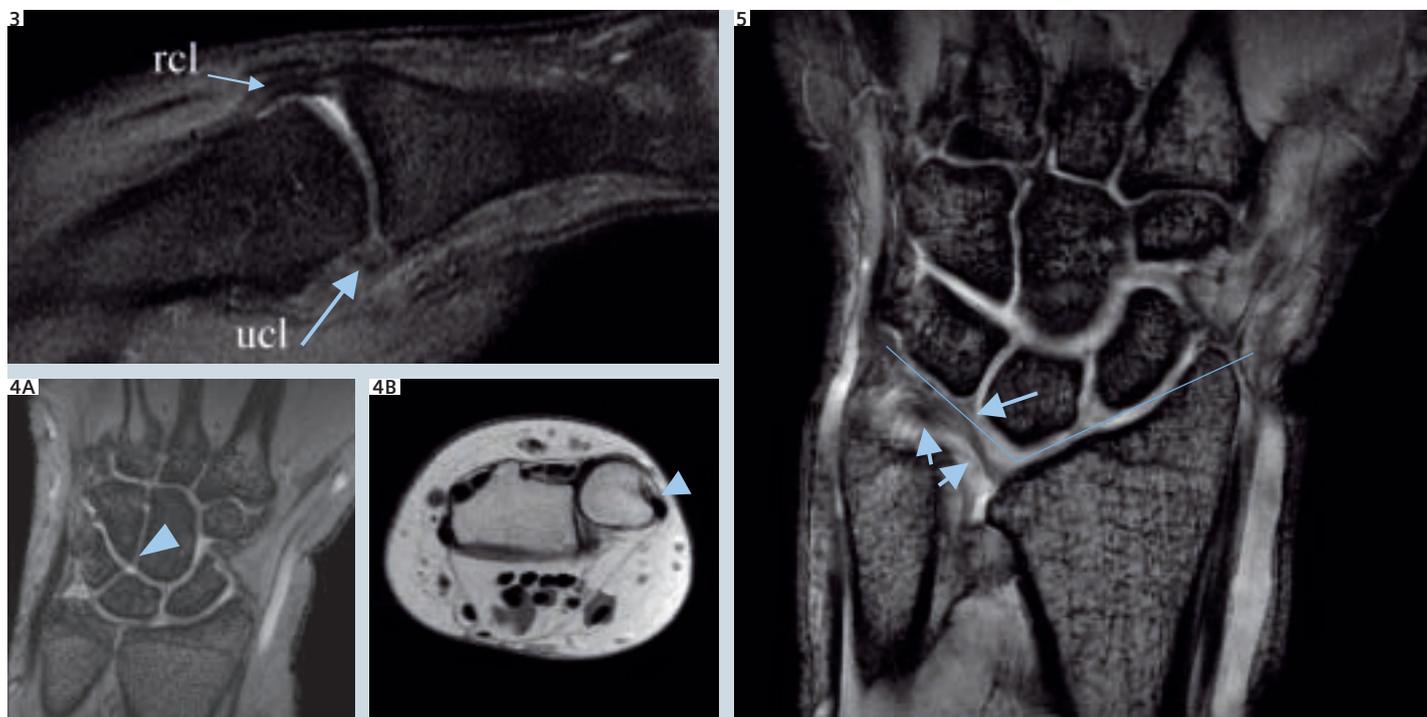
Our first patient for the BC-10 coil was a department employee we'll call Maddie. Maddie had a several year history of wrist pain with possible arthritic degeneration. Her job duties included extensive use of a keyboard, which aggravated the wrist pain. Her orthopedic surgeon had prescribed a wrist MRI. After six months of worsening wrist pain, Maddie still had not made an appointment for her test. Her reasons turned out to be two-fold. First,



1A A coronal gradient echo image of Maddie's wrist demonstrating arthritic degeneration with a widened scapholunate space and possible triangular fibrocartilage (TFC) tear (A). Axial fat suppressed protondensity-weighted image demonstrating extensor tendon sheath effusion.



2 A 55-year-old male with wrist pain demonstrating both TFC (thin arrow) and lunotriquetral tears. Synovial hyperplasia (*) can also be well appreciated. A scapholunate ligament defect is also questioned (thick arrow).



3 Coronal image of the thumb in an 18-year-old woman with a possible gamekeepers' injury. The tendons are intact and the patient was treated without surgery.

4 A 24-year-old woman imaged after a motor vehicle accident and referred for ongoing ulnar nerve pain and wrist instability. A scapholunate tear is demonstrated (large arrowhead) as well as a subluxation of the extensor carpi ulnaris (small arrowhead).

5 A 26-year-old woman with complaint of wrist pain. Madelung's deformity is well visualized in these coronal images with a characteristic V-shape proximal carpal row caused by a congenital underdevelopment of the head of the radius. The TFC (short arrows) and lunotriquetral ligament (long arrow) are well shown and intact.

she was claustrophobic and did not want to lie in the magnet, especially in the prone position. Second, she had a previous shoulder injury ipsilateral to the painful wrist. She was unable to lift her arm straight over her head and so did not want to endure what was certain to be a painful and unsettling exam. The MAGNETOM Espree, combined with the BC-10 resulted in an optimal solution. Maddie was placed in the decubitus position with the affected wrist on the padded table surface. The coil was placed over the wrist, and sandbagged against her thigh. Once in the magnet, Maddie was able to lean back against the bore wall with a cushion behind her knees for the comfort of her back. Maddie did not suffer any claustrophobia as her head was entirely out of the magnet, despite her being only 5' 4" (1.64 m) tall. She also did not suffer any shoulder pain. The wrist was very close to isocenter, and the image quality was outstanding. As a result of the MRI, her pain has been dis-

covered to be primarily arthritic in nature and she has avoided surgery. In addition to wrist injuries, the BC-10 coil has also been used to image fingers as shown in Fig. 3. The very small fields of view which are achievable with this coil enable high resolution images of the small ligaments found in the fingers. Small FoV images are inherently more sensitive to motion than are large FoV images. The patient comfort achievable with the BC-10 coil in the decubitus position has improved patient comfort and cooperation which are key to obtaining motion-free images.

Discussion and Conclusions

In the last four months, we have scanned approximately 25 patients for wrist, finger, thumb and elbow indications. The decubitus position is used for nearly all of these patients. Image quality is equal to or better than that which we obtain with our solenoid coil. Patient scans can

be completed in 30-45 minutes rather than the 45 minutes to 1 hour slots on the conventional scanners. The BC-10 is a birdcage coil rather than phased array. As a result we are not able to use integrated Parallel Acquisition Technique (iPAT) in our sequences. This has not been a problem in wrist imaging. We image almost exclusively at an 8 cm FoV and our objectives are to achieve maximum signal-to-noise with maximum spatial resolution. With the huge improvement in patient comfort afforded by the combination of MAGNETOM Espree, BC-10 and decubitus position, the exam does not require further hastening.

Literature

- 1 Kocharian, A., Adkins, MC., Amrami, KK, et. al. Wrist: Improved MR Imaging with Optimized Transmit-Receive Coil Design. *Radiology* 2002; 223: 870-876.
- 2 Zlatkin, MB., Rosner, J. MR imaging of ligaments and triangular fibrocartilage complex of the wrist. *Radio-logic Clinics of North America*. 44(4): 595-623, ix, 2006 Jul.