

MSK Ultrasound Bites: Tips and Tricks

Diagnostic Musculoskeletal Ultrasound in the Evaluation of the Radiocarpal Joint

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The radiocarpal joint is a synovial joint of the distal wrist that is formed between the radius and the proximal row of carpal bones, the scaphoid, lunate and triquetral bones. Wrist injuries are common and occur from overuse and trauma. The radiocarpal joint is composed of the proximal concave surface of the radius and the articular disc or triangular fibrocartilage. The distal portion of this joint includes the convex row of carpal bones.

Diagnostic musculoskeletal ultrasound (MSKUS) offers a portable, real-time, and cost-effective alternative that is gaining traction in rehabilitation and sports medicine settings. MSKUS has emerged as a valuable, non-invasive imaging modality for evaluating wrist ligaments, discs and bones. MSKUS is excellent at detecting changes in ligament composition and continuity. This manuscript will review the utility of MSKUS in evaluating the radiocarpal joint injury including anatomy, common mechanism of injury patterns, sonographic techniques, and clinical implications for those in the rehabilitation profession.

Due to its small size, and variety of structures in a small space, diagnosis of acute radiocarpal injury by physical examination is often difficult. By integrating MSKUS into clinical practice, providers can improve the accuracy of diagnosis, enhance diagnostic confidence, monitor healing progression, and guide rehabilitation strategies to optimal patient outcomes for those with wrist injuries.

INTRODUCTION

The radiocarpal joint is crucial to hand and wrist function. It connects the forearm to the hand and is essential for movements of the wrist. Wrist movements that allow lifting, gripping and twisting all require functional use of the radiocarpal joint.

ANATOMY OF THE RADIOCARPAL JOINT

The radiocarpal joint is a biaxial ellipsoid joint, meaning that it has two degrees of freedom resulting in wrist flexion and extension, and radial and ulnar deviation. The distal radius articulates with the scaphoid and lunate carpal bones. The distal portion of the radius has two concave surfaces for articulation with the scaphoid and lunate. The distal radius has an indirect articulation with the triquetrum via the triangular fibrocartilage complex (TFCC). As these bones have no actual muscle attachments, they form what is known as an intercalated segment, meaning they are dependent on the forces from muscles crossing their joints to create movement.¹

THE ROLE OF MSK ULTRASOUND IN RADIOCARPAL JOINT

ADVANTAGES

- **Non-Invasive:** Musculoskeletal Ultrasound (MSKUS) is a non-invasive imaging technique that can be used for the examination of the ligaments and bones of the distal wrist.²
- **Real-Time Imaging:** Structures such as the radiocarpal joint and the scapholunate ligament of the dorsal wrist can be evaluated with MSKUS.
- **High-Resolution Visualization:** Detailed images of the radiocarpal joint and the associated ligaments can be attained with MSKUS.³
- **Accessibility and Cost-Effectiveness:** MSKUS is portable, widely available, and less expensive than magnetic resonance imaging (MRI).

LIMITATIONS

- **Operator Dependency:** MSKUS requires skill and experience for accurate interpretation of findings. The ability to sonograph the distal portion of the wrist is

largely influenced by the operator and the availability and technical considerations of state-of-the-art equipment.

- **Depth Limitations:** While increased depth may limit visualization of structures, superficial wrist structures are generally visible.
- **Artifacts and Shadows:** Bone and calcifications may create image artifacts, requiring adjustments in transducer positioning and frequency.

SONOGRAPHIC TECHNIQUE FOR EVALUATING THE RADIOCARPAL JOINT

EQUIPMENT SETUP

- **Transducer Type:** Because of the superficial nature of the wrist structures, a standard high-frequency, linear array transducer is normally used. In some instances, the L-shaped, hockey stick-type transducer may be required.
- **Patient Position:** The patient is typically sitting with the volar forearm on the surface with the dorsal wrist facing superior. The dorsal surface is normally viewed as the structures are more superficial and easier to visualize. The transducer is placed in long axis (LAX) to view the radiocarpal joint, while, short axis (SAX) is used to view the scapholunate ligament.
- **Dynamic Assessment:** Dynamic views of the wrist can be performed by having the patient flex or extend while visualizing the dorsal tissues and bones.⁴

NORMAL SONOGRAPHIC APPEARANCE

Typically, the radiocarpal joint is viewed in both the LAX and SAX. Typically, there is no joint effusion; therefore, the joint recess is collapsed or barely visible on ultrasound. The capsule should be thin and not distended. The dorsal ligaments are normally continuous and should exhibit a normal fibrillar pattern, indicating they are intact and healthy. The synovium is typically visualized as a very thin echogenic line, with no synovial hypertrophy. The articular surfaces of the radius and the carpal bones should include uniform anechoic or hypoechoic cartilage layers and demonstrate smooth, continuous hyperechoic cortical lines with no physical breaks or breaches.

PATHOLOGIC FINDINGS IN INJURED RADIOCARPAL JOINTS

- Hyperechoic irregularities of bone of the radius, scaphoid, and lunate are visible.
- Hypoechoic bands of synovial tissue folds are present.
- Anechoic or hypoechoic joint effusion and/or synovitis (synovial hypertrophy) and cysts within the joint.

Joint effusion is somewhat compressible and mobile when transducer pressure is applied to the area. This is different from synovitis, which appears as hypoechoic or isoechoic, non-compressible tissue within the joint recess.

Synovitis may be associated with conditions such as rheumatoid arthritis, psoriatic arthritis, or other inflammatory arthropathies. Lastly, a ganglion cyst may appear as a well-defined, round or lobulated cystic structure with anechoic or hypoechoic internal contents. The cyst will usually have a small, smooth wall and exhibit posterior acoustic enhancement. These cysts will typically be minimally or non-compressible and painful.

CLINICAL IMPLICATIONS FOR REHABILITATION PROVIDERS

MSKUS provides real-time feedback for rehabilitation professionals, facilitating early diagnosis of injury and intervention. Key applications include:

- **Early Detection of Injury / Accurate Injury Grading:** MSKUS can detect small anechoic or hypoechoic fluid collections in the radiocarpal recess that may be invisible to the naked eye. Finding this early will help guide treatment planning. Additionally, small ligament sprains or partial tears may be seen on ultrasound as irregular loss of normal fibrillar patterns.
- **Dynamic Functional Testing:** Rehabilitation professionals can use MSKUS to dynamically stress the tissues with gentle wrist motion to reveal instability or soft tissue impingement between bones or abnormal findings such as cysts.
- **Guided Interventions:** Ultrasound imaging assists in dry needling and precision-guided injections, such as corticosteroids for inflammation or treatment for ganglion cysts.⁵
- **Patient Education:** Real-time imaging serves as a visual aid to explain the nature of the injury and set realistic expectations for recovery.

LIMITATIONS AND CHALLENGES

Despite its advantages, MSKUS cannot entirely replace MRI for complex cases. Additionally, the expertise required for optimal imaging techniques limits its immediate adoption across all rehabilitation settings.

CONCLUSION

MSKUS is a valuable, dynamic, and cost-effective imaging modality for evaluating the radiocarpal joint. It provides high-resolution, real-time visualization of bones, cartilage, and soft tissues in both acute and chronic settings. Ultrasound allows visualization of dynamic wrist movement. Incorporating MSKUS into the physical therapists' clinical practice for distal wrist examination enhances diagnostic accuracy, supports timely management decisions, and ultimately improves patient outcomes in cases of suspected radiocarpal injury.

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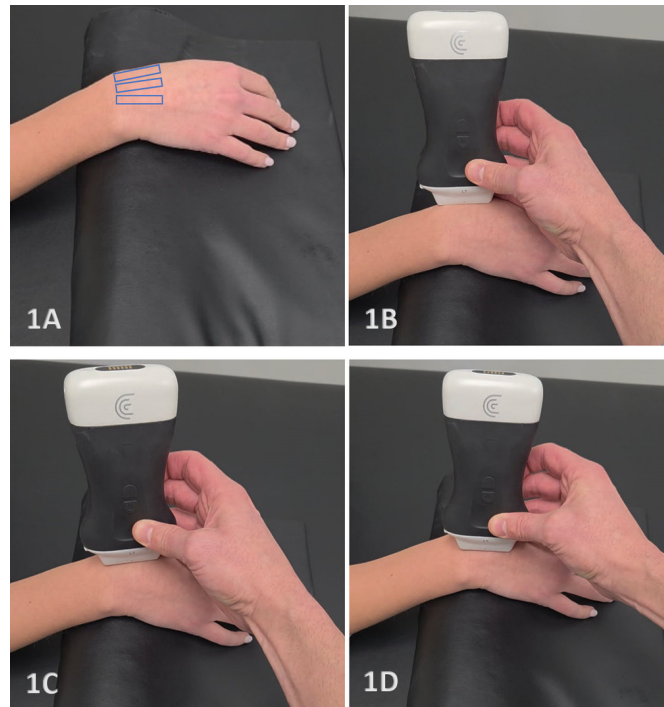


Figure 1A. Patient Positioning for Radiocarpal Joint

The patient is seated facing the examiner with the forearm supported on the examination table. For dorsal imaging, the forearm is kept in pronation, and the wrist is placed in slight flexion to open the dorsal radiocarpal joint recess. For reference, the blue boxes shown above indicate the three placements of the transducer for long axis viewing of the radiocarpal joint.

Figures 1B-1D: Transducer Placement over the Radiocarpal Joint in Long Axis View (LAX)

For the long-axis (LAX) assessment of the radiocarpal joint, the transducer is placed on the dorsal aspect of the wrist and aligned longitudinally with the distal forearm. Initial placement is performed at the radial aspect of the dorsal wrist, centered over the distal radius and scaphoid, using the radial styloid as the primary surface landmark for orientation as shown in Figure 1B. From this starting position, the transducer is translated ulnarly allowing the radial styloid to move out of view while maintaining visualization of the distal radius and achieving a more complete longitudinal view across the scaphoid as shown in Figure 1C. Finally, the transducer is translated further ulnarly to obtain the third view, where the lunate and capitate enter the imaging plane along with the distal radius as shown in Figure 1D. Additional gel or a standoff may be helpful to accommodate dorsal wrist curvature and optimize visualization of the superficial joint capsule. Gentle transducer toggling is used to improve image quality and reduce anisotropy of the overlying tendons.

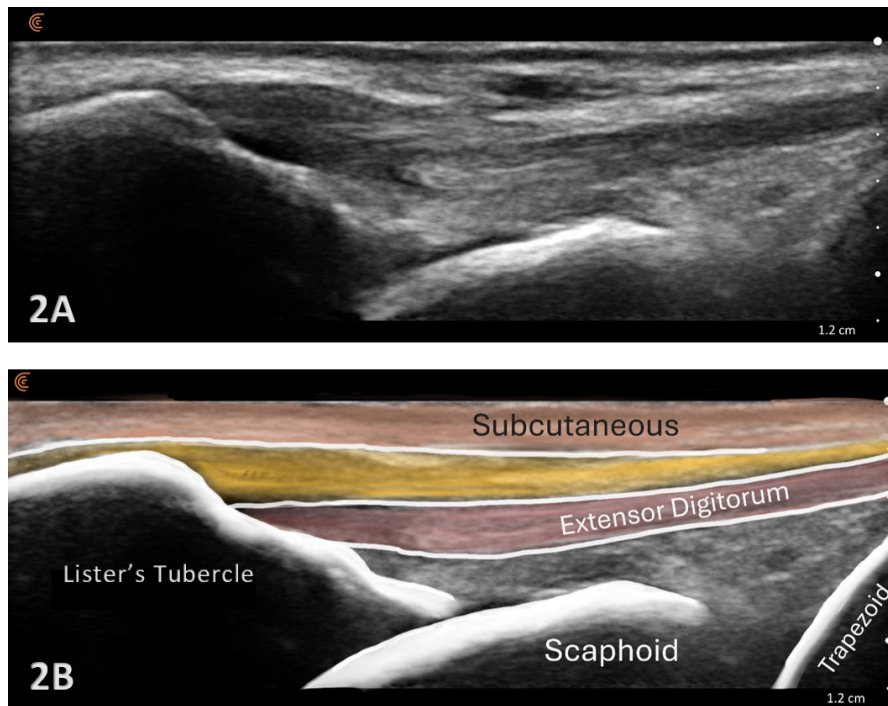


Figure 2. Radiocarpal Joint in LAX at Lister's Tubercle

When evaluating the radiocarpal joint in long axis, the examination begins with the transducer placed longitudinally over Lister's tubercle on the dorsal aspect of the distal radius as is demonstrated in Figures 2A and 2B. The transducer placement is demonstrated in [Figure 1B](#). This initial radial placement serves as the primary reference position for transducer orientation and alignment. From this location, the transducer is gently translated distally while maintaining a strict long-axis orientation, allowing the examiner to progress from the distal radius toward the radiocarpal joint space and onto the scaphoid.

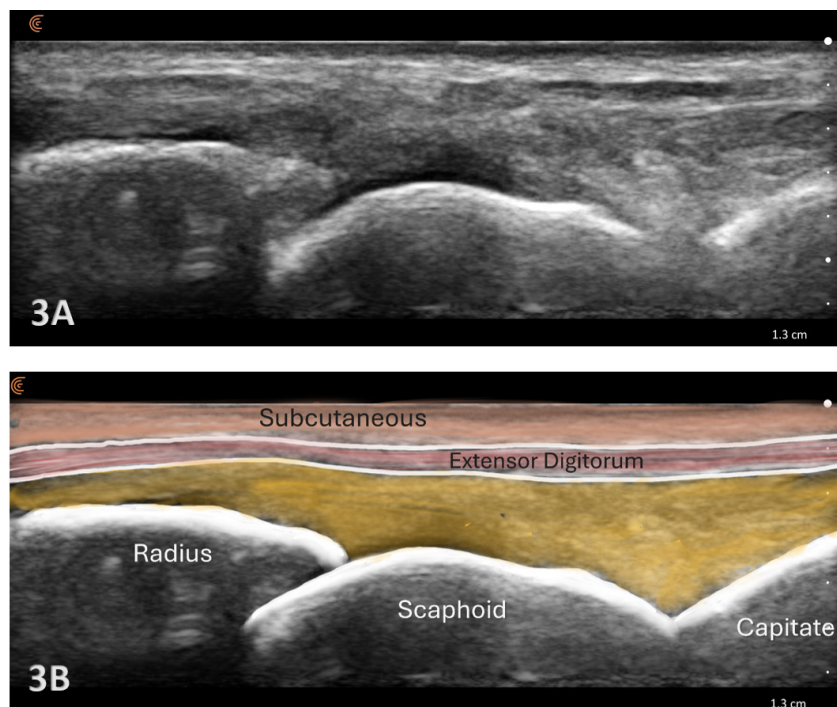


Figure 3. Radiocarpal Joint in LAX at Distal Radius

Following the initial view over Lister's tubercle, the transducer is translated ulnarly while maintaining the same longitudinal alignment, allowing the radial styloid to move out of view and providing a more centralized dorsal view across the distal radius and scaphoid. The proximal edge of the capitate is easily viewed here as well. See Figure 1C.

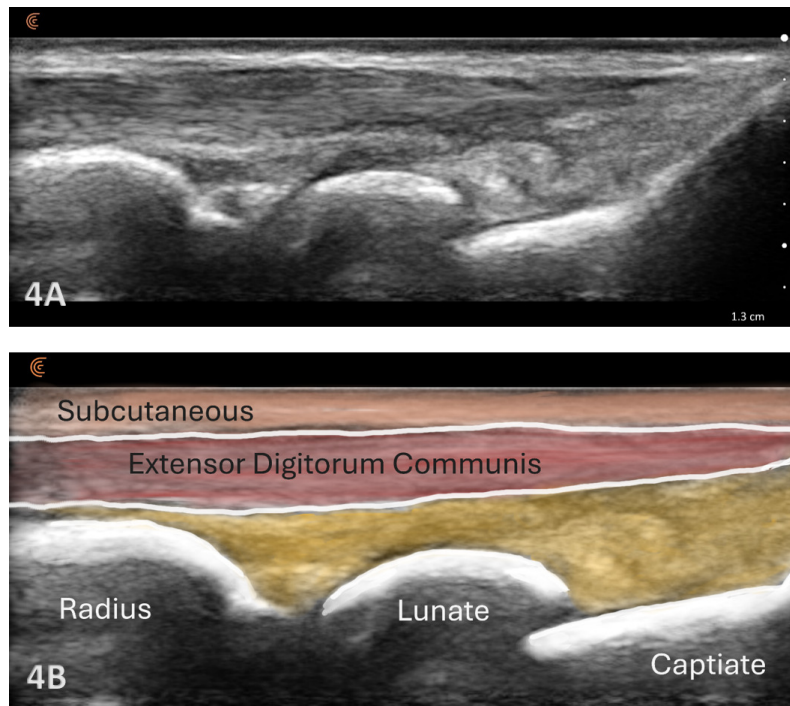


Figure 4. Radiocarpal Joint in LAX over

The transducer is then translated further ulnarly to obtain the third placement (Figure 1D), where the lunate and capitate enter the imaging plane along with the distal radius. These three sequential dorsal positions, initially over Lister's tubercle, followed by progressive ulnar translation, allow for systematic visualization of the radiocarpal joint.

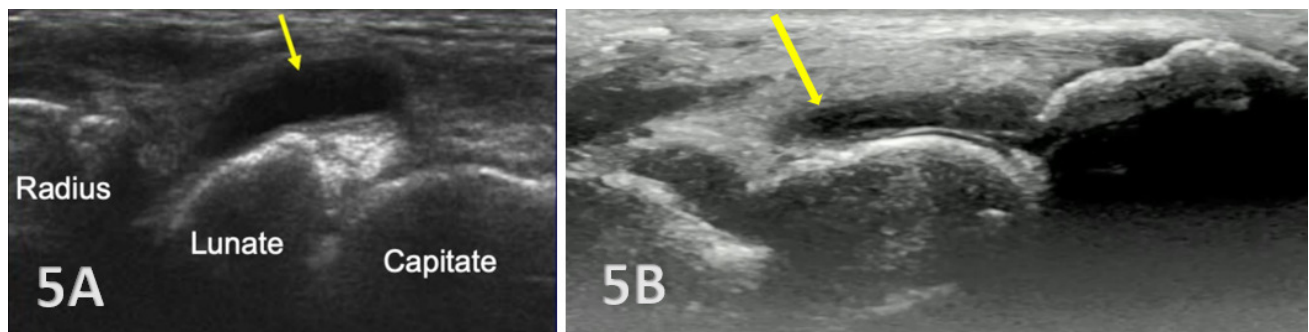


Figure 5. Radiocarpal Joint Effusion

The joint effusion shown above demonstrates dorsal swelling overlying the lunate in both images, consistent with distention of the dorsal radiocarpal joint recess. Radiocarpal joint effusion is one of the most commonly identified wrist pathologies on ultrasound and appears as an anechoic or hypoechoic fluid collection within the joint recess. Effusions may result from acute trauma, inflammatory processes, overuse, or degenerative changes. With gentle dynamic compression, the fluid typically displaces within the recess, helping differentiate a true effusion from synovial thickening. In larger effusions, the dorsal recess becomes visibly distended with fluid superficial to the carpal bones, providing a clear sonographic correlate to dorsal wrist swelling.

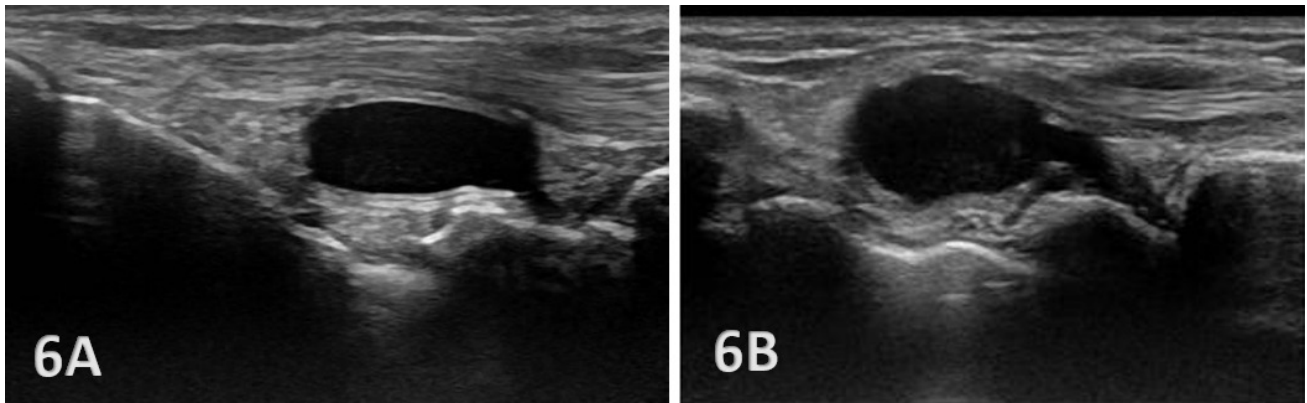
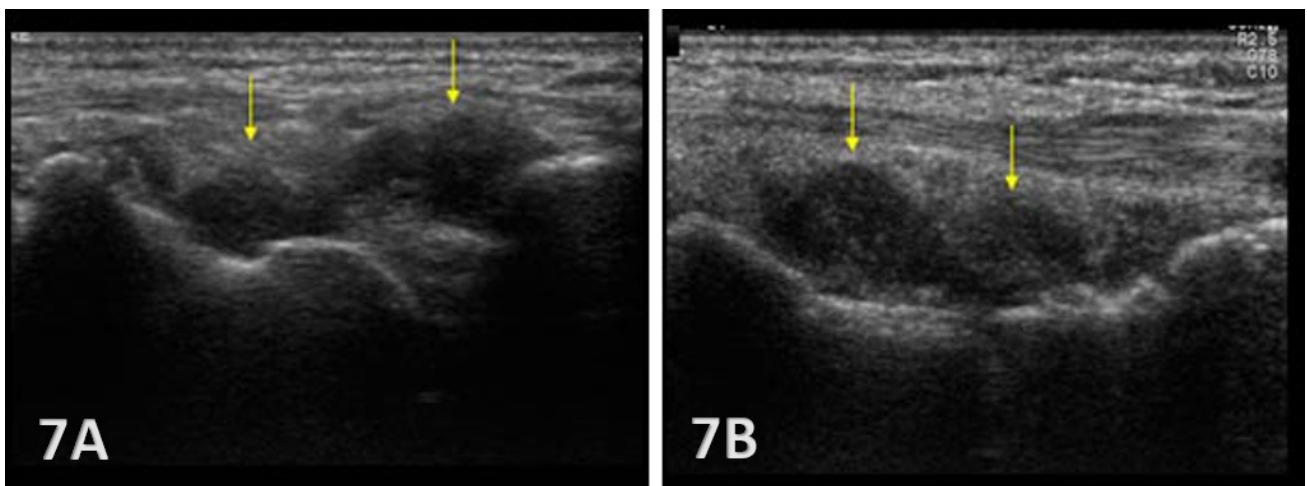


Figure 6. Dorsal Wrist Ganglion Cysts

Figure 6A demonstrates a dorsal wrist ganglion cyst located more radially, closer to the level of Lister's tubercle, highlighting a common site near the dorsal radiocarpal capsule. Figure 6B shows a ganglion cyst positioned more centrally, directly overlying the lunate. These images emphasize that dorsal ganglion cysts may occur at varying locations along the radiocarpal joint while maintaining a well-defined, extra-articular appearance that remains distinct from intra-articular radiocarpal joint effusions during dynamic ultrasound assessment.



Figures 7. Osteoarthritis with hypervascularized thickened synovium

Figure 7A demonstrates the dorsal wrist imaged more radially, with Lister's tubercle serving as a key surface landmark for transducer orientation. Figure 7B illustrates a more ulnar transducer position, capturing the dorsal radiocarpal joint over the distal radius with the lunate and capitate in view. Together, these images demonstrate radiocarpal osteoarthritis characterized by thickened synovium, which on Doppler ultrasound would indicate synovial hypervascularity and active inflammation. Associated degenerative changes may include irregular or uneven cortical margins, osteophyte formation, capsular thickening, and narrowing of the radiocarpal joint space.



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