

MSK Ultrasound Bites: Tips and Tricks

Diagnostic Musculoskeletal Ultrasound in the Evaluation of the Brachialis

Robert C. Manske, PT, DPT, MEd, SCS, ATC, CSCS, FAPTA, Chris Wolfe, PT, DPT, OCS, Cert MDT, Phil Page, PT, PhD, ATC, CSCS, FACSM, Michael Voight, PT, DHSC, SCS, OCS, ATC, CSCS, FAPTA

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The anterior upper arm is composed of the biceps brachii, the coracobrachialis and the brachialis muscles. Collectively, these 3 muscles flex the elbow. The brachialis is known as the workhorse of the elbow as it functions the same despite rotation of the forearm due to its distal attachment on the ulna. The brachialis sits anatomically directly dorsal to the biceps brachii. Although brachialis muscle injuries are rare, they can occur from either contusions or from repetitive overuse. Diagnostic musculoskeletal (MSK) ultrasound offers a portable, real-time, and cost-effective alternative that is gaining traction in rehabilitation and sports medicine settings. MSK ultrasound has emerged as a valuable, non-invasive imaging modality for evaluating brachialis injuries including tissue hypertrophy or structural changes and damage in the upper and anterior forearm. MSK ultrasound is adept at detecting changes in tendon tissue composition and integrity. Furthermore, this manuscript will review the utility of MSK ultrasound in evaluating the brachialis muscle including its anatomy, common injury patterns, sonographic techniques, and clinical implications for professional rehabilitation. By integrating MSK ultrasound into clinical practice, providers can improve the accuracy of diagnosis, enhance diagnostic confidence, monitor healing progression, and guide rehabilitation strategies to optimal patient outcomes.

INTRODUCTION

Biceps brachii injuries are the most common injury to the anterior elbow. Injuries to the brachialis muscle are rare but can occur with or without injury to the biceps brachii.^{1,2} In 2001 the first case report of brachialis muscle tear from lifting a heavy object was published.³ Because of the rarity of injury to this muscle and its conflicting morphology described below, diagnosis of brachialis injuries is a challenge.⁴

ANATOMY OF THE BRACHIALIS

The brachialis is a strong thick muscle on the anterior elbow and upper arm. It originates on the anterior distal half surface of the humerus and runs distally to attach on the proximal ulna at both the ulnar tuberosity and the coronoid process.⁵ Unlike some of the other anterior arm muscles who have multiple functions, the brachialis' function is isolated to flexion of the elbow.⁶ Due to its large cross-sectional area (7 cm²) it is the greatest force generator at the elbow.⁷ The brachialis has been shown to provide up to 47% of elbow flexion torque.⁸ The brachialis may be responsible for elbow stability throughout both concentric and eccentric muscle function and is preferentially recruited over the biceps brachii when undergoing a strong eccentric contraction.⁹ Authors of classic textbooks have described the

brachialis as having only one head,¹⁰ although others have disagreed, and feel that it may be divided into two heads; superficial and deep.¹¹ And more recently, Piagkou and colleagues found a four-headed brachialis specimen.⁵ The brachialis muscle is innervated by the musculocutaneous nerve and some parts of the radial nerve, while branches of the brachial artery and recurrent radial artery provide its blood supply.

Brachialis injury typically occurs as repetitive overuse or acute trauma caused by hyperextending the elbow against resistance. The repetitive pull-ups in rock climbers, with the forearm in pronation may create a strain or tendinopathy of the brachialis known as "climber's elbow."¹² There have been case study descriptions of injuries to brachialis in football, hockey, rugby, and while lifting weights heavy objects.^{1-3,13-19} Patients will typically complain of constant or intermittent anterior elbow and upper arm pain. There is rarely bruising or neurological injury with these muscle tears. Patients may notice a slight swelling in the anterior arm or cubital fossa. There will be some degree of weakness of elbow flexion depending upon the extent of injury; however, supination and pronation strength and range of motion should be spared. A loss of extension range of motion may be seen if symptoms are severe, for example in the case of bony avulsion.

THE ROLE OF MSK ULTRASOUND IN BRACHIALIS EVALUATION

ADVANTAGES

- **Real-Time Imaging:** Allows dynamic evaluation of brachialis integrity while the elbow and forearm can be moved through available range of motion.
- **High-Resolution Visualization:** Provides detailed images of soft tissue structures, including the brachialis muscle and tendon fibers and their attachment to the enthesis.
- **Accessibility and Cost-Effectiveness:** MSK ultrasound is portable, widely available, and less expensive than magnetic resonance imaging (MRI).

LIMITATIONS

- **Operator Dependency:** Requires skill and experience for accurate interpretation of findings. The ability to sonograph is to a large extent influenced by the operator and the availability and technical considerations of state-of-the-art equipment.
- **Depth Limitations:** Because of the superficial location of the brachialis, visualization is very effective, and depth does not seem to be a limiting factor for its examination.
- **Artifacts and Shadows:** Bone and calcifications may create image artifacts, requiring adjustments in probe positioning and frequency.

SONOGRAPHIC TECHNIQUE FOR EVALUATING THE BRACHIALIS

EQUIPMENT SETUP

- **Transducer Type:** Because of the medium depth of the brachialis, a high-frequency, linear array transducer is normally used.
- **Patient Position:** Patient is supine or seated with the arm resting on a pillow or supported on a table. The elbow is flexed slightly (20–30°) and forearm supinated to allow for better visualization of the brachialis deep to the biceps brachii. Adjust the arm position to allow optimal access to the anterior compartment of the upper arm.
- **Dynamic Assessment:** Stress maneuvers, such as resisted elbow flexion or passive elbow extension, can be applied during MSK ultrasound to reveal tendon or muscle fiber disruptions, dynamic impingement of adjacent structures, or changes in echogenicity that may indicate tendinopathy or partial tears.

EXAMINATION PROTOCOL

The brachialis is assessed using a linear high-frequency transducer (10–15 MHz), placed transversely over the distal anterior upper arm to identify the brachialis deep to the biceps brachii. In the short-axis (SAX) view, begin at the dis-

tal third of the humerus, visualizing the biceps superficially and the brachialis as a deeper, more hypoechoic structure adjacent to the humerus. Rotate the transducer 90° for a long-axis (LAX) view, tracing the muscle proximally toward the mid-humerus and distally to its insertion on the ulnar tuberosity.

NORMAL SONOGRAPHIC APPEARANCE

Normally the brachialis tendon is viewed in both LAX and SAX views. The brachialis tendon can be seen distally at the ulnar attachment. The hyperechoic outline of the ulna will be seen below the brachialis. The brachialis tendon will be more hyperechoic in appearance, while proximally from the ulna the brachialis muscle will be hypoechoic tissue. In the LAX view the muscle should be fibrillar. The sound-head may need to be toggled at the distal tendons insertion to avoid anisotropy. Dynamic visualization can be performed with resisted elbow flexion and forearm pronation and supination.^{20,21}

PATHOLOGIC FINDINGS IN BRACHIALIS INJURY

- Hypoechoic thickening due to swelling and edema
- Disruption of fibrillar pattern in partial tears and ruptures
- Cortical irregularity and interruption in bony avulsions of insertion
- Associated edema and effusion

CLINICAL IMPLICATIONS FOR REHABILITATION PROVIDERS

MSK ultrasound provides real-time feedback for rehabilitation professionals, facilitating early diagnosis and intervention. Key applications include:

- **Early Detection of Injury / Accurate Injury Grading:** MSK ultrasound can help guide treatment planning by quantifying muscle injury, tendinopathy, and bony avulsion of the insertion
- **Dynamic Functional Testing:** Rehabilitation professionals can use MSK ultrasound during physical therapy sessions to monitor recovery and assess muscle function dynamically. Serial MSK ultrasound imaging aids in assessing tissue remodeling, thickness and readiness for rehabilitation progression.
- **Guided Interventions:** Ultrasound imaging assists in precision-guided injections, such as corticosteroids for inflammation.
- **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, MSK ultrasound cannot entirely replace MRI for complex elbow and forearm cases. Addition-

ally, the expertise required for optimal imaging technique limits its immediate adoption across all rehabilitation settings.

CONCLUSION

Diagnostic MSK ultrasound is a valuable tool for the evaluation of the brachialis injuries of the elbow and upper arm, offering fast, accurate, and cost-efficient imaging for rehabilitation professionals. Its ability to provide real-time, dynamic assessments makes it particularly suited for rehabilitation providers who can integrate the MSK ultrasound findings into clinical decision-making, optimizing treatment strategies and improving patient outcomes. However, practitioners must be adequately trained to maximize its diagnostic potential. By integrating MSK ultrasound into practice, rehabilitation providers can enhance patient care, improve outcomes, and reduce the burden of false diagnoses or delayed treatment.

PATIENT POSITIONING

The patient is positioned seated or supine with the arm resting in a supinated or neutral position, elbow slightly flexed (approximately 20–30°) to place the brachialis muscle under mild tension. A towel roll or pillow under the forearm may help stabilize the limb for optimal imaging.



Figure 1A: Transducer Placement on Brachialis in Long Axis (LAX): Humero-ulnar View

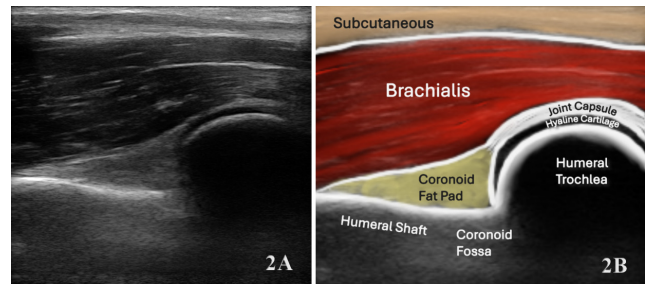
To obtain a LAX view over the humero-ulnar joint, the transducer is placed longitudinally along the anterior distal arm, just medial to the biceps tendon and will follow the muscle fibers of the brachialis deep to the biceps brachii. The scan begins proximally in the mid-humeral region and follows distally toward its insertion on the coronoid process and tuberosity of the ulna.

Figure 1B: Transducer Placement on Brachialis in Long Axis (LAX): Humero-radial View

To obtain a LAX view over the humero-radial joint, the transducer is placed longitudinally along the anterior distal arm, just lateral to the biceps tendon and will follow the muscle fibers of the brachialis deep to the biceps brachii. The scan begins proximally in the mid-humeral region and follows distally toward its insertion.

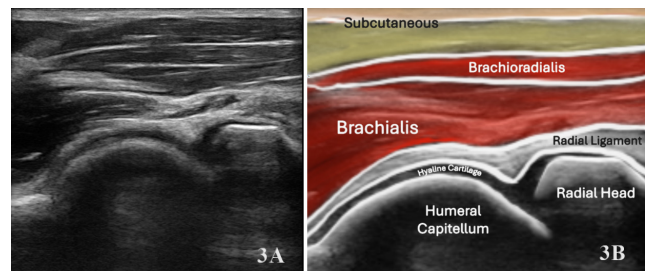
Figure 1C: Transducer Placement on Brachialis in Short Axis (SAX)

To obtain a SAX view, rotate the transducer perpendicular to the muscle fibers, centered over the distal anterior humerus. Glide the transducer from medial to lateral and sweep from proximal to distal to examine the full region. Adjusting the depth of the transducer may allow the examiner to visualize the full distal brachialis on the screen along with the lateral and medial muscular borders of the brachioradialis and pronator teres.



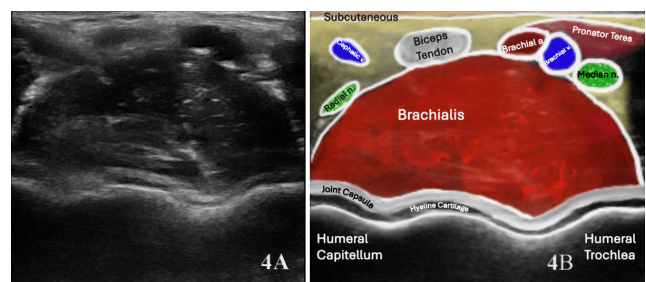
Figures 2A and 2B: Normal Brachialis Appearance in LAX: Humero-ulnar View

Refer to Figure 1A for transducer positioning. In LAX, the brachialis muscle appears as a deep, hypoechoic muscle belly with faint internal fibrillar patterning. Proximally, it is seen arising from the lower half of the anterior humerus and inserting distally onto the coronoid process and ulnar tuberosity. The cortical surface of the distal humerus and proximal ulna appear as bright echogenic lines with posterior acoustic shadowing. The biceps brachii tendon lies superficially and may partially obscure deeper structures, requiring angulation of the transducer for optimal visualization.



Figures 3A and 3B: Normal Brachialis Appearance in LAX: Humero-radial View

Refer to Figure 1B for transducer positioning. In the LAX humero-radial view, the brachialis muscle appears as a deep, hypoechoic structure with subtle internal fibrillar patterning, located just deep to the brachioradialis muscle. This view offers a clear window into the distal anterior humerus, including the radial fossa, capitellum, and humero-radial joint. The radial head, seen articulating with the capitellum, forms a curvilinear, echogenic surface along the deep aspect of the scan. Distal to the brachialis, the supinator muscle is visualized wrapping obliquely around the proximal radius, particularly evident over the radial head. Proper transducer angulation may be necessary to minimize anisotropy and fully visualize the brachialis, especially near its myotendinous junction. The cortical margins of the distal humerus and radial head appear as bright echogenic lines with posterior acoustic shadowing. This view is ideal for assessing the structural integrity of the brachialis and for evaluating adjacent osseous and muscular landmarks of the anterior elbow.



Figures 4A and 4B: Normal Brachialis Appearance in SAX

Refer to Figure 1C for transducer positioning. In SAX, the brachialis appears as a homogenous, oval-to-flat hypoechoic muscle belly situated deep to the biceps brachii, often separated by a thin echogenic fascial plane. The neurovascular bundle brachial artery, median nerve lies medial to the brachialis and must be identified to avoid misinterpretation. In more distal imaging, the muscle transitions to a tendon inserting onto the ulna, visualized as a more echogenic and compact structure.

PATHOLOGY

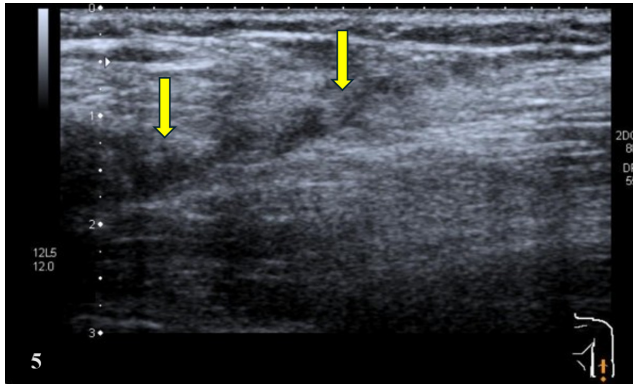
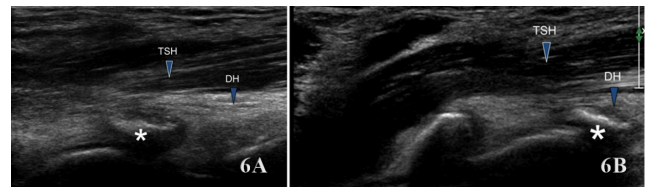


Figure 5: Brachialis Muscle Rupture

The brachialis muscle demonstrated above exhibits an inhomogeneous structure with decreased echogenicity, consistent with a brachialis muscle rupture. Notable findings include disruption of the normal fibrillar echotexture, loss of tendon tension, and fluid tracking along the muscle belly. These are all hallmark features of a muscle tear. The LAX view provides a clear assessment of the extent and severity of the rupture.²²



Figures 6A and 6B: Brachialis Bony Detachment

In Figure 6A, a LAX view of a 54-year-old patient with bony detachment (asterisk) at the coronoid insertion of the deep head of the brachialis. In Figure 6B, a LAX view of a 23-year-old patient with bony detachment (asterisk) at the coronoid insertion of the deep head of the brachialis. TSH, tendon of the superficial head; DH, deep head.²³

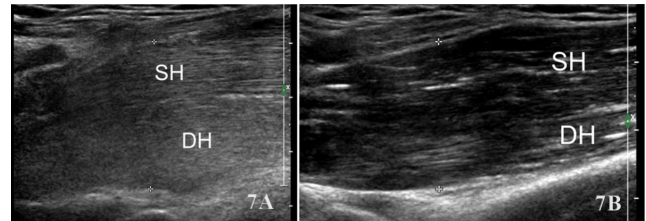


Figure 7: LAX View of Swollen Brachialis Muscle secondary to DOMS

In Figure 7A, this demonstrates a LAX view of a 30-year-old patient with delayed onset muscular soreness. The muscle is markedly swollen and hyperechoic in comparison with the contralateral side shown in Figure 7B. SH, superficial head; DH, deep head.²³

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