# Advantages of DOC Technique to Evaluate Distal Biceps Tendon Injuries

David M Koppy, BS, R.T.(R)(MR)
Nicholas A Ott, MD
Christopher J Dorvault, MD

The biceps brachii muscle is a large muscle located on the anterior aspect of the upper arm that functions to supinate the forearm and flex the elbow. The biceps brachii muscle has 2 heads that insert distally on the radial tuberosity as the distal biceps tendon (see **Figure 1**). Like other structures in the body, the distal biceps tendon can be injured or damaged. Injury to this tendon usually occurs in the dominant extremity of men between the ages of 40 and 60 years.[1] The mechanism of injury is commonly when an eccentric extension force is applied to a contracting biceps muscle such as during heavy lifting.[1]

Diagnosis of distal biceps tendon injury can be made with a combination of physical examination and imaging modalities such as sonography and magnetic resonance (MR) imaging. The physical examination that has demonstrated reliability in diagnosing these injuries is the hook test.[2] Sonography has a dynamic capability and has proven valuable for imaging the distal biceps tendon, especially the aponeurosis.[3] Traditionally, MR imaging has been considered the standard in noninvasive diagnosis of distal biceps tendon injury due to the level of detail that can be obtained with this modality and its utility in surgical planning.[4]

An MR imaging technique that has been developed and widely accepted for specialized imaging of the distal biceps is the flexed elbow, abducted shoulder, and supinated forearm (FABS) position.[5] This technique allows for longitudinal visualization of the length of tendon at its insertion on the radial tuberosity.

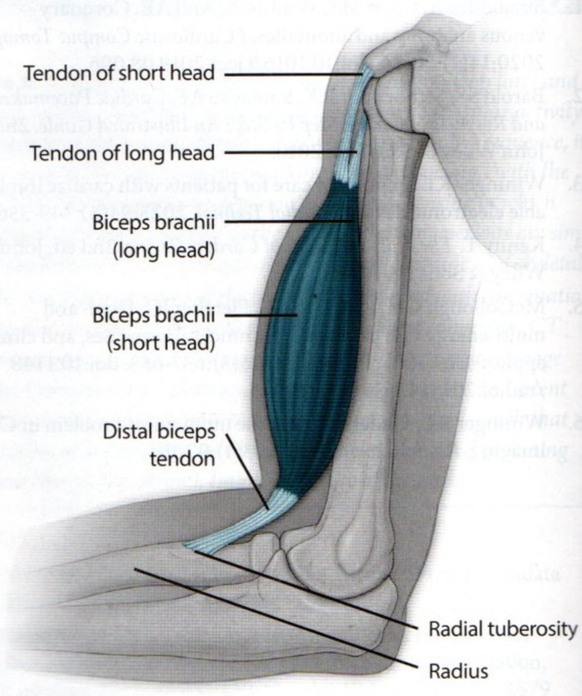


**Figure 1.** *Anatomy of the biceps brachii muscle. Figure courtesy of Lauren Shavell, Design Pics via Getty Images.*

Advantages of this technique include visualization of retracted fibers as well as better differentiation between partial and complete tendon tears.[6,7] Although widely used, a disadvantage of this technique is the added time required to reposition the patient. Efforts to reduce scan time and maximize efficiency have led to the development of a novel MR imaging technique for imaging distal biceps tendon pathology, the double oblique coronal (DOC) technique, which has been used at the Andrews Institute as an alternative to the FABS technique.

## Double Oblique Coronal Technique

The DOC sequence involves 2 coronal angles: the axial plane through both epicondyles of the humerus and the sagittal midline plane of the elbow. The DOC sequence captures the biceps tendon in its entirety from the biceps brachii muscle belly to its attachment on the radial tuberosity without requiring patient repositioning, enabling it to provide key diagnostic findings while reducing elbow scan times.

### *Scan Parameters*

All images were captured with the Signa HDxt 3.0T MR system with software version HD16.0 (GE Healthcare) or the MAGNETOM Lumina (Siemens Healthineers), a 3 T MR system using a high-definition knee coil or a high-resolution flex coil. The optimal MR imaging sequence was T2-weighted fat-saturated with a frequency matrix of 320, a phase matrix of 192, and phase field of view of 80% (see **Table**). Slices were acquired at a thickness of 2 mm with a 0.5 mm gap with 2 averages.

Table

**Resolution of Elbow MR Imaging Sequences via Routine and DOC Techniques**[a]

| Technique | T1-weighted, mm | T2-weighted fat-saturated, mm | Phase direction |
|---|---|---|---|
| Routine | | | |
| Axial | 0.63 × 0.38 × 2.5 | 0.63 × 0.38 × 2.5 | Right to left |
| Coronal | 0.73 × 0.44 × 2.5 | 0.73 × 0.44 × 2.5 | Right to left |
| Sagittal | 0.73 × 0.44 × 2.5 | 0.73 × 0.44 × 2.5 | Anterior to posterior |
| DOC[b] | | | |
| Coronal | 0.83 × 0.50 × 2.0 | 0.83 × 0.50 × 2.0 | Right to left |

*Abbreviations: DOC, double oblique coronal; MR, magnetic resonance.*
*[a] Phase and frequency directions might vary according to patient position.*
*[b] No axial and sagittal sequences.*

### *Patient Positioning*

The same position used for a routine elbow MR imaging examination is used for the DOC sequence, with the shoulder flexed and the arm overhead or by the patient's side (see **Figure 2**). The patient can be prone or supine. The ideal position depends on the patient's comfort level and range of motion.

### *Scout Imaging*

Initial planning for the DOC sequence involves capturing an axial image through the humeral epicondyles and a sagittal image showing the muscle belly of the biceps and the myotendinous junction attaching to the radius. If the distal biceps tendon is not clearly visible in these initial images, then additional images should be obtained after angling from the biceps muscle belly to the radius. The angle required for optimal visualization depends on the amount of elbow extension the patient can tolerate for the examination. The greater

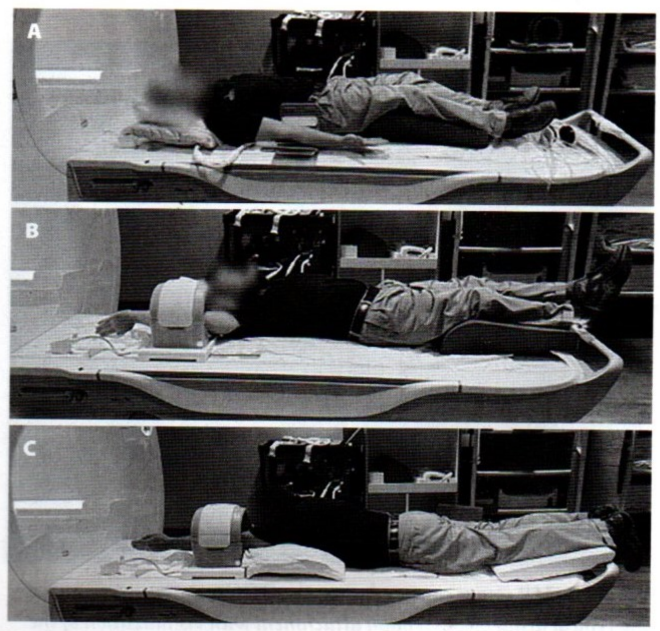


**Figure 2.** *Images demonstrating the different options for patient positioning used to capture the double oblique coronal (DOC) sequence. A. Supine with arm by the side and elbow placed in a high-resolution flex coil. B. Supine with shoulder flexed and arm above the head and placed in a high-definition knee coil. C. Prone with shoulder flexed and arm above the head and placed in a high-definition knee coil. Photographs courtesy of the authors.*

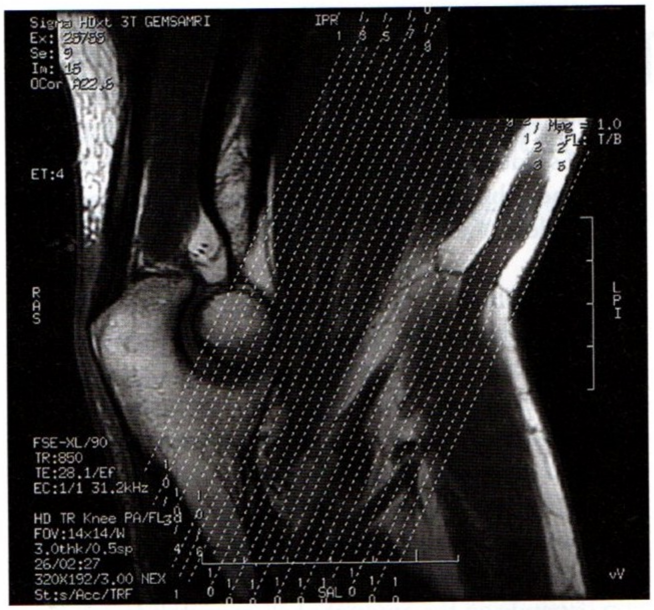


**Figure 3.** *Localizer magnetic resonance (MR) image for the DOC technique showing slice positioning used during routine sagittal imaging for optimal anatomic visualization. Image courtesy of the authors.*

**Figure 4.** *Sagittal image showing angle between the biceps muscle belly and the radial tuberosity. Image courtesy of the authors.*

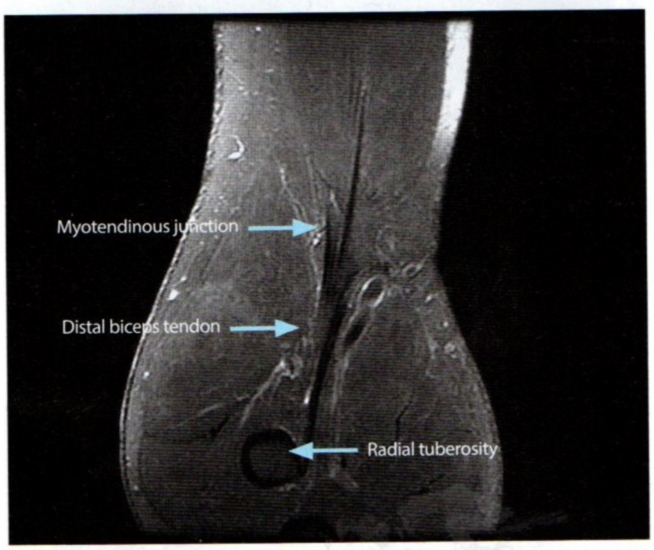


**Figure 5.** *MR image captured using the DOC technique demonstrating typical distal biceps tendon attachment with visualization of the myotendinous junction. Image courtesy of the authors.*

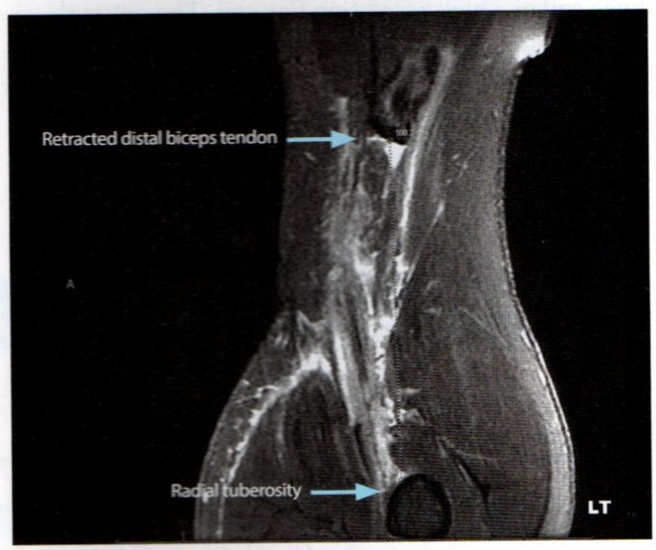


**Figure 6.** *MR image showing the utility of the DOC technique for diagnosing a distal biceps tendon attachment that is torn and retracted from the radial tuberosity. Image courtesy of the authors.*

the extension achievable by the patient, the smaller the necessary angle for image acquisition. An angle ranging from 25° to 35° traditionally has been used at the authors' institution (see **Figures 3-6**).

## Conclusion

The DOC technique introduced in this short report represents an alternative to the FABS technique that can be equally useful for diagnosing distal biceps tendon pathology. As scan volumes continue to increase throughout health care systems, MR technologists should maximize efficiency by using techniques that reduce scan time while still capturing key diagnostic findings. In the authors' experience with the DOC technique, the duration of elbow MR examinations has been reduced by eliminating the need for patient repositioning while still providing key diagnostic findings. Anecdotally, the technique has been easily taught to MR technologists and has a minimal learning curve for interpreting radiologists.

Future investigations with the DOC technique are planned to evaluate diagnostic accuracy and potential time savings. In addition, studies aimed at exploring the application of the double oblique coronal technique to other areas of the musculoskeletal system, such as the ankle, would be of value to clinicians and patients.

---

*David M Koppy, BS, R.T.(R)(MR), works for Andrews Institute of Orthopedics and Sports Medicine.*

*Nicholas A Ott, MD, is PGY-1 radiology resident at the University of Miami and former research fellow at Andrews Research and Education Foundation in Gulf Breeze, Florida.*

*Christopher J Dorvault, MD, is musculoskeletal radiologist for Acumen Medical Imaging and Interventional at the Andrews Institute of Orthopedics and Sports Medicine.*

*The research team would like to acknowledge the efforts of James Andrews, MD, in encouraging the scientific process of introducing the DOC technique. The authors also would like to acknowledge Jean Cook, BS, R.T.(R)(MR), and Benjamin Finney, R.T.(R)(MR), for their support with project logistics.*

## References

1. Bernstein AD, Breslow MJ, Jazrawi LM. Distal biceps tendon ruptures: a historical perspective and current concepts. *Am J Orthop.* 2001;30(3):193-200.
2. O'Driscoll SW, Goncalves LB, Dietz P. The hook test for distal biceps tendon avulsion. *Am J Sports Med.* 2007;35(11):1865-1869. doi:10.1177/0363546507305016
3. Blasi M, De la Fuente J, Pérez-Bellmunt A, et al. High-resolution ultrasound in the assessment of the distal biceps brachii tendinous complex. *Skeletal Radiol.* 2019;48(3):395-404. doi:10.1007/s00256-018-3043-0
4. de la Fuente J, Blasi M, Martínez S, et al. Ultrasound classification of traumatic distal biceps brachii tendon injuries. *Skeletal Radiol.* 2018;47(4):519-532. doi:10.1007/s00256-017-2816-1
5. Nguyen M-L, Rosenthal J, Karas S, et al. A comprehensive review of the normal, abnormal, and post-operative MRI appearance of the distal biceps brachii. *Skeletal Radiol.* 2020;49(11):1695-1707. doi:10.1007/s00256-020-03501-0
6. Giuffrè BM, Moss MJ. Optimal positioning for MRI of the distal biceps brachii tendon: flexed abducted supinated view. *AJR Am J Roentgenol.* 2004;182(4):944-946. doi:10.2214/ajr.182.4.1820944
7. Stevens K, Kwak A, Poplawski S. The biceps muscle from shoulder to elbow. *Semin Musculoskelet Radiol.* 2012;16(4):296-315. doi:10.1055/s-0032-1327004