Dynamic Magnetic Resonance Imaging of Partial-Thickness Retearing of Distal Biceps Tendon After Endobutton Repair

Eric Y. Chang, MD, Michael Thompson, MD, and Christine B. Chung, MD

Abstract

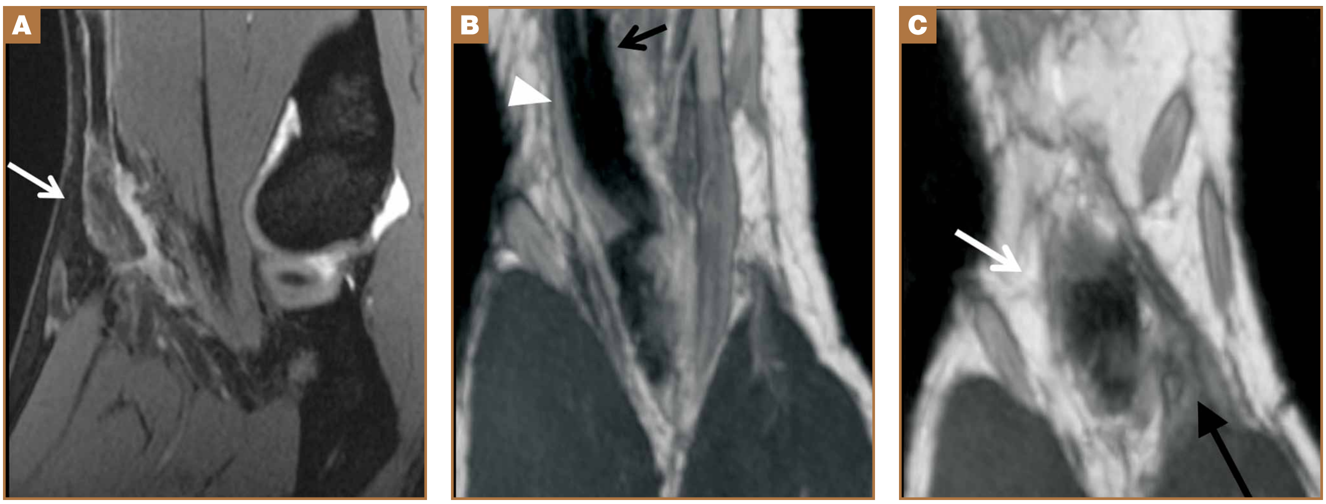
We report a case of ruptured distal biceps tendon repaired with a 1-incision Endobutton technique with longitudinal clinical and dynamic magnetic resonance imaging (MRI) follow-up. During the postoperative period, heterotopic ossification (HO) adjacent to the radial tuberosity and retearing of the repaired distal biceps tendon were visible on imaging studies. This prompted gentler rehabilitation. By 1-year follow-up, the patient had returned to preinjury activity levels without additional surgery. In this case, dynamic MRI revealed the space-occupying nature of the focus of HO with resultant narrowing of the radioulnar space. This may have contributed to tendon impingement, retearing, and remodeling. Potential implications for gentler postoperative rehabilitation in patients with this pattern of HO are discussed.

Retearing after repair of the distal biceps tendon is rare.[1] Heterotopic ossification (HO) is also considered uncommon, though reported rates in the literature vary widely, depending on repair and follow-up methods.[1-3]

In this article, we report a case of ruptured distal biceps tendon repaired with a 1-incision Endobutton technique with longitudinal clinical and imaging follow-up, and we discuss the potential biomechanical and rehabilitative implications of clinically occult retearing after repair.

This case is unique in that the patient was a physician who procured multiple magnetic resonance imaging (MRI) examinations during the postoperative period and again at 1-year follow-up. We witnessed formation of a small focus of HO, which entered and significantly narrowed the radioulnar space on forearm pronation on dynamic MRI. There was no obvious clinical evidence for retearing; high-grade partial-thickness tendon retearing was diagnosed on MRI. This prompted a gentler rehabilitation protocol. Subsequent scar formation and tendon remodeling allowed the patient to return to full

Figure 1. Acute distal biceps tendon rupture. (A) Reconstructed 3-dimensional (3-D) sagittal oblique dual-echo steady-state image and (B,C) coronal oblique proton-density 3-D fast-spin echo images show retracted distal biceps tendon stump (white arrows). Also visible are long (arrowhead) and short (small black arrow) head contributions to tendon and partially intact lacertus fibrosis (long black arrow).



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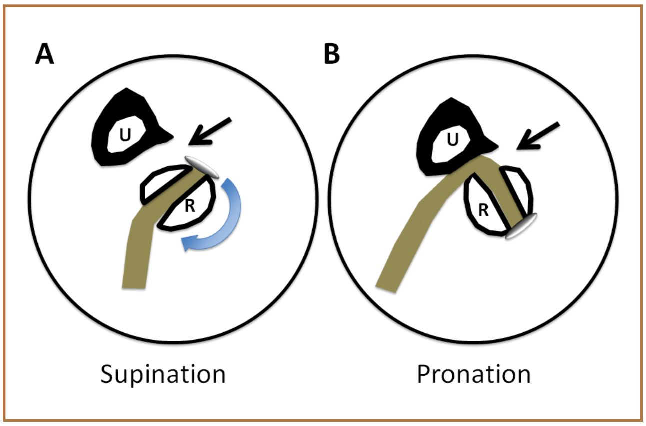

Figure 2. Diagram of expected postoperative appearance of proximal forearm after distal biceps tendon repair using Endobutton (Arthrex, Naples, Florida). Forearm in (A) supination and (B) pronation shows radioulnar space (arrows) narrowed on pronation but accommodating repaired tendon.
Abbreviations: R, radius; U, ulna.

activity by 1-year follow-up, confirming recent reports that intrasubstance signal abnormalities[4] and even rerupture on MRI are not correlated with symptoms.[5] The patient provided written informed consent for print and electronic publication of this case report.

Case Report

A healthy right-hand–dominant 32-year-old man was rock climbing when he heard a pop and felt sudden weakness in his right elbow. The injury occurred during eccentric contraction, while he was climbing a 45° overhanging wall with his right elbow fully extended and forearm maximally pronated. Immediately after injury, he noticed obvious deformity in the right arm. Before this incident, there was no history of elbow symptoms or any medication use.

Physical examination revealed distortion of the biceps with a palpable defect in the right elbow consistent with a complete biceps tendon rupture. This was confirmed on MRI, which showed avulsion of the distal biceps tendon from its insertion on the radius. There was 4 cm of proximal retraction of the tendon, which was kept at the level of the joint line by a partially intact lacertus fibrosis (**Figure 1**).

As the patient was physically active, operative treatment was chosen with the expectation of restoration to full function and strength. Six days after injury, surgery was performed using a 1-incision anterior approach with an Endobutton technique, as first described by Bain and colleagues[6] and subsequently detailed by other authors.[7] The diameter of the distal biceps tendon after attachment to the Endobutton (Arthrex, Naples, Florida) was measured, and a corresponding 7-mm unicortical tunnel was drilled into the radial tuberosity. During surgery, there was full range of motion (ROM) at the elbow and forearm. Before closure, the wound was copiously irrigated to minimize the potential of HO. In our practice, we do not routinely administer prophylactic anti-inflammatory drugs to low-risk patients because of the theoretical risks for delayed tendon–bone healing[8] and inferior healing strength.[9] The theoretical, expected postoperative appearance is illustrated in **Figure 2**.

For 7 days after surgery, the patient wore a posterior elbow splint in a flexed, supinated position. Afterward, rehabilitation initially consisted of passive ROM progressing to active ROM at postoperative week 4. Pronation was slow to return, but essentially full ROM was regained by 7 weeks after surgery. Seven weeks after surgery, a radiograph showed a small amount of HO near the radial tuberosity (**Figure 3A**). However, the patient was clinically progressing well, and by 9 weeks was comfortably performing slow, controlled arm curls with a 10-lb weight. Despite the clinical improvements, MRI 9 weeks after surgery showed high-grade partial-thickness retearing of the distal biceps tendon without significant retraction. With dynamic MRI, it was evident that the focus of HO near but external to the distal tendon entered the radioulnar space on pronation (**Figures 3B–3D**). On axial images of the center of

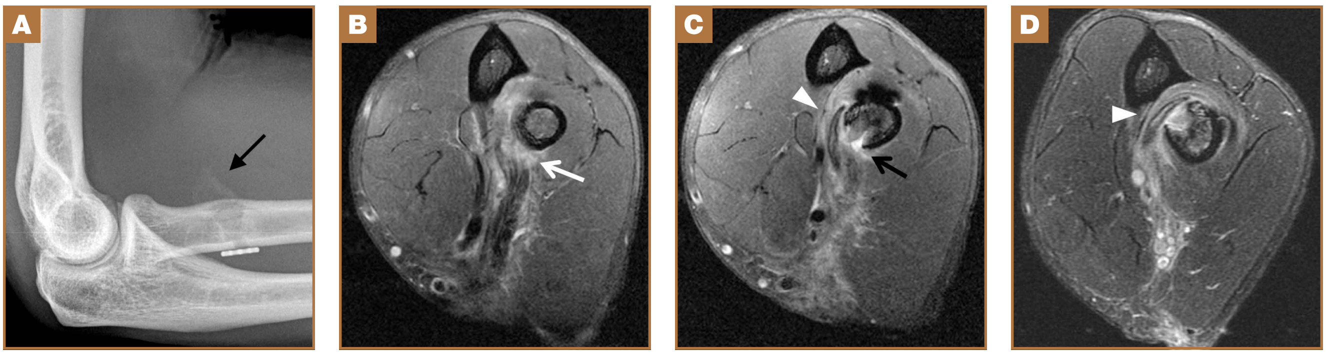

Figure 3. Imaging shortly after surgery. (A) Seven weeks after surgery, lateral radiograph shows expected location of Endobutton (Arthrex, Naples, Florida) and early heterotopic bone formation (arrow). (B,C) Nine weeks after surgery, axial T2-weighted magnetic resonance imaging (MRI) in flexed, abducted, and supinated position shows high-grade partial-thickness tear of biceps tendon with retracted fibers (white arrow), focal kink and fluid at torn distal tendon (black arrow), and heterotopic piece of bone (arrowhead). (D) Axial T2-weighted MRI in extended and pronated position at essentially same level and plane as (B) shows piece of bone (arrowhead) entering and partially occupying radioulnar space, acting as “trapdoor” to impinge on tendon.

Figure 4. One year after surgery. (A) Lateral radiograph shows mature heterotopic bone (arrow) near radial tuberosity. In addition, axial T2-weighted magnetic resonance imaging in (B) flexed, abducted, and supinated position and (C) extended, semipronated position shows hypointense focus of bone (arrowheads) incorporated into distal tendon remnant and scar tissue.

the cortical tunnel, the short-axis diameter of the heterotopic bone measured 2.5 mm, and the bone clearly was occupying part of the radioulnar space during pronation. As the patient was not having pain and was increasing in strength, the clinical team resumed rehabilitation, albeit at a gentler pace.

By 1-year follow-up, the patient had returned to preinjury activity levels, which included rock climbing and weightlifting without pain or loss of strength. One year after surgery, radiographs and MRI showed maturation of heterotopic bone, which was incorporated with scar tissue along the remodeled distal biceps tendon remnant (**Figures 4A-4C**).

Discussion

Distal biceps tendon ruptures historically have been considered relatively rare injuries. Postrepair complications are uncommon but well known. HO has been described with all distal biceps tendon repair techniques, but rates vary depending on follow-up method. Given the data reported, HO is thought to have a higher incidence with the 2-incision technique than with the 1-incision technique.[10] The literature includes fewer reports of HO with the Endobutton technique[11,12] than with the suture anchor technique.[3] Incidence of HO after distal biceps tendon repair has been reported to be as high as 50%, with Marnitz and colleagues[5] suggesting that its presence does not necessarily affect clinical outcome. This was confirmed in our patient's case.

A much rarer complication of repair is rerupture, which can be asymptomatic or symptomatic.[5] The most common failure site, discovered during surgery, is the fixation site.[2,13] The true incidence of rerupture is unknown, as MRI typically is not obtained for asymptomatic patients. However, Marnitz and colleagues[5] recently found increased intratendinous signal and thickness of repaired tendons in the majority of intact postoperative cases and no significant correlation between any MRI features, including tendon rerupture, and clinical measures. This was confirmed in our patient's case, in which the MRI-based diagnosis of partial retear was not correlated with adverse clinical outcome at 1-year follow-up. Marnitz and colleagues[5] hypothesized that the increased thickness of the repaired tendon would predispose the patient to impingement.

Our patient had no demonstrable loss of motion during surgery. However, postoperative dynamic MRI clearly showed insufficient room in the pronated radioulnar space for both heterotopic bone and repaired biceps tendon. It is possible that a space-occupying peritendinous hematoma or HO soon after surgery caused early loss of pronation. In a study of 10 volunteers, mean radioulnar distance was 4.0 mm (range, 2.1-6.0 mm) at its minimum in pronation.[14] We used the same technique to measure our patient's radioulnar space in active semipronation: 7 mm. This diameter was the same as that of the distal biceps tendon during surgery (**Figure 3D**). Had our patient been in maximum pronation during imaging, we would have expected a further decrease in radioulnar distance. Given the insufficient room in this case, it is possible that, during the attempt to regain full pronation, attritional wear of the repaired biceps tendon occurred with a corresponding maturation of the focus of heterotopic bone. Supporting this theory is the patient's lack of history of traumatic loading, which would have suggested tensile failure of the repair. By 1-year follow-up, scar-tissue maturation and remodeling had occurred, and there was sufficient overall biomechanical strength to withstand return to normal activity.

The literature includes multiple reports of in vitro biomechanical studies of various types of distal biceps tendon fixation,[15-17] and multiple authors have demonstrated the superior pullout strength of cortical fixation buttons,[18,19] such as the Endobutton. It is important to note that all biomechanical tests are performed in cadaveric specimens and are therefore likely applicable only at time zero, after in vivo repair. In part stemming from the results of these cadaveric biomechanical tests, earlier and more aggressive rehabilitation protocols have been developed with the assumption that time zero is the weakest point.[20] If in fact the native repaired biceps tendon is retorn and remodeled, there will exist a nadir in strength because of the high concentration of biomechanically inferior type III collagen in scar tissue (as opposed to the very strong type I collagen in native tendons).[21] In the absence of complete rerupture, biomechanical strength would continue to improve during scar maturation and continued healing, leading to the typical excellent clinical result, as seen in our case.

This case report illustrates the dynamic MRI appearance of a small focus of HO after distal biceps tendon repair and adds to the time-zero cadaveric data of distal biceps tendon repair. The small focus of HO near the repaired distal tendon may have caused tendon impingement in pronation because of its space-occupying nature and possible attritional tendon wear. A gentler rehabilitation protocol for this pattern of HO, during a period in which biomechanically inferior scar tissue is maturing, may be warranted. Despite the high rates of clinical success with distal biceps tendon repair, there is lack of agreement between ex vivo cadaveric studies and the in vivo scenario. A prospective study involving a larger series of patients with postoperative dynamic MRI examinations would be useful to better understand the true in vivo course of distal biceps tendon repair.

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