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# Partial tears of the distal biceps tendon: MR appearance and associated clinical findings

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**Abstract** *Purpose:* To describe the magnetic resonance (MR) appearance and associated clinical findings of partial distal biceps tendon tears. *Design:* Twenty elbow MR images at 1.5 T, performed over a 7 year period, were reviewed for an appearance of partial tears in the distal biceps. These images were assessed by two musculoskeletal radiologists for the extent of: (a) abnormal signal intensity within the tendon, and the presence of (b) bicipitoradial bursitis, and (c) bony microavulsive injury of the radial tuberosity. Medical records for nine of the 20 cases were reviewed for the clinical findings of ecchymosis, trauma, sensation of a "pop", loss of function, and acuity of onset. *Results:* Twenty partial distal biceps tendon tears were seen. All displayed an abnormally increased signal in the distal biceps tendon. Three of 20 (15%) showed a 25% to 50% tear, ten of 20 (50%) showed a 50% tear, and seven of 20 (35%) showed a 75% to 90% tear. Bicipitoradial bursitis was seen in 11 of 20 (55%) cases. Bony microavulsive injury of the radial tuberosity was observed in 10 of 20 (50%). Of the nine cases reviewed for associated clinical findings, surprisingly, only three (33%) experienced an acute traumatic episode with an abrupt onset of pain. An insidious onset was reported in four of nine (44%). Sensation of a "pop" was recorded in only two of nine (22%) cases. Ecchymosis and loss of function were not seen in any of the cases. Finally, surgical conformation was obtained for three cases. *Conclusion:* Partial distal biceps tendon tears have a characteristic MR appearance, demonstrate little functional deficit, and may be attritional in their etiology due to the observation of a low number of patients reporting trauma or an acute onset.

**Keywords** Elbow, injuries · Elbow, MR · Tendons, injuries · Tendons, MR

## Introduction

Rupture of the biceps brachii tendon most often occurs proximally in the long head. This represents 96% of all biceps tendon injuries, while the distal biceps tendon accounts for only 3% of all injuries of the biceps tendons [1, 2, 3, 4, 5, 6]. Rupture of the distal biceps tendon is a relatively rare injury. Complete rupture of the distal tendon from its insertion on the radial tuberosity is thought to be more common than partial tears and is often dramatic in appearance, easy to diagnose clinically, and typically requires surgical intervention [2, 5, 7]. A partial rupture, on the other hand, is not as frequently seen, and is rarely treated surgically [8]. Approximately 20 cases have been described [1, 4, 5, 8, 9, 10, 11].

Falchook and colleagues [4] concluded in their study of rupture of the distal biceps tendon that magnetic resonance (MR) imaging can help confirm distal biceps tendon ruptures, distinguish partial from complete tears, and exclude other lesions as a cause for the patient's symp-

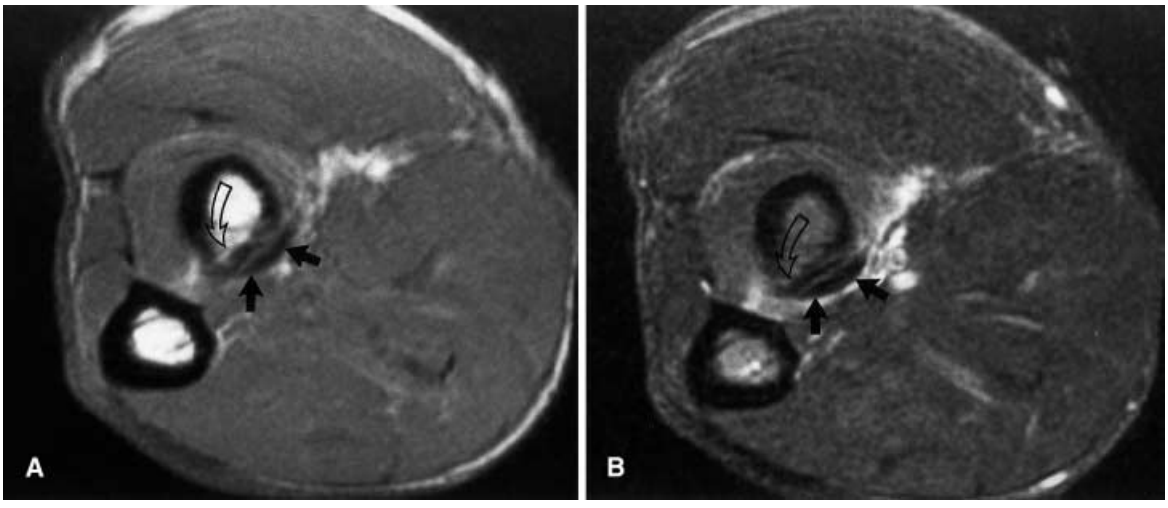


**Fig. 1A, B** A 50-year-old man with a surgically proven partial tear of the distal biceps tendon. **A** Transverse T1-weighted (400/14) spin-echo and **B** transverse T2-weighted fat-suppressed (3166/76) fast spin-echo MR images obtained at the level of the radial tuberosity (*curved arrows*) demonstrate thickening of the distal biceps tendon with increased signal and intratendinous tear at its insertion at the radial tuberosity (*arrows* in **A** and **B**). The extent of the tear was graded as 30%

toms. The MR imaging appearance of a partial tear in the distal biceps tendon, however, has not been well described in the literature [1, 4]. Previous anecdotally described MR imaging findings of partial tears of the distal biceps tendon include increased intratendinous signal intensity on axial T2-weighted images, tendon thinning or thickening, and sometimes peritendinous fluid [1, 2, 4]. MR findings such as osseous or bursa abnormalities have, to our knowledge, rarely been discussed in association with partial tears of the distal biceps tendon. Thus, we sought to describe the magnetic resonance appearance and associated clinical findings of partial distal biceps tendon tears.

## Materials and methods

We retrospectively reviewed MR images and clinical findings obtained in 20 patients with a clinical diagnosis of partial distal biceps tendon tear. The patient population was composed of 14 men and six women ranging in age from 35 to 77 years (mean 50 years).

All MR imaging was performed on a 1.5-T scanner (Signa, General Electric Medical Systems, Milwaukee, Wis.) utilizing an extremity surface coil in the sagittal, coronal, and transverse planes. Subjects were generally placed in a prone position with the elbow extended. Imaging included, in all cases, a T1-weighted spin-echo sequence (TR/TE, 400–500/14 ms) and a T2-weighted sequence (2000–4000/70–90) with or without frequency-selective fat suppression in the transverse plane. In addition, a fast short tau inversion recovery sequence (fast STIR;TR/TE/inversion time, 2600–3500/40–65/150) and a T2-weighted fat-suppressed fast spin-echo sequence (2000/70) in the sagittal and coronal planes were available. In five of 20 patients fast STIR images in the transverse plane were also available. Other imaging parameters usually included a field of view of 13–16 cm, slice thickness of 4 mm, intersection gap of 1 mm, 2 signals acquired, and an imaging matrix size of 256×256. An echo-train-length of 8 was used for all fast spin-echo sequences.

MR imaging examinations of the patients were reviewed retrospectively and interpreted in consensus by two musculoskeletal radiologists (M.E.S., D.W.). Assessment of the distal biceps tendon was principally carried out with use of the axial images. Midsagittal MR images were also evaluated. The images of the patients were assessed for: (a) the approximate percentage cross-sectional area of tendon displaying abnormal signal intensity, representing edema fluid at the site of the avulsion of the biceps tendon, (b) bi-

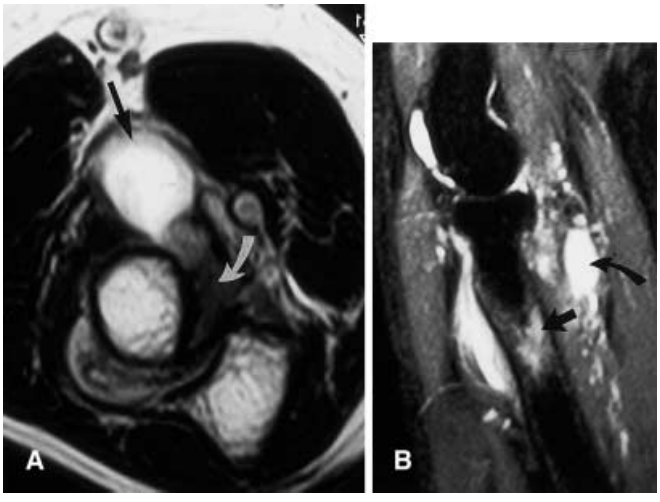


**Fig. 2A, B** Extensive (70% of the tendon substance) partial tear of the distal biceps tendon with bicipitoradial bursitis in a 77-year-old woman. **A** Thickening with increased signal of the distal biceps tendon is demonstrated on the transverse T2-weighted (3500/96) fast spin-echo MR image (*curved arrow*). In addition an enlarged fluid-filled bicipitoradial bursa is visible (*arrow*). **B** Sagittal fast STIR MR image (3240/40; inversion time 150) demonstrates marrow edema at the radial tuberosity consistent with a microavulsive injury (*arrow*). Fluid in the enlarged bicipitoradial bursa is also noted (*small curved arrow*)


**Fig. 3A–D** Partial tear of the distal biceps tendon with involvement of 80% of the tendon substance. **A** Transverse T1-weighted spin-echo MR image (500/16) and **B** transverse T2-weighted MR image (3450/83) show signal alteration within the thickened distal biceps tendon (*arrows*). **C** Transverse T1-weighted spin-echo and **D** transverse T2-weighted fast spin-echo MR images obtained one section more caudal than **A** and **B** respectively, demonstrate that some tendon fibers (*arrows*) remain attached at the radial tuberosity (*open arrow*)

cipitoradial bursitis defined as fluid collection in the bicipitoradial bursa that separates the tendon and the radial tuberosity, often accompanying tears of the distal biceps [12], and (c) bony microavulsive injury, defined as focal marrow edema of the radial tuberosity at the tendon's insertion.

The patients' clinical records and surgical reports (where available) were obtained and correlated with the MR imaging examinations after the studies had been reviewed. These records were reviewed for the associated clinical findings of ecchymosis, trauma, sensation of a “pop”, loss of function, and acuity of onset.

## Results

All 20 patients were clinically diagnosed with partial distal biceps tendon tears. These partial tendon ruptures were characterized on MR imaging by increased intratendinous fluid signal intensity on T2-weighted scans at the site occupied by the tendon at its insertion on to the radial tuberosity (Figs. 1, 2). The signal varied in its extent: three of 20 (15%) showed a 25% to 50% tear (Fig. 1), ten of 20 (50%) showed a 50% tear, and seven of 20 (35%) showed a 75% to 90% tear (Figs. 2, 3).

Bicipitoradial bursitis was seen in 11 of 20 (55%) (Fig. 2). Of these 11 patients, two displayed a 25% to 30% tear, six displayed a 50% tear, and three displayed an 80% tear. In addition, bony microavulsive injury of the radial tuberosity was observed in 10 of 20 (50%) patients (Fig. 2B). Of these 10 patients, two displayed a 25% to 30% tear, three displayed a 50% tear, and five displayed a 75% to 80% tear.

Of the seven patients showing a higher-grade tendon tear (75% to 90% tear), three displayed bicipitoradial bursitis, five displayed microavulsive injury, three displayed both, and two displayed neither. Of the 13 lower-grade tears (≤50% tear), eight displayed bicipitoradial bursitis, five displayed microavulsive injury, three displayed both, and three displayed neither. In summary, six of 20 (30%) displayed both findings of bursitis and marrow edema, five of 20 (25%) displayed neither, five of 20 (25%) displayed bursitis only, and four of 20 (20%) displayed marrow edema only.

We were able to obtain associated clinical histories for nine of the 20 patients imaged, each history varying in the amount of details and completeness. Of these nine

only three patients experienced acute trauma. These three also reported a history of an abrupt onset of pain. One of these patients reported trauma described as a "ripping and burning sensation" accompanied by numbness, tingling, and swelling in the antecubital fossa. An insidious onset was documented in four of cases presented. Sensation of a "pop", again normally associated with complete tears, was recorded in only two cases. Finally, ecchymosis and loss of function were not seen in any of the cases.

Surgical confirmation and repair of partial tendon rupture was performed in three cases by three separate surgeons. Surgical reports obtained correlated with the MR findings in these cases.

## Discussion

Partial ruptures of the distal biceps tendon are uncommon injuries and the diagnosis may be difficult to make because of subtle symptoms and clinical findings. In the authors' experience, MR imaging can be useful in diagnosing this injury.

Fitzgerald and colleagues [1] looked at 12 cases of complete tears and four cases of partial tears on T2-weighted images in both the axial and sagittal planes. They concluded that MR imaging is accurate in the diagnosis of distal tendon injury and delineating between partial and complete tears. We utilized similar criteria to this study but acknowledge that our MR findings, specifically the signal intensity changes, may be the result of another variant of tendon abnormality such as tendinosis. Our three surgically confirmed cases of partial tears, however, did show a strikingly similar MR appearance to the other cases without surgical proof.

We found that bicipitoradial bursitis occurred frequently (55%) in association with partial tearing of the distal biceps. The bicipitoradial bursa separates the distal tendon from the anterior aspect of the radial tuberosity just proximal to the tendon insertion and serves to reduce the friction between the bone and tendon. Chronic inflammation of the adjacent bicipitoradial bursa may be contributory to distal biceps tendon rupture [7]. To our knowledge, there are few reports describing the MR appearance of bicipitoradial bursitis [12, 13, 14], with only one recent report describing this finding in four patients with partial tears of the distal biceps tendon [12]. Durr et al [11], in their series, reported a significant bursalike lesion in three of four patients with partial ruptures.

Bone marrow edema was found in half our patients with partial tears in the distal biceps tendon. The increased marrow signal intensity on T2-weighted images is similar in appearance to the avulsions produced at the insertion of the medial collateral ligament in knee injuries [15], the microavulsion associated with epicondylitis and ulnar collateral ligament injuries in the repetitive overuse of the elbow [16], and calcaneal marrow edema in plantar fasciitis of the foot [17]. Marrow edema patterns associated with tendon disorders may reflect a hyperemic state or altered biomechanics as described by Raiken et al [18].

Patients with acute complete ruptures may experience an audible or palpable "popping" or tearing sensation and present with sharp pain in the antecubital fossa [3, 5]. Ecchymosis and antecubital swelling may also develop. Our study revealed a very low number of patients reporting actual acute trauma, an abrupt onset, or sensation of a "pop". None reported ecchymosis or loss of function associated with the injury. This suggests the clinical findings may be different in partial tears compared with those listed above for complete tears.

Our study further supports this notion, by describing four patients reporting an insidious onset associated with their partial biceps tendon tear. In fact, the majority of patients with ruptures of the distal biceps tendon describe minor trauma that should not have been strong enough to cause the rupture of a healthy tendon [19]. The clinical history of a relatively minor trauma leading to a major tendon injury may suggest that, in many cases, ruptures are in fact the final stage of degenerative tendon disease [20]. These findings were corroborated by Durr et al. [11], four cases in their series also being atraumatic.

Seiler and colleagues [21] suggested a hypovascular zone near the insertion of the tendon on the radial tuberosity might limit repair mechanisms in this area and predispose to rupture. In addition, they described the distance available for the biceps tendon between the radius and ulna was decreased by approximately 50% in pronation, as compared with supination. They hypothesized that bony irregularities surrounding this area and/or inflammation of the biceps tendon could further compromise this narrow inlet, leading to mechanical impingement of the biceps tendon as it is rotated through pronation and supination.

These findings may also be analogous to the supraspinatus component of the rotator cuff and the posterior tibialis tendon, where the combination of ischemia and local impingement may also predispose to tendon degeneration and eventually rupture. We believe that the presence of bicipitoradial bursitis may be a manifestation of this type of mechanical impingement. In addition, the marrow edema we noted may be a result of chronic avulsive stress from the mechanics of pronation/supination. Finally, we believe our data and the above data support a primary attritional etiology for partial ruptures in the case of the distal biceps tendon.

In comparing the high-grade partial tears with the low-grade partial tears in our study, we found that roughly 71% of patients with high-grade tears had the associated finding of microavulsive injury versus 38% of patients with low-grade tears. A similar comparison of the

high-grade lesions versus lower-grade for the finding of bicipitoradial bursitis revealed roughly 43% of patients versus 62% of patients, respectively. Although these numbers are small, perhaps the bursitis occurs in early stages and marrow edema in the late stages.

A major weakness of this study was selection bias due to a selected patient cohort and the fact that only patients who were sent for imaging were included. Patients with only minimal tearing of the tendon may not have been referred for MR imaging based on an unimpressive clinical presentation. This may have contributed to our low number of patients demonstrating limited partial tearing (<50% of tendon ruptured) of the distal biceps tendon on MR imaging. Second, the MR findings were not evaluated independently; therefore the presence of one sign may have affected a reviewer determining whether other findings were present. Third, very little information was available about the range and average duration of the patients' symptoms and the precise time interval from onset of symptoms to imaging. Lastly, the small number of patients in our study, and the even smaller number of cases with a detailed clinical history and surgical confirmation, indicates a need for further validation of our findings. Despite the surgical confirmation in three cases, 17 lack surgical or histologic proof of a partial tear, raising the possibility that the signal intensity changes could represent something other than a tear such as tendinosis.

Accepting the above limitations, we conclude from this study that partial distal biceps tendon tears show signal changes with frequently associated bursitis and marrow edema demonstrating little functional loss. The large number of patients in our series without a specific traumatic event, ecchymosis, or an acute onset suggest that some partial tears may be attritional in etiology.

## References


1. Fitzgerald SW, Curry DR, Erickson SJ, Quinn SF, Friedman H. Distal biceps tendon injury: MR imaging diagnosis. Radiology 1994; 191:203–206.
2. Logan PM, Janzen DL, Connell DG. Tear of the distal biceps tendon presenting as an antecubital mass: magnetic resonance imaging appearances. Can Assoc Radiol J 1996; 47:342–346.
3. Visuri T, Lindholm H. Bilateral distal biceps tendon avulsions with use of anabolic steroids. Med Sci Sports Exerc 1994; 26:941–944.
4. Falchook FS, Zlatkin MB, Erbacher GE, Moulton JS, Bisset GS, Murphy BJ. Rupture of the distal biceps tendon: evaluation with MR imaging. Radiology 1994; 190:659–663.
5. Rokito AS, McLaughlin JA, Gallagher MA, Zuckerman JD. Partial rupture of the distal biceps tendon. J Shoulder Elbow Surg 1996; 5:73–75.
6. Hovelius L, Josefsson G. Rupture of the distal biceps tendon: report of five cases. Acta Orthop Scand 1977; 48:280–282.
7. Fritz RC, Steinbach LS, Tirman PF, Martinez S. MR imaging of the elbow: an update. Radiol Clin North Am 1997; 35:117–144.
8. Bourne MH, Morrey BF. Partial rupture of the distal biceps tendon. Clin Orthop 1991; 271:143–148.
9. Foxworthy M, Kinninmonth AW. Median nerve compression in the proximal forearm as a complication of partial rupture of the distal biceps brachii tendon. J Hand Surg [Br] 1992; 17:515–517.
10. Nielsen K. Partial rupture of the distal biceps brachii tendon: a case report. Acta Orthop Scand 1987; 58:287–288.
11. Durr HR, Stabler A, Pfahler M, et al. Partial rupture of the distal biceps tendon. Clin Orthop 2000; 374:195–200.
12. Skaf AY, Boutin RD, Dantas RWM, et al. Bicipitoradial bursitis: MR imaging findings in eight patients and anatomic data from contrast material opacification of bursae followed by routine radiography and MR imaging in cadavers. Radiology 1999; 212:111–116.
13. Spence LD, Adams J, Gibbons D, Mason MD, Eustace S. Rice body formation in bicipito-radial bursitis: ultrasound, CT, and MRI findings. Skeletal Radiol 1998; 27:30–32.
14. Liessi G, Cesari S, Spaliviero B, Dell'Antonio C, Avventi P. The US, CT and MR findings of cubital bursitis: a report of five cases. Skeletal Radiol 1996; 25:471–475.
15. Schweitzer ME, Tran D, Deely DM, Hume EL. Medial collateral ligament injuries: evaluation of multiple signs, prevalence and location of associated bone bruises, and assessment with MR imaging. Radiology 1995; 194:825–829.
16. Martin CE, Schweitzer ME. MR imaging of epicondylitis. Skeletal Radiol 1998; 27:133–138.
17. Grasel RP, Schweitzer ME, Kovalovich AM, et al. MR imaging of plantar fasciitis: edema, tears, and occult marrow abnormalities correlated with outcome. AJR 1999; 173:699–701.
18. Raiken DP, Morrison WB, Carrino JA, Schweitzer ME, Snearly WN, Johnson CE. Marrow edema patterns on MR images of the ankle: association with tendinopathy (abstract). Radiology 1998; 209(P):344.
19. Koch S, Tillmann B. The distal tendon of the biceps brachii: structure and clinical correlations. Annals of Anatomy 1995; 177:467–474
20. Kainberger F, Mittermaier F, Seidl G, Parth E, Weinstabl R. Imaging of tendons: adaptation, degeneration, rupture. Eur J Radiol 1997; 25:209–222.
21. Seiler JG, Parker LM, Chamberland PD, Sherbourne GM, Carpenter WA. The distal biceps tendon: two potential mechanisms involved in its rupture: arterial supply and mechanical impingement. J Shoulder Elbow Surg 1995; 4:149–156.