

## Don't Miss Popeye

A 42-year-old man presented to the ED with left arm pain secondary to an injury he sustained at work. The patient stated that he had been helping to lift a heavy steel beam at a construction site when he experienced abrupt onset of pain in his left arm. He further noted that his left arm felt slightly weaker than normal after the injury.

The patient was left-hand dominant, denied any other injury, was otherwise in good health, and on no medications. With the exception of an appendectomy at age 12 years, his medical history was unremarkable. Regarding his social history, he admitted to smoking one pack of cigarettes per day, and to occasional alcohol consumption. He had no known drug allergies.

On physical examination, the patient's vital signs were:

blood pressure, 125/76 mm Hg; heart rate, 78 beats/min; respiratory rate, 16 breaths/min; and temperature, 98.6°F. Oxygen saturation was 99% on room air.

Examination of the patient's left shoulder revealed no swelling or tenderness; he was able to fully internally/externally rotate the left shoulder, and lift his left hand above his head. The patient did have tenderness along the biceps area of the left arm, but no tenderness in the triceps area. The left elbow was tender in the antecubital fossa, but without swelling. He had full range of motion of the left elbow but with some pain. He likewise had full range of motion in his left wrist, but no tenderness or swelling. The left radial pulse was 2+. The patient had 5/5 grip strength with the left hand and good capillary refill.

The physician assistant (PA) evaluating the patient diagnosed an arm strain. At discharge, he referred the patient to an occupational health physician (OHP) for follow-up. He also instructed the patient to take ibuprofen 400 mg every 6 to 8 hours, and to limit use of his left arm for 3 days.

The patient followed up with the OHP approximately 3 weeks after discharge from the ED. The OHP was concerned the patient had experienced a distal biceps tendon rupture and referred the patient emergently to an orthopedic surgeon. The orthopedic surgeon saw the patient the next day, agreed with the diagnosis of a distal biceps tendon rupture, and attempted surgical repair the following day. The orthopedic surgeon informed the patient prior to the surgery that the delay in the referral and surgery could result in a poor functional outcome. The patient did have a difficult recovery period, and a second surgery was required, which did not result in any significant functional improvement.

The plaintiff sued the treating PA and supervising emergency physician (EP) for failure to properly diagnose the biceps tendon rupture, failure to appreciate the existence of a 3-week window of opportunity to repair the distal biceps tendon rupture, and failure to obtain an urgent orthopedic referral. The experts for the defense argued that the poor outcome was not a consequence of any delay in diagnosis or surgical repair. In addition, the defense disputed the existence of a 3-week window



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of opportunity for successful repair of a distal biceps tendon rupture. The jury returned a defense verdict.

## Discussion

### Proximal and Distal Biceps Tendon Ruptures

While both proximal and distal biceps tendon ruptures involve the biceps brachii, they are managed differently and have the potential for very different outcomes.<sup>1</sup> At its proximal attachment, the biceps has two distinct tendinous insertions—the long head and the short head. For the distal attachment, the two muscle bellies unite at the midshaft of the humerus and attach as a single tendon on the radial tuberosity. In general, 96% of biceps tendon ruptures involve the long head, 1% involve the short head, and only 3% involve the distal tendon.<sup>1</sup> Biceps tendon ruptures occur more commonly in men, patients who use anabolic steroids, cigarette smokers, patient history of tendinopathy, or patients who have a rotator cuff tear.<sup>1</sup> Biceps tendon ruptures have not been found to be associated with statin use.<sup>2</sup> The mechanism of injury includes heavy-lifting activities, such as weight lifting and rock climbing. However, when associated with a tendinopathy, minimal force may be involved.<sup>1</sup>

### Signs and Symptoms

For proximal biceps tendon rupture, patients usually present with an acute or gradual onset of pain, swelling, and bruising of the upper arm and shoulder. Occasionally, if there is an inciting event, the patient may describe hearing or feeling a “popping” or “snapping” sound. On physical examination, the patient may exhibit a “Popeye” sign—a bulge in the distal biceps area due to the retracted biceps muscle belly. There is also tenderness along the biceps.

On testing, it has been estimated that patients can experience strength loss of approximately 30% with elbow flexion.<sup>1</sup> In contrast, patients with distal biceps tendon ruptures usually complain of pain, swelling, and possibly bruising in the antecubital fossa, as was the case with this patient. Similar to proximal ruptures, the patient may admit to hearing or feeling a “popping” sound if there is an inciting event. The patient may exhibit a “reverse Popeye” deformity, with a bulge in the proximal arm secondary to retraction of the biceps muscle belly proximally.<sup>1</sup>

### Diagnosis

There are two tests that can be performed to assist in making the diagnosis—the biceps squeeze test and the hook test.

**Biceps Squeeze Test.** The first test to assess for distal biceps tendon rupture is the biceps squeeze test, in which the clinician forcefully squeezes the patient’s biceps muscle to observe for forearm flexion/supination. This test is similar in principle to the Thompson test for Achilles tendon rupture. If there is no forearm movement, the injury is suspicious for a complete distal biceps tendon rupture. In one observational study of this test, 21 of 22 patients with a positive biceps squeeze test were found to have a complete distal biceps tendon tear at surgery.<sup>3</sup>

**Hook Test.** The second test is the hook test. While the patient actively supinates with the elbow flexed at 90°, an intact hook test permits the examiner to “hook” his or her index finger under the intact biceps tendon from the lateral side. The absence of a “hook” means that there is no cord-like structure under which the examiner can hook a finger, indicating distal avulsion.<sup>4</sup> In one study comparing the hook test to magnetic resonance imaging (MRI) in 33 patients with this suspected injury, the hook test had 100% sensitivity and specificity, while MRI only demonstrated a 92% sensitivity and 85% specificity.<sup>4</sup>

### Imaging Techniques

The need for diagnostic imaging is based somewhat on the location of the rupture—proximal or distal. Ultrasound has been shown to have a high sensitivity and specificity for identifying normal tendons and complete tears of the long head biceps tendon (ie, proximal). It is not sensitive at identifying proximal partial tears, however. For distal ruptures, ultrasound imaging of the distal biceps tendon is technically difficult and not reliable. For patients with suspected distal biceps tendon ruptures, the EP should consult with orthopedic services prior to ordering an MRI. While MRI is considered the gold standard imaging test, it is neither 100% sensitive nor specific. The bottom line is that the absence of pathologic findings on MRI is not sufficient enough to exclude biceps tendon pathology.<sup>5</sup>

### Treatment and Management

Regarding management, the majority of patients with proximal biceps tendon ruptures tend to do well with conservative management. The exception is for younger, active patients who are less willing to accept the cosmetic deformity, or patients whose occupation makes them unable to tolerate minimal weakness or fatigue cramping (eg, carpenters), in which case referral for a

surgical repair (tenodesis) may be appropriate.<sup>1</sup> However, multiple systematic reviews examining tenotomy vs tenodesis have not shown any functional improvement, only cosmetic.<sup>1,6,7</sup>

Distal biceps tendon ruptures are usually treated surgically, since conservative management results in a decrease of 30% to 50% supination strength and 20% flexion strength.<sup>1,8</sup> This surgery, however, is not without complications. Approximately 20% of the patients will have a minor complication and 5% will have major complications following surgery on the distal biceps tendon.<sup>9</sup> It is preferable to operate on distal ruptures less than 4 weeks from the initial injury; otherwise, these injuries may be more difficult to fix, require a graft, and have less predictable outcomes.<sup>1</sup> Nonoperative management should be reserved for the elderly or less active patients with multiple comorbidities, especially if the nondominant arm is involved.<sup>10</sup>

## Summary

The PA clearly missed the correct diagnosis on this patient. A more thorough history and focused physical examination would have led to the correct diagnosis sooner, along with earlier surgical repair. It is impossi-

ble, however, to know if the outcome would have been any different in this uncommon injury.

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