The Hook Test for Distal Biceps Tendon Avulsion

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Background: Complete biceps tendon avulsions are frequently missed on clinical examination, suggesting the need for a reliable diagnostic test.

Hypothesis: Complete distal biceps avulsions can be reliably detected with the Hook test.

Study Design: Cohort study (diagnosis); Level of evidence, 2.

Methods: The hook test was performed by a single surgeon in a cohort of 45 patients undergoing surgical exploration of the distal biceps tendon. While the patient actively supinates with the elbow flexed 90°, an intact hook test permits the examiner to hook his or her index finger under the intact biceps tendon from the lateral side. With an abnormal hook test, indicating distal avulsion, there is no cord-like structure under which the examiner may hook a finger.

Results: Thirty-three patients had an avulsion and 12 had a partial tear. The hook test was abnormal in 33 of 33 (100%) patients with complete biceps avulsions, and intact in 12 of 12 with partial detachments. However, it was painful in 9 of those 12. In the noninjured contralateral arms, which served as the normal control group, 45 of 45 (100%) had a normal hook test. Magnetic resonance imaging (MRI) diagnosed a complete tear in 11 of 12 patients with partial tears and in 11 of 13 with complete lesions. The sensitivity and specificity were both higher with the hook test (both 100%) than with MRI (92% and 85%, respectively).

Conclusions: The hook test is a highly sensitive and specific test for assessment of distal biceps tendon avulsions.

Keywords: biceps; tendon; avulsion; rupture; elbow

For over a decade, the senior author (S.O.) has performed a very simple clinical test to determine whether the biceps tendon is still attached to the radius distally. Because the biceps tendon represents a cord as it passes through the antecubital fossa, it is possible for the examiner to hook a finger underneath the cord. In our experience, it has been possible to establish the diagnosis of a complete distal biceps tendon avulsion clinically with confidence in the presence or absence of magnetic resonance imaging (MRI) and despite the findings of MRI. The purpose of this study was to review the sensitivity and specificity of this physical examination test for distal biceps tendon avulsions and to test the following hypotheses. First, we hypothesized that in the normal elbow, it should be possible for the examiner to hook a finger behind the biceps tendon from the lateral side (intact hook test). Second, if the biceps tendon is avulsed distally, the hook test should be “abnormal,” meaning that it is not possible to hook one’s finger behind the lateral side of any structure in the antecubital fossa. This is independent of whether a tendon-like structure is palpable there.

MATERIALS AND METHODS

Forty-eight consecutive patients who were evaluated and explored surgically for a known or possible partial or complete
avulsion of the distal biceps tendon from November 1, 1995 to November 30, 2005 by the senior author (S.O.) were reviewed after institutional review board approval. The patients were identified from a surgical registry in which all operative cases of the senior author are recorded. Four independent search parameters permit identification of the cases so that none would be missed. An independent reviewer, not involved in the cases of these patients, reviewed the records and operative notes for documentation of the hook test and correlated with the surgical findings. Of the 48 patients, the hook test was performed in 45. In 3 patients, the muscle retraction was so severe that the test was not even performed. These 45 patients formed the study cohort for this report.

For a control group of normal elbows, the noninjured contralateral arm was examined. The findings were all recorded preoperatively. All patients were personally examined by the senior author (S.O.), who also performed the hook test and dictated the clinical note on each patient personally. The hook test was performed in a blinded fashion. In other words, the findings of the hook test were determined before MRI or before viewing the MRI scans if the patients brought them.

**Hook Test**

To perform the hook test, the patient is asked to actively flex the elbow to 90° while sitting or standing and to fully supinate the forearm to its end point of supination. For examining the right elbow, the examiner’s left index finger is brought in from the lateral side of the antecubital fossa beneath the lateral edge of the biceps tendon in an attempt to hook the tendon (Figure 1A). In the normal patient, the finger can be inserted beneath the tendon approximately 1 cm and in some cases right up to the distal interphalangeal joint of the examiner’s finger (Figures 1B, 1C, 2B, and 2C). This allows the examiner to fully hook the biceps tendon and pull it forward (intact hook test). On the medial side, to examine the lacertus fibrosus or bicipital aponeurosis, the examiner’s right hand would be brought in for the examination for the right elbow and the index finger used to palpate beneath the lacertus fibrosus in the distal portion of the antecubital fossa in a similar fashion. However, the space beneath the lacertus fibrosus is much smaller and tighter; therefore, the finger cannot be hooked under the edge of the lacertus fibrosus as far as it can be hooked under the lateral edge of the biceps tendon. Also, the medial edge of the lacertus fibrosus feels thin and sharp and sheet-like, whereas the lateral edge of the biceps tendon feels thick and cord-like. For the left elbow, the examiner simply switches hands and performs the same maneuvers in a mirror image. If the biceps tendon is completely avulsed distally, the hook test is “abnormal” as there is no cord-like structure under which the examiner may hook a finger from the lateral side of the antecubital fossa (Figures 1D, 1E, and 2A). If the lacertus fibrosus is also avulsed, then there is no medial sheet-like edge under which the examiner can hook a finger. However, if the lacertus fibrosus is still intact, which it occasionally is, then the hook test will be abnormal because the biceps tendon has been avulsed distally, but there will be a sheet-like

**Figure 1.** A, the hook test for a distal biceps tendon avulsion is performed with the elbow flexed 90° and the forearm fully supinated actively to the end point of supination. B and C, intact hook test. When the biceps tendon is intact, it is possible to fully insert the finger under the lateral edge of the biceps tendon for about 1 cm or more depending on the relative size of the patient’s muscles and the examiner’s finger. The finger passes between the biceps tendon and underlying brachialis muscle. D and E, abnormal hook test. With a complete avulsion of the distal biceps tendon, the hook test is abnormal, indicated by the absence of a cord-like structure spanning the antecubital fossa behind which to hook the examiner’s finger. (Copyright Mayo Foundation, Rochester, Minnesota.)
structure of the lacertus fibrosus intact anteromedially. Finally, if the hook test is intact, the examiner should pull vigorously on the biceps tendon to see if the pain in the antecubital fossa is reproduced (painful hook test). A painful response, with an intact tendon, suggests a partial tear or other injury of the tendon or its sheath.

Biceps avulsions were defined as complete if there were no tissues in continuity between the end of the biceps tendon and the radial tuberosity, such that the tendon could be retrieved from the wound without having to release tissues further. The avulsion or tear was defined as partial if the tendon end was held against the tuberosity, even if by a few small fibers, such that surgical release was required to retrieve the tendon from the wound or pull it off the tuberosity.

**RESULTS**

The average patient age was 49 years (range, 25-72 years). Forty-four patients were male and 1 was female. The right side was involved 24 times and the left 21 times. The injuries were acute (10 days or less since injury) in 14 cases (31%), subacute (11-21 days between injury and surgery) in 5 cases (11%), and chronic (>21 days after injury) in 26 cases (58%). In the chronic cases, the diagnosis had generally been missed.

The avulsions of the distal biceps tendon were complete in 33 patients and partial in 12. Of the complete avulsions, 28 also had disruption of the lacertus fibrosus, while this structure was intact in 5. All complete avulsions were repaired through a modified 2-incision technique according to Morrey et al. Partial tears were repaired through the same 2-incision technique in 5 cases and through a single posterior incision in 7 cases.

The hook test was abnormal in 33 of 33 (100%) patients with complete distal biceps tendon avulsions and was intact in 12 of 12 (100%) patients with partial tears ($\chi^2 > 45; P = .000$) (Table 1). Thus, sensitivity and specificity for the hook test were both 100%. The positive predictive value was 100% and negative predictive value was 100%. In all 45 of the 45 contralateral noninjured arms (100%), which served as the control group, the hook test was normal.

An extension or modification of the hook test is used in patients suspected to have partial distal biceps tendon avulsions. The modification includes pulling vigorously on the biceps tendon after having hooked it with a finger. In 9 of the 12 patients with partial avulsions, this modified hook test reproduced their pain in the antecubital fossa. In 3 of the 12, this modification of the test was not documented as having been performed.

Twenty-five of the patients had preoperative MRI. In our practice, we do not routinely order MRI for suspected complete distal biceps avulsions, but we do for a suspected partial tear. Thus, 12 of 12 patients with partial tears had MRI. Of the 33 complete tears, MRI was used on only 13. Most of these scans either came in with the patient or were done in the early years of the study period. The MRI was consistent with a partial tear of the biceps tendon in 11 of 12 (92%) of
the patients with partial tears. The MRI was consistent with the diagnosis of a complete avulsion in 11 of 13 (85%) of the patients with complete avulsions (Table 2). Thus, sensitivity and specificity for MRI were 92% and 85%, respectively. In 3 of 25 patients with preoperative MRI, the clinical diagnosis of a complete avulsion in 2 patients and a partial tear in 1 patient was correctly diagnosed with the hook test despite the MRI having been interpreted to show the opposite.

**DISCUSSION**

Prompt diagnosis of an acute distal biceps tendon avulsion is important, as success rates with acute treatment are better than for treatment of chronic lesions and complication rates rise as the interval between injury and surgery increases.\(^1,5,8,11,13\) Despite this, a delay in diagnosis is common.\(^3,5,7,8,12\) This was evidenced by the present series, in which 58% of the cases were delayed more than 3 weeks. Furthermore, treatment delays beyond approximately 2 to 4 months may render a primary repair impossible and present the need for reconstruction with a tendon graft.\(^3,4,6,14\) The results of tendon grafts are not uniformly successful and are inferior to those of primary repair of acute avulsions.\(^14\)

Despite what might be thought of as obvious clinical signs of a distal biceps tendon avulsion, such as proximal retraction of the muscle belly, bruising and change in contour, and weakness in flexion and supination, these injuries continue to be missed. Thus, there must be a reason why it is easy to believe that the biceps tendon is intact when it is not. It is our impression that the reason for this is that after avulsion and retraction of the biceps tendon, the brachialis tendon is easily mistaken for the biceps tendon. A critical factor that makes the hook test so simple and yet so reliable is that it is used not to detect the presence of a tendon but to detect a tendon spanning the antecubital fossa in front of the brachialis, from which it can be easily distinguished (Figure 3). The biceps tendon is easily hooked away from the brachialis muscle. The brachialis tendon is intramuscular at that level and there is no potential space between the tendon and the muscle within which it sits. Thus, it may be possible to partially indent the brachialis muscle but not to hook the finger behind the tendon after a biceps avulsion. This is especially important in large muscular men such as weight lifters and power lifters, in whom the brachialis tendon can be very stout and easily mistaken for a biceps tendon if the hook test is not performed.

The hook test has proven to be highly reliable in the clinical setting for establishing the diagnosis, even in situations in which the diagnosis was thought to have been difficult to make. Sensitivity and specificity were both high (100%) and better than MRI (85% and 92%, respectively). Using the hook test, it is possible to distinguish between an avulsion that is complete versus partial. A complete avulsion will have an abnormal hook test (tendon cannot be hooked), whereas a partial tear will have a painful hook test (tendon can be hooked but is painful when pulled on). This is valuable information, because partial tears of the distal biceps tendon can often be treated through a single posterior incision.\(^6\) Furthermore, a modification of the hook test can be used along the medial side of the antecubital fossa to determine the integrity of the lacertus fibrosus. This is especially important in chronic avulsions, because if the lacertus fibrosus is intact, the tendon will

**TABLE 2**

Accuracy of MRI Compared With Surgical Findings*  

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<tr>
<th>Surgical Examination</th>
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<tr>
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<tr>
<td>Total</td>
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*MRI, magnetic resonance imaging.
have been prevented from retracting far up into the arm and will likely be amenable to a primary repair even after a long delay in treatment. However, if the lacertus fibrosus is ruptured, a chronic avulsion will be more likely to require a tendon graft. Thus, determination of the integrity of the lacertus fibrosus is indeed an important prognostic factor and will influence decision-making in patients presenting with chronic biceps tendon avulsions. It is critical that the hook test be performed from the lateral side of the biceps tendon rather than the medial side because if the lacertus fibrosus is intact (which it sometimes is in complete biceps avulsions), the lacertus fibrosus may be mistakenly thought to be the biceps tendon proper and the diagnosis is missed.

A recent report by Ruland et al demonstrated similarly good results for diagnosing distal biceps avulsions with the squeeze test. Because that study was not published until the end of our study period, we were not able to compare the 2 tests.

There are potential pitfalls in applying and interpreting the hook test. The patient must not forcefully flex the elbow against resistance, especially if they have large muscles in the arm. Doing so will render the brachialis very firm and narrow the space between the biceps tendon (if it is intact) and underlying brachialis muscle. Sufficient contraction of the biceps tendon, while permitting the brachialis to remain somewhat relaxed, is achieved by having the patient actively supinate the forearm to the limit of supination. Any resistance thought necessary to emphasize the findings should only be performed by supinating against resistance, not flexing against resistance. Also, the forearm must be supinated to move the muscle-tendon junction of the biceps proximally away from the antecubital fossa. As mentioned above, the hook test is performed by hooking a finger under the lateral edge of the biceps tendon so as not to mistake the lacertus fibrosus for the biceps tendon. However, the most likely pitfall is for the examiner to “palpate” a tendon in the antecubital fossa rather than “hooking” a finger behind the tendon (Figure 1). Conceivably, a large amount of adipose tissue or scar in the antecubital fossa might make it difficult to hook the tendon. The contralateral elbow, if noninjured, should be examined for comparison. Any side-to-side difference in the hook test should be considered seriously.

In conclusion, the hook test is a highly reliable and accurate test for diagnosing distal biceps tendon avulsions, whether acute or chronic. Its specificity and sensitivity are very high (both 100%). The diagnosis of a distal biceps avulsion can be made with accuracy and confidence using the hook test, independent of the MRI findings. It is equally accurate for distinguishing complete from partial lesions. With a partial avulsion, the hook test was intact in our patients (ie, tendon is present to hook a finger behind). However, pulling on the tendon during the hook reproduced the pain in patients with partial avulsions. We have never yet come across a case in which there has been any question of complete distal biceps tendon avulsion based on the hook test alone despite the fact that many other factors may have potentially misled us, such as referring diagnoses of intramuscular or musculotendinous ruptures and MRI reports that were wrong.

REFERENCES