Clinical Evaluation of the Distal Biceps Tendon

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16.1 Introduction

Distal biceps pathology is a common cause of pain and weakness in athletes and may result in a Popeye deformity. The spectrum of pathology ranges from tendinosis and low-grade partial tears, and in severe cases may lead to high-grade tears or complete ruptures. The tendon insertion is difficult to examine and palpate precisely due to the deep anatomic location of the bicipital tuberosity; the resultant vague localization of symptoms often results in delayed diagnosis and progression of tears.

A thorough understanding of the extent and course of the DBT is necessary for a systematic clinical evaluation of the distal biceps tendon (DBT) region, and clinical findings may be supplemented with in-clinic sonography for accurate diagnosis.

16.2 Anatomy

The biceps brachii muscle has two distinct muscle bellies that continue as the long and short components of the DBT. The DBT begins in the distal arm at the musculotendinous junction of the biceps brachii and can be palpated approximately 3 cm proximal to the anterior elbow crease (AEC). The tendon traverses the AEC and courses across the layers of the cubital fossa for a mean of 9 cm (7–12 cm) to insert into the bicipital tuberosity (BT) of the proximal radius [1]. The BT can be located approximately 3–4 cm distal to the AEC; the tuberosity lies in an anterior orientation in full supination and rotates posteriorly in full pronation. The lacertus fibrosus is an aponeurotic band of fascia that is attached to the medial aspect of the DBT; the band courses ulnarly and merges with the superficial fascia that encircles the flexors of the forearm. Contraction of the forearm flexors tenses the BA, pulling the biceps tendon distally and medially. An intact aponeurosis prevents retraction of the ruptured DBT; however, it is often torn or elongated in retracted DBT tears.

16.3 Clinical Evaluation

Patients with non-traumatic DBT pathology (tendinosis, partial tears) may present with forearm and arm pain with overuse and exertion, and occasionally may complain of weakness and

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fatigue in certain work-related activities. Traumatic ruptures present with sudden severe pain and bruising after forceful eccentric contraction-related activity and a change is the contour of the biceps is noted.

Clinical evaluation of the DBT should involve an assessment of the arm, and the cubital fossa and proximal forearm. The upper limb is inspected to detect any bruising and the biceps contour is compared to the unaffected arm to identify a "Popeye" deformity. Complete rupture of the DBT results in a proximal shift of the muscle belly; the resultant Popeye deformity can be differentiated from a distally shifted biceps seen in a proximal long head rupture (Fig. 16.1). The biceps muscle belly and the DBT are then palpated from proximal to distal, and tautness of the DBT is assessed with isometric contraction. The bicipital tuberosity is palpated for tenderness from the volar and dorsal aspects of the proximal forearm; in a muscular individual, volar palpation is difficult, and dorsal palpation is performed approximately 4 cm distal to the radiocapitellar joint in a fully pronated forearm. Thereafter, elbow flexion and supination strength tests are performed and compared with the unaffected side. Partial or complete ruptures usually present with weakness in supination, and this weakness is best appreciated in the terminal range of motion. Flexion weakness is often mild and strength testing using a dynamometer is useful to quantify the weakness.

Special tests have been described for assessment of structural integrity of DBT. These tests are useful in complete ruptures and can also be used in the post-surgical period to evaluate healing and repair integrity.

(a) **Biceps crease interval (BCI)**

The Popeye deformity may sometimes be subtle and may not be apparent in early stages of injury. The BCI is useful to quantify the proximal retraction "when visible or palpable alterations in biceps contour and proximal tendon migration are absent or equivocal" [2]. BCI is the distance between the AEC and the cusp of the distal descent of the biceps muscle, as described by ElMaraghy et al. (Fig. 16.2). BCI is measured on both

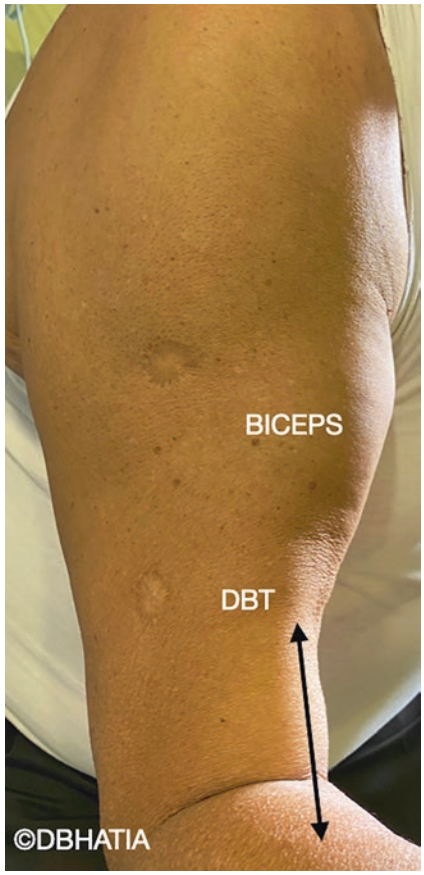

Fig. 16.1 A complete rupture of the distal biceps tendon (DBT) is shown. The tendon has retracted (arrows) into the mid-arm resulting in a "Popeye" deformity

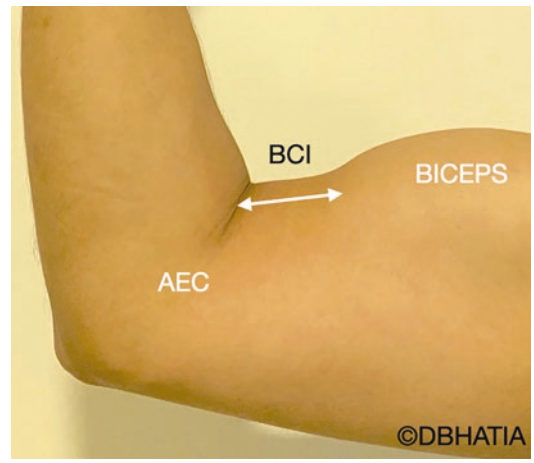

Fig. 16.2 The biceps crease interval (BCI) is the distance between the anterior elbow crease (AEC) and the cusp of the distal descent of the biceps muscle

arms and is expressed as the biceps crease ratio (BCR = affected BCI/unaffected BCI). A BCI > 6.0 cm or a BCR > 1.2 is diagnostic of complete DBT rupture (sensitivity 96%, diagnostic accuracy 93%).

(b) **The Bicipital aponeurosis (BA) flex test**

The BA flex test is performed for assessment of integrity of the lacertus fibrosus in complete DBT ruptures. In a normal arm, the bicipital aponeurosis can be palpated as follows: the wrist is flexed and forearm is supinated to tension the distal attachment of BA. The elbow is flexed to 75° and isometrically contracted to tension the proximal attachment of BA. The BA can then be palpated as it diverges distally in an ulnar direction from the DBT, and the result of the BA flex test is documented as intact or absent (Fig. 16.3). ElMaraghy and Devereaux found that BA remained intact in 59% of complete DBT ruptures and resulted in lesser tendon retraction [3]. The test was found to have 100% sensitivity and 90% specificity, with overall diagnostic accuracy of 94%.

(c) **Hook test**

The hook test was first described by O'Driscoll et al. as a reliable diagnostic test for DBT ruptures [4]. The test can also be used to assess the integrity of the lacertus fibrosus in a complete DBT rupture. The test is performed with the elbow in 90° flexion and forearm supinated. The examiner passes a finger under the lateral aspect of DBT in an attempt to hook it. In an intact tendon, the finger passes under the taut DBT and the taut tendon can be palpated (Fig. 16.4). In an avulsed and retracted tendon, the taut DBT is absent, and the hook test is abnormal. If the tendon is intact and a painful response is elicited (painful hook test), then the test is suggestive of a partial DBT tear. Phadnis and Bain have described four grades of interpretation of the hook test (Normal: Taut, unyielding, and symmetric; A1: Taut, yielding, and asymmetric; A2: Lax and asymmetric; A3: absent cord) [5]. O'Driscoll et al. described the test to be 100% specific and sensitive with a positive and negative predictive value of 100%. In another study, Luokkala et al. described the sensitivity of

Fig. 16.3 The bicipital aponeurosis can be palpated as it diverges distally in an ulnar direction from the distal biceps

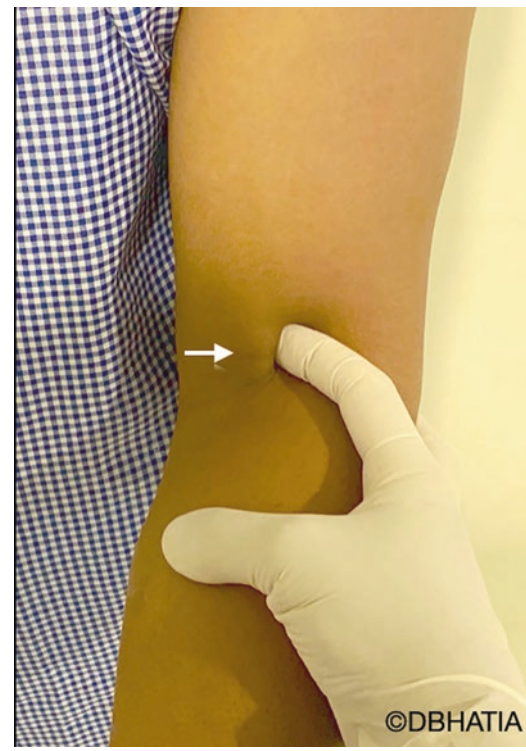

Fig. 16.4 The hook test is demonstrated. The examiner passes a finger under the lateral aspect of distal biceps tendon (arrow) in an attempt to "hook" it

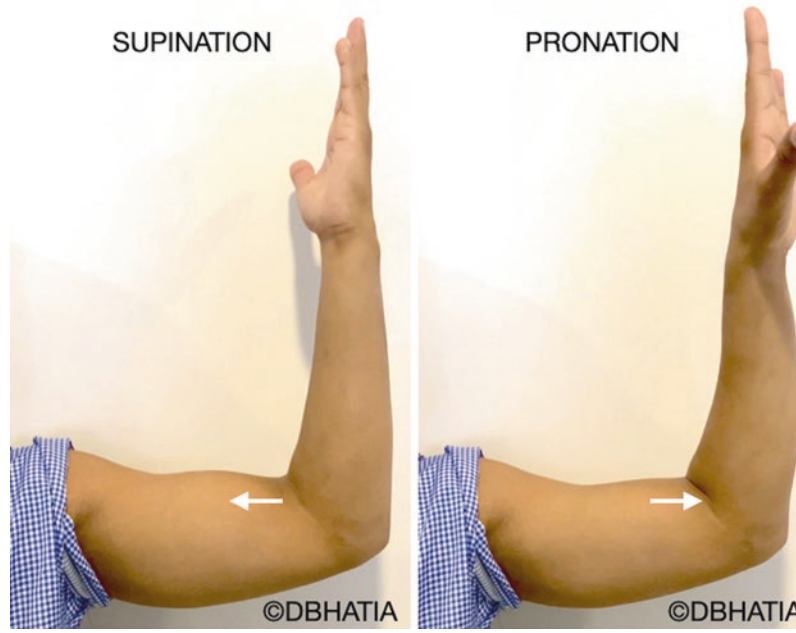

Fig. 16.5 The biceps supination-pronation test is shown. In an intact DBT, the biceps moves proximally with supination and distally with pronation (arrows)

the hook test as 78% (all tears), 83% (complete tears), 45% (intact lacertus fibrosus), and 30% (partial tears) [6]. In delayed cases (8 weeks or more), a positive hook test was suggestive of the need for allograft reconstruction (75% probability), while in a negative test, the probability of reconstruction was only 20%.

(d) **Supination-Pronation test**

Metzman and Tivener described the supination-pronation test as a reliable and pain-free test that would help to evaluate the structural integrity of the DBT and to isolate the DBT from the lacertus fibrosus [7]. They described the test as follows: with both shoulders abducted to 90° and the elbows flexed to approximately 60–70°, the patient is asked to actively perform pronation and supination. In an intact DBT, a change in the biceps muscle contour in the arm is observed; the biceps moves proximally with supination and distally with pronation (Fig. 16.5). Absence of biceps migration with dynamic rotation is suggestive of a complete DBT rupture. The contour of the biceps may be difficult to observe in some patients; in such cases, the movement of the biceps can be palpated during dynamic rotations. The supination-pronation test may be useful in an acute scenario where palpation of the DBT (Hook test) and biceps muscle (squeeze test) cannot be performed due to pain.

(e) **Biceps Squeeze test**

The biceps squeeze test described by Ruland et al. is analogous with the Thompson test has been used in the diagnosis of Achilles tendon rupture [8]. The test is performed as follows: The forearm is placed in a comfortable position in the patients lap in 60–80° flexion and slight pronation. The biceps muscle in the arm is squeezed firmly with both hands at the distal myotendinous junction and around the muscle belly (Fig. 16.6). This "squeeze" pulls the muscle into an anterior bow and results in forearm supination. As described by the authors, an absence of forearm supination with this maneuver indicates complete rupture of the biceps brachii tendon or muscle belly.

(f) **TILT sign**

This sign was described by Shim and Strauch as a sensitive (100%) test for diagnosis of partial tears of DBT [9]. The test is based on the "anatomical rotation of the radial tuberosity in full pronation to allow palpation from the dorsal side of the fore-

Fig. 16.6 The biceps squeeze test pulls the muscle into an anterior bow and results in forearm supination

arm." The test is performed as follows: The elbow is flexed to 90° and the forearm is rotated to full supination. The dorsal forearm is palpated at the area over the radial tuberosity. Next the forearm is rotated into full pronation and the tuberosity area is palpated in a similar way. Tenderness over the radial (or lateral) aspect of the tuberosity (TILT sign) in full pronation, but not in supination is suggestive of a partial DBT tear (Fig. 16.7).

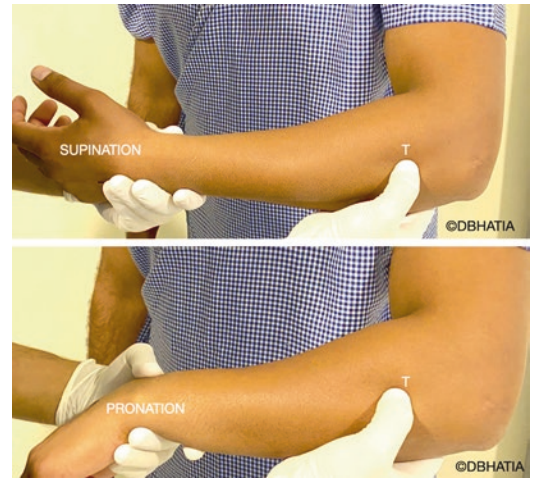

Fig. 16.7 The TILT sign is positive if tenderness can be felt over the radial aspect of the tuberosity (T) in full pronation, but not in supination

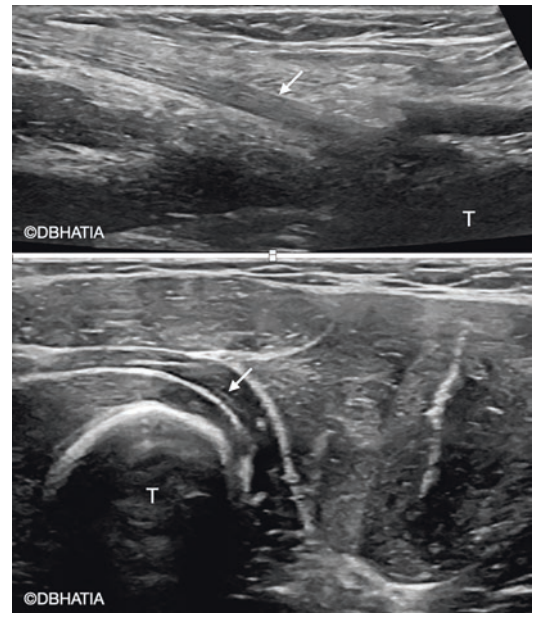

Fig. 16.8 Sonographic evaluation of the distal biceps tendon (arrows) is demonstrated using the probe placed on the volar (top image) and dorsal (bottom image) aspects of the arm and forearm. [T: bicipital tuberosity]

16.3.1 Sonography

In-clinic ultrasonography (USG) is an excellent method of assessing the DBT integrity and can be a useful adjunct to clinical examination (Fig. 16.8). USG is advantageous as it is inexpensive and permits dynamic evaluation and comparison with the contralateral elbow. The discontinuity of the tendon can be demonstrated and the retraction can be quantified in acute and chronic complete DBT tears. Partial tears and bursitis can be assessed and sonography-guided

injections can be used for diagnostic and therapeutic purposes. Sonography is also useful to assess tendon integrity in the postoperative period.

In summary, clinical evaluation of the distal biceps tendon (DBT) should involve assessment of the region spanning the lower arm and the upper forearm. Special tests for tendon integrity should be used in combination to evaluate the DBT and the bicipital aponeurosis. In-clinic sonography is an excellent tool to supplement the diagnosis of partial and complete tears.

Conflict of Interest The author certifies that he has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements) that might pose a conflict of interest in connection with the submitted article.

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