Long Head of the Biceps Tendinopathy

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20.1 Anatomy

The long head of the biceps (LHB) tendon originates from the superior glenoid labrum at the supraglenoid tubercle. Typically, its origin is posterior in up to 85% of shoulders (Nho et al. 2010). For approximately 35 mm, the tendon course is intra-articular until it reaches the bicipital groove, which lies between the greater and lesser tuberosities. Despite its intra-articular position, the tendon remains extrasynovial. The bicipital groove is hourglass in shape, with the widest portion at the superior aspect measuring from 9 to 12 mm wide and about 2.2 mm deep. The midportion of the groove narrows to a width of 6.2 mm and the depth slightly increases to 2.4 mm. The average length of the bicipital groove is 5 cm. Additional soft tissue restraints serve to stabilize the tendon within the bicipital groove, namely, the biceps sling, which receives contributions from the subscapularis, supraspinatus, coracohumeral ligament, and superior glenohumeral ligament. The transverse humeral ligament also contributes to the soft tissue envelope of the LHB tendon in the groove. As the tendon exits the bicipital groove, the pectoralis major tendon provides stability (Rudzki et al. 2015).

The function of the LHB tendon remains controversial, but some studies describe its role in shoulder stability in overhead throwing athletes (Longo et al. 2011). Some authors have also noted a 10% decrease in forearm supination strength and elbow flexion strength

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after spontaneous rupture of the biceps, possibly elucidating the tendon's role in those actions (Rudzki et al. 2015).

20.2 Pathology

The natural history of LHB pathology begins with either dysvascular degeneration (tendinosis) or inflammation (tendinitis), in which the tendon becomes inflamed and hyperemic as it undergoes repetitive mechanical insults. The synovial sheath that encases the tendon may also develop synovitis. As more intra-tendinous signal changes occur, the tendon is prone to partial tearing and degenerative changes (Fig. 20.1). The tendon becomes thick and fibrotic, which can lead to decreased or aberrant motion in the bicipital groove, finally resulting in spontaneous rupture of the LHB tendon (McDonald et al. 2013). Although isolated LHB tendinopathy is possible, it usually occurs concomitantly with other shoulder pathologies such as rotator cuff disease. Other entities that may be responsible for irritation of the LHB tendon include bicipital groove osteophytes and associated groove stenosis, systemic inflammatory disease, lesions of the soft tissues encompassing the biceps pulley, and superior labrum anterior to posterior (SLAP) tears. LHB tendon pathology may also be related to instability of the tendon as it traverses the bicipital groove. Instability can range from mild subluxation of the tendon to complete dislocation out of the bicipital groove (Fig. 20.2). Elser et al. (2011) found up to a 32% incidence of biceps pulley injury in a series of shoulder arthroscopies, and pulley lesions were commonly associated with SLAP tears and rotator cuff injuries.

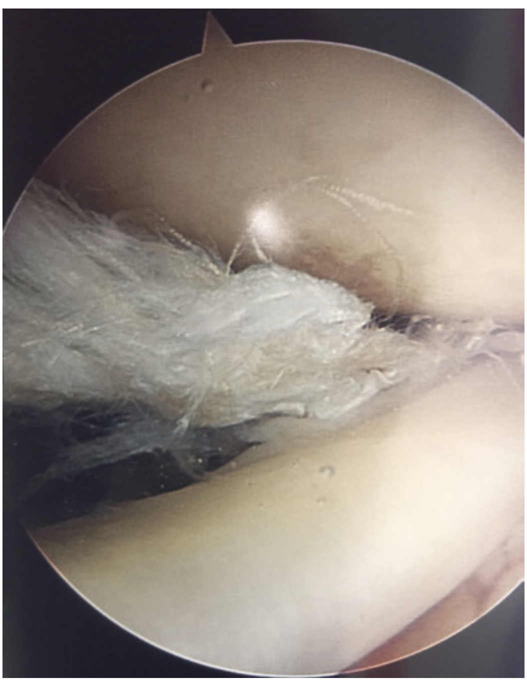

Fig. 20.1 Arthroscopic view of the biceps tendon with partial tearing and fraying

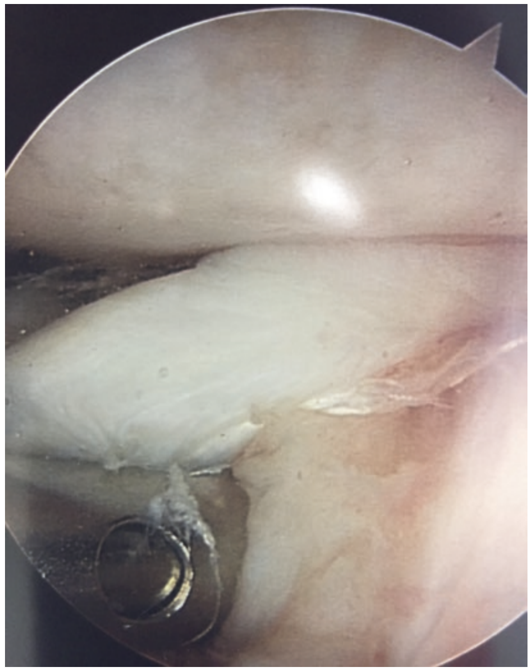

Fig. 20.2 Arthroscopic view of the biceps tendon subluxed out of the bicipital groove

20.3 History and Physical Exam

The typical description of LHB pathology is progressive anterior shoulder pain associated with chronic overuse syndromes. In younger patients with suspected LHB pathology, participation in overhead sports is common. A single traumatic event is also possible, during which the patient may hear an audible pop. Additional shoulder pathology can raise suspicion for LHB tendon instability. For instance, a tear of the subscapularis tendon may lead to LHB instability due to its intimate association as part of the biceps pulley.

One indication of LHB pathology is point tenderness to palpation of the tendon within the bicipital groove. The tendon can be palpated in the rotator interval, at the transverse humeral ligament, and beneath the attachment of the pectoralis major tendon insertion. We believe palpation to be the most diagnostic physical exam finding of biceps pathology. Physical exam maneuvers that elicit LHB tendon pain include Speed's test and Yergason's test. A positive Speed's test is indicated by pain with resisted forward flexion with the forearm extended and fully supinated. The Yergason test evokes pain with resisted forearm supination with the elbow flexed at 90 degrees and the arm adducted. These tests, however, may also be positive in SLAP tears, but in true SLAP lesions, there will be humeral head subluxation and a positive labral click, with the pain felt "deep," while the biceps will be less deep, more painful, and usually without a labral click. The "3-Pack" exam, coined by O'Brien, incorporates bicipital groove palpation, the throwing test, and active compression test. With high inter-rater reliability and sensitivity, the "3-Pack" exam can isolate biceps-labral complex lesions specific to three different zones: inside, junctional, and bicipital groove (Taylor et al. 2016). If the patient has sustained a spontaneous rupture of the biceps tendon, a "Popeye" sign may be evident in which an enlarged distal biceps mass is visualized (Rudzki et al. 2015) (Figs. 20.3 and 20.4).

Differential Diagnosis for Long Head of the Biceps Tendon Pathology:

- LHB tendinopathy/tenosynovitis
- LHB partial tear
- LHB rupture
- LHB instability (subluxation and/or dislocation)
- SLAP tear
- Acromioclavicular joint pathology
- Anterosuperior rotator cuff tear
- Subcoracoid impingement
- Subscapularis pathology

Fig. 20.3 Clinical photographs of a patient with a "Popeye" sign, which is a distal biceps mass indicative of biceps tendon rupture

Fig. 20.4 Clinical photographs of a patient with a "Popeye" sign, which is a distal biceps mass indicative of biceps tendon rupture

20.4 Diagnosis

Further workup of suspected LHB tendon lesions may include imaging and injections. A standard radiographic series of the shoulder will assist in identifying other potential causes of shoulder pain. Magnetic resonance imaging (MRI) is frequently utilized in the assessment of shoulder pathology. Not only can MRI assist in diagnosis of isolated LHB tendon injuries, but it can also aid in diagnosing concomitant shoulder pathology. MRI allows assessment of the tendon itself and its milieu, including its sheath, peritendinous fluid, and the bicipital groove. Further, magnetic resonance arthrography may be useful in isolated LHB tendon injuries. Ultrasound is another imaging modality of use, in particular, due to the ability for a dynamic exam. The tendon can be visualized during a subluxation event and assessed for complete rupture. If a skilled ultrasonographer is available, ultrasound can be more cost-effective. Corticosteroid injections into the biceps tendon sheath can prove to be both diagnostic and therapeutic (Nho et al. 2010).

20.5 Treatment

Non-operative management of LHB tendinopathy consists of rest, activity modifications, anti-inflammatory medications, and physical therapy. Corticosteroid injections, as mentioned above, can be administered in the subacromial space, glenohumeral joint, or directly into the tendon sheath. The glenohumeral injection may spread to the LHB tendon sheath based on their anatomic relationship (Nho et al. 2010). Hashiuchi et al. (2011) determined that LHB tendon sheath injections performed under ultrasound guidance were more accurate in their series of 30 biceps sheath injections evaluated with postinjection computed tomography. Care must be taken to inject corticosteroids into the bicipital groove and not the tendon substance, which may be detrimental to the tendon itself (Nho et al. 2010). Spontaneous complete ruptures of the LHB tendon are typically treated non-operatively with minimal consequence due to the "autotenodesis" phenomenon. Residual symptoms may include cosmetic concerns related to the "Popeye" deformity and a fatigue-related cramping of the biceps brachii muscle. The "autotenodesis" effect occurs due to the tendon's soft tissue restraints keeping it in the bicipital groove and the hourglass shape of the groove creating a bottleneck for the wide portion of the tendon as it retracts distally (Rudzki et al. 2015).

When non-operative treatment fails, the discussion of surgical management is initiated and may relate to associated shoulder pathology. Isolated LHB tendinopathy surgical indications include partial-thickness tearing or fraying greater than 25–50% of the tendon diameter and persistent subluxation or dislocation. Other relative indications for surgical management of the LHB are SLAP tears and intraoperative findings suggestive of biceps pathology at the time of surgery for other pathologies (Khazzam et al. 2012). Factors to consider in surgical decision-making include the patient's activity level, hand dominance, age, and functional expectations.

Current surgical management of the long head of the biceps tendon can be categorized as debridement, tenotomy, or tenodesis. Debridement is typically elected if less than 30% of the tendon diameter is involved (Khazzam et al. 2012). Arthroscopic tenotomy is performed utilizing the standard posterior viewing portal and working through the anterosuperior portal. Various instruments can be used to transect the tendon at its origin and the LHB tendon retracts into the bicipital groove. Some authors have described maintaining a wider portion of tendon to secure in the narrow portion of the groove or including a piece of labrum in the transection to prevent distal migration of the tendon through the bicipital groove (Rudzki et al. 2015) (Fig. 20.5). Goubier et al. (2014) described looping the free edge of biceps tendon about itself to provide substantial bicipital groove restraint. A neat tendon edge should be maintained to prevent subsequent mechanical symptoms.

Techniques for tenodesis include interference screw, suture anchor, unicortical button,

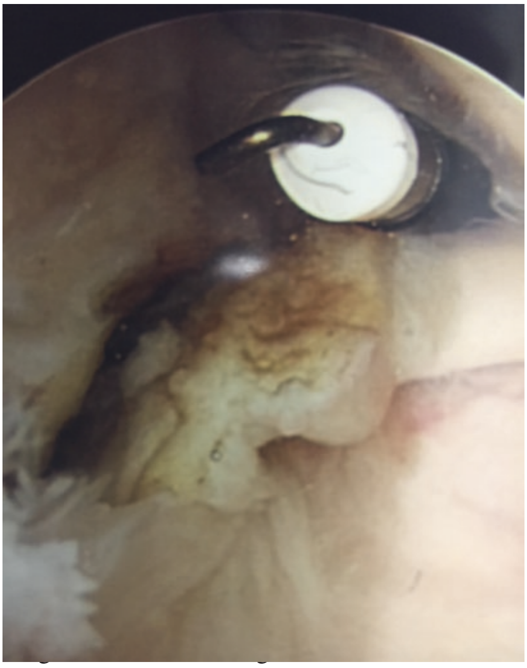

Fig. 20.5 Arthroscopic view of a biceps tenotomy, retaining a wide portion of the tendon to prevent retraction of the remaining tendon distally through the bicipital groove

tendon and then placing two suture anchors. One anchor is placed proximally, and the second anchor is placed 1–1.5 cm distal to the first. Chiang et al. (2016) compared suture anchor tenodesis with interference screw technique. Their technique for the Y-knot all-suture anchor fixation included bicortical drilling, was performed in a series of cadavers, and compared this fixation to interference screw tenodesis models with biomechanical testing. The all-suture anchor technique proved to have an equivalent ultimate failure load, but increased displacement with cyclic loading.

Button tenodesis can achieve either unicortical or bicortical fixation. Care is taken with bicortical drilling as the axillary and radial nerves are at risk. The transected LHB tendon is whipstitched and threaded through the button, which is passed through the drill hole. A tension-slide technique is used to secure the construct (Rudzki et al. 2015).

Soft tissue tenodesis is performed by suturing the LHB tendon to the overlying soft tissue roof of the bicipital groove. The percutaneous

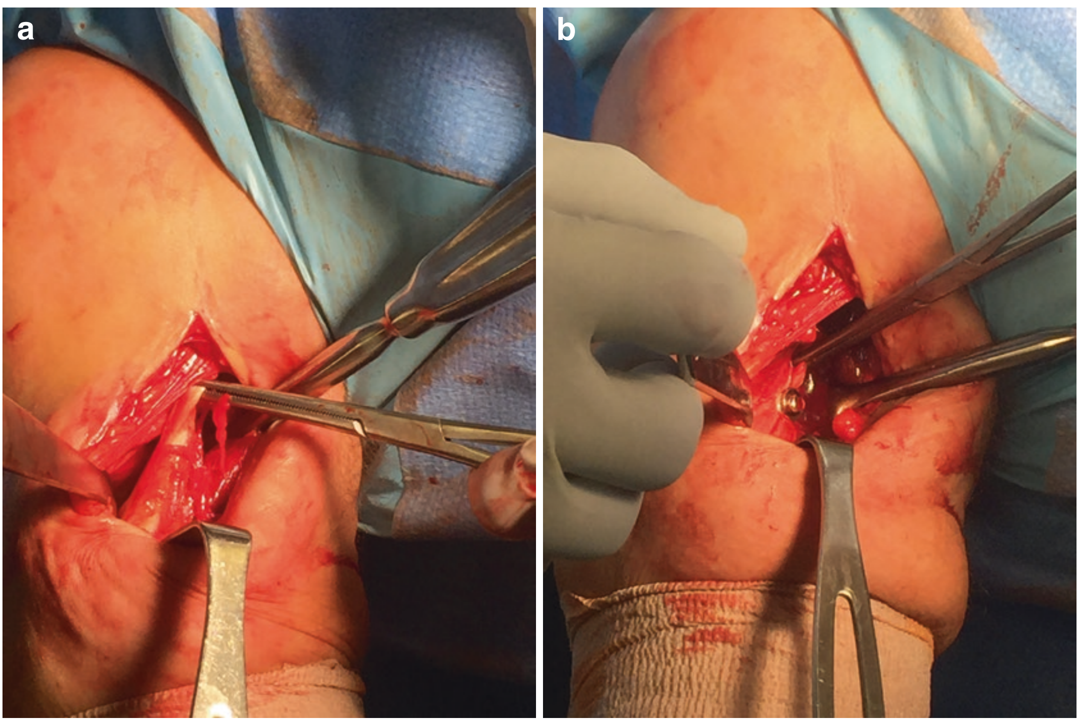

Fig. 20.6 Photographs of an open subpectoral biceps tenodesis. (**a**) Isolation of the biceps tendon. (**b**) Final construct after tenodesis with a screw and washer

intra-articular transtendon (PITT) technique described by Sekiya et al. (2003) uses a spinal needle to capture the biceps tendon via the lateral rotator interval. Sutures are shuttled through the soft tissue construct and the procedure is repeated 5–6 cm distally for dual fixation.

O'Brien has described a soft tissue tenodesis technique in which he transfers the long head to the short head to maintain the normal anatomy and course for the muscle with excellent results (Drakos et al. 2008).

Werner et al. (2014) compared arthroscopic suprapectoral tenodesis to open subpectoral tenodesis in patients with isolated superior labrum or LHB pathology. Both procedures resulted in equally excellent clinical and functional outcomes at 2 years of follow-up. Both techniques utilized interference screws for tenodesis fixation. Kolz et al. (2015) performed biomechanical studies on the LHB tendon in both the suprapectoral and subpectoral regions and found that the tendon had a higher tensile strength in the suprapectoral region. They also found that the suprapectoral region can resist higher failure loads. Based on this study, they concluded that tenodesis in the suprapectoral region may yield a stronger construct.

Postoperative care depends on the operative technique performed and any other associated pathology addressed at the time of surgery. Patients receiving tenotomy are typically placed in a sling for 1 week until pain subsides, with gradual return to activity. For tenodeses, patients are immobilized in a sling for approximately 4 weeks and begin active elbow flexion at 6–8 weeks postoperatively. This course allows for the tenodesis site to heal appropriately (Patel et al. 2016).

20.6 Discussion

In comparing LHB tenotomy with tenodesis, major differences include the formation of a "Popeye" deformity and fatigue-related cramps, both of which are more likely after tenotomy. In tenodesis, the length-tendon relationship is maintained, while tenotomized patients may exhibit a slight decrease in strength with forearm supination and elbow flexion (Patel et al. 2016). Friedman et al. (2015) evaluated patients younger than age 55 for 3 years after tenotomy or tenodesis. "Popeye" deformity and cramping were more common in the tenotomy group. However, functional and subjective outcome scores were similar after 3 years. Potential complications of LHB tenodesis may include persistent pain, tenodesis failure, and refractory tenosynovitis (Virk et al. 2016). In the case of tenodesis failure, symptoms usually remit over time, similar to if the patient had a spontaneous LHB rupture.

Many techniques have been described for the surgical treatment of long head of the biceps tendon pathology, with limited data on a clear-cut gold standard procedure. Equipped with knowledge of the risks and benefits of each technique, the patient and surgeon should arrive at an appropriate course of action based on patient expectations, functional status, cosmetic concerns, and demographics. Surgeon proficiency with each technique should also play a role in operative planning.

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