Chapter

Arthroscopic Tenotomy versus Open Tenodesis of the Long Head Biceps Brachii Tendon

Matilde Delvecchio, Gian Mario Micheloni, Andrea Giorgini and Giuseppe Porcellini

Abstract

The aim of the chapter is to compare the surgical treatment of tendinopathies of the long head of the biceps brachii, in particular arthroscopic tenotomy versus open tenodesis. Arthroscopic tenotomy of the long head of the biceps tendon is the preferred technique in cases where pain is to be relieved and in cases where the long head is subluxated with injury to the upper fibers of the subscapularis muscle. Subpectoral open tenodesis of the long head of the biceps tendon may be the preferable technique in selected cases of younger patients, athletes, or with high functional demand; in these cases, a good recovery of muscle strength, less muscle cramping, and less imperfection should be achieved.

Keywords: tenodesis, tenotomy, long head biceps brachii, arthroscopy, shoulder pain

1. Introduction

The pathology of the long head of the biceps brachii (LHB) tendon can cause shoulder pain, in particular anterior shoulder pain. Although it may also manifest as a primary isolated LHB tendinopathy, this condition is frequently linked to rotator cuff tendinopathy.

The LHB's functional role has been and continues to be poorly understood.

According to several experimental and clinical research, the LHB tendon may function as a glenoid labrum elevator, an anterior stabilizer, a posterior stabilizer, and a depressor of the humeral head [1–3].

Following tenotomy or tenodesis, these functions might disappear.

LHB tendon pathology can be classified into three different categories: LHB degeneration (peritendinous, inflammation, hypertrophy, partial or complete tear), LHB anchor disorders (SLAP lesions), and LH instability (subluxation or dislocation) [4].

Regarding the surgical management of LHB tendinopathy, there is still no universal agreement: some support tenotomy while others support tenodesis.

Tenotomy is a simple surgical technique that can be carried out using an arthroscopic procedure. A postoperative Popeye deformity in the upper arm that is accompanied by pain and/or cramping in the retracted muscle can be linked to this operation.

Technically more difficult and need a longer duration of recuperation is LHB tenodesis. The tenodesis of the biceps brachii is said to increase strength, however, this is not well supported in the literature.

2. Long head biceps brachii tendon

2.1 Anatomy of LHBT

The long head biceps tendon is a structure of the glenohumeral joint. It originates from the supraglenoid tubercle and glenoid superior labrum, with the proximal tendon moving laterally into the rotator cuff interval before being encircled by the biceps pulley and housed in the biceps groove. A common distal tendon attachment onto the radial tuberosity ligament is shared by the muscle when it leaves the biceps pulley and passes underneath the transverse humeral ligament to form the biceps brachii muscle belly [5].

2.2 Anatomical variations

Anatomical variations are very common. The most common observed anatomical variations included aberrant origins, supernumerary accessory heads and LHBT absence [6, 7]. The most common aberrant origin of the LHB at the shoulder is the presence of a bifurcate tendon origin and an anomalous LHBT origin from the supraspinatus [8]. In rare cases, there may be a trifurcated origin or four-headed biceps variant. In some shoulders, no anatomic structure distinct from the transverse humeral ligament can be recognized to support a role in the stability of the LHBT in the bicipital groove [9].

A positive correlation was found between observed anatomical variances of the LHBT origin and the presence of anterosuperior labral fraying, abnormal superior glenohumeral ligament [7], and LHBT absence and the presence of shoulder pain and instability [10].

2.3 Function of LHBT

The functional role of LHBT at the shoulder and its contribution to glenohumeral joint biomechanics and stability is not clearly understood [11]. Some researchers think that LHBT has a role in humeral head depression and stabilization, whereas some others suggest that the tendon plays no role [12]. A considerable superior migration of the head of the humerus was observed after tenotomy in a large study of 291 patients undergoing LHB tenotomy for irreparable full-thickness rips of the rotator cuff, by Walch and Edwards [13].

2.4 Lesions

LHB tendon pathology can be classified into three different categories: LHB degeneration (peritendinous, inflammation, hypertrophy, partial or complete tear), LHB anchor disorders (SLAP lesions), and LH instability (subluxation or dislocation) [4, 14].

These are common cause of anterior shoulder pain with associated dysfunction of forward flexion and disorders in patients with rotator cuff tears [15].

2.5 Clinical examination

Clinical examination can be conducted with objective examination, instrumental investigations, such as ultrasonography and MRI.

When conducting a clinical study, it is important to investigate symptoms like pain, evaluate stability, and check for any structural abnormalities.

One of the most important diagnostic criteria has been a precise patient history that includes a description of the mechanism of injury.

It is possible to look for Popeye's sign, a bulge on the medial side of the upper arm that becomes more noticeable with vigorous or resistant elbow flexion and has a different aspect from the opposite arm was described as Popeye sign.

According to research, the LHB is innervated by a network of sensory sympathetic fibers, particularly near its beginning, which may contribute to the pathogenesis of shoulder discomfort [16].

LHB pathologic physical examination is difficult, because at the time of testing, cartilage disease and typically concurrent soft tissue pathology (rotator cuff, pulleys, labrum) interfere. Additionally, there is no recognized pain pattern unique to the biceps tendon.

Clinical objectivity is studied by some clinical tests, such as biceps groove palpation, Speed's, Yergason's, and Uppercut test.

Speed's test: the patient is asked to flex the arm against resistance while keeping the elbow extended and the forearm supinated; the test is positive if there is pain at the biceps groove; Holtby reports a sensitivity of 32% and a specificity of 75% [17].

Yergason's test: the patient flexes the elbow to 90° while keeping the arm adducted to the chest, then asked to supinate the forearm against resistance; in case of pain at the bicipital groove, the test is positive; Holtby reports a sensitivity of 43% and specificity of 79% [17, 18].

Uppercut test: the patient is posed with the shoulder in neutral rotation and the elbow flexed to 90°, the forearm is supinated and the patient clenches his fingers into a fist, then the examiner grasps the patient's fist and invites the patient to make a movement against resistance similar to an uppercut; the test is positive in case of anterior pain [17, 19].

Arthroscopy is by far the most accurate diagnostic investigation of proximal biceps pathology.

The Constant score is still utilized in most studies as the primary outcome score after rotator cuff surgery since biceps therapy is still considered to be an important component of treatment and the long biceps tendon is located proximal to the supraspinatus tendon, which is typically affected [20].

2.6 Treatment

In most cases, conservative management is preferred, which includes rest, nonsteroidal anti-inflammatory medicines, physical therapy, and steroid injections.

Surgery is frequently recommended if symptoms that have been treated conservatively for more than 3 months continue [21].

Surgical treatment of LHB tendon is also recommended in cases of isolated symptomatic pathology, such as SLAP II (or higher stages of Snyder classification), partial tears, hour-glass deformity, or in concomitant rotator cuff lesions with biceps instability and tendinitis and finally at the time of shoulder arthroplasty [22].

Both open and arthroscopic procedures are part of the surgical strategy. An increasing number of surgeons now advocate arthroscopic management [23].

2.6.1 Tenotomy

Depending on the surgeon's preference, shoulder arthroscopy is performed while the patient is in the lateral decubitus or beach chair position.

Diagnostic arthroscopy is performed with a standard posterior portal and a standard anterior interval portal is used to evaluate the biceps tendon, using an arthroscopic probe. The identification of ripping, instability, degeneration, or inflammation of the long head of the biceps tendon or superior labrum attachment is used to confirm the study's final eligibility. For patients who had a biceps tenotomy, the surgeon used an arthroscopic biter, an electrothermal device, or a knife to separate the long head of the biceps tendon from its proximal anchor to the superior labrum [24].

Tenotomy is a surgical procedure that might involve either releasing the LHB with a portion of superior labrum or just cutting the tendon at the very base of the origin. The final alternative, known as the "fish tail" or "T-wedge" approach, catches beneath the transverse humeral ligament and is occasionally recognized as a soft tissue tenodesis [22]. Tenotomy is much easier to perform and requires less complicated rehabilitation, and it allows an earlier return to daily activities [25].

2.6.2 Tenodesis

Tenodesis is performed by arthroscopic, open, or mini-open surgery. It can also be separated into fixation methods for soft tissue, osseous, and intraosseous structures, with or without the use of implants [22]. The approach used for LHB tenodesis may occasionally be determined by concurrent disease, such as rotator cuff or labral pathology, but the treating surgeon ultimately has the final say.

Open vs. arthroscopic approaches, fixation methods, and tenodesis locations—generally referred to as suprapectoral or subpectoral—are all technical issues. The level may be distal subpectoral, suprapectoral, intra-articular, or proximal intra-articular. It is crucial to preserve the link between muscle length and tension and avoid overtightening the final fixation [22].

Open LHB tenodesis is usually performed subpectorally. Initially, a biceps tenotomy is performed at the biceps-labral junction with an arthroscopic scissor or basket; then an axillary incision of about 3 cm centered on the lower edge of the pectoralis major is made; the arm is intrarotolated, and the lower edge of the pectoralis major is retracted bluntly upward to allow probing of the biceps groove and biceps tendon. Following the release of the tendon, the proximal tendon is removed and a braided suture 15 mm proximal to the myotendinous junction is performed and a bioabsorbable interference screw connected to the pectoralis major tendon is inserted until the screw rests against the anterior cortical surface of the humerus. Finally, the ends of the suture are tied and cut to secure it [26].

Tenodesis can also be performed *via* suprapectoral arthroscopy. The biceps tendon is marked with a suture, then a biceps tenotomy is performed at the level of the biceps-labral junction. A subacromial bursectomy is performed to visualize the ligaments covering the tendon in the groove. The biceps tendon is electrocauterized, and the marked portion of the tendon is then extracted from the anterolateral portal. The proximal 15 mm of the tendon is removed and replaced with a braided locking suture. A bone tunnel is then performed on a guide wire inserted in the bicipital groove and a bioabsorbable tenodesis is performed to fix the tendon to the proximal humerus [26].

Subacromial decompression is performed with a cutting block technique if required, and the rotator cuff is repaired if necessary, *via* standard antero- and posterolateral accessory portals based on tear configuration [24].

The success of the therapy as a whole, as determined by patient-reported outcomes, should not be primarily attributed to the tenodesis procedure itself, as LHB tenodesis is frequently carried out in conjunction with other procedures, it should be noted [26].

3. Arthroscopic tenotomy versus open tenodesis of the long head biceps brachii tendon

Although both tenotomy and tenodesis can benefit LHBT lesions, no consensus has been formed about which procedure is better. In numerous research [23, 27–29] the effectiveness of biceps tenotomy and various tenodesis procedures in the treatment of LHB lesions has been compared; nevertheless, the best surgical plan is still up for debate. Although it does not improve shoulder strength, biceps tenotomy or tenodesis reduces pain and improves the functional range of motion (**Figures 1**–**3**) [28].

The simple and well-tolerated arthroscopic biceps tenotomy method reduces operating time, streamlines postoperative rehabilitation, and enables patients to resume normal activities as soon as feasible [30].

However, there are certain disadvantages to the treatment, such as the potential deformity of the arm's anatomic profile (Popeye sign), the possibility of cramping and fatigue pain, and biomechanical modifications to the humeral head's response to LHBT capacity [10].

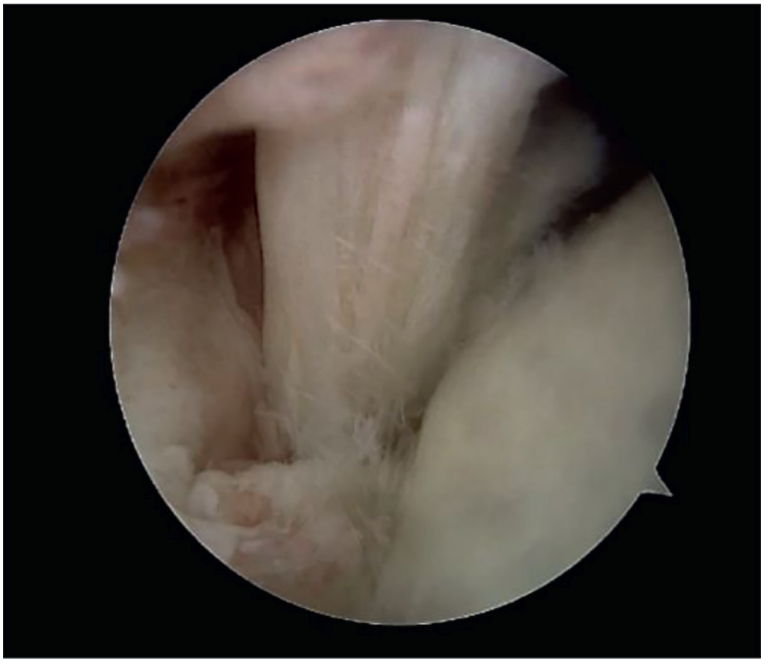

Figure 1.
Lesion of LHBT.

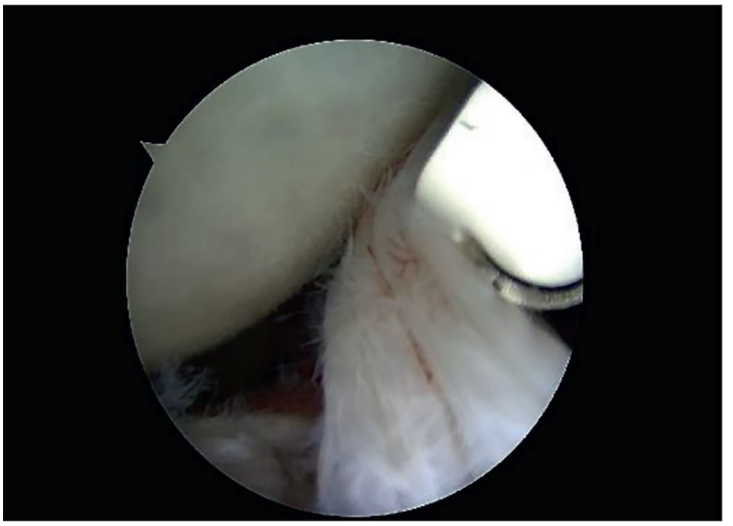

Figure 2.
Arthroscopic stability test.

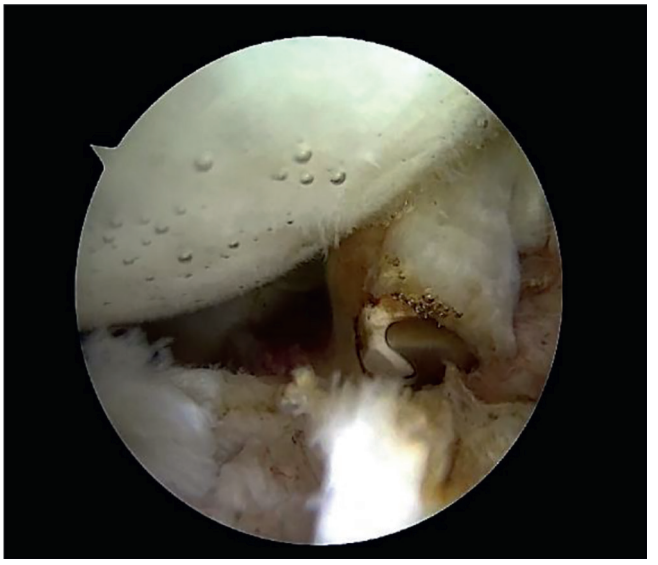

Figure 3.
Arthroscopic tenotomy of LHBT.

Tenotomy and tenodesis have different rates of esthetic deformity (Popeye sign) at 43 and 8%, respectively [21].

However, while LHB tenotomy was more frequently linked to a Popeye deformity, Gurnani et al. did discover a difference in the upper arm's esthetic look and cramping pain: following every LHB tendon tenotomy and tenodesis, the Popeye deformity was not present [20]. These findings may be explained by auto-tenodesis of the LHB, following tenotomy in the bicipital groove and failure of the tenodesis [31]. Inflammation in the bicipital groove or rotator interval may stimulate the

biceps tendon to undergo autotenodesis and the time of immobilization after rotator cuff surgery may also affect the autotenodesis, resulting in less Popeye abnormalities [14].

Tenotomy is surgically simpler to do than tenodesis since no fixation is necessary, but it is more likely to cause muscle cramping, the Popeye sign, decreased elbow flexion, and decreased supination power [14, 25, 32, 33]. One of the main reason for preferred tenotomy is simplicity [31]. Tenotomy requires less rehabilitation and immobilization, yields better functional outcomes, and enables an earlier resumption of daily activities [27].

Tenotomy is a very straightforward and repeatable operation that greatly reduces shoulder discomfort without the need for postoperative rehabilitation [14]. Compared to tenodesis, arthroscopic tenotomy achieves comparable levels of postoperative discomfort and patient satisfaction [12].

Pain at the bicipital groove may be greater for those undergoing a subpectoral biceps tenodesis [34], however, biceps tenotomy is associated with earlier pain relief after surgical treatment of LHB tendinopathy [35].

Tenotomy is therefore often recommended for older, inactive individuals who are less concerned with the esthetic outcome, and who are not engaged in physically demanding or heavy labor tasks [36].

Due to the drawbacks of tenotomy, some surgeons support tenodesis, which, despite longer recovery periods and a more technically challenging procedure, results in a better ability to return to activity, a lower incidence of cosmetic deformities and cramping pain, and a closer approximation of normal anatomy [10].

Treatment algorithms generally recommend tenodesis for younger patients or those with cosmetic concerns.

Both procedures produce great therapeutic results, however, younger people, athletes, and patients who are concerned about their appearance cosmetically should consider tenodesis. By maintaining the LHBT length-tension relationship, it enables a better recovery to physical activity while being a longer and more expensive treatment that also necessitates longer rehabilitation [37].

The scar cosmesis may also play a role in patients' assent since biceps tenodesis frequently replaces tenotomy due to its enhanced cosmetic appearance [36].

Tenodesis seem to have superior forearm supination strength and Constant scores and to have a less rate of "Popeye" deformity than tenotomy [38].

Tenodesis, despite requiring more technical skill and a longer period of postoperative rehabilitation, it offers a quicker return to physical activity, less cosmetic abnormalities, and a better alignment with normal anatomy [37].

Concerns have been raised that using the open technique could increase the risk of wound complications and nerve damage [39].

While patient opinion of open tenodesis compared to arthroscopic tenodesis has not been examined, it can be a significant factor in selecting surgical treatment together with surgeon experience and choice.

In conclusion, the surgical prephgfference and technical experience of the surgeons should be taken into consideration when deciding whether to execute the tenodesis using an open or arthroscopic method.

Conflict of interest

The authors declare no conflict of interest.

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