Arthroscopic Tenodesis of the Long Head of the Biceps

Michael E. Birns, MD; Jean-Jacques Mbabuike, MD; David A. Porter, MD; Gregory J. Galano, MD

Abstract: The long head of the biceps (LHB) is commonly implicated in shoulder pathology due to its anatomic course and intimacy with the rotator cuff and superior labrum of the glenoid. Treatment of tendinosis of the LHB may be required secondary to partial thickness tears, instability/subluxation, associated rotator cuff tears, or SLAP (superior labrum, anterior to posterior) lesions. Treatment options include open or arthroscopic techniques for tenodesis vs tenotomy. Controversy exists in the orthopedic literature regarding the preferred procedure. The all-arthroscopic biceps tenodesis technique is a viable and reproducible option for treatment. This article provides a review of the all-arthroscopic biceps tenodesis technique using proximal interference screw fixation and its subsequent postoperative regimen. All-arthroscopic biceps tenodesis maintains elbow flexion and supination power, minimizes cosmetic deformities, and leads to less fatigue soreness after active flexion. Thus, arthroscopic biceps tenodesis should be offered and encouraged as a treatment option for younger, active patients. [Orthopedics. 2014; 37(11):743-747.]

The long head of the biceps (LHB) is commonly implicated in shoulder pathology due to its anatomic course and intimacy with the rotator cuff and superior labrum of the glenoid. Despite the breadth of literature regarding pathology of the LHB, controversy exists regarding the function of the LHB and the management of LHB disorders. There is little debate over the function of the biceps at the elbow joint, where it serves as both a flexor and a supinator of the forearm. At the glenohumeral joint, however, the function of the biceps has been questioned. While some propose a vestigial role of the long head, others believe it functions as a critical anterior and posterior stabilizer1-5 in addition to acting as a depressor of the humeral head.4,6 Electromyographic studies have confirmed the role of the LHB as a flexor and stabilizer at the glenohumeral joint.7 Despite these studies, Levy et al8 concluded that the LHB contributes significantly to active tension at the elbow or forearm.

Biceps pathology is a common cause of anterior shoulder pain and can result in marked disability of the glenohumeral joint.9 Disorders of the long head encompass inflammatory tendonitis, degenerative tendinosis, instability, and traumatic rupture. Isolated biceps tendonitis is rare. Most of the pathology occurs in conjunction with rotator cuff pathology. Neviaser et al10 found that inflammatory changes in the LHB were often (70%) associated with rotator cuff tendinopathy. Murthi et al9 further described concomitant rotator cuff tears in 90% of patients with tendonitis. Nonetheless, the anatomy of the biceps tendon within the glenohumeral joint predisposes it to tendinopathy as a result of degenerative wear. The progression from tenosynovitis to tendinosis and partial rupture usually begins as a result of excessive friction within the bicipital groove or secondary inflammatory changes associated with rotator cuff pathology. Spontaneous complete long head rupture is uncommon and often results from an acute traumatic rupture secondary to eccentric loading. Partial rupture of the long head, however, is more often associated with concomitant degenerative tendinopathy. Such tendinosis may be due to the aforemen-
mented repetitive friction in the bicipital groove or impinging forces at the subacromial space causing shearing of the bicipital tendon during active and passive range of motion.\(^1\) If rupture does occur, a resultant cosmetic “Popeye” deformity is often seen.

Overall, while there is much debate regarding surgical intervention and how to treat patients with biceps tendinopathy, the trend toward arthroscopic management has become more accepted. In this article, the authors describe a technique for arthroscopic tenodesis and review the literature on this topic.

**ANATOMY**

The biceps is composed of both long and short heads. The short head tendon originates at the coracoid process and is rarely involved in biceps pathology. The tendon of the long head originates proximally from the superior labrum at the supraglenoid ridge. The tendinous portion of the LHB courses intra-articularly over the humeral head and through the bicipital groove before joining the musculotendinous junction at the level of the surgical neck of the humerus. During its course through the groove, numerous stabilizers have been identified via cadaveric analysis. The subscapularis tendon, supraspinatus tendon, and glenohumeral and coracohumeral ligaments all play a role in stabilizing the tendinous portion of the LHB. Thus, while the LHB has its own pain sensory fibers and may be responsible for anterior shoulder pain, pathology of the rotator cuff or labrum may also affect the LHB due to its intricate anatomic relationship.

**INDICATIONS**

Management of biceps pathology is generally conservative initially, involving anti-inflammatory drugs, activity modification, and physical therapy. Steroid injections, either intra-articularly or directly into the bicipital tendon sheath, are also used to decrease inflammation or associated glenohumeral pain. Likewise, injections into the subacromial space have been used for patients with symptoms secondary to impingement. Conservative management is limited due to the mechanical etiology of most pathology. Controversy remains regarding whether tenodesis or tenotomy is the ideal surgical treatment. Historically, in terms of tenodesis, open tenodesis has been the preferred technique.\(^12\) Studies\(^11,12\) comparing the results for patients undergoing tenotomy with those for patients undergoing tenodesis found only minimal functional advantage for tenodesis and the most significant difference to be the cosmetic deformity after tenotomizing the LHB.

Although controversy exists regarding surgical management of LHB pathology, indications for surgical management are absolute and include biceps tendon tear greater than 25%, refractory biceps tendonitis (6 months of conservative measures and injections), Type IV SLAP tears (superior labrum, anterior to posterior) tears involving the biceps tendon, failed SLAP repairs, SLAP tears in patients older than 45 years, biceps instability/dislocation into the glenohumeral joint, and concomitant rotator cuff pathology, particularly subscapularis tears.\(^11\) The senior author (G.J.G.) generally prefers tenodesis to tenotomy for active patients younger than 60 years with appropriate biceps pathology. Activity level and cosmetic outcome are of greater concern when selecting patients for tenodesis over tenotomy. The only contraindications for this procedure are patients with low demand, obese patients, elderly patients, or patients who have a chronic rupture of the LHB with retraction from its origin.

It is generally agreed that the biceps tendon may be a generator of pain, even with other known shoulder pathology. The cosmetic deformity known as the Popeye sign can be just as concerning to patients and has a relatively high rate of occurrence. In a systematic review by Slenker et al\(^13\) involving 699 patients who underwent tenotomy, the frequency of developing the Popeye sign was 42%, compared with 8% for 433 patients who underwent tenodesis. Distal arm cramping and fatigue,\(^14\) another common complaint after tenotomy, is the final reason the senior author (G.J.G.) typically advocates for tenodesis of the biceps in patients with appropriate indications.

Tenodesis not only is recommended to prevent cosmetic deformity, but also results in less fatigue soreness after active flexion. Thus, it is recommended for younger, active patients who have high physical demands. In older, sedentary patients, for whom cosmesis is less of a concern and physical demand is much less, tenotomy may be a more appropriate surgical intervention. Khazzam et al\(^15\) recently described a treatment algorithm when determining how to approach patients with biceps pathology. They recommend surgical intervention only after at least 12 weeks of conservative management has failed, unless there is a biceps dislocation. A patient’s age, activity level, and functional demands should determine surgical management. Concomitant shoulder pathology, which is significant, should also influence surgical management.

**TECHNIQUE**

Diagnostic arthroscopy is performed through a standard posterior portal (Figure 1). Attention is focused on the biceps anchor to assess for a SLAP tear and on the biceps tendon for signs of tendonitis or partial tear (Figure 2). An anterior work portal is established just superior to the subscapularis tendon in the medial portion of the rotator interval.

Once it has been determined that a biceps tenodesis will be performed based on pathology, a suture shuttling device is penetrated through the biceps tendon approximately 1 cm lateral to its labral insertion (30° straight SutureLasso; Arthrex Inc, Naples, Florida).
The biceps tendon is capped with a forktip and advanced into the predrilled hole.

The spinal needle is reinserted through the cannula and the biceps tendon proximal to the anchor is transected and removed by pulling the tagging stitch.

Postoperative Protocol

The biceps is retracted out of the groove. Electrocautery is used to clear the bony bed of the groove (Figure 5).

The spade-tipped drill is introduced through the cannula and used to create an 8.5×20-mm socket (Biceps Tenodesis SwiveLock; Arthrex Inc). The shaver is used to remove bony debris. The probe is removed and tension is applied to the tagging suture at the proximal end of the tendon to allow the biceps to reenter the groove and establish physiological tension.

The anchor is then introduced through the cannula and the forktip is used to capture and advance the biceps tendon into the socket (Figure 6; 8×19.5-mm Biocomposite Biceps Tenodesis SwiveLock; Arthrex Inc). The anchor can be lightly impacted until the tip of the screw is at the level of the bone. The screw is then advanced until the head is slightly proud to the bone to allow cortical interference fixation (Figure 7). The suture prethreaded in the anchor is pulled to test fixation; if it is adequate, the suture is unloaded (Figure 8). Residual biceps tendon proximal to the anchor is transected and removed by pulling the tagging stitch.

Postoperative Protocol

Traditionally, for a purely isolated biceps tenodesis, maintaining the operative arm in a sling is recommended for 4 weeks, with progression from early passive to full passive range of motion by 6 weeks. Formal physical therapy is generally begun 7 to 10 days later. Physical therapy usually begins on the 7th or 10th day with gentle active-assisted range of motion and progresses to active-assisted exercises against gravity, followed by active exercises in the first month. The patients are encouraged to use the arm for daily activities as tolerated.
after surgery. Elbow range of motion and grip strengthening are encouraged, even in the immediate postoperative period. Restriction of active elbow flexion and supination exercises until 6 weeks postoperatively is recommended to protect the tenodesis repair. Additionally, similar to the postoperative protocol for a varied technique of an all-arthroscopic biceps tenodesis described by Guelich and Lintner, passive external rotation is limited to below 45°. Unrestricted range of motion and strengthening exercises begin at 6 weeks. Sport-specific training begins approximately 3 months postoperatively, with a return to sport and full activity at 4 to 6 months. It is not uncommon for biceps pathology to be associated with other shoulder conditions. If another major concomitant procedure is performed (ie, rotator cuff repair), it will dictate the postoperative rehabilitation protocol.

**Discussion**

Advances in surgical techniques have allowed for arthroscopic management of LHB pathology. Arthroscopic tenotomy was initially performed for patients with concomitant rotator cuff pathology. Walch et al found that for patients with rotator cuff pathology, additional biceps tenotomy provided more relief than leaving the LHB intact. More recently, however, arthroscopic tenodesis has become a minimally invasive treatment option for those wanting to maintain some level of function while avoiding the cosmetic deformity associated with tenotomy. Boileau et al described the tenotomized biceps tendon being brought into a humeral socket and fixed to the top of the bicipital groove using a bioabsorbable interference screw. Discussion continues regarding the ideal location for the tenodesis. Despite the lack of clinical outcome studies about ideal location, one retrospective case-control study found that tenodesis at the more distal half of the bicipital groove led to significantly less postoperative pain than tenodesis at the proximal site. Although that study had limitations, it is the only one to the authors' knowledge currently addressing the controversy regarding the site for tenodesis.

The all-arthroscopic biceps tenodesis technique has been shown to be a viable alternative to other widely used techniques, including open supraspinatus or subpectoral approaches. Despite the controversy over tenodesis vs tenotomy, biceps tenodesis has been shown to better maintain the length-tension relation, prevent muscle atrophy, maintain elbow flexion and supination power, minimize cosmetic deformities, and avoid cramping pain. Compared with open approaches, an all-arthroscopic approach to biceps tenodesis uses only standard arthroscopic portals, requires less assistance, and may lead to less risk of humeral fracture and neurovascular damage. The senior author (G.J.G.) recognizes the advantage of this arthroscopic technique over others because of the subpectoral placement of the tenodesis. Theoretically, placement here, as opposed to the top of the bicipital groove, could decrease the risk of postoperative pain. In addition, this technique uses the forktip interference screw. The senior author (G.J.G.) believes this makes handling the tendon insertion point easier and decreases surgical time, which can be critical in the shoulder, where swelling can be an important factor.

Common complications of arthroscopic tenodesis are similar to those for all surgical techniques for biceps tendinopathy. Possible outcomes include, but are not limited to, failure of the tenodesis, infection, persistent pain, and hematoma/seroma. Despite the favorable outcomes of subpectoral biceps tenodesis, humeral fracture and neurovascular injury, although uncommon, have been documented. Humerus fractures are caused by stress risers that come into play when drilling a hole in the diaphysis of the humerus. The recommended humeral width and depth for screw placement only differ by several millimeters. This complication was thought to be insignificant, but several cases have been reported in the literature. Anatomically, the musculocutaneous nerve, radial nerve, and deep brachial artery course have been associated with an increased risk of injury due to their close proximity when using the subpectoral approach. These neurovascular structures are normally only approximately 1 cm from the medial retractors; with inadequate rotation of the upper extremity, an area of possible injury can result.

The technique of all-arthroscopic biceps tenodesis is simple and reproducible. The biceps tendon can be safely tenodesed to the bicipital groove if the aforementioned technique is followed. The senior author (G.J.G.) has had favorable clinical results with this all-arthroscopic technique and has not reported known failures of fixation or postoperative bicipital pain. An all-arthroscopic technique for biceps tenodesis is relatively new. Consequently, both short-term and long-term outcome studies are lacking. The senior author (G.J.G.) is currently collecting long-term data on patients who underwent biceps tenodesis using this technique. Studies are needed to determine the functional outcomes and residual pain scores after various tenodesis techniques. Focus on location of the tenodesis in relation to the tendon using an all-arthroscopic technique would allow surgeons to further improve the described technique. This minimally invasive procedure is a good alternative for the treatment of biceps pathology. As surgeons gain experience with this technique, it could yield results similar to or better than those with conventional methods.

**Conclusion**

The authors have described, and advocated for, a minimally invasive approach to biceps tenodesis using an interference screw. Despite...
continued controversy regarding surgical management of biceps pathology, it is clear a patient population exists that benefits from tenodesis. The functional and cosmetic advantages have been significant in patients treated with this technique. Thus, arthroscopic biceps tenodesis should be offered and encouraged as a treatment option for younger, active patients.

REFERENCES


