J Shoulder Elbow Surg (2023) 32, 1801–1811

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

The long head of the biceps tendon: a valuable tool in shoulder surgery

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Anatomy and function: The long head of the biceps tendon (LHBT) has different properties and characteristics that render it a valuable tool in the hands of shoulder surgeons. Its accessibility, biomechanical strength, regenerative capabilities, and biocompatibility allow it to be a valuable autologous graft for repairing and augmenting ligamentous and muscular structures in the glenohumeral joint.
Shoulder surgery applications: Numerous applications of the LHBT have been described in the shoulder surgery literature, including augmentation of posterior-superior rotator cuff repair, augmentation of subscapularis peel repair, dynamic anterior stabilization, anterior capsule reconstruction, post-stroke stabilization, and superior capsular reconstruction. Some of these applications have been described meticulously in technical notes and case reports, whereas others may require additional research to confirm clinical benefit and efficacy.
Conclusion: This review examines the role of the LHBT as a source of local autograft, with biological and biomechanical properties, in aiding outcomes of complex primary and revision shoulder surgery procedures.
Level of evidence: Narrative Review

Keywords: Tenodesis; rotator cuff; superior capsule; anterior stabilization; subscapularis; biologic augmentation; autograft

The anatomic characteristics of the long head of the biceps tendon (LHBT) are well defined in contrast to its functional role, which remains poorly understood.[86] The location of the LHBT, as well as its course over the humeral head, places it at high risk of abrasion, impingement, and injury.[74,86] In addition, its high association with rotator cuff pathology entails concomitant injury when the latter structure is torn or damaged.[1,7] This can cause the LHBT to act as a pain generator and result in significant shoulder disability and dysfunction.[31,68] The role of the LHBT as a pain generator has led to increased utilization of intraoperative tenotomy or tenodesis at both index surgery and revision surgery.[1,4]

Although many surgeons believe in discarding the LHBT during shoulder surgery, we review the value of retaining the tendon during the surgical treatment of shoulder pathologies.[40,85] Different properties in the LHBT allow it to act as a beneficial tool in shoulder surgery. The LHBT is a locally available structure in the patient's glenohumeral joint and is easily accessible during surgical procedures.[40,85] It is a viable source of live tenocytes and possesses biomechanical strength that can act to support compromised tendons and ligaments.[39,81] Moreover, the LHBT has been shown to mimic the physiologic demands

Institutional review board approval was not required for this review article.

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https://doi.org/10.1016/j.jse.2023.04.009

of adjacent structures in the shoulder such as the rotator cuff.[40,70,85] Given all these factors, the LHBT should be considered a reliable and accessible autograft option to augment or reconstruct diseased structures in the shoulder.[40,85] The purpose of this review was to evaluate of the role of the LHBT as a ligamentous or tendinous augmentation in the setting of complex primary and revision shoulder surgery.

Anatomy and function

The origin of the LHBT lies in continuity with the glenoid labrum at the supraglenoid tubercle of the scapula (Fig. 1).[21,83] It inserts medially to the glenoid articular rim, allowing the formation of a subsynovial recess.[83] The LHBT courses through the bicipital groove with a curvature of around 30°-40° (Fig. 1).[37] During this course, the tendon is stabilized by the anatomic morphology of the bicipital groove, which has a depth of around 4 mm, and an opening angle with the medial wall of up to 56° (Fig. 1).[20,37] Additional stability is provided by the medial sling, formed by the superior glenohumeral ligament and the coracohumeral ligament.[9,50] The posterior sling, consisting of the anterior fibers of the supraspinatus and infraspinatus tendons and the posterior portion of the coracohumeral ligament, prevents posterior subluxation of the tendon during external rotation and abduction.[37,51]

The proximal part of the LHBT is vascularized by the ascending vessels of the anterior humeral circumflex artery.[8] The distal part of the LHBT, on the other hand, is vascularized through branches of the brachial and deep brachial arteries.[8] Sensory and sympathetic innervation is more prominent in the proximal part of the LHBT near its insertion when compared with its distal portion near the muscle-tendon junction.[3]

The LHBT has an average tendon length of 9 cm, with 3-4 cm residing intra-articularly.[2] It generally has a diameter of around 5-6 mm but can be larger when pathologic.[2] Different anatomic variations of the LHBT exist, and these have implications on its utility and therapeutic potential.[24] Selecting the ideal site for biceps tenodesis may be predicated on the length of the graft required for a given augmentation.

Beyond structural benefits, the LHBT is a source of live autologous cells. This makes the tendon an attractive source for the augmentation of regenerative approaches and techniques in the glenohumeral joint.[75] Tendon-derived stem cells (TDSCs) present in the LHBT have been identified and explored as a viable source of multipotent stem cells.[75] As a matter of fact, it has been shown that the LHBT remains an appropriate source of TDSCs with high regenerative potential, regardless of inflammation status.[75]

Studies assessing the function of the LHBT have yielded controversial results.[44] There is some agreement on the role played by the LHBT in stabilizing the joint when the upper

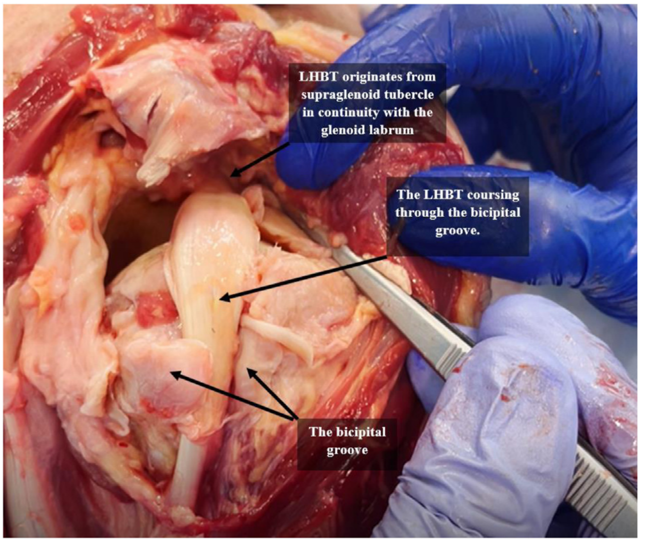

Figure 1 Course of long head of biceps tendon *(LHBT)* demonstrated in cadaveric shoulder.

extremity is in abduction and external rotation.[43,87] In addition, the LHBT can act as a humeral head depressor and can prevent anterior translation of the shoulder.[28,45,59] Nevertheless, the functional value of the LHBT for most shoulder functions remains debatable.

Rotator cuff augmentation

Augmentation of superior cuff repair

Rotator cuff pathology affects approximately 2 million persons in the United States each year.[71] Despite numerous developments in surgical approaches and techniques, retear rates of massive rotator cuff tears remain high, with some reported incidence rates reaching 94% after surgery.[32] Augmentation of rotator cuff repair using different methods has been proposed with an emphasis on the need for not only mechanical stabilization but also biological support.[17,62,69] Extracellular matrix–based acellular grafts have been proposed as an option that provides structural support and tissue growth, and autologous biological solutions have been suggested as an option for cell-mediated regeneration.[15,57,73] These approaches possess limitations regarding immunoreactivity and with respect to providing the appropriate tendinous microarchitecture and generating the right regenerative response.[41,25,84] Some commercially available scaffolds meet these criteria, but their high cost constitutes a limitation for many patients.[34,36,47,49] As such, the need for a cost-effective autograft that can provide the right structural and biological support has been discussed for several years.

The LHBT is a potential autograft in the setting of rotator cuff tears.[17] Surgeons often opt to perform tenotomy

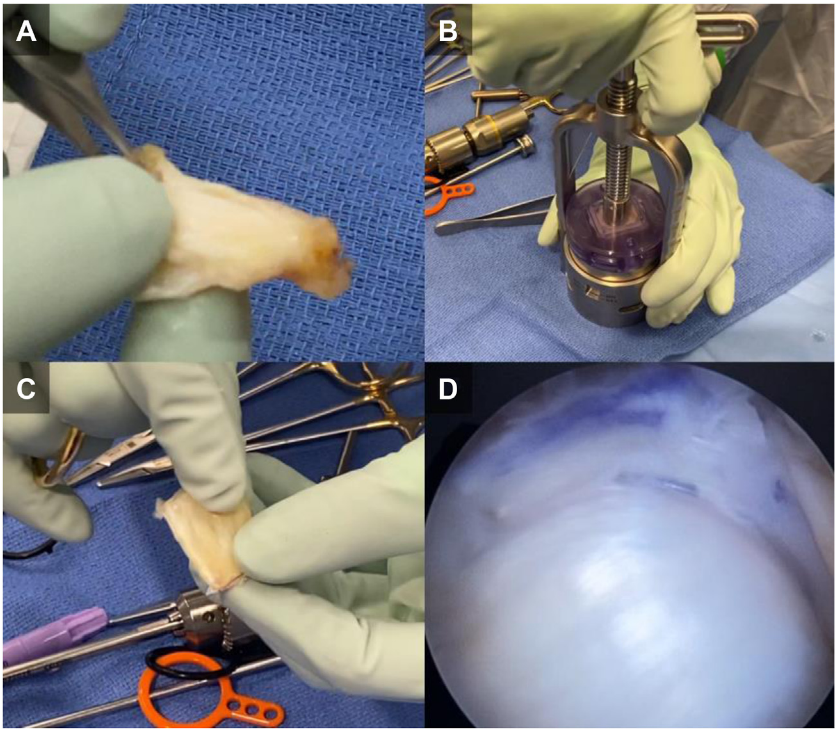

Figure 2 Compression technique as described by Tokish et al,[80] whereby the long head of the biceps tendon is harvested (**A**), compressed (**B**), prepared into a patch (**C**), and introduced on top of a rotator cuff repair as a form of augmentation (**D**).

or tenodesis of the tendon during the operation.[7,17] The proximal portion of the LHBT can provide a free, easily accessible, straightforward option for rotator cuff augmentation, without concerns for immune reaction or architectural misalignment.[1,17] The distal end of the LHBT can undergo tenodesis or tenotomy according to surgeon preference, and the harvested tendon can be used to augment the repair of the diseased cuff.[17] The LHBT may provide both structural and biological roles in massive rotator cuff tears with otherwise recognized high retear rates.[17]

Several techniques have been proposed in the literature to augment rotator cuff repair using LHBT. Bhatia[11] proposed the utilization of the LHBT as well as vasculature-preserved subacromial bursa to augment rotator cuff repair. The author described using sutures from the subscapularis repair to perform tenodesis of the LHBT, before detaching it proximal to the tenodesis, and using the proximal stump as a graft for cuff augmentation.[11] The rotator cuff is then mobilized and repaired together with the LHBT and the bursa in a biceps-cuff-bursa unit.[11] Tang and Zhao[79] proposed arthroscopic dynamic LHBT rerouting to manage irreparable posterior-superior rotator cuff tears. Their technique involved opening the bicipital groove and establishing a new groove through the greater tuberosity.[79] The authors then described rerouting the free LHBT into its new groove and repairing the rotator cuff in a side-to-side manner over the newly positioned LHBT.[79] Selim and Badawy[76] proposed another technique for LHBT augmentation of massive rotator cuff tears that involved débridement and mobilization of the rotator cuff before tenotomy of the LHBT at its insertion on the glenoid. They then described passing the proximal part of the LHBT through the mobilized rotator cuff and reflecting it over itself to create a new LHBT–rotator cuff complex.[76] Colbath et al[17] explored the potential uses of the LHBT as a scaffold for biological augmentation of the rotator cuff. They suggested the utilization of the LHBT to generate a biological autologous scaffold using a surgical graft expander.[17] The scaffold can be structurally altered, or "smashed," to produce bioactive signals capable of supporting augmentation of rotator cuff repair.[17] A similar technique was described by Tokish et al,[81] who reported tenodesis, harvesting, and compression of the LHBT into a patch (Fig. 2). The patch would act as a regenerative graft that can be placed on top of the rotator cuff tendon to augment its repair (Fig. 2).[81]

To confirm the suitability of the use of the LHBT as a tool for rotator cuff augmentation, several studies have explored the biomechanical, histologic, and clinical properties of this type of autograft in aims of demonstrating its therapeutic benefit and potential. In one animal study, for example, Xu et al[88] explored the outcomes of biceps-augmented rotator cuff repair in a rabbit model and compared them with a tear-completion repair and an in situ repair. They analyzed the biomechanics of repairs by

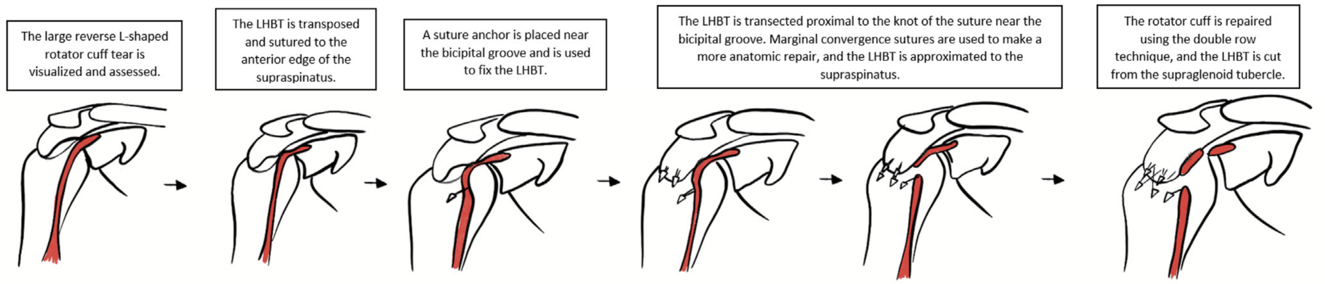

Figure 3 Use of long head of biceps tendon (LHBT) for rotator cuff repair as described by Lin et al.[53]

assessing load to failure and stiffness.[88] Biceps-augmented repair achieved significantly higher failure load and stiffness on biomechanical testing, as well as better histologic scores at 12 weeks postoperatively, when compared with both in situ repair and tear-completion repair.[88] Clinical studies exploring the therapeutic benefit of biceps augmentation have also been conducted with different techniques and promising results. Lin et al[53] reported on 3 patients with full-thickness rotator cuff tears who were treated by a double-row technique with transposition of the LHBT as an augmentation (Fig. 3). In their described technique, the authors used the autograft to fill the defect in the rotator cuff when a complete primary repair could not be performed (Fig. 3).[53] At 6 months' follow-up, the average visual analog scale (VAS) score of the patients decreased from 6.33 to 1.23 whereas the average Constant score increased from 45.33 to 88.[53] Similarly, Panzert et al[66] reported on 21 patients who underwent open supraspinatus tendon reconstruction using an infraspinatus tendon shift and LHBT augmentation. The procedure involved releasing the infraspinatus tendon from its insertion point and fixing the mobilized infraspinatus onto the damaged area on the anteromedial aspect of the shoulder.[66] The LHBT then underwent tenodesis at the bicipital groove and was released at its insertion on the supraglenoid tubercle.[66] Subsequently, the free proximal tendon was positioned according to the circumstance of the defect and was used to augment any remaining deficiency in the rotator cuff.[66] The authors reported a significant improvement in the Constant score, from 48 points to 87 points at 12 months' follow-up, as well as magnetic resonance imaging findings, which showed intact reconstructions in 90% of the patients.[66] The different proposed techniques and methods, as well as the promising results, show that the LHBT can provide a beneficial tool for use in the setting of rotator cuff repair augmentation.

Augmentation of subscapularis peel repair

Subscapularis failure after total shoulder replacement compromises patient outcomes and may require revision surgery.[13] Most reports suggest that the incidence rates of subscapularis repair failure vary between 1% and 6%.[13] Armstrong et al,[4] however, found ultrasonographic evidence of subscapularis repair failure in 13% of patients at 8 months' follow-up. When patient dissatisfaction is sufficient, revision repair, tendon transfer, and conversion to reverse shoulder arthroplasty can be considered as salvage options.[27,30] Nevertheless, surgeons should identify methods to limit subscapularis failure or should perfect techniques that preserve the subscapularis insertion.

Hawthorne et al[38] described the role of the LHBT in augmenting a subscapularis repair after shoulder arthroplasty. Eighteen human cadaveric shoulders requiring subscapularis peel repair were randomized into 3 groups: traditional transosseous repair, repair with horizontal LHBT augmentation, and repair with V-shaped LHBT augmentation (Fig. 4).[38] Cyclic displacement, load to failure, and stiffness of the repair were tested using a servohydraulic system and compared between the 3 groups.[38] The LHBT repair groups had significantly higher stiffness and load to failure when compared with the standard repair group. The findings of the study showed that the LHBT can provide a biological autograft that can help secure a subscapularis repair and improve its biomechanical strength.[38] In addition, the tenocytes from the native tendon can produce cytokines that can lead to improved subscapularis healing and tissue regeneration[38]; nevertheless, additional in vivo studies are required to determine the potential benefits of this intervention.

Anterior cable reconstruction

Anterior cable reconstruction (ACR), imperfectly also called "bio-SCR," is a procedure in which the LHBT is left attached to the supraglenoid tubercle, subluxated from the bicipital groove, and attached (with a suture anchor) to the tuberosity posterior to the bicipital groove.[22,67] The residual rotator cuff is sutured into the repaired biceps with side-to-side sutures.[22,67] The concept behind ACR, like superior capsular reconstruction (SCR), is to prevent the loss of humeral containment and, as a result, limit superior head

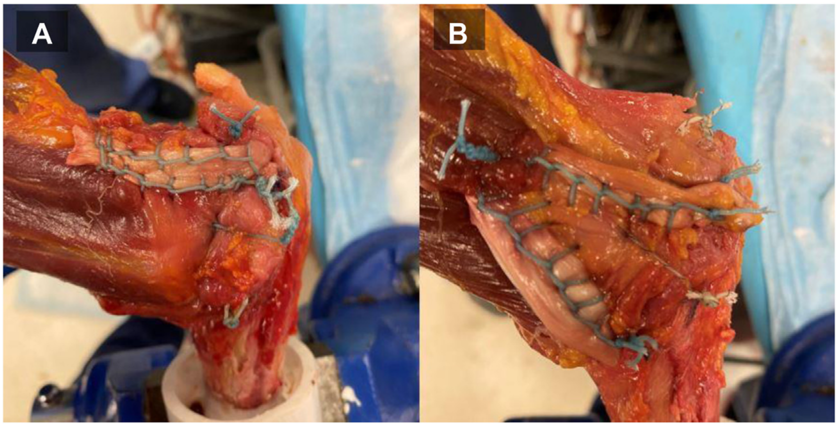

Figure 4 Cadaveric model demonstration of single row with horizontal augmentation of long head of biceps tendon (**A**) and single row with V-shaped augmentation of long head of biceps tendon (**B**), as described by Hawthorne et al.[38]

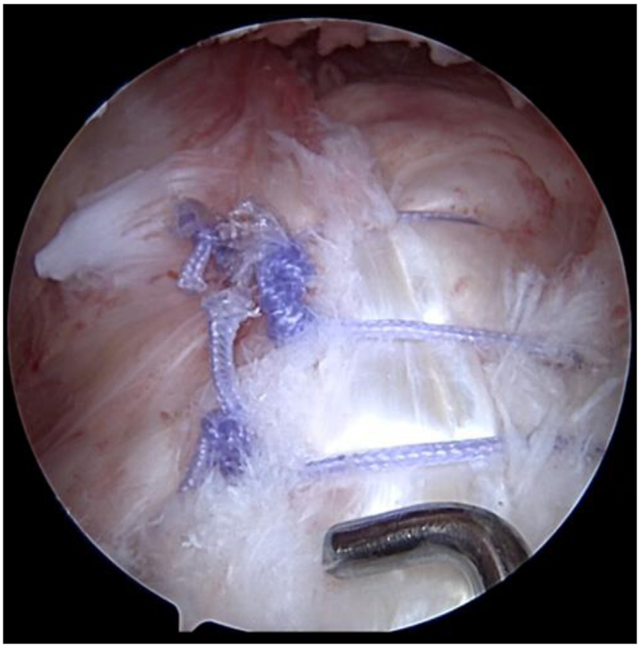

Figure 5 Anterior cable reconstruction is a procedure in which the long head of the biceps tendon is left attached to the supraglenoid tubercle, subluxated from the bicipital groove, and attached (with a suture anchor) to the tuberosity posterior to the bicipital groove. The residual rotator cuff is sutured into the repaired biceps with side-to-side sutures.

migration (Fig. 5).[10,39,42] In addition, ACR purports to enhance healing of the residual rotator cuff repair. ACR contrasts with the novel description by Colbath et al[17] and Tokish et al[81] of a detached LHBT that is molded (smashed) into an augmentation patch, in that ACR with the LHBT procedure leaves the LHBT attached to the supraglenoid tubercle and translocated to the greater tuberosity.[67] Whether the LHBT is used as an ACR or ‘‘smashed graft’’ depends on the repairability of the rotator cuff, severity of the tear, and degree of tendinopathy.

Several biomechanical studies have tested the eligibility of the LHBT as a potential graft for rotator cuff augmentation. Berthold et al[10] investigated 3 techniques for SCR using the LHBT and found that using the LHBT for SCR improved the function of the shoulder by decreasing glenohumeral superior translation (ghST), maximum cumulative deltoid force, and subacromial peak contact pressure. El-Shaar et al[29] compared the biomechanics of SCR using an LHBT autograft vs. SCR using a tensor fasciae latae (TFL) autograft and reported that in SCR with LHBT autograft, ghST would occur at 393.2% of the force needed for it to occur in the setting of a massive rotator cuff tear, whereas in SCR with TFL autograft, ghST would occur at only 194% of this force. This finding meant that the LHBT offered a biomechanically stronger autograft option for SCR when compared with the TFL.[29]

Several techniques have been proposed for the utilization of the LHBT in SCR, with particular focus on prioritizing ACR during the procedure.[54,67] Park et al[67] described how reconstructing the anterior cable assists in maintaining a functional fulcrum and superior stability in the glenohumeral joint, without restricting range of motion. Similarly, Llanos-Rodríguez et al[54] described the importance of addressing the anterior portion of anterior L-shaped tears in the rotator cuff. They suggested that the LHBT can be used in SCR for massive rotator cuff tears but not as an autograft for augmentation, rather as a static stabilizer that favors the healing of the supraspinatus tendon repair.[54] The authors performed transposition of the LHBT into a new bony trough, tenodesis of the LHBT on its new path, and then tenotomy of the LHBT distal to its attachment point (Fig. 6).[54] At that stage, the anterior capsular reconstruction was completed, and attention was directed toward repairing the posterosuperior rotator cuff (Fig. 6).[54]

Many studies have reported positive clinical outcomes following SCR using LHBT as an autograft in patients with massive rotator cuff tears. Lee et al,[52] in a systematic review, examined the clinical and functional outcomes of

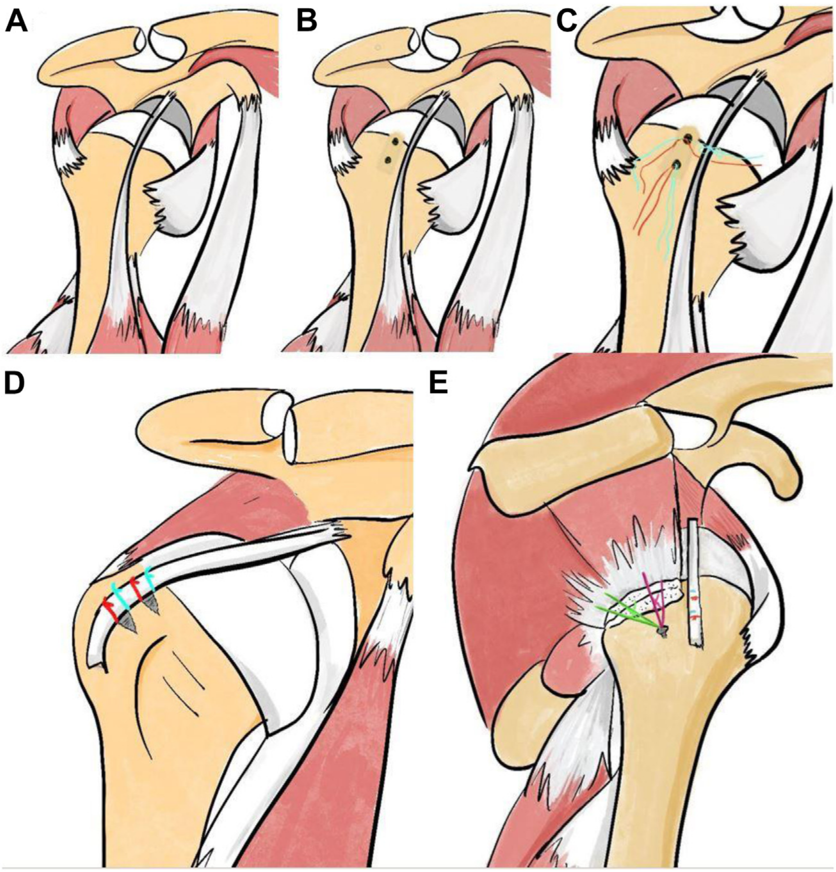

Figure 6 Anterior capsular reconstruction using long head of biceps tendon as described by Llanos-Rodríguez et al.[54] (**A**) The location of the biceps tendon is determined and appreciated. (**B**) The bone bed on the superior glenoid and greater tuberosity is prepared to incorporate 2 anchors. (**C**) Sutures are passed through and around the biceps tendon to secure it onto the new bony trough. (**D**) Once all sutures are tied, a tenotomy of the long head of the biceps tendon is performed. (**E**) The delaminated tear is repaired with anterior capsular reinforcement.

different grafts used in SCR and showed that the LHBT provided improvements in postoperative American Shoulder and Elbow Surgeons (ASES) and VAS scores, as well as postoperative forward elevation, supporting its suitability as a potential autograft option. In another systematic review, Cheppalli et al[16] explored patient-reported outcome scores in 7 studies that included 133 patients who underwent SCR using the LHBT as an autograft. All patients in the review demonstrated clinically significant improvements postoperatively at a follow-up range of 6-40.7 months.[16] Although the results of this systematic review generally showed that the LHBT constituted a safe and effective autograft source, 3 studies reported tear rates of 21%, 37%, and 66% based on postoperative magnetic resonance imaging.[16] Accordingly, more research may be needed to accurately confirm that the improved healing has also been demonstrated when the autologous LHBT is used for SCR in patients with massive rotator cuff tears. Barth et al[6] examined 82 patients with massive rotator cuff tears who underwent repair by either a double-row technique (n = 28), a transosseous-equivalent technique with absorbable patch reinforcement (n = 30), or SCR with an LHBT autograft (n = 24). Ultrasonographic evaluation performed 1 year postoperatively showed that the supraspinatus and infraspinatus tendons remained intact in 91.7% and 100% of the patients in the SCR-LHBT group, respectively.[6] These rates were statistically greater than the rates of 60.7% and 74%, respectively, seen in the double-row group and 56.7% and 76.5%, respectively, seen in the transosseous–synthetic patch group.[6] Patients in the SCR-LHBT group had significantly improved strength compared with those in the other groups.[6] These patients also witnessed significantly improved postoperative ASES and VAS pain scores, albeit without significant differences between the groups.[6] Llinás et al[55] compared clinical and structural outcomes in patients with massive rotator cuff tears undergoing repair only (n = 50) or repair with partial SCR (n = 56) using the autologous LHBT as a graft. At 2-year follow-up, using ultrasonography, they found that the retear rate was significantly lower in the group that underwent repair with partial SCR and LHBT (14%) compared with the repair-only group (46%, $P < .01$).[55]

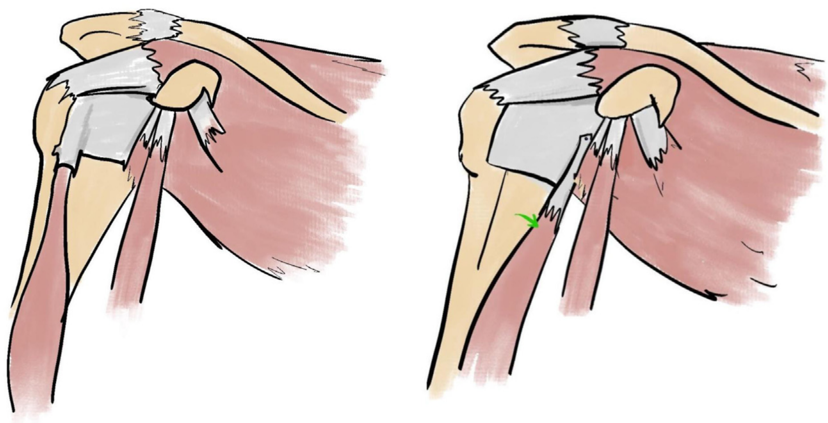

Figure 7 Illustration showing use of the long head of biceps tendon for anterior dynamic stabilization. After a subscapularis split is conducted, the long head of the biceps tendon is transposed (*green arrow*) and attached onto the anterior rim of the glenoid, providing a hammock effect and acting as a sling to prevent anterior translation of the humeral head.

ASES scores, VAS scores, forward flexion, and abduction were all significantly greater in the SCR-LHBT group as well.[55]

In conclusion, the LHBT constitutes a useful, inexpensive autologous graft option for the ACR procedure, with good results on both biomechanical assessment and long-term clinical follow-up. We consider the use of an LHBT in this setting a useful surgical option for deficient or thinned supraspinatus cuff repair procedures (with an intact or repairable infraspinatus tendon). A grossly deficient infraspinatus may be better treated with tendon transfer or arthroplasty.

Glenohumeral stabilization

Treating shoulder instability in the setting of collision athletes, patients with critical bone loss, and patients with capsulolabral defects remains challenging.[78,82] In these patients, arthroscopic Bankart repair has much higher recurrence and lower return-to-sport rates than previously believed.[72,80] The re-emergence of the remplissage procedure and open Bankart and arthroscopic bone block procedures underscores this reality.[26,72,80] Furthermore, the North American experience with the Latarjet procedure is associated with a higher complication rate when compared with European reports.[35,58,77] The LHBT may be used as an adjunct in shoulder stabilization procedures for both hemiparetic and athletic populations using the Nicola technique or dynamic anterior stabilization.[18,23,33]

In 1929, Nicola[65] introduced the Nicola procedure, which involves stabilizing the shoulder by transferring the LHBT from the bicipital groove through the humeral head. In 1931, the author reported on a series of 20 patients who were treated using this technique, all of whom achieved satisfactory results.[64] The success of the Bankart procedure (1923) essentially supplanted this procedure, except in patients with hemiparesis.[5] In 2004, Krishnan et al[48] performed humeral capsular shift and augmentation of the rotator interval, in conjunction with the Nicola procedure, to treat complex multidirectional shoulder instability. They described the procedure as the ‘‘kitchen sink operation’’ to help treat complex shoulder instability, and they reported good outcomes.[48] At a minimum follow-up of 2 years, 9 of the 10 patients who were treated with this procedure achieved objective and subjective alleviation of laxity and instability, respectively.[48] Several different authors described the use of biceps suspension-plasty for recurrent instability—which is a derivative of the Nicola procedure—and achieved great outcomes.[46,63] One particular study by Kohan et al[46] involved 5 patients with 7 shoulders treated with biceps suspension-plasty for recurrent multidirectional instability. At a mean follow-up of 3.2 years, none of the patients underwent repeated surgery and all of them considered their shoulders to be much better or somewhat better than before.[46]

In contrast to findings in patients with hemiparesis, the rate of recurrent shoulder instability in contact athletes remains imperfect after arthroscopic stabilization.[23,33] Collin and Lädermann[18] suggested the idea of transposing the LHBT through a subscapularis split and attaching it into the anterior glenoid margin to help treat anteroinferior shoulder instability and maintain dynamic anterior stabilization: the dynamic anterior stabilization procedure (Fig. 7). The principles behind using the LHBT in dynamic anterior stabilization are a derivative of the Latarjet procedure.[18,23,33] Through a subscapularis-split approach, the LHBT can provide a hammock effect by lowering the inferior part of the subscapularis and can act as a sling to prevent translation of the humeral head over the anterior-inferior rim of the glenoid (Fig. 7).[18,23,33] The aforementioned authors stated that this conservative technique would provide the benefit of the sling effect seen in the Bristow-Latarjet procedure but in an easier and safer manner.[18] The technique would be used to supplement the stabilization provided by the standard Bankart repair.[18] Very similar techniques were described by Gonçalves and Murthi,[33] DeFroda et al,[23] and Milenin and Toussaint,[61] all of whom noted the stabilizing benefits of this technique while highlighting its safety and low complication risk.

Several biomechanical studies have supported the use of the LHBT in the setting of glenohumeral stabilization. Mehl et al[60] conducted a biomechanical cadaveric study to compare the standard Bankart repair with the dynamic anterior shoulder stabilization technique using the LHBT. The authors reported that although both procedures decreased anterior glenohumeral translation, the LHBT group demonstrated less relative anterior translation when compared with the Bankart repair group in the context of minor glenoid bone defects.[60] Bokshan et al[12] conducted a biomechanical cadaveric study as well and examined the differences between the use of the LHBT and the use of the transferred conjoined tendon for anterior shoulder instability and 20% bone loss. The authors reported greater resistance to anterior translation in the LHBT group at mid-range shoulder abduction.[12] In a third biomechanical cadaveric study, Lobao et al[56] compared the LHBT transfer technique with both Bankart repair and the Latarjet procedure. The authors reported that the LHBT offered a legitimate treatment option for anterior instability as it provided superior stabilization when compared with Bankart repair but inferior stabilization when compared with the Latarjet procedure in subcritical glenoid defects.[56]

Clinically, Collin et al[19] retrospectively reviewed 23 patients who underwent arthroscopic dynamic anterior stabilization using the LHBT in combination with Bankart repair for anteroinferior instability. They wanted to evaluate the short-term outcomes at a minimum of 2 years' follow-up and did so by assessing range of motion, the Rowe score, and recurrence.[19] The authors reported a significant improvement in the Rowe score postoperatively, with around 91% of patients showing improvement beyond the minimal clinically important difference.[19] Range of motion was maintained postoperatively, and recurrence developed in only 3 patients, 1 of whom was treated conservatively whereas the other 2 underwent revision with the Latarjet procedure.[19] No complications relating to a postoperative Popeye deformity or biceps cramping were reported in the study.[19] In another case series, de Campos Azevedo and Ângelo[14] reported on 3 patients with chronic traumatic anteroinferior glenohumeral instability treated with arthroscopic trans-subscapular transposition of the LHBT onto the anteroinferior glenoid. The authors described excellent outcomes based on clinical scores and radiographic evidence at 1-year follow-up.[14] Finally, DeFroda et al[23] reported on the case of a patient with recurrent anterior shoulder instability and previous Bankart repair who was treated with dynamic anterior stabilization by transposition of the LHBT onto the anterior glenoid neck. The authors reported that the patient demonstrated full range of motion, no complications, and no recurrent instability events at 16 months' follow-up.[23]

Zacharias et al[89] have proposed a different way of using the LHBT in treating shoulder instability. The authors conducted a biomechanical cadaveric study to explore the use of the LHBT to reconstruct the anterior glenoid labrum.[89] They described performing tenotomy of the LHBT at the level of the pectoralis major insertion and using the stump to conduct labral reconstruction.[89] LHBT-reconstructed labra had significantly greater peak force than the deficient labra and intact labra.[89] Long-term clinical data will be needed to confirm the benefit of this autologous labral reconstruction in vivo.

Arthroscopic anterior shoulder instability in athletes has a higher rate of recurrent dislocation than initially believed.[19,72] Efforts to augment arthroscopic repair are increasingly becoming popular.[89] Dynamic anterior stabilization, although biomechanically sound, has limited clinical data available, and larger series with longer follow-up will be required.[19,14,23]

Conclusion

The properties and characteristics of the LHBT render it a valuable surgical tool for augmentation of tendon and ligament repair in shoulder surgery. The tendon is easily accessible, inexpensive when compared with other graft options, autologous, biomechanically strong, and rich in TDSCs that can aid recovery. The LHBT is a promising autograft with numerous applications, such as rotator cuff augmentation, subscapularis peel repair augmentation, dynamic anterior stabilization, and anterior capsular reconstruction. Many of these applications have been biomechanically and clinically studied, whereas others still require further research to confirm benefit and efficacy.

Disclaimers:

Funding: No funding was disclosed by the authors.
Conflicts of interest: Paul Sethi serves as a paid consultant for Arthrex and receives research funding from Arthrex. Arthrex was not involved in the study or in the preparation of this manuscript. Anand Murthi reports financial relationships with DePuy Royalties, Ignite Orthopaedics, and Spock Globus Royalties, none of which were involved in the study or in the preparation of this manuscript. John M. Tokish reports financial relationships with Arthrex, Mitek, and DePuy Royalties, none of which were involved in the study or in the preparation of this manuscript. Joseph A. Abboud

receives royalties from DJO Global, Zimmer-Biomet, Smith & Nephew, Stryker, and Globus Medical; research support from Lima Corporation–Italy, Orthofix, Arthrex, and Orthopaedic Research and Education Foundation (OREF); and royalties and financial or material support from Wolters Kluwer, none of which were involved in the study or in the preparation of the manuscript. The other author, his immediate family, and any research foundations with which he is affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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