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General

Revisiting the Role of the Long Head of the Biceps in Shoulder Stability

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The long head of the biceps (LHB) tendon has traditionally been regarded as an expendable structure in shoulder surgery, often sacrificed without significant functional consequence. Histologic studies identify neural elements within the LHB and therefore provide biologic plausibility for afferent signaling; however, they do not establish an independent or clinically important contribution to proprioception. Cadaveric biomechanical studies demonstrate that applied LHB loading can resist humeral head translation, assist joint centering, and share load with capsulolabral structures under specific experimental conditions. Conversely, electromyographic and clinical studies show limited routine LHB recruitment during isolated shoulder motion and generally favorable outcomes after tenotomy or tenodesis. The evidence therefore supports a context-dependent model in which the LHB functions as a secondary stabilizer whose relevance varies with arm position, pathology, patient demands, and the integrity of surrounding structures. The LHB should be viewed as neither universally expendable nor universally essential, and surgical decisions should balance the dominant pain generator against the potential mechanical contribution of the tendon in the individual shoulder.

INTRODUCTION

The glenohumeral joint achieves extensive motion at the expense of inherent bony stability.[1,2] Joint centering therefore depends on static restraints, including the labrum, capsule, and glenohumeral ligaments, and on dynamic control by the rotator cuff and scapulothoracic musculature.[3-5] Sensorimotor feedback further coordinates muscular responses during movement.[6,7] The long head of the biceps (LHB), which originates from the supraglenoid tubercle and superior labrum and traverses the joint, is positioned to influence these mechanisms.[8] Historically, it has often been treated as an expendable pain generator because tenotomy and tenodesis generally produce limited functional loss.[9,10] Whether the tendon nevertheless provides clinically relevant stability in selected shoulders remains debated.

This debate has practical importance since the LHB is frequently encountered during arthroscopic treatment of rotator cuff and superior labral pathology. A procedure that detaches the tendon can relieve pain arising from the bicipital groove or biceps-labral complex, but it also removes the tendon from its native intra-articular course.[8-10] Favorable postoperative outcomes demonstrate that this alteration is well tolerated in many shoulders; they do not, by themselves, show that the native tendon lacks all mechanical function. Conversely, a measurable stabilizing effect in a cadaveric model does not establish that preservation will improve symptoms, prevent instability, or enhance athletic performance. The clinical question is therefore not simply whether the LHB stabilizes the shoulder, but when its contribution is large enough to matter relative to the patient's pain, pathology, and functional demands.

The available evidence is best understood as a continuum from biologic plausibility to mechanical capability and, finally, demonstrated clinical function. This narrative review synthesizes histologic, neuroanatomic, biomechanical, electromyographic, and clinical evidence concerning the LHB and glenohumeral stability. Its central premise is that the LHB is a context-dependent secondary stabilizer: its importance varies with patient demands, shoulder position and pathology, and the integrity of the rotator cuff and capsulolabral restraints. This framework avoids treating the tendon as either universally expendable or universally essential.

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METHODOLOGY

This narrative review used PubMed, Scopus, and Google Scholar to identify literature concerning the LHB and shoulder stability. Search terms included "long head of biceps," "biceps tendon," "shoulder stability," "glenohumeral stability," "proprioception," "mechanoreceptors," "sensorimotor control," "SLAP lesions," and "biceps tenodesis." Priority was given to biomechanical, histologic, neuroanatomic, electromyographic, and clinical outcome studies that directly informed the proposed stabilizing role of the LHB. Additional sources were identified through citation tracking. Given this was a narrative review, formal systematic-review methods and quantitative meta-analysis were not performed. Foundational mechanistic studies from the 1990s and early 2000s were interpreted alongside contemporary biomechanical and clinical evidence, with particular attention to findings that challenge older assumptions.

Evidence was interpreted according to study design. Histologic studies assessed a potential sensory substrate, biomechanical studies characterized controlled loading or release, electromyographic studies examined recruitment, and clinical studies evaluated outcomes. Since conclusions from one category cannot automatically be extended to another, the review developed a clinically useful synthesis rather than a pooled treatment effect.

The apparent effect of the LHB varies with shoulder position, tendon loading, associated pathology, and the integrity of surrounding stabilizers, therefore the evidence is organized within a context-dependent framework (Table 1). For each clinical setting, the table identifies representative studies by author and citation, describes the evidence and principal finding, and provides a concise translational interpretation. This structure allows biomechanical observations to be distinguished from demonstrated clinical outcomes.

OVERVIEW OF SHOULDER STABILITY RELEVANT TO THE LONG HEAD OF THE BICEPS

DEFINITIONS AND COMPONENTS OF SHOULDER STABILITY

Shoulder stability is the ability to maintain the humeral head centered within the glenoid throughout functional motion.[3-5] The osseous architecture, labrum, capsule, glenohumeral ligaments, and negative intra-articular pressure provide passive restraint, while the rotator cuff supplies concavity-compression and active centering.[1,3-5] The LHB spans the glenohumeral joint from the superior glenoid-labral complex to the bicipital groove, an arrangement that may influence translation and load sharing.[8,11]

The contribution of each restraint changes across the arc of motion. Capsuloligamentous structures become particularly important near end range, whereas coordinated rotator cuff and scapular activity continuously manages the shear and compressive forces generated by larger muscles such as the deltoid.[3-5] The glenoid labrum deepens the articular concavity and provides an attachment for the capsule and superior biceps-labral complex.[1,3] Due to the fact that the LHB crosses the joint before turning into the groove, its line of pull also changes with elevation and rotation.[8,11] A stabilizing effect observed in one arm position therefore cannot be assumed to occur with the same magnitude or direction throughout normal motion.

Sensorimotor control integrates proprioceptive information with anticipatory and reflexive muscle activity. Afferent input arises from multiple capsular, labral, and musculotendinous structures, and these overlapping pathways contribute to coordinated periarticular activity.[5-7,12,13] The intra-articular course of the LHB places it in a position to influence joint mechanics and potentially provide afferent input, but its independent contribution must be distinguished from this distributed sensorimotor network.

Proprioception includes awareness of joint position and movement as well as afferent information that may contribute to automatic motor responses.[6,7] Injury, pain, capsulolabral disruption, and rotator cuff dysfunction can each alter these processes, making it difficult to attribute a measured deficit to a single anatomic structure.[5,12,13] In this framework, the LHB may provide one stream of information while the capsule, labrum, muscle spindles, cutaneous receptors, and central motor strategies provide others. Demonstrating neural tissue within the tendon is therefore relevant, but the functional question depends on whether its signal is unique, sufficiently large, and irreplaceable by the broader system.

PROPRIOCEPTIVE AND SENSORIMOTOR CONSIDERATIONS OF THE LONG HEAD OF THE BICEPS

HISTOLOGIC AND NEUROANATOMICAL EVIDENCE

Histologic studies demonstrate neural elements within and around the LHB. Alpantaki et al. identified a net-like distribution of sensory and sympathetic nerve fibers, with greater density near the proximal tendon and biceps anchor.[14] Subsequent studies described axonal and molecular features of the tendon and superior labrum.[15,16] These findings establish an anatomic substrate capable of afferent signaling, but receptor or axon density alone does not demonstrate that the LHB provides a clinically meaningful component of shoulder proprioception.

The proximal concentration of neural elements is anatomically notable because the biceps anchor is exposed to deformation as tension is transmitted between the tendon and superior labrum.[14-16] This distribution could permit detection of local tensile or nociceptive stimuli and may partly explain why the proximal LHB can function as a pain generator. However, sensory and sympathetic fibers are not synonymous with specialized mechanoreceptors, and histologic identification does not reveal how frequently a receptor is activated during daily or athletic motion. It also cannot determine whether the resulting signal changes conscious joint-position sense or produces a clinically meaningful motor response.

Table 1. Representative studies supporting a context-dependent role of the LHB

Clinical context	Evidence type	Representative studies	Key findings	Clinical takeaway
Sensorimotor plausibility	• Histologic • Neuroanatomic	• Alpantaki et al. (2005) • Blumer et al. (2020) • Boesmueller et al. (2019) • Guanche et al. (1999) • Vangsness et al. (1995) • Witherspoon et al. (2014)	• Neural elements present in LHB and adjacent tissues • Proximal concentration near biceps anchor	• Supports biologic plausibility • Clinical proprioceptive importance unproven
Intact shoulder	• Cadaveric biomechanical • EMG	• Pagnani et al. (1996) • Rauck et al. (2022) • Levy et al. (2001) • Yamaguchi et al. (1997)	• Loaded LHB reduced translation • Posterior stabilization during forward flexion • Minimal activity during isolated shoulder motion	• Mechanical capacity demonstrated • Routine recruitment unproven
Anterior instability and abduction-external rotation	• Cadaveric biomechanical	• Itoi et al. (1993, 1994) • Rodosky et al. (1994) • Pagnani et al. (1996)	• Greater stability in abduction-external rotation • Reduced anterior translation • Biceps-labral complex added restraint	• May matter when anterior restraints fail • Clinical validation limited
Rotator cuff deficiency	• Cadaveric biomechanical	• Katthagen et al. (2024) • Govender et al. (2022)	• Stabilized infraspinatus/subscapularis deficiency • No effect with isolated supraspinatus deficiency • Tenotomy altered humeral-head position/load	• Effect depends on the deficient cuff tendon
SLAP pathology	• Biomechanical • Clinical	• Rodosky et al. (1994) • Hwang et al. (2014) • Stepanyan et al. (2025) • Boileau et al. (2009) • Parnes et al. (2021)	• Biceps-labral complex restrained translation • LHB loading stressed the superior labrum • Tenodesis produced favorable outcomes in selected patients	• Anchor may stabilize or cause symptoms • Consider age, demand, tissue, and pain source
Overhead athletes	• EMG and kinematic • Clinical • Expert consensus	• Levy et al. (2001) • Yamaguchi et al. (1997) • Chalmers et al. (2014) • Verma et al. (2025)	• Limited isolated-shoulder LHB activity • Similar pitching kinematics after repair/tenodesis • Expert consensus remains divided	• Extreme-position role plausible • Essential proprioceptive role unproven
After tenotomy or tenodesis	• Randomized clinical • Systematic review and meta-analysis • Prospective clinical	• MacDonald et al. (2020) • Belk et al. (2021) • Hartland et al. (2022) • Özcan et al. (2025)	• Overall function generally preserved • No measured proprioceptive/strength deficit with concomitant tenotomy	• Not universally necessary • High-demand effects remain uncertain

Mechanoreceptors and free nerve endings are also distributed throughout the glenohumeral capsule, labrum, ligaments, subacromial bursa, and surrounding musculotendinous tissues.[17-19] The biceps-labral complex therefore forms one potential source of input within a redundant afferent network rather than an isolated sensory organ. Its intra-articular and tendinous position may allow it to respond to local tension or deformation, but histology cannot determine the magnitude, timing, or clinical importance of that signal.

SENSORIMOTOR INTEGRATION AND SHOULDER CONTROL

The neural architecture of the LHB provides biologic plausibility for participation in shoulder sensorimotor control. It has been hypothesized that tension-related afferent input could influence periarticular muscle activity, analogous to reflex pathways described in other joints.[6,13] However, a specific LHB-mediated reflex arc and a causal effect on rotator cuff recruitment have not been demonstrated. The presence of neural elements should therefore be interpreted as evidence of potential signaling capacity rather than proof of a necessary proprioceptive function.

Afferent information can influence movement at several levels, including conscious position perception, spinal or brainstem-mediated responses, and anticipatory cortical motor programs.[6,7] These mechanisms operate over different time scales and are modified by pain, fatigue, prior injury, and training. A change in shoulder muscle timing after labral or rotator cuff injury may therefore reflect multiple interacting factors rather than loss of a discrete biceps signal.[13,20,21] For the LHB to be considered clinically necessary for sensorimotor stability, studies would need to show a reproducible deficit after isolated alteration of the tendon and relate that deficit to symptoms, instability, or performance. Current histologic and observational data do not satisfy that standard.

Clinical shoulder disorders can be associated with altered joint-position sense or muscle-response timing, but such observations do not isolate the LHB from concomitant labral, capsular, rotator cuff, pain-related, and central adaptations.[13,20,21] Direct clinical evidence remains limited. Özcan et al. found no measurable proprioceptive or strength deficit attributable to concomitant biceps tenotomy after rotator cuff repair, although this design could not isolate the effect of the LHB procedure from the underlying tear and repair.[22] No study has established a clinically important change in proprioceptive acuity before and after an isolated LHB procedure in otherwise comparable shoulders.[21]

BIOMECHANICAL ROLE OF THE LHB IN GLENOHUMERAL STABILITY

Cadaveric studies demonstrate that the LHB can resist translation when the tendon is externally loaded. Itoi et al. found that LHB loading increased anterior stability with the shoulder in abduction and external rotation, a position in which the anterior capsulolabral structures are stressed.[23, 24] These findings demonstrate mechanical capability under controlled conditions, but they do not establish the frequency or magnitude of physiologic LHB recruitment during functional activity.

Abduction and external rotation are clinically relevant because they reproduce the late-cocking position of throwing and the position of vulnerability for anterior instability.[23,24] In this orientation, the loaded tendon may act as a compressive or restraining structure across the humeral head and may share load with the anterior capsule and labrum. The observation is consistent with a secondary stabilizing role when primary restraints are stressed. Nevertheless, cadaveric testing typically fixes the scapula, applies a predetermined tendon force, and removes the adaptive muscle coordination present in vivo. These design features isolate a mechanical effect but may amplify or simplify the tendon's contribution relative to normal activity.

Pagnani et al. applied a constant 55-N load to the LHB in cadaveric shoulders and observed reduced anterior, superior, and inferior translation.[25] At 45° of elevation, anterior translation decreased by more than 1 cm under the study's experimental conditions. The effect varied with arm elevation, consistent with changes in tendon orientation and moment arm. Since the imposed load and cadaveric preparation do not reproduce intact neuromuscular control, the magnitude should not be interpreted as a direct estimate of in vivo stabilization.

The multidirectional effect reported by Pagnani et al. is often cited as evidence that the LHB can function as a dynamic brake.[25] It also illustrates why the terminology requires care. A tendon that reduces translation when tension is applied has stabilizing capacity, but it functions dynamically only if the muscle is recruited and generates an appropriate force during the task of interest. EMG studies discussed below question whether substantial recruitment routinely occurs during isolated shoulder motion. Mechanical efficacy and physiologic activation are therefore complementary but separate questions, and neither can be used alone to define the tendon's clinical importance.

The LHB may also assist humeral head centering and share load with the rotator cuff and capsulolabral complex.[10,25] Its contribution appears to depend on the integrity of surrounding structures. Katthagen et al. reported a stabilizing effect in simulated infraspinatus or subscapularis deficiency but not in isolated supraspinatus deficiency, demonstrating that rotator cuff deficiency is not a single biomechanical state.[26] Other work suggests that LHB alteration can affect humeral head position or supraspinatus loading in selected cuff-deficient models.[27] These findings support a situational rather than uniform stabilizing role.

Tension is transmitted between the LHB and its superior labral origin. This relationship creates a potential tradeoff: loading of the biceps-labral complex may augment restraint under some conditions, while also producing traction or torsional stress implicated in SLAP pathology.[28-30] In experimental models, detachment of the biceps anchor or superior labrum can increase translation, whereas unloading the complex may reduce stress at a symptomatic superior

labral attachment.[29,30] The same anatomic connection may therefore be stabilizing or pathologic depending on tissue integrity, position, and loading.

ORTHOPEDIC IMPLICATIONS OF ALTERING THE LONG HEAD OF THE BICEPS

POTENTIAL IMPACT ON SHOULDER STABILITY

Systematic reviews and clinical outcome studies generally report substantial pain relief and preserved overall shoulder function after tenotomy or tenodesis.[8,9,31,32] Gross postoperative instability is uncommon, indicating that static restraints, the rotator cuff, and scapulothoracic musculature compensate effectively in most patients. These outcomes temper cadaveric findings obtained with imposed tendon loading and argue against classifying the LHB as a universally necessary stabilizer.

Tenotomy and tenodesis both remove the intra-articular tendon from its native superior labral attachment, although tenodesis preserves a distal fixation point and may better maintain length-tension relationships for elbow and forearm function.[31,32] Comparative studies focus primarily on pain, cramping, cosmetic deformity, strength, and patient-reported shoulder scores rather than on subtle instability or sensorimotor end points. Favorable results therefore provide strong evidence that routine shoulder function can be maintained after either procedure, but they are less definitive regarding small effects in selected positions or high-demand tasks. Differences in age, activity level, associated repair, tendon quality, and rehabilitation also limit direct translation across patient groups.

The consequences of LHB alteration may nevertheless differ when other stabilizers are compromised. Cadaveric evidence suggests increased translation after unloading the LHB in selected positions or pathologic models.[23,25,26,33] Conversely, detachment can reduce traction on a painful or unstable superior labral attachment.[29] In patients with rotator cuff tears, superior migration and altered force couples arise from the cuff lesion itself, making the independent effect of tenotomy or tenodesis difficult to determine.[27,33] Surgical decisions should therefore be based on the dominant pathology and the condition of associated stabilizers rather than on an assumed universal function of the tendon.

POTENTIAL IMPACT ON PROPRIOCEPTION AND SENSORIMOTOR CONTROL

Surgical alteration of the intra-articular LHB changes one potential source of afferent input. Whether this produces measurable changes in joint-position sense, periarticular muscle recruitment, or perceived stability is uncertain. Assertions that reflex stabilization will be absent or that the rotator cuff must adopt a different firing pattern after tenodesis remain hypotheses rather than demonstrated clinical effects. The limited available clinical evidence has not identified a consistent measurable proprioceptive deficit.[21,22]

This distinction is especially relevant for overhead athletes, whose performance depends on repeated positioning near terminal abduction and external rotation, rapid force transfer, and precise sequencing across the trunk, scapula, shoulder, elbow, and wrist. A small sensorimotor change could theoretically matter even when routine clinical scores remain normal. At present, however, that possibility has not been demonstrated as an isolated consequence of tenotomy or tenodesis. Pain relief itself may improve movement confidence and muscle recruitment, while concomitant labral or cuff treatment may independently alter proprioception. Studies designed around sport-specific tasks and appropriate comparison groups are needed before preservation can be recommended solely to protect afferent function.

Favorable clinical outcomes after tenotomy or tenodesis do not exclude subtle effects in specific high-demand populations, but such effects should not be assumed in the absence of direct testing. Future studies should evaluate joint-position sense and neuromuscular responses before and after isolated LHB procedures, stratified by associated pathology and activity demands.

THE LHB AS A CONTEXT-DEPENDENT STABILIZER

Several lines of evidence support classifying the LHB as a situational secondary stabilizer rather than a routinely active primary stabilizer. Diplock et al. concluded that its contribution to glenohumeral arthrokinematics remains incompletely understood.[10] Wire-electrode studies by Levy et al. and Yamaguchi et al. found little LHB activity during isolated shoulder motion when elbow and forearm activity were controlled, which argues against continuous recruitment as a primary shoulder stabilizer.[34,35] These EMG findings do not negate the mechanical effect of a loaded tendon; instead, they limit how broadly cadaveric loading experiments can be translated to normal activity.

In an intact, pain-free shoulder, the rotator cuff, capsule, labrum, and scapular musculature appear sufficient to maintain stability through most activities, and the LHB may contribute little measurable additional control.[10,34,35] Its relative importance may increase when the arm approaches a vulnerable position, when the superior labrum or anterior capsule is stressed, or when part of the rotator cuff force couple is deficient.[23-26] The same tendon may therefore be mechanically redundant in one shoulder but useful in another. This model also explains why a structure can demonstrate stabilizing capacity in the laboratory while removal remains clinically successful in most patients: compensation depends on the integrity and demands of the system in which the tendon operates.

Contemporary biomechanical studies illustrate why clinical context matters. Katthagen et al. found that LHB loading improved stability with simulated infraspinatus or subscapularis deficiency but not supraspinatus deficiency.[26] Stepanyan et al. reported that tenotomy or tenodesis altered biomechanical stability in a model of SLAP tear and repair.[33] Together, these studies suggest that the impor-

tance of the tendon depends on which neighboring restraint is deficient and on the condition of the biceps-labral complex. They do not establish that preservation improves patient-reported outcomes in those settings.

Clinical evidence further challenges universal preservation. For isolated type II SLAP lesions, Boileau et al. reported greater satisfaction and return to sport after tenodesis than after SLAP repair.[36] In active-duty patients younger than 35 years, Parnes et al. reported a 20% failure rate after primary repair compared with no failures after primary tenodesis, while a systematic review found higher return to activity after tenodesis than revision SLAP repair.[37,38] The NEER Circle consensus also identified age and patient demand as important treatment considerations while documenting persistent disagreement in competitive athletes.[39]

These results emphasize that preserving the native biceps-labral attachment is not necessarily equivalent to restoring better function.[36-39] A painful or unstable superior labral complex may impose traction-related symptoms that outweigh any secondary stabilizing benefit, and tenodesis can address that pain source while avoiding the prolonged or unsuccessful recovery associated with repeat repair. At the same time, available cohorts differ in age, sport, occupational demands, chronicity, and concomitant pathology. The findings support individualized treatment rather than a universal age cutoff or procedure, particularly for young throwers in whom return to the same level of performance remains difficult to predict.

Throwing-specific evidence does not demonstrate an indispensable proprioceptive role. Chalmers et al. found similar pitching kinematics and no significant group differences in the measured muscle activity among pain-free pitchers after SLAP repair or biceps tenodesis.[40] This does not establish equivalence for every elite thrower, but it weakens the prediction that biceps detachment necessarily disrupts neuromuscular control. Likewise, the absence of a measurable proprioceptive deficit after concomitant tenotomy in the study by Özcan et al. argues for caution in inferring clinical function from neural anatomy alone.[22]

LIMITATIONS OF CURRENT EVIDENCE

The evidence base is limited by cadaveric preparations, externally imposed tendon loads, small histologic studies, indirect sensorimotor measures, and heterogeneous clinical populations. Biomechanical findings vary with arm position, load magnitude, capsulolabral integrity, and the specific rotator cuff tendon modeled as deficient. Specimen age and tissue quality may also differ substantially from those of young athletes in whom the stabilizing question may be most consequential. Conversely, experimental loading protocols cannot reproduce pain inhibition, fatigue, anticipatory activation, or the coordinated contributions of the trunk and scapula. Accordingly, mechanical capability should not be equated with routine activation or clinically necessary function.

Clinical studies frequently include concomitant rotator cuff repair, labral treatment, subacromial procedures, or rehabilitation changes that obscure the independent effect of an LHB procedure. Common outcome instruments emphasize pain and general function and may not detect small changes in apprehension, joint-position accuracy, or sport-specific control. Direct assessment before and after isolated tenotomy or tenodesis remains scarce, and selection bias can influence comparisons between repair, tenotomy, and tenodesis. Future work should combine in vivo imaging or kinematic assessment with EMG and validated proprioceptive testing, stratify patients by the deficient stabilizing structure, and relate measurable changes to symptoms and return to activity. Until such evidence is available, conclusions should remain proportional to the study design and clinical setting.

CONCLUSION

The LHB should be viewed as neither a vestigial structure nor a universally indispensable stabilizer. Histologic evidence establishes the capacity for afferent signaling, but a clinically important independent proprioceptive role has not been demonstrated. Biomechanical evidence shows that a loaded LHB can resist translation and share load under selected conditions, whereas EMG and clinical outcomes demonstrate that the tendon is not routinely required for satisfactory function. Its contribution is therefore best characterized as secondary and context dependent, varying with pathology, arm position, patient demands, and the integrity of the rotator cuff and capsulolabral structures. Treatment should address the dominant clinical problem while recognizing that the mechanical value of the LHB may differ among shoulders.

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Pranav Krish, Ryne Jenkins, Robert Faccone, and Anthony Cappellino contributed to the literature review, manuscript drafting, critical revision of the manuscript, and approval of the final version for submission. Charles Ruotolo conceived the study, supervised manuscript development, provided critical intellectual input throughout the review process, critically revised the manuscript for important intellectual content, and approved the final version for submission. All authors meet the International Committee of Medical Journal Editors criteria for authorship and have read and approved the final manuscript.

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REFERENCES

1. Almajed YA, Hall AC, Gillingwater TH, Alashkham A. Anatomical, functional and biomechanical review of the glenoid labrum. *J Anat*. 2022;240(4):761-771. doi:10.1111/joa.13582

2. Lugo R, Kung P, Ma CB. Shoulder biomechanics. *Eur J Radiol*. 2008;68(1):16-24. doi:10.1016/j.ejrad.2008.02.051

3. Bigliani LU, Kelkar R, Flatow EL, Pollock RG, Mow VC. Glenohumeral stability: biomechanical properties of passive and active stabilizers. *Clin Orthop Relat Res*. 1996;(330):13-30. doi:10.1097/00003086-199609000-00003

4. Lippitt SB, Vanderhooft JE, Harris SL, Sidles JA, Harryman DT II, Matsen FA III. Glenohumeral stability from concavity-compression: a quantitative analysis. *J Shoulder Elbow Surg*. 1993;2(1):27-35. doi:10.1016/S1058-2746(09)80134-1

5. Warner JJ, Lephart S, Fu FH. Role of proprioception in pathoetiology of shoulder instability. *Clin Orthop Relat Res*. 1996;(330):35-39. doi:10.1097/00003086-199609000-00005

6. Myers JB, Lephart SM. The role of the sensorimotor system in the athletic shoulder. *J Athl Train*. 2000;35(3):351-363. https://pmc.ncbi.nlm.nih.gov/articles/PMC1323397/

7. Riemann BL, Lephart SM. The sensorimotor system, part II: the role of proprioception in motor control and functional joint stability. *J Athl Train*. 2002;37(1):80-84. https://pmc.ncbi.nlm.nih.gov/articles/PMC164312/

8. Elser F, Braun S, Dewing CB, Giphart JE, Millett PJ. Anatomy, function, injuries, and treatment of the long head of the biceps brachii tendon. *Arthroscopy*. 2011;27(4):581-592. doi:10.1016/j.arthro.2010.10.014

9. MacDonald P, Verhulst F, McRae S, et al. Biceps tenodesis versus tenotomy in the treatment of lesions of the long head of the biceps tendon in patients undergoing arthroscopic shoulder surgery: a prospective double-blinded randomized controlled trial. *Am J Sports Med*. 2020;48(6):1439-1449. doi:10.1177/0363546520912212

10. Diplock B, Hing W, Marks D. The long head of biceps at the shoulder: a scoping review. *BMC Musculoskelet Disord*. 2023;24(1):232. doi:10.1186/s12891-023-06346-5

11. Rauck RC, Jahandar A, Kontaxis A, et al. The role of the long head of the biceps tendon in posterior shoulder stabilization during forward flexion. *J Shoulder Elbow Surg*. 2022;31(6):1254-1260. doi:10.1016/j.jse.2021.12.026

12. Kholinne E, Kim D, Kwak JM, et al. Topography of sensory receptors within the human glenohumeral joint capsule. *J Shoulder Elbow Surg*. 2021;30(4):779-786. doi:10.1016/j.jse.2020.07.006

13. Day A, Taylor NF, Green RA. The stabilizing role of the rotator cuff at the shoulder: responses to external perturbations. *Clin Biomech (Bristol, Avon)*. 2012;27(6):551-556. doi:10.1016/j.clinbiomech.2012.02.003

14. Alpantaki K, McLaughlin D, Karagogeos D, Hadjipavlou A, Kontakis G. Sympathetic and sensory neural elements in the tendon of the long head of the biceps. *J Bone Joint Surg Am*. 2005;87(7):1580-1583. doi:10.2106/JBJS.D.02840

15. Blumer R, Boesmueller S, Gesslbauer B, et al. Structural and molecular characteristics of axons in the long head of the biceps tendon. *Cell Tissue Res*. 2020;380(1):43-57. doi:10.1007/s00441-019-03141-4

16. Boesmueller S, Blumer R, Gesslbauer B, Hirtler L, Fialka C, Mittermayr R. Molecular pattern and density of axons in the long head of the biceps tendon and the superior labrum. *J Clin Med*. 2019;8(12):2129. doi:10.3390/jcm8122129

17. Guanche CA, Noble J, Solomonow M, Wink CS. Periarticular neural elements in the shoulder joint. *Orthopedics*. 1999;22(6):615-617. doi:10.3928/0147-7447-19990601-12

18. Vangsness CT Jr, Ennis M, Taylor JG, Atkinson R. Neural anatomy of the glenohumeral ligaments, labrum, and subacromial bursa. *Arthroscopy*. 1995;11(2):180-184. doi:10.1016/0749-8063(95)90064-0

19. Witherspoon JW, Smirnova IV, McIff TE. Neuroanatomical distribution of mechanoreceptors in the human cadaveric shoulder capsule and labrum. *J Anat*. 2014;225(3):337-345. doi:10.1111/joa.12215

20. Scanaliato JP, Kerzner B, Bach BR Jr, Garrigues GE. Long head of the biceps tendon pathology: from etiology to management. *J Am Acad Orthop Surg*. 2025;33(20):e1191-e1204. doi:10.5435/JAAOS-D-24-00723

21. Fox JA, Luther L, Epner E, LeClere L. Shoulder proprioception: a review. *J Clin Med*. 2024;13(7):2077. doi:10.3390/jcm13072077

22. Özcan C, Güven N, Kaya S. Does concomitant biceps tenotomy affect shoulder proprioception and strength? A prospective intra-individual comparison after arthroscopic rotator cuff repair. *Med Sci Monit*. 2025;31:e950383. doi:10.12659/MSM.950383

23. Itoi E, Kuechle DK, Newman SR, Morrey BF, An KN. Stabilising function of the biceps in stable and unstable shoulders. *J Bone Joint Surg Br*. 1993;75(4):546-550. doi:10.1302/0301-620X.75B4.8331107

24. Itoi E, Newman SR, Kuechle DK, Morrey BF, An KN. Dynamic anterior stabilisers of the shoulder with the arm in abduction. *J Bone Joint Surg Br*. 1994;76(5):834-836. doi:10.1302/0301-620X.76B5.8083280

25. Pagnani MJ, Deng XH, Warren RF, Torzilli PA, O'Brien SJ. Role of the long head of the biceps brachii in glenohumeral stability: a biomechanical study in cadavera. *J Shoulder Elbow Surg*. 1996;5(4):255-262. doi:10.1016/S1058-2746(96)80051-6

26. Katthagen JC, Wermers J, Paus C, et al. The long head of the biceps has a stabilizing effect on the glenohumeral joint in simulated infraspinatus or subscapularis but not supraspinatus rotator cuff deficiency: a biomechanical study. *Arthroscopy*. 2024;40(4):1059-1065. doi:10.1016/j.arthro.2023.08.018

27. Shavana G, Cronjé JY, Mcduling C, et al. A biomechanical study on the effect of long head of biceps tenotomy on supraspinatus load and humeral head position during shoulder abduction. *Journal of shoulder and elbow surgery*. 2022;31(6):1294-1299. doi:10.1016/j.jse.2021.12.014

28. Healey JH, Barton S, Noble P, Kohl HW III, Ilahi OA. Biomechanical evaluation of the origin of the long head of the biceps tendon. *Arthroscopy*. 2001;17(4):378-382. doi:10.1053/jars.2001.21244

29. Hwang E, Carpenter JE, Hughes RE, Palmer ML. Effects of biceps tension and superior humeral head translation on the glenoid labrum. *J Orthop Res*. 2014;32(11):1424-1429. doi:10.1002/jor.22688

30. Rodosky MW, Harner CD, Fu FH. The role of the long head of the biceps muscle and superior glenoid labrum in anterior stability of the shoulder. *Am J Sports Med*. 1994;22(1):121-130. doi:10.1177/036354659402200119

31. Belk JW, Kraeutler MJ, Houck DA, Chrisman AN, Scillia AJ, McCarty EC. Biceps tenodesis versus tenotomy: a systematic review and meta-analysis of level I randomized controlled trials. *J Shoulder Elbow Surg*. 2021;30(5):951-960. doi:10.1016/j.jse.2020.11.012

32. Hartland AW, Islam R, Teoh KH, Rashid MS. Clinical effectiveness of tenotomy versus tenodesis for long head of biceps pathology: a systematic review and meta-analysis. *BMJ Open*. 2022;12(10):e061954. doi:10.1136/bmjopen-2022-061954

33. Stepanyan H, Hui AT, Hung VT, et al. Biceps tenodesis/tenotomy disrupts biomechanical glenohumeral stability in the setting of superior labrum anteroposterior tear and repair. *Arthroscopy*. 2025;41(11):4440-4451. doi:10.1016/j.arthro.2025.05.022

34. Levy AS, Kelly BT, Lintner SA, Osbahr DC, Speer KP. Function of the long head of the biceps at the shoulder: electromyographic analysis. *J Shoulder Elbow Surg*. 2001;10(3):250-255. doi:10.1067/mse.2001.113087

35. Yamaguchi K, Riew KD, Galatz LM, Syme JA, Neviaser RJ. Biceps activity during shoulder motion: an electromyographic analysis. *Clin Orthop Relat Res*. 1997;(336):122-129. doi:10.1097/00003086-199703000-00017

36. Boileau P, Parratte S, Chuinard C, Roussanne Y, Shia D, Bicknell R. Arthroscopic treatment of isolated type II SLAP lesions: biceps tenodesis as an alternative to reinsertion. *Am J Sports Med*. 2009;37(5):929-936. doi:10.1177/0363546508330127

37. Parnes N, Dunn JC, Czajkowski H, DeFranco MJ, Green CK, Scanaliato JP. Biceps tenodesis as an attractive alternative to superior labral anterior-posterior (SLAP) repair for type II SLAP lesions in active-duty military patients younger than 35 years. *Am J Sports Med*. 2021;49(14):3945-3951. doi:10.1177/03635465211049373

38. Nadeem IM, Vancolen S, Horner NS, Leroux T, Alolabi B, Khan M. Management of failed SLAP repair: a systematic review. *HSS J*. 2020;16(3):261-271. doi:10.1007/s11420-019-09700-3

39. Verma NN, Hoenecke H, MacDonald P, et al. Principles of the superior labrum and biceps complex: an expert consensus from the NEER Circle. *J Shoulder Elbow Surg*. 2025;34(6):1543-1557. doi:10.1016/j.jse.2024.09.040

40. Chalmers PN, Cip J, Trombley R, et al. Restoration of neuromuscular control during the pitch after operative treatment of SLAP tears. *Orthop J Sports Med*. 2014;2(7 suppl 2):2325967114S00034. doi:10.1177/2325967114S00034