Long Head of Biceps Tenodesis; Indications and Techniques: Systematic Review

Adel H. Adawy [a], Mohamed S. Singer [a], Saad A. Shoulah [a], Marwan A. Elsayed [b]

[a] Orthopedic Surgery Department, Faculty of Medicine, Benha University, Benha, Egypt. [b] Orthopedic department faculty of medicine , zagazig university zagazig , sharqia , Egypt.

Correspondence to: Marwan Abd El-Wahab Elsayed, Orthopedic department faculty of medicine , zagazig university zagazig , sharqia , Egypt.

E.Mail: manohopa@gmail.com

Received: 3 July 2019

Accepted: 1 September 2019

Abstract

The long head of the biceps (LHB) tendon is often implicated in various shoulder pathologies because of its anatomic course and its close relation to the rotator cuff and the superior labrum of the glenoid. Non-operative treatment continues to have a role for patients who have mild symptoms with tendinopathy or partial tears of the biceps tendon. Surgical treatment is considered for patients with partial tears of the biceps tendon, biceps pulley lesions and SLAP lesions. The choice of treatment whether repair, tenotomy or biceps tenodesis remains controversial. Biceps tenodesis is the preferred technique to manage LHB lesions especially in younger patients, laborers, athletes and patients who want to avoid a cosmetic deformity. This systematic review suggested that the most commonly used and studied indications for LHB tenodesis were LHB tearing, LHB instability, and LHB tenosynovitis. Biceps tenodesis can be performed by arthroscopic or open techniques, using either soft tissue or bony fixation, and the fixation devices varies from screws to anchors to buttons to just bony tunnels with no hardware. According to our review, both arthroscopic and open biceps tenodesis showed similar pain relief and clinical outcomes and either of these methods may be recommended for patients with disorders of the biceps tendon and there is no consensus about the best fixation technique.

Introduction

Anatomic course and its close relation to the rotator cuff and the superior labrum of the glenoid. (1) There is a persistent controversy regarding the function of the LHB tendon and the management of the various disorders associated with it. (2)

The long head of the biceps (LHB) tendon is often implicated in various shoulder pathologies because of its

Non-operative treatment continues to have a role for patients who have mild

symptoms with tendinopathy or partial tears of the biceps tendon. Non-operative treatment usually involves rest, activity modification, use of non-steroidal anti-inflammatory drugs, physical therapy and corticosteroid injections. [3]

Surgical treatment is considered for patients with partial tears of the biceps tendon, biceps pulley lesions and SLAP lesions. The choice of treatment whether repair, tenotomy or biceps tenodesis remains controversial [4-6] . Biceps tenotomy is usually indicated in patients older than 60 years and can be performed relatively simply arthroscopically. It produces pain relief but is associated with problems such as cramping pain, restricted elbow flexion, cosmetic deformity (Popeye sign), fatigue pain and a decrease in elbow flexion and supination power. [4,5]

Biceps tenodesis is the preferred technique to manage LHB lesions especially in younger patients, laborers, athletes and patients who want to avoid a cosmetic deformity. Tenodesis, although requiring a longer rehabilitation period and having increased technical difficulty in its execution, allows for a better return to physical activity with a lower incidence of cosmetic deformity. [7,8]

Biceps tenodesis can be performed by arthroscopic or open techniques, using either soft tissue or bony fixation, and the fixation devices varies from screws[9]to anchors[10] to buttons[11] to just bony tunnels [12] with no hardware. A biomechanical assessment of 4 tenodesis techniques was performed (open sub-pectoral bone tunnel biceps tenodesis, arthroscopic interference screw technique, open sub-pectoral interference screw fixation technique and arthroscopic suture anchor tenodesis) [13]. However, few clinical studies compare different techniques in biceps tenodesis with conflicting results.

Despite the increased popularity of the procedure and the expanding number of techniques and research analyzing the technical details of fixation, the indications for LHB tenodesis have not been properly evaluated, and there is no consensus about the best fixation technique. The purpose of the current study is to conduct a systematic review of the literature on biceps tenodesis, as regard indications and techniques.

Materials and Methods

A systematic review performed according to PRIMSA guidelines using the Cochrane database of systematic reviews, the Cochrane central register of

controlled trials, PubMed, and MEDLINE as database for search. We included studies published between January 2010 and October 2018.

Search key words will be arthroscopic biceps tenodesis, open biceps tenodesis, sub-pectoral biceps tenodesis and LHB tenodesis.

Inclusion criteria:

- Cadaveric studies.
- Clinical studies with at least 2 years of follow up.
- English literatures only.

Exclusion criteria:

- Non-human studies.
- Reviews, commentaries, and general discussion papers not presenting data on impacts.
- Articles describing techniques only.

When only validated scoring systems were used by the authors in their studies, then the average primary outcome measurement (score) was used to separate patients into those with good or excellent outcomes and those with poor results as described in **table 1**. [14-16]

Table 1: Grading of Objective Scores;

Scoring System	Good or Excellent	Poor
Constant score	>or=40	<40
ASES score	>or=70	<70
SANE score	>or=70	<70

Results

A total of 482 studies were identified in the literature, of which we chose 31[17-46] based on our inclusion and exclusion criteria.

There were 10 studies with Level III evidence, 18 studies with Level IV evidence, 2 studies with level II evidence and one study with level I evidence.

There were 9 studies that evaluated the role of arthroscopic biceps tenodesis and 19 studies that evaluated open biceps tenodesis; out of the 32 articles, there were 3 studies that directly compared open and arthroscopic biceps tenodesis.

The articles we reviewed used a variety of outcome measures, including the American Shoulder and Elbow Surgeons (ASES) score; Constant score; University of California, Los Angeles shoulder score, Simple Shoulder Test score, visual

analog scale (VAS) of pain; Single Assessment Numeric Evaluation score; and personal patient assessments.

The indications used for LHB tenodesis included: shoulder pain, LHB tendon instability, LHB tenosynovitis, LHB tendon tearing, degenerative LHB tendon, clinical exam findings of LHB tendon pathology, SLAP tears, failed SLAP repair, and failed conservative management.

The two most commonly recorded indications were LHB tendon tearing and instability. Tenosynovitis was the third most commonly used indication. Other commonly reported indications for LHB tenodesis in clinical studies included SLAP tear, shoulder pain, and a positive clinical exam.

Among all studies, a total of 423 arthroscopic tenodesis procedures and a total of 840 open tenodesis procedures were performed. The number of patients in each study showed wide variation, ranging from as few as 5 patients to as many as 314patients.

Among all studies, there were 12 studies used interference screws as a fixation device for biceps tenodesis, 4 studies used suture anchors, 2 studies used soft tissue fixation, 3 studies used bony tunnels, one study used endobutton and there were one study did not describe devices at all.

There were one study using single knotless anchors, one study used double knotless anchors and one study used dual suture anchors. Three studies directly compared interference screws and suture anchors.

A study done in 20111, directly compared soft tissue tenodesis (STT group) , suture anchors tenodesis and knotless anchors tenodesis (BFAT group) .In this study, the STT group achieved comparable good and excellent clinical and subjective cosmetic results compared with the BFAT group. However, MRI revealed that in almost 75% of cases, a distalization of the LHB and thereby a failure of the STT was present. This resulted in significantly inferior results, in particular in the objective grading of the cosmetic deformity and the overall LHB score. The comparable good and excellent results concerning pain and function of the STT group compared with the BFAT group may be explained by an auto-tenodesis phenomenon of the LHB within the distal bicipital groove after a failure of the tenodesis has occurred [(36)]

In comparison between soft tissue fixation and interference screws fixation

the serial ultrasound follow-up showed seven empty bicipital grooves in the soft tissue tenodesis (STT) group, compared with two empty grooves in the bony interference tenodesis (BIFT) group, which presented a significant difference. The Popeye deformity occurred in only two of seven patients in the STT group with empty bicipital grooves, and the deformity disappeared before postoperative 6 months. Two patients in the BIFT group with an empty groove never manifested a Popeye deformity in the first place. The percentage of Popeye deformity occurrence showed no significant difference between the two groups.[(42)]

In a cadaveric study, compared between single knotless anchors, double knotless anchors and interference screws fixation. There was no significant difference in cadaver age or bone density between any of the groups. The interference screw fixation had the highest ultimate failure load and stiffness which were significantly higher than the results for the single and double knotless screw groups. The double knotless screw group had the second highest ultimate failure load and stiffness; both values were significantly greater than corresponding results of the single knotless screw fixation. [(43)]

The mean displacement in response to cyclic loading was significantly less for the interference screw group than for the double knotless screw group. The most common mode of failure was suture slippage from the locking mechanism of the anchor screw for both the single (6/8) and double knotless screw (7/8) fixations, while biceps tendon tearing was most common for the interference screw fixation (6/8).[(43)]

The complication rates of patients over 65 years old who underwent open sub-pectoral biceps tenodesis were compared to those of patients younger than 65 years old [(45)]. They found that no difference in complication rates for patients over 65 and that clinical outcome scores were satisfying and showed improvements over time [(45)].

Across all studies, 801 patients (95.4%) who underwent open tenodesis had a good or excellent outcome and 39 patients (4.6%) had a poor outcome.

Across all studies, 404 patients (95.5%) who underwent arthroscopic tenodesis had a good or excellent outcome and 19 patients (4.5%) had a poor outcome.

These findings suggested good or excellent outcomes in both arthroscopic and open tenodesis groups.

Overall, 39 patients in the open tenodesis group had a poor outcome; among these patients, 13 had persistent pain and 16 had failure of the tenodesis with the Popeye deformity. There were also minor complications, which included 3 cases of superficial infection that resolved with antibiotics, 5 cases of stiffness that resolved with physiotherapy, and 2 cases of transient brachial plexopathy that resolved spontaneously within 6 months. Nineteen patients in the arthroscopic tenodesis group had a poor outcome; among these patients, 9 had failure with the presence of the Popeye deformity and 5 had persistent pain. In addition, there were 5 cases of stiffness of the shoulder that resolved with physiotherapy***(Table 2)***.

Table 2. Complications of arthroscopic and open tenodesis

Complications	Arthroscopic	Open
Failure/Popeye deformity	9	16
Persistent pain	5	13
Stiffness	5 (resolved at latest follow-up)	5 (resolved at latest follow-up)
Superficial infection		3 (resolved with antibiotics)
Brachial plexopathy		2 (transient)

Discussion

Our literature review compares the subjective and objective outcomes of biceps tenodesis for lesions of the LHB, both open and arthroscopic. We found that both groups of patients had good to excellent results in 98% of cases.

Lesions of the long head of the biceps brachii can be a significant source of pain in the shoulder. The lesions may vary from degeneration to mechanical irritation, inflammation, or trauma- or sports-related lesions. Biceps tendon lesions are divided into 3 types: instability, inflammatory, and traumatic.[47-50]

The most commonly recorded indications for LHB tenodesis in our systematic review were LHB tearing, LHB instability, and tenosynovitis of the LHB. However, lack of clarity in reporting of surgical indications was noted.

Firstly, tears were not subdivided based on the degree of tearing in this review because most articles did not clearly describe the magnitude of tendon tearing.

Instability of the long head of biceps referred to both subluxation and dislocation. Furthermore, the majority of the studies did not explain whether these findings were detected on clinical exam, through advanced imaging or during the operative procedure and clinical examination were found to be vague and missing important details on the specific diagnostic physical exam maneuvers.

It is very common to have other pathologies concomitant with LHB pathology including but not limited to rotator cuff tears or tendinosis, impingement, labral tears and osteoarthritis (acromioclavicular and glenohumeral). Therefore, it is also the difficulty in diagnosis that makes indications for LHB tenodesis variable and indistinct.

An important challenge noted during this review was the lack of documentation of "conservative management" in the studies reviewed. Conservative management, in most cases, should be the first step in management of LHB pathology. Although failure of conservative management is listed as an indication in many studies (15.4 %), the specific details of the treatment are not consistently reported. The duration of non-operative management and modalities used is also absent from the majority of the studies in this review. This information is important as it allows clinicians appraising the evidence to appreciate what the modality and duration of conservative measures were trialled before surgery.

Treatment of these lesions starts non-operatively with non-steroidal anti-inflammatory drugs, activity modification, physiotherapy, or local steroid injections.

Biceps lesions with failed conservative treatment can be managed surgically, and the options include tenotomy or tenodesis, either arthroscopic or open.

Tenotomy is technically less challenging and may result in muscle cramping and the classic Popeye deformity.[49,51,52]

A variety of open and arthroscopic methods of tenodesis have been reported in the literature.

Biceps tenodesis can be performed by arthroscopic or open techniques, using either soft tissue or bony fixation, and the fixation devices varies from screws to anchors to buttons to just bony tunnels with no hardware.

The soft tissue tenodesis of the LHB is defined as the tenodesis of the LHB to the soft tissue such as the rotator cuff or the rotator interval using suture material. It is also called the percutaneous intra-articular trans-tendon technique.[53]

The bony fixation techniques are the tenodesis of the LHB using a suture anchor, knotless anchor, interference screw, button , bony tunnel , or other techniques such as key-hole fixation.

The outcomes after tenodesis have been generally good. In this systematic review we found 98% good or excellent outcomes of both arthroscopic and open tenodesis of the biceps tendon.

Tenodesis of the LHB shows good results in regard of shoulder function scores and pain relief. However, there is no consensus for the fixation type.

In our review we excluded all articles in which patients underwent a concomitant rotator cuff tear to minimize potentially confounding variables.

In our review of open tenodesis we found a similar complication rate of only 2%.

Our review had a total of 423 arthroscopic LHB tenodesis patients and a total of 840 open LHB tenodesis patients. The number of patients in each study showed wide variation, ranging from 5 to 314 patients.

We found good or excellent results in 98% of patients in both groups. There were 9 failures in patients who underwent arthroscopic tenodesis and 16 failures in the open group.

According to our review, both arthroscopic and open biceps tenodesis showed similar pain relief and clinical outcomes and either of these methods may be recommended for patients with disorders of the biceps tendon.

Conclusion

Biceps tenodesis can be performed by arthroscopic or open techniques, using either soft tissue or bony fixation, and the fixation devices varies from screws to anchors to buttons to just bony tunnels, with no hardware. Both open and arthroscopic biceps tenodesis provided satisfactory outcomes in most patients, and there were no identifiable differences in this review.

Despite the increased popularity of the procedure and the expanding number of techniques and research analyzing the

technical details of fixation, the indications for LHB tenodesis have not been properly evaluated, and there is no consensus about the best fixation technique.

References

1.Friedman DJ, Dunn JC, Higgins LD, Warner JJP. Proximalbiceps tendon: Injuries and management. Sports MedArthrosc.2008;16:162-169.

2.Nho SJ, Strauss EJ, Lenart BA, Provencher, M. T., Mazzocca, et al.. Long head of thebiceps tendinopathy: Diagnosis and management. J AmAcadOrthop Surg. 2010;18:645-656.

3.Wilk KE, Hooks TR. The Painful Long Head of the Biceps Brachii. Clinics in sports medicine. 2016; 35(1): 75-92.

4.Gill TJ, McIrvin E, Mair SD, Hawkins RJ. Results of bicepstenotomy for treatment of pathology of the long head ofthe biceps brachii.J Shoulder Elbow Surg. 2001;10:247-249.

5.Kelly AM, Drakos MC, Fealy S, Taylor SA, O'Brien SJ. Arthroscopic release of the long head of the bicepstendon: Functional outcome and clinical results. Am JSports Med. 2005;33:208-213.

6.Hsu AR, Ghodadra NS, Provencher MT, Lewis, P. B., and Bach B. R. Bicepstenotomy versus tenodesis: A review of clinical outcomesand biomechanical results. J Shoulder Elbow Surg. 2011;20:326-332.

7.Jarrett CD, McClelland WBJ, Xerogeanes JW. Minimallyinvasive proximal biceps tenodesis: An anatomical studyfor optimal placement and safe surgical technique.J Shoulder Elbow Surg. 2011;20:477-480.

8.Ahrens PM, Boileau P. The long head of biceps andassociated tendinopathy.J Bone Joint Surg Br. 2007;89:1001-1009.

9.Boileau P, Krishnan SG, Coste JS, Walch G. Arthroscopic biceps tenodesis: a new technique using bioabsorbable interference screw fixation. Arthroscopy. 2002; 18(9): 1002-1012.

10.Scheibel, M., Schröder, R. J., Chen, J., &Bartsch, M. Arthroscopic soft tissue tenodesis versus bony fixation anchor tenodesis of the long head of the biceps tendon. Am j sports medicine. 2011;39(5): 1046-1052.

11.Snir N, Hamula M, Wolfson T, Laible C, Sherman O. Long head of the biceps tenodesis with cortical button technique. Arthroscopy techniques. 2013; 2(2): e95-e97.

12.Kany J, Guinand R, Amaravathi RS, Alassaf I.The keyhole technique for arthroscopic tenodesis of the long head of the biceps tendon.In vivo prospective study with a radio-opaque marker.OrthopTraumatolSurg Res. 2015; 101(1):31-34.

13.Mazzocca AD, Bicos J, Santangelo S, Romeo AA, Arciero RA. The biomechanical evaluation of four fixationtechniques for proximal biceps tenodesis.Arthroscopy.2005;21:1296-1306.

14. Booker S, Alfahad N, Scott M, Gooding B, Wallace WA. Use of scoring systems for assessing and reporting the outcome results from shoulder surgery and arthroplasty.World J Orthop.2015; 6:244-251.

15. Provencher MT, McCormick F, Dewing C, McIntire S, Solomon D. A prospective analysis of 179 type 2 superior labrum anterior and posterior repairs: Outcomes and factors associated with success and failure. Am J Sports Med. 2013; 41:880-886.

16.Schroder DT, Provencher MT, Mologne TS, Muldoon MP, Cox JS. The modified

Bristow procedure for anterior shoulder instability: 26-year outcomes in Naval Academy midshipmen. Am J Sports Med. 2006; 34:778-786.

17.Gombera MM, Kahlenberg CA, Nair R, Saltzman MD, Terry MA. All-arthroscopic suprapectoral versus open subpectoral tenodesis of the long head of the biceps brachii.Am J Sports Med. 2015; 43:1077-1083.

18. Werner BC. Arthroscopic suprapectoral and open subpectoral biceps tenodesis: A comparison of minimum 2- year clinical outcomes. Am J Sports Med. 2014; 42:2583-2590.

19. Gottschalk MB, Karas SG, Ghattas TN, Burdette R. Subpectoral biceps tenodesis for the treatment of type II and IV superior labral anterior and posterior lesions. Am J Sports Med. 2014; 42:2128-2135.

20. Said HG, Babaqi AA, Mohamadean A, Khater AH, Sobhy MH. Modified subpectoral biceps tenodesis.IntOrthop. 2014; 38:1063-1066.

21. McCormick F, Nwachukwu BU, Solomon D. The efficacy of biceps tenodesis in the treatment of failed superior labral anterior posterior repairs.Am J Sports Med. 2014; 42:820-825.

22. Werner BC, Pehlivan HC, Hart JM. Biceps tenodesis is a viable option for salvage of failed SLAP repair. J Shoulder Elbow Surg. 2014; 23:179-184.

23. Gupta AK, Chalmers PN, Klosterman EL. Subpectoral biceps tenodesis for bicipital tendonitis with SLAP tear. Orthopedics.2015; 38:48-53.

24. Ek ET, Shi LL, Tompson JD, Freehill MT, Warner JJ. Surgical treatment of isolated type II superior labrum anterior-posterior (SLAP) lesions: Repair versus biceps tenodesis.J Shoulder Elbow Surg. 2014; 23:1059-1065.

25. Anthony SG, McCormick F, Gross DJ, Golijanin P, Provencher MT. Biceps tenodesis for long head of the biceps after auto rupture or failed surgical tenotomy: Results in an active population. J Shoulder Elbow Surg. 2015; 24:36-40.

26. Tangari M, Carbone S, Gallo M. Long head of the biceps tendon rupture in professional wrestlers: Treatment with a mini-open tenodesis. J Shoulder Elbow Surg. 2011; 20:409-413.

27. Ng CY, Funk L. Symptomatic chronic long head of biceps rupture: Surgical results. Int J Shoulder Surg. 2012; 6:108-111.

28.Denard PJ, Lädermann A, Parsley BK, Burkhart SS. Arthroscopic biceps tenodesis compared with repair of isolated type II SLAP lesions in patients older than 35 years. Orthopedics.2014; 37:292-297.

29. Shen J, Gao QF, Zhang Y, He YH. Arthroscopic tenodesis through positioning portals to treat proximal lesions of the biceps tendon. Cell BiochemBiophys. 2014; 70:1499-1506.

30. Delle Rose G, Borroni M, Silvestro A. The long head of biceps as a source of pain in active population: Tenotomy or tenodesis? A comparison of 2 case series with isolated lesions.Musculoskelet Surg. 2012; 96:47-52.

31. Gumina S, Carbone S, Perugia D, Perugia L, Postacchini F. Rupture of the long head biceps tendon treated with tenodesis to the coracoid process. Results at more than 30 years.IntOrthop. 2011; 35:713–716.

32. Jancosko JJ, Duggan DP, Nottage WM. Arthroscopically assisted mini-open transdeltoid biceps tenodesis: Surgical technique and preliminary results. Tech Shoulder Elbow Surg. 2013; 14:69–72.

33. Lutton DM, Gruson KI, Harrison AK, Gladstone JN, Flatow EL. Where to tenodese

the biceps: Proximal or distal. ClinOrthop. 2011; 469:1050–1055.

34. Price MD, Anstey DE, Carroll K, Gill TJ. Arthroscopically-assisted biceps tenodesis using a suture anchor. CurrOrthopPract. 2011; 22:524–528.

35. Sanders B, Lavery KP, Pennington S, Warner JJP. Clinical success of biceps tenodesis with and without release of the transverse humeral ligament.J Shoulder Elbow Surg. 2012; 21:66–71.

36. Scheibel M, Schroder RJ, Chen J, Bartsch M. Arthroscopic soft tissue tenodesis versus bony fixation anchor tenodesis of the long head of the biceps tendon. Am J Sports Med. 2011; 39:1046–1052.

37. Senturk I, Ozalay M, Akpinar S, Leblebici B, Murat cinar B, Tuncay C. Clinical and isokinetic comparison between tenotomy and tenodesis in biceps pathologies. ActaOrthopTraumatolTurc.2011; 45:41–46.

38. Shank JR, Singleton SB, Braun S. A comparison of forearm supination and elbow flexion strength in patients with long head of the biceps tenotomy or tenodesis.Arthroscopy.2011; 27:9–16.

39. Soliman OA, Koptan WMT. Proximal humeral fractures treated with hemiarthroplasty: Does tenodesis of the long head of the biceps improve results?.Injury.2013; 44:461–464.

40. Tahal, Dimitri S., J. ChristophKatthagen, Alexander R. Vap, Marilee P. Horan. Subpectoral biceps tenodesis for tenosynovitis of the long head of the biceps in active patients younger than 45 years old. Arthroscopy. 2017; 33.6:1124-1130.

41. Jacxsens, Matthijs, Erin K. Granger, and Robert Z. Tashjian. Clinical and sonographic evaluation of subpectoral biceps tenodesis with a dual suture anchor technique demonstrates improved outcomes and a low failure rate at a minimum 2-year follow-up. Archives of orthopaedic and trauma surgery. 2018; 138.1:63-72.

42. Hwang, Jung-Taek, Cheol Jung Yang.,Kyu-Cheol Noh, Yoon Suk Hyun. Which is better for arthroscopic tenodesis of the long head of the biceps: Soft tissue or bony interference fixation?. Arthroscopy. 2016; 32.4:560-567.

43. Hong, Chih-Kai, Chih-Hsun Chang, Florence L., Chiang, MingJou, et al. Biomechanical properties of suprapectoral biceps tenodesis: double knotless screw fixation is superior to single knotless screw fixation. Archives of orthopaedic and trauma surgery. 2018; 1-8.

44. Hong, Chih-Kai, Kai-Lan Hsu, Fa-ChuanKuan, Cheng-Li Lin, Ming-Long Yeh. Biomechanical Evaluation of a Transtendinous All-Suture Anchor Technique Versus Interference Screw Technique for Suprapectoral Biceps Tenodesis in a Cadaveric Model. Arthroscopy. 2018; 34.6:1755-1761.

45.Voss, Andreas, Simone Cerciello, Jessica DiVenere, Felix Dyrna, John Apostolakos. Open subpectoral biceps tenodesis in patients over 65 does not result in an increased rate of complications. BMC musculoskeletal disorders. 2017; 18.1:430.

46.Schoch, Christian, Michael Geyer, and BjörnDrews. Suprapectoral biceps tenodesis using a suture plate: clinical results after 2 years. Archives of orthopaedic and trauma surgery. 2017; 137.6:829-835.

47. Friedman DJ, Dunn JC, Higgins LD, Warner JJP. Proximal biceps tendon: Injuries and management. Sports Med Arthrosc. 2008; 16:162-169.

48. Nho SJ, Strauss EJ, Lenart BA. Long head of the biceps tendinopathy: Diagnosis and management. J Am AcadOrthop Surg. 2010; 18:645-656.

49. Gill TJ, McIrvin E, Mair SD, Hawkins RJ. Results of biceps tenotomy for treatment of pathology of the long head of the biceps brachii.J Shoulder Elbow Surg. 2001; 10:247-249.

50. Yamaguchi K, Bindra R. Disorders of the biceps tendon. In: Iannotti J, Williams GR, eds. Disorders of the shoulder: Diagnosis and management. Philadelphia: Lippincott Williams& Wilkins. 1999; 159-190.

51. Kelly AM, Drakos MC, Fealy S, Taylor SA, O'Brien SJ. Arthroscopic release of the long head of the biceps tendon: Functional outcome and clinical results. Am J Sports Med. 2005; 33:208-213.

52. Slenker NR, Lawson K, Ciccotti MG, Dodson CC, Cohen SB. Biceps tenotomy versus tenodesis: Clinical outcomes. Arthroscopy.2012; 28:576-582.

53. Sekiya JK, Elkousy HA, Rodosky MW. Arthroscopic biceps tenodesis using the percutaneous intra-articular transtendon technique.Arthroscopy.2003; 19:1137-1141.

To cite this article: Adel H. Adawy, Mohamed S. Singer, Saad A. Shoulah, Marwan A. Elsayed. Long Head of Biceps Tenodesis; Indications and Techniques: Systematic Review. BMFJ 2019;36(1):1-12