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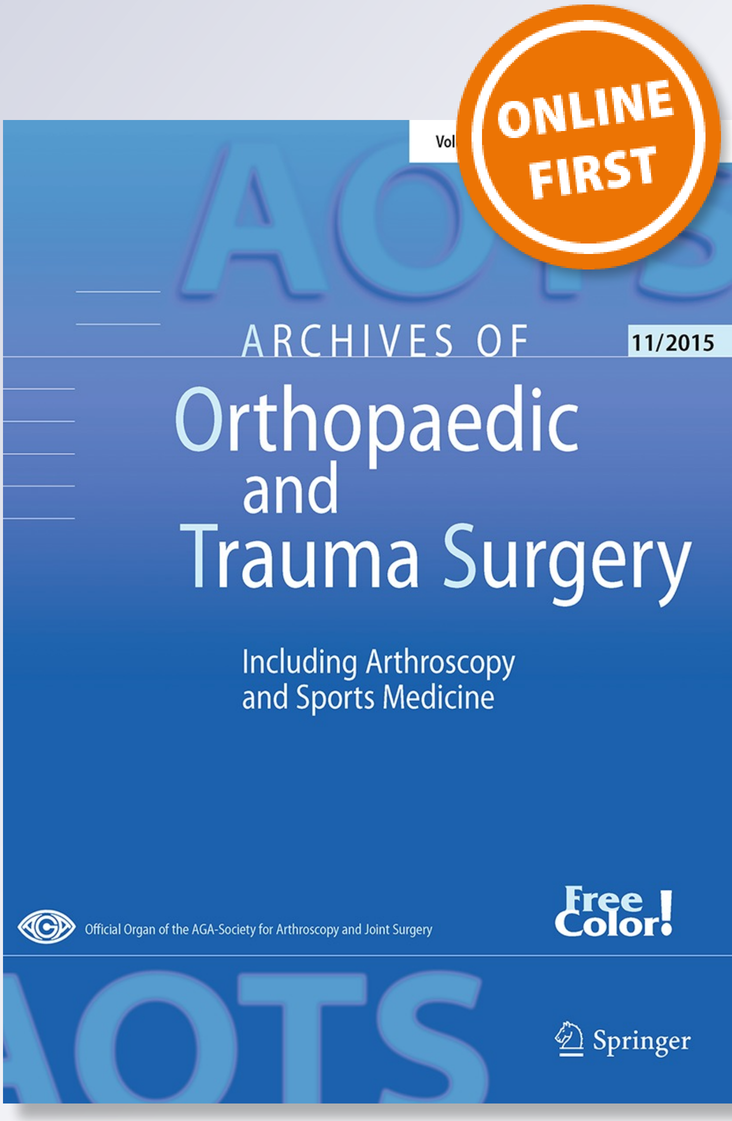

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ARTHROSCOPY AND SPORTS MEDICINE

# Arthroscopic tenodesis versus tenotomy of the long head of biceps tendon in simultaneous rotator cuff repair

**Dominik Meraner[1] · Christoph Sternberg[2] · Jordi Vega[4] · Julia Hahne[1] · Michael Kleine[3] · Jan Leuzinger[2]**

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**Abstract**

*Introduction* Full thickness rotator cuff tears are a common cause of shoulder pain and disability. While the role of the rotator cuff seems to be well known, the clinical significance of the biceps tendon for shoulder function has still been a subject of controversy. The aim of this study was to evaluate differences between tenodesis or tenotomy in simultaneous rotator cuff repair.

*Methods* For this retrospective study 53 consecutive patients (25f/28m, Ø age 58 years) undergoing arthroscopic double row rotator cuff reconstruction and suture bridge repair were included. The LHB was treated with tenodesis ($n = 24$) or tenotomy ($n = 29$). Clinical examination was carried out for all patients after an average of 34 months (range 27–38) following arthroscopic surgery. The Constant score, level of pain, range of motion in flexion and abduction, and isometric force for the operated and healthy shoulder in flexion and abduction were recorded.

*Results* Patients in the tenodesis and tenotomy group reached similar good result regarding the Constant score ($86.6 \pm 11.9$ vs. $81.3 \pm 12.2$; $P = 0.120$), pain (median 0, range 0–8 vs. Median 0, range 0–10; $P = 0.421$), and range of motion (flexion: median 180°, range 90°–180° vs. median 180°, range 90°–180°; $P = 0.833$; abduction: median 180°, range 90°–180° vs. median 180°, range 120°–180°; $P = 0.472$). Postoperative popeye sign was found only in one patient (1.9 %). At the time of postoperative follow-up, no patient reported cramping of the biceps. Isometric forces in abduction of the tenotomy group (mean $4.7 \pm 2.9$ kg; maximum $5.5 \pm 2.8$ kg) was significant lower compared to the tenodesis group (mean $6.6 \pm 3.0$ kg, $P = 0.019$; maximum $7.7 \pm 2.9$ kg, $P = 0.007$) and compared to healthy shoulders (mean $6.1 \pm 3.0$ kg $P = 0.004$; maximum $7.4 \pm 3.1$ kg, $P = 0.001$), all other measurements were similar.

*Conclusion* According to our results arthroscopic biceps tenodesis and tenotomy are valuable procedures in simultaneous rotator cuff repair regarding function, pain, and range of motion. However, the tenotomy group showed reduced strength in abduction.

*Level of evidence* Level IV, retrospective case series.

**Keywords** Tenotomy · Tenodesis · Biceps tendon · Shoulder arthroscopy

## Introduction

Full thickness rotator cuff tears are a common cause of shoulder pain and disability [5]. The all-arthroscopic repair of small, large, and massive rotator cuff tears is a frequently used procedure providing good clinical results [11, 16, 17, 22].

While the role of the rotator cuff seems to be well known, the clinical significance of the biceps tendon for shoulder function has been a subject of controversy for some time.

There is a wide consensus that the long head of the biceps (LHB) tendon is a troublesome pain generator in the shoulder. Isolated LHB pathologies, such as tenosynovitis,

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rupture, subluxation or instability pulley lesions, and SLAP lesions were successfully treated with tenotomy or tenodesis [1, 3, 4, 8, 10].

Walch [24] and Boileau [3] described in two independent studies that performing tenotomy or tenodesis of the LHB tendon can effectively treat severe pain and dysfunction caused by an irreparable rotator cuff tear. Despite these encouraging clinical results, arthroscopic tenotomy does not appear to alter the progressive radiographic changes that occur with long-standing rotator cuff tears [3, 24]. Some authors detected that the LHB played a key role in the development of full thickness rotator cuff tears [12, 13]. Instability of the LHB varies from subluxation to dislocation and is usually associated with rotator cuff tears, especially subscapularis tendon tears [2]. Habermeyer et al. [9] defined four different arthroscopically observed types of lesions of the superior glenohumeral ligament (SGHL) combined with LHB instability and supraspinatus and/or subscapularis tendon tears. They found that a pulley lesion leads to instability of the LHB tendon, causing increased passive anterior translation and upward migration of the humeral head, resulting in an anterosuperior impingement of the shoulder.

While the role of the LHB tendon as a troublesome pain generator in the shoulder seems to be clear, there is doubt about its biomechanical function. A majority of biomechanical studies investigating the role of the LHB have focused on its contributions to glenohumeral stability, restraining abnormal translations [10, 14, 18]. Pagnani et al. [18] tested the effect of simulated contraction of the LHB in 10 cadaveric shoulders and showed significantly decreased humeral head translations anteriorly, superiorly, and inferiorly when load was applied to the biceps, especially in lower angles of elevation. Itoi et al. [10] concluded from their biomechanical studies that the LHB and the short head of the biceps brachii are anterior stabilizers to the glenohumeral joint in abduction and external rotation. Kumar et al. [14]. found in their biomechanical studies that the LHB plays a stabilizing role in the glenohumeral joint in powerful elbow flexion and supination. In vivo radiographic studies as performed by Warner and McMahon [25] showed a significant superior translation of the humeral head at all degrees of abduction in patients with rupture of the LHB. In another study intraoperative electrical stimulation of the biceps muscle was performed during arthroscopy and five patients showed a better central positioning of the humeral head.

Kido et al. [12] documented in their radiographic study higher humeral head positions in patients with rotator cuff tears without contraction of the biceps tendon. Because of the difficulties to perform biomechanical and in vivo studies there is still no consens about the role of the LHB tendon in glenohumeral kinematics.

Current surgical treatment strategies of LHB pathologies are either reconstructive techniques and tenodesis or tenotomy. Based on our experience, surgical repair is only indicated in rare cases and is not recommendable in cases of arthroscopic full rotator cuff tear repair. There is only little knowledge of combined rotator cuff repair and tenodesis or tenotomy of the LHB [6, 8, 13, 15, 21].

Hyun et al. [15] proved that arthroscopic biceps tenodesis done with one suture anchor resulted in good clinical outcomes, when done along with rotator cuff repair at the same time. Shank et al. [23] found no statistical difference concerning clinical function in the elbow joint. Forearm supination and elbow flexion strength were the same in the tenotomy-, tenodesis- and control groups. Other authors described differences between tenotomy and tenodesis in the development of a popeye sign, but could not find significant differences in the clinical or functional outcome when concomitant rotator cuff lesions repair was performed [6, 13, 21].

In our institution, arthroscopic rotator cuff repair is frequently performed with concomitant tenodesis or tenotomy, since we believe that persistent pain from the LHB is likely to have more negative functional consequences than the loss of the tendon itself. And, therefore, the aim of the present study was to evaluate differences between tenotomy or tenodesis in simultaneous rotator cuff repair.

## Materials and methods

This retrospective study included 53 patients (25 females, 28 males) with a mean age of 58.49 years (range 39–77), who underwent arthroscopic double row rotator cuff reconstruction and suture bridge repair between March and July 2009. All patients underwent preoperative magnetic resonance imaging (MRI) and plain X-rays were also taken, namely anteroposterior and outlet view. No postoperative MRI was performed, except for patients having persistent pain or loss of function for more than 3 months postoperatively. Plain X-rays were performed on the first day after surgery and 6 weeks postoperatively. Included were only patients with a preoperative MRI, verifying rupture or partial rupture of the supraspinatus tendon, pain and/or loss of function of their shoulder and positive clinical tests (e.g. Jobe test) for the supraspinatus. The decision for tenodesis or tenotomy was made intraoperatively. If the LHB tendon showed a complete or partial rupture or severe degenerative signs like intratendineous splitting, tenotomy was performed. Excluded were patients with an irreparable rupture of the supraspinatus tendon, due to degeneration or retraction of the ruptured tendon to the level of the glenoid [19].

## Surgical procedure

All patients were operated by two experienced surgeons who were not involved in the follow-up evaluation of the patients. For the standardized arthroscopic surgery, all patients were placed in the beach chair position, after regional anesthesia with an interscalene block was administered. A 4-mm scope with a 30° angle was used for imaging. After setting a dorsal standard portal for the camera entrance, a diagnostic arthroscopy was performed to evaluate the subscapularis, supraspinatus, and infraspinatus tendon. The LHB tendon, its pulley, the sulcus bicipitalis, and the labral complex and glenohumeral ligaments were also assessed and all pathologic findings were photo-documented (Fig. 1).

Tenodesis was performed with a common suture anchor loaded with two orthocord sutures (Fig. 2). The anchor was placed in the bicipital groove (Fig. 2a); one suture was passed through the tendon twice, and the other one passed through the tendon using lasso loop technique (Fig. 2b). After knotting the sutures with a common knot pusher, the tendon was cut with a radiothermal device and projecting parts of the tendon were cut off with a punch.

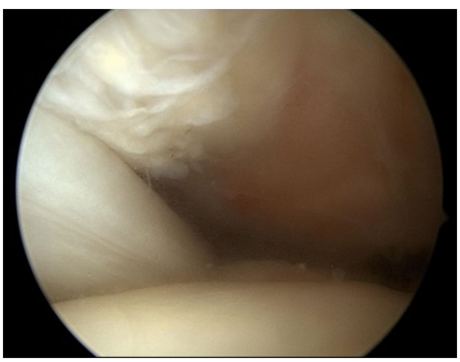

**Fig. 1** Long head of biceps (LHB) tendon with pulley lesion and rupture of the supraspinatus (SSP) tendon

Tenotomy was performed according to Koh et al. [13] by cutting the tendon with a broad part of the superior labrum, which then sticks in the sulcus bicipitalis leading to a kind of soft tissue tenodesis.

Tenotomy and tenodesis were performed in 54.7 and 45.3 % of patients, respectively. Concomitant treatments included acetabuloclavicular joint resection (43.4 %) and capsulotomy (9.4 %). Alltogether, 5/53 = 0.0943 = 9.4 % (SLAP) and 9/53 = 0.1698 = 17.0 % pulley lesions were detected. 22/53 = 0.4150 = 41.5 % presented with synovitis of the LHB.

All patients were treated with an abduction-orthesis for 6 weeks and restricted weight bearing in elbow flexion for further 2 weeks. Regular assisted physiotherapy was not applicable in our postoperative regime.

Postoperative clinical examination included the Constant score; pain was measured on a scale from 0 (no pain) to 15 points (extreme pain), and the range of motion in flexion and abduction was assessed using a goniometer. Isometric force in both arms was measured in abduction and flexion with IsoForce Control EVO2.

## Statistics

Descriptive statistics were used to summarize baseline data. For categorical variables, percentages were calculated. Normal distribution was determined visually by the

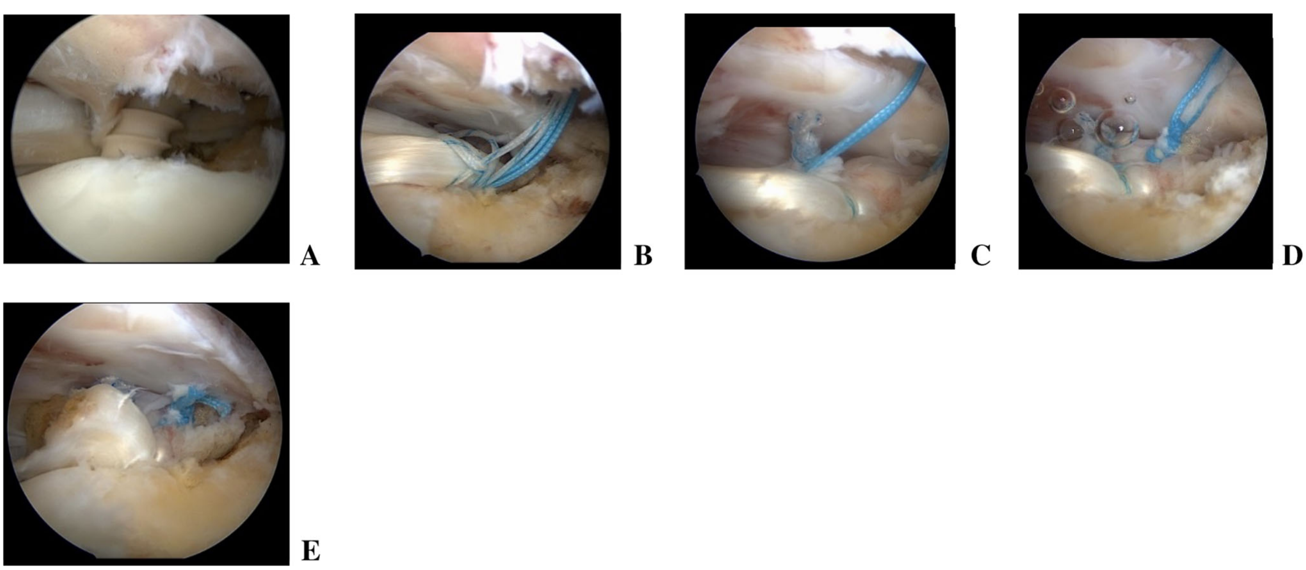


**Fig. 2** Tenodesis: **a** insertion of the screw in the bicipital groove after preparing the sulcus with the shaver. **b** Lasso loop. **c** Lasso loop after cutting and preparing the modified Mason-Allen stitch. **d** Knotting of the second wire. **e** Result of the tenodesis after tenotomy

**Table 1** Baseline characterisctics

| | Tenodesis ($n = 24$) | Tenotomy ($n = 29$) | $P$ value* |
|---|---|---|---|
| Age (years) | 57.6 ± 9.0 | 59.2 ± 9.2 | 0.530 |
| Gender (female/male) | 9/15 | 16/13 | 0.271 |
| Shoulder side (right/left) | 14/10 | 19/10 | 0.776 |
| Dominant arm (yes/no) | 14/10 | 22/7 | 0.240 |
| Concomitant treatment(s) | | | |
| Acetabuloclavicular joint resection (yes/no) | 11/13 | 12/17 | 0.786 |
| Capsulotomy (yes/no) | 3/21 | 2/27 | 0.649 |

* Indepentent *t* test and Chi-square tests

inspection of histograms and using the Kolmogorov–Smirnov test. Normal distributed continuous variables were expressed as mean and standard deviation, while for non-normal distributed continuous variables median and range were used. Equity of variances was established by performing Levenes tests. Treatment group comparisons were performed using independent *t* tests and Mann–Whitney *U* tests, Chi-square, and Kruskal–Wallis tests. Paired *t* tests were performed to analyze differences regarding isometric forces between operated and healthy shoulders. The alpha level was maintained at a $P < 0.05$ for all analyses. All data were analyzed using SPSS 21® (IBM® Corporation, Armonk, USA).

## Results

Baseline characteristicts of the tenodesis and tenotomy group were similar (Table 1).

The majority of patients reached a Constant score above 80 points (75.5 %; mean and SD: 83.7 ± 12.3), had no pain (0 points; 77.4 %; median 0 range 0–10), and yield full range of motion in flexion (88.7 %; median 180 range 90–180) and abduction (79.2 %; median 180 range 90–180). However, there was no significant difference between the treatment groups regarding Constant score, pain, and range of motion (Table 2). Postoperative popeye sign was found only in one patient (1.9 %) of the tenotomy group. At the time of postoperative follow-up, no patient reported cramping of the biceps. Isometric force measurements of the operated shoulder showed significant differences between the tenotomy and tenodese group in mean and maximum abduction, but not in flexion (Table 2). Paired comparisons between all operated and healthy shoulders showed also significant differences between mean (5.6 ± 3.1 vs. 6.5 ± 3.4, $P = 0.004$) and maximum (6.5 ± 3.0 vs. 8.0 ± 4.4, $P = 0.002$) abduction force, but not for isometric force in flexion (mean 12.5 ± 5.7 vs. 13.0 ± 6.2, $P = 0.509$; maximum 14.5 ± 5.9 vs. 14.5 ± 6.8, $P = 0.921$). However, isometric forces in abduction of the tenotomy group was significantly lower compared to the tenotomy group and compared with healthy shoulders (Table 2).

## Discussion

Arthroscopic tenotomy and tenodesis of the LHB tendon combined with arthroscopic rotator cuff repair in a cohort of 53 patients showed similar results in function, pain, range of motion, and strength, except for the isometric force in the abduction, in which case the tenotomy group had poorer results.

We have compared our results to the ones published from other authors.

Boileau et al. [4] reported a final Constant score of 61.2 in 39 cases of tenotomy and 72.8 in 33 cases of tenodesis, which are lower than the Constant scores in our cohort. But it has to be taken into account that the majority of the cohort had massive, irreparable rotator cuff tears (34 out of 43). Therefore, the poorer clinical outcome is no surprise.

Edwards et al. [7] found patient satisfaction in 82 % of the cases of tenotomy versus in 90 % of tenodesis. We could also find a high grade of satisfaction in our tenotmoy group, as there were no cases of cramping of the biceps.

Scheibel et al. [20] conclude in a comparative study that bony anchor fixation might have better results in functional outcomes, contrary to our results. Significant differences were found for the LHB-score, the cosmetic result and the structural integrity of the construct. But for the constant score results were the same in both groups—like that in our study.

Zhang et al. [27] found that tenotomy and tenodesis done simultaneously with rotator cuff repair deliver the same results regarding strength as well as Constant score.

Wittstein and Queen [29] state that the tenotomy group had lower supination peak torque relative to the nonoperated side, compared to the tenodesis group. But there was no difference when measuring peak flexion torque or supination or flexion endurance.

Koh et al. [13] found similar results in functional outcome in their comparative study between tenotomy and

**Table 2** Postoperative outcome compared between tenodesis and tenotomy

| | Tenodesis ($n = 24$) | Tenotomy ($n = 29$) | *P* value* |
|---|---|---|---|
| Constant score (points) | 86.6 ± 11.9 | 81.3 ± 12.2 | 0.120 |
| Pain (0–15 points) | 0 (0–8) | 0 (0–10) | 0.421 |
| Flexion (°) | 180 (90–180) | 180 (90–180) | 0.833 |
| Abduction (°) | 180 (90–180) | 180 (120–180) | 0.472 |
| Cramps (yes/no) | 0/24 | 0/29 | – |
| Popeye sign (yes/no) | 0/24 | 1/28 | 1.000 |
| Isometric force measurements | | | |
| Operated shoulder in flexion (mean[a], kg) | 13.3 ± 5.7 | 11.8 ± 5.7 | 0.340 |
| Healthy shoulder in flexion (mean[a], kg) | 12.9 ± 6.6 | 13.1 ± 6.0 | 0.892 |
| *P* value[b] (operated vs. healthy) | 0.708 | 0.157 | – |
| Operated shoulder in flexion (maximum, kg) | 15.2 ± 6.0 | 13.9 ± 5.9 | 0.446 |
| Healthy shoulder in flexion (maximum, kg) | 14.0 ± 7.1 | 15.0 ± 6.7 | 0.606 |
| *P* value[b] (operated vs. healthy) | 0.308 | 0.064 | – |
| Operated shoulder in abduction (mean[a], kg) | 6.6 ± 3.0 | 4.7 ± 2.9 | **0.019** |
| Healthy shoulder in abduction (mean[a], kg) | 7.0 ± 3.9 | 6.1 ± 3.0 | 0.366 |
| *P* value[b] (operated vs. healthy) | 0.393 | **0.004** | **–** |
| Operated shoulder in abduction (maximum, kg) | 7.7 ± 2.9 | 5.5 ± 2.8 | **0.007** |
| Healthy shoulder in abduction (maximum, kg) | 8.7 ± 5.5 | 7.4 ± 3.1 | 0.310 |
| *P* value[b] (operated vs. healthy) | 0.224 | **0.001** | – |

* Independent *t* tests and Mann–Whitney *U* tests, Chi-square tests, and Kruskal–Wallis tests

[a] Mean of three measures

[b] Paired *t* tests

tenodesis, but described the occurence of more popeye signs in patients treated with tenotomy.

Interestingly, only one patient of the tenotomy group showed a popeye sign, while none of the tenodesis group reported a sign of migration of the LHB. This might be explainable, because the technique used for tenotomy described by Kim [13] leads to a broad shaped rear section of the loose end of the tendon, which normally gets stuck in the sulcus leading to a soft tissue tenodesis.

There were also no signs of cramping in our tenotomy group at the time of follow-up; however, cramping sensations shortly after surgery were not evaluated.

Other authors such as Kany et al. [26] also reported no cases of cramping in their study, whereas Duff et al. [28] could find such a condition in only 2 out of 117 patients after tenotomy.

Limitations of the present study are mainly related to its retrospective design. No preoperative data were available. Furthermore, it was not possible to evaluate, since it was not a randomized trial and the two treatment groups were not compared to all arthroscopic rotator cuff repair without LHB treatment, if the simultaneous rotator cuff repair influenced the outcome of the LHB-tendon-intervention in any way.

We conclude that according to our results arthroscopic LHB tendon tenotomy and tenodesis are both valuable procedures in simultaneous rotator cuff repair regarding function, pain, and range of motion. However, patients after tenotomy showed reduced strength in abduction.

We also conclude that tenotomy combined with cuff repair probably might be a cost- and time-saving procedure compared to tenodesis, because there is no implant needed and there is also no need for any kind of knotting technique.

**Compliance with ethical standards**

**Conflict of interest** None.

## References


1. Andrews JR, Carson WG Jr, McLeod WD (1985) Glenoid labrum tears related to long head of the biceps. Am J Sports Med 13:337–341
2. Bennet WF (2003) Arthroscopic repair of isolated subscapularis tears: a prospective cohort with 2- to 4-year follow-up. Arthroscopy 19(2):131–143. doi:10.1053/jars.2003.50053
3. Boileau P, Baqué F, Valerio L, Ahrens P, Chuinard C, Trojani C (2007) Isolated arthroscopic biceps tenotomy or tenodesis improves symptoms in patients with massive irreparable rotator cuff tears. J Bone Joint Surg Am 89(4):747–757. doi:10.2106/JBJS.E.01097
4. Boileau P, Krishan SG, Coste JS, Walch G (2002) Arthroscopic biceps tenodesis: a new technique using bioabsorbable

interference screw fixation. Arthroscopy 18(9):1002–1012. doi:10.1053/jars.2002.36488
5. Cofield RH (1985) Rotator cuff disease oft he shoulder. J Bone Joint Surg Am 67(6):974–979
6. De Carli A, Vadalà A, Zanzotto E, Zampar G, Vetrano M, Iorio R, Ferretti A (2012) Reparable rotator cuff tears with concomitant long.head biceps lesions: tenotomy or tenotomy/tenodesis? Knee Surg Sports Traumatol Arthrosc 20(12):2553–2558. doi:10.1007/s00167-012-1918-5 **(Epub 2012 Feb 15)**
7. Edwards TB, Walch G, Sirveaux F, Molé D, Nové-Josserand L, Boulahia A, Neyton L, Szabo I, Lindgren B (2005) Repair of tears of the subscapularis. J Bone Joint Surg Am 87(4):725–730. doi:10.2106/JBJS.D.02051
8. Frost A, Zafar MS, Maffulli N (2009) Tenotomy versus tenodesis in the management of pathologic lesions of the tendon of the long head of the biceps brachii. Am J Sports Med 37(4):828–833. doi:10.1177/0363546508322179 **(Epub 2008 Sep 1)**
9. Habermeyer P, Magosch P, Pritsch M, Scheibel MT, Lichtenberg S (2004) Anterosuperior impingement of the shoulder as a result of pulley lesions: a prospective arthroscopic study. J Shoulder Elbow Surg 13(1):5–12. doi:10.1016/j.jse.2003.09.013
10. Itoi E, Kuechle DK, Newman SR, Morrey BF, An KN (1993) Stabilising function of the biceps in stable and unstable shoulders. J Bone Joint Surg Br 75:546–550
11. Jones CK, Savoie FH 3rd (2003) Arthroscopic repair of large and massive rotator cuff tears. Arthroscopy 19(6):564–571. doi:10.1016/S0749-8063(03)00169-5
12. Kido T, Itoi E, Konno N, Sano A, Urayama M, Sato K (2000) The depressor function of biceps on the head of the humerus in shoulders with tears of the rotator cuff. J Bone Joint Surg Br 82:416–419
13. Kho KH, Ahn SH, Kim SM, Yoo JC (2010) Treatment of biceps tendon lesions in the setting of rotator cuff tears: prospective cohort study of tenotomy versus tenodesis. Am J Sports Med 38(8):1584–1590. doi:10.1177/0363546510364053. **(Epub 2010 Jun 15)**
14. Kumar VP, Satku K, Balasubramaniam P (1989) The role of the long head of the biceps brachii in the stabilization of the head of the humerus. Clin Orthop Relat Res 244:172–175
15. Lee HI, Shon MS, Koh KH, Lim TK, Heo J, Yoo JC (2014) Clinical and radiologic results of arthroscopic biceps tenodesis with suture anchor in the setting of rotator cuff tear. J Shoulder Elbow Surg 23(3):e53–e60. doi:10.1016/j.jse.2013.06.004 **(Epub 2013 Sep 8)**
16. Lyons TR, Savoie FH 3rd, Field LD (2001) Arthroscopic repair of partial-thickness tears of the rotator cuff. Arthroscopy 17(2):219–223
17. Millet PJ, Mazzocca A, Guanche CA (2004) Mattress double anchor footprint repair: a novel, arthroscopic rotator cuff repair technique. Arthroscopy 20(8):875–879. doi:10.1016/j-arthro.2004.07.015
18. Pagnani MJ, Deng XH, Warren RF, Torzilli PA, O'Brien SJ (1996) Role of the long head of the biceps brachii in glenohumeral stability: a biomechanical study in cadavera. J Shoulder Elbow Surg 5(4):255–262
19. Patte D (1990) Classification of rotator cuff lesions. Clin Orthop Relat Res (254):81–86
20. Scheibel M, Schröder RJ, Chen J, Bartsch M (2011) Arthroscopic soft tissue tenodesis versus bony fixation anchor tenodesis of the long head of the biceps tendon. Am J Sports Med 39(5):1046–1052. doi:10.1177/0363546510390777 **(Epub 2011 Jan 21)**
21. Sentürk I, Ozalay M, Akpinar S, Leblebici B, Cinar BM, Tuncay C (2011) Clinical and isokinetik comparison between tenotomy and tenodesis in biceps pathologies. Acta Orthop Traumatol Turc 45(1):41–46. doi:10.3944/AOTT.2011.2308 **(Epub 2010 Jun 15)**
22. Severud EL, Ruotolo C, Abbott DD, Nottage WM (2003) All-arthroscopic versus mini-open rotator cuff repair: a long term retrospective outcome comparison. Arthroscopy 19(3):234–238. doi:10.1053/jars.2003.50036
23. Shank JR, Singleton SB, Hawkins J, Decker MJ, Torry MR (2006) A comparison of supination and elbow flexion strength in patients either proximal biceps release or tenodesis. Presented at the Meeting of the American Orthopedic Society for Sports Medicine, Hershey
24. Walch G, Edwards TB, Boulahia A, Nové-Josserand L, Neyton L, Szabo I (2005) Arthroscopic tenotomy of the long head of the biceps in the treatment of rotator cuff tears: clinical and radiographic results of 307 cases. J Shoulder Elbow Surg 14(3):238–246. doi:10.1016/j.jse.2004.07.008
25. Warner JJ, MCMahon PJ (1995) The role of the long head of the biceps brachii in superior stability of the glenohumeral joint. J Bone Joint Surg Am 77:366–372
26. Kany J, Guinand R, Amaravathi RS, Alassaf I (2015) The keyhole technique for arthroscopic tenodesis of the long head of the biceps tendon. In vivo prospective study with a radio-opaque marker. Orthop Traumatol Surg Res 101(1):31–34. doi:10.1016/j.otsr.2014.10.016 **(Epub 2015 Jan 8)**
27. Zhang Q, Zhou J, Ge H, Cheng B (2015) Tenotomy or tenodesis for long head biceps lesions in shoulders with reparable rotator cuff tears: a prospective randomised trial. Knee Surg Sports Traumatol Arthrosc 23(2):464–469. doi:10.1007/s00167-013-2587-8 **(Epub 2013 Jul 5)**
28. Duff SJ, Campbell PT (2012) Patient acceptance of long head of biceps brachii tenotomy. J Shoulder Elbow Surg 21(1):61–65. doi:10.1016/j.jse.2011.01.014 **(Epub 2011 Mar 30)**
29. Wittstein JR, Queen R, Abbey A, Toth A, Moorman CT 3rd (2011) Isokinetic strength, endurance, and subjective outcomes after biceps tenotomy versus tenodesis: a postoperative study. Am J Sports Med 39(4):857–865. doi:10.1177/0363546510387512 **(Epub 2010 Dec 28)**