



## Comparison of the clinical outcomes of chronic rupture, arthroscopic tenotomy and tenodesis of proximal biceps tendon

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### Abstract

Biceps tendon disorders are substantial cause of intense shoulder pain, and thus they require a careful medical attention. We compared the clinical outcomes of chronic rupture, tenotomy and tenodesis of proximal biceps tendon of patients underwent arthroscopic shoulder surgery. We included 98 patients over 50 years-old who underwent arthroscopic surgery for rotator cuff tears and grouped as tenotomy, tenodesis and chronic rupture of biceps tendon. Preoperative and postoperative 24-months follow-up Visual Analog Scale (VAS) score and the University of California–Los Angeles (UCLA) Shoulder Scale scores were compared. Chronic biceps rupture was the most common pathology in massive rotator cuff rupture group (75.9%). As tenotomy, tenodesis and chronic rupture groups were compared in terms of VAS and UCLA score improvements (preoperative and postoperative change); tenotomy showed better outcomes and there was a statistically significant difference between tenotomy and tenodesis groups in terms of improvements in VAS and UCLA scores ( $p = 0.036$ ,  $p = 0.010$ , respectively). No statistically significant difference between chronic rupture and tenodesis in terms of VAS and UCLA scores improvements were observed ( $p = 1.000$ ,  $p = 0.250$ , respectively). Also, tenotomy showed superior VAS score improvement than chronic tendon rupture ( $p=0.024$ ) however no statistically significant difference was observed in UCLA score improvement between tenotomy and chronic rupture ( $p = 0.527$ ). According to our study, tenotomy seems to be a more appropriate surgical method than tenodesis in massive and full-thickness rotator cuff tears with severe biceps tendon degeneration, and also it is not necessary to perform tenodesis in cases with chronic biceps rupture.

**Keywords:** chronic proximal biceps tendon rupture, biceps tenodesis, biceps tenotomy, rotator cuff tear, shoulder, shoulder arthroscopy

### 1. Introduction

The functional role of the long head of the biceps tendon (LHBT) is still not fully established. However, biceps tendon disorders are substantial cause of intense shoulder pain and range of motion (ROM) limitation, and thus they require a remarkable medical attention. It is important to reveal the relationship between biceps tendon disorders and other shoulder lesions since the treatment of a local shoulder lesion may not solve all shoulder complaints of the patient. The LHBT originates from the superior glenoid tubercle and superior labrum, extends through the intra-articular space and passes distally through the intertubercular sulcus (1). The close relationship of proximal biceps tendon with the shoulder ligaments and rotator cuff muscles causes high stress exposure and wear due to function. In this way, LHBT disorders are seen in a wide spectrum; from mild inflammation to complete chronic rupture.

Chronic rupture of the LHBT may occur due to inflammatory arthritis, osteophyte formation, subacromial impingement syndrome, rotator cuff tear, local injections applied to biceps tendon sheath and high-dose corticosteroid therapy (2). It occasionally develops in patients over the age of 50 and is usually associated with intrinsic tendon degeneration at the superior labrum insertion or in the

bicipital groove (3, 4). There is yet no consensus on the treatment modalities of biceps tendon ruptures however, acute ruptures in high demanding physically active patients may require surgical interventions while non-operative treatment may be sufficient in sedentary patients with chronic degeneration (5). Nevertheless, each patient should be evaluated separately, and the treatment decision should be made individually.

Although there are many studies in the literature comparing tenotomy and tenodesis performed in patients underwent shoulder arthroscopy (6-8), to the best of our knowledge, there is no study that compares the clinical outcomes between chronic biceps tendon rupture and tenotomy or tenodesis. In this study, we aimed to compare the postoperative 24-months clinical results of patients with chronic rupture of the LHB and patients who underwent tenotomy or tenodesis. By comparing the preoperative and postoperative VAS and UCLA score improvements of the patients which we divided into three groups (chronic rupture, tenotomy and tenodesis), we investigated the following research questions:

1- Is there a statistically significant difference between

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preoperative and postoperative clinical outcomes of tenodesis, tenotomy and chronic biceps rupture?

2-Is tenodesis a necessity in patients with severe biceps tendon degeneration? Is tenotomy sufficient?

## 2. Materials and Methods

A retrospective study was carried out with the approval of our institutional review board in accordance with the Declaration of Helsinki. 179 patients who underwent arthroscopic shoulder surgery between January 2016 and January 2021 in our institute were analyzed. Patients over the age of 50 who underwent arthroscopic shoulder surgery and who were compatible with the standard follow-up program and at least 24 months follow-up in our institute were included in this study. Exclusion criteria were follow-up duration less than 24 months, incomplete follow-up data, previous surgery of the same shoulder, systemic inflammatory diseases and patients who did not have biceps disorders (Fig.1).



Fig.1A-1B. Utilization of the tenotomy process

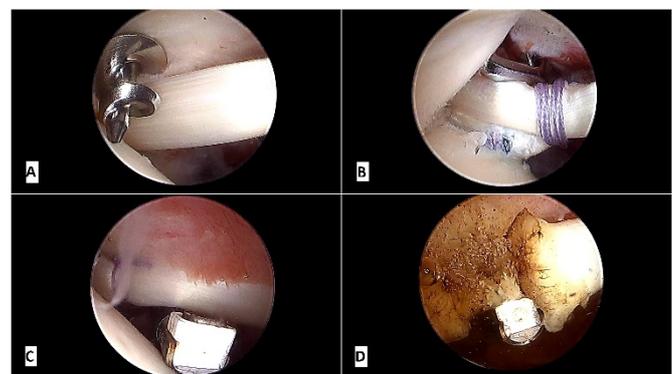
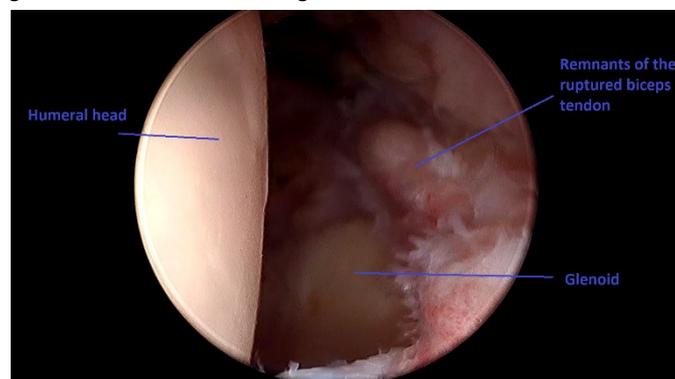


Fig. 2A: Anchor application to the humeral head for tenodesis, 2B: Suture application to the long head of biceps tendon, 2C: Identification of the tenotomy level of biceps tendon, 2D: Application of the tenotomy process

Tenotomy or tenodesis was preferred by the surgeon in response to tendon tears, injury or inflammation and according to biceps tendon degeneration severity. All surgeries were performed by the same surgeon in beach chair position. Arthroscopic tenotomy or tenodesis was performed to biceps tendon if significant degeneration was observed (Fig.2). Tenodesis was performed using suture anchor technique (Fig.2). The rotator cuff tears were repaired with either tendon-tendon, tendon-bone or both with suture anchors. Debridement was only performed to the superior glenolabral insertion area of biceps tendons with chronic rupture (Fig.3). Velpeau Bandage was applied to all patients

postoperatively. After 1 week of immobilization, passive ROM exercises were performed. Active ROM exercises were allowed after 6 weeks. Clinical follow-ups were routinely performed. In our clinical follow-ups, we routinely record UCLA and VAS score analysis in the preoperative and postoperative periods in order to assess the effectiveness of our surgical treatment. The preoperative and postoperative 24-months UCLA and VAS score records of all patients included in our study were compiled and analyzed. The cases were analyzed retrospectively, with video images recorded during surgery, medical records and preoperative and postoperative scale forms of each scoring systems. The preoperative and postoperative differences of UCLA scale and VAS scoring systems for all three groups that we divided into three groups as tenotomy, tenodesis and chronic biceps rupture were compared.

Fig. 3. Chronic rupture of long head of biceps tendon. The glenolabral insertion are is degenerated and the tendon which cannot



be visualized in the picture, is retracted within the bicipital groove.

### 2.1. Statistical analysis

Statistical analysis was carried out with SPSS v.22.0 software (SPSS Inc., IBM Corporation, Armonk, New York, USA). For this study, due to the data not being normally distributed ( $p < 0.05$ , Shapiro-Wilk test), non-parametric tests were used to compare the independent groups and pairwise comparison tests were used to determine the particular differentiating group. Preoperative and postoperative scores were compared using a repeated-measure Wilcoxon signed rank test. The study was carried out at 95% confidence level and  $p < 0.05$  was considered statistically significant.

### 3. Results

Of the 98 patients (mean age  $61.2 \pm 8.44$ ; range 50-83, 41 male); 31 (31.6%) had tenotomy, 31 (31.6%) had tenodesis and 36 (36.7%) patients had chronic tendon rupture. When the cuff pathologies of the patients were examined, partial rotator cuff tear was observed in 33 (33.7%) cases, full-thickness in 36 (36.7%) cases, and massive rotator cuff tear in 29 (29.6%) cases. Within the tenotomy group, patients with partial (16.6%) and full thickness rotator cuff tears (46.7%) were in the majority; while in chronic biceps tendon rupture group, massive rotator cuff tears were mostly observed (75.9%).

**Table 1.** Preoperative and Postoperative VAS and UCLA score values (minimum, maximum, median)

		Preoperative_VAS Score			Postoperative_VAS Score			Preoperative UCLA Score			Postoperative_UCLA Score		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
<b>Rotator Cuff_Pathology</b>	Partial	3.00	7.00	4.94	2.00	6.00	3.55	9.00	24.00	16.52	13.00	32.00	24.15
	Full-thickness	3.00	8.00	5.17	2.00	7.00	3.67	6.00	26.00	18.06	14.00	33.00	25.81
	Massive	3.00	9.00	5.31	1.00	7.00	3.72	8.00	26.00	17.17	10.00	33.00	24.83
<b>Biceps Tendon Disorder</b>	Tenotomy	3.00	7.00	5.13	1.00	5.00	3.30	6.00	26.00	17.50	14.00	33.00	26.77
	Tenodesis	3.00	8.00	5.23	2.00	7.00	3.94	9.00	24.00	17.84	15.00	31.00	24.13
	Spontaneous Rupture	3.00	9.00	5.05	1.00	7.00	3.68	8.00	24.00	16.62	10.00	33.00	24.19

When the preoperative and the postoperative UCLA and VAS scores of the patients were compared according to Wilcoxon Signed Rank Test, it was observed that the postoperative scores significantly improved in all three groups ( $p = 0.001$ ). The minimum, maximum and average values of VAS and UCLA scores measured in the preoperative and postoperative period are shown in Table 1. As a result of comparing the improvements of UCLA and VAS scores in the postoperative period, it was observed that the tenotomy group showed better improvement compared to the tenodesis group ( $p = 0.036$ ,  $p = 0.010$ , respectively). There was also a statistically significant difference between tenotomy and chronic biceps rupture in terms of VAS score ( $p = 0.024$ ). However, no statistically significant difference between tenodesis and chronic biceps rupture in terms of improvement in VAS scores ( $p=1.000$ ) was observed. As the UCLA score improvements were compared, tenotomy was

found to have a statistically significant difference compared to tenodesis ( $p=0.010$ ) however, when compared with chronic biceps rupture, there was no significant difference between them ( $p=0.527$ ). When chronic biceps rupture was compared with tenodesis, there was also no statistically significant difference between them in terms of UCLA score development ( $p=0.250$ ). The minimum, maximum and mean values of the improvement between preoperative and postoperative UCLA and VAS scores for each biceps tendon procedure is given in Table 2.

When postoperative total VAS and UCLA scores were compared between tenotomy, tenodesis, and chronic biceps rupture groups, no statistically significant difference was observed ( $p=0.620$ ,  $p=0.247$ , respectively) although significant differences in terms of score improvements between preoperative and postoperative periods were observed.

**Table 2.** UCLA and VAS score improvement in each biceps tendon disorder group

		VAS score total change				UCLA score total change			
		Min	Max	Median	Mean	Min	Max	Median	Mean
<b>Biceps Disorder</b>	Tenotomy	.00	6.00	2.00	2.50	4.00	19.00	9.00	9.27
	Tenodesis	.00	6.00	1.00	1.52	.00	13.00	6.00	6.29
	Rupture	.00	6.00	1.00	1.70	-1.00	14.00	8.00	7.57

**4. Discussion**

In the context of rotator cuff tears, 90% of patients demonstrates accompanying LHBT disorders and 45% of cases has also LHBT instability (9, 10). During the surgical treatment of shoulder lesions such as rotator cuff tears and labral tears, if biceps tendon disorders are not given full consideration, the pain may not completely vanish and the patient's satisfaction will also decrease (11). In the literature, there are different views about the superiority of the surgical methods that can be performed in biceps tendon disorders. Although both biceps tenotomy and tenodesis have shown successful outcomes, there is still no consensus on the superiority of these two procedures (12-15). In a study performed by Belay et al. (2019), tenotomy and tenodesis were compared and the researchers stated that VAS scores at the 3<sup>rd</sup> month follow-up were lower in the tenotomy group; however, they did not find a significant difference between

tenodesis and tenotomy at the 2<sup>nd</sup> year follow-ups. The researchers also declared that these patients needed less pain killers at the 2<sup>nd</sup> week follow-up than those who underwent tenodesis (16). Franceschi et al. (2007) reported that patients underwent tenotomy had significantly better functional shoulder outcomes and higher satisfaction levels than the tenodesis group did. (17). In a systematic review presented by Frost et al. (2009), the failure rates and clinical outcomes of tenotomy and tenodesis were searched in various studies, both procedures present a similar number of good to excellent results, ranging from 65% to 90% in the tenotomy group, and 40% to 93% in the tenodesis group. The failure rates for tenodesis varied from 5% to 48% and 13% to 35% for tenotomy (18). In the same review, it is mentioned that patients underwent tenotomy are occasionally allowed to return to daily normal activities immediately after the operation while tenodesis generally requires a strict

postoperative rehabilitation protocol (18).

In a study conducted by Castricini et al. (2018), tenotomy and tenodesis were compared in 69 patients with rotator cuff tears, and the superiority of tenodesis over tenotomy was not observed in terms of postoperative Constant and Murley scores, quality of life, pain, and muscle strength (6). Gill et al. and Kelly et al. compared biceps tenotomy and tenodesis and found no differences in terms of clinical outcomes between them (19, 20). In a study conducted by Hufeland (2019), one-year clinical outcome scores of tenodesis and tenotomy were compared. No significant difference was found between the two methods in terms of clinical scores, however, they observed higher muscle strength with tenodesis 6 months after surgery (21). In a randomized controlled trial performed by MacDonald et al. (2020), 114 patients were compared in terms of the clinical results such as pain, cramps and muscle strength of tenotomy and tenodesis. According to their study, although both tenotomy and tenodesis provided satisfactory clinical improvements, there was no difference between both procedures (22). In a systematic review performed by Slenker et al (2012), sixteen studies were included to the review and the clinical outcomes of tenodesis and tenotomy were compared. In this review, 74% of 433 patients who underwent tenodesis had good / excellent results; while in 699 patients who underwent tenotomy this rate was found to be 77%. However, they added that tenotomy or tenodesis in general were not superior to each other (23). In a study performed by Friedman (2015), functional results of 42 patients who underwent tenotomy or tenodesis were compared, and DASH, ASES and VAS scores were found to be similar across the groups. The researchers also indicated that the frequency of cramping complaints was higher in the tenotomy group while pain was encountered more in the tenodesis group (5).

Although the LHBT is thought to play an important role in the stability of the shoulder joint (24), the complete mechanism of the process has not been fully elucidated. In the literature, a statistically significant difference between biceps tenotomy and tenodesis was not detected therefore, preservation of the degenerated tendon may not be necessary. Indeed, especially in arthroscopic surgery of massive and full-thickness rotator cuff tears, the LHBT is generally found ruptured or grossly shredded, yet it is still observed that the cuff repair outcomes are satisfying. We also observed that the clinical outcome improvements of our patients who underwent arthroscopic rotator cuff repair showed very good/excellent results in our clinic although no repair was performed to a complete chronic LHBT rupture. Therefore, we conducted this study to compare the clinical outcomes of chronic LHBT rupture, tenodesis and tenotomy which yielded significant results. UCLA and VAS shoulder scores were compared in terms of preoperative and postoperative period, and also improvement after surgery.

Rupture of LHBT is usually a sequela of a massive and

full-thickness rotator cuff rupture and develops by the loss of the protective soft tissue cover (9, 25). The biceps tendon is usually progressively injured, flattened, torn and eventually ruptured as the rotator cuff tear extends (26). The vast majority of LHBT ruptures are confronted over the age of 50 and commonly comprises intrinsic tendinous degeneration (3, 4). Isolated ruptures which are not associated with rotator cuff tears are much rarer and tend to occur in middle-aged patients as a result of traumatic injuries (27). Isolated rupture of LHBT has also been reported in non-traumatic conditions such as hypothyroidism (28), and steroid injection (29) etc. nevertheless, these were not addressed in our study.

We particularly analyzed “chronic” proximal biceps tendon ruptures that occur over time due to the degenerative process in patients with massive and full-thickness rotator cuff rupture and excluded acute spontaneous traumatic ruptures. The incidence of chronic rupture of proximal biceps tendon has been reported to be approximately 5% (26). The possible reason for higher rate in our study may be that the majority of patients who underwent surgery had massive rotator cuff tears.

There are some limitations in our study. First, there exists an inevitable potential failure to demonstrate the superiority of one technique over the other secondary to several factors such as concomitant shoulder lesions which should also be repaired. Since the number of patients who have been operated for biceps tendon alone is low, it seems necessary to perform this study in patients with accompanying rotator cuff ruptures. Also, as seen in literature, many of the studies included patients undergoing either a tenotomy or a tenodesis with a concomitant surgical intervention such as rotator cuff repair. The comparison between the procedures is difficult and their reliability is questionable because of this potential influence of aforementioned other shoulder lesions. The other limitation is the retrospective nature of our study.

We believe that tenotomy is a more appropriate surgical method than tenodesis in massive and full-thickness rotator cuff tears with severe biceps tendon degeneration, and also it is not necessary to perform tenodesis in cases with chronic biceps rupture.

#### **Conflict of interest**

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#### **Authors' contributions**

Concept: F.İ.C., Design: E.G., Data Collection or Processing: İ.G.Ş, Analysis or Interpretation: F.İ.C., C.Y.K., Literature Search: F.İ.C., Writing: F.İ.C.

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