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Comparing the outcomes of arthroscopic tenodesis versus tenotomy for the treatment of the long head of biceps tendon pathologies during supraspinatus tendon repair

Supraspinatus Yırtığı Tedavisi Sırasında Biseps Uzun Başı Patolojilerinin Tedavisinde Artroskopik Tenodez Ve Tenotominin Sonuçlarının Karşılaştırılması

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ABSTRACT

Aim: Long head of the biceps tendon pathologies are frequently accompanied by full-thickness rotator cuff tear. The purpose of this study was to compare functional scores, complication rates and time to return to work after tenotomy and tenodesis who underwent arthroscopic supraspinatus repair (ASR).

Methods: Overall, 129 patients who underwent ASR surgery were divided into 2 groups. Group 1 consisted of 62 patients who underwent biceps tenodesis and group 2 consisted of 67 patients who underwent biceps tenotomy. We evaluated demographic data, clinical findings, complications and American Shoulder and Elbow Surgeons, Constant Murley, Visual analogue scale and 36-item Short Form subscale scores.

Results: Mean follow-up time was 13.68±4.22 months. Mean postoperative and pre-operative-postoperative differences of ASES, CM, VAS and SF-36 subscale scores were not significantly different between the two groups. Popeye sign was positive for 13 (19.4%) patients in group 2, however, none of patients in group 1 was positive (p<0.001). Other complications were not significantly different between two groups.

Conclusion: The results show that arthroscopic biceps tenotomy and tenodesis are both viable treatments for proximal biceps tendon pathology, yielding similar clinical outcomes in the context of concomitant rotator cuff repair. Tenotomy can be chosen instead of tenodesis, which is technically more difficult and expensive.

Keywords: Biceps tendon, tenodesis, tenotomy, shoulder arthroscopy

ÖZ

Amaç: Tam kat supraspinatus tendon yırtıkları sıklıkla biseps uzun baş tendonu patolojileri ile birlikte görülmektedir. Bu çalışmanın amacı artroskopik supraspinatus tamiri yapılan ve ek olarak biseps uzun başı tendon patolojisi nedeniyle tenodez ve tenotomi tedavisi yapılan hastaların klinik skor, komplikasyon oranı ve işe dönüş oran ve zamanlarını karşılaştırmaktır.

Yöntemler: 129 artroskopik rotator manşet onarımı yapılan hasta 2 gruba ayrıldı. 1. Grupta biseps tenodezi uygulanan 62 hasta, 2. grupta ise biseps tenotomisi uygulanan 67 hasta bulunmakta idi. Demografik ve klinik bulgular, komplikasyonlar, American Shoulder and Elbow Surgeons (ASES), Constant Murley (CM), Visual analogue scale (VAS) ve 36-item Short Form (SF-36) alt skorları değerlendirildi.

Bulgular: Ortalama takip süresi 13.68±4.22 ay idi. Ortalama ASES, CM, VAS ve SF-36 skorlarına bakıldığında gruplar arasında postoperatif ve preoperatif-postoperatif fark değerlerinde anlamlı fark bulunmadı. Popeye bulgusu 2. grupta 13 (%19,4) hastada pozitif iken 1. grupta hiçbir hastada görülmedi (p<0.001). Diğer kompikasyon oranlarında gruplar arasında anlamlı fark saptanmadı.

Sonuç: Artroskopik supraspinatus tamiri yapılan hastalarda, biseps tenodezi ve tenotomisi bisep uzun baş patolojilerinde klinik olarak iyi sonuç veren tedavi metodlarıdır. Teknik olarak daha zor ve maliyetli tenodez yerine tenotominin güvenle tercih edilebileceğini düşünmekteyiz.

Anahtar Kelimeler: Biseps tendonu, tenodez, tenotomi, omuz artroskopisi

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INTRODUCTION

Rotator cuff (RC) rupture is the one of the most common causes of shoulder pain and disability [1]. Arthroscopic rotator cuff repair (ACRC) has experienced increasing popularity in the treatment of RC ruptures. Long head of the biceps tendon (LHBT) pathologies are frequently accompanying full-thickness rotator cuff tear (RCT) [2]. LHBT lesion may cause chronic pain and limitation of shoulder flexion after ARCR, when left untreated [3]. For this reason, routine intervention to the LHBT during ARCR is recommended [4].

Management of concomitant LHBT lesions with RCT remains controversial [3, 5]. The most popular treatment options are biceps tenotomy and tenodesis. Both options are reliable and useful to reduce pain and increase range of motion (ROM) [6]. Tenotomy is a less technically demanding, quicker and cheaper method, and the rehabilitation process is also accelerated. Muscle cramps, Popeye's deformity, and loss of supination strength are, however, major concerns after tenotomy; some authors favor tenodesis particularly in younger patients. The main advantages of tenodesis are maintaining normal muscle tension with lower cosmetic deformities and higher supination strength [2]. There are many studies to compare functional results following tenotomy and tenodesis. A recent meta-analysis report higher Constant Score after tenodesis [3] and cosmetic deformity is also less frequent after tenodesis [6]. On the other hand, many studies report similar functional results and complication rates [7]. In a recent randomized controlled study, 69 patients were evaluated and there were no significant difference in functional scores, life quality measures and arm strength. Popeye's deformity was in fact higher in patients received tenotomy [8].

The cost of treatment is an important concern after orthopedic procedures. The burden of the treatment consists of not only cost of implants, but also additional physiotherapy, prolonged time prior to returning to work, which also affect the cost of the treatment indirectly.

Some studies suggest tenodesis, however for long-term outcomes, some studies reported that there is no difference in terms of the clinical outcomes between it and tenotomy. There is in fact no consensus for the management of LHBT pathologies when performing ASR [9, 10]. The purpose of this study was therefore to compare functional scores, complication rates, and time to return to work after tenotomy and tenodesis who underwent ASR.

MATERIALS AND METHODS

After institutional review board approval (Approval date-number: 02/06/2021, 2021-7/24), the medical records of 189 patients who underwent ARCR between February 2017 and December 2019, were evaluated. Of these, 70 patients were excluded because they either had a RC tear that was not repaired (n = 54) or had isolated subscapularis tendon repairs (n = 16); thus, 129 patients were included in the study. Patients were divided into two groups, either as having undergone biceps tenodesis (group 1) or tenotomy (group 2). The arthroscopic views of one patient from both groups are shown in Figure 1-2. Two different surgeon's patients were assessed, as two groups. One surgeon performs tenotomy for biceps pathologies with rotator cuff tear in his clinical practice and, the other one performs tenodesis.The study was conducted in accordance with the 1964 Declaration of Helsinki and its later updates.

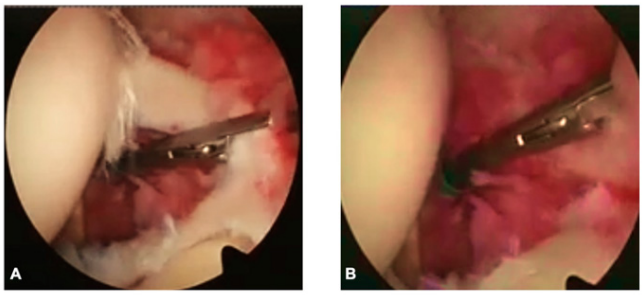

Figure 1: Arthroscopic view of a patient who underwent biceps tenotomy. A-before intervention, B-after intervention

Inclusion criteria of this study were patients aged > 18 years old, who underwent arthroscopic isolated anterosuperior, superior, and/or posterosuperior supraspinatus tendon repair with either biceps tenotomy or tenodesis and a minimum 6 month follow-up.

Excluded patients were those with symptomatic acromioclavicular arthritis, the presence of degenerative glenohumeral arthritis, frozen

shoulder, irreparable supraspinatus tendon tear, concomitant infraspinatus, teres minor and/or subscapularis tendon rupture, history of previous shoulder dislocation, patient under 18 years old, previous shoulder surgery from the affected side, follow-up period less than 6 months and ipsilateral neurological deficits.

All operations were performed in the beach chair position under general anesthesia. The standard posterior portal was used to examine the glenohumeral joint, the torn supraspinatus tendon was repaired with trans osseous equivalent double-row configuration. One surgeon performed a tenotomy, the other performed tenodesis for all their patients. The tenotomy was performed through the anterolateral portal with a radiofrequency probe from the most proximal side of the LHBT. Those patients who underwent biceps tenodesis, the LHBT was attached to bicipital groove with interference screw Bio composite tenodesis screw (Arthrex, USA). Subacromial decompression was performed to all patients, however acromioplasty was not routinely performed.

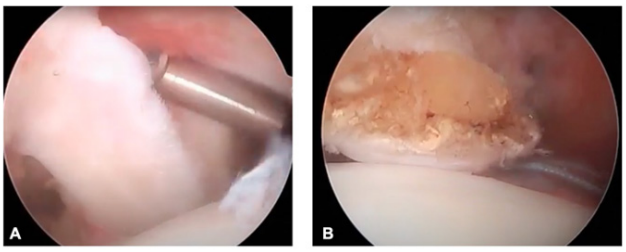

Figure 2: Arthroscopic view of a patient who underwent biceps tenodesis. A-before intervention, B-after intervention

Patients were held in velpeau bandage for four weeks postoperatively. Passive pendulum exercises and active elbow movement was immediately allowed. Active shoulder movements started after postoperative fourth week. Stretching was prohibited for 12 weeks. In patients who underwent tenodesis, biceps strengthening was started after 8th week.

Age, gender, body mass index, operated side, dominant side, number of comorbidities (classified as 0 and ≥1), tear chronicity (<3 months acute and >3 months chronic), tear size, subjective weakness that was mentioned by patient (present / absent) at last follow-up examination, surgery duration, return to work time and follow-up time, were all assessed. Tear size classification of full-thickness cuff ruptures were performed by assessing the magnetic resonance imaging (MRI) results according to the DeOrio and Cofield classification. Full-thickness tears of 1 cm were small, 1 - 3 cm were medium, 3 - 5 cm were large, and more than 5 cm were massive [11]. After tear size analysis, it was seen that it was homogenously distributed between groups (p=0.983). Intraoperative long head of biceps tendon injuries were noted and in group 2 rate of degenerative SLAP, lesions were significantly high; in group 1 the rate of partial LHBT ruptures were high (p<0.001). The mean age was significantly different between groups (52.77 vs 59.82, group 1 vs group 2) (p<0.001) (Table 1).

For the functional and quality of life evaluation of patients, pre- and postoperative American Shoulder and Elbow Surgeons (ASES) scores [12], Constant-Murley (CM) scores [13], Visual analogue scale (VAS) [14] and 36-item Short Form Health Survey (SF-36) [15] scores, were all evaluated.

The postoperative Yergason test was performed on all patients and anterior shoulder pain (ASP) was noted. Presence of Popeye signs and muscle cramps were recorded. In addition, complications (re-rupture and frozen shoulder) were recorded and compared with other outcomes.

Statistics: The mean, standard deviation, median, lowest and highest value, frequency and ratio were used in the presentation of descriptive statistics. The Shapiro-Wilk test was used for the evaluation of the distribution of variables. The Chi-Square test and Fischer exact tests were used in the comparison of independent qualitative data. The Mann-Whitney U test was used in the comparison of independent quantitative data. A P-value of < 0.05 was considered statistically significant. All statistical analysis was performed using IBM SPSS for Windows, version 22 (IBM corp., Armonk, NY).

RESULTS

Table 1 presents the general demographics and disease-specific characteristics of the 129 patients included in this study (Table 1). When compared to group 1, group 2 had a significantly lower return to work time (p<0.001). Gender distribution was

Table 1: Demographic and disease-specific characteristics of the patients

Variable	Entire Study Population	Group 1	Group 2	p
Patient number, n (%)	129 (100)	62 (48.1)	67 (51.9)	0.424
Age, year, SD	56.43±4.37	52.77±2.63	59.82±2.54	<0.001
Gender, n (%)				
Female	74 (57.4)	42 (67.7)	32 (47.8)	022
Male	55 (42.6)	20 (32.3)	35 (52.2)	
BMI, kg/m2	27.34±2.47	27.12±2.45	27.55±2.50	0.334
Injured side, n (%)				
Right	65 (50.4)	30 (48.4)	35 (52.2)	0.662
Left	64 (49.6)	32 (51.6)	32 (47.8)	
Tear Chronicity, n (%)				
Acute	36 (27.9)	22 (35.5)	14 (20.9)	0.065
Chronic	93 (72.1)	40 (64.5)	53 (79.1)	
Long head of biceps tendon injury, n (%)				
partial rupture	24 (18.6)	18 (29)	6 (9)	<0.001
tenosynovitis	58 (45)	34 (54.8)	24 (35.8)	
subluxation	20 (15.5)	10 (16.1)	10 (14.9)	
degenerative slap	24 (18.6)	0 (0)	24 (35.8)	
dislocation	3 (2.3)	0 (0)	3 (4.5)	
Comorbidity, n (%)				
yes	28 (21.7)	10 (16.1)	18 (26.9)	0.139
no	101 (78.3)	52 (83.9)	49 (73.1)	
Tear size, n (%)				
Small	30 (23.3)	14 (22.6)	16 (23.9)	0.983
Medium	74 (57.4)	36 (58.1)	38 (56.7)	
Large	25 (19.4)	12 (19.4)	13 (19.4)	
Dominant side, n (%)				
Yes	78 (60.5)	36 (58.1)	42 (62.7)	0.592
No	51 (39.5)	26 (41.9)	25 (37.3)	
Surgery time, minutes, SD	87.05±14.03	95.96±9.27	78.80±12.61	0.155
Frozen Shoulder, n (%)				
Yes	8 (6.2)	2 (3.2)	6 (9)	0.178
No	121 (93.8)	60 (96.8)	61 (91)	
Re-rupture, n (%)				
Yes	9 (7)	4 (6.5)	5 (7.5)	0.822
No	120 (93)	58 (93.5)	62 (92.5)	
Return to work time, days, SD	83.83±14.40	86.77±16.27	81.11±11.92	<0.001
Follow-up time, months, SD	13.68±4.22	13.09±3.59	14.23±4.70	0.071

Abbreviations: SD standard deviation, p<0.05 was defined as significant and defined bold

significantly different between groups (p=0.022). In terms of LHBT injury, 34 (54.8%) patients had tenosynovitis in group 1, 24 (35.8%) had tenosynovitis and 24 (35.8%) had degenerative SLAP lesion in group 2 and the difference was significant (p<0.001). Other clinical findings and complications were not significantly different between two groups (p>0.05).

Table 2 presents the postoperative physical examination findings and complication rates compared between two groups. The Popeye sign was positive in 13 patients in group 2, however, none of patients in group 1 was positive (p<0.001).

Preoperative and postoperative ASES, CM, VAS and SF-36 subscale scores at final examination for all patients are shown in Table 3. Mean differences of the scores between preoperative and postoperative values were also defined. All postoperative clinical, quality of life subscales and VAS scores were not significantly different

Table 2: Postoperative clinical outcomes and complications

Variable	Entire Study Population	Group 1	Group 2	P
Subjective muscle weakness, n (%)				
Yes	12 (9.3)	4 (6.5)	8 (11.9)	0.284
No	117 (90.7)	58 (93.5)	59 (88.1)	
Popeye sign, n (%)				
Yes	13 (10.1)	0 (0)	13 (19.4)	<0.001
No	116 (89.9)	62 (100)	54 (80.6)	
Anterior shoulder pain, n (%)				
Yes	19 (14.7)	10 (16.1)	9 (13.4)	0.666
No	110 (85.3)	52 (83.9)	58 (86.6)	
Muscle cramp, n (%)				
Yes	13 (10.1)	8 (12.9)	5 (7.5)	0.305
No	11 (89.9)	54 (87.1)	62 (92.5)	
Re-rupture, n (%)				
Yes	9 (7)	4 (6.5)	5 (7.5)	0.822
No	120 (93)	58 (93.5)	62 (92.5)	
Frozen Shoulder, n (%)				
Yes	8 (6.2)	2 (3.2)	6 (9)	0.178
No	121 (93.8)	60 (96.8)	61 (91)	

Abbreviations: SD standard deviation, p<0.05 was defined as significant and defined bold

Table 3: Mean difference of preoperative and postoperative clinical scores compared between two groups

Clinical Score	All patients	Group 1	Group 2	p
ASES	36.79 ± 9.32	37.09±8.82	36.52±9.81	0.728
CM	37.20±10.27	38.48±9.27	36.01±11.06	0.174
VAS	4.12 ± 1.40	4.16±1.35	4.08±1.45	0.773
SF-36				
Physical functioning	25.07±9.78	24.03±9.18	26.04±10.28	0.245
Role limitations due to physical health	56.58±20.13	58.06±19.61	55.22±20.66	0.426
Role limitations due to emotional problems	44.81±29.44	44.22±31.41	45.35±27.72	0.828
Energy/fatigue	46.66±18.12	46.45±16.35	46.86±19.74	0.897
Emotional well-being	34.07±13.79	35.48±12.70	32.77±14.70	0.267
Social functioning	44.99±12.69	44.19±13.85	45.73±11.57	0.494
Pain	52.62±15.68	51.90±13.64	53.29±17.44	0.616
General health	49.06±16.01	49.67±17.31	48.50±14.82	0.680
Health change	62.69±23.20	62.09±22.96	63.43±23.56	0.745

ASES American Shoulder and Elbow Surgeons Score, CM Constant Murley score, VAS Visual analogue scale

between the two groups. Nevertheless, all post operational improvement scores were similar between both groups (p>0.05).

DISCUSSION

The most important findings of this study were that clinical scores, quality of life scores and complication rates were not significantly different in patients undergoing tenodesis or tenotomy of the biceps tendon, concomitant to ASR. However, two significantly different results were found between the two techniques: return to work time was higher in the tenodesis group and the Popeye sign was present in 13 patients in the tenotomy group, while none of the patients in tenodesis group presented with it.

The debate between biceps tenodesis and tenotomy is challenging to surgeons and patients. Many studies have found no significant differences in pain, function or limitations between tenotomy and patients with tenodesis [8, 16, 17]. Elsewhere, some authors favoring tenodesis have compared it with tenotomy in terms of increased shoulder pain and loss of supination power with biceps tenotomy [18, 19]. For our part, we found no significant difference in terms of clinical scores, pain score

and quality of life scores between tenotomy and tenodesis. Physical examination findings were assessed and only the Popeye sign was seen, significantly high, in the tenotomy group, though subjective muscle weakness rates were similar.

In a previous prospective double-blinded randomized controlled trial, MacDonald et al. reported that there was no difference in subjective clinical outcomes, between patients who underwent biceps tenodesis and tenotomy at postoperative 24 months. In that study, the Popeye sign was 3.5 times higher after tenotomy, compared with tenodesis [7]. The significant improvements in ASES and CM scores for both groups that were found in our study is similar to that seen in previous studies [7, 8, 20]. However, Godeneche et al. [21], Meraner et al. [10] and some other previous studies have reported better results after tenodesis than tenotomy, based on the CM score.

The Popeye sign may be seen following biceps tenotomy because of the retracted LHBT. Literature has many varying reports regarding Popeye deformity. Aflatooni et al. reported that although a higher proportion of patients with tenotomy reported limitations and the Popeye sign (+3%) compared with patients with tenodesis, those disparities were larger for weakness (+6% in tenotomy) and even greater for spasms/cramping (+12%), biceps pain (+9%), and shoulder pain (+17%) [22]. Castricini et al. and Hassan et al. found little to no significant difference in downsides such as the Popeye sign between the two procedures, except that patients with tenotomy experienced more shoulder pain, as well as biceps spasms and cramping [8, 23]. Lee et al. also found no difference in outcomes of function or pain between tenodesis and patients with tenotomy [18]. Our findings showed only higher Popeye sign rates in the tenotomy group compared with tenodesis and in terms of clinical scores, no significant difference was found.

Studies that we have discussed so far, however, were not completely biceps procedures with concomitant ARCR. A previous meta-analysis and systematic review comparing tenotomy and tenodesis procedures performed concomitantly with RCR, found that patients undergoing RCR with tenotomy were significantly more likely to generate a lower Constant-Murley score and develop a Popeye deformity, however these differences were not clinically significant and there was no significant difference in patient satisfaction [3, 19]. Our results are also consistent with these findings. Delayed failure of tenodesis fixation may help to explain our finding that showed none of patients in the tenodesis group had the Popeye sign. Long-term follow-up results may show more reliable outcomes of tenodesis failure rates.

Aflatooni et al. [22] found a delayed rupture or failure rate of 11% in their tenodesis group, consistent with other studies reporting delayed failure or rupture rates up to 20% [24]. The senior author has found that delayed failures do occur with interference screw fixation devices, and is most common within 3–12 weeks post-op. This is consistent with other authors' findings [24]. We found no tenodesis failure with physical examination. Extra magnetic resonance imaging may give more reliable results for failure of tenodesis.

Limitations: In our study, mean age, LHBT pathology and gender distributions were statistically different between groups. In group 2, both mean age and degenerative SLAP lesion numbers were high, and these differences may affect the clinical outcomes. Additionally, patients were not randomized but rather received biceps tenodesis or tenotomy after consulting with the senior author, which may have influenced our results due to selection bias. Finally, follow-up time was relatively short: longer follow-up may give more reliable results.

Conclusion: The results show that arthroscopic biceps tenotomy and tenodesis are both viable treatments for proximal biceps tendon pathology, yielding similar clinical outcomes with concomitant supraspinatus tendon repair. Tenotomy can be chosen instead of tenodesis, which is technically more difficult and expensive.

Conflict of Interest: No conflict of interest was declared by the authors.

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Ethics Committee Approval: Ethics Committee of the Faculty of Medicine of Uludağ University, (Approval date-number: 02/06/2021, 2021-7/24),

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