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Clinical and isokinetic comparison between tenotomy and tenodesis in biceps pathologies

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Objectives: The purpose of this study to compare clinical and isokinetic results of patients who underwent biceps tenotomy or tenodesis for chronic tenosynovitis.

Methods: Arthroscopic biceps tenotomy, arthroscopy assisted or arthroscopic biceps tenodesis were done in 20 patients who had diagnosis of chronic tenosynovitis and in whom conservative treatment was not helpful. Rotator cuff repair and acromioplasty was performed in 18 patients and acromioplasty alone in two patients in addition to biceps surgery. Arthroscopic biceps tenotomy was done in 10 patients (5 female, 5 male; mean age 63, range 53-75), 10 patients underwent tenodesis out of which arthroscopy assisted biceps tenodesis was done in 8 patients and all arthroscopic biceps tenodesis was done in 2 patients (4 female, 6 male; mean age 57, range 49-66). All patients were evaluated with Constant and UCLA scores preoperatively and postoperatively. The average follow-up of the patients 3,1 years (between 1-8 years). Isokinetically elbow flexion and forearm supination were compared using the Cybex (Biodex 3, Cybex Biomedical System, NY, USA) machine. Pre-operative results of each group were compared with the post-operative results, using Mann-Whitney U test.

Results: Preoperative average constant scores of tenotomy group were 64.40, whereas postoperative scores were 89.50 (p=0.002), and preoperative average constant scores of tenodesis group were 62.80, whereas postoperative scores were 86.70 (p=0.003). Preoperative average UCLA scores of tenotomy group were 23.20 whereas postoperative UCLA scores 22.60 (p=0.003), preoperative average UCLA scores of tenodesis group were 30.00 whereas postoperative UCLA scores was 29.20 (p=0.004). In both groups statistically significant improvement of UCLA and Constant scores was detected. Comparison between Constant, UCLA scores and isokinetic measurements of both groups showed no statistically significant difference (p>0.05). No complication was noted.

Conclusion: In the treatment of chronic tenosynovitis, biceps tenodesis and tenotomy of long head of biceps showed similar clinical, functional, isokinetic and cosmetic results. No Popeye deformity was seen in the tenotomy group.

Key words: Arthroscopy/method; range of movement, articular; rotator cuff/injury/surgery; shoulder impengement syndrome; shoulder joint/injury/surgery/radiography; tendinitis/surgery; tendon injuries/surgery; tendon, paraarticular/injury/surgery/biceps tendinitis/biceps tendon/tenodesis/tenotomy.

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The method of tenotomy or tenodesis is used to change the anatomical position of the long head of biceps within the glenohumeral joint for the treatment of biceps pathology related to preliminary shoulder pain.[1,2] Indications for tenotomy or tenodesisare; pain that does not respond to conservative treatment with biceps subluxation and limitation of movement of shoulder with more than 50% ruptures in biceps tendon, medial subluxation, and subscapularis rupture.[3,4] Short surgery time, no necessity of a fastener, no implant insufficiency, and the fact that it enables fast and early rehabilitation makes biceps tenotomy superior to tenodesis. The most important disadvantage is the cosmetic deformity as a result of decreased muscle power, and bunching of biceps tendon (Popeye deformity) as a result of distal migration of tendon.[5,6]

Our objective in this study is to make clinical and isokinetic evaluation of patients retrospectively who were treated with biceps tenotomy and biceps tenodesis in our clinic.

Patients and methods

20 patients who were diagnosed with chronic biceps tenosynovitis accompanied by subacromial compression syndrome between 2001 and 2007; and were treated with arthroscopic biceps tenotomy or arthroscopy assisted/arthroscopic biceps tenodesis were evaluated retrospectively. Ten patients (5 females, 5 males; average age 63; age range 53-75) were treated with arthroscopic biceps tenotomy, ten patients under went tenodesis (4 females 6 males; average age 57; age range 49-66) out of which eight patients were treated with arthroscopy assisted biceps tenodesis and 2 patients were treated with arthroscopic biceps tenodesis. Patients did not have any history of trauma. In the examination it was found that Speed and Yergason tests were positive. It was observed that Neer and Hawkins tests were positive in 19 patients; supraspinatus muscle motor strength was 4 out of 5. All patients were assessed with Constant and UCLA scores. Anterior-posterior, suprascapular outlet, axillary and bicipital groove radiograms were performed. In the bicipital groove radiogram, degeneration in the groove was observed in all patients (Fig. 1). In postoperavite MRI images, complete rotator cuff tear was observed in 19 patients and os acromiale was observed in 1 patient. Biceps tendinitis and fluid collection around tendon were observed in all patients.

Fig. 1. Xray view of biceps groove.

All the patients had been admitted to the hospital with chronic pain. Betamethasone and prilocaine were injected into biceps tendon sheath and sub-acromial region of patients who did not respond to the 6 weeks of conservative treatment (Ice application, anti-inflammatory drugs and physiotherapy) and had severe night pains. Injection test of all patients was positive. It was decided to perform surgical treatment of the patients who did not have symptom relief and who did not respond to six months of physiotherapy. 18 patients were treated with acromioplasty, rotator cuff repair and 2 patients were treated with acromyoplasty only. Rotator cuff tears were full-thickness and small tomedium (up to 3 cm) in size. Patients were monitored for an average of 3.1 years (range 1-8 years). Surgeries were conducted with interscalene nerve block for five patients and with general anesthesia for fifteen patients. Biceps tenotomy or tenodosis were decided according to the evaluation of the condition of the tendon during the surgery (Fig. 2). Arthroscopy assisted biceps tenodesis was conducted by the key-hole technique in one patient and by suture hook technique in seven patients. Arthroscopic biceps tenodesis was conducted by biodegradable interference screw technique. Extraarticular part of biceps was dragged into the joint by the help of a probe during arthroscopy and checked; friction tendinitis in biceps tendon and degeneration in long head of biceps, fibrillation, and findings of chronic inflammation were observed in all patients. SLAP lesions and glenohumeral osteoarthritis were not observed in any of the patients. During the follow-up it was observed that none of the patients needed analgesia. No com-

plications such as rupture, implant insufficiency and heterotopic ossification developed in any of the patients. Rotator cuff repair rehabilitation protocol was used after surgery. Rehabilitation protocol for patients who were treated with tenodesis was same as for ones who were treated with tenotomy. In the first days after surgery, patients were given arm slings until their pain disappeared and ice was applied. On second or third day pendular movement was allowed. At the end of first week overhead wheel and joint mobility exercises were commenced. Exercises were increased as the symptoms allowed. Resistive movements were not allowed until the end of first three months. All patients were evaluated with pre-operative and post-operative Constant and UCLA scores. Cybex (Biodex 3, Cybex Miomedical System NY, USA) was used for post-operative elbow flexion and forearm supination muscle strengthening. Dynamometer calibration was conducted for each patient before the test. Patients were made to sit in supine position and neutral hand position was adjusted as stated in the user manual and elbow axis was made parallel to entrance axis of the dynamometer for all muscle activities. Patients were asked to hold the bar of arm stabilizer with their other hands. Peak torque values for elbow flexion and forearm supination obtained at 60, 120 and 180°/second angular velocity were examined. Cybex assessment was conducted at the last follow-up of patients. Statistical evaluation was made by Mann-Whitney U test. $p<0.05$ values were statistically significant.

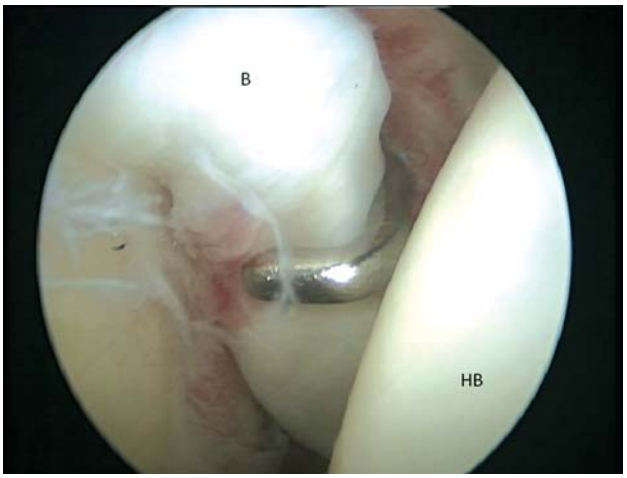

Fig. 2. Arthroscopic view of long head of biceps. **B:** Biceps tendon, **HB:** Humeral head. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

Results

Age, length of follow-up, tenotomy or tenodesis procedure and scores of patients are given in Table 1. In tenotomy group, patients' pre-operative average

Table 1. Patient demographics and scores.

No	Age	Sex	Follow up (year)	Surgery	Constant preop	Constant postop	UCLA preop	UCLA postop
1	61	K	5	Tenotomy	64	95	23	31
2	53	E	3	Tenotomy	68	95	26	33
3	58	K	1	Tenotomy	64	88	23	31
4	66	E	2	Tenotomy	62	86	21	29
5	69	K	3	Tenotomy	60	80	20	25
6	65	K	3	Tenotomy	64	95	23	31
7	63	E	3	Tenotomy	64	90	25	29
8	65	K	3	Tenotomy	64	90	23	31
9	75	E	3	Tenotomy	64	86	23	29
10	54	E	1	Tenotomy	70	90	25	31
11	49	K	2	Tenodesis	60	80	21	27
12	66	E	1	Tenodesis	66	85	25	29
13	52	E	5	Tenodesis	64	90	23	29
14	57	K	4	Tenodesis	64	80	21	27
15	60	E	8	Tenodesis	62	85	21	29
16	52	K	3	Tenodesis	64	90	23	31
17	64	E	2	Tenodesis	62	90	23	31
18	55	E	3	Tenodesis	64	95	25	33
19	59	E	7	Tenodesis	62	88	23	29
20	55	K	1	Tenodesis	60	84	21	27

Constant scores were 64.40 and post-operative average Constant scores were 89.50 (p=0.002) while in the tenodesis group this was 62.80 pre-operatively and 86.70 (p=0.003) post-operatively. Average UCLA values were 23.20 pre-operatively and 30.00 (p=0.003) post-operatively while in tenodesis group this was 22.60 pre-operatively and 29.20 (p=0.004) post-operatively. There was a significant recovery in UCLA and Constant scores of both patient groups (Tables 2 and 3).

There was no statistically significant difference in elbow flexion and forearm supination obtained at 60, 120 and 180°/second angular velocity in terms of peak torque values in both groups (p>0.05) (Table 4). No Popeye deformation was observed in any patients (circumvention of biceps tendon to distal).

Table 2. The statistical analysis of preoperative and postopeative Constant scores.

	Constant preop	Constant postop	p
Tenotomy	64.40±2.797	89.50±4.813	0.002
Tenodesis	62.80±1.982	86.70±4.785	0.003

Table 3. The statistical analysis of preoperative and postopeative UCLA scores.

	UCLA preop	UCLA postop	p
Tenotomy	23.20±1.814	30.00±2.160	0.003
Tenodesis	22.60±1.578	29.20±1.989	0.004

Discussion

Since biceps tendon sheath is the continuation of the synovial membrane within glenohumeral joint and interconnected with rotator cuff, any inflammatory incident related to rotator cuff or biceps tendon affects the other. The tendon of the long head of biceps may cause a mechanical compression similar to compression syndrome caused by rotator cuff tendons with stiffness due to synovium surrounding it. Mechanical effects on rotator cuff and long head of biceps are age dependent and are generally coexisting.[7] Tenosynovitis observed in biceps tendon generally develops in the segment within bicipital groove under the transverse humeral ligament. In first stages swelling and color change are observed in the affected part of the tendon. However at this stage the tendon is mobile within the groove. In the later stages the tendon gets thicker, fibrosis develops and its vascularity decreases. Rough appearance with hemorrhagic adherence, biceps atrophy or hypertrophy develops in the tendon. Boileau et al.[8] showed that biceps tendon takes the shape of an hourglass and causes mechanical symptoms at this stage. Worn atrophic tendon is the sign of pre-rupture stage. Round cell infiltration, degeneration in tendon fibers and oedema are observed in the histology of hypertrophic tendon. Symptoms of tenosynovitis and eventually the pain disappears with the development of rupture.[9] In case the biceps tendon inflammation is not accompanied with another pathology of shoulder, it is called primary bicipital tenosynovitis and seen in only 5% of cases.[10] Isolated tendinitis of the long head of biceps is rare. It was reported that bicipital groove abnormalities and repetitive trauma are the main causes of biceps tenosynovitis and develops due to degenerative changes in old patients. In our findings, biceps tendon pathologies were established during surgery and these were associated with rotator cuff problems, and biceps pathologies developed due to degenerative changes accompanied with subacromial compression. For a better understanding of biceps muscle function, experimental and clinic studies have been concluded as described in the literature. In cadaveric and clinical studies it has been found that the biceps muscle is a depressor of the humeral head, an anterior stabilizer, a posterior stabilizer, glenoid labrum elevator, and also a humeral head compressor.[11-18] These functions of biceps disappear after tenotomy or tenodesis. There are studies that contradict these studies and show that biceps tendon has nothing to do with the shoulder function.[19,20] In recent studies, it is acknowledged that the long head of biceps has the role of a passive anterior stabilizing the shoulder.[17,18]

Table 4. The statistical analysis of isokinetic scores.

	Group 1 Tenotomy	Group 2 Tenodesis	p*
60° Flexion	24.590 ± 10.614	26.770 ± 13.238	0.880
60° Supination	6.170 ± 2.728	5.510 ± 2.946	0.306
120° Flexion	14.810 ± 5.187	18.920 ± 9.242	0.450
120° Supination	5.770 ± 2.778	4.890 ± 1.964	0.239
180° Flexion	15.450 ± 3.526	16.290 ± 5.450	0.650
180° Supination	5.420 ± 2.116	4.860 ± 1.829	0.384

*p<0.05: Statistically relevant

In recent years studies have been conducted understand the biceps tendon pathologies.[21-24] Subluxation and dislocation that develops in biceps tendon are generally accompanied by rotator cuff rupture particularly subscapularis tendon rupture resulting in an abnormal rotator interval.[21] According to Walch et al. subscapular is muscle, superior glenohumeral ligament (SGHL) and coracohumeral ligament (CHL) form a pulley system for the tendon of the long head of biceps.[21,25] Partial ruptures of subscapularis tendon may cause dislocation of biceps and according to Bennet this is the first step in the breakdown of the pulley system. Later on, this lesion is accompanied with a rupture in SGHL and CHL medial head and subluxation of the biceps tendon may develop. Progressive subluxation may cause progression of rupture in subscapularis and biceps dislocation may develop as a result. Subscapular rupture may result in pain on the anterior aspect of the shoulder.[22]

There are clinical studies that compare tenotomy and tenodesis in the literature. In a study by Gill et al.,[26] 30 patients with chronic biceps tenosynovitis, tendon dislocation and partial rupture were treated with tenotomy of the long head of biceps with results indicating less rest pain, less restriction in daily activities due to pain and less time to return to work were in patients. They reported that revision (tendonesis) was needed due to cosmetic deformation in only one patient. Oshbar et al.,[27] treated half of 160 patients with biceps tenotomy and the other half with biceps tenodesis. There was no significant difference between the two groups in terms of cosmetic deformity, bicipital spasm and anterior shoulder pain. Wolf and et al.[5] in a cadaver study, reported findings that support tenodesis. They compared groups treated with tenotomy of the long head of biceps and tenodesis biomechanically. In physiological cyclic overloading after tenotomy and tenodesis in 20 cadaver shoulders, 40% of tendons of tenotomy group demonstrated a distal migration of biceps stump from the groove. Consequently, authors have recommended tenodesis due to cosmetic deformity and dysfunction. In general tenodesis is recommended for young and active patients and tenotomy is recommended for old patients in literature.[28] Frost et al.[28] emphasized that there are no differences between the two techniques and biceps tenotomy should be the method of choice. In a study by Kelly et al., a decreased muscle power was observed in patients especially under 60 years of age, but there was no significant differences in patients over 60 years.[6] In our study similar results were obtained. Patients treated with tenodesis and tenotomy were compared by measurement of muscle power for elbow flexion and forearm supination with both shoulder scores and dynamometer and it was found that there is no difference between the two groups clinically and functionally. Popeye deformation may be observed following tenotomy of the long head of biceps due to distal migration. In a study, long head of biceps tenotomy was conducted and Popeye deformity was reported in 70% of patients (82.7% of males and 38% of females). This ratio varies from 3%[26] to 70%[6] in the literature. However in our study this deformity did not develop in any of the patients. This situation rarely causes a problem in and is not recognized by the patient. Tendon does not usually migrate distally after hypertrophic tenosynovitis with rotator cuff rupture treated with biceps tenotomy. There are different hypotheses explaining this. The first opinion argues that the long head of biceps undergoes auto-tenodesis in bicipital groove after tenotomy. The second opinion is that biceps tendon is covered by double synovial sheath in both intraarticular and extrasynovial part. It is covered by visceral sheath on the interior side and with parietal sheath on the exterior. Parietal sheath prevents the tendon from sliding after it passes transverse humeral ligament. The third opinion is that biceps tendon is nourished by mesotenon. Mesotenon consists of terminal branch of anterior humeral circumflex artery. Mesotenon adheres to the visceral sheath of the tendon and prevent it from distal migration.[29]

Our study has two shortcomings. The first one is that the number patients included in the study is small. This study can be repeated with large number of patients in the future. The second is that this is a retrospective study and a prospective study can be done in the future where isokinetic dynamometer is compared preoperatively and postoperatively. Tenotomy and tenodesis in the treatment of biceps tendon pathologies is still a matter of discussion in literature. In this study patient treated with tenotomy and tenodesis were compared retrospectively. In conclusion, a clinical, functional, isokinetic and cosmetic difference was not found between the two techniques.

Conflicts of Interest: No conflicts declared.

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