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Original Article

Biceps Tenotomy is Associated with Similar Clinical Results and Lower Complications than Subpectoral Tenodesis with Rotator Cuff Repair in Elderly Patients

Kutalmış Albayrak[1], Özgür İsmail Türk[2], Muhammed Bilal Kürk[1], Mert Demirci[1], Ahmet Keskin[1], Serda Duman[1]

[1]Department of Orthopaedics and Traumatology, University of Health Sciences Baltalimanı Bone Diseases Training and Research Hospital, İstanbul, Türkiye
[2]Department of Orthopedics and Traumatology, Ghent University Hospital, Ghent, Belgium

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ORCID iDs of the authors: K.A. 0000-0002-8427-8856, Ö.İ.T. 0000-0003-1545-6820, M.B.K. 0000-0001-8956-3819, M.D. 0009-0004-3058-6329, A.K. 0000-0001-8627-5651, S.D. 0000-0002-1626-6001

ABSTRACT

Objective: The objective is to compare the clinical outcomes and complications of biceps tenotomy vs. subpectoral biceps tenodesis in elderly patients undergoing arthroscopic rotator cuff repair.

Methods: This retrospective study analyzed 38 patients aged ≥65 who underwent arthroscopic supraspinatus repair between 2020 and 2022. Patients were divided into 2 groups: biceps tenotomy (n = 22) and subpectoral tenodesis (n = 16). Preoperative and postoperative functional outcomes were assessed using Constant and ASES (American Shoulder and Elbow Surgeons Score) scores. Complication rates, including humeral fractures and Popeye deformity, were documented. Statistical analysis was performed using independent *t*-tests and chi-square tests.

Results: Both groups demonstrated significant postoperative improvements in Constant and ASES scores ($P < .001$). Tenotomy was associated with shorter operative time (81 ± 12.2 vs. 94 ± 18.2 minutes, $P = .02$). Two humeral fractures occurred in the tenodesis group, while none were observed in the tenotomy group. Popeye deformity was reported in 3 patients in the tenotomy group and none in the tenodesis group. Muscle cramping occurred more frequently in the tenotomy group (5 vs. 1). Despite these differences, functional outcomes and patient satisfaction were comparable between groups.

Conclusion: Both biceps tenotomy and subpectoral tenodesis provide excellent functional outcomes in elderly patients undergoing rotator cuff repair. Tenotomy offers the advantages of shorter operative time and lower complication rates, making it a safer option for elderly patients with higher surgical risks. Surgical decisions should be individualized based on patient-specific factors.

Keywords: Rotator cuff injuries, biceps tendon, arthroscopy, tenotomy, elderly

INTRODUCTION

Rotator cuff tears (RCT) are one of the most common degenerative pathologies of the shoulder and are often accompanied by biceps tendon lesions. Studies show that 30%-50% of patients with RCTs have pathologies such as biceps tendinitis, biceps tendon subluxation, or complete tear.[1-3] This high rate frequently brings biceps tendon interventions to the agenda during rotator cuff repair. Accordingly, biceps tenotomy or tenodesis during rotator cuff repair has become an increasingly preferred strategy. In the literature, the rates of these interventions with rotator cuff repair have been reported to be between 40% and 70%.[4] Indications for surgical treatment may vary between authors, but generally accepted indications are 25% to greater than 50% partial thickness long head biceps (LHB) tear, medial subluxation of the LHB tendon, and subluxation of the LHB tendon associated with a subscapularis tear.[5]

Corresponding author: Kutalmış Albayrak, **E-mail:** kutalmisalbayrak@gmail.com

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The literature specifically comparing subpectoral biceps tenodesis with biceps tenotomy has focused on the functional outcomes of both procedures.[6,7] Compared to tenotomy, subpectoral tenodesis has been widely reported to result in lower rates of "Popeye deformity" and better preservation of biceps muscle strength. Although there is a significant difference between both methods in terms of the "Popeye sign," there are studies that argue that there is no significant difference in terms of functional improvement and patient satisfaction.[8-10] Age, functional needs, and esthetic concerns are important factors to consider when choosing between tenotomy and tenodesis.[11] There is no consensus in the literature on this subject, and results from different studies may differ from each other.[12,13]

In addition, the risk of complications during tenodesis is higher in elderly patients. The literature reports that complications such as humeral fracture or non-displaced fissure may occur during tenodesis, especially in patients with osteoporosis, ongoing bicipital pain, biceps rupture, and musculocutaneous neuropathy.[14-18] However, there is no study in the literature that analyses these 2 patient groups, especially in terms of complications in elderly patients. In our study, we hypothesized that tenotomy in the elderly patient group will be associated with fewer complications, higher patient satisfaction, and better functional outcomes.

MATERIAL AND METHODS

Study Design and Population

The study protocol was approved by the Baltalimanı Bone Diseases Training and Research Hospital Review Board (Date: 02.10.2024, Number: 29/199). Informed consent was obtained from all patients. This retrospective study evaluated patients over the age of 65 who underwent arthroscopic supraspinatus repair between 2020 and 2022, with a minimum follow-up period of 2 years. A total of 38 patients were included in the study, divided into 2 groups: 22 patients who underwent LHB tenotomy (group 1) and 16 patients who underwent open subpectoral biceps tenodesis (group 2).

Inclusion criteria consisted of patients with a minimum of 2 years of follow-up, who received either tenotomy or open subpectoral tenodesis as part of their surgical intervention. Exclusion criteria included patients with additional rotator cuff injuries (other than supraspinatus), those with prior surgeries on the affected shoulder, distal biceps pathology, or patients who were lost to follow-up.

Surgical Technique

The patient is positioned in the beach-chair position under general anesthesia. The arm is prepped and draped in a sterile fashion, ensuring full access to the shoulder joint and bicipital groove.

A standard diagnostic arthroscopy is performed through a standard posterior portal to assess the glenohumeral joint, rotator cuff, and the long head of the biceps tendon (LHBT). The degree of fraying or pathology in the biceps tendon is evaluated, and based on the findings, the decision for either tenotomy or tenodesis is made. If the decision is made to tenotomize through an anterior arthroscopic portal, the tendon is released from its attachment at the supraglenoid tubercle using an electrocautery device. The tendon retracts into the bicipital groove naturally after release.

If tenodesis was decided, subpectoral tenodesis was performed with all suture anchors according to the technique described by Lacheta et al.[15]

The arm is positioned in 90° of abduction and 90° of elbow flexion. An incision is created along the axillary crease, beginning 1 cm superior and extending 2 cm inferior to the inferior border of the pectoralis major tendon. The pectoralis major tendon, coracobrachialis, and the short head of the biceps brachii are identified, and the overlying fascia is incised. The pectoralis major tendon is retracted superiorly, facilitating palpation of the bicipital groove to locate the LHB tendon. A right-angle clamp is then utilized to encircle and retrieve the tendon.

A drill guide is positioned within the bicipital groove, approximately 2 cm distal to the inferior border of the pectoralis major tendon, and a 1.6 mm drill is employed to create a unicortical bone tunnel for the insertion of an anchor. One suture strand is used to whipstitch the tendon with 4 Krackow-style passes on each side, starting 1 cm proximal to the musculotendinous junction and extending 2 cm distally. The proximal portion of the tendon is excised, and the suture is passed through the

MAIN POINTS

- Both biceps tenotomy and subpectoral biceps tenodesis have satisfactory results in arthroscopic rotator cuff repair.
- Though biceps tenodesis provides limited benefit in terms of Popeye deformity and cosmesis, it prolongs the operation time and increases the complication rates.
- Although Popeye deformity is a recognized entity among physicians, it is well tolerated, especially by elderly patients.
- The possible disadvantage of biceps tenotomy compared to tenodesis in elderly people is that they experience more pain due to muscle cramps.
- Intraoperative or postoperative humeral fracture is a complication of subpectoral biceps tenodesis, even with the use of all-suture anchors.

tendon to facilitate its reduction to the anchor under tension. The sutures are securely tied, and the periosteum of the bicipital groove is stripped using an elevator to prepare the cortical surface.

Data Collection

Preoperative clinical and functional scores were assessed, including Constant and ASES scores. Radiological evaluation included MRI to assess rotator cuff integrity using the Goutallier classification[17] for fatty degeneration and the Patte classification[19] for retraction. Postoperatively, patients were evaluated for functional improvement using the Constant and ASES scores. Complications such as intraoperative fractures or Popeye deformity were also documented. Popeye deformity was assessed through a standardized physical examination conducted by experienced clinicians. The assessment included observing the biceps contour while the patient's arm was in both a relaxed and a flexed position.

Outcome Measures

The primary outcome measures were postoperative functional scores (Constant and ASES), the occurrence of Popeye deformity, and intraoperative complications such as humeral fissures or fractures. Secondary outcomes included operative time and patient-reported outcomes regarding satisfaction and shoulder function.

Statistical Analysis

Descriptive statistics were used to summarize the patient characteristics, and comparisons between the 2 groups were performed using independent *t*-tests for continuous variables and chi-square tests for categorical variables. Statistical significance was defined as $P < .05$.

Pearson's χ^2 test was used to investigate possible differences between the 2 groups in terms of age, gender, rotator cuff tear size, diabetes mellitus, and smoking history. Fisher's exact test was used to analyze possible differences between the 2 groups in terms of associated lesions and preoperative dominant hand. VAS (Visual Analog Scale) score, ROM (Range of Motion), ASES score, Constant score, and rotator cuff tear size were evaluated using repeated measures analysis of variance, and a *P*-value less than .05 was considered significant in all analyses. Statistical analysis was performed using SPSS Inc.; Chicago, IL, USA (Statistical Package for the Social Sciences) version 11.

RESULTS

Patient

Patient characteristics are shown in Table 1. A total of 38 patients were included in the study, with 22 patients in the tenotomy group (group 1) and 16 patients in the open subpectoral tenodesis group (group 2). There were no significant differences between group 1 and group 2 in terms of age (57.8 ± 9.1, 56.3 ± 6.2), follow-up time (12.8 ± 1.4, 11.6 ± 2.2 months), sex (14/8, 7/9 female/male ratio), body mass index (26.8 ± 2.2, 28.1 ± 2.7), or the involvement of the dominant arm (+/−, 12/10, 10/6) respectively ($P > .05$).

Table 1. Patient Characteristics

	Tenotomy Group 1 (n = 22)	Tenodesis Group 2 (n = 16)	*P*
Age	57.8 ± 9.1	56.3 ± 6.2	n.s.
Follow-up time (months)	15.8 ± 2.4	14.2 ± 2.6	n.s.
Sex (female/male)	14/8	7/9	n.s.
BMI (kg/m^2)	28.1 ± 2.7	26.8 ± 3.2	n.s.
Dominant arm	12	10	n.s.
Diabetes mellitus	4	4	n.s.
Smoking	3	4	n.s.

n.s., non-significant.

Preoperative Assesments

All preoperative assesment parameters are summarized in Table 2. Both groups had similar preoperative Constant (47.2 ± 8.6, 48.7 ± 11.2) and ASES (52.6 ± 6.4, 53.1 ± 9.4) scores, with no statistically significant difference ($P > .05$).

Preoperative MRI findings were also similar between the 2 groups. The distribution of Goutallier stages (14/8, 11/5; 0-1 vs. 2) and Patte retraction stages (16/6, 9/7; 1 vs. 2) did not show any significant differences between group 1 and group 2, respectively ($P > .05$).

Postoperative Functional Outcomes

The mean operative time was significantly shorter in the tenotomy group. Group 1 had an average operative time of 81 ± 12.2 minutes, while group 2 had an average of 94 ± 18.2 minutes ($P = .001$). Both groups demonstrated significant improvements in functional outcomes

Table 2. Preoperative Assesments Parameters

	Tenotomy Group 1 (n = 22)	Tenodesis Group 2 (n = 16)	*P*
Rotator cuff tear size (small/medium)	8/14	9/7	n.s.
Constant score	47.2 ± 8.6	48.7 ± 11.2	n.s.
ASES score	52.6 ± 6.4	53.1 ± 9.4	n.s.
Goutallier classification (0-1/2)	14/8	11/5	n.s.
Patte classification (1/2)	16/6	9/7	n.s.

ASES, American Shoulder and Elbow Surgeons; n.s., non-significant.

after surgery. In group 1 (tenotomy), the postoperative Constant score improved from 47.2 ± 8.6 to 95.2 ± 2.4 (P < .001), while in group 2 (tenodesis), the score improved from 48.7 ± 11.2 to 92.4 ± 2.7 (P < .001). The postoperative ASES scores showed similar improvements in both groups, with no statistically significant difference between them (P > .05). Group 1 improved from 52.6 ± 6.4 to 94.6 ± 2.2, and group 2 improved from 53.1 ± 9.4 to 91.7 ± 2.9 (P = .001).

Both procedures resulted in excellent functional outcomes, with significant improvements in postoperative Constant and ASES scores in both groups. There was no statistically significant difference between the 2 groups in terms of functional recovery or patient satisfaction. However, the tenotomy group demonstrated a shorter operative time and fewer intraoperative complications.

Complications

Two humeral fractures were observed in group 2 (tenodesis), whereas no fractures were seen in group 1 (tenotomy). Although this difference is numerically significant, it was not found to be statistically significant (P > .05). Both patients were treated conservatively using a brace, and complete union was obtained. The occurrence of Popeye deformity was rare in both groups. Three Popeye deformities were observed in the tenotomy group, and no cases were observed in the tenodesis group. However, muscle cramping was observed more frequently in Group 1 (tenotomy), where 5 patients experienced postoperative cramps compared to 1 patient in group 2. Nevertheless, patients occasionally reported that these cramps did not significantly affect their quality of life. Postoperative patient reported outcomes and complications are summarized in Table 3. Early postoperative radiographs and healed final radiographs of patient with fractures are shown in Figure 1.

Table 3. Postoperative Patient Reported Outcomes and Complications

	Tenotomy Group 1 (n = 22)	Tenodesis Group 2 (n = 16)	*P*
Complications	0	2	n.s.
Revisions	0	0	n.s.
Humerus fracture	0	2	n.s.
Popeye deformity	3	0	n.s.
Muscle cramping	5	1	n.s.
Postop Constant score	95.2 ± 2.4	92.4 ± 2.7	n.s.
Postop ASES score	94.6 ± 2.2	91.7 ± 2.9	n.s.
Operation time (minutes)	81 ± 12.2	94 ± 18.2	***P* = .02***

ASES, American Shoulder and Elbow Surgeons; n.s., non-significant; *Indicates significant values.

DISCUSSION

The most important finding of our study is that although both tenodesis and tenotomy show comparable functional results in elderly patients, tenodesis is slightly superior in preventing Popeye deformity, while tenotomy is associated with shorter operative time and a lower risk of complications.

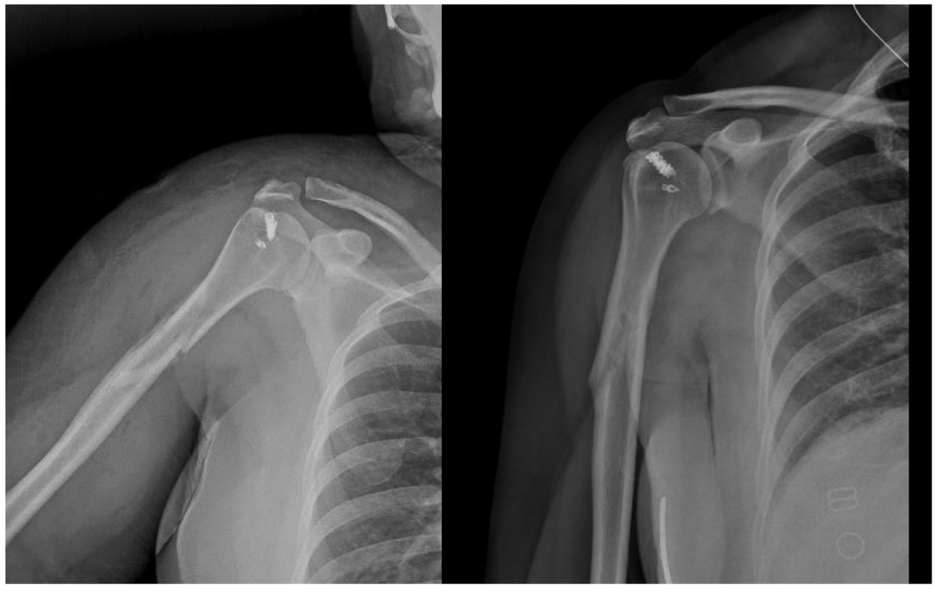

Figure 1. Early postoperative anterior posterior (AP) radiographs and healed final radiographs of patient with fracture.

In elderly patients undergoing rotator cuff repair, the choice between tenotomy and tenodesis remains a subject of debate, particularly regarding functional outcomes, complication rates, and surgical complexity. Our findings suggest that both techniques yield comparable functional outcomes, as demonstrated by significant improvements in postoperative Constant and ASES scores in both groups. These results are consistent with prior studies indicating that there is no significant difference in functional recovery or patient satisfaction between tenotomy and tenodesis.[6,20] Given the similarities in functional outcomes, other factors such as complication risks and operative time should guide surgical decision-making in this older patient population.

Studies showed that a notable difference between the 2 procedures lies in the complication profiles. Although tenodesis is associated with a lower incidence of Popeye deformity, which may be a cosmetic concern for some patients, it also carries a higher risk of complications such as humeral fractures, particularly in older patients with poor bone quality.[13,21] In our study, 2 patients in the tenodesis group experienced humeral fractures, while none occurred in the tenotomy group. This finding aligns with existing literature, which reports an increased risk of humeral fractures during subpectoral tenodesis, particularly when using interference screws or knotless anchors. However, there is also a risk of fracture of the humerus when using all-suture anchors.[8,9] Although the risk of fracture in all-suture anchors seems to be low, fractures can be seen in patients with relatively poor bone quality during hammering. If tenodesis is intended, perhaps suprapectoral tenodesis may reduce the risk of fracture.

Although anterior shoulder pain is reported more frequently as a complication in these patients in the literature,[11,22] we did not find any difference between the 2 groups. We did not observe any persistent pain even in 2 patients with humeral fractures. Although we reported more buttock deformity in the tenotomy group, the patients did not complain about this condition. These were findings based on a doctor's observation. Therefore, it should be discussed whether it is necessary to take the additional risks of tenodesis to avoid Popeye deformity in patients in this age group.

Despite these advantages, tenotomy is not without its limitations. Muscle cramping, though not statistically significant, was more frequently observed in our tenotomy group. This aligns with the findings of prior studies, which suggest that while tenotomy offers a simpler surgical approach with fewer complications, it may be accompanied by muscle-related symptoms in some cases.[14] However, given the relatively low incidence of major complications and the reduced surgical complexity, tenotomy may still be the preferred option in elderly patients with lower functional demands and higher surgical risks.

This study has several inherent limitations that should be considered when interpreting the results. First, the relatively small sample size of 38 patients may limit the statistical power and the generalizability of the findings. Larger cohort studies or randomized controlled trials would be necessary to confirm these results. Second, the decision to perform tenotomy or tenodesis was based on the surgeon's preference, introducing an element of subjectivity that could affect outcomes. This variability in surgical decision-making may lead to biases in both the selection of patients and the assessment of postoperative results. Finally, subjective complaints such as muscle cramping, which were more frequently reported in the tenotomy group, may also be influenced by individual patient perception, further complicating the comparison of outcomes between the 2 procedures.

Although both tenotomy and tenodesis offer excellent functional results, tenotomy may be more suitable for elderly patients due to its lower complication rate, shorter operative time, and reduced risk of more serious complications such as humeral fracture. However, the decision should be tailored to the individual patient, taking into account factors such as aesthetic concerns, bone quality, and the potential for residual pain.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethics committee approval was received for this study from the Baltalimanı Bone Diseases Training and Research Hospital Review Board (Date: 02.10.2024, Number: 29/199).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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