Tenotomy Versus Tenodesis in the Management of Pathologic Lesions of the Tendon of the Long Head of the Biceps Brachii

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Tenotomy Versus Tenodesis in the Management of Pathologic Lesions of the Tendon of the Long Head of the Biceps Brachii

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Background: Primary and secondary lesions of the tendon of the long head of the biceps brachii are common, with no clear consensus about their optimal management.

Hypothesis: There is no difference in outcomes of tenotomy and tenodesis for lesions of the tendon of the long head of the biceps brachii.

Study Design: We performed a comprehensive quantitative review of the published English-language literature comparing the outcomes of tenotony and tenodesis for lesions of the tendon of the long head of the biceps brachii.

Methods: All relevant articles in peer-reviewed journals were retrieved, and each article was scored using the Coleman Methodology Score, a highly repeatable methodology score, by 2 independent reviewers.

Results: Scores were predominantly low for quality of the studies, with patient number and validated outcome measures being the weakest areas.

Conclusion: There is a lack of quality evidence to advocate one technique over the other. We emphasize the need for appropriately powered, well-conducted, randomized, controlled trials comparing the outcomes of these 2 procedures. There is little difference in the outcome of tenotomy compared with tenodesis. Tenotomy is easy and quick, with less need for postoperative rehabilitation. We therefore suggest that biceps tenotomy be the preferred method.

Clinical Relevance: Biceps pathologic lesions are common. There is no evidence base for their most appropriate management.

Keywords: tenotomy; tenodesis; tendinitis; long head of biceps brachii (LHB); rotator cuff lesions

The tendon of the long head of the biceps brachii (LHB) is commonly involved in pathological processes and is a frequent cause of shoulder pain.[17,22,26,30] Lesions may arise from isolated abnormalities such as primary tendinopathy[26] or, more commonly, from a more complex disease process such as impingement and thus develop secondary tendinopathy.[17,22,26,30] There is no clear consensus on the optimal management of LHB tendon lesions. Some authors advocate biceps tenotomy,[15,19,29] as it is well tolerated with little postoperative rehabilitation. A tenotomy may, however, have functional implications, as the biceps muscle, although primarily involved in elbow function, is also a depressor of the humeral head.[2] Other groups, therefore, advocate tenodesis[2,4,6] as the option of choice, believing that the closer restoration of normal anatomy is beneficial.

Here we conduct a comprehensive quantitative review of the published literature on the management of biceps tendon lesions to assess the methodology of those studies and analyze the reported outcomes.

MATERIALS AND METHODS

A comprehensive literature search using Medline, Embase, Cochrane, CINAHL, and Google Scholar was conducted to identify the studies that used biceps tenotomy or tenodesis

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TABLE 1
Coleman Methodology Score

Part A (one score in each section)	Score
Study size, number of tendons	
>60	10
41-60	7
20-40	4
<20, unclear	0
Mean follow-up, mo	
>24	5
12-24	2
<12	0
Number of surgical procedures reported in each surgical outcome	
1 procedure only	10
>1 procedure but >90% undergoing that procedure	7
<90% undergoing single procedure or unclear	0
Type of study	
Randomized controlled trial	15
Prospective cohort study	10
Retrospective cohort study	0
Diagnostic certainty	
In all	5
In >80%	3
In <80%	0
Description of surgical procedure	
Adequate (technique stated, and details of procedure given)	5
Fair (technique only, no elaboration given)	3
Inadequate	0
Description of postoperative rehabilitation	
Well described and >80% of patients complying	10
Well described with 60%-80% compliance	5
Protocol not reported or <60% compliance	0
Part B (score given in each option in each section)	**Score**
Outcome criteria	
Outcome measure clearly defined	2
Timing of outcome measure defined	2
Use of outcome measure that has a good reported reliability	3
Use of outcome with good sensitivity	3
Procedure for assessing outcome	
Patients recruited (results not taken from surgeons' files)	5
Investigator independent of surgeon	4
Written assessment	3
Completion of assessment by patients themselves with little intervention from surgeon	3
Description of patient selection	
Criteria reported and unbiased	5
Recruitment rate reported and >80%	5
<80%	3
Eligible patients not included in study satisfactorily accounted for 100% recruitment	5

in the management of LHB lesions. The key words "biceps tenodesis" and "biceps tenotomy" were used. All journals were considered, and all relevant articles written in English were retrieved. We excluded case reports, literature reviews, letters to editors, and articles not specifically reporting outcomes.

The criteria developed by Coleman et al[7] were used to assess the methods of each article. Each study was blinded and assessed twice by 2 assessors independently of each other. Each study was scored for each of the criteria reported in Table 1 to give a total Coleman Methodology Score of between 0 and 100. A perfect score of 100 would represent a study design that largely avoids the influence of chance, various biases, and confounding factors. Any discrepancies were given the higher score to show the study in the best light.

The Coleman scoring system is a method of analyzing the quality of the studies reviewed, and it is accurate and reproducible in systematic reviews.[7,28] Also, we devised the system and have used it successfully for several years. In addition, it has been validated outside our research center.[18]

TABLE 2
Synopsis of Studies on Tenotomy Alone[a]

Article	Walch[29]	Klinger[20]	Edwards[11]	Gill[15]	Kelly[19]
Age, y (range)	64.3 (39-81)	68 (63-82)	64.1 (not specified)	50 (16-75)	48 (18-83)
Number of patients	307	17	11	12	40
Other surgery or shoulder injury	Large RCTs	RCTs	Subscapularis tear	Various lesions	Various lesions
Excellent/good outcome	71%	76%	82%	90% return to sport	65%
Poor outcome	13.7%	24%	9%	13%	35%
Popeye sign	50%	12%	Not mentioned	3%	70%
Coleman Score, reviewer 1/2	77/77	77/74	55/56	42/40	52/49

[a]RCT, rotator cuff tear

TABLE 3
Synopsis of Studies on Tenodesis Alone[a]

Article	Boileau[4]	Becker[1]	Post[26]	Nord[23]	Berlemann[2]	Dines[8]	Drakos[9]	Checchia[6]
Age, y (range)	63 (25-78)	51 (19-71)	34 (19-58)	60 (41-77)	62 (54-66)	35 (18-63)	39 (15-67)	62 (41-80)
Number of patients	43	54	17	10	15	20	40	15
Concurrent surgery/ shoulder injury	RCTs	CA ligament divided	No	RCTs and labral lesion	SAD	No	15 patients had other	RCT repair, ACJ excision
Excellent/good outcome	Increased constant score	40%	92%	90%	64%	70%	80%	93%
Poor outcome	5%	48%	8%	0%	13%	30%	5%	0%
Coleman Score, reviewer 1/2	74/76	66/66	46/49	52/49	36/29	36/36	61/64	56/56

[a]RCT, rotator cuff tear; CA, coracoacromial ligament; SAD, subacromial decompression; ACJ, acromioclavicular joint.

Statistics

Regression analysis was used to assess the extent of agreement between the Coleman scores of the 2 investigators, each of whom had performed the scoring independently of the other. The intraclass correlation coefficient was used to give a score for Cronbach's α. The same method was used to assess correlation between the year of publication and the Coleman score. Analysis was performed using SPSS statistics software (SPSS Science Inc, Chicago, Illinois).

RESULTS

A total of 20 publications met our inclusion criteria. The same study had been published in 2 separate journals, so its results were only included once.[4,5] The articles retrieved spanned a 26-year period from 1982 to 2008. Five studies evaluated the role of tenotomy, 8 evaluated the role of tenodesis, and 6 reported the results from both tenodesis and tenotomy. A summary of the findings can be seen in Tables 2, 3, and 4.

The studies investigated patients within a wide age range (15[9]-85[3] years). In many studies, most patients undergoing the tenotomy or tenodesis had a preexisting shoulder injury such as a rotator cuff tear or subacromial impingement.[8,26]

Tenodesis gives good or excellent results in 40%[1] to 100%[13] of patients, and a failure rate of between 5%[4] and 48%.[1] Similarly, 65%[19] to 100%[14] of patients undergoing a tenotomy had a good or excellent outcome, with a failure rate of 13%[15] to 35%.[19] The studies that compared the 2 procedures did not show any significant differences between the 2 groups other than the Popeye sign being present in 3%[15] to 70%[19] of patients who underwent tenotomy.

The Coleman Methodology Score for the investigations included in this study varied from 21 to 79. When the methods of each article were blindly assessed twice, the scores were highly reproducible (Tables 2-4). The Coleman Methodology Scores for the studies showed a mean score of 58 ± 14. The intraclass correlation coefficient gave a Cronbach's α of 0.990. Studying Coleman's score and year of publication gave an intraclass correlation coefficient with a Cronbach's α of 0.56.

There was 1 randomized controlled study,[14] 7 prospective cohort studies, and 11 retrospective cohort studies. The numbers of patients in the various articles also showed wide variation, ranging from 10[23] to 307.[29] These differences partly account for the large differences in the Coleman scores given to the various studies.

DISCUSSION

Untreated or undiagnosed lesions of the tendon of the LHB are a common cause of persistent pain and dysfunction of the

TABLE 4
Synopsis of Studies Comparing Tenotomy and Tenodesis[a]

Article	Osbahr[24]	Edwards[12]	Boileau[3]	Paulos[25]	Franceschi[13]	Franceschi[14]
Age, y (range)	56 (23-76)	53 (not specified)	68 (52-85)	55 (not specified)	59 (40-81)	64.7 (53-81)
Tenotomies, n	80	13	39	10	11	29
Tenodeses, n	80	48	33	39	11	27
Concurrent surgery/ shoulder injury	Yes	Subscapularis tear	RCT	RCT and SAD	RCT	SLAP lesion and RCT
Excellent/good outcome	Generally good	Beneficial effect from surgery	65%	83% reasonable outcome	100%	All significant improvement in UCLA score
Poor outcome	Few poor	Few poor	11%	16% still had pain over biceps	0%	0%
Popeye sign	Not found	No comment	62%	19%	No	59%
Difference between procedures	None	None	Increased PS no other difference	Increased PS in tenotomy no other differences	None	Tenotomy group better function and satisfaction
Coleman Score, reviewer 1/2	59/62	55/58	60/59	21/21	67/65	79/75

[a]RCT, rotator cuff tear; SAD, subacromial decompression; SLAP, superior labrum anterior and posterior; UCLA, University of California–Los Angeles; PS, Popeye sign.

shoulder. Eaken et al[10] described 3 areas of the LHB that could present with injury requiring operative intervention: a tendinopathy or a tear, a medial subluxation of the tendon, or a degenerative unstable superior labrum anterior and posterior (SLAP) lesion. Patients with chronic biceps tendinopathy have pain on palpation of the bicipital groove, especially during overhead activity, and positive Yergason's test or Speed's maneuver. These patients often undergo procedures for other shoulder problems, as the biceps injury is often secondary to, for example, impingement or rotator cuff tear.[17,22,26,30] All studies show a reliable improvement in postoperative outcomes for patients with LHB injury, regardless of whether tenotomy or tenodesis is performed.

There are no clinical trials to definitively show which mode of management for LHB lesions is more appropriate. The Coleman Methodology Scores in the present study were reproducible between the 2 reviewers. The intraclass correlation coefficient gave a Cronbach's α of 0.990. This indicates a high correlation between the Coleman scores given to each article by each independent marker. However, the relatively low scores bear witness to the fact that the available data have methodological deficiencies. The articles did not improve from a methodological point of view with more recent publication, hence the relatively low intraclass correlation coefficient with a Cronbach's α of 0.56 when studying Coleman score and year of publication.

There is little difference in outcome between tenodesis and tenotomy for the treatment of LHB lesions. The failure rates for tenodesis varied from 5%[4] to 48%,[1] and those of tenotomy from 13%[15] to 35%.[19] Both these procedures produce a similar number of good to excellent outcomes as well, ranging from 65%[19] to 90%[15] in the tenotomy group, and 40%[1] to 93%[6] in the tenodesis group. Interestingly, Franceschi et al[14] did find that patients undergoing tenotomy as opposed to tenodesis had a significantly better result for shoulder function and satisfaction with the procedure. Hawkins et al[16] studied only muscle strength after tenodesis or tenotomy of the LHB using isokinetic strength tests and found no difference in forearm supination or elbow flexion strength between the study groups. There was also no difference between patients who had undergone either operation or a control group of patients who had not undergone any surgery. It would therefore seem that there is no discernable loss of strength after either tenodesis or tenotomy.

The studies that compared the 2 procedures did not evidence any significant differences other than the Popeye sign being present in 3%[15] to 70%[19] of patients who underwent a tenotomy. It was rarely a problem when present and often not even noticed by the patients themselves.[3] The Popeye sign, however, is not always a consequence of tenotomy, and biceps tenodesis patients and biceps tenotomy patients were equally satisfied with the cosmetic appearance of the operated limb.[24] Part of the reason why the tenotomy group did well may be that the cut end of the biceps tendon may lie to rest in the bicipital groove, leaving the overall biceps muscle length relatively unchanged, as the tendon, remaining in the bicipital groove, may in fact undergo autotenodesis.[24]

Patients undergoing tenotomy are generally allowed to return to their normal activities almost immediately after surgery. Patients undergoing tenodesis, instead, adhere to a strict postoperative rehabilitation regimen involving restriction of elbow flexion/extension, supination, and pronation for 6 weeks after surgery.[5] Obviously, there is an advantage in the tenotomy group who return to their everyday activities sooner.

Some authors believe that tenodesis should be reserved for younger, more active patients. However, failures

occurred more frequently in the youngest patients offered tenodesis, with an average age of only 21. This young group of patients fared worse with tenodesis.[8] However, patients under the age of 60 reported reduction in strength endurance after tenotomy, which was not noticed in the group of patients above the age of 60. This decrease was, however, minimal, with a mean number of repetitions of biceps curls of 32.3 compared with 34.2 on the nonaffected contralateral arm.[19] Although it is statistically significant, it is probably not clinically relevant. There is no evidence to support performing tenodesis in favor of tenotomy in younger patients unless there is a particular reason the Popeye sign would be undesirable.

Tenodesis or tenotomy may produce proximal migration of the humeral head from the loss of the depressing function the intra-articular portion of the LHB.[2,21,27] Boileau et al[3] found a reduction in acromiohumeral distance of 1.1 mm 3 years after either tenotomy or tenodesis: this was not statistically significant and its clinical implications are doubtful. Walch et al[29] found a similar loss of acromiohumeral space of 1.3 mm 57 months postoperatively, with no associations between humeral migration or acetabularization of the acromion and postoperative outcome. It therefore seems that this theoretical role of LHB as a humeral depressor is not a significant determinant of postoperative function.

CONCLUSION

There is little difference in the outcome of tenotomy compared with tenodesis. Both procedures have a similar rate of success and failure. There is no discernable difference in complications other than the increased incidence of Popeye sign in the tenotomy group, which rarely seems to worry the patient. Tenotomy is easy and quick, with less need for postoperative rehabilitation. Therefore, on the basis of this comprehensive quantitative review of the literature, a tenotomy of the LHB can be safely performed with a high rate of subjective and objective success in most patients regardless of age. Consideration should be given to performing tenodesis in very thin patients who may be concerned about cosmetic appearance. Given the disparity of opinions and the lack of relevant studies, appropriately powered, well-conducted, randomized, controlled trials comparing the outcomes of these 2 procedures should be planned.

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