Outcomes of Biceps Tenotomy Versus Tenodesis During Arthroscopic Rotator Cuff Repair

An Analysis of Patients From a Large Multicenter Database

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Background: Studies to date evaluating biceps tenotomy versus tenodesis in the setting of concomitant rotator cuff repair (RCR) have demonstrated relatively equivalent pain and functional outcomes.

Hypothesis: It was hypothesized that a significant difference could be demonstrated for pain and functional outcome scores comparing biceps tenotomy versus tenodesis in the setting of RCR if the study was adequately powered.

Study Design: Cohort study; Level of evidence, 3.

Methods: The Arthrex Surgical Outcomes System database was queried for patients who underwent arthroscopic biceps tenotomy or tenodesis and concomitant RCR between 2013 and 2021; included patients had a minimum of 2 years of follow-up. Outcomes between treatment types were assessed using the American Shoulder and Elbow Surgeons Shoulder (ASES), Single Assessment Numeric Evaluation (SANE), visual analog scale (VAS) for pain, and Veterans RAND 12-Item Health Survey (VR-12) scores preoperatively and at 3 months, 6 months, 1 year, and 2 years postoperatively. Results were stratified by age at surgery (3 groups: <55, 55-65, >65 years) and sex.

Results: Overall, 1936 primary RCRs were included for analysis (1537 biceps tenodesis and 399 biceps tenotomy patients). Patients who underwent tenotomy were older and more likely to be female. A greater proportion of female patients aged <55 years and 55 to 65 years received a biceps tenotomy compared with tenodesis (P = .012 and .026, respectively). All scores were comparable between the treatment types preoperatively and at 3 months, 6 months, and 1 year postoperatively. At 2-year follow-up, patients who received a biceps tenodesis had statistically more favorable ASES, SANE, VAS pain, and VR-12 scores (P ≤ .031); however, the differences did not exceed the minimal clinically important difference (MCID) for these measures.

Conclusion: Our findings indicate that surgeons are more likely to perform a biceps tenotomy in female and older patients. Biceps tenodesis provided improved pain and functional scores compared with tenotomy at 2-year follow-up; however, the benefit did not exceed previously reported MCID for the outcome scores. Both procedures provided improvement in outcomes; thus, the choice of procedure should be a shared decision between the surgeon and patient.

Keywords: biceps tenodesis; biceps tenotomy; rotator cuff repair

Patients with rotator cuff tears have a high incidence of concomitant long head of biceps tendon pathology and associated disability.28 When performing a rotator cuff repair (RCR) with biceps pathology that necessitates surgical management, the treating surgeon is faced with the choice of performing either a biceps tenotomy or a biceps tenodesis.23,26 Multiple studies have demonstrated improvement in pain and functional outcomes with either tenotomy or tenodesis.1,3,10,13,14 Tenotomy offers the advantage of decreased surgical time and avoidance of an extra surgical incision in some cases. Proponents of biceps tenodesis argue that this procedure results in a better cosmetic result (avoidance of a Popeye deformity) and avoids the prolonged cramping that occurs after a biceps tenotomy.1
Kim et al. evaluated their results comparing tenotomy versus tenodesis for patients in the setting of concomitant RCR. They noted improved functional outcomes for both patient cohorts without a significant intergroup difference. However, their study evaluated a total of only 135 patients; thus, it might have been underpowered. To the best of our knowledge, there are no large studies evaluating the outcomes regarding biceps tenodesis versus tenotomy in the setting of a concomitant RCR. There are also no studies that have stratified patient outcomes with regard to age and/or sex of the patient.

The purpose of this study was to compare the pain and functional outcome scores between patients treated with biceps tenotomy versus biceps tenodesis in the setting of RCR. We hypothesized that, after controlling for patient age and sex, there would be no difference in outcomes based on the management of the biceps tendon.

METHODS

Database and Patient Selection

After receiving institutional review board approval for this study, we retrospectively queried the Surgical Outcomes System (Arthrex) global database, which includes patients from approximately 267 centers and 3000 surgeons, for patients who had undergone an arthroscopic biceps tenotomy or tenodesis and concomitant RCR between 2013 and 2021. Patients were included in the study if they had a minimum of 2 years of follow-up, with scores from at least 1 of the study outcome measures collected at 2-year follow-up. Excluded were patients missing demographic data (age and sex), those younger than 35 years, and those undergoing open RCR, revision RCR, or rotator cuff debridement without repair.

A total of 1936 patients with primary RCRs met the study inclusion criteria. The biceps tendon was managed with biceps tenotomy in 399 patients (tenotomy group) and biceps tenodesis in 1537 patients (tenodesis group). We stratified the patients in each treatment group by sex and age range: between 35 and 54 years (< 55 year group; mean age, 49.3 ± 3.9 years), 55 to 65 years (mean age, 60.2 ± 3.1 years), and > 65 years (mean age, 70.3 ± 3.8 years).

Outcome Measures

Functional outcomes were assessed with the American Shoulder and Elbow Surgeons Shoulder (ASES) index and function scores, the Single Assessment Numeric Evaluation (SANE), a 10-point visual analog scale (VAS) for pain, and the Veterans RAND 12-Item Health Survey (VR-12) Mental Component Summary (MCS) and Physical Component Summary (PCS). The ASES index score is the full ASES score comprising assessments of function and pain in equal parts. The ASES function score is a subscore composed of the sum of 10 functional questions (responses graded 0-3 points) from the ASES assessment questionnaire. All outcome measures were collected preoperatively and postoperatively at 3-month, 6-month, 1-year, and 2-year follow-up; the VR-12 was not assessed at 3-month follow-up but was available for all other time points.

Statistical Analysis

We compared the difference between the tenotomy versus tenodesis groups in terms of age group and sex using the chi-square test. Outcome scores at each time point were compared by treatment group, as stratified by age group and sex. The outcome scores had a nonparametric distribution as assessed by the Shapiro-Wilk test; thus, statistical comparisons were made using the Mann-Whitney U test. In addition, we compared the change in preoperative and 2-year postoperative scores (Δ) between treatment groups. All analyses were performed using R Software (Version 3.6.3; R Core Team), with P < .05 indicating statistical significance.

In addition to quantifying statistically significant differences, we compared the difference between the mean score of patients undergoing biceps tenotomy and tenodesis and the minimal clinically important difference (MCID) as reported in studies by Cvetanovich et al., Kim et al., and Tasbrian et al. of patients undergoing arthroscopic RCR. In cases in which more than 1 of these studies reported an MCID for a given outcome score, the lowest reported MCID was used to assess clinical significance. The statistical power to detect a difference equivalent to the lowest reported MCID between tenotomy and tenodesis groups was calculated using G²Power.
For the power analysis, we considered the sample sizes as the smallest number of patients with available data for each age group and sex (eg, men <55 years: n = 31 for tenotomy, n = 238 for tenodesis).

RESULTS

The results of the power analysis are shown in Table 1. Adequate (≥80%) statistical power was present to detect the MCID for nearly all outcome measures; only the MCID for the SANE score in women aged <55 years was underpowered.

Patients who underwent tenotomy were older (62.6 ± 8.1 vs 60.3 ± 8.8 years; P < .001) and more likely to be female (48% vs 37%; P < .001) compared with those who underwent tenodesis. The tenotomy group had a greater proportion of women younger than 55 years (20% vs 11%; P = .012) and between 55 and 65 years (25% vs 19%; P = .026) compared with their male counterparts (Figure 1).

TABLE 1
Study Power to Detect the Lowest Reported MCID for the Included Outcome Measures

|                | ASES (MCID, 11.1-27.1 points) | SANE (MCID, 13-16.9 points) | VAS Pain (MCID, 1.5-2.4 points) |
|----------------|-------------------------------|-----------------------------|---------------------------------|
| Overall        | 100.0                         | 100.0                       | 100.0                           |
| Age <55 y      |                               |                             |                                 |
| Male           | 96.6                          | 80.5                        | 99.5                            |
| Female         | 93.7                          | 73.9                        | 98.6                            |
| Age 55-65 y    |                               |                             |                                 |
| Male           | 100.0                         | 99.1                        | 100.0                           |
| Female         | 100.0                         | 97.0                        | 100.0                           |
| Age >65 y      |                               |                             |                                 |
| Male           | 100.0                         | 97.4                        | 100.0                           |
| Female         | 99.9                          | 95.6                        | 100.0                           |

Values are expressed as percentages. ASES, American Shoulder and Elbow Surgeons; MCID, minimal clinically important difference; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.

Study power was calculated for the lowest MCID as reported in studies by Cvetanovich et al,7 Kim et al,12 and Tashjian et al27; range of lowest MCIDs from all 3 studies shown. The MCID for the Veterans RAND 12-Item Health Survey has not been reported for arthroscopic rotator cuff repair.

Figure 1. Age and sex distribution of patients undergoing tenotomy versus tenodesis. *Statistically significant difference by sex within age group (P < .05).
TABLE 2
Outcomes of Patients in the Tenotomy and Tenodesis Groups

| Outcome Measure | Tenotomy (n = 399) | Tenodesis (n = 1537) | P       |
|-----------------|-------------------|----------------------|---------|
|                  | % (n)    | Mean ± SD         | % (n)    | Mean ± SD         |         |
| Preoperative     |         |                   |         |                   |         |
| ASES function    | 92.5 (369) | 13.5 ± 5.9        | 90.6 (1392) | 14.1 ± 5.9        | .042    |
| ASES index       | 92.2 (368) | 47.6 ± 18.1       | 90.5 (1391) | 49.3 ± 18.3       | .090    |
| SANE             | 92.5 (369) | 36.5 ± 20.6       | 90.3 (1388) | 37.8 ± 21.2       | .263    |
| VAS pain         | 93.2 (372) | 5.0 ± 2.4         | 92.3 (1418) | 4.8 ± 2.4         | .222    |
| VR-12 MCS        | 92.0 (367) | 51.1 ± 11.5       | 88.5 (1360) | 52.6 ± 10.7       | .050    |
| VR-12 PCS        | 92.6 (367) | 37.3 ± 7.9        | 88.5 (1360) | 36.8 ± 8.0        | .327    |
|                  |         |                   |         |                   |         |
| 3 monthsa        |         |                   |         |                   |         |
| ASES function    | 92.5 (369) | 17.4 ± 6.2        | 90.7 (1394) | 16.8 ± 6.2        | .072    |
| ASES index       | 92.5 (369) | 68.2 ± 17.3       | 90.7 (1394) | 67.6 ± 16.5       | .371    |
| SANE             | 92.2 (368) | 56.1 ± 21.8       | 90.4 (1390) | 55.0 ± 21.5       | .354    |
| VAS pain         | 93.7 (374) | 2.2 ± 1.9         | 91.9 (1413) | 2.1 ± 1.9         | .437    |
|                  |         |                   |         |                   |         |
| 6 months         |         |                   |         |                   |         |
| ASES function    | 90.7 (362) | 22.9 ± 5.7        | 87.7 (1348) | 22.7 ± 5.6        | .328    |
| ASES index       | 90.7 (362) | 81.5 ± 15.6       | 87.7 (1348) | 80.9 ± 15.8       | .508    |
| SANE             | 90.7 (362) | 71.9 ± 23.5       | 87.8 (1350) | 72.0 ± 22.0       | .584    |
| VAS pain         | 92.0 (367) | 1.3 ± 1.6         | 89.1 (1370) | 1.4 ± 1.7         | .862    |
| VR-12 MCS        | 90.0 (359) | 54.7 ± 9.4        | 87.0 (1337) | 55.3 ± 9.1        | .157    |
| VR-12 PCS        | 90.0 (359) | 44.9 ± 8.5        | 87.0 (1337) | 45.2 ± 8.0        | .780    |
|                  |         |                   |         |                   |         |
| 1 year           |         |                   |         |                   |         |
| ASES function    | 90.0 (359) | 25.6 ± 5.3        | 87.2 (1341) | 25.9 ± 4.8        | .274    |
| ASES index       | 90.0 (359) | 86.9 ± 15.6       | 87.2 (1341) | 87.8 ± 14.6       | .434    |
| SANE             | 90.0 (359) | 77.9 ± 25.4       | 87.5 (1345) | 79.2 ± 24.5       | .364    |
| VAS pain         | 90.5 (361) | 1.2 ± 1.7         | 88.0 (1355) | 1.1 ± 1.6         | .511    |
| VR-12 MCS        | 89.5 (357) | 55.1 ± 8.4        | 86.9 (1335) | 55.5 ± 8.6        | .326    |
| VR-12 PCS        | 89.5 (357) | 47.6 ± 7.9        | 86.9 (1335) | 48.0 ± 8.0        | .293    |
|                  |         |                   |         |                   |         |
| 2 years          |         |                   |         |                   |         |
| ASES function    | 98.5 (393) | 25.9 ± 5.4        | 98.7 (1517) | 26.4 ± 5.2        | .011    |
| ASES index       | 98.5 (393) | 87.2 ± 16.6       | 98.7 (1517) | 88.6 ± 16.2       | .008    |
| SANE             | 98.5 (393) | 76.0 ± 29.1       | 98.8 (1518) | 80.6 ± 25.7       | .005    |
| VAS pain         | 100.0 (399) | 1.2 ± 1.9       | 100.0 (1537) | 1.1 ± 1.8        | .031    |
| VR-12 MCS        | 98.7 (394) | 54.1 ± 8.8        | 97.6 (1500) | 55.1 ± 8.5        | .021    |
| VR-12 PCS        | 98.7 (394) | 47.2 ± 8.5        | 97.6 (1500) | 48.4 ± 8.3        | .003    |
| Δ (preoperative to 2 y) |         |                   |         |                   |         |
| ASES function    | 91.7 (366) | 12.5 ± 6.7        | 89.4 (1374) | 12.4 ± 6.7        | .728    |
| ASES index       | 91.5 (365) | 39.7 ± 19.7       | 89.3 (1373) | 39.5 ± 20.1       | .813    |
| SANE             | 91.7 (366) | 39.7 ± 34.3       | 89.2 (1371) | 43.0 ± 32.2       | .175    |
| VAS pain         | 93.2 (372) | 3.8 ± 2.6         | 92.3 (1418) | -3.7 ± 2.6        | .801    |
| VR-12 MCS        | 91.5 (365) | 3.1 ± 11.0        | 86.9 (1335) | 2.7 ± 10.6        | .541    |
| VR-12 PCS        | 91.5 (365) | 10.1 ± 8.4        | 86.9 (1335) | 11.8 ± 9.0        | .005    |

aBoldface P values indicate statistically significant difference between treatment groups (P < .05). ASES, American Shoulder and Elbow Surgeons; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale; VR-12, Veterans RAND 12-Item Health Survey; MCS, mental component score; PCS, physical component score.

bThe 3-month postoperative VR-12 scores were not assessed.

Overall Outcomes

Pain and functional outcomes were comparable between the tenotomy and tenodesis patients preoperatively and at 3 months, 6 months, and 1 year postoperatively (Table 2). At the 2-year follow-up, the tenodesis group had significantly better scores on all outcome measures compared with the tenotomy group: ASES function (26.4 ± 5.2 vs 25.9 ± 5.4; P = .011), ASES index (88.6 ± 16.2 vs 87.2 ± 16.6; P = .008), SANE (80.6 ± 25.7 vs 76.0 ± 29.1; P = .005), VAS pain (1.1 ± 1.8 vs 1.2 ± 1.9; P = .031), VR-12 MCS (55.1 ± 8.5 vs 54.1 ± 8.8; P = .021), and VR-12 PCS (48.4 ± 8.3 vs 47.2 ± 8.5; P = .003) (Table 2). However, none of these differences surpassed the previously reported MCID threshold (Table 1).5,11,21

Outcomes Stratified by Age Group and Sex

At the 2-year follow-up, patients aged under 55 years in the tenodesis group had significantly higher VR-12 MCS scores compared with their counterparts in the tenotomy group (men: 54.6 ± 9.2 vs 52.1 ± 9.2; P = .046; women: 53.3 ±
2 years

Preoperative ±VAS, visual analog scale; VR-12, Veterans RAND 12-Item Health Survey. Elbow Surgeons; MCS, Mental Component Summary; PCS, Physical Component Summary; SANE, Single Assessment Numeric Evaluation; P (preoperative to 2 y)

Table 4. Male patients aged 55 to 65 years had slightly better ASES function (28.7 vs 33.3 ± 9.0 vs 42.8 ± 11.5; P = .038), and the female patients had significantly higher VR-12 PCS scores (47.8 ± 9.0 vs 42.8 ± 10.4; P = .013) (Table 3). This was not true for the male patients in that age group (49.0 ± 7.9 vs 48.0 ± 9.7; P = .656). No differences were noted on any outcome measure at any time in patients (male or female) aged 55 to 65 years (Table 4). Male patients aged >65 years old who underwent tenodesis had a significantly higher 2-year SANE score (84.0 ± 23.1 vs 72.4 ± 32.0; P = .003) than their counterparts who underwent tenotomy, although this was not the case for the female patients (74.6 ± 32.4 vs 74.8 ± 31.3; P = .696). In addition, men >65 years old had slightly better ASES function and VAS scores, which approached significance but were not above the MCID (Table 5).

Delta Analysis

The relative improvement in pain scores and the majority of the functional outcome scores were comparable between the tenotomy and tenodesis groups, regardless of sex and age group (Tables 3-5). In general, the tenotomy group started with lower functional outcome scores (except for the VR-12 PCS) and had lower scores postoperatively compared with the tenodesis group. However, preoperative to 2-year improvement in SANE score for men aged >65 years was significantly better for tenodesis compared with tenotomy (Δ = 45.7 ± 28.7 vs 33.3 ± 39.0 points; P = .027) (Table 5). This was not the case for female patients (P = .568). Of note, the greater improvement in VR-12 PCS scores for tenodesis compared with tenotomy in female patients aged <55 years approached significance (Δ = 13.5 ± 8.6 vs 9.6 ± 9.3 points; P = .061) (Table 3). No other significant differences regarding improvement in outcome scores were identified in these stratified cohorts at 2-year follow-up.

DISCUSSION

We found that biceps tenodesis resulted in significantly improved pain and functional scores at 2-year follow-up compared with tenotomy for each patient subgroup. However, the benefit did not exceed the previously reported MCID for these outcome measures. Despite more favorable outcomes in young, female patients who receive a tenodesis compared with a tenotomy, surgeons perform a tenotomy in young female patients at a greater rate compared with their male counterparts. Older male patients compared with younger men were more likely to receive a tenotomy despite significantly improved functional outcome scores noted with tenodesis. This study represents the largest comparative cohort study to date reviewing biceps tenotomy versus tenodesis in the setting of concomitant RCR, with a total of 1537 tenodesis patients and 399 tenotomy patients included for review.

One prospective randomized controlled trial has been published demonstrating improved pain scores for patients

| Outcome Measure | Men | Tenotomy | Tenodesis | P | Women | Tenotomy | Tenodesis | P |
|-----------------|-----|----------|-----------|---|--------|----------|-----------|---|
|                  | n   | Mean ± SD| n          | Mean ± SD |         | n          | Mean ± SD |   |
| Preoperative     |     |          |            |             |         |            |           |   |
| ASES function    | 31  | 13.6 ± 5.7| 245        | 14.0 ± 6.0 | .664    | 30         | 10.8 ± 6.0| .052 |
| ASES index       | 31  | 46.8 ± 19.9| 244        | 48.7 ± 19.1| .625    | 30         | 35.8 ± 16.4| .011 |
| SANE             | 31  | 34.7 ± 20.1| 245        | 36.9 ± 20.8| .642    | 30         | 33.8 ± 22.7| .485 |
| VAS pain         | 31  | 5.2 ± 2.6 | 252        | 4.9 ± 2.5  | .623    | 30         | 6.4 ± 1.8 | .020 |
| VR-12 MCS        | 31  | 49.3 ± 11.9| 242        | 50.9 ± 11.3| .461    | 29         | 45.3 ± 12.6| .051 |
| VR-12 PCS        | 31  | 37.7 ± 8.7 | 242        | 36.9 ± 8.2 | .752    | 29         | 34.0 ± 7.2 | .525 |
| 2 years          |     |          |            |             |         |            |           |   |
| ASES function    | 35  | 26.4 ± 5.4 | 272        | 26.2 ± 5.3 | .682    | 32         | 23.5 ± 7.6 | .100 |
| ASES index       | 35  | 87.4 ± 17.6| 272        | 87.3 ± 16.7| .809    | 32         | 78.1 ± 22.1| .056 |
| SANE             | 35  | 75.5 ± 27.0| 272        | 82.3 ± 20.7| .153    | 32         | 70.4 ± 29.2| .061 |
| VAS pain         | 35  | 1.3 ± 1.8 | 276        | 1.3 ± 1.8  | .773    | 33         | 2.2 ± 2.6 | .332 |
| VR-12 MCS        | 35  | 52.1 ± 9.2 | 270        | 54.6 ± 9.2 | .046    | 32         | 49.2 ± 11.5| .038 |
| VR-12 PCS        | 35  | 48.0 ± 9.7 | 270        | 49.0 ± 7.9 | .656    | 32         | 42.8 ± 10.4| .013 |
| Δ (preoperative to 2 y) | | | | | | | | |
| ASES function    | 31  | 12.5 ± 6.3 | 242        | 12.1 ± 6.4 | .699    | 30         | 12.4 ± 8.2 | .634 |
| ASES index       | 31  | 39.6 ± 19.4| 241        | 38.6 ± 20.9| .991    | 30         | 42.7 ± 22.2| .907 |
| SANE             | 31  | 43.9 ± 29.2| 242        | 46.1 ± 26.1| .945    | 30         | 38.2 ± 31.8| .672 |
| VAS pain         | 31  | -3.7 ± 2.4 | 252        | -3.6 ± 2.8 | .859    | 30         | -4.4 ± 2.4 | .479 |
| VR-12 MCS        | 31  | 2.1 ± 12.5 | 238        | 3.9 ± 11.7 | .486    | 29         | 4.2 ± 11.6 | .732 |
| VR-12 PCS        | 31  | 10.0 ± 10.3| 238        | 12.2 ± 9.0 | .484    | 29         | 9.6 ± 9.3 | .061 |

aBoldface P values indicate statistically significant difference by sex between treatment groups (P < .05). ASES, American Shoulder and Elbow Surgeons; MCS, Mental Component Summary; PCS, Physical Component Summary; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale; VR-12, Veterans RAND 12-Item Health Survey.
Outcomes of Tenotomy Versus Tenodesis in Patients Aged 55 to 65 Years

| Outcome Measure | Men | Women |
|-----------------|-----|-------|
|                 | Preoperative |     | 2 years |     |
|                 | Tenotomy | Tenodesis | Tenotomy | Tenodesis |
|                 | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD | P |
| ASES function   | 89 | 14.4 ± 5.8 | 374 | 14.9 ± 6.0 | .331 | 77 | 12.7 ± 5.4 | 211 | 13.0 ± 5.9 | .846 |
| ASES index      | 89 | 51.3 ± 16.8 | 374 | 51.7 ± 17.4 | .776 | 77 | 45.7 ± 17.2 | 211 | 44.7 ± 18.3 | .744 |
| SANET           | 89 | 35.1 ± 17.3 | 372 | 36.7 ± 19.8 | .441 | 77 | 37.1 ± 22.8 | 212 | 35.8 ± 22.5 | .712 |
| VAS pain        | 91 | 4.6 ± 2.2  | 380 | 4.6 ± 2.3  | .998 | 77 | 5.1 ± 2.3  | 215 | 5.4 ± 2.4  | .619 |
| VR-12 MCS       | 89 | 51.2 ± 12.2 | 364 | 53.1 ± 9.8 | .488 | 76 | 50.7 ± 12.4 | 203 | 50.7 ± 11.9 | .998 |
| VR-12 PCS       | 89 | 38.5 ± 7.3  | 364 | 37.7 ± 7.8 | .357 | 76 | 36.2 ± 7.5  | 203 | 35.3 ± 8.4  | .325 |

| Δ (preoperative to 2 y) | Men | Women |
|-------------------------|-----|-------|
|                        | Tenotomy | Tenodesis | Tenotomy | Tenodesis |
|                        | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD | P |
| ASES function          | 88 | 12.6 ± 5.8 | 370 | 12.0 ± 6.6 | .554 | 76 | 13.4 ± 7.0 | 207 | 12.7 ± 7.0 | .386 |
| ASES index             | 88 | 39.5 ± 16.7 | 370 | 38.2 ± 19.1 | .728 | 76 | 42.0 ± 21.6 | 207 | 42.8 ± 20.1 | .977 |
| SANET                  | 88 | 44.8 ± 29.1 | 367 | 45.2 ± 31.3 | .703 | 76 | 42.9 ± 34.5 | 208 | 43.5 ± 33.2 | .952 |
| VAS pain               | 91 | -3.7 ± 2.2  | 380 | -3.6 ± 2.5  | .866 | 77 | -4.0 ± 2.8  | 215 | -4.3 ± 2.4  | .687 |
| VR-12 MCS              | 89 | 3.0 ± 12.7  | 360 | 2.4 ± 10.1  | .919 | 75 | 3.7 ± 9.7   | 198 | 3.3 ± 11.4  | .663 |
| VR-12 PCS              | 89 | 10.6 ± 8.0  | 360 | 11.6 ± 8.6  | .248 | 75 | 11.3 ± 8.3  | 198 | 11.8 ± 9.2  | .417 |

*ASES, American Shoulder and Elbow Surgeons; MCS, Mental Component Summary; PCS, Physical Component Summary; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale; VR-12, Veterans RAND 12-Item Health Survey.

with biceps tenotomy compared with biceps tenodesis 3 months after surgery, but there was no difference in pain scores 2 years after surgery. To date, most studies (including large meta-analyses) have not been able to demonstrate a consistent difference in pain or functional outcome scores when comparing these 2 procedures in the setting of concomitant rotator cuff repair. As a result, authors have concluded that the decision to proceed with tenotomy or tenodesis should be based on patient and surgeon preferences. However, all these studies are likely underpowered: the largest study had 252 patients included (202 tenotomy and 50 treated with tenodesis). The other studies ranged from 20 to 151 patients. An appropriately powered study may be able to detect a difference in pain scores and/or functional outcomes when comparing these 2 procedures.

Recently, 7 systematic reviews have been performed comparing biceps tenotomy versus tenodesis. Most of these reviews did not demonstrate a significant functional difference between these 2 procedures. Popeye deformity and cramping were more common after tenotomy than with tenodesis. The review by Liu et al demonstrated decreased supination strength and worse Constant and Simple Shoulder Test scores after tenotomy. Ahmed et al and Zhou et al similarly demonstrated lower Constant scores after tenotomy.

In contrast to previous studies, the results of this study demonstrated significantly improved VAS pain and functional outcomes (ASES, SANE, VR-12) scores for patients with biceps tenodesis compared with biceps tenotomy in patients with concomitant rotator cuff repair at 2-year follow-up. However, differences between procedures at 2-year follow-up did not exceed the MCID. Therefore, the presence of a clinical benefit for patients who receive biceps tenodesis over tenotomy remains uncertain. This study also demonstrated that patients undergoing tenotomy were more likely to be older than 65 years. In patients younger than 65, tenotomy was used at a greater rate in female compared with male patients. This trend regarding the surgical procedure is concerning given that, when stratified according to age and sex, older male patients (>65 years) had improved functional outcome scores with a tenodesis, as was the case with female patients between the ages of 35 and 54 years. Instead of relying on conventional generalizations for patient selection, surgeons should consider individualized discussion with each patient and choose between tenotomy and tenodesis according to the patient’s preferences (eg, physical activity, cosmosis, recovery period).

The data from this study also suggest a procedural choice bias in favor of tenodesis compared with tenotomy. Of the 1936 RCRs included, a biceps tenotomy was only performed in 21% (n = 399) of cases. Tenodesis may be more common due to patient preference, surgeon preference, and/or industry influence. Based on the data presented herein, surgeons who strongly prefer (or perform only) biceps tenodesis may consider performing biceps tenotomy in selected patients.
A limitation of this study is that it was a retrospective review, and the findings are therefore subject to lack of control over exposure factor, covariates, and potential confounders such as type of tenodesis implant (suture anchors, endobutton, bone tunnels, tenodesis screw) and/or location of tenodesis (intra-articular, suprapectoral, subpectoral). Because this is a retrospective review, patients included may not be representative of the general population and there is likely a selection bias. Furthermore, a greater proportion of female patients received a biceps tenotomy in the younger than 55 years and 55- to 65-year age groups, potentially introducing selection bias. We attempted to control for this by comparing outcomes after stratifying our cohort based on age and sex. There were likely other factors that were considered but not recorded in the database that may have affected the surgeons’ decisions to perform a tenodesis or tenotomy. For example, we were unable to stratify the data according to the type of biceps pathology present and compare the results of tenotomy versus tenodesis with no treatment. Furthermore, data regarding size of the rotator cuff tear, postoperative infection, nerve injury, muscle cramping, cosmesis, and strength were not available for comparison of tenotomy versus tenodesis given the nature of the database. Finally, recall bias and misclassification bias are also potentially present, given the nature of this global database with several surgeon contributors.

**CONCLUSION**

Biceps tenodesis generally resulted in significantly improved pain and functional scores compared with tenotomy for each patient subgroup at 2-year follow-up. However, the benefit did not exceed previously reported MCID for outcome scores after RCR. Despite more favorable outcomes in young female patients who received a tenodesis compared with a tenotomy, surgeons perform a tenotomy in young female patients at a greater rate compared with in their male counterparts. Compared with younger men, older male patients were more likely to receive a tenotomy despite significantly improved functional outcome scores noted with tenodesis. Both procedures provide improvement in pain and functional outcomes. Therefore, the choice of procedure should be a shared decision between the surgeon and patient.

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