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Influence of workers' compensation status on postoperative outcomes in patients following biceps tenodesis: a matched-pair cohort analysis

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Background and hypothesis: Although the literature on the association of workers' compensation (WC) status with negative outcomes after orthopedic surgery is extensive, there is a paucity of evidence on outcomes in WC recipients undergoing biceps tenodesis. We hypothesized that WC patients would report significantly worse outcomes postoperatively on patient-reported outcome measures (PROMs).

Methods: Functional and health-related quality-of-life PROMs and a visual analog scale score for pain were administered preoperatively and at 12 months postoperatively to consecutive patients undergoing isolated biceps tenodesis between 2014 and 2018 at our institution. Thirty-eight WC patients were matched 1:2 to non-WC patients by age, body mass index, and operative limb. The minimal clinically important difference, substantial clinical benefit, and patient acceptable symptom state were calculated for all patients via anchor- and distribution-based methods. Rates of achievement and the likelihood of achievement were determined.

Results: All patients showed significant improvements in all outcome measures ($P < .001$). WC patients reported inferior postoperative scores on all PROMs examined. WC status significantly predicted a reduced likelihood of achieving substantial clinical benefit for the American Shoulder and Elbow Surgeons score (odds ratio [OR], 0.38; 95% confidence interval [CI], 0.17-0.81; $P = .01$) and the patient acceptable symptom state (OR, 0.28; 95% CI, 0.12-0.65; $P = .003$) for the American Shoulder and Elbow Surgeons score, Single Assessment Numeric Evaluation score (OR, 0.24; 95% CI, 0.10-0.61; $P = .003$), Constant-Murley Subjective Assessment (OR, 0.25; 95% CI, 0.08-0.77; $P = .016$), and visual analog scale pain score (OR, 0.27; 95% CI, 0.16-0.47; $P < .001$).

Conclusion: WC patients reported inferior scores on all postoperative PROMs and demonstrated lower odds of achieving substantial benefit and satisfaction regarding improvements in both function and pain compared with non-WC patients.

Level of evidence: Level III; Retrospective Cohort Comparison; Treatment Study

Keywords: Worker's compensation; patient-reported outcomes; bicep tenodesis; clinically significant outcomes; American Shoulder and Elbow Surgeon Score; minimum clinical importance differences

Despite pain relief and functional improvement occurring after surgical intervention, outcomes of shoulder surgery are generally inferior in workers' compensation (WC) patients than in those without a work-related injury.[9,17,18,23,24,26,30] It is possible that this population experiences inferior outcomes

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because of higher occupational demands, secondary gain, or lower resilience, as well as differences in comorbidities, prior treatments, expectations, or educational levels.[16,28] Following shoulder surgery, WC patients may exhibit slower or suboptimal recovery in comparison to patients without occupational claims.[5,11,17]

Biceps tenodesis (BT) is increasingly performed to treat lesions of the long head of the biceps tendon, as well as labral pathologies, and provides patients with pain relief and improved function.[6,25,29,31,32,34,35] WC status portends worse patient-reported outcome measures (PROMs)[10,12,36] and decreased odds of achieving clinically significant outcomes (CSOs) in the short term after BT[25]; however, the rate and duration of return to work as well as range of motion were equivalent to those in patients without work-related injuries in some studies.[1,36] Therefore, the same WC patients who report worse subjective outcomes may exhibit no difference in clinical outcome measures compared with their non-WC counterparts.

The purpose of this investigation was to compare clinical outcomes and complication rates following isolated BT in WC patients and patients without work-related injuries in a matched-cohort analysis. We hypothesized that WC patients would experience worse subjective outcomes and have a higher complication rate than matched non-WC patients.

Methods

Study design and patient demographic characteristics

A prospectively maintained institutional registry was queried for patients who underwent isolated BT between March 2014 and March 2018 via an electronic data collection service (Outcome Based Electronic Research Database [OBERD]; Universal Research Solutions, Columbia, MO, USA). The inclusion criteria were receipt of a primary arthroscopic suprapectoral BT or open subpectoral BT, with or without concurrent rotator cuff débridement, for the indication of tenosynovitis, a superior labral tear from anterior to posterior (SLAP), partial tearing, or biceps instability, as well as completion of preoperative and postoperative PROMs. The exclusion criteria were full-thickness rotator cuff tears, concurrent rotator cuff repair or shoulder arthroplasty, and a history of ipsilateral BT. Following preoperative PROM collection, BT was performed by the senior authors (B.J.C., N.V., and B.F.) as previously described.[2,13] Demographic variables including age, sex, and WC status were collected and stored in the database. Similarly, intraoperative variables including the tenodesis approach and fixation device (ie, screw or suture anchor), as well as findings regarding the long head of the biceps tendon on arthroscopy, were collected and documented by trained research coordinators at the time of the operation.

Patient-reported outcomes

A total of 210 patients who completed preoperative and 12-month postoperative PROMs were included in the analysis following appropriate exclusion. Patients enrolled in the prospective registry completed shoulder-specific functional PROMs including the American Shoulder and Elbow Surgeons (ASES) form and Single Assessment Numeric Evaluation (SANE), as well as health-related quality-of-life PROMs including the VR-12 Physical Component Score (PCS), Short Form 12 (SF-12) PCS, and VR6D score. In addition, patients completed mental health PROMs including the VR-12 Mental Component Score and SF-12 Mental Component Score. Patients also completed a visual analog scale (VAS) questionnaire on their level of pain, consisting of the question, "How would you rate your shoulder pain today as a percentage of normal 0 to 100, with 100 being normal?" Patients also completed anchor questions regarding the level of improvement in function and pain of the index shoulder, identical to questions outlined in a previous study,[7] which enabled the calculation of CSOs. The Outcome Based Electronic Research Database (OBERD) allows patients to begin completing PROMs within 3 months before or after the 1-year time point. Patients who were seen in the clinic within a month following the expiry of these PROMs were allowed to complete the questionnaires.

Statistical analysis

Statistical analysis was performed using RStudio software (version 1.0.143; R Foundation for Statistical Computing, Vienna, Austria). An a priori power analysis was performed to determine the sample size necessary to identify an effect size comparable to changes found in a previous study on the impact of WC status on outcomes after shoulder surgery.[23] With α set at .05, a population of 36 patients would sufficiently attain a power of 80% on a 2-sample t test. Continuous variables were given as means with standard deviations and 95% confidence intervals (CIs), whereas categorical variables were presented as frequencies and percentages. Paired t tests were used to determine whether postoperative patient-reported outcome scores were statistically different from preoperative scores within the entire patient cohort. Independent t tests were used to determine whether statistically significant differences existed in continuous variables between the smoking and nonsmoking groups. CSO thresholds were calculated through either anchor- or distribution-based methods. Anchor-based methods used receiver operating characteristic curves with an area under the curve (AUC) > 0.7 defined as predictive. If anchor-based methods to calculate the minimal clinically important difference (MCID) were inadequately predictive, we used a distribution-based method in which the MCID was defined as 50% of the sample standard deviation of the score change. Binary logistic regression was performed to determine whether there was a significant relationship between achievement of each CSO and WC status. Statistical significance was set at $\alpha = .05$.

Results

Of the 210 patients included in the prospectively collected data repository during the study period, all had their insurance status documented, and 38 WC patients met the inclusion criteria. Among the WC patients, 4 underwent revision BT for rerupture, whereas 10 patients in the non-WC cohort underwent revision procedures. Of the latter

Table I Unmatched demographic variables and patient-reported outcome scores for WC and non-WC patients

	WC patients	Non-WC patients	All patients	*P* value
Overall, n	38	172	210	
Demographic variable				
Age, yr	43.7 ± 13.3	52.2 ± 12	50.7 ± 12.6	<.001*
Male sex, n (%)	18 (47.4)	109 (63.4)	127 (60.5)	.1
BMI, kg/m^2	31.9 ± 10.6	28.4 ± 5.53	28.9 ± 6.73	.034*
Right side, n (%)	21 (67.7)	65 (49.2)	86 (52.8)	.178
Postoperative score				
ASES	57.4 ± 22.9	72.8 ± 24.9	70.0 ± 25.3	.003*
SANE	57.1 ± 23.6	69.6 ± 29.8	67.2 ± 29.1	.062
Constant-Murley	16.9 ± 8.36	22.2 ± 9.18	21.3 ± 9.24	.025*
SF-12 PCS	36.8 ± 7.34	41.9 ± 10.6	40.9 ± 10.2	.024*
VR-12 PCS	39.2 ± 8.06	43.9 ± 10.6	42.9 ± 10.3	.046*
SF-12 MCS	48.8 ± 10.4	52.6 ± 10.3	51.8 ± 10.4	.146
VR-12 MCS	51.7 ± 10.9	56.2 ± 10.5	55.2 ± 10.7	.079
VR6D	0.62 ± 0.12	0.70 ± 0.14	0.68 ± 0.14	.005*
VAS pain	40.5 ± 24.3	25.9 ± 27.1	28.5 ± 27.2	.011*

WC, workers' compensation; *BMI*, body mass index; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation; *SF-12*, Short Form 12; *PCS*, Physical Component Score; *MCS*, Mental Component Score; *VAS*, visual analog scale.
* Statistically significant.

patients, 5 underwent revision BT for rerupture, 3 underwent rotator cuff débridement and subacromial decompression for recurrent impingement, 1 underwent capsular release for adhesive capsulitis, and 1 underwent rotator cuff repair for a full-thickness tear. The rate of surgical complications was not significantly different between the WC and non-WC cohorts (10.5% vs. 5.8%, $P = .28$). The overall cohort consisted of 127 male patients (60.5%). The mean age of the cohort was 50.7 ± 12.6 years, the mean body mass index was 28.9 ± 6.73 kg/m^2, and the mean follow-up period was 13.2 ± 5.6 months (range, 9-16 months). Following propensity matching with the ratio set to 1:2, the 38 WC patients were matched to a cohort of 87 non-WC patients. Demographic information for the patient cohorts before and after matching can be found in Tables I and II. All patients experienced significant improvements in PROM scores from baseline at 1-year follow-up ($P < .001$ to $P = .006$). After stratification by WC status, however, non-WC patients did not demonstrate significant improvements in mental health scores from baseline (Table III).

Comparison of WC and non-WC patients before propensity matching

A comparison of demographic variables and postoperative PROM scores before propensity matching is provided in Table I. Significant differences were found between WC and non-WC patients in the ASES score (57.4 ± 22.9 vs. 72.8 ± 24.9, $P = .003$), Constant-Murley subjective assessment (16.9 ± 8.36 vs. 22.2 ± 9.18, $P = .025$), SF-12 PCS (36.8 ± 7.34 vs. 41.9 ± 10.6, $P = .024$), VR-12 PCS (39.2 ± 8.06 vs. 43.9 ± 10.6, $P = .046$), VR6D score (0.62 ± 0.12 vs. 0.70 ± 0.14, $P = .005$), and VAS pain score (40.5 ± 24.3 vs. 25.9 ± 27.1, $P = .011$). No differences were noted between the 2 cohorts in the postoperative SANE score and mental health PROMs.

Matched-pair analysis of WC vs. non-WC patients

The cohort of 38 WC patients underwent 1:2 propensity matching to non-WC patients by age, body mass index, affected side, and intraoperative variables (approach, fixation device, and findings on arthroscopy). Post-match intraoperative findings are provided in Table IV. Following matching, WC patients demonstrated significantly lower preoperative and postoperative PROM scores ($P < .001$ to $P = .038$) other than the SANE score at baseline (Table V).

Clinically significant outcomes

Calculations of threshold values for CSOs were performed in the study cohort. The MCID was determined by both anchor- and distribution-based methods, whereas substantial clinical benefit (SCB) and the patient acceptable symptom state (PASS) were determined using anchor-based methods. The final values calculated for the 3 PROMs in question, as well as the VAS pain score, are given in Table VI. The values used to calculate achievement of the MCID, SCB, and PASS were as follows: net increase of 10.2, net increase of 20.8 (AUC, 0.84), and absolute postoperative score of 78.8 (AUC, 0.89), respectively, on the ASES assessment; net increase of

Table II Matched demographic variables for WC and non-WC patients

	WC patients	Non-WC patients	*P* value
Age, yr	43.7 ± 13.3	46.5 ± 11.5	.228
Male sex, n (%)	18 (47.4)	48 (55.2)	.542
BMI, kg/m^2	31.9 ± 10.6	29.4 ± 5.95	.063
Operative limb, n (%)			>.999
Right	21 (67.7)	45 (67.2)	
Left	17 (32.3)	107 (32.8)	

WC, workers' compensation; *BMI*, body mass index.

Table III Preoperative and postoperative patient-reported outcome scores

Score	Preoperative	Postoperative	*P* value
All patients			
ASES	47.2 ± 18.9	70.0 ± 25.3	<.001*
SANE	33.9 ± 21.6	67.2 ± 29.1	<.001*
Constant-Murley	12.5 ± 6.57	21.3 ± 9.24	<.001*
SF-12 PCS	37.3 ± 8.99	40.9 ± 10.2	<.001*
VR-12 PCS	39.3 ± 9.22	42.9 ± 10.3	<.001*
SF-12 MCS	50.8 ± 10.9	51.8 ± 10.4	.006*
VR-12 MCS	53.6 ± 10.8	55.2 ± 10.7	<.001*
VR6D	0.63 ± 0.11	0.68 ± 0.14	<.001*
VAS pain	50.0 ± 22.9	28.5 ± 27.2	<.001*
Non-WC patients			
ASES	49.2 ± 19.5	72.8 ± 24.9	<.001*
SANE	35.3 ± 22.2	69.6 ± 29.8	<.001*
Constant-Murley	13.3 ± 6.67	22.2 ± 9.18	<.001*
SF-12 PCS	38.6 ± 9.41	41.9 ± 10.6	<.001*
VR-12 PCS	40.9 ± 9.38	43.9 ± 10.6	<.001*
SF-12 MCS	52.7 ± 10.4	52.6 ± 10.3	.40
VR-12 MCS	55.4 ± 10.2	56.2 ± 10.5	.051
VR6D	0.66 ± 0.11	0.70 ± 0.14	<.001*
VAS pain	47.9 ± 23.0	25.9 ± 27.1	<.001*
WC patients			
ASES	38.4 ± 13.5	57.4 ± 22.9	<.001*
SANE	28.6 ± 18.3	57.1 ± 23.6	<.001*
Constant-Murley	9.00 ± 4.79	16.9 ± 8.36	<.001*
SF-12 PCS	32.1 ± 4.04	36.8 ± 7.34	<.001*
VR-12 PCS	32.8 ± 4.77	39.2 ± 8.06	<.001*
SF-12 MCS	43.0 ± 9.22	48.8 ± 10.4	<.001*
VR-12 MCS	46.2 ± 9.95	51.7 ± 10.9	<.001*
VR6D	0.54 ± 0.08	0.62 ± 0.12	<.001*
VAS pain	58.4 ± 20.8	40.5 ± 24.3	<.001*

ASES, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation; *SF-12*, Short Form 12; *PCS*, Physical Component Score; *MCS*, Mental Component Score; *VAS*, visual analog scale; *WC*, workers' compensation.
* Statistically significant.

13.5, net increase of 30.2 (AUC, 0.81), and absolute postoperative score of 78.9 (AUC, 0.87), respectively, on the SANE; net increase of 4.02, net increase of 11.0 (AUC, 0.83), and absolute postoperative score of 22.5 (AUC, 0.83), respectively, on the Constant-Murley subjective assessment. CSOs for the VAS pain score were determined in a previous study[21] and were as follows: net decrease of 12.9 for the MCID (AUC, 0.86), net decrease of –25.1 for SCB (AUC, 0.84), and absolute postoperative score of 27.4 for the PASS (AUC, 0.86).

A comparison of achievement rates for each CSO in WC vs. non-WC patients is given in Table VII. WC patients demonstrated significantly reduced rates of achievement of SCB for the ASES score and the PASS for all PROMs. There were no significant differences in achievement rates of the MCID for any PROM.

Binary logistic regression analysis

Binary logistic regression identified WC status as a significant predictor of reduced achievement of SCB for the ASES score (odds ratio [OR], 0.37; 95% CI, 0.17-0.81; $P = .01$), as well as reduced achievement of the PASS for the ASES score (OR, 0.28; 95% CI, 0.12-0.65; $P = .003$), SANE score (OR, 0.24; 95% CI, 0.10-0.61; $P = .003$), and Constant-Murley score (CMS) (OR, 0.25; 95% CI, 0.08-0.77; $P = .016$) (Table VIII). In addition, WC status predicted significantly reduced achievement of the PASS for the VAS pain score (OR, 0.27; 95% CI, 0.16-0.47; $P < .001$).

Discussion

The influence of WC status on postoperative outcomes has been extensively documented for multiple orthopedic procedures. However, this investigation is among the first investigations in the current body of literature to evaluate patient-reported outcomes of WC recipients following BT. The primary findings of this study include that WC recipients reported worse scores on all postoperative PROMs than their matched non-WC counterparts; WC recipients had a significantly reduced likelihood of achieving substantial functional improvements as measured by the ASES score; and WC recipients had a significantly reduced likelihood of achieving a satisfactory state regarding both function and pain.

There has been a longstanding association between WC status and negative outcomes, both clinical and patient reported, in patients undergoing shoulder arthroplasty or shoulder arthroscopy.[3,9,17,18,23,24,26,30] Mahure et al[22] examined a large population database for revision shoulder procedures after arthroscopic rotator cuff repair and found WC status to be a significant risk factor for subsequent ipsilateral surgery (OR, 2.11; 95% CI, 1.89-2.36; $P < .001$). In a systematic review and meta-analysis of

Table IV Intraoperative findings

	WC patients, n (%)	Non-WC patients, n (%)	*P* value
Biceps tendon on arthroscopy			.051
Complete tear	1 (2.9)	8 (10)	
Partial tear	1 (2.9)	12 (15)	
Tenosynovitis	28 (80)	56 (70)	
No gross pathology	5 (14.3)	4 (5.0)	
Fixation device			.272
Suture anchor	23 (57.1)	60 (66.2)	
Tenodesis screw	15 (42.9)	27 (33.8)	
Tenodesis approach			.551
ASPBT	12 (26.7)	22 (18.8)	
OSPBT	26 (74.3)	65 (81.2)	

WC, workers' compensation; *ASPBT*, arthroscopic suprapectoral biceps tenodesis; *OSPBT*, open subpectoral biceps tenodesis.

Table V Independent *t* test analysis of preoperative and postoperative patient-reported outcome scores

Score	Non-WC patients	WC patients	*P* value
Preoperative			
ASES	48.56 ± 19.5	38.4 ± 13.5	.006*
SANE	34.0 ± 21.8	28.6 ± 18.3	.22
Constant-Murley	13.3 ± 7.49	9.00 ± 4.79	.015*
SF-12 PCS	39.5 ± 9.65	32.1 ± 4.04	<.001*
VR-12 PCS	41.7 ± 9.36	32.8 ± 4.77	<.001*
SF-12 MCS	53.1 ± 9.29	43.0 ± 9.22	<.001*
VR-12 MCS	56.0 ± 8.80	46.2 ± 9.95	<.001*
VR6D	0.67 ± 0.11	0.54 ± 0.08	<.001*
VAS pain	46.7 ± 2.31	58.4 ± 20.8	.016*
Postoperative			
ASES	74.6 ± 23.6	57.4 ± 22.9	<.001*
SANE	68.8 ± 28.5	57.1 ± 23.6	.032*
Constant-Murley	22.4 ± 7.77	16.9 ± 8.36	.004*
SF-12 PCS	43.2 ± 10.2	36.8 ± 7.34	.001*
VR-12 PCS	45.1 ± 9.75	39.2 ± 8.06	.003*
SF-12 MCS	53.4 ± 10.5	48.8 ± 10.4	.038*
VR-12 MCS	57.04 ± 11.1	51.7 ± 10.9	.021*
VR6D	0.72 ± 0.14	0.62 ± 0.12	<.001*
VAS pain	23.8 ± 24.1	40.5 ± 24.3	.001*

WC, workers' compensation; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation; *SF-12*, Short Form 12; *PCS*, Physical Component Score; *MCS*, Mental Component Score; *VAS*, visual analog scale.
* Statistically significant.

outcomes of WC claimants following shoulder surgery, Koljonen et al[20] found that 16 of the 21 included studies observed a statistically significant correlation between WC status and poor surgical outcomes. With respect to PROM scores at long-term follow-up, Morris et al[23] found that WC patients reported worse Constant, ASES, and Western Ontario Osteoarthritis of the Shoulder Index scores ($P = .001$ to $P = .003$) at 2 years after reverse total shoulder arthroplasty; however, they did not contextualize these postoperative scores through CSOs. Cvetanovich et al[7] established CSO thresholds for patients undergoing arthroscopic rotator cuff repair and found that WC claimants were less likely to achieve SCB for the ASES score and the PASS for the ASES score, SANE score, and CMS.

Literature on outcomes in WC claimants following BT is less extensive. Chalmers et al[4] performed a study on combined BT and labral repair for biceps-labral pathology and observed through subgroup analysis that non-WC patients reported a smaller increase in the ASES score compared with the entire cohort (24 vs. 26), suggesting that WC patients reported a greater increase in this score from baseline. However, it is difficult to interpret the clinical significance of this point difference without CSO data. Kahlenberg et al[19] similarly evaluated outcomes of WC claimants following arthroscopic suprapectoral BT and reported no significant difference compared with the results of non-WC patients. However, only 4 patients were included in the WC subgroup.

Only 1 other study on the achievement of CSOs following isolated BT has been published: Puzzitiello et al[25] established CSOs for the ASES score, SANE score, and CMS in isolated BT patients with 6 months' follow-up and found WC status to predict reduced achievement of the MCID for the ASES score and the PASS for the SANE score and CMS. However, WC status has not been fully evaluated as an independent risk factor for inferior outcomes at long-term follow-up. Our study examines the largest cohort of WC patients undergoing isolated BT with both functional and pain PROMs at 1-year follow-up. These results are consistent with those of the previous study, as well as the overarching literature on outcomes in WC recipients. In addition, we observed a reduced likelihood of achieving the PASS for the VAS pain score at long-term follow-up. Furthermore, nearly twice as many WC patients underwent reoperations as non-WC patients (10.5% vs. 5.8%); however, this finding was not statistically significant ($P = .28$). Following shoulder arthroplasty, Cvetanovich et al[8] demonstrated that WC patients had a higher reoperation rate than non-WC patients (16% vs. 2%, $P = .30$). It is possible that because of higher-demand occupations, WC patients may be at higher risk of reinjury, symptom progression, and subsequently, reoperation. WC status may portend a higher rate of reoperation following certain upper-extremity procedures in comparison to the general population. However, further investigations with larger sample sizes are needed to establish any relationship between WC status and reoperation following BT. In summary, these results indicate that although WC patients were able to achieve clinically significant improvements after surgery at the same rate as non-WC patients, they are more likely to remain dissatisfied in their perceptions.

Table VI Calculated MCID, SCB, and PASS

Anchor	Value	AUC	Distribution
MCID			
ASES score	10.2	0.53	10.2
SANE score	14.9	0.42	13.5
Constant-Murley score	9.00	0.68	4.02
VAS pain score	−12.9	0.86*	—
SCB			
ASES score	20.8	0.84*	—
SANE score	30.2	0.81*	—
Constant-Murley score	11.0	0.83*	—
VAS pain score	−25.1	0.84*	—
PASS			
ASES score	78.8	0.89*	—
SANE score	78.9	0.87*	—
Constant-Murley score	22.5	0.83*	—
VAS pain score	27.4	0.86*	—

MCID, minimal clinically important difference; *SCB*, substantial clinical benefit; *PASS*, patient acceptable symptom state; *AUC*, area under curve; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation; *VAS*, visual analog scale.
* Appropriately predictive.

Table VII Achievement percentage of MCID, SCB, and PASS

	Non-WC patients, %	WC patients, %	*P* value
MCID			
ASES score	71.3	65.8	.69
SANE score	58.6	60.5	.99
Constant-Murley score	32.2	44.7	.25
VAS pain score	52.9	63.2	.39
SCB			
ASES score	58.6	34.2	.02*
SANE score	39.1	50.0	.35
Constant-Murley score	28.7	21.1	.50
VAS pain score	37.9	42.1	.81
PASS			
ASES score	52.9	23.7	.005*
SANE score	48.3	18.4	.003*
Constant-Murley score	32.2	10.5	.02*
VAS pain score	58.6	28.9	.004*

MCID, minimal clinically important difference; *SCB*, substantial clinical benefit; *PASS*, patient acceptable symptom state; *WC*, workers' compensation; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation; *VAS*, visual analog scale.
* Statistically significant.

This finding reinforces the literature showing that WC patients may report worse subjective outcomes without overt differences in clinical and surgical improvements compared with non-WC patients.

Galdi et al[14] polled patients on their decisions to undergo BT vs. biceps tenotomy and found pain relief to be the most important consideration (OR, 1.82; $P = .03$), followed by strength (OR, 1.16; $P = .617$) and appearance (OR, 1.109; $P = .562$), among patient preferences with respect to outcomes of their biceps surgical procedure. This result makes the findings regarding reduced achievement of the PASS for the VAS pain score in WC patients particularly salient. Such findings can be used to counsel WC patients to modify their expectations during the postoperative period.

Investigators have posited several hypotheses regarding the mechanism by which WC status may lead to negative outcomes following surgery. These include financial incentivizing owing to secondary gain, reduced resilience factors, lengthier time to treatment, and higher disposition to injury owing to workload and occupational demand, although support for each theory in the literature remains variable.[16,28] For example, a case-control study by Razmjou et al[26] compared outcomes of WC claimants who underwent expedited surgery vs. those who did not and found that accelerated time to surgery resulted in a significantly greater likelihood of achieving the MCID for the ASES score as well as returning to work at the time of follow-up, supporting that timely treatment can improve outcomes in WC patients.

In addition, Smith et al[27] surveyed patients undergoing treatment of shoulder and proximal biceps pathology on their expectations and found that patient preferences were independent of activity level, contradicting the notion that WC claimants may have increased expectations owing to occupational demand. Grant et al[15]

Table VIII Binary logistic regression analysis of WC status and CSO achievement

	OR (95% CI)	*P* value
MCID		
ASES score	0.78 (0.34-1.75)	.54
SANE score	1.08 (0.50-2.36)	.84
Constant-Murley score	1.71 (0.78-3.73)	.18
VAS pain score	1.64 (0.98-2.73)	.06
SCB		
ASES score	0.37 (0.17-0.81)	.01*
SANE score	1.56 (0.72-3.36)	.26
Constant-Murley score	0.66 (0.27-1.64)	.37
VAS pain score	1.17 (0.71-1.93)	.5
PASS		
ASES score	0.28 (0.12-0.65)	.003*
SANE score	0.24 (0.10-0.61)	.003*
Constant-Murley score	0.25 (0.08-0.77)	.016*
VAS pain score	0.27 (0.16-0.47)	<.001*

WC, workers' compensation; *CSO*, clinically significant outcome; *OR*, odds ratio; *CI*, confidence interval; *MCID*, minimal clinically important difference; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation; *VAS*, visual analog scale; *SCB*, substantial clinical benefit; *PASS*, patient acceptable symptom state.
* Statistically significant.

identified a significant relationship between the level of stress reported by WC claimants and their reported long-term disability and observed that patients considered the claims process and delay in treatment their greatest sources of stress.

Our investigation has limitations that should be taken into consideration prior to interpretation of these results. The sample size was limited to patients who were compliant with PROM completion at 1-year follow-up, which may introduce a risk of selection bias, although precedent in the literature has shown the performance of CSO calculations in a similar manner.[33] The generalizability of the study population may be limited because the study subjects were patients who underwent isolated BT at a high-volume tertiary referral center. As such, cautious application of findings to patients undergoing more heterogeneous management or presenting to smaller community clinics is warranted. Although patients were queried for 1-year follow-up, our prospective database begins collecting data within 3 months of this time point. Thus, if patients complete the survey at 9 months, their function may be reported as lower than what they may experience at 12 months postoperatively. Furthermore, as emphasized previously, the relationship between WC and outcomes is likely multifactorial, and variables such as time to surgery and symptom duration could not be collected and analyzed because of the retrospective nature of this review. Future investigations should focus on collecting more granular data and further developing the dependence of outcomes in WC claimants on wait time prior to treatment.

Conclusion

WC status in patients undergoing isolated BT is a significant predictor of a reduced likelihood to achieve the PASS for the ASES score, SANE score, CMS, and VAS pain score, as well as reduced achievement of SCB for the ASES score, at 1-year follow-up compared with their non-WC counterparts. These findings present important information to integrate when counseling WC claimants on their expectations of postoperative improvements in pain and function.

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