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The impact of workers' compensation on recovery after biceps tenodesis

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Background: There remains a paucity of studies examining the impact of workers' compensation (WC) on a variety of outcomes after biceps tenodesis. The purpose of this study was to compare the postoperative recovery curves after biceps tenodesis in patients with and without WC claims.

Methods: Using the Surgical Outcomes System database, we assessed the postoperative recovery outcomes of all patients who had outcomes recorded at least 6 months after isolated biceps tenodesis for the treatment of a diagnosis of biceps tendinitis, stratified by WC status. The outcomes analyzed included visual analog scale, American Shoulder and Elbow Surgeons, VR-12 (Veterans RAND 12 Item Health Survey) mental and physical, Simple Shoulder Test, and Single Assessment Numeric Evaluation scores.

Results: Overall, 139 patients with WC claims underwent isolated biceps tenodesis vs. 786 patients without WC claims. Demographic characteristics and comorbidities were similar in the 2 groups. Patients without WC claims had significantly improved visual analog scale, VR-12, American Shoulder and Elbow Surgeons, Single Assessment Numeric Evaluation, and Simple Shoulder Test scores at all times points after 3 months and 1 year compared with patients with WC claims.

Conclusions: On analysis of patients' recovery after isolated biceps tenodesis, WC claims led to significantly worse pain and functional outcomes at every time point of analysis (3, 6, 12, and 24 months). Furthermore, patients with WC claims had worse preoperative-to-postoperative improvements in most outcomes. This information can be used to educate surgeons and patients on postoperative expectations, as well as to perform analyses focused on health economics, value, and policy.

Level of evidence: Level III; Retrospective Cohort Comparison Using Large Database; Treatment Study

Keywords: Biceps tendinitis; Biceps tenodesis; workers' compensation; workmans' compensation; shoulder; arthroscopy

The outcomes of biceps tenodesis or tenotomy for biceps or superior labral pathology have shown very predictably high rates of pain relief, as well as improvements in shoulder function and patient-reported outcome measures.[2,6,11,18] Although there is controversy about which is the best technique of tenodesis[1,5,6] or whether to

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perform a tenodesis or tenotomy,[13] all of these methods are associated with good clinical outcomes.

In the field of shoulder surgery, workers' compensation (WC) status has been shown to have a negative impact on the outcomes of patients undergoing superior labrum anterior-posterior (SLAP) repairs,[3,4,8,16,18] rotator cuff repairs,[9,10] and anatomic[7] or reverse[12] shoulder arthroplasties. However, there is a paucity of clinical evidence on the impact of WC status after biceps tenodesis.[14] Therefore, the purpose of this article was to analyze the outcomes of biceps tenodesis in patients with an active WC claim and compare them with a control group without an active WC claim. Our hypothesis was that WC claims would have a negative impact on the recovery curves after biceps tenodesis.

Methods

Surgical Outcomes System database

We used the Surgical Outcomes System global database (Arthrex, Naples, FL, USA) to report on patients who underwent biceps tenodesis for a diagnosis of biceps tendon or insertion pathology in a retrospective case-control study. All patients enrolled in the database from January 1, 2011 to December 31, 2017 were reviewed as part of this study. Patient-reported outcomes such as the visual analog scale (VAS) pain score (range, 0-10), American Shoulder and Elbow Surgeons (ASES) score,[15] VR-12 (Veterans RAND 12 Item Health Survey) physical score, and Single Assessment Numeric Evaluation (SANE) score (or Subjective Shoulder Value; range, 0%-100%) were collected online at specific time points, including preoperatively and 2 weeks, 6 weeks, 3 months, 6 months, 1 year, and 2 years postoperatively. The follow-up percentage at each time point is included in Supplementary Table S1. In addition, demographic, injury, and surgical details were collected. We excluded patients with less than 6 months' follow-up within the global database; those with concomitant anterior or posterior labral pathology, revision biceps tenodesis procedures, or concomitant procedures (eg, distal clavicle excision); and those with significant concomitant rotator cuff tears requiring repair.

Demographic characteristics and pathologic considerations

Demographic characteristics and comorbidities are summarized in Table I. Of the patients who underwent biceps tenodesis, 139 had WC coverage (WC group) whereas 786 had no WC coverage (non-WC group). We were not able to differentiate between patients who underwent arthroscopic biceps tenodesis and those with open biceps tenodesis or to evaluate the technique used to perform biceps tenodesis. All outcomes were assessed using the minimal clinically important difference (MCID) after biceps tenodesis.[14]

Surgical details

We did not include any patient with a concomitant rotator cuff repair, distal clavicle excision, or anterior or posterior labral repair; instead, we focused only on patients with isolated biceps tenodesis.

Table I Study population demographic characteristics

	WC (n = 139)	Non-WC (n = 786)	*P* value
Sex, % (n)			.53
Male	61.2 (85)	58.3 (458)	
Female	36.7 (51)	39.4 (310)	
Unlisted	2.2 (3)	2.3 (18)	
Ethnicity, % (n)			.15
Non-Hispanic	80.6 (112)	82.2 (646)	
Hispanic	2.9 (4)	1.3 (10)	
Unlisted	16.5 (23)	16.5 (130)	
Race, % (n)			.095
White	68.3 (95)	72.5 (570)	
Black	7.2 (10)	3.9 (31)	
Asian	0.0 (0)	1.1 (9)	
Indian	0.0 (0)	0.0 (0)	
Other	24.5 (34)	22.4 (176)	
Tobacco use, % (n)			.013
Nonsmoker	82.0 (114)	88.9 (699)	
Smoker	16.5 (23)	9.5 (75)	
Unlisted	1.4 (2)	1.5 (12)	
Diabetes, % (n)			.74
No	87.8 (122)	92.0 (723)	
Yes	6.5 (9)	6.0 (47)	
Unlisted	5.8 (8)	2.0 (16)	
Age, yr	47.1	50.4	.0015
BMI	31.7	28.2	.00011

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

Statistical analysis

Descriptive statistics were used for overall outcomes in patients who underwent biceps tenodesis, as well as comparisons between the WC and non-WC groups. The Fisher exact test was used for dichotomous variables, whereas the Student *t* test with unequal variances was used to compare continuous variables. A multivariate regression analysis was performed incorporating age, sex, ethnicity, and comorbidities. The level of statistical significance was defined as $P < .05$.

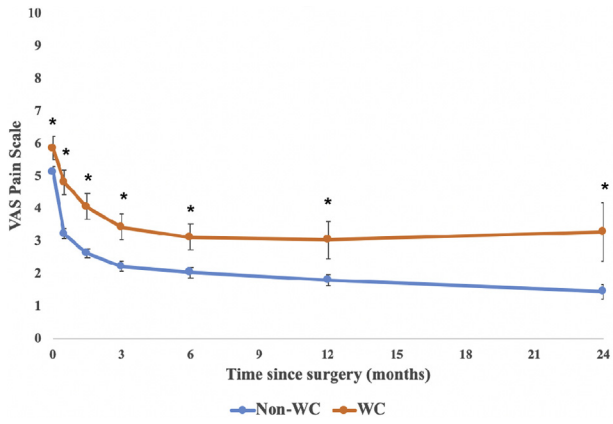

Figure 1 Postoperative visual analog scale (*VAS*) pain scores after biceps tenodesis comparing workers' compensation (*WC*) patients with non-WC patients. *$P < .05$.

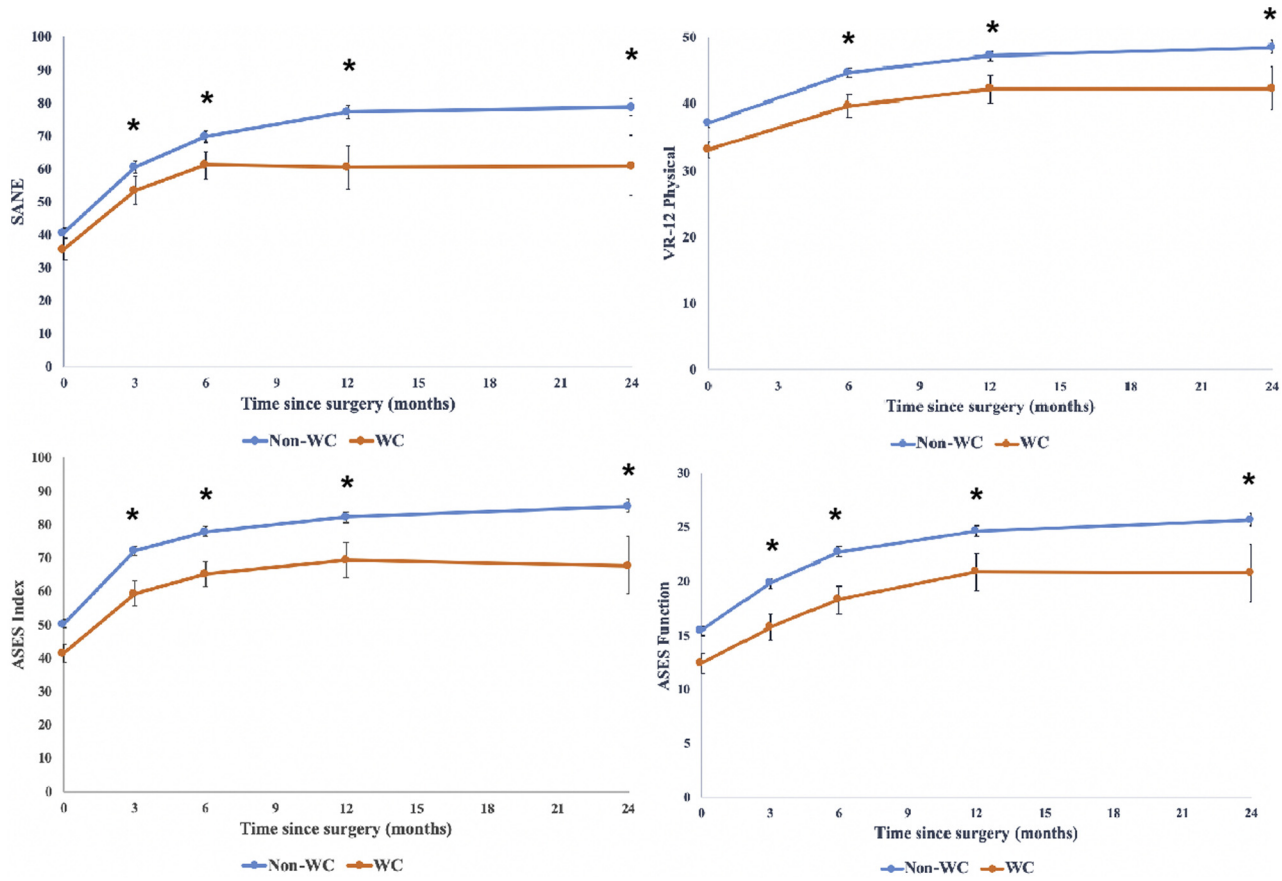

Figure 2 Postoperative recovery curves for Single Assessment Numeric Evaluation (*SANE*) score, Veterans RAND 12 Item Health Survey (*VR-12*) physical score, American Shoulder and Elbow Surgeons (*ASES*) Function score, and ASES Index score comparing workers' compensation (*WC*) patients with non-WC patients. *$P < .05$.

Results

Overall, patients who underwent biceps tenodesis showed significant improvements in pain and functional outcome measures between preoperative and various postoperative time points in both the WC group and non-WC group ($P < .01$), with both the ASES score and SANE score increasing well above the MCID.[14] However, patients with WC claims had worse pain and functional recovery curves than patients without WC claims. These comparisons were performed for VAS scores (Fig. 1), as well as ASES Index and Function, SANE, and VR-12 physical scores (Fig. 2). Both the ASES score and SANE score were improved beyond the MCID[14] when the non-WC group was compared with the WC group at each time point at 6 months and beyond.

Pain scores

Patients showed significant improvements ($P < .01$) in pain scores from preoperatively to postoperatively in both the WC group and non-WC group at 1 year (Table II, Fig. 1). At every time point, the WC group did significantly worse ($P < .01$) than the non-WC group in terms of the pain score (Table III). Furthermore, when the mean changes in preoperative-to-postoperative VAS scores were compared (Table IV), the non-WC group had significantly reduced pain scores compared with the change in the WC group at 3 months ($P = .08$), 1 year ($P = .11$), and 2 years ($P < .01$) postoperatively. Multivariate analysis incorporating age, body mass index, ethnicity, diabetes mellitus, and smoking maintained the significant impact of WC status on VAS pain scores.

Functional recovery curves

Patients showed significant improvements in all functional outcome measures at 1 year compared with preoperatively in both the WC group and non-WC group (Table II). Patients in the WC group had significantly higher VR-12 physical, ASES, and SANE scores ($P < .01$) than those in the non-WC group, exceeding the MCID (Table III). On comparison of the mean differences in preoperative and postoperative functional scores (Table IV), the non-WC group showed a significantly larger change in function from preoperatively to postoperatively compared with the WC

Table II Preoperative vs. postoperative (1-year) PROMs in WC group vs. non-WC group after biceps tenodesis

	Non-WC	WC
VAS score		
Preoperatively	5.11	5.84
Postoperatively	1.78	3.02
P value	<.0001	<.0001
VR-12 physical score		
Preoperatively	37.0	33.0
Postoperatively	47.2	42.2
P value	<.0001	<.0001
ASES Function score		
Preoperatively	15.5	12.4
Postoperatively	24.7	20.9
P value	<.0001	<.0001
ASES Index score		
Preoperatively	50.3	41.4
Postoperatively	82.3	69.5
P value	<.0001	<.0001
SANE score		
Preoperatively	40.6	35.6
Postoperatively	77.1	60.5
P value	<.0001	<.0001

PROM, patient-reported outcome measure; *WC*, workers' compensation; *VAS*, visual analog scale; *VR-12*, Veterans RAND 12 Item Health Survey; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation.

Table III Comparison of mean PROMs in WC group vs. non-WC group after biceps tenodesis

	Preoperative	6 mo	1 yr	2 yr
VAS score				
Non-WC	5.11	2.02	1.78	1.43
WC	5.84	3.11	3.02	3.27
P value	<.001	<.0001	<.0001	<.001
VR-12 physical score				
Non-WC	37.0	44.7	47.2	48.5
WC	33.0	39.6	42.2	42.3
P value	<.0001	<.0001	<.0001	<.001
ASES Function score				
Non-WC	15.5	22.7	24.7	25.7
WC	12.4	18.3	20.9	20.8
P value	<.0001	<.0001	<.0001	<.001
ASES Index score				
Non-WC	50.3	78.0	82.3	85.6
WC	41.4	65.3	69.5	67.8
P value	<.0001	<.0001	<.0001	<.001
SANE score				
Non-WC	40.6	69.9	77.2	78.7
WC	35.6	61.2	60.5	61.1
P value	<.05	<.001	<.0001	<.001

PROM, patient-reported outcome measure; *WC*, workers' compensation; *VAS*, visual analog scale; *VR-12*, Veterans RAND 12 Item Health Survey; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation.

group; changes in ASES Index scores were significantly larger at 6 months ($P < .05$) and 2 years ($P < .05$) and changes in SANE scores were significantly larger at 1 year ($P < .05$) and 2 years ($P = .05$) in non-WC patients compared with WC patients. Multivariate analysis incorporating age, body mass index, ethnicity, diabetes mellitus, and smoking maintained the significant impact of WC status on ASES, VR-12, and SANE scores.

Discussion

Although procedures such as biceps tenodesis can predictably improve a patient's pain and shoulder function, there are certain important patient considerations that influence postoperative outcomes. WC claims are known to be important drivers of functional improvement and pain relief after a variety of orthopedic procedures. In shoulder surgery, WC claims have been associated with worse outcomes after SLAP repairs,[3,4,8,16,18] rotator cuff repairs,[9,10] and anatomic[7] or reverse[12] shoulder arthroplasties. Given the paucity of studies examining the impact of WC status on outcomes after biceps tenodesis, we performed this analysis focusing on patients' postoperative recovery curves comparing WC with non-WC patients.

Overall, biceps tenodesis does improve patients' pain and functional outcome measures in both those with and those without WC claims. However, of the 925 patients undergoing biceps tenodesis, the 139 patients with WC claims had significantly worse pain and functional outcomes than the 786 patients without WC claims at each time point postoperatively, with the difference exceeding the MCID. At 6 months, the WC patients had an over 1-point higher mean VAS score, as well as almost 10-point worse ASES Index and SANE scores. These differences only widened by 1 and 2 years postoperatively, exceeding the MCID at each time point. Although the WC patients had slightly worse preoperative pain, VR-12 physical, ASES Function, ASES Index, and SANE scores, the mean differences between preoperative and postoperative outcomes were better for the non-WC group compared with the WC group for all measures at most time points. Although patients with WC claims still improve after biceps tenodesis, these results demonstrate the marked impact a WC claim has on a patient's pain and functional recovery.

The findings of our study are consistent with those of other studies examining the association between pain and functional recovery after shoulder surgery. The impact of WC status on the shoulder has been best studied in the repair of SLAP tears. In a study by Denard et al,[4] 55

Table IV Postoperative change in PROMs in WC group vs. non-WC group

	3 mo	6 mo	1 yr	2 yr
VAS score				
Non-WC	2.84	3.05	3.26	3.63
WC	2.42	2.73	2.81	2.12
P value	.08	.18	.11	<.001
VR-12 physical score				
Non-WC	—	7.41	10.14	11.15
WC	—	6.81	9.42	8.09
P value	—	.58	.60	.16
ASES Function score				
Non-WC	4.08	7.17	9.22	9.95
WC	3.25	5.54	8.75	7.60
P value	.29	<.05	.59	.10
ASES Index score				
Non-WC	20.7	27.1	31.8	34.9
WC	17.1	22.7	28.0	22.3
P value	.09	<.05	.12	<.05
SANE score				
Non-WC	19.0	28.9	36.2	36.2
WC	16.8	24.5	25.4	20.9
P value	.41	.07	<.05	<.05

PROM, patient-reported outcome measure; *WC*, workers' compensation; *VAS*, visual analog scale; *VR-12*, Veterans RAND 12 Item Health Survey; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation.

patients who underwent SLAP repair were examined at 77 months' follow-up. Patients with WC claims had a worse rate of "good or excellent" results (65% vs. 95%, $P = .009$) and worse SANE score (80% vs. 90%, $P = .025$). In an analysis of 22 patients with WC claims who underwent SLAP repairs, Verma et al[16] found a high reoperation rate (22%) and low rate of return to work at the previous functional level (37%). Other studies have similarly found patients with WC claims to do worse after SLAP repairs than non-WC patients.[3,8] These studies' findings are similar to our results after biceps tenodesis, with worse pain and functional outcomes at each time point studied postoperatively. Furthermore, our findings are similar to those of Werner et al,[18] who reported that WC claims led to inferior functional scores after biceps tenodesis for a failed SLAP repair in 24 patients.

In recent years, multiple studies have demonstrated similarly worse outcomes associated with WC claims after rotator cuff repairs[9,10] and total shoulder arthroplasties.[7,12,17] In a systematic review of 12 studies investigating various factors after rotator cuff repair, WC claims were found to have a negative impact on overall functional outcomes.[9] Similarly, Morris et al[12] found that after reverse shoulder arthroplasty, patients with WC claims had worse Constant, ASES, and Western Ontario Osteoarthritis of the Shoulder index scores, as well as worse patient satisfaction scores, than those without WC claims. In a statewide database study of all reverse and anatomic total shoulder arthroplasties, Villacis et al[17] demonstrated that WC claims were associated with a significantly higher risk of complications. Although we did not look at complications, the worse functional recovery seen in these studies after rotator cuff repair and shoulder arthroplasty is consistent with our findings after biceps tenodesis in patients with WC claims.

Recovery curves have become an increasingly important measure to understand a patient's pain and shoulder function at various time points after shoulder procedures. In our study, patients in the non-WC group had a mean VAS score of 2.01 at 6 months postoperatively, which decreased to 1.79 and 1.50 at 1 year and 2 years postoperatively, respectively. However, in the WC group, the mean was 3.04 at 6 months and slightly increased to 3.18 at 1 years and 3.11 at 2 years. A similar trend was noted in ASES Index scores, with the mean score in the non-WC group increasing gradually at 6 months (77.7), 1 year (82.0), and 2 years (84.8). This is compared to a much smaller increase in the WC group, from 66.1 at 6 months to 67.1 at 1 year and 69.3 at 2 years. These results suggest that the impact of WC claims influences the full spectrum of recovery after biceps tenodesis, demonstrating the need for more guarded expectations in WC patients.

The study's results should only be taken into account after consideration of its important limitations. Although this is the largest individual series evaluating the outcomes after biceps tenodesis and the impact of WC status on outcomes, our study remains limited by its short-term follow-up. Thus, we are unable to comment on the sustainability in each group. The Surgical Outcomes System database enables construction of patient-reported outcome recovery curves; however, these patient-reported outcome measures are not linked to arthroscopic vs. open technique, different indications and treatment algorithm preferences by different surgeons, intraoperative or postoperative complications, recurrence of instability, reoperations, or patient range of motion. We were also unable to evaluate any radiographic parameters that potentially could impact outcomes. Finally, as is the case for all database studies, the outcomes are dependent on the accuracy of the coding of each surgical procedure performed.

Conclusion

Significant improvements in pain and function were found after biceps tenodesis in patients with and without active WC claims. However, on analysis of patients' recovery after isolated biceps tenodesis, WC claims led to significantly worse pain and functional outcomes at every major time point (3, 6, 12, and 24 months). Furthermore, although patients with WC claims started out worse preoperatively, they also had worse

preoperative-to-postoperative improvements in pain. These results highlight the importance of considering various patient factors when evaluating shoulder procedures such as biceps tenodesis. This information can be used to educate surgeons and patients on postoperative expectations and expected recovery progression. Furthermore, this study, combined with many of the other recent studies in shoulder surgery, can serve as a foundation and help shape various efforts in health economics, value, and policy.

Disclaimer

Laurence D. Higgins is an employee of Arthrex.

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Supplementary data

Supplementary data to this article can be found online at 10.1016/j.jse.2020.01.095.

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