Do Outcomes Differ after Rotator Cuff Repair for Patients Receiving Workers' Compensation?

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Abstract Comparisons of outcomes after rotator cuff repair between Worker's Compensation Board (WCB) recipients and nonrecipients generally do not consider patient, injury, and shoulder characteristics. We compared preoperative differences between WCB recipients and nonrecipients and determined the impact on their 6-month postoperative outcome. We evaluated a prospective cohort of 141 patients with full-thickness rotator cuff tears, 36 of whom (26%) were WCB recipients, preoperatively and 3 and 6 months after rotator cuff repair. Their mean age was

54.0 ± 10.4 years (standard deviation) and 102 (72%) patients were male. Shoulder range of motion, Western Ontario Rotator Cuff (WORC) index, and American Shoulder and Elbow Surgeons' score were used to evaluate outcomes. We performed regression analyses to control for baseline differences in age, baseline scores, smoking status, symptom duration, injury type, and associated biceps disorder between WCB recipients and nonrecipients. WCB recipients were younger and more likely to smoke, have a traumatic injury, and undergo surgery within 6 months of injury. WCB recipients had lower recovery for all outcomes when these differences were not considered but when differences were accounted for, only 6-month WORC scores were lower in WCB recipients. Clinicians should consider preoperative characteristics before concluding WCB recipients experience less recovery after surgical repair.

Level of Evidence: Level I, prognostic study. See the Guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Introduction

Rotator cuff tear is a common shoulder injury that influences patients' shoulder function and health-related quality of life [2, 30]. Rotator cuff injuries are common in the working population; in fact, a rotator cuff disorder ranks second only to back and neck pain in frequency of occurrence in the workplace [27]. Work productivity is significantly limited as indicated by high claims rates and costs attributed to workplace rotator cuff injuries [21, 45, 46]. Surgical repair of rotator cuff injuries effectively reduces pain and improves function and shoulder range of motion (ROM) [1, 3, 11, 13, 22, 28, 33, 39].

However, several studies reported WCB recipients with rotator cuff tears experience lower recovery and patient satisfaction than their nonrecipients [18, 32, 39, 44]. It also was suggested WCB recipients report worse pain and lower function before surgery than those with nonwork-related injuries [22, 30, 32, 43, 44]. However, few studies have compared WCB recipients and nonrecipients in terms of patient characteristics (eg, age/gender) or injury characteristics (eg, traumatic versus degenerative injuries) [20, 30, 32, 39, 41, 43, 44]. These other characteristics may help explain why recovery differs between these two patient populations.

Factors most commonly considered to have an effect on postoperative outcome are age, gender, smoking status, and tear size [2, 8, 10, 12, 16, 17, 18, 22, 23, 29, 33, 34, 36, 39, 41, 44]; contradictory results have been reported, with some studies suggesting these factors do have an impact on outcome [8, 10, 12, 22, 29, 36, 41, 44] and others suggesting they do not [16–18, 23, 33, 34, 39]. However, to our knowledge, no study has explored whether these factors affect patients with compensation claims differently from those without compensation claims (eg, do large tears have a worse outcome in WCB recipients than nonrecipients; does smoking have a different impact on outcome in WCB recipients than nonrecipients?). If WCB recipients and nonrecipients respond differently to treatment owing to different preoperative characteristics, we may gain a better understanding of expected outcomes between these patient groups, and it also may help explain why previous studies have been heterogeneous in their findings.

Our initial objectives were to (1) determine if patient (age, gender, smoking status), injury (tear size, type of onset, chronicity, accompanying labral or biceps disorder), or preoperative shoulder characteristics (pain, function, shoulder ROM, strength) differed between WCB recipients and nonrecipients with a full-thickness rotator cuff tear, and (2) report how 6-month outcomes may vary between groups when these differences are not considered. We then (3) determined if controlling for preoperative differences between groups could partially explain any postoperative differences in pain, function, and ROM between WCB recipients and nonrecipients, and (4) explored the differential influence of age, gender, smoking, and tear size on postoperative outcome if these characteristics varied between recipients and nonrecipients.

Materials and Methods

We prospectively followed a cohort of 141 patients who underwent surgical repairs of full-thickness rotator cuff tears between April 1997 and July 2000. Participants were

recruited from two surgeons' practices; one surgeon (RB) was a shoulder specialist whereas the other (DO) specialized in sport medicine, including shoulder disorders. Eligible patients had a diagnosis of a full-thickness rotator cuff tear based on history, physical examination, and radiographic investigations, without accompanying Bankart lesions, severe glenohumeral osteoarthritis, or any previous surgery on the affected shoulder. Although most patients underwent MRI, CT, or arthrograms in addition to plain radiography preoperatively, the diagnosis of a full-thickness tear was confirmed during surgery for final determination of study eligibility. We received ethics approval from the regional health ethics board for this study. All participants provided signed informed consent before inclusion.

Patients were assessed preoperatively by a shoulder physical therapist (CLC) who did not treat participants. Demographic factors (age, gender) and patient-specific factors (WCB involvement, smoking status, type of injury onset, chronicity of tear) also were collected preoperatively. Of the 141 patients enrolled, 36 (26%) were WCB recipients. The mean age was 54.0 ± 10.4 years and 102 (72%) were male.

We used the Western Ontario Rotator Cuff (WORC) index and the American Shoulder and Elbow Surgeons' (ASES) questionnaires to assess shoulder pain and function [24, 26, 31]. Active ROM included flexion measured with the patient in a standing position and external rotation assessed in a supine position with the arm in an abducted position. Abduction was not included in the ROM analysis owing to alterations in measurement technique midway through the study, whereas internal rotation was measured using vertebral levels, a method that did not allow for inclusion in the global shoulder ROM score.

Shoulder strength was measured using a subjective rating scale that could not be reliably quantified [4]; thus strength was included as a dichotomous variable where patients either did or did not have antigravity strength in forward flexion and external rotation. Patients were reassessed by the same physical therapist 3 and 6 months postoperatively.

Patients were placed in the beach chair position. Both surgeons started with an arthroscopic evaluation. Superior labral anteroposterior lesions were débrided or repaired [40]. The biceps disorder was treated by débridement or tenodesis. All patients underwent acromioplasty with coracoacromial ligament transection.

Rotator cuff tear size was based on the ASES classification (small, 0–10 mm; medium, 11–30 mm; large, 31–49 mm; massive, > 50 mm) [9]. Tear size was measured intraoperatively along the anteroposterior base (length) and the widest mediolateral aspect (retraction) using a flexible ruler or a probe tip with millimeter markings.

The two study surgeons chose repair type based on clinical experience and patient characteristics (eg, tear size, tissue quality). For one surgeon (DO), patients underwent mini-open or open repairs. For the other surgeon (RB), if the tear was mobilized easily and bone and tissue quality were adequate to obtain good purchase of suture anchors, an arthroscopic repair was performed. Otherwise, a mini-open or open repair was performed, again depending on tissue quality and mobility. Health status and comorbidities did not alter choice of surgical approach. Mini-open repairs were performed in 84 (60%), arthroscopic in 24 (17%), and open repairs in 33 (23%) patients. WCB recipients and nonrecipients were distributed similarly between the two surgeons (Table 1). Surgical approach also was similar between groups, indicating WCB status did not influence the surgeons' choice of surgical approach (Table 1).

All patients received standardized preoperative and perioperative care at one hospital. Patients were encouraged to attend postoperative therapy at a rehabilitation unit with access to pool therapy and group strengthening classes. However, as a referral center for a large geographic region, some patients received therapy elsewhere.

Regardless of rehabilitation location, method of surgical repair, or WCB status, all patients were prescribed the same regimen. Patients wore a Velpeau sling for 6 weeks and were referred for physical therapy 2 weeks postoperatively. During the initial 6 weeks, only self-assisted ROM (excluding abduction), pendulum exercises, and isometric scapular stabilization exercises were permitted. Between 6 and 10 weeks after surgery, self-assisted stretching toward end range, active shoulder ROM, and closed chain strengthening exercises were added and scapular stabilization exercises progressed. Ten weeks postsurgery, progressive strengthening started, beginning with isometric and progressing to isotonic exercises. Therapist-assisted joint mobilization also was added to maximize ROM.

For measurement of pain and function, the WORC index and the ASES index were the dependent variables. The

WORC index, reliable and valid for patients with rotator cuff disorders, is a disease-specific tool that evaluates physical symptoms (including pain), sports and recreation, work, lifestyle, and emotions [24]. The ASES index is a reliable and valid joint-specific questionnaire that assesses functional limitations and pain during shoulder activities [26, 31]. Both indices are measured on a scale of 0 to 100, where 100 indicates no pain or shoulder dysfunction.

Active shoulder ROM, the third dependent variable, was measured using a goniometer as per published standards [7] for forward flexion in standing and external rotation in abduction. For the purpose of analysis, a global ROM score, calculated by summing movement in these planes, was used to determine the impact of WCB status on ROM in more than one plane of movement.

Six months postoperatively, the WORC and ASES questionnaires were completed by 113 patients (80%), whereas 107 patients (76%) returned for ROM assessment. Patients who missed the 6-month assessment were similar ($p > 0.05$) in baseline and surgical characteristics to those who completed the visit, with the exception of smokers, who were more likely ($p = 0.01$) to drop out. Nonrespondents were similarly distributed between WCB recipients and nonrecipients ($p = 1.0$), as was the smoking distribution between nonrespondents in both groups ($p = 0.46$).

To determine if the WCB recipients and nonrecipients were different before surgery, we compared the following baseline characteristics between the two patient groups: age, gender, smoking status, duration of shoulder symptoms, injury onset type (traumatic/insidious), preoperative WORC and ASES scores, preoperative ROM and strength, tear size, and associated labral or biceps disorder. Chi square tests were used for categorical data (gender, smoking status, type of onset, chronicity and size of tear, labral and biceps disorder, and strength) and independent t tests were used for continuous variables (age, shoulder ROM, ASES and WORC scores). As we focused on shoulder-specific variables, comorbid conditions were not evaluated. We were interested in preoperative patient characteristics, as this information would assist clinicians in determining postoperative needs and setting appropriate patient expectations before surgery.

Comparison then was made of the 6-month WORC and ASES scores and shoulder ROM using independent t tests between groups to determine if the groups had different outcomes when preoperative differences were not considered.

Multiple linear regression analysis then was used to examine 6-month WORC and ASES outcomes and global ROM (flexion plus external rotation), controlling for any baseline differences seen between groups. Regression allowed us to determine the effect of WCB status while

Table 1. Surgeons and surgical approach by distribution

Variable	WCB recipient	Nonrecipient	p Value*
Number	36 (26%)	105 (74%)	
Surgeon			0.22
Surgeon 1	26 (72%)	87 (83%)	
Surgeon 2	10 (28%)	18 (17%)	
Surgical approach			0.21
Arthroscopic	4 (11%)	20 (19%)	
Mini-open	20 (56%)	64 (61%)	
Open	12 (33%)	21 (20%)	

* Analyzed using chi square test; WCB = Worker's Compensation Board.

simultaneously controlling for the effect of other variables we found different between groups in the first stage of the analysis. Thus, when we examined the independent effect of WCB status, we compared patients with similar characteristics with the exception of WCB status. Variables were considered only for the regression analysis if $p \leq 0.05$ to prevent overfitting the model with unnecessary variables. With the number of subjects available for analysis at 6 months, the model was powered to detect a medium effect size ($\alpha = 0.05$; $\beta = 0.20$) with up to nine variables [14]. We conducted extensive regression diagnostic tests (residual analysis, leverage statistics, and Cook's distance) to ensure our model met regression modeling assumptions [25].

To further alienate the potential confounding effects of baseline factors on the difference between WCB recipients and nonrecipients in the 6-month WORC and ASES outcomes and global ROM, propensity scores were used in the multiple regression analyses instead of the confounders [37]. Significant differences observed in the confounders between WCB recipients and nonrecipients disappeared when controlled for by the propensity scores (data not shown).

To meet our final objective, differential responses were explored for age and smoking status between WCB recipients and nonrecipients, as these characteristics were different between groups. Only smoking status seemed to have a differential impact; thus, the other exploratory analysis is not shown. Analysis was performed using SPSS[®] Version 14.0 (SPSS Inc, Chicago, IL).

Results

Important preoperative differences were noted between WCB recipients and nonrecipients (Table 2). WCB recipients were younger and more likely to smoke, to have had a traumatic injury, and to have received surgery within 6 months of onset of symptoms than nonrecipients. Although substantial preoperative limitations in pain, function, and ROM were reported by all patients, WCB recipients reported worse pain and function ($p \leq 0.001$ for WORC and ASES scores) preoperatively than nonrecipients whereas ROM was not different between groups ($p = 0.07$). Nonrecipients were more likely to have biceps disorders than recipients (Table 2).

At 6 months, WCB recipients reported lower ($p \leq 0.001$) ASES and WORC scores than nonrecipients when preoperative differences were not considered (Table 3). Global ROM also was lower ($p < 0.01$) at 6 months in the WCB recipients (Table 3).

When preoperative differences were considered, WCB recipients still had lower ($p = 0.002$) WORC scores than similar nonrecipients (Table 4), whereas WCB recipients'

Table 2. Baseline patient characteristics by WCB status

Variable	WCB recipient	Nonrecipient	p Value
Number	36 (26%)	105 (74%)	
Patient characteristics			
Age* (years)	51.2 (8.7)	55.0 (10.7)	0.04 [†]
Male	28 (78%)	74 (71%)	0.52 [‡]
Smoker	14 (39%)	20 (19%)	0.02 [‡]
Injury characteristics			
Onset of injury			0.05 [‡]
Traumatic	33 (92%)	80 (76%)	
Insidious	3 (8%)	25 (24%)	
Time to surgery			0.004 [‡]
< 6 months	17 (50%)	22 (22%)	
≥ 6 months	17 (50%)	77 (78%)	
Tear size			0.93 [‡]
Small	11 (36%)	33 (32%)	
Moderate	12 (39%)	41 (40%)	
Large/massive	8 (26%)	29 (28%)	
Biceps disorder	2 (6%)	22 (21%)	0.04 [‡]
Labral disorder	6 (17%)	20 (19%)	1.0 [‡]
Shoulder characteristics			
Preoperative WORC score*	31.7 (18.5)	44.9 (19.2)	< 0.001 [†]
Preoperative ASES score*	43.3 (18.2)	56.1 (19.8)	0.001 [†]
Preoperative antigravity strength	20 (56%)	65 (62%)	0.56 [‡]
Preoperative active global ROM* [§]	155.5° (61.9°)	177.6° (61.9°)	0.07 [†]

* Values are expressed as means, with standard deviations in parentheses; [†]analyzed using independent t test; [‡]analyzed using chi square test; [§]global ROM = forward flexion in standing + external rotation in supine with the arm in an abducted position; WCB = Worker's Compensation Board; WORC = Western Ontario Rotator Cuff Index; ASES = American Shoulder and Elbow Surgeons' Index; ROM = range of motion.

Table 3. Unadjusted health-related quality of life and ROM at 6 months postoperative

Variable	6 months		p Value*
	WCB recipient	Nonrecipient	
WORC score	59.6 (19.2)	80.9 (13.6)	< 0.001
ASES score	72.9 (14.3)	82.9 (13.0)	0.001
Active global ROM [†]	173.0° (40.5°)	196.1° (31.3°)	0.01

Values are expressed as means, with standard deviations in parentheses; *analyzed using independent t tests; [†]global ROM = forward flexion in standing + external rotation in supine with the arm in an abducted position; WCB = Worker's Compensation Board; WORC = Western Ontario Rotator Cuff Index; ASES = American Shoulder and Elbow Surgeons' Index; ROM = range of motion.

Table 4. Multiple linear regression analysis of 6-month WORC scores

Variable	Multivariate analysis		
	B	SE	p Value
WCB patient	−14.1	4.4	0.002
Smoking	4.3	4.8	0.37*
WCB × smoking	−19.0	7.7	0.02
Baseline WORC	0.18	0.09	0.05
Age	0.06	0.15	0.98
Traumatic onset	5.4	4.0	0.17
Biceps disorder	4.2	3.9	0.29
> 6 months to surgery	−0.11	3.5	0.98
Predicted 6-month WORC score by smoking and WCB status [†]			
Smoking	WCB status		
	No	Yes	
No	78.8	64.8	
	(95% CI, 73.5–84.2)	(95% CI, 55.7–73.8)	
Yes	83.2	50.1	
	(95% CI, 74.2–92.2)	(95% CI, 39.8–60.4)	

* Although smoking status seems insignificant, it must be retained in the model because there is a significant interaction between smoking and WCB status; [†]clinical significance of this finding is that the impact of smoking status only had a negative impact on WCB recipients; smoking status did not have a negative impact on the outcome of nonrecipients; WORC = Western Ontario Rotator Cuff Index; B = regression coefficient; SE = standard error; WCB = Worker's Compensation Board; CI = confidence interval.

Table 5. Multiple linear regression analysis of 6-month ASES scores

Variable	Multivariate analysis		
	B	SE	p Value
WCB patient	−6.6	3.3	0.05
Smoking	−7.1	3.3	0.04
Baseline ASES	0.19	0.07	0.01
Age	−0.07	0.13	0.57
Traumatic onset	4.0	3.3	0.23
Biceps disorder	6.0	3.4	0.08
> 6 months to surgery	−0.98	3.3	0.75

ASES = American Shoulder and Elbow Surgeons' Index; B = regression coefficient; SE = standard error; WCB = Worker's Compensation Board.

6-month ASES scores were marginally lower ($p = 0.05$) than nonrecipients' scores (Table 5). Finally, once baseline differences between groups were considered, WCB status did not influence 6-month ROM outcomes (Table 6).

Smoking only appeared to have a negative effect on WCB recipients' 6-month WORC scores. A nonrecipient who smoked was predicted to have a 6-month WORC score that was higher ($p = 0.02$) than a WCB recipient

Table 6. Multiple linear regression analysis of global ROM

Variable	Multivariate analysis		
	B	SE	p Value
WCB patient	−16.2	8.8	0.07
Smoking	−0.56	9.7	0.95
Baseline ASES*	0.26	0.19	0.17
Age	−.037	0.36	0.30
Traumatic onset	−5.5	9.2	0.56
Biceps disorder	10.9	9.1	0.23
> 6 months to surgery	2.3	8.4	0.79

* Only baseline ASES was used in the model to avoid overfitting with two measures of pain and function; ASES score was chosen based on a stronger relationship with ROM than the Western Ontario Rotator Cuff Index score; ROM = range of motion; B = regression coefficient; SE = standard error; WCB = Worker's Compensation Board.

who also smoked (Table 4). Six-month ASES scores and global ROM scores were not differentially affected by subject's smoking and WCB status. Smoking led to lower ASES scores in WCB recipients and nonrecipients whereas ROM was not different between smokers and nonsmokers, regardless of WCB status.

Discussion

Although surgical repair of rotator cuff tears reportedly leads to substantial improvements in pain and function [1, 11, 13, 22, 28, 33, 39], previous studies have reported WCB recipients report lower recovery than nonrecipients [20, 30, 32, 39, 41, 43, 44]. Previous research also suggests WCB recipients start with poorer outcomes preoperatively [22, 30, 32, 43, 44]. However, these studies do not control for different patient and injury characteristics that may help explain their differential recovery; also, these studies do not consider how preoperative dissimilarities affect postoperative recovery (Table 7). We therefore asked whether (1) patient characteristics differed between WCB recipients and nonrecipients with full-thickness rotator cuff tears; (2) whether 6-month outcomes varied between groups when these differences are not considered; (3) controlling for preoperative differences found between groups could partially explain any postoperative differences seen in pain, function, and ROM between WCB recipients and nonrecipients, and finally (4) if these characteristics varied between recipients and nonrecipients, we explored the differential influence of age, gender, smoking, and tear size on postoperative outcome.

We note several limitations to our study. We used two experienced surgeons and compared three surgical approaches commonly used to repair full-thickness rotator

Table 7. Summary of studies comparing postoperative outcomes between WCB and non-WCB patients

Study	Number of participants	Study design	Outcome evaluated	Results relating to WCB comparison	Study limitations
Iannotti et al. [22]	n = 24 (60%) WCB recipients, n = 16 (40%) nonrecipients	Prospective cohort study	Patient satisfaction, strength, Constant score, activity level, return to work	WCB status did not impact patient satisfaction, Constant score, or activity level WCB recipients took longer to return to work but had higher job demands than nonrecipients	No risk adjustment performed No preoperative comparison between WCB recipients and nonrecipients Single surgeon used
McKee and Yoo [30]	n = 23 (32%) WCB recipients n = 48 (68%) nonrecipients	Prospective cohort study	SF-36, Shoulder Pain and Disability Index	WCB status was associated with lower preoperative and postoperative scores on both scales	No risk adjustment performed Single surgeon used
Misamore et al. [32]	n = 24 (22%) WCB recipients n = 79 (78%) nonrecipients	Retrospective cohort study	UCLA Shoulder Rating Scale, return to work	WCB recipients had lower preoperative and postoperative functional scores, lower overall scores than nonrecipients More nonrecipients returned to preinjury occupation than recipients	Retrospective study design No risk adjustment performed Variable followup period Single surgeon used
Shimmers et al. [39]	n = 11 (27%) WCB recipients n = 30 (73%) nonrecipients Excludes losses to followup	Retrospective cohort study	UCLA Shoulder Rating Scale	WCB recipients reported lower UCLA scores than nonrecipients	Retrospective study design No risk adjustment performed Variable followup period Single surgeon used
Viola et al. [43]	n = 335 (32%) WCB recipients (of which 22 [18%] had rotator cuff tears) n = 728 (68%) nonrecipients (of which 100 [82%] had rotator cuff tears)	Retrospective review of prospectively collected data	Preoperative SF-36, Simple Shoulder Test	Age- and gender-adjusted preoperative SF-36 scores were lower for WCB recipients than nonrecipients with rotator cuff tears Simple Shoulder Test scores were not different between WCB recipients and nonrecipients with rotator cuff tears	Sample includes only a small number of patients with rotator cuff tears No risk adjustment for Simple Shoulder Test scores Single surgeon used
Watson and Sonnabend [44]	n = 94 (15%) WCB recipients n = 573 (85%) nonrecipients	Prospective cohort study	Adapted Simple Shoulder Test, patient satisfaction	WCB recipients were more likely to be displeased postoperatively and less likely to report improvement in Simple Shoulder Test than nonrecipients	No risk adjustment performed Single surgeon used

WCB = Worker's Compensation Board.

cuff tears, increasing the applicability of our results to general clinical practice as they do not denote results related to one surgeon's technical expertise or experience, but instead reflect results expected in surgeons with shoulder expertise. As repair type was dispersed similarly across WCB recipients and nonrecipients, it did not appear to substantially affect outcomes, but this is a potential confounder of our reported results. Because we obtained substantial information about patient, shoulder, and injury characteristics preoperatively, we were able to measure important differences between the two groups and then measure their impact on subsequent postoperative recovery. We focused on issues related primarily to the shoulder and as a result did not measure patient comorbidities nor did we determine their work level, parameters that may impact outcome after rotator cuff repair [15, 41, 42]. Tashjian et al. [41] reported patients with more comorbidities reported lower preoperative scores than their healthier counterparts. However, two subsequent reports found that the presence of more comorbidities did not result in worse postoperative shoulder functional recovery [6, 42]. Boissonnault et al., however, reported lower health status scores postoperatively in patients who had more comorbidities [6]. As neither of these studies were limited to WCB recipients, it is possible that comorbid conditions could differentially impact recovery in the WCB population; thus the impact of comorbid conditions may be a potential determinant of outcome in this subpopulation. The omission of activity and work level from our prospective evaluation was an unfortunate oversight, as it is possible the WCB recipients may have had more physically demanding jobs, which negatively affected their 6-month WORC scores. Sallay et al. [38] reported WCB recipients were more likely to have longer work hours and may have increased work demands compared with nonrecipients. However, our chosen outcomes were related to patients' pain, function, and global ROM, rather than return to work, therefore our results still assist in determining how the chosen preoperative characteristics affect self-reported recovery and ROM 6 months after rotator cuff surgery in WCB recipients and nonrecipients. Additional research into this complex and challenging patient group should consider job demands as a potential determinant of outcome.

Our short-term followup of 6 months postoperatively precludes determination of whether these factors influence longer-term outcomes. Previous studies suggest substantial recovery occurs during the first 6 months after surgery [3, 5, 19, 35]. As our aim was to look at what factors affect early postoperative recovery, when there is the most variation in recovery, our results are useful for clinicians working with patients during early postoperative rehabilitation to set realistic expectations based on preoperative characteristics and WCB status.

Finally, the legal and remuneration aspects of WCB systems may vary within and between countries. Our results therefore may not be directly comparable to certain geographic areas based on regional compensation laws.

Most other studies reporting WCB patients with lower function and more pain did not consider other baseline differences (Table 7). Our WCB recipients were younger and more likely to have had a traumatic injury and to have their surgery within 6 months of onset of symptoms. Thus, some of the reported baseline differences in shoulder function and pain between groups may be related to the chronicity of the injury in the nonrecipients.

When we did not consider these preoperative differences, our 6-month results were similar to those reported in the literature: WCB recipients appear to have worse pain and function and lower ROM than nonrecipients [18, 32, 39, 44]. However, when we account for all the reported differences preoperatively, ROM no longer differs between groups at 6 months and the difference between groups in the ASES score is substantially reduced. Only the WORC score remained substantially lower in the WCB recipients. The WORC score measures work-related and emotional impact of shoulder dysfunction in addition to shoulder pain and function. We presume work-related injuries have consequences beyond the loss of shoulder function and pain, which may be reflected in the lower WORC score.

We particularly note the conditional effect of smoking on 6-month WORC scores and the negative impact of smoking on 6-month ASES scores. Based on the WORC score, only the WCB recipients appeared to experience a negative impact on recovery related to smoking. In contrast, smokers appeared more likely to have lower 6-month ASES scores, regardless of WCB status. The inconsistencies in our findings may be related to the small sample size of patients who either smoked or were WCB recipients. Further, the nonrespondents were more likely smokers, and although nonrespondent smokers were similarly distributed between WCB recipient and nonrecipient groups, this differential dropout may have had an impact on our results. We also only measured whether patients smoked or not; thus, we were not able to ascertain if the impact of smoking was related to the dose of nicotine exposure. Future studies should consider measuring the number of cigarettes smoked to better understand the relationship between smoking and recovery after rotator cuff repair.

We found WCB recipients were different from nonrecipients in characteristics that have an effect on patient outcome. When the other group differences are considered, the impact of WCB status on patient outcomes is mitigated. Only on the WORC score did WCB recipients still have lower 6-month scores than nonrecipients, even after considering baseline differences. ASES scores and global ROM appeared less affected by WCB status after baseline

variations were incorporated. Clinicians should consider other potential baseline differences that may impact recovery before concluding WCB status leads to less recovery after surgical repair. Future research also should consider job demand differences and evaluate smoking exposure levels between WCB respondents and nonrespondents to determine the impact of these factors on postoperative recovery.

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