Narcotic Use and Resiliency Scores Do Not Predict Changes in Sleep Quality 6 Months After Arthroscopic Rotator Cuff Repair

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Background: Patients with rotator cuff disease commonly complain of difficulty sleeping. Arthroscopic repair has been associated with improved sleep quality in many patients with rotator cuff tears; however, some individuals continue to suffer from sleep disturbance postoperatively.

Purpose: To determine whether changes in sleep quality following rotator cuff repair are predicted by a patient's narcotic use or ability to cope with stress (resilience).

Study Design: Case series; Level of evidence, 4.

Methods: A total of 48 patients undergoing arthroscopic rotator cuff repair were prospectively enrolled and completed the Connor-Davidson Resilience Scale (CD-RISC) preoperatively. The Pittsburgh Sleep Quality Index (PSQI) was administered preoperatively and at multiple intervals postoperatively for 6 months. Narcotic utilization was determined via a legal prescriber database. Pre- and postoperative sleep scores were compared using paired *t* tests and the McNemar test. Linear regression was used to determine whether narcotic use or CD-RISC score predicted changes in sleep quality.

Results: An increased number of patients experienced good sleep at 6 months postoperatively ($P < .01$). Mean ± SD nocturnal pain frequency improved from 2.5 ± 1.0 at baseline to 0.9 ± 1.1 at 6 months. CD-RISC score had a positive predictive value on changes in PSQI score ($R^2 = 0.09$, $P = .028$) and nocturnal pain frequency ($R^2 = 0.08$, $P = .041$) at 2 weeks. Narcotic use did not significantly predict changes in PSQI score or nocturnal pain frequency ($P > .05$).

Conclusion: Most patients with rotator cuff disease will experience improvement in sleep quality following arthroscopic repair. Patients demonstrated notable improvements in nocturnal pain frequency as soon as 6 weeks following surgery. CD-RISC resiliency scores had a significant positive predictive value on changes in sleep quality and nocturnal pain frequency at 2 weeks. Narcotic use was not associated with change in sleep quality.

Keywords: rotator cuff repair; sleep quality; resiliency; narcotic use

Patients with rotator cuff disease commonly complain of difficulty sleeping. A previous study found that sleep disturbance is 3 to 6 times more common in patients with rotator cuff tears than the general population.[1] Poor sleep is often a salient factor in these patients' decisions to seek care. Arthroscopic repair has been associated with improved sleep quality in many patients with full-thickness rotator cuff tears[1]; however, some individuals continue to suffer from sleep disturbance postoperatively. Previous studies have reported that up to 41% of patients continue to have poor sleep quality following repair of a full-thickness tear.[1,8]

Pre- and postoperative narcotic use has been associated with sleep disturbance following repair.[1,8] Additional patient factors that affect change in sleep quality have not

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been identified. Psychosocial factors are often implicated in patient outcomes, and previous studies have established that greater psychological distress is associated with increased pain and impaired function in patients with rotator cuff pathology.[3,9] However, it is not clear if the ability to cope with stress, known as *resilience*,[5] is related to outcomes following rotator cuff repair. In patients with physical disabilities, higher resilience has been associated with improved sleep quality.[7] This relationship has not been investigated in patients who have undergone rotator cuff repair.

The purpose of this study was to determine if changes in sleep quality following arthroscopic rotator cuff repair are predicted by patterns of narcotic use or a patient's ability to cope with stress. Our hypothesis was that patients with prolonged narcotic utilization or low resiliency scores will experience less improvement in sleep quality following rotator cuff repair.

METHODS

This study was a prospective series of continuous patients who underwent arthroscopic rotator cuff repair from July 2016 to April 2018. Patients who were 18 years or older and scheduled for arthroscopic repair of a full-thickness rotator cuff tear were eligible for enrollment. Arthroscopic rotator cuff repairs were performed by 2 fellowship-trained orthopaedic surgeons at a single institution. Upon approval from the institutional review board, patients were enrolled preoperatively from July 2016 to April 2018. A total of 68 patients were enrolled and asked to complete 2 questionnaires prior to surgery: the Pittsburgh Sleep Quality Index (PSQI) and Connor-Davidson Resilience Scale (CD-RISC). The questionnaires were administered and scored by a research assistant who was not involved in patient care. Patients were asked to complete the same PSQI questionnaire during clinical follow-up visits at 2 weeks, 6 weeks, 3 months, and 6 months postoperatively.

Overall, 48 patients completed the 6-month follow-up and were thus included in analysis. Demographic information such as age, sex, American Society of Anesthesiologists (ASA) score, previous diagnosis of sleep apnea, and use of prescription sleeping aids was collected from the electronic medical record (Table 1). Rotator cuff tear pattern, repair technique, and intraoperative complications reported in the operative notes were also recorded. Tear size was measured by the number of rotator cuff muscles torn.

The primary outcome measure was the PSQI, which is a validated measure of sleep quality.[2] The PSQI consists of 19 questions scored on a 21-point scale. Higher scores are associated with decreased sleep quality, and a score higher than 5 indicates sleep disturbance. The secondary outcome measure was nocturnal pain frequency, which is quantified by question 5i on the PSQI. This question asks patients how often they have trouble sleeping secondary to pain, and the answer is graded on a scale from 0 (best) to 3. The CD-RISC survey was administered preoperatively to determine baseline resiliency scores. The questionnaire is a validated 25-item scale for quantifying an individual's adaptive capacity.[5] Questions pertain to the patient's ability to adapt to change and cope with stress. Each of the 25 items carries a 5-point range of responses. Scores range from 0 to 100, with higher scores reflecting greater resilience.

TABLE 1
Demographic Information (N = 48 Patients)

	n (%)
Male:female	25:23
Age, y	62 (34-81)[a]
ASA score	
ASA 1	7 (15)
ASA 2	31 (64)
ASA 3	10 (21)
Sleep apnea diagnosis	8 (16.7)
Use of prescription sleeping aids	11 (22.9)
Preoperative narcotic use	
Acute exposure	25 (52)
Nonsustained or intermediate exposure	16 (33)
Chronic sustained exposure	6 (13)
Muscles torn	
Supraspinatus only	24 (50)
Subscapularis only	2 (4.2)
Supraspinatus, subscapularis	7 (14.6)
Supraspinatus, infraspinatus	11 (22.9)
Supraspinatus, infraspinatus, subscapularis	4 (8.3)

[a]Mean (range). ASA, American Society of Anesthesiologists.

All patients adhered to the same 3-phase postoperative rehabilitation protocol. Phase 1 consisted of 6 weeks of sling immobilization. Patients began pendulum and passive range of motion exercises at weeks 1 to 2. Phase 2 consisted of active shoulder range of motion exercises starting at week 7 and progressive strengthening starting at week 9. Phase 3 continued progressive strengthening exercises. At 6 months, the patient was cleared to resume activity as tolerated.

All patients were subject to the same postoperative pain management protocol. Following surgery, patients were prescribed oxycodone (5 mg), oxycodone/acetaminophen (5 mg/325 mg), or hydrocodone/acetaminophen (5 mg/325 mg) every 6 hours as needed. At the first postoperative clinic appointment, patients were prescribed a 14-day supply of the same medication if needed. If further pain medication was required, patients were weaned with a 14-day supply of hydrocodone/acetaminophen (if previously prescribed oxycodone or oxycodone/acetaminophen) or tramadol (if previously prescribed hydrocodone/acetaminophen). Each patient's pre- and postoperative narcotic utilization was determined via a legal prescriber database. Duration of preoperative narcotic use was categorized as acute exposure (first opioid prescription issued within 30 days of surgery), nonsustained or intermediate sustained exposure (1 or more opioid prescriptions issued within 1 year of surgery without continuous use or continuous use for less than 6 months), or chronic sustained exposure (continuous use for longer than 6 months). Continuous use was defined as a period longer than 90 days without an interruption in prescription refills. These categories are based on definitions used in a previous study evaluating preoperative opioid use

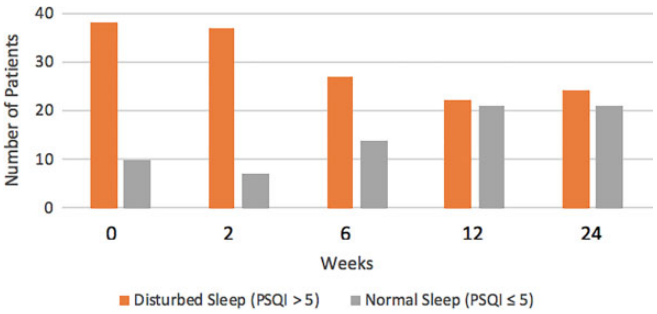

Figure 1. Number of patients experiencing normal versus disturbed sleep. Normal sleep is defined as a Pittsburgh Sleep Quality Index (PSQI) score ≤5. Disturbed sleep is defined as a PSQI score >5.

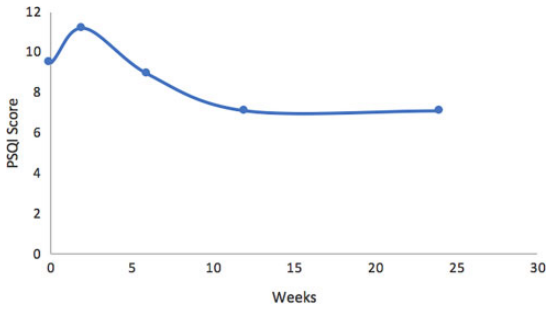

Figure 2. Changes in sleep quality over time. Sleep quality was quantified by Pittsburgh Sleep Quality Index (PSQI) score.

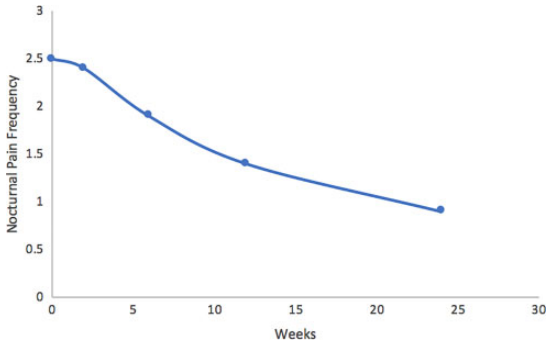

Figure 3. Changes in nocturnal pain frequency over time. Nocturnal pain frequency was quantified by the patient's answer to Pittsburgh Sleep Quality Index question 5i, graded from 0 (best) to 3.

in patients undergoing spine surgery.[12] Postoperative narcotic use was quantified by the number of postoperative opioid prescriptions issued in the 6 months following surgery.

Statistical Analysis

Postoperative mean sleep scores were compared with baseline via paired t tests, and the postoperative rate of good sleep quality (PSQI ≤5) was compared with the McNemar test, which is the paired equivalent of the chi-square test for categorical data. It was used to compare the rate of good sleep quality in the same group of patients at different time points. Linear regression was used to determine if CD-RISC score, preoperative narcotic use, postoperative narcotic use, or demographic and injury factors, such as age, sex, number of muscles torn, diagnosis of sleep apnea, and use of prescription sleeping aids, predicted changes in sleep quality. Predictive value of a variable was determined by the value of R^2. Statistical values were calculated with R (v 3.4.0; R Foundation for Statistical Computing)[10] with RStudio (v 1.0.153; RStudio Inc).[11] Probability values <.05 were considered significant. A post hoc power analysis was performed. Given previous studies, we estimated that 90% of patients would have poor sleep quality (PSQI >5) and that at 6 months following surgery, the number reporting sleep disturbance would drop to 60%. By setting power to 80% and assuming a type 1 error of 0.05, the minimum number of participants required was 42. A total of 48 patients has 75% power to detect a moderate relationship ($R^2 = 0.15$) with a P value of .05.

RESULTS

Of the 48 patients completing follow-up, 25 were male and 23 were female, with a mean age of 62 years (range, 34-81 years). A majority of patients had an isolated tear of the supraspinatus (50%), followed by combined tears of the supraspinatus/infraspinatus (23%) and the supraspinatus/subscapularis (14.6%). Regarding preoperative narcotic use, 52% were categorized as having acute exposure, 33% as having nonsustained or intermediate sustained exposure, and 13% as having chronic sustained exposure (Table 1).

At baseline, 21% (10 of 48) of patients reported having good sleep quality (PSQI ≤5). At 3 and 6 months, 49% (21 of 43) and 47% (21 of 45) of patients reported good sleep quality, respectively (Figure 1). Compared with baseline, this improvement in the rate of good sleep quality at 3 and 6 months was statistically significant ($P = .015$ and .01, respectively). Mean ± SD PSQI score improved from 9.5 ± 5.1 at baseline to 7.1 ± 5.0 at 6 months (Figure 2). The mean nocturnal pain frequency (question 5i on the PSQI) gradually improved from 2.5 ± 1.0 preoperatively to 0.9 ± 1.1 at 6 months (Figure 3). Improvement from the patient's preoperative nocturnal pain frequency was significant at 6 weeks ($P = .03$), 3 months ($P < .001$), and 6 months ($P < .001$).

Linear regression showed a significant positive predictive value of CD-RISC score on changes in PSQI score ($R^2 = 0.09$, $P = .028$) and nocturnal pain frequency ($R^2 = 0.08$, $P = .041$) at 2 weeks. The predictive value was not significant at any other time points. Pre- and postoperative narcotic use did not significantly predict changes in PSQI score or nocturnal pain frequency at any time interval ($P >$ .05). Preoperative ASA score was associated with a significant positive predictive value on PSQI score at 2 weeks

($R^2 = 0.12$, $P = .013$) and 6 weeks ($R^2 = 0.11$, $P = .02$), but this did not persist at 3 months and 6 months. Sex was associated with a significant positive predictive value on PSQI score at 6 weeks ($R^2 = 0.16$, $P = .006$) but was otherwise not significant. Age, number of muscles torn, diagnosis of sleep apnea, and use of prescription sleeping aids were not associated with a significant predictive value on changes in PSQI score or nocturnal pain frequency at any time point.

DISCUSSION

Sleep disturbance is a common complaint in patients with rotator cuff disease, and previous studies have demonstrated improved sleep quality following arthroscopic repair.[1,8] Our study supports these findings, with our cohort demonstrating an improvement in mean PSQI score from 9.5 at baseline to 7.1 at 6 months. The percentage of patients reporting good sleep (PSQI $\leq$5) improved significantly, from 21% at baseline to 49% at 3 months and 47% at 6 months. Improvement in patient baseline nocturnal pain frequency score (PSQI question 5i) was significant at 6 weeks, 3 months, and 6 months. Resiliency (CD-RISC) score was associated with a significant positive predictive value on changes in PSQI score and nocturnal pain frequency at 2 weeks, but this was not sustained at later time points. Pre- and postoperative narcotic use did not significantly predict changes in PSQI score or nocturnal pain frequency at any time interval.

In 2015, Austin et al[1] investigated sleep disturbances in relation to arthroscopic rotator cuff repair. In a study of 56 patients, the authors found that 89% had a PSQI score indicative of sleep disturbance (PSQI >5), with a mean score of 12 prior to surgery. By 6 months, the percentage of patients experiencing sleep disturbance decreased to 38%, and the mean PSQI score dropped to 6. The results of our study also demonstrated an improvement in sleep quality, albeit to a lesser degree. Both studies demonstrated significant improvement in sleep scores at the same late time intervals (3 and 6 months postoperatively), suggesting that the improvement in sleep quality following repair is somewhat delayed.

Postoperative pain may be partly responsible for the delay in sleep quality improvement. Austin et al[1] found that the pain visual analog scale (VAS) score correlated with PSQI score. The VAS pain scores in their patient cohort were highest at 2 weeks, allowing the authors to suggest that higher pain levels in the immediate weeks following surgery may have contributed to the delay in improvement of sleep quality. In our study, we analyzed pain's effect on sleep slightly differently, using the patient's answer to question 5i on the PSQI questionnaire for our statistical analysis. This question asks patients how often they have trouble sleeping secondary to pain. We found that improvement in this nocturnal pain frequency score occurred at a more rapid rate than improvement in total PSQI score. The improvement in nocturnal pain frequency score became significant at 6 weeks, while the improvement in total PSQI score did not become significant until 3 months. The early improvement in nocturnal pain frequency scores versus the delayed improvements in overall sleep quality suggests that changes in sleep quality are multifactorial and not solely related to pain experienced during the night.

In an attempt to investigate additional factors that might affect sleep quality, we evaluated patient resiliency (CD-RISC) scores and their relation to PSQI scores and nocturnal pain frequency. We found that the CD-RISC score had a significant positive relationship to changes in both sleep quality and nocturnal pain frequency at 2 weeks, indicating that patients with higher resilience actually had worse sleep impairment at 2 weeks. This result suggests that a patient's ability to cope with stress, as measured by the CD-RISC, impairs changes in sleep quality in the immediate weeks following repair. This result is counterintuitive, and it is not clear why this occurred. In a prospective study of 47 patients suffering from rotator cuff pathology, Cho et al[4] found that patients' levels of depression and anxiety decreased following arthroscopic rotator cuff repair. Similarly, in a prospective study of 85 patients evaluated by the Distress Risk Assessment Method before and after arthroscopic rotator cuff repair, Potter et al[9] found that the prevalence of patients experiencing psychological distress significantly decreased following repair.

We also evaluated the effect of pre- and postoperative narcotic use on sleep quality. We found that both pre- and postoperative narcotic use was not significantly associated with changes in PSQI scores or changes in nocturnal pain frequency. This result was surprising, as narcotic use has been associated with disruption of the sleep cycle.[6,13] Additionally, after evaluating sleep quality for a minimum of 2 years in 37 patients who underwent rotator cuff repair, Horneff et al[8] found that continued postoperative narcotic use was associated with decreased sleep quality. Given this information, we had hypothesized that narcotic use would have a negative impact on the change in sleep quality following rotator cuff repair. As our results suggest that changes in sleep quality are not associated with narcotic consumption, future studies are necessary to identify whether other factors contribute to a patient's improvement (or lack of improvement) in sleep quality.

Our study had multiple limitations. The main limitation was the 29% rate of loss to follow-up, which may have led to some bias in the results. Another limitation is that we did not include a control group of nonoperatively treated patients with which to compare sleep scores. Inclusion of this group would have better demonstrated whether arthroscopic repair specifically resulted in improved sleep quality. We were unable to include a measure of repair integrity in our analysis, as we did not have the appropriate funding to conduct the necessary imaging studies. We recognize that if the repair fails, sleep quality may be affected. However, the purpose of our study was not to determine how repair healing affects sleep quality but to determine if resilience or narcotic use is associated with changes in sleep quality. Previous studies have similarly evaluated sleep disturbance following rotator cuff repair without an objective measurement of healing.[1,8] The assessment of resilience in this study was based on the CD-RISC score, and there could be other psychological factors that affect

the response to surgery. Additionally, our follow-up duration was limited to 6 months. But as Horneff et al[8] demonstrated that there was no significant improvement in sleep quality in their cohort beyond 6 months, we determined that a longer follow-up duration was not necessary for conclusion.

CONCLUSION

Most patients with rotator cuff disease will experience improvement in sleep quality following arthroscopic repair. Patients in the current study demonstrated notable improvements in nocturnal pain frequency as soon as 6 weeks following surgery. CD-RISC resiliency scores had a significant positive predictive value on changes in sleep quality and nocturnal pain frequency at 2 weeks. Narcotic use was not associated with change in sleep quality.

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