Received: 20 Dec 2024 | **Accepted:** 09 May 2025 **Genel Tıp Derg. Volume** 35/**Issue** 3 (June), 455-461
DOI: 10.54005/geneltip.1604642

ORIGINAL ARTICLE

Associations Between Sleep Quality and Shoulder Pain and Function

Omuz Ağrı ve Fonksiyonunun Uyku Kalitesiyle İlişkisi

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How to cite ?

Zincirci Ekici D, İlbeği S, Atar S, Demirhan E, Kuru Ö. Associations of Sleep Quality With Shoulder Pain and Shoulder Function Genel Tıp Derg. 2025;35 (3): 455-461

ABSTRACT

Aim: The most common cause of shoulder pain is rotator cuff disease (RCD). Nocturnal pain is common in patients and is one of the main reasons for visiting a doctor. This study aims to evaluate the effect of shoulder function and nocturnal pain on sleep quality in patients with RCD.
Methods: Ninety-three patients who presented to the outpatient clinic with RCD-related shoulder pain between October 2024 and December 2024 were included in the study. Shoulder function was assessed by the Penn Shoulder Score (PSS) and sleep quality by the Pittsburgh Sleep Quality Index (PSQI). Patients' magnetic resonance imaging (MRI) findings were recorded.
Results: The mean PSQI score was 6.7±2.7. In the group with better sleep quality, the PSS was higher and the Penn Pain subscore was lower ($p<0.001$). While the presence of nocturnal pain was associated with a 0.25-fold decrease in sleep quality, a one-unit increase in PSS was associated with a 1.06-fold improvement in sleep quality (p values are 0.019 and 0.001, respectively). The function subscale of the PSS was found to be a risk factor for nocturnal pain, and a one-unit increase in the function subscore was associated with a 0.25-fold decrease in nocturnal pain ($p<0.001$).
Conclusions: Impaired shoulder function and the presence of nocturnal pain are risk factors for poor sleep quality. Assessment of sleep quality and nocturnal pain is important for the management and follow-up of these patients.

Keywords: Rotator cuff injuries, Shoulder pain, Sleep disorders, Sleep quality

ÖZ

Amaç: Omuz ağrısı sık görülen kas-iskelet sistemi ağrılarından biridir ve en sık nedeni de rotator manşet hastalıklarıdır (RCD). Omuz ağrısı olan hastalarda gece ağrısı sık görülür ve doktor başvurusunun önemli nedenlerinden biridir. Bu çalışmanın amacı omuz ağrısı olan hastalarda omuz fonksiyonu ve gece ağrısının uyku kalitesine etkisini değerlendirmektir.
Gereç ve Yöntemler: Ekim 2024 ve Aralık 2024 tarihleri arasında omuz ağrısı ile polikliniğe başvuran ve RCD tanısı alan 93 hasta çalışmaya dahil edilmiştir. Omuz fonksiyonu Penn Omuz Skoru (PSS) ve uyku kalitesi Pittsburgh Uyku Kalitesi İndeksi (PSQI) kullanılarak değerlendirilmiştir. Hastaların ilgili omuzlarından gerçekleştirilen manyetik rezonans görüntüleme (MRI) bulguları kaydedilmiştir.
Bulgular: Katılımcıların ortalama PSQI skoru 6,7±2,7 olarak hesaplandı ve %63,4'ünün PSQI skoru 5'in üzerindeydi. Uyku kalitesi iyi olan grupta PSS daha yüksek, Penn Ağrı alt skorunun daha düşük olduğu saptandı ($p<0,001$). Gece ağrısı varlığı uyku kalitesinde 0,25 kat azalmaya neden olurken, PSS'de bir birimlik artış ise uyku kalitesinde 1,06 kat düzelmeye neden olduğu görüldü (p değeri sırasıyla 0.019 ve 0.001). PSS'nin fonksiyon alt ölçeğinin gece ağrısı için risk faktörü olduğu ve fonksiyon skorunda bir birimlik artmanın gece ağrısında 0,25 kat azalmaya neden olduğu saptandı ($p<0.001$).
Sonuçlar: Bozulmuş omuz fonksiyonu ve gece ağrısı varlığı RCD nedenli omuz ağrısı olan hastalarda uyku kalitesini bozan risk faktörleridir. Omuz ağrılı hastaların uyku kalitesinin ve gece ağrısı varlığının değerlendirilmesi, bu hastaların tedavi ve takibinde önem arz eden bir durumdur.

Anahtar Kelimeler: Rotator manşet yaralanmaları, Omuz ağrısı, Uyku bozuklukları, Uyku kalitesi

Introduction

Shoulder pain is a common musculoskeletal complaint (1). It can be caused by intra-articular pathology or peri-articular soft tissue pathology (2). 70% of shoulder pain is caused by rotator cuff disease (RCD), including subacromial impingement, rotator cuff (RC) tendinopathy, and RC tears (3). RCD can cause severe pain, decreased range of motion, decreased muscle strength, shoulder limitations, depression, and sleep disturbances (4). The majority of patients report nocturnal pain due to RCD (5). The presence of comorbidities, low educational level, depression, anxiety, and impaired upper extremity function are factors associated with pain (6). It has been reported in the literature that RC tears affect sleep quality more than subacromial impingement syndrome and RC tendinopathies, but the size of the tear does not affect sleep quality (7,8,9). However, Gumina et al found that patients with smaller tear sizes had poorer sleep quality (10).

Magnetic resonance imaging (MRI) has become a widely used diagnostic tool for the evaluation of shoulder pathology in patients presenting with shoulder pain. These include RC and subdeltoid/subacromial bursa and other structural abnormalities (11). Several studies have shown that there is a poor correlation between MRI findings and shoulder pain and function (12). Nevertheless, MRI is an imaging modality that we frequently use in surgical decision-making, conservative treatment planning, and in our daily clinical practice when evaluating patients with shoulder pain. The incidence of sleep disturbance, anxiety, and depression is high in patients with musculoskeletal pain (13,14). Patients with shoulder pain also report pain at night. As a result, they wake up frequently during the night and

Peer-Review: Double anonymized - Two External
Plagiarism Checks: Yes - intihal.net
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Selcuk University Press
Genel Tıp Dergisi | e-ISSN: 2602-3741
https://dergipark.org.tr/tr/pub/geneltip
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their sleep quality is reduced (5,7). Poor sleep quality harms the quality of life of patients and daytime activities. Identifying and treating sleep disturbance in patients with shoulder pain may contribute to better pain control and recovery (15). Despite studies in the literature investigating the cause of nocturnal shoulder pain, there is still no consensus on the underlying cause (16-18). Khazzam et al showed that female sex, depression, low back pain, diabetes, and cervical pain were associated with poor sleep quality in patients with RCD, but the extent to which these factors influence sleep quality is not known (7). Identifying the factors that disrupt sleep in shoulder pain and breaking this vicious cycle is important for treatment. Previous research has studied heterogeneous groups of patients with pain from different shoulder pathologies, regional pain outside the shoulder, and comorbidities that can disrupt sleep, such as diabetes and hypothyroidism. This makes it difficult to understand the factors that affect sleep in RCD, the most common shoulder condition.

We hypothesized that patients with rotator cuff disease would have nocturnal pain and poor sleep quality in conditions dominated by inflammatory processes, such as bursitis and tendinosis, rather than in the presence of a tear. To this aim, we investigated the effect of shoulder function and MRI findings on the presence of nocturnal pain and sleep quality in patients with rotator cuff disease.

Materials and Methods

Our study was designed as a cross-sectional clinical trial. Ethical approval was obtained from the local ethics committee (Prof. Dr. Cemil Taşcıoğlu City Hospital ethics committee approval date 21.10.24 and approval number: 184). Individuals presenting with shoulder pain to the Physical Medicine and Rehabilitation Outpatient Clinic were included in the study after evaluation of the inclusion and exclusion criteria. Written informed consent was obtained from participants and the study was conducted under the tenets of the Declaration of Helsinki.

Participants

Inclusion criteria for the study were defined as male and female patients aged 18-75 years with unilateral shoulder pain for at least three months and rotator cuff lesion on MRI of the relevant shoulder within the previous three months. Exclusion criteria were defined as traumatic shoulder pain, frozen shoulder, history of shoulder surgery, cervical radiculopathy, radicular pain or history of cervical surgery, fibromyalgia, history of malignancy, diabetes, thyroid dysfunction, morbid obesity, history of neurological or psychiatric disease, obstructive sleep apnea, and presence of glenohumeral and acromioclavicular osteoarthritis, bicipital tendinitis, capsular, labral and ligamentous lesions, calcific tendonitis and full-thickness RC tears on MRI. A detailed history was taken from patients presenting with shoulder pain. A physical examination was carried out. Demographic data (age, sex, education level, occupation), pain duration, body mass index (BMI), and MRI findings were recorded. Shoulder function and sleep quality were assessed.

The Penn Shoulder Score (PSS)

The Penn Shoulder Score (PSS) is a self-rating scale for the shoulder, validated and reliable in 2006 and adapted to Turkish in 2017 (19, 20). It consists of three subscales assessing pain, satisfaction, and function. The total score ranges from 0 to 100 points. The maximum PSS total score of 100 indicates high function, low pain, and high satisfaction with shoulder function.

Shoulder pain is assessed for three different conditions: rest (armrest next to the body), normal activity, and excessive activity. For each condition, pain is scored from 0 to 10. 0 - no pain, 10 - worst possible pain. The Penn pain subscore ranges from 0 to 30. High scores indicate severe pain. The total score is subtracted from 30 and added to the PSS (20).

Patient satisfaction with shoulder function is also rated on a scale of 0-10. 0 - not satisfied at all, 10 - very satisfied. The maximum score for this section is 10. Higher scores indicate greater patient satisfaction with current shoulder function (20).

The functioning subscale consists of 20 items, each scored on a 4-point Likert scale. It is scored as 0 - can't do it at all, 1 - very difficult, 2 - with some difficulty, and 3 - no difficulty. Each question is worth a maximum of 3 points, and if all activities can be performed without difficulty, the total score is calculated as 60 points. As some of the items in this subscale may not apply to all patients, 'did not do it before injury' is also included. For each question where this option is selected, 3 points are deducted from the maximum subscale score. The total score for the remaining questions is calculated and divided by the total possible score and multiplied by 60. For example, if a patient has a total score of 27 for the Function subscale and answered 'did not do it before injury' for 2 items, the total possible score is 54 (60-6). The final function score is calculated as 27/54=0.5, then 0.5×60=30. The patient's final Function

subscale score is 30 (20).

The Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI) is a valid and reliable tool for assessing patients' sleep quality over the past month (21). This scale consists of 19 questions and seven subcategories, each scored from 0 to 3. The total score ranges from 0 to 21, with higher scores indicating poorer sleep quality. The Turkish validity and reliability study of the PSQI was conducted by Ağargün et al. It was shown that the Turkish version has high internal consistency (Cronbach α = 0.804 for all items) (22). A PSQI total score of 5 and below indicates good sleep quality, and a score above 5 indicates poor sleep quality (22).

MRI Findings

Patients' MRI findings were reviewed using the Picture Archiving and Communication System (PACS), and shoulder MRIs were reported by a radiologist experienced in musculoskeletal MRI interpretation. The RC tendons were assessed for tendinitis and rupture, as were the subacromial-subdeltoid bursa, acromioclavicular joint, glenohumeral joint, humeral head, and biceps tendon, according to previously published literature (23). Patients were divided into three groups according to MRI findings: isolated RC tendinosis, RC tendinosis, and subacromial/subdeltoid bursitis or RC tendinosis, partial rupture, and subacromial/subdeltoid bursitis.

Statistical Analysis

Descriptive statistics were expressed as mean ± standard deviation (SD) or median (min-max) for continuous variables and as n (%) for nominal variables. The Kolmogorov-Smirnov test was used to test the normality of the data. Continuous variables were compared using the Mann-Whitney U and Kruskal-Wallis tests (with a post hoc test), as the variables had a non-normal distribution according to the normality tests. The $\chi 2$ and Fisher exact tests were used to assess differences between categorical variables. Logistic regression analysis was used to determine factors associated with poor sleep quality (dependent variable: PSQI). Age, sex, BMI, disease duration, PSS, Penn Pain Subscore, Penn Satisfaction Subscore, Penn Function Subscore, nocturnal pain, RC tendinosis, RC partial rupture, and subacromial/subdeltoid bursitis were the independent variables. Variables to be included in the binary logistic regression analysis were entered into the model using the forward selection method. The p-value was set at 0.05 for variables to be included in the model and 0.1 for variables not to be included. The Hosmer-Lemeshow test was used to test the appropriateness of the regression model. 95% confidence intervals were calculated for the odds ratio. Wald statistical analysis was used to determine the significance of the B coefficient, and $p<0.05$ was considered significant. Analyses were performed using IBM SPSS Statistics for Windows, version 23.0 (IBM Corp., Armonk, NY, USA).

Results

A total of 93 participants (70 female, 23 male) who met the inclusion criteria and did not meet the exclusion criteria were included in the study. Sex, age, education level, occupation, BMI, symptom duration, presence of nocturnal pain, PSQI, and PNS data of the participants are shown in Table 1.

Table 1. Sociodemographic, Anthropometric, and Clinical Data

Variables	n (%)	Mean ± SD
Sex: Female/Male	70 (%75.3) / 23 (%24.7)	
Age (years)		52.01 ± 11.89
Educational Level		
Illiterate	6 (%6.5)	
Literate	3 (%3.2)	
Primary School	28 (%30)	
Middle School	24 (%25.8)	
High School	26 (%28)	
University	6 (%6.5)	
Occupation		
Housewife	50 (%53.8)	
Office worker	14 (%15)	
Heavy-duty workers	29 (%31.2)	
BMI (kg/m^2)		28.14 ± 4.3
Obesity (BMI>30 kg/m^2)	29 (%31.2)	
Symptom Duration, months		9.4 ± 7.9
Night pain, present/absent	68 (%73) / 25 (%27)	
PSQI		6.7 ± 2.7
Sleep Quality		
Good sleep quality (PSQI≤5)	34 (%36.6)	
Poor Sleep Quality (PSQI>5)	59 (%63.4)	
Penn Pain Subscore		10.9 ± 5.3
Penn Satisfaction Subscore		4.5 ± 2.2
Penn Function Subscore		33.9 ± 12.3
PSS		57.5 ± 17.7

Categorical data are given as numbers (percentages), others as mean ± standard deviation (SD), BMI: Body Mass Index, PSQI: Pittsburgh Sleep Quality Index, PSS: Penn Shoulder Score.

Anthropometric and clinical data of participants according to sleep quality are shown in Table 2. No significant difference was found between those with good and poor sleep quality in terms of age, BMI, and symptom duration (p-values are 0.114, 0.469, and 0.32,

respectively). The poor sleep quality group reported more nocturnal pain and lower shoulder function scores (p-values are <0.001).

Table 2. Comparison by Anthropometric and Clinical Data According to Sleep Quality

	Sleep Quality		
	Poor Sleep Quality 59 / 63.4 (n/%)	**Good Sleep Quality 34 / 36.6 (n/%)**	**p-value**
Age (years) (mean ± SD)	53.49 ± 11.75	59.44 ± 11.85	0.114**
BMI, kg/m², (mean ± SD)	27.89 ± 3.87	28,57 ± 4.98	0.469**
Duration of Symptom (months) (mean ± SD)	10.08 ± 8.68	8.24 ± 6.25	0.32***
Obesity (BMI>30 kg/m²), (n/%)	15 / 16.1	14 / 15.1	0.114*
Presence of night pain, (n/%)	52 / 88.1	16 / 47.1	**<0.001***
PSS, (mean ± SD)	50.96 ± 17.20	68.73 ± 12.37	**<0.001*****
Penn Pain Subscore, (mean ± SD)	12.46 ± 5.42	8.24 ± 3.91	**<0.001*****
Penn Satisfaction Subscore, (mean ± SD)	3.71 ± 1.97	5.82 ± 2.01	**<0.001*****
Penn Function Subscore, (mean ± SD)	29.70 ± 12.23	41.14 ± 8.68	**<0.001*****

* χ2 test, **Independent Samples t-test, ***Mann Whitney-U Test. Categorical data are given as number (n), and others as mean ± SD or median (min-max). BMI: Body-Mass Index, PSS: Penn Shoulder Score, SD: Standard deviation

A comparison of clinical and anthropometric data of patients according to MRI findings is shown in Table 3. According to the Kruskal-Wallis test, the mean age of the group with RC tendinosis, partial rupture, and bursitis is statistically higher than the other two groups (isolated RC tendinosis, RC tendinosis, and bursitis) (Bonferroni corrected p-value is <0.001).

Binary logistic regression analysis was performed to assess factors influencing sleep quality (Table 4). The variables age, sex, BMI, symptom duration, Penn pain subscore, Penn satisfaction subscore, Penn function subscore, RC tendinosis, RC partial rupture, and subacromial/subdeltoid bursitis were not included in the model as p>0.1. After analysis, nocturnal pain and PSS were identified as risk factors for sleep disturbance (Nagelkerke R^2=0.383; Hosmer-Lemeshow=0.643). While the presence of nocturnal pain was associated with a 0.25-fold decrease in sleep quality, a one-unit increase in PSS was associated with a 1.06-fold improvement in sleep quality.

Table 3. Comparison of Anthropometric and Clinical Data According to MRI Findings

	MRI Findings			
	Tendinosis (n=27)	**Tendinosis and Bursitis (n=26)**	**Tendinosis, Bursitis, and Partial Rupture (n=40)**	**p-value**
Age (years) (min-max)	46.52 ± 11.95	48.54 ± 10.14	57.98 ± 10.33	<0.001*
BMI, kg/m²	27.67 ± 4.45	27.93 ± 4.47	28.59 ± 4.14	0.592*
Duration of Symptom (months)	8.37 ± 6.17	9.08 ± 6.01	10.33 ± 9.83	0.748*
PSQI	7.04 ± 2.74	6.96 ± 2.84	6.40 ± 2.66	0.515*
PSS	60.73 ± 15.92	56.18 ± 16.58	56.07 ± 19.71	0.555*
Penn Pain Subscore	10.41 ± 5.28	11.12 ± 5.11	11.13 ± 5.56	0.860*
Penn Satisfaction Subscore	4.70 ± 2.69	4.54 ± 1.86	4.30 ± 2.14	0.752*
Penn Function Subscore	36.43 ± 9.38	32.76 ± 12.02	32.89 ± 14.17	0.572*

*Kruskal-Wallis Test, Bonferroni corrected p-value 0.017. Data are presented as median (min-max). BMI: Body-Mass Index, PSS: Penn Shoulder Score. PSQI: Pittsburgh Sleep Quality Index

Table 4. Regression Analysis for Factors Affecting Sleep Quality

							%95 CI	
	B	**SE**	**Wald**	**df**	**p value**	**Odds Ratio**	**Lower Limit**	**Upper Limit**
Nocturnal Pain	-1.373	0.588	5.457	1	0.019	0.253	0.08	0.802
Penn Shoulder Score	0.06	0.019	10.359	1	0.001	1.061	1.024	1.101
Coefficient	-3.164	1.340	5.579	1	0.018	0.042		

CI: Confidence interval, df: Degrees of freedom, SE: Standart error

Binary logistic regression analysis was performed to assess factors influencing nocturnal pain (Table 5).

Table 5. Regression Analysis for Factors Affecting Nocturnal Pain

							%95 CI	
	B	**SE**	**Wald**	**df**	**p value**	**Odds Ratio**	**Lower Limit**	**Upper Limit**
Penn Function Subscore	-0.133	0.031	17.961	1	<0.001	0.875	0.823	0.931
Coefficient	6.024	1.303	21.376	1	<0.001	413.384		

CI: Confidence interval, df: Degrees of freedom, SE: Standart error

The variables age, sex, BMI, symptom duration, RC tendinosis, RC partial rupture, and subacromial/subdeltoid bursitis were not included in the model as p>0.1. Penn pain subscore, Penn satisfaction subscore, and Penn function subscore were included in the model because p<0.001. In the analysis, the Penn function subscale was found to be a risk factor for night pain (Nagelkerke R^2=0.380; Hosmer-Lemeshow=0.981). According to this result, a one-unit increase in the function score is associated with a 0.25-fold decrease

in nocturnal pain.

Discussion

Our study showed that the presence of nocturnal pain and poor shoulder function influenced sleep quality in patients with RCD. We found that the presence of nocturnal pain caused a 0.25-fold decrease in sleep quality, and a 1 unit increase in PSS caused a 1.06-fold increase in sleep quality.

The most common complaint reported by patients with rotator cuff syndrome is pain (5). Khazzam et al. reported nocturnal pain in 91% of patients with RC injury and Mulligan et al. reported nocturnal pain in 93% of patients (7,15). In our study, 73% of patients reported nocturnal shoulder pain. The reason for the lower nocturnal pain reported in our study compared to previous studies may be that patients with full-thickness RC rupture were not included in the study. In another study by Mengi et al, Shoulder Pain and Disability Scale (SPADI) disability and total scores, Short Form-36 physical function score, and the presence of subscapularis tendinopathy were found to be independent determinants of nocturnal pain. The same study found no association between the SPADI pain subscale and nocturnal pain (6). However, the factors associated with nocturnal pain are not fully understood in the literature. In contrast to the study by Mengi et al, we did not find a relationship between MRI findings and nocturnal pain in our study. We did not obtain data to explain the pathophysiology of nocturnal pain in our study. The PSS pain subscale assesses the severity of shoulder pain at rest (armrest next to the body), with normal activity, and with excessive activity. The PSS pain subscale may not be sensitive enough to assess nocturnal pain, but the function subscale asks about the ability to lie on the painful shoulder at night and may therefore be more sensitive to assess the presence of nocturnal pain. The results of our study support this sensitivity, but further research is needed to assess the sensitivity of these scales for nocturnal pain.

In the literature, mean PSQI scores ranged from 7.68 to 11.57 in studies evaluating sleep disturbance in shoulder pain (7-9,24,25). The inclusion of comorbidities (diabetes, depression, osteoarthritis, neck, and low back pain) in the study by Khazzam et al, the inclusion of patients with acute painful subacromial impingement syndrome in the study by Tekeoğlu et al, and the inclusion of patients with any painful shoulder pathology, including frozen shoulder, glenohumeral-acromioclavicular osteoarthritis, RC syndrome or myofascial pain syndrome in the patient group of Tombak et al. may account for the higher mean PSQI scores (7,24,25). In contrast to previous studies, we included patients with chronic unilateral shoulder pain, intact RC muscles, and no comorbidities that could cause sleep disturbance. In our study, the mean PSQI score was 6.7. The main reason for the lower PSQI scores in our study may be our patient selection criteria.

Studies have shown that there is a dynamic relationship between pain and sleep (26). A recent review reported that factors affecting sleep quality in people with RC injuries include not only the presence of nocturnal pain, but also shoulder stiffness, inability to position the arm comfortably while sleeping, and shoulder function (27). In our study, consistent with the literature, we showed that the presence of nocturnal pain and reduced shoulder function were associated with poor sleep quality. To the best of our knowledge, studies investigating the relationship between sleep quality and MRI findings in patients with shoulder pain have been performed in a patient population with RC tear. Gumina et al. reported that patients with small RC tears had poorer sleep quality than those with large and massive tears (10). Reyes et al. showed that there was no relationship between tear size and morphology and pain severity and sleep quality in patients with full-thickness RC tears (9). MRI is one of the most commonly used imaging modalities for the evaluation of painful shoulder pathology. It is clear that MRI provides important information that influences the management of RC lesions, but it is also possible to find degenerative findings on MRI in the asymptomatic population (28,29). In contrast to previous studies, we investigated the relationship between sleep quality and MRI findings in patients with RCD without a full-thickness tear. We found no association between MRI findings and poor sleep quality.

Our study has several limitations. First, our study was designed as a cross-sectional clinical study and is not sufficient to demonstrate causal relationships of sleep-related factors. Prospective studies are needed to better understand this issue. Other limitations include the lack of a control group and the use of a subjective tool, the PSQI, to assess sleep quality. Most of the participants were women, so the results of our study cannot be generalized to men. The fact that the participants were not blinded to the MRI results may have caused them to be concerned about the results

of the report. In a study like this, it would be ideal if the participants were blinded to the MRI results.

Conclusion

Nocturnal pain and poor sleep quality are common problems in patients with shoulder pain. In our study, we found that the presence of nocturnal pain and shoulder disability were risk factors for poor sleep quality. MRI findings were not associated with nocturnal shoulder pain or sleep quality in RCD. The assessment of sleep quality and nocturnal pain in patients with shoulder pain is an important issue in the management and follow-up of these patients.

Conflict of interest

The authors declare that they have no conflicts of interest.

Financial support

The authors state that no financial support has been received.

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