The Influence of Nociplastic Pain Mechanisms in Rotator Cuff Tears

A influência do componente nociplástico na gênese da dor da lesão do manguito rotador

Rafael Waldolato[1] Benno Ejnisman[2] Gustavo Waldolato[1]

[1] Orthopedics and Traumatology Department, Hospital Universitário Ciências Médicas, Belo Horizonte, MG, Brazil
[2] Department of Orthopedics and Traumatology, Universidade Federal de São Paulo, São Paulo, SP, Brazil

Address for correspondence Rafael Waldolato, MD, Serviço de Ortopedia e Traumatologia, Rua Bernardo Guimarães, 2032, Lourdes, Belo Horizonte, MG, CEP 30140-087, Brazil (e-mail: rwaldolato@hotmail.com).

Rev Bras Ortop 2026;61(4):s00461827217.

Abstract

Objective To identify individuals with a full-thickness posterosuperior rotator cuff tear who present with central pain sensitization, supporting the presence of a nociplastic pain mechanism, and to analyze the factors associated with the higher prevalence of this pattern.

Methods Descriptive and analytical cross-sectional study. Only patients diagnosed by magnetic resonance imaging demonstrating a full-thickness posterosuperior rotator cuff tear were included, excluding partial tears and full-thickness subscapularis tears. The identification of the nociplastic mechanism was performed using the Central Sensitization Questionnaire (CSI).

Results Out of a sample of 100 patients, there was a 26% prevalence of nociplastic pain. The factors associated with it were: 1) mood disorder (OR 8.29; $p = 0.020$); 2) increase in visual analog pain scale (OR 1.85; $p = 0.003$); and 3) neuropathic pain (OR 82.49; $p < 0.001$).

Conclusion Central pain mechanisms, such as central sensitization and nociplastic pain, are notably prevalent in patients with rotator cuff tears. These mechanisms are associated with psychosocial factors, pain intensity, and neurosensory symptoms, and were not directly related to the degree of structural involvement, muscle degeneration, or tear extent.

Keywords
- central nervous system sensitization
- nociplastic pain
- rotator cuff

Resumo

Objetivo Identificar os indivíduos com ruptura de espessura completa do manguito rotador póstero-superior que apresentam um estado de sensibilização central da dor sustentando a presença do componente nociplástico na gênese álgica; e analisar os fatores associados à maior prevalência desse padrão.

Métodos Estudo transversal descritivo e analítico. Foram incluídos apenas pacientes com diagnóstico por exame de ressonância magnética demonstrando lesão de espessura completa dos componentes póstero-superiores do manguito não incluindo

Palavras-chave
- dor nociplástica
- manguito rotador
- sensibilização do sistema nervoso central

Work developed at Hospital Universitário Ciências Médicas, Belo Horizonte, MG, Brazil.

received
October 2, 2025
accepted
June 16, 2026

DOI https://doi.org/10.1055/s-0046-1827217.
ISSN 0102-3616.

Editor-in-Chief: Geraldo da Rocha Motta Filho.

© 2026. The Author(s).
This is an open access article published by Thieme under the terms of the Creative Commons Attribution 4.0 International License, permitting copying and reproduction so long as the original work is given appropriate credit (https://creativecommons.org/licenses/by/4.0/)

Thieme Revinter Publicações Ltda., Rua Rego Freitas, 175, loja 1, República, São Paulo, SP, CEP 01220-010, Brazil

lesões parciais tampouco as lesões completas do subescapular. A identificação do componente nociplástico foi realizado através do Questionário de Sensibilização Central (CSI).

Resultados Amostra de 100 pacientes notando-se prevalência de 26% de dor nociplástica. Os fatores associados foram: 1) transtorno do humor (razão de chances [RC] 8 29; $p = 0$ 020); 2) o aumento na escala visual analógica da dor (RC 1.85; $p = 0$ 003); e 3) a presença de dor neuropática (RC 82.49; $p < 0001$).

Conclusão Os mecanismos centrais da dor (a sensibilização central e dor nociplástica) apresentam prevalências destacáveis nesse grupo de pacientes. Esses mecanismos estão associados a fatores psicossociais intensidade do quadro álgico e sintomas neurossensoriais e não guardam relação direta com o grau de comprometimento estrutural da lesão.

Introduction

Rotator cuff tears have a high prevalence rate in the general population,[1] and full tendon tears have a prevalence of up to 20.7%.[2] Pain is the main symptom, present in up to 98.7% of patients.[3] The main structures involved in the pain mechanism include the tendons, especially the supraspinatus tendon, and the subacromial bursa.[4] Although anatomical restoration of the rotator cuff is considered the standard treatment, a portion of these patients maintain chronic pain,[5] regardless of repair integrity. It is estimated that rotator cuff repairs show excellent results in 80 to 85% of cases,[6] and pain remains between 6.72% and 17.2%.[7] These findings indicate that pain is not solely due to nociceptor activation but also involves other pathophysiological mechanisms, in addition to structural impairment.

There are three types of pain. In nociceptive pain, a noxious stimulus triggers a response at the peripheral nerve endings.[8] Neuropathic pain corresponds to pain originating from disease or injury of the somatosensory system, characterized by symptoms such as tingling, burning, and electric shock.[8,9] And nociplastic pain is present even without clear evidence of actual or potential tissue injury, or of injury or impairment to the somatosensory system[8,10] based on central pain sensitization pathways, correlated with psychosocial factors.[8]

Despite advances in understanding pain, gaps remain in the understanding of chronic pain and unsatisfactory treatment outcomes. Most studies focus on structural aspects of the injury, while psychosocial factors remain underexplored; their relationship with central sensitization may be a key factor. Understanding these mechanisms will contribute to more effective clinical management, enabling personalized therapeutic approaches and improving patient outcomes.

Methods

The present research was approved by the Research Ethics Committee, under CAAE:63594822.6.0000.5134.

The present is a cross-sectional study conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines, with a sample of 100 patients. Inclusion and non-inclusion criteria are shown in ►**Table 1**. Posterosuperior rotator cuff partial tears (supraspinatus, infraspinatus, and teres minor) and full-thickness subscapularis tears were excluded to homogenize the sample, identifying a specific pattern of structural impairment.

Demographic data on age, sex, and upper-limb dominance were collected. Occupational activity was categorized according to the level of upper-limb demand required to perform the job and was classified as manual labor, such as a construction worker or a high-intensity upper-limb athlete; active work, such as a teacher, dentist, or housekeeper; and inactive activities, such as an administrative worker, driver, physician, or unemployed. Physical activity was classified as either active or inactive. Comorbidities were noted, emphasizing mood disorders, including previous diagnosis or recurrent use of psychotropic medications.

The symptoms evaluated were nocturnal pain (when there is intensification in this period of the day); cervical and/or shoulder myofascial pain[11]; pain at rest; passive restriction of range of motion; and pseudoparesis.[12] Magnetic resonance imaging was performed in all patients to categorize the structural impairment.

Pain intensity was reported using the Visual Analog Scale (VAS) over the previous 4 weeks to reduce bias, with categories defined as mild (VAS ≤ 3), moderate (VAS between 4–6), and intense (VAS ≥ 7). The research on neuropathic

Table 1 Inclusion and non-inclusion criteria

Inclusion	Non-inclusion
Shoulder pain	Do not want to participate
Rotator cuff tear	Non-signed Informed Consent Form
(by magnetic resonance imaging)	Posterosuperior rotator cuff partial tear
*independent of the therapeutic plan	Full-thickness subscapularis tears Previous shoulder surgeries Traumatic event Cervical involvement and radiculopathy Degenerative joint disease

symptoms was performed by applying the Douleur Neuropathique Score (DN4),[13] and the Central Sensitization Inventory (CSI) was applied to observe the central sensitization component.[14]

Qualitative variables were presented in absolute numbers and frequencies, and quantitative variables by measures of central tendency and dispersion. A 95% confidence interval was considered. Univariate analysis was employed using the Fisher's exact test. To obtain a more consistent analysis, given the interaction of different factors, a binary logistic model was applied, and the quality of the fit was assessed using the Hosmer-Lemeshow test. In all results, the significance level was 0.05.

Results

Demographic Analysis and Sample Categorization

The sample consisted of 100 patients (62 female and 38 male). The mean age was 63.4 years, and 56% were younger than 65 years. Physical activity was reported by a few participants; 23% exercised regularly. Seventy-two participants had comorbidities; systemic arterial hypertension was the most commonly reported, with 60%, and mood disorders were reported by 21 participants.

Nocturnal pain was the most reported symptom (86%), followed by myofascial pain (49%), pain at rest (44%), passive restriction (14%), and pseudoparesis (10%). The most affected tendon was the supraspinatus, in 96% of the patients, followed by the infraspinatus tear, in 43%. Sixty-one patients had Patte 1 injury. Regarding the anteroposterior dimension, medium-sized tears were the most prevalent, at 47%, followed by small tears, at 30%. Only 16% had an advanced degree (50% or more) of fatty degeneration. The demographic analysis and clinical categorization are shown in ►**Tables 2**–**3**.

Table 2 Sociodemographic categorization of the sample of 100 people

Characteristics	Analysis
Sex	
Female	62 (62.0%)
Male	38 (38.0%)
Age (years)	
Minimum/Maximum	41.0/85.0
Median [Q1; Q3]	63.0 [56.8;70.0]
Mean (DP)	63.4 (9.3)
Age group	
$<$ 65 years	56 (56.0%)
$\geq$ 65 years	44 (44.0%)
Occupation	
Active	36 (36.0%)
Manual	30 (30.0%)
Inactive	34 (34.0%)

Abbreviations: SD, standard deviation; Q1, first quartile; Q3, third quartile.

Prevalences

The prevalences of nociplastic and neuropathic pain are shown in ►**Table 4**. In the entire sample, the prevalence of neuropathic pain was 15.0% (95% CI, 9.3–23.3%), and nociplastic pain was 26.0% (18.4–35.4%). Females had a higher prevalence in both pain patterns, but that was not statistically significant. Regarding the age group, there was no distinction in nociplastic pain. Among neuropathic symptoms, electric shock had the highest prevalence, present in 30%, followed by pinprick, burning, and tingling, with 25%, 20%, and 20%, respectively.

Factors Associated with Nociplastic Pain

At baseline, as shown in ►**Table 5**, a statistically significant association with a higher prevalence of nociplastic pain was observed among patients with inactive occupational status compared with those classified as manual laborers; patients with mood disorders; those presenting myofascial pain as a symptom; those with neuropathic pain; those reporting burning pain, electric shock-like pain, tingling, pins and needles, or numbness; and those classified as having severe pain on the VAS compared with patients with mild pain. Still analyzing pain intensity, 20 patients had mild pain (mean 2.8), 51 had moderate pain (mean 5.2), and 29 had severe pain (mean 7.4). Among patients with nociplastic pain only, the mean pain intensity was 6.92, compared with 4.8 in the absence of a diagnosis.

When analyzed in the multiple model controlled by sex and age group (►**Table 6**), mood disorder (OR 8.29, $p = 0.020$), an increase in VAS score (OR 1.85, $p = 0.003$), and neuropathic pain (OR 82.49, 95% CI 12.03-1761.16, $p < 0.001$) remained as characteristics that increase the chance of pain. The model was well adjusted, as indicated by $p > 0.05$ in the Hosmer-Lemeshow test.

Discussion

The findings of the current study suggest a multifactorial pattern for pain, corroborated by Ravindra et al.,[15] who observed poor postoperative results in a sample of 93 patients, in which psychosocial factors (especially previous pain, emotional wellbeing, and opioid abuse) were more strongly associated with persistent pain after surgical repair, compared to structural factors. This mental health impairment promotes a state of cyclical feedback with hypersensitivity and perpetuation of pain, responsible for the definition of the pain pattern.[16]

Woolf [17] described the phenomenon of central sensitization by postulating that pain hypersensitivity did not come only from nociceptors, but also from a response to peripheral sensitization,[17] and changes in the central stimuli processing,[17] and became chronic pain conditions that do not fit exclusively nociceptive or neuropathic pain, such as fibromyalgia, chronic fatigue syndrome, irritable bowel syndrome, tension headache, migraine, temporomandibular

Table 3 Clinical categorization

Characteristics	Analysis
Dominance	
Left-handed	23 (23.0%)
Right-handed	77 (77.0%)
Physical activity practice	23 (23.0%)
Comorbidities	72 (72.0%)
Systemic arterial hypertension	60 (60.0%)
Diabetes mellitus	26 (26.0%)
Chronic kidney disease	5 (5.0%)
Mood disorders	21 (21.0%)
Symptoms	
Period	
0–3 months	14 (14.0%)
4–12 months	28 (28.0%)
12–36 months	31 (31.0%)
> 36 months	27 (27.0%)
Type of symptoms	
Nocturnal pain	86 (86.0%)
Myofascial pain	49 (49.0%)
Pain at rest	44 (44.0%)
Passive restriction	14 (14.0%)
Pseudoparesis	10 (10.0%)
Side of symptoms	
Right	66 (66.0%)
Left	34 (34.0%)
Tendon tear	
Supraspinatus	96 (96.0%)
Infraspinatus	43 (43.0%)
Teres minor	4 (4.0%)
Patte	
P1	61 (61.0%)
P2	20 (20.0%)
P3	19 (19.0%)
Cofield and DeOrio	
Small	30 (30.3%)
Medium	47 (47.5%)
Large	16 (16.2%)
Extensive	6 (6.1%)
Goutalier	
0	28 (28.0%)
1	32 (32.0%)
2	24 (24.0%)
3	15 (15.0%)
4	1 (1.0%)
Pain	
Electric shock	30 (30.0%)
Pins and needles	25 (25.0%)
Burning	20 (20.0%)
Tingling	20 (20.0%)
Painful cold sensation	13 (13.0%)
Numbness	12 (12.0%)
Rubbing/Friction	3 (3.0%)
Itching/Pruritus	2 (2.0%)
Hypoesthesia to touch	1 (1.00%)
Hypoesthesia to pinprick	0 (-)
Visual Analog Pain Scale	
Mild	23 (23.0%)
Moderate	50 (50.0%)
Severe	27 (27.0%)

dysfunction, myofascial pain syndrome, primary dysmenorrhea, among others, in what has come to be called central sensitivity syndrome, physiopathologically characterizing nociplastic pain.[18]

Social factors intensify this mechanism, expanding it into a biopsychosocial model for understanding chronic pain. Patients with nociplastic symptoms have, on average, higher rates of professional inactivity and social security issues.[19] This is corroborated by the current study, which demonstrated that patients with an inactive occupation (including unemployment) showed, in the univariate analysis, a correlation with nociplastic pain. A sedentary lifestyle also negatively affects the perception of pain.[20] In the present study, 23% of the sample engaged in some physical activity, and among patients with nociplastic pain, only 4 exercised regularly. The findings were not statistically significant ($p = 0.289$), although there is a tendency toward fewer nociplastic symptoms among physically active patients, consistent with the literature. Based on this unexpected finding, it is concluded that the sample size may have been insufficient for this specific factor. Another possible explanation is the sample's composition, which reflects a higher prevalence of elderly people and a significantly lower prevalence of physical activity compared with younger people.

Nocturnal pain was present in 86% of the sample, corroborating that neuroendocrine mechanisms (such as melatonin levels) act on the spread of shoulder pain,[21,22] in addition to being closely associated with sleep disorders and consequently the spread of psychosocial disorders, it deregulates the limbic system and promotes a proinflammatory state. This point aligns with the data from the present sample, in which nocturnal pain was present in 86% of patients, although no statistically significant correlation was observed ($p = 0.129$). The plausible explanation is precisely the high

Table 4 Prevalences of neuropathic and nociplastic pain for the entire sample and according to sex and age group

Characteristics and statistic	Neuropathic pain	Nociplastic pain
Total sample (100) n	15	26
Prevalence (95%CI)	15.0% (9.3–23.3%)	26.0% (18.4–35.4%)
Sex	$p = 0.154$	0.241
Female N	12	19
Prevalence (95% CI)	19.4% (11.4–30.9%)	30.7% (20.6–42.3%)
Male n	3	7
Prevalence (95% CI)	7.9% (2.7–20.8%)	18.4% (9.2–33.4%)
Age group	$p = 0.785$	0.499
$<$ 65 years N	9	13
Prevalence (95% CI)	16.1% (8.7–27.8%)	23.2% (14.1–35.6%)
$\geq$ 65 years N	6	13
Prevalence (95% CI)	13.6% (6.4–26.7%)	29.6% (18.2–44.2%)

Abbreviation: CI, confidence interval.
Note: The *p*-values refer to Fisher's exact test.

prevalence of this symptom in the entire sample, present both in patients with and without the diagnosis of nociplastic pain.

It was observed that patients with neuropathic symptoms had a higher chance of nociplastic pain, with a high association (OR = 82.49), which strongly suggests an overlap of mechanisms. Studies show that patients with chronic musculoskeletal pain often have neuropathic symptoms[10,23] without necessarily presenting damage to the somatosensory system.

The DN4 score was used to identify neuropathic-like symptoms.[13] Given the high co-occurrence of nociplastic pain and neuropathic symptoms, it is noteworthy that in central sensitization conditions, any and all neuropathic-like symptoms should be considered, regardless of the DN4 score. The CSI tool was used,[24] and not specifically for nociplastic pain. Since central sensitization is the main pathophysiological mechanism, it is useful for indirect assessment of the prevalence of nociplastic pain. Although DN4 and CSI are validated tools, they may have limitations in populations with localized musculoskeletal pain, as in this study, and the emergence of new instruments or more refined criteria would represent an important advance in clinical practice. Fifty percent of patients with severe pain were compatible with a nociplastic pain diagnosis, meaning approximately sixfold higher odds when compared to those with mild pain. Previous studies[25–27] have already shown that the intensity of preoperative pain is linked to worse postoperative outcomes, with the possibility of triggering the central pain mechanism and its negative impact being raised.

Regarding tear size, it was not possible to establish a relationship with nociplastic pain or neuropathic-like symptoms, demonstrating a dissociation between the severity of the structural impairment and pain persistence. Thus, once again, chronic rotator cuff pain is likely to stem from multifactorial interactions rather than just the degree of structural impairment.

The prevalence of central sensitization in our research (26%) is similar to that reported by Bilika et al.[28] (15.6%) in a cross-sectional study of 64 patients with shoulder pain without evident structural impairments.[28] Noten et al.[29], in a 2016 systematic review with 38 studies and 2,411 patients, identified a prevalence of 54% for some sensitization pattern, whether peripheral or central. Among those limited to central sensitization, the prevalence was 30%.[29] It is noteworthy again that the origin of shoulder pain was not specified, which included rotator cuff tendinopathies, subacromial syndrome, adhesive capsulitis, and nonspecific chronic pain. The distinguishing feature of the present study is its exclusive focus on patients with nontraumatic structural tears of the posterosuperior rotator cuff. Another strength of the present study is the simultaneous investigation of neurosensory symptoms resembling neuropathic symptoms, together with central sensitization, an aspect that remains underexplored in the literature. The conceptual imprecision between nociplastic and neuropathic pain may be one reason for this gap. Studies investigating these symptoms in patients with rotator cuff tears have reported prevalence rates ranging from 10.9 to 15.8%.[7]

Recent data demonstrate that patients with central sensitization have higher levels of pain, poorer sleep quality, and higher rates of depression and anxiety, reinforcing the importance of considering multiple domains (biological, psychological, and functional) in chronic shoulder pain. By

Table 5 Factors associated with nociplastic pain in the univariate evaluation

Characteristics	Nociplastic pain			
	No	Yes	OR (CI 95%)	*P*-value
	(*n* = 74)	(*n* = 26)		
Sex				
Female	43 (58.1%)	19 (73.1%)	1.00	–
Male	31 (41.9%)	7 (26.9%)	0.51 (0.18–1.32)	0.180
Age group				
< 65 years	43 (58.1%)	13 (50.0%)	1.00	–
≥ 65 years	31 (41.9%)	13 (50.0%)	1.39 (0.56–3.43)	0.475
Occupation				
Active	26 (35.1%)	10 (38.5%)	3.46 (0.94–16.74)	0.082
Manual	27 (36.5%)	3 (11.5%)	1.00	–
Inactive	21 (28.4%)	13 (50.0%)	5.57 (1.56–26.65)	0.015
Dominance				
Left-handed	19 (25.7%)	4 (15.4%)	1.00	–
Right-handed	55 (74.3%)	22 (84.6%)	1.90 (0.63–7.11)	0.289
Physical activity practice	19 (25.7%)	4 (15.4%)	0.53 (0.14; 1.59)	0.289
Comorbidities	51 (68.9%)	21 (80.8%)	1.89 (0.67–6.23)	0.252
Systemic arterial hypertension	43 (58.1%)	17 (65.4%)	1.36 (0.55–3.59)	0.515
Diabetes mellitus	17 (23.0%)	9 (34.6%)	1.78 (0.65–4.66)	0.248
Mood disorders	10 (13.5%)	11 (42.3%)	4.69 (1.69–13.37)	0.003
Symptoms				
Period				
0–3 months	10 (13.5%)	4 (15.4%)	1.00	–
4–12 months	19 (25.7%)	9 (34.6%)	1.18 (0.30–5.25)	0.814
12–36 months	24 (32.4%)	7 (26.9%)	0.73 (0.18–3.29)	0.666
> 36 months	21 (28.4%)	6 (23.1%)	0.71 (0.16–3.32)	0.654
Type of symptoms				
Characteristics	**Nociplastic pain**			
	No	**Yes**	**OR (CI 95%)**	***P*-value**
	(*n* = 74)	**(*n* = 26)**		
Pain at rest	31 (41.9%)	13 (50.0%)	1.39 (0.56–3.43)	0.475
Passive restriction	11 (14.9%)	3 (11.5%)	0.75 (0.16–2.65)	0.675
Pseudoparesis	7 (9.5%)	3 (11.5%)	1.25 (0.25–4.91)	0.762
Myofascial pain	30 (40.5%)	19 (73.1%)	3.98 (1.54–11.28)	0.006
Nocturnal pain	66 (89.2%)	20 (76.9%)	0.40 (0.13–1.35)	0.129
Side of symptoms				
Right	47 (63.5%)	19 (73.1%)	1.00	–
Left	27 (36.5%)	7 (26.9%)	0.64 (0.23–1.67)	0.378
Tendon tear				
Supraspinatus	71 (95.9%)	25 (96.2%)	1.06 (0.13–21.89)	0.963
Infraspinatus	32 (43.2%)	11 (42.3%)	0.96 (0.38–2.37)	0.934
Patte				
P1	46 (62.2%)	15 (57.7%)	1.00	–
P2	15 (20.3%)	5 (19.2%)	1.02 (0.29–3.16)	0.971
P3	13 (17.6%)	6 (23.1%)	1.42 (0.43–4.29)	0.547

Table 5 (*Continued*)

Characteristics	Nociplastic pain			
	No	Yes	OR (CI 95%)	*P*-value
	(*n* = 74)	(*n* = 26)		
Cofield and DeOrio				
Small	23 (31.5%)	7 (26.9%)	1.00	–
Medium	33 (45.2%)	14 (53.8%)	1.39 (0.50–4.18)	0.536
Large	13 (17.8%)	3 (11.5%)	0.76 (0.14–3.26)	0.720
Extensive	4 (5.5%)	2 (7.7%)	1.64 (0.20–10.49)	0.608
Biceps tendon abnormality	30 (40.5%)	12 (46.2%)		
Pain characteristics				
Burning	7 (9.5%)	13 (50.0%)	9.57 (3.31–30.14)	< 0.001
Painful cold sensation	7 (9.5%)	6 (23.1%)	2.87 (0.84–9.64)	0.085
Electric shock	14 (18.9%)	16 (61.5%)	6.86 (2.63–18.93)	< 0.001
Tingling	6 (8.1%)	14 (53.8%)	13.22 (4.44–44.16)	< 0.001
Pins and needles	13 (17.6%)	12 (46.2%)	4.02 (1.52–10.85)	0.005
Numbness	2 (2.7%)	10 (38.5%)	22.50 (5.31–156.09)	< 0.001
Neuropathic pain	1 (1.4%)	14 (53.8%)	85.17 (15.10–1616.46)	< 0.001
Visual Analog Pain Scale				
Mild	20 (27.0%)	3 (11.5%)	1.00	–
Moderate	40 (54.1%)	10 (38.5%)	1.67 (0.45–8.05)	0.474
Characteristics	**Nociplastic pain**			
	No	**Yes**	**OR (CI 95%)**	***P*-value**
	(*n* = 74)	**(*n* = 26)**		
Severe	14 (18.9%)	13 (50.0%)	6.19 (1.64–30.82)	0.012

Abbreviations: CI, confidence interval; OR, odds ratio.

identifying the characteristics of nociplastic pain, the focus of treatment shifts from structural interventions to a multimodal approach centered on modulating the central nervous system. This means prioritizing strategies such as pain neuroscience education, psychological counseling, progressive rehabilitation, and supervised physical exercise over invasive interventions that, in many cases, will not provide significant pain relief in these patients.

The present study has some limitations. The cross-sectional design makes it impossible to directly infer causality between the associated factors and nociplastic pain, and self-reported questionnaires are subject to bias. Notably, the prevalence of nociplastic pain was assessed indirectly using the CSI tool. On the other hand, the use of validated tools, available in a Portuguese-adapted version,[30] allows for greater cultural precision. It is also noteworthy that the structural evaluation of the tear was based exclusively on a single imaging modality, thereby reducing biases related to heterogeneity in techniques and interpretations. In addition, the sample was numerically significant, with good clinical

Table 6 Factors associated with nociplastic pain in the multiple model

Characteristics	OR (CI 95%)	*P*-value
Interceptor	0.01 (0.00–0.03)	< 0.001
Sex male (ref. female)	1.37 (0.33–5.85)	0.661
Age group ≥ 65 years (ref. < 65 years)	3.11 (0.77–15.31)	0.127
Mood disorders	8.29 (1.48–57.27)	0.020
Neuropathic pain	82.49 (12.03–1,761.16)	< 0.001
Visual Analog Pain Scale	1.85 (1.28–2.92)	0.003

Abbreviations: CI, confidence interval; OR, odds ratio.
Note: *P*-value (Hosmer-Lemeshow test) 0.888.

representation of the population treated in specialized orthopedic services and good data dispersion across clinical and sociodemographic variables, allowing for a more robust statistical analysis and the identification of reliable associations.

Conclusion

Central pain mechanisms, such as central sensitization and nociplastic pain, are notably prevalent in patients with rotator cuff tears. These mechanisms are associated with psychosocial factors, pain intensity, and neurosensory symptoms, and were not directly related to the degree of structural involvement, muscle degeneration, or extent of tear.

Data Availability

Data will be available upon request to the corresponding author.

Authors' Contributions

Each author contributed individually and significantly to the development of this article: BE and RW: conceptualization; methodology; writing – original draft; writing - revision and editing. GW: data curation, methodology, writing – original draft, writing – review & editing.

Financial Support

The authors declare that they did not receive financial support from agencies in the public, private, or non-profit sectors to conduct the present study.

Conflict of Interests

The authors have no conflict of interests to declare.

References

1 Tempelhof S, Rupp S, Seil R. Age-related prevalence of rotator cuff tears in asymptomatic shoulders. J Shoulder Elbow Surg 1999;8 (04):296–299. Doi: 10.1016/S1058-2746(99)90148-9
2 Yamamoto A, Takagishi K, Osawa T, et al. Prevalence and risk factors of a rotator cuff tear in the general population. J Shoulder Elbow Surg 2010;19(01):116–120. Doi: 10.1016/j.jse.2009.04.006
3 Itoi E. Rotator cuff tear: physical examination and conservative treatment. J Orthop Sci 2013;18(02):197–204. Doi: 10.1007/s00776-012-0345-2
4 Chillemi C, Petrozza V, Franceschini V, et al. The role of tendon and subacromial bursa in rotator cuff tear pain: a clinical and histopathological study. Knee Surg Sports Traumatol Arthrosc 2016;24 (12):3779–3786. Doi: 10.1007/s00167-015-3650-4
5 Dai X, Yuan M, Dang M, Liu D, Fei W. Development and Validation of a Predictive Model for Chronic Postsurgical Pain After Arthroscopic Rotator Cuff Repair: A Prospective Cohort Study. J Pain Res 2023;16:3273–3288. Doi: 10.2147/JPR.S423110
6 Curtis AS, Burbank KM, Tierney JJ, Scheller AD, Curran AR. The insertional footprint of the rotator cuff: an anatomic study. Arthroscopy 2006;22(06):609.e1. Doi: 10.1016/j.arthro.2006.04.001
7 Balta S, Pekince O. The relationship between neuropathic pain and the outcomes of minimally invasive pain management in rotator cuff ruptures. Medicine (Baltimore) 2023;102(45):e35940. Doi: 10.1097/MD.0000000000035940
8 Raja SN, Carr DB, Cohen M, et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. Pain 2020;161(09):1976–1982. Doi: 10.1097/j.pain.0000000000001939
9 Backonja MM. Defining neuropathic pain. Anesth Analg 2003;97 (03):785–790. Doi: 10.1213/01.ANE.0000062826.70846.8D
10 Kosek E. The concept of nociplastic pain-where to from here? Pain 2024;165(11S):S50–S57. Doi: 10.1097/j.pain.0000000000003 305
11 Steen JP, Jaiswal KS, Kumbhare D. Myofascial Pain Syndrome: An Update on Clinical Characteristics, Etiopathogenesis, Diagnosis, and Treatment. Muscle Nerve 2025;71(05):889–910. Doi: 10.1002/mus.28377
12 Tokish JM, Brinkman JC. Pseudoparalysis and Pseudoparesis of the Shoulder: Definitions, Management, and Outcomes. J Am Acad Orthop Surg 2024;32(21):965–974. Doi: 10.5435/JAAOS-D-23-00863
13 Bouhassira D, Attal N, Alchaar H, et al. Comparison of pain syndromes associated with nervous or somatic lesions and development of a new neuropathic pain diagnostic questionnaire (DN4). Pain 2005;114(1-2):29–36. Doi: 10.1016/j.pain.2004.12.010
14 Mayer TG, Neblett R, Cohen H, et al. The development and psychometric validation of the central sensitization inventory. Pain Pract 2012;12(04):276–285. Doi: 10.1111/j.1533-2500.2011.00493.x
15 Ravindra A, Barlow JD, Jones GL, Bishop JY. A prospective evaluation of predictors of pain after arthroscopic rotator cuff repair: psychosocial factors have a stronger association than structural factors. J Shoulder Elbow Surg 2018;27(10):1824–1829. Doi: 10.1016/j.jse.2018.06.019
16 Terminology | International Association for the Study of Pain. International Association for the Study of Pain (IASP) [Accessed September 1, 2025]. . Available from: https://www.iasp-pain.org/resources/terminology/
17 Woolf CJ. Evidence for a central component of post-injury pain hypersensitivity. Nature 1983;306(5944):686–688. Doi: 10.1038/306686a0
18 Yunus MB. Fibromyalgia and overlapping disorders: the unifying concept of central sensitivity syndromes. Semin Arthritis Rheum 2007;36(06):339–356. Doi: 10.1016/j.semarthrit.2006.12.009
19 Zhaoyang R, Martire LM, Darnall BD. Daily pain catastrophizing predicts less physical activity and more sedentary behavior in older adults with osteoarthritis. Pain 2020;161(11):2603–2610. Doi: 10.1097/j.pain.0000000000001959
20 Vaegter HB, Kinnunen M, Verbrugghe J, et al. Physical activity should be the primary intervention for individuals living with chronic pain A position paper from the European Pain Federation (EFIC) 'On the Move' Task Force. Eur J Pain 2024;28(08):1249–1256. Doi: 10.1002/ejp.2278
21 Ha E, Lho YM, Seo HJ, Cho CH. Melatonin Plays a Role as a Mediator of Nocturnal Pain in Patients with Shoulder Disorders. J Bone Joint Surg Am 2014;96(13):e108. Doi: 10.2106/JBJS.M.01011
22 Terabayashi N, Watanabe T, Matsumoto K, et al. Increased blood flow in the anterior humeral circumflex artery correlates with night pain in patients with rotator cuff tear. J Orthop Sci 2014;19 (05):744–749. Doi: 10.1007/s00776-014-0604-5
23 Fitzcharles MA, Cohen SP, Clauw DJ, Littlejohn G, Usui C, Häuser W. Nociplastic pain: towards an understanding of prevalent pain conditions. Lancet 2021;397(10289):2098–2110. Doi: 10.1016/S0140-6736(21)00392-5
24 Scerbo T, Colasurdo J, Dunn S, Unger J, Nijs J, Cook C. Measurement Properties of the Central Sensitization Inventory: A Systematic Review. Pain Pract 2018;18(04):544–554. Doi: 10.1111/papr.12636
25 van Boekel RLM, Warlé MC, Nielen RGC, et al. Relationship Between Postoperative Pain and Overall 30-Day Complications in a Broad Surgical Population: An Observational Study. Ann Surg 2019;269(05):856–865. Doi: 10.1097/SLA.0000000000002583

26 Lappalainen E, Ruohoaho U-M, Kokki H, et al. Postoperative pain in a prospectively assessed surgical short-stay cohort: A subgroup analysis. Acta Anaesthesiol Scand 2022;66(10):1193–1201. Doi: 10.1111/aas.14139
27 Wu F, Liu J, Zheng L, et al. Preoperative pain sensitivity and its correlation with postoperative acute and chronic pain: a systematic review and meta-analysis. Br J Anaesth 2024;133(03): 591–604. Doi: 10.1016/j.bja.2024.05.010
28 Bilika P, Nijs J, Fandridis E, Dimitriadis Z, Strimpakos N, Kapreli E. In the Shoulder or in the Brain? Behavioral, Psychosocial and Cognitive Characteristics of Unilateral Chronic Shoulder Pain with Symptoms of Central Sensitization. Healthcare (Basel) 2022;10 (09):1658. Doi: 10.3390/healthcare10091658
29 Noten S, Struyf F, Lluch E, D'Hoore M, Van Looveren E, Meeus M. Central Pain Processing in Patients with Shoulder Pain: A Review of the Literature. Pain Pract 2017;17(02):267–280. Doi: 10.1111/papr.12502
30 Andias R, Silva AG. Cross-Cultural Adaptation and Psychometric Properties of the European Portuguese Version of the Central Sensitization Inventory in Adolescents With Musculoskeletal Chronic Pain. Pain Pract 2020;20(05):480–490. Doi: 10.1111/papr.12875