Pain Medicine, 2025, **26**, 299–320
https://doi.org/10.1093/pm/pnaf023
Advance access publication 12 March 2025
Review Article

OXFORD

ACUTE, REGIONAL ANESTHESIOLOGY & PERIOPERATIVE PAIN SECTION

Preoperative management of patients with chronic moderate to severe shoulder pain to improve postoperative outcomes: A systematic review

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Abstract

Objectives: To assess if implementing interventions to effectively manage preoperative chronic moderate to severe shoulder pain in patients undergoing rotator cuff repair (RCR) can improve shoulder surgery outcomes.

Methods: A systematic review was conducted following the PRISMA and SIGN guidelines. Randomized clinical trials (RCTs), metanalysis, systematic revisions and cohort studies in Spanish/English, published within the last 10 years, evaluating interventions to control preoperative chronic moderate to severe shoulder pain in patients undergoing RCR and their impact in postoperative shoulder outcomes were included. Selected records were graded following the 2011 Oxford Centre for Evidence-Based Medicine levels of evidence (OCEBML). RCTs were graded using the PEDro scale.

Results: Twenty-nine records were included in the analysis. Evidence suggests that preoperative chronic moderate to severe shoulder pain is the strongest risk factor for postoperative shoulder pain (OCEBML III). Patient-related factors and shoulder pain characteristics can also influence surgery outcomes (OCEBML II/III). Predictors of better shoulder function at 2 years after surgery include higher preoperative scores on the Western Ontario Rotator Cuff index and the Constant-Murley score in the contralateral shoulder (OCEBML III). Preoperative analgesia to control shoulder pain can improve postoperative pain (OCEBML I). Preoperative patient teaching and intensive postoperative follow-up also improve pain intensity and function (OCEBML II).

Discussion: Preoperative chronic shoulder pain together with patient-related factors are significant predictors of postoperative shoulder outcomes, emphasizing the need for proactive pain assessment and tailored therapeutic programs.

Keywords: rotator cuff; glenohumeral joint; chronic pain; shoulder pain; postoperative outcomes.

Introduction

The glenohumeral joint is the most mobile joint of the human body, allowing a range of motion in multiple planes. Thus, injuries of the glenohumeral joint or the rotator cuff tendons stabilizing the joint result in restricted motion, causing chronic pain.[1] The prevalence of shoulder pain increases with age, being more than 20% after 70 years old.[2] Shoulder pain can last for months, impairing the functional, physical, and mental well-being of patients, as well as their capacity to work.[3]

Initial analgesic treatment should consist of a comprehensive program including physical therapy, medications such as non-steroidal anti-inflammatory drugs (NSAIDS) and joint injections.[4] When conservative treatment fails, surgery may be considered.[4] However, some patients still experience persistent dissatisfaction and pain after surgery.[5,6] Satisfaction is considered as a global measure of quality of the anesthetic-surgical process. As the result of quality care, satisfaction encompasses a set of both objective and subjective conditions, which must be measured based on the perception and expectations of users in relation to the medical care received.

Preoperative pain intensity has been identified as a strong predictive factor for postoperative pain and function,[7,8] and some studies suggest that preoperative interventions aiming to control pain intensity,[9–12] or the neuropathic component of pain[13] may improve postoperative outcomes. Nevertheless, to our knowledge, no systematic reviews focusing exclusively on the interventions to control preoperative pain have been identified.

The objective of this systematic review—conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[14] and SIGN guidelines[16]—is to investigate if preoperative interventions aiming to achieve pain control in patients with chronic moderate to severe shoulder pain who are candidates for surgery, can improve postoperative outcomes and patient satisfaction.

Received: 24 October 2024. **Revised:** 11 February 2025. **Accepted:** 23 February 2025

Methods

A scientific committee composed of 3 expert shoulder surgeons and an anesthesiologist expert in pain management was constituted. A systematic review was conducted by the committee according to the PRISMA statement[14] and SIGN guidelines,[15] aiming to find out if some interventions to achieve preoperative shoulder pain control in patients undergoing rotator cuff repair (RCR) improve surgery outcomes. The review protocol was registered at the international prospective register of systematic reviews (PROSPERO CRD42023388698; January 2023). To define study acceptability criteria and design, we used PICO model (Population, Intervention, Control and Outcome).[16] This study aimed to investigate the impact of preoperative interventions to control shoulder pain on postoperative outcomes and satisfaction levels in adult patients who are candidates for RCR surgery.

Search strategy

A systematic review—including papers in Spanish and English, published within the last 10 years, and evaluating different preoperative pain management interventions and their impact on postoperative pain results—was conducted in Embase, PubMed, and Cochrane using the search terms related to preoperative pain management and shoulder pathologies (Table S1). Two independent reviewers screened the search results. Any disagreements regarding study inclusion were resolved through discussion and consensus, with a third independent reviewer providing input if necessary.

Inclusion and exclusion criteria

Systematic reviews, meta-analysis, randomized control trials (RCTs), cohort prospective studies and cohort cross-sectional studies containing information about pre or perioperative shoulder pain intensity, shoulder function, patient satisfaction, anxiety and depression measured by standardized scales in patients ≥18 years old undergoing RCR were included. Exclusion criteria were other study types (eg, case reports, reviews, retrospective studies), other publication types (eg, letter to the editor), studies investigating acute pain, postoperative interventions and/or studies without pain evaluation or without any intervention.

The electronic databases were searched for references from April 2011 to February 2023.

Study selection

Two independent evaluators assessed publications against the eligibility criteria based on the title and/or abstract. Relevant articles from other sources identified by the Scientific Committee and considered relevant to the investigation could be added to the analysis after confirming they met eligibility criteria.

Quality assessment

Quality of evidence for the studies of interest was assessed by two independent investigators using the 2011 Oxford Centre for Evidence-Based Medicine (OCEBM) levels of evidence[17] that range from 1 to 5, 1 being the highest level of evidence and 5 the lowest level (level 1, systematic reviews of RCT or n-of-1 trials; level 2, RCT or, exceptionally, observational studies with dramatic effect; level 3, non-randomized controlled cohorts/follow-up studies; level 4, case series, case–control studies or historically controlled studies; and level 5, mechanism-based reasonings).

Quality of clinical trials included was assessed by the same investigators using the PEDro scale, which scores 10 items (random allocation, concealed allocation, similarity at baseline, subject blinding, therapist blinding, assessor blinding, >85% follow-up for at least one key outcome, intention-to-treat analysis, between-group statistical comparison for at least one key outcome, and point and variability measures for at least one key outcome) as either present (1) or absent (0) and a score out of 10 is obtained by summation.[18] An inter-rater reliability generalized kappa statistic of between 0.40 and 0.75 has been reported for the PEDro scale.[19]

Data extraction

Full-text copies of publications were included for analysis by fulfilling a preestablished extraction form with information regarding the study type, patients (N, study arms), duration of the follow-up, pain and mental status evaluation (using standardized tests), intervention, main outcomes, conclusions, OCEBM level of evidence and the PEDro score.

Doubts or disagreements regarding data-extraction were discussed until a consensus was reached, with a third author making the final decision if necessary. Missing data were requested from the authors of included studies.

Data synthesis

Data were extracted from all full-text reports by two independent reviewers. First, the information obtained was extracted to organize the data and prepare it for analysis: Year of publication, study location, sample size and characteristics, dropout rate, measurement instruments, and health outcomes. A meta-analysis of the findings was not possible due to the variety of designs and results of the included studies and the different measures used.

Results

Study selection

Search from the database returned 139 records. After removing duplicates, 103 articles were left. Titles and abstracts were screened for completion with inclusion and exclusion criteria leaving 36 records to be full text reviewed. Twenty-seven articles identified through the systematic search were included in the final analysis (Figure 1). Two additional relevant articles that met eligibility criteria (Mardani-Kivi et al., 2016;[20] Spence et al., 2011[21]) were identified after full text evaluation of Galindo-Ávalos et al., 2019[22] and included in the final analysis by the Scientific Committee (Table 1).

Characteristics of the studies included in the final analysis

Of the 29 records included, 2 were systematic reviews of RCTs (Table 2; OCEBM level I), 10 were RCTs (Table 3; OCEBM level II) and 17 were prospective cohort studies (Table 4; OCEBM level III). Both systematic reviews of RCTs included followed all PRISMA recommendations. All RCTs included had high quality, according to the PEDro score obtained (Table 5).

Pain was assessed using the numeric rating scale (NRS), Brief Pain Inventory, Visual Analogic Scale (VAS), Verbal Rating Scale (VRS), American Shoulder and Elbow Surgeons Score (ASES), Short-Form McGill Pain Questionnaire (SF-MPQ),

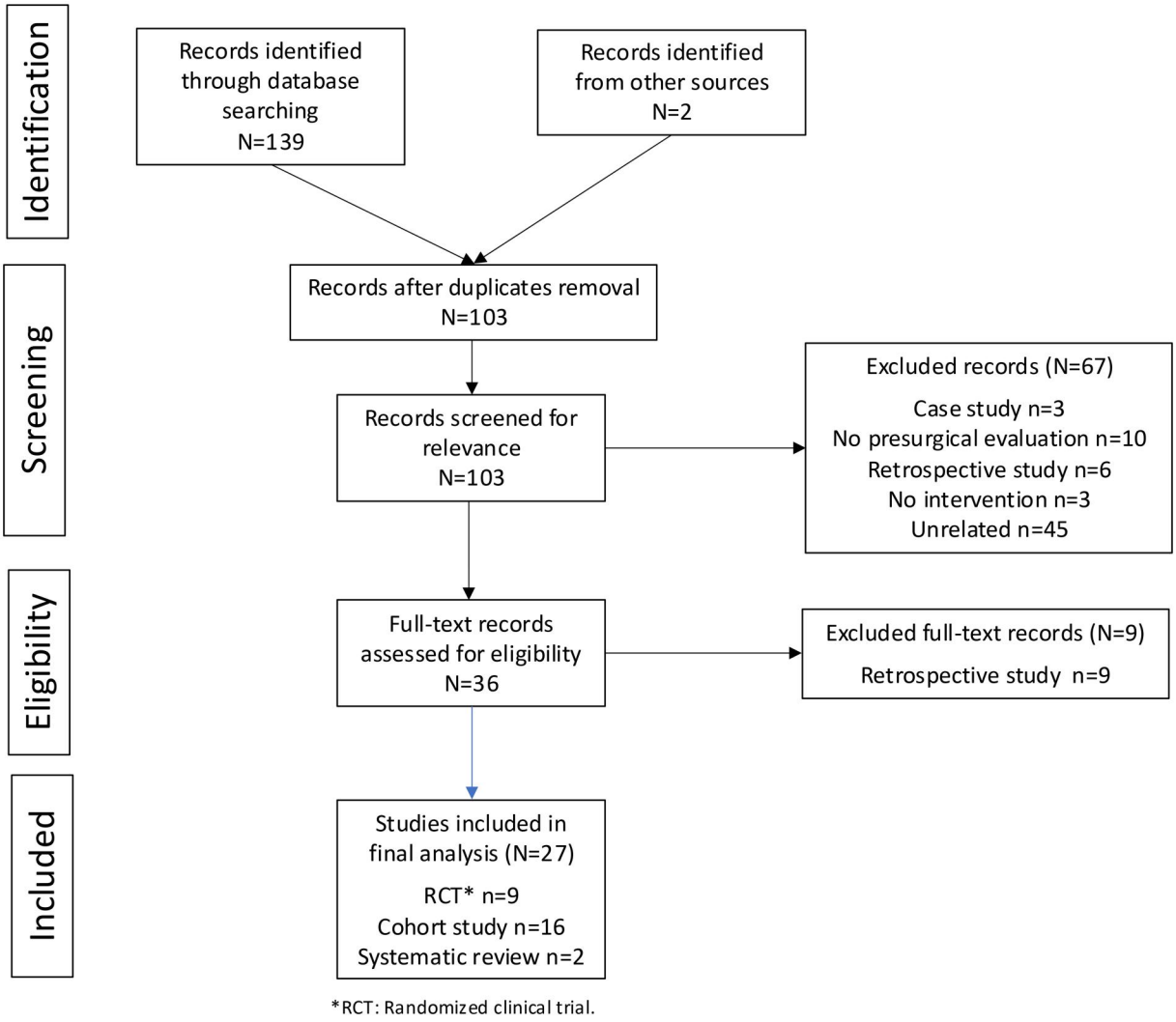

Figure 1. Flow diagram following PRISMA recommendations 2020.[15]

Simple Shoulder Test, RAND questionnaire, American Pain Society Patient Outcome (APS-POQ-R) questionnaire, Constant-Murley (CM) Test and the DN4 questionnaire.

Preoperative interventions evaluated include patient education (call center for patients, leaflet), multimodal analgesia, preoperative use of acetaminophen, NSAIDS, gabapentin, corticosteroid injections (dexamethasone + mepivacaine), opioids, perioperative interscalene block or use of tetracaine plus bupivacaine in supraclavicular brachial plexus nerve blocks.

Review of the evidence

Assessment and diagnosis of preoperative pain

Seven prospective cohort studies evaluated the impact of preoperative shoulder pain, including preoperative pain at rest, neuropathic pain, or central sensitization on postoperative outcomes after shoulder surgery (OCEBM level III).

First, Rizvi et al.,[23] in a study including 2172 patients undergoing RCR in which pain frequency and severity was measured preoperatively and 6 weeks after surgery, concluded that preoperative shoulder pain was the stronger risk factor for postoperative pain. The severity of preoperative shoulder pain at night, preoperative pain at rest, and frequency of extreme pain showed the strongest independent associations with the frequency of pain.[23] Work-related injury status, female sex, smaller tear size, and younger age were also associated with higher postoperative pain.[23] These findings are in line with those reported by Stiglitz et al.[24] in a previous prospective continuous study evaluating 231 patients after arthroscopic shoulder surgery in terms of postoperative pain intensity and associated risk factors. In addition, it reported that VAS values in patients undergoing shoulder surgery due to work accidents or occupation-related diseases were 1 to 1.3 points higher than in other patients, even 1 year after surgery.[24]

Tonotsuka et al.[12] investigated if the presence of persistent preoperative rest pain could influence shoulder surgery outcomes in 266 patients undergoing arthroscopic RCR, and found that patients in whom preoperative rest pain could be resolved before surgery showed a 2-year ASES score comparable to that of patients without preoperative rest pain. Conversely, patients with refractory preoperative rest pain obtained significantly lower scores, evidencing that preoperative rest pain control is essential for achieving positive surgical outcomes in terms of pain and performance in the activities of daily living.[12] Likewise, Kadum et al.[25] assessed the relationship between preoperative sensitivity to pain (pain electrical threshold), the degree of pain at rest and the

Table 1. Records selected for final analysis.

Reference	Study type	Authors	Title	Citation	Year	DOI or PMID
Systematic Reviews of Randomized Clinical Trials						
[23]	Syst. Review of RCTs	Galindo-Ávalos J., Colin-Vázquez A. López-Valencia J., Gómez-Gómez J.M., Bernal-Fortich L.D.	Eficacia y seguridad de la analgesia preventiva con gabapentinoides para pacientes sometidos a cirugía artroscópica de hombro: Una revisión sistemática y metanálisis	Acta Ortop Mex. 2019 Nov-Dec; 33(6):416-423.	2019	PMID: 32767888
[35]	Syst. review of RCTs Consensus document w/ recommendations	Toma O., Persoons B., Pogatzki-Zahn E, Van de Velde M., Joshi G.P.; PROSPECT Working Group collaborators.	PROSPECT guideline for rotator cuff repair surgery: Systematic review and procedure-specific postoperative pain management recommendations	Anaesthesia. 2019 Oct; 74 (10):1320-1331.	2019	10.1111/anae.14796
Randomized Clinical Trials						
[43]	RCT	Jolissaint J.E., Scarola G.T., Odum S.M., Leas D., Hamid N.; CORE Research Group.	Opioid-free shoulder arthroplasty is safe, effective, and predictable compared with a traditional perioperative opiate regimen: A randomized controlled trial of a new clinical care pathway.	J Shoulder Elbow Surg. 2022 Jul; 31(7):1499-1509.	2022	10.1016/j.jse.2021.12.015
[36]	RCT	Yang J., Wang S., Liu L., Shao Y., Wang J.	The analgesic effect and safety of preoperative versus postoperative administration of celecoxib in patients who underwent arthroscopic rotator cuff repair: A randomized, controlled study.	Inflammopharmacology. 2022 Feb; 30(1):185-191.	2022	10.1007/s10787-021-00893-w
[46]	RCT Double blind	Valeberg B.T., Dihle A., Småstuen M.C., Endresen A.O., Rustøen T.	The effects of a psycho-educational intervention to improve pain management after day surgery: A randomised clinical trial	Journal of clinical nursing (2021) 30:7-8 (1132-1143). Date of Publication: 1 Apr 2021	2021	10.1111/jocn.15659
[45]	RCT	Singh A.M., Kirsch J.M., Patel M. S., Gutman M., Harper T., Lazarus M., et al.	Effect of Perioperative Acetaminophen on Pain Management in Patients Undergoing Rotator Cuff Repair: A Prospective Randomized Study	Journal of shoulder and elbow surgery (2021). Date of Publication: 24 Mar 2021	2021	10.1016/j.jse.2021.03.132
[28]	RCT Double blind	Hah J.M., Cramer E., Hilmoe H., Schmidt P., McCue R., Trafton J., et al.	Factors Associated With Acute Pain Estimation, Postoperative Pain Resolution, Opioid Cessation, and Recovery: Secondary Analysis of a Randomized Clinical Trial	JAMA network open (2019) 2:3 (e190168). Date of Publication: 1 Mar 2019	2019	10.1001/ jamanetworkopen.2019.0168
[37]	RCT	Liu X.N., Noh Y.-M., Yang C.-J., Kim J.U., Chung M.H., Noh K.C.	Effects of a Single-Dose Interscalene Block on Pain and Stress Biomarkers in Patients Undergoing Arthroscopic Rotator Cuff Repair: A Randomized Controlled Trial	Arthroscopy—Journal of Arthroscopic and Related Surgery (2017) 33:5 (918-926). Date of Publication: 1 May 2017	2017	10.1016/j.arthro.2016.09.018
[21]	RCT Triple blind	Mardani-Kivi M., Karimi Mobarakeh M., Keyhani S., Haghighi M., Hashemi-Motlagh K., Saheb-Ekhtiari K.	Arthroscopic Bankart surgery: Does gabapentin reduce postoperative pain and opioid consumption? A triple-blinded randomized clinical trial	Orthop Traumatol Surg Res. 2016 Sep; 102(5):549-53.	2016	10.1016/j.otsr.2016.01.028.
[39]	RCT Double blind	Pearson L.T., Lowry B.P., Culp W. C. Jr., Kitchings O.E., Meyer T. A., McAllister R.K., et al.	Effect of adding tetracaine to bupivacaine on duration of analgesia in supraclavicular brachial plexus nerve blocks for ambulatory shoulder surgery	Proc (Bayl Univ Med Cent). 2015 Jul; 28(3):307-11.	2015	10.1080/08998280.2015.11929258

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Table 1. (continued)

Reference	Study type	Authors	Title	Citation	Year	DOI or PMID
[38]	RCT Double blind	DeMarco J.R., Componovo R., Barfield W.R., Liles L., Nietert P.	Efficacy of augmenting a subacromial continuous-infusion pump with a pre-operative interscalene block in outpatient arthroscopic shoulder surgery: A prospective, randomized, blinded, and placebo-controlled study	Arthroscopy—Journal of Arthroscopic and Related Surgery (2011) 27:5 (603-610). Date of Publication: May 2011	2011	10.1016/j.arthro.2011.01.003
[22]	RCT Double blind	Spence D., Goff J., Mohan E., Bowen K., Osborne L., Maye J.	Perioperative administration of gabapentin for shoulder arthroscopy: A prospective, randomized, double-blind, placebo-controlled study	AANA J. 2011 Aug; 79(4 Suppl): S43-50.	2011	PMID: 22403966
Prospective Cohort Studies						
[29]	Cohort study Prospective	Souza V.S., Ribeiro H.D.W., Machado J.C., Medeiros L.F., Castro M.S., Souza A.	Nociceptive Profile and Analgesic use of Patients Submitted to Rotator Cuff Repair Surgery: A Prospective Cohort.	Rev Bras Ortop (Sao Paulo). 2021 Mar 31; 57(5):856-862.	2021	10.1055/s-0040-1719087
[24]	Cohort study Prospective	Rizvi S.M.T., Bishop M., Lam P.H., Murrell G.A.C.	Factors Predicting Frequency and Severity of Postoperative Pain After Arthroscopic Rotator Cuff Repair Surgery	Am J Sports Med. 2021 Jan; 49 (1):146-153.	2021	10.1177/0363546520971749
[32]	Cohort study Prospective	Martusiewicz A., Khan A.Z., Chamberlain A.M., Keener J.D., Aleem A.W.	Outpatient narcotic consumption following total shoulder arthroplasty	JSES International (2020). Date of Publication: 2020	2020	10.1016/j.jses.2019.11.005
[30]	Cohort study Prospective	Morris B.J., Sheth M.M., Laughlin M.S., Elkousy H.A., Edwards T. B.	Risk Factors for Preoperative Opioid Use in Patients Undergoing Primary Anatomic Total Shoulder Arthroplasty	Orthopedics (2020) 43:6 (356-360). Date of Publication: 3 Sep 2020	2020	10.3928/01477447-20200721-12
[44]	Cohort study Prospective	Leas D.P., Connor P.M., Schiffern S.C., D'Alessandro D.F., Roberts K.M., Hamid N.	Opioid-free shoulder arthroplasty: A prospective study of a novel clinical care pathway	Journal of Shoulder and Elbow Surgery (2019) 28:9 (1716-1722). Date of Publication: 1 Sep 2019	2019	10.1016/j.jse.2019.01.013
[13]	Cohort study Prospective	Tonotsuka H., Sugaya H., Takahashi N., Kawai N., Sugiyama H., Marumo K.	Preoperative pain control in arthroscopic rotator cuff repair: Does it matter?	Clin Orthop Surg. 2019 Jun; 11 (2): 192–199. Date of Publication: 1 Jun 2019	2019	10.4055/cios.2019.11.2.192
[40]	Cohort study Prospective	YaDeau J.T., Dines D.M., Liu S.S., Gordon M.A., Goytizolo E.A., Lin Y., et al.	What Pain Levels Do TSA Patients Experience When Given a Long-acting Nerve Block and Multimodal Analgesia?	Clinical Orthopaedics and Related Research (2019) 477:3 (622-632). Date of Publication: 1 Mar 2019	2019	10.1097/CORR.0000000000000597
[41]	Cohort study Prospective	Elkassabany N.M., Wang A., Ochroch J., Mattera M., Liu J., Kuntz A.	Improved quality of recovery from ambulatory shoulder surgery after implementation of a multimodal perioperative pain management protocol	Pain Medicine (United States) (2019) 20:5 (1012-1019). Date of Publication: 2019	2019	10.1093/pm/pny152
[9]	Cohort study Prospective	Jenssen K.K., Lundgreen K., Madsen J.E., Kvakestad R., Dimmen S.	Prognostic Factors for Functional Outcome After Rotator Cuff Repair: A Prospective Cohort Study With 2-Year Follow-up	The American journal of sports medicine (2018) 46:14 (3463-3470). Date of Publication: 1 Dec 2018	2018	10.1177/0363546518803331
[26]	Cohort study Prospective	Kadum B., Inngul C., Ihrman R., Sjödén G.O., Sayed-Noor A.S.	Higher preoperative sensitivity to pain and pain at rest are associated with worse functional outcome after stemless total shoulder arthroplasty: A prospective cohort study	Bone and Joint Journal (2018) 100B : 4 (480-484). Date of Publication: 1 Apr 2018	2018	10.1302/0301-620X.100B4.BJJ-2017-1000.R1

(continued)

Table 1. (continued)

Reference	Study type	Authors	Title	Citation	Year	DOI or PMID
[14]	Cohort study Prospective	Ko S., Choi C., Kim S., Chae S., Choi W., Kwon J.	Prevalence and Risk Factors of Neuropathic Pain in Patients with a Rotator Cuff Tear	Pain Physician 2018 Mar; 21(2): E173-E180.	2018	PMID: 29565960
[34]	Cohort study Prospective	Horneff J.G., Tjoumakaris F., Wowkanech C., Pepe M., Tucker B., Austin L.	Long-term Correction in Sleep Disturbance Is Sustained After Arthroscopic Rotator Cuff Repair	The American journal of sports medicine (2017) 45:7 (1670-1675). Date of Publication: 1 Jun 2017	2017	10.1177/0363546517692551
[42]	Cohort study Prospective	Pham T.T., Bayle Iniguez X., Mansat P., Maubisson L., Bonnevialle N.	Postoperative pain after arthroscopic versus open rotator cuff repair. A prospective study	Orthopaedics and Traumatology: Surgery and Research (2016) 102:1 (13-17). Date of Publication: 1 Feb 2016	2016	10.1016/j.otsr.2015.11.005
[33]	Cohort study Prospective	Austin L., Pepe M., Tucker B., Ong A., Nugent R., Eck B., et al.	Sleep disturbance associated with rotator cuff tear: Correction with arthroscopic rotator cuff repair	The American journal of sports medicine (2015) 43:6 (1455-1459). Date of Publication: 1 Jun 2015	2015	10.1177/0363546515572769
[27]	Cohort study Prospective	Valencia C., Fillingim R.B., Bishop M., Wu S.S., Wright T.W., Moser M., et al.	Investigation of central pain processing in postoperative shoulder pain and disability	Clinical Journal of Pain (2014) 30:9 (775-786). Date of Publication: September 2014	2014	10.1097/AJP.0000000000000029
[8]	Cohort study Prospective	Desai V.N., Cheung E.V.	Postoperative pain associated with orthopedic shoulder and elbow surgery: A prospective study	Journal of Shoulder and Elbow Surgery (2012) 21:4 (441–450). Date of Publication: April 2012	2012	10.1016/j.jse.2011.09.021
[25]	Cohort study Prospective	Stiglitz Y., Gosselin O., Sedaghatian J., Sirveaux F., Molé D.	Pain after shoulder arthroscopy: A prospective study on 231 cases	Orthopaedics and Traumatology: Surgery and Research (2011) 97:3 (260-266). Date of Publication: May 2011	2011	10.1016/j.otsr.2011.02.003

Table 2. Detail of systematic reviews (SR) included in the final analysis.

SR #1	**Galindo-Ávalos et al. Eficacia y seguridad de la analgesia preventiva con gabapentinoides para pacientes sometidos a cirugía artroscópica de hombro: Una revisión sistemática y metanálisis.** ***Acta Ortop Mex. Nov-Dec 2019; 33(6):416-423.*** **doi: 10.35366/93352**
Oxford CEBM Levels of Evidence	Level 1
Type of study	Systematic review of randomized controlled trials
Duration of follow-up	24 hours
Patients	$n = 287$ patients undergoing arthroscopic shoulder surgery; mean age 43.4 years
Pain/psychological assessment	Pain: Numerical 10-point scale; opioid use
Intervention	Use of gabapentinoids vs. placebo in arthroscopic shoulder surgery
Main points	• This review included 5 randomized controlled trials. • Preoperative use of gabapentinoids was associated with a 0.77 reduction in pain scores in the 24 hours after surgery $P = .04$). • Preoperative use of gabapentinoids was associated with lower morphine equivalent use in the 24 hours after surgery: Reduction of 2.02 mg, $P = .02$. • Gabapentinoids use significantly reduced nausea and vomiting (RR = 0.60, 95% CI 0.6, 1.00, $P = .05$), but there were no significant differences in dizziness or sedation.
Conclusions	Preoperative use of gabapentinoids reduced postoperative pain, total morphine consumption, and morphine-related complications after arthroscopic shoulder surgery.
SR #2	Toma et al. PROSPECT guideline for rotator cuff repair surgery: Systematic review and procedure-specific postoperative pain management recommendations. *Anaesthesia. 2019 Oct; 74(10):1320-1331.* doi: 10.1111/anae.14796
Oxford CEBM Levels of Evidence	Level 1
Type of study	Systematic review of randomized controlled trials; consensus document with recommendations
Patients	Patients undergoing rotator cuff repair
Pain/psychological assessment	Pain: Numerical rating scale; visual analog scale
Intervention	Analgesic, anesthetic, or surgical interventions for rotator cuff repair
Main points	• This review included 59 randomized controlled trials and one systematic review. • Preoperative and intraoperative interventions that improved postoperative pain: Paracetamol, cyclooxygenase-2 inhibitors, intravenous dexamethasone, regional analgesia with interscalene or suprascapular block, and arthroscopic surgery. • Limited evidence regarding the benefit of the preoperative use of gabapentin, opioids, glucocorticoids, or α-2-adrenoceptor agonists, and the postoperative use of transcutaneous electrical nerve stimulation.
Conclusions	Pain management after arthroscopic shoulder surgery should include paracetamol and nonsteroidal anti-inflammatory drugs before or during surgery and should be administered postoperatively. An interscalene block is the preferred option for regional analgesia, and the use of intravenous dexamethasone is recommended to prolong the analgesic effect of the interscalene block. Postoperative opioid use is reserved for rescue analgesia.

degree of pain on exertion (measured by VAS) with postoperative function in 63 patients with primary osteoarthritis of the shoulder who underwent stemless total shoulder arthroplasty. All 3 parameters were recorded preoperatively, as well as at 3 and 12 months postoperatively.[25] Although pain and function improved significantly in all patients after surgery, those with a higher preoperative sensitivity to pain, a lower electrical pain threshold and higher preoperative pain at rest had more modest results.[25]

Likewise, Desai et al.[7] recorded the preoperative pain and anticipated postoperative pain of 78 patients undergoing elbow or shoulder surgery using the SF-MPQ questionnaire, finding that both preoperative and anticipated postoperative pain were independent predictors of increased postoperative pain.

The effect of central pain processing in postoperative shoulder pain and disability was investigated by Valencia et al.[26] in 78 patients with shoulder pain lasting longer than 3 months before undergoing shoulder surgery. The study concluded that baseline measures of central pain processing were not predictive of postoperative pain outcomes six months after surgery.[26]

Finally, Ko et al.[13] investigated the prevalence of the neuropathic component of pain in patients with a rotator cuff tear. The study included a cohort of 101 patients <60 years old requiring arthroscopic surgery for a full-thickness RCR, 16% of whom had neuropathic pain (as assessed by DN4).[13] The presence of neuropathic pain significantly correlated with a higher prevalence of smoking, higher VAS scores, larger cuff tears, greater medial retraction of the cuffs and more severe fatty degeneration of the rotator cuff muscles.[13] In addition, multiple logistic regression analyses showed that higher mean VAS score and greater tear size were independent variables for neuropathic pain in these patients.[13]

Assessment of shoulder function

Jenssen et al.[8] investigated the prognostic factors that predict functional outcomes after RCR in a prospective cohort study (OCEBM Level III) including 647 patients followed up for 25 months. The multivariable linear regression analysis showed that the strongest positive independent predictors of shoulder function at 2 years were, on one hand, the preoperative Western Ontario Rotator Cuff (WORC) index score, and on the other hand, the Constant-Murley score in the contralateral shoulder.[8] The model also indicated that activities of daily living, age, subacromial decompression, and biceps surgery had independent positive associations with better shoulder function 2 years after surgery, while previous surgery in the ipsilateral or contralateral shoulder, smoking, partial RCR, preoperative pain, and atrophy in the infraspinatus were all independent factors negatively associated with shoulder function at that time.[8]

Table 3. Detail of RCTs included in the final analysis.

RCT #1	Jolissaint et al. Opioid-free shoulder arthroplasty is safe, effective, and predictable compared with a traditional perioperative opiate regimen: A randomized controlled trial of a new clinical care pathway. *J Shoulder Elbow Surg. 2022 Jul; 31(7):1499-1509*. DOI 10.1016/j.jse.2021.12.015
Oxford CEBM Levels of Evidence	Level 2
PEDro	7/11
Type of study	Single-center RCT
Duration of follow-up	6 weeks
Patients	$N = 67$ who underwent shoulder arthroplasty
Pain/psychological assessment	Numeric rating scale from 0 to 10
Intervention	2 treatment arms: Either a completely opioid-free, multimodal perioperative pain management pathway (OF), or a traditional opioid-containing perioperative pain management pathway (OC).
Main points	• Pain levels were significantly lower in the OF group at 12 hours, 24 hours, and 2 weeks. • Median pain ratings were similar between the OF group and the OC group at the 6-week time point. • Of the 35 patients in the OF pathway, 1 required a rescue opioid medication for left cervical radiculopathy that ultimately necessitated cervical spine fusion after recovery from right shoulder arthroplasty, and 1 was noted to have taken an opioid medication, diverted from a prior prescription, at the 2-week visit. • The morphine milliequivalents received in the OF group was 20 compared with 4936.25 in the OC group. • There were no readmissions in the OF pathway. • No differences between the groups with regard to constipation, falls, or delirium.
Conclusions	A multimodal, opioid-free perioperative pain management pathway is safe and effective in patients undergoing total shoulder arthroplasty and offers superior pain relief to that of a traditional opioid-containing pain management pathway at 12 hours, 24 hours, and 2 weeks postoperatively.
RCT #2	Yang et al. The analgesic effect and safety of preoperative versus postoperative administration of celecoxib in patients who underwent arthroscopic rotator cuff repair: A randomized, controlled study. *Inflammopharmacology. 2022 Feb; 30(1):185-191*. DOI 10.1007/s10787-021-00893-w
Oxford CEBM Levels of Evidence	Level 2
PEDro	8/11
Type of study	RCT
Duration of follow-up	3 months
Patients	$N = 106$ patients who underwent arthroscopic rotator cuff repair
Pain/psychological assessment	
Intervention	The pain visual analog scale (VAS) score at rest or flexion, salvage consumption of pethidine, patient's satisfaction score, modified University of California at Los Angeles (UCLA) score and adverse events were evaluated.
Main points	• Following parameters were reduced in the preoperative analgesia group vs postoperative analgesia group: • Pain VAS scores at rest at 12 h and D1 (but not D2, D3, or D7). • Pain VAS scores at flexion at 12 h, D1 and D2 (but not D3 or D7). • Rescue analgesia rate. • 7-day pethidine consumption. • The overall satisfaction scores at D1 and D3 (but not at D7 or M3) were elevated in preoperative analgesia group compared to postoperative analgesia group. • No difference of modified UCLA scores at D7 or M3, or the occurrences of adverse events were found between the two groups.
Conclusions	Celecoxib preoperative administration remits acute pain and facilitates satisfaction but does not improve long-term shoulder joint function recovery compared to its postoperative administration
RCT #3	Valeberg et al. The effects of a psycho-educational intervention to improve pain management after day surgery: A randomised clinical trial. *J Clin Nurs. 2021 Apr; 30(7-8):1132-1143*. doi: 10.1111/jocn.15659
Oxford CEBM Levels of Evidence	Level 2
PEDro	7/11
Type of study	Double-blind, randomized controlled trial
Duration of follow-up	6 months
Patients	$n = 220$ patients (397 men, 250 women) with shoulder surgery or breast reconstruction; mean age 51 years. 2 groups: Control ($n = 119$) and intervention ($n = 101$)

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Table 3. (continued)

RCT #1	Jolissaint et al. Opioid-free shoulder arthroplasty is safe, effective, and predictable compared with a traditional perioperative opiate regimen: A randomized controlled trial of a new clinical care pathway. *J Shoulder Elbow Surg. 2022 Jul; 31(7):1499-1509*. DOI 10.1016/j.jse.2021.12.015
Pain/psychological assessment	Pain: Numerical rating scale (NRS)
Intervention	Pain management education for patients following rotator cuff arthroscopic surgery: Information booklet + phone coaching during the 7 postoperative days.
Main points	• There were no significant differences postoperatively between groups in terms of pain intensity with movement or pain interference with daily function. • 6 months after surgery, the pain in the intervention group was significantly better than in the control group (1.2 vs. 0.5; $P = .02$). • In each group, pain intensity and interference with daily function reduced significantly over time. • Factors associated with higher levels of pain intensity with movement and interference with daily function following surgery: Young age, being female, preoperative pain, having had previous surgery, and zero adherence to pain treatment. • The intervention group showed better adherence to pain treatment following surgery ($P < .01$): 37% of the patients adhered to treatment in the intervention group and 45% in the control group.
Conclusions	There were no significant differences in the level of pain intensity or pain interference with daily function between groups.
RCT #4	Singh et al. Effect of Perioperative Acetaminophen on Pain Management in Patients Undergoing Rotator Cuff Repair: A Prospective Randomized Study. *J Shoulder Elbow Surg. 2021 Mar 24; S1058-2746(21)00329-3*. doi: 10.1016/j.jse.2021.03.132
Oxford CEBM Levels of Evidence	Level 2
PEDro	7/11
Type of study	Double-blind, RCT
Duration of follow-up	10 months
Patients	$n = 57$ patients (32 men, 31 women); mean age 57.8 years. 3 groups: Group 1 (control): Allowed to take 5 mg oxycodone and/or 1000 mg paracetamol orally every 6 hours as needed following surgery. Group 2 (control): 5 mg oxycodone every 6 hours as needed following surgery. Group 3: 1000 mg paracetamol orally every 6 hours one day before and after surgery, and every 8 hours for postoperative days 2–5; this group was allowed to take 5 mg oxycodone every 6 hours after surgery.
Pain/psychological assessment	Pain: Scale from 0 to 100
Intervention	Primary arthroscopic rotator cuff repair and interscalene block with liposomal bupivacaine
Main points	• Group 3 used less oxycodone than the other two groups ($P = .017$). • Group 3 took fewer pills per day than the other two groups during the 7 postoperative days ($P < .05$). • Group 3 reported better pain control than the other two groups ($P = .04$). • There were no significant differences among groups regarding satisfaction with pain control nor medication-associated side effects following surgery.
Conclusions	The use of paracetamol before surgery significantly reduced the use of opioids postoperatively and improved pain control after surgery.
RCT #5	Hah et al. Factors Associated With Acute Pain Estimation, Postoperative Pain Resolution, Opioid Cessation, and Recovery: Secondary Analysis of a Randomized Clinical Trial. *JAMA Netw Open. 2019 Mar 1; 2(3):e190168*. doi: 10.1001/jamanetworkopen.2019.0168
Oxford CEBM Levels of Evidence	Level 2
PEDro	9/11
Type of study	Double-blind, RCT
Duration of follow-up	2 years after surgery
Patients	$n = 371$ patients (146 men, 225 women) with shoulder surgery ($n = 7$) or other (e.g., mastectomy, knee surgery, hip surgery); mean age 56.7 years
Pain/psychological assessment	Pain: Numeric rating scale—Brief Pain Inventory (0, no pain; 10 worst pain)
Intervention	Gabapentin (1200 mg preoperatively, 600 mg 3 times a day postoperatively) vs. active placebo (lorazepam 0.5 mg preoperatively, inactive placebo postoperatively) for 72 hours after surgery
Main points	• Patients were divided into 3 trajectories based on pain during the 10 postoperative days: High, medium, or low pain. • The mean trajectory in the high-pain subgroup was a predictor of more prolonged pain and a delay in opioid cessation. • Preoperative factors associated with high postoperative pain trajectory: Female, high preoperative pain, history of alcohol or drug use, and receiving active placebo. • The worst pain experienced on day 10 after surgery was the best predictor of time to pain resolution (HR, 0.83; 95% CI, 0.78–0.87; $P < .001$), discontinuation of opioid use (HR, 0.84; 95% CI, 0.80–0.89; $P < .001$), and complete recovery from surgery (HR, 0.91; 95% CI, 0.86–0.96; $P < .001$).

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Table 3. (continued)

RCT #1	Jolissaint et al. Opioid-free shoulder arthroplasty is safe, effective, and predictable compared with a traditional perioperative opiate regimen: A randomized controlled trial of a new clinical care pathway. *J Shoulder Elbow Surg. 2022 Jul; 31(7):1499-1509.* DOI 10.1016/j.jse.2021.12.015
Conclusions	The worst pain reported on postoperative day 10 was predictive of the time to pain resolution, discontinuation of opioid use, and full recovery post surgery.
RCT #6	Liu et al. Effects of a Single-Dose Interscalene Block on Pain and Stress Biomarkers in Patients Undergoing Arthroscopic Rotator Cuff Repair: A Randomized Controlled Trial. *Arthroscopy. 2017 May; 33(5):918-926.* doi: 10.1016/j.arthro.2016.09.018
Oxford CEBM Levels of Evidence	Level 2
PEDro	8/11
Type of study	RCT
Duration of follow-up	3 days before surgery and 66 hours post surgery
Patients	$n = 62$ patients ($n = 31$ in each group) with rotator cuff tear; 17 men, 14 women in the intervention group, 15 men and 16 women in the control group; mean age 59.7 years in the intervention group, and 56.8 years in the control group
Pain/psychological assessment	Pain: Visual Analogue Scale
Intervention	Interscalene block and general anesthesia (SISB/GA) vs. general anesthesia (GA) during rotator cuff arthroscopic surgery
Main points	• Pain was significantly less on the day of surgery in the SISB/GA group than in the GA group (2.50 vs. 3.82; $P < .001$) and especially at 6 hours after surgery (2.42 vs. 4.23; $P < .001$). • Insulin levels were significantly lower in the SISB/GA group than in the GA 42 hours after surgery (10.55 vs. 20.39; $P = .048$). • There were no significant changes among groups regarding fibrinogen or dehydroepiandrosterone sulfate over time after surgery. • There was no correlation between pain score and biomarkers in the 3 postoperative days.
Conclusions	After arthroscopic rotator cuff surgery, interscalene block was effective in relieving pain on the day of surgery and reduced insulin levels 42 hours after surgery.
RCT #7	Mardani–Kivi et al. Arthroscopic bankart surgery: Does gabapentin reduce postoperative pain and opioid consumption? A triple-blinded randomized clinical trial. *Orthop Traumatol Surg Res. 2016 Sep; 102(5):549-53.* doi: 10.1016/j.otsr.2016.01.028
Oxford CEBM Levels of Evidence	Level 2
PEDro	9/11
Type of study	Triple-blind RCT
Duration of follow-up	24 hours
Patients	$n = 76$ ($n = 38$ in each group) with a Bankart lesion and candidates for arthroscopic surgery; 11 women, 27 men in the intervention group, 8 women, 30 men in the control group; mean age 30.2 years in the intervention group, 28.3 years in the control group
Pain/psychological assessment	Pain: Visual analog scale; opioid use
Intervention	Gabapentin (600 mg) vs. paracetamol before arthroscopic Bankart surgery
Main points	• There were no significant differences between groups in terms of postoperative pain. • The group that received gabapentin used significantly fewer opioids than the control group at 6 h and 24 h after surgery ($P < .001$). • There were no significant differences in dizziness or sedation between groups. • The gabapentin group experienced significantly less nausea and vomiting 6 h after surgery ($P < .001$) but similar at 24 h.
Conclusions	A single dose of gabapentin prior to arthroscopic Bankart surgery did not reduce postoperative pain but did reduce opioid consumption.
RCT #8	Pearson et al. Effect of adding tetracaine to bupivacaine on duration of analgesia in supraclavicular brachial plexus nerve blocks for ambulatory shoulder surgery. *Proc (Bayl Univ Med Cent).* 2015 Jul; 28(3):307-11. doi: 10.1080/08998280.2015.11929258
Oxford CEBM Levels of Evidence	Level 2
PEDro	8/11
Type of study	Double-blind, RCT
Duration of follow-up	3 days
Patients	$n = 84$ ($n = 42$ in each group); 16 women, 26 men in the control group; 19 women, 23 men in the intervention group; mean age 48.7 years in control group and 54.1 years in intervention group
Pain/psychological assessment	Pain: Visual Analogue Scale (0–10)
Intervention	Addition of 1% tetracaine (or saline) to 0.25% bupivacaine for supraclavicular brachial plexus block before surgery
Main points	• Two patients in the intervention group reported a failed block. • The age of the intervention group was significantly older than that of the control group (mean age 54 vs. 48 years; $P = .04$). • Preoperative pain: Mean of 3 for both groups; postoperative pain: Mean of 1 for both groups. • There were no significant differences in the duration of analgesia between the two groups: Mean of 16.6 ± 8.3 hours in the control group and 17.1 ± 7.3 hours in the study group; $P = .69$. • In both groups, motor function recovered at 21 hours.

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Table 3. (continued)

RCT #1	**Jolissaint et al. Opioid-free shoulder arthroplasty is safe, effective, and predictable compared with a traditional perioperative opiate regimen: A randomized controlled trial of a new clinical care pathway. *J Shoulder Elbow Surg. 2022 Jul; 31(7):1499-1509*. DOI 10.1016/j.jse.2021.12.015**
Conclusions	There was no significant difference in the duration of postoperative analgesia between the group receiving 0.25% bupivacaine and the group receiving 1% tetracaine with 0.25% bupivacaine.
RCT #9	DeMarco et al. Efficacy of augmenting a subacromial continuous-infusion pump with a preoperative interscalene block in outpatient arthroscopic shoulder surgery: A prospective, randomized, blinded, and placebo-controlled study. *Arthroscopy. 2011 May; 27(5):603-10.* doi: 10.1016/j.arthro.2011.01.003
Oxford CEBM Levels of Evidence	Level 2
PEDro	8/11
Type of study	Double-blind, RCT
Duration of follow-up	80 hours post-surgery
Patients	$n = 53$ patients ($n = 28$ intervention group, $n = 25$ control group) with shoulder pain and weakness
Pain/psychological assessment	Pain: Visual analog scale; opioid use
Intervention	Interscalene block (Group 1) vs. placebo (Group 2) during shoulder arthroscopic surgery
Main points	• The pain in group 1 was significantly less than that in group 2 at 6 hours after surgery (30.9 vs. 61.8; $P = .001$). • Opioid consumption in group 1 was lower than that in group 2 at 6 hours (0.6 pills vs. 1.1 pills; $P < .1$). • Twenty hours after discharge, group 1 experienced greater pain than group 2 (61.4 vs. 48.7) but the difference was not significant. • After 20 hours, there were no significant differences in the pain experienced between the groups.
Conclusions	The addition of the interscalene block improved pain control only 6 hours after surgery, with a rebound at 20 hours, and without significant differences with the other group after 20 hours.
RCT #10	Spence et al. Perioperative administration of gabapentin for shoulder arthroscopy: A prospective, randomized, double-blind, placebo-controlled study. *AANA J. 2011 Aug; 79(4 Suppl):S43-50.*
Oxford CEBM Levels of Evidence	Level 2
PEDro	7/11
Type of study	Double-blind, RCT
Duration of follow-up	24 hours
Patients	$n = 57$ ($n = 26$ in intervention group, $n = 31$ in control group) with arthroscopic surgery; 4 women, 22 men in the intervention group, 5 women, 26 men in the control group; mean age 31.8 years in the intervention group, 31.5 years in control group
Pain/psychological assessment	Pain: Verbal numerical rating scale (0, no pain; 10, worst possible pain)
Intervention	Gabapentin (300 mg) vs. paracetamol after shoulder arthroscopy with interscalene block
Main points	There were no significant differences in postoperative pain scores between groups. The use of morphine equivalent after surgery was similar between the two groups. There were no significant differences in sleep duration or pattern between groups. There were no significant differences in adverse effects (dizziness, drowsiness) between the 2 groups
Conclusions	The use of gabapentin did not improve outcomes in patients undergoing shoulder arthroscopy with interscalene block.

Table 4. Detail of Cohort studies (CS) included in the final analysis.

CS #1	Souza et al. Nociceptive Profile and Analgesic use of Patients Submitted to Rotator Cuff Repair Surgery: A Prospective Cohort. *Rev Bras Ortop (Sao Paulo). 2021 Mar 31; 57(5):856-862.* Doi 10.1055/s-0040-1719087
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	One day before surgery, after surgery
Patients	$n = 40$ patients with rotator cuff injury and pain for >6 months.
Pain/psychological assessment	Sociodemographic Questionnaire, Functional Pain Scale, Visual Analogue Scale (VAS), Quantitative Sensory Test (QST) and Conditioned Pain Modulation Task (CPM).
Intervention	Rotator cuff repair surgery.

Main points	• Small injury patients presented significant differences after surgery compared to before surgery in:
	  • Heat QST score ($P = .015$)
	  • The humor domain ($P = .003$).
	• Compared to large injury patients, small injury patients presented a significant higher degree of catastrophism.

Conclusions	Patients with small rotator cuff injury showed higher catastrophism and humour alterations when compared to patients with large rotator cuff injury.
CS #2	Rizvi et al. Factors Predicting Frequency and Severity of Postoperative Pain After Arthroscopic Rotator Cuff Repair Surgery. *Am J Sports Med. 2021 Jan; 49 (1):146-153.* doi: 10.1177/0363546520971749
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	6 weeks after surgery
Patients	$n = 2172$ patients (1213 men, 959 women); mean age 59 years; 847 patients with partial tear, 1325 with complete tear
Pain/psychological assessment	Pain: 5 point scale (5 = most intense or frequent pain, as applicable)
Intervention	Arthroscopic Rotator Cuff Repair Surgery
Main points	• Preoperative factors associated with the frequency of pain 6 weeks after surgery: Pain intensity at night ($r = 0.33$; $P < .001$), pain at rest ($r = 0.32$; $P < .001$), and frequency of extreme pain ($r = 0.31$; $P < .001$) had a stronger association. Other associations were a reduced Gerber manoeuvre ($r = 20.21$; $P < .001$), work-related injury ($P < .001$), younger age ($P = .001$), and being female ($P = .04$). • The size of the tear was inversely correlated with the intensity of pain (R^2=0.85). • Preoperative factors associated with pain intensity 6 weeks after surgery: Preoperative pain intensity ($r = 0.35$; $P < 01$) had the strongest association; others were high stiffness ($P < .001$), poorer patient assessment of their own shoulder ($P < .001$), reduced sports activity ($P < .001$), and work-related injury ($P < .001$).
Conclusions	The magnitude and frequency of preoperative pain were the most important factors in determining postoperative pain, with a slight correlation. Patients with smaller tears experienced more post-operative pain.
CS #3	Martusiewicz et al. Outpatient narcotic consumption following total shoulder arthroplasty. *JSES Int. 2020 Jan 16; 4(1):100-104.* doi: 10.1016/j.jses.2019.11.005
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	6 weeks after surgery
Patients	$n = 50$ patients (20 men, 30 women); mean age 63.7 years
Pain/psychological assessment	Pain: Visual Analog Scale
Intervention	Arthroscopic total shoulder surgery and interscalene block, followed by use of pain medication as needed
Main points	• 24% (12/50) of patients were taking narcotics before surgery for shoulder pain. • In the 6 weeks after surgery, 26% (13/50) of patients took ≤10 oxycodone 5 mg pills; 10% (5/50) of patients did not take oxycodone. • Approximately half (26/50) of patients stopped taking oxycodone within 2 weeks after surgery. • Pain decreased significantly after surgery, reducing 45.5 points to a score of 17.8 ($P < .001$). • 86% (43/50) of patients were very satisfied with pain control. • Preoperative narcotic use and tobacco use were associated with greater postoperative narcotic use.
Conclusions	The use of 25–30 pills of oxycodone 5 mg is reasonable after arthroscopic total shoulder surgery.
CS #4	Morris et al. Risk Factors for Preoperative Opioid Use in Patients Undergoing Primary Anatomic Total Shoulder Arthroplasty. *Orthopedics. 2020 Nov 1; 43 (6):356-360.* doi: 10.3928/01477447-20200721-12

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Table 4. (continued)

CS #1	Souza et al. Nociceptive Profile and Analgesic use of Patients Submitted to Rotator Cuff Repair Surgery: A Prospective Cohort. *Rev Bras Ortop (Sao Paulo). 2021 Mar 31; 57(5):856-862.* Doi 10.1055/s-0040-1719087
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	Pre- vs post-surgery
Patients	$n = 982$ patients with glenohumeral osteoarthritis
Pain/psychological assessment	Pain: American Shoulder and Elbow Surgeons (ASES); Constant-Murley test
Intervention	Total shoulder arthroplasty
Main points	• 25.9% (254/982) of patients took opioids before surgery. • Patients with opioids use, compared to patients not taking opioids, had worse preoperative pain with the Constant test (2.8 vs. 4.0; $P < .001$) and with ASES (6.6 vs. 5.6; $P < .001$), greater difficulty in activities of daily living (6.4 vs. 7.7; $P < .001$), lower overall ASES score (30.6 vs. 38.4; $P < .001$), and lower Constant-Murley values ($P = .02$). • Factors associated with greater opioid use before surgery: Female ($P = .023$), younger age ($P = .019$), obesity ($P = .043$), chronic back pain ($P < .001$), and lower socioeconomic status ($P = .02$).
Conclusions	25.9% of patients took opioids before surgery and these had worse pain and greater difficulty in activities of daily living.
CS #5	Leas et al. Opioid-free shoulder arthroplasty: A prospective study of a novel clinical care pathway. *J Shoulder Elbow Surg. 2019 Sep; 28(9):1716-1722.* doi: 10.1016/j.jse.2019.01.013
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	2 weeks
Patients	$n = 35$ patients (17 men, 18 women); mean age 71 years
Pain/psychological assessment	Pain: Visual analog scale; ASES (American Shoulder and Elbow Surgeons); Simple Shoulder Test; RAND questionnaire
Intervention	Total shoulder arthroplasty with interescalene block; oral gabapentin and celecoxib postoperatively
Main points	• 74.3% (35/50) of patients received one or two postoperative doses of paracetamol. • Before surgery, pain was a median of 6; at 6 and 12 hours after surgery, the median pain was 0. On discharge, the pain was a median of 2. • The most pain was experienced 32 hours after surgery (median of 4) and decreased 3 days after surgery (median of 3). • Two patients received opioids postoperatively: One patient required "rescue" opioids during hospitalization, and another patient received a low-dose opioid for 2 weeks postoperatively. • There were no delirium or falls in the hospital; in the two weeks after surgery, 37.1% (13/35) of patients reported constipation and 14.3% (5/35) reported falls. • Almost all (34/35) patients reported being satisfied with pain control in the 2 weeks after surgery.
Conclusions	Multimodal pain control without opioids is safe and effective in patients after arthroscopic shoulder surgery.
CS #6	Tonotsuka et al. Preoperative pain control in arthroscopic rotator cuff repair: Does it matter? *Clin Orthop Surg.* 2019 Jun; 11(2): 192–199. doi: 10.4055/cios.2019.11.2.192
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	At least 2 years
Patients	$n = 266$ patients ($n = 273$ shoulders); 128 women, 145 men; mean age 65.2 years 3 groups: A+, patients who received several corticosteroid injections but whose pain persisted; A-, patients who received corticosteroids and whose pain disappeared before surgery; B, patients without pain, who did not receive corticosteroids
Pain/psychological assessment	Pain: ASES (American Shoulder and Elbow Surgeons Score)
Intervention	Corticosteroid injections (dexamethasone + mepivacaine) before arthroscopic rotator cuff surgery
Main points	• The preoperative ASES score was significantly lower in group A+ (33.2 ± 14.2) than groups A- (53.9 ± 11.9) and B (62.3 ± 11.2); $P < .001$ for both. • Postoperative pain was significantly higher in group A+ (35/91) than in groups A- (10/91) and B (7/91); $P < .001$ for both. • The ASES score at the end of follow-up (mean 29.6 ± 9.7 months after surgery) was significantly lower in the A+ group (92.1 ± 8.4) than in the A- groups (97.6 ± 5.4) and B (99.0 ± 2.5); $P < .001$ for both. • There were no significant differences between groups A- and B in the ASES score at the end of follow-up.

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Table 4. (continued)

CS #1	Souza et al. Nociceptive Profile and Analgesic use of Patients Submitted to Rotator Cuff Repair Surgery: A Prospective Cohort. *Rev Bras Ortop (Sao Paulo). 2021 Mar 31; 57(5):856-862.* Doi 10.1055/s-0040-1719087
Conclusions	Patients whose pain was resolved before surgery (group A-) had postoperative outcomes comparable to those of patients without preoperative pain (group B).
CS #7	YaDeau et al. What Pain Levels Do TSA Patients Experience When Given a Long-acting Nerve Block and Multimodal Analgesia? *Clin Orthop Relat Res. 2019 Mar; 477(3):622-632.* doi: 10.1097/CORR.0000000000000597
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	6 months
Patients	$n = 102$ patients (54 men, 48 women); mean age 66 years
Pain/psychological assessment	Pain: Numerical rating scale for pain at rest and on exertion (0, no pain; 10, worst possible pain)
Intervention	Total shoulder arthroplasty with interscalene block; multimodal analgesia in the postoperative period
Main points	• Preoperative pain had a median of 2 at rest and 7 on exertion. • Pain on exertion had a median of 2 on postoperative day (POD) 1, 5 on POD 3, and 3 on POD 14. • 39% (40/102) of patients reported pain on exertion ≥4 on POD 14. • Pain decreased to 0 at rest and 1 on exertion at POD 90. • Median opioid consumption was 14 mg in the first 24 hours, 30 mg on POD 3, and 0 on POD 8. • The median PainOut questionnaire score (sleep problems, nausea, itching, drowsiness) was 0 on POD 1 and POD 14. • The median Opioid-Related Symptom Distress scale score was 0.3 on POD 1.
Conclusions	The use of interscalene block and multimodal analgesia decreased pain after surgery, and limited opioid consumption to a mean of 7 days.
CS #8	Elkassabany et al. Improved quality of recovery from ambulatory shoulder surgery after implementation of a multimodal perioperative pain management protocol. *Pain Med. 2019 May 1; 20(5):1012-1019.* Doi: 10.1093/pm/pny152
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	1 week after surgery
Patients	$n = 252$ ($n = 132$ patients without multimodal management [control], $n = 120$ with multimodal management); 71 and 72 men and 61 and 48 women, respectively; mean age 51 and 54 years, respectively
Pain/psychological assessment	Pain: QoR-9 (Patient-Related Quality of Recovery Questionnaire), APS-POQ-R (American Pain Society Patient Outcome Questionnaire)
Intervention	Shoulder arthroscopy with interscalene block; multimodal analgesia preoperatively, intraoperatively, and postoperatively
Main points	• QoR-9: Significantly higher in the group with multimodal analgesia at all time points, although the minimum clinically important difference only occurred at 24 h (13.4 vs. 14.9; $P < .005$) and 48 h postoperatively (14.0 vs. 15.0; $P < .005$). • Patients who received multimodal analgesia reported better quality of pain management in terms of pain intensity, pain interference with daily activities, and sleep, and had negative feelings up to 2 days after surgery. • APS-POQ-R: Patients with multimodal management had severe pain for less time and better pain control during the 24 hours postoperatively ($P < .001$). • With the multimodal protocol, opioid consumption decreased during the 72 hours postoperatively, with a cumulative reduction of 34.4 mg (111.2 mg without multimodal management vs. 76.8 mg with multimodal management, $P < .05$).
Conclusions	The use of preoperative multimodal analgesia improved the quality of recovery and many aspects of postoperative pain, and also reduced opioid consumption.
CS #9	Jennsen et al. Prognostic Factors for Functional Outcome After Rotator Cuff Repair: A Prospective Cohort Study With 2-Year Follow-up. *Am J Sports Med. 2018 Dec; 46(14):3463–3470.* doi: 10.1177/0363546518803331
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	2-year follow-up
Patients	$n = 647$ patients (397 men, 250 women) with rotator cuff tear; mean age 58 years
Pain/psychological assessment	Pain: Visual analog scale as part of the Constant-Murley test (0, intense pain; 15, no pain)
Intervention	Arthroscopic rotator cuff surgery
Main points	• The preoperative WORC (Western Ontario Rotator Cuff) index was 44%, and 81% at the end of follow-up. • Factors associated with better shoulder function 2 years after surgery: Higher preoperative WORC and better Constant-Murley score in the contralateral shoulder were the factors with the strongest association, followed by older age, better function in daily living activities, subacromial decompression, and biceps surgery.

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Table 4. (continued)

CS #1	Souza et al. Nociceptive Profile and Analgesic use of Patients Submitted to Rotator Cuff Repair Surgery: A Prospective Cohort. *Rev Bras Ortop (Sao Paulo). 2021 Mar 31; 57(5):856-862.* Doi 10.1055/s-0040-1719087
	• Factors associated with worse shoulder function 2 years after surgery: Previous surgery on the ipsilateral or contralateral shoulder, tobacco use, preoperative pain, partial rotator cuff repair, infraspinatus atrophy. • The rotator cuff repair rate was 80%.
Conclusions	The strongest prognostic factors for a better WORC index two years after surgery were a better WORC and Constant-Murley score (in the contralateral shoulder) before surgery.
CS #10	Kadum et al. Higher preoperative sensitivity to pain and pain at rest are associated with worse functional outcome after stemless total shoulder arthroplasty: A prospective cohort study. *Bone Joint J. 2018 Apr 1; 100-B(4):480–484.* doi: 10.1302/0301-620X.100B4.BJJ-2017–1000.R1
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	1 year after surgery
Patients	$n = 63$ patients (32 men, 31 women) with primary shoulder osteoarthritis; mean age 71 years
Pain/psychological assessment	Pain: Visual analog scale for pain at rest and on exertion; QuickDASH questionnaire; Pain Matcher® unit
Intervention	Total shoulder arthroplasty
Main points	• Pain significantly decreased from preoperative state to 3 and 12 months after surgery using the visual analog scale pain score at rest or on exertion and the QuickDASH score ($P < .001$ in all cases). • Preoperative Pain Matcher threshold and pain at rest were inversely correlated with QuickDASH score at 12 months after surgery ($r \geq 0.4$; $P < .05$).
Conclusions	All patients improved their function and pain after surgery, but this improvement was less in patients with greater preoperative pain sensitivity, a lower pain threshold, and greater preoperative pain at rest.
CS #11	Ko et al. Prevalence and Risk Factors of Neuropathic Pain in Patients with a Rotator Cuff Tear. *Pain Physician. 2018 Mar; 21(2):E173-E180.*
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	4 weeks
Patients	$n = 101$ (53 men, 48 women); <60 years; with complete rotator cuff tear; shoulder pain >3 months
Pain/psychological assessment	Pain: DN4; Visual analog scale
Intervention	Arthroscopic surgery of rotator cuff
Main points	• 15.8% (16/101) of patients with a complete rotator cuff tear had neuropathic pain, according to DN4. • Compared with patients without neuropathic pain, patients with neuropathic pain had significantly: Higher smoking prevalence ($P = .042$), higher VAS in the last 4 weeks ($P = .008$), larger tear ($P = .003$), more cuff retraction ($P = .016$), greater fatty degeneration of rotator cuff muscles (supraspinatus, $P < .001$; subscapularis, $P < .001$; infraspinatus, $P = .003$). • Higher VAS in the last 4 weeks and the tear size were independent factors for neuropathic pain.
Conclusions	• 15.8% of patients with a complete rotator cuff tear had neuropathic pain, based on DN4. • A higher VAS in the last 4 weeks and the tear size were independent factors for neuropathic pain.
CS #12	Horneff et al. Long-term Correction in Sleep Disturbance Is Sustained After Arthroscopic Rotator Cuff Repair. *Am J Sports Med. 2017 Jun; 45(7):1670–1675.* doi: 10.1177/0363546517692551
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	Minimum least 2 years after surgery (followed up at a mean of 27.8 months (range, 26.5–30.6 months).
Patients	$n = 37$ patients with complete rotator cuff tear, followed-up for 2 years
Pain/psychological assessment	Pain: Visual Analogue Scale
Intervention	Arthroscopic shoulder surgery—only if the clavicular or glenohumeral joint was affected—for pain
Main points	• Improvement in PSQI (Pittsburgh Numeric Evaluation Index) did not increase significantly from 6 to 24 months postoperatively (5.5 at 6 months, 6.2 at 24 months). • 41% of patients still had sleep disturbance; before surgery, 89% had sleep disturbance. • The visual analog scale for pain and the Simple Shoulder Test improved from 6 to 24 months postoperatively, with a moderate correlation with the PSQI score. • The use of narcotics for sleeping was associated with worse sleep, and the difference in PSQI between patients taking or not taking narcotics increased with time after surgery, being greater in those taking them: A difference of 3.7 PSQI points ($P = .02$) at 6 months, and 7.4 ($P < .001$) at 24 months.

(continued)

Table 4. (continued)

CS #1	Souza et al. Nociceptive Profile and Analgesic use of Patients Submitted to Rotator Cuff Repair Surgery: A Prospective Cohort. *Rev Bras Ortop (Sao Paulo). 2021 Mar 31; 57(5):856-862.* Doi 10.1055/s-0040-1719087
Conclusions	The improvement in sleep after arthroscopic shoulder surgery was maintained at 2 years, without improving from 6 to 24 months.
CS #13	Pham et al. Postoperative pain after arthroscopic versus open rotator cuff repair. A prospective study. *Orthop Traumatol Surg Res. 2016 Feb; 102(1):13–7.* doi: 10.1016/j.otsr.2015.11.005
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	6 weeks post-surgery
Patients	$n = 95$ patients who underwent rotator cuff surgery ($n = 45$ arthroscopy, group A; $n = 50$ open, group O)
Pain/psychological assessment	Pain: Visual Analogue Scale
Intervention	Shoulder surgery
Main points	• Preoperative pain levels were higher in group A than in group O (6.5 vs. 5.4 points; $P = .005$). • The level of pain in the 6 weeks postoperatively was equivalent in the two groups ($P = .22$). • ≥4 weeks after surgery, group A used more second-step analgesics than group O ($P = .01$). • During 6 weeks after surgery, 75% of group A and 66% of group B reported no shoulder pain ($P = .34$). • Preoperative and postoperative pain were positively correlated ($R = 0.25$; $P = .02$). • Patients with a tear of 1 or more tendons used more third-step analgesics ($P = .001$).
Conclusions	No surgery was superior to the other in terms of postoperative pain
CS #14	Austin et al. Sleep disturbance associated with rotator cuff tear: Correction with arthroscopic rotator cuff repair. *Am J Sports Med. 2015 Jun; 43(6):1455–9.* doi: 10.1177/0363546515572769
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	24 weeks
Patients	$n = 56$ patients (27 men, 29 women) with complete rotator cuff tear; mean age 59.8 years
Pain/psychological assessment	Pain: Visual Analogue Scale
Intervention	Shoulder arthroscopy
Main points	• The improvement in PSQI (Pittsburgh Numeric Evaluation Index) increased significantly from the preoperative level (11.7) to 6 months after surgery (6.0 points; $P < .018$). • At 3 months, 31% of patients achieved normal sleep (PSQI ≤5), and at 6 months, 62%. • 41% of patients still had sleep disturbance; before surgery, 89% had sleep disturbance. • Visual analog pain scale and the Simple Shoulder Test improved from 6 to 24 months postoperatively, with moderate correlation with PSQI score. • Preoperative use of narcotics for sleep was associated with worse sleep after surgery (12, 18, and 24 weeks) ($P < .001$). • Prolonged narcotic use after surgery (12, 18, and 24 weeks) was associated with worse sleep ($P < .001$).
Conclusions	Arthroscopic surgery improved patients' sleep, although narcotic use both before and after surgery negatively affected sleep.
CS #15	Valencia et al. Investigation of central pain processing in postoperative shoulder pain and disability. *Clin J Pain. 2014 Sep; 30(9):775–86.* doi: 10.1097/AJP.0000000000000029
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	6 months after surgery
Patients	$n = 77$ patients for disability assessment ($n = 73$ for pain assessment)
Pain/psychological assessment	Pain: Numerical rating scale; BPI (Brief Pain Inventory). Psychological: PHQ-9 (Patient Health Questionnaire); PCS (Pain Catastrophizing Scale)
Intervention	Arthroscopic shoulder surgery—only if the clavicular or glenohumeral joint was affected—for pain
Main points	• 6 months after surgery, 81% of patients noted improvement in pain intensity. • There were no significant differences in baseline values between patients who had pain or not, nor between those whose degree of disability improved or not. • Comparing patients whose degree of disability or pain improved or not, the only significant difference was found in pain at the fifth stimulus of 50°C. • There were no significant differences between groups regarding psychological evaluation with PHQ-9 or PCS. • The change in response to suprathreshold heat pain response (SHPR) 3 months after surgery was a predictor of pain intensity at 6 months and degree of disability.

(continued)

Table 4. (continued)

CS #1	Souza et al. Nociceptive Profile and Analgesic use of Patients Submitted to Rotator Cuff Repair Surgery: A Prospective Cohort. *Rev Bras Ortop (Sao Paulo). 2021 Mar 31; 57(5):856-862.* Doi 10.1055/s-0040-1719087
Conclusions	Change in central pain processing 3 months after surgery may be an important factor in the transition to severe pain and disability 6 months after surgery.
CS #16	Desai et al. Postoperative pain associated with orthopedic shoulder and elbow surgery: A prospective study. *J Shoulder Elbow Surg. 2012 Apr; 21(4):441–50.* doi: 10.1016/j.jse.2011.09.021
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	6 weeks
Patients	$n = 78$ patients (39 men, 39 women) who underwent shoulder or elbow surgery ($n = 39$ in each group); mean age 51 years
Pain/psychological assessment	Pain: SF-MPQ (Short-Form McGill Pain Questionnaire), visual analog scale from 0 to 10.5
Intervention	Shoulder or elbow arthroscopic surgery
Main points	• Patient-reported preoperative pain (PP) and anticipated postoperative pain (APP) were predictors of postoperative pain. • The APP was greater than the postoperative pain at day 3 and 6 weeks (4.9, 3.2, and 1.6, respectively, on the visual analog scale; 14.1, 9.4, and 2.5 on the sensory indicators of the SF-MPQ; and 2.5, 1.5 and 0.2 in the affective indicators of the SF-MPQ). • Postoperative pain was significantly greater in patients with higher PP and APP. • The APP was greater than the postoperative pain, which in turn decreased from day 3 after surgery to 6 weeks after.
Conclusions	Patient-reported PP and APP were predictive of postoperative pain, and surgeons should take them into account in pain management.
CS #17	Stiglitz et al. Pain after shoulder arthroscopy: A prospective study on 231 cases. *Orthop Traumatol Surg Res. 2011 May; 97(3):260–6.* doi: 10.1016/j.otsr.2011.02.003
Oxford CEBM Levels of Evidence	Level 3
Type of study	Prospective cohort study
Duration of the follow-up	1 year
Patients	$n = 231$ patients (82 men, 118 women); mean age 56.1 years
Pain/psychological assessment	Pain: Visual Analog Scale
Intervention	Shoulder arthroscopic surgery
Main points	• Pain on the day of surgery was lower (2.2) than preoperative pain (2.9), then rebounded on days 1 (2.8) and 2 (3.3) and decreased at 30 days (2.2) and a year later (1.2). • 83.9% of patients were very satisfied with the pain after surgery. • Patients with the most preoperative pain were those with decompression arthroscopy (3.5), followed by reconstructive arthroscopy (2.6), or arthroscopy for instability (1.0). • Considering the types of arthroscopy, only decompression arthroscopy achieved significantly less pain one year after surgery compared to preoperative pain (2.4 and 3.5, respectively). • Patients with reconstructive arthroscopy used more morphine after surgery. • Postoperative pain was greater in men than in women and in patients with a work-related injury.
Conclusions	Arthroscopic surgery achieved good pain management, which was maintained for a year.

Table 5. Quality of RCTs evaluated using the PEDro scale.

	Items evaluated											
	1	2	3	4	5	6	7	8	9	10	11	Score
Jolissaint et al.[42] (2022)	x	x	x	x				x		x	x	7/11
Yang et al. (2022)	x	x		x			x	x	x	x	x	8/11
Valeberg et al. (2021)	x	x		x			x	x		x	x	7/11
Singh et al.[36] (2021)	x	x	x	x				x		x	x	7/11
Hah et al.[25] (2019)	x	x	x	x	x	x	x	x		x	x	9/11
Liu et al. (2017)	x	x		x			x	x	x	x	x	8/11
Mardani-Kivi et al.[18] (2016)	x	x	x	x	x	x	x	x		x	x	9/11
Pearson et al. (2015)	x	x	x	x	x	x	x			x	x	8/11
DeMarco et al. (2011)	x	x	x	x	x		x	x	x		x	8/11
Spence et al.[19] (2011)	x	x	x	x	x		x	x		x	x	7/11

1. Eligibility criteria were specified (*does not count on the total); 2. Subjects were randomly allocated to groups; 3. Allocation was concealed; 4. The groups were similar at baseline regarding the most important prognostic indicators; 5. There was blinding of all subjects; 6. There was blinding of all therapists who administered the therapy; 7. There was blinding of all assessors who measured at least one key outcome; 8. Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups; 9. All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analyzed by "intention to treat"; 10. The results of between-group statistical comparisons are reported for at least one key outcome; 11. the study provides both point measures and measures of variability for at least one key outcome.

Assessment of psychosocial aspects

The preoperative use of narcotics has been investigated in one RCT (OCEBM Level II) and six prospective cohort studies (OCEBM Level III) included in the review.

First, Hah et al.[27] analyzed, in a double-blind RCT, 371 patients undergoing different types of surgery (only 7 of them undergoing shoulder arthroplasty or arthroscopy) and randomized to receive gabapentin pre- and postoperatively or active placebo (lorazepam preoperatively and placebo postoperatively) for 72 hours. Average pain trajectories during the first 10 postoperative days were compared among individuals, identifying a cluster of patients with low pain and another with high pain, being this latter one predictive of prolonged pain and delayed opioid cessation (by Cox proportional hazards regression).[27] Preoperative risk factors for the high pain cluster were female sex, elevated preoperative pain, a history of alcohol or drug abuse treatment, and receiving active placebo.[27] Worst pain reported on postoperative day 10 was the best predictor of time to pain resolution, opioid cessation, and complete surgical recovery.[27]

The remaining cohort studies focused on patients undergoing shoulder surgery. Souza et al.,[28] in a prospective cohort study that included 40 patients with either small or large rotator cuff injuries, demonstrated that those with small injuries experienced higher levels of pain preoperatively than those with larger injuries, and this was associated with higher opioid consumption, catastrophism and humor alterations postoperatively compared to those with larger injuries. Morris et al.[29] investigated the risk factors for preoperative opioid use in another cohort study including 982 patients undergoing total shoulder arthroplasty for primary glenohumeral joint osteoarthritis, 26% of whom were taking preoperative opioids for shoulder pain. Female sex, younger age, obesity, chronic back pain, and lower socioeconomic status were significantly associated with increased preoperative opioid use following multivariate logistic regression.[29] Convoy et al.[30] demonstrated that patients with opioid use exhibited significantly worse preoperative pain scores ($P < .001$), ASES scores ($P < .001$), and total CM scores ($P < .002$), which define the level of pain and the ability to carry out normal daily activities, as compared to the non-opioid group. Martusiewicz et al.[31] evaluated the postoperative outpatient narcotic consumption in a cohort of 50 patients undergoing primary total shoulder arthroplasty. Multivariate regression found that preoperative narcotic exposure was associated with an increased consumption of morphine equivalent units 6 weeks after surgery ($P = .004$).[31] On the other hand, older age was identified as a protective factor for narcotic consumption.[31] Austin et al.[32] enrolled 56 patients, 86% of them with sleep problems—as assessed by the Pittsburgh Sleep Quality Index (PSQI)—to study whether arthroscopic RCR for full-thickness tears improved sleep disturbance. Patients were assessed preoperatively and postoperatively up to 6 months.[32] A statistically significant improvement in PSQI was achieved 3 months after surgery ($P = .0012$) and continued through 6 months ($P = .0179$). A multivariable linear regression of surgical and demographic factors versus PSQI scores demonstrated that preoperative and prolonged postoperative narcotic use negatively affected sleep.[32] Horneff et al.[33] reported in an extension study that the significant improvement of the PSQI score, recorded 6 months after surgery, was maintained through 24 months. However, 41% of the patients still displayed PSQI scores >5, indicative of sleep disturbance.[33] Function and pain (as assessed by the Simple Shoulder Test and VAS, respectively) continued to improve during the follow-up, showing a moderate strength correlation with the PSQI score.[33] Regression models again demonstrated a strong association between the use of narcotic pain medication and poor sleep.[33]

Therapeutic approaches

Preoperative interventions

Our review identified only one guideline—PROSPECT guideline—with recommendations for optimal patient management before RCR, which was elaborated following a systematic revision of RCTs (OCEBM Level I).[34] Therapeutic preoperative interventions recommended to improve postoperative shoulder pain include acetaminophen, cyclo-oxygenase-2 inhibitors, and intravenous dexamethasone.

Yang et al.[35] investigated the optimal timing for celecoxib administration in an RCT including 106 patients who were candidates for shoulder surgery (OCEBM Level II). Patients were randomized to receive celecoxib either before or after arthroscopic RCR and VAS scores at rest of flexion were recorded, as well as patients' satisfaction and modified University of California at Los Angeles (UCLA) score. Results demonstrated that the preoperative administration of celecoxib lowered acute pain and improved patient satisfaction.[35] Nevertheless, long-term shoulder function recovery showed a stronger association with postoperative celecoxib administration.[35]

Perioperative interventions

The PROSPECT guideline also provides recommendations on perioperative interventions to improve postoperative shoulder pain, which include interscalene block or suprascapular nerve block (with or without axillary nerve block).[34] These recommendations are in line with the findings of several RCTs included in our review regarding the perioperative

use of interscalene block[36–38] and implemented in different degrees in multimodal analgesia protocols reported in prospective studies.[39,40]

Pham et al.,[41] in a cohort study (OCEBM Level III) included in our review evaluating 95 patients who underwent RCR by either arthroscopy or open surgery, concluded that arthroscopy did not significantly improve pain intensity compared to open surgery (OCEBM Level III).

Conflicting evidence was found for perioperative use of gabapentin. Mardani-Kivi et al.,[20] in an RCT including 76 patients undergoing shoulder Bankart arthroscopy and who were randomized to receive either 600 mg of gabapentin or placebo perioperatively, conclude that the preemptive use of gabapentin compared to placebo did not significantly decrease pain intensity after surgery, although it decreased opioid consumption (OCEBM Level II). Spence et al.[21]—in a prospective RCT of 70 patients randomized to receive either 300 mg of gabapentin or placebo before undergoing shoulder arthroscopy—found similar results showing that gabapentin at that dose was not efficacious in improving pain intensity or opioid consumption (OCEBM Level II). Conversely, Galindo-Ávalos et al.,[22] in a systematic review including 5 RCTs comparing gabapentinoids (gabapentin and pregabalin at dosages from 1500 to 1200 mg per day) with placebo in patients undergoing shoulder arthroscopic surgery, concluded that its use was associated with reduced pain scores 24 hours postoperatively (OCEBM Level I). However, that reduction was of 0.77 in the VAS scale, which may not be clinically relevant.[22]

Jolissaint et al. in an RCT ($N = 67$, OCEBM Level II) and Leas et al.[42,43] in a prospective cohort study ($N = 35$, OCEBM Level III) investigated the feasibility of an entirely opioid-free perioperative management of patients, showing that it was a safe and effective option in properly selected patients, although some patients might require postoperative rescue opioids.

Singh et al.,[44] in an RCT including 57 patients undergoing RCR that were randomized to receive either oxycodone plus acetaminophen postoperatively (every 6 hours) or acetaminophen with or without oxycodone 1 day before surgery and postoperatively (every 8 hours), demonstrated that the perioperative use of acetaminophen significantly decreased opioid consumption and improved overall pain control (OCEBM Level II).

Psycho-educational interventions, such as preoperative teaching and an intense postoperative follow-up, have also proven to improve shoulder pain intensity and pain interference with shoulder function[45] (OCEBM Level II). Nevertheless, to be effective, preoperative teaching about pain and pain management should be conducted for a few minutes on the day before surgery, and ideally involving a family member.[45]

Discussion

Our research inquiry formulated following the PICO methodology (Population, Intervention, Comparator, Outcomes),[16] aimed to investigate whether adult patients who are candidates for RCR surgery and received preoperative interventions to control shoulder pain, demonstrated better postoperative outcomes and higher levels of satisfaction with the surgery. The review identified 30 records assessing this topic. The strongest evidence was found for studies evaluating therapeutic approaches, while evidence the lowest evidence was that supporting the assessment of shoulder pain and function, as well as psychosocial aspects.

Altogether, the evidence reviewed underscored the importance of effectively controlling preoperative shoulder pain in patients who are candidates for RCR. In fact, preoperative shoulder pain is a predictor of postoperative shoulder pain, and several studies have consistently identified preoperative shoulder pain-related factors independently associated with worse surgery outcomes.[7,12,23–25] Thus, the severity of preoperative pain at night,[23] frequency of extreme pain,[23] higher sensitivity to pain,[25] presence of pain at rest,[12,23,25] lower electrical pain thresholds[25] and anticipated postoperative pain[7] are associated with higher postoperative pain levels and frequency and poorer shoulder function after surgery.[8] Other factors such as work-related injuries, female sex, smaller tear size, and younger age were also identified as contributing to higher postoperative pain levels[23,24] (OCEBM Level II and III).

These results indicate that thorough evaluation of preoperative shoulder pain intensity serves as a critical component in the comprehensive care of patients undergoing shoulder surgery, especially due to its predictive value in postoperative outcomes. Preoperative chronic pain assessment should be performed using standardized tools, such as the VAS, NRS, or VRS scales or SF-MPQ questionnaire, among others, to ensure an accurate and reliable evaluation, enabling longitudinal tracking of pain outcomes through the patient follow-up.[46] A comprehensive preoperative pain assessment is important because it facilitates the implementation of evidence-based and tailored interventions thorough the identification of high-risk individuals who may experience elevated levels of postoperative pain, thus optimizing analgesic interventions, and setting realistic patient expectations.[19,41]

It has been described that about 16% of patients with rotator cuff tears may have neuropathic pain.[13] Smokers and those with higher VAS scores, larger cuff tears, greater medial retraction of cuffs or more severe fatty degeneration of the rotator cuff muscles are more likely to present neuropathic pain[13] (OCEBM Level III). Therefore, surgeons should be vigilant when facing those patient profiles and use DN4 questionnaire to confirm or rule out a neuropathic component of pain that would require specific analgesic treatment.[47]

Regarding shoulder function after RCR, preoperative WORC index, which records signs, symptoms and limitations associated with rotator cuff diseases, and preoperative Constant-Murley score in the contralateral shoulder, were the strongest prognostic factors for increased WORC index at 2-year follow-up (OCEBM Level III), as usually rotator cuff tears reflect the degenerative disease affecting both shoulders.[8] Previous surgery in the ipsilateral or contralateral shoulder, smoking, partial RCR, preoperative pain and atrophy in the infraspinatus were all independent factors negatively associated with functional outcomes (OCEBM Level III). Although not all these factors are modifiable, proper selection of patients may lead to successful functional surgery outcomes.[8]

High preoperative pain levels and worse preoperative functional scores have been associated with higher opioid consumption, catastrophism, and humor alterations postoperatively (OCEBM Level III).[27,28] Conversely, older age is reported as a protective factor for narcotic consumption (OCEBM Level III).[31] Sleep disturbance has been

reported in patients with rotator cuff tears, and although it generally improves after surgery, preoperative and prolonged postoperative narcotic use negatively impacts sleep (OCEBM Level III).[32,33] While both pain intensity and opioid use are associated with sleep disturbances, opioid dependence can affect sleep architecture independently. Sleep disturbance may even be a motivation for opioid consumption.[48] Therefore, when possible, counseling patients to discontinue narcotics before surgery and as soon as possible after surgery may improve sleep problems.[32]

This systematic review only identified one guideline—PROSPECT—focused on postoperative pain management.[34] Nevertheless, it includes some recommendations in line with the evidence reviewed, such as preoperative administration of acetaminophen, cyclo-oxygenase-2 inhibitors and intravenous dexamethasone and perioperative interscalene block or suprascapular nerve block, to improve postoperative shoulder pain (OCEBM Level I). It also highlights the limited evidence regarding the perioperative use of gabapentin. PROSPECT guideline recommends an arthroscopic approach over mini-open repair of rotator cuff tears (Grade B). Our review only identified one cohort study in this regard which found no differences between arthroscopic and open surgery in terms of postoperative shoulder pain level.[41]

Psycho-educational interventions, such as preoperative teaching and thorough postoperative follow-up, have demonstrated to improve pain intensity and minimize the impact of pain on shoulder function in several RCTs (OCEBM Level II).[49–51] Nevertheless, to be effective, preoperative teaching about pain and pain management should be conducted a few minutes or the day before surgery, and ideally involving a family member.[34]

This review has several limitations, such as the scarcity of available studies answering our PICO question and the relatively low level of evidence provided by the identified works. Despite these limitations, a notable strength lies in the direction of focusing the postoperative pain management strategy toward the preoperative period.

Conclusions

In conclusion, the evidence reviewed unveils preoperative chronic moderate to severe shoulder pain as the strongest risk factor for postoperative shoulder pain. Patient-related factors (work-related shoulder injury, female sex, smaller tear size, younger age, history of alcohol or drug abuse) and shoulder pain characteristics (anticipated pain, electrical pain threshold, frequency of extreme pain, refractory pain at rest) are significant predictors of postoperative pain intensity, frequency, and shoulder function, emphasizing the need for proactive pain assessment/function and management strategies. Thus, implementation of tailored evidence-based treatment programs may help improve patient outcomes. Those may be accompanied by psycho-educational interventions such as patient education, and an intense postoperative follow-up.

In summary, optimizing preoperative shoulder pain management, considering psychosocial factors, and tailoring therapeutic approaches to individual patient needs could be key elements in enhancing postoperative shoulder outcomes and overall patient satisfaction in shoulder surgery. These findings provide valuable insights for healthcare professionals in their efforts to improve the well-being and deliver a holistic care to individuals undergoing shoulder surgical procedures.

Acknowledgments

The authors thank Anna Nualart and Raquel Lloris from VML HEALTH for providing editorial services.

Supplementary material

Supplementary material is available at *Pain Medicine* online.

Funding

Esteve Pharmaceuticals SA supported the logistical aspects of the study and editorial services.

Conflicts of interest: All authors participated in scientific programs sponsored by Esteve Pharmaceuticals SA. The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Data availability

The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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https://doi.org/10.1093/pm/pnaf023
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