



Original Research Article

Association Between Preoperative Anxiety And Postoperative Pain Following Third-Molar Surgery: A Prospective Observational Study.

Name of Author:

Dr. Shreyas Orvakonde^{1*}, Dr. Bidyalaxmi Mutum², Dr. Benoy Jacob³, Dr. Anjali Valsa Rajan⁴

Affiliation:

¹Assistant Professor, Department of Dentistry, Chamarajanagar Institute of Medical Sciences, Yadapura, Chamarajanagar, Karnataka, India. drshre890@gmail.com

²Lecturer, JSS Dental College and Hospital, SS Nagar, Bannimantap, Mysuru, Karnataka, India. drbidyalaxmi890@jssuni.edu.in

³Private Practitioner, Kerala, India. drbensdentalcare@gmail.com

⁴Private Practitioner, Kerala, India. anjalivrb@gmail.com

Corresponding Author: Dr. Shreyas Orvakonde.

Email: drshre890@gmail.com

Received: 02. 01. 2026

Revised: 10. 01. 2026

Accepted: 20. 01. 2026

Published: 30. 01. 2026

Abstract: Background: Postoperative pain following mandibular third-molar surgery varies considerably between individuals despite comparable surgical procedures. Preoperative dental anxiety may contribute to this variability. Aim: To evaluate the association between preoperative dental anxiety and postoperative pain following surgical removal of impacted mandibular third molars. **Materials and Methods:** This prospective observational study included 80 adults undergoing surgical removal of a unilateral impacted mandibular third molar under local anesthesia. Preoperative anxiety was assessed using the Modified Dental Anxiety Scale (MDAS). Postoperative pain was measured using a 0–10 visual analogue scale (VAS) at 6, 24, 48, and 72 hours. Surgical characteristics and analgesic consumption were recorded. Correlation and multivariable regression analyses were used to evaluate the association between anxiety and postoperative pain. **Results:** The mean MDAS score was 12.4 ± 4.2 . Mean VAS scores decreased from 5.8 ± 1.7 at 6 hours to 2.1 ± 1.3 at 72 hours ($P < 0.001$). MDAS demonstrated positive correlations with pain at 6 hours ($r = 0.46$, $P < 0.001$), 24 hours ($r = 0.51$, $P < 0.001$), 48 hours ($r = 0.34$, $P = 0.002$), and 72 hours ($r = 0.25$, $P = 0.026$). Patients with severe anxiety had greater analgesic consumption than those with lower anxiety ($P = 0.003$). Preoperative MDAS remained independently associated with 24-hour pain after adjustment for demographic and operative variables ($P < 0.001$). **Conclusion:** Greater preoperative dental anxiety was associated with increased early postoperative pain following mandibular third-molar surgery. Preoperative anxiety screening may assist in identifying patients at risk of greater postoperative discomfort.

Keywords: Dental anxiety; Mandibular third molar; Postoperative pain; Tooth extraction; Visual analogue scale

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INTRODUCTION

Surgical removal of impacted third molars is one of the most commonly performed dentoalveolar surgical procedures. Although usually undertaken as an outpatient procedure, third-molar surgery produces predictable tissue trauma and an acute inflammatory response that may result in pain, facial swelling, trismus, and impairment of normal daily activities. Among these postoperative sequelae, pain remains one of the principal concerns for patients and an important determinant of perceived quality of postoperative recovery [1,2].

Postoperative pain following mandibular third-molar surgery is typically most pronounced during the early postoperative period and subsequently declines as tissue healing progresses. Nevertheless, the intensity and duration of pain vary substantially between individuals. Surgical difficulty, duration of surgery, extent of bone removal, tooth sectioning, age, anatomical position of the tooth, and local inflammatory factors have all been implicated in determining postoperative pain [2,3]. Longer and technically more difficult operations have generally been associated with greater postoperative morbidity, although operative factors alone do not completely explain the substantial variability in pain

reported by patients undergoing apparently similar procedures [3,4].

Pain is not determined exclusively by the magnitude of tissue injury. It represents a multidimensional experience influenced by biological, psychological, cognitive, and contextual factors. Consequently, patients exposed to similar surgical stimuli may report markedly different pain intensities. A systematic review of predictors of postoperative pain identified preoperative anxiety, pre-existing pain, age, and type of surgery among significant predictors of postoperative pain, supporting the importance of psychological variables in perioperative pain assessment [5].

Dental anxiety is particularly relevant in oral surgical practice. It encompasses apprehension, fear, or heightened emotional arousal associated with dental treatment and may range from mild uneasiness to severe anxiety capable of interfering with treatment. Procedures involving local anesthetic injection, surgical instrumentation, bone removal, and anticipation of postoperative discomfort may be particularly anxiety provoking. Third-molar surgery therefore provides an appropriate clinical model for investigating interactions between anxiety and acute postoperative pain.

Several instruments have been developed for measuring dental anxiety. The Modified Dental Anxiety Scale (MDAS), developed from the Corah Dental Anxiety Scale, is a brief five-item instrument that incorporates anxiety associated with local anesthetic injection. Each item is scored from 1 to 5, producing an overall score ranging from 5 to 25, with increasing scores indicating increasing dental anxiety [6]. Its simplicity and ease of administration make it particularly suitable for routine clinical research immediately before dental procedures.

The possible relationship between preoperative anxiety and postoperative recovery after third-molar surgery has attracted increasing attention. Lago-Méndez et al. evaluated anxiety and postoperative recovery following lower third-molar removal and observed that patients with high trait anxiety experienced greater postoperative pain, while increased dental anxiety was associated with poorer aspects of postoperative recovery [7]. Another prospective investigation examining state and trait anxiety demonstrated that anxiety contributed to postoperative pain and analgesic consumption following third-molar surgery [8].

Rudin et al. investigated psychological and psychophysiological predictors of postoperative pain following mandibular third-molar surgery. Their findings demonstrated that psychological vulnerability, in combination with experimental pain perception, could explain part of the variation in postoperative pain, reinforcing the concept that psychological characteristics contribute to individual differences in postsurgical pain responses [9].

However, the available literature has not been entirely consistent. Onwuka et al. investigated 60 patients undergoing impacted mandibular third-molar surgery and found no statistically significant correlation between preoperative dental anxiety measured using the MDAS and postoperative pain during the seven-day follow-up period [10]. Similarly, other investigations have suggested that preoperative nociceptive sensitivity or surgical factors may be stronger determinants of postoperative pain than dental anxiety itself [11].

Conversely, Xu and Xia evaluated 136 patients undergoing impacted third-molar extraction and demonstrated a significant positive correlation between dental anxiety and pain on the first postoperative day ($r=0.542$, $P<0.001$) [12]. Their findings are clinically important because they suggest that the influence of anxiety may be greatest during the acute postoperative phase rather than throughout the entire recovery period. More recently, prospective evidence has continued to indicate relationships between preoperative dental anxiety and postoperative symptom severity following lower third-molar surgery, even after consideration of clinical and surgical variables [13].

Preoperative communication may also modify this relationship. Akomolafe et al., in a randomized study of patients undergoing mandibular third-molar extraction, demonstrated that the method used to provide preoperative information influenced anxiety levels, although postoperative pain progressively decreased in both study groups [14]. Similarly, interventions intended to reduce perioperative anxiety, including music-based strategies, have been investigated in third-molar surgery, suggesting increasing interest in psychological modification as an adjunct to conventional perioperative management [15].

These findings indicate that the relationship between anxiety and postoperative pain is complex. Differences among previous studies may be attributable to the anxiety instrument used, timing of assessment, postoperative pain measurement, analgesic protocols, surgical difficulty, patient characteristics, and statistical adjustment for confounding factors. Operative complexity deserves particular consideration because increased surgical difficulty and longer operating time are independently associated with greater pain after mandibular third-molar removal [3,4]. Failure to account for such variables may therefore exaggerate or obscure the relationship between anxiety and postoperative pain.

Identification of anxiety as an independent and potentially modifiable predictor of postoperative pain would have practical implications. Anxiety assessment is inexpensive, non-invasive, and readily incorporated into preoperative evaluation. Patients with elevated anxiety could potentially benefit from enhanced counselling, expectation management, behavioural interventions, or

appropriately individualized perioperative analgesic strategies. Conversely, establishing that surgical rather than psychological factors predominantly determine postoperative pain would also improve risk stratification and patient counselling.

Therefore, the present prospective observational study was designed to evaluate the association between preoperative dental anxiety and postoperative pain following surgical removal of impacted mandibular third molars. In addition, the study aimed to determine whether preoperative anxiety remained associated with postoperative pain after accounting for relevant demographic and operative variables.

AIM

To evaluate the association between preoperative dental anxiety and postoperative pain following surgical removal of impacted mandibular third molars.

OBJECTIVES

1. To assess the level of dental anxiety before mandibular third-molar surgery using the Modified Dental Anxiety Scale.
2. To determine postoperative pain intensity at predetermined intervals following surgery.
3. To evaluate the correlation between preoperative MDAS score and postoperative VAS pain scores.
4. To compare postoperative pain and analgesic consumption across different levels of preoperative dental anxiety.
5. To determine whether preoperative dental anxiety independently predicts postoperative pain after controlling for relevant demographic and surgical variables.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study included adult patients undergoing surgical removal of an impacted mandibular third molar in the Department of Oral and Maxillofacial Surgery. Patients presenting for third-molar surgery were consecutively assessed for eligibility. The study evaluated the association between preoperative dental anxiety and postoperative pain following mandibular third-molar surgery.

The study protocol was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrolment. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Study Population

Adult patients requiring surgical removal of a single unilateral impacted mandibular third molar under local anesthesia were screened for participation. A total of 86 patients were assessed for eligibility. Six were excluded because of failure to meet the eligibility criteria or incomplete postoperative follow-up, leaving 80 participants for the final analysis.

Inclusion Criteria

Patients aged 18–40 years who required surgical removal of a unilateral impacted mandibular third molar were eligible. Participants were required to have American Society of Anesthesiologists physical status I or II, be capable of understanding and completing the anxiety and postoperative pain assessment scales, and provide written informed consent.

Exclusion Criteria

Patients were excluded if they had an acute infection at the surgical site, a chronic pain disorder, or regular use of analgesics, corticosteroids, sedatives, anxiolytics, or antidepressants. Other exclusion criteria were a history of psychiatric illness likely to interfere with anxiety assessment, pregnancy or lactation, known allergy or contraindication to medications used during treatment, multiple dental extractions during the same surgical appointment, and inability to complete postoperative follow-up.

Preoperative Assessment

A detailed medical and dental history was obtained before surgery. Demographic and clinical variables, including age, sex, previous dental extraction experience, history of previous third-molar surgery, and relevant clinical characteristics, were recorded.

Preoperative radiographs were evaluated for the position and anatomical characteristics of the impacted mandibular third molar. Angulation was categorized according to Winter's classification. The relationship of the tooth to the anterior border of the ramus and the depth of impaction were assessed according to the Pell and Gregory classification.

Assessment of Preoperative Dental Anxiety

Preoperative dental anxiety was assessed immediately before surgery using the Modified Dental Anxiety Scale (MDAS) [6]. The MDAS consists of five questions assessing anxiety related to an anticipated dental visit, waiting for dental treatment, drilling, scaling, and local anesthetic injection. Each item is scored from 1 to 5, providing a total score ranging from 5 to 25, with higher scores representing greater dental anxiety.

For descriptive and subgroup analyses, participants were classified into three categories according to their MDAS scores: low anxiety (5–9), moderate anxiety (10–18), and severe anxiety (≥ 19). The total MDAS score was retained as a continuous variable for correlation and multivariable regression analyses.

Surgical Procedure

All surgical procedures were performed under standardized aseptic conditions using local anesthesia. An inferior alveolar nerve block, lingual nerve block, and buccal nerve infiltration were administered according to the institutional anesthetic protocol.

After confirmation of adequate anesthesia, a mucoperiosteal flap was raised to provide surgical

access. Bone removal was performed as required according to the position and depth of impaction. Tooth sectioning was undertaken when necessary to facilitate removal while minimizing surgical trauma. The impacted tooth was delivered using appropriate elevators and/or forceps. Following extraction, the socket was inspected, irrigated with sterile saline, and the surgical wound was closed with sutures.

The duration of surgery was recorded in minutes from the initial incision to placement of the final suture. Bone removal and tooth sectioning were documented because these operative characteristics could influence postoperative pain and were therefore considered potential confounding variables.

Postoperative Medication and Analgesic Consumption

All participants received a standardized postoperative analgesic regimen according to the institutional protocol. Participants were instructed to follow the prescribed medication schedule and to avoid additional analgesics other than the designated rescue medication.

Rescue analgesic consumption was recorded during the first 72 postoperative hours. The total number of rescue analgesic tablets consumed by each participant was used for analysis. Analgesic consumption was additionally compared across the predefined MDAS anxiety categories.

Assessment of Postoperative Pain

Postoperative pain intensity was assessed using a 0–10 pain scale, with 0 representing no pain and 10 representing the worst imaginable pain. Participants were instructed in the use of the scale before leaving the department.

Pain intensity was recorded at four predefined postoperative intervals: 6 hours, 24 hours, 48 hours, and 72 hours. The 24-hour postoperative pain score was designated as the principal postoperative pain outcome because it represented the early postoperative period during which the relationship between preoperative anxiety and acute postoperative pain was of primary interest.

Postoperative pain assessments were documented using a standardized follow-up record. The repeated measurements permitted evaluation of both the association between anxiety and pain at individual time points and the temporal pattern of pain during the first 72 hours after surgery.

Outcome Measures

The primary outcome was the association between preoperative MDAS score and postoperative pain

intensity, with the 24-hour postoperative pain score serving as the principal pain endpoint.

Secondary outcomes included the correlations between preoperative MDAS score and pain scores at 6, 48, and 72 hours; differences in postoperative pain across low-, moderate-, and severe-anxiety categories; postoperative rescue analgesic consumption; and the association of demographic and operative characteristics with postoperative pain.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 26.0. Continuous variables were assessed for distributional characteristics and summarized as mean $\pm$ standard deviation when approximately normally distributed. Categorical variables were presented as frequencies and percentages. Differences in continuous variables between two independent groups were assessed using the independent-samples *t* test when parametric assumptions were satisfied. Comparisons of continuous outcomes among the three anxiety categories were performed using one-way analysis of variance (ANOVA). Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate.

The relationship between the continuous preoperative MDAS score and postoperative pain at 6, 24, 48, and 72 hours was evaluated using Pearson's correlation coefficient. Correlation coefficients (*r*) with 95% confidence intervals were reported.

Changes in postoperative pain across the four assessment intervals were analyzed using repeated-measures analysis, accounting for the within-participant nature of the serial pain measurements.

A multivariable linear regression model was constructed with the 24-hour postoperative pain score as the dependent variable. Preoperative MDAS score was the principal explanatory variable. Age, sex, duration of surgery, tooth sectioning, and impaction difficulty were included as covariates to evaluate whether preoperative anxiety remained associated with postoperative pain after adjustment for demographic and operative characteristics. Unstandardized regression coefficients (*B*) with 95% confidence intervals and standardized regression coefficients (β) were reported separately. Model assumptions and multicollinearity were assessed before interpretation. Model fit was expressed using the adjusted R^2 .

All statistical tests were two-tailed, and a *P* value <0.05 was considered statistically significant.

RESULTS

Participant Characteristics

A total of 86 patients scheduled for surgical removal of an impacted mandibular third molar were assessed for eligibility. Six patients were excluded because they did not fulfil the predefined eligibility criteria or had incomplete postoperative follow-up. Thus, **80 patients were included in the final analysis.**

The mean age of the participants was **26.8 ± 5.4 years**, with an age range of 18–40 years. Of the 80 participants, 34 (42.5%) were males and 46 (57.5%) were females. Mesioangular impaction was the most frequent angulation, observed in 32 (40.0%) patients, followed by horizontal impaction in 22 (27.5%), vertical impaction in 18 (22.5%), and distoangular impaction in 8 (10.0%).

The mean duration of surgery was **31.6 ± 9.8 minutes**. Bone removal alone was required in 29 (36.3%) patients, while both bone removal and tooth sectioning were required in 51 (63.7%). The demographic and operative characteristics are summarized in Table 1.

Table 1. Demographic and clinical characteristics of the study participants (n=80)

Variable	Value
Age (years), mean ± SD	26.8 ± 5.4
Sex, n (%)	
Male	34 (42.5)
Female	46 (57.5)
Side of impaction, n (%)	
Right	38 (47.5)
Left	42 (52.5)
Winter's classification, n (%)	
Mesioangular	32 (40.0)
Horizontal	22 (27.5)
Vertical	18 (22.5)
Distoangular	8 (10.0)
Pell and Gregory ramus relationship, n (%)	
Class I	27 (33.8)
Class II	39 (48.8)
Class III	14 (17.5)
Duration of surgery (min), mean ± SD	31.6 ± 9.8
Surgical procedure, n (%)	
Bone removal without tooth sectioning	29 (36.3)
Bone removal with tooth sectioning	51 (63.7)

Distribution of Preoperative Dental Anxiety

The mean preoperative MDAS score was **12.4 ± 4.2**, indicating that appreciable dental anxiety was present in the study population. Based on the predefined categories, 25 (31.3%) participants had low anxiety, 45 (56.3%) had moderate anxiety, and 10 (12.5%) had severe anxiety.

Females demonstrated a higher mean MDAS score than males (**13.3 ± 4.1 vs. 11.2 ± 4.0**), and this difference was statistically significant ($P=0.024$). Previous experience of dental extraction was associated with lower anxiety scores compared with patients without previous extraction experience ($P=0.031$).

Table 2. Distribution of preoperative dental anxiety according to MDAS

MDAS category	Score range	n (%)	MDAS, mean ± SD
Low anxiety	5–9	25 (31.3)	7.6 ± 1.2
Moderate anxiety	10–18	45 (56.3)	13.2 ± 2.4
Severe anxiety	≥19	10 (12.5)	20.8 ± 1.5
Overall	5–25	80 (100)	12.4 ± 4.2

The predominance of moderate anxiety is clinically plausible. For comparison, Xu and Xia reported moderate anxiety in 56.6% and severe anxiety in 6.6% of 136 patients undergoing impacted third-molar extraction, although differences in patient populations and classification thresholds should be considered.

Postoperative Pain

Postoperative pain was highest during the initial postoperative period and progressively declined thereafter. The mean VAS pain score was **5.8 ± 1.7 at 6 hours**, decreasing to **4.9 ± 1.6 at 24 hours**, **3.4 ± 1.5 at 48 hours**, and **2.1 ± 1.3 at 72 hours**. Repeated-measures analysis demonstrated a significant reduction in pain across the four postoperative assessment periods ($P<0.001$).

Table 3. Postoperative VAS pain scores according to assessment time

Postoperative interval	VAS score, mean $\pm$ SD	Median (IQR)
6 hours	5.8 $\pm$ 1.7	6.0 (5.0–7.0)
24 hours	4.9 $\pm$ 1.6	5.0 (4.0–6.0)
48 hours	3.4 $\pm$ 1.5	3.0 (2.0–4.0)
72 hours	2.1 $\pm$ 1.3	2.0 (1.0–3.0)

Repeated-measures effect of time: $P < 0.001$.

The declining postoperative pain trajectory was consistent with the expected clinical course after third-molar surgery and with previous studies demonstrating progressive pain reduction during postoperative follow-up.

Association Between Preoperative Anxiety and Postoperative Pain

A positive correlation was observed between the preoperative MDAS score and postoperative pain at all four assessment intervals. The association was strongest during the early postoperative period.

At 6 hours, MDAS score demonstrated a moderate positive correlation with VAS pain ($r = 0.46$, $P < 0.001$). A similar relationship was observed at 24 hours ($r = 0.51$, $P < 0.001$). The strength of the association subsequently decreased at 48 hours ($r = 0.34$, $P = 0.002$) and 72 hours ($r = 0.25$, $P = 0.026$).

Table 4. Correlation between preoperative MDAS score and postoperative VAS pain

Postoperative interval	Correlation coefficient (r)	95% CI	P value
6 hours	0.46	0.27 to 0.62	< 0.001
24 hours	0.51	0.33 to 0.65	< 0.001
48 hours	0.34	0.13 to 0.52	0.002
72 hours	0.25	0.03 to 0.44	0.026

The findings indicated that increasing preoperative anxiety was associated with greater postoperative pain, particularly within the first 24 hours after surgery.

The magnitude of the 24-hour association ($r = 0.51$) is close to the relationship reported by Xu and Xia, who observed a correlation of $r = 0.542$ between dental anxiety and first-day postoperative pain. Importantly, published evidence is not uniform: Onwuka et al. reported no significant overall correlation between MDAS and postoperative pain in their cohort.

Postoperative Pain According to Anxiety Category

A graded increase in postoperative pain was observed across the three anxiety categories.

At 24 hours, patients with low anxiety had a mean VAS score of **3.9 $\pm$ 1.3**, compared with **5.1 $\pm$ 1.3** among moderately anxious patients and **6.4 $\pm$ 1.2** among patients with severe anxiety. The difference was statistically significant ($P < 0.001$).

A similar pattern was present at 6, 48, and 72 hours, although between-group differences became smaller as the postoperative interval increased.

Table 5. Comparison of postoperative pain according to preoperative anxiety level

Postoperative VAS	Low anxiety (n=25)	Moderate anxiety (n=45)	Severe anxiety (n=10)	P value
6 hours	4.8 $\pm$ 1.4	6.0 $\pm$ 1.4	7.3 $\pm$ 1.2	< 0.001
24 hours	3.9 $\pm$ 1.3	5.1 $\pm$ 1.3	6.4 $\pm$ 1.2	< 0.001
48 hours	2.8 $\pm$ 1.3	3.5 $\pm$ 1.3	4.4 $\pm$ 1.4	0.004
72 hours	1.7 $\pm$ 1.1	2.2 $\pm$ 1.2	2.9 $\pm$ 1.5	0.031

Values are presented as mean $\pm$ SD. Comparisons were performed using one-way ANOVA.

Postoperative Analgesic Consumption

Analgesic requirement also tended to increase with preoperative anxiety. Patients in the severe-anxiety group consumed a greater number of rescue analgesic tablets during the first 72 postoperative hours than patients with moderate or low anxiety.

The mean total rescue analgesic consumption was **2.6 $\pm$ 1.2 tablets** in the low-anxiety group, **3.4 $\pm$ 1.4 tablets** in the moderate-anxiety group, and **4.3 $\pm$ 1.6 tablets** in the severe-anxiety group ($P = 0.003$).

This pattern supported the pain-score findings, suggesting that patients with greater preoperative anxiety experienced a higher postoperative analgesic requirement.

Multivariable Analysis of Factors Associated With 24-Hour Postoperative Pain

A multivariable linear regression model was constructed using the 24-hour VAS score as the dependent variable. Preoperative MDAS score, age, sex, duration of surgery, tooth sectioning, and impaction difficulty were entered as explanatory variables.

After adjustment for the other covariates, **preoperative MDAS score remained independently associated with greater postoperative pain** (adjusted $\beta=0.38$; 95% CI: 0.16–0.29 per MDAS point; $P<0.001$).

Duration of surgery was also independently associated with 24-hour postoperative pain (adjusted $\beta=0.27$; $P=0.011$). Greater surgical difficulty demonstrated a smaller but statistically significant association (adjusted $\beta=0.22$; $P=0.032$). Age and sex were not independently associated with the 24-hour pain score after adjustment.

Table 6. Multivariable linear regression analysis of predictors of VAS pain at 24 hours

Predictor	Adjusted β	B (95% CI)	P value
Preoperative MDAS score	0.38	0.22 (0.16–0.29)	<0.001
Age	–0.08	–0.02 (–0.07 to 0.03)	0.421
Female sex	0.11	0.34 (–0.18 to 0.86)	0.196
Duration of surgery	0.27	0.04 (0.01–0.07)	0.011
Tooth sectioning	0.14	0.39 (–0.09 to 0.87)	0.109
Higher impaction difficulty	0.22	0.51 (0.05–0.97)	0.032

Model adjusted $R^2 = 0.39$; overall model $P<0.001$.

Thus, approximately 39% of the variability in the 24-hour postoperative pain score was explained by the variables included in the model. Importantly, the association between MDAS and postoperative pain persisted after adjustment for operative characteristics, suggesting that preoperative anxiety may contribute to postoperative pain independently of the technical complexity of third-molar surgery.

Summary of Principal Findings

The principal finding was a positive association between preoperative dental anxiety and postoperative pain following mandibular third-molar surgery. The relationship was most pronounced during the first 24 postoperative hours and gradually weakened during subsequent follow-up. Patients with severe preoperative anxiety reported greater postoperative pain and required more rescue analgesics than patients with low anxiety.

Furthermore, preoperative MDAS remained independently associated with 24-hour postoperative pain after adjustment for age, sex, surgical duration, tooth sectioning, and impaction difficulty. These findings support the hypothesis that psychological status before surgery may contribute to individual variability in acute postoperative pain following third-molar removal.

DISCUSSION

The present study evaluated the association between preoperative dental anxiety and postoperative pain following surgical removal of impacted mandibular third molars. The principal finding was that increasing preoperative anxiety, measured using the Modified Dental Anxiety Scale (MDAS), was associated with greater postoperative pain, particularly during the first 24 hours after surgery. The correlation was strongest at 24 hours and progressively weakened at 48 and 72 hours. Patients with severe anxiety also demonstrated greater analgesic consumption. Importantly, preoperative MDAS score remained independently associated with 24-hour postoperative pain after adjustment for demographic and operative variables. These observations suggest that psychological status before surgery may contribute to interindividual variation in acute postoperative pain.

The observed association is consistent with the findings of Lago-Méndez et al. [7], who prospectively evaluated 145 patients undergoing lower third-molar removal.

They reported that patients with high trait anxiety experienced greater postoperative pain and that patients with greater trait or dental anxiety tended to have poorer postoperative recovery. Their study is particularly relevant because it demonstrated that the influence of anxiety was not restricted to subjective anticipation before surgery but could extend into the postoperative period.

Similarly, de-Ávila et al. [8] evaluated the influence of state and trait anxiety on recovery following lower third-molar surgery and demonstrated an association between psychological characteristics and postoperative outcomes. Collectively, these findings support a biopsychosocial interpretation of acute postsurgical pain, whereby tissue injury provides the nociceptive stimulus but psychological characteristics influence its perception, interpretation, and behavioural response. The magnitude of the association observed in the present study is also comparable with that reported by Xu and Xia [12]. In their prospective investigation of 136 patients undergoing impacted third-molar extraction,

dental anxiety was positively correlated with pain on the first postoperative day. Their reported correlation coefficient of 0.542 suggests a moderate relationship between the two variables. The present findings similarly showed the strongest association during the early postoperative period. This temporal pattern may indicate that anxiety exerts its greatest influence when inflammatory nociception is relatively intense and when patients are adapting to the immediate consequences of surgery.

Further support comes from the prospective study by Qiao et al. [13], involving 213 patients undergoing lower third-molar surgery. The investigators found that greater preoperative dental anxiety was associated with an increased risk of severe postoperative symptoms. Compared with patients without anxiety, adjusted odds ratios for postoperative symptom severity increased across anxiety categories, although the dose-response relationship became nonlinear at higher anxiety scores. These findings are important because clinical, radiological, and surgery-related characteristics were included as control variables, suggesting that the observed relationship could not be explained solely by surgical complexity.

Nevertheless, the available evidence is not uniform. Onwuka et al. [10] evaluated 60 patients undergoing impacted mandibular third-molar surgery using the MDAS and daily postoperative VAS measurements. Five patients were lost to follow-up, and no significant correlation was identified between preoperative dental anxiety and postoperative pain during the seven-day observation period. Differences between their results and the present findings may reflect sample size, timing of pain assessment, analgesic use, surgical characteristics, statistical power, or differences in the distribution of anxiety within the populations studied.

The timing of pain measurement may be particularly important. In the present study, the association between anxiety and pain was greatest at 6 and 24 hours and became progressively weaker by 72 hours. As postoperative inflammation resolves, biological recovery may increasingly dominate the pain trajectory, reducing the relative contribution of psychological factors. Studies assessing pain only several days after surgery could therefore underestimate an anxiety-pain relationship that was stronger during the immediate postoperative phase.

More recent evidence also indicates that the pathway between anxiety and postoperative pain may not always be direct. A prospective observational investigation across different types of dental extraction reported that preoperative anxiety was associated with greater intraoperative discomfort and that intraoperative discomfort subsequently influenced postoperative pain. The investigators found evidence for an indirect rather than a consistent direct anxiety-pain effect [16]. This suggests that the association may involve interacting

psychological and procedural pathways rather than a simple linear causal relationship.

Several mechanisms may explain why anxious patients experience greater postoperative pain. Anxiety can increase vigilance toward potentially threatening bodily sensations. Consequently, nociceptive sensations that might otherwise be perceived as tolerable may receive greater cognitive attention and be interpreted as more intense or threatening. Anticipatory anxiety can also alter expectations concerning pain, and negative expectations may amplify the subjective experience of postoperative discomfort.

Physiological stress responses may provide another mechanism. Anxiety activates autonomic and neuroendocrine pathways and can produce increased sympathetic arousal, muscular tension, and changes in cardiovascular responses. Such responses do not necessarily generate postoperative pain directly, but they may modify the patient's overall experience of surgical stress. Psychological distress has also previously been associated with increased dental anxiety and greater postoperative pain following third-molar extraction [17]. The present analysis additionally identified duration of surgery as an independent predictor of postoperative pain. This observation is biologically plausible because prolonged surgery frequently reflects greater operative difficulty, more extensive tissue manipulation, greater bone removal, or the need for tooth sectioning. Previous investigations have similarly demonstrated relationships between surgical difficulty and postoperative morbidity following mandibular third-molar removal [3,4]. Consequently, operative complexity should be considered whenever the relationship between psychological variables and postoperative pain is investigated.

The multivariable findings are therefore important. If anxiety were merely a marker for difficult surgery, its association with postoperative pain would be expected to disappear after adjustment for operative factors. Instead, MDAS remained independently associated with the 24-hour VAS score. This supports the possibility that anxiety contributes additional explanatory information beyond conventional surgical predictors. However, the observational design does not establish that anxiety itself causes increased postoperative pain.

The greater rescue analgesic consumption observed among patients with severe anxiety provides additional support for the clinical relevance of the association. Analgesic consumption represents a behavioural outcome that complements subjective VAS assessment. Nevertheless, analgesic consumption is itself influenced by individual pain tolerance, medication preferences, previous experience, and adherence to postoperative instructions. It should therefore be interpreted as a supportive rather than an entirely objective measure of pain.

The clinical implications of these findings are relevant because anxiety is identifiable before surgery. The MDAS contains only five questions and can be administered rapidly without equipment or specialist psychological assessment [6]. Incorporating a brief anxiety assessment into preoperative evaluation may therefore help identify patients who are more likely to experience difficult early postoperative recovery.

Importantly, identifying anxiety does not necessarily imply that all anxious patients require pharmacological anxiolysis. Effective communication and appropriate preoperative counselling may themselves be valuable. Akomolafe et al. [14] randomized 90 patients undergoing mandibular third-molar extraction to verbal or audiovisual preoperative information. Verbal information produced lower preoperative anxiety than realistic audiovisual information, illustrating that not only the amount but also the manner in which procedural information is communicated may affect patient anxiety.

Non-pharmacological interventions have also been investigated. Monteiro et al. [15] systematically reviewed randomized trials assessing music during third-molar extraction, reflecting increasing interest in simple strategies aimed at reducing perioperative anxiety and pain. More recent clinical studies have evaluated other distraction and relaxation approaches. However, the effectiveness of anxiety-reduction interventions should not be inferred merely from an observational association between anxiety and pain. Demonstrating that anxiety predicts pain and demonstrating that reducing anxiety reduces pain are distinct research questions.

Recent randomized evidence reinforces this distinction. Yuce et al. [18] studied 180 patients allocated to Reiki, sham Reiki, or no intervention before mandibular third-molar surgery. Reiki did not significantly reduce preoperative anxiety compared with the other groups, although postoperative pain differed between groups. These results illustrate the complexity of attributing postoperative pain changes solely to reductions in anxiety and emphasize the need for appropriately controlled intervention studies.

Other pharmacological studies have similarly investigated anxiety and pain within third-molar surgery. Torun et al. [19], studying outpatient mandibular third-molar surgery under remifentanyl sedation, reported that high preoperative anxiety did not significantly affect intraoperative pain. Another investigation using oral midazolam combined with low-dose ketamine demonstrated reduced anxiety during surgery together with lower early postoperative pain under the intervention condition [20]. These heterogeneous findings further indicate that anxiety, intraoperative pain, postoperative pain, sedation, surgical trauma, and analgesic treatment interact in complex ways.

Taken together, the findings of the present study and

previous literature suggest that preoperative anxiety should be considered one component of postoperative pain risk rather than an isolated determinant. Surgical trauma remains fundamental, but psychological vulnerability may modify how that trauma is experienced. A practical perioperative approach should therefore integrate technically atraumatic surgery, adequate local anesthesia, evidence-based analgesia, clear communication, realistic expectation setting, and recognition of patients with substantial dental anxiety.

STRENGTHS AND LIMITATIONS

A major strength of the study was its prospective design, with anxiety measured before surgery and pain assessed systematically at multiple predefined postoperative intervals. Use of the validated MDAS provided a standardized measure of dental anxiety. Recording pain repeatedly at 6, 24, 48, and 72 hours allowed evaluation of the temporal relationship between anxiety and postoperative pain rather than reliance on a single measurement.

The analysis also incorporated operative variables such as surgical duration, impaction characteristics, and tooth sectioning. Multivariable modelling consequently allowed evaluation of whether anxiety remained associated with postoperative pain after accounting for clinically relevant confounding factors.

Several limitations should nevertheless be acknowledged. First, the observational design precludes causal inference. An association between anxiety and pain does not demonstrate that reducing anxiety will necessarily reduce postoperative pain. Second, both MDAS and VAS are self-reported measures and may be affected by individual interpretation and response tendencies. Third, the study was conducted at a single centre, which may limit generalizability. Fourth, potentially relevant psychological factors such as pain catastrophizing, depression, general trait anxiety, previous painful dental experiences, and expected postoperative pain were not comprehensively evaluated.

Analgesic intake may also modify recorded pain scores and should be considered when interpreting postoperative VAS measurements. Finally, although several operative variables were controlled statistically, residual confounding from unmeasured differences in surgical trauma, operator technique, inflammatory response, and individual pain sensitivity cannot be excluded.

CONCLUSION

Preoperative dental anxiety was positively associated with postoperative pain following surgical removal of impacted mandibular third molars, with the strongest relationship occurring during the first 24 hours after surgery. Patients with greater anxiety also demonstrated higher postoperative analgesic requirements. After adjustment for demographic and surgical variables,

preoperative MDAS score remained independently associated with early postoperative pain.

These findings suggest that assessment of dental anxiety may provide useful additional information during preoperative risk evaluation. Brief screening using the MDAS, combined with appropriate counselling, expectation management, atraumatic surgical technique, and adequate postoperative analgesia, may contribute to a more patient-centred approach to third-molar surgery. Larger multicentre prospective studies and randomized trials are required to determine whether targeted reduction of preoperative anxiety can meaningfully reduce postoperative pain and analgesic consumption.

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