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Clinical considerations of sedation in dental surgery: a systematic review

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Abstract

Introduction: In dental surgical procedures such as dental implants, extractions, and dental repairs, the demand for sedation has increased in an attempt to improve surgical quality and patient comfort, especially for those requiring longer surgeries and experiencing anxiety. **Objective:** It was to analyze the key clinical considerations of sedation in dental procedures to improve surgical conditions and patient comfort. **Methods:** The systematic review rules of the PRISMA Platform were followed. The search was carried out from March to May 2025 in the Scopus, Embase, PubMed, Science Direct, Scielo, and Google Scholar databases. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** A total of 120 articles were found. A total of 18 articles were evaluated in full and 10 were included and developed in the present systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 22 studies with a high risk of bias and 25 studies that did not meet GRADE and AMSTAR-2. It was concluded that intranasal and sublingual midazolam significantly reduces anxiety levels during dental procedures in children. Pregabalin coadministered with dexamethasone demonstrated significant efficacy in controlling postoperative pain and anxiety, as well as sedative effects. Ketamine-propofol may be a better option due to reduced episodes of vomiting and nausea in patients and higher levels of dental surgeon satisfaction. High doses of remifentanil can be safely used in multiple dental surgeries on the same day. The use of diazepam, midazolam, and nitrous oxide as preoperative sedation techniques for anxious patients undergoing third molar extractions is effective in controlling anxiety, with little effect on vital signs and retrograde amnesia. Patients under sedation for dental procedures frequently experience obstructive apnea/hypopnea events.

Keywords: Dentistry. Sedation. Surgical procedures. Dental surgery.

Introduction

In dental surgical procedures, such as dental implants, extractions, and dental repairs, the demand for sedation has increased to improve surgical quality and patient comfort, particularly in patients requiring longer surgeries and experiencing anxiety [1-3]. However, it is necessary to focus on the perioperative period in patients with hypotension. Sedation with high doses of propofol can be harmful and requires critical reevaluation [1].

Furthermore, the development of remimazolam, initially intended for procedural sedation, allows for the reconsideration of benzodiazepines as a hypnotic component of general anesthesia, as well as a combination of remimazolam and remifentanil for induction and maintenance of anesthesia [4]. In this context, surgical removal of third molars is one of the most commonly performed procedures by dentists and can cause patient anxiety. Sedation in dental surgery can result in reduced pain and anxiety, improved patient compliance, and improved patient satisfaction [1].

Although several agents have been used in dental surgery, the ideal agent and regimen are not yet established. Dexmedetomidine is a potent and highly selective α-2 adrenergic receptor agonist. Activation of

these receptors in the central nervous system results in reduced blood pressure and heart rate, and decreased arousal. Midazolam is a benzodiazepine derivative that effectively reduces anxiety and provides good operative outcomes and patient satisfaction. Furthermore, dexmedetomidine may be a better sedative for dental sedation than midazolam due to its analgesic properties, shorter recovery profile, and less cognitive impairment and respiratory depression [5].

Based on this, a systematic review study analyzed what is considered a long oral surgery and conducted a cost-effectiveness analysis of sedative agents used for intravenous sedation and sedation protocols. The study defined long procedures as having a mean duration of 31 minutes for extractions and 79 minutes for implant-related surgeries. The sedative agents identified were midazolam, dexmedetomidine, propofol, and remimazolam. The cost analysis revealed midazolam as the most cost-effective option and propofol as the most expensive option. Midazolam, dexmedetomidine, propofol, and remimazolam have demonstrated safety and efficacy as sedative agents in prolonged procedures. Although midazolam is the most cost-effective option, dexmedetomidine, propofol, and remimazolam offer subjective and clinical benefits [6].

It is also noted that nitrous oxide (N2O) is important in dental surgical procedures, as the literature has shown that there is no statistically significant difference between N2O and other sedative techniques in all evaluated outcomes [7].

Therefore, the present study analyzed, through a systematic review, the main clinical considerations of the use of sedation in dental procedures, in order to provide better surgical conditions and comfort to patients.

Methods

Study Design

This study followed the international systematic review model, following the PRISMA (preferred reporting items for systematic reviews and meta-analysis) rules. Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. Accessed on: 04/18/2025. The AMSTAR-2 (Assessing the methodological quality of systematic reviews) methodological quality standards were also followed. Available at: https://amstar.ca/. Accessed on: 04/18/2025.

Data Sources and Search Strategy

The literature search process was carried out from March to May 2025 and developed based on Scopus, Embase, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The following descriptors (DeCS /MeSH Terms) were used *"Dentistry. Sedation. Surgical procedures. Dental surgery",* and the Boolean expression "and" was used between the MeSH terms and "or" between the historical findings.

Study Quality and Risk of Bias

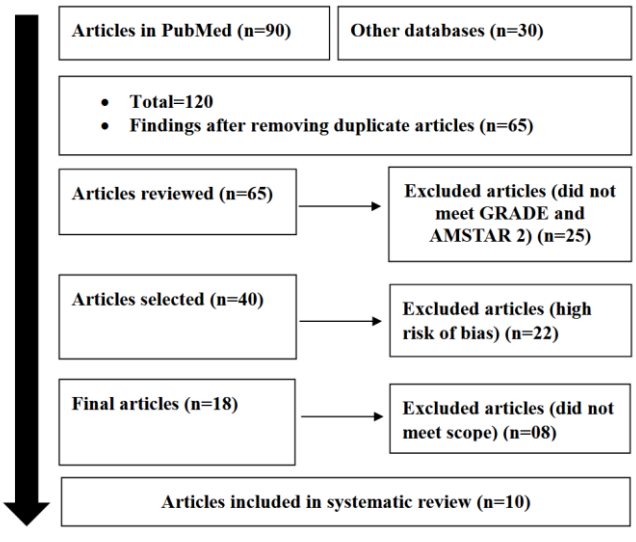
The quality was classified as high, moderate, low, or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analyses of randomized clinical trials, followed by randomized clinical trials. The low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using Cohen's d test.

Results and Discussion

Summary of Findings

A total of 120 articles were found and submitted to eligibility analysis, with 10 final studies being selected to compose the results of this systematic review. The studies listed were of medium to high quality (Figure 1), considering the level of scientific evidence of studies such as meta-analysis, consensus, randomized clinical, prospective, and observational. Biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies presented homogeneity in their results, with X^2=86.5%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 22 studies with a high risk of bias and 25 studies that did not meet GRADE and AMSTAR-2.

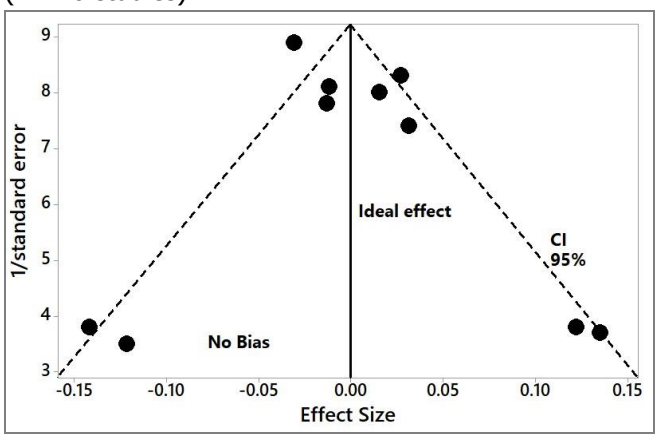
Figure 1. Screening and selection of the article.



Source: Own authorship.

Figure 2 presents the results of the risk of bias of the studies through the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test (d). The precision (sample size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph had a symmetrical behavior, not suggesting a significant risk of bias, either among studies with small sample sizes (lower precision) that are shown at the base of the graph or in studies with large sample sizes that are presented at the top.

Figure 2. The symmetric funnel plot suggests no risk of bias among the small sample size studies shown at the bottom of the graph. High confidence and high recommendation studies are shown above the graph (n= 10 studies).



Source: Own authorship.

Major Clinical Outcomes - Sedation and Dental Surgery

A randomized clinical trial evaluated the behavioral effects and changes in anxiety levels in children after sedation with intranasal and sublingual midazolam. Twenty children aged 3 to 7 years were randomly assigned to sedation with intranasal midazolam (0.2 mg/kg) in Group A (n=10) or sublingual midazolam (0.2 mg/kg) in Group B (n=10). There was a significant reduction in anxiety levels from baseline to 20 minutes after drug administration in Group A (p=0.004) and Group B (p=0.003). There were no significant changes in salivary cortisol levels before or after drug administration in either group [8].

Diniz et al. (2024) [9] conducted a randomized clinical trial to evaluate the efficacy of the coadministration of pregabalin and dexamethasone for preemptive analgesia and anxiety control in lower third molar surgeries. The variables evaluated were pain, measured by the Visual Analog Scale (VAS), anxiety assessed by the State-Trait Anxiety Inventory (STAI), hemodynamic parameters [Blood Pressure (BP), Heart Rate (HR), Oxygen Saturation (SpO2)] and sedation assessed by the Ramsay scale. Thirty-one patients were included. The test group showed a significant reduction in pain at 2, 4, 6, 8, 12, 16, 24, and 48 hours after surgery and in the consumption of rescue analgesics. Anxiety, assessed by STAI and VAS, showed a significant reduction in the test group ($p < 0.001$). Furthermore, there was a significant reduction in BP at most time points evaluated ($p < 0.05$) and a significant reduction in HR at two different time intervals ($p = 0.003$ and $p = 0.009$), indicating a positive effect in the test group. There was no significant difference in SpO2 between the groups. The sedation assessment revealed a significant difference at all time points, favoring the test group ($p < 0.05$). There were no significant postoperative adverse effects.

Canpolat et al. (2017) [10] investigated the efficacy of ketamine-propofol and ketamine-dexmedetomidine in children for sedation during tooth extraction through a randomized clinical trial. Of the 60 participants, 30 (50%) were in each group. No statistically significant differences were found in heart rate, noninvasive blood pressure at any time point, or number of drug repetitions ($p>0.05$). Nausea and vomiting were statistically higher in the ketamine-dexmedetomidine group ($p<0.05$). Ketamine-propofol may be a better option due to the reduction in vomiting and nausea episodes and higher levels of surgeon satisfaction.

The authors Torun et al. (2017) [11] developed a randomized clinical study to evaluate the sedative-analgesic activity of different doses of remifentanil and the effects of preoperative anxiety on intraoperative pain levels in patients treated at a dental clinic. Patients (n = 60) were divided into two groups according to the dose of remifentanil infusion administered: group R1: 0.05 µg/kg/min; group R2: 0.1 µg/kg/min. The following were evaluated: hemodynamic parameters, State-Trait Anxiety Inventory (STAI) TX-I score, level of pain due to local anesthetic injection, time to reach a score of 3 on the Ramsay Sedation Scale (RSS), bolus dose amount, total drug consumption, recovery period, patient and surgeon satisfaction, and complications. The patient satisfaction score on a visual analog scale (VAS) was 90 in the R1 group and 100 in the R2 group. The surgeon satisfaction score was 80 in the R1 group and 90 in the R2 group. The time to reach an RSS score of 3 and the number of boluses administered were significantly shorter in the R2 group than in the R1 group.

A randomized clinical trial compared three sedation protocols with diazepam, midazolam, and nitrous oxide. One hundred and twenty patients scheduled for third molar extraction were selected. All 120 patients had moderate to severe anxiety levels, according to the Corah Dental Anxiety Scale. No

statistically significant differences were found in patient heart rate. However, differences in systolic and diastolic blood pressure were statistically significant after 15 minutes of nitrous oxide sedation. Oximetry data showed no differences between the three sedation protocols. There were also no statistically significant differences observed in the retrograde amnesia test. The differences in anxiety from preoperative to postoperative were statistically significant for all techniques, demonstrating their effectiveness in controlling anxiety [12].

Farah et al. (2019) [13] conducted a randomized clinical trial to assess the efficacy of herbal medicine (valerian) in controlling anxiety during mandibular third molar extraction, compared to midazolam. Twenty anxious patients scheduled for bilateral mandibular third molar extraction were selected. Patients received capsules containing either 100 mg of valerian or 15 mg of midazolam orally 60 minutes before the procedures. No statistically significant differences in oxygen saturation were observed in either group. Although midazolam was more effective in reducing the physiological parameters studied, valerian appeared to provide the necessary comfort and relaxation, without sedation and with less drowsiness than midazolam, during third molar extraction.

Kohzuka et al. (2019) [14] analyzed 46 participants under sedation for dental procedures, of whom 43 were randomly allocated to the control group (n = 23, without nasopharyngeal tube) or the group with nasopharyngeal tube (n = 20). In the control group, the non-desaturate abnormal respiratory index was higher than the desaturated abnormal respiratory index (35.2 vs. 7.2). The obstructive abnormal respiratory index was higher than the central abnormal respiratory index, and half of the abnormal respiratory indexes were accompanied by irregular breathing. Despite the obstructive nature of the abnormal breathing, the nasopharyngeal tube did not significantly reduce the abnormal respiratory index.

Lee et al. (2024) [15] observed that the use of dexmedetomidine 1 mcg/kg reduced the requirements of propofol and remifentanil during maintenance of anesthesia in children when administered as a post-induction bolus. Elderly patients undergoing tooth extraction are particularly susceptible to delayed cognitive recovery after sedation. Sedation with remimazolam significantly improves early postoperative cognitive recovery, leading to faster hemostasis and a shorter time to discharge [16].

Finally, a 2024 multicenter randomized clinical trial explored the efficacy and safety of remimazolam in tooth extraction surgery. Patients in the control group were anesthetized with midazolam, and patients in the observation group were anesthetized with remimazolam. General demographic data were collected from the patients, using propensity score matching (PSM) to balance baseline data for the two groups. PSM matching was performed according to a 1:1 ratio, and 40 patients were included in the observation and control groups. There was no statistical significance in the baseline data for either group. The use of remimazolam during tooth extraction can stabilize the patient's hemodynamics, shorten the recovery time and onset of symptoms, stabilize the patient's behavior, have an excellent calming effect, present fewer adverse reactions, and be safer [17].

Conclusion

It was concluded that intranasal and sublingual midazolam significantly reduces anxiety levels during dental procedures in children. Pregabalin co-administered with dexamethasone demonstrated significant efficacy in controlling postoperative pain and anxiety, as well as sedative effects. Ketamine-propofol may be a better option due to reduced episodes of vomiting and nausea in patients and higher levels of dental surgeon satisfaction. High doses of remifentanil can be safely used in multiple dental surgeries on the same day. The use of diazepam, midazolam, and nitrous oxide as preoperative sedation techniques for anxious patients undergoing third molar extractions is effective in controlling anxiety, with little effect on vital signs and retrograde amnesia. Patients under sedation for dental procedures frequently experience obstructive apnea/hypopnea events.

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