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Pain management in periodontal therapy using local anesthetics and other drugs: an integrative review

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Background: Surgical and non-surgical periodontal procedures often lead to postoperative pain. Clinicians use pharmacological methods such as anesthetics, anti-inflammatory drugs, and analgesics for relief. However, the multitude of options makes it challenging to select the best approach for routine dental care.
Objective: This review aimed to describe previous studies regarding the pharmacological management used for pain control during periodontal procedures as well as factors that may interfere with patients' perception of pain.
Methods: We included studies (period of 2000–2023, whose approach corresponded to the pharmacological protocols used for preoperative, trans-operative, and postoperative pain control in adult patients undergoing surgical and non-surgical periodontal therapy.
Results: A total of 32 studies were included in the analysis, of which 17 (53%) were related to anesthetic methods and 15 (47%) were related to therapeutic protocols (anti-inflammatory/analgesic agents). These studies predominantly involved nonsurgical periodontal procedures. Studies have reported that factors related to age, type of procedure, and anxiety can influence pain perception; however, only seven of these studies evaluated anxiety.
Conclusions: Numerous methods for pain control can be applied in periodontal therapy, which are accomplished through anesthetic methods and/or therapeutic protocols. Factors such as anxiety, age, and type of procedure are related to pain perception in patients. Thus, it is the responsibility of dentists to evaluate each clinical situation and define the best protocol to follow based on the literature.

Keywords: Anesthetics; Anti-Inflammatory Agents; Pain Management; Pain Perception; Periodontal Diseases; Periodontics.

INTRODUCTION

Periodontal treatment restores health and provides balance to periodontal tissues [1]. Surgical and non-surgical periodontal treatments are intended to establish a healthy periodontal condition for individuals with a compromised periodontium. The most prevalent periodontal treatments (non-surgical periodontal treatment), scaling and root planing, remove bacterial biofilms and supra- and subgingival calculi to reduce local inflammation [2,3]. Evidence shows that non-surgical periodontal treatment reduces tooth loss by up to 58% over time [4].

Surgical periodontal procedures, such as open flap debridement, allow better access and visualization of the

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roots and adjoining periodontal tissues for professional manipulation and also contribute to forming tissue anatomy susceptible to biofilm control through hygiene [2,4]. Surgical management is sometimes necessary, including the removal of adjacent soft tissue and bone [5].

There are various periodontal procedures, and a common concern among patients is postoperative pain [6,7]. Periodontal treatment can be painful, with aggravated intensity influenced by physiological and cognitive components [8]. The International Association for the Study of Pain defines pain as an unpleasant sensory and emotional experience related to or similar to actual or potential tissue injuries [9]. The pain assessment process is complex and can be influenced by factors, such as anxiety, previous experience, and age [10,11]. Understanding patients' pain intensity and the variables affecting this process is essential because pain can produce emotional responses that influence patients' acceptance and comfort regarding procedures [6,7]. Thus, the ability to effectively manage the patient's pain response requires the skill of a prudent professional [12]. Pain control strategies used in routine clinical practice include pharmacological management with anesthetics, anti-inflammatory drugs, and analgesics, which provide relief from operative and postoperative pain [13,14]. However, the numerous medications and therapeutic protocols available make this variety of options a factor that can make the professional choice difficult in routine dental practice.

This integrative review aimed to collect and synthesize previous research on pharmacological protocols and anesthetic techniques used for pain control during periodontal therapies as well as factors that may interfere with patients' perception of pain.

METHODS

We formulated the following question on the proposed theme to guide the integrative review: “Which pharmacological interventions are used for pain control before, during, and after periodontal therapy?” The question was elaborated based on the acronym POT, in which the "Population" of this study were the patients submitted to periodontal treatment; the "Outcome" was their respective perception of pain; and the "Type of study" was the study design that best answered the elaborated question.

The inclusion criteria were as follows: 1) articles published in English, Portuguese, or Spanish between the period of 2000–2023; 2) randomized clinical trials; 3) studies that addressed surgical and non-surgical periodontal therapy in adult patients associated with pharmacological management for pain control; and 4) studies with pain evaluation as the primary outcome. We excluded studies that used combinations of drugs, an association of therapies (combined use of anxiolytics or antibiotics), implantology, or dentin hypersensitivity.

We performed a bibliographical search in July 2021 and updated the search in July 2023 using the following databases: Medical Literature Analysis and Retrieval System Online (MEDLINE via PubMed), Cochrane Library, Latin American and Caribbean Literature on Health Sciences (LILACS), Brazilian Library of Dentistry (BBO), and Scientific Electronic Library Online (SciELO). The terms used to develop the search strategy were based on the "Population" and the "Outcome" of this study. Descriptors verified in the Medical Subject Headings (MeSH) and free terms were used in the search expressions, both of which were adapted to the specificities of access for each cited database. Appendix A lists the search terms used.

The studies located in the initial literature search were organized using EndNote X6® reference manager software (Thomson Reuters, New York, NY, USA). Duplicates were excluded, and titles and abstracts were reviewed following the study inclusion criteria to sequentially analyze the full text.

To collect the data provided by the included studies, we prepared seven tables based on information regarding study identification and factors that may influence pain perception during periodontal treatment. The tables were

organized as follows: 1) study characteristics, 2) population, 3) periodontal procedure, 4) anesthetic technique, 5) pharmacological support, 6) pain measurement, and 7) factors associated with pain perception. The data were organized into Excel tables (Microsoft Excel 2011 for Windows, Microsoft, Redmond, WA, USA). Appendix B presents the categories used to collect the data.

Descriptive data analysis was performed by categorizing the extracted data and identifying the variables of interest. We used tables to identify and establish a synthesis of the research on pain control in periodontal procedures.

RESULTS

The initial literature search resulted in 2,079 studies, with the majority found in MEDLINE (1,127), followed by Cochrane (652), SciELO (165), and finally LILACS and BBO (135). Duplicate exclusion resulted in 1,622 studies, 43 of which were selected after analyzing the titles and abstracts. Finally, 32 studies that met the inclusion criteria were analyzed. However, one study was excluded because of the absence of data of interest, which prevented understanding of the study. The steps involved in the study inclusion process are shown in Figure 1.

1. Study characteristics

Of the 32 studies published on the subject, 12 (38%) were performed in Brazil, 8 (25%) in India, 3 (9%) in the United States, 2 (6%) in South Korea, 1 (3%) in Norway, 1 (3%) in Switzerland, 1 (3%) in Egypt, 1 (3%) in Malaysia, 1 (3%) in Saudi Arabia, 1 (3%) in Germany, and 1 (3%) in Iran. All studies were performed between the period 2000–2018.

The most prevalent study design was the parallel design, which was used in 15 studies [15-29], followed by the split-mouth design, which was used in 10 [30-39], and the crossover design, which was used in 7 studies [40-46].

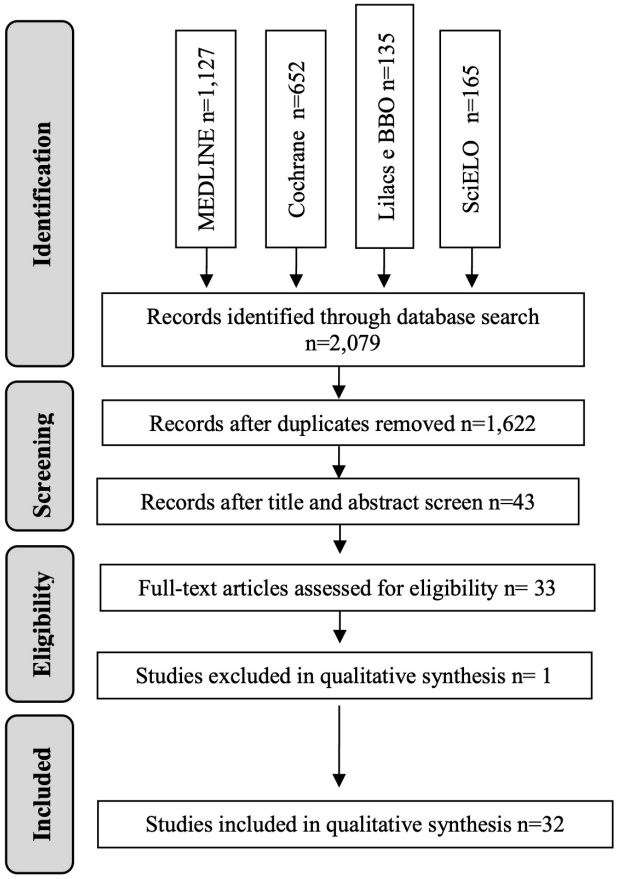

Fig. 1. Flow diagram

2. Population

The patients included in these studies were aged between 18 and 77 years, with a mean age of 40.2 years, indicating a predominance of young adults. The number of patients included in the studies ranged from 7 to 122. Some studies showed a higher prevalence of female participants [15,16,18,20,21,25,26,36,38,40,42-44], whereas others showed a higher number of male participants [17,19,23,26,27,31-35,37,39,45,46]. Four studies did not provide information on sex [22,24,29,30].

Regarding the study population, 12 (38%) studies did not include patients with systemic conditions, such as diabetes and hypertension [17,18,23,24,26-29,43-46], and 18 (56%) included these patients as long as the disease was controlled or did not interfere with their oral condition [15,19-22,25,30-40,42]. Two (6%) studies did not provide this information [16,41]. Common exclusion criteria included allergies to the studied substances,

Table 1. Characteristics of the included studies - Anesthesia (methods)

Authors and country	Purpose	Design	Sample size (sample loss)	Age (mean ± SD)	Main findings (Outcome)
Antoniazzi, et al. (2015) [30] Brazil	To compare EMLA, injectable 2% lidocaine, topical 2% benzocaine, and a placebo during subgingival SRP.	Split-mouth	41 (9)	49.4 ± 9.4	EMLA provided topical anesthetic efficacy similar to injectable lidocaine, and better than topical benzocaine or a placebo substance.
Carr, et al. (2001) [31] USA	To evaluate the efficacy of lidocaine transoral patch and compare it with a benzocaine-containing gel in needle procedures or SRP.	Split-mouth	40 (0)	NS	The lidocaine delivery system was shown to be more effective than the benzocaine gel preparation.
Chang, et al. (2016) [32] South Korea	To determine differences in pain according to types of local anesthesia methods (lidocaine 2% with 1:100,000 epinephrine), and to identify possible contributing factors, such as anxiety.	Split-mouth	33 (2)	51.36	The administration rate influenced pain during local anesthesia, and a relief in injection pain during local anesthesia was observed using the computer-controlled anesthetic delivery system.
Chintala, et al. (2017) [33] India	To evaluate and compare the efficacy of intra-pocket anesthetic gel (20% benzocaine) and injected local anesthesia (2% lidocaine) during SRP.	Split-mouth	15 (0)	NS	20% benzocaine gel showed similar efficacy to injected 2% lidocaine, with no adverse treatment outcomes.
Chung, et al. (2011) [34] South Korea	To evaluate the efficacy of EMLA cream, a 5% eutectic mixture of prilocaine and lidocaine, during SRP.	Split-mouth	40 (0)	31.03 ± 7.10	Significant reduction in pain perception was achieved with the application of EMLA cream.
Dayakar, et al. (2016) [35] India	To evaluate the efficacy of a pocket anesthetic gel (Oraqix, Dentsply Pharmaceuticals) containing lidocaine (2.5%) and prilocaine (2.5%) during SRP.	Split-mouth	30 (0)	43.67 ± 7.85	Anesthetic gel, 25 mg/g lidocaine plus 25 mg/g prilocaine showed a statistically significant reduction compared to the placebo.
Hassan, et al. (2013) [40] Malaysia	To assess the experiences of pain or discomfort with non-surgical periodontal therapy, and to identify preferences regarding the anesthetic method.	Crossover	30 (0)	NS	Pain or discomfort was observed during the injection. Higher preferences for local anesthetic gel.
Jeffcoat, et al. (2001) [15] USA	To evaluate the anesthetic efficacy of 5% anesthetic gel (lidocaine 25 mg/g plus prilocaine 25 mg/g) during SRP.	Parallel	122 (0)	Active gel 43 (20-71) / Placebo 46 (21-86)	Prilocaine 5% dental gel was well tolerated and clinically effective in reducing pain during SRP.
Jorkjend, et al. (2000) [41] Norway	To investigate the effect of 2% lignocaine with adrenaline (1/80 000) after gingivectomy in a dose-dependent manner.	Crossover	57 (0)	47	Large volumes of local anesthetic containing 2% lignocaine and adrenaline (1/80 000) produced greater pain intensity than the standard volume.
Kasaj, et al. (2007) [36] Germany	To evaluate the anesthetic gel Dynexan® (lidocainhydrochlorid 20 mg/g) compared to placebo after non-surgical periodontal therapy.	Split-mouth	40 (0)	55 ± 6.5	Dynexan® was statistically more effective than the placebo in reducing pain after non-surgical periodontal therapy.
Magnusson, et al. (2003) [16] USA	To evaluate the efficacy of anesthetic gel (lidocaine 25 mg/g plus prilocaine 25 mg/g) when applied to periodontal pockets for SRP.	Parallel	87 (2)	Anesthetic gel 46 / Placebo 48	Anesthetic gel (lidocaine 25 mg/g plus prilocaine 25 mg/g) was significantly more effective in reducing SRP pain compared to the placebo.
Mishra, et al. (2016) [37] India	Evaluate the efficacy of 10% lidocaine and 20% benzocaine during periodontal probing.	Split-mouth	90 (0)	39.60 ± 7.32	Local anesthetic gels provided significant pain reduction during probing.
Moraes, et al. (2012) [42] Brazil	To compare the effects of liposomal lidocaine/prilocaine, lidocaine/prilocaine, thermoset anesthetic during SRP compared to Oraqix® and aplacebogel.	Crossover	40 (2)	43.6 ± 11.2	No differences were found between the intervention groups regarding pain frequency/intensity.
Pandit, et al. (2010) [38] India	To analyze and compare the efficacy of 5% EMLA (lidocaine 25 mg/g plus prilocaine 25 mg/g), 20% lignocaine patch, and EDA during non-surgical periodontal debridement.	Split-mouth	25 (0)	NS	The efficacy of the 20% lignocaine patch and EMLA was comparable, and both were superior to EDA.
Prasad, et al. (2018) [39] India	To evaluate the efficacy between 2% lidocaine gel and placebo during periodontal probing	Split-mouth	20 (0)	35.2 ± 2.55	Administration of 2% lidocaine gel showed a significant reduction in pain during probing.

Table 1. (continued)

Authors and country	Purpose	Design	Sample size (sample loss)	Age (mean ± SD)	Main findings (Outcome)
Steffens, et al. (2009) [17] Brazil	To compare the clinical efficacy of 2% mepivacaine with norepinephrine 1:100,000 and 2% lidocaine with epinephrine 1:100,000 in preventing and controlling pain after open flap debridement.	Parallel	12 (0)	37 ± 6.8	The use of 2% mepivacaine with norepinephrine 1:100,000 promoted greater pain control in the immediate postoperative period than 2% lidocaine with epinephrine 1:100,000 after flap SRP surgery.
Steffens, et al. (2011) [18] Brazil	To compare the clinical efficacy of 2% lidocaine with 1:100,000 epinephrine and 2% mepivacaine with 1:100,000 norepinephrine in delaying the onset of pain after periodontal surgery.	Parallel	36 (4)	37.5 ± 8.0	Mepivacaine was superior in reducing pain compared to lidocaine at 1, 2 and 3-hour periods.

EDA, electronic dental anesthesia; NS, not specified; SD, standard deviation; SRP, scaling and root planing.
Source: the authors.

pregnancy or lactation, and acute pain or infection.

3. Periodontal treatment

The most prevalent periodontal condition in these studies was chronic periodontal disease, as mentioned in 26 studies [15-19,21,24,26-28,30-40,42-46]. Surgeries such as gingivectomy and clinical crown augmentation were addressed in five studies [20,23,25,29,41]. One article did not specify the periodontal conditions [22].

Periodontal therapy with scaling and root planing was predominant and was analyzed in 27 (85%) studies. These include non-surgical periodontal therapy or procedures requiring open flap debridement [15-20,22,24,26-28, 30-40,42-46]. Surgeries such as gingivectomy and clinical crown augmentation were studied in five articles (15%) [20,23,25,29,41].

4. Anesthetic technique

Regarding the interventions, 17 (53%) studies were related to anesthetic techniques used for pain control during periodontal procedures (Table 1). Four (23%) studies performed anesthetic techniques during surgical periodontal therapies and 13 (77%) during non-surgical periodontal treatments such as scaling and root planing. Considering surgical periodontal procedures, these studies compared the effects of lidocaine and mepivacaine on pain control [17,18]. Mepivacaine outperformed lidocaine in reducing immediate postoperative pain [17,18]. In addition, the use of larger volumes of anesthetic has been correlated with higher levels of pain perceived by patients [41]. Furthermore, computer-controlled administration of local anesthetics proved to be more effective in reducing pain during the procedure [32]. For non-surgical periodontal treatment, the anesthetic methods evaluated in these studies were topical administration (intrapockets and transoral patches) [16,30,31,33-39,42], conventional administration (injectable) [30,33], and computer-controlled administration of local anesthetics [42]. Common formulations used for intrapocket administration include gels and creams containing lidocaine (2%, 5%, and 10%) [33,36,37,39], lidocaine (2.5%) with prilocaine (2.5%) [16,30,34,35,38,42], and benzocaine (20%) [30,31,33,37]. The results indicate that the use of a topical anesthetic is more effective in reducing pain than a placebo and is comparable to injectable anesthesia, with no reported side effects, making it the preferred choice among patients.

5. Pharmacological pain management

Table 2 shows 15 (47%) studies regarding pharmacological management used for pain control in periodontal procedures, of which 14 (93%) [19,20,22-29,43-46] were performed in surgical periodontal therapies and one in non-surgical periodontal treatment [21]. The most studied therapeutic classes are selective and non-selective non-steroidal anti-inflammatory drugs for Cox-2 [24-29, 43,45,46] and steroidal anti-inflammatory drugs [24-26,29,43,46]. The most common protocols for pain

Table 2. Characteristics of the included studies - Pharmacological (therapy)

Authors and country	Purpose	Design	Sample size (Sample loss)	Age (mean ± SD)	Main findings (Outcome)
Agarwal, et al. (2010) [19] India	To determine the local anti-inflammatory and analgesic effect of 0.074% diclofenac mouthwash in patients after periodontal surgery.	Parallel	20 (0)	NS	The use of 0.074% diclofenac mouthwash at a dose of 15 ml twice a day was effective for post-surgical symptomatic relief.
Al-Hezaimi, et al. (2011) [20] Saudi Arabia	To evaluate the analgesic effect of ketorolac tromethamine adhesive film after periodontal surgery.	Parallel	68 (0)	NS	Significant reduction in pain intensity using a ketorolac tromethamine patch film compared to a placebo, with a single 30 mg dose effective in controlling post-surgical pain.
Ettlin, et al. (2006) [21] Switzerland	To investigate the analgesic effect of a single 800 mg dose of ibuprofen during and after SRP.	Parallel	64 (3)	Ibuprofen arginine - 56.0 (12.9) / Placebo - 53.6 (11.1)	800 mg ibuprofen arginine administered 30 minutes before treatment reduced the mean and maximum pain levels during SRP compared with the placebo.
Hungund, et al. (2011) [22] India	To evaluate the analgesic effect of preoperative administration of 10 mg ketorolac tromethamine compared with placebo during periodontal surgery.	Parallel	40 (0)	NS	10 mg of ketorolac administered immediately before periodontal surgery improved patient response during the procedure.
Kashefimehr, et al. (2017) [23] Iran	To verify the effect of the administration of novafen on pain relief after periodontal surgery.	Parallel	70 (0)		Novafen administration before periodontal surgeries resulted in pain relief after surgery.
Konuganti, et al. (2015) [24] India	To evaluate the efficacy of single doses of 120 mg etoricoxib or 8 mg dexamethasone in open flap debridement surgery procedures.	Parallel	60 (0)	NS	The use of preventive medication, either etoricoxib or dexamethasone, was effective for pain prevention after open flap debridement surgical procedure.
Peres, et al. (2012) [25] Brazil	To compare the preventive effect of a nonsteroidal COX-2 inhibitor with a SAID for periodontal crown lengthening surgery.	Parallel	30 (2)	Selective COX-2 inhibitor: 34.43 (8.37) / SAID:33.00 (10.91)	Both anti-inflammatory drugs showed similar potential for pain and edema relief after periodontal surgery.
Pilatti, et al. (2006) [43] Brazil	To compare the effectiveness of celecoxib, dexamethasone, and a placebo in managing postoperative pain intensity after periodontal surgery.	Crossover	20 (0)	36	Celecoxib showed a statistically significant difference in pain intensity compared to the placebo group.
Rashwan. (2009) [44] Egypt	To compare a combination of acetaminophen, 500 mg, with caffeine, 30 mg, to 400 mg ibuprofen, in pain management after periodontal surgery.	Crossover	20 (5)	37.9 ± 7.5	500 mg acetaminophen with 30 mg caffeine was effective in controlling postoperative pain after open flap debridement.
Steffens, et al. (2010) [46] Brazil	To evaluate the efficacy of single preoperative doses of etoricoxib and dexamethasone in preventing and controlling pain after flap surgery for root scaling and straightening.	Crossover	7 (1)	38 ± 7.8	Adopting a preoperative medication protocol with etoricoxib may be effective in controlling pain after flap surgery for scaling and root straightening.
Steffens, et al. (2010) [45] Brazil	To evaluate the efficacy of 120 mg etoricoxib or 8 mg dexamethasone as a single-dose preventive medication after open-flap debridement surgery.	Crossover	20 (5)	40 ± 9.7	Preventive medication protocol using etoricoxib or dexamethasone effectively prevented pain and discomfort after open-flap debridement surgery.
Steffens, et al. (2011) [28] Brazil	To compare the efficacy of celecoxib and etoricoxib in pain prevention after open-flap debridement surgery.	Parallel	60 (4)	38 ± 8	Preoperative medication protocol using 120 mg etoricoxib was found to be as effective as using two divided doses of 200 mg celecoxib for pain prevention after open flap debridement surgery.

management after periodontal procedures involve the use of preemptive and postoperative approaches for both therapeutic categories. The administration of analgesic and anti-inflammatory medications has been shown to be

Table 2. (continued)

Authors and country	Purpose	Design	Sample size (Sample loss)	Age (mean ± SD)	Main findings (Outcome)
Steffens, et al. (2011) [26] Brazil	To evaluate and compare the efficacy of two different dexamethasone protocols, 4 mg dexamethasone, and 8 mg dexamethasone, during open flap debridement.	Parallel	60 (3)	Dexamethasone 4 mg (N = 19) - 36.0 ± 6.5 Dexamethasone 8 mg (N = 18) - 39.7 ± 9.3 Placebo (N = 20) - 39.0 ± 8.2	Medication protocol using 8 mg dexamethasone administered one hour before surgery was more effective than two divided doses of 4 mg dexamethasone for pain prevention after open flap debridement surgery.
Steffens, et al. (2012) [27] Brazil	To compare the effects of preemptive analgesia with celecoxib and etoricoxib on pain after open-flap debridement.	Parallel	18 (0)	37 ± 6.7	The use of 90 mg of etoricoxib in a single preoperative dose proved effective for the initial control of pain following open flap debridement.
Zardo, et al. (2013) [29] Brazil	To verify the difference in postoperative pain intensity in patients undergoing mucogingival surgery using different preventive analgesia protocols with 90 mg etoricoxib or 8 mg dexamethasone administered in a single preoperative dose.	Parallel	60 (2)	36.56 ± 9.57	The use of a single preventive dose of 90 mg etoricoxib or 8 mg dexamethasone may be an effective protocol for the prevention and control of postoperative pain in patients undergoing mucogingival surgery.

COX, cyclooxygenase; N, number; NS, not specified; SAID, steroidal anti-inflammatory drug; SD, standard deviation; SRP, scaling and root planing.
Source: The author

effective in reducing pain compared with placebo.

6. Pain evaluation

Both types of interventions analyzed in these studies, whether through anesthetic methods or therapeutic protocols, had as their main focus the verification of pain control and its intensity during and after periodontal therapy. Postoperative follow-up was predominantly performed. To record the intensity of the patient's pain, one or more scales were used according to each author's criteria. A total of 25 (78%) studies used the Visual Analog Scale alone or in combination [15-28,30,31, 33-36,39,41,44-46]. The Numerical Rating Scale [17,24,27,29,35,42-46] and Verbal Rating Scale [15,16,23,33-35,38,42,44] were also frequently applied. Data were presented as tables containing mean ± standard deviations and graphs.

7. Factors associated with pain perception

Although some studies reported that factors such as age, therapeutic modality, extent of the procedure, and anxiety may influence postoperative pain [17,25,46], these data were not evaluated in most studies because only seven (21%) studies assessed anxiety before the procedures [18,25,28,32,42,43,45]. The latter studies used the State of Portrait Anxiety Inventory and the Corah Dental Anxiety Scale.

Regarding postoperative guidelines, four (12%) studies recommended mouth rinsing with 0.12% chlorhexidine gluconate solution [25,27,37,46], and one (3%) instructed patients not to consume alcohol after the procedure [41]. In addition, six (18%) studies reported that dentin hypersensitivity was the most frequent postoperative complaint, which was treated with desensitizing agents [17,26-28,45,46].

All participants provided informed consent and were approved by the local ethics committee. The predominant setting used to conduct the research was dental teaching clinics, with only four (12%) studies conducted in dental offices [15,16,21,41].

DISCUSSION

The results demonstrated that topical anesthesia was the most commonly used technique, along with pharmacological therapies using anti-inflammatory drugs. Factors such as age, anxiety, and procedure type influenced patients' pain perception. Regarding the anesthetic techniques, local anesthetics were routinely applied before or during the procedure [30,40,47,48]. Needle-related pain and anxiety concerns influence the choice of anesthetic technique, showing a strong patient preference for non-injective anesthesia [48,49]. Pain during scaling and root planing was reduced by 50% when an anesthetic gel was used compared with a placebo gel [16,30,33-35,37,42]. The former effectively reduces the pain caused by scaling and root planing and can be an alternative to the injectable anesthetic technique [41,50]. Computerized anesthesia is a suitable option. Computer-controlled administration of local anesthetics causes a significant decrease in pain perception because administration occurs at a consistent volume and pressure regardless of tissue density or resistance [51]. A lack of systematic reviews related to this anesthetic technique has been identified owing to the small number of primary studies addressing this topic [52].

Modulation of the inflammatory response for pain control is not new, and many drugs modulate various periodontal conditions [14]. Steroidal anti-inflammatory drugs or corticosteroids are used to treat multiple disorders owing to their immunosuppressive properties, including phospholipase A2 reduction. The studies included in this review indicated that these drugs effectively controlled pain after nonsurgical [21] and surgical periodontal procedures [19,20,22,23,44]. For surgical periodontal procedures, we most frequently observed preemptive administration of single doses [24-29,45,46].

Nonsteroidal anti-inflammatory drugs inhibit the arachidonic acid cyclooxygenase metabolic pathway. Therefore, they are commonly used as analgesics to treat pain and various inflammatory conditions. Previous studies have shown that patients who received anti-inflammatory drugs for prolonged periods tended to have a lower probing depth and less gingival inflammation, exerting a "protective" effect on periodontal inflammation. However, prolonged use causes undesirable effects, for example, in the gastrointestinal tract, and in specific patients, these drugs should be used with caution or avoided [14,20,53]. An effective alternative for patients with restrictions on the use of non-steroidal anti-inflammatory drugs was a 0.074% diclofenac mouthwash at a dose of 15 mL, and ketorolac tromethamine adhesive film in preventive or preemptive protocols. The variety of therapeutic protocols and the absence of fixed pharmacological protocols were addressed considering the importance of patient and practitioner preferences [53].

Periodontal treatment is perceived as painful by patients with periodontal disease. Procedures that may involve injections or tissue cutting, such as bone resections and gingivectomy, cause higher levels of expected and experienced pain than noninvasive methods [54,55]. Factors, such as age and procedure type, were significantly associated with discomfort during therapy, postoperative pain, and dental hypersensitivity. Consequently, dental surgeons should estimate pain expectations based on these factors and provide proper pain control [53].

Many patients become anxious about the factors influencing pain perception during periodontal therapy. The patients tended to anticipate pain during the procedure. Because anticipated pain correlates with actual pain, patients can experience a more significant amount of pain during the procedure [56]. Therefore, a higher level of anxiety increases the likelihood and expectation that the treatment would be painful [8,56].

Pain sensation is a physiological and cognitive component. Afferent neural pathways mediate the pathophysiology of postoperative pain by sensitizing nerve fibers in response to noxious stimuli and the release of inflammatory mediators [57]. Physiologically,

aggressive stimuli are transformed into action potentials by pain-specific receptors (nociceptors) of afferent nerve fibers. The pain stimulus is transmitted to the central nervous system and interpreted in the cerebral cortex [57]. Simultaneously, the cognitive component of pain is established from an individual's perception, which is determined by expectations and learning. Thus, information from previous experiences is used to constitute expectations regarding future perceptions and interpret sensory input [58]. The cognitive processes that generate and sustain a patient's perception of pain need to be addressed along with the sensory experiences of pain during treatment. These processes influence the patient's thoughts and behaviors toward treatment [54].

Considering that postoperative pain involves a unique combination of pathways, an analgesic protocol may involve therapeutic interventions for pain management via various mechanisms of action. Using pharmacological methods, it is possible to act directly on nociceptors and modulate the production of pro-inflammatory mediators [14,57]. In addition to pharmacological intervention, reducing the risk of tissue injury and inflammation as much as possible, together with physical, emotional, and psychological preparations in the preoperative period, can attenuate the intensity of pain experienced [54,56,57]. One limitation of the present study is that it was a secondary study based on published articles whose internal validity (risk of bias) was not evaluated. Language and date restrictions were applied during the selection of studies, and data collection was not performed in a paired manner. Despite these limitations, some gaps have been identified in the literature. Further studies and systematic reviews are needed to deepen our knowledge of little-explored topics, with the aim of developing treatment protocols that address the operative and postoperative times of existing periodontal procedures.

The present review provides a broad overview of the current knowledge regarding the pharmacological methods used to control pain perception in patients during and after different periodontal therapies. Factors such as anxiety, age, and procedure type performed were observed to be predisposing factors for changes in pain perception. Primary studies on computerized anesthesia are also required, given the lack of research on this subject. In summary, various methods are available for pain management during and after periodontal therapy, including anesthetic and pharmacological approaches. There is no standardized protocol, and the choice depends on individual patient preferences and clinical situations. Intrapocket anesthetics have proven effective in reducing pain, particularly in nonsurgical periodontal treatment, making them a preferred choice for patients with needle anxiety. Regarding pharmacological pain management, preemptive and postoperative analgesia protocols are valuable for postoperative pain management during periodontal surgery. Professionals should assess each case and, based on the current literature, select the most suitable pain control protocol, considering patient preferences, especially regarding anesthetic methods.

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