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## Topical anesthetics in pediatric dentistry: A literature review

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### Abstract

**Introduction:** Topical anesthetics are of great interest in pediatric dentistry because they act on the peripheral nerves reducing the sensation of pain when applying local anesthetics.

**Objective:** To analyze the most recent literature on topical anesthetics: benzocaine, lidocaine, eutectic mixture of local anesthetics (EMLA), generalities, doses and presentations, uses and adverse effects.

**Methodology:** Articles on topical anesthetics in pediatric dentistry were analyzed in the databases PubMed, SCOPUS and Google academic with emphasis on the last 5 years. This was done with the words: "dental anesthetic", "benzocaine", "lidocaine", "Pediatric dentistry", "EMLA".

**Results:** It has been found that 20% benzocaine is the most used anesthetic, its main use is before local anesthetic puncture, it has a pleasant taste, however, high rates of allergies have been reported. As for lidocaine, it is effective when applied in 1 minute, its 10% aerosol presentation has presented the best results, its toxicity levels are low but it has an unpleasant taste. EMLA is a mixture of lidocaine 2.5% and prilocaine 2.5%, it is used before puncture, when placing orthodontic separators and in small biopsies, its application time is 2 to 10 minutes and it can cause numbness in unwanted areas.

**Conclusion:** Currently there is no topical formulation that completely eliminates the pain caused by needle puncture, therefore, products with greater efficacy are awaited.

**Keywords:** Topical dental anesthetic, benzocaine, lidocaine, pediatric dentistry, EMLA

### 1. Introduction

Fear and anxiety are the most prevalent problems in pediatric dentistry; fear of pain due to a needle stick is most often found in a child, which compromises their dental health <sup>[1, 2, 3]</sup>. It is psychologically and clinically beneficial to apply some topical anesthetic agent before injecting any type of intraoral anesthesia <sup>[4]</sup>. These agents act by blocking the terminal fibers of the sensory nerve endings, thus controlling painful stimulation during needle insertion <sup>[5]</sup>, decreasing pain perception, as well as improving the relationship between the child and the practitioner <sup>[1]</sup>. Topical anesthetics are very common and readily available, their presentations are in the form of ointment, gel or spray in various percentages of concentrations <sup>[6, 7]</sup>.

Currently there are articles and studies with information of great interest about the most common topical anesthetics currently used in pediatric dentistry. The aim of this study is to analyze the most recent literature on topical anesthetics: benzocaine, lidocaine, eutectic mixture of local anesthetics (EMLA) and to investigate their generalities, doses and presentations, uses and adverse effects.

### 2. Materials and Methods

Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using guidelines, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews <sup>[8]</sup>. The search was performed using Boolean logical operators AND, OR and NOT. The search was

performed using Boolean logical operators AND, OR and NOT; with the keywords: "Topical dental anesthetic", "Topical benzocaine", "Topical lidocaine", "Pediatric dentistry", "EMLA". The keywords were used individually, as well as each of them related to each other.

### 3. Results and Discussion

#### 3.1 Benzocaine

##### 3.1.1 General information

Benzocaine is a local anesthetic used in pain control and belongs to the class of ester local anesthetic drugs [9], which has marked as an anesthetic agent in surgical procedures and also as a Na<sup>+</sup> channel blocker. Benzocaine analogs have been found to possess biological potentials including antibacterial, antifungal, and anticancer [10].

This topical anesthetic acts at a depth of 2-3 mm, to be effective it should be applied on a previously dried area [11].

##### 3.1.2 Dosages and presentations

Benzocaine is available in many different forms, including solutions, tablets, sprays, creams, and gels. It is commercially available in concentrations of 5%, 10% or 20% in solutions and sprays, which can be applied topically to the desired area [12]. Within oral preparations, these can contain concentrations ranging from 7.5% to 20%, among which the 20% presentation is the most widely used because of its fast action, acceptable taste and lack of systemic absorption [13, 14].

Perceptions and preferences of pediatric dentists show that the preferred type of topical anesthetic is benzocaine in gel form [15].

##### 3.1.3 Uses

Benzocaine is well known for its role as an anesthetic agent and is widely used in oral ulcers, ear pain, and dental complications [10], as well as being used to relieve pain caused by teething, periodontal irritation, burns, and wounds [13]. Within the area of pediatric dentistry, they are used for the control of local pain caused by puncture, orthodontic banding, vomiting reflex, buccal mucositis, and rubber dam staple placement [12].

##### 3.1.4 Adverse effects

Benzocaine is relatively safe and low risk when applied topically. However, pediatric exposure to such large concentrations may result in methemoglobinemia, which is characterized by cyanosis, hypoxia and dyspnea that do not improve with oxygen administration. Other adverse effects include hypotension, bradycardia, cardiac arrest, seizures, drowsiness, dizziness, edema, and allergic reactions [9, 13, 16, 17, 18].

In a study by Wang on benzocaine or benzocaine combined with tetracaine, it was concluded that when applied to the cheek mucosa, it does not induce clinically significant elevations in methemoglobin levels. Thus, adequate ossification is important, as it may help to avoid the phenomenon of overdose with these drugs [19].

Some patients may experience sensitization to the drug. Topical use of benzocaine is not recommended in patients with deep wounds, injuries, or severe burns [9]. In addition, children and the elderly population have been found to be more prone to hypersensitivity reactions to this anesthetic, therefore, it should be used with caution as it may cause tenderness, itching, and edema in the applied area.

It has been found that 20% benzocaine is currently the most used anesthetic in pediatric dentistry for pain caused by needle puncture, in the placement of orthodontic bands, oral

ulcers, among others. It has a fast action, and its taste is acceptable, however, it is an ester type drug, with a low anesthetic potency and a high risk of allergic reactions, therefore alternatives with better pharmacological properties, with less risk of allergies, are still being sought.

#### 3.2 Lidocaine

##### 3.2.1 General information

Lidocaine is an amide-type anesthetic that nonselectively blocks sodium channels in sensory afferents, including Ad and c fibers, which reduces ectopic discharge and signal propagation [20].

The topical anesthetic action of lidocaine has been found to be ineffective if left for a period of only 30 seconds; however, there is not much difference after a waiting period of 1 minute or 3 minutes, so a waiting period of 1 minute is valid [21, 22].

##### 3.2.2 Dosages and presentations

Lidocaine is available in multiple forms, such as gel, patch, sprays and solutions [22], these presentations can be found in gel doses at 2%, ointment at 5% and spray solution at 10% [23]. It has been found that the 10% dose of lidocaine gives the same result as the 20% dose with mepivacaine [24].

Several authors have reported in the literature that, within the lidocaine patch presentation, the 5% presentation can significantly reduce the pain of needle injection more than the gel in children [25, 26, 27, 28].

##### 3.2.3 Uses

The topical application of lidocaine is of great help during dental treatment, since it reduces dental phobia, especially in children, by mitigating discomfort and pain [12], and also reduces the pain caused by needle puncture in the buccal mucosa [21].

Some authors have claimed that 5% lidocaine gel only relieves the pain caused by needle insertion, but not the pain caused by the injection itself, unless 10 minutes have elapsed since the administration of topical anesthesia. There are even studies that question whether topical anesthesia has any effect on pain during needle insertion or injection [29].

##### 3.2.4 Adverse effects

Lidocaine has a good margin of safety before reaching toxic blood levels. However, since it can be applied in various forms to the same patients, care should be taken to keep track of the total dose administered to minimize its systemic toxicity [30]. Recently, topical lidocaine application has been more frequently reported to have an unpleasant taste, which is not pleasant for pediatric patients [21].

Recent literature has found lidocaine to be effective when applied at a time of 1 minute or more before needle stick, its doses vary between 2-5% in gel and patches, with patch being more effective versus gel and 10% in spray. The latter has better results, its toxicity levels are very low, so it is safe to use. It should be noted that lidocaine has been reported to have an unpleasant taste, which is a major disadvantage in its use in pediatric dentistry.

#### 3.3 Eutectic mixture of local anesthetics

##### 3.3.1 General information

Eutectic Mixture of Local Anesthetics (EMLA) is an oil-in-water emulsion of 2.5% lidocaine and 2.5% prilocaine, these agents are combined eutectically resulting in the formation of polyoxyethylene fatty acid emulsifiers at mouth temperature (37°C), which facilitates their absorption [31].

### 3.3.2 Dosages and presentations

EMLA is available in the dosage range of 2.5 to 5%. The effective duration for 5% EMLA has been reported to be 2 to 10 min, which is as effective as longer intraoral application times<sup>[37]</sup>.

They are usually formulated as foams, ointments, pastes, creams, and gels to be applied to the affected area intraorally<sup>[38, 39]</sup>.

Patch application with 5% lidocaine/prilocaine has been found to have greater efficacy in controlling pain caused by dental needle puncture, and the patient's pulse rate decreases even after dental needle puncture<sup>[40, 41]</sup>.

### 3.3.3 Uses

EMLA was specifically formulated to provide anesthesia on the intact skin surface and is effective when used primarily before painful events such as venipuncture or needle insertion<sup>[32]</sup>. It was not originally indicated for the oral mucosa but has been reported by several authors to be the most effective topical agent in dentistry<sup>[33, 34, 35]</sup>.

Among the recommendations for the use of EMLA is its use as the only anesthetic in small mucosal biopsies and scrapings in all patients; in addition, a superior and first-line recommendation is to use it in pediatric dentistry for anesthesia in patients and children with needle phobia<sup>[31]</sup>, as well as to use it when elastomeric orthodontic separators are to be used, since it significantly reduces discomfort and pain during placement<sup>[36]</sup>.

### 3.3.4 Adverse effects

These topical medications generally do not provide sustained action because of their short retention time. They usually also act on other non-targeted parts of the oral cavity, which can cause numbness of the mouth and throat, leading to swallowing problems and even choking, especially in pediatric patients<sup>[39]</sup>.

In recent literature the use of EMLA has become of great relevance due to the efficacy it has shown, it is an oil-in-water emulsion of 2.5% lidocaine and 2.5% prilocaine, it is used for small mucosal biopsies, before placement of orthodontic spacers and before injection with local anesthesia. It has been found that the intraoral application time is between 2 to 10 minutes, being a great inconvenience in the attention times of patients in pediatric dentistry, besides it can have dispersed numbness effects in unwanted areas, which is a disadvantage compared to other topical anesthetics.

## 4. Conclusions

Currently in pediatric dentistry there is no topical formulation capable of completely eliminating the pain caused by the needle puncture, however, there are several products that help to reduce the pain of the puncture. Among them is benzocaine, being the most commonly used at a dose of 20%, it has a pleasant taste for children, however high rates of allergies have been reported. Lidocaine is effective when applied in a short time of 1 minute, its 10% aerosol presentation has the best results, its toxicity levels are low, so it is safe to use. However, it has an unpleasant taste, which is a disadvantage for its use in children. Lastly, there is EMLA, a mixture of lidocaine 2.5% and prilocaine 2.5%, which requires a long application time of 2 to 10 minutes and can cause effects in undesired areas, for which reason it is of low use compared to other anesthetics in pediatric dentistry.

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