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Evaluation of Taste Acceptability of Lavender Oil as a Natural Topical Anesthetic During Inferior Alveolar Nerve Block in Children (A Randomized Controlled Trial)

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Abstract:

Introduction: Topical anesthetics applied to the mucosa prior to injection have long been used to relieve pain before the insertion of the local anesthetic needle. Both lidocaine and benzocaine gels have long been used for this purpose. However, the increase in adverse reactions associated with the use of these chemicals, especially in young children, has been the main reason for the search for alternative. The use of herbs to relieve oral and dental pain has been a popular option for centuries. Nowadays, patients are increasingly turning to oral medications with pleasant tastes and pleasant flavors. Undesirable tastes in medications often lead to patient noncompliance and intolerance. Therefore, masking the bitter taste of medications is essential to ensure patient acceptance, especially in children.

Aim of the Study: To evaluate the taste acceptability of lavender oil at concentrations of 1% and 3% as a natural topical anesthetic compared to 20% benzocaine gel during surface anesthesia for inferior alveolar nerve block in children.

Materials and Methods: A randomized double-blind clinical study was conducted on 90 children attending the Pediatric Dentistry Department at the University of Damascus. Cooperative children (Frankl behavior ratings 3 and 4) aged 7–11 years were included. The sample was divided into three groups of 30 children each: 1% lavender oil, 3% lavender oil, and 20% benzocaine gel. Each material was applied for two minutes. Children were then asked to rate the taste of the material used for anesthesia as good (1), acceptable (2), or bad (3).

Result: The results showed statistically significant differences among the study groups, with a marked superiority of 1% lavender oil over the other anesthetics.

onclusions:1% lavender oil demonstrated a more pleasant and acceptable taste among children compared to 20% benzocaine gel and 3% lavender oil.

Key Words: Taste Acceptability, Topical Anesthetics, Lavender Oil, Benzocaine Gel, Injection.

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تقييم تقبّل طعم زيت الخزامى كمخدر سطحي طبيعي أثناء إجراء حقنة إحصار العصب السني السنخي السفلي عند الأطفال (دراسة مضبوطة معشاة)

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الملخص:

المقدمة: استخدمت مواد التخدير السطحية التي تطبق على الغشاء المخاطي قبل الحقن لتخفيف الألم قبل إدخال إبرة التخدير الموضعي حيث استخدم كل من جل البنزوكائين و الليدوكائين منذ زمن طويل لهذا الغرض.إلا أن الزيادة في ردود الفعل السلبية المرتبطة باستخدام هذه المواد الكيميائية خاصة عند الأطفال الصغار كان السبب الرئيسي للبحث عن بدائل لهذه المواد، كما أن استخدام المواد العشبية في تخفيف آلام الفم و الأسنان كان خياراً جيداً و شائعاً لعدة قرون وفي الوقت الحاضر، يزداد إقبال المرضى على الأدوية الفموية ذات المذاق اللذيذ و النكهة اللطيفة. غالباً ما تؤدي النكهات غير المرغوبة في الأدوية إلى عدم التزام المريض و عدم تحملها، لذلك، يعد إخفاء الطعم المر للأدوية أمراً ضرورياً لضمان تقبل المريض لها وخاصة الأطفال.

الهدف من البحث: تقييم تقبل طعم زيت الخزامى بتركيزين(1% و 3%) كمخدر سطحي طبيعي مقارنة بجل البنزوكائين20% أثناء إجراء حقنة إحصار العصب السني السنخي السفلي عند الأطفال.

المواد والطرائق: تم إجراء دراسة مضبوطة معشاة ثنائية التعمية شملت 90 طفلاً من مراجعي قسم طب أسنان الأطفال بجامعة دمشق، تم اختيار الأطفال متعاونين(حسب مقياس فرانكل 3و4)، ضمن الفئة العمرية 7−11عام، **تم** تقسيم العينة إلى ثلاث مجموعات حيث تضمنت كل مجموعة 30طفل وهي مجموعة زيت الخزامى1%، مجموعة زيت الخزامى 3%، مجموعة جل البنزوكائين20%،تم تطبيق كل مادة من المواد لمدة دقيقتين، تم سؤال الطفل عن تقبله لطعم المادة المستخدمة في التخدير بإجابته على سؤال إن كان الطعم جيد وترميزه بالرقم(1) أم عادي وترميزه بالرقم(2) أم سيء وترميزه بالرقم(3).

النتائج: أظهرت النتائج وجود فروق ذات دلالة إحصائية بين مجموعات الدراسة مع تفوق واضح لزيت الخزامى1% على حساب بقية المخدرات.

الاستنتاجات: يمتلك زيت الخزامى بتركيز 1% طعماً محبباً ومقبولاً عند الأطفال بالمقارنة مع جل البنزوكائين20% وزيت الخزامى3%.

الكلمات المفتاحية: تقبل الطعم، المخدر السطحي، زيت الخزامى، جل البنزوكائين، الحقن.

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Introduction:

Providing pediatric patients with dental treatment without pain or discomfort has always been a critical concern for dentists, and this focus has evolved alongside advancements in materials and techniques in the field (Elicherla et al., 2021). Local anesthesia is employed in pediatric dentistry to reduce or eliminate pain associated with therapeutic procedures; however, the method of administration itself can be a significant source of pain. Indeed, fear of the injection is the most common cause of dental anxiety among children.(Bani et al,2024)

Various methods have been explored to reduce pain during local anesthesia, including the use of lasers, cooling, pressure, and vibration (Campanella et al., 2018). Additionally, topical anesthetic agents applied to the mucosa prior to injection have been employed to alleviate pain before the administration of local anesthetic needles. Both lidocaine and benzocaine gels have long been used for this purpose (Mundiya, 2022)

It is noteworthy that the use of herbal remedies for alleviating oral and dental pain has been a common and valuable practice for centuries due to their availability, efficacy, and safety, without the adverse effects associated with chemical agents. Numerous plants possess anesthetic and analgesic properties, including coconut, lavender, turmeric, and betel leaves. However, while herbal substances may not be the most potent analgesics, they can be effective in managing mild to moderate pain (Tirupathi et al., 2022).

The use of essential oils extracted from plants may involve certain side effects despite their natural origin and therapeutic safety, such as irritation and hypersensitivity of the eyes, mucous membranes, and skin due to direct contact. Therefore, essential oils should initially be diluted in a carrier vegetable oil to prevent allergic reactions associated with topical application (Reyes et al., 2020).

Lavender:

Lavender is among the 15 most widely used essential oil plants worldwide. It belongs to the

Lamiaceae family and is extensively distributed throughout the Mediterranean region. Lavender contains over 100 chemical constituents, primarily oxidized monoterpenes. Its two main components are:

Linalool (20–35%): A monoterpene alcohol with anti-inflammatory and analgesic effects (Koulivand et al., 2013).

Linalyl acetate (30–55%): The ester of linalool, possessing muscle-relaxing and sedative properties, and enhancing the effects of linalool (Smetan et al., 2018).

Figure(1): Lavender Oil

Figure(2):Lavender plant

Nowadays, patients increasingly demand oral formulations with a palatable taste and pleasant flavor. Unpleasant tastes in formulations often lead to poor patient compliance and intolerance. Therefore, masking the bitter taste of medications is essential to ensure patient acceptance, particularly in children (Wei et al., 2015).

Although previous research has examined the anesthetic and sedative effects of lavender oil, studies addressing its taste acceptability in children remain limited. Therefore, this study aims to compare the taste acceptability of lavender oil at two concentrations (1% and 3%) with 20% benzocaine gel during topical anesthesia prior to inferior alveolar nerve injection in children.

Materials and Methods:

Study Design:

This study is a randomized, controlled, double-blind clinical trial.

Sample Description:

The sample size was calculated using the G*Power program with a 95% confidence level, based on data from previous similar studies(Dasarraju et al,2020)(Sudha et al,2024)

The study will include 90 children aged 7–11 years who are patients at the Department of Pediatric Dentistry, Damascus University.

Participants will be randomly assigned to three groups:

Group I: Lavender oil (1% concentration)

Group II: Lavender oil (3% concentration)

Group III: Benzocaine gel (20% concentration)

Inclusion and Exclusion Criteria:

Inclusion Criteria:

Medically healthy and cooperative children requiring **dental treatment of mandibular primary molars.**

Exclusion Criteria:

- presence of abscess or infection in the operative area.
- Lack of parental consent to participate in the study

Materials:

- Sterile disposable examination instruments (mirror, explorer, tweezers, tray, napkin holder).
- Infection control equipment (gloves, mask, medical gown).
- Aspirating syringe.
- Short needle tips.
- Sterile cotton pellets.
- 2% lidocaine cartridges with 1:80,000 epinephrine.
- 20% benzocaine gel.
- Lavender oil diluted with grape seed oil at concentrations of 1% and 3%. Both formulations were obtained from Biosham Company (Syria), specialized in the production of essential and natural oils.

Procedures:

Informed Consent:

Prior to the study, informed consent was obtained from the parents after providing a brief explanation of the procedures to be performed.

Each child was interviewed to assess their behavior using Frankl's Behavior Rating Scale, and only children rated as grade 3 or 4 were included. A clinical examination was then conducted, followed by obtaining the child's medical history to exclude any systemic or general diseases and ensure the child's physical and mental well-being.

Group Allocation and Application Procedure:

The children were randomly assigned into three groups. In all groups, isolation and drying of the site designated for the local anesthetic injection were performed. Subsequently, the test materials were applied using a sterile cotton pellet for two minutes, as follows:

Group I: Application of 0.3 mL lavender oil (1%)

Group II: Application of 0.3 mL lavender oil (3%)

Group III: Application of 0.3 mL benzocaine gel (20%)

The anesthetic agent for each child was assigned according to the sequence of patient enrollment in the department, ensuring equal distribution among the three group, children numbered 1 to 30 received 1% lavender oil; those numbered 31 to 60 received 3% lavender oil; and those numbered 61 to 90 received 20%benzocaine gel, blinding was ensured by masking both the child and the external evaluator from knowing the type of agent used.

After topical application, the child's taste acceptance was assessed in the presence of a parent to ensure comfort and minimize the influence of the researcher, the question was asked in a neutral format (1=good, 2=acceptable,3=poor) immediately after the procedure, and responses were recorded directly.

Statistical Analysis:

Frequencies and percentages were calculated for the taste acceptability scale. The Chi-square test was used to

compare the differences in taste acceptability among the study groups for the topical anesthetic agents.

Results:

The ages of the children included in the study ranged from 7 to 11 years, with a mean age of 8.21 years. The sample consisted of 53% males and 47% female.

Frequencies and Percentages for the Taste Acceptability Scale:

A total of 46.7% of the participants rated the taste of the topical anesthetic as good, while 30% described it as acceptable, and only 23.3% considered the taste to be bad or unpleasant .

Comparison Between Study Groups According to the Taste Acceptability Scale:

The proportion of children who rated the taste of 1% lavender oil as good was 73.3% of the group members, whereas 50% of children in the 3% lavender oil group rated it as good, and this percentage decreased to 16.7% in the 20% benzocaine group.

The highest percentage of children reporting a bad taste was observed in the 20% benzocaine group (46.7%), while the lowest was in the 1% lavender oil group (6.7%).

The Chi-square test revealed statistically significant differences between the study groups regarding the taste acceptability of the topical anesthetic. 1% lavender oil showed a clear superiority in taste acceptability compared to the other anesthetics, whereas 20% benzocaine was the least accepted.

The chi-square test showed a statistically significant difference in taste acceptance between 3% lavender oil group and 20% benzocaine gel group, with a p-value of 0.009, these results indicate that children found the taste of 3% lavender oil more acceptable than that of 20% benzocaine gel .

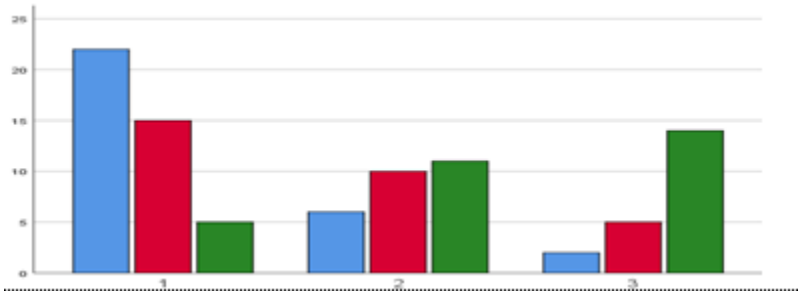
Table(1 :) the results of the Chi-square test comparing the study groups regarding the taste acceptability of the topical anesthetic:

		Lavender 1%		Lavender 3%		Benzocaine 20%		The total		P-value
		N	%	N	%	N	%	N	%	
Taste acceptability	Good	22	24.4	15	16.7	5	5.6	42	46.7	.000
	Acceptable	6	6.7	10	11.1	11	12.2	27	30.0	
	Bad	2	2.2	5	5.6	14	15.6	21	23.3	
The total		30	33.3	30	33.3	30	33.3	90	100.0	

N: number

%: percentage

From Table 1, it can be observed that the P-value is less than 0.05 when comparing the three study groups. This indicates a statistically significant difference between the groups regarding the taste acceptability of the topical anesthetic, with 1% lavender oil showing the highest acceptability, followed by 3% lavender oil, while 20%
benzocaine gel was the least accepted anesthetic.



Figure(3):Frequencies and percentages of the topical anesthetic taste acceptable scale

Study groups:

Lavender oil 1%

Lavender oil 3%

Benzocaine gel 20%

Discussion:

Many children consider the injection to be the most painful part of dental treatment. While local anesthesia eliminates discomfort or pain during dental procedures, the injection itself is often perceived as unpleasant and frequently induces anxiety, especially in children (Singh et al., 2024).

In a study conducted by Singh et al, 2013 , which assessed discomfort, pain, and anxiety in 44 children aged 10–13 years following the extraction of a primary canine, the experience of the local anesthetic injection was rated as worse than the extraction procedure.(Singh et al,2013)

Many dental procedures require the use of injectable local anesthetic agents to reduce pain and enhance the clinical performance of the dentist. Due to childhood experiences, the needle prick is often perceived as a painful event, which provokes fear in most children. Therefore, it is especially necessary in pediatric dentistry to employ adjunctive methods that reduce pain perception during needle insertion (Pathan et al., 2020).

Ongoing research has been conducted to develop new methods and techniques that make the administration of local anesthesia more comfortable. Among all the approaches used, topical anesthetic agents applied to the mucosa remain the gold standard in pediatric dentistry (Patil et al., 2021).

Various forms of local anesthetic agents are available for children, including gels, sprays, or solutions containing lidocaine or benzocaine. However, some of these agents have drawbacks, such as a bitter taste and unpleasant odor, which has prompted the search for natural alternatives, including essential oils like clove oil and other plant-derived products, due to their local availability, low cost, and minimal side effects compared to conventional drugs (Pathan et al., 2020).

The injection was administered using 2% lidocaine with 1:80,000 epinephrine, as it is one of the most commonly used local anesthetic solutions and is considered safe and effective(Afsal et al., 2019).

One of the main reasons for diluting essential oils is to prevent skin irritation or other dermatological reactions. Higher concentrations of essential oils increase the risk of adverse effects. Therefore, according to Tisserand and Young (2014), it is recommended that essential oils be diluted for topical use (prior to therapeutic procedures) in both children and adults to concentrations ranging from 1% to 3% to ensure safety, reduce the likelihood of sensitization, and maintain effectiveness(Tisserand,young,2014). Additionally, it is preferable to blend the essential oil with a carrier vegetable oil when using the topical application method (Petersen et al., 2003).

Grape seed oil was used as a carrier because it has a composition rich in unsaturated fatty acids, particularly linoleic acid, which allows it to be mixed with essential oils or active compounds without causing adverse chemical interactions. Additionally, it facilitates controlled diffusion of the essential oil (Shawahna et al.,2022).

The essential oils were stored in a cool, dry place away from direct light to preserve the stability of the active compounds in the mixture, prevent their degradation or microbial growth, and were used in the study within their shelf life (Dedebas et al., 2022).

The children's taste acceptability of the tested materials was evaluated, as the taste of dental materials influences anxiety, particularly in children and patients with special dental needs. Consequently, anxiety is closely associated with pain, with each tending to increase as the other intensifies (Shindova & Belchova, 2021; Mohan et al., 2025).

1% and 3% lavender oil and 20% benzocaine gel were applied for two minutes, based on the study conducted by Bhalla et al. (2009). This study evaluated the duration of topical anesthetic application and concluded that a two-minute application is sufficient to achieve the desired effect of topical anesthetic products on the tissues.(Bhalla et al,2009)

The results of this study indicated that taste acceptability in children was higher for 1% lavender oil compared to 3% lavender oil and 20% benzocaine gel. This can be explained by the fact that higher concentrations of lavender oil produce a stronger and more pronounced taste, reducing children's acceptance, whereas the 1% concentration diluted with grape seed oil provides a milder flavor. Additionally, lavender oil has a naturally pleasant taste and a soothing aroma (Abdel Hai, 2024), making the experience more positive for children compared to benzocaine gel, which has a chemical and artificial taste and is therefore less acceptable.

Moreover, the use of grape seed oil as a carrier helped to soften the strong taste of the essential oil, increasing children's satisfaction and taste acceptability. Grape seed oil is a natural vegetable oil with a mild flavor and aroma, a neutral taste suitable for culinary use in sauces, baked goods, and pickles, which further enhances children's acceptance of it (Shawahna et al., 2022).

Although the child's feedback is useful for evaluating taste acceptance, it may be influenced by the desire to please adults or the child's understanding of the scale. Therefore, future studies are recommended to include behavioral measure or a facial scale for children to enhance objectivity.

Conclusion:

There are clear differences in children's acceptance of the taste of materials used for topical anesthesia. Lavender oil at 1% showed the highest level of acceptance compared to both lavender oil 3% and benzocaine gel 20%. The comparison between lavender oil3% and benzocaine gel20% also showed that lavender oil 3% was more acceptable to children than benzocaine gel 20%. These findings support the possibility of using certain natural formulations with more acceptable flavors for children when applying topical anesthesia.

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