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Sex Differences in Children's Pain and Anxiety During Local Anesthesia Using Buzzy as a Pain-Relief Aid

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Abstract:

Introduction: Pain and anxiety during dental procedures, particularly during local anesthesia administration, remain significant concerns in pediatric dentistry. The Buzzy device — combining vibration and cold — is used as a nonpharmacological intervention to mitigate these responses.

The aim of the research: To evaluate gender-based differences in pain and anxiety responses among children aged 6–10 years after the application of the Buzzy device during inferior alveolar nerve block injections, using the FLACC and FIS assessment tools.

Materials and Methods: Twenty-five children (11 males and 14 females, aged 6–10 years) received the Buzzy device applied adjacent to the injection site prior to inferior alveolar nerve block administration. Pain was evaluated using the FLACC Scale and anxiety was assessed using the Facial Image Scale (FIS), both before and after the injection. Comparisons between males and females were conducted using the Mann–Whitney U test.

Results: No significant age difference was found between genders (P = 0.670). Before anesthesia, both pain (FLACC) and anxiety (FIS) scores were very low in both groups. After anesthesia, mean FLACC and FIS scores increased slightly between males and females, with females showing higher median values; however, gender differences were not statistically significant for FLACC (P = 0.202) or for FIS (P = 0.103). Correlation analysis revealed weak and non-significant relationships between pain and anxiety scores before ($\rho = -0.102$, P = 0.627) and after anesthesia ($\rho = 0.221$, P = 0.289).

Conclusion: In conclusion, the Buzzy device proved to be an effective adjunct for pain and anxiety control during inferior alveolar nerve block injections in children, with similar benefits observed across genders.

Key words: Pain; Anxiety; Local anesthesia; Vibration; Cold; Buzzy device; Gender; FLACC; FIS.

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الفروق بين الجنسين في إدراك الألم والقلق لدى الأطفال أثناء التخدير الموضعي عند استخدام جهاز Buzzy كوسيلة مساعدة لتخفيف الألم

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الملخص:

المقدمـــة: يُعـدّ الألـم والقلـق أثنـاء الإجـراءات السـنية، ولا سـيما خـلال إعطـاء التخـدير الموضـعي، من التحديات الشائعة في طب أسنان الأطفال. ويُستخدم جهاز — Buzzy الذي يجمع بين الاهتزاز والبرودة — كوسيلة غير دوائية لتخفيف هذه الاستجابات.

الهدف من البحث: تقييم الفروق بين الجنسين في استجابة الأطفال للألم والقلق بعد استخدام جهاز Buzzy أثناء حقن التخدير الموضعي للعصب السنخي السفلي، وذلك باستخدام أداتي التقييم FLACC وFIS، لدى الأطفال الذين تتراوح أعمارهم بين 6 و10 سنوات.

المواد والطرائق: شمل البحث خمسةً وعشرين طفلًا (11 ذكرًا و14 أنثى، تتراوح أعمارهم بين 6 و10 سنوات)، حيث تم تطبيق جهاز Buzzy بالقرب من موقع الحقن قبل إعطاء التخدير الموضـعي للعصـب السـنخي السـفلي. تـم تقيـيم الألـم باسـتخدام مقيـاسFLACC ، والقلـق باستخدام مقياس الصور الوجهيةFIS ، قبل وبعد الحقن. أُجريت المقارنات بين الجنسين باستخدام اختبار Mann–Whitney U.

النتـائج: لـم تُسـجّل فـروق معنويـة فـي الأعمـار بـين الجنسـين .(P = 0.670) قبـل التخـدير، كانـت قـيم الألـم (FLACC) والقلـق (FIS) منخفضـة جـدًا لـدى المجموعتين. بعـد التخـدير، ارتفعت المتوسطات قليلًا لدى الذكور والإناث، حيث أظهرت الإناث قيمًا وسطية أعلى، إلا أن الفروق بين الجنسين لم تكن ذات دلالـة إحصـائية لكل من (P = 0.202) FLACC و .(P = 0.103) FISكما أظهـر تحليـل الارتبـاط علاقـة ضـعيفة وغيـر معنويـة بـين الألـم والقلق قبل (ρ = –0.102, P = 0.627) وبعد التخدير.(ρ = 0.221, P = 0.289)

الاسـتنتاجات: أثبـت جهـاز Buzzy فعاليتـه كوسـيلة مسـاعدة فـي ضـبط الألـم والقلـق أثنـاء حقـن التخدير الموضعي للعصب السنخي السفلي لدى الأطفال، مع تحقيق نتائج متقاربة بين الجنسين.

الكلمـات المفتاحيـة: الألـم؛ القلـق؛ التخـدير الموضـعي؛ الاهتـزاز؛ البـرودة؛ جهـاز Buzzy ؛ الجنس؛ مقياسFLACC ؛ مقياسFIS.

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Introduction:

Dental fear and anxiety are common challenges in children and often represent the early stages of dental phobia, characterized by excessive or irrational fear of dental examinations and treatments. Such anxiety can disrupt daily activities and lead to long-term avoidance of dental care, negatively affecting oral health over time. Among the various forms of dental anxiety, needle-related dental phobia is particularly prevalent, encompassing both the anticipated pain and anxiety associated with injections. Studies have shown that this type of phobia can significantly hinder children's cooperation during dental procedures and negatively impact their overall experience in the dental clinic (Milgrom., et al. 1997; Goyal., et al. 2024).

Local anesthesia plays a pivotal role in managing children's behavior during dental procedures. Effective pain control not only improves immediate comfort but also helps prevent long-term psychological and physical consequences, including heightened sensitivity to future pain. Most pediatric dental anesthesia techniques rely on conventional methods, such as local infiltration or nerve block injections using syringes with disposable carpules and needles (AAPD 2024).

To reduce injection-related pain and anxiety, various strategies have been developed, including optimizing anesthetic properties, modifying delivery techniques, and using advanced injection systems such as computer-assisted devices. In addition, non-pharmacological interventions—including cooling, vibration, laser therapy, and virtual reality—have demonstrated efficacy in improving children's experience, increasing acceptance of injections, and reducing resistance to future procedures (Remi., et al. 2023).

In this context, the Buzzy device has emerged as an innovative tool to alleviate pain and anxiety in children. By combining extraoral vibration and cold application, the device inhibits the transmission of nociceptive signals and activates central pain-inhibitory pathways. Its effectiveness has been demonstrated in medical procedures such as intramuscular injections and blood draws, prompting researchers to explore its application in pediatric dentistry to improve local anesthesia experiences and reduce distress without additional pharmacological intervention (Hambouta., et al. 2025، Zhou., et al. 2025).

Despite the growing evidence of its efficacy, children's responses to the Buzzy device may vary according to gender, as some studies suggest differences between males and females in pain perception and anxiety responses during medical procedures. Therefore, the present study aimed to evaluate the effectiveness of the Buzzy device in reducing pain and anxiety during local anesthesia injections in children aged 6–10 years, with particular emphasis on gender differences.

Materials And Methods

Study Setting:

This within-group comparative study evaluated differences in pain and anxiety responses between male and female children within a single cohort. The study was conducted at the Department of Pediatric Dentistry, University of Damascus. The sample size was determined using G*Power 3.1, with a significance level of $\alpha = 0.05$ and a study power of $\beta = 0.80$, based on previous similar studies (Suohu. et al. 2020; AlHareky., et al. 2021). Measurements were recorded both before and after the administration of the inferior alveolar nerve block injection, and the Buzzy device was applied throughout the procedure.

Inclusion Criteria:

Children were included if they:

1. Were classified as positive or definitely positive on the Frankl behavior scale.
2. Were healthy, aged 6–10 years, and required an inferior alveolar nerve block.

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3. Had no allergy to local anesthetics and no history of previous dental treatment.
4. Had parental consent and no neurological or psychological disorders.

Exclusion Criteria:

Children were excluded if they:

1. Had chronic disease or behavioral disorders.
2. Had local issues at the injection site (e.g., swelling, inflammation, rash).
3. Had allergy to local anesthetics or sensitivity to cold (e.g., Sickle Cell Disease, Raynaud's Disease).
4. Had neuropathy or Complex Regional Pain Syndrome (CRPS).
5. Lacked parental consent.

Materials:

Instruments and Equipment Used:

Figure 1. Infection control and personal protective equipment

Figure 2. Topical anesthetic

1. Examination tools for each patient (dental mirror, explorer, tweezers) (Figure 1).
2. Infection control and personal protective equipment, including disposable gloves, disposable mask, patient bibs, intermediate-level surface disinfectants, and cotton (Figure 1).
3. Topical anesthetic: 20% Benzocaine, cotton rolls (Figure 2).
4. Conventional aspirating syringe ‹short needles, 27-gauge‹ local anesthetic ampoules: 2% lidocaine with 1:80,000 epinephrine (China, Shanghai, Kohope) (Figure 3).
5. Buzzy device (CS Lifesciences Europe Limited, The Black Church, St. Mary's Place, Dublin, Ireland) (Figure 4).

Figure 3. Syringe, needles, anesthetic ampoules

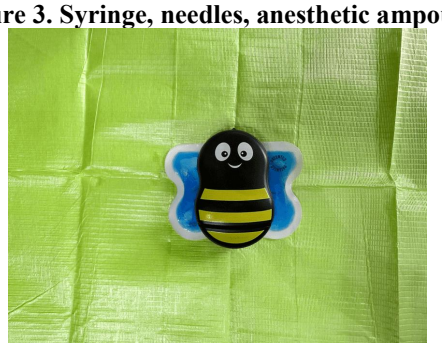

Figure 4. Buzzy device

Study Procedure:

After seating the child in the dental chair, the Buzzy device was introduced with a simple explanation of its mechanism. The gel wings of the device were pre-cooled in a refrigerator prior to the procedure.

When the child was ready, the cooled wing was attached to the Buzzy device, which was then positioned over the mandibular ramus area (the injection site) with the vibration mechanism activated. The device remained in place for one minute before the injection (Figure 5). Immediately after this period, the child was asked to indicate their anxiety level using the Facial Image Scale (FIS), and pain behaviours were assessed simultaneously using the FLACC Scale. The injection site was then dried, and a topical anesthetic gel was applied for 60 seconds. This was followed by administration of an inferior alveolar nerve block using 2% lidocaine with adrenaline via a conventional syringe (Figure 6). After completion of the injection, FLACC scores were recorded again, and the child was asked once more to indicate their anxiety level using the FIS Scale.

Figure 5. The device remained in place for one minute before the injection.

Figure 6. The administration of an inferior alveolar nerve block.

Statistical Analysis:

Data were collected and organized using Microsoft Excel, and then analyzed using SPSS version 25. Descriptive statistics were calculated for all variables, including mean ± standard deviation (SD) and median for pain (FLACC) and anxiety (FIS) scores. Due to the small sample size and non-normal distribution of the data, non-parametric tests were used for comparisons:
Mann–Whitney U test was applied to compare pain and anxiety scores between males and females. Wilcoxon signed-rank test was used to compare pre- and post-injection scores within each group. Correlation between pain and anxiety scores was assessed using Spearman's rank correlation coefficient (ρ). Statistical significance was set at $\alpha = 0.05$.

Results:

This study involved 25 children, comprising 11 males (44%) and 14 females (56%). The mean age was 7.55 ± 1.04 years for males and 7.43 ± 1.16 years for females, with median values of 8.0 and 7.0 years, respectively. (Table 1)
The Mann–Whitney U test revealed no statistically significant difference in age between genders ($P = 0.670$), indicating homogeneity of age across the study groups. (Table 1)
Prior to anesthesia, the mean FIS score was 1.09 ± 0.30 in males and 1.00 ± 0.00 in females, with median values of 1.0 for both groups. Following

anesthesia, the mean score increased slightly among males (1.18 ± 0.41) while remaining unchanged in females (1.00 ± 0.00). (Table 2)

The Mann–Whitney U test indicated no statistically significant differences between genders either before (P = 0.259) or after anesthesia administration (P = 0.103). (Table 2)

Before anesthesia, both males and females showed very low pain-related scores, with mean values of 0.09 ± 0.30 and 0.29 ± 0.47, respectively, and median scores of 0.0 in both groups. Following anesthesia, the mean FLACC score increased to 0.55 ± 1.04 in males and 1.21 ± 1.37 in females, with median values of 0.0 and 0.5, respectively. (Table 3)

Despite the slight increase in scores after anesthesia administration, the Mann–Whitney U test revealed no statistically significant gender differences either before (P = 0.236) or after anesthesia (P = 0.202). (Table 3)

Before local anesthesia administration, the correlation coefficient was negative but weak (ρ = –0.102, P = 0.627), indicating no significant association between reported anxiety and observed pain behaviours. (Table 4)

After anesthesia, the correlation coefficient became positive (ρ = 0.221, P = 0.289), yet the relationship remained weak and statistically non-significant. (Table 4)

Table 1. Age distribution of participants by gender, with the Mann-Whitney U test for homogeneity of age.

	N	Minimum	Maximum	Median	Mean	Std. Deviation	*P-value*
Male	11	6.00	9.00	8.00	7.55	1.036	.670
Female	14	6.00	10.00	7.00	7.43	1.158	

N: Number of cases.

*: a significant difference.

Table 2. Facial Image Scale (FIS) scores before and after local anesthesia administration by gender with the Mann–Whitney U test comparison.

	N	Minimum	Maximum	Median	Mean	Std. Deviation	*P-value*
Before local anesthesia administration							
Male	11	1.00	2.00	1.00	1.09	0.302	.259
Female	14	1.00	1.00	1.00	1.00	0.000	
After local anesthesia administration							
Male	11	1.00	2.00	1.00	1.18	0.405	.103
Female	14	1.00	1.00	1.00	1.00	0.000	

N: Number of cases.

*: a significant difference.

Table 3. FLACC Scale scores before and after local anesthesia administration by gender with the Mann–Whitney U test comparison.

	N	Minimum	Maximum	Median	Mean	Std. Deviation	*P-value*
Before local anesthesia administration							
Male	11	0.00	1.00	0.00	0.09	0.302	.236
Female	14	0.00	1.00	0.00	0.29	0.469	
After local anesthesia administration							
Male	11	0.00	3.00	0.00	0.55	1.036	.202
Female	14	0.00	3.00	0.50	1.21	1.369	

N: Number of cases.

*: a significant difference.

Table 4. Correlation between anxiety (FIS) and pain (FLACC) scores before and after local anesthesia administration using Spearman's rho test.

Time points	Anxiety measurement	Pain measurement	Correlation coefficient	*P-value*
Before local anesthesia administration	FIS Scale	FLACC Scale	-0.102	.627
After local anesthesia administration			0.221	.289

*: a significant difference.

Discussion:

The perception of pain is an individual and subjective experience that varies from person to person. It is strongly influenced by several factors, including personal history, social and cultural environment, personality traits, age, cognitive development, as well as various psychological and behavioral elements that shape how each individual perceives and responds to pain (Muller., et al. 2017; Klatchoian DA., et al. 1993).

This study aimed to evaluate the effectiveness of the Buzzy device in reducing pain and anxiety during inferior alveolar nerve block injections in children aged 6–10 years, with particular emphasis on gender differences. Our findings indicate that the use of the Buzzy device effectively minimized both pain and anxiety during dental injections. Both males and females showed low FLACC and FIS scores prior to anesthesia, which increased slightly after the injection, but the differences were not statistically significant. This suggests that the device provides a reliable non-pharmacological method for enhancing children's comfort during invasive dental procedures. Although no significant gender differences were observed, the slightly higher scores in females may reflect psychosocial or developmental variations in pain perception.

These results are consistent with several previous studies, including Banka et al., 2024; Shetty et al., 2023; Alanazi et al., 2018; Sahithi et al., 2021; Alhareky et al., 2021; Tirupathi et al., 2022, all of which confirmed the effectiveness of the Buzzy device in reducing pain and anxiety in children during dental anesthesia procedures. Conversely, our findings differ from those of Narimany et al., 2024, who reported no significant effect of the Buzzy device in reducing pain and anxiety in children. This discrepancy may be attributed to differences in the age range of participants, the small sample size of only 30 children, the use of a split-mouth design, and variations in the timing of FLACC measurements. (Banka., et al. 2024)(Shetty., et al. 2023)(Alanazi., et al. 2018)(Sahithi., et al. 2021)(Alhareky., et al. 2021)(Tirupathi et al., 2022).

Regarding gender and dental anxiety, our results are consistent with the Sun review, 2024, which found no significant differences in dental anxiety between males and females in preschool and school-aged children. (Sun., et al. 2024).

Similarly, our findings align with Kalra, 2021, who reported no significant differences in anxiety levels before tooth extraction based on age or gender when assessing children in the waiting room. (Kalra., et al. 2021) Additionally, our findings support those of Meurs et al., 2005, who reported no significant relationship between gender and the number or effectiveness of coping strategies used by children during dental treatment. Their study showed that coping strategies are influenced more by factors such as age, dental anxiety, and previous pain experiences. These results suggest that children's behavioral and emotional responses during dental procedures are shaped more by individual and emotional factors rather than biological sex differences, which aligns with our study where no significant differences were observed between boys and girls in pain and anxiety levels following the use of the Buzzy device. (Meurs., et al. 2005)

In contrast, our results differ from those of Alshoraim, 2018, and Saatchi, 2015. Alshoraim reported significantly higher fear levels in females compared to males, which may be due to behavioral differences, as girls tend to express their feelings more clearly, while boys may suppress fear. Cultural and social factors may also play a role, as expressing fear is often more socially acceptable for girls. Similarly, Saatchi noted that females exhibit higher levels of dental anxiety, potentially related to the greater ability of females to express feelings of fear, as well as the higher prevalence of physiological and psychological conditions such as social phobia, panic, depression, stress, and general fear among females, contributing to increased dental anxiety. (Alshoraim., et al. 2018), (Saatchi., et al. 2015)

Future studies with larger sample sizes are recommended to further explore potential gender-specific responses to non-pharmacological pain control devices in pediatric dentistry.

Limitations:

Limitations of the current study include the small sample size and the lack of a control group without Buzzy, which may limit the generalizability of the findings. In addition, the study focused only on

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children aged 6–10 years, and results may differ in younger or older populations. Despite these limitations, the study provides valuable evidence supporting the use of the Buzzy device as a safe, effective, and easily applicable tool for reducing pain and anxiety in children during local anesthesia administration.

Conclusion:

In conclusion, the Buzzy device proved to be an effective adjunct for pain and anxiety control during inferior alveolar nerve block injections in children, with similar benefits observed across genders.

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