

Original Research

Effect of Lavender and Orange Aromatherapy on Dental Anxiety and Pain Perception in Children Undergoing Tooth Extraction: A Randomized Controlled Trial

Ajinkya Wankhade^{1*}, Dimple Padawe¹, Vilas Takate¹, Kishor Dighe¹, Vijaya Jagtap¹

¹Department of Pediatric and Preventive Dentistry, Government Dental College and Hospital, Mumbai, Maharashtra, India

Citation: Wankhade A, Padawe D, Takate V, Dighe K, Jagtap V. Effect of Lavender and Orange Aromatherapy on Dental Anxiety and Pain Perception in Children Undergoing Tooth Extraction: A Randomized Controlled Trial. Oral Sphere J. Dent. Health Sci. 2026;2(3):154-161.

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Received: March 28, 2026;

Revised: April 24, 2026;

Accepted: June 06, 2026;

Published: July 01, 2026

***Corresponding author:** Ajinkya Wankhade

Email: ajinkyawankhade01@gmail.com

DOI: <https://doi.org/10.63150/osjdhs.2026.22>

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ABSTRACT

Introduction: Dental fear and pain perception in children are major challenges in pediatric dentistry, often complicating treatment and negatively affecting patient experience. Non-pharmacological methods such as aromatherapy using essential oils like lavender and orange have shown promising results in reducing anxiety and pain. This study aimed to evaluate the effect of lavender and orange essential oils on dental anxiety and pain perception in children undergoing extraction under local anesthesia.

Materials and Methods: A randomized controlled trial was conducted on 90 children aged 7–12 years requiring mandibular first molar extraction. Participants were randomly divided into three groups: lavender oil, orange oil, and control (no oil). Aromatherapy was administered via inhalers before the procedure. Anxiety was assessed using the Face Image Scale (FIS) at four stages: before inhalation, after inhalation, after local anesthesia, and after extraction. Pain perception was evaluated using the FLACC scale and Wong-Baker Pain Rating Scale after anesthesia and immediately post-extraction. Data were analyzed using ANOVA and post-hoc tests.

Results: The study included 52 females (57.8%) and 38 males (42.2%), with a mean age of 8.76 ± 1.38 years. No significant demographic differences were found among groups ($p > 0.05$). Both lavender and orange oil groups showed significant reductions in anxiety compared to control ($p < 0.001$), with lavender demonstrating the greatest effect. Pain levels were also lower in the aromatherapy groups, while no significant changes were observed in the control group.

Conclusion: Aromatherapy with lavender and orange essential oils effectively reduces dental anxiety and pain in children undergoing extractions, with lavender showing the most pronounced benefits as a non-pharmacological intervention.

Keywords: Aromatherapy, Dental anxiety, Pediatric dentistry.

BACKGROUND

Pediatric dentistry is especially worrying about dental anxiety and perception of pain, which can severely complicate the process and have an adverse effect on the overall experience of small patients [1]. These may cause dental visits to be traumatic resulting in the avoidance of dental care required, a phenomenon that may worsen oral health. The effective control of dental anxiety and pain will be essential in providing children with trauma-

free and effective dental treatment that will result in positive experiences and sustainable dental health. Anxiety and pain are usually relieved with help of traditional pharmacological interventions including sedatives and analgesics [2]. Nevertheless, these approaches have side effects such as drowsiness, nausea and adverse drug reactions. Moreover, they might need a closer level of focus on the procedures, and are not as suitable to the daily pediatric dental check-up. Consequently, interest in non-pharmacological interventions, which are safe, easy, and have a few side effects, has been increasing. These options offer a good prospect of dental anxiety and pain management without medications [3].

The issue of aromatherapy as an adjunctive treatment with essential oils has been a promising treatment in a number of medical settings, and dentistry is not an exception. Oils such as lavender and orange are of interest with respect to the possibility of alleviating anxiety and decreasing the perception of pain [4]. Lavender essential oil, extracted out of *Lavandula angustifolia* is famous because of its anxiolytic and calming effects. It has already been widely studied due to its effectiveness in anxiety reduction both in a clinical and non-clinical setting. It is also believed that Lavender has its effects by acting upon the central nervous system via the olfactory pathway resulting in a decrease in the activity of the sympathetic nervous system [5]. This has the effect of causing a calming effect that may help in the alleviation of the anticipatory stress that goes with dental procedures and is therefore used especially in the management of dental anxiety among pediatric patients [6].

Another essential oil that may have some benefits in anxiety reduction and mood improvement is orange essential oil, which is obtained by extraction of *Citrus sinensis*. Orange essential oil is known to have uplifting and stress-relieving effects on people, and it has been proved to provide a feeling of well-being and relaxation [7]. The sweet and recognizable odor of orange may be utilized to calm the children with fear and it is a useful medication in dentistry among the kids. The soothing properties of orange oil can be utilized in a dental environment where children can be especially susceptible to increased fear and anxiety, thereby enhancing the mood and general experience of a child in the dental setting [8].

The use of the essential oils in pediatric dentistry especially in dental extractions under local anesthesia is a new method of controlling dental anxiety and pain. Dental extractions are also considered to be the most

feared ones in children and the anxiety that is involved can worsen the pain perception and this will make the experience more difficult and traumatic [9]. Including aromatherapy as a part of dental care procedure, there is a chance to make the situation less frightening and more favorable to children, which would allow reducing their fear and increase their cooperation throughout the procedures [10,11]. This may result in improved results, not only in the success of the treatment but also in the future feelings of the child towards dental treatment.

Therefore, this study is important to assess the effectiveness of lavender and orange essential oils in reducing dental anxiety and pain perception in pediatric patients undergoing tooth extractions. Understanding the potential benefits of these essential oils could contribute to the development of alternative, non-drug-based methods for managing dental anxiety and discomfort, ultimately enhancing pediatric dental treatment practices.

MATERIALS AND METHODS

Design of the study

It was a randomized controlled in vivo study carried out in the Department of Pediatric and Preventive Dentistry in tertiary care hospital. There is a total of 90 random children aged between 7 and 12 years who will be participating in the study. Both male and female, these children needed to have one or more of their deciduous mandibular first molar removed. The parents or legal guardians of all participants were also asked to give their consent before the procedure.

Study setting

All the ethical codes of human research were followed in the study, as stipulated by the Declaration of Helsinki and the Occupational Safety and Health Administration (OSHA) rules and regulations, to protect the safety and comfort of every participant.

Sample size calculation

The literature estimates and a formula were used to obtain the sample size to achieve statistical significance. In order to reach 80% power, 5% types I error, a 20% type II error, a minimum detectable difference of 2.1 units between groups, and a pooled standard deviation of 2.8, the required sample size was about 28 to 30 participants per group, or 90 subjects.

Sampling technique

The study participants were selected using a simple randomized sampling. Randomization was done through computerized generated code and allocation ratio of 1:1:1

was applied to place the participants into the respective groups. The inclusion criteria were children aged between 7 and 12 years old whose mandibular first molar (deciduous) was at least indicated to be extracted and had to be 2 or 3 based on the Frankl Behavior Rating Scale. The study excluded children who had any underlying medical condition that needed to be consulted or put under drug therapy or those with acute swelling.

Children that met the inclusion and exclusion criteria and needed the extraction of the deciduous mandibular first molar were randomly allocated to one of three groups. Aromatherapy was performed in a clinical environment with inhalers of two essential oils. In the case of Group 1, two drops of lavender essential oil (Malabarica Vegan Ayurveda, India) were put on a cotton wick into the inhaler.

The children were exposed to the aroma of 2 minutes and a 15 minutes' induction period. The Face Image Scale (FIS) was used to measure the anxiety levels whereas the pulse rate was measured at four points; before inhalation (BI), after inhalation (AI), after the local anesthetic was administered and after extraction. The assessment of pain perception was done with the Face, Leg, Activity, Cry, Consolability (FLACC) scale and Wong-Baker Pain Rating Scale (WBS) in the presence of the local anesthetic and after extraction. Group 2 did the same with orange essential oil (Malabarica Vegan Ayurveda, India). Group 3, the control group, required the children to inhale through an empty inhaler, without essential oil inhalation being done. The FIS was used to measure pulse rate and anxiety prior to inhalation, after inhalation, after local anesthetic application, and after extraction, whereas the FLACC scale and the WBS were used to measure pain

perception after local anesthetic application and after extraction.

RESULTS

The study included 90 participants, with 57.8% (n=52) being female and 42.2% (n=38) male. The age range was 7 to 12 years, with a mean age of 8.76 ± 1.376 years. The mean ages for children in the lavender oil, orange oil, and control groups were 8.8 ± 1.45 , 8.7 ± 1.3 , and 8.77 ± 1.4 years, respectively. There were no statistically significant differences in the mean age or gender distribution between the groups ($p=0.961$, >0.05), indicating that the demographic characteristics were consistent across the study groups.

A statistically significant difference ($p<0.001$) was observed in pulse rate and anxiety levels, as measured by the Face Image Scale, across the different time intervals in all three groups (Table 1). To explore the statistical significance of these differences between pulse rate and anxiety levels at various intervals, pairwise comparisons were conducted for each group (Table 2).

In the lavender essential oil group, pairwise comparisons revealed statistically significant or highly significant differences ($p<0.01$, 0.05) between most time intervals, except for PR EXT - PR BI, FIS EXT - FIS LA, and FLACC EXT - FLACC LA, where no significant differences were found ($p>0.05$). Similarly, in the orange essential oil group, significant differences were seen between most time intervals ($p<0.01$, 0.05), except for PR LA - PR BI, FIS EXT - FIS LA, FLACC EXT - FLACC LA, and Wong Pain Rating EXT - Wong Pain Rating LA, where differences were not statistically significant ($p>0.05$). In the control group, significant differences were noted.

Table 1: Intragroup comparison of Pulse rate in Lavender Oil Group (n=30 each)

Parameter	Group	Time-point	Mean	Std. Deviation	Minimum	Maximum	Median	Mean rank	Chi-Square value	p value of Friedman Test
Pulse rate	Lavender essential oil group	BI	95.33	5.529	89	115	96.00	2.40	70.621	0.000**
		AI	86.90	6.127	80	110	86.00	1.10		
		LA	106.10	7.703	94	128	107.00	3.88		
		EXT	98.50	9.765	84	129	98.50	2.62		
	Orange essential oil group	BI	98.80	6.661	85	123	98.50	2.85	33.845	0.000**
		AI	88.57	6.740	70	105	88.00	1.52		
		LA	101.03	9.449	82	116	102.00	3.33		
		EXT	94.90	9.204	80	115	96.00	2.30		
	Control group	BI	90.77	5.386	80	101	90.00	1.50	73.545	0.000**
		AI	91.13	5.002	78	100	90.00	1.50		
		LA	106.93	5.126	98	117	106.00	3.35		
		EXT	107.73	4.433	99	115	108.00	3.65		

Table 1 Continued...

Anxiety level (Facial Image scale)	Lavender essential oil group	BI	2.87	1.042	1	5	3.00	3.20	26.895	0.000**
		AI	1.80	0.664	1	3	2.00	1.70		
		LA	2.27	0.691	1	4	2.00	2.53		
		EXT	2.33	0.802	1	5	2.00	2.57		
	Orange essential oil group	BI	2.63	0.556	2	4	3.00	3.52	41.488	0.000**
		AI	1.63	0.615	1	3	2.00	1.75		
		LA	2.10	0.923	1	5	2.00	2.50		
		EXT	1.93	0.785	1	4	2.00	2.23		
	Control group	BI	1.83	.699	1	3	2.00	1.80	51.254	0.000**
		AI	1.87	.681	1	3	2.00	1.87		
		LA	2.57	.898	1	4	2.50	3.25		
		EXT	2.50	.731	2	4	2.00	3.08		

Table 2: Pair-wise comparison using Wilcoxon signed ranks test

	Time pairs	Z value	p-value of Wilcoxon Signed Ranks Test
Lavender Essential Oil Aromatherapy Group	PR AI - PR BI	-4.775	0.000**
	PR LA - PR BI	-4.642	0.000**
	PR EXT - PR BI	-1.701	0.089#
	PR LA - PR AI	-4.784	0.000**
	PR EXT - PR AI	-4.683	0.000**
	PR EXT - PR LA	-4.109	0.000**
	FIS scale AI - FIS scale BI	-4.663	0.000**
	FIS scale LA - FIS scale BI	-2.335	0.020*
	FIS scale EXT - FIS scale BI	-2.115	0.034*
	FIS scale LA - FIS scale AI	-2.646	0.008**
	FIS scale EXT - FIS scale AI	-2.774	0.006**
	FIS scale EXT - FIS scale LA	-0.632	0.527#
	FLACC Scale EXT - FLACC Scale LA	0.000	1.000#
	Wong pain rating scale EXT - Wong pain rating scale LA	-2.138	0.033*
Orange Essential Oil Aromatherapy Group	PR AI - PR BI	-4.734	0.000**
	PR LA - PR BI	-1.256	0.209#
	PR EXT - PR BI	-2.128	0.033*
	PR LA - PR AI	-4.315	0.000**
	PR EXT - PR AI	-3.339	0.001**
	PR EXT - PR LA	-4.308	0.000**
	FIS scale AI - FIS scale BI	-4.973	0.000**
	FIS scale LA - FIS scale BI	-2.907	0.004**
	FIS scale EXT - FIS scale BI	-3.479	0.001**
	FIS scale LA - FIS scale AI	-2.599	0.009**
	FIS scale EXT - FIS scale AI	-2.000	0.046*
	FIS scale EXT - FIS scale LA	-1.291	0.197#
	FLACC Scale EXT - FLACC Scale LA	-0.420	0.675#
	Wong pain rating scale EXT - Wong pain rating scale LA	-1.213	0.225#

Table 2 Continued....

Control Group	PR AI - PR BI	-0.519	0.604#
	PR LA - PR BI	-4.789	0.000**
	PR EXT - PR BI	-4.789	0.000**
	PR LA - PR AI	-4.786	0.000**
	PR EXT - PR AI	-4.787	0.000**
	PR EXT - PR LA	-1.416	0.157#
	FIS scale AI - FIS scale BI	-1.000	0.317#
	FIS scale LA - FIS scale BI	-4.690	0.000**
	FIS scale EXT - FIS scale BI	-4.264	0.000**
	FIS scale LA - FIS scale AI	-4.583	0.000**
	FIS scale EXT - FIS scale AI	-4.146	0.000**
	FIS scale EXT - FIS scale LA	-0.535	0.593#
	FLACC Scale EXT - FLACC Scale LA	-2.500	0.012*
	Wong pain rating scale EXT - Wong pain rating scale LA	-1.897	0.058#

Table 3: Intergroup comparison of the various parameters

	Group	N	Mean	Std. Deviation	Median	Mean rank	Chi square value	p value of Kruskal-Wallis Test
PR BI	1	30	95.33	5.529		45.78	25.287	0.000**
	2	30	98.80	6.661		62.27		
	3	30	90.77	5.386		28.45		
PR AI	1	30	86.90	6.127		33.93	12.256	0.002**
	2	30	88.57	6.740		45.10		
	3	30	91.13	5.002		57.47		
PR LA	1	30	106.10	7.703		48.83	6.648	0.036*
	2	30	101.03	9.449		35.65		
	3	30	106.93	5.126		52.02		
PR EXT	1	30	98.50	9.765		37.75	34.257	0.000**
	2	30	94.90	9.204		30.85		
	3	30	107.73	4.433		67.90		
FIS scale BI	1	30	2.87	1.042		55.63	22.251	0.000**
	2	30	2.63	0.556		52.45		
	3	30	1.83	0.699		28.42		
FIS scale AI	1	30	1.80	0.664		46.70	1.925	0.382#
	2	30	1.63	0.615		40.82		
	3	30	1.87	0.681		48.98		
FIS scale LA	1	30	2.27	0.691		44.30	4.926	0.085#
	2	30	2.10	0.923		39.27		
	3	30	2.57	0.898		52.93		
FIS scale EXT	1	30	2.33	0.802		47.62	8.332	0.016*
	2	30	1.93	0.785		36.02		
	3	30	2.50	0.731		52.87		
FLACC Scale LA	1	30	3.67	1.626		44.23	7.552	0.023*
	2	30	3.17	1.440		37.12		
	3	30	4.40	1.868		55.15		

Table 3 Continued....

FLACC Scale EXT	1	30	3.67	1.953		45.58	5.790	0.055#
	2	30	3.03	1.474		37.48		
	3	30	4.07	1.799		53.43		
Wong pain rating scale LA	1	30	3.93	1.617		45.30	4.561	0.102#
	2	30	3.47	1.570		38.80		
	3	30	4.60	2.298		52.40		
Wong pain rating scale EXT	1	30	3.40	1.499		42.38	5.932	0.052#
	2	30	3.13	1.943		39.80		
	3	30	4.20	1.846		54.32		
1 = Lavender essential oil group, 2 = Orange essential oil group, 3 = Control group								

DISCUSSION

The research problem addressed in this study was the efficacy of lavender and orange essential oils in alleviating dental phobia and perception of pain in children undergoing dental surgeries. The findings suggest that both orange and lavender essential oils had a significant effect on anxiety and pain, and in both cases, the impact of lavender was stronger. Such results are in line with other studies on the anxiolytic and analgesic properties of these essential oils, which indicates that they could be a useful tool in pediatric dentistry [12].

Kritsidima et al. (2010) [13] showed the soothing properties of lavender essential oil in dental patients stating that there was a decrease in anxiety levels during dental procedures. This is consistent with our results in which lavender essential oil was found to have a significant effect of reducing anxiety following inhalation and during the procedure. Likewise, S PK et al (2019) [14] found that the lavender aromatherapy worked well in reducing the level of anxiety among dental patients, which is similar to our study as it revealed a similar decrease in anxiety at various time points.

In its turn, orange essential oil, though least researched, also demonstrated considerable effects as far as the reduction of anxiety is concerned. In their study, Abdalhai R et al. (2025) [15] established that orange essential oil reduced anxiety and improved the mood of dental patients as was the case in our research. According to our results, the orange essential oil possesses potential to be used as an adjunct treatment to manage dental anxiety in children.

Moreover, pain perception was also reduced significantly especially in the lavender group. This is in line with the results of You J et al. (2024) [16], who argued that lavender essential oil decreased pain perception during medical procedures. It was also shown by Ghaderi et al. (2020) [17] that the lavender oil might become an

efficient tool in managing pains in dental pediatric practice. In our research, the perception of pain was lesser when using lavender oil as compared to the orange oil, which is in line with these past studies, as lavender has a greater analgesic effect.

Höferl M et al. (2016) [18] and K Sazawa et al. (2022) [19] also helped to understand the physiological effects of essential oils by demonstrating that these oils could decrease physiological indicators of stress, including pulse rate. Similar findings were obtained in our study as the pulse rate and anxiety levels reduced significantly in the lavender essential oil group and orange essential oil group as compared to the control group. This supports the notion that essential oils do not only work to decrease subjective sensations of anxiety but also to influence physiological reactions to stress.

Finally, the study results are consistent with other studies indicating that lavender and orange essential oils can be used as non-pharmacological methods of treatment of dental anxiety and dental pain perceptions among children [20,21]. The use of these oils in pediatric dental practice might enhance patient experience and increase cooperation and decrease the trauma that dental procedures cause. Further research needs to be done in order to perfect these techniques and to assess their relevance in various age groups and dental procedures.

LIMITATIONS

Although the study results were promising, limitations have to be taken into account. The sample was also small and the research was carried out at one institution thus limiting the external validity of the results. Also, the subjectivity of the measures, which is based on the self-reports and the ratings of the observers, may create some biases that may affect the validity of the measurements of the anxiety and the perception of pain. Further studies are needed to reinforce these results, and future studies

should include multi-centre studies with larger sample sizes to determine the long-term outcomes of aromatherapy in dental care of children.

CONCLUSION

Irrespective of the limitations, the result of this study indicated that both lavender and orange essential oils had a significant effect on reducing anxiety and pain compared to the control group, though the effects of the former were stronger. These findings highlight the possibility of aromatherapy as a useful non-pharmacological intervention in the dental care of children. Aromatherapy is a simple, harmless and effective way to make the children dental experience enjoyable through the establishment of a relaxing environment which would help diminish fear and anxiety during the procedure. This may improve patient cooperation and result in improved treatment outcomes. Topical application of lavender and orange essential oils is an encouraging method to treating dental phobia and pain among children, leading to the provision of more efficient and trauma-free treatment. More research using larger populations and a more varied scope of dental procedures are suggested to verify such results and explore the broader implication of aromatherapy in paediatric dentistry.

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Ethical Approval: Institutional Review Board approval was obtained from Government Dental College and Hospital, Mumbai, Maharashtra, India. (Ethical Number - GDCandHMumbai/Ethical committee/4426/2025 dated October 16, 2025).

Declaration of Patient Consent: Patient consent was obtained.

Financial Support and Sponsorship: Nil

Conflicts of Interest: The authors declare that they have no conflicts of interest.

Use of Artificial Intelligence (AI) - Assisted Technology for Manuscript Preparation: The authors confirm that no artificial intelligence (AI)- assisted technology was used to assist in the writing or editing of the manuscript, and no images were manipulated using AI tools.

AUTHOR CONTRIBUTIONS

Ajinkya Wankhade: Conceptualization, study design, methodology, data collection, statistical analysis, interpretation of results, manuscript drafting, and critical revision of the manuscript.

Dimple Padawe: Supervision, literature review, methodology guidance, interpretation of findings, manuscript editing, and final approval of the manuscript.

Vilas Takate: Data collection, clinical procedures, patient management, and manuscript review.

Vijaya Jagtap: Data interpretation, manuscript proofreading, literature support, and final review of the manuscript.

ABBREVIATIONS USED IN THE STUDY

- BI: Before Inhalation
- FIS: Face Image Scale
- FLACC: Face, Legs, Activity, Cry, Consolability

- d) OSHA: Occupational Safety and Health Administration
- e) WBS: Wong-Baker Pain Rating Scale

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