

## CLINICAL EVALUATION OF THE EFFECT OF VOLATILE OILS ON ANXIETY OF CHILDREN DURING DENTAL PROCEDURES: AN IN-VIVO STUDY

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### ABSTRACT

Management of dental anxiety is one of the most challenging tasks for pediatric dental practitioners. Conscious sedation or general anesthesia had been used to solve the problem. Because of the risks of these methods, aromatherapy makes a big leap in addressing dental anxiety. **Aim:** Evaluate and compare the effect of essential oils (lavender and orange) inhalation on children's vital signs and anxiety during dental procedures.

**Materials and Methods:** The study was conducted on 60 children aged 6 to 12 years who need to extract at least one primary tooth. The children were divided into three groups according to the type of inhaled oil; Group (A): Lavender essential oil, Group (B): Orange essential oil, Group (C): Control group. All vital signs including pulse, blood pressure and oxygen saturation were measured before starting the treatment and after the inhalation of the essential oil and then after the anesthesia and extraction. Wong backer scale was used to evaluate children's anxiety level.

**Results:** Compared with controls, both the Lavender group and the Orange group showed a significant change in post-treatment anxiety levels with respect to Wong Packer Pain Scale, along with a decrease in pulse rate and respiratory rate. When compared with Lavender, Orange oil did not result in statistical significance, although Lavender showed better results than Orange.

**Conclusion:** Both Lavender and Orange essential oil are effective in managing anxiety and can be used to prepare the anxious child before dental procedure.

**KEYWORDS:** Essential oils, Anxiety, Vital signs, Wong Packer Pain Scale, Pediatric patient.

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## INTRODUCTION

One of the main problems that many children face when visiting dentists is fear of pain, and anxiety. Dental anxiety has been defined as “an unusual fear or fear of visiting a dentist for treatment or preventive care, and an unexplained anxiety about dental procedures”, which can have physiological, behavioral, and cognitive consequences.<sup>(1)</sup> High anxiety levels may also affect the relationship between patients and dentists, leading to misdiagnosis. Most dentists believe that anxious patients cause stress and may affect their dental practice.<sup>(2)</sup>

Dental fear and anxiety (DFA) in children and adolescents range from 5% to 20% in various countries, with some cases being a dental phobia. Furthermore, a greater sensitivity to pain is observed in anxious patients, which is the primary cause of uncooperative behavior in dental visits.<sup>(3)</sup> Controlling dental anxiety is the key aspect of managing children for dental visits. Conscious anesthesia such as nitrous oxide or a general anesthesia is a well-known practice to control anxiety in dental surgery. These drug methods have been approved for association with some side effects and cannot be applied for allergic patients because it is accompanied by fatigue, confusion, or insomnia.<sup>(4)</sup>

Many factors cause concern around dental setting including odors (eugenol, dentin chopped), sounds (speed drilling, screaming children), and sights (blood, needles), sensation (high frequency vibration), and gag stimulation procedures.<sup>(5)</sup> To overcome the factors such as sounds and smell that increase anxiety levels of the pediatric patients, distraction (audio analgesia) and aroma therapy can be used as psychological techniques, in which the patient listens to music and experiences a good smell during the dental treatment. Due to the success in medical environments and adult dentistry, many dentists believe that these techniques may be successful in management of pediatric dental patients.<sup>(6)</sup>

Aromatherapy is the use of essential oils to relieve emotional or physical discomfort. It is a type of complementary medicine where the oil of volatile plants is used to enhance the level of physical, spiritual, psychological, and physiological health.<sup>(6,7)</sup> A use of this therapy is in many forms including massage and inhalation, Pliers, bathrooms, or topical application. Inhalation and massage are the most used forms, especially in medical field. The presence of essential oils varies from colorless to some of the spectrum color, and most of the oil color relates to its medicinal properties. For example, blue oil (Chamomile) or yellow oil (Patchouli, Citrus, and Lemongrass).<sup>(8)</sup> It involves inhaling scented oils and volatile molecules from oil, which reach the lungs and spread quickly in the blood, causing the brain to be activated through a systemic blood circulation.

However, these molecules are also bind with the olfactory receptors, which creates an electrophysiological response, which reaches the brain.<sup>(9)</sup> Neocortex activation is expected to occur through this response, which has an effect on odor perception and reaches the limbic system areas including amygdala and hypothalamus, areas where hormone levels and emotions are controlled with the additional clinical advantage of being nonsurgical and inexpensive.<sup>(10)</sup>

Many essential oils were used in dentistry such as lavender oil, eucalyptus oil and apples oil and bergamot oil. Studies on animal found that, evidence of citrus oils can relieve stress-induced immunosuppression,<sup>(11)</sup> and may have potential anti-depression effects in mice<sup>(12)</sup>. This result was followed up in a clinical study on patients with depression. A mixture of citrus fragrance was able to be reducing doses of antidepressants drugs, and normalizing endocrine hormone levels, and immunity function in depression cases.<sup>(13)</sup>

Citrus sinensis (Orange peel essential oil), known as sweet oranges, is one of the most prevalent and important essential oils worldwide,

and has a high reputation for its fragrance, making it easier to handle and hence take advantage of its therapeutic properties. The essence of orange peel benefits from the following characteristics: transparency, pleasantness, fragrance, and a high level of freshness just like orange fruit. <sup>(14)</sup> Studies have shown that the smell of oranges is a suitable smell to reduce anxiety. It reduces the activity of the sympathetic nervous system by 16% and increases the activity of the sympathetic nervous system by 12%. The current study was conducted to evaluate and compare the effect of essential oils (lavender and orange) inhalation on children's vital signs and anxiety during dental procedures. <sup>(15)</sup>

### **Study Design and Methods:**

#### **Study Design:**

This study was conducted on 60 children (30 male and 30 female), between the ages of 6 and 10 years, who needed to extract at least one primary molar. Children were collected from the outpatient dental clinic, Pediatric Dentistry Department, Faculty of Dentistry, Zigzag University. Children and their guardians were notified of the study; explain all examinations, clinical procedures and follow-up and informed written consent was obtained before the procedures. The sample size for this study was calculated according to Jaykaran and Tamghna (2013). <sup>(16)</sup>

#### **Criteria for inclusion and exclusion:**

1. Children without any medical or systemic diseases.
2. Children smart enough to fill the anxiety scale.
3. Children who will agree to volunteer in the study.
4. Children with Frankl behavior rating scale, categories 2, 3 and 4, with parents who agreed to contribute.

#### **Participants were randomly divided into three groups;**

**The first group:** consisted of 20 children were received the dental treatment under essential oil therapy using lavender oil.

**The second group:** consisting of 20 children, were received the dental treatment under essential oil therapy using orange oil.

**The third group:** consisted of 20 children were treated without any essential oils as a negative control group.

A form containing the child's appropriate medical history was filled in with the informed consent signed by asking the child's parents.

#### **Methods of evaluation:**

- 1) Respiratory rate was recorded manually.
- 2) The pulse oximeter determined the levels of oxygen saturation and pulse rate.
- 3) Wong Packer Pain Scale was used to assess children's anxiety level.

Initially, the child's oxygen saturation and pulse rates were recorded with the pulse oximeter and breathing rate were also manually recorded. Each child was asked to point the images he/she felt were similar at the moment in Wong Packer Pain Scale. Scores were noted and recorded for each distressed figure chosen by the patient. Thus, the result can range from 0 to 10. Higher grades indicate great concern on the Wong Packer Pain Scale. <sup>(17)</sup>

The child was taken to a dental treatment room which was prepared for study and allowed to inhale the lavender or orange essential oils before starting treatment. Five drops of each oil were dropped on a sterile gauze cloth, and the children were asked to inhale the oil free from any skin contact for three minutes. The children in the control group received treatment in the traditional way without using any essential oils. The operative procedures

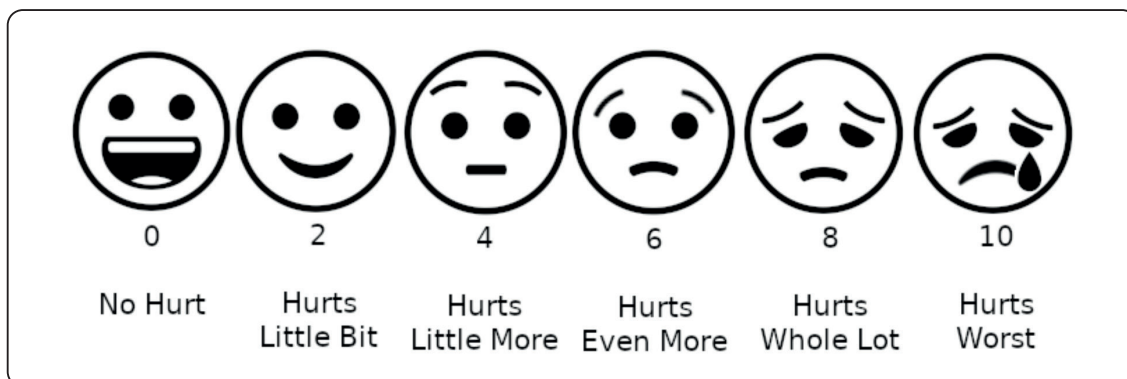


Fig. (1) Wong Packer Pain Scale

were done in all children. After administration of local anesthesia and extraction procedure was done in all children, the respiratory and pulse rate and oxygen saturation were recorded again, and the child was again asked to point the images in Wong Packer Pain Scale (Figure 1). One ampoule of local anesthesia (4% of articaine solution with 0.0006 mg / ml of epinephrine) was given to all children to extract teeth to maintain consistency ‘then the teeth were extracted without any surgical trauma.

Figure 1: **Data analysis**

For data analysis, the SPSS 22.0 package program was used. In analyzing demographic data, descriptive statistics were used. t test, ANOVA test was used to compare pre- and posttreatment mean of anxiety. Kruskal–Wallis test was used to compare the pre- and post-operative changes in respiratory rate, pulse rate and oxygen saturation. While respiratory rate, pulse rate and oxygen saturation levels between all groups were compared using the Mann-Whitney test. All results were tested at a level of significance 0.05.

**RESULTS**

Table 1 showed that, before starting a study, no statistically significant difference was found between all groups in terms of age’ according to their introductory characteristics ( $p > 0.05$ ). A total of 60 participants were included in the current in vivo study, with an average age of  $8.8 \pm 0.8$  years.

This included 30 male and 30 female children.

TABLE (1): Mean age of all groups

Group	Mean age	Total number
Group 1 (Lavander)	$8.5 \pm 0.5$	20
Group 2 (Orange)	$8.8 \pm 0.8$	20
Group 3 (Control)	$8.3 \pm 0.3$	20
All mean age	$8.8 \pm 0.8$	60

Wong Packer Pain Scale (WPPS) was used to measure the anxiety level. A t-test was used to determine the statistical significance. It was found that the mean anxiety level in the experimental groups reduced postoperatively ( $0.63 \pm 0.23$ ) and ( $0.60 \pm 0.23$ ) in Lavander and Orange groups respectively as compared to the preoperative level ( $1.54 \pm 0.29$ ) which was found to be statistically significant ( $P < 0.05$ ). In the control group, no statistically significant differences were seen between pre- and post-treatment mean anxiety levels. While in comparing the pre- and post-operative mean anxiety levels in two experimental groups there was no statistically significant differences were observed (Table 2).

The group 1 (Lavender) showed a decrease in mean pulse and respiratory rates while oxygen saturation levels were increased after treatment compared with the other two study groups. The group 2 (Orange) showed a decrease in mean pulse and respiratory rates but with an increase in

oxygen saturation levels after treatment. However, the change is lower compared to group 1. As far as the control group, the results showed postoperative increase in mean pulse and respiratory rates with decreases in oxygen saturation levels (Table 3).

Using the ANOVA test (Table 4); Wong Packer Pain Scale (WPPS) showed significant difference in anxiety level between all three groups. Changes in the level of anxiety regarding to the respiratory rate, oxygen saturation and pulse rate between the three study groups using Kruskal Wallis test showed statistically significant difference in all parameters except oxygen saturation level.

Comparison between the lavender group and the control group (Table 5); showed a statistically

significant difference in relation to the Wong Packer Pain Scale. Statistical significance is also obtained using the Mann-Whitney test with respiratory rate, oxygen saturation level and pulse rate. The comparison of the orange group with the control group showed a statistically significant difference regarding to the Wong Packer Pain Scale. Respiratory and pulse rate showed a statistically significant change using the Mann-Whitney test while no significant difference in oxygen saturation level. The comparison of the lavender with the orange group showed no statistically significant difference with respect to the Wong Packer Pain Scale. Respiratory rate, pulse rate, and oxygen saturation levels also showed no statistically significant difference when calculated using the Mann-Whitney test.

TABLE (2). Comparison between pre- and post-operative mean anxiety scores in the study groups.

Group	Mean WPPS		P value
	Preoperative	Postoperative	
Group 1 (Lavender)	1.90 ± 0.24	0.63 ± 0.26	P < 0.05
Group 2 (Orange)	1.87 ± 0.25	0.60 ± 0.23	P < 0.05
Group 3 (Control)	1.89 ± 0.23	1.54 ± 0.29	P ≥ 0.05

TABLE (3): Comparison between pre-and post-treatment mean vital sign scores in the study groups.

Group	Respiratory rate		Oxygen saturation		Pulse rate	
	Pre	Post	Pre	Post	Pre	Post
Group 1 (Lavender)	21.87 ± 2.18	20.28 ± 1.41	97.59 ± 1.24	98.09 ± 1.11	99.9 ± 13.16	91.04 ± 10.21
Group 2 (Orange)	21.99 ± 2.69	20.43 ± 1.75	97.86 ± 1.26	98.14 ± 0.99	99.2 ± 12.23	90.36 ± 10.71
Group 3 (Control)	21.84 ± 2.10	21.91 ± 1.89	97.68 ± 1.25	97.57 ± 1.09	98.4 ± 12.74	102.90 ± 11.28

TABLE (4): Changes in anxiety levels before and after treatment regarding to all parameters.

Parameters	Group 1 (Lavender)	Group 2 (Orange)	Group 3 (Control)	P value
Wong Packer Pain Scale <sup>(a)</sup>	-4.15 ± 1.44	-4.11 ± 2.15	0.07 ± 1.23	<0.001
Pulse rate <sup>(b)</sup>	-8.99 (-43.16)	-8.1 (-41.51)	5.1 (-4.23)	0.0001
Respiratory rate <sup>(b)</sup>	-2.1 (-6.29)	-2.2 (-6.01)	0.0 (-2.22)	0.0001
Oxygen saturation <sup>(b)</sup>	1.1 (-3.51)	0.01 (-1.20)	0.0 (-2.21)	0.005

*p < 0.001 is considered significant a Mean ± S.D, the p value is computed using ANOVA test b Median (Min, Max), the p value is computed using Kruskal–Wallis test*

TABLE (5): Comparison between different groups regarding to changes in anxiety levels before and after treatment.

Group	Wong Packer Pain Scale <sup>(a)</sup>	Respiratory rate <sup>(b)</sup>	Oxygen saturation <sup>(b)</sup>	Pulse rate <sup>(b)</sup>
Lavender vs control	<0.0001	<0.0001	0.002	<0.0001
Orange vs control	<0.0001	<0.0001	0.013	<0.0001
Lavender vs Orange	0.99	0.67	0.15	0.86

*a p value is computed using Tukey's HSD test (Wong Packer Pain Scale) b p value is computed using Mann-Whitney test; p < 0.016 is significant after adjusting for multiple comparison (pulse rate, respiratory rate, and oxygen saturation)*

## DISCUSSION

One of the challenges in protecting children's oral health is to overcoming children's anxieties of dentistry.<sup>(20&21)</sup> Fearful and anxious children experience Pain of higher intensity and longer duration. Thus, the focus of research is to reduce these feelings. To accomplish this, pediatric dentists use many behavioral guidance techniques, either nonpharmacological or pharmacological. The pharmacological drugs, such as benzodiazepines, have been accompanied with unwanted sedative, the effects of withdrawal; and the possibility of addiction is another harmful effect.

Aromatherapy is one of the most effective non-pharmacological ways to manage dental anxiety. The current study compared two essential oils (aromatherapy), to relieve anxiety levels in pediatric patients with those in the control group. Oil efficacy was measured using the Wong Baker Pain Scale, along with three objective measures including respiratory rate, pulse rate, and oxygen saturation levels.<sup>(22)</sup>

Wong-Baker's Pain Rating Scale is a way for someone to self-assess and effectively communicate the severity of pain they may feel. The scale contains a series of six faces ranging from a happy face at zero to signify "harmless" and a crying face at ten to signify "the worst." The Wong-Baker Pain Assessment Scale, the most popular among young

children, is often described as appropriate for children ages 3 to 18.<sup>(17)</sup>

Pulse rate was used for evaluation because it is the simplest biological parameter to measure, and also because increased heart rate is the commonest physiological parameter of anxiety and fear. This indicator has been found to be more consistent with the anxiety associated with dental procedure than other physiological parameters.<sup>(23)</sup>

Respiratory rate was chosen because, individual anxiety levels tend to increase respiratory rate. It is thought to be the result of increased involuntary muscle contraction that leads to increased activation of respiratory muscles and respiratory centers in the brain.<sup>(24)</sup> Stress and anxiety can alter respiratory rate, which may over time change oxygen saturation and/or carbon dioxide levels in the blood. Oxygen saturation measurement was also used to assess anxiety levels in this study.<sup>(25)</sup>

Controlling anxiety through many ways becomes an important issue in pediatric dentistry. Aromatherapy is one possible nonpharmacologic way of gaining more attention recently, as it is cost-effective and safe for children during dental procedures.<sup>(26&27)</sup>

In the current study, there was a specific positive effect that aromatherapy, as an inhaler, had an impact on children's anxiety scores. This is consistent with previous studies on the effect of lavender and

orange essential oils on dental anxiety. <sup>(28&29)</sup> The main difference between this study and previous studies is the testing of the efficacy of the oils in the form nebulizer. When comparing the nebulizer with inhalants, nebulizer had a better effect on decreasing anxiety. <sup>(30,31)</sup> This difference may be due to, the result of a light and continuous supply of essential oil molecules with the nebulizer compared with periodic inhalation of oil by inhalers.

In this study the comparison of pre- and post-treatment anxiety levels reported by the Wong Packer Pain Scale index showed unchanging levels among controls. The control group showed an increase in respiratory rate and pulse rate with decreases in oxygen saturation levels after treatment. It may be due to the anxiety caused by dental procedure. <sup>(32)</sup> Anxiety and fear increase the amount of pain sensation and it causes an alarm reaction that occurs by vasoconstriction and dilatation of the blood vessels and causing more epinephrine and norepinephrine to be released, resulting in higher physiological parameter values.

Aromatherapy (Lavender or Orange) has been found to be very effective in reducing children's anxiety levels compared with controls. These results were in agreement with the results of Lehrner et al. <sup>(30)</sup>, and Kretsiedema et al. <sup>(1)</sup>, in. They noted that patients who experience the smell of oranges had a higher level of calmness. While Kritsedima et al., noted that lavender odor reduces anxiety in dental patients, although future visits may not be affected.

This study was disagreed with the number of studies that showed that inhalation of the essential oils was statistically not significant in reducing dental anxiety. <sup>(33&34)</sup> This may be due to the use of diffuser instead of direct inhalation of cotton or tissue as in our study, so less effect on child. A decreased pulse rate may be due to the reaction of the essential oil with the parasympathetic nervous system to adjust anxiety. As the parasympathetic activity increases,

the sympathetic nervous system decreased with lavender and orange oils. Hence, essential oils can have a relaxant effect on the respiration. Oxygen saturation levels postoperatively in the essential oils' groups showed no significant change compared with the control group. This may be due to hidden and ambiguous hypoxia due to unintentional neck flexion, which may reduce airway during dental treatment and result in a slight and insignificant change in oxygen saturation levels. <sup>(35&36)</sup>

Lavender and Orange groups showed a significant change in post-operative levels for all parameters in the study except oxygen saturation levels when compared with control group. Although this study showed no statistical significance in post-operative parameters levels, when comparing lavender and orange groups. The lavender group showed better results with a relatively lower respiratory and pulse rates and slightly increased oxygen saturation levels compared with the orange group. Inhaling volatile particles of lavender essential oil, they reach the lungs and spread rapidly to the blood, causing brain stimulation. However, these molecules are also attached to olfactory receptors, creating a physiological response to the electro cranial system. The resulting neocortex activation is expected to reach limbic system areas, including amygdale, hypothalamus, and areas where hormone levels and feelings are controlled. <sup>(3)</sup>

This study was supported by the previous committee studies using lavender perfume to reduce dental anxiety among patients through inhalation. <sup>(37&38)</sup> One study comparing the effect of lavender and rose oils on anxiety reduction between group of orthopedic patients. Lavender appears to be most significant in controlling anxiety, followed by rose oil. <sup>(37)</sup> Aromatherapy, an inexpensive and noninvasive treatment worldwide, is currently used to manage various disorders associated with anxiety, stress, chronic pain and depression.

## CONCLUSION

Based on the results of this study, it can be concluded that:

- (a) Essential oils inhalation (lavender or sweet oranges) with droplets decreases the anxiety in children during dental procedure;
- (b) Aromatherapy with lavender or orange reduced the respiratory and pulse rates in children;
- (c) Lavender and orange essential oils can be used as a natural and easy-to-prepare material with minimal side effects as anxiolytic and sedative to increase a child's positive impression towards the dental field.

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