



**Comparative evaluation of two different behavior management techniques: (aroma therapy and mobile gaming application) and it's relation in reducing dental anxiety during a dministration of local anaesthesia in 6-9 years old children – randomized controlled trial.**

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### **ABSTRACT**

**Background:** Dental anxiety is defined as “an abnormal fear or apprehension of visiting the dentist for prophylaxis or treatment, and irrational anxiety about dental procedures”. Fear and anxiety in children are immediately appreciated after seeing a needle. Dental anxiety can be controlled through various ways by using non- pharmacological methods. Aromatherapy is one of the potential non-drug methods, Lavender essential oil has been known for its soothing properties for centuries, and it is one of the most effective aromatherapy oils. It stimulates the parasympathetic nervous system and reduces blood pressure and anxiety levels at the same time. Mobile gamming application have become very common and technologically very advanced in this era. Pedodontists use this as a distraction technique to reduce the anxiety and also demonstrating the use of common dental instruments like airtor, ultrasonic scalers, tooth filling material, etc.

**Aim:** To evaluate and compare the effect of Aroma therapy and Mobile gaming application on reduction of dental anxiety during administration of local anaesthesia.

**Method:** 30 Children aged between 6 to 9 years were selected using random allocation sampling method. Children were divided into 2 groups; Group A - Aroma therapy (n=15) and Group B - Mobile gaming application (n=15). Dental anxiety of patient in each group was checked and noted in three-time intervals before, during and after the treatment. The parameters to calculate the level of dental anxiety are Heart rate by Pulse oximeter and Facial expression by visual Analog scale (VAS).

**Result and Conclusion:** According to the scores on visual analogue scale, reduction in dental anxiety is seen during the administration of local anaesthesia in group A. And in group B reduction in anxiety is seen after the administration of local anaesthesia. Non-significant results were obtained when heart rate is compared in three-time intervals in both the groups.

### **INTRODUCTION**

Dental fear and dentistry are common and potentially distressing problem for both the general public and the dentists. Dental anxiety is defined as “an abnormal fear or apprehension of visiting the dentist for prophylaxis or treatment, and irrational anxiety about dental procedures” and can have physiological, cognitive and behavioural consequences. Its intensity ranges from nervousness to dental phobia. This is considered a major barrier to successful treatment completion. As a result, dental anxiety affects dentists work lives and potentially reduces productivity. <sup>1</sup> This may increase the time of appointment per visit.

Coping with dental anxiety has been suggested as one of the most challenging things in practicing dentistry.<sup>2</sup>

A child's behaviour related to anxiety and fear is considered the most difficult aspect of child control. This behaviour is a result of separation from the mother, exposure to dental equipment and various dental treatments. The child's anxiety and relapse during the next treatment session will undoubtedly affect the effectiveness of the dentist and reduce the chances of a successful treatment. Anxiety in children usually occurs when they see syringes. Children's fears appear immediately after seeing a needle. At the same time, sudden movements of children can cause needle injuries. Anxiety affects children's life in many ways. Besides anxiety and fear children face some other consequences such as poor oral health, pain and abscess, loss of deciduous and permanent teeth and occlusal disharmony. Low levels of worry can lead to irregular referrals and lack of follow-up care. Anxiety can cause problems such as trouble sleeping and low self-esteem. Children express their fears in a variety of ways. Pain and anxiety can increase the heart rate, blood pressure, respiration rate and unintentional body movements. Accordingly, anxiety control is one of the most important factors in successful treatment.<sup>3</sup>

Anxiety is usually managed with both pharmacologically and nonpharmacological methods. Pharmacologic treatment of anxiety can significantly improve patient outcomes. However, it is associated with some risks, need additional equipment and cannot be used in patients with allergies and other medications. Various side effects such as fatigue, confusion, and restlessness are also observed. <sup>2</sup>By non- pharmacological method there are various ways to control dental anxiety, the initial approach is short-term distraction and relaxation.<sup>3</sup>

Aromatherapy is one of the potential non-drug methods that has achieved a lot more attention in recent years. It is feasible and also safe for children who are planned to undergo dental procedures under local anaesthesia. Different aromas are commercially available in the market, Lavender essential oil has been known for its soothing properties for centuries, and it is one of the most effective aromatherapy oils. It stimulates the parasympathetic nervous system and reduces blood pressure and anxiety levels at the same time. A dose-dependent effect of sedatives has also been demonstrated in several studies, and supplements have recently begun to be used clinically. Side effects such as prolonged sedation with GABA receptor agonist sedatives can be prevented by choosing lavender oil aromatherapy.<sup>4</sup>

Delivering aromatherapy by spreading the volatile fragrance of essential oils to a particular isolated environment is one of the common methods. The aromatic compounds are transformed into chemical signals through the nasal mucosa which in turn are relayed to the brain; these signals produce physiological and psychological effects on target organs/tissues to alter mood and cognitive function. Over the past decades, the increased popularity of aromatherapy used to treat anxiety disorders has been seen and well documented. Besides being pocket friendly, this non-invasive therapy with herb- or plant-derived fragrances has fewer or even no reported any side effects and does not tend to cause any type of dependency. Due to inhalation of aroma molecules, it stimulates the limbic system of brain via the olfactory system, which leads to increase in the carbohydrates in brain and stop the actions of the neurotransmitters (e.g., serotonin and histamine). Aromatherapy allow patients to relax their bodies and moods, and can facilitate their planned dental treatment afterwards. Additionally, the fragrances in dental offices may also mask the unpleasant odour of eugenol, which is considered one of the leading causes of patient-reported anxiety.<sup>5</sup>

Studies that are related to computer technicalities used for minimizing anxiety, have kept an eye on distraction during the dental procedures rather than psychological preparation before the dental appointment. Since use of smartphones have become very common and technologically very advanced in this era, they can be installed with proper simulation games to act as a newer, easy, and cost effective way to reduce dental anxiety in children needing

dental procedure.<sup>(6)</sup> Mobile dentist games that are available online, on play store and apple store approved by a committee of experienced Pedodontists for clinical usage and demonstrating the use of common dental instruments like airtor, ultrasonic scalers, tooth filling material, etc. in the form of animation with audio-visual effects were used to give children a new and attractive experience of their usage, sounds produced, and clinical effects obtained.<sup>7</sup>

## **MATERIALS AND METHOD**

This randomized, interventional, clinical study is conducted in the Department of Paediatric and Preventive Dentistry, after obtaining approval from the Institutional Review Board and Ethics Committee (SDKS/PG/Syn/Pedo3/18/2020) and written informed consent from the parents and assent from the children is taken. The study included 60 children selected using random allocation sampling method, aged 6 to 9 years. Patient is evaluated on the basis of Frankl's behaviour rating scale. Short case history of the patient is taken.<sup>7</sup> The study was carried forward after ethical clearance from the ethical committee. The study was conducted abiding by all human ethical principles as per the WMA- Declaration of Helsinki and Guidelines of Good Clinical Practice (ICMR) was observed. This study was conducted after obtaining parent's verbal and written consent, child's assent about study protocol in the vernacular language that is best understood by them. Both the genders had equal opportunity to participate in the study.

### **INCLUSION CRITERIA**

1. Subjects in age group of 6-9 years.
2. Patient with Frankl's behaviour rating score of 2 or 3.
3. Patient at their first dental visit.
4. Patients with prior parental consent.
5. Patient requiring Local Anaesthesia for treatment.<sup>8</sup>

### **EXCLUSION CRITERIA**

1. Patient with Frankl's behaviour rating score of 1 or 4.
2. Non-co-operative patients.
3. Medically compromised patient.
4. Patient requiring Pharmacological behaviour management.
5. Patients with previous history of LA administration.
6. Patient allergic to local anaesthetics.
7. Previous severe medical conditions that may have induced the anxiety of any medical environment.<sup>8</sup>

### **ARMAMENTARIUM USED**

1. 2 ml syringe.
2. 2% Lignocaine LA solution
3. Lavender essential oil.
4. Smartphone with a gaming application.
5. Pulse Oximeter.
6. Visual Analog Scale (VAS).<sup>8</sup>

The procedure is explained to the child and their parents in the waiting room in the local language (Marathi or Hindi) by the examiner. Informed consent is obtained from the selected children parents visiting for the first time who required local anaesthetic procedure. Children thus selected is further divided by picking the lots. Children picking the even number in the lot were selected in group A (Aroma therapy) and children with odd number were selected in

group B (Mobile gaming application). Each child is allowed to participate in the study only once.<sup>7</sup>

The selected samples are allocated in two groups:

- Group A - Aroma Therapy. (n=30)
- Group B - Mobile gaming application. (n=30)

A single examiner has checked the patient and carried out the study to rule out any operator bias in recording the scores. Dental anxiety of patient in each group is checked and noted in three-time intervals before, during and after the procedure. The parameters to calculate the level of dental anxiety are Heart rate by Pulse oximeter and Facial expression by visual Analog scale (VAS).

### **BEFORE THE PROCEDURE**

In group A and B both the parameters, Heart rate (HR) by pulse oximeter and Facial expression by Visual analogue scale (VAS) were checked and noted before the administration of local anaesthesia.

### **DURING THE PROCEDURE**

- **GROUP A:** In group A, children were subjected to Aroma therapy through lavender essential oil that is commercially available in market. The patient was taken to a different room that contains the volatile fragrance of Lavender essential oil. And the procedure was carried out in this environment.
- **GROUP B:** In group B, a mobile was given to play a dentist game. A smartphone holder was placed on the dental chair which made playing an interactive game on the smart phone accessible for the child during the treatment. The selected game was Crazy Dentist, by bonbongame.com, version- 1.3.5 downloaded from google play store on android phone. The game has stages with different tasks such as fantasy versions of dental extraction, cavity preparation, filling, scaling, or brushing. There was no image of blood or syringes in the game.

In group A and B both the parameters, Heart rate (HR) by pulse oximeter and Facial expression by Visual analogue scale (VAS) were checked and noted during the procedure.

### **AFTER THE PROCEDURE**

In Group A and B both the parameters, Heart rate (HR) by pulse oximeter and Facial expression by Visual analogue scale (VAS) were checked and noted after the procedure.<sup>7</sup>

### **RESULT**

The software used in the analysis were SPSS 24.0 and Graph Pad Prism 7.0 version and  $p < 0.05$  is considered as level of significance.

The statistical tests used for the analysis of the result were:

1. Students unpaired t test
2. Student's paired t test

### **Table 1:**

Table 1 shows comparison of heart rate score before, during and after the procedure in group A using Student's paired t test. Mean and standard deviation is calculated. The p- value during and after the procedure are 1.69 and 0.25 respectively, which shows a statistically non-significant results in table 1.

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Before Treatment	101.36	15	11.74	2.14	-	-
During Treatment	104.20	15	11.10	2.02	2.83±9.17	1.69 P=0.10
After Treatment	100.90	15	9.09	1.66	0.46±10.18	0.25 P=0.80

**Table 2:**

Table 2 shows comparison of anxiety on VAS score before, during and after the procedure in group A using Student's paired t test. Mean difference calculated during and after the procedure are  $0.90\pm 1.37$  and  $0.40\pm 1.27$ . P- value during the administration of local anaesthesia is 0.001 which gives the significant result.

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Before Treatment	3.16	15	1.53	0.27	-	-
During Treatment	4.06	15	1.72	0.31	$0.90\pm 1.37$	2.58 P=0.001
After Treatment	2.76	15	1.73	0.31	$0.40\pm 1.27$	1.71 P=0.097

**Table 3:**

Table 3 shows comparison of Heart Rate score before, during and after the procedure in group B using Student's Paired t test. Mean difference calculated during and after the procedure are  $0.03\pm 19.21$  and  $1.03\pm 6.86$ . P- value during and after the administration of local anaesthesia are P=0.99 and P=0.41 respectively which gives the non- significant results.

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Before Treatment	98.13	15	7.45	1.36	-	-
During Treatment	98.10	15	18.56	3.38	$0.03\pm 19.21$	0.01 P=0.99
After Treatment	99.16	15	820	1.49	$1.03\pm 6.86$	0.82 P=0.41

**Table 4:**

Table 4 shows the comparison of anxiety on VAS score before, during and after the procedure in group B using Student's Paired t test. Mean and standard deviation is calculated. The p- value after the procedure is 0.003, which shows a reduction in anxiety and gives a statistically significant result in table 4.

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Before Treatment	3.16	15	1.74	0.31	-	-
During Treatment	3.80	15	2.09	0.38	$0.63\pm 2.23$	1.55 P=0.13
After Treatment	2.46	15	1.52	0.27	$0.70\pm 1.17$	3.25 P=0.003

**Table 5:**

Table 5 shows comparison of heart Rate score in two groups before, during and after the procedure using Student's unpaired t test. The calculated p- value are as follows: before- 0.20, during- 0.12 and after- 0.44 which gives statistically non- significant results.

Treatment	Group A		Group B		t-value	p-value
	Mean	SD	Mean	SD		
Before Treatment	101.36	11.74	98.13	7.45	1.27	0.20
During Treatment	104.20	11.10	98.10	18.56	1.54	0.12
After Treatment	100.90	9.09	99.16	8.20	0.77	0.44

**Table 6:**

Table 6 shows comparison of heart Rate score in two groups before, during and after the procedure using Student's unpaired t test. The calculated p- value is more than 0.05 which gives statistically non- significant results in all the three-time intervals of the procedure.

Treatment	Group A		Group B		t-value	p-value
	Mean	SD	Mean	SD		
Before Treatment	3.16	1.53	3.16	1.74	0.00	1.00
During Treatment	4.06	1.72	3.80	2.09	0.53	0.59
After Treatment	2.76	1.73	2.46	1.52	0.71	0.48

## DISCUSSION

The aim of this study was to investigate the impact of aroma therapy and a dental game application on anxiety levels in children between the ages of 6-9 who require Inferior alveolar nerve block for dental treatment. Anxiety is a negative emotion associated with actual or potential tissue damage. Various techniques have been proposed to reduce anxiety in children receiving dental care. Despite the widespread use of mobile phone technology, it has not been utilized for this purpose. Playing dental games on mobile phones during treatment can provide a natural and frequent way to distract child patients from the trauma of injection.<sup>9</sup>

Aromatherapy is currently used to alleviate symptoms such as cold or flu, anxiety, nausea, pain, body aches, headaches, and circulatory problems. These essential oils are known for their calming, carminative, and sedative effects. Therefore, the olfactory effects of these oils on mood, physiology, and behaviour were studied. To measure anxiety levels in paediatric dental patients, pulse and facial expressions were used as indicators. Visual analogue scales for facial expressions and pulse oximeters were used to measure heart rate.<sup>10</sup>

The behaviour of children in a dental office is influenced by various factors such as age, personality, parenting style, parental anxiety, medical and dental history, knowledge about their dental problems, and the type of dental environment. Children between the ages of 6-9 were included in this study as they are considered suitable for comparing the efficacy of two behavioural control techniques. According to Piaget's cognitive developmental stage, children in this age group have complete verbal and speech development, are independent of parents, and accept reality and rules. However, higher levels of acquired anxiety in this age range suggest considerable dental anxiety, and thus behavioural control measures, particularly novel methods, are still necessary in this age group. The two groups in this study had no significant age distribution differences, and patients with previous dental experiences were excluded to eliminate potential confounding effects. Evidence suggests that the level of stimulation decreases as children gain experience in the dental environment, and previous dental visits help children cope with their stress from dental procedures.<sup>11</sup>

Significant difference was seen (p= 0.001) in group A (which received aromatherapy) experienced a significant reduction in anxiety during treatment compared to other groups, as measured by the Visual Analogue Scale (VAS) in accordance with this study. In the study cited by Nirmala K, Nirmala K, and Kamatham R, the use of aromatherapy with lavender was

found to decrease dental anxiety and pain in children, as measured by the FLACC observational scale.<sup>12</sup> Kweh TJ and Lim GS also noted in their review that aromatherapy, which uses essential oils to produce physiological or pharmacological effects through the sense of smell, can be beneficial for patients. Patients who received aromatherapy reported a greater improvement in mood and a reduction in perceived anxiety.<sup>13</sup>

There was no significant difference seen in reduction of anxiety when the heart rate of children is calculated and compared before, during and after the administration of local anaesthesia in group A (Aroma therapy). The P value is calculated: During the treatment- (p=0.10) and after the treatment- (p=0.80). Similarly, in the studies quoted by Seyyed-Rasooli et al. argue that aromatherapy massage did not decrease the heart rate in paediatric patients.<sup>14</sup> Also, Van Dijk claims that aromatherapy massage has no effect on heart rate in paediatric patients.<sup>15</sup> In Bikmoradi's study, it was determined that there was no statistically significant difference in terms of heart rate and respiratory rate between the participants in the group in which inhalation aromatherapy was applied with lavender oil and the participants in the control group.<sup>16</sup>

Our study showed no significant difference in heart rate in all three-time intervals (before, during, and after administration of local anaesthesia) in group B, which used a mobile dental game application. The study done by Nivedita P and Amar K. in 2019 used subjective scales such as FIS and FR to assess child behaviour and found no significant differences between the two techniques (Tell Show Do and Interactive mobile game) on the parameter of FR rating. It is important to note that the FR scale is a subjective assessment of child behaviour and may not accurately indicate the degree of the behaviour or a change in behaviour. Similarly, no significant differences were found in the FIS scores, which could be attributed to the limitations of the scale as a subjective expression. Both techniques resulted in a reduction in PR, but there was no significant difference between the two. Overall, these findings suggest that the use of a mobile dental game application may not have a significant impact on heart rate but may be a useful tool for improving child behaviour during dental procedures.<sup>17</sup>

In the study it is seen that the use of a mobile dental game application was associated with a significant decrease in anxiety after the administration of local anaesthesia, as measured by a visual analogue scale (VAS). The meta-analytical survey conducted by Nora Suleiman-Martos in 2022 also found that game-based interventions had a positive impact on reducing preoperative anxiety in children before and during the induction of anaesthesia. In particular, a mean difference of -10.62 (95% CI -13.85, -7.39) on the Modified Yale Preoperative Anxiety Scale was recorded in favour of mobile dental game-based interventions. These findings suggest that game-based interventions, such as mobile dental game applications, can be effective in reducing preoperative anxiety in children.<sup>18</sup> However, it is important to note that engaging a child with smartphone applications may be a distraction in the behaviour guidance technique, as suggested by the study conducted by Jong-Hyuk Lee et al. Therefore, it is important to consider the appropriate use of mobile dental game applications as a tool for reducing preoperative anxiety in children, while also ensuring that it does not interfere with the overall behaviour guidance technique during dental procedures.<sup>19</sup>

Based on our study, it is found that both aroma therapy and mobile dental gaming applications were effective in reducing anxiety in children during and after the administration of local anaesthesia. However, there was no significant difference in heart rate between the two groups. Instead, the visual analogue scale (VAS) was used to measure anxiety levels, and it showed a significant decrease in anxiety during both aroma therapy and mobile gaming application. These findings suggest that the use of non-pharmacological interventions, such as aroma therapy and mobile dental gaming applications, may be effective in reducing anxiety in children during dental procedures, as measured by subjective self-report measures

like VAS. However, it is important to note that more research is needed to confirm these findings and to better understand the mechanisms underlying the effects of these interventions.

## **CONCLUSION**

In group A, children subjected to Aroma therapy through lavender essential oil that is commercially available in market and in group B, children playing an interactive game on the smart phone: Crazy Dentist, by bonbongame.com, version- 1.3.5 downloaded from google play store on android phone are compared and evaluated to check its relation in reduction of dental anxiety.

Based on this in-vivo study findings, within the limitations, it can be concluded that:

- Lavender essential oil showed reduction in dental anxiety during the administration of local anaesthesia when all the readings from visual analogue scale was statistically analysed.
- Mobile gaming application helps in reduction of dental anxiety after the procedure is completed when data was analysed from the readings of visual analogue scale.
- It was also found that, no statistically significant difference is seen in reduction of dental anxiety in both the groups, when heart rate is used as a parameter.

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