Clinical Trial

AROMATHERAPY VERSUS CONSCIOUS SEDATION EVALUATION IN REDUCING DENTAL ANXIETY IN PEDIATRIC DENTAL PATIENTS

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ABSTRACT

Recent research has sparked a discussion over the best ways to treat young children with caries in their primary dentition. When children usually fear injections and the dental environment, there is a need to ensure that they have a smooth dental experience. Therefore the study aims to differentiate the effect of aromatherapy and conscious sedation in reducing dental anxiety among children undergoing extraction. This randomized clinical trial was conducted in a private dental college for patients who visit the Department of Pediatric and Preventive Dentistry in Chennai. The study population was 6-9 years old children and 30 of them were divided randomly into aromatherapy and conscious sedation groups. A Venham picture scale was employed to assess dental anxiety and a digital pulse oximeter for pulse and oxygen saturation. A sphygmomanometer was used to assess the blood pressure. All the parameters were assessed before and after the extraction. SPSS version 23.0 was used for statistical analysis of the data in which independent and paired t-tests were done to assess the distribution of difference in the parameters. The mean age of the aromatherapy and conscious sedation group were 7.93 ±1.033 and 7.20 ±1.612 respectively. In both groups, pulse and anxiety levels were significantly reduced post-extraction. Also post-extraction, oxygen levels were significantly higher in conscious sedation groups. Both aromatherapy and conscious sedation were effective ways to reduce anxiety and heart rate in children undergoing dental procedure.

Key words: Dental anxiety, Aromatherapy, Lavender oil, Nitrous oxide, Conscious sedation, Venham picture scale.

Introduction

Over the world, aromatherapy is a burgeoning alternative therapy. Americans spend more than 300 crores on this therapy each year, as reported by the National Institutes of Health National Center for Complementary and Integrative Medicine [1]. By 2050, it is anticipated that the global market will reach 500 crores. Also known as integrative medicine [2].

Understanding the distinction between integrative therapy and alternative therapy is crucial for frontline nurses. While integrative therapy stands alone and takes the place of any traditional medical care, alternative medicine uses therapy to supplement conventional medical care [3]. These therapies fall under the categories of hypnotic therapy, biologically based practices, persuasive and spiritual practices, biofeedback, and authentic medical systems, such as AYUSH and traditional Chinese medicine (TCM), developed by the National Institutes of Health and the National Center for Complementary and Integrative Health [4]. Aromatherapy in dentistry care falls under the umbrella of mind-body therapy [5].

Nursing care uses essential oils to supplement therapeutic measures and reduce anxiety. Applications of plant-based essential oils are anticipated to be measurable, including pre-anxiety symptoms, essential oil interventions, and post-anxiety symptoms [6]. Anxiety levels before and after the delivery of an essential oil can be used to gauge the outcome and determine the efficacy of the oil [7].

The practice of aromatherapy dates back thousands of years. Hippocrates, the founder of modern medicine, promoted aromatherapy because he thought that scented baths and massages were essential for maintaining health [8]. Some researchers suggest that aromatherapy is a sustainable therapy for the mind, body, and spirituality [9].

One of the herbs that is frequently studied for its medical and aromatic properties is lavender, or Lavandula, which belongs to the Lamiaceae family. Since ancient times, the purple-blue flower of the shrub has been utilized for healing several diseases [10]. Lavandula angustifolia, Lavandula latifolia, Lavandula stoechas, and Lavandula intermedia are the four species of lavender that are used most frequently. It is grown for commercial purposes all over the world. It is grown in Himachal Pradesh, Uttar Pradesh, and the Kashmir Valley region of India. It is known to have anxiolytic, anti-inflammatory, antinociceptive, antioxidant, and

antibacterial properties have all been reported [11, 12]. From ancient times, Lavandula angustifolia (lavender) oil from the plant has been extensively exploited as a medicinal and cosmetic agent. The European Medication Authority has granted authorization as a herbal medication. According to reports, lavender oil provides calming, unwinding, and anti-infectious effects. It has also been demonstrated to enhance sleep. Lavender oil inhalation has recently received a lot of attention in aromatherapy, a natural stress-reduction technique. Autonomic factors including blood pressure and heart rate have been shown to drop when using lavender aromatherapy. Inhaling lavender oil has also been shown to reduce anxiety during gynecological exams and postpartum depression as well.

A remedy for the issue of antibiotic resistance, invasive procedures, adverse effects, or even drug addiction may be found in herbal items like lavender essential oils [13]. Due to the development of medication resistance, these qualities make lavender an extremely beneficial medical herb today. Various studies have been conducted on the use of herbal essential oils in dentistry and medicine [14]. A promising substitute for several of the synthetic materials used in dentistry sciences is a lavender species. As an alternative to antibiotics, a treatment for local infections, a method of easing dental anxiety, or a way to stop biofilm from forming on teeth, it may also be used to treat local infections [15]. It can be vaporized, applied locally, or utilized in oral formulations. Because of the numerous applications of lavender sourcing its medicinal properties, there is a need to focus on its use in the dental field for a wholesome experience [16]. Therefore this study aims to compare the effect of aromatherapy and conscious sedation in reducing dental anxiety in pediatric dental patients.

Materials and Methods

Study design
A randomized trial.

Study setting
The investigation was carried out at a private dental institution in Chennai's pediatric and preventive dentistry department.

Study population
The study population included patients visiting the outpatient department of pediatric dentistry aged 6-9 years. 30 children were allotted randomly into 2 groups namely the aromatherapy group and the conscious sedation group.

Inclusion criteria
- Children between the age group of 6 and 9 years who require treatments that are extraction of mandibular molar etc. and whose parents were willing to participate in the study were included.
- Children who fit within category three of Frankl's behavior rating scale, or (positive: patient cooperates with the dentist and accepts treatment; patient exhibits occasionally cautious behavior; patient is generally willing to comply with dentist's requests.)

Exclusion criteria
- Children whose parents were not willing to take part in the study were excluded,
- Children who were challenged systemically were excluded,
- Children getting the same treatments under GA were excluded.
- Children with short-term severe pain and/or rapid treatment intervention
- Children who give the impression of having behavior problems (excessive attachment to parents etc.)

Ethical clearance
- An institutional ethical committee's approval for the study's conduct was acquired before it began.
- The parents of the study subjects provided their written informed consent.
- The participants' identities were kept private.

Sample size calculation
G Power computed the sample size based on the Janthasila *et al*. study from 2023 [5] with a p-value of 0.05 and 95 power and an effect size of 0.756. Thirty was the estimated sample size.

Sampling
The study participants were chosen using a simple random sampling procedure.

Survey instrument
The anxiety levels of the study subjects were assessed using the Venham picture scale. Eight cards—one labeled "anxious" and the other "non-anxious"—make up the Venham Picture Test. The children were asked to point to the figure that, at the time, most closely resembled them. The numbers were on top of the deck of cards while it was on display. If the child pointed at the "anxious" figure, a score of one was recorded; if the child pointed at the "non-anxious" figure, a score of zero was recorded. The total score was calculated by adding the number of times the "anxious" figure was chosen (minimum score: 0; maximum score: 8) **(Figure 1)** [17].

A digital pulse oximeter was employed to assess the pulse rate and oxygen saturation of the child during the appointment. A BP apparatus was used to measure the blood pressure of the children.

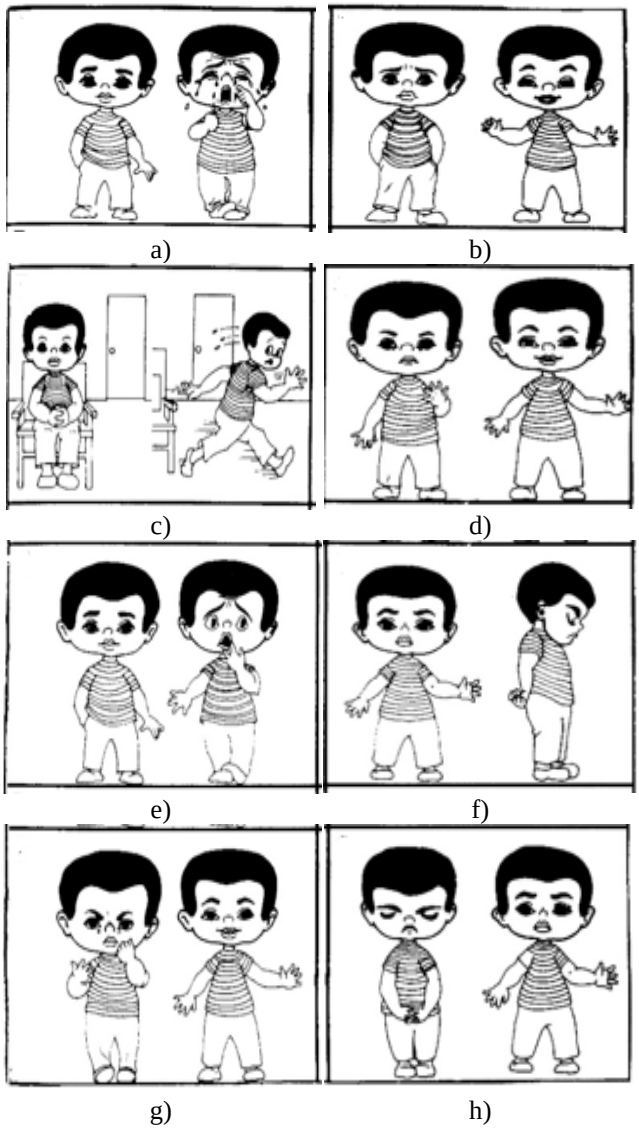

Figure 1. Venham Picture Scale

Randomization and allocation concealment

A statistics consultant created a random block design using a computer. Block randomization admitted for an equal distribution of the two groups mandibular quadrants (A: The aromatherapy side and B: Conscious sedation side) within each block, which represented two quadrants. To choose which side will be attended to during the visit, a simple random sequence was constructed. 30 sheets of standard size were inserted with the block randomized list sequence. Afterward, each sheet was covered with a piece of black paper, and the two papers were inserted into an envelope. The 30 blocks were all built in the same way.

The sleeves or covers were carefully combined in a plastic container before being sequentially labeled with the numbers 1 through 30. The next chain was written on 30 sheets in a similar manner. The 30 envelopes were numbered 1 through 30 and mixed in another plastic container. When patients were selected for the examination session, the envelopes were placed into each container in number order and the patients opened each one in turn.

Blinding

Due to the nature of the intervention, it was not possible to blind the researchers or the patients. The statistician who analyzed the data was blinded about the allocation of the groups.

Data collection

Thirty children were screened who came to the pedodontic department of a tertiary dental center. All study procedures were carried out by a single investigator. According to Frankl's behavior rating scale, the patients were monitored and their behavior was documented. Once the patient's guardians had signed the informed consent form and the patient met the trial's inclusion specifications, they were given a thorough explanation of the study methodology. Only then was the patient allowed to participate in the experiment. Children were randomly divided into two groups.

Children who were allocated to the aromatherapy group were made to sit in a separate room for 30 minutes and aromatherapy was delivered through a humidifier. Lavender oil was infused in the humidifier. Extraction was done in the same room after 30 minutes the child was allowed to sit. The other 15 children underwent conscious sedation by intranasal administration of nitrous oxide with a nasal hood. After the child went to the stage of conscious sedation, extraction was done.

Blood pressure, pulse rate, oxygen saturation, and anxiety were assessed before and after the extraction in both groups.

Statistical analysis

Microsoft Excel spreadsheet was used to enter the data, and SPSS software was used to analyze it (version 23.0). Descriptive statistics, which included mean, standard deviation, frequency, and percentages were used to analyze the data. To determine if the distribution of all parameters was normally distributed, the Kolmogorov-Smirnov test was used. Paired t-tests for intragroup comparison and independent t-tests for used to assess the differences in the means of continuous variables for intergroup comparisons at $p<0.05$.

Results and Discussion

There were 30 study participants included in the study and they were divided into two groups with a 1:1 allocation ratio. The mean age of the aromatherapy group was found to be 7.93 ±1.033 and the conscious sedation group was 7.20 ± 1.612 **(Figure 2)**. In the aromatherapy group, 46.7% males and 53.3% females were distributed and in the conscious sedation group, 60% males and 40% females were present **(Table 1)**.

In the aromatherapy and conscious sedation groups, there

was a significant difference in the pulse and anxiety which were reduced post-extraction, and in the conscious sedation group oxygen saturation was significantly increased post-extraction **(Table 2)**.

Independent t-test revealed that before the extraction, there was no significant difference between the groups in any of the parameters but post extraction, Oxygen saturation was statistically higher in the conscious sedation group than the aromatherapy group. Also post extraction, the anxiety level was significantly lower in the aromatherapy group than in the conscious sedation group **(Table 3)**.

This shows that both aromatherapy and conscious sedation significantly reduce the anxiety and pulse of the patients during the extraction procedure.

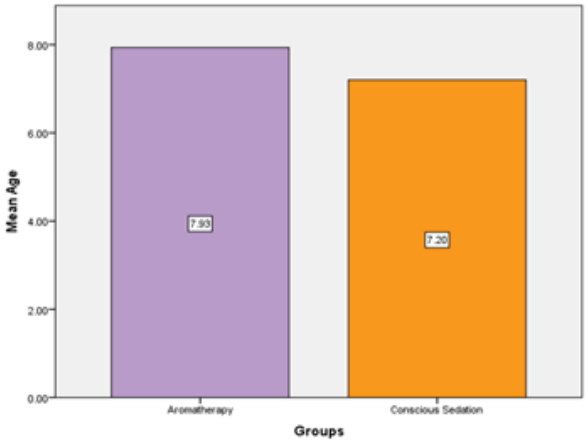

Figure 2. Distribution of age among the study groups

Table 1. Distribution of gender among the study groups

Groups	Males	Females
Aromatherapy	7 (46.7)	8(53.3)
Conscious sedation	9(60)	6(40)

Table 2. Paired t-test showing mean differences between the pre-and post-extraction in various parameters among the study groups

Paired t-test					
		Mean	Std. Deviation	Std. Error Mean	p-value
Pair 1	Aromatherapy pre-oxygen saturation	98.067	.7988	.2063	.217
	Aromatherapy post-oxygen saturation	97.800	.4140	.1069	
Pair 2	Aromatherapy pre-pulse beats/minute	82.600	5.3426	1.3794	**0.000**
	Aromatherapy post-pulse beats/minute	79.200	4.9886	1.2880	
Pair 3	Aromatherapy pre-anxiety level	4.800	.4140	.1069	**0.000**
	Aromatherapy post-anxiety level	.533	.5164	.1333	
Pair 4	Conscious sedation spare-oxygen saturation	98.200	.6761	.1746	**0.000**
	Conscious sedation post-oxygen saturation	99.667	.4880	.1260	
Pair 5	Conscious sedation pre-pulse beats/minute	84.333	5.9362	1.5327	**0.000**
	Conscious sedation post-pulse beats/minute	77.000	6.2106	1.6036	
Pair 6	Conscious sedation pre-anxiety level	4.867	.3519	.0909	**0.003**
	Conscious sedation post-anxiety level	3.533	1.4075	.3634	
Pair 7	Aromatherapy pre-blood pressure	113.67	6.114	1.579	0.082
	Aromatherapy post-blood pressure	112.67	6.230	1.609	
Pair 8	Conscious sedation pre-blood pressure	111.33	2.968	.766	0.751
	Conscious sedation post-blood pressure	111.00	3.381	.873	

Table 3. Independent t-test showing mean differences between the study groups in various parameters

Independent t-test				
	Groups	Mean	Std. Deviation	p-value
Pre BP	Aromatherapy	113.6667	6.11400	0.198
	Conscious sedation	111.3333	2.96808	
Pre oxygen saturation	Aromatherapy	98.0667	.79881	0.626
	Conscious sedation	98.2000	.67612	
Pre pulse	Aromatherapy	82.6000	5.34255	0.408
	Conscious sedation	84.3333	5.93617	
Pre anxiety	Aromatherapy	4.8000	.41404	0.638
	Conscious sedation	4.8667	.35187	
Post BP	Aromatherapy	112.6667	6.22973	0.373
	Conscious sedation	111.0000	3.38062	
Post oxygen saturation	Aromatherapy	97.8000	.41404	**0.000**
	Conscious sedation	99.6667	.48795	
Post pulse	Aromatherapy	79.2000	4.98856	0.294
	Conscious sedation	77.0000	6.21059	
Post	Aromatherapy	.5333	.51640	**0.000**

anxiety	Conscious sedation	3.5333	1.40746

Among the dental procedures that can cause dental anxiety is dental extraction. Because local anesthetic was administered using a syringe, this might be conceivable. An injection phobia is a main element that can contribute to the progression of dental anxiety [18]. According to recent research on dental anxiety before extraction of permanent teeth that comprised 164 oral surgery patients at Pacific Dental College in India, of these patients, 35.2% had this phobia. Tooth phobia that may develop during a tooth extraction process can make the procedure more difficult and reduce the likelihood of a successful extraction [19]. Dental trauma or unpleasant encounters, as well as frightened attitudes, picked up from dentally nervous family members, might be linked to the etiology of dental anxiety [20]. Dental anxiety patients can be divided into four groups based on the main causes of their fear: those who are afraid of a particular stimulus, those who have a low level of trust for dental professionals, those who have low levels of anxiety about most things in general, and those who fear that medical emergencies may occur while they are receiving dental treatment [21]. Anxious patients will show some refusal symptoms while obtaining care, regardless of how dental anxiety is classified. These physical, behavioral, cognitive, and emotional symptoms of anxiety-related refusal can all be classified as symptoms of anxiety [22]. The physiological symptoms, which include dyspnea, hyperventilation, tachycardia, hypertension, tachypnea, nausea, and vomiting, are the ones that are most likely to indicate that the treatment has failed [23]. These physiologic symptoms can be reduced by sedation. Using sedatives eases nervousness, irritation, and agitation to simplify scheduled dental treatments. Sedation has two major purposes: to make it feasible for dentists to work efficiently and to keep patients as at ease and comfortable as possible [24].

The current study used conscious sedation with nitrous oxide and aromatherapy with lavender oil to reduce dental anxiety among children undergoing extraction. In a similar study done in Iran, when 45 preschoolers underwent pulp therapy under LA, conscious sedation and cognitive behavior therapy significantly reduced dental anxiety and higher cooperation compared to the control group [25]. Similarly, in a study done in Turkey, Dental rehabilitation under conscious sedation improved the quality of life and dental behavior [26]. Aromatherapy also has its share of success. In a study done in Nellore, children who were undergoing dental treatment under local anesthesia, dental anxiety was reduced by lavender or sweet orange aromatherapy when administered through a nebulizer or inhaler, but only sweet orange helped alleviate the discomfort that the children self-reported [27]. Also in 72 orthodontic patients lavender oil and rose oil were given as intervention for their appointments. Participants' heart rate and blood pressure, both objective indicators of dental anxiety, and a subjective dental anxiety scale reduced during the aromatherapy [28].

A systematic review and meta-analysis that analyzed 6 clinical trials found that aromatherapy, when utilized judiciously, reduces anxiety levels, and blood pressure during dental procedures [29]. Also, another systematic review, which assessed 11 randomized controlled trials and 6 clinical trials reported that compared to negative control and music intervention, aromatherapy reduced anxiety and its physiologic symptoms such as pain, mood, alertness, and calmness among patients undergoing dental treatment [30].

Contrastingly music therapy was found to reduce dental anxiety among dental patients which was also proved to significantly reduce dental anxiety, blood pressure, and heart rate [31, 32]. Other therapies beyond music include hypnosis, acupuncture, diversion, reinforcement of good behavior, stop signaling, and exposure-based therapies including systematic desensitization, modeling, muscular relaxation, and cognitive therapy [33]. Our team has extensive knowledge and research experience that has translated into high quality [34-44]. This present study also has its limitations. It only compared two interventions when there are a lot of existing strategies to assess dental anxiety. Also, the lack of a control group can be another limitation of the study. The study assessed patients only undergoing extraction when it could have assessed all the dental procedures under local anesthesia. The results of this present study therefore cannot be generalized.

Conclusion

Within the limitations of the present study, both aromatherapy and conscious sedation effectively reduced dental anxiety and its objective physiological symptom pulse rate. Since there is no control group, future studies with a control group for patients undergoing dental procedures under LA should be assessed with various types of aromatic oils given through a nebulizer or diffuser.

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Conflict of interest: None

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Ethics statement: The study was performed after approval by the Institutional Human Ethical Committee (IHEC/SDC/PEDO-2005/22/127).

References

1. Brignardello-Petersen R. Aromatherapy may be effective in reducing anxiety in patients undergoing dental treatment. J Am Dent Assoc. 2020;151(11):e109. doi:10.1016/j.adaj.2020.07.005
2. Price S, Price L. Aromatherapy for health professionals E-Book. Elsevier Health Sciences; 2011.

3. Pal SK, Shukla Y. Herbal medicine: Current status and the future. Asian Pac J Cancer Prev. 2003;4(4):281-8.
4. Jamshidi N, Cohen MM. The clinical efficacy and safety of tulsi in humans: A systematic review of the literature. Evid Based Complement Alternat Med. 2017;2017(1):9217567. doi:10.1155/2017/9217567
5. Janthasila N, Keeratisiroj O. Music therapy and aromatherapy on dental anxiety and fear: A randomized controlled trial. J Dent Sci. 2023;18(1):203-10. doi:10.1016/j.jds.2022.06.008
6. Malcolm BJ, Tallian K. Essential oil of lavender in anxiety disorders: Ready for prime time? Ment Health Clin. 2018;7(4):147-55.
7. Mojtehedi M, Salehi-Pourmehr H, Ostadrahimi A, Asnaashari S, Esmaeilpour K, Farshbaf-Khalili A. Effect of aromatherapy with essential oil of Lavandula angustifolia mill- citrus bergamia and mindfulness-based intervention on sexual function, anxiety, and depression in postmenopausal women: A randomized controlled trial with factorial design. Iran J Nurs Midwifery Res. 2022;27(5):392-405.
8. Sibbritt DW, Catling CJ, Adams J, Shaw AJ, Homer CS. The self-prescribed use of aromatherapy oils by pregnant women. Women Birth. 2014;27(1):41-5.
9. Shaaban HA, El-Ghorab AH, Shibamoto T. Bioactivity of essential oils and their volatile aroma components. J Essent Oil Res. 2012;24(2):203-12.
10. Sen I. Lavender essential oil: Your complete guide to lavender essential oil uses, benefits, applications and natural remedies. CreateSpace Independent Publishing Platform; 2016.
11. Nisa NT, Chisti H. Handbook of lavender as a medicinal plant. GRIN Verlag; 2017.
12. Silva GL, Luft C, Lunardelli A, Amaral RH, Melo DA, Donadio MV, et al. Antioxidant, analgesic and anti-inflammatory effects of Lavender essential oil. An Acad Bras Cienc. 2015;87(2 Suppl):1397-408.
13. Erland LA, Mahmoud SS. Lavender (lavandula angustifolia) oils. Essential Oils in Food Preservation, Flavor and Safety. 2016:501-8.
14. Kajjari S, Joshi RS, Hugar SM, Gokhale N, Meharwade P, Uppin C. The effects of Lavender essential oil and its clinical implications in dentistry: A review. Int J Clin Pediatr Dent. 2022;15(3):385-8.
15. Arslan I, Aydinoglu S, Karan NB. Can lavender oil inhalation help to overcome dental anxiety and pain in children? A randomized clinical trial. Eur J Pediatr. 2020;179(6):985-92.
16. Dagli N, Dagli R, Mahmoud RS, Baroudi K. Essential oils, their therapeutic properties, and implication in dentistry: A review. J Int Soc Prev Community Dent. 2015;5(5):335-40.
17. Buchanan H, Niven N. Validation of a facial image scale to assess child dental anxiety. Int J Paediatr Dent. 2002;12(1):47-52.
18. Maulina T, Djustiana N, Shahib MN. The effect of music intervention on dental anxiety during dental extraction procedure. Open Dent J. 2017;11(1):565-72.
19. Nair MA, Shankarapillai R, Chouhan V. The dental anxiety levels associated with surgical extraction of tooth. Int J Dent Clin. 2009;1(1):20-3.
20. Haliti F, Juric H. The relationship between dental trauma, anxiety and aggression behavior in 7 to14 year old children in kosovo. Acta Stomatol Croat. 2017;51(1):3-12.
21. Jeddy N, Nithya S, Radhika T, Jeddy N. Dental anxiety and influencing factors: A cross-sectional questionnaire-based survey. Indian J Dent Res. 2018;29(1):10-5.
22. Stenebrand A, Wide Boman U, Hakeberg M. Dental anxiety and symptoms of general anxiety and depression in 15-year-olds. Int J Dent Hyg. 2013;11(2):99-104.
23. Halonen H, Nissinen J, Lehtiniemi H, Salo T, Riipinen P, Miettunen J. The association between dental anxiety and psychiatric disorders and symptoms: A systematic review. Clin Pract Epidemiol Ment Health. 2018;14:207-22.
24. Dantas LP, de Oliveira-Ribeiro A, de Almeida-Souza LM, Groppo FC. Effects of passiflora incarnata and midazolam for control of anxiety in patients undergoing dental extraction. Med Oral Patol Oral Cir Bucal. 2017;22(1):e95-101.
25. Kebriaee F, Sarraf Shirazi A, Fani K, Moharreri F, Soltanifar A, Khaksar Y, et al. Comparison of the effects of cognitive behavioural therapy and inhalation sedation on child dental anxiety. Eur Arch Paediatr Dent. 2015;16(2):173-9.
26. Guney SE, Araz C, Tirali RE, Cehreli SB. Dental anxiety and oral health-related quality of life in children following dental rehabilitation under general anesthesia or intravenous sedation: A prospective cross-sectional study. Niger J Clin Pract. 2018;21(10):1304-10.
27. Nirmala K, Kamatham R. Effect of aromatherapy on dental anxiety and pain in children undergoing local anesthetic administrations: A randomized clinical trial. J Caring Sci. 2021;10(3):111-20.
28. S PK, Aafaque S, S S, N N. Effect of aromatherapy on dental anxiety among orthodontic patients: A randomized controlled trial. Cureus. 2019;11(8):e5306.
29. Purohit A, Singh A, Purohit B, Shakti P, Shah N. Is aromatherapy associated with patient's dental anxiety levels? A systematic review and meta-analysis. J Dent Anesth Pain Med. 2021;21(4):311-9.
30. Cai H, Xi P, Zhong L, Chen J, Liang X. Efficacy of aromatherapy on dental anxiety: A systematic review of randomised and quasi-randomised controlled trials. Oral Dis. 2021;27(4):829-47.
31. Packyanathan JS, Lakshmanan R, Jayashri P. Effect of music therapy on anxiety levels on patient undergoing Dental extractions. J Family Med Prim Care. 2019;8(12):3854-60.
32. Bradt J, Teague A. Music interventions for dental anxiety. Oral Dis. 2018;24(3):300-6.

33. Appukuttan DP. Strategies to manage patients with Dental anxiety and Dental phobia: Literature review. Clin Cosmet Investig Dent. 2016;8 (Issue 1):35-50.
34. Priyadarshini P, Jeevanandan G, Govindaraju L, Subramanian EMG. Clinical evaluation of instrumentation time and quality of obturation using paediatric hand and rotary file systems with conventional hand K-files for pulpectomy in primary mandibular molars: A double-blinded randomized controlled trial. Eur Arch Paediatr Dent. 2020;21(6):693-701.
35. Juliet S, Jeevanandan G, Govindaraju L, Ravindran V, Subramanian EM. Comparison between three rotary files on quality of obturation and instrumentation time in primary teeth− A double blinded randomized controlled trial. J Orofac Sci. 2020;12(1):30-4.
36. Divya S, Jeevanandan G, Sujatha S, Subramanian EMG, Ravindran V. Comparison of quality of obturation and post-operative pain using manual vs rotary files in primary teeth - A randomised clinical trial. Indian J Dent Res. 2019;30(6):904-8.
37. Jeevanandan G, Govindaraju L, Subramanian EMG, Priyadarshini P. Comparative evaluation of quality of obturation and its effect on postoperative pain between Pediatric hand and rotary files: A double-blinded randomized controlled trial. Int J Clin Pediatr Dent. 2021;14(1):88-96.
38. Preethy NA, Jeevanandan G, Mathew MG, Subramanian EM. Evaluation of quality of obturation using two different rotary files and hand files in primary Teeth: A randomized controlled trial. Int J Clin Pediatr Dent. 2021;14(4):471-4.
39. Aishuwariya T, Ramesh S. Comparison of quality of obturation using Radiographs-A retrospective study. Int J Dentistry Oral Sci. 2021;8(6):2833-8.
40. Sruthi S, Jeevanandan G, Govindaraju L, Subramanian E. Assessing quality of obturation and instrumentation time using Kedo-SG blue, Kedo-SH, and reciprocating hand K-files in primary mandibular molars: A double-blinded randomized controlled trial. Dent Res J (Isfahan). 2021;18:76.
41. Jeevanandan G, Govindaraju L. Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: A double blinded randomised clinical trial. Eur Arch Paediatr Dent. 2018;19(4):273-8. doi:10.1007/s40368-018-0356-6
42. Jeevanandan G, Thomas E. Volumetric analysis of hand, reciprocating and rotary instrumentation techniques in primary molars using spiral computed tomography: An *in vitro* comparative study. Eur J Dent. 2018;12(1):21-6.
43. Jayachandar D, Gurunathan D, Jeevanandan G. Prevalence of early loss of primary molars among children aged 5-10 years in Chennai: A cross-sectional study. J Indian Soc Pedod Prev Dent. 2019;37(2):115-9.
44. Soni S, Bhatia R, Oberoi J. Evaluation of the efficacy of aromatherapy on anxiety level among pediatric patients in a dental setting: A randomized control trial. Int J Oral Care Res. 2018;6(2):44-9.