



Is aromatherapy associated with patient's dental anxiety levels? A systematic review and meta-analysis

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The use of aromatherapy for the reduction of anxiety levels during dental treatment procedures has been well established in the literature; however, there is limited evidence regarding its efficacy. The present meta-analysis is an attempt to assess the association between the use of aromatherapy and anxiety levels among dental patients. A comprehensive search was conducted across Medline, Scopus, Web of Science, EBSCO host, Cochrane databases, and Google Scholar for studies evaluating aromatherapy and anxiety level among dental patients. PRISMA guidelines were followed for the meta-analysis. Randomized and cluster-randomized trials comparing aromatherapy with controls were included. The random-effects model was used to assess the mean differences in anxiety levels of patients visiting dental OPD. The significance value was set at $P < 0.05$. Six studies were identified that met the requirements for inclusion. Aromatherapy was significantly associated with reduction in patient anxiety levels during dental treatment (pooled mean difference: -3.36 [95% CI, -3.77 - -2.95, $P = 0.00001$). Low heterogeneity was noted between studies ($I^2 = 1\%$, $P = 0.41$) analyzed in the meta-analysis. High certainty of the evidence was obtained from the association between the use of aromatherapy and dental anxiety. This meta-analysis suggests that aromatherapy is effective in reducing dental anxiety. When used judiciously, the results of this work should encourage the use of aromatherapy to reduce patient anxiety levels during dental procedures

Keywords: Aromatherapy; Dental Anxiety; Dental offices; Lavender; Odor.



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INTRODUCTION

Fear and anxiety from dentists and dentistry is a potentially distressing and common problem, both for the dentist and the patient. Previous literature has documented the prevalence of dental anxiety to be common among children and adolescents, in the range of 5% to 20% globally [1]. Dental anxiety is considered to be a major obstacle to the completion of successful treatment. Patients with dental anxiety are more likely to be

uncooperative during dental care, making it difficult, if not impossible, for dentists to complete the procedure. Therefore, dental fear affects the working potential of the dental professional and compromises performance [2].

Aromatherapy has been used for almost 6,000 years, to improve a person's mood or health and works both physically and emotionally [3]. Aromatherapy is the use of aromatic compounds such as essential oils for therapeutic or medicinal purposes [4]. Aromatic oils are extracted from various parts of plants, herbs, trees, and flowers for medicinal purposes, and over forty different

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types of oils are available [5]. These oils have antimicrobial activity of varying degrees and are believed to have antiviral, antifungal, and antioxidant properties.

Aromatherapy works by activating our sense of smell, and the essential oils are used in very small amounts. Aroma has a powerful impact on the body, as they act on the olfactory nerve cells in the nasal cavity, sending impulses to the limbic system, which stimulates the nervous and circulatory system [6]. Lemon, chamomile, lavender, orange, apple, cedarwood, and bergamot are a few sources of the essential oils used regularly in aromatherapy [7]. Aromatherapy applications include massage, topical applications, inhalation, and alternative medicine [2]. Essential oils can also influence psychological states, and they have been used to help patients waiting in dental offices to feel less anxious.

One of the most daunting challenges for dental practitioners has been identified as managing dental anxiety. Conscious sedation or general anesthesia is the most common method of treatment. These treatments, however, come with certain complications that necessitate extra equipment, and cannot be used for patients who have allergies or are taking other medicines [8-11]. Although aromatherapy has been used for several years, before and during dental procedures, there is no evidence to support their use and safety, to date. Therefore, the present study was conducted to establish conclusive evidence regarding aromatherapy in dental procedures. This meta-analysis aims to provide evidence for the effectiveness of aromatherapy in reducing anxiety among dental patients.

METHODS

Inclusion criteria: The inclusion and exclusion criterion for study selection were determined before the literature search. Randomized and cluster-randomized trials comparing the effect of aromatherapy with a reported and validated measure of anxiety or stress among patients attending dental out-patient departments or clinics were

included. Non-randomized studies, i.e., those comparing two different forms of aromatherapy without a control group, were excluded. Studies in which no clinical data were reported, studies using unvalidated measures of anxiety, [12-16] and studies involving patients with a history of other surgeries (labor, heart, abdominal surgery etc) were also excluded [17-21].

Search Strategy: A literature search was conducted across Medline, Cochrane databases, Scopus, Web of Science, EBSCO host, and Google Scholar for publications up till March, 2021. Guidelines were followed for the meta-analysis. The following terms were used in the search: aromatherapy or lavender scent or odor or essential oils and dental anxiety or dental fear. The Cochrane Database of Systematic Reviews was searched for pertinent publications. The literature search was conducted independently by two investigators (AP and AS), according to a pre-defined criteria, from the selected databases. To assess whether the articles could be retrieved in full, and to exclude ineligible studies, the title and abstracts were pre-screened. Retrieved articles were read before they were included in the review. Differences between the judgement of the two investigators were resolved by discussion. In the event of a lack of consensus, a third person with expertise in the subject, pre-approved by the two investigators, helped make a decision. The selected papers' references were manually checked and potentially significant papers were retrieved. The articles were searched using English keywords. No restrictions were placed on the language of publications. Through manual searching of non-indexed journals, an attempt was made to check the grey literature for unpublished publications, and two related articles were thus found.

Data Extraction and Quality Assessment: The two investigators used guidelines published by the Cochrane Collaboration to extract outcome data. Differences between the two investigators were resolved by discussion. Characteristics of the trials included and excluded from the meta-analysis are presented in Table 1 and 2. Quality was assessed based on randomization

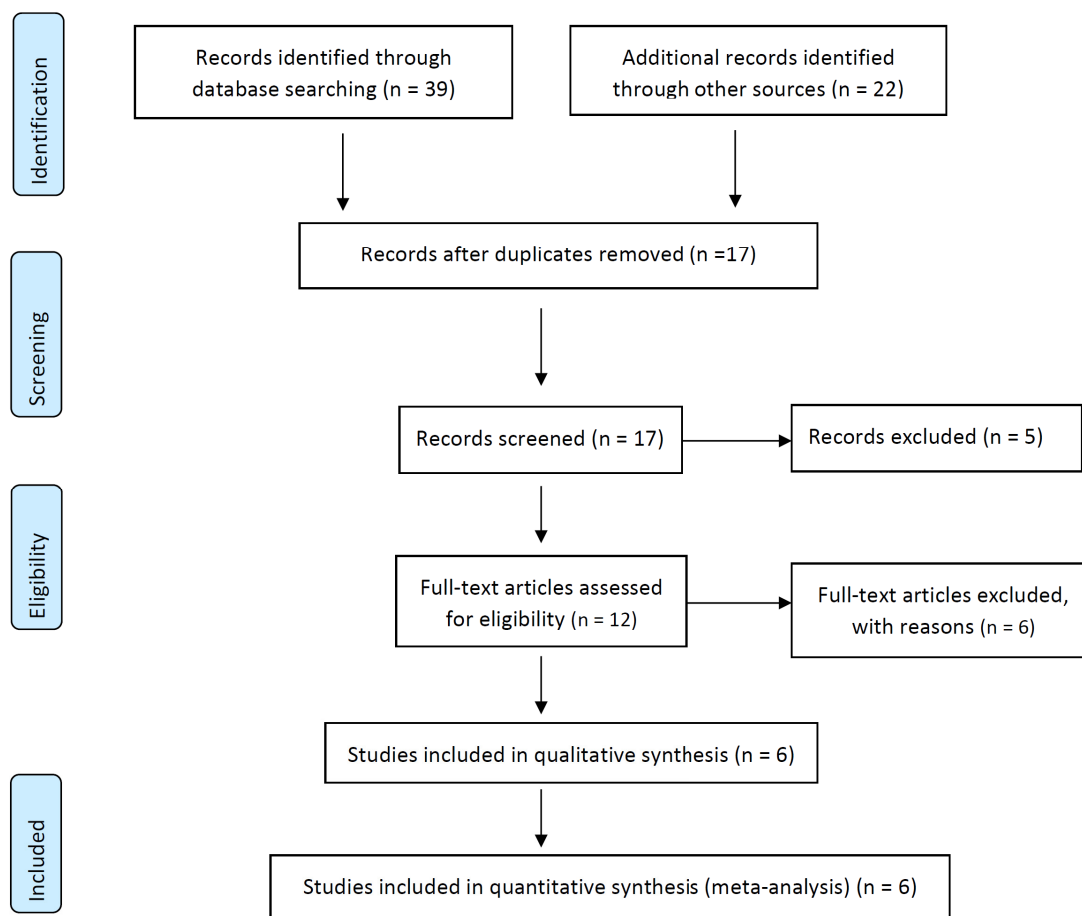


Fig. 1. Flow diagram of study selection process

(adequate sequence generation and allocation concealment), blinding, anxiety level as the primary outcome measure, loss to follow-up, and other biases.

Statistical Analysis: The systematic review was conducted using the Cochrane Program Review Manager, version 5.3. The mean differences in anxiety level between the treatment (State-Trait Anxiety Inventory [STAI] and Modified Dental Anxiety Scale [MDAS]) and control groups were assessed using a random-effects model. Mean difference with 95% confidence intervals was calculated to assess anxiety levels between the two groups. Since there were less than ten studies included in the study, publication bias was not assessed. Certainty of evidence was assessed using GRADE analysis. Statistical significance was set at $P < 0.05$.

RESULTS

The six trials reported in the meta-analysis compared the effect of aromatherapy on dental anxiety among the intervention and control groups. The studies were carried out with 1,318 participants (Intervention Group 693 & Control group 625). To measure the dental anxiety, the Mean State-Trait Anxiety Inventory/Modified Dental Anxiety Scale was used, out of the six trials, five [2,9,10,11,22] reported significant ($P < 0.05$) positive effects of aromatherapy on dental anxiety, with one showing no effect [23].

The results of the literature search are presented in Fig. 1. Characteristics of the 6 trials included in the analysis and the 6 excluded studies are described in Tables 1 and 2. A total of 670 and 648 participants were included in

Table 1. Characteristics of studies included in meta-analysis

Author; Year	Study Location	Study Design	Number of Participants (n)	Age Mean (SD)	Method of Measuring Anxiety	Anxiety level Mean (SD)		Method of Aromatherapy	Statistical Method (P-Value)
						Intervention Group	Control Group		
Kritsidima M et al; 2010 [22]	London	RCT	340 I-170 C-170	39.3 (12.8)	STAI	7.46 (2.43)	10.71 (4.35)	Candle Warmer	ANOVA (P < 0.001)
Lehrner J et al; 2000 [23]	Austria	RCT	72 I-35 C-37	34.1 (9.7)	STAI	38 (11.5)	38.9 (9.5)	Electrical Dispenser	ANOVA (P > 0.5)
Lehrner J et al; 2005 [9]	Austria	RCT	149 I-98 C-51	40.8 (13.4)	STAI	36.9 (10.7)	43.3 (13.4)	Electrical Dispenser	ANOVA (P = 0.028)
Maybodi et al; 2018 [10]	Iran	RCT	60 I-30 C-30	36.3 (3)	STAI	36.8 (1.61)	39.73 (1.49)	Not Mentioned	ANOVA (P = 0.019)
Venkataraman M et al; 2016 [11]	India	RCT	100 I-50 C-50	35 (12.5)	MDAS	11.74 (4.10)	15.40 (4.18)	Candle Warmer	ANOVA (P < 0.00001)
Zabirunnisa M et al; 2014 [2]	India	RCT	597 I-310 C-287	35 (12.5)	MDAS	11.7 (4.10)	15.4 (4.8)	Candle Warmer	ANOVA (P = 0.001)

ANOVA, analysis of variance; C, Control group; I, Intervention group; MDAS, Modified Dental Anxiety Scale; n, number; RCT, randomized controlled trials; SD, standard deviation; STAI, State-Trait Anxiety Inventory.

Table 2. Characteristics of trials excluded from meta-analysis [12-15]

Author; year	Study Location	Study Design	Number of Participants (n)	Reason for Exclusion
Soni S et al; 2018	India	RCT	30	Different outcome measures; different age group
Pradopo S et al; 2107	Indonesia	RCT	80	Different outcome measures
Toet A et al; 2010	Netherlands	Non RCT	219	Non randomized controlled trial
Nardarajah D et al; 2018	India	RCT	100	Different measures of anxiety
Hasheminia D et al; 2014	Iran	RCT	56	Only patients with moderate and high anxiety levels were included
Bunget et al; 2018	Romania	RCT	20	Insufficient data- SD not provided

RCT, randomized controlled trials; SD, standard deviation.

Table 3. Quality assessment of trials included in meta-analysis

Trial ID	Sequence Generation	Allocation Concealment	Blinding	Attrition	Adverse effects	Other sources of bias
Kritsidima M et al; 2010 [22]	Yes	Yes	Yes	NA	None Reported	-
Lehrner J et al; 2000 [23]	Yes	None Reported	Unclear	NA	None Reported	-
Lehrner J et al; 2005 [9]	Yes	None Reported	Unclear	NA	None Reported	-
Maybodi et al; 2018 [10]	Yes	None Reported	Unclear	NA	None Reported	-
Venkataraman M et al; 2016 [11]	Yes	Yes	Yes	NA	None Reported	-
Zabirunnisa M et al; 2014 [2]	Yes	Yes	Yes	NA	None Reported	-

the aromatherapy and control groups, respectively. The quality of trials included in the analysis is presented in Table 3. The allocation sequence was adequately generated in the entered studies. However, allocation concealment was declared by only two studies. No adverse effects were reported in any study.

The meta-analyses of randomized controlled trials which evaluated the effect of aromatherapy on patients’ dental anxiety levels are presented in Fig. 2. Aromatherapy was associated with a significant reduction in patient dental anxiety level among patients on whom it was applied, compared to the control group (pooled mean difference:

Table 4. GRADE assessment for certainty of evidence of association between aromatherapy versus control on patient’s dental anxiety level

No of studies	Study design	Certainty assessment					Other considerations	No of patients		Effect Absolute (95%CI)	Certainty
		Risk of bias	Inconsistency	Indirectness	Imprecision	Aromatherapy Group		Control Group			
6	Randomized Trials	Not serious	Not serious	Not serious	Not serious	Strong association, all plausible residual confounding would suggest spurious effect	693	625	MD 3.36 lower (3.77 lower to 2.95 lower)	⊕⊕⊕⊕ HIGH	

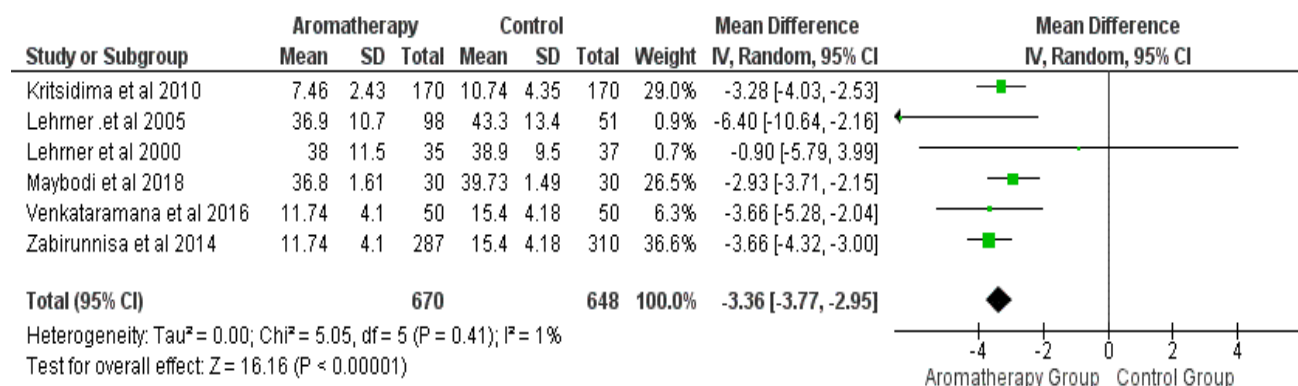


Fig. 2. Meta-analysis of randomized control trials evaluating effect of aromatherapy on patient dental anxiety level

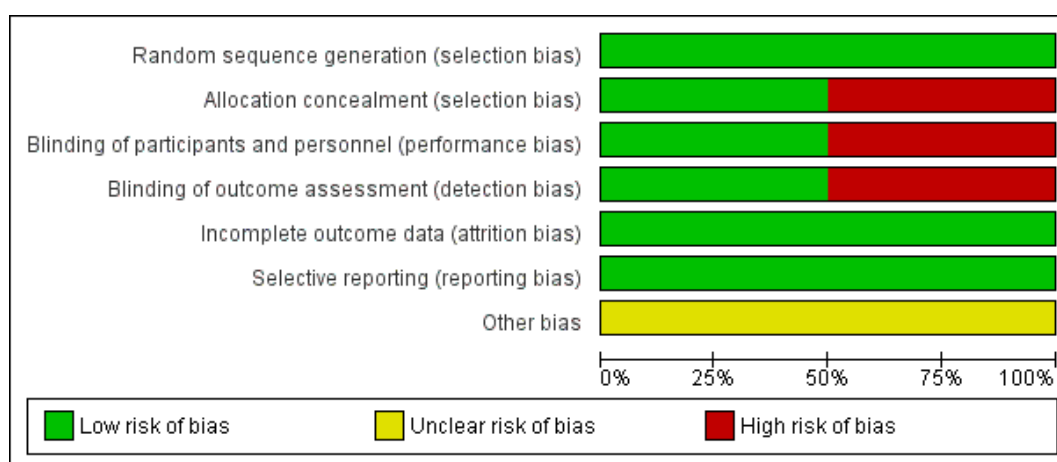


Fig. 3. Risk of bias graph: review authors’ judgements about each risk of bias item presented as percentages across all included studies

-3.36 [95% CI, -3.77 -2.95], P = 0.00001; Fig. 2). Heterogeneity between trials was very low (I² = 1%, P = 0.41; Fig. 2).

Grade assessment was conducted to assess the certainty of evidence. The level of evidence obtained for the association between the use of aromatherapy and dental anxiety was high (Table 4). Risk of bias was assessed by Cochrane risk of Bias assessment tool; the risk of bias graph and summary are presented in Fig. 3 and 4. Fig.

5 shows the funnel plot of included studies evaluating effect of aromatherapy on patient dental anxiety level.

DISCUSSION

The present meta-analysis is the first in the scientific literature to provide evidence on the effect of aromatherapy on patient dental anxiety levels. This included

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Kritsidima M et al; 2010	+	+	+	+	+	+	?
Lehrner J et al; 2000	+	-	-	-	+	+	?
Lehrner J et al; 2005	+	-	-	-	+	+	?
Maybodi et al; 2018	+	-	-	-	+	+	?
Venkataraman M et al; 2016	+	+	+	+	+	+	?
Zabirunnisa M et al; 2014	+	+	+	+	+	+	?

Fig. 4. Risk of bias summary: review authors' judgements about each risk of bias item for each included study

six randomized clinical trials and demonstrated a significant reduction in patient dental anxiety levels upon using aromatherapy. Mean State-Trait Anxiety Inventory/Modified Dental Anxiety Scale (STAI/MDAS) scores were calculated, which are among the commonly used anxiety tools in applied psychology. These are reliable and sensitive measures of dental anxiety, and researchers can compare their results with those of others [24].

An integral part of meta-analysis is the evaluation of the accuracy of effects across studies. Heterogeneity in meta-analysis represents the difference in research outcomes between different studies. The I^2 statistic explains the percentage variance that is due to heterogeneity rather than chance across studies. An I^2 value of 1% was noted in the present meta-analysis and indicates no observed heterogeneity. A lower heterogeneity is always desirable, as it reflects consistent findings across studies.

The findings of various studies showed that inhalation

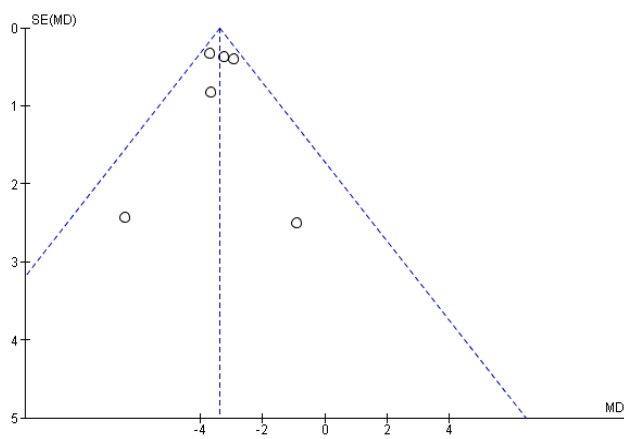


Fig. 5. Funnel plot of included studies evaluating effect of aromatherapy on patient dental anxiety level

aromatherapy was effective in the reduction of anxiety level and depression [25-33]. Dentists are concerned about their patients' comfort, and aromatherapy can be used in dental clinics to help patients with dental anxiety. Aromatherapy can also be used to treat mouth ulcers [34]. Notably, dental anxiety is related to adverse patient outcomes, and aromatherapy is one of the most effective non-pharmacological methods for managing dental anxiety [35]. The application of aromatic oils for medicinal purposes can be traced to the ancient Egyptian and Chinese cultures. Apart from providing an ambient odor, aromatherapy can provide respiratory decongestion, disinfection, and other psychological benefits. Inhaling aromas stimulates the olfactory system, related to the sense of smell. Molecules enter the body through the nose or mouth, then travel to the lungs and other areas of the body. Aromas affect the limbic system of the brain, which is related to heart rate, blood pressure, breathing, memory, stress, emotions, and hormonal balance, as they enter the brain. Aromatherapy can have a subtle but holistic impact on the whole body in this way [5].

The world Health Organization has noted the health benefits of complementary and alternative medicines. These play a key role in not only the treatment, but also the prevention of chronic illnesses, thus enhancing the quality of life [36]. Medicinal plants were used to treat various illnesses due to their accessibility. Aromatherapy is a form of therapy that entails the use of essential oils

for treatment. At present, the World Health Organization recognizes aromatherapy as a method of treatment commonly used to relieve pain and anxiety, to improve the mood, promote a sense of relaxation, and to ameliorate daily stress problems [37-39]. The limitations of the present study include a limited number of analyzed studies, and the fact that the study protocol was not registered. The present study was intended to provide evidence for the association between aromatherapy and dental anxiety. However, further trials on the association between aromatherapy with dental anxiety are required.

CONCLUSION

This meta-analysis provided conclusive evidence related to the effectiveness of aromatherapy on anxiety levels among dental patients. These results conclude that aromatherapy is effective at reducing patient dental anxiety. When used judiciously, the results of this work should encourage the use of aromatherapy to reduce the patient dental anxiety levels.

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AUTHOR CONTRIBUTIONS

Abhishek Purohit: Conceptualization, Methodology, Writing - original draft, Writing - review & editing

Abhinav Singh: Conceptualization, Methodology, Software, Supervision, Writing - original draft, Writing - review & editing

Bharathi Purohit: Conceptualization, Funding acquisition, Methodology, Supervision, Writing - original draft, Writing - review & editing

Prateek Shakti: Methodology, Writing - original draft

Nidhi Shah: Software, Writing - original draft, Writing - review & editing

CONFLICT OF INTEREST: The authors declare no competing interest in the manuscript.

SEARCH STRATEGY

1. Aromatherapy and Dental anxiety
(<https://www.ncbi.nlm.nih.gov/PubMed/?term=Aromatherapy+and+Dental+anxiety>)
(<https://www.cochranelibrary.com/advanced-search>)
(<https://www.sciencedirect.com/search?q=Aromatherapy%20and%20Dental%20anxiety&lastSelectedFacet=articleTypes&articleTypes=FLA>)
(https://scholar.google.com/scholar?hl=en&cas_sdt=0%2C5&q=Aromatherapy+and+Dental+anxiety+&btnG=)
2. Odor and Dental anxiety
(<https://www.ncbi.nlm.nih.gov/PubMed/?term=Odor+and+Dental+anxiety>)
(<https://www.cochranelibrary.com/advanced-search>)
(<https://www.sciencedirect.com/search?q=Odor%20and%20Dental%20anxiety&articleTypes=FLA&lastSelectedFacet=articleTypes>)
(https://scholar.google.com/scholar?hl=en&cas_sdt=0%2C5&q=odor+and+Dental+anxiety+&btnG=)
3. Aromatherapy or essential oils or aroma therapy AND dental anxiety or dental fear or dental phobia.
([http://web.b.ebscohost.com/ehost/resultsadvanced?vid=4&sid=9f296f2c-aff0-4484-9767-e4d9106fa64b%40sessionmgr102&bquery=\(+aromatherapy+or+essential+oils+or+aroma+therapy+\)+AND+\(+dental+anxiety+or+dental+fear+or+dental+phobia+\)&bdata=JmRiPWRkaCZjbGkwPUZUJmNsdjA9WSZ0eXBIPTEmc2VhcmNoTW9kZT1BbmQmc2l0ZT1laG9zdC1saXZl](http://web.b.ebscohost.com/ehost/resultsadvanced?vid=4&sid=9f296f2c-aff0-4484-9767-e4d9106fa64b%40sessionmgr102&bquery=(+aromatherapy+or+essential+oils+or+aroma+therapy+)+AND+(+dental+anxiety+or+dental+fear+or+dental+phobia+)&bdata=JmRiPWRkaCZjbGkwPUZUJmNsdjA9WSZ0eXBIPTEmc2VhcmNoTW9kZT1BbmQmc2l0ZT1laG9zdC1saXZl))
(https://scholar.google.com/scholar?hl=en&cas_sdt=0%2C5&q=Aromatherapy+or+essential+oils+or+aroma+therapy+AND+dental+anxiety+or+dental+fear+or+dental+phobia.&btnG=)

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