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Effect of Aromatherapy on Dental Anxiety and Vital Signs During Impacted Wisdom Tooth Surgery: A Randomized Crossover Clinical Trial

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Abstract

Background: Lavender has calming and anxiolytic properties. The present study investigated the impact of lavender aromatherapy on dental anxiety in patients undergoing bilateral impacted mandibular third molar surgery.

Methods: Twenty-five patients requiring bilateral impacted mandibular third molar extraction were included. One side was operated on under lavender oil aromatherapy (lavender condition), and the contralateral side served as the placebo condition. Aromatherapy was administered 15 minutes before surgery using a diffuser with lavender oil. Baseline anxiety levels were assessed using the modified dental anxiety scale (MDAS), while vital signs were used as objective indicators of perioperative stress. Vital signs (pulse rate, blood pressure, and oxygen saturation) were recorded before and after surgery. Postoperative pain intensity was assessed using the visual analog scale (VAS), and trismus was recorded.

Results: The study sample consisted of 25 patients evaluated under both crossover conditions. MDAS scores ranged between 5 and 22, with a mean of 10.46 ± 4.05. Statistically significant differences were observed between the lavender and placebo conditions for postoperative oxygen saturation ($P = .033$) and post-operative systolic blood pressure ($P = .023$). No statistically significant differences were found between the conditions for MDAS, VAS, pulse rate, or diastolic blood pressure ($P > .05$). However, within the lavender condition, a statistically significant reduction in oxygen saturation was observed from preoperative to post-operative periods ($P = .018$).

Conclusions: Lavender oil aromatherapy may influence selected post-operative physiological parameters, particularly systolic blood pressure and oxygen saturation. However, these findings should be interpreted cautiously, and further studies are needed to establish standardized protocols. While it serves as a nonpharmacological adjunct to standard treatments, further studies are needed to establish standardized protocols.

Keywords: Aromatherapy, dental anxiety, essential oils, oral surgery, post-operative pain

What is already known on this topic?

- *Dental anxiety is common during invasive dental procedures such as impacted third molar surgery and may affect both psychological and physiological responses.*
- *Lavender aromatherapy has been reported to have calming and anxiolytic effects in various clinical and dental settings.*
- *Existing studies on dental aromatherapy are limited by heterogeneous patient populations and study designs.*

What this study adds on this topic?

- *This study evaluates the effects of lavender aromatherapy specifically in patients undergoing bilateral impacted mandibular third molar surgery using a randomized within-patient controlled (crossover) trial.*

INTRODUCTION

Dental anxiety is among the most frequently encountered problems related to dental care.[1] Pain plays a dual role in this condition, both contributing to its development and reinforcing its persistence over time.[2] Procedures such as local anesthetic administration and tooth extraction are commonly perceived as painful and may therefore

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- *Lavender aromatherapy was associated with statistically significant differences between the conditions in post-operative oxygen saturation (P=.033) and post-operative systolic blood pressure (P=.023), suggesting a possible modulatory effect on selected physiological parameters.*
- *No significant differences were observed between lavender and placebo conditions in terms of modified dental anxiety scale scores, pain intensity, trismus, or edema, suggesting that lavender aromatherapy may serve as a nonpharmacological adjunct under different crossover conditions rather than a replacement for standard anxiety management.*

trigger anxiety responses. Reported prevalence rates of dental anxiety range between 54% and 92% in individuals undergoing different dental interventions.[3] Dental anxiety may manifest with various physiological and behavioral responses that complicate dental treatment.[4] To address this challenge, various pharmacological and nonpharmacological interventions are utilized in clinical practice to reduce patient stress and improve treatment outcomes.[5]

Tooth extraction represents 1 of the invasive dental procedures and is frequently associated with post-operative discomfort. For this reason, numerous investigations have examined the relationship between extraction procedures and anxiety levels.[2,6,7]

In recent years, aromatherapy has gained attention as a nonpharmacological adjunct in clinical settings.[8,9] This approach is based on the premise that inhaled aromatic compounds may influence physiological and psychological states via olfactory stimulation. Among essential oils, lavender is widely recognized for its calming and anxiolytic characteristics. It is considered that its effects occur partly through activation of the parasympathetic nervous system and lead to reductions in blood pressure and anxiety.[8]

Previous studies have explored the role of aromatherapy in dental settings.[10,11] These studies indicated that lavender may reduce anxiety in patients undergoing tooth extraction; however, they were conducted in heterogeneous populations.[11] To date, no randomized within-patient controlled crossover trials have examined the effects of aromatherapy on dental anxiety and physiological vital signs during bilateral impacted third molar surgery. Therefore, the present study aimed to evaluate the impact of lavender oil aromatherapy on dental anxiety, pain perception, post-operative clinical findings, and perioperative vital signs using a randomized within-patient crossover design.

MATERIALS AND METHODS

Ethical Approval

This study was approved by the Clinical Research Ethics Committee of Van Yüzüncü Yıl University, Faculty of Clinical Sciences (Decision Number: 14, September 20, 2021).

Study Design and Study Participants

The study was conducted at the Faculty of Dentistry of Van Yüzüncü Yıl University and included patients aged 18-40 years who required extraction of bilaterally impacted mandibular third molars, characterized by complete mucosal coverage and partial bony retention. A total of 25 patients who attended the clinic between October 2021 and October 2022 were enrolled. All participants provided written informed consent before joining the study. Eligible participants were systemically healthy individuals (American Society of Anesthesiologists (ASA) physical status I or II) who voluntarily consented to participate. Exclusion criteria included failure to attend follow-up visits, use of medications outside the study protocol, smoking, pregnancy or lactation, and allergy to lavender oil or any of the medications prescribed during the study.

This study was conducted as a randomized within-patient controlled (crossover) trial. Each participant received both interventions on contralateral sides. The allocation of interventions to the right or left side, as well as the order of surgery, was randomized using the envelope method. This study was designed as a single-blind trial. While the nature of aromatherapy prevents complete blinding of the participants, the surgeon, the researcher who performed the post-operative measurements (visual analog scale [VAS] and trismus), and the statistician were blinded to the treatment periods to ensure unbiased data collection and analysis. In the lavender condition, lavender oil (Art de Hulie Aromatherapy, Hülya Kayhan) was administered via inhalation both before and throughout the extraction. Aromatherapy was initiated 15 minutes prior to surgery, using approximately 4 drops of lavender oil in 200 mL of water, delivered via a diffuser in a 40 m^2 treatment room. In

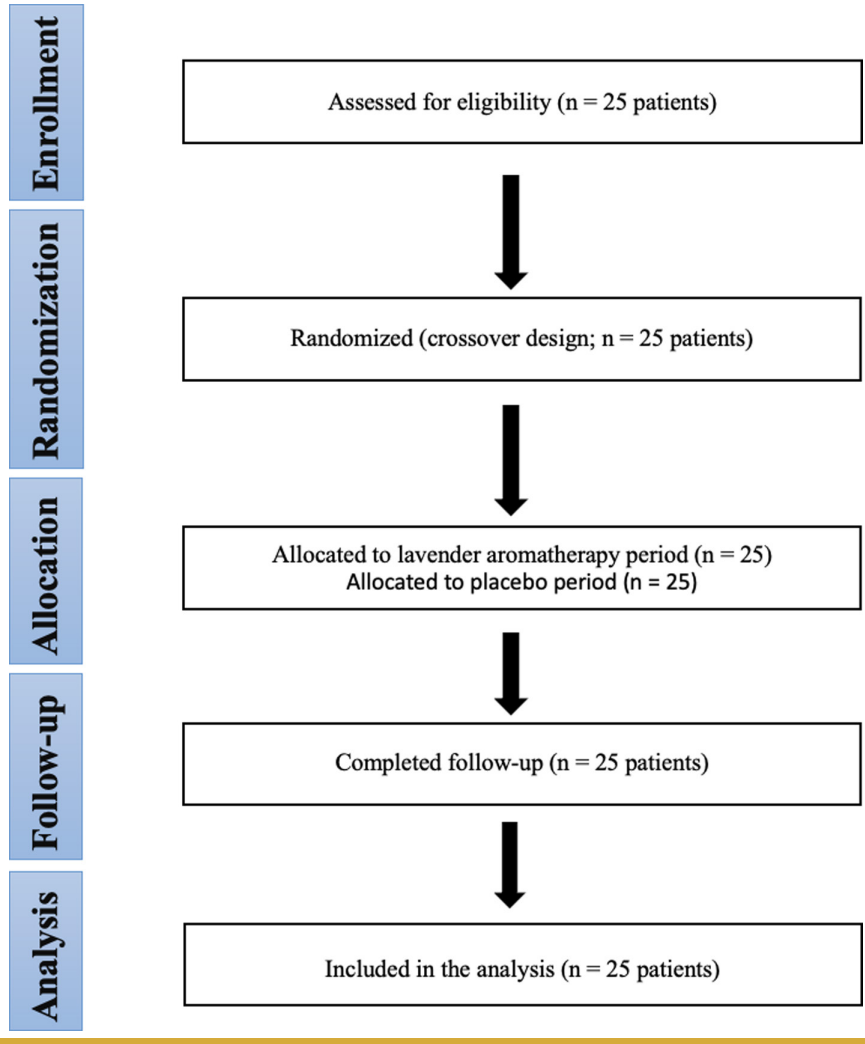


Figure 1. Consolidated Standards of Reporting Trials (CONSORT) flow diagram of the randomized within-patient (crossover) controlled clinical trial.

the placebo condition, the diffuser operated with water only, without the addition of essential oil (Figure 1).

The primary endpoint of the study was the change in oxygen saturation levels during the surgical procedure. Secondary endpoints included pulse rate, blood pressure, post-operative pain (VAS), trismus, and edema. A power analysis was performed using G*Power software (v3.1.9.7) to determine the required sample size. Based on Cohen's effect size conventions, assuming a large effect size ($d = 0.60$) for paired/crossover comparisons, with a Type I error rate of $\alpha = 0.05$ and a statistical power of 80% ($1 - \beta = 0.80$), the minimum required sample size was calculated as 25 patients in total.

The 2 extractions were performed at least 2 weeks apart. The modified dental anxiety scale (MDAS) was administered 15 minutes before each surgical session to assess the participants' baseline anxiety levels and ensure that there were no significant differences in pre-procedural anxiety between the 2 treatment periods. Vital parameters, including pulse rate, oxygen saturation, and blood pressure, were measured both before and after each procedure. Blood pressure measurements were obtained using a manual sphygmomanometer, while pulse rate and oxygen saturation were measured with a pulse oximeter. To ensure data validity and minimize artifacts, clinicians were instructed to confirm proper probe placement and wait for a stable reading before recording the values.

Following extraction, wounds were closed with the same brand and size of silk sutures in all cases. Post-operative medication consisted of Augmentin® BID 1000 mg (875 mg amoxicillin + 125 mg clavulanic acid, twice daily), Arveles® 25 mg (dexketoprofen, twice daily), and Andorex® mouthwash

(chlorhexidine gluconate + benzydamine HCl, 3 times daily). Sutures were removed 1 week post-operatively.

Pain was assessed using the VAS at set time intervals: 3, 6, 12, and 24 hours on day 1, and once daily on days 2-7. Paracetamol® (acetaminophen) 500 mg was prescribed as a rescue analgesic. Facial swelling was assessed using 3 linear measurements between anatomical landmarks (angle–lateral canthus, tragus–labial commissure, and tragus–pogonion) before surgery and on post-operative days 2 and 7. Trismus was quantified by measuring maximum interincisal distance at the same time intervals.

Statistical Analysis

Data analysis was conducted using the Number Cruncher Statistical System (NCSS) 2007 software (Kaysville, Utah, USA). Descriptive statistical measures, including mean, median, standard deviation, frequency, percentage, maximum, and minimum values, were calculated. Normality of the data was evaluated using the Shapiro–Wilk test in combination with graphical assessment. For non-normally distributed continuous variables, the Wilcoxon Signed Ranks test was used for paired comparisons between the 2 crossover conditions, as well as for intra-condition (preoperative vs. postoperative) analyses. For parameters with 3 or more follow-up intervals, the Friedman test followed by the Bonferroni–Dunn procedure was applied. To minimize potential period effects, the order of interventions was randomized. Additionally, no significant period or carryover effects were detected, and no significant differences were observed between the first and second surgical sessions ($P > .05$). A P-value < .05 was considered statistically significant.

RESULTS

The study sample consisted of 25 patients (9 males, 16 females) evaluated under both crossover conditions, resulting in a total of 50 surgical extractions of bilaterally impacted mandibular third molars (complete mucosal coverage and partial bony retention). Pre-operative MDAS scores varied between 5 and 22, with a mean value of 10.46 ± 4.05. Comparison of MDAS scores between the 2 conditions revealed no statistically significant difference ($P > .05$). Additionally, no significant period or carryover effects were detected, as no statistically significant differences were observed in vital signs or anxiety scores between the first and second surgical sessions, regardless of the intervention sequence ($P > .05$). Regarding vital signs, statistically significant differences were observed between the lavender and placebo conditions in terms of post-operative oxygen saturation ($P = .033$) and post-operative systolic blood pressure ($P = .023$) (Table 1). However, no statistically significant differences were found between the 2 conditions for pre-operative vital signs, or for post-operative diastolic blood pressure and pulse rate ($P > .05$). Additionally, an intra-condition evaluation revealed that the decrease in post-operative oxygen saturation measurements compared with pre-operative measurements within the lavender condition was statistically significant ($P = .018$); whereas no such intra-condition difference was observed for the other vital signs. Although a decrease in pulse rate was observed in both conditions, it was not statistically significant ($P > .05$).

For systolic blood pressure, while the difference between the post-operative measurements of the 2 conditions was significant ($P = .023$), the intra-condition changes from pre-operative to post-operative measurements did not significantly differ within either condition ($P > .05$), and the mean change between the conditions was not statistically significant ($P = .210$). When changes in pre-operative and post-operative diastolic blood pressure measurements were evaluated, a decrease was observed in the lavender condition ($P = .236$), whereas an increase was observed in the placebo condition ($P = .180$). However, the change from pre-operative to post-operative measurements did not differ significantly between the conditions ($P = .165$).

In the measurements taken to assess mouth opening and edema, there was no statistically significant difference ($P > .05$) in mouth opening measurements at baseline ($P = .208$), day 2 ($P = .481$) and day 7 ($P = .634$). No statistically significant difference was found between the lavender and placebo conditions in terms of facial swelling measurements (angle–lateral canthus, tragus–labial commissure, and tragus–pogonion) at any of the post-operative follow-up periods ($P > .05$).

No significant differences were observed between the conditions with respect to post-operative VAS score changes; however, a greater reduction was noted in the lavender condition ($P > .05$) (Figure 2).

DISCUSSION

Evidence regarding the therapeutic effects of essential oils remains inconclusive; however, clinical trials investigating aromatherapy in medical and dental settings are increasing.[12,13] This study investigated the effects of lavender aromatherapy on vital signs and post-operative complications associated with impacted third molar surgery, a procedure commonly associated with high levels of anxiety and pain. Lavender aromatherapy demonstrated a statistically significant influence on oxygen saturation and systolic blood pressure levels; however, its effects on other physiological and clinical parameters, including pain, trismus, and edema, did not reach statistical significance. Moss et al[14] reported that lavender (Lavandula angustifolia) essential oil stimulated the parasympathetic system, thereby reducing anxiety, improving mood, and increasing sedation. Diego et al[13] demonstrated in a randomized clinical trial that rosemary increased

Table 1. Evaluation of Patients' Vital Signs (Oxygen Saturation, Systolic Blood Pressure, Diastolic Blood Pressure and Pulse Rate) Across Different Follow-up Periods

Vital Signs		Lavender Condition (n=25)	Placebo Condition (n=25)	P^1
Oxygen saturation				
Pre-operative	Min–max (Median)	88-100 (98)	96-100 (99)	**.073**
	Mean ± SD	96.72 ± 3.88	98.64 ± 1.22	
Post-operative	Min–max (Median)	83-100 (98)	94-100 (99)	**.033***
	Mean ± SD	95.52 ± 5.31	98.4 ± 1.47	
	P^1	**.018***	**.636**	
Difference (Post-operative-Pre-operative)	Min–max (Median) Mean ± SD	−7/−2 (0) −1.2 ± 2.35	−5/−2 (0) −0.24 ± 1.71	**.085**
Systolic blood pressure				
Pre-operative	Min–max (Median)	90-149 (110)	97-130 (112)	**.559**
	Mean ± SD	112.56 ± 14.86	114.16 ± 10.75	
Post-operative	Min–max (Median)	90-137 (110)	80-130 (112)	**.023***
	Mean ± SD	109.80 ± 12.55	113.33 ± 11.61	
	P^1	**.236**	**.756**	
Difference (Post-operative-Pre-operative)	Min–max (Median) Mean ± SD	−24-17 (0) −2.76 ± 10.89	−36-20 (0) −0.58 ± 10.83	**.210**
Diastolic blood pressure				
Pre-operative	Min–max (Median)	47-93 (70)	52-80 (65)	**.808**
	Mean ± SD	67.00 ± 9.60	66.60 ± 7.25	
Post-operative	Min–max (Median)	50-80 (66)	55-94 (70)	**.180**
	Mean ± SD	65.92 ± 6.73	69.71 ± 10.48	
	P^1	**.660**	**.220**	
Difference (Post-operative-Pre-operative)	Min–max (Median) Mean ± SD	−24-10 (0) −1.08 ± 6.60	−10-42 (0) 2.83 ± 10.25	**.174**
Pulse Rate				
Pre-operative	Min–max (Median)	65-126 (85)	60-130 (88)	**.146**
	Mean ± SD	85.44 ± 15.34	89.56 ± 14.76	
Post-operative	Min–max (Median)	67-98 (80)	63-137 (86)	**.095**
	Mean ± SD	81.40 ± 9.60	86.96 ± 15.83	
	P^1	**.301**	**.131**	
Difference (Post-operative-Pre-operative)	Min–max (Median) Mean ± SD	−47-21 (−3) −4.04 ± 16.75	−31-17 (−5) −4.30 ± 12.46	**.915**

Min, minimum; Max, maximum; SD, standard deviation.
P^1, Wilcoxon signed-ranks test.
*$P < .05$.

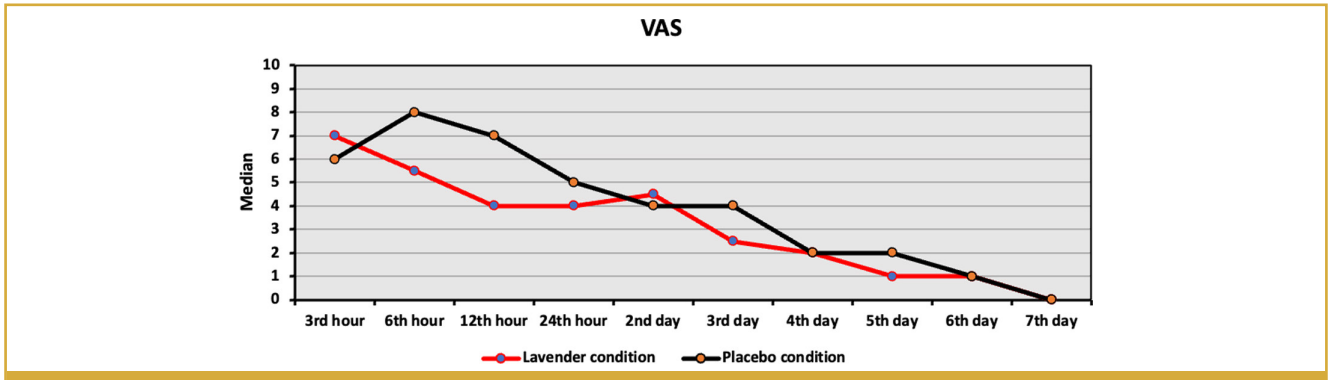


Figure 2. Distribution of median VAS scores across the post-operative follow-up intervals under both crossover conditions. VAS, visual analog scale.

alertness, whereas lavender promoted relaxation. Similarly, Nardarajah et al[11] evaluated lavender tablets in patients undergoing mandibular third molar extraction and reported lower anxiety levels in the lavender condition compared with controls, although differences from the placebo condition were not statistically significant.

Toet et al[15] examined the effects of orange and apple odors on dental anxiety in 219 patients. Their findings revealed no significant differences in anxiety, mood, or pain among groups, suggesting that not all pleasant ambient fragrances yield anxiolytic effects. Martin further noted that relaxing odors could paradoxically heighten pain perception by directing attention to discomfort. In this study, lavender aromatherapy did not cause statistically significant changes in most vital signs, which may be attributed to altered pain perception as patients became calmer.[16]

Karan et al[10] evaluated lavender oil inhalation in 126 patients undergoing third molar extraction. A significant decrease in systolic blood pressure was observed in the lavender group, although pain and baseline anxiety scores did not differ significantly. In accordance with their findings, a statistically significant difference was observed between the conditions in post-operative systolic blood pressure ($P = .023$) and post-operative oxygen saturation ($P = .033$), suggesting a possible modulatory effect on selected physiological parameters. Additionally, an intra-condition evaluation revealed a statistically significant decrease in oxygen saturation within the lavender condition compared to its baseline ($P = .018$). While lavender aromatherapy was associated with slightly lower values for pulse rate and diastolic blood pressure, these changes were not statistically significant. These findings suggest that lavender oil inhalation may modulate autonomic nervous system activity, potentially influencing hemodynamic parameters and oxygen saturation during stressful surgical procedures.

Comparable results were reported by Kumar et al[17], who investigated pediatric dental patients receiving orange oil aromatherapy. Significant reductions were noted in anxiety and blood pressure, though changes in oxygen saturation and pulse rate were not significant.

Post-operative pain during the 7-day follow-up period was assessed and observed lower VAS scores in the lavender condition, though not at a statistically significant level. Soltani et al[18] reported similar findings in pediatric patients undergoing tonsillectomy, where lavender aromatherapy reduced paracetamol use despite nonsignificant changes in VAS scores. The analgesic effects of lavender may be related to its anti-inflammatory and neuromodulatory properties.[19,20]

This study has several limitations. First, the recognizable aroma of lavender oil makes achieving a perfect double-blind design challenging, as participants may identify the intervention. This could introduce expectancy effects, although mitigation was achieved by blinding the surgeons, outcome assessors, and statisticians. Second, while post-operative oxygen saturation and systolic blood pressure showed statistically significant differences between the conditions, the physiological values remained within safe clinical limits, and further research with larger sample sizes is needed to confirm the clinical significance of these findings. Lastly, although a crossover design was employed to minimize individual variability, environmental factors in a multi-unit clinical setting might have influenced some physiological measurements.

CONCLUSIONS

This study evaluated the effects of lavender aromatherapy on anxiety, pain, and post-operative complications in patients undergoing impacted third molar surgery. Lavender oil inhalation may serve as a supportive nonpharmacological adjunct that is associated with differences in certain perioperative physiological parameters, particularly systolic blood pressure and oxygen saturation. However, it does not significantly affect dental anxiety or post-operative clinical outcomes. While essential oils may have potential as adjunctive approaches alongside conventional modalities, further large-scale studies are needed to determine whether these small physiological differences translate into meaningful clinical benefits in dental practice.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Artificial Intelligence Usage Statement: ChatGPT (OpenAI) was used only for language and grammar improvements. The authors reviewed and approved the final text and take full responsibility for the content.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Van Yüzüncü Yıl University (Approval no: 14, Date: September 20, 2021).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – S.K.T., N.H.K., A.H.; Design – N.H.K., A.H., M.B.B.; Supervision – S.K.T.; Resources – N.H.K., A.H., M.B.B.; Materials – S.K.T., N.H.K., A.H.; Data Collection and/or Processing – N.H.K., A.H., M.B.B.; Analysis and/or Interpretation – N.H.K., A.H., M.B.B.; Literature Search – S.K.T., N.H.K., A.H., M.B.B., A.B.Ö.; Writing Manuscript – S.K.T., N.H.K., A.H., M.B.B.; Critical Review – S.K.T., A.B.Ö.

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