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The Menstrual Cycle Phase and Effect of Aromatherapy on Orthodontic Debonding Pain

Kevser Kurt Demirsoy[1,a], S.Kutalmış Buyuk[2,b,*], Tugce Alpaydın[2,c]

[1]*Department of Orthodontics, Faculty of Dentistry, Nevsehir Hacı Bektas Veli University, Nevsehir, Türkiye*
[2]*Department of Orthodontics, Faculty of Dentistry, Ordu University, Ordu, Türkiye*
**Corresponding author*

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ABSTRACT

Objectives: The aim of this prospective clinical study was to evaluate the effects of the menstrual cycle phases and aromatherapy on women's perception of orthodontic debonding pain.

Materials and Methods: The materials of this study were consisted of randomly selected 48 female patients (mean age: 19.00±3.40 years). Four different study groups were performed. LA+; the patients in the luteal phase and received aromatherapy (n=12), LA-; the patients in the luteal phase and did not receive aromatherapy (n=13), FA+; the patients in the follicular phase and received aromatherapy (n=11), FA-; the patients in the follicular phase and did not receive aromatherapy(n=12). Debonding was performed and the pain experience for each tooth was scored by the patient on a visual analogue scale (VAS). Also, participants' general responses to pain were assessed with the Pain Catastrophizing Scale (PCS). The aromatherapy protocol was to inhale lavender oil from approximately 30 cm for 3 minutes, 3 minutes before debonding.

Results: It was found that the mean VAS scores were higher in the luteal phase than in the follicular phase, however this difference was not statistically significant. There was no statistically significant difference between the groups with and without aromatherapy in terms of VAS scores. The correlation between total PCS scores and total VAS scores was statistically significant (r=0.310).

Conclusions: Debonding in female patients is recommended for the comfort of patients on days when the patient's menstrual phase is in the follicular phase. It should be considered that patients with a lower pain threshold will experience more pain during the orthodontic debonding procedure.

Keywords: Aromatherapy, Menstrual Phase, Orthodontic Debonding, Pain.

Menstrüel Döngü Evresi ve Aromaterapinin Ortodontik Debonding Ağrısına Etkisi

Süreç

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ÖZ

Amaç: Bu prospektif klinik çalışmanın amacı, menstrüel siklus evrelerinin ve aromaterapinin kadınların ortodontik debonding ağrı algısı üzerindeki etkilerini değerlendirmektir.

Yöntem: Çalışmamızın materyallerini rastgele seçilmiş 48 kadın hasta (ortalama yaş: 19,00±3,40 yıl) oluşturmuştur. Dört farklı çalışma grubu gerçekleştirilmiştir. LA+; luteal fazda olup aromaterapi alan hastalar (n=12), LA-; luteal fazda olan ve aromaterapi almayan hastalar (n=13), FA+; foliküler fazda olup aromaterapi alan hastalar (n=11), FA-; folliküler fazda olan ve aromaterapi almayan hastalar (n=12). Debonding işleminden sonra, her diş için ağrı deneyimi hasta tarafından görsel analog skalada (VAS) puanlanmıştır. Ayrıca, katılımcıların ağrıya genel tepkileri Ağrı Felaketleştirme Ölçeği (PCS) ile değerlendirilmiştir. Aromaterapi protokolü, debonding işleminden 3 dakika önce yaklaşık 30 cm'den 3 dakika boyunca lavanta yağını soluyarak gerçekleştirilmiştir.

Bulgular: Ortalama VAS skorlarının luteal fazda foliküler faza göre daha yüksek olduğu bulunmuştur; ancak bu fark istatistiksel olarak anlamlı değildir. Aromaterapi alan ve almayan gruplar arasında VAS skorları açısından istatistiksel olarak anlamlı fark bulunmamıştır. Toplam PCS puanları ile toplam VAS puanları arasındaki korelasyon istatistiksel olarak anlamlıdır (r=0.310).

Sonuç: Ortodontik tedavi gören kadın hastalarda debonding işleminin, daha az ağrı hissetmeleri için menstrüel evrenin foliküler fazında olduğu dönemlerde yapılması önerilmektedir. Ağrı eşiği düşük olan hastaların ortodontik debonding işlemi sırasında daha fazla ağrı duyabileceği göz önünde bulundurulmalıdır.

Anahtar Kelimeler: Aromaterapi, Menstrüel Evre, Orthodontik Debonding, Ağrı.

[a] *k_ldemirsoy@hotmail.com* *https: //orcid.org/0000-0001-7271-4377*
[b] *skbuyuk@gmail.com* *https: //orcid.org/0000-0002-7885-9582*
[c] *tugceeimamogluu@gmail.com* *https: //orcid.org/0000-0002-9683-5816*

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Introduction

The sensation of pain is an important physiological and emotional experience that can vary according to factors such as gender, age, past experiences with pain, emotional stress, and cultural background.[1] Different levels of pain sensation accompany the process depending on the applied biomechanical principles in various stages of orthodontic treatment. Approximately 95% of patients undergoing orthodontic treatment reported that they experience varying degrees of pain.[2] There is not enough literature data on the presence, causes, and severity of pain in the debonding phase when brackets, tubes and/or bands are removed. The debonding phase is a painful procedure of varying severity from person to person. It has been reported that while some individuals feel very low levels of pain, some individuals feel a higher level of pain.[1] Many studies have reported that female patients feel more pain than male patients and this is related to gonadal hormones.[3,4]

The menstrual cycle of women consists of two consecutive phases: the follicular and luteal phases. Although the length of a cycle varies among women, it is 28 days on average.[5] The luteal phase is 14 days before the first day of menstrual bleeding and the remaining days of the cycle are the follicular phase. While the follicular phase may show different durations according to the cycles (14-21 days), it is stated that the luteal phase has more stable periods.[6] It is known that fluctuations in hormonal, physical and psychological symptoms occur in the follicular and luteal phases of the menstrual cycle.[7] Thermal, pressure and ischemic pain perceptions increase in the luteal phase compared to the follicular phase.[8]

Aromatherapy is the practice of using natural aromatic essential oils for a range of applications that have been shown to improve mood, relieve pain, and improve cognitive function.[9] Aromatherapy is performed by releasing the volatile scent of essential oils into a certain environment. Aroma compounds are converted into chemical signals via the nasal mucosa and these are transferred to the brain.[10] This practice with plant-based fragrances has a very low application cost, has no side effects reported in the literature, and does not tend to cause addiction.[11-13]

Some studies have reported that aromatherapy can be used among non-pharmacological treatment methods for dental anxiety, since it reduces dental anxiety levels.[14,15] While the scents of natural essential oils are diffused into the air by candles or dispensers, inhalation of scent molecules stimulates the limbic system of the brain through the olfactory system.[10] This may enable patients to relax their bodies and tense mental states[16] the implementation of various planned dental treatments may become easier and more comfortable for the patient.[14] Moreover, it has been reported that the application of aromatherapy in dental clinics also masks the unpleasant eugenol odour reported by the patient as one of the main sources of anxiety.[17]

When we searched the literature, we could not find a study investigating the menstrual cycle phase and the effect of aromatherapy on orthodontic debonding pain perception. The aim of this study was to evaluate the effects of the follicular and luteal phases of the menstrual cycle and aromatherapy on women's perception of orthodontic debonding pain. There are 2 hypotheses tested in this study:

- Aromatherapy reduces the level of pain during the orthodontic debonding process.
- Women feel less pain in the follicular phase during orthodontic debonding.

Materials and Methods

The research protocol of this clinical study was approved by the Nevsehir Hacı Bektas Veli University Ethics Committee (No: 2020.13.142, Date: 23 June 2020). The scope of the study was explained to all patients participating in the study and a signed and informed consent form was obtained from the patient/parents. Patients with a history of ongoing psychiatric treatment, history of mild to severe periodontal disease, difficulty in communication, irregular menstrual cycle, amenorrhea, pregnancy, history of combined oral contraceptive use, any pain sensation in the orofacial region and using analgesics within 24 hours before the appointment were excluded from the study. Patients in the debonding phase of orthodontic treatment and treated with fixed orthodontic treatment using metal brackets, patients with regular menstrual cycles, and without systemic disease were included in this study.

The sample size was determined using the G*Power software program (Version 3.1.9.2, Universität Düsseldorf, Germany) with an alpha error probability of 0.05 and a power of 95% (effect size 0.5). Power analysis showed that a total of 45 patients were adequate. The material of this study consists of 48 patients (average age: 19.00±3.40 years) who were randomly selected from female patients who were treated at the Department of Orthodontics, Faculty of Dentistry of Ordu University and met the inclusion criteria. Four different study groups were designed depending on whether aromatherapy was applied or not and whether the menstrual phase was in the follicular or luteal phase. LA+; the patients in the luteal phase and received aromatherapy (n=12), LA-; the patients in the luteal phase and did not receive aromatherapy (n=13), FA+; the patients in the follicular phase and received aromatherapy (n=11), FA-; the patients in the follicular phase and did not receive aromatherapy (n=12).

Debonding was performed by the same orthodontist (T.A.) and debonding was started after taking medical anamnesis. The researcher interviewed all patients and debonding was performed using a torque action with the same debonding device (Ixion™, DB Orthodontics). The brackets were removed one by one from right to left in the

maxilla and mandible and a 100 mm VAS was prepared for each tooth (Figure 1). According to this scale, a score of 0 means "no pain" and scores increasing from 0 to 100 represent an increase in pain. Patients were asked to mark according to the level of discomfort experienced after bracket/tube/band removal from each tooth, and the pain experience for each tooth was scored by the patient in VAS.

Figure 1. Removal of brackets with finger pressure and torque movement during the orthodontic debonding process.

Figure 2. Aromatherapy process applied by inhalation and lavender oil used in this study.

Participants' general responses to pain were assessed with the Pain Catastrophizing Scale (PCS). PCS is one of the basic scales that also includes cognitive and emotional components related to pain.[18,19] To assess the link between personal characteristics and actual pain during debonding, PCS consisting of 13 statements describing participants' general response to any painful situation, different thoughts and feelings that may be associated with pain, was used. PCS questionnaires were administered to patients after debonding.

The aromatherapy group was randomly selected among patients who met the criteria. The patient inhaled the aroma in a glass godet by dropping 5 drops of lavender oil into 10 cc water, 3 minutes before the debonding process at about 30 cm[20] (Figure 2). Skin contact is avoided. Lavender natural essential oil (100% pure Lavandula angustifolia Mill. NU13950, lot number 9133, Code APE 7490B) was purchased from Nu-KA Defne Essencia (Antalya, Türkiye). The origin country of the lavender plant is France. The other group was the control group and aromatherapy was not applied.

Statistical analysis was performed using the statistical analysis program (SPSS Inc., version 20 for Windows; Chicago, IL, USA). The distribution of the data was evaluated by the Shapiro-Wilks normality test. Mann Whitney U-test was used to compare VAS values between groups and Spearman's rank correlation coefficient analysis was used to evaluate the correlation between total VAS score and PCS. Statistical significance level was determined as $p<0.05$.

Results

The distribution of ages by groups shown in Table 1. The comparison of the VAS and PCS scores of the subjects who did not receive aromatherapy are shown in Table 2, and the data of the subjects who received aromatherapy are shown in Table 3. The higher VAS scores were observed in both the upper and lower jaws in both the groups that received and did not receive aromatherapy in the luteal phase. While the total VAS score of the LA+ group was 211.83, this value was 143.64 in the FA+ group. The comparison of the VAS and PCS scores of the individuals who received and did not receive aromatherapy in the luteal phase is shown in Table 4. Although there was no statistically significant difference in VAS scores between the LA+ and LA− groups, all VAS scores were higher in the LA+ group. The comparison of VAS and PCS scores of individuals who received and did not receive aromatherapy in the follicular phase is shown in Table 5. Although there was no statistically significant difference in VAS scores between the FA+ and FA− groups, all VAS scores were higher in the FA+ group. Spearman correlation values between VAS scores and PCS scores are given in Table 6. The correlation between total PCS scores and total VAS scores was statistically significant ($r=0.310$, $P<0.05$), regardless of menstrual stage and aromatherapy application.

Discussion

It was concluded that the application of aromatherapy in female patients did not reduce the level of pain during the orthodontic debonding procedure. However, the level of pain felt by female patients when orthodontic debonding is applied in the follicular phase less than in the luteal phase. Accordingly, while the first hypothesis of this study was rejected, the second hypothesis was accepted.

Many factors have been identified that may cause pain during the orthodontic debonding procedure. General health status of the patient, gender, tooth structure, mobility in teeth, direction of force applied during debonding are some of these factors.[21] It has been reported that the most effective of these factors are the mobility of the teeth and the direction of force applied during orthodontic debonding. It has been reported that patients feel less pain during debonding in intrusive forces than in mesial/distal, facial/lingual or extrusive forces.[21]

Table 1. Comparison of the ages of individuals between groups

	Groups				Pα
	LA+ (n=12) Mean (SD)	LA− (n=13) Mean (SD)	FA+ (n=11) Mean (SD)	FA− (n=12) Mean (SD)	
Age (years)	19.14 (3.03)	18.43 (3.28)	18.67 (2.52)	19.79 (4.63)	0.778

LA+: the patients in the luteal phase and received aromatherapy, LA−: the patients in the luteal phase and did not receive aromatherapy, FA+: the patients in the follicular phase and received aromatherapy, FA−: the patients in the follicular phase and did not receive aromatherapy, SD: Standard deviation, α Results of One-way analysis of variance.

Table 2. Comparison of VAS and PCS scores of subjects without aromatherapy

	LA−	FA−	p*
	Mean (SD)	Mean (SD)	
Upper tooth VAS scores	59.92 (102.47)	40.58 (45.71)	0.478
Lower tooth VAS scores	82.00 (138.34)	36.42 (39.67)	0.870
Total VAS scores	141.92 (232.13)	77.00 (75.73)	0.913
PCS scores	8.46 (12.87)	4.08 (5.45)	0.464

LA−: the patients in the luteal phase and did not receive aromatherapy, FA−: the patients in the follicular phase and did not receive aromatherapy, SD: Standard deviation, *Results of Mann-Whitney U test.

Table 3. Comparison of VAS and PCS scores of aromatherapy subjects

	LA+	FA+	p*
	Mean (SD)	Mean (SD)	
Upper tooth VAS scores	109.00 (123.95)	79.36 (164.58)	0.116
Lower tooth VAS scores	120.83 (160.78)	64.27 (106.71)	0.708
Total VAS scores	211.83 (272.37)	143.64 (233.84)	0.267
PCS scores	4.42 (8.27)	2.73 (4.88)	0.699

LA+: the patients in the luteal phase and received aromatherapy, LA−: the patients in the luteal phase and did not receive aromatherapy, SD: Standard deviation, *Results of Mann-Whitney U test.

Table 4. Comparison of VAS and PCS scores of subjects without aromatherapy

	LA+	LA−	p*
	Mean (SD)	Mean (SD)	
Upper tooth VAS scores	109.00 (123.95)	59.92 (102.47)	0.113
Lower tooth VAS scores	120.83 (160.78)	82.00 (138.34)	0.956
Total VAS scores	211.83 (272.37)	141.92 (232.13)	0.265
PCS scores	4.42 (8.27)	8.46 (12.87)	0.315

LA+: the patients in the luteal phase and received aromatherapy, LA−: the patients in the luteal phase and did not receive aromatherapy, SD: Standard deviation, *Results of Mann-Whitney U test.

Table 5. Comparison of VAS and PCS scores of subjects with and without aromatherapy in the follicular phase

	FA+	FA−	p*
	Mean (SD)	Mean (SD)	
Upper tooth VAS scores	79.36 (164.58)	40.58 (45.71)	0.734
Lower tooth VAS scores	64.27 (106.71)	36.42 (39.67)	0.734
Total VAS scores	143.64 (233.84)	77.00 (75.73)	0.735
PCS scores	2.73 (4.88)	4.08 (5.45)	0.769

FA+: the patients in the follicular phase and received aromatherapy, FA−: the patients in the follicular phase and did not receive aromatherapy, SD: Standard deviation, *Results of Mann-Whitney U test.

Table 6. Spearman correlation values between VAS scores and PCS scores

	Upper tooth VAS scores	Upper tooth VAS scores	Total VAS scores
PCS scores	0.330*	0.201	0.310*

* The correlation level is significant at the P<0.05 level

In this study, the fact that all patients were female and the debonding procedure was performed by the same orthodontist and using the same direction of movement (torque movement) allowed us to obtain pure study data. It has been stated that the short handle of the tool to be used in the debonding process with torque movement and the application of finger pressure during disassembly create a more tolerable pain level in the patient.[21] In this study, a standard short-handled removal forceps was used in all patients and the teeth were supported by finger pressure during the procedure.

The results of this prospective clinical study show that menstrual cycle phases affect the severity of orthodontic pain perceived by the patient during orthodontic debonding. Although there was no statistically significant difference, it was observed that the VAS scores obtained in the luteal stage were higher than the follicular stage. Although there are many side effects in orthodontic

treatments, pain is one of the leading side effects.[22] As far as we have researched, there is no study in the literature on the menstrual phase and the perception of pain that develops with orthodontic debonding procedure. The studies investigating the relationship between the menstrual cycle and orthodontic pain are also limited. Riley *et al.*[8] emphasized that the effects of the menstrual cycle on the perception of pain are too obvious to be ignored. Estrogen levels decrease and progesterone levels increase during the luteal phase. Pain sensation is higher in the luteal phase than in the follicular phase and during menstruation.[23] According to molecular biology studies, decreased estrogen causes the hypothalamus to release norepinephrine, which triggers a drop in acetylcholine, dopamine, and serotonin, which can lead to premenstrual syndrome with common symptoms such as pain sensitivity, insomnia, fatigue, and depression.[24] The fact that the GABAergic system, which affects neuronal excitability, is associated with estrogen and progesterone levels that change during menstrual phases explains the change in perception of pain sensation during menstrual phases.[25] Ileri *et al.*[5] investigated the relationship between menstrual phase and pain level following lace-back procedure in female patients during orthodontic treatment, they stated that there is a higher pain level in the luteal phase and that menstrual cycle phases may have an important role in how women perceive orthodontic pain in clinical applications.

The length of the menstrual cycle is determined by the rate and quality of follicular growth and development, and it is normal for the cycle to vary in everyone. It is known that between the ages of 25-35, more than 60% of the cycles are between 25 and 28 days.[26] Progesterone levels normally rise after ovulation and peak around 8-10 days after the luteinizing hormone surge.[27] In this study, we included patients in the follicular phase and luteal phase of the menstrual cycle in order to see the maximum effect of hormonal changes. One of the limitations of this study is that methods such as determining the hormonal level from the blood level or ultrasonographic examination were not used. Since these procedures, which can be considered as interventional, are difficult to implement in terms of ethics, menstrual phases were determined with the calendar method.

Aromatherapy is a form of therapy that uses aromatic compounds such as essential oils for therapeutic or medicinal purposes and has been in use for nearly 6000 years to improve the mood or health of individuals with both physical and emotional effects.[28] Aromatic oils are obtained from various parts of plants, herbs, trees and flowers for medicinal purposes, and there are more than forty different types of oils. These oils have varying degrees of antimicrobial activity and are thought to have effects with antiviral, antifungal, and antioxidant properties.[29] Aromatherapy works in connection with the sense of smell, and it has been stated that its possible mechanism of action is by acting on the olfactory nerve cells in the nasal cavity and sending impulses to the limbic system, which stimulates the nervous and circulatory system.[30] Lemon, chamomile, lavender, orange, apple, cedarwood and bergamot are a few sources of essential oils often used in aromatherapy, and it is known that these aromatic oils should be used in very small amounts.[29,31] Aromatherapy treatments can be done through massage, topical applications or inhalation. In this study, the protocol of applying lavender oil by inhalation,[20] as followed in the groups treated with aromatherapy. Although many studies have been conducted in the literature on aromatherapy and dental anxiety, there is no study evaluating the relationship between orthodontic treatment-induced pain and aromatherapy. While some studies concluded that aromatherapy did not affect dental anxiety,[32] it was concluded that aromatherapy reduced the level of dental anxiety in some studies.[14,15] According to this study findings, there was no statistically significant difference in terms of debonding pain levels between the groups with and without aromatherapy at different menstrual phases.

In this prospective study, two scales were used to evaluate pain levels after orthodontic debonding; VAS and PCS. The VAS is one of the most used tools to measure patient-perceived discomfort during orthodontic treatment or other clinical practice.[33,34] Scott and Huskisson[35] reported that the VAS is a scale that is easily understood by most patients, it is reliable, and it has high reproducibility. On the other hand, there are also studies reporting that the VAS has some practical limitations in clinical practice and that many patients have difficulty in assessing the distance accurately.[36] When assessing pain and disability, not only physical characteristics such as frequency, duration and severity of pain should not be considered, but also cognitive and emotional components should be considered.[18,19] In this context, the PCS has been a very useful scale to assess the link between personal pain perception and actual pain during debonding. Also, it was observed that there was a significant correlation between the total VAS scores and the total PCS scores. If we interpret it for clinical applications; it was found that individuals who are more sensitive to pain in their daily life have higher pain levels than other patients during the orthodontic debonding procedure.

Conclusions

Based on the findings of this prospective clinical study;

- Orthodontic debonding should be performed between the days when the patient's menstrual phase is in the follicular phase to reduce the patient's pain level and increase comfort.
- It has been observed that the application of aromatherapy does not reduce the pain levels during the orthodontic debonding procedure in female patients.
- It should be considered that patients with a lower pain threshold will experience more pain during the orthodontic debonding procedure, and orthodontic debonding should be done in female patients by considering individual differences.

Conflict of Interests

The authors of the present study declare no conflict of interest.

Ethical standards

The research protocol of this clinical study was approved by the Nevsehir Hacı Bektas Veli University Ethics Committee (No: 2020.13.142, Date: 23 June 2020). This study has been conducted in full accordance with the World Medical Association Declaration of Helsinki.

References

1. Bavbek NC, Tuncer BB, Tortop T, Celik B. Efficacy of different methods to reduce pain during debonding of orthodontic brackets. Angle Orthod 2016; 86: 917-924.
2. Krishnan V. Orthodontic pain: from causes to management--a review. Eur J Orthod 2007; 29: 170-179.
3. Normando TS, Calçada FS, Ursi WJ, Normando D. Patients' report of discomfort and pain during debonding of orthodontic brackets: a comparative study of two methods. World J Orthod 2010; 11: e29-e34.
4. Williams OL, Bishara SE. Patient discomfort levels at the time of debonding: a pilot study. Am J Orthod Dentofacial Orthop 1992; 101: 313-317.
5. Ileri Z, Baka ZM, Akin M, Apiliogullari S, Basciftci FA. Effect of menstrual cycle on orthodontic pain perception: A controlled clinical trial. J Orofac Orthop 2016; 77: 168-175.
6. Sherman BM, Korenman SG. Hormonal characteristics of the human menstrual cycle throughout reproductive life. J Clin Invest 1975; 55: 699-706.
7. Hanci V, Ayoğlu H, Yilmaz M, et al. Effect of menstrual cycle on the injection pain due to propofol. Eur J Anaesthesiol 2010; 27: 425-427.
8. Riley JL 3rd, Robinson ME, Wise EA, Price D. A meta-analytic review of pain perception across the menstrual cycle. Pain 1999; 81: 225-235.
9. Lee MS, Choi J, Posadzki P, Ernst E. Aromatherapy for health care: an overview of systematic reviews. Maturitas 2012; 71: 257-260.
10. Lv XN, Liu ZJ, Zhang HJ, Tzeng CM. Aromatherapy and the central nerve system (CNS): therapeutic mechanism and its associated genes. Curr Drug Targets 2013; 14: 872-879.
11. Lee YL, Wu Y, Tsang HW, Leung AY, Cheung WM. A systematic review on the anxiolytic effects of aromatherapy in people with anxiety symptoms. J Altern Complement Med 2011; 17: 101-108.
12. Perry N, Perry E. Aromatherapy in the management of psychiatric disorders. CNS Drugs 2006; 20: 257-80.
13. Fitzgerald M, Culbert T, Finkelstein M, Green M, Johnson A, Chen S. The effect of gender and ethnicity on children's attitudes and preferences for essential oils: a pilot study. Explore 2007; 3: 378-385.
14. Hasheminia D, Kalantar Motamedi MR, Karimi Ahmadabadi F, Hashemzehi H, Haghighat A. Can ambient orange fragrance reduce patient anxiety during surgical removal of impacted mandibular third molars? J Oral Maxillofac Surg 2014; 72: 1671-1676.
15. Zabirunnisa M, Gadagi JS, Gadde P, Myla N, Koneru J, Thatimatla C. Dental patient anxiety: Possible deal with Lavender fragrance. J Res Pharm Pract 2014; 3: 100-103.
16. hang Y, Wu Y, Chen T, et al. Assessing the metabolic effects of aromatherapy in human volunteers. Evid Based Complement Alternat Med 2013; 2013: 356381.
17. Hakeberg M, Berggren U. Dimensions of the Dental Fear Survey among patients with dental phobia. Acta Odontol Scand 1997; 55: 314-318.
18. Sullivan MJ, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess 1995; 7: 524–532.
19. Osman A, Barrios FX, Kopper BA, et al. Factor structure, reliability, and validity of the Pain Catastrophizing Scale. J Behav Med 1997; 20: 589–605.
20. Karan NB. Influence of lavender oil inhalation on vital signs and anxiety: A randomized clinical trial. Physiol Behav 2019; 211: 112676.
21. Williams OL, Bishara SE. Patient discomfort levels at the time of debonding: a pilot study. Am J Orthod Dentofacial Orthop 1992; 101: 313-317.
22. Gosney MB. An investigation into factors which may deter patients from undergoing orthodontic treatment. Br J Orthod 1985; 12: 133-138.
23. Curiel-Montero F, Alburquerque-Sendín F, Fernández-de-Las-Peñas C, Rodrigues-de-Souza DP. Has the Phase of the Menstrual Cycle Been Considered in Studies Investigating Pressure Pain Sensitivity in Migraine and Tension-Type Headache: A Scoping Review. Brain Sci 2021; 11: 1251.
24. Gudipally PR, Sharma GK. Premenstrual Syndrome. In: StatPearls. Treasure Island (FL): StatPearls Publishing; November 14, 2021.
25. Martin VT. Ovarian hormones and pain response: a review of clinical and basic science studies. Gend Med 2009; 6 Suppl 2: 168-192.
26. Speroff L, Glass RH, Kase NG. Regulation of the menstrual cycle. In: Speroff L, Glass RH, Kase NG (eds) Clinical gynecologic endocrinology and infertility, pp 200–246. Lippincott Williams & Wilkins, Baltimore, 1999.
27. Erden V, Yangn Z, Erkalp K, Delatioğlu H, Bahçeci F, Seyhan A. Increased progesterone production during the luteal phase of menstruation may decrease anesthetic requirement. Anesth Analg 2005; 101: 1007-1011.
28. Worwood VA. The Complete Book of Essential Oils and Aromatherapy. Revised and Expanded: Over 800 Natural, Nontoxic, and Fragrant Recipes to Create Health, Beauty, and Safe Home and Work Environments. first ed. New World Library; 2016.
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: 311-319.
30. Jimson S, Malathi L, Devi N, Sankari L. Aromatherapy in dentistry – a review. Biomed Pharmacol J 2016; 9: 827–828.
31. Chouhan S, Sharma K, Guleria S. Antimicrobial Activity of Some Essential Oils-Present Status and Future Perspectives. Medicines (Basel) 2017; 4: 58.
32. Fux-Noy A, Zohar M, Herzog K, et al. The effect of the waiting room's environment on level of anxiety experienced by children prior to dental treatment: a case control study. BMC Oral Health 2019; 19: 294.
33. Erdinç AM, Dinçer B. Perception of pain during orthodontic treatment with fixed appliances. Eur J Orthod 2004; 26: 79-85.
34. Jones M, Chan C. The pain and discomfort experienced during orthodontic treatment: a randomized controlled clinical trial of two initial aligning arch wires. Am J Orthod Dentofacial Orthop 1992; 102: 373-381.

35. Scott J, Huskisson EC. Accuracy of subjective measurements made with or without previous scores: an important source of error in serial measurement of subjective states. Ann Rheum Dis 1979; 38: 558-559.

36. Park KS, Lee YJ, Lee J, Ha IH. A study on the effectiveness of pharmacopuncture for chronic neck pain: A protocol for a pragmatic randomized controlled trial. Medicine (Baltimore) 2020; 99: e21406.