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

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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

Öz

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


Sonuç: Ortodontik tedavi gören kadın hastalarda debonding işlemi, daha az ağrı hissettirmeleri için menstrüel evrenin folliküler fazında olduğu dönemde yapılmaya önerilmektedir. Ağrı eşliğinde olup hastaların ortodontik debonding işlemi sırasında daha fazla ağrı duyabileceğini göz önünde bulundurulmalıdır.

Anahtar Kelimeler: Aromaterapi, Menstrüel Evre, Ortodontik Debonding, Ağrı.
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. 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. 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. Many studies have reported that female patients feel more pain than male patients and this is related to gonadal hormones.

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. 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. It is known that fluctuations in hormonal, physical and psychological symptoms occur in the follicular and luteal phases of the menstrual cycle. Thermal, pressure and ischemic pain perceptions increase in the luteal phase compared to the follicular phase.

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. 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. 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.

Some studies have reported that aromatherapy can be used among non-pharmacological treatment methods for dental anxiety, since it reduces dental anxiety levels. 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. This may enable patients to relax their bodies and tense mental states; the implementation of various planned dental treatments may become easier and more comfortable for the patient. 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.

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 Nevşehir Hacı Bektaş 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: 19.0±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 (lixion®, 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.

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. 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. 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. 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.
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. 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.

### Table 1. Comparison of the ages of individuals between groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>LA+ (n=12) Mean (SD)</th>
<th>LA− (n=13) Mean (SD)</th>
<th>FA+ (n=11) Mean (SD)</th>
<th>FA− (n=12) Mean (SD)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>19.14 (3.03)</td>
<td>18.43 (3.28)</td>
<td>18.67 (2.52)</td>
<td>19.79 (4.63)</td>
<td>0.778</td>
</tr>
</tbody>
</table>

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, *Results of One-way analysis of variance.

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

<table>
<thead>
<tr>
<th></th>
<th>LA− Mean (SD)</th>
<th>FA− Mean (SD)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper tooth VAS scores</td>
<td>59.92 (102.47)</td>
<td>40.58 (45.71)</td>
<td>0.478</td>
</tr>
<tr>
<td>Lower tooth VAS scores</td>
<td>82.00 (138.34)</td>
<td>36.42 (39.67)</td>
<td>0.870</td>
</tr>
<tr>
<td>Total VAS scores</td>
<td>141.92 (232.13)</td>
<td>77.00 (75.73)</td>
<td>0.913</td>
</tr>
<tr>
<td>PCS scores</td>
<td>8.46 (12.87)</td>
<td>4.08 (5.45)</td>
<td>0.464</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>LA+ Mean (SD)</th>
<th>FA+ Mean (SD)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper tooth VAS scores</td>
<td>109.00 (123.95)</td>
<td>79.36 (164.58)</td>
<td>0.116</td>
</tr>
<tr>
<td>Lower tooth VAS scores</td>
<td>120.83 (160.78)</td>
<td>64.27 (106.71)</td>
<td>0.708</td>
</tr>
<tr>
<td>Total VAS scores</td>
<td>211.83 (272.37)</td>
<td>143.64 (233.84)</td>
<td>0.267</td>
</tr>
<tr>
<td>PCS scores</td>
<td>4.42 (8.27)</td>
<td>2.73 (4.88)</td>
<td>0.699</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>LA+ Mean (SD)</th>
<th>LA− Mean (SD)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper tooth VAS scores</td>
<td>109.00 (123.95)</td>
<td>59.92 (102.47)</td>
<td>0.113</td>
</tr>
<tr>
<td>Lower tooth VAS scores</td>
<td>120.83 (160.78)</td>
<td>82.00 (138.34)</td>
<td>0.956</td>
</tr>
<tr>
<td>Total VAS scores</td>
<td>211.83 (272.37)</td>
<td>141.92 (232.13)</td>
<td>0.265</td>
</tr>
<tr>
<td>PCS scores</td>
<td>4.42 (8.27)</td>
<td>8.46 (12.87)</td>
<td>0.315</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>FA+ Mean (SD)</th>
<th>FA− Mean (SD)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper tooth VAS scores</td>
<td>79.36 (164.58)</td>
<td>40.58 (45.71)</td>
<td>0.734</td>
</tr>
<tr>
<td>Lower tooth VAS scores</td>
<td>64.27 (106.71)</td>
<td>36.42 (39.67)</td>
<td>0.734</td>
</tr>
<tr>
<td>Total VAS scores</td>
<td>143.64 (233.84)</td>
<td>77.00 (75.73)</td>
<td>0.735</td>
</tr>
<tr>
<td>PCS scores</td>
<td>2.73 (4.88)</td>
<td>4.08 (5.45)</td>
<td>0.769</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Upper tooth VAS scores</th>
<th>Upper tooth VAS scores</th>
<th>Total VAS scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS scores</td>
<td>0.330*</td>
<td>0.201</td>
<td>0.310*</td>
</tr>
</tbody>
</table>

* The correlation level is significant at the P<0.05 level.
treatments, pain is one of the leading side effects. 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. 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 sensitivity is higher in the luteal phase than in the follicular phase and during menstruation. 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. 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 sensitivity during menstrual phases. Ileri et al. investigated the relationship between menstrual phase and pain level following face-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. Progesterone levels normally rise after ovulation and peak around 8-10 days after the luteinizing hormone surge. 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. 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. 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. 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. Aromatherapy treatments can be done through massage, topical applications or inhalation. In this study, the protocol of applying lavender oil by inhalation, 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, it was concluded that aromatherapy reduced the level of dental anxiety in some studies.

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. Scott and Huskisson 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. 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. 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 Nevşehir Hacı Bektaş 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
