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Effect of Music Therapy on Dental Anxiety in Periodontal Surgery

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ABSTRACT

Introduction: Pharmacological or non-pharmacological methods are applied to eliminate fear and anxiety problems related to dental treatments in many patients. As a non-invasive, non-pharmacological method with an anxiolytic effect, music therapy is preferred in the management of anxiety and fear. This study aimed to investigate the effect of music therapy on dental anxiety in patients scheduled to undergo periodontal surgery.

Material and Method: The study included a total of 46 patients, 23 in the study group and 23 in the control group, who were scheduled to undergo periodontal surgery. During the surgical procedure, the patients in the study group listened to music using in-ear headphones that isolated ambient sounds. The patients in the control group wore in-ear headphones to isolate ambient sounds, but they did not listen to any music. All patients were asked to complete the Modified Dentistry Anxiety Scale (MDAS), the State-Trait Anxiety Inventory-State (STAI-S), and the Dental Fear Survey (DFS) before and after surgery. Systolic blood pressure (SBP) and diastolic blood pressure were measured as vital signs before and after surgery, and the Visual Analog Scale (VAS) scores were recorded twice (at the end of and 30 minutes after the surgical procedure).

Results: In the study group, the post-test MDAS, STAI-S, and DFS measurement values showed statistically significant decreases compared to the pre-test measurement values (P<0.001, P=0.009, and P<0.001, respectively), but there was no statistically significant difference in the control group (P=0.093, P=0.923, and P=0.460, respectively). In both the study and control groups, the post-test VAS measurement values statistically significantly decreased compared to the pre-test measurement values (P=0.002 and P=0.019, respectively). While the post-test SBP values decreased statistically significantly in the study group compared to the pre-test measurement values (P=0.020), there was no statistically significant difference in the control group (P=0.705). No statistically significant difference was found between the pre-test and post-test measurement values of the DFS scores in the study or control group (P=0.083 and P=0.160, respectively).

Clinical significance: This study is the first clinical study to evaluate the effect of music on anxiety in periodontal surgery simultaneously with four different scales. Music therapy was found to be effective in reducing dental anxiety and fear during periodontal surgery.

Key Words: Dental Anxiety, Music Therapy, Periodontal Surgery, Systolic And Diastolic Blood Pressure, MDAS, STAI-S, DFS, VAS.

Periodontal Cerrahide Müzik Terapinin Dental Kaygıya Etkisi

Süreç

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ÖZ

Giriş: Birçok hastada diş tedavilerine bağlı korku ve kaygı sorunlarını ortadan kaldırmak için farmakolojik veya farmakolojik olmayan yöntemler uygulanmaktadır. Anksiyete ve korku tedavisinde noninvaziv, farmakolojik olmayan, anksiyolitik etkiye sahip bir yöntem olan müzik terapisi tercih edilmektedir. Bu çalışmada periodontal cerrahi planlanan hastalarda müzik terapisinin dental anksiyeteye etkisinin araştırılması amaçlandı.

Gereç ve Yöntem: Çalışmaya periodontal cerrahi planlanan 23'ü çalışma grubunda, 23'ü kontrol grubunda olmak üzere toplam 46 hasta dahil edildi. Cerrahi işlem sırasında çalışma grubundaki hastalar ortam seslerini izole eden kulak içi kulaklık kullanarak müzik dinlediler. Kontrol grubundaki hastalar ortam seslerini izole etmek için kulak içi kulaklık taktılar ancak herhangi bir müzik dinlemediler. Tüm hastalardan ameliyat öncesi ve sonrası Modifiye Diş Hekimliği Anksiyete Ölçeği'ni (MDAS), Durumluk-Sürekli Kaygı Envanteri-Durumunu (STAI-S) ve Dental Korku Anketini (DFS) doldurmaları istendi. Ameliyat öncesi ve sonrası vital bulgular olarak sistolik kan basıncı (SKB) ve diyastolik kan basıncı ölçüldü ve Görsel Analog Skala (VAS) skorları iki kez (cerrahi işlem sonunda ve ameliyattan 30 dakika sonra) kaydedildi.

Bulgular: Çalışma grubunda son test MDAS, STAI-S ve DFS ölçüm değerleri ön test ölçüm değerlerine göre istatistiksel olarak anlamlı düşüşler gösterdi (sırasıyla P<0,001, P=0,009 ve P<0,001), ancak kontrol grubunda istatistiksel olarak anlamlı bir fark yoktu (sırasıyla P=0.093, P=0.923 ve P=0.460). Hem çalışma hem de kontrol gruplarında son test VAS ölçüm değerleri ön test ölçüm değerlerine göre istatistiksel olarak anlamlı düzeyde azaldı (sırasıyla P=0,002 ve P=0,019). Çalışma grubunda son test SKB değerleri ön test ölçüm değerlerine göre istatistiksel olarak anlamlı derecede azalırken (P=0,020), kontrol grubunda ise istatistiksel olarak anlamlı bir fark saptanmadı (P=0,705). Çalışma ve kontrol grubunda DFS puanlarının ön test ve son test ölçüm değerleri arasında istatistiksel olarak anlamlı bir fark bulunmadı (sırasıyla P=0,083 ve P=0,160).

Klinik önemi: Bu çalışma, periodontal cerrahide müziğin anksiyete üzerindeki etkisini dört farklı ölçekle eş zamanlı olarak değerlendiren ilk klinik çalışmadır. Müzik terapisinin periodontal cerrahi sırasında diş kaygısını ve korkuyu azaltmada etkili olduğu bulundu.

Anahtar Kelimeler: Diş Kaygısı, Müzik Terapisi, Periodontal Cerrahi, Sistolik ve Diyastolik Kan Basıncı, MDAS, STAI-S, DFS, VAS.

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Introduction

Dental anxiety, which is frequently encountered in patients undergoing dental treatment as a more specific situation than general anxiety, occurs as a result of negative experiences gained in the personal, family, or social environment and can cause problems for both the physician and the patient. Dental anxiety can result in patients delaying their appointments for dental treatments and not attending their control visits regularly or et al.[1] This situation increases the incidence of dental diseases.[2] Not knowing what to expect in dental treatments and the possibility of pain during or after dental procedures usually cause anxiety and fear in patients. When anxiety and fear are observed in patients, these emotional states must be controlled by the physician in order for the process to progress appropriately. Among the effective methods in anxiety management are providing the patient with information about the treatment procedure, pharmacological options, behavioral management, biological feedback, and hypnosis. Pharmacological options offer short-term solutions. However, patients receiving pharmacological therapy are at increased risk due to drug interactions and potential overdose. Applications such as hypnosis should only be performed by professionals. Behavioral management is another method preferred in individuals with dental anxiety to reduce the use of anxiolytic drugs and relieve or decrease anxiety and fear. It has been reported that individuals with high anxiety levels prefer non-pharmacological interventions more in their dental treatments. Listening to music is the easiest non-invasive alternative to pharmacological intervention for the control of anxiety during the procedure. In particular, the anxiolytic effects of music have been investigated in various fields, including surgical, cardiac, and oncology patients.[3] Appropriate music has been shown to have a strong effect on brain waves, leading people to a state of deep relaxation, and music is currently accepted as a therapeutic application with scientifically proven beneficial psychological and physiological effects.[4–5]

Periodontal surgical procedures are frequently performed under local anesthesia and can increase the level of anxiety of patients upon their arrival at the dental unit and seeing materials to be used during surgery, and while in the operating room. However, in the literature, there is no study evaluating the effect of listening to music on anxiety in patients undergoing periodontal surgery. Therefore, this study aimed to evaluate the effects of music therapy on dental anxiety in patients scheduled to undergo periodontal surgery, using the Modified Dentistry Anxiety Scale (MDAS), the State-Trait Anxiety Inventory-State (STAI-S), the Dental Fear Survey (DFS), and the Visual Analog Scale (VAS).

Material and Method

This research was designed as a randomized prospective cohort study and included individuals who presented to the Department of Periodontology of Kirikkale University Faculty of Dentistry. The study was conducted in accordance with the ethical rules of the Declaration of Helsinki and approved by the Non-Interventional Research Ethics Committee of the university (**meeting date:** 12/01/2022, **meeting number:** 2022/01, **decision number:** 2022.01.03). Prior to the study, all individuals participating in the study were given detailed information about the purpose and methodology of the study, and their consent was obtained using an informed consent form.

Patients who required periodontal surgery (frenectomy, gingivectomy, gingivoplasty, mucogingival surgery, implant surgery, and sinus lifting) were included in the study. The sample consisted of a total of 46 individuals, of whom 23 were included in the music therapy group (study group) and 23 did not listen to any music (control group). Each patient who agreed to participate in the study was allocated to one of the two groups using the lottery method, in which the first patient undergoing the same type of surgical procedure drew his/her group, and the next patient was assigned to the other group.

Pre-surgical Process

The consent form was completed by each patient. The patients participating in the study were informed that they could withdraw from the study at any time and were not attempted to be persuaded in any way to continue the study. The pre-surgical measurement of blood pressure values and the completion of the anxiety and fear scales were undertaken in the waiting room.

Surgical Procedure

The surgical procedure was standardized for each periodontal surgery. After the surgical dressing was covered, infiltration anesthesia was induced by administering an Ultracaine solution containing articaine and epinephrine (1: 100,000). Five minutes after the application, the level of numbness in the relevant area was checked, and the surgical procedure was initiated when this level was deemed sufficient. Pre-surgical procedures and surgery were performed by a single physician. If the patient complained of pain or discomfort during the procedure, an additional anesthetic solution was administered, and the procedure was resumed once the patient's complaint subsided. Additional anesthesia requirements were recorded. Post-surgical instructions concerning wound care, hemostasis, and the use of prescribed drugs were provided for each patient after the procedure.

Application of Music Therapy

Before the surgical procedure, the participants in both groups were asked to bring in-ear headphones that they routinely used to isolate external sounds. During surgery, the study group listened to classical Western music (Bach, Beethoven, and Chopin), choosing the tracks themselves. During surgical preparation, the patients were asked to

put on the headphones before the sterile dressing was placed. The patients were allowed to control the volume or stop the music using the music player. Thus, each patient was able to adjust the sound to a personally appropriate level, allowing them to communicate with the physician. Music was played until the end of the procedure. When it was necessary to communicate with the patient during the procedure, the music was temporarily stopped and resumed by the patient after communication was over.

Monitoring of Vital Signs and Evaluation of Anxiety, Fear, and Pain

The blood pressure values of the patients were first recorded in the waiting room. The anxiety values were measured before and after the procedure using the MDAS and STAI-S, fear levels were measured before and after the procedure using the DFS, and pain levels were recorded twice (at the end of and 30 minutes after the procedure) using the VAS. In order to record the VAS scores, the patients were asked to evaluate their current pain intensity on a scale of 0 to 10. Blood pressure values were measured again after the procedure.

After the patients had rested for a while in the waiting room for postoperative observation, they were asked, "Would you undergo the same procedure again?", and their responses were recorded.

Statistical Analysis

The G*Power (ver. 3.1.9.2, Franz Faul, Êniversität Kiel, Germany) package program was used to calculate the sample size and power required for the study. It was determined that at least 46 sample units were needed to achieve an effect width of f = 0.25 with a type 1 error probability of $\alpha = 0.05$ and power of 0.91.

The statistical analyses of the data obtained from the study were undertaken using the SPSS (version 22.0, SPSS Inc., Chicago, IL, USA) package program. Descriptive statistics were reported using mean ± standard deviation values for normally distributed numerical data, and median (minimum-maximum) values for continuous data that did not comply with the normal distribution. The descriptive statistics of categorical variables were reported using numbers and percentages (%). Correlation analyses and ratio comparisons between categorical variables were performed with either the chi-square test or Fisher's exact test, depending on the sample sizes in the cross-tab boxes. The conformity of data to the normal distribution was evaluated using the Shapiro-Wilk test. Independent-samples t-test (Student's t-test) was used to compare numerical data between two normally distributed independent groups, and the Mann-Whitney U test was used to compare non-normally distributed data. The dependent-samples t-test (paired t-test) was used to compare numerical variables between two normally distributed repeated measures, and the Wilcoxon signed rank test to compare two non-normally distributed repeated measures. The two-way mixed analysis of variance was performed to test whether the research groups had an effect (interaction effect) on the changes in the repeated measurements of MDAS, STAI-S, DFS, and VAS scores measured at two different times. During this analysis, the Bonferroni correction was applied for the intra-group and inter-group comparisons. The homogeneity of variances was evaluated with Levene's test. The assumption of the homogeneity of covariance matrices was evaluated using Box's M test. In cases where the assumption of the homogeneity of covariance matrices was not met, Pillai's trace test was employed as a multivariate analysis method. $P < 0.05$ was accepted as the limit of significance in all statistical comparisons.

Results

The study included a total of 46 patients, of whom 23 were in the control group and 23 were in the study group. Of all the patients, 67.4% (n=31) were female, and 32.6% (n=15) were male. The mean age of the patients was 39.26 ±15.19 (min-max: 18-67) years. Statistical findings concerning the comparison of sociodemographic characteristics between the groups are shown in Table 1. Gender distribution and mean age were statistically similar between the study and control groups (*P*=.753 and *P*=0.879, respectively). The patients were similarly distributed between the groups according to their place of residence (*P*=0.846). Income status, employment status, and education level were also similar in the two groups (*P*=0.552, *P* =0.422, and *P* =0.753, respectively).

Table 2 presents the statistical findings on the comparison of the study and control groups in terms of other characteristics that could have an effect on anxiety. The rate of additional anesthesia requirements was statistically similar between the groups (*P*=0.730). The rates of patients with companions and those with a history of previous dental treatment were statistically similar (*P*= .555 and *P*=1.000, respectively). The patients in both groups also had similar thoughts about undergoing the same procedure again (*P*=0.116). Lastly, there was no statistically significant difference between the operative times of the study and control groups (*P*=0.991).

The intra-group and inter-group comparisons of the MDAS scores measured at two different times are shown in Table 3. Accordingly, the time x group interaction effect was not statistically significant [F (1;44) = 2.615, *P*=0.113]. The main effect of time was statistically significant [F (1;44) = 16.342, *P*<.001]. However, when the main effect of group was evaluated, the MDAS scores did not statistically differ between the groups [F (1;44)=0.276, *P*= 0.602]. In the control group, the change in the MDAS score from the pre-test to the post-test was not statistically significant (*P*=0.093). In the study group, the decrease in the post-test MDAS score was statistically significant compared to the pre-test score (*P*<.001). Figure 1 presents the line chart of the inter-group comparison of the changes in the MDAS scores measured at two different times.

Table 1. Statistical findings on the comparison of sociodemographic characteristics between the groups

			Study Group (n = 23) n (%)	Control Group (n = 23) n (%)	*P* value
Gender	Male		7 (30.4%)	8 (34.8%)	0.753a
	Female		16 (69.6%)	15 (65.2%)	
Place of residence		Province	17 (73.9%)	19 (82.6%)	0.846b
		District	5 (21.7%)	3 (13%)	
		Village	1 (4.3%)	1 (4.3%)	
Income status		Below 5,500 TL	14 (60.9%)	12 (52.2%)	0.552a
		5,500 TL and over	9 (39.1%)	11 (47.8%)	
Employment status		Employed	9 (39.1%)	5 (21.7%)	0.422a
		Unemployed	10 (43.5%)	12 (52.2%)	
		Student	4 (17.4%)	6 (26.1%)	
Education level		İlliterate	2 (8.7%)	0 (0%)	0.753b
		Primary school	8 (34.8%)	10 (43.5%)	
		High school	6 (26.1%)	6 (26.1%)	
		University	7 (30.4%)	7 (30.4%)	
Age (years)			**Mean ± SD** 39.61 ± 15.09	**Mean ± SD** 38.91 ± 15.61	0.879c

a: Chi-square test b: Fisher's exact test c: Independent-samples t-test (Student's t-test) SD: Standard Deviation

Table 2. Statistical findings on the comparison of groups in terms of other characteristics with possible effects on anxiety

		Study Group (n = 23) n (%)	Control Group (n = 23) n (%)	*P* value
Additional anesthesia	Applied	6 (26.1%)	5 (21.7%)	0.730a
	Not applied	17 (73.9%)	18 (78.3%)	
Patient companion	Present	13 (56.5%)	11 (47.8%)	0.555a
	Absent	10 (43.5%)	12 (52.2%)	
History of dental treatment	Present	23 (100%)	22 (95.7%)	1.000b
	Absent	0 (0%)	1 (4.3%)	
Thoughts about future procedure	Positive	18 (78.3%)	13 (56.5%)	0.116a
	Undecided	5 (21.7%)	10 (43.5%)	
Operative time		**Mean ± SD** **Median (min-max)** 80.43 ± 31 85 (35-130)	**Mean ± SD** **Median (min-max)** 80 ± 31.15 75 (45-150)	0.991c

a: Chi-square test b: Fisher's exact test c: Mann-Whitney U test SD: Standard Deviation

Table 3. Statistical findings on the intra-group and inter-group comparisons of the MDAS, STAI-S, DFS, and VAS scores measured at two different times.

	Group	Pre-test	Post-test	P value
		Mean ± SS	**Mean ± SS**	
MDAS	Control	10.48 ± 2.99	9.96 ± 2.83	0.093
	Study	10.30 ± 4.19	18 (78.3%)	<0.001
	P value	0.872	0.366	Interaction effect F (1;44) = 2.615 P = 0.113
STAI-S	Control	36.22 ± 9.15	36.04 ± 8.97	0.923
	Study	37.96 ± 6.75	33.04 ± 6.72	0.009
	P value	0.467	0.206	Interaction effect F (1;44) = 3.491 P = 0.068
DFS	Control	37.09 ± 19.02	36.26 ± 12.09	0.460
	Study	37.48 ± 11.41	32.17 ± 7.01	<0.001
	P value	0.918	0.168	Interaction effect F (1;44) = 8.169 P = 0.006
VAS	Control	3.39 ± 1.80	2.52 ± 1.78	0.019
	Study	2.87 ± 1.68	1.70 ± 0.82	0.002
	P value	0.316	0.049	Interaction effect F (1;44) = 0.366 P = 0.548

MDAS: Modified Dentistry Anxiety Scale, STAI-S: State-Trait Anxiety Inventory-State, DFS: Dental Fear Scale, VAS: Visual Analog Scale, SD: Standard Deviation

The intra-group and inter-group comparisons of the STAI-S scores measured at two different times are given in Table 3. The time x group interaction effect was close to the statistical significance limit [F (1;44) = 3.491, *P* = .068]. The main effect of time was at the limit of statistical significance [F (1;44) = 4.023, *P* = .051]. When the main effect of the group was evaluated, the STAI-S scores did not statistically significantly differ between the groups [F (1;44) = .101, *P* = .752]. In the control group, the pre-test and post-test measurement values of the STAI-S variable were not statistically different (*P* = .923). However, in the study group, there was a statistically significant decrease in the post-test STAI-S score compared to the pre-test value (*P* = .009). Figure 1 shows the line chart of the inter-group comparison of the changes in the STAI-S scores measured at two different times.

Table 3 shows the intra-group and inter-group comparisons of the DFS scores measured at two different times. According to the results, the time x group interaction effect was statistically significant [F (1;44) = 8.169; *P*=.006]. In the control group, there was no statistically significant difference between the pre-test and post-test measurement values related to the DFS variable (*P*=.460). In the study group, the post-test DFS value significantly differed from the pre-test value (*P*< .001). The inter-group comparison of the pre-test and post-test DFS values did not reveal any significant difference (*P*=.918 and *P*=.168, respectively). Figure 1 presents the line chart of the changes in the DFS scores measured at two different times, according to the group.

The intra-group and inter-group comparisons of the VAS values measured at two different times are given in Table 3. The time x group interaction effect was not statistically significant (F=0.366, *P*=0.548). The main effect of time was statistically significant (F = 16.519, *P* < .001).

When the main effect of group was evaluated, the VAS scores did not statistically significantly differ between the groups [F (1;44) = 2.970, *P*=0.092). The pre-test and post-test measurement values of the VAS variable were statistically significantly different when compared between the control and study groups (*P*=0.019 and *P*=0.002, respectively). While the pre-test VAS scores of the two groups did not statistically significantly differ, there was a statistically significant difference in the post-test VAS scores (*P*=0.316 and *P*=0.049, respectively). The line chart of the changes in the VAS scores measured at two different times is presented in Figure 1.

In the control group, the pre-test and post-test measurement values of systolic blood pressure were not statistically different (*P*=0.705; Table 4). However, in the study group, there was a statistically significant difference between the pre-test and post-test measurement values of systolic blood pressure (*P*=0.020). The inter-group comparison of the pre-test and post-test systolic blood pressure values did not indicate any significant difference (*P*=0.515 and *P*=0.385, respectively). Figure 2 shows the line chart of the changes in the systolic blood pressure values of the groups measured at two different times.

No statistically significant differences were found between the pre-test and post-test measurement values of diastolic blood pressure in the control group (*P*=0.160) or the study group (*P*=0.083) (Table 4). There were also no statistically significant differences in the pre-test and post-test values of diastolic blood pressure between the two groups (*P*=0.629 and *P*=0.133, respectively). Figure 2 presents the line chart of the changes in diastolic blood pressure values measured at two different times, according to the group.

Table 5 shows the statistical findings concerning the comparison of the study and control groups in terms of the pre-test to post-test changes in the MDAS, STAI-S, DFS, and VAS scores and systolic and diastolic blood pressure values. Accordingly, the time-dependent decrease in the MDAS and STAI-S values was greater in the study group. The difference between the groups was close to the statistical significance limit but not significant (*P*=0.056 for MDAS and *P*=0.068 for STAI-S). Although the time-dependent decrease in the VAS score and systolic and diastolic blood pressure values was greater in the study group than in the control group, there was no statistically significant difference between the groups (*P*=0.548, *P*=0.123, and *P*=0.397, respectively). Lastly, the time-dependent decrease in the DFS value was statistically significant in both groups (*P*=.001).

Discussion

Controlling anxiety and fear in dental treatments is important for the physician, the patient, and the success of the procedure. Pharmacological or non-pharmacological options with anxiolytic effects are preferred to control anxiety. Studies have reported that patients with dental anxiety prefer non-pharmacological methods more. Music therapy, a non-pharmacological method that has been applied for centuries across the world in different types of diseases, is more suitable than pharmacological options in terms of applicability, side effects, and cost, and is positively received by patients. Music therapy is also preferred in surgical procedures that increase anxiety. Bradt and Teague (2018) found music therapy to be an effective tool in controlling patients' anxiety levels during surgical procedures. [6] Specifically, the anxiolytic effects of music have been investigated in various fields, including surgical, cardiac, and oncology patients. [3] Considering the advantages of music therapy related to its application, ability to reduce surgical stress and sedative requirement, and provision of relief by eliminating feelings of anxiety and fear without any side effects compared to pharmacological alternatives, we investigated the effects of this therapy on the anxiety levels of patients undergoing surgical procedures by comparing patients that did receive this therapy and controls.

Many studies involving music interventions suggest that some types of music decrease activity in the sympathetic nervous system, provide relaxation, and reduce anxiety in patients. Music therapy relieves feelings

of anxiety, fear, and stress.[7] Listening to music affects the limbic system by stimulating the right hemisphere of the cerebrum, creating a psychophysiological response. [8] Enkephalin and endorphin are released through the activation of the parasympathetic system.[9] The resulting psychophysiological response decreases the pain and stress levels of patients and has positive effects on their vital signs and pain intensity. It has been found that listening to music reduces blood pressure, normalizes arrhythmias, and induces relaxation in surgical procedures performed under local anesthesia.[10]

For determining dental fear and anxiety levels in patients, behavioral and physiological changes are observed, or questionnaires and standard scales are used.[11] Many scales have been developed to assess anxiety levels, and each stands out with different features. In a study comparing six different scales, Schuurs and Hoogstraten (1993) reported that none of the scales fully reflected the concept of dental anxiety; therefore, more than one scale should be used in studies on dental anxiety.[12] Hakeberg and Berggren (1997) stated that one or more scales should be used in clinical studies to ensure data reliability and evaluate dental anxiety.[13] In another study, the completion of such scales before the procedure did not have any negative effects on anxiety and fear levels.[14] In our study, anxiety and fear levels were evaluated using different scales (MDAS, STAI-S, and DFS). As a short, comprehensible, and simple instrument, the MDAS is one of the most commonly used scales to measure dental anxiety. In addition to containing questions related to traditional treatment, the MDAS has the advantage of being completed easily and quickly.[15] The STAI-S is another easy-to-apply and easy-to-assess scale that can be used to assess instantaneous feelings of anxiety, tension, and nervousness, as well as susceptibility to anxiety. It is widely accepted in the literature, is well tolerated by patients, and has also been found to be reliable and valid for the Turkish population. The VAS is the most commonly used oral scale to assess pain. It is one of the preferred pain measurement tools due to its ease of use, independence of language, and simple structure for the participant and researcher.

Many studies have shown the curative effect of classical music on various diseases. In the current study, the patients listened to pieces of classical western music through in-ear headphones. During the procedure, the control to change, stop, or resume the music or adjust the volume was left to the patients. This allowed the patients to use the volume that was most comfortable for them, and they welcomed the idea of having this control. Sound level control by the patient is also recommended in order not to distract the surgical team during surgery.[16] With the provision of external sound insulation, the sounds related to surgical materials and medical conversations between the surgical team members about the procedure did not reach the patient, preventing an associated increase in anxiety levels.

In a study conducted with 80 (52 female and 28 male) patients, Zorba *et al.*[17] (2004) investigated the effects of age, gender, and education level on anxiety [Dental Anxiety Scale (DAS) and DFS]. The authors determined that age and education status were not significantly related to either scale score, whereas gender provided significant results for DAS but non-significant results for DFS. On completion of the study, it was concluded that female patients were more prone to anxiety. In a study by Holtzman and Berg (1997), DFS was administered to 398 adults, and scores were calculated.[18] Age and gender differences were noted, and it was reported that the significance of fear and anxiety decreased with increasing age. Anxiety was mostly seen in young female participants, while age and physiological response had no relationship with fear and anxiety among men. Concerning the studies evaluating the effects of age and gender on anxiety in the literature, it is generally suggested that the significance of fear and anxiety decreases with increasing age and that women have higher anxiety levels than men. In the current study, mean age and gender distributions were similar between the groups, and their effects on anxiety were negligible.

In a study conducted by Erakman and Bayram (2019), the anxiolytic effect of listening to music and changes in vital signs were examined during the extraction of impacted mandibular wisdom teeth.[3] There was no statistically significant difference in the MDAS scores between the group that received the music intervention and the control group. In another study, Packyanathan *et al*.[19] (2019) evaluated the MDAS scores and systolic and diastolic blood pressure values before and after tooth extraction in a total of 50 patients randomly allocated to the test (music therapy) and control (no intervention) groups and found reductions in all these variables in the test group. In contrast, these variables increased in the control group. Rubalcava *et al*.[20] (2015), examining the effect of music therapy on the changes in physiological parameters in individuals with dental anxiety, observed a decrease in the MDAS scores, systolic and diastolic blood pressure values, and salivary cortisol concentration. Similarly, in our study, we determined that the MDAS scores and blood pressure values decreased in the study group. We consider that this is due to the effect of music on the psychophysiological or autonomic nervous system.

Bradt *et al*.[21] (2016) conducted a study to evaluate and compare the effects of music therapy on psychological and physical outcomes in individuals with cancer and found that this therapy reduced the STAI scores, heart rate, respiratory rate, and blood pressure. Lai *et al*.[22] (2008) explored the effects of music on state anxiety and physiological indices in patients who underwent root canal treatment. The authors reported that significant improvements in the anxiety values measured before and after the procedure and the heart rate and blood pressure values measured during the procedure in the music therapy group, while there was no significant difference in the blood pressure and heart rate values in the control group. Similarly, in our study, the STAI-S scores and blood pressure values decreased in the group that listened to music during the procedure. This can be explained by the

effect of music therapy on reducing the activity of the neuroendocrine and sympathetic nervous systems.

In this study, the pre-test DFS scores of the study and control groups were statistically similar. There was a decrease in the DFS scores over time, with this change being found to be statistically significant in the study group and non-significant in the control group. The post-test DFS scores were lower in the study group than in the control group. There was a statistically significant difference between the two groups in terms of the pre-test to post-test changes in the DFS scores. Music creates positive effects on the patient's endocrine and nervous systems, enabling meaningful reactions to occur in emotions and thoughts. Studies have shown that music positively affects hormones such as serotonin, dopamine and adrenaline, which regulate people's emotional state; It has been observed that it regulates physiological functions such as blood pressure and respiratory rhythm and ensures the balance of oxygen and blood supply in the brain. [23] Similar to the results of other studies, our study demonstrated the physiological and psychological effectiveness of music and its reduction in dental fear levels.

In a study that aimed to measure the effect of music on sedative requirement and hemodynamic values and compare the anxiolytic effects of music and self-administered midazolam, Lepage *et al.*[24] (2001) found that listening to music was associated with a decrease in midazolam requirement. Similarly, in another study, it was reported that music provided deep relief from anxiety and reduced the amount of medication required for sedation and analgesia.[25]

Gümüş *et al*. (2020) conducted a study to examine the effect of music as a non-pharmacological pain relief method in the post-operative period in children and found it to be effective in reducing the pain felt during this period.[26] Şen *et al.* (2010) investigated the effect of music therapy on post-operative pain and the duration of its efficacy and observed that this therapy reduced post-operative analgesic requirement and pain intensity.[27] In our study, the VAS scores were found to be lower in the group that listened to music during the procedure. The additional anesthesia requirement during the procedure was also lower in the music therapy group. These findings can be attributed to the anxiolytic effects of music therapy. A limitation of our study may be that the in-ear headphones are not standard. It added to the end of the last paragraph in the discussion section.

Our study is the first clinical research to evaluate the effect of music on anxiety during periodontal surgery using four different scales simultaneously. The fact that many surgical procedures were performed may be one of the weaknesses of the study. Reducing surgical variability may further demonstrate the effectiveness of music.

The results of our study are also supported by different studies in the literature evaluating the efficacy of music therapy in reducing anxiety.[28]

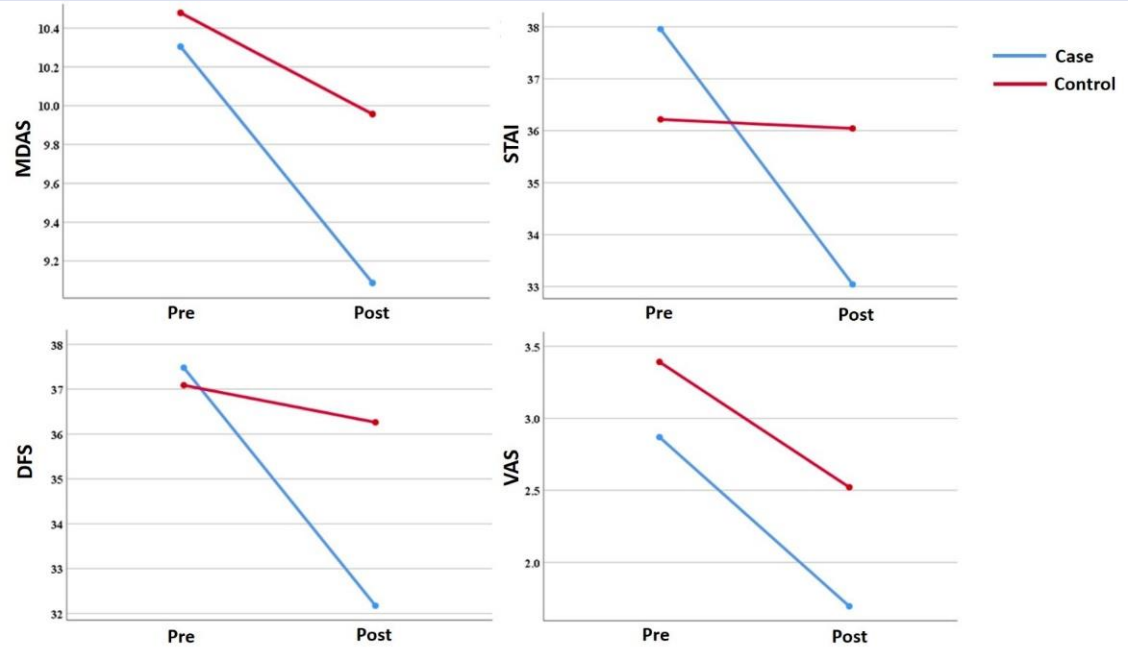

Figure 1. Line graph of the inter-group comparison of the changes in the MDAS, STAI-S, DFS, and VAS scores measured at two different times.

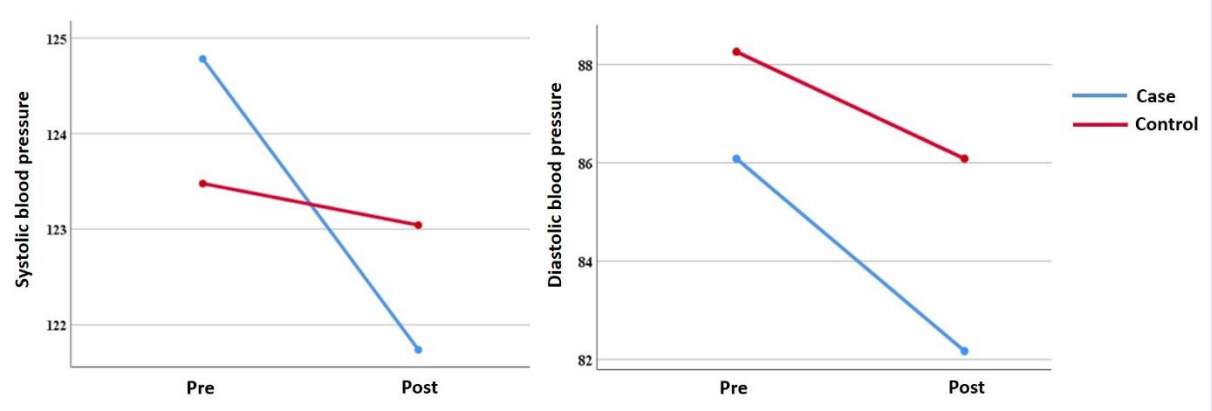

Figure 2. Line graph of the inter-group comparison of the changes in the systolic and diastolic blood pressure values measured at two different times.

Table 4. Statistical findings on the intra-group and inter-group comparisons of the systolic and diastolic blood pressure values measured at two different times.

	Group	Pre-test	Post-test	*P* value
		Mean ± SS	**Mean ± SS**	
Systolic blood pressure	**Control** Median (min-max) (123.48 ± 6.47)	120 (120-140)	120 (120-130) (123.04 ± 4.7)	0.705a
	Study Median (min-max) 124.78 ± 7.3	120 (120-140)	120 (110-130) 121.74 ± 4.91	0.020a
	P value	0.515b	0.385b	
Diastolic blood pressure	**Control** Median (min-max) 88.26 ± 11.54	80 (80-110)	36.04 ± 8.97 86.09 ± 9.88	0.160a
	Study Median (min-max) 86.09 ± 8.91	80 (80-110)	80 (70-100) 82.17 ± 5.99	0.083a
	P value	0.629b	0.133b	

Table 5. Statistical findings on the comparison of the groups in terms of the pre-test to post-test changes in the investigated variables.

	Group n		Pre-test	Post-test	Pre-test to post-test change	*P* value
			Mean ± SD	**Mean ± SD**		
MDAS	Study	23	10.3 ± 4.19	9.09 ± 3.57	1.21 ± 1.62	0.056b
	Control	23	10.48 ± 2.99	9.96 ± 2.83	0.52 ± 1.27	
STAI-S	Study	23	37.96 ± 6.75	33.04 ± 6.72	4.91 ± 6.52	0.068a
	Control	23	36.22 ± 9.15	36.04 ± 8.97	0.17 ± 10.26	
DFS	Study	23	37.48 ± 11.41	32.17 ± 7.01	5.30 ± 5.93	0.001b
	Control	23	37.09 ± 14.02	36.26 ± 12.09	0.82 ± 4.60	
VAS	Study	23	2.87 ± 1.68	1.70 ± 0.82	1.17 ± 1.49	0.548a
	Control	23	3.39 ± 1.8	2.52 ± 1.78	0.86 ± 1.89	
Systolic blood pressure	Study	23	124.78 ± 7.3	121.74 ± 4.91	3.04 ± 5.58	
	Control	23	123.48 ± 6.47	123.04 ± 4.7	0.43 ± 5.62	0.123b
Diastolic blood pressure	Study	23	86.09 ± 8.91	82.17 ± 5.99	3.91 ± 9.4	0.397b
	Control	23	88.26 ± 11.54	86.09 ± 9.88	2.17 ± 7.35	

a: Independent-samples t-test (Student's t-test)
b: Mann-Whitney U test

Conclusion

Our study is the first clinical research to evaluate the effect of music on anxiety during periodontal surgery using four different scales simultaneously. We found music therapy to be effective in reducing dental anxiety and fear levels during periodontal surgery. Music therapy is a non-pharmacological anxiolytic method that can be used to provide anxiolytic activity during periodontal surgery, and it can be applied before or during the procedure in individuals with high levels of anxiety and fear to protect them from side effects that may develop due to drug use. It is recommended that the anxiolytic

effects of music therapy be further evaluated in larger samples.

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